

# ACADEMICS



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### Catalog Legend

- E** Accessible via the Engage app in the Library
- MM** Accessible via the Math Mania experience within Engage
- IFX** Interactable Object accessible via the Engage app

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# 1st Grade

## Mathematics

### Geometry

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#### Rhombus Tile

Simple geometry manipulatives that can be used to teach about shapes and angles, or create tessellations. [IFX](#)

#### Pentagon Tile

Simple geometry manipulatives that can be used to teach about shapes and angles, or create tessellations. [IFX](#)

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Simple geometry manipulatives that can be used to teach about shapes and angles, or create tessellations. [IFX](#)

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#### Trapezoid Tile

Simple geometry manipulatives that can be used to teach about shapes and angles, or create tessellations. [IFX](#)

#### Square Tile

Simple geometry manipulatives that can be used to teach about shapes and angles, or create tessellations. [IFX](#)

#### 10 x 10 x 10 Cube

A giant cube composed of 1,000 smaller cubes, each of which is individually addressable and highlightable with the user's hand. These cubes can be expanded and stacked, allowing for a visualization of dimensions. [IFX](#)

### Measurement & Data

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#### Tape Measure

Interactive at-scale measuring tool. Users can extend the tape in 1-foot segments up to 10 feet. Designed for general use as a training or teaching tool. [IFX](#)

#### Tape Measure (Metric)

Interactive at-scale measuring tool. Users can extend the tape in half-meter segments up to 5 meters. Designed for general use as a training or teaching tool. [IFX](#)

#### Random Number Clock

A clock that rapidly cycles through numbers such that it selects a random number (1-10) when the stop button is pressed. [IFX](#)

#### Penny

Realistic models of US coins to build familiarity with money and making change. [IFX](#)

#### Nickel

Realistic models of US coins to build familiarity with money and making change. [IFX](#)

#### Dime

Realistic models of US coins to build familiarity with money and making change. [IFX](#)

#### Quarter

Realistic models of US coins to build familiarity with money and making change. [IFX](#)

#### Fraction Pizzeria

Physics-based unit blocks that allow students to build ramps and experiment with physical applications of fractions by constructing a variety of slopes. (unlimited) [E](#)

# 2nd Grade

## Mathematics

### Basic Operations & Reasoning | Adding & Subtracting Within 20

#### Adding with Place Value Blocks

Use Place Value Blocks to visualize addition. (2 min) [E](#) [MM](#)

#### Addition with 10 Frames

Use Frames to visualize addition with base 10. (3 min) [E](#) [MM](#)

#### Adding 7+6

Learn how to add 7+6 using the Number Line. (4 min) [E](#) [MM](#)

#### Adding 8+7

Learn how to add 8+7 by making a group of ten. (3 min) [E](#) [MM](#)

#### Subtracting with a Number Line

Use a number line to solve a subtraction problem. (1 min) [E](#) [MM](#)

#### Subtraction Using Place Value Blocks

Use Place Value Blocks to visualize Subtraction. (1 min) [E](#) [MM](#)

#### Adding with Arrays

Learn to breakdown an array and add with it. (2 min) [E](#) [MM](#)

#### Addition Based on Arrays Word Problems

Learn how to use arrays to solve word problems. (2 min) [E](#) [MM](#)

#### Repeated Addition Example: Haircuts

Learn how to solve word problems by adding the same number many times. (2 min) [E](#) [MM](#)

#### Subtraction with 10 Frames

Use Frames to subtract 13-6. (1 min) [E](#) [MM](#)

#### Subtracting 14-6

Learn how to subtract 14-6 by first thinking about subtracting 2 and 4. (4 min) [E](#) [MM](#)

#### Addition & Subtraction Word Problems: Gorillas

Use Arrays to solve a word problem about gorillas. (6 min) [E](#) [MM](#)

#### Addition & Subtraction Word Problems: Superheroes

Solve a subtraction word problem using deductive reasoning. (4 min) [E](#) [MM](#)

### Basic Operations & Reasoning | Place Value

#### Intro to Place Values

Learn the Basics of Base 10 Numbers. (3 min) [E](#) [MM](#)

#### Identifying Value in Digits

Learn how to identify value in different number digits. (3 min) [E](#) [MM](#)

#### Creating the Largest Number

Visual Examples of how to create the largest 3-digit number. (3 min) [E](#) [MM](#)

#### Expanded Form of Numbers

Expand numbers to visualize the hundreds, tens, and one's spot of numbers. (3 min) [E](#) [MM](#)

#### Number and Word Form of a Number

Expand numbers to visualize the hundreds, tens, and one's spot of numbers. (2 min) [E](#) [MM](#)

#### Word Form and Expanded Form

Differentiate between expanded word form and expanded number form. (1 min) [E](#) [MM](#)

#### Use Place Value Blocks to show Numbers within 1,000

Visualize Place Value to 1,000 by using Place Value Blocks. (4 min) [E](#) [MM](#)

#### Counting by 10s

Students learn to count by 10s using visual examples. (2 min) [E](#) [MM](#)

#### Place Value Tables within 1,000

Students will use Place Value Tables to visualize place value of 1000. (3 min) [E](#) [MM](#)

#### Skip-Counting by 5s

Work on a problem and solve it by skip counting by 5. (2 min) [E](#) [MM](#)

#### Skip-Counting by 100s

Learn to count by hundreds in this visual exercise. (3 min) [E](#) [MM](#)

#### Greater Than and Less Than Symbols

Learn the greater than symbol and the less than symbol. (5 min) [E](#) [MM](#)

#### Comparing Whole Numbers

Learn how to compare whole numbers. (2 min)

#### Regrouping Whole Numbers: 675

Visualize how regrouping whole numbers doesn't change the outcome of the number. (4 min) [E](#) [MM](#)

#### Understanding Even and Odd Numbers Visually

Visually see the difference between even and odd numbers. (4 min) [E](#) [MM](#)

### Basic Operations & Reasoning | Add & Subtract Within 100

#### Adding 2-Digit Numbers Without Regrouping

Use Place Value to add 2-digit numbers. (2 min) [E](#) [MM](#)

#### Understanding Place Value when Adding Ones

Learn how to add  $37 + 2$  by thinking about place value. (2 min) [E](#) [MM](#)

#### Understanding Place Value when Adding Tens

Learn how to add  $23 + 30$  by thinking about place value. (3 min) [E](#) [MM](#)

## **Adding with Regrouping**

Use Regrouping to Add  $35 + 27$  in this exercise. (4 min) [E](#) [MM](#)

## **Addition and Subtraction with Number Lines**

Learn to see three-digit numbers as hundreds, tens, and ones. (2 min) [E](#) [MM](#)

## **Breaking Apart 2-Digit Addition Problems**

Visualize different ways to break apart addition problems. (5 min) [E](#) [MM](#)

## **Adding $53+17$ by Making Groups of 10**

Learn addition within a 100 using  $53+7$ . (3 min) [E](#) [MM](#)

## **Adding by Making a Group of 10**

Using groups of 10 to add. (3 min) [E](#) [MM](#)

## **Strategies for Adding 2-Digit Numbers**

Visualize different strategies to add 2-digit numbers. (3 min) [E](#) [MM](#)

## **Subtracting 1s using Place Value**

Learn how to subtract 4 from 46 by thinking about place value. (2 min) [E](#) [MM](#)

## **Subtracting 10s using Place Value**

Learn how to subtract 40 from 65 by thinking about place value. (2 min) [E](#) [MM](#)

## **Subtracting 2-Digit Numbers Without Regrouping**

Learn how to subtract 31 from 64 by thinking about tens and ones. (2 min) [E](#) [MM](#)

## **Subtracting a 1-Digit Number with Regrouping**

Learn how to subtract  $35 - 8$  using regrouping. (3 min) [E](#) [MM](#)

## **Missing Numbers in Addition and Subtraction**

Solve a problem with a missing number in the problem. (6 min) [E](#) [MM](#)

## **Addition Word Problems: Horses**

Solve a word problem about horses using addition. (3 min) [E](#) [MM](#)

## **Subtraction Word Problem: Crayons**

Solve a subtraction word problem about crayons. (4 min) [E](#) [MM](#)

## **Subtraction Word Problem: Basketball**

Solve a subtraction problem about basketball. (2 min) [E](#) [MM](#)

## **Adding and Subtracting on Number Line Word Problems**

Use a number line to solve a word problem. (4 min) [E](#) [MM](#)

## **Adding Two Digit Numbers on a Number Line**

Use a number line to solve an addition problem with 2-digit numbers. (3 min) [E](#) [MM](#)

## **Multi-Step Addition Word Problems**

Use addition multiple times to solve a word problem. (4 min) [E](#) [MM](#)

## **Multi-Step Subtraction Word Problems**

use Subtraction multiple times to solve a word problem. (4 min) [E](#) [MM](#)

## **Basic Operations & Reasoning | Add & Subtract within 1,000**

### **Adding 10 or 100**

Use place value blocks to add 10s or 100s. (4 min) [E](#) [MM](#)

### **Adding 1s, 10s, and 100s**

Use place value blocks to add 100s, 10s, and 1s. (4 min) [E](#) [MM](#)

### **Adding and Subtracting on Number Line**

Learn to add and subtract numbers like 585 and 368 using a number line. (3 min) [E](#) [MM](#)

### **Adding 3-Digit Numbers (No Regrouping)**

Learn to add  $327 + 251$  by utilizing place value. (3 min) [E](#) [MM](#)

### **Addition using Groups of 10 and 100**

Learn to rewrite addition problems to make them easier to solve. (4 min) [E](#) [MM](#)

## **Breaking Apart 3-Digit Addition Problems**

Visualize different ways to break up addition problems using place value. (4 min) [E](#) [MM](#)

### **Subtracting 1,10, and 100**

Learn how to subtract 1s, 10s, and 100s through place value blocks. (4 min) [E](#) [MM](#)

### **Subtracting 1s, 10s, and 100s**

Learn how to subtract 1s, 10s, and 100s through place value blocks (3 min) [E](#) [MM](#)

### **Subtracting 3-Digit Numbers**

Learn how to subtract  $357-251$  with place value blocks. (3 min) [E](#) [MM](#)

### **Subtracting with Place Value Blocks (Regrouping)**

Learn how to use place value blocks to regroup and subtract  $438-272$ . (3 min) [E](#) [MM](#)

### **Adding Four 2-Digit Numbers**

Learn how to add 4 2-digit numbers at a time. (3 min) [E](#) [MM](#)

### **Adding Multiple 2-Digit Numbers: Word Problems**

Solve a word problem by adding multiple 2-digit numbers. (3 min) [E](#) [MM](#)

## **Basic Operations & Reasoning | Money & Time**

### **Counting American Coins**

Learn to differentiate and count American coins. (4 min) [E](#) [MM](#)

### **Counting Dollars**

Learn to differentiate and count American dollars. (3 min) [E](#) [MM](#)

### **Time on a Number Line**

Use a timeline to visualize time. (2 min) [E](#) [MM](#)

### **Telling Time (Labeled Clock)**

Learn to tell time on an analog clock in this exercise. (3 min) [E](#) [MM](#)

## Geometry

### Rhombus Tile

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## Geometry | Shapes & Parts of Shapes

### Recognizing Shapes

Learn how to identify circles, triangles, squares, rectangles, rhombuses, and trapezoids. (6 min) [E](#) [MM](#)

### Cousin Fal's Shape Collection

Learn how to classify shapes based on their number of sides, number of corners, and side-lengths. (4 min) [E](#) [MM](#)

### Shapes and Angles

Learn about shapes and angles and how to identify them. (3 min) [E](#) [MM](#)

### Equal Parts of Circles and Rectangles

Learn to identify equal parts of a circle and rectangle. (3 min) [E](#) [MM](#)

### Partitioning Rectangles

Follow along as a rectangle is broken into multiple equal parts up to 2 rows and 5 columns. (3 min) [E](#) [MM](#)

## Measurement & Data

### 10 x 10 x 10 Cube

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### Tape Measure

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## Measurement & Data | Measurement

### Getting a Sense of Meters and Centimeters

See how a meter is broken down into centimeters and how they relate to each other. (6 min) [E](#) [MM](#)

### Getting a Sense of Inches and Feet

See how a foot is broken down into inches and how they relate to each other. (6 min) [E](#) [MM](#)

### Measuring in Inches

Measures a flower in inches. (1 min) [E](#) [MM](#)

**Measuring Lengths (cm, m)** Measure various objects with a ruler. (5 min) [E](#) [MM](#)

### Measuring Lengths in Different Units

Measures the same rectangle in different units and then compares the size of the different units. (3 min) [E](#) [MM](#)

### Estimating Lengths

Estimates the length of an object when given the length of another object. (2 min) [E](#) [MM](#)

### Length Word Problem: US Customary

Solve a length word problem example. (4 min) [E](#) [MM](#)

### Length Word Problem: Chalk Lines

Solve a length word problem with addition and subtraction. (6 min) [E](#) [MM](#)

## Measurement & Data | Data

### Picture Graphs

A picture graph, or pictograph, is a graph used to display information that uses images or symbols to represent data. (3 min) [E](#) [MM](#)

**Making Picture Graphs and Line Plots**

To create a line plot, first create a number line that includes all the values in the data set. Next, place an X (or dot) above each data value on the number line.

(3 min) [E](#) [MM](#)

**Creating a Bar Graph**

Create a bar chart using data from a survey.

(1 min) [E](#) [MM](#)

**Reading Bar Graphs: Bikes**

Learn to read and interpret bar graphs.

(1 min) [E](#) [MM](#)

**Read Line Plots**

A line plot is a graph that displays data using a number line. To create a line plot, first create a number line that includes all the values in the data set. Next, place an X (or dot) above each data value on the number line. (4 min) [E](#) [MM](#)

## Science

### Earth & Space Science

**Pond**

Explore a freshwater pond and the plants that surround it. (1 min)

**Explore the Deep Ocean**

Follow along in a Submarine and see the ocean from a new view. (2 min)

**Explore the Mallows Ghost Fleet**

Students are introduced to Mallows Bay-Potomac River National Marine Sanctuary and the "Ghost Fleet." Students make inferences about how human actions affect the environment. (4 min)

### Life Science

**360 Orangutan School**

Go inside the International Animal Rescue Sanctuary in the forests of Borneo to see what it takes to teach a baby orangutan... to be an orangutan. (9 min)

**Arctic Orca**

Orca Foraging in a school fish with free divers. (1 min)

**Bears of Kamchatka, Kambalnaya****River**

Follow along as you experience the Bears of Kamchatka and learn about their habitat, daily life, and mating season. (5 min)

**Chengdu Panda Base, China**

Get an in-depth look at the pandas that call Chengdu Panda Base their home and learn about their habitat, diet, and daily life. (11 min)

**Climbing the Redwoods- Fight for the Forests**

Climb 200 feet up 'Grandfather,' the highest Redwood in a Northern California Grove, while learning about the Redwood Forest and preservation efforts. (2 min)

**Diving Under Icebergs with a Seal in Antarctica**

Take a 360 journey under an iceberg with a crabeater seal and Gentoo Penguins in Antarctica (2 min)

**Diving with Great White Shark**

Experience a Great white shark up close and personal while learning about the majestic creatures. (2 min)

**Elephant Seals and King Penguin Chicks**

These King Penguin chicks get our (elephant) seal of approval. (2 min)

**Elephants on the Brink**

A herd of African elephants curiously investigates its surroundings in South Africa and happens to notice cameras filming their behavior. (3 min)

**Fox's Point of View at Night- Planet Earth II: Cities**

Through the eyes of an urban fox, can you find food, spot the hazards, and track down a mate in a bustling city at night? (4 min)

**360° Getting Licked by a Cow in Ireland 4k**

Up close and personal with cows. Now you'll know what it's like to be licked and sniffed by them. Wait for the inspection to unfold as reverse cow tipping comes into play. (1 min)

**Glow Worm Caves of New Zealand**

Deep below ground, strange carnivorous worms' glow and twinkle like the night sky to attract their prey. (2 min)

**Gorillas in the Congo: A Jump VR Video**

Experience gorillas in their natural habitat of the Congo Jungle. (2 min)

**Great Hammerhead Shark Encounter**

Dive into this 360° video and go face to face with a curious great hammerhead shark. (2 min)

**Great White Sharks**

Get up close with Great White Sharks on an actual dive while learning more about them. (2 min)

**How Animals see the World**

Experience how different animals see the world: human, cat, dog, fly, rat, and a snake. (4 min)

**Isle of Jaws**

Suit up and join the team on the search for the mysterious "Isle of Jaws" in Discovery's first-ever full virtual reality act. (7 min)

**Lions 360**

Join National Geographic Explorer, Martin Edström, and come face to face with Gibson and his mother, as they struggle with their pride's alpha male. (5 min)

## **Manatee: Crystal River National Wildlife Refuge**

Underwater cinematographer and VR filmmaker Adam Ravetch takes us on an adventure on Florida's Crystal River as he captures the river's wild manatees in their natural habitat at the Crystal River National Wildlife Refuge. (3 min)

## **Ocean to Plate: A Journey into the Seafood Supply Chain**

Learn how populations and appetites grow. Global fisheries are reaching their ecological capacity, yet at least a third of harvested fish and seafood is lost or wasted along the supply chain. (7 min)

## **Play with Meerkats: Animals with Cameras**

Get up close and personal with Meerkats as they investigate the camera. (1 min)

## **Playful Elephants Swim**

A family of elephants decide to take a break from the hot South Africa sun and swim in the local watering hole as Vicky Brooker, elephant curator, talks about the animals. (2 min)

## **Red Kite Bird Feeding Frenzy**

Watch the once endangered Red Kite Bird feeding while learning about them. (1 min)

## **Rescuing Rhinos- Racing Extinction**

Orphaned at 2 weeks old in November 2014, Matimba was found next to her mother who had been killed by poachers for her horn. Weighing only 35 pounds at the time, she has been protected and nursed back to health in South Africa. (5 min)

## **The Eye of the Tiger**

Look at the day in the life of tiger at the Dierenpark Amersfoort Zoo. (2 min)

## **Surrounded by Lemurs- Perth Zoo- Australia**

Take a private tour of Lemur Island and encounter these critically endangered species. (4 min)

## **The Fight to save Threatened Species**

Get closer than ever before to the most extraordinary creatures on the planet...before they disappear. Whale sharks, rhinos, elephants, manta rays and lions are all threatened with extinction. (2 min)

## **What it's like to be Surrounded by Wild Dogs**

See how Wild dogs differ from domesticated ones and how they interact within a herd. (1 min)

## **Baboon 1**

See how a group of Baboons interact. Part 1. (1 min)

## **Baboon 2**

See how a group of Baboons interact. Part 2. (1 min)

## **Baboon 3**

See how a group of Baboons interact. Part 3. (1 min)

## **Cows**

See a group of African Cows roam in search of food. (1 min)

## **Deer**

See Antelope deer feeding on a plain. (1 min)

## **Elephant 1**

See a herd of elephants graze about. Part 1. (1 min)

## **Elephant 2**

See a herd of elephants graze about. Part 2. (1 min)

## **Elephant 3**

See a herd of elephants graze about. Part 3. (1 min)

## **Elephant 4**

See a herd of elephants graze about. Part 4. (1 min)

## **Giraffe 1**

Get up close with a giraffe as it feeds. Part 1. (1 min)

## **Giraffe 2**

Get close with a giraffe as it feeds. Part 2. (1 min)

## **Hyena 1**

Watch a hyena feed on a fresh kill. (1 min)

## **Hyena 2**

Watch a hyena approach cautiously for a snack. (1 min)

## **Lemur 1**

Watch lemurs climb and play in a zoo. Part 1. (1 min)

## **Lemur 2**

Watch lemurs climb and play in a zoo. Part 2. (1 min)

## **Lemur 3**

Watch lemurs climb and play in a zoo. Part 3. (1 min)

## **Leopard**

Watch a leopard munch on a meal. (1 min)

## **Lioness 1**

A curious Lioness sniffs at the camera. (1 min)

## **Lioness 2**

Lioness sniffs at food. (1 min)

## **Monkey 1**

Monkeys steal a sweet treat. (1 min)

## **Monkey 2**

Watch a monkey enjoy a fun treat. (1 min)

## **Monkey Cage**

See two playful monkeys in a zoo. (1 min)

## **Rhino 1**

Watch a Rhino wallow in a mud hole. (1 min)

## **Rhino 2**

Watch a baby rhino enjoy a bottle. (1 min)

## **Rhino 3**

Watch a baby rhino frolic around. (1 min)

## **Zebra 1**

Watch a herd of Zebras Graze. (1 min)

## **Zebra 2**

Watch how zebras move as a herd. (1 min)

## **Sharks**

Explore an aquarium of sharks. (1 min)

## **Surrounded by White Lions**

Experience white lions at a preserve. (10 min)

## Reptile Room- Discovery Nature and Animal

Take a virtual tour inside a reptile room at a zoo. (1 min)

### In the Presence of Animals

Experience a dangerous world with some of the planet's most at-risk species: an endangered jaguar, a rainforest sloth, a massive bison, fluttering monarchs, and a mother olive ridley turtle. (5 min)

### Protecting Ocean Anchor Species- Racing Extinction

Join marine biologist Luke Tipple as he swims alongside anchor species like manta rays and whale sharks and shares why they are vital to the survival of our oceans and why they need to be protected. (3 min)

### Surrounded by Wild Elephants

Come face to face with the largest land animal on the planet, the African elephant. Follow along as this herd of giants take a detour to investigate a stranger in their midst. (3 min)

## Physical Science

### Big Bang Sound

Sound effect of what scientists estimate the big bang would have sounded like. (unlimited)

### Music Playground

Concert hall with interactive musical instruments that can be used to collaboratively play, teach, or learn about music and soundwaves. (unlimited) [E](#)

### Light Lab

This highly interactive classroom teaches students about the electromagnetic spectrum including activities like the Double Slit Experiment, shining lights through a prism, building their own waves, stacking light, and playing with lenses. (unlimited) [E](#)

### Music Note- A

Interactive music notes spanning 4 octaves and using 10 different instrument sounds.

[IFX](#)

### Music Note- A Sharp

Interactive music notes spanning 4 octaves and using 10 different instrument sounds.

[IFX](#)

### Music Note- B

Interactive music notes spanning 4 octaves and using 10 different instrument sounds.

[IFX](#)

### Music Note- C

Interactive music notes spanning 4 octaves and using 10 different instrument sounds.

[IFX](#)

### Music Note- C Sharp

Interactive music notes spanning 4 octaves and using 10 different instrument sounds.

[IFX](#)

### Music Note- D

Interactive music notes spanning 4 octaves and using 10 different instrument sounds.

[IFX](#)

### Music Note- D Sharp

Interactive music notes spanning 4 octaves and using 10 different instrument sounds.

[IFX](#)

### Music Note- E

Interactive music notes spanning 4 octaves and using 10 different instrument sounds.

[IFX](#)

### Music Note- F

Interactive music notes spanning 4 octaves and using 10 different instrument sounds.

[IFX](#)

### Music Note- F Sharp

Interactive music notes spanning 4 octaves and using 10 different instrument sounds.

[IFX](#)

### Music Note- G

Interactive music notes spanning 4 octaves and using 10 different instrument sounds.

[IFX](#)

### Music Note- G Sharp

Interactive music notes spanning 4 octaves and using 10 different instrument sounds.

[IFX](#)

## Social Studies

### Economics

#### Wheat Harvest

Ride along with a farmer through the various processes involved in harvesting wheat from a field. (3 min)

#### George the Farmer - Apples VR

Join George the Farmer and his mates Simone and Ben as they investigate how apples are grown. (4 min)

#### George the Farmer - Dairy VR

Join George the Farmer and his mates Simone and Ben as they investigate where delicious dairy products like milk and yogurt really come from. (4 min)

#### George the Farmer Chickpeas – VR

Join George the Farmer and his mates Simone and Ben as they investigate chickpeas at harvest time. (4 min)

#### George the Farmer Forestry – VR

Join George the Farmer and his mates Simone and Ben as they investigate some of the products made from Pine Trees in sustainable pine plantations. (4 min)

#### Travel-Dream-Imagine - A VR Journey from the desert floor to the Sea

Travel with us as we step into the Judea Desert, bathe in a waterfall, wet our feet in the red sea, dive among corals, and float in one of the wonders of the world - the dead sea. (2 min)

#### Himalayas: A Trek to School

Follow two girls as they travel for up to 6 hours a day to school in a remote Himalayan village. (8 min)

## **Civil Rights Museum**

Five Civil Rights leaders - Rosa Parks, John Lewis, Martin Luther King Jr., Thurgood Marshall, and Medgar Evers - come to life and teach you their stories on interactive stages. (unlimited) [E](#)

## **Independence Hall**

Join George Washington, John Adams, Thomas Jefferson, Benjamin Franklin, and John Hancock as they come to life to tell you their stories about the founding of the United States. (unlimited) [E](#)

# 3rd Grade

## Mathematics

### Basic Operations & Reasoning | Intro to Multiplication

#### Intro to Multiplication

Follow along as students dive into the concept of multiplication. (3 min) [E](#) [MM](#)

#### Equal Groups

Find the number of objects in equal groups using skip counting and repeated addition. (3 min) [E](#) [MM](#)

#### Multiplication as Repeated Addition

Explore the idea of multiplication being the same as repeated addition. (3 min) [E](#) [MM](#)

#### Multiplication on the Number Line

Uses a number line to represent and solve simple multiplication expressions. (4 min) [E](#) [MM](#)

#### Multiplication as Equal Groups

Uses arrays and repeated addition to visualize multiplication. (3 min) [E](#) [MM](#)

#### More Ways to Multiply

Use arrays and repeated addition to multiply. (5 min) [E](#) [MM](#)

#### Multiplication with Arrays

Explore representing 12 with multiplication. (4 min) [E](#) [MM](#)

#### Multiplication in Real World Contexts

See how to relate multiplication to real world contexts. (5 min) [E](#) [MM](#)

### Commutative Property of Multiplication

Explore what happens when we multiply numbers in different orders. (4 min) [E](#) [MM](#)

### Basic Operations & Reasoning | 1-Digit Multiplication

#### Distributive Property when Multiplying

Use the distributive property to break up  $4 \times 7$  into smaller numbers. (6 min) [E](#) [MM](#)

#### Properties and Patterns for Multiplication

Learn to change the order of numbers or decompose numbers to simplify the multiplication problems. (8 min) [E](#) [MM](#)

### Basic Operations & Reasoning | Addition, Subtraction & Estimation

#### Rounding to the Nearest 10 on the Number Line

Learn to round numbers to the nearest ten using a number line. (9 min) [E](#) [MM](#)

#### Rounding to the Nearest 100 on the Number Line

Learn to round numbers to the nearest hundreds using a number line. (7 min) [E](#) [MM](#)

#### Rounding to the Nearest 10 and 100

Learn to round up to 4-digit numbers to the nearest ten and hundred. (6 min) [E](#) [MM](#)

#### Estimating when Adding Multi-Digit Numbers

Learn about estimating when adding multi-digit numbers. (4 min) [E](#) [MM](#)

### Using Place Value to Add 3-Digit Numbers: Part 1

Explore adding two 3-digit numbers using place value and carrying. (2 min) [E](#) [MM](#)

### Using Place Value to Add 3-Digit Numbers: Part 2

Learn to use regrouping to add  $536 + 398$ . (2 min) [E](#) [MM](#)

#### Adding 3-Digit Numbers

Learn to use regrouping, or carrying to add  $709 + 996$ ,  $373 + 88$ , and  $149 + 293$ . (3 min) [E](#) [MM](#)

#### Estimating when Subtracting Large Numbers

Use estimation to find reasonable solutions to 2 and 3-digit subtraction problems. (3 min) [E](#) [MM](#)

#### Subtraction by Breaking Apart

Solve 2 and 3-digit subtraction problems by breaking apart the numbers by place value. (3 min) [E](#) [MM](#)

#### Adding and Subtracting on a Number Line

Add and subtract numbers like 585 and 368 using a number line. (2 min) [E](#) [MM](#)

#### Methods for Subtracting 3-Digit Numbers

Subtract  $357 - 156$  using place value strategies. (5 min) [E](#) [MM](#)

#### Worked Example: Subtracting 3-Digit Numbers

Learn to use regrouping (borrowing) and place value to subtract  $971 - 659$ . (3 min) [E](#) [MM](#)

#### Subtracting 3-Digit Numbers (Regrouping)

Use regrouping (borrowing) and place value to subtract  $629 - 172$ . (3 min) [E](#) [MM](#)

#### Worked Example: Subtracting 3-Digit Numbers (Regrouping Twice)

Use regrouping (borrowing) to subtract  $913 - 286$ . (4 min) [E](#) [MM](#)

#### Worked Example: Subtracting 3-Digit Numbers (Regrouping Twice)

Learn to borrow from a 0 to subtract  $301 - 164$ . (4 min) [E](#) [MM](#)

## Worked Example: Subtracting 3-Digit Numbers (Regrouping from 0)

Learn to borrow from a 0 to subtract

301-164. (2 min) [E](#) [MM](#)

## Missing Number for 3-Digit Addition within 1,000

Solve for the missing number in problems

like  $\_\_ + 261 = 630$ . (4 min) [E](#) [MM](#)

## 3-Digit Addition Word Problems

Work through a word problem that involves

3-digit addition. (2 min) [E](#) [MM](#)

## 3-Digit Subtraction Word Problems

Work through a word problem that involves

3-digit subtraction. (3 min) [E](#) [MM](#)

## Basic Operations & Reasoning | Intro to Division

### Division as Equal Groups

Visualize division as equal groups of

objects. (4 min) [E](#) [MM](#)

### Visualizing Division with Arrays

Use Arrays to represent division expression.

(2 min) [E](#) [MM](#)

### Division in Context

Learn to relate division expression to real

world contexts. (4 min) [E](#) [MM](#)

### Relating Division to Multiplication

Learn about the relationship between multiplication and division problems.

(3 min) [E](#) [MM](#)

### Multiplication Word Problem: Parking Lot

Use a picture and repeated addition to solve a multiplication word problem.

(2 min) [E](#) [MM](#)

### Division Word Problem: School Building

Use a picture and understanding of multiplication to solve a division problem.

(4 min) [E](#) [MM](#)

## Basic Operations & Reasoning | More with Multiplication & Division

### Unknowns with Multiplication and Division

Find the missing number in multiplication

and division equations. (5 min) [E](#) [MM](#)

### Multiplication Word Problems: Soda Party

Use a picture and repeated addition to solve a multiplication word problem.

(2 min) [E](#) [MM](#)

### Division Word Problems: Blueberries

Use a picture and understanding of multiplication to solve a division word

problem. (4 min) [E](#) [MM](#)

### Associative Property of Multiplication

Explore the associative property of

multiplication. (3 min) [E](#) [MM](#)

### Properties of Multiplication

Use pictures and practice problems to see

commutativity and associativity in

multiplication. (5 min) [E](#) [MM](#)

### Using Associative Property to Simplify Multiplication

Use the associative property to multiply

2-digit numbers by 1-digit numbers.

(4 min) [E](#) [MM](#)

### Multiplying by Multiples of 10

Learn how to decompose multiples of ten to

multiply. (3 min) [E](#) [MM](#)

### Multiplying by Tens Word Problems

Learn to multiply by 10s to solve a word

problem. (3 min) [E](#) [MM](#)

## Basic Operations & Reasoning | Arithmetic Patterns & Problem Solving

### Order of Operations (2-Step Expressions)

Learn to evaluate 2-step whole number expressions with different operations.

(4 min) [E](#) [MM](#)

### 2-Step Estimation Word Problems

Solve 2-step estimation word problems

with whole numbers. (3 min) [E](#) [MM](#)

### Setting Up 2-Step Word Problems

Learn to represent 2-step word problems

with equations. (2 min) [E](#) [MM](#)

### 2-Step Word Problems: Truffles

Solve a two-step word problem by drawing a picture and creating an equation.

(5 min) [E](#) [MM](#)

### 2-Step Word Problems: Running

Solve a two-step word problem by drawing a picture and creating an equation.

(3 min) [E](#) [MM](#)

### 2-Step Word Problems: Theater

Solve a 2-step word problem by drawing a picture and creating an equation.

(3 min) [E](#) [MM](#)

### Finding Patterns in Numbers

Learn to identify patterns in number sequences by analyzing three different

sequences. (3 min) [E](#) [MM](#)

### Recognizing Number Patterns

Explore whole number patterns and their rules, including patterns in tables.

(3 min) [E](#) [MM](#)

### Intro to Even and Odd Numbers

Learn the difference between even and odd numbers and how they interact when added

together. (7 min) [E](#) [MM](#)

### Patterns with Multiplying Even and Odd Numbers

Explore the patterns in products when multiplying even and odd numbers.

(3 min) [E](#) [MM](#)

**Patterns in Hundreds Chart**

Explore patterns with the numbers in a hundreds chart. (4 min) [E](#) [MM](#)

**Patterns in Multiplication Tables**

Explore the multiplication table and work to fill in missing pieces. (5 min) [E](#) [MM](#)

## Basic Operations & Reasoning | Time

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**Telling Time with Number Line**

Use a number line to tell time and find the duration of an event. (7 min) [E](#) [MM](#)

**Telling Time to the Nearest Minute (Labeled Clock)**

Learn to read the time on labeled analog clocks to the nearest minute. (4 min) [E](#) [MM](#)

**Telling Time to the Nearest Minute (Unlabeled Clock)**

Learn to read the time on unlabeled analog clocks to the nearest minute. (3 min) [E](#) [MM](#)

**Time Differences Example**

Learn to find the difference between the times shown on two different analog clocks. (4 min) [E](#) [MM](#)

**Time Word Problem: Travel Time**

Learn to work through a word problem involving calculating. (4 min) [E](#) [MM](#)

**Time Word Problem: Puzzle**

Figure out how long it took to solve a puzzle when given the start and finish time. (2 min) [E](#) [MM](#)

## Geometry

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**Fraction Pizzeria**

Physics-based unit blocks that allow students to build ramps and experiment with physical applications of fractions by constructing a variety of slopes. (unlimited) [E](#)

**Rhombus Tile**

Simple geometry manipulables that can be used to teach about shapes and angles, or build tessellations. [IFX](#)

**Pentagon Tile**

Simple geometry manipulables that can be used to teach about shapes and angles, or build tessellations. [IFX](#)

**Octagon Tile**

Simple geometry manipulables that can be used to teach about shapes and angles, or build tessellations. [IFX](#)

**Obtuse Isosceles Triangle Tile**

Simple geometry manipulables that can be used to teach about shapes and angles, or build tessellations. [IFX](#)

**Narrow Rhombus Tile**

Simple geometry manipulables that can be used to teach about shapes and angles, or build tessellations. [IFX](#)

**Hexagon Tile**

Simple geometry manipulables that can be used to teach about shapes and angles, or build tessellations. [IFX](#)

**Equilateral Triangle Tile**

Simple geometry manipulables that can be used to teach about shapes and angles, or build tessellations. [IFX](#)

**Acute Isosceles Triangle Tile**

Simple geometry manipulables that can be used to teach about shapes and angles or build tessellations. [IFX](#)

**Wide Rhombus Tile**

Simple geometry manipulables that can be used to teach about shapes and angles, or build tessellations. [IFX](#)

**Trapezoid Tile**

Simple geometry manipulables that can be used to teach about shapes and angles, or build tessellations. [IFX](#)

**Square Tile**

Simple geometry manipulables that can be used to teach about shapes and angles, or build tessellations. [IFX](#)

## Geometry | Area

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**Intro to Quadrilaterals**

Discover attributes and features of four-sided shapes, including parallelograms, rhombuses, rectangles, and squares. (8 min) [E](#) [MM](#)

**Intro to Area and Unit Squares**

Explore area by comparing two figures' space on a surface. Using unit square, learn to measure areas. (4 min) [E](#) [MM](#)

**Measuring Rectangles with Different Unit Squares**

Find areas of a rectangle with different sized units. (3 min) [E](#) [MM](#)

**Creating Rectangles with a Given Area 1**

Learn to create a rectangle with a given area. (3 min) [E](#) [MM](#)

**Creating Rectangles with a Given Area 2**

Learn to create a rectangle that has the same area (but different side lengths) than a given rectangle. (3 min) [E](#) [MM](#)

**Counting Unit Squares to Find Area Formula**

Learn to use unit squares to see why multiplying side-lengths can also find the area of rectangles. (5 min) [E](#) [MM](#)

**Transitioning from Unit Squares to Area Formula**

Learn to find the area of a rectangle both by counting unit squares and multiplying side lengths. (3 min) [E](#) [MM](#)

**Finding Missing Side when Given Area**

Find the missing length on a rectangle when given the area of the rectangle. (3 min) [E](#) [MM](#)

**Comparing Areas of Plots of Land**

Find the area of two rectangles to solve a word problem. (3 min) [E](#) [MM](#)

**Area and the Distributive Property**

Use the distributive property to find area of rectangles. (4 min) [E](#) [MM](#)

### Decomposing Shapes to Find Area: Grids

Find the area of an irregular shape by decomposing it into 2 rectangles.

(3 min) [E](#) [MM](#)

### Decomposing Shapes to Find Area: Add

Find the area of an irregular 10-sided shape by breaking it into smaller rectangles.

(3 min) [E](#) [MM](#)

### Decomposing Shapes to Find Area: Subtract

Find the area of an irregular shape by decomposing it into 2 rectangles and subtracting the area of the rectangles.

(3 min) [E](#) [MM](#)

## Geometry | Perimeter

### Perimeter: Introduction

Perimeter is a math concept that measures the total length around the outside of a shape. (3 min) [E](#) [MM](#)

### Perimeter of a Shape

Learn to find the perimeter of a shape. (2 min) [E](#) [MM](#)

### Finding Perimeter when a Side Length is Missing

Learn to find perimeter of a shape by using the clues to figure out the length of a side if it isn't labeled. (3 min) [E](#) [MM](#)

### Finding Missing Side Length when Given Perimeter

Learn to find the lengths of unknown sides on a shape by using the given perimeter and the lengths of known sides. (5 min) [E](#) [MM](#)

### Perimeter Word Problem: Tables

Solves a perimeter word problem that involves combining two perimeters. (4 min) [E](#) [MM](#)

### Perimeter Word Problem: Skating Rink

Solve a word problem involving perimeter of a rectangle. (3 min) [E](#) [MM](#)

### Comparing Areas and Perimeters of Rectangles

Compare the areas and perimeters of rectangles to a given rectangle.

(5 min) [E](#) [MM](#)

## Fractions, Decimals, Percents & Ratios | Understanding Fractions

### Intro to Fractions

Visualize how to divide wholes into equal-sized pieces to create unit fractions.

(4 min) [E](#) [MM](#)

### Cutting Shapes into Equal Parts

Visualize and explore how cutting shapes into parts equal a fraction of the object.

(2 min) [E](#) [MM](#)

### Identifying Unit Fractions Word Problem

Solve a word problem by using a unit fraction. (2 min) [E](#) [MM](#)

### Fractions in Contexts

Use fractions to represent real-world contexts. (4 min) [E](#) [MM](#)

### Identifying Numerators and Denominators

Identifying numerators and denominators in fractions. (2 min) [E](#) [MM](#)

### Recognize Fractions

Use fractions to name parts of a whole. (4 min) [E](#) [MM](#)

### Recognizing Fractions Greater than 1

Use fraction models to identify a fraction greater than 1. (1 min) [E](#) [MM](#)

### Relating Number Lines to Fraction Bars

Learn to use fraction bars to show fractions on a number line. (3 min) [E](#) [MM](#)

### Fractions on a Number Line

Explore how to represent fractions on a number line. (4 min) [E](#) [MM](#)

### Finding 1 on the Number Line

Locate 1 on a number line labeled with 0 and a unit fraction. (2 min) [E](#) [MM](#)

### Fractions Greater than 1 on the Number Line

Use a number line to plot fractions greater than 1. (3 min) [E](#) [MM](#)

### Representing 1 as a Fraction

Explore various ways to represent the number 1 as a fraction, like  $1/1$ ,  $2/2$ , and  $3/3$ . (4 min) [E](#) [MM](#)

### Relating Fractions to 1

Use 1 as a benchmark for identifying fractions greater than or less than 1. (3 min) [E](#) [MM](#)

### Whole Numbers as Fractions

Explore how to represent whole numbers as fractions. (4 min) [E](#) [MM](#)

### Writing Whole Numbers as Fractions

Learn how to represent fractions as whole numbers and whole numbers as fractions. (2 min) [E](#) [MM](#)

## Fractions, Decimals, Percents & Ratios | Equivalent Fractions & Comparing Fractions

### Comparing Fractions with > and < Symbols

Explore and learn how to compare fractions. (5 min) [E](#) [MM](#)

### Comparing Fractions Visually

Learn to compare fractions by graphing them a number line and drawing fraction models. (4 min) [E](#) [MM](#)

### Comparing Fractions with the Same Denominator

Learn to compare fractions with the same denominator. (3 min) [E](#) [MM](#)

### Comparing Unit Fractions

Compare fractions by visualizing them as parts of a whole. (3 min) [E](#) [MM](#)

### Comparing Fractions with the Same Numerator

Compare fractions with the same numerator visually. (4 min) [E](#) [MM](#)

### Comparing Fractions of Different Wholes: Part 1

Utilize visual fraction models to compare fractions. (5 min) [E](#) [MM](#)

### Comparing Fractions of Different Wholes: Part 2

Utilize visual fraction models to compare fractions. (3 min) [E](#) [MM](#)

### Equivalent Fractions with Visuals

Learn to use same-sized wholes to show equivalent fractions. (6 min) [E](#) [MM](#)

### Equivalent Fraction Models

Use same-sized wholes to show equivalent fractions. (4 min) [E](#) [MM](#)

### Equivalent Fractions Visually

Use number lines and fraction models to show equivalent fractions. (4 min) [E](#) [MM](#)

### Creating Equivalent Fractions

Learn about equivalent fractions. (4 min) [E](#) [MM](#)

## Measurement & Data | Measuring Mass & Volume

### Understanding Mass (Grams and Kilograms)

Learn about what mass means and examine the masses of real objects. (7 min) [E](#) [MM](#)

### Word Problems with Mass

Solve word problems involving mass. (4 min) [E](#) [MM](#)

### Understanding Volume (Liters)

Learn about what volume means and examine the masses of real objects. (5 min) [E](#) [MM](#)

### Word Problems with Volume

Solve a word problem using volume. (4 min) [E](#) [MM](#)

## Measurement & Data | Represent & Interpret Data

### Creating Picture and Bar Graphs

Create and interpret bar and picture graphs. (5 min) [E](#) [MM](#)

### Solving Problems with Picture Graphs

Use picture graphs to solve word problems. (4 min) [E](#) [MM](#)

### Interpreting Picture Graphs: Paint

Solve a multi-step word problem utilizing a picture graph. (2 min) [E](#) [MM](#)

### Interpreting Picture Graphs: Notebook

Solve a multi-step word problem utilizing a picture graph. (4 min) [E](#) [MM](#)

### Reading Bar Graphs: Movies

Interpret bar graphs to answer questions about a context. (4 min)

### Interpreting Bar Graphs: Colors

Solve a multi-step word problem using a bar graph. (4 min) [E](#) [MM](#)

### Measuring Lengths to the Nearest 1/4 Unit

Use a ruler to measure lengths to the nearest 1/4 unit. (2 min) [E](#) [MM](#)

### Graphing Data on Line Plots

Learn about measurements on line plots, also called dot plots. (5 min) [E](#) [MM](#)

### Interpreting Line Plots with Fractions

Interpret data on line plots to the nearest 1/4 unit with some unlabeled tick marks. (4 min) [E](#) [MM](#)

## Science

### Earth & Space Science

#### Earth Cutaway

A model of Earth with a section cut away to expose its layers. [IFX](#)

#### Earth Cutaway Info

An Infographic model of Earth with a section cut away to expose its layers. [IFX](#)

#### Grand Canyon

Explore the Grand Canyon from different observation decks around the natural wonder. (unlimited) [E](#)

#### Google Data Center Tour

Take a Google data Center Tour and Learn about the massive scale, the incredible attention to security and privacy and the amazing efforts to make the data center extremely efficient and green. (9 min)

#### Solar System 360 Degree Tour

Take a 360 degree virtual tour of our Solar system with the help of Crash Course Astronomy host Phil Plait. (5 min)

#### Explore the Solar System

Take a 360-degree virtual tour of our Solar System, with the help of Crash Course Astronomy host Phil Plait. (5 min)

#### VR Solar System Space Video

This amazing 360 virtual reality video will transport you through our galactic neighborhood, the solar system. (18 min)

#### Solar System

Be immersed in an interactive classroom that allows students to visit each planet, watch them orbit, and learn about each one. (Unlimited) [E](#)

#### Solar System model

Animated model of the solar system. Rotation and revolution speeds are scaled accurately. [IFX](#)

## Cloud Climb

Explore how clouds, the atmosphere and weather all come together to create different aspects of the Earth's sky.

(unlimited) [E](#)

## Chennai Floods Aftermath

Be immersed in a documentary emphasizing the impact, rescue, and reason for the floods in Chennai, India. (6 min)

## After the Floods: Rebuilding Ellicott City

An immersive journey through the flooding, aftermath, and reconstruction of Ellicott City, Maryland to give a new perspective to the damage done by the flooding. (6 min)

## Kamchatka Volcano Eruption

National Geographic VR takes you to the rim of a spectacular erupting volcano: Klyuchevskoy, one of the tallest and most active volcanoes on the planet. (2 min)

## Life in Haiti: After a Devastating Natural Disaster

Join filmmaker Dylan Roberts on a journey to the Haitian city of Jérémie, and the small village of Manish, to witness the aftermath of a colossal storm. (5 min)

## Category 3 Hurricane Landfall Simulation

Experience a category 3 hurricane through a simulation with guided popups. (1 min)

## Earthquake VR Experience

Simulation of a virtual earthquake to provide lifelike training experience without an actual earthquake. (2 min)

## Inside Hurricane Maria

See inside Hurricane Maria and see how it changes from a category 1 to a category 5 in about 24 hours. (5 min)

## Life Science

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### Glow Worm Caves of New Zealand

Deep below ground, you will learn about strange carnivorous worms. (2 min)

## How Animals See the World

Experience how different animals see the world. Includes a human, cat, dog, fly, rat, and snake's point of view. (4 min)

## Attenborough and the Giant Dinosaur

Learn all about the Titanosaur with David Attenborough. (4 min)

## Giraffatitan Dinosaur: Back to Life in 360 VR

Encounter the Jurassic giant Giraffatitan, one of the tallest dinosaurs that ever lived, and learn all about how it lived and who its descendants are. (4 min)

## Rhomaleosaurus Sea Dragon: Back to Life in 360 VR

Encounter the prehistoric sea dragon Rhomaleosaurus, as it roams the gallery over 180 million years after it died. (4 min)

## VR Jurassic Dinosaur

Explore what life was like during the age of the dinosaur. (3 min)

## Bears of Kamchatka, Kambalnaya River

Follow along as you experience the Bears of Kamchatka and learn about their habitat, daily life, and mating season. (5 min)

## Chengdu Panda Base, China

Get an in-depth look at the pandas that call Chengdu Panda Base their home and learn about their habitat, diet, and daily life. (11 min)

## Diving Exploration of Kelp Forest Aquarium

Explore the Kelp Forest at Monterey Bay Aquarium. (3 min)

## Gorillas in the Congo: A Jump VR Video

Experience gorillas in their natural habitat of the Congo Jungle. (2 min)

## Zebra 1

Watch a herd of Zebras Graze. (1 min)

## Zebra 2

Watch how zebras move as a herd. (1 min)

## Hyena 1

Watch a hyena feed on a fresh kill. (1 min)

## Hyena 2

Watch a hyena approach cautiously for a snack. (1 min)

## Lemur 1

Watch lemurs climb and play in a zoo. Part 1. (1 min)

## Lemur 2

Watch lemurs climb and play in a zoo. Part 2. (1 min)

## Lemur 3

Watch lemurs climb and play in a zoo. Part 3. (1 min)

## Lions 360 (5 min)

National Geographic Explorer Martin Edström, you will come face to face with Gibson and his mother, as they struggle with their pride's alpha male. (5 min)

## Ocean to Plate: A Journey into the Seafood Supply Chain

As populations and appetites grow, global fisheries are reaching their ecological capacity, yet at least a third of harvested fish and seafood is lost or wasted along the supply chain. (7 min)

## Physical Science

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### Gas in Tank

Three colored liquids of different densities that flow out of pipes and stack on top of each other in a tank. [IFX](#)

### Liquid Particles in Tank

Liquid particles that move randomly inside a tank. [IFX](#)

### Solid Particle Arrangement

Rotating cube of crystalline atomic structure. [IFX](#)

### Bunsen Burner and Breaker

Interactive model of a Bunsen burner, beaker, and ring stand. Toggling the valve turns on the burner flame and starts a chemical reaction in the beaker. [IFX](#)

### Electromagnet- Small Solenoid

Animated visualization of an electromagnetic solenoid with 15 coils. [IFX](#)

## Electromagnet – Large Solenoid

Animated visualization of an electromagnetic solenoid with 26 coils. [IFX](#)

## Magnet- Like Poles

Animated visualization of two bar magnets with like poles repelling each other. [IFX](#)

## Magnet – Opposite Poles

Animated visualization of two bar magnets attracting each other. [IFX](#)

## Magnet – Single Bar

Animated visualization of the electromagnetic field surrounding a single bar magnet. [IFX](#)

## Magnet – Two Bars

Animated visualization of the electromagnetic field surrounding two bar magnets. [IFX](#)

## Magnet – Horseshoe

Animated visualization of the electromagnetic field surrounding a horseshoe magnet. [IFX](#)

# Social Studies

## Civil Rights

### Civil Rights Museum

Five Civil Rights leaders - Rosa Parks, John Lewis, Martin Luther King Jr., Thurgood Marshall, and Medgar Evers - come to life and teach you their stories on interactive stages. (unlimited) [E](#)

### Independence Hall

Join George Washington, John Adams, Thomas Jefferson, Benjamin Franklin, and John Hancock as they come to life to tell you their stories about the founding of the United States. (unlimited) [E](#)

## Economics

### 360 Illinois Farm Tour : It Starts with a Seed

Follow a fifth-generation farmer and see the challenge, solutions that technology offers, and ultimately the fruits of our labor that will transform into food, feed and fuel used throughout the state, across the country and around the globe.

Part 1 (6 min)

### 360 Farm Tour: As the Corn Grows

Follow a fifth-generation farmer and see the challenge, solutions that technology offers, and ultimately the fruits of our labor that will transform into food, feed and fuel used throughout the state, across the country and around the globe.

Part 2 (4 min)

### 360 Farm Tour: Harvesting the Corn

Follow a fifth-generation farmer and see the challenge, solutions that technology offers, and ultimately the fruits of our labor that will transform into food, feed and fuel used throughout the state, across the country and around the globe.

Part 3 (4 min)

### 360 Farm Tour: Protecting the Corn

Follow a fifth-generation farmer and see the challenge, solutions that technology offers, and ultimately the fruits of our labor that will transform into food, feed and fuel used throughout the state, across the country and around the globe.

Part 4 (4 min)

### A 360 Look Inside Brooklyn's Farming Revolution

Visit a high-tech, hydroponic farm that's fueling a new food revolution that is breaking away from the traditional, transport-heavy, industrial food system and blazing the trail for the future of super-efficient urban farming. (3 min)

### Ace Center @ Hermitage Greenhouse

Join students from Hermitage High School as they explain how a greenhouse works and the different features within it. (3 min)

### George the Farmer Forestry – VR

Join George the Farmer and his mates Simone and Ben as they investigate some of the products made from Pine Trees in sustainable pine plantations. (4 min)

### Smithfield Sow Farm 360° Virtual Tour

Take a virtual tour of Smithfield's sow farm and learn about the care and work that goes into taking care of their hogs. (6 min)

### Google Data Center Tour

Take a Google data Center Tour and Learn about the massive scale, the incredible attention to security and privacy and the amazing efforts to make the data center extremely efficient and green. (9min)

### Ocean to Plate: A Journey into the Seafood Supply Chain

As populations and appetites grow, global fisheries are reaching their ecological capacity, yet at least a third of harvested fish and seafood is lost or wasted along the supply chain. (7 min)

### Story of Oats

In this 360 video tour, you'll get to see how oats are transformed from a plant in the field to the food on your table. (6 min)

### Weaving Around the World

Follow the process of weaving that has been developed across cultures for thousands of years. From Venice to Addis Ababa, and the West Bank to the Navajo Nation Reservation. (4 min)

## Geography

### Explore the Deep Ocean

Follow along in a Submarine and see the ocean from a new view. (2 min)

## Canyon

Peer down into a canyon from the top.  
(1 min)

## Antarctica- Part II

See Antarctica from aboard a ship as it sails around Antarctica and see the different wildlife. (6 min)

## Damming the Nile : Episode 1

Africa's largest hydroelectric power project is two thirds finished and the dam can already control the flow of the Blue Nile, which is deeply upsetting downstream Egypt who they didn't consult before building started. (13 min)

## Damming the Nile: Episode 2

Africa's largest hydroelectric power project is two thirds finished and the dam can already control the flow of the Blue Nile, which is deeply upsetting downstream Egypt who they didn't consult before building started. (16 min)

## Okinawa 360 - VR Sea Tour

Explore the diverse aquatic life surrounding Okinawa. (5 min)

## Explore the World in 4K

Venture around the world and see different aspects of the natural world and various cities and wildlife. (3 min)

## The Hidden World of National Parks

Follow rangers on a journey to places most people never go. Experience the sights, sounds, and adventures of Kenai Fjords, Hawai'i Volcanoes, Carlsbad Caverns, Bryce Canyon, and Dry Tortugas in stunning 360° video. (5 min)

## Iceland

Soar over Iceland and take in the different views that Iceland has to offer. (3 min)

## Africa at Night- Planet Earth II:

### Grasslands

Take your chances in the savannah at night, surrounded by some of the largest and most fearsome animals in Africa all while taking in the night sky in the savannah. (4 min)

## Travel-Dream-Imagine- A VR Journey from the desert floor to the Sea

Travel with us as we step into the Judea desert, bathe in a waterfall in a hidden oasis, wet our feet in the red sea, dive among corals and finally float in one of the wonders of the world - the dead sea. (2 min)

## Grand Canyon

Explore the Grand Canyon from different observation decks around the natural wonder. (unlimited) [E](#)

## Climbing the Redwoods: Fight for the Forests

Climb 200 feet up 'Grandfather,' the highest Redwood in a Northern California Grove while learning about the Redwood Forest and preservation efforts. (2 min)

## Protecting Ocean Anchor Species: Racing Extinction

Join marine biologist Luke Tipple as he swims alongside manta rays and whale sharks while sharing why they are vital to the survival of our oceans. (3 min)

## Rescuing Rhinos: Racing Extinction

Join a conservation biologist on an interactive mission to learn how animals critical to the world's ecosystem thrive and survive in the wild. (5 min)

## The Fight to Save Threatened Species

Get closer than ever before to the most extraordinary creatures on the planet. Whale sharks, rhinos, elephants, manta rays, and lions are all threatened with extinction. (2 min)

## Volcano

Experience an erupting volcano. [IFX](#)

## After the Floods: Rebuilding Ellicott City

Take an immersive journey through the flooding, aftermath, and reconstruction of Ellicott City, Maryland to give a new perspective on the damage done by flooding. (6 min)

## Chennai Floods Aftermath

Take an immersive journey through the impact, rescue, and reason for the floods that occurred in Chennai, India, in December 2015. (6 min)

## Kamchatka Volcano Eruption

National Geographic VR takes you to the rim of a spectacular erupting volcano: Klyuchevskoy, one of the tallest and most active volcanoes on the planet. (2 min)

## Life in Haiti: After a Devastating Natural Disaster

Join filmmaker Dylan Roberts on a journey to the Haitian city of Jérémie, and the small village of Manish, to witness the aftermath of a colossal storm. (5 min)

## Category 3 Hurricane Landfall

### Simulation

Experience a category 3 hurricane through a simulation with guided popups. (1 min)

## Earthquake VR Experience

Be exposed to a virtual earthquake that provides a life-like training experience, without an actual earthquake. (2 min)

## Expedition to the Heart of Active Volcano

Join a group of climbers as they embark on a scientific exploration into an active volcano. (5 min)

## Close-Range Tornado

Get up close and personal with a tornado near Wray, CO from May 7<sup>th</sup>, 2016. (8 min)

## Boston Snowstorm from Bunker Hill Monument

Watch a major winter storm move through the city of Boston in this time-lapse from the top of Bunker Hill Monument. (3 min)

## Inside Hurricane Maria

Watch Hurricane Maria change from a category 1 to a category 5 in about 24 hours. (5 min)

## Nuclear Power Plant

Recreation of a nuclear power plant that students can explore. The interactive map allows students to tour the entire facility while illustrating how the different components are connected in the process of nuclear power generation. (unlimited) [E](#)

## Nuclear Control Room

Replica of the nuclear control room found at Three Mile Island. (unlimited) [E](#)

## World Geography

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### A London City Guided Tour

Guided tour of some of London's most iconic landmarks. (5 min)

### Immerse yourself in a tour around the Forbidden City of China

With red walls and yellow tiles, the resplendent and magnificent Forbidden City is a treasure of China's ancient palace architecture. (5 min)

### Leshan Giant Buddha- Leshan, China

Go on a tour of the Entire Leshan scenic area, including the famous stone Buddha statue. (9 min)

### The Dream of Egypt's Tuthmosis IV

A tour around the statue of the Sphinx temple and the pyramids of Giza. (4 min)

### Damming the Nile : Episode 1

Africa's largest hydroelectric power project is two thirds finished and the dam can already control the flow of the Blue Nile, which is deeply upsetting downstream Egypt who they didn't consult before building started. (13 min)

### Damming the Nile: Episode 2

Africa's largest hydroelectric power project is two thirds finished and the dam can already control the flow of the Blue Nile, which is deeply upsetting downstream Egypt who they didn't consult before building started. (16 min)

## Himalayas: A Trek to School

Follow two girls as they travel for up to 6 hours a day to school in a remote Himalayan village. (8 min)

## Travel-Dream-Imagine- A VR Journey from the Desert Floor to the Sea

Travel with us as we step into the Judea desert, bathe in a waterfall in a hidden oasis, wet our feet in the red sea, dive among corals and finally float in one of the wonders of the world - the dead sea. (2 min)

## GoPro VR: New York City Jump

There's no better way to see New York City in 360 then through the eyes of a born and bred NY photographer. (3 min)

## Video of the Aurora Borealis over

### Alaska's Chatanika River

A 360 timelapse video of the Aurora Borealis filmed during a geomagnetic storm by William Briscoe Photography. (5 min)

## Explore Lake Ontario Schooner:

### St. Peter

Explore the wreck of schooner St. Peter, which lies Lake Ontario National Marine Sanctuary. Students research the technologies used by maritime archaeologists to locate and image shipwrecks and participate in simulations of the use of two of these technologies, sonar, and photogrammetry. (4 min)

## VR Pearl Harbor Attack Reenactment, Japanese Midget Submarine/ Explore South Dakota's Badlands

EXP.1: The Japanese midget submarine, manned by Ensign Kazuo Sakamaki, failed in its mission to attack and destroy American warships. (6min)

EXP.2:The Badlands is home to the largest mixed grass prairie where bison and other wildlife graze freely. (2 min)

## Grand Canyon

Explore the Grand Canyon from different observation decks around the natural wonder. (unlimited) [E](#)

## Cool VR Walk on the Moon with NASA/ Yosemite

EXP.1- Experience a walk on the Moon from the Project Apollo Archive. (2min)

EXP.2-Experience a guided tour of some of Yosemite's majestic spots. (4 min)

## Waterfall 1

View a waterfall and the surrounding plant life. (1 min)

## Waterfall 2

View a waterfall and the surrounding plant life. (1 min)

## Waterfall 3

View a waterfall and the surrounding plant life. (1 min)

## History

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## Independence Hall

Join George Washington, John Adams, Thomas Jefferson, Benjamin Franklin, and John Hancock as they come to life to tell you their stories about the founding of the United States. (unlimited) [E](#)

## Historic Jamestown

Interactive experience where students will experience the reason for the English Colonization and the significance of the location regarding resources, defensibility, and economic development. (unlimited) [E](#)

## Civil Rights Museum

Five Civil Rights leaders - Rosa Parks, John Lewis, Martin Luther King Jr., Thurgood Marshall, and Medgar Evers - come to life and teach you their stories on interactive stages. (unlimited) [E](#)

# 4th Grade

## Mathematics

### Basic Operations & Reasoning | Place Value

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#### Place Value Blocks

Identify numbers represented by place value blocks. (6 min) [E](#) [MM](#)

#### Place Value Tables

Learn about how to use a place value table to break up a number. (2 min) [E](#) [MM](#)

#### Finding Place Value

Find the place value of 3 in 4356. (2 min) [E](#) [MM](#)

#### Creating the Largest Number

Learn how to arrange digits to make the largest possible number. (2 min) [E](#) [MM](#)

#### Writing a Number in Expanded Form

Learn to write 14,897 in expanded form. (5 min) [E](#) [MM](#)

#### Writing Numbers in Words and Standard Form

Write whole numbers in words and write numbers in word form and standard form. (5 min) [E](#) [MM](#)

#### Regrouping Whole Number Place Values

Learn to regroup whole numbers by their place values. (6 min) [E](#) [MM](#)

#### Regrouping Numbers into Various Place Values

Visualize different ways to regroup 4500. (2 min) [E](#) [MM](#)

#### Adding Whole Numbers by Their Place Values

Learn to add numbers like 19 thousands + 7 tens by thinking about their place values. (6 min) [E](#) [MM](#)

#### Multiplying Whole Numbers by 10

Visualize a pattern from multiplying whole numbers by 10. (7 min) [E](#) [MM](#)

#### Dividing Whole Numbers by 10

Visualize a pattern from dividing whole numbers by 10. (7 min) [E](#) [MM](#)

#### Understanding Place

Learn how a digit in one place represents ten times what it represents in the place to its right. (3 min) [E](#) [MM](#)

#### Place Value when Multiplying and Dividing by 10

Learn how multiplying and dividing by 10 affects place value. (5 min) [E](#) [MM](#)

#### Comparing Multi-Digit Numbers

Learn to compare multi-digit numbers such as 350,000 and 53,000. (6 min) [E](#) [MM](#)

#### Comparing Whole Number Place Values

Learn to compare whole numbers written in expanded form, written form, and number form. (2 min) [E](#) [MM](#)

### Basic Operations & Reasoning | Addition, Subtraction, & Estimation

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#### Rounding Whole Numbers to Nearest Hundred

Learn to round 24,259 to the nearest hundred. (4 min) [E](#) [MM](#)

#### Rounding Whole Numbers to Nearest Thousand

Learn to round 423,275 to the nearest Thousand. (2 min) [E](#) [MM](#)

#### Rounding Whole Numbers: Missing Digit

Find the missing digit in an estimation problem by using a number line. (6 min) [E](#) [MM](#)

#### Rounding Whole Numbers Word Problems

Solve word problem by rounding whole numbers to the nearest ten, hundred, or thousand. (3 min) [E](#) [MM](#)

#### Relate Place Value to Standard Algorithm for Multi-Digit Addition

Learn to transition from a place value chart to standard algorithm when adding multi-digit numbers. (6 min) [E](#) [MM](#)

#### Adding Multi-Digit Numbers: 48,029+233,930

Learn to add 48,029+233,930 using the standard algorithm. (2 min) [E](#) [MM](#)

#### Relate Place Value to Standard Algorithm for Multi-Digit Subtraction

Learn to transition from a place value chart to standard algorithm when subtracting multi-digit numbers. (6 min) [E](#) [MM](#)

#### Multi-Digit Subtraction: 389,002-76,151

Learn to subtract 389,002-76,151 using the standard algorithm. (3 min) [E](#) [MM](#)

### Basic Operations & Reasoning | Multiply by 1-Digit Numbers

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#### Comparing with Multiplication

Learn to represent multiplication equations as comparisons. (3 min) [E](#) [MM](#)

#### Comparing with Multiplication and Addition: Giraffe

Learn to solve two multiplication comparison word problems. (5 min) [E](#) [MM](#)

#### Comparing with Multiplication and Addition: Money

Learn to solve two multiplication comparison word problems. (7 min) [E](#) [MM](#)

**Comparing with Multiplication: Magic**

Solve a multiplication comparison word problem with Harry Potter characters.

(1 min) [E](#) [MM](#)

**Multiplying 1-Digit Numbers by 10, 100, and 1000**

Learn to find a pattern from multiplying 1-digit numbers by 10, 100, and 1000.

(6 min) [E](#) [MM](#)

**Multiplying 1-Digit Numbers by Multiples of 10, 100, and 1000**

Learn to find a pattern from multiplying 1-digit numbers by multiples of 10, 100, and 1000. (8 min) [E](#) [MM](#)

**Using Area Model and Properties to Multiply**

Learn to use place value, the distributive property, associative property, and an area model to show more ways to multiply.

(6 min) [E](#) [MM](#)

**Estimating with Multiplication**

Learn to use an area model to multiply  $6 \times 7981$ . (3 min) [E](#) [MM](#)

**Multiplying 2-Digits by 1-Digit with Partial Products**

Learn to estimate to find reasonable products to 1-digit by 2, 3, and 4-digit multiplication expressions. (4 min) [E](#) [MM](#)

**Multiplying 3-Digit by 1-Digit**

Learn to multiply a 3-digit number by a 1-digit number without regrouping.

(2 min) [E](#) [MM](#)

**Multiplying 3-Digit by 1-Digit (Regrouping)**

Learn to multiply a 3-digit number by a 1-digit number using regrouping.

(2 min) [E](#) [MM](#)

**Basic Operations & Reasoning | Multiply by 2-Digit Numbers****Multiplying 10s**

Learn to multiply multiples of 10 by other multiples of 10, such as  $30 \times 50$ .

(5 min) [E](#) [MM](#)

**Multiplying with Area Model:  $16 \times 27$** 

Learn to use an area model to multiply  $16 \times 27$ . (9 min) [E](#) [MM](#)

**Multiplying with Area Model:  $78 \times 65$** 

Learn to use an area model to multiply  $78 \times 65$ . (5 min) [E](#) [MM](#)

**Estimating 2-Digit Multiplication**

Learn to estimate to find reasonable products to 2-digit multiplication expressions. (3 min) [E](#) [MM](#)

**Multiplying Two 2-digit Numbers****Using Partial Products**

Learn to use the distributive property to find each part of the product to get the whole product. (5 min) [E](#) [MM](#)

**Multiplying 2-Digit Numbers**

Learn to multiply 2-digit numbers. (4 min) [E](#) [MM](#)

**Basic Operations & Reasoning | Division****Estimating Division that Results in Non-Whole Numbers**

Use estimation to find quotients that are non-whole numbers. (4 min) [E](#) [MM](#)

**Introduction to Remainders**

Visualize and learn how a remainder is what's left over in a division problem.

(5 min) [E](#) [MM](#)

**Quotients that are Multiples of 10**

Visualize how to break down division problems using multiples of 10.

(6 min) [E](#) [MM](#)

**Division Using Place Value**

Learn to use an understanding of place value to divide  $5600 \div 8$  and  $846 \div 2$ .

(8 min) [E](#) [MM](#)

**Division with Area Models**

Use area models to divide  $268 \div 2$  and  $856 \div 8$ . (8 min) [E](#) [MM](#)

**Estimating Quotients**

Solve using estimation to determine if quotients are reasonable or unreasonable.

(4 min) [E](#) [MM](#)

**Introduction to Division with Partial Quotients (No Remainder)**

Learn to divide multi-digit numbers by a single-digit numbers using partial quotients. (6 min) [E](#) [MM](#)

**Division with Partial Quotients (Remainder)**

Learn to divide multi-digit numbers by single-digit numbers using partial quotients. (7 min) [E](#) [MM](#)

**Intro to Long Division (No Remainders)**

Visualize how to do long division with the problem  $96 \div 4$ . (3 min) [E](#) [MM](#)

**Division Word Problem: Field Goals**

Work to solve a division word problem involving field goals. (3 min) [E](#) [MM](#)

**Multiplication Word Problem: Pizza**

Work to solve a multiplication word problem about pizza. (3 min) [E](#) [MM](#)

**2-Step Estimation Word Problem**

Learn to use estimation to solve multi-step word problems involving addition, subtraction, multiplication, and division.

(3 min) [E](#) [MM](#)

## Basic Operations & Reasoning | Factors, Multiples, & Patterns

### Understanding Factor Pairs

Use multiplication and an understanding of area to identify factor pairs for 6 and 16.

(4 min) [E](#) [MM](#)

### Finding Factors of a Number

Identify the factors of 120. (10 min) [E](#) [MM](#)

### Reasoning about Factors and Multiples

Use the equation  $3 \times 5 = 15$  to understand the relationship between factors and multiples.

(2 min) [E](#) [MM](#)

### Finding Factors and Multiples

Use divisibility rules to determine if numbers are factors of 154 and then finds multiples of 14. (4 min) [E](#) [MM](#)

### Identifying Multiples

Use skip counting and division to identify multiples of 9. (4 min) [E](#) [MM](#)

### Prime Numbers

Identify that prime numbers are numbers that have only 2 factors: 1 and themselves.

(8 min) [E](#) [MM](#)

### Recognizing Prime and Composite Numbers

Learn to recognize prime numbers in a group of numbers and if it is prime, composite or neither. (5 min) [E](#) [MM](#)

### Factors and Multiples: Days of the Week

Learn to use factors and multiples to figure out days of the week. (5 min) [E](#) [MM](#)

### Math Patterns: Table

Visualize and identify a pattern with the number of seats at a table. (4 min) [E](#) [MM](#)

### Math Patterns: Toothpicks

Visualize and explore a pattern of creating figures with toothpicks. (6 min) [E](#) [MM](#)

## Geometry

### Rhombus Tile

Simple geometry manipulatives that can be used to teach about shapes and angles, or create tessellations. [IFX](#)

### Pentagon Tile

Simple geometry manipulatives that can be used to teach about shapes and angles, or create tessellations. [IFX](#)

### Octagon Tile

Simple geometry manipulatives that can be used to teach about shapes and angles, or create tessellations. [IFX](#)

### Obtuse Isosceles Triangle Tile

Simple geometry manipulatives that can be used to teach about shapes and angles, or create tessellations. [IFX](#)

### Narrow Rhombus Tile

Simple geometry manipulatives that can be used to teach about shapes and angles, or create tessellations. [IFX](#)

### Hexagon Tile

Simple geometry manipulatives that can be used to teach about shapes and angles, or create tessellations. [IFX](#)

### Equilateral Triangle Tile

Simple geometry manipulatives that can be used to teach about shapes and angles, or create tessellations. [IFX](#)

### Acute Isosceles Triangle Tile

Simple geometry manipulatives that can be used to teach about shapes and angles, or create tessellations. [IFX](#)

### Wide Rhombus Tile

Simple geometry manipulatives that can be used to teach about shapes and angles, or create tessellations. [IFX](#)

### Trapezoid Tile

Simple geometry manipulatives that can be used to teach about shapes and angles, or create tessellations. [IFX](#)

### Square Tile

Simple geometry manipulatives that can be used to teach about shapes and angles, or create tessellations. [IFX](#)

### Protractor

At-scale measuring tool for measuring angles. Designed to be used with geometric tiles, or as a general teaching/training tool.

[IFX](#)

## Geometry | Plane Figures

### Terms & Labels in Geometry

Explore geometry fundamentals, including points, line segments, rays, and lines.

(13 min) [E](#) [MM](#)

### Lines, Line Segments, & Rays

Learn the difference between lines, line segments, and rays. (3 min) [E](#) [MM](#)

### Angles: Introduction

Learn about angles and the parts of an angle, like the vertex. (7 min) [E](#) [MM](#)

### Naming Angles

Learn to name angles based on their vertex and endpoints. (2 min) [E](#) [MM](#)

### Identifying an Angle

Identify pictures of angles to their degrees. (2 min)

### Acute, Right, & Obtuse Angles

Learn about angle types and see examples of each. (5 min) [E](#) [MM](#)

### Recognizing Angles

Identify acute, obtuse, and right angles in diagrams and pictures. (2 min) [E](#) [MM](#)

### Drawing Acute, Right and Obtuse Angles

Learn how to draw acute, right, and obtuse angles with given points. (3 min) [E](#) [MM](#)

### Parallel & Perpendicular Lines Intro

Learn how to identify parallel and perpendicular lines. (2 min) [E](#) [MM](#)

### Parallel & Perpendicular Lines

Learn to identify parallel lines and perpendicular lines. (3 min) [E](#) [MM](#)

### Drawing Parallel Line Segments

Use given points to draw parallel line segments. (2 min) [E](#) [MM](#)

**Classifying Triangles**

Explore how triangles are classified based on their sides and angles. (6 min) [E](#) [MM](#)

**Classifying Triangles by Angles**

Learn how to categorize a triangle by its angles vs. the length of the sides.

(6 min) [E](#) [MM](#)

**Worked Example: Classifying Triangles**

Work through sample problems categorizing triangles as scalene, isosceles, equilateral, acute, right, or obtuse.

(2 min) [E](#) [MM](#)

**Classifying Shapes by Line and Angle Types**

Learn to categorize shapes based on their sides and angles. (2 min) [E](#) [MM](#)

**Quadrilateral Properties**

Learn about the properties of quadrilaterals, parallelograms, trapezoids, rhombuses, rectangles, and squares.

(5 min) [E](#) [MM](#)

**Classifying Shapes by Lines and Angles**

Learn to classify a shape based on hints about its sides and angles. (4 min) [E](#) [MM](#)

**Intro to Reflective Symmetry**

Introduction to the concept of an "axis of symmetry". (3 min) [E](#) [MM](#)

**Identifying Symmetrical Figures**

Learn to identify lines of symmetry on three shapes. (6 min) [E](#) [MM](#)

**Geometry | Measuring Angles****Angle Measurement & Circle Arcs**

Learn to measure angles as part of a circle. (8 min) [E](#) [MM](#)

**Measuring Angles with a Circular Protractor**

Use a circular protractor to measure angles. (2 min) [E](#) [MM](#)

**Angles in Circles Word Problem**

Solve word problems about angles as part of a circle. (3 min) [E](#) [MM](#)

**Measuring Angles in Degrees**

Learn how to measure an angle with a protractor. (8 min) [E](#) [MM](#)

**Measuring Angles Using a Protractor**

Learn to use a virtual protractor to measure angles. (3 min) [E](#) [MM](#)

**Measuring Angles Using a Protractor 2**

Use a protractor to measure several angles. (4 min) [E](#) [MM](#)

**Constructing Angles**

Use a protractor to create  $10^\circ$  and  $155^\circ$  angles. (3 min) [E](#) [MM](#)

**Decomposing an Angle**

Find the measure of angles by adding or subtracting. (2 min) [E](#) [MM](#)

**Decomposing Angles**

Find the measure of angles using addition. (3 min) [E](#) [MM](#)

**Geometry | Area & Perimeter****Area & Perimeter Word Problem:****Dog Pen**

Figure out the width of a dog pen in this word problem. (3 min) [E](#) [MM](#)

**Area & Perimeter Word Problem:****Table**

Solve this word problem and find the dimension of a table. (5 min) [E](#) [MM](#)

**Comparing Areas Word Problem**

Compare the area of two posters using their side-lengths. (3 min) [E](#) [MM](#)

**Fractions, Decimals, Percents, & Ratios | Equivalent Fractions & Comparing Fractions****Equivalent Fractions with Models**

Learn to use fraction models and tape diagrams to help identify equivalent fractions. (6 min) [E](#) [MM](#)

**Equivalent Fractions on Number Lines**

Learn to use a number line to help identify equivalent fractions with different denominators. (5 min) [E](#) [MM](#)

**Equivalent Fractions**

Learn how equivalent fractions represent the same amount, even with different numerators and denominators.

(4 min) [E](#) [MM](#)

**More on Equivalent Fractions**

Learn to use fraction models and multiplication to find equivalent fractions. (5 min) [E](#) [MM](#)

**Equivalent Fractions and Different Wholes**

Visualize that two fractions are equivalent only if they refer to the same whole.

(6 min) [E](#) [MM](#)

**Comparing Fractions of Different Wholes**

Learn to compare fractions of different wholes. (5 min) [E](#) [MM](#)

**Finding Common Denominators**

Learn how to use the least common multiple of the denominators to rewrite fractions, making them easier to compare or add. (5 min) [E](#) [MM](#)

**Common Denominators:  $\frac{1}{4}$  and  $\frac{5}{6}$** 

Learn how to find common denominators for fractions with different numerators and denominators by identifying multiples of the original denominators. (8 min) [E](#) [MM](#)

**Common Denominators: 3/5 and 7/2**

Visualize how to rewrite fractions with different denominators as equivalent fractions with a common denominator.

(4 min) [E](#) [MM](#)

**Comparing Fractions: Tape Diagram**

Learn to compare fractions with unlike denominators by drawing bars.

(2 min) [E](#) [MM](#)

**Comparing Fractions: Number Line**

Learn to compare fractions on a number line. (3 min) [E](#) [MM](#)

**Comparing Fractions: Fraction Models**

Learn to compare fractions visually with pies. (3 min) [E](#) [MM](#)

**Comparing Fractions 1 (Unlike Denominators)**

Learn to compare fractions by finding a common denominator. (4 min) [E](#) [MM](#)

**Comparing Fractions Word Problems**

Work to compare fractions using real-world contexts. (5 min) [E](#) [MM](#)

## Fractions, Decimals, Percents, & Ratios | Add & Subtract Fractions

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**Decomposing a Fraction Visually**

Use a tape diagram to decompose  $7/9$ .

(5 min) [E](#) [MM](#)

**Decomposing a Mixed Number**

Use fraction models to decompose  $2\frac{1}{4}$ .

(5 min) [E](#) [MM](#)

**Adding Fractions with Like Denominators**

Learn to add  $3/15 + 7/15$ . (3 min) [E](#) [MM](#)

**Subtracting Fractions with Like Denominators**

Learn to subtract  $8/18 - 5/18$ . (3 min) [E](#) [MM](#)

**Fraction Word Problem: Piano**

Solve a fraction word problem about practicing piano. (3 min) [E](#) [MM](#)

**Fraction Word Problem: Pizza**

Solve a fraction model to figure out what fraction of a pizza is left. (5 min) [E](#) [MM](#)

**Fraction Word Problem: Spider Eyes**

Solve a fraction word problem about spider eyes. (2 min) [E](#) [MM](#)

**Writing Mixed Numbers as Improper Fractions**

Visualize how to rewrite  $5\frac{1}{4}$  as an improper fraction. (7 min) [E](#) [MM](#)

**Writing Improper Fractions as Mixed Numbers**

Visualize how to rewrite  $7/4$  as a mixed number. (4 min) [E](#) [MM](#)

**Adding Mixed Numbers with Like Denominators**

Visualize adding mixed numbers with common (like) denominators. (3 min) [E](#) [MM](#)

**Subtracting Mixed Numbers with Like Denominators**

Visualize subtracting mixed numbers with common (like) denominators. (2 min) [E](#) [MM](#)

**Mixed Number Addition with Regrouping**

Learn to use regrouping to add mixed numbers with common (like) denominators. (4 min) [E](#) [MM](#)

**Subtracting Mixed Numbers with Regrouping**

Learn to use regrouping to subtract mixed numbers with common (like) denominators. (3 min) [E](#) [MM](#)

**Fraction Word Problem: Lizard**

Solve a fraction word problem about the length of a lizard. (2 min) [E](#) [MM](#)

**Subtracting Mixed Numbers with Like Denominators Word Problem**

Solve a word problem involving mixed number subtraction by using a visual model. (3 min) [E](#) [MM](#)

**Visually Converting Tenths and Hundredths**

Learn to rewrite  $8/10$  with a denominator of 100. (4 min) [E](#) [MM](#)

**Decomposing Hundredths**

Learn to decompose  $47/100$  into tenths and hundredths. (4 min) [E](#) [MM](#)

**Decomposing Hundredths on Number Line**

Visualize how to decompose  $26/100$  into tenths and hundredths using a number line. (2 min) [E](#) [MM](#)

**Adding Fractions (Denominators 10 & 100)**

Learn to add  $3/10 + 7/100$  by finding a common denominator. (5 min) [E](#) [MM](#)

**Adding Fractions:  $7/10 + 13/100$** 

Use visual models to add  $7/10$  and  $13/100$ . (3 min) [E](#) [MM](#)

**Making Line Plots with Fractional Data**

Use a line plot to represent data sets. (3 min) [E](#) [MM](#)

**Interpreting Line Plots with Fractions**

Use a Line plot to visualize the difference between two numbers. (3 min) [E](#) [MM](#)

**Reading a Line Plot with Fractions**

Explore the concept of interpreting data on line plots, particularly focusing on how to read and understand line plots that display measurements in fractions. (3 min) [E](#) [MM](#)

## Fractions, Decimals, Percents, & Ratios | Multiply Fractions

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**Multiplying Fractions and Whole Numbers Visually**

Visually represents this process and practices understanding the relationship between fractions and whole numbers in multiplication. (4 min) [E](#) [MM](#)

### Fraction Multiplication on the Number Line

Use number lines to help solve multiplication equations. (3 min) [E](#) [MM](#)

### Equivalent Fractions and Whole Number Multiplication Problems

Learn to relate mixed numbers to whole number/fraction multiplication problem. (3 min) [E](#) [MM](#)

### Multiplying Unit Fractions and Whole Numbers

Learn how to multiply a whole number by a fraction, using both visual and computational methods. (3 min) [E](#) [MM](#)

### Multiplying Mixed Numbers by Whole Numbers

Use repeated addition to help multiply a whole number by a mixed number. (3 min) [E](#) [MM](#)

### Multiplying Fractions Word Problem: Milk

Solve a multiplication Fraction Word Problem about Milk. (2 min) [E](#) [MM](#)

### Multiplying Fractions Word Problem: Movies

Solve a multiplication fraction word problem about movies. (4 min) [E](#) [MM](#)

### Multiplying Fractions by Whole Numbers Word Problem

Solve a word problem that involves multiplying a fraction by a whole number. (3 min) [E](#) [MM](#)

## Fractions, Decimals, Percents, & Ratios | Understanding Decimals

### Writing a Number as a Fraction and Decimal

Show the connection between decimals and fractions using a grid diagram and number lines. (4 min) [E](#) [MM](#)

### Writing Decimals and Fractions Greater than 1 Shown on Grids

Learn to decimal numbers and fractions greater than 1 shown on grids. (3 min) [E](#) [MM](#)

### Writing Decimals and Fractions Shown on Number Lines

Learn to write decimal numbers and fractions greater than 1 shown on number lines. (3 min) [E](#) [MM](#)

### Rewriting Fractions as Decimals

Learn to rewrite two fractions as decimals. (4 min) [E](#) [MM](#)

### Decimals as Words

Visualize how to write 0.17 and 40.03 in words. (6 min) [E](#) [MM](#)

### Relating Decimals and Fractions in Words

Learn to relate equivalent decimals and fractions written in word form. (3 min) [E](#) [MM](#)

### Decimal Place Value

Learn how decimal numbers and understanding place value to the right of the decimal. (6 min) [E](#) [MM](#)

### Graphing Tenths from 0 to 1

Visualize and learn how to graph 0.6 on a number line. (2 min) [E](#) [MM](#)

### Identifying Tenths on a Number Line

See how to identify a point graphed on a number line. (2 min) [E](#) [MM](#)

### Graphing Hundredths from 0 to 0.1

Visualize and learn how to graph 0.4 on a number line. (3 min) [E](#) [MM](#)

### Identifying Hundredths on a Number Line

Learn to identify decimals graphed on a number line. (3 min) [E](#) [MM](#)

### Plotting Decimal Numbers on a Number Line

Find decimals with hundredths on a number line. (4 min) [E](#) [MM](#)

### Decimal Place Value with Regrouping

Visualize and discuss decimal numbers that are greater than 1. (6 min) [E](#) [MM](#)

### Rewriting Decimals as Fractions: 0.8

Convert 0.8 to a fraction. (1 min) [E](#) [MM](#)

### Rewriting Decimals as Fractions: 0.15

Convert the decimals to a fraction and simplify. (2 min) [E](#) [MM](#)

### Rewriting Decimals as Fractions: 0.36

Follow this example of how we convert a decimal to a simplified fraction. (2 min) [E](#) [MM](#)

### Rewriting Decimals as Fractions: 2.75

Follow this example of how we convert a decimal to a simplified fraction. (3 min) [E](#) [MM](#)

### Common Fractions and Decimals

Explores the concept of converting common fractions (1/5, 1/4, 1/2) into decimals. (5 min) [E](#) [MM](#)

### Comparing Decimals Visually

Use grid diagrams to compare 0.17 and 0.2. (4 min) [E](#) [MM](#)

### Comparing Decimal Numbers on a Number Line

Use a number line to compare decimals. (2 min) [E](#) [MM](#)

### Comparing Numbers Represented Different Ways

Compare decimals, fractions and number diagrams in these practice problems. (8 min) [E](#) [MM](#)

### Comparing Decimals (Tenths and Hundredths)

Use greater and less than symbols to compare decimals. (4 min) [E](#) [MM](#)

## Measurement & Data

### Fraction Pizzeria

Physics-based unit blocks that allow students to build ramps and experiment with physical applications of fractions by constructing a variety of slopes. (unlimited) [E](#)

## Tape Measure

Interactive at-scale measuring tool. Users can extend the tape in 1-ft segments up to 10 feet. [IFX](#)

## Tape Measure- Metric

Interactive at-scale measuring tool. Users can extend the tape in segments up to 10 meters. [IFX](#)

## Rhombus Tile

Simple geometry manipulables that can be used to teach about shapes and angles, or build tessellations. [IFX](#)

## Pentagon Tile

Simple geometry manipulables that can be used to teach about shapes and angles, or build tessellations. [IFX](#)

## Octagon Tile

Simple geometry manipulables that can be used to teach about shapes and angles, or build tessellations. [IFX](#)

## Obtuse Isosceles Triangle Tile

Simple geometry manipulables that can be used to teach about shapes and angles, or build tessellations. [IFX](#)

## Narrow Rhombus Tile

Simple geometry manipulables that can be used to teach about shapes and angles, or build tessellations. [IFX](#)

## Hexagon Tile

Simple geometry manipulables that can be used to teach about shapes and angles, or build tessellations. [IFX](#)

## Equilateral Triangle Tile

Simple geometry manipulables that can be used to teach about shapes and angles, or build tessellations. [IFX](#)

## Acute Isosceles Triangle Tile

Simple geometry manipulables that can be used to teach about shapes and angles or build tessellations. [IFX](#)

## Wide Rhombus Tile

Simple geometry manipulables that can be used to teach about shapes and angles, or build tessellations. [IFX](#)

## Trapezoid Tile

Simple geometry manipulables that can be used to teach about shapes and angles, or build tessellations. [IFX](#)

## Square Tile

Simple geometry manipulables that can be used to teach about shapes and angles, or build tessellations. [IFX](#)

## 10 x 10 x 10 Cube

A giant cube composed of 1,000 smaller cubes, each of which is individually addressable and highlightable with the user's hand. These cubes can be expanded and stacked, allowing for a visualization of dimensions (e.g. how 10x10x10 in 3D can be laid out into 100x10 in 2D). [IFX](#)

## Rhombus Tile

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Simple geometry manipulables that can be used to teach about shapes and angles, or build tessellations. [IFX](#)

## Trapezoid Tile

Simple geometry manipulables that can be used to teach about shapes and angles, or build tessellations. [IFX](#)

## Square Tile

Simple geometry manipulables that can be used to teach about shapes and angles, or build tessellations. [IFX](#)

## Protractor

At-scale measuring tool for measuring angles. Designed to be used with geometric tiles, or as a general teaching/training tool. [IFX](#)

## Penny

Realistic models of US coins to build familiarity with money and making change. [IFX](#)

## Nickel

Realistic models of US coins to build familiarity with money and making change. [IFX](#)

## Dime

Realistic models of US coins to build familiarity with money and making change. [IFX](#)

## Quarter

Realistic models of US coins to build familiarity with money and making change. [IFX](#)

## Measurement & Data | Units of Measurement

### Metric System: Units of Weight

Identify metric units of mass or weight such as milligram, gram, and kilogram.

(5 min) [E](#) [MM](#)

## Choose Pounds or Ounces to Measure Weight

Identify the US customary units of mass or weight such as ounce, pound, and ton.

(2 min) [E](#) [MM](#)

## U.S. Customary Units: Weight

Identify the US customary units of mass or weight such as ounce, pound, and ton.

(4 min) [E](#) [MM](#)

**Metric System: Units of Volume** Learn about metric units of volume or capacity such as milliliters and liters.

(4 min) [E](#) [MM](#)

## U.S. Customary Units: Fluid Volume

Learn about the US customary units of volume or capacity such as teaspoon, fluid ounce, cup, pint, quart, and gallon.

(7 min) [E](#) [MM](#)

## Metric System: Units of Distance

Discuss metric units of length or distance such as millimeter, centimeter, meter, and kilometer. (7 min) [E](#) [MM](#)

## U.S. Customary Units: Distance

Learn about the US customary units of length or distance such as inch, foot, and yard. (5 min) [E](#) [MM](#)

## Finding Reasonable Units of Measurement Example

Decide a reasonable unit of time for baking cookies. (4 min) [E](#) [MM](#)

## Time Differences Example

Learn to find the difference between the times shown on two different analog clocks. (4 min) [E](#) [MM](#)

## Time Word Problem: Puzzle

Figure out how long it took to solve a puzzle when given the start and finish time. (2 min) [E](#) [MM](#)

## Time Word Problem: Travel Time

Solve what time you leave if you are traveling 39 minutes and need to be home at 6:15. (4 min) [E](#) [MM](#)

## How to Convert kg to mg and t to oz

Convert kilograms to milligrams and tons to ounces. (4 min) [E](#) [MM](#)

## Converting Pounds to Ounces

Learn to convert pounds to ounces. (2 min)

## Metric Units of Mass Review

(g and kg)

Learn to convert between liters and milliliters. (2 min) [E](#) [MM](#)

## Converting US Customary Units of Volume

Learn to convert between gallons, quarts, pints, cups, and fluid ounces. (2 min) [E](#) [MM](#)

## Converting Metric Units of Length

Learn convert kilometers, meters, and centimeters. (2 min) [E](#) [MM](#)

## Converting Feet to Inches

Learn to convert feet to inches.

(1 min) [E](#) [MM](#)

## Converting Yards to Inches

Learn to convert between yards, feet, and inches. (6 min) [E](#) [MM](#)

## Converting Units of Time

Learn to convert hours, minutes, and seconds. (4 min) [E](#) [MM](#)

## Time Word Problem: Susan's Break

Solve what time do you leave if you are traveling 39 minutes and need to be home at 6:15. (4 min) [E](#) [MM](#)

## Word Problem: Making Change

Understand the importance the relationship between these units and demonstrates how to apply this knowledge to solve real-world problems involving time intervals. (3 min) [E](#) [MM](#)

## Currency Conversion Word Problem

Solve how much change is due in this conversion word problem. (1 min) [E](#) [MM](#)

## Multi-Step Unit Conversion Examples (Metric)

Learn to convert between American dollars and Chinese yuan in this word problem. (5 min) [E](#) [MM](#)

## Multi-Step Unit Conversion Examples (U.S. Customary)

Solve multi-step unit conversion examples with metric units of measure. (5 min) [E](#) [MM](#)

## Number & Operations

### Fraction Pizzeria

Students can learn about fractions by taking customers' orders, building pizzas, running the register, and experimenting with slopes. (unlimited) [E](#)

## Science

### Earth & Space Science

#### Canyon

Peer down into a canyon from the top. (1 min)

#### Grand Canyon

Explore the Grand Canyon from different observation decks around the natural wonder. (unlimited) [E](#)

#### Earth Cutaway

A model of Earth with a section cut away to expose its layers. [IFX](#)

#### Earth Cutaway info

An Infographic model of Earth with a section cut away to expose its layers. [IFX](#)

#### Nuclear Power Plant

Recreation of a nuclear power plant that students can explore. The interactive map allows students to tour the entire facility while illustrating how the different components are connected in the process of nuclear power generation. (unlimited) [E](#)

#### Damming the Nile : Episode 1

Africa's largest hydroelectric power project is two thirds finished and the dam can already control the flow of the Blue Nile, which is deeply upsetting downstream Egypt who they didn't consult before building started. (13 min)

## Damming the Nile: Episode 2

Africa's largest hydroelectric power project is two thirds finished and the dam can already control the flow of the Blue Nile, which is deeply upsetting downstream Egypt who they didn't consult before building started. (16 min)

## Ocean to Plate: A Journey into the Seafood Supply Chain

As populations and appetites grow, global fisheries are reaching their ecological capacity, yet at least a third of harvested fish and seafood is lost or wasted along the supply chain. (7 min)

## Cloud Climb

Explore how clouds, atmosphere, and weather all come together to create different aspects of the Earth's sky. (unlimited) [E](#)

## Category 3 Hurricane Landfall Simulation

Experience a category 3 hurricane through a simulation with guided popups. (1 min)

## E.4.9C.5 | Close-Range Tornado

Get up close and personal with a tornado near Wray, CO from May 7<sup>th</sup>, 2016. (8 min)

## Life Science

### Protecting Ocean Anchor Species-Racing Extinction

Join marine biologist Luke Tipple as he swims alongside Anchor species like manta rays and whale sharks and shares why they are vital to the survival of our oceans and why they need to be protected. (3 min)

### Red Kite Bird Feeding Frenzy

Watch the once endangered Red Kite Bird feeding while learning about them. (1 min)

### Baboon 1

See how a group of Baboons interact. Part. 1 (1 min)

### Baboon 2

See how a group of Baboons interact. Part. 2 (1 min)

### Baboon 3

See how a group of Baboons interact. Part. 3 (1 min)

### Hyena 1

Watch a hyena feed on a fresh kill. (1 min)

### Hyena 2

Watch a hyena approach cautiously for a snack. (1 min)

### Lioness 1

A curious Lioness sniffs at the camera. (1 min)

### Lioness 2

Lioness sniffs at food. (1 min)

### Anatomy Lab

Highly interactive anatomy classroom that allows students to assemble the human body piece by piece with over 90 separate body parts to learn about. (unlimited) [E](#)

### Brain

Realistic model of a human brain. [IFX](#)

### Heart

Realistic model of a human heart. [IFX](#)

### Liver

Realistic model of a human liver. [IFX](#)

### Lungs

Realistic model of human lungs. [IFX](#)

### What Happens Inside Your Body?

The human body is an amazing and unique machine that triggers thousands of processes every second, learn about them on this adventure. (8 min)

### Human Digestive System in VR

Take an amazing journey through the body and find out what happens to your food as it travels through the digestive system. (3 min)

### Bears of Kamchatka, Kambalnaya

### River

Follow along as you experience the Bears of Kamchatka and learn about their habitat, daily life, and mating season. (5 min)

### Chengdu Panda Base, China

Get an in-depth look at the pandas that call Chengdu Panda Base their home and learn about their habitat, diet, and daily life. (11 min)

## Explore the Coral Restoration

Learn about the ecology of coral reefs, natural and human threats to corals, and the science of coral restoration. (4 min)

### Reef 2

Swim along an active thriving reef. (1 min)

### Reef 3

Swim along an active thriving reef. (1 min)

### Reef 4

Swim along an active thriving reef. (1 min)

## Physical Science

### Light Lab

This highly interactive classroom teaches students about the electromagnetic spectrum including activities like Double Slit Experiment, shining lights through a prism, building their own waves, stacking light, and playing with lenses. (unlimited) [E](#)

### Speed of Light

Visualization of the speed of light showing a glowing orb that revolves around the earth 7 times in one second. [IFX](#)

### Music Playground

Be immersed in a concert hall with intractable musical instruments that can be used collaboratively to play, teach, or learn about music and sound waves. (unlimited) [E](#)

### Music Note: A

Interactive music notes spanning 4 octaves and using 10 different instrument sounds.

[IFX](#)

### Music Note: A Sharp

Interactive music notes spanning 4 octaves and using 10 different instrument sounds.

[IFX](#)

### Music Note: B

Interactive music notes spanning 4 octaves and using 10 different instrument sounds.

[IFX](#)

### Music Note: C

Interactive music notes spanning 4 octaves and using 10 different instrument sounds.

[IFX](#)

## Music Note: C Sharp

Interactive music notes spanning 4 octaves and using 10 different instrument sounds.

[IFX](#)

## Music Note: D

Interactive music notes spanning 4 octaves and using 10 different instrument sounds.

[IFX](#)

## Music Note: D Sharp

Interactive music notes spanning 4 octaves and using 10 different instrument sounds.

[IFX](#)

## Music Note: E

Interactive music notes spanning 4 octaves and using 10 different instrument sounds.

[IFX](#)

## Music Note: F

Interactive music notes spanning 4 octaves and using 10 different instrument sounds.

[IFX](#)

## Music Note: F Sharp

Interactive music notes spanning 4 octaves and using 10 different instrument sounds.

[IFX](#)

## Music Note: G

Interactive music notes spanning 4 octaves and using 10 different instrument sounds.

[IFX](#)

## Music Note: G Sharp

Interactive music notes spanning 4 octaves and using 10 different instrument sounds.

[IFX](#)

## Social Studies

### Civics

#### Supreme Court

Recreation of the front bench of the United States Supreme Court Chamber. [IFX](#)

## Civil Rights

### Medgar Evers House

Explore a recreation of the Medgar Evers House and National Monument. Made in collaboration with the Evers family. (unlimited) [E](#)

### Civil Rights Museum

Civil Rights leaders: Rosa Parks, John Lewis, Martin Luther King Jr., Thurgood Marshall, and Medgar Evers, come to life to tell you their stories on interactive stages. (unlimited) [E](#)

## Geography

### Weaving Around the World

Follow the process of weaving that has been developed across cultures for thousands of years. From Venice to Addis Ababa, and the West Bank to the Navajo Nation Reservation. (4 min)

### Chennai Floods Aftermath

Take an immersive journey through the impact, rescue, and reason for the floods that occurred in Chennai, India, in December 2015. (6 min)

### Himalayas: A Trek to School

Follow two girls as they travel up to 6 hours a day to school in a remote Himalayan village. (8 min)

### Life in Haiti: After a Devastating

#### Natural Disaster

Join filmmaker Dylan Roberts on a journey to the Haitian city of Jérémie, and the small village of Manish, to witness the aftermath of a colossal storm. (5 min)

### Out of Syria: Back to School

Step into the lives of two teenagers from war-torn Syria, Mustafa and Sarah. They both fled the fighting with their families. They left their homelands and their schools behind. (4 min)

## Protecting Ocean Anchor Species:

### Racing Extinction

Join marine biologist Luke Tipple as he swims alongside manta rays and whale sharks while sharing why they are vital to the survival of our oceans. (3 min)

## History

### Historic Jamestown

Interactive experience where students will experience the reason for the English Colonization and the significance of the location regarding resources, defensibility and economic development. (unlimited) [E](#)

### Liberty Bell

Realistic recreation of the Liberty Bell in Philadelphia, PA. Touch the bell to hear it ring, just as it would have sounded before it cracked. [IFX](#)

### Independence Hall

Join George Washington, John Adams, Thomas Jefferson, Benjamin Franklin, and John Hancock as they come to life to tell you their stories about the founding of the United States. (unlimited) [E](#)

### Battle Road: The American Revolution

Two hundred and forty-one years after the original battle, scores of professional reenactors, organizers, onlookers and photographers gather at Lexington and Concord and Minute Man National Historical Park to honor the memory of this critical turning point in American history. (5 min)

### Castillo Cannon Drill

Stand aboard the Castillo's gun deck and see what firing a cannon would be like in the 1740s. (6 min)

### Civil War: A Letter from the Trenches

Get transported back to the 1860's to "experience" what life was like for a young cadet in the Confederate army, trekking through the mud and dodging enemy fire as you journey through the trenches. (5 min)

# 5th Grade

## Mathematics

### Basic Operations & Reasoning | Multi-Digit Multiplication & Division

#### Strategies for Multiplying Multiples of 10, 100 and 1,000

Learn the strategy of estimating in multi-digit multiplication. (7 min) [E](#) [MM](#)

#### Estimating Multi-Digit Multiplication

Learn the skill of estimating the product of multi-digit numbers. (3 min) [E](#) [MM](#)

#### Relate Multiplication with Area

Models to the Standard Algorithm

Learn the concept of multi-digit multiplication. (7 min) [E](#) [MM](#)

#### Intro to Standard Way of Multiplying Multi-Digit Numbers

Learn the standard algorithm for multiplying a multi digit number by a single digit number. (4 min) [E](#) [MM](#)

#### Understanding the Standard Algorithm for Multiplication

Visualize the standard algorithm for multiplication in these three examples: one complete walkthrough, one where the viewer is asked to identify mistakes in incorrect solutions, and one where the viewer is asked to fill in a missing number. (5 min) [E](#) [MM](#)

#### Multiplying Multi-Digit Numbers:

$6,742 \times 23$

Learn to break down the process step by step, demonstrating how to multiply each digit and carry over numbers. (4 min) [E](#) [MM](#)

#### Strategies for Dividing Multiples of 10, 100, and 1,000

Visualize and understand how to divide numbers that are multiples of 10, 100, and 1,000. (7 min) [E](#) [MM](#)

#### Estimating Multi-Digit Division

Learn the concept of estimating multi-digit division problems. (3 min) [E](#) [MM](#)

#### Long Division with Remainders:

$2,292 \div 4$

Learn the long division process for multi-digit numbers, including examples with remainders. (10 min) [E](#) [MM](#)

#### Long Division with Remainders:

$3,771 \div 8$

Visualize and solve a long division problem with a remainder. (3 min) [E](#) [MM](#)

#### Introduction to Dividing by 2-Digits

Visualize how to approximate numbers for easier division and practice this skill with examples (5 min) [E](#) [MM](#)

#### Dividing by 2-Digits: $9,815 \div 65$

Learn the process of dividing large numbers, specifically 9,815 divided by 65. (5 min) [E](#) [MM](#)

#### Dividing by 2-Digits: $7,182 \div 42$

Learn to break complex division problems into easy step-by-step portions. (3 min) [E](#) [MM](#)

#### Dividing by a 2-Digits: $4,781 \div 32$

Learn to break complex division problems into easy step-by-step portions. (4 min) [E](#) [MM](#)

### Basic Operations & Reasoning | Powers of 10

#### Multiplying and Dividing by 10, 100, 1,000

Learn how multiplying and dividing whole numbers by 10, 100, and 1,000 shifts the digits of the number left or right, respectively. (9 min) [E](#) [MM](#)

#### Multiplying and Dividing Decimals by 10

Explore the concept of multiplying and dividing decimals by 10, 100, and 1,000. (4 min) [E](#) [MM](#)

#### Multiplying and Dividing Decimals by 10, 100, 1,000

Learn how each digit in a decimal shifts place when multiplied or divided by these powers of 10, providing a visual and intuitive understanding of the process. (5 min) [E](#) [MM](#)

#### Introduction to Powers of 10

Learn about exponents and exponential notations in this intro. (4 min) [E](#) [MM](#)

#### Using Exponents with Powers of 10

Explore the concept of multiplying by powers of 10. (5 min) [E](#) [MM](#)

#### Multiplying and Dividing by Powers of 10

Learn about the patterns when multiplying or dividing numbers by powers of 10. (5 min) [E](#) [MM](#)

#### Exponents and Powers of 10 Patterns

Visualize and demonstrate how to perform calculations involving powers of ten. (7 min) [E](#) [MM](#)

#### Fractions as Division by Power of 10

Explore the concept of multiplying and dividing numbers by powers of 10. (5 min) [E](#) [MM](#)

**Comparing Decimal Place Values**

Explore the concept of place value in multi-digit numbers, emphasizing how a digit's value changes based on its position.

(6 min) [E](#) [MM](#)

**Geometry | Volume****Volume Intro**

Learn the difference in finding volume, length, and area and how they involve measuring dimensions to quantify a certain aspect of an object or space. (8 min) [E](#) [MM](#)

**Measuring Volume with Unit Cubes**

Explore the concept of volume, emphasizing that it's a measure of how much space something takes up.

(2 min) [E](#) [MM](#)

**Measuring Volume as Area Times Length**

Learn to calculate the volume of a rectangular prism, you can multiply the dimensions (width, depth, and height) together in any order (8 min) [E](#) [MM](#)

**Volume of a Rectangular Prism**

Learn how to calculate the volume of a box using the height, width, and depth.

(2 min) [E](#) [MM](#)

**Volume in Unit Cubes by Decomposing Shape**

Explore the concept of decomposing complex shapes into simpler ones to calculate volume. (3 min) [E](#) [MM](#)

**Volume Through Decomposition**

Explore the concept of finding the volume of complex shapes by decomposing them into simpler, non-overlapping rectangular prisms. (4 min) [E](#) [MM](#)

**Volume Word Problem: Water Tank**

Learn the concept of volume, specifically focusing on how to calculate the volume of a complex shape by subtracting the volume of an object within it from the total volume. (5 min) [E](#) [MM](#)

**Geometry | Coordinate Plane****Introduction to the Coordinate Plane**

Learn how coordinates are used to locate a point on a coordinated plane. (7 min) [E](#) [MM](#)

**Coordinate Plane: Graphing Points**

Visualize and learn the basics of the coordinate plane. (3 min) [E](#) [MM](#)

**Coordinate Plane Graphing Word Problem**

Visualize and learn the concept of using a coordinate plane to solve real-world problems. (2 min) [E](#) [MM](#)

**Interpreting Plotted Points** Learn the concept of interpreting data points on a coordinate plane. (2 min) [E](#) [MM](#)

**Geometry | Properties of Shape****Classifying Triangles**

Explore how triangles are classified based on their sides and angles. (6 min) [E](#) [MM](#)

**Classifying Triangles by Angles**

Learn to classify triangles based on the angles. (6 min) [E](#) [MM](#)

**Intro to Quadrilaterals**

Explore and learn the many different types of quadrilaterals. (9 min) [E](#) [MM](#)

**Quadrilateral Properties**

Learn about the properties of quadrilaterals, parallelograms, trapezoids, rhombuses, rectangles, and squares.

(5 min) [E](#) [MM](#)

**Kites as a Geometric Shape**

Explore the world of quadrilaterals, specifically focusing on kites. (6 min) [E](#) [MM](#)

**Quadrilateral Types**

Learn to identify quadrilaterals such as kites, trapezoids, parallelograms, rhombuses, rectangles, and squares by side length, presence of parallel sides, and angle type. (3 min) [E](#) [MM](#)

**Classifying Quadrilaterals**

Learn the many different relationships between the types of quadrilaterals.

(3 min) [E](#) [MM](#)

**Algebra | Algebraic Thinking****Constructing Numerical Expressions**

Learn to use the information in each word problem to construct a numerical expression that represents the information. (2 min) [E](#) [MM](#)

**Evaluating Expressions with & without Parentheses**

Explore the concept of order of operations, emphasizing the importance of parentheses in mathematical expressions. (2 min) [E](#) [MM](#)

**Translating Expressions with Parentheses**

Understand the importance of parentheses in expressions, and how they can change the meaning of calculations. (9 min) [E](#) [MM](#)

**Graphing Patterns on a Coordinate Plane**

Learn about understanding numerical patterns. Explore how to generate a second pattern from a given one by applying a rule, in this case, multiplying by 3 and adding 1. (3 min) [E](#) [MM](#)

**Interpreting Patterns on a Coordinate Plane**

Explore the concept of numerical patterns, focusing on how to generate, identify, and graph them on a coordinate plane.

(4 min) [E](#) [MM](#)

**Interpreting Relationships in Ordered Pairs**

Explore the concept of numerical patterns, focusing on how to generate, identify, and graph these patterns on a coordinate plane. (4 min) [E](#) [MM](#)

**Graphing Sequence Relationships**

Explore the concept of numerical patterns.

(3 min) [E](#) [MM](#)

## Fractions, Decimals, Percents, & Ratios | Decimal Place Value

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**Place Value with Decimals**

Learn the relationship between place value and decimals. (4 min) [E](#) [MM](#)

**Thousandths on the Number Line**

Explore the value of a point on a number line that falls between two known values, in this case 0.03 and 0.04. (2 min) [E](#) [MM](#)

**Write a Decimal in Expanded Form**

Learn to break down each digit according to its place value and write it in expanded form. (3 min) [E](#) [MM](#)

**Decimals in Written Form  
(Hundredths)**

Learn to write a decimal in word form by writing out the whole number portion. (4 min) [E](#) [MM](#)

**Decimals in Written Form  
(Thousandths)**

Learn how to read and write decimals in different forms, focusing on thousandths. (3 min) [E](#) [MM](#)

**Expressing Decimals in Multiple  
Forms**

Learn to break down decimals into place values, show how to write them in expanded form, separate each decimal part, and explain how to say them in words. (4 min) [E](#) [MM](#)

**Visual Understanding of Regrouping  
Decimals**

Explore the concept of place value in decimals, focusing on how to regroup value from one place to another. (5 min) [E](#) [MM](#)

**Regrouping with Decimals**

Explore the concept of expressing decimals in different forms. (4 min) [E](#) [MM](#)

**Regrouping with Decimals: 21.3**

Learn about place values, and how regrouping can change the appearance of a number, but not its value. (4 min) [E](#) [MM](#)

**Comparing Decimals: 9.97 and 9.798**

Learn to compare two decimals by looking at the largest place value. (4 min) [E](#) [MM](#)

**Comparing Decimals: 156.378 and  
156.348**

Learn how to determine which decimal is greater by comparing each place value, starting from the left and moving right, until a difference is found. (2 min) [E](#) [MM](#)

**Ordering Decimals**

Practice comparing decimals and learning how to order numbers with decimals from least to greatest. (4 min) [E](#) [MM](#)

**Ordering Decimals Through****Thousandths**

Learn all about comparing decimals (3 min) [E](#) [MM](#)

**Comparing Decimals in Different  
Representations**

Learn how to determine which of two decimals is larger by converting them into a common format. (5 min) [E](#) [MM](#)

**Comparing Decimals Word Problems**

Explore the concept of comparing decimals. Learn the importance of aligning place values and starting from the largest place value when comparing. (4 min) [E](#) [MM](#)

**Rounding Decimals on the Number  
Line**

Learn how to round decimals using a number line, visually showing which whole number, tenth, hundredth, or thousandth is closest. (4 min) [E](#) [MM](#)

**Worked Example: Rounding Decimals  
to Nearest Tenth**

Visualize how to round decimals and identify the tenth place in each decimal. (2 min) [E](#) [MM](#)

**Rounding Decimals Word Problems**

Explore how to adjust decimals to the closest tenth, hundredth, and whole number, all while highlighting the importance of grasping place value. (5 min) [E](#) [MM](#)

## Fractions, Decimals, Percents, & Ratios | Add Decimals

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**Common Fractions and Decimals**

Explores the concept of converting common fractions ( $\frac{1}{5}$ ,  $\frac{1}{4}$ ,  $\frac{1}{2}$ ) into decimals. (5 min) [E](#) [MM](#)

**Estimating Decimal Addition**

Learn all about how to estimate when adding decimals. (4 min) [E](#) [MM](#)

**Introduction to Adding Decimals:  
Tenths**

Learn how to visualize and calculate the addition of tenths using both numerical and visual methods, reinforcing the understanding of decimal addition. (6 min) [E](#) [MM](#)

**Adding Decimals with Ones and  
Tenths Parts**

Learn how to add decimals, specifically to the tenths. (6 min) [E](#) [MM](#)

**Adding Decimals with Ones, Tenths,  
and Hundredths**

Learn about aligning decimal points and adding each place value separately, from hundredths to ones. (7 min) [E](#) [MM](#)

**Adding Decimals with Hundredths**

Learn the different ways to add decimals involving hundredths. (7 min) [E](#) [MM](#)

## Fractions, Decimals, Percents, & Ratios | Subtract Decimals

### Estimating Decimal Subtraction

Learn to estimate when subtracting decimals. (4 min) [E](#) [MM](#)

### Strategies for Subtracting Basic Decimals

Explore the world of subtracting decimals, focusing on tenths. (6 min) [E](#) [MM](#)

### Strategies for Subtracting more Complex Decimals with Tenths

Learn all about subtraction of decimals, particularly those in the tenths place. (9 min) [E](#) [MM](#)

### Subtracting Decimals: 9.57-8.09

Visualize how to find the least common denominator of two fractions. (1 min) [E](#) [MM](#)

### Subtracting Decimals: 10.1-3.93

Learn how to subtract decimals down to the hundredth place. (2 min) [E](#) [MM](#)

### Subtraction Strategies with Hundredths

Learn about different strategies for subtraction, breaking down the process into manageable steps, and emphasizes the importance of understanding the concept behind the calculations. (6 min) [E](#) [MM](#)

### More Advanced Subtraction Strategies with Hundredths

Explore the concept of subtracting decimals, specifically hundredths. (5 min) [E](#) [MM](#)

## Fractions, Decimals, Percents, & Ratios | Add & Subtract Fractions

### Visually Adding Fractions: $5/6 + 1/4$

Learn to add two fractions with different denominators, you need to find the least common multiple of the denominators. (6 min) [E](#) [MM](#)

### Visually Subtracting Fractions: $3/4 - 5/8$

Learn about understanding how to add and subtract fractions with unlike denominators. (4 min) [E](#) [MM](#)

### Estimating Adding Fractions with Unlike Denominators

Learn all about estimating the sum of fractions with unlike denominators. (5 min) [E](#) [MM](#)

### Finding Common Denominators

Learn all about finding common denominators in fractions. (5 min) [E](#) [MM](#)

### Common Denominators: $1/4$ and $5/6$

Learn how to find common denominators for fractions with different numerators and denominators by identifying multiples of the original denominators. (8 min) [E](#) [MM](#)

### Common Denominators: $3/5$ and $7/2$

Learn how to rewrite fractions with different denominators as equivalent fractions with a common denominator. (4 min) [E](#) [MM](#)

### Adding Fractions with Unlike Denominators Intro

Learn to add fractions with different denominators, such as  $1/2$  and  $1/3$ , you need to find a common denominator. (4 min) [E](#) [MM](#)

### Adding Fractions with Unlike Denominators

Learn how to add two fractions with different denominators. (8 min) [E](#) [MM](#)

## Subtracting Fractions with Unlike Denominators Intro

Learn how to subtract fractions with unlike denominators. (4 min) [E](#) [MM](#)

## Subtracting Fractions with Unlike Denominators

Learn to identify the least common multiple of the two denominators when subtracting fractions with different denominators. (5 min) [E](#) [MM](#)

### Adding and Subtracting 3 Fractions

Learn how to add and subtract fractions with unlike denominators. (5 min) [E](#) [MM](#)

### Solving for the Missing Fraction

Learn how to add and subtract fractions with unlike denominators. (6 min) [E](#) [MM](#)

### Adding Mixed Numbers:

#### 19 $3/18 + 18 \frac{2}{3}$

Visualize how to add mix numbers and simplify the fraction. (2 min) [E](#) [MM](#)

### Subtracting Mixed Numbers:

#### 7 $6/9 - 3 \frac{2}{5}$

Visualize how to subtract two mixed numbers by converting to improper fractions. (2 min) [E](#) [MM](#)

### Adding Mixed Numbers with Regrouping

Learn how to add mixed numbers with unlike denominators. (5 min) [E](#) [MM](#)

### Subtracting Mixed Numbers with Regrouping (Unlike Denominators)

Learn how to subtract mixed numbers with unlike denominators. (4 min) [E](#) [MM](#)

### Adding Fractions Word Problem: Paint

Learn how to add and subtract fractions with unlike denominators through a real-world problem. (6 min) [E](#) [MM](#)

### Subtracting Fractions Word Problem: Tomatoes

Learn how to solve word problems involving the addition and subtraction of fractions with unlike denominators. (4 min) [E](#) [MM](#)

## Fractions, Decimals, Percents, & Ratios | Multiply Fractions

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### Multiplication as Scaling with Fractions

Visualize and understand how multiplying fractions can be seen as scaling, or resizing, the value of a number. (5 min) [E](#) [MM](#)

### Fraction Multiplication as Scaling Examples

Visualize examples of how multiplying by a fraction scales a number up or down. (4 min) [E](#) [MM](#)

### Multiplying Fractions by Whole Numbers on a Number Line

Learn to multiply fractions by whole numbers on the number line. (2 min) [E](#) [MM](#)

### Multiplying Unit Fractions and Whole Numbers

Learn how to multiply a whole number by a fraction, using both visual and computational methods. (3 min) [E](#) [MM](#)

### Multiplying Fractions and Whole Numbers Visually

Learn the concept of multiplying fractions and whole numbers. (4 min) [E](#) [MM](#)

### Multiplying Fractions and Whole Numbers

Learn and visualize how to multiply fractions and how they combine into parts of a whole. (3 min) [E](#) [MM](#)

### Multiplying 2 Fractions: Fraction Model

Visualize multiplying fractions using fraction models. (5 min) [E](#) [MM](#)

### Multiplying 2 Fractions: Number Line

Visualize how the process of multiplying fractions by fraction is represented on a number line. (5 min) [E](#) [MM](#)

### Multiplying 2 Fractions: $\frac{5}{6} \times \frac{2}{3}$

Work through multiplying 2 fractions with different denominators. (3 min) [E](#) [MM](#)

### Multiplying Mixed Numbers

Follow along and visualize how to multiply mixed numbers. (4 min) [E](#) [MM](#)

### Finding Area with Fractional Sides 1

Learn how to calculate the area of rectangles with fractional side lengths. (4 min) [E](#) [MM](#)

### Finding Area with Fractional Sides 2

Learn how to calculate the area of rectangles with fractional side lengths. (7 min) [E](#) [MM](#)

### Multiplying Fractions Word Problem: Muffins

Learn how to solve word problems involving the multiplication of fractions. (4 min) [E](#) [MM](#)

### Multiplying Fractions Word Problem: Laundry

Learn how to solve word problems involving multiplication of fractions. (2 min) [E](#) [MM](#)

### Multiplying Fractions Word Problem: Bike

Learn how to multiply fractions and mixed numbers. (4 min) [E](#) [MM](#)

## Fractions, Decimals, Percents, & Ratios | Divide Fractions

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### Understanding Fractions as Division

Learn about the relationship between multiplication and division. (7 min) [E](#) [MM](#)

### Creating a Fraction Through Division

Learn about the relationship between division and multiplication using fractions. (3 min) [E](#) [MM](#)

### Creating Mixed Numbers with Fraction Division

Learn how to interpret fractions as division problems. (5 min) [E](#) [MM](#)

### Multiplication and Division

#### Relationship for Fractions

Learn how multiplication and division are related, even when we're dealing with fractions. (4 min) [E](#) [MM](#)

#### Visually Dividing Unit Fraction by a Whole Number

Learn how to divide fractions by whole numbers. (3 min) [E](#) [MM](#)

#### Dividing a Unit Fraction by a Whole Number

Learn how to divide fractions by whole numbers. (3 min) [E](#) [MM](#)

#### Visually Dividing Whole Numbers by Unit Fractions

Learn how to divide whole numbers by fractions. (3 min) [E](#) [MM](#)

#### Dividing a Whole Number by a Unit Fraction

Learn how to divide a whole number by a fraction. (2 min) [E](#) [MM](#)

#### Fraction Division in Context

Practice dividing a fraction by a whole number to solve problems. (3 min) [E](#) [MM](#)

#### Dividing Fractions and Whole Number Word Problems

Use tape diagrams to visually represent division with fractions. (5 min) [E](#) [MM](#)

## Fractions, Decimals, Percents, & Ratios | Multiply Decimals

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### Estimating with Multiplying Decimals and Whole Numbers

Learn all about the concept of estimating products in multiplication problems involving decimals and whole numbers. (3 min) [E](#) [MM](#)

### Multiplying Decimals and Whole Numbers with Visuals

Demonstrate how to use a number line or model to visualize the process of multiplication and find the product.

(4 min) [E](#) [MM](#)

### Strategies for Multiplying Decimals and Whole Numbers

Use different methods for multiplying whole numbers with decimals.

(7 min) [E](#) [MM](#)

### Strategies for Multiplying Multi-Digit Decimals by Whole Numbers

Learn how to multiply decimals and whole numbers. (4 min) [E](#) [MM](#)

### Estimating Decimal Multiplication

Use estimation to simplify the process of multiplying decimals. (4 min) [E](#) [MM](#)

### Developing Strategies for Multiplying Decimals

Learn how to multiply decimals, specifically focusing on the strategy of converting decimals to fractions to make the multiplication process easier. (5 min) [E](#) [MM](#)

### Understanding Decimal Multiplication

Learn how to use a hundred grid to represent decimal multiplication.

(3 min) [E](#) [MM](#)

### Multiplying Decimals Using

#### Estimation

Learn all about multiplying decimals by using estimation. (4 min) [E](#) [MM](#)

### Developing Strategies for Multiplying 2-Digit Decimals

Learn to multiply decimals by treating them as fractions. (4 min) [E](#) [MM](#)

## Fractions, Decimals, Percents, & Ratios | Divide Decimals

### Estimating Decimal Division

Practice rounding decimals to the nearest whole number or a simple fraction, then perform the division. (3 min) [E](#) [MM](#)

### Divide Whole Numbers with Decimal Quotients: $5 \div 2$

Learn how to divide whole numbers to get a decimal quotient. (3 min) [E](#) [MM](#)

### Divide Whole Numbers with Decimal Quotients: $78 \div 12$

Learn how to break down division problems by finding multiples and using remainders. (4 min) [E](#) [MM](#)

### Dividing a Decimal by a Whole Number with Fraction Models

Visualize the concept of dividing decimals by whole numbers using the idea of converting tenths to hundredths to make division more intuitive. (2 min) [E](#) [MM](#)

### Dividing a Decimal by a Whole Number on the Number Line

Visualize the concept of dividing decimals by whole numbers, emphasize understanding division as splitting a quantity into equal parts and use the number line as a visual tool. (2 min) [E](#) [MM](#)

### Dividing a Decimal by a Whole Number Example

Follow this example of how to divide a decimal by a whole number. (3 min) [E](#) [MM](#)

### Visually Dividing a Whole Number by a Decimal

Understand how to divide whole numbers by decimals. (3 min) [E](#) [MM](#)

### Dividing a Whole Number by a Decimal on a Number Line

Explore the concept of dividing whole numbers by decimals on a number line. (2 min) [E](#) [MM](#)

### Division Strategies for Decimal Quotients

Different examples demonstrate how to use fractions, tenths, and reciprocals to multiply instead of divide so we can arrive at the correct answer. (9 min) [E](#) [MM](#)

### Pattern when Dividing by Tenths and Hundredths

Use the strategy of converting whole numbers to tenths or hundredths to make the process clearer when dividing whole numbers by decimals. (5 min) [E](#) [MM](#)

### Dividing Whole Numbers by Decimals Examples

Learn two techniques to divide whole numbers by decimals. (5 min) [E](#) [MM](#)

## Measurement & Data

### Fraction Pizzeria

Physics-based unit blocks that allow students to build ramps and experiment with physical applications of fractions by constructing a variety of slopes. (unlimited) [E](#)

### Tape Measure

Interactive at-scale measuring tool. Users can extend the tape in 1-ft segments up to 10 feet. [IFX](#)

### 10 x 10 x 10 Cube

A giant cube composed of 1,000 smaller cubes, each of which is individually addressable and highlightable with the user's hand. These cubes can be expanded and stacked, allowing for a visualization of dimensions. [IFX](#)

## Measurement & Data | Converting Units of Measure

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### Converting Units: Minutes to Hours

Learn how to convert minutes to hours by dividing the minutes by 60. (5 min) [E](#) [MM](#)

### Converting Units: Metric Distance

Learn all about converting different metric units to a common unit, in this case, meters.

(4 min) [E](#) [MM](#)

### Converting Units: Centimeters to Meters

Learn how to convert centimeters to meters by understanding the meaning of the "centi" prefix, which represents 1/100.

(3 min) [E](#) [MM](#)

### U.S. Customary and Metric Units

Learn the world of measurement units, distinguishing between U.S. customary units and metric units. (5 min) [E](#) [MM](#)

### Measurement Word Problem: Tea Party

Explore the concept of converting metric units within a real-world context.

(4 min) [E](#) [MM](#)

### Time Word Problem: Susan's Break

Explore the concept of converting units of time, specifically minutes, into hours.

(4 min) [E](#) [MM](#)

### Converting Units: US Volume

Learn how to convert US Customary units of volume (gallons, quarts, pints, and cups).

(5 min) [E](#) [MM](#)

### Same Length in Different Units

Explore the concept of converting US customary units, specifically yards to inches.

(6 min) [E](#) [MM](#)

### Measurement Word Problem: Running Laps

Understand how to convert units within the US customary system to solve word problems. (8 min) [E](#) [MM](#)

### Measurement Word Problem: Elevator

Learn the concept of converting units within the U.S. customary system.

(7 min) [E](#) [MM](#)

### Measurement Word Problem: Blood Drive

Explore the concept of converting units within the US customary system.

(4 min) [E](#) [MM](#)

### Measurement Word Problem: Distance Home

Explore the concept of converting units within the US customary system, specifically focusing on how to apply this skill to solve multi-step, real-world problems. (4 min) [E](#) [MM](#)

## Measurement & Data | Line Plots

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### Making Line Plots with Fractional Data

Learn about creating line plots to represent data sets. (3 min) [E](#) [MM](#)

### Interpreting Line Plots with Fractions

Use a line plot to find the difference between the two heaviest babies.

(3 min) [E](#) [MM](#)

### Reading a Line Plot with Fractions

Explore the concept of interpreting data on line plots, particularly focusing on how to read and understand line plots that display measurements in fractions. (3 min) [E](#) [MM](#)

### Line Plot Distribution: Trail Mix

Explore how to interpret data on line plots, specifically focusing on measurements in fractions of a unit. (3 min) [E](#) [MM](#)

## Number & Operations

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### Fraction Pizzeria

Students can learn about fractions by taking customers' orders, building pizzas, running the register, and experimenting with slopes. (unlimited) [E](#)

## Science

### Earth & Space Science

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#### 360 Degree Video of the Milky Way

Interactive timelapse of the moving night sky. (1 min)

#### Star Visualization- Exponential

Visualization of the number of stars in the universe using color-coded exponential groups. [IFX](#)

#### Journey into the Orion Nebula

This visualization journeys into the famous star-forming region of the Orion Nebula based on an image from the Hubble Space Telescope. (2 min)

#### Panoramic Video of the Night Sky and Milky Way: Visualize Astronomy

Enjoy a panoramic video of the night sky and Milky Way. (1 min)

#### Solar System 360 Degree Tour

Take a 360 degree virtual tour of our Solar system with Crash Course host Phil Plait. (5 min)

#### Solar System

Interactive classroom that allows students to visit each planet, watch them orbit, and learn about each one. (unlimited) [E](#)

#### VR Solar System Space Video

This amazing 360 virtual reality video will transport you through our galactic neighborhood, the solar system. (18 min)

## Solar Eclipse 2017 Casper, Wyoming

On August 21<sup>st</sup>, 2017 a total solar eclipse took place. See the view of it from Casper, Wyoming. (5 min)

### Sun

Rotating model of the Sun. [IFX](#)

### Moon Phases

Interactive display of the phases of Earth's Moon. [IFX](#)

### Solar System Model

Animated model of the solar system. Rotation and revolution speeds are scaled accurately. [IFX](#)

### Swirling Galaxy

Rotating spiral-shaped galaxy. [IFX](#)

### The Aurora Borealis over Alaska's Chatanika River

Explore a timelapse of the Aurora Borealis filmed during a geomagnetic storm by William Briscoe Photography. (5 min)

### Enter the Black Hole

Enter a black hole and explore the area around it. (5 min)

### Explore the Solar System

Take a virtual tour of our Solar System, with the help of Crash Course Astronomy host Phil Plait. (5 min)

### Journey to the Edge of Space

Experience what it's like to leave Earth, traveling to over 90,000 feet into the stratosphere. (5 min)

### Mars: The Red Planet VR

#### Documentary

Explore the planet Mars and see its history of exploration. (12 min)

### The Night Sky and Milky Way:

#### Visualize Astronomy

Enjoy a panoramic view of the night sky and the Milky Way. (1 min)

### Solar Eclipse

Watch a total solar eclipse that took place in Casper, Wyoming on August 21<sup>st</sup>, 2017. (5 min)

## VR Solar System Space Video

This amazing 360 video will transport you through our galactic neighborhood, the solar system. (18 min)

### Damming the Nile: Episode 1

Journey from the sacred source of the Blue Nile, down waterfalls, and through canyons to see this giant dam being built. Travel on East Africa's first metro train, go for a traditional Ethiopian lunch, and hear the government's view on the political crisis the dam project has created. (13 min)

### Damming the Nile: Episode 2

Journey to the great farming projects of Sudan, fly to a festival on the banks of the Nile and explore the ancient Sudanese pyramid. Then launch in a balloon over Luxor to find out how much this river means to the land of the pharaohs. (16 min)

### Climbing the Redwoods: Fight for the Forests

Climb 200 feet up 'Grandfather,' the highest Redwood in a Northern California Grove while learning about the Redwood Forest and preservation efforts. (2 min)

## Life Science

### How Animals see the World

Experience how different animals see the world: human, cat, dog, fly, rat, and a snake. (4 min)

### Fox's Point of View at Night- Planet Earth II: Cities

Through the eyes of an urban fox, can you find food, spot the hazards, and track down a mate in a bustling city at night? (4 min)

### Glow Worm Caves of New Zealand

Deep below ground, strange carnivorous worms' glow and twinkle like the night sky to attract their prey. (2 min)

### Great Hammerhead Shark Encounter

Dive into this 360° video and go face to face with a curious great hammerhead shark. (2 min)

## 360 Orangutan School

Go inside the International Animal Rescue Sanctuary in the forests of Borneo to see what it takes to teach a baby orangutan... to be an orangutan. (9 min)

### Gorillas in the Congo: A Jump VR Video

Experience gorillas in their natural habitat of the Congo Jungle. (2 min)

### Rhomaleosaurus Sea Dragon: Back to Life in 360 VR

Encounter the prehistoric sea dragon Rhomaleosaurus, as it roams the gallery over 180 million years after it died. (4 min)

### Attenborough and the Giant Dinosaur

David Attenborough meets the biggest animal ever to walk on Earth - a Titanosaur. (4 min)

### Giraffatitan Dinosaur: Back to Life in 360 VR

Encounter the Jurassic giant Giraffatitan, one of the tallest dinosaurs that ever lived, and learn all about how it lived and who its descendants are. (4 min)

### VR Jurassic Dinosaur

Explore what life was like during the age of the dinosaur. (3 min)

### Diving Under Icebergs with a Seal in Antarctica

Take a 360 journey under an iceberg with a crabeater seal and Gentoo Penguins in Antarctica. (2 min)

### Elephant Seals and King Penguin

#### Chicks

These King Penguin chicks get our (elephant) seal of approval. (2 min)

#### Giraffe 1

See a giraffe interacting with its natural habitat. (1 min)

#### Giraffe 2

See a giraffe interacting with its natural habitat. (1 min)

## **Bears of Kamchatka, Kambalnaya River**

Follow along as you experience the Bears of Kamchatka and learn about their habitat, daily life, and mating season. (5 min)

## **Chengdu Panda Base, China**

Get an in-depth look at the pandas that call Chengdu Panda Base their home and learn about their habitat, diet, and daily life. (11 min)

## **Diving Exploration of Kelp Forest Aquarium**

Explore the Kelp Forest at Monterey Bay Aquarium. (3 min)

## **Travel-Dream-Imagine: A VR Journey from the Desert Floor to the Sea**

Travel with us as we step into the Judea Desert, bathe in a waterfall, wet our feet in the red sea, dive among corals, and float in one of the wonders of the world - the dead sea. (2 min)

## **Diving with Great White Shark**

Experience a great white shark up close and personal while learning about the majestic creature. (2 min)

## **Protecting Ocean Anchor Species: Racing Extinction**

Join marine biologist Luke Tipple as he swims alongside manta rays and whale sharks while sharing why they are vital to the survival of our oceans. (3 min)

## **Tiger Shark Encounter in the Bahamas: SharkFest**

Get face-to-face with massive tiger sharks as you plunge into the crystal-clear waters of the Bahamas. (3 min)

## **Whale Sharks: Giants of the Deep**

Encounter a group of Whale Sharks feeding as they migrate south. (2 min)

## **Explore an Underwater Mountain from a Submarine**

Ride along in a submarine and explore the ocean floor. (4 min)

## **Explore the Deep Ocean**

Follow along in a Submarine and see the ocean from a new view. (2 min)

## **Kelp**

Swim through a kelp forest. (1 min)

## **Reef 2**

Swim along an active thriving reef. (1 min)

## **Reef 3**

Swim along an active thriving reef. (1 min)

## **Reef 4**

Swim along an active thriving reef. (1 min)

## **Explore the Blue Hawaiian Adventure**

Learn about the diversity of life found in the Hawaiian Islands, and explore the ecology of three different species, their importance to Native Hawaiian culture, and the conservation measures in place for their protection. (4 min)

## **Explore the Coral Restoration**

Learn about the ecology of coral reefs, natural and human threats to corals, and the science of coral restoration. (4 min)

## **Lion Whisperer: Racing Extinction**

Follow along with Kevin Richardson as he explains the complexities of his relationship to his pride, and summarizes his life's work of protecting these amazing animals from the game hunting trade. (4 min)

## **Lions 360**

Join National Geographic Explorer, Martin Edström, and come face to face with Gibson and his mother, as they struggle with their pride's alpha male. (5 min)

## **Red Kite Bird Feeding Frenzy**

Watch the once endangered Red Kite Bird feed while learning about them. (1 min)

## **Hyena 1**

Watch a hyena feed on a fresh kill. (1 min)

## **Hyena 2**

Watch a hyena approach cautiously for a snack. (1 min)

## **Leopard**

Watch a leopard munch on a meal. (1 min)

## **Lioness 1**

A curious Lioness sniffs at the camera. (1 min)

## **Lioness 2**

Lioness sniffs at food. (1 min)

## **Ocean to Plate: A Journey into the Seafood Supply Chain**

Learn how populations and appetites grow. Global fisheries are reaching their ecological capacity, yet at least a third of harvested fish and seafood is lost or wasted along the supply chain. (7 min)

## **Shoaling in the Deep**

Dive down deep into the heart of a shoal of fish, follow a manta ray as it skims the ocean floor, and lock eyes with a moray eel lurking in an underwater cave. (3 min)

## **Whale Sharks at Risks- Racing Extinction**

Experience a close encounter with a whale shark- the largest fish on the Planet. (4 min)

# Physical Science

## **Gas in Tank**

Three colored liquids of different densities that flow out of pipes and stack on top of each other in a tank. [IFX](#)

## **Liquid Particles in Tank**

Liquid particles that move randomly inside a tank. [IFX](#)

## **Solid Particle Arrangement**

Rotating cube of crystalline atomic structure. [IFX](#)

## **Hydrogen and Helium Formation**

Protons, neutrons, and electrons that move around randomly and then collide to form hydrogen and helium atoms. [IFX](#)

## **Earth Magnetic Field**

Animated visualization of the electromagnetic field surrounding Planet Earth. [IFX](#)

## **Microscope**

Highly interactive science lab microscope with 4 different, insertable slides that they can view at 3 different zoom levels. [IFX](#)

## **International Space Station**

Model of the exterior of the International Space Station. [IFX](#)

**X- Ray Machine**

Interactive model of an x-ray machine. [IFX](#)

## Social Studies

### Civics

**Independence Hall**

Join George Washington, John Adams, Thomas Jefferson, Benjamin Franklin, and John Hancock as they come to life to tell you their stories about the founding of the United States. (unlimited) [E](#)

**Women's March in Chicago**

Witness a Women's Rights march in Chicago that was held on January 21, 2017. (1 min)

**March for Our Lives**

Be immersed in Pioneer Valley's March for Our Lives that was held on March 24, 2018. (1 min)

**Syrians "Have to Survive Having No Rights" in Lebanon**

Learn about Syrian refugees who are living in makeshift settlements under harsh conditions, with no legal rights in Lebanon's Bekaa Valley. (3 min)

### Civil Rights

**Civil Rights Museum**

Five Civil Rights leaders - Rosa Parks, John Lewis, Martin Luther King Jr., Thurgood Marshall, and Medgar Evers - come to life and teach you their stories on interactive stages. (unlimited) [E](#)

**Historic Jamestown**

Interactive experience where students will experience the reason for the English Colonization and the significance of the location regarding resources, defensibility, and economic development. (unlimited) [E](#)

**Out of Syria: Back to School**

Step into the lives of two teenagers from war-torn Syria, Mustafa and Sarah. They both fled the fighting with their families. They left their homelands and their schools behind. (4 min)

**Seeking Home: Life Inside the Calais Migrant Camp**

Become part of a camp in northern France where migrants and refugees hope to make it across the English channel to start a new life in the United Kingdom. (6 min)

**Women's March in Chicago**

Witness a Women's Rights march in Chicago that was held on January 21, 2017. (1 min)

**March for Our Lives**

Be immersed in Pioneer Valley's March for Our Lives that was held on March 24, 2018. (1 min)

**Syrians "Have to Survive Having No Rights" in Lebanon**

Learn about Syrian refugees who are living in makeshift settlements under harsh conditions, with no legal rights in Lebanon's Bekaa Valley. (3 min)

**Traveling While Black**

This film offers a revealing view of the Green Book Era as told through Ben's Chili Bowl, a black-owned restaurant in Washington, to remind us of the hardships that African-Americans faced during that time period. (20 min)

**Discover the Taj Mahal, India**

Join Asha Leo as she ventures around India and explores the Taj Mahal. (5 min)

**Hajj: Experience the Journey to Mecca**

Walk with Al Jazeera's, Basma Atassi, in Mecca to see the major landmarks that millions of Muslims visit during the period of Hajj, the annual Islamic Pilgrimage. (8 min)

**Japan: Where Tradition Meets the Future**

Explore Japanese tradition, modernity, and nature. (3 min)

**Taj Mahal 360 Degree (VR) Tour in India**

Explore one of the 7 Wonders of the World, the Taj Mahal in India. (2 min)

**CR.5.2| Walking Tours of Japan: Kiyomizudera Temple in Kyoto**

Experience a walking tour of Kiyomizudera Temple in Kyoto, Japan. (17 min)

### Economics

**AeroFarms: The Future of Farming**

See how AeroFarms in Newark, NJ grows over 2 million pounds of greens a year without sunlight, soil, or pesticides, making it the world's largest indoor vertical farm. (2 min)

### Geography

**Antarctica: Part II**

View Antarctica from aboard a ship as it sails around for you to see the different wildlife. (6 min)

**Back to Nature: Rainforest**

Escape to the lush temperate rainforest of Southern Australia. (4 min)

**Chennai Floods Aftermath**

Take an immersive journey through the impact, rescue, and reason for the floods that occurred in Chennai, India, in December 2015. (6 min)

**Iceland**

Soar over Iceland and take in the different views that it has to offer. (3 min)

**Life in Haiti: After a Devastating Natural Disaster**

Join filmmaker Dylan Roberts on a journey to the Haitian city of Jérémie, and the small village of Manish, to witness the aftermath of a colossal storm. (5 min)

## Climbing the Redwoods: Fight for the Forests

Climb 200 feet up 'Grandfather,' the highest Redwood in a Northern California Grove while learning about the Redwood Forest and preservation efforts. (2 min)

## Category 3 Hurricane Landfall Simulation

Experience a category 3 hurricane through a simulation with guided popups. (1 min)

## History

### Explore a WWI Trench in VR

Explore and discover how WWI soldiers lived in the trenches, view across No Man's Land, explore an officer's quarters, step inside the first aid field hospital and navigate the wet and muddy trench system. (2 min)

### Virtually Inside the First Tanks

Join Richard "The Challenger" Cutland and Nicholas "Chieftain" Moran as they explore the oldest members of the collection at The Tank Museum at Bovington, UK, including the world's last surviving Mark I tank: the oldest surviving combat tank in the world. (7 min)

### 1. VR Pearl Harbor Attack Reenactment, Japanese Midget Submarine/

### 2. Explore South Dakota's Badlands

EXP.1: The Japanese midget submarine, manned by Ensign Kazuo Sakamaki, failed in its mission to attack and destroy American warships. (6 min)  
EXP.2: The Badlands is home to the largest mixed grass prairie where bison and other wildlife graze freely. (2 min)

### Honor Everywhere

See the World War II Memorial, Arlington National Cemetery, US Marines Corps War Memorial, US Air Force Memorial and the Korean Memorial. (9 min)

## Remembering Pearl Harbor VR: Experience History

Follow Lt. James Downing, who at 103 is the second-oldest living American veteran to have witnessed that day, who recounts his time as postmaster of the USS West Virginia. (2 min)

### 1941 Battle Reenactment

Watch the reenactment of this World War II battle from 1941. In this video, you'll see operating German vehicles, such as the Pz.Kpfw. III medium tank as well as the StuG III self-propelled gun. The tanks on the Soviet side are the T-34-76 and the BT-7. (3 min)

### 1. Cool VR Walk on the Moon/ 2. Yosemite

EXP.1-Experience a walk on the Moon from the Project Apollo Archive. (2 min)  
EXP.2-Experience a guided tour of some of Yosemite's majestic spots. (4 min)

### Nuclear Bunker

Replica of an underground nuclear bunker to be used as a shelter from potential disasters. (unlimited)

### Medgar Evers House

Recreation of the Medgar Evers House and National Monument. Built in collaboration with the Evers family. (unlimited)

### Civil Rights Museum

Five Civil Rights leaders - Rosa Parks, John Lewis, Martin Luther King Jr., Thurgood Marshall, and Medgar Evers - come to life and teach you their stories on interactive stages. (unlimited)

### Segregated Lunch Counter

Model of a 1960s diner style lunch counter where civil rights activists like John Lewis held sit-ins to protest segregation. (unlimited)

## Traveling while Black

This film offers a revealing view of the Green Book era as told through Ben's Chili Bowl, a black-owned restaurant in Washington, and reminds us that the humiliations heaped upon African-Americans during that time period. (20 min)

### The JFK Assassination

Follow along as you get an in-depth look into the assassination of JFK. (4 min)

### Historic Jamestown

Interactive experience where students will grasp the reason for the English Colonization and the significance of the location regarding resources, defensibility, and economic development. (unlimited) [E](#)

### Independence Hall

Join George Washington, John Adams, Thomas Jefferson, Benjamin Franklin, and John Hancock as they come to life to tell you their stories about the founding of the United States. (unlimited) [E](#)

### Battle Road: The American Revolution

Be surrounded by scores of professional reenactors, organizers, onlookers, and photographers as they gather at Lexington, Concord, and Minute Man National Historical Park to honor the memory of this critical turning point in American history. (5 min)

### Liberty Bell

Realistic recreation of the Liberty Bell in Philadelphia, PA. Touch the bell to hear it ring, just as it would have sounded before it cracked. [IFX](#)

# 6th Grade

## Mathematics

### Basic Operations & Reasoning | Exponents & Order of Operations

#### Intro to Exponents

Learn about exponents and how they represent repeated multiplication.

(3 min) [E](#) [MM](#)

#### The Zeroth Power

Consider two different ways to think about why a number raised to the zero power equals one.

(4 min) [E](#) [MM](#)

#### Exponents of Decimals

Explore that exponents of decimals can be calculated by multiplying the decimal number by itself as many times as the exponent indicates.

(3 min) [E](#) [MM](#)

#### Powers of Fractions

Explore how to raise fractions to a power.

(2 min) [E](#) [MM](#)

#### Order of Operations Introduction

Learn to follow PEMDAS (Parentheses, Exponents, Multiplication and Division, and Addition and Subtraction) to accurately evaluate expressions and avoid common mistakes.

(5 min) [E](#) [MM](#)

#### Worked Example: Order of Operations (PEMDAS)

Learn to follow PEMDAS to simplify and accurately solve mathematical expressions, ensuring a correct final answer.

(5 min) [E](#) [MM](#)

#### Order of Operations Examples:

##### Exponents

Understanding the impact of parentheses on calculations helps avoid common mistakes and enhances problem-solving skills. (4 min) [E](#) [MM](#)

##### Comparing Exponent Expressions

Evaluate the expressions: 2 cubed minus 2, 2 squared plus 3 to the power of 0, and 3 squared. (2 min) [E](#) [MM](#)

#### Order of Operations Example:

**Fractions and Exponents** Follow the order of operations to simplify expressions and find the correct answer.

(4 min) [E](#) [MM](#)

### Basic Operations & Reasoning | Negative Numbers

#### Introduction to Negative Numbers

Explore negative numbers and see them visualized on a number line. (3 min) [E](#) [MM](#)

#### Negative Symbol as Opposite

Learn about opposites in math and how they relate to negative numbers.

(5 min) [E](#) [MM](#)

#### Number Opposites

Explore how opposite of a positive number is its negative counterpart, while the opposite of a negative number is its positive counterpart. (3 min) [E](#) [MM](#)

#### Negative Decimals on the Number Line

Learn to locate negative decimals on a number line. (1 min) [E](#) [MM](#)

#### Decimals & Fractions on the Number Line

Explore how to plot numbers on a number line and visualize numerical values.

(2 min) [E](#) [MM](#)

#### Compare Rational Numbers Using a Number Line

Learn to compare positive and negative numbers, decimals, and fractions using a number line. (6 min) [E](#) [MM](#)

#### Numerical Inequality Word Problems

Learn to compare quantities using inequalities. (3 min) [E](#) [MM](#)

#### Ordering Negative Numbers

Visualize ordering negative numbers on a number line helps clarify their positions, with the least number on the left and the greatest on the right. (3 min) [E](#) [MM](#)

#### Ordering Rational Numbers

Learn how to order numbers from least to greatest using a number line. (4 min) [E](#) [MM](#)

#### Absolute Value Examples

Visualize how absolute value of a number represents its distance from zero on a number line, always resulting in a positive value. (2 min) [E](#) [MM](#)

#### Meaning of Absolute Value

Learn how absolute value is a fundamental math concept that measures the distance of a number from zero, regardless of its sign.

(4 min) [E](#) [MM](#)

#### Comparing Absolute Values on the Number Line

Explore absolute values and inequalities using a number line with three numbers: a, b, and c. (4 min) [E](#) [MM](#)

#### Placing Absolute Values on the Number Line

Learn and practice how to sort values from least to greatest using a number line.

(2 min) [E](#) [MM](#)

#### Comparing Absolute Values

Compare absolute values to determine which number is further from zero, regardless of its positive or negative sign.

(4 min) [E](#) [MM](#)

#### Testing Solutions to Absolute Value Inequalities

Learn how to determine if given values of x satisfy various absolute value inequalities.

(6 min) [E](#) [MM](#)

**Interpreting Absolute Value**

Solve this weight change scenario by plotting the changes on a number line to determine who lost the most weight.

(4 min) [E](#) [MM](#)

**Geometry****Rhombus Tile**

Simple geometry manipulables that can be used to teach about shapes and angles, or build tessellations. [IFX](#)

**Pentagon Tile**

Simple geometry manipulables that can be used to teach about shapes and angles, or build tessellations. [IFX](#)

**Octagon Tile**

Simple geometry manipulables that can be used to teach about shapes and angles, or build tessellations. [IFX](#)

**Obtuse Isosceles Triangle Tile**

Simple geometry manipulables that can be used to teach about shapes and angles, or build tessellations. [IFX](#)

**Narrow Rhombus Tile**

Simple geometry manipulables that can be used to teach about shapes and angles, or build tessellations. [IFX](#)

**Hexagon Tile**

Simple geometry manipulables that can be used to teach about shapes and angles, or build tessellations. [IFX](#)

**Equilateral Triangle Tile**

Simple geometry manipulables that can be used to teach about shapes and angles, or build tessellations. [IFX](#)

**Acute Isosceles Triangle Tile**

Simple geometry manipulables that can be used to teach about shapes and angles or build tessellations. [IFX](#)

**Wide Rhombus Tile**

Simple geometry manipulables that can be used to teach about shapes and angles, or build tessellations. [IFX](#)

**Trapezoid Tile**

Simple geometry manipulables that can be used to teach about shapes and angles, or build tessellations. [IFX](#)

**Square Tile**

Simple geometry manipulables that can be used to teach about shapes and angles, or build tessellations. [IFX](#)

**Random Number Clock**

A clock that rapidly cycles through numbers such that it selects a random number (1-10) when the stop button is pressed. Can be used for basic math/statistics activities or studying the nature of random behavior. [IFX](#)

**Geometry | Plane Figures****Area of a Parallelogram**

Explore how to calculate the area of a parallelogram. (3 min) [E](#) [MM](#)

**Finding Height of a Parallelogram**

Learn that the area of a parallelogram equals the base times the height. (2 min) [E](#) [MM](#)

**Area of a Triangle**

Learn how to find the area of a rectangle and a parallelogram is found by multiplying the base by the height. (6 min) [E](#) [MM](#)

**Finding Area of Triangles**

Learn to find the area of a triangle is found by multiplying one half of the base by the height. (2 min) [E](#) [MM](#)

**Triangle Missing Side Example**

Learn how to find a missing piece of a triangle using just the area and height. (3 min) [E](#) [MM](#)

**Finding Area by Rearranging Parts**

Explore Learn how to find a missing piece using just the area and height. (4 min) [E](#) [MM](#)

**Area of Composite Shapes**

Determine the area of two triangles, a rectangle, and a trapezoid, and then add up the areas of the four shapes to get the total area. (5 min) [E](#) [MM](#)

**Area of Quadrilateral with 2 Parallel Sides**

Learn how to find the area of a quadrilateral by splitting it into two triangles. (4 min) [E](#) [MM](#)

**Geometry | Coordinate Plane****Points on the Coordinate Plane****Examples**

Learn to use the coordinate plane to graph points, lines, and more. (7 min) [E](#) [MM](#)

**Plotting a Point (Ordered Pair)**

Explore how to plot ordered pairs on a coordinated plane. (2 min) [E](#) [MM](#)

**Finding the Point not Graphed**

Learn to spot the missing point on a graph by comparing coordinate pairs to points. (1 min) [E](#) [MM](#)

**Quadrants of the Coordinate Plane**

Explore the coordinate plane and learn how it's divided into four sections, called quadrants, which quadrants are positive, and which are negative. (3 min) [E](#) [MM](#)

**Points and Quadrants Example**

Explore how plotting points on a graph involves moving along the x and y axes. (2 min) [E](#) [MM](#)

**Coordinate Plane Word Problem****Examples**

Explore how to calculate the distance between two points, using the x and y coordinates. (5 min) [E](#) [MM](#)

## Drawing a Quadrilateral on the Coordinate Plane Example

Explore how to make a four-sided shape called a quadrilateral using line segments on a coordinated plane. (2 min) [E](#) [MM](#)

## Area of a Parallelogram on the Coordinate Plane

Find the area of a parallelogram by multiplying the base by the height. (2 min) [E](#) [MM](#)

## Coordinates of a Missing Vertex

Explore how to find the vertices of a rectangle when you are given three of them. (3 min) [E](#) [MM](#)

## Example of Shapes on a Coordinate Plane

Visualize drawing a rectangle on a coordinate plane and then finds its height. (2 min) [E](#) [MM](#)

## Dimensions of a Rectangle from Coordinates

Explore how to determine the length of a side of a rectangle given the coordinates of its vertices. (4 min) [E](#) [MM](#)

## Coordinates of Rectangle Example

Solve a challenging problem involving a quadrilateral on the coordinate plane. (2 min) [E](#) [MM](#)

## Parallelogram on the Coordinate Plane

Graph the given coordinates of three of the polygon vertices and find where the 4th vertex is. (5 min) [E](#) [MM](#)

## Geometry | 3D Figures

### Counting Faces and Edges of 3D Shapes

Identify the faces and edges on various 3D shapes. (4 min) [E](#) [MM](#)

### Recognizing Common 3D Shapes

Identify the following 3D shapes: square pyramid, rectangular prism, triangular prism, cylinder, and cone. (3 min) [E](#) [MM](#)

## Volume with Fractional Cubes

Explore another way of finding the volume of a rectangular prism involves dividing it into fractional cubes, finding the volume of one, and then multiplying that volume by the number of cubes that fit into our rectangular prism (4 min) [E](#) [MM](#)

## Volume of a Rectangular Prism: Fractional Dimensions

Learn how to find the volume of a rectangular prism that has fractional side lengths. (4 min) [E](#) [MM](#)

## How Volume Changes from Changing Dimensions

Explore and discuss changing dimensions on a rectangular prism affects its volume. (4 min) [E](#) [MM](#)

## Volume of a Rectangular Prism: Word Problem

Explore how to find the volume of a rectangular prism fish tank that has fractional side lengths. (6 min) [E](#) [MM](#)

## Intro to Nets of Polyhedra

Explore how nets of polyhedra are just 2D objects that wrap around 3D objects, like wrapping paper around presents. (7 min) [E](#) [MM](#)

## Surface Area Using a Net: Triangular Prism

Learn the steps to compute the surface area of a triangular prism (3 min) [E](#) [MM](#)

## Surface Area Using a Net: Rectangular Prism

Learn whether a certain net could be folded up into a certain rectangular prism. (4 min) [E](#) [MM](#)

## Surface Area of a Box (Cuboid)

Learn how to find the surface area of a cuboid which has 6 rectangular faces, add the areas of all 6 faces. (3 min) [E](#) [MM](#)

## Surface Area of a Box Using Nets

Learn how to find the surface area of cereal box using nets. (5 min) [E](#) [MM](#)

## Surface Area Word Problem Example

Solve a word problem that involves surface area of a square pyramid. (5 min) [E](#) [MM](#)

## Algebra | Variables & Expressions

### What is a Variable?

Explore and learn how variables are symbols, often letters, that represent different values in various situations. (3 min) [E](#) [MM](#)

### Terms, Factors, & Coefficients

Understand how terms are the components added or subtracted, factors are the elements multiplied within each term, and coefficients are the numbers multiplying variables (7 min) [E](#) [MM](#)

### Why aren't we Using the Multiplication Sign?

Explore how representing multiplication with variables can be tricky due to the similarity between the variable "x" and the multiplication symbol. (5 min) [E](#) [MM](#)

### Evaluating an Expression with One Variable

Explore the expression  $5t + 3$  to calculate the cost of participating in a hospital raffle fundraiser. (2 min) [E](#) [MM](#)

### Evaluating Exponent Expressions with Variables

Learn to evaluate expressions with exponents and variables. (3 min) [E](#) [MM](#)

### Evaluating Expressions Like $5x^2$ & $\frac{1}{3}(6)^x$

Explore how evaluating expressions with exponents involves substituting a given value for the variable and following the order of operations. (2 min) [E](#) [MM](#)

### Evaluating Expressions with Two Variables

Learn how to evaluate expressions with two variables involves substituting the given values for each variable and simplifying the expression. (2 min) [E](#) [MM](#)

### Evaluating Expressions with Two Variables: Fractions & Decimals

Explore how to evaluate expressions with two variables involves substituting the given values for each variable and simplifying the expression. (3 min) [E](#) [MM](#)

### Expression Value Intuition

Discover how expressions change as variables within them shift. (5 min) [E](#) [MM](#)

### Evaluating Expressions with Variables: Temperature

Learn to substitute the variable with a value to solve the problem. (2 min) [E](#) [MM](#)

### Evaluating Expressions with Variables: Cubes

Discover how to calculate the total surface area of cube-shaped containers with varying side lengths. (3 min) [E](#) [MM](#)

### Evaluating Expressions with Variables: Exponents

Learn to evaluate an algebraic expression with exponents by following the order of operations (PEMDAS). (3 min) [E](#) [MM](#)

### Writing Basic Expressions with Variables

Discover how to represent various operations like addition, subtraction, multiplication, and division using variables. (3 min) [E](#) [MM](#)

### Writing Algebraic Subtraction Expressions

Learn how to turn word statements into algebraic expressions. (2 min) [E](#) [MM](#)

### Writing Expressions with Variables

Explore how to write simple algebraic expressions from mathematical statements. (2 min) [E](#) [MM](#)

### Writing Expressions with Parentheses

Explore using parentheses and how they help follow the correct order of operations. (2 min) [E](#) [MM](#)

### Writing Expressions with Variables & Parentheses

Explore expressions and how to simplify them step by step. (3 min) [E](#) [MM](#)

### Writing Basic Expressions Word Problems

Determine and write the basic expressions from this word problem. (3 min) [E](#) [MM](#)

### Least Common Multiple

Learn that the least common multiple (LCM) is the smallest number that two or more numbers can divide into evenly. (4 min) [E](#) [MM](#)

### Least Common Multiple: Repeating Factors

Determine the least common multiple of two integers. (3 min) [E](#) [MM](#)

### Least Common Multiple of Three Numbers

Explore how to find the LCM of 3 different numbers. (6 min) [E](#) [MM](#)

### Greatest Common Factor Examples

Explore and learn how the greatest common factor (GCF) of a set of numbers is the largest factor that all the numbers share. (7 min) [E](#) [MM](#)

### Greatest Common Factor Explained

Learn how to find the GCD/GCF of two numbers, list their factors, identify the common factors, and choose the largest one. (6 min) [E](#) [MM](#)

### Factor with the Distributive Property

Learn how the distributive property helps us factor out the greatest common factor (GCF) in math problems. (3 min) [E](#) [MM](#)

### Distributive Property over Addition

Learn how to apply the distributive law of multiplication over addition and why it works. (5 min) [E](#) [MM](#)

### Distributive Property over Subtraction

Learn how to apply the distributive property of multiplication over subtraction and why it works. (2 min) [E](#) [MM](#)

### Distributive Property with Variables

Learn to apply the distributive property to an algebraic expression, you multiply each term inside the parentheses by the number or variable outside the parentheses. (7 min) [E](#) [MM](#)

### Intro to Combining Like Terms

Explore how to add terms with coefficients and variables. (5 min) [E](#) [MM](#)

### Combining Like Terms

Learn how to add and subtract variables like apples(a) or x's. (3 min) [E](#) [MM](#)

### Combining Like Terms Example

Learn how to simplify algebraic expressions by combining like terms. (4 min) [E](#) [MM](#)

### Equivalent Expressions

Learn how to find equivalent expressions by combining terms and factoring. (2 min) [E](#) [MM](#)

## Algebra | Equations & Inequalities

### Variables, Expressions, & Equations

Learn how to use variables like x, y, and z to represent unknown values. (7 min) [E](#) [MM](#)

### Testing Solutions to Equations

Learn how to solve an equation with one variable. (4 min) [E](#) [MM](#)

### Same Thing to Both Sides of Equations

Visualize how to keep an equation balanced with this scale problem. (3 min) [E](#) [MM](#)

### Representing a Relationship with an Equation

Learn about balancing scales and solving equations. We discover that to find a mystery mass, we can set up an equation using equal signs and balance both sides. (3 min) [E](#) [MM](#)

**Dividing Both Sides of an Equation**

Learn how to find the mass of a mystery object using a balanced scale. (3 min) [E](#) [MM](#)

**One-Step Equations Intuition**

Learn how to solve a balance scale problem with unknown mass. (5 min) [E](#) [MM](#)

**One-Step Addition & Subtraction Equations**

Learn how to solve simple equations with one unknown variable. (2 min) [E](#) [MM](#)

**One-Step Addition Equation**

Learn how to solve simple equations by isolating the variable by removing other terms on the same side. (2 min) [E](#) [MM](#)

**One-Step Addition & Subtraction Equations: Fractions & Decimals**

Learn how to solve equations by learning how to isolate the variable by adding or subtracting terms from both sides of the equation. (5 min) [E](#) [MM](#)

**One-Step Division Equations**

Learn how to solve simple algebraic equations systematically. (11 min) [E](#) [MM](#)

**One-Step Multiplication Equations**

Learn to solve equations with  $x$  divided by a number, like  $x/3 = 14$ . (3 min) [E](#) [MM](#)

**One-Step Multiplication & Division****Equations: Fractions & Decimals**

Learn to balance equations by applying the same operation on both sides, simplifying fractions, and eliminating decimals. (8 min) [E](#) [MM](#)

**One-Step Multiplication Equations:****Fractional Coefficients**

Learn how to solve equations with fractions by using reciprocals. (4 min) [E](#) [MM](#)

**Finding Mistakes in One-Step Equations**

Learn how to spot mistakes in solving algebraic equations. (4 min) [E](#) [MM](#)

**Modeling with One-Step Equations**

Work through this problem to figure out how many pizzas can be bought with the money provided. (4 min) [E](#) [MM](#)

**Testing Solutions to Inequalities**

Learn to solve inequality puzzles by trying different numbers and seeing which ones make the puzzle true. (5 min) [E](#) [MM](#)

**Plotting Inequalities**

Explore how to plot inequalities on a number line. (2 min) [E](#) [MM](#)

**Plotting an Inequality Example**

Visualize how to  $x$  is less than 4 by using a number line. (2 min) [E](#) [MM](#)

**Inequalities Word Problems**

Learn to use inequalities to compare values. (2 min) [E](#) [MM](#)

**Dependent & Independent Variables**

Explore independent and dependent variables: how to identify the independent/dependent variables in each setting, and how to write equations with the dependent variable by itself. (2 min) [E](#) [MM](#)

**Dependent & Independent Variables:****Graphing**

Visualize how to plot the answer of a problem on a graph. (1 min) [E](#) [MM](#)

**Writing Equations for Relationships****Between Quantities**

Learn how to write equations representing real-world scenarios. (6 min) [E](#) [MM](#)

**Analyzing Relationships Between****Variables**

Explore and analyze the relationship between variables in a problem. (3 min) [E](#) [MM](#)

## Fractions, Decimals, Percents, & Ratios | Ratios

**Intro to Ratios**

Learn about Ratios and how they are the relationship between two numbers. (4 min) [E](#) [MM](#)

**Basic Ratios**

Learn how ratios compare two quantities and can be written as "a to b" or "a:b". (3 min) [E](#) [MM](#)

**Part: Whole Ratios**

Explore ratios in this visual example and learn how to represent ratios as fractions. (3 min) [E](#) [MM](#)

**Ratios with Tape Diagrams**

Learn to find missing values using given ratios and discover equivalent ratios by multiplying or dividing both parts by the same number. (4 min) [E](#) [MM](#)

**Ratios with Tape Diagrams (Part:Whole)**

Learn to read a part-to-whole ratio from a tape diagram showing the ratio of the two parts. (3 min) [E](#) [MM](#)

**Equivalent Ratio Word Problems**

Learn to solve ratio word problems, using examples like Yoda Soda for guests, fish ratios in a tank, ice cream sundae ingredients, and dog color ratios at a park. (6 min) [E](#) [MM](#)

**Simplify a Ratio from a Tape Diagram**

Use a tape diagram to simplify a ratio in this visual problem. (3 min) [E](#) [MM](#)

**Ratios and Double Number Lines**

Use double number lines to visualize equivalent ratios and describe a ratio relationship between two quantities. (6 min) [E](#) [MM](#)

**Solving Ratio Problems with Tables**

Learn to solve for missing values in a table. (5 min) [E](#) [MM](#)

**Equivalent Ratios**

Learn to identify equivalent ratios by determining if you can multiply or divide the corresponding parts of the ratio by the same amount. (5 min) [E](#) [MM](#)

**Equivalent Ratios: Recipe**

Identify the correct ratios in this cake recipe problem. (5 min) [E](#) [MM](#)

**Understanding Equivalent Ratios**

Learn what it means for two ratios to be equivalent. (6 min) [E](#) [MM](#)

## Interpreting Unequal Ratios

Use this example to interpret the ratio of pepper to fish in two recipes to decide which tastes spicier. (3 min) [E](#) [MM](#)

## Ratios on Coordinate Plane

Understand and visualize that ratios represent the relationship between two quantities and can be visualized on a graph. (5 min) [E](#) [MM](#)

## Ratios and Measurement

Learn to complete ratio tables and solve unit conversion problems with examples like hours to weeks, yards to miles, millimeters to feet, and dollars per pound to dollars per ounce. (7 min) [E](#) [MM](#)

## Part to Whole Ratio Word Problem: Using Tables

Learn to use ratios to determine the number of indoor and outdoor playtimes in a class with a 2:3 ratio and 30 total playtimes. (3 min) [E](#) [MM](#)

## Fractions, Decimals, Percents, & Ratios | Arithmetic with Rational Numbers

### Adding Decimals: $9.087 + 15.31$

Learn to add decimals by filling in any missing digits to complete this problem. (3 min) [E](#) [MM](#)

### Adding Decimals: $0.822 + 5.65$

Work to solve this decimal addition problem. (2 min) [E](#) [MM](#)

### Adding Three Decimals

Work to solve this decimal addition problem. (3 min) [E](#) [MM](#)

### Subtracting Decimals: $9.005 - 3.6$

Learn to subtract decimals by lining up the decimal points. (2 min) [E](#) [MM](#)

## Subtracting Decimals: $39.1 - 0.794$

Learn to subtract decimals by aligning the decimal points and place values. (2 min) [E](#) [MM](#)

## Adding Decimals Word Problem

Solve this word problem by adding decimals to find the total weight of newborn twins. (2 min) [E](#) [MM](#)

## Adding & Subtracting Decimals Word Problem

Learn how to manage a bank account balance by adding and subtracting money with decimals. (2 min) [E](#) [MM](#)

## Dividing a Fraction by a Whole Number

Visually learn to divide fractions by whole numbers using multiplication. (4 min) [E](#) [MM](#)

## Meaning of the Reciprocal

Learn about reciprocals and how they are essential in understanding fractions. (4 min) [E](#) [MM](#)

## Dividing a Whole Number by a Fraction

Explore how dividing a whole number by a fraction involves multiplying the whole number by the fraction's reciprocal. (3 min) [E](#) [MM](#)

## Dividing a Whole Number by a Fraction with Reciprocal

Understand and visualize that dividing by a fraction involves finding the reciprocal and multiplying. (4 min) [E](#) [MM](#)

## Understanding Division of Fractions

Learn to divide mixed numbers by converting the mixed numbers to improper fractions, the simplify the division problem by finding the reciprocal of one of the fractions. (6 min) [E](#) [MM](#)

## Dividing Fractions: $2/5 \div 7/3$

Solve this word problem by dividing  $2/5 \div 7/3$ . (2 min) [E](#) [MM](#)

## Dividing Fractions: $3/5 \div 1/2$

Explore how dividing two fractions is the same as multiplying the first fraction by the reciprocal of the second fraction. (4 min) [E](#) [MM](#)

## Dividing Mixed Numbers

Learn to divide mixed numbers by converting them to improper fractions. (4 min) [E](#) [MM](#)

## Writing Fraction Division Story Problems

Explore how to solve this word problem involving fractions. (4 min) [E](#) [MM](#)

## Dividing Whole Numbers & Fractions: T-Shirts

Learn how to calculate the number of baby T-shirts that can be made from 48 yards of fabric. (2 min) [E](#) [MM](#)

## Area with Fraction Division Example

Discover the length of a yoga mat with a width of  $3/5$  meters and an area of 1 and  $2/25$  square meters. (3 min) [E](#) [MM](#)

## Intro to Multiplying Decimals

Learn how to multiply decimals. (4 min) [E](#) [MM](#)

## Decimal Multiplication Place Value

Learn about how to rewrite decimal multiplication using fractions, we can use the commutative and associative properties of multiplication to justify how we place the decimal point in the standard multiplication algorithm. (5 min) [E](#) [MM](#)

## Multiplying Challenging Decimals

Learn to multiply decimals easily by treating them as whole numbers first. (4 min) [E](#) [MM](#)

## Dividing by 2-Digits: $9,815 \div 65$

Learn the process of dividing large numbers, specifically 9,815 divided by 65. (5 min) [E](#) [MM](#)

## Dividing by 2-Digits: $7,182 \div 42$

Learn to divide large numbers by two-digit numbers by breaking it in to steps. (3 min) [E](#) [MM](#)

## Dividing Whole Numbers to Get a Decimal

Learn how to divide two numbers and find a decimal answer. (3 min) [E](#) [MM](#)

### Dividing a Decimal by a Whole Number

Learn how to divide decimals using long division. (2 min) [E](#) [MM](#)

### Dividing a Whole Number by a Decimal

Learn how dividing a whole number by a decimal can be simplified by multiplying both numbers by 10, shifting the decimal point to the right. (4 min) [E](#) [MM](#)

### Dividing Decimals with Hundredths

Explore how dividing decimals can be made simple by multiplying both numbers by the same amount to eliminate decimals. (4 min) [E](#) [MM](#)

### Dividing Decimals Completely

Learn to make dividing decimals easier by converting them into whole numbers. (7 min) [E](#) [MM](#)

### Long Division with Decimals

Learn to divide a decimal by another decimal. (4 min) [E](#) [MM](#)

### Dividing by a Multi-Digit Decimal

Work through the different steps needed to divide decimals. (5 min) [E](#) [MM](#)

## Fractions, Decimals, Percents, & Ratios | Rates & Percentages

### Intro to Rates

Learn how rates are closely related to ratios and play a significant role in math subjects like algebra and calculus. (5 min) [E](#) [MM](#)

### Solving Unit Rate Problem

Visualize and explore how to solve for a unit rate. (2 min) [E](#) [MM](#)

### Solving Unit Price Problem

Visualize and explore how to solve for a unit price. (2 min) [E](#) [MM](#)

### Rate Problems

Learn to find unit rates and use them to solve problems. (4 min) [E](#) [MM](#)

### Comparing Rates Example

Visualize how to compare rates in this math problem. (7 min) [E](#) [MM](#)

### The Meaning of Percent

Visualize and learn about percentages by shading 20% of a square. (3 min) [E](#) [MM](#)

### Meaning of 109%

Visualize how to represent 109% using shading. (3 min) [E](#) [MM](#)

### Percents from Fraction Models

Learn how to rewrite the fraction with a denominator of 100, as "percent" means "per 100." (4 min) [E](#) [MM](#)

### Finding Percentages with a Double Number Line

Work to determine the percentage of students taking the bus to school in a class of 28. (2 min) [E](#) [MM](#)

### Finding the Whole with a Tape Diagram

Use a tape diagram to solve this problem. (3 min) [E](#) [MM](#)

### Fraction, Decimal, and Percent from Visual Model

Learn how to convert shaded parts of a square into fractions, decimals, and percentages with ease. (3 min) [E](#) [MM](#)

### Converting Percents to Decimals & Fractions Example

Explore how to convert percentages to decimals and fractions. (3 min) [E](#) [MM](#)

### Percent of a Whole Number

Discover how to calculate percentages with a simple example: finding 30% of 6. (2 min) [E](#) [MM](#)

### Ways to Rewrite a Percentage

Discover how to calculate 2% of 90 using various methods, such as converting percentages to fractions and decimals. (2 min) [E](#) [MM](#)

### Finding Common Percentages

Explore how to find the percentage of a number by simply multiplying or dividing by the corresponding fraction e. (3 min) [E](#) [MM](#)

### Finding a Percent

Discover how to calculate percentages with this simple method. (3 min) [E](#) [MM](#)

### Percent Word Problem: Recycling Cans

Visualize and learn how to calculate the percentage of recycled cans. (3 min) [E](#) [MM](#)

## Measurement & Data | Representing Data Sets

### Representing Data

Explore a few different ways to look at data. (8 min) [E](#) [MM](#)

### Frequency Tables & Dot Plots

Learn to organize data into frequency tables and dot plots (sometimes called line plots). (7 min) [E](#) [MM](#)

### Creating a Histogram

Explore how a histogram is a graphical display of data using bars of different heights. (7 min) [E](#) [MM](#)

### Interpreting a Histogram

Learn how to read and interpret histograms, which summarize data by sorting it into buckets. (4 min) [E](#) [MM](#)

### Reading Box Plots

Box and whisker plots seek to explain data by showing a spread of all the data points in a sample. The "whiskers" are the two opposite ends of the data. (3 min) [E](#) [MM](#)

### Constructing a Box Plot

Learn how to construct a box and whisker plot to help analyze data. (8 min) [E](#) [MM](#)

### Worked Example: Creating a Box Plot (Odd Number of Data Points)

Learn how to create a box plot with 11 data points. (3 min) [E](#) [MM](#)

### Worked Example: Creating a Box Plot (Even Number of Data Points)

Learn how to create a box plot using 14 data points. (3 min) [E](#) [MM](#)

### Interpreting Box Plots

Learn how to evaluate what we know and what we don't know about a dataset given its box plot. (8 min) [E](#) [MM](#)

## Comparing Dot Plots, Histograms, and Box Plots

Learn to determine which data displays would be helpful in situations.

(5 min) [E](#) [MM](#)

## Shapes of Distributions

Explore how some distributions are symmetrical, with data evenly distributed about the mean. Other distributions are "skewed," with data tending to the left or right of the mean. (5 min) [E](#) [MM](#)

## Clusters, Gaps, Peaks & Outliers

Explore examples looking at different features of distributions, such as clusters, gaps, peaks, and outliers for distributions. (6 min) [E](#) [MM](#)

## Statistics & Probability | Intro to Statistics & Data Sets

### Statistical Questions

Explore what makes a question statistical. (9 min) [E](#) [MM](#)

### Representing Data

Explore a few of the many ways to look at data. (8 min) [E](#) [MM](#)

### Frequency Tables & Dot Plots

Learn to organize data into frequency tables and dot plots (sometimes called line plots). (7 min) [E](#) [MM](#)

### Creating a Histogram

Discover how a histogram is a graphical display of data using bars of different heights. (7 min) [E](#) [MM](#)

### Interpreting a Histogram

Learn how to read and interpret histograms, which summarize data by sorting it into buckets. (5 min) [E](#) [MM](#)

### Statistics Intro: Mean, Median, & Mode

Explore what the mean, median and mode is in a data set. (9 min) [E](#) [MM](#)

## Mean, Median, & Mode Example

Use a set of numbers to find the mean, median, and mode. (4 min) [E](#) [MM](#)

## Missing Value Given the Mean

Learn how to find the value of a missing piece of data if you know the mean of the data set. (5 min) [E](#) [MM](#)

## Impact on Median & Mean: Removing an Outlier

Explore the effects of removing a low outlier from a data set. (5 min) [E](#) [MM](#)

## Impact on Median & Mean: Increasing an Outlier

Explore the effects of modifying a value in a data set. (4 min) [E](#) [MM](#)

## Median & Range Puzzlers

Solve an interesting median and range challenge problem. (7 min) [E](#) [MM](#)

## Interquartile Range (IQR)

Learn to find the interquartile range (IQR) by first find the median (middle value) of the lower and upper half of the data. (6 min) [E](#) [MM](#)

## Mean Absolute Deviation (MAD)

Explore how Mean absolute deviation (MAD) of a data set is the average distance between each data value and the mean. (9 min) [E](#) [MM](#)

## Mean Absolute Deviation Example

Find the mean absolute deviation of a data set that's given in a bar chart. (6 min) [E](#) [MM](#)

## Shapes of Distributions

Explore the difference in symmetrical and "skewed" distributions. (5 min) [E](#) [MM](#)

## Clusters, Gaps, Peaks & Outliers

Explore looking at different features of distributions, such as clusters, gaps, peaks, and outliers for distributions. (7 min) [E](#) [MM](#)

# Science

## Earth & Space Science

### Cloud Climb

Explore how clouds, the atmosphere and weather all come together to create different aspects of the Earth's sky. (unlimited) [E](#)

### Solar System

Interactive classroom that allows students to visit each planet, watch them orbit, and learn about each one. (Unlimited) [E](#)

### Sun

Rotating model of the Sun. [IFX](#)

### Solar System Model

Animated model of the solar system. Rotation and revolution speeds are scaled accurately. [IFX](#)

### Moon Phases

Interactive display of the phases of Earth's Moon. [IFX](#)

### 1. Cool VR Walk on the Moon/ 2.

#### Yosemite

EXP.1: Walk on the Moon from the Project Apollo Archive. (2 min)

EXP.2: Experience a guided tour of some of Yosemite's majestic spots. (4 min)

### The Aurora Borealis over Alaska's

#### Chatanika River

Explore a timelapse of the Aurora Borealis filmed during a geomagnetic storm by William Briscoe Photography. (5 min)

### 360 Degree Video of the Milky Way

Explore a timelapse of the moving night sky. (1 min)

### Enter the Black hole

Enter a black hole and explore the area around it. (5 min)

## **First-Ever 360 VR Filmed in Space:**

### **One Strange Rock**

Fly side-by-side with astronauts and experience weightlessness, the speed of traveling at 17 thousand miles per hour, and take in a stunning view of Earth. (5 min)

### **Explore the Solar System**

Take a virtual tour of our Solar System, with the help of Crash Course Astronomy host Phil Plait. (5 min)

### **Journey into the Orion Nebula**

Journey into the famous star-forming region of the Orion Nebula based on an image from the Hubble Space Telescope. (2 min)

### **Journey to the Edge of Space**

Experience what it's like to leave Earth, traveling to over 90,000 feet into the stratosphere. (5 min)

### **Mars: The Red Planet VR**

#### **Documentary**

Explore the planet Mars and see its history of exploration. (12 min)

### **NASA's Curiosity Mars Rover at Namib**

#### **Dune**

View the Namib Dune and portions of Mount Sharp through the eyes of the Mars Rover. (2 min)

### **The Night Sky and Milky Way:**

#### **Visualize Astronomy**

Enjoy a panoramic video of the night sky and Milky Way. (1 min)

### **Solar Eclipse**

Watch a total solar eclipse that took place in Casper, Wyoming on August 21<sup>st</sup>, 2017. (5 min)

### **Space Experience**

View Earth from Space below the International Space Station but beware... meteorites have been forecast. (1 min)

### **Take a VR Tour of 6 Real Exoplanets**

Team up with astrophysicists to experience a scientifically accurate, VR tour of 6 exoplanets. (11 min)

## **VR Solar System Space Video**

This amazing 360 virtual reality video will transport you through our galactic neighborhood, the solar system. (18 min)

### **First ever 3D VR filmed in Space**

See life from the view of Astronauts in the International Space Station. (5 min)

### **Curiosity Mars Rover's**

View the Glen Torridon area of Mars from the eyes of the Mars Rover. (2 min)

### **Sample Asteroid Bennu**

Follow along on NASA's first asteroid sample return mission as they make a daring attempt to collect samples from an asteroid. (4 min)

### **Nuclear Power Plant**

Recreation of a nuclear power plant that students can explore. The interactive map allows students to tour the entire facility while illustrating how the different components are connected in the process of nuclear power generation. (unlimited) [E](#)

### **Nuclear Control Room**

Replica of the nuclear control room found at Three Mile Island. (unlimited) [E](#)

### **360 Orangutan School**

Go inside the International Animal Rescue Sanctuary in the forests of Borneo to see what it takes to teach a baby orangutan... to be an orangutan. (9 min)

### **Caring for Rhinos**

A herd of nine rhinos graze in the South African bush while we hear Chris Sussons, game reserve manager, give some cool facts about rhinos and why they need to protect them from poachers. (2 min)

### **Elephants on the Brink**

A herd of African elephants curiously investigates its surroundings in South Africa and happens to notice cameras filming their behavior. (3 min)

## **Lion Whisperer- Racing Extinction**

Kevin Richardson, also known as the "lion whisperer", explains the complexities of his relationship to his pride, and summarizes his life's work of protecting these amazing animals from the game hunting trade. (4 min)

### **Manatee: Crystal River National Wildlife Refuge**

Underwater cinematographer and VR filmmaker Adam Ravetch takes us on an adventure on Florida's Crystal River as he captures the river's wild manatees in their natural habitat at the Crystal River National Wildlife Refuge. (3 min)

### **Ocean to Plate: A Journey into the Seafood Supply Chain**

As populations and appetites grow, global fisheries are reaching their ecological capacity, yet at least a third of harvested fish and seafood is lost or wasted along the supply chain. (7 min)

### **Protecting Ocean Anchor Species- Racing Extinction**

Join marine biologist Luke Tipple as he swims alongside Anchor species like manta rays and whale sharks and shares why they are vital to the survival of our oceans and why they need to be protected. (3 min)

### **Rescuing Rhinos- Racing Extinction**

Orphaned at 2 weeks old in November 2014, Matimba was found next to her mother who had been killed by poachers for her horn. Weighing only 35 pounds at the time, she has been protected and nursed back to health in South Africa. (5 min)

### **The Fight to save Threatened Species**

Get closer than ever before to the most extraordinary creatures on the planet...before they disappear. Whale sharks, rhinos, elephants, manta rays and lions are all threatened with extinction. (2 min)

### **Explore the Coral Restoration**

Students will research the ecology of coral reefs, natural and human threats to corals, and the science of coral restoration. (4 min)

## Life Science

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### Climbing the Redwoods- Fight for the Forests

Climb 200 feet up 'Grandfather,' the highest Redwood in a Northern California Grove, while learning about the Redwood Forest and preservation efforts. (2 min)

### Diving with Great White Shark

Experience a Great white shark up close and personal while learning about the majestic creatures. (2 min)

### Protecting Ocean Anchor Species- Racing Extinction

Join marine biologist Luke Tipple as he swims alongside Anchor species like manta rays and whale sharks and shares why they are vital to the survival of our oceans and why they need to be protected. (3 min)

### Explore the Coral Restoration

Students will research the ecology of coral reefs, natural and human threats to corals, and the science of coral restoration. (4 min)

### Cell Classroom

Interactive classroom located inside an animal cell. Infographics help students learn about the parts of a cell, alongside animations of the protein synthesis process. (unlimited) [E](#)

### Plant Cell

Interactive classroom located inside a plant cell. Explore the different organelles and components of the cell and explore the photosynthesis process. (unlimited) [E](#)

## Physical Science

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### Electromagnet: Small Solenoid

Animated visualization of an electromagnetic solenoid with 15 coils. [IFX](#)

### Electromagnet: Large Solenoid

Animated visualization of an electromagnetic solenoid with 26 coils. [IFX](#)

### Magnet: Like Poles

Animated visualization of two bar magnets with like poles repelling each other. [IFX](#)

### Magnet: Opposite Poles

Animated visualization of two bar magnets attracting each other. [IFX](#)

### Magnet – Single Bar

Animated visualization of the electromagnetic field surrounding a single bar magnet. [IFX](#)

### Magnet – Two Bars

Animated visualization of the electromagnetic field surrounding two bar magnets. [IFX](#)

### Magnet – Horseshoe

Animated visualization of the electromagnetic field surrounding a horseshoe magnet. [IFX](#)

## Social Studies

### Civics

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### A London City Guided Tour

Take a guided tour to view some of London's most iconic landmarks. (5 min)

### Amazing Morocco

Join Louis as he adventures around Morocco. (8 min)

### Discover the Taj Mahal, India

Join Asha Leo as she ventures around India and explores the Taj Mahal. (5 min)

### Hajj: Experience the Journey to Mecca

Walk with Al Jazeera's Basma Atassi in Mecca and see the major landmarks that millions of Muslims visit during the period of Hajj, the annual Islamic Pilgrimage. (8 min)

### Himalayas: A Trek to School

Follow two girls as they travel up to 6 hours a day to school in a remote Himalayan village. (8 min)

### Japan: Where Tradition Meets the Future

Explore Japanese tradition, modernity, and nature. (3 min)

### North Korea

Tour throughout the Northeastern parts of North Korea including Rason, Namyang, Hoeryong, Chongjin, Kyongson, and Chilbo. (19 min)

### The Fight for Falluja

Experience firsthand the battles Iraqi forces endured to retake the important strategic city of Fallujah from ISIS. (11 min)

### Syrians "Have to Survive Having No Rights" in Lebanon

Learn about Syrian refugees who are living in makeshift settlements under harsh conditions, with no legal rights in Lebanon's Bekaa Valley. (3 min)

### Beyond the Map | A Day in a Favela

Step inside this 360 experience of a day in a Favela and meet some truly inspiring people. (3 min)

### Women's March in Chicago

Witness a Women's Rights march in Chicago that was held on January 21, 2017. (1 min)

### March for our Lives

Be immersed in Pioneer Valley's March for Our Lives that was held on March 24, 2018. (1 min)

## Economics

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### Back to Nature- Rainforest

Escape to the lush temperate rainforest of Southern Australia. (4 min)

### Damming the Nile: Episode 1

Journey from the sacred source of the Blue Nile, down waterfalls, and through canyons to see this giant dam being built. Travel on East Africa's first metro train, go for a traditional Ethiopian lunch and hear the government's view on the political crisis the dam project has created. (13 min)

## **Damming the Nile: Episode 2**

Journey to the great farming projects of Sudan, fly to a festival on the banks of the Nile, and explore the ancient Sudanese pyramid. Then launch in a balloon over Luxor to find out how much this river means to the land of the pharaohs. (16 min)

## **Climbing the Redwoods- Fight for the Forests**

Climb 200 feet up 'Grandfather,' the highest Redwood in a Northern California Grove while learning about the Redwood Forest and preservation efforts. (2 min)

## **Pond**

Explore a freshwater pond and the plants that surround it. (1 min)

## **Forest**

View a tranquil forest and the plant life throughout it. (1 min)

## **Waterfall 1**

View a waterfall and the surrounding plant life. (1 min)

## **Waterfall 2**

View a waterfall and the surrounding plant life. (1 min)

## **Waterfall 3**

View a waterfall and the surrounding plant life. (1 min)

## **Geography**

### **A London City Guided Tour**

Take a guided tour to view some of London's most iconic landmarks. (5 min)

### **Amazing Morocco**

Join Louis as he adventures around Morocco. (8 min)

### **Athens, Parthenon, Parthenonas,**

### **Acropolis- VR Walk**

Go on a journey through Athens and see its main attractions from Ancient Greece. (5 min)

### **Discover the Taj Mahal, India**

Join Asha Leo as she ventures around India and explores the Taj Mahal. (5 min)

## **Hajj: Experience the Journey to Mecca**

Walk with Al Jazeera's Basma Atassi in Mecca and see the major landmarks that millions of Muslims visit during the period of Hajj, the annual Islamic Pilgrimage. (8 min)

## **Taj Mahal 360 Degree (VR) Tour in India**

Explore one of the 7 Wonders of the World, the Taj Mahal in India. (2 min)

## **Walking Tours of Japan- Kiyomizudera Temple in Kyoto**

Experience a walking tour of Kiyomizudera Temple in Kyoto, Japan. (17 min)

## **Immerse Yourself in a Tour Around the Forbidden City of China**

With red walls and yellow tiles, the resplendent and magnificent Forbidden City is a treasure of China's ancient palace architecture. (5 min)

## **Leshan Giant Buddha- Leshan, China**

Go on a tour of the Entire Leshan scenic area, including the famous stone Buddha statue. (9 min)

## **Grand Canyon**

Explore the Grand Canyon from different observation decks around the natural wonder. (unlimited) [E](#)

## **Volcano**

Experience an erupting volcano. [IFX](#)

## **Earth Cutaway**

A model of Earth with a section cut away to expose its layers. [IFX](#)

## **Earth Cutaway info**

An Infographic model of Earth with a section cut away to expose its layers. [IFX](#)

## **History**

### **Crawl Inside a 3,500-Year-Old**

### **Egyptian Tomb**

Descend 7 meters under the sandy hills of southern Egypt to become one of the first modern humans to explore a newly discovered ancient Egyptian tomb. (3 min)

## **The Dream of Egypt's Tuthmosis IV**

A tour around the statue of the Sphinx temple and the pyramids of Giza. (4 min)

## **Ancient Egypt- Hall of Pharaohs**

Visit the Hall of Pharaohs and interact and learn from 5 of Egypt's most well-known pharaohs of all time: Ramesses the Great, Nefertiti, King Tut, Alexander the Great, and Cleopatra. (unlimited) [E](#)

## **Ancient Egypt- The Great Pyramids**

Explore the hidden passageways of the Great Pyramid of Giza as you learn about the famous structure and its significance to Ancient Egyptian culture and traditions. (unlimited) [E](#)

## **Dholavira: Archaeological site that contains ruins of the Ancient Indus Valley Civilization**

Dholavira is an archaeological site that contains one of the five largest Harappan sites and most prominent archaeological sites in India belonging to the Indus Valley Civilization. (2 min)

## **Immerse yourself in a tour around the Forbidden City of China**

With red walls and yellow tiles, the resplendent and magnificent Forbidden City is a treasure of China's ancient palace architecture. (5 min)

## **Leshan Giant Buddha- Leshan, China**

Go on a tour of the Entire Leshan scenic area, including the famous stone Buddha statue. (9 min)

## **Athens, Parthenon, Parthenonas, Acropolis- VR Walk**

Go on a journey through Athens and its main attractions from Ancient Greece. (5 min)

## **Amphora Jar- Greek Artifact**

A collection of artifacts from Ancient Greece. [IFX](#)

## **Aphrodite Statue- Greek Artifact**

A collection of artifacts from Ancient Greece. [IFX](#)

## **Discobolus Statue- Greek Artifact**

A collection of artifacts from Ancient Greece. [IFX](#)

## **Hercules and Calliope Statue- Greek Artifact**

A collection of artifacts from Ancient Greece. [IFX](#)

## **Lebes Gamikos Vassel- Greek Artifact**

A collection of artifacts from Ancient Greece. [IFX](#)

## **Pelike Jar- Greek Artifact**

A collection of artifacts from Ancient Greece. [IFX](#)

## **Ancient Greek- Amphitheater Section**

Modular building pieces designed to have students design/recreate Ancient Greek amphitheaters. These can be used to build scenes for reenacting plays, studying Ancient Greek culture, or learning about architecture and design principles. [IFX](#)

## **Ancient Greek- Decorated Wall- Corner**

Modular building pieces designed to have students design/recreate Ancient Greek amphitheaters. These can be used to build scenes for reenacting plays, studying Ancient Greek culture, or learning about architecture and design principles. [IFX](#)

## **Ancient Greek- Decorated Wall- Inside Corner**

Modular building pieces designed to have students design/recreate Ancient Greek amphitheaters. These can be used to build scenes for reenacting plays, studying Ancient Greek culture, or learning about architecture and design principles. [IFX](#)

## **Ancient Greek- Decorated Wall- Top Corner**

Modular building pieces designed to have students design/recreate Ancient Greek amphitheaters. These can be used to build scenes for reenacting plays, studying Ancient Greek culture, or learning about architecture and design principles. [IFX](#)

## **Ancient Greek- Decorated Wall- Top Side**

Modular building pieces designed to have students design/recreate Ancient Greek amphitheaters. These can be used to build scenes for reenacting plays, studying Ancient Greek culture, or learning about architecture and design principles. [IFX](#)

## **Ancient Greek- Doorway**

Modular building pieces designed to have students design/recreate Ancient Greek amphitheaters. These can be used to build scenes for reenacting plays, studying Ancient Greek culture, or learning about architecture and design principles. [IFX](#)

## **Ancient Greek- Doric Column**

Modular building pieces designed to have students design/recreate Ancient Greek amphitheaters. These can be used to build scenes for reenacting plays, studying Ancient Greek culture, or learning about architecture and design principles. [IFX](#)

## **Ancient Greek- Doric Column- Fluted**

Modular building pieces designed to have students design/recreate Ancient Greek amphitheaters. These can be used to build scenes for reenacting plays, studying Ancient Greek culture, or learning about architecture and design principles. [IFX](#)

## **Ancient Greek- Tiled Floor Plane**

Modular building pieces designed to have students design/recreate Ancient Greek amphitheaters. These can be used to build scenes for reenacting plays, studying Ancient Greek culture, or learning about architecture and design principles. [IFX](#)

## **Ancient Greek- Roof- Corner 1**

Modular building pieces designed to have students design/recreate Ancient Greek amphitheaters. These can be used to build scenes for reenacting plays, studying Ancient Greek culture, or learning about architecture and design principles. [IFX](#)

## **Ancient Greek- Roof- Corner 2**

Modular building pieces designed to have students design/recreate Ancient Greek amphitheaters. These can be used to build scenes for reenacting plays, studying Ancient Greek culture, or learning about architecture and design principles. [IFX](#)

## **Ancient Greek- Roof- Pediment**

Modular building pieces designed to have students design/recreate Ancient Greek amphitheaters. These can be used to build scenes for reenacting plays, studying Ancient Greek culture, or learning about architecture and design principles. [IFX](#)

## **Ancient Greek- Roof- Center**

Modular building pieces designed to have students design/recreate Ancient Greek amphitheaters. These can be used to build scenes for reenacting plays, studying Ancient Greek culture, or learning about architecture and design principles. [IFX](#)

## **Ancient Greek- Semicircle Wall**

Modular building pieces designed to have students design/recreate Ancient Greek amphitheaters. These can be used to build scenes for reenacting plays, studying Ancient Greek culture, or learning about architecture and design principles. [IFX](#)

## **Ancient Greek- Steps- Short**

Modular building pieces designed to have students design/recreate Ancient Greek amphitheaters. These can be used to build scenes for reenacting plays, studying Ancient Greek culture, or learning about architecture and design principles. [IFX](#)

## **Ancient Greek- Steps- Side Detail**

Modular building pieces designed to have students design/recreate Ancient Greek amphitheaters. These can be used to build scenes for reenacting plays, studying Ancient Greek culture, or learning about architecture and design principles. [IFX](#)

## **Ancient Greek- Wall- Medium**

Modular building pieces designed to have students design/recreate Ancient Greek amphitheaters. These can be used to build scenes for reenacting plays, studying Ancient Greek culture, or learning about architecture and design principles. [JFX](#)

## **Ancient Greek Wall- Short**

Modular building pieces designed to have students design/recreate Ancient Greek amphitheaters. These can be used to build scenes for reenacting plays, studying Ancient Greek culture, or learning about architecture and design principles. [JFX](#)

## **Ancient Greek Wall- Short Painted**

Modular building pieces designed to have students design/recreate Ancient Greek amphitheaters. These can be used to build scenes for reenacting plays, studying Ancient Greek culture, or learning about architecture and design principles. [JFX](#)

## **Pompeii Amazing Tour in VR- Italy**

Pompeii was an ancient Roman town-city near modern Naples, that was mostly destroyed and buried under 4 to 6 m (13 to 20 ft) of volcanic ash and pumice in the eruption of Mount Vesuvius in 79 AD. (15 min)

## **Carnegie Hall feat. The Philadelphia Orchestra**

The Philadelphia Orchestra performs Grieg's "In the Hall of the Mountain King" from Peer Gynt Suite No. 1 under the direction of Music Director Yannick Nézet-Séguin in Carnegie Hall's Stern Auditorium's Perelman Stage on October 13, 2015. (3 min)

## **Orchestra VR**

Join the Los Angeles Philharmonic as they perform the iconic opening of Beethoven's timeless Fifth Symphony at Walt Disney Concert Hall. (4 min)

## **Bruegel: A Fall With the Rebel Angels**

In partnership with the Royal Museums of Fine Arts of Belgium, the Google Cultural Institute has designed an immersive experience that lets you explore The Fall of the Rebel Angels (1562) like never before. (4 min)

## **Dreams of Dali**

Go inside and beyond Dali's painting Archaeological Reminiscence of Millet's Angelus and explore the world of the surrealist master like never before in this mesmerizing 360° video. (5 min)

## **Weaving Around the World**

Follow the process of weaving that has been developed across cultures for thousands of years. From Venice to Addis Ababa, and the West Bank to the Navajo Nation Reservation. (4 min)

## **The Nutcracker: The Royal Ballet**

Immerse yourself in the extraordinary world of The Royal Ballet as you follow young dancer Julia Roscoe as she prepares for her debut as a snowflake in the Nutcracker. (7 min)

# 7th Grade

## Mathematics

### Basic Operations & Reasoning | Integers: Addition & Subtraction

#### Zero Pairs Worked Example

Explore what makes a zero pair and use integer chips to represent the numbers. (2 min) [E](#) [MM](#)

#### Subtracting with Integer Chips

Use Integer chip diagrams to model and evaluate sums. (5 min) [E](#) [MM](#)

#### Adding Negative Numbers on the Number Line

Learn how to model  $6 + (-2)$  using vertical number lines. (5 min) [E](#) [MM](#)

#### Signs of Sums on a Number Line

Let's build intuition for the sign of sum involving negative and positive numbers. (8 min) [E](#) [MM](#)

#### Subtracting with Integer Chips

Model subtraction expressions using positive and negative integer chips. (5 min) [E](#) [MM](#)

#### Number Equations & Number Lines

Use integer equations to describe diagram. (3 min) [E](#) [MM](#)

#### Graphing Negative Number Addition and Subtraction Expressions

Explore how to graph addition and subtraction expressions involving negative numbers on the number line. (4 min) [E](#) [MM](#)

#### Interpreting Numeric Expressions

##### Example

Choose the correct interpretation of the integer expression  $3 + (-7)$ . (3 min) [E](#) [MM](#)

#### Adding the Opposite with Integer

##### Chips

Use integer chips to explore the conjecture that subtracting a number gives the same result as adding the opposite of the number. (5 min) [E](#) [MM](#)

#### Adding the Opposite with Number

##### Lines

Explore the claim that subtracting a number is the same as adding its opposite using number lines. (5 min) [E](#) [MM](#)

#### Subtracting a Negative = Adding a Positive

Find out why subtracting a negative number is the same as adding the absolute value of that number. (2 min) [E](#) [MM](#)

#### Adding Integers: Find the Missing

##### Value

Use number lines to find missing addends in addition equations with integers. (3 min) [E](#) [MM](#)

#### Subtracting Integers: Find the Missing

##### Value

Use number lines to find missing numbers in subtraction equations with integers. (7 min) [E](#) [MM](#)

#### Substitution with Negative Numbers

Practice substituting positive and negative values for variables. (8 min) [E](#) [MM](#)

#### Ordering Expressions

Let's get some practice thinking about adding and subtracting variables representing positive and negative numbers on the number line. (7 min) [E](#) [MM](#)

### Basic Operations & Reasoning | Interpreting Negative Numbers

#### Absolute Value as Distance Between Numbers

Explore what  $|a-b|$  really means, and we verify that  $|a-b| = |b-a|$  by looking at an example. (5 min) [E](#) [MM](#)

#### Interpreting Absolute Value as Distance

Work through a bunch of examples that stretch our thinking on absolute value. (11 min) [E](#) [MM](#)

#### Interpreting Negative Number Statements

Use examples to represent negative numbers in real world situations. (4 min) [E](#) [MM](#)

#### Negative Number Word Problem: Temperature

Use a number line to solve a word problem that includes a negative number. (4 min) [E](#) [MM](#)

#### Negative Number Word Problem: Alaska

Figure out the temperature in Fairbanks, Alaska by adding and subtracting negative numbers. (4 min) [E](#) [MM](#)

#### Associative and Commutative

##### Properties of Addition with Negatives

Explore how the commutative and associative properties apply to addition, but not to subtraction. (4 min) [E](#) [MM](#)

#### Equivalent Expressions with Negative Numbers

Learn that we can commute and associate terms if we keep the signs with the terms. (5 min) [E](#) [MM](#)

## Basic Operations & Reasoning | Negative Numbers: Multiplication & Division

### Why a Negative Times a Negative is a Positive

Use the distributive property to understand the products of negative numbers.

(6 min) [E](#) [MM](#)

### Why a Negative Times a Negative Makes Sense

Use the repeated addition model of multiplication to give an understanding of multiplying negative numbers.

(5 min) [E](#) [MM](#)

### Multiplying Positive & Negative Numbers

Learn some rules of thumb for multiplying positive and negative numbers.

(6 min) [E](#) [MM](#)

### Dividing Positive & Negative Numbers

Learn some rules of thumb for multiplying positive and negative numbers.

(5 min) [E](#) [MM](#)

### Interpreting Multiplication & Division of Negative Numbers

Let's think about the meaning of negative numbers in different situations.

(4 min) [E](#) [MM](#)

### Rational Number Word Problem:

#### Cosmetics

Convert minutes into hours and solve this word problem involving fractions.

(2 min) [E](#) [MM](#)

### Exponents with Negative Bases

Learn what we know about negative numbers to determine how negative bases with exponents are affected and what patterns develop. (4 min) [E](#) [MM](#)

### 1 and -1 to Different Powers

Explore different exponents affect the value of a number: when raised to the power of zero, any number equals one; when raised to an even power, negative numbers yield positive results; and when raised to an odd power, negative numbers yield negative results. (6 min) [E](#) [MM](#)

### Equivalent Expressions with Negative Numbers (Multiplication & Division)

Figure out whether some expressions are equivalent. (8 min) [E](#) [MM](#)

## Basic Operations & Reasoning | Order of Operations

### Intro to Order of Operations

Show the steps and clarifies the purpose of order of operations: to have ONE way to interpret a mathematical statement.

(10 min) [E](#) [MM](#)

### Worked Example: Order of Operations (PEMDAS)

Simplify and accurately solve mathematical expressions, ensuring a correct final answer.

(5 min) [E](#) [MM](#)

### Order of Operations Example

Simplify this tricky expression using the order of operations. Expression includes negative numbers and exponents.

(5 min) [E](#) [MM](#)

## Geometry

### Rhombus Tile

Simple geometry manipulable that can be used to teach about shapes and angles, or build tessellations. [IFX](#)

### Pentagon Tile

Simple geometry manipulable that can be used to teach about shapes and angles, or build tessellations. [IFX](#)

### Octagon Tile

Simple geometry manipulable that can be used to teach about shapes and angles, or build tessellations. [IFX](#)

### Obtuse Isosceles Triangle Tile

Simple geometry manipulable that can be used to teach about shapes and angles, or build tessellations. [IFX](#)

### Narrow Rhombus Tile

Simple geometry manipulable that can be used to teach about shapes and angles, or build tessellations. [IFX](#)

### Hexagon Tile

Simple geometry manipulable that can be used to teach about shapes and angles, or build tessellations. [IFX](#)

### Equilateral Triangle Tile

Simple geometry manipulable that can be used to teach about shapes and angles, or build tessellations. [IFX](#)

### Acute Isosceles Triangle Tile

Simple geometry manipulable that can be used to teach about shapes and angles or build tessellations. [IFX](#)

### Wide Rhombus Tile

Simple geometry manipulable that can be used to teach about shapes and angles, or build tessellations. [IFX](#)

### Trapezoid Tile

Simple geometry manipulable that can be used to teach about shapes and angles, or build tessellations. [IFX](#)

### Square Tile

Simple geometry manipulable that can be used to teach about shapes and angles, or build tessellations. [IFX](#)

### Protractor

At-scale measuring tool for measuring angles. Designed to be used with geometric tiles, or as a general teaching/training tool. [IFX](#)

## Geometry | Scale Copies

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### Exploring Scale Copies

Learn to use virtual manipulatives to identify figures that scale proportionally. (2 min) [E](#) [MM](#)

### Identifying Corresponding Parts of Scaled Copies

Learn to identify corresponding parts of scaled copies. (2 min) [E](#) [MM](#)

### Corresponding Points and Sides of Scaled Shapes

Identify corresponding sides and corresponding points in scale copies of figures. (3 min) [E](#) [MM](#)

### Identifying Scale Copies

Look at side measures on figures to determine if they are scale copies. (4 min) [E](#) [MM](#)

### Identifying Scale Factor in Drawings

Identify the scale factor used to create a scale copy. (2 min) [E](#) [MM](#)

### Interpreting Scale Factors in Drawings

Interpret a scale factor to determine if a scale copy will be larger or smaller than the original figure. (2 min) [E](#) [MM](#)

### Identifying Values in Scale Copies

Identify missing side lengths in scale drawings. (4 min) [E](#) [MM](#)

### Scale Drawings

Find the missing side length in a scale drawing when given either a set of corresponding side lengths or one side length and the scale factor. (3 min) [E](#) [MM](#)

### Scale Drawing: Centimeters to

### Kilometers

Use ratios to figure out how far apart two cities should be on a map. (2 min) [E](#) [MM](#)

### Interpreting a Scale Drawing

Understand how a scale drawing is converted into real numbers using the scale factor. (5 min) [E](#) [MM](#)

### Creating Scale Drawings

Use real world contexts to create scale drawings on a grid. (2 min) [E](#) [MM](#)

### Making a Scale Drawing

Use your knowledge about scale factor, length, and area to assist. (3 min) [E](#) [MM](#)

### Scale Factors and Area

Explore how scale factors affect the area of a scaled figure. (6 min) [E](#) [MM](#)

### Solving a Scale Drawing Word Problem

Solve a word problem by using a scale drawing and finding the scale factor. (6 min) [E](#) [MM](#)

## Geometry | Area & Circumference of Circles

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### Radius, Diameter, Circumference & $\pi$

Learn how the number Pi allows us to relate the radius, diameter, and circumference of a circle. (11 min) [E](#) [MM](#)

### Labeling Parts of a Circle

Explore the different parts of a circle - radius, diameter, center, and circumference. (2 min) [E](#) [MM](#)

### Radius & Diameter from Circumference

Find the radius and diameter of a circle given the circumference. (3 min) [E](#) [MM](#)

### Relating Circumference and Area

Use formulas and a specific example to see how area and circumference relate. (5 min) [E](#) [MM](#)

### Area of a Circle

Learn how to use this formula, ( $A = \pi r^2$ ) to find the area of a circle when given the diameter. (4 min) [E](#) [MM](#)

### Partial Circle Area and Arc Length

Find the area of a semicircle and the arc length of a partial circle. (3 min) [E](#) [MM](#)

### Finding Circumference of a Circle when Given the Area

Learn how to find the circumference, the distance around a circle, when given the area. (2 min) [E](#) [MM](#)

### Area of a Shaded Region

Find the area of a shaded region where you first determine the area of a square and then the area of a circle. (2 min) [E](#) [MM](#)

### Impact of Increasing the Radius

Learn how the circumference and area change if the radius of a circle changes. (3 min) [E](#) [MM](#)

## Geometry | Vertical, Complementary, & Supplementary Angles

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### Angles: Introduction

Learn about angles and the parts of an angle, like the vertex. (7 min) [E](#) [MM](#)

### Complementary & Supplementary Angles

Learn about complementary and supplementary angles, as well as the definitions of adjacent and straight angles. (8 min) [E](#) [MM](#)

### Vertical Angles

Solve problems involving the intersection of two lines. (7 min) [E](#) [MM](#)

### Vertical Angles are Congruent Proof

Explore how to prove that vertical angles are equal. (5 min) [E](#) [MM](#)

### Find Measure of Vertical Angles

Find the measure of the remaining angles given two intersecting lines and the measure of vertical angles. (3 min) [E](#) [MM](#)

### Find Measure of Angles Word Problem

Solve this word problem to find the measure of angles. (4 min) [E](#) [MM](#)

### Equation Practice with

### Complementary Angles

Given the algebraic expressions that represent a pair of complementary angles, learn how to form and solve an equation to find an unknown angle. (2 min) [E](#) [MM](#)

### Equation Practice with Supplementary Angles

Given the algebraic expressions that represent a pair of supplementary angles, form and solve an equation. (2 min) [E](#) [MM](#)

### Equation Practice with Vertical Angles

Given the algebraic expressions that represent a pair of supplementary angles, form and solve an equation. (2 min) [E](#) [MM](#)

## Geometry | Constructing Triangles

### Construct a Right Isosceles Triangle

Learn how to build a triangle that is both a right triangle and an isosceles triangle. (2 min) [E](#) [MM](#)

### Construct a Triangle with Constraints

Learn to construct a triangle given the constraints. (4 min) [E](#) [MM](#)

### Triangle Inequality Theorem

Explore the intuition behind the triangle inequality theorem. (6 min) [E](#) [MM](#)

## Geometry | Volumes

### Slicing a Rectangular Pyramid

Learn what happens when you slice vertically into a rectangular pyramid. (3 min) [E](#) [MM](#)

### Volume Word Problem: Gold Ring

Find the incremental volume of a ring in cubic inches. (3 min) [E](#) [MM](#)

### Volume of Triangular Prism & Cube

Using the formulas for the volume of triangular prism and cube to solve some solid geometry problems. (4 min) [E](#) [MM](#)

### Volume of Rectangles Inside Rectangles

Learn to solve for the volume of rectangles inside rectangles. (5 min) [E](#) [MM](#)

### Cylinder Volume & Surface Area

Learn how to find the volume of a cylinder using these formulas;  $c \pi r^2 h$ , and its surface area is  $2\pi r h + 2\pi r^2$ . (8 min) [E](#) [MM](#)

### Volume of a Sphere

Use the formula for the volume of a sphere is  $V = \frac{4}{3} \pi r^3$ , where  $V$  = volume and  $r$  = radius. (3 min) [E](#) [MM](#)

### Volume of a Cone

Explore the formula for the volume of a cone is  $V = \frac{1}{3} h \pi r^2$ . (6 min) [E](#) [MM](#)

## Algebra | Proportional Relationships

### Introduction to Proportional Relationships

Explore proportional relationships are relationships between two variables where their ratios are equivalent. (5 min) [E](#) [MM](#)

### Identifying Constant of Proportionality Graphically

Identify the constant of proportionality from a line graphed on a coordinate plane. (4 min) [E](#) [MM](#)

### Constant of Proportionality from Graph

Learn how to find constant of proportionality by looking at the graph of a line. (2 min) [E](#) [MM](#)

### Identifying the Constant of Proportionality from Equation

Understanding what a constant of proportionality is and how to identify it in an equation. (4 min) [E](#) [MM](#)

### Constant of Proportionality from Equation

Identify the constant of proportionality from equations. (2 min) [E](#) [MM](#)

### Constant of Proportionality from Tables

Identifying proportionality constants by looking at tables of values. (3 min) [E](#) [MM](#)

### Constant of Proportionality from Table (With Equations)

Identify the constant of proportionality from table. (2 min) [E](#) [MM](#)

### Comparing Constants of Proportionality

Explore an example comparing constants of proportionality. (4 min) [E](#) [MM](#)

### Comparing Proportionality Constants

Compare constants of proportionality in various forms, such as graphs, equations, contexts, diagrams, and tables. (3 min) [E](#) [MM](#)

### Interpret Proportionality Constants

Interpret what the constant of proportionality means in a context. (3 min) [E](#) [MM](#)

### Intro to Proportional Relationships

Explore if a relationship is proportional, you should look at the ratios between the two variables. (4 min) [E](#) [MM](#)

### Proportional Relationships: Movie Tickets

Use this example to determine if the price you pay is proportional to the number of tickets that are bought. (2 min) [E](#) [MM](#)

### Proportional Relationships: Bananas

Explore a proportionality problem about eating bananas. (3 min) [E](#) [MM](#)

### Proportional Relationships: Spaghetti

Explore a table of ratios and test them for equivalence and determine whether the relationship is proportional. (1 min) [E](#) [MM](#)

### Proportional Relationships

Determine which ratios are proportionate to a ratio provided in a context. (4 min) [E](#) [MM](#)

### Is Side Length & Area Proportional?

Solve the question by drawing a square and thinking about the relationship between side length and area. (4 min) [E](#) [MM](#)

### Is Side Length & Perimeter Proportional?

Solve by drawing a square and thinking about the relationship between side length and perimeter. (3 min) [E](#) [MM](#)

### Identifying Proportional Relationships from Graphs

Identify proportional relationships from graphs. (3 min) [E](#) [MM](#)

### Proportional Relationships: Graphs

Learn how to tell proportional relationships by drawing graphs. (7 min) [E](#) [MM](#)

### Interpreting Graphs of Proportional Relationships

Interpret graphs of proportional relationships. (3 min) [E](#) [MM](#)

### Worked Example: Solving Proportions

Learn the reasoning behind solving proportions. (7 min) [E](#) [MM](#)

### Writing Proportions Example

Explore examples of writing two ratios and setting them equal to solve proportion word problems. (6 min) [E](#) [MM](#)

### Proportion Word Problem: Cookies

Explore how to solve this word problem about proportion involving cookies. (6 min) [E](#) [MM](#)

### Proportion Word Problem: Hot Dogs

Solve this proportion word problem involving hot dogs. (5 min) [E](#) [MM](#)

### Equations for Proportional Relationships

Learn how to write a proportional equation  $y=kx$  where  $k$  is the so-called "constant of proportionality". (5 min) [E](#) [MM](#)

### Writing Proportional Equations from Tables

Write an equation to describe the relationship between the number of scoops in an ice cream cone and the price.  $C$  (3 min) [E](#) [MM](#)

### Writing Proportional Equations

Figure out the constant of proportionality when dealing with a constant rate. (2 min) [E](#) [MM](#)

## Algebra | Expressions

### Intro to Combining Like Terms

Explore adding like terms is a fundamental concept in algebra. (4 min) [E](#) [MM](#)

### Combining Like Terms with Negative Coefficients & Distribution

Explore how to layer the distributive property on top of using order of operations and combining like terms. (4 min) [E](#) [MM](#)

### Combining Like Terms with Negative Coefficients

Solve this example of combining like terms in an expression. (5 min) [E](#) [MM](#)

### Combining Like Terms with Rational Coefficients

Learn how to rewrite algebraic expressions by combining like terms that have decimals and fraction coefficients. (4 min) [E](#) [MM](#)

### The Distributive Property with Variables

Learn how to apply the distributive property to factor out the greatest common factor from an algebraic expression like  $2+4x$ . (6 min) [E](#) [MM](#)

### Factoring with the Distributive Property

Learn how to factor the expression  $4x+18$  into the expression  $2(2x+9)$ . (4 min) [E](#) [MM](#)

### Equivalent Expressions: Negative Numbers & Distribution

Learn how to identify equivalent expressions using your knowledge of the distributive property and negative numbers. (4 min) [E](#) [MM](#)

### Interpreting Linear Expressions:

#### Diamonds

Match the expression to their meanings regarding linear expressions. (2 min) [E](#) [MM](#)

### Interpreting Linear Expressions:

#### Flowers

Let's practice matching expressions to their meaning in this example of interpreting linear expressions. (2 min) [E](#) [MM](#)

### Writing Expressions Word Problems

Learn how to write expressions with variables to describe situations described in word problems. (5 min) [E](#) [MM](#)

## Algebra | Equations

### Same Thing to Both Sides of Equations

Solve for the mystery mass's weight by using a balance scale. (2 min) [E](#) [MM](#)

### Intro to Two-Step Equations

Solve a two-step equation using the concept of equality: what we do to one side of the equation must be done to the other. (5 min) [E](#) [MM](#)

### Two-Step Equations Intuition

Demonstrate how we solve an equation expressed such:  $ax + b = c$ . (9 min) [E](#) [MM](#)

### Worked Example: Two-Step Equations

Solve the equation  $-16 = x/4 + 2$ . (3 min)

### Two-Step Equations with Decimals and Fractions

Learn how to solve equations that involve decimals and fractions. (8 min) [E](#) [MM](#)

### Two-Step Equations with Decimals and Fractions

Let's practice some two step equations, some of which require merging terms and using the distributive property. (14 min) [E](#) [MM](#)

### Find the Mistake: Two-Step Equations

Explore how to check our own work (and other people's work) for correctness. (4 min) [E](#) [MM](#)

### Equation Word Problem: Super Yoga (Part 1)

Using information from the super yoga word problem, explore all the possible combinations and create equations which express the possibilities. (7 min) [E](#) [MM](#)

## Equation Word Problem: Super Yoga (Part 2)

Using information from the super yoga word problem, explore all the possible combinations and create equations which express the possibilities. (8 min) [E](#) [MM](#)

## Two-Step Equation Word Problem: Computers

Learn how to construct and solve a basic linear equation to solve a word problem. (5 min) [E](#) [MM](#)

## Two-Step Equation Word Problem: Garden

Solve this word problem and find the dimensions of a garden given only the perimeter. (2 min) [E](#) [MM](#)

## Two-Step Equation Word Problem: Oranges

Learn how to solve a word problem by writing an equation to model the situation. (6 min) [E](#) [MM](#)

## Algebra | Inequalities

### Testing Solutions to Inequalities

Explore how inequalities are like puzzles where you compare two things. (5 min) [E](#) [MM](#)

### One-Step Inequalities Examples

Explore how linear inequalities begin with multiplying and dividing by negative numbers. (10 min) [E](#) [MM](#)

### One-Step Inequalities: $-5c \leq 15$

Solve the inequality, we'll graph the solution. (3 min) [E](#) [MM](#)

### One-Step Inequality Word Problem

Explore how inequalities are used in real life problems. (2 min) [E](#) [MM](#)

### Two-Step Inequalities

Learn how to solve a two-step inequalities problem. (4 min) [E](#) [MM](#)

## Two-Step Inequality Word Problem: Apples

Solve this word problem about apples involving two-step inequality. (6 min) [E](#) [MM](#)

## Two-Step Inequality Word Problem: R&B

Interpret the information and then construct a linear inequality to solve it. (2 min) [E](#) [MM](#)

## Fractions, Decimals, Percents, & Ratios | Rates & Percentages

### Rates with Fractions

Solve an example problem with rates with fractions. (5 min) [E](#) [MM](#)

### Rewriting Decimals as Fractions: 2.75

Solve an example of how we convert a decimal to a simplified fraction. (3 min) [E](#) [MM](#)

### Worked Example: Converting a Fraction (7/8) to a Decimal

Learn how to write the fraction, 7/8 as a decimal. (2 min) [E](#) [MM](#)

### Fraction to Decimal: 11/25

Write 11/25 as a decimal (2min) [E](#) [MM](#)

### Fraction to Decimal with Rounding

Learn to write 16/21 as a rounded decimal. (3 min) [E](#) [MM](#)

### Comparing Rational Numbers

Explore how to compare Rational Numbers. (7 min) [E](#) [MM](#)

### Solving Percent Problems

Solve this percent problem using algebra. (6 min) [E](#) [MM](#)

### Percent Word Problem: Magic Club

Solve percent word problems including percent comparisons and percent of change. (8 min) [E](#) [MM](#)

### Percent Word Problems: Tax and Discount

Solve percent word problems involving tax, tip, and discounts. (6 min) [E](#) [MM](#)

## Percent Word Problem: Guavas

Solve this percent word problem to find the full price when you know the discount price. (6 min) [E](#) [MM](#)

## Fractions, Decimals, Percents, & Ratios | Rational Numbers: Addition & Subtraction

### Adding Fractions with Different Signs

Use a number line to add fractions with different signs. (4 min) [E](#) [MM](#)

### Adding and Subtracting Fractions with Negatives

Use the properties of addition to strategically add and subtract fractions with negatives and unlike denominators. (4 min) [E](#) [MM](#)

### Adding & Subtracting Rational Numbers: $79\% - 79.1 - 58 \frac{1}{10}$

Evaluate how to add/subtract rational numbers. (5 min) [E](#) [MM](#)

### Adding & Subtracting Rational Numbers: $0.79 - 4/3 - 1/2 + 150\%$

Evaluate how to add/subtract rational numbers. (4 min) [E](#) [MM](#)

## Fractions, Decimals, Percents, & Ratios | Rational Numbers: Multiplication & Division

### Rational Number Word Problem: School Report

Visualize this word problem then use subtraction and multiplication of decimals and fractions to get at the answer. (4 min) [E](#) [MM](#)

## Rational Number Word Problem: Ice

Determine the volume of frozen water and express the answer as a fraction.

(3 min) [E](#) [MM](#)

## Rational Number Word Problem:

### Computers

Compare the weight of two objects using a ratio of integers. (3 min) [E](#) [MM](#)

## Rational Number Word Problem: Stock

Utilize proportions and fractions to determine shareholders profit in this word problem. (4 min) [E](#) [MM](#)

## Rational Number Word Problem:

### Checking Account

Use your knowledge of decimals and adding negative and positive numbers to bring your account back into the black.

(3 min) [E](#) [MM](#)

## Negative Signs in Fractions

Solve and find equivalent expressions to -g/h. (5 min) [E](#) [MM](#)

## Expressions with Rational Numbers

Learn to compare expressions with positive and negative fractions. (6 min) [E](#) [MM](#)

## Multiplying Positive and Negative

### Fractions

Explore examples of multiplying and dividing fractions with negative numbers.

(4 min) [E](#) [MM](#)

## Dividing Negative Fractions

Explore how dividing by a fraction is the same as multiplying by its reciprocal.

(4 min) [E](#) [MM](#)

## Dividing Mixed Numbers

Explore how to change mixed numbers into improper fractions, divide, and then change the answer back to a mixed number.

(3 min) [E](#) [MM](#)

## Statistics & Probability | Intro to Statistics & Probability

### Intro to Theoretical Probability

Explore probability through the example of flipping a quarter and rolling a die.

(8 min) [E](#) [MM](#)

### Simple Probability: Yellow Marble

In order to find the probability of picking a yellow marble from a bag, we must first determine the number of possible outcomes, and then how many of them meet our constraints. (3 min) [E](#) [MM](#)

### Simple Probability: Non-Blue Marble

Explore this example we are figuring out the probability of randomly picking a non-blue marble from a bag. (10 min) [E](#) [MM](#)

### Experimental Probability

Explore how to make reasonable estimates of the likelihood of future events.

(7 min) [E](#) [MM](#)

### Intuitive Sense of Probabilities

Explore what probabilities really mean.

(9 min) [E](#) [MM](#)

### Theoretical and Experimental Probabilities

Compare expected probabilities to what really happens when we run experiments.

(7 min) [E](#) [MM](#)

### Making Predictions with Probability

Explore how theoretical probability helps to predict the number of times a spinner will land on an elephant. (5 min) [E](#) [MM](#)

### Probability Models Example: Frozen

#### Yogurt

Model the probability of a frozen yogurt line having 0, 1, or 2 people in it.

(8 min) [E](#) [MM](#)

### Sample Spaces for Compound Events

Explore the notion of a "sample space". See a sample space represented as a tree diagram, table, and list. (9 min) [E](#) [MM](#)

## Die Rolling Probability

Explore the probability of rolling doubles on a pair of dice and create a grid of all possible outcomes. (5 min) [E](#) [MM](#)

### Probability of a Compound Event

Learn how to use sample space diagrams to find probabilities. (5 min) [E](#) [MM](#)

### Counting Outcomes: Flower Pots

Find the number of ways you can put four types of flowers into three types of pots.

(2 min) [E](#) [MM](#)

### Count Outcomes Using Tree Diagram

Explore how tree diagrams can be used to find the number of possible outcomes and calculate the probability of possible outcomes. (4 min) [E](#) [MM](#)

### Reasonable Samples

Explore how to make a valid conclusion, you'll need a representative, not skewed, sample. (4 min) [E](#) [MM](#)

### Comparing Distributions with Dot Plots (Example Problem)

Examine two distributions in dot plots to draw conclusions about the times of Olympic swimmers. (4 min) [E](#) [MM](#)

# Science

## Earth & Space Science

### Cloud Climb

Explore how clouds, atmosphere, and weather all come together to create different aspects of the Earth's sky. (unlimited) [E](#)

### Moon Phases

Interactive display of the phases of Earth's Moon. [IFX](#)

### Antarctica: Unexpected Snow

See how a Penguin and Seal colony as a winter storm moves in. (2 min)

## Category 3 Hurricane Landfall

### Simulation

Experience a category 3 hurricane through a simulation with guided popups. (1 min)

### Close-Range Tornado

Get up close and personal with a tornado near Wray, CO from May 7<sup>th</sup>, 2016. (8 min)

### Boston Snowstorm from Bunker Hill Monument

Watch a major winter storm move through the city of Boston in this time-lapse from the top of Bunker Hill Monument. (3 min)

### Inside Hurricane Maria

Watch Hurricane Maria change from a category 1 to a category 5 in about 24 hours. (5 min)

### Ace Center @ Hermitage Greenhouse

Join students from Hermitage High School as they explain how a greenhouse works and the different features within it. (3 min)

### After the Floods: Rebuilding Ellicott City

Take an immersive journey through the flooding, aftermath, and reconstruction of Ellicott City, Maryland to give a new perspective on the damage done by flooding. (6 min)

### Back to Nature: Rainforest

Escape to the lush temperate rainforest of Southern Australia. (4 min)

### Chennai Floods Aftermath

Take an immersive journey through the impact, rescue, and reason for the floods that occurred in Chennai, India, in December 2015. (6 min)

### Damming the Nile: Episode 1

Journey from the sacred source of the Blue Nile, down waterfalls, and through canyons to see this giant dam being built. Travel on East Africa's first metro train, go for a traditional Ethiopian lunch, and hear the government's view on the political crisis the dam project has created. (13 min)

### Damming the Nile: Episode 2

Journey to the great farming projects of Sudan, fly to a festival on the banks of the Nile and explore the ancient Sudanese pyramid. Then launch in a balloon over Luxor to find out how much this river means to the land of the pharaohs. (16 min)

### Life in Haiti: After a Devastating Natural Disaster

Join filmmaker Dylan Roberts on a journey to the Haitian city of Jérémie, and the small village of Manish, to witness the aftermath of a colossal storm. (5 min)

### Climbing the Redwoods: Fight for the Forests

Climb 200 feet up 'Grandfather,' the highest Redwood in a Northern California Grove while learning about the Redwood Forest and preservation efforts. (2 min)

### Earthquake VR Experience

Be exposed to a virtual earthquake that provides a life-like training experience, without an actual earthquake. (2 min)

### Expedition to the Heart of Active Volcano

Join a group of climbers as they embark on a scientific exploration into an active volcano. (5 min)

### Sun

Rotating model of the Sun. [IFX](#)

### Solar System

Animated model of the solar system. Rotation and revolution speeds are scaled accurately. [IFX](#)

### Solar Eclipse

Watch a total solar eclipse that took place in Casper, Wyoming on August 21<sup>st</sup>, 2017. (5 min)

## Life Science

### Cell Classroom

Interactive classroom located inside an animal cell. Infographics help students learn about the parts of a cell, alongside animations of the protein synthesis process. (unlimited) [E](#)

### Plant Cell

Interactive classroom located inside a plant cell. Explore the different organelles and components of the cell and explore the photosynthesis process. (unlimited) [E](#)

### 360 Video of a Heart Valve Operation the Heart Center Leipzig

Experience exclusive insights into surgery in full 360 degree video. Head of Cardiac Surgery Prof. Michael Borger explains what happens during a mitral valve Operation. (4 min)

### Human Digestive System in VR

Take an amazing 360 VR journey through the body and find out what happens to your food as it travels through the digestive system. (5 min)

### What Happens Inside Your Body?

The human body is an amazing and unique machine that triggers thousands of processes every second, learn about them on this adventure. (5 min)

### Fox's Point of View at Night- Planet Earth II: Cities

Through the eyes of an urban fox, can you find food, spot the hazards, and track down a mate in a bustling city at night? (4 min)

### Glow Worm Caves of New Zealand

Deep below ground, strange carnivorous worms' glow and twinkle like the night sky to attract their prey. (2 min)

### Great Hammerhead Shark Encounter

Dive into this 360° video and go face to face with a curious great hammerhead shark. (2 min)

### Giraffe 1

See a giraffe interacting with its natural habitat. (1 min)

**Giraffe 2**

See a giraffe interacting with its natural habitat. (1 min)

**Anatomy Lab**

Highly interactive anatomy classroom that allows Students assemble the human body piece by piece with over 90 separate body parts to learn about. (unlimited) [E](#)

**Physical Science****Periodic Table**

Interactive classroom that teaches students about the periodic table of elements, their chemical and physical properties, and their atomic structures. [IFX](#)

**Covalent Bonding- H2**

Simple visualization of the covalent bond between two hydrogen atoms. [IFX](#)

**Covalent Bonding – Glucose****Hybridized**

Visualization of a covalently bonded glucose molecule with hybridized orbitals. [IFX](#)

**Covalent Bonding – O2 Hybridized**

Visualization of two covalently bonded oxygen atoms with hybridized orbitals. [IFX](#)

**Covalent Bonding – H2O Hybridized**

Visualization of a covalently bonded water molecule with hybridized orbitals. [IFX](#)

**Ionic Bonding – NaCl**

Animated visualization of the ionic bond between a sodium atom and a chlorine atom. [IFX](#)

**Ionic Bonding – NaOH**

Animated visualization of the ionic bond between a sodium atom and a hydroxide anion. [IFX](#)

**Ionic Bonding- NaF**

Animated visualization of the ionic bond between a sodium atom and a fluorine atom. [IFX](#)

**Ionic Bonding – MgSO4**

Animated visualization of the ionic bond between a magnesium atom and a sulfate anion. [IFX](#)

**Gas in Tank**

Three colored liquids of different densities that flow out of pipes and stack on top of each other in a tank. [IFX](#)

**Liquid Particles in Tank**

Liquid particles that move randomly inside a tank. [IFX](#)

**Solid Particle Arrangement**

Rotating cube of crystalline atomic structure. [IFX](#)

**Elementary Particle Swarm**

Protons, Neutrons, and Electrons that move around randomly. [IFX](#)

**Hydrogen and Helium Formation**

Protons, neutrons, and electrons that move around randomly and then collide to form hydrogen and helium atoms. [IFX](#)

**Microscope**

Highly interactive science lab microscope with 4 different, insertable slides that they can view at 3 different zoom levels. (unlimited) [IFX](#)

**Cloud Climb**

Explore how clouds, the atmosphere and weather all come together to create different aspects of the Earth's sky. (unlimited) [E](#)

**Social Studies****Early World History****Ancient Egypt: Hall of Pharaohs**

Visit the Hall of Pharaohs and interact and learn from 5 of Egypt's most well-known pharaohs of all time: Ramesses the Great, Nefertiti, King Tut, Alexander the Great, and Cleopatra. (unlimited) [E](#)

**Ancient Egypt: The Great Pyramids**

Explore the hidden passageways of the Great Pyramid of Giza as you learn about the famous structure and its significance to Ancient Egyptian culture and tradition. (unlimited) [E](#)

**Crawl Inside a 3,500-Year-Old****Egyptian Tomb**

Descend 7 meters under the sandy hills of southern Egypt to become one of the first modern humans to explore a newly discovered ancient Egyptian tomb. (3 min)

**The Dream of Egypt's****Tutmosis IV**

A tour around the statue of the Sphinx temple and the pyramids of Giza. (4 min)

**Immerse Yourself in a Tour Around the Forbidden City of China**

With red walls and yellow tiles, the resplendent and magnificent Forbidden City is a treasure of China's ancient palace architecture. (5 min)

**Leshan Giant Buddha- Leshan, China**

Go on a tour of the Entire Leshan scenic area, including the famous stone Buddha statue. (9 min)

**Dholavira: Archaeological Site That Contains Ruins of the Ancient Indus Valley Civilization**

Dholavira is an archaeological site that contains one of the five largest Harappan sites and most prominent archaeological sites in India belonging to the Indus Valley Civilization. (2 min)

**Athens, Parthenon, Parthenonas, Acropolis: VR Walk**

Go on a journey through Athens and its main attractions from Ancient Greece. (5 min)

**Pompeii Amazing Tour in VR- Italy**

Explore the site of Pompeii, an ancient Roman town-city near modern Naples, that was mostly destroyed and buried under 4 to 6 m (13 to 20 ft) of volcanic ash and pumice in the eruption of Mount Vesuvius in 79 AD. (15 min)

## **Witness the Mysterious World of West African Voodoo**

Journey to Togo, a tiny nation in West Africa, that contains the region's largest Voodoo market- 'Marche des Fetches' and learn about the rich history that surrounds this religion. (5 min)

### **World Religions**

See the different major religions of the world and how they are dispersed across the world. (9 min)

### **Bruegel: The Fall of the Rebel Angels**

In partnership with the Royal Museum of Fine Arts of Belgium, the Google Cultural Institute has designed an immersive experience that lets you explore The Fall of the Rebel Angels (1562) like never before. (4 min)

## **History**

### **Leshan Giant Buddha- Leshan, China**

Go on a tour of the Entire Leshan scenic area, including the famous stone Buddha statue. (9 min)

### **Immerse Yourself in a Tour Around the Forbidden City of China**

With red walls and yellow tiles, the resplendent and magnificent Forbidden City is a treasure of China's ancient palace architecture. (5 min)

### **Japan - Where Tradition Meets the Future**

Explore Japanese tradition, modernity, and nature as you venture around Japan. (3 min)

### **Let's Go Rickshaw Ride Around**

#### **Japan 1**

Learn about traditional Japanese cuisine and take in sites. (3 min)

### **Let's Go Rickshaw Ride Around**

#### **Japan 2**

See the bridge, Togetsu-kyo which means "The moon crossing bridge," over the Katsura River which flows through the center of Arashiyama. (2 min)

## **Let's Go Rickshaw Ride Around Japan 3**

The path leading to Okochi Sanso garden from Nonomiya Shrine is about 400m long. (2 min)

### **Walking Tours of Japan- Kiyomizudera Temple in Kyoto**

Experiences a walking tour of Kiyomizudera Temple in Kyoto, Japan. (17 min)

## **Witness the Mysterious World of West African Voodoo**

Journey to Togo, a tiny nation in West Africa, that contains the region's largest Voodoo market- 'Marche des Fetches' and learn about the rich history that surrounds this religion. (5 min)

### **World Religions**

See the different major religions of the world and how they are dispersed across the world. (9 min)

### **Haji- Experience the Journey to Mecca**

Walk with Al Jazeera's Basma Atassi in Mecca and see the major landmarks that millions of Muslims visit during the period of Hajj, the annual Islamic pilgrimage. (8 min)

### **Bruegel: a fall with the Rebel Angels**

In partnership with the Royal museums of Fine Arts of Belgium, the Google Cultural Institute has designed an immersive experience which lets you explore The Fall of the Rebel Angels (1562) like never before. (4 min)

### **Historic Jamestown**

Interactive experience where students will experience the reason for the English Colonization and the significance of the location regarding resources, defensibility, and economic development. (unlimited) [E](#)

### **Machu Picchu Tour- Panorama Field Trip**

A panoramic photo sphere with 5 images of Machu Picchu that the user can toggle through as a slideshow. (unlimited)

## **US History**

### **Civil War: A Letter from the Trenches**

Get transported back to the 1860s to "experience" what life was like for a young cadet in the Confederate army, trekking through the mud and dodging enemy fire as you journey through the trenches. (5 min)

### **Historic Jamestown**

Interactive experience where students will experience the reason for the English Colonization and the significance of the location regarding resources, defensibility, and economic development. (unlimited) [E](#)

### **Independence Hall**

Join George Washington, John Adams, Thomas Jefferson, Benjamin Franklin, and John Hancock as they come to life to tell you their stories about the founding of the United States. (unlimited) [E](#)

### **Battle Road: The American Revolution**

Be surrounded by scores of professional reenactors, organizers, onlookers, and photographers as they gather at Lexington, Concord, and Minute Man National Historical Park to honor the memory of this critical turning point in American history. (5 min)

### **Liberty Bell**

Realistic recreation of the Liberty Bell in Philadelphia, PA. Touch the bell to hear it ring, just as it would have sounded before it cracked. [IFX](#)

# 8th Grade

## Mathematics

### Basic Operations & Reasoning | Repeating Decimals

#### Converting a Fraction to a Repeating Decimal

Learn to convert a fraction like  $\frac{19}{27}$  into a decimal, you should divide 27 into 19, and use the remainder to figure out the decimal. (4 min) [E](#) [MM](#)

#### Converting Repeating Decimals to Fractions (Part 1)

Learn the process of converting a repeating decimal to a fraction can be broken down into a few easy steps. (4 min) [E](#) [MM](#)

#### Converting Repeating Decimals to Fractions (Part 2)

Learn how repeated decimals can be converted into fractions by shifting the decimal to the right and subtracting the decimals. (9 min) [E](#) [MM](#)

### Basic Operations & Reasoning | Square & Cube Roots

#### Intro to Square Roots

Learn about the square root symbol (the principal root) and what it means to find a square root. (5 min) [E](#) [MM](#)

#### Intro to Cube Roots

Learn the meaning of cube roots and how to find them. Also learn how to find the cube root of a negative number. (8 min) [E](#) [MM](#)

#### Worked Example: Cube Root of a Negative Number

Learn how to find the cube root of negative 512 by breaking it down into prime factors. (4 min) [E](#) [MM](#)

#### Square Root of a Decimal

Learn how to find the square root of a decimal number. (3 min) [E](#) [MM](#)

#### Dimensions of a Cube from its Volume

When we know the volume of a cube, we can use the cube root of the volume to find the length of each side. (3 min) [E](#) [MM](#)

### Basic Operations & Reasoning | Intro to Irrational Numbers

#### Intro to Rational & Irrational Numbers

Learn the difference between rational and irrational numbers, learn how to identify them, and discover why some of the most famous numbers in mathematics, like Pi and e, are actually irrational. (6 min) [E](#) [MM](#)

#### Classifying Numbers: Rational & Irrational

Learn to write any rational number as the ratio of two integers. (2 min) [E](#) [MM](#)

### Classifying Numbers

Learn to classify numbers as one of these four categories: rational numbers, irrational numbers, integers, and whole numbers. (9 min) [E](#) [MM](#)

#### Worked Example: Classifying Numbers

Decide which number set 3.4028 belongs to: integer, rational, or irrational. (7 min) [E](#) [MM](#)

#### Approximating Square Roots

Learn how to find the approximate values of square roots. (5 min) [E](#) [MM](#)

#### Comparing Irrational Numbers with Radicals

Learn how to sort a bunch of numbers ( $4\sqrt{2}$ ,  $2\sqrt{3}$ ,  $3\sqrt{2}$ ,  $\sqrt{17}$ ,  $3\sqrt{3}$ , 5) from least to greatest without using a calculator. (6 min) [E](#) [MM](#)

#### Approximating Square Roots to Hundredths

Explore how to find the perfect squares around 45 and use them to make an educated guess. (7 min) [E](#) [MM](#)

#### Comparing Values with Calculator

Learn how to compare 22.9% to  $\sqrt{0.45}$  using a calculator. (4 min) [E](#) [MM](#)

### Basic Operations & Reasoning | Properties of Exponents

#### Exponents with Negative Bases

Learn to what we know about negative numbers to determine how negative bases with exponents are affected and what patterns develop. (5 min) [E](#) [MM](#)

#### The 0 & 1st Power

Learn different ways of thinking about exponents. (5 min) [E](#) [MM](#)

**Even & Odd Numbers of Negatives**

Explore whether multiplication and division problems give us a positive or negative result by thinking about how many negative numbers are used in the computation.

(7 min) [E](#) [MM](#)

**1 and -1 to Different Powers**

Explore the different exponents affect the value of a number: when raised to the power of zero, any number equals one; when raised to an even power, negative numbers yield positive results; and when raised to an odd power, negative numbers yield negative results. (6 min) [E](#) [MM](#)

**Powers of Zero**

Explore what happens when you have zero to the zero powers. (4 min) [E](#) [MM](#)

**Sign of Expressions Challenge Problems**

Explore your understanding of what happens when we multiply or divide a bunch of positive or negative numbers. (9 min) [E](#) [MM](#)

**Exponent Properties with Products**

Learn the different properties that help to simplify expressions with exponents. (14 min) [E](#) [MM](#)

**Exponent Properties with Parentheses**

Learn two exponent properties:  $(ab)^c = (a^c)(b^c)$  and  $(a^b)^c = a^{b \cdot c}$ . (6 min) [E](#) [MM](#)

**Exponent Properties with Quotients**

Learn how to simplify expressions like  $(5^6)/(5^2)$ . Also learn how  $1/(a^b)$  is the same as  $a^{-b}$ . (9 min) [E](#) [MM](#)

**Negative Exponents**

Explore how negative exponents can be rewritten. (7 min) [E](#) [MM](#)

**Negative Exponent Intuition**

Learn how negative exponents work. (5 min) [E](#) [MM](#)

**Multiplying & Dividing Powers (Integer Exponents)**

Learn that any base  $a$  and any integer exponents  $n$  and  $m$ ,  $a^n \cdot a^m = a^{n+m}$ . For any non-zero base,  $a^n/a^m = a^{n-m}$ . (4 min) [E](#) [MM](#)

**Powers of Products & Quotients (Integer Exponents)**

For any integers  $a$  and  $b$  and for any exponents  $n$ ,  $(a \cdot b)^n = a^n \cdot b^n$  and  $(a/b)^n = a^n/b^n$ . These are worked examples for using these properties with integer exponents.

(7 min) [E](#) [MM](#)

**Multiplying Multiples of Powers of 10**

Learn how to multiply  $(9 \cdot 10^9)(-2 \cdot 10^{-3})$ . (3 min) [E](#) [MM](#)

**Approximating with Powers of 10**

Learn how to approximate how much larger the world population was than the US population in 2014. (4 min) [E](#) [MM](#)

**Basic Operations & Reasoning | Scientific Notation****Scientific Notation Example: 0.000000003457**

Explore scientific notation and see examples of it. (4 min) [E](#) [MM](#)

**Scientific Notation Examples**

Learn about Scientific notation and explore examples. (11 min) [E](#) [MM](#)

**Multiplying & Dividing in Scientific Notation**

In order to simplify multiplication and division using scientific notation, you should multiply and divide numbers with the same base and add or subtract the exponents. (3 min) [E](#) [MM](#)

**Multiplying Three Numbers in Scientific Notation**

Explore why multiplying very big or very small numbers is much easier when using scientific notation. (8 min) [E](#) [MM](#)

**Subtracting in Scientific Notation**

Learn how to subtract numbers written in scientific notation. (4 min) [E](#) [MM](#)

**Simplifying in Scientific Notation Challenge**

Solve a hairy expression and simplify in scientific notation. (6 min) [E](#) [MM](#)

**Scientific Notation Word Problem: Red Blood Cells**

Use scientific notation to solve how many red blood cells are in the human body. (5 min) [E](#) [MM](#)

**Scientific Notation Word Problem: U.S. National Debt**

Use scientific notation to solve what your part of the national debt is. (6 min) [E](#) [MM](#)

**Scientific Notation Word Problem: Speed of Light**

Learn to simplify multiplication and division using scientific notation. (5 min) [E](#) [MM](#)

**Geometry | Angles Between Intersecting Lines****Angles, Parallel Lines, & Transversals**

When a third line, called a transversal, crosses these parallel lines, it creates angles. Some angles are equal, like vertical angles (opposite angles) and corresponding angles (same position at each intersection). (7 min) [E](#) [MM](#)

**Parallel & Perpendicular Lines**

Parallel lines are lines that never intersect, and they form the same angle when they cross another line. Perpendicular lines intersect at a 90-degree angle, forming a square corner. (4 min) [E](#) [MM](#)

**Missing Angles with a Transversal**

When a third line called a transversal crosses two parallel lines, we can find the measures of angles using properties like corresponding angles, vertical angles, and supplementary angles. (2 min) [E](#) [MM](#)

## Measures of Angles Formed by a Transversal

Solve an equation to find missing angles given two parallel lines and a transversal.

(5 min) [E](#) [MM](#)

## Angles in a Triangle Sum to 180°

### Proof

Explore how the sum of the interior angle measures of a triangle always adds up to

180°. (4 min) [E](#) [MM](#)

## Isosceles & Equilateral Triangles

### Problems

Explore the differences between isosceles & equilateral triangles. (6 min) [E](#) [MM](#)

## Triangle Exterior Angle Example

Explore how to find angle measures by using exterior angles. (6 min) [E](#) [MM](#)

## Worked Example: Triangle Angles (Intersecting Lines)

Learn how to find unknown angles in triangles and intersecting lines.

(5 min) [E](#) [MM](#)

## Worked Example: Triangle Angles (Diagram)

Find the missing angle measures in the triangles by using this fact and looking at complementary (adding up to 90 degrees) and supplementary (adding up to 180

degrees) angles. (6 min) [E](#) [MM](#)

## Triangle Angle Challenge Problem

Learn about the sum of exterior angles in a polygon, specifically a pentagon.

(8 min) [E](#) [MM](#)

## Triangle Angle Challenge Problem 2

Find angle measures in triangles when the given measures are algebraic expressions.

(6 min) [E](#) [MM](#)

## Geometry | Triangle Angles

## Angles in a Triangle Sum to 180°

### Proof

Explore how the sum of the interior angle measures of a triangle always adds up to

180°. (4 min) [E](#) [MM](#)

## Isosceles & Equilateral Triangles

### Problems

Use the properties of Isosceles triangles to find the missing angles in composite

figures. (6 min) [E](#) [MM](#)

## Triangle Exterior Angle Example

Discover how exterior angles are formed outside a triangle by extending a side.

(6 min) [E](#) [MM](#)

## Worked Example: Triangle Angles (Intersecting Lines)

Learn how to find unknown angles in triangles and intersecting lines.

(5 min) [E](#) [MM](#)

## Worked Example: Triangle Angles (Diagram)

Find the missing angle measures in the triangles by using the knowledge you have of triangle angles.

(6 min) [E](#) [MM](#)

## Triangle Angle Challenge Problem 1

Learn about the sum of exterior angles in a polygon, specifically a pentagon.

(8 min) [E](#) [MM](#)

## Triangle Angle Challenge Problem 2

Find angle measures in triangles when the given measures are algebraic expressions.

(6 min) [E](#) [MM](#)

## Geometry | Pythagorean Theorem

## Intro to the Pythagorean Theorem

The Pythagorean theorem is a cornerstone of math that helps us find the missing side length of a right triangle. In a right triangle with sides A, B, and hypotenuse C, the theorem states that  $A^2 + B^2 = C^2$ . The hypotenuse is the longest side, opposite the right angle. (11 min) [E](#) [MM](#)

## Pythagorean Theorem Example

Apply the Pythagorean theorem to find the missing side length of a right triangle, even when the missing length is one of the shorter sides. (4 min) [E](#) [MM](#)

## Pythagorean Theorem with Isosceles Triangle

Learn to find the value of a base (x) in an isosceles triangle. (4 min) [E](#) [MM](#)

## Use Pythagorean Theorem to Find Area of an Isosceles Triangle

Learn to find the area of an isosceles triangle using the Pythagorean theorem.

(4 min) [E](#) [MM](#)

## Pythagorean Theorem Word Problem: Carpet

Use the Pythagorean theorem to solve the missing width of the carpet. (3 min) [E](#) [MM](#)

## Pythagorean Theorem Word Problem: Fishing Boat

Solve this word problem using Pythagorean theorem. (4 min) [E](#) [MM](#)

## Pythagorean Theorem in 3D

Discover how to find the length of an edge in a 3D shape using the Pythagorean theorem. (6 min) [E](#) [MM](#)

## Distance Formula

Learn how to find the distance between two points by using the distance formula, which is an application of the Pythagorean theorem. (10 min) [E](#) [MM](#)

### Garfield's Proof of the Pythagorean Theorem

Use a trapezoid made of two identical right triangles and half of a square to show that the sum of the squares of the two shorter sides equals the square of the longest side of a right triangle. (9 min) [E](#) [MM](#)

### Bhaskara's Proof of the Pythagorean Theorem

Explore mathematician Bhaskara's elegant visual proof of the Pythagorean theorem. (9 min) [E](#) [MM](#)

### Pythagorean Theorem Proof Using Similarity

Explore proof of the Pythagorean theorem using similarity. (10 min) [E](#) [MM](#)

### Another Pythagorean Theorem Proof

Visualize how to prove the Pythagorean theorem. (11 min) [E](#) [MM](#)

## Geometry | Intro to Transformations

### Rigid Transformations Intro

Explore the three main types: translations (moving the shape), rotations (turning the shape), and reflections (flipping the shape like a mirror image). (7 min) [E](#) [MM](#)

### Dilations Intro

Explore how dilations are a type of non-rigid transformation. (2 min) [E](#) [MM](#)

### Identifying Transformations

Explore the four types of transformations: rotations (spinning a shape around a point), translations (shifting a shape), reflections (flipping a shape over a line), and dilations (shrinking or expanding a shape). (4 min) [E](#) [MM](#)

## Geometry | Types & Properties of Transformations

### Translating Points

Explore how a translation is a way to move a point or shape by a certain number of units in a certain direction on a coordinate plane. (4 min) [E](#) [MM](#)

### Translating Shapes

Explore how to translate shapes. (2 min) [E](#) [MM](#)

### Determining Translations

Learn how to find the translation by figuring out how much the x- and y-coordinates need to change to map one triangle onto the other. (2 min) [E](#) [MM](#)

### Rotating Points

Explore what it means to rotate angles and how positive and negative rotations affect the angles. (2 min) [E](#) [MM](#)

### Determining Rotations

Discover how to see the angle of rotation. (3 min) [E](#) [MM](#)

### Reflecting Points

Explore Reflections and how to create mirror images of points, keeping the same distance from the line. (4 min) [E](#) [MM](#)

### Reflecting Shapes

Find new points (A', B', C', D') by keeping the same x-coordinates and changing the y-coordinates to their opposite signs. (3 min) [E](#) [MM](#)

### Determining Reflections

Explore a line of reflection is an imaginary line that flips one shape onto another. (2 min) [E](#) [MM](#)

### Finding Measures Using Rigid Transformations

Explore how to find the measurements after a rigid transformation. (5 min) [E](#) [MM](#)

### Rigid Transformations: Preserved Properties

Explore how rigid transformations, like rotations and reflections, change a shape's position but keep its size and shape. (7 min) [E](#) [MM](#)

### Mapping Shapes

Find the right sequence of rigid transformations (like rotations, translations, and reflections) to map one triangle onto another. (9 min) [E](#) [MM](#)

## Geometry | Dilations

### Dilating Points

Discover how dilations are a way to stretch or shrink shapes around a point called the center of dilation. (3 min) [E](#) [MM](#)

### Dilations: Scale Factor

Explore how to scale dilations. (5 min) [E](#) [MM](#)

### Dilating Shapes: Expanding

Let's dilate a rectangle around a point P using a scale factor  $1\frac{2}{3}$ . (3 min) [E](#) [MM](#)

### Dilating Shapes: Shrinking by $1/2$

Find the new positions of the points after dilation. (3 min) [E](#) [MM](#)

### Dilations and Properties

Explore whether the properties of a shape are preserved or not preserved after a dilation. (6 min) [E](#) [MM](#)

## Geometry | Congruence & Similarity

### Congruent Shapes & Transformations

Explore how congruent shapes and transformations can be congruent. (2 min) [E](#) [MM](#)

### Non-Congruent Shapes & Transformations

Explore how dilations affect congruency. (2 min) [E](#) [MM](#)

**Similar Shapes & Transformations**

Explore how two shapes are similar if we can change one shape into the other using rigid transformations (like moving or rotating) and dilations (making it bigger or smaller). (3 min) [E](#) [MM](#)

**Side Lengths After Dilation**

Explore how in a dilation, if the scale factor is greater than 1, the shape will stretch away from the center of dilation, getting larger. If the scale factor is between 0 and 1, the shape will shrink towards the center, getting smaller. All the lengths in the figure change by the same scale factor. (2 min) [E](#) [MM](#)

## Algebra | Solving Equations with One Unknown

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**Intro to Equations with Variables on Both Sides**

Learn to solve the equation  $2x + 3 = 5x - 2$ . (9 min) [E](#) [MM](#)

**Equations with Variables on Both Sides:  $20 - 7x = 6x - 6$** 

Solve the equation  $20 - 7x = 6x - 6$ . (4 min) [E](#) [MM](#)

**Equation with Variables on Both Sides: Fractions**

Solve the equation  $(3/4)x + 2 = (3/8)x - 4$ . (5 min) [E](#) [MM](#)

**Equation with the Variable in the Denominator**

Solve the equation  $7 - 10/x = 2 + 15/x$ . (4 min) [E](#) [MM](#)

**Equations with Parentheses**

Solve the equation  $-9 - (9x - 6) = 3(4x + 6)$  using the distributive property. (6 min) [E](#) [MM](#)

**Number of Solutions to Equations**

See how some equations have one solution, others have no solutions, and still others have infinite solutions. (5 min) [E](#) [MM](#)

**Worked Example: Number of Solutions to Equations**

Explore the equation  $8(3x + 10) = 28x - 14 - 4x$  and try to find the solutions. (2 min) [E](#) [MM](#)

**Creating an Equation with No Solutions**

Show how to complete the equation  $-11x + 4 = \_\_x + \_\_$  so that it has no solutions. (2 min) [E](#) [MM](#)

**Creating an Equation with Infinitely Many Solutions**

Show how to complete the equation  $4(x - 2) + x = 5x + \_\_$  so that it has infinitely many solutions. (2 min) [E](#) [MM](#)

**Sums of Consecutive Integers**

Use algebra to set up an equation to solve for the smallest of the four integers. (5 min) [E](#) [MM](#)

**Sum of Integers Challenge**

Solve the following problem: the sum of three consecutive odd integers is 231. (4 min) [E](#) [MM](#)

## Algebra | Graphing Proportional Relationships

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**Rates & Proportional Relationships Example**

Explore and compare a rate given in an equation to a rate shown on a graph. (2 min) [E](#) [MM](#)

**Rates & Proportional Relationships: Gas Mileage**

Choose equations that give a faster rate than the relationship given in a table. (3 min) [E](#) [MM](#)

**Graphing Proportional Relationships: Unit Rate**

Graph the equation of a line that represents a proportional relationship given a unit rate. (4 min) [E](#) [MM](#)

**Graphing Proportional Relationships from a Table**

Graph the equation of a line that represents a proportional relationship given a table. (2 min) [E](#) [MM](#)

**Graphing Proportional Relationships from an Equation**

Graph the equation of a line that represents a proportional relationship given an equation. (3 min) [E](#) [MM](#)

## Algebra | Solutions to Linear Equations

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**Intro to the Coordinate Plane**

Explore how to create a system of two perpendicular axes (the x and y axes) which could be used to plot points in a plane. (11 min) [E](#) [MM](#)

**Solutions to 2-Variable Equations**

Learn about what an ordered pair and how to test solutions to 2-variable equations. (3 min) [E](#) [MM](#)

**Worked Example: Solutions to 2-Variable Equations**

Learn how to check if an ordered pair is a solution to a given equation. (3 min) [E](#) [MM](#)

**Completing Solutions to 2-Variable Equations**

Given a 2-variable equation and the x or y values of a solution find the value of the other variable in the solution. (7 min) [E](#) [MM](#)

## Algebra | Intercepts

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**Intro to Intercepts**

Learn what x- and y-intercepts are. (6 min) [E](#) [MM](#)

**X-Intercept of a Line**

Determine the x-intercept of a linear equation from a graph. (2 min) [E](#) [MM](#)

**Intercepts from an Equation**

Find the x and y-intercepts of  $-5x + 4y = 20$ . (4 min) [E](#) [MM](#)

**Intercepts from a Table**

Find the y-intercept of the graph of a linear function given a table of values. (4 min) [E](#) [MM](#)

**Worked Example: Intercepts from an Equation**

Find the x and y-intercepts of the equation  $2y + 1/3x = 12$ . (4 min) [E](#) [MM](#)

**Algebra | Slope****Intro to Slope-Intercept Form**

Learn how to calculate the slope of the line in a graph by finding the change in y and the change in x. (7 min) [E](#) [MM](#)

**Slope & Direction of a Line**

Find the slope of a line given its graph. (3 min) [E](#) [MM](#)

**Positive & Negative Slope**

Find the slope of the line that goes through the ordered pairs (4,2) and (-3, 16). (5 min) [E](#) [MM](#)

**Slope from Graph**

Worked examples of finding the slope of a line given its equation, using many forms of equations. (5 min) [E](#) [MM](#)

**Slope of a Line: Negative Slope**

Learn to convert equations like  $4x + 2y = -8$  into slope-intercept form. (4 min) [E](#) [MM](#)

**Slope from Equation**

When two points have the same y-value, it means they lie on a horizontal line. The slope of such a line is 0, and you will also find this by using the slope formula. (6 min) [E](#) [MM](#)

**Worked Example: Slope from Two****Points**

Find the slope of the line that goes through the ordered pairs (4,2) and (-3, 16). (7 min) [E](#) [MM](#)

**Converting to Slope-Intercept Form**

Learn to convert equations like  $4x + 2y = -8$  into slope-intercept form. (5 min) [E](#) [MM](#)

**Slope of a Horizontal Line**

When two points have the same y-value, it means they lie on a horizontal line. The slope of such a line is 0, and you will also find this by using the slope formula. (5 min) [E](#) [MM](#)

**Algebra | Slope-Intercept Form****Intro to Slope-Intercept Form**

Slope-intercept form ( $y=mx+b$ ) of linear equations highlights the slope (m) and the y-intercept (b) of a line. (9 min) [E](#) [MM](#)

**Worked Examples: Slope-Intercept****Intro**

Explore the relationship between slope, y-intercept, and linear equation in slope-intercept form. (4 min) [E](#) [MM](#)

**Graph from Slope-Intercept Equation**

Graph a linear equation in slope-intercept form. (3 min) [E](#) [MM](#)

**Slope-Intercept Equation from Graph**

Learn to write equations in slope-intercept form for three different lines. (11 min) [E](#) [MM](#)

**Slope-Intercept Equation from Slope & Point**

Learn how to write an equation in slope-intercept form ( $y=mx+b$ ) for the line with a slope of  $-3/4$  that goes through the point (0,8). (4 min) [E](#) [MM](#)

**Slope-Intercept Equation from Two****Points**

Write an equation of the line that passes through the points (-1,6) and (5,-4). (7 min) [E](#) [MM](#)

**Slope-Intercept Form Problems**

Learn how to solve problems involving writing an equation in slope-intercept form. (15 min) [E](#) [MM](#)

**Slope-Intercept Form from a Table**

Learn how to write an equation of the line that matches up to a table of values. (4 min) [E](#) [MM](#)

**Algebra | Linear Equations & Functions****What is a Function?**

Visualize examples of various kinds of functions. (8 min) [E](#) [MM](#)

**Worked Example: Evaluating Functions from Equation**

Learn how to evaluate  $f(x)=49-x^2$  at  $x=5$ . (1 min) [E](#) [MM](#)

**Function Notation Example**

Use function notation to help Frank figure out how much water he can put in his balloon. (2 min) [E](#) [MM](#)

**Worked Example: Evaluating Functions from Graph**

Evaluating a function at  $x=-1$  using the graph of that function. (1 min) [E](#) [MM](#)

**Equations vs. Functions**

Explore the difference between equations and functions. (4 min) [E](#) [MM](#)

**Manipulating Formulas: Temperature**

Use the formula for converting from Fahrenheit to Celsius and solve it for F to convert from Celsius to Fahrenheit. (3 min) [E](#) [MM](#)

**Obtaining a Function from an Equation**

Larn to obtain a function from an equation. The function represents the same relationship between the quantities in the equation. (3 min) [E](#) [MM](#)

**Linear Graphs Word Problems**

Explore how we would go about making sense of the direction of a linear graph that represents a relationship between two real-world quantities. (5 min) [E](#) [MM](#)

**Linear Graphs Word Problem: Cats**

Find the y-intercept and the slope of a linear relationship representing someone accumulating cats. (3 min) [E](#) [MM](#)

**Linear Equations Word Problems: Volcano**

Find the y-intercept and the slope of a linear relationship representing someone climbing a volcano. (6 min) [E](#) [MM](#)

**Linear Equations Word Problems: Earnings**

Find the slope of a linear relationship between the number of work hours and the money earned. (4 min) [E](#) [MM](#)

**Modeling with Linear Equations: Snow**

Use a linear equation to model the amount of snow on the ground. (5 min) [E](#) [MM](#)

**Linear Function Example: Spending Money**

Solve an interesting application problem using a linear model. (5 min) [E](#) [MM](#)

**Fitting a Line to Data**

Learn to create a scatter plot and then fit a line to data on the median California family income. (8 min) [E](#) [MM](#)

**Comparing Linear Functions: Equation vs. Graph**

Solve for a given the formula of a linear function and the graph of another and determine which function increases faster. (2 min) [E](#) [MM](#)

**Comparing Linear Functions: Same Rate of Change**

Solve when given a table of values of a linear function and four linear graphs and determine which graph has the same rate of change as the function represented in the table. (2 min) [E](#) [MM](#)

**Comparing Linear Functions: Faster Rate of Change**

Solve when given a table of values of a linear function and four linear graphs and determine which graph increases faster than the function represented in the table. (4 min) [E](#) [MM](#)

**Comparing Linear Functions Word Problem: Climb**

Solve when given the formula and a table of values that represent two people climbing a wall and determine which one started out higher. (5 min) [E](#) [MM](#)

**Comparing Linear Functions Word Problem: Walk**

Solve when given a table of values that represents four people walking to school and determine which one started out farther from the school. (4 min) [E](#) [MM](#)

**Comparing Linear Functions Word Problem: Work**

Solve when given a table of values that represents a person walking to work and determine which verbal description represents someone starting at the same distance from work. (4 min) [E](#) [MM](#)

**Linear Functions Word Problem: Fuel**

Examine this real-world relationship and draw the graph that represents this relationship best. (5 min) [E](#) [MM](#)

**Linear Functions Word Problem: Pool**

Examine this real-world relationship and draw the graph that represents this relationship best. (3 min) [E](#) [MM](#)

**Modeling with Linear Equations: Gym Membership & Lemonade**

Constructing linear equations to solve word problems. (10 min) [E](#) [MM](#)

**Linear Functions Word Problem: Iceberg**

Examine this real-world relationship and find the formula of the function that represents this relationship. (6 min) [E](#) [MM](#)

**Linear Functions Word Problem: Paint**

Examine this real-world relationship and find the formula of the function that represents this relationship. (8 min) [E](#) [MM](#)

**Testing if a Relationship is a Function**

Learn to determine if points on a graph represent a function. (2 min) [E](#) [MM](#)

**Relations and Functions**

Learn to determine if a relation given by a set of ordered pairs is a function. (7 min) [E](#) [MM](#)

**Recognizing Functions from Graph**

Checking whether a given set of points can represent a function. (4 min) [E](#) [MM](#)

**Checking if a Table Represents a Function**

Determine if y is a function of x from looking at a table. (1 min) [E](#) [MM](#)

**Recognizing Functions from Table**

Checking whether a table of people and their heights can represent a function that assigns a height to a name. (5 min) [E](#) [MM](#)

**Checking if an Equation Represents a Function**

Determine if y is a function of x from looking at an equation. (4 min) [E](#) [MM](#)

**Does a Vertical Line Represent a Function?**

Explaining why a vertical line doesn't represent a function. (2 min) [E](#) [MM](#)

**Recognizing Functions from Verbal Description**

Check whether y can be described as a function of x if y is always three more than twice x. (2 min) [E](#) [MM](#)

**Recognizing Functions from Verbal Description Word Problem**

Check whether a description of the price of an order can be represented as a function of the shipping cost. (3 min) [E](#) [MM](#)

## Recognizing Linear Functions

Learn to recognize if a function is linear.

(4 min) [E](#) [MM](#)

## Linear & Nonlinear Functions: Table

Learn to determine if a table of values represents a linear function. (2 min) [E](#) [MM](#)

## Linear & Nonlinear Functions: Word Problem

Learn to determine if the relationship described in a word problem is a function.

(4 min) [E](#) [MM](#)

## Linear & Nonlinear Functions: Missing Value

Learn to find the missing value in a table to make sure it represents a linear equation.

(2 min) [E](#) [MM](#)

## Interpreting a Graph Example

Learn to interpret the graphs of a linear functions. (2 min) [E](#) [MM](#)

## Algebra | Intro to Systems of Equations

### Systems of Equations: Trolls, Tolls (Part 1)

Explore this troll of a problem and learn about setting up a system of equations.

(7 min) [E](#) [MM](#)

### Systems of Equations: Trolls, Tolls (Part 2)

Explore this troll of a problem and learn about setting up a system of equations.

(6 min) [E](#) [MM](#)

### Testing a Solution to a System of Equations

Check whether  $(-1, 7)$  is a solution of the system:  $x + 2y = 13$  and  $3x - y = -11$ .

(2 min) [E](#) [MM](#)

## Algebra | Solving Systems of Equations with Graphing

### Systems of Equations with Graphing

When solving systems of linear equations, one method is to graph both equations on the same coordinate plane. The intersection of the two lines represents a solution that satisfies both equations. (8 min) [E](#) [MM](#)

### Systems of Equations with Graphing: $y = 7/5x - 5$ & $y = 3/5x - 1$

Graph the following system of equations and solve it by looking for the intersection point:  $y = 7/5x - 5$  and  $y = 3/5x - 1$ . (2 min) [E](#) [MM](#)

### Systems of Equations with Graphing: $5x + 3y = 7$ & $3x - 2y = 8$

Learn how to solve a system of linear equations by graphing each equation separately. (6 min) [E](#) [MM](#)

### Systems of Equations with Graphing: Chores

Solve this Graphical Systems Application Problem. (5 min) [E](#) [MM](#)

### Systems of Equations with Graphing: Exact & Approximate Solutions

Solve a system of two linear equations in standard form, and then approximate the solution of a system whose solution isn't clearly visible. (6 min) [E](#) [MM](#)

## Algebra | Solving Systems of Equations with Substitution

### Systems of Equations with Substitution: $2y = x + 7$ & $x = y - 4$

When solving a system of equations using substitution, you can isolate one variable and substitute it with an expression from another equation. (4 min) [E](#) [MM](#)

### Systems of Equations with

#### Substitution: $y = 4x - 17.5$ & $y + 2x = 6.5$

Learn to solve the system of equations  $y = 4x - 17.5$  and  $y + 2x = 6.5$  using substitution. (4 min) [E](#) [MM](#)

### Systems of Equations with

#### Substitution: $-3x - 4y = -2$ & $y = 2x - 5$

Learn to solve the system of equations  $-3x - 4y = -2$  and  $y = 2x - 5$  using substitution. (4 min) [E](#) [MM](#)

### Systems of Equations with

#### Substitution: $9x + 3y = 15$ & $y - x = 5$

Learn to solve the system of equations  $9x + 3y = 15$  and  $y - x = 5$  using substitution. (6 min) [E](#) [MM](#)

### Systems of Equations with

#### Substitution: $y = -5x + 8$ & $10x + 2y = -2$

Learn to solve the system of equations  $y = -5x + 8$  and  $10x + 2y = -2$  using substitution. (4 min) [E](#) [MM](#)

### Systems of Equations with

#### Substitution: $y = -1/4x + 100$ & $y = -1/4x + 120$

Learn to solve the system of equations  $y = -1/4x + 100$  and  $y = -1/4x + 120$  using substitution. (4 min) [E](#) [MM](#)

## Algebra | Number of Solutions to Systems of Equations

### Systems of Equations Number of Solutions: Fruit Prices (Part 1)

Explore an example of a system of equations that has no solutions. (9 min) [E](#) [MM](#)

### Systems of Equations Number of Solutions: Fruit Prices (Part 2)

Explore an example of a system of equations that has infinite solutions. (7 min) [E](#) [MM](#)

**Solutions to Systems of Equations:****Dependent vs. Independent**

Explore an example of analyzing a system to see if it's dependent or independent system of equations. (5 min) [E](#) [MM](#)

**Number of Solutions to a System of Equations**

When given three lines on the coordinate plane, identify one system of two lines that has a single solution, and one system that has no solution. (3 min) [E](#) [MM](#)

**Number of Solutions to a System of Equations Graphically**

Determine how many solutions the following system of equations has by considering its graph:  $10x - 2y = 4$  and  $10x - 2y = 16$ . (6 min) [E](#) [MM](#)

**Number of Solutions to a System of Equations Algebraically**

Solve several examples about the number of solutions of systems of equations using algebraic reasoning. (6 min) [E](#) [MM](#)

**How Many Solutions Does a System of Linear Equations Have if There are At Least Two?**

Explore the solution to this question. (2 min) [E](#) [MM](#)

**Algebra | Systems of Equations Word Problems****Age Word Problem: Imran**

Solve the following age word problem: In 40 years, Imran will be 11 times as old as he is right now. How old is he right now? (4 min) [E](#) [MM](#)

**Age Word Problem: Ben & William**

Solve the following age word problem: William is 4 times as old as Ben. 12 years ago, William was 7 times as old as Ben. How old is Ben now? (6 min) [E](#) [MM](#)

**Age Word Problem: Arman & Diya**

Solve the following age word problem: Arman is 18. Diya is 2. How many years will it take for Arman to be 3 times as old as Diya? (5 min) [E](#) [MM](#)

**System of Equations Word Problem: Walk & Ride**

Solve a problem about distances walking and riding bus to school. (7 min) [E](#) [MM](#)

**System of Equations Word Problem: No Solution**

Solve a problem about a toy factory. (5 min) [E](#) [MM](#)

**System of Equations Word Problem: Infinite Solutions**

Solve a problem about a vegetable farmer. (5 min) [E](#) [MM](#)

**Systems of Equations with Substitution: Coins**

Solve a word problem about the number of nickels and quarters in a piggy bank by creating a system of equations and solving it. (6 min) [E](#) [MM](#)

**Measurement & Data | Data & Modeling****Constructing a Scatter Plot**

Explore how to construct a scatter plot from information provided. (2 min) [E](#) [MM](#)

**Example of Direction in Scatter Plots**

Discover how to compare different graphs in this example. (2 min) [E](#) [MM](#)

**Scatter Plot: Smokers**

Explore how a negative linear association goes up, as one variable goes up, the other variable goes down at a constant rate. (2 min) [E](#) [MM](#)

**Estimating the Line of Best Fit Exercise**

Explore how to find the line of best fit when looking for a linear trend. (1 min) [E](#) [MM](#)

**Line of Best Fit: Smoking in 1945**

Discover how to guess how many smoked in 1945 by drawing a line that slopes down through the points. (5 min) [E](#) [MM](#)

**Estimating with Linear Regression (Linear Models)**

Explore how line of best fit is a straight line that shows the relationship between two sets of data. (3 min) [E](#) [MM](#)

**Interpreting a Trend Line**

Use the graph to show how studying affects test scores. (3 min) [E](#) [MM](#)

**Two-Way Frequency Tables and Venn Diagrams**

Discover how to use Venn Diagrams and two-way tables. (6 min) [E](#) [MM](#)

**Two-Way Relative Frequency Tables**

Calculate the relative frequency of accidents for SUVs by dividing the number of SUVs that had accidents by the total number of SUVs. (4 min) [E](#) [MM](#)

**Interpreting Two-Way Tables**

Explore how two-way tables help us understand how categories relate. (2 min) [E](#) [MM](#)

**Science****Earth & Space Science****1. Cool VR Walk on the Moon with NASA/ 2. Yosemite**

EXP.1- Experience a walk on the Moon from the Project Apollo Archive. (2min)  
EXP.2- Experience a guided tour of some of Yosemite's majestic spots. (4 min)

**Journey into the Orion Nebula**

This visualization journeys into the famous star-forming region of the Orion Nebula based on an image from the Hubble Space Telescope. (2 min)

## Mars- The Red Planet VR

### Documentary

Explore the planet Mars and see its history of exploration. (12 min)

### NASA's Curiosity Mars Rover at Namib Dune

View the Namib Dune and portions of Mount Sharp through the eyes of the Mars Rover. (2 min)

### First ever 3D VR filmed in Space

See life from the view of Astronauts in the International Space Station. (5 min)

### Curiosity Mars Rover's

View the Glen Torridon area of Mars from the eyes of the Mars Rover. (2 min)

### Sample Asteroid Benu

Follow along on NASA's first asteroid sample return mission as they make a daring attempt to collect samples from an asteroid. (4 min)

### International Space Station

Model of the exterior of the International Space Station. (unlimited)

### First-Ever 360 VR filmed in Space:

#### One Strange Rock

Fly side-by-side with astronauts and experience weightlessness, the speed of traveling at 17-thousand miles per hour and take in a stunning view of Earth. (5 min)

### Sun Formation

See lots of Particles colliding to form the Sun. [IFX](#)

### Big Bang Explosion

Explosion particle effect with fire, smoke, and plasma. [IFX](#)

### Big Bang Sound

Sound effect of what scientists estimate the big bang would have sounded like. [IFX](#)

### Panoramic Video of the Night Sky and Milky Way:Visualize Astronomy

Enjoy a panoramic video of the night sky and Milky Way. (1 min)

## Journey to the Edge of Space

Experience what it's like to leave Earth, traveling to over 90,000 feet into the stratosphere. (5 min)

### VR Solar System Space Video

This amazing 360 virtual reality video will transport you through our galactic neighborhood, the solar system. (18 min)

### Journey into the Orion Nebula

This visualization journeys into the famous star-forming region of the Orion Nebula based on an image from the Hubble Space Telescope. (2 min)

### 360 Degree Video of the Milky Way

Interactive timelapse of the moving night sky. (1 min)

### Moon Phases

Interactive display of the phases of Earth's Moon. [IFX](#)

### Solar System Model

Animated model of the solar system.

Rotation and revolution speeds are scaled accurately. [IFX](#)

### Solar System

Interactive classroom that allows students to visit each planet, watch them orbit, and learn about each one. (Unlimited) [E](#)

### Earth Magnetic Field

Animated visualization of the electromagnetic field surrounding Planet Earth. [IFX](#)

### Earth Cutaway

A model of Earth with a section cut away to expose its layers. [IFX](#)

### Earth Magnetic Field

Animated visualization of the electromagnetic field surrounding Planet Earth. [IFX](#)

### After the Floods: Rebuilding Ellicott City

Take an immersive journey through the flooding, aftermath, and reconstruction of Ellicott City, Maryland to give a new perspective on the damage done by flooding. (6 min)

## Chennai Floods Aftermath

Take an immersive journey through the impact, rescue, and reason for the floods that occurred in Chennai, India, in December 2015. (6 min)

### Kamchatka Volcano Eruption

National Geographic VR takes you to the rim of a spectacular erupting volcano: Klyuchevskoy, one of the tallest and most active volcanoes on the planet. (2 min)

### Life in Haiti: After a Devastating

#### Natural Disaster

Join filmmaker Dylan Roberts on a journey to the Haitian city of Jérémie, and the small village of Manish, to witness the aftermath of a colossal storm. (5 min)

### Category 3 Hurricane Landfall

#### Simulation

Experience a category 3 hurricane through a simulation with guided popups. (1 min)

### Expedition to the Heart of Active Volcano

Join a group of climbers as they embark on a scientific exploration into an active volcano. (5 min)

### Close-Range Tornado

Get up close and personal with a tornado near Wray, CO from May 7<sup>th</sup>, 2016. (8 min)

### Boston Snowstorm from Bunker Hill Monument

Watch a major winter storm move through the city of Boston in this time-lapse from the top of Bunker Hill Monument. (3 min)

### Inside Hurricane Maria

Watch Hurricane Maria change from a category 1 to a category 5 in about 24 hours. (5 min)

### Surrounded by Lemurs- Perth Zoo-Australia

Take a private tour of Lemur Island and encounter these critically endangered species. (4 min)

## **The Fight to Save Threatened Species**

Get closer than ever before to the most extraordinary creatures on the planet...before they disappear. Whale sharks, rhinos, elephants, manta rays and lions are all threatened with extinction. (2 min)

### **Elephants on the Brink**

A herd of African elephants curiously investigates its surroundings in South Africa and happens to notice cameras filming their behavior. (3 min)

### **Ocean to Plate: A Journey into the Seafood Supply Chain**

As populations and appetites grow, global fisheries are reaching their ecological capacity, yet at least a third of harvested fish and seafood is lost or wasted along the supply chain. (7 min)

### **Protecting Ocean Anchor Species- Racing Extinction**

Join marine biologist Luke Tipple as he swims alongside Anchor species like manta rays and whale sharks and shares why they are vital to the survival of our oceans and why they need to be protected. (3 min)

### **Lion Whisperer- Racing Extinction**

Kevin Richardson, also known as the "lion whisperer", explains the complexities of his relationship to his pride, and summarizes his life's work of protecting these amazing animals from the game hunting trade. (4 min)

### **Caring for Rhinos**

A herd of nine rhinos graze in the South African bush while we hear Chris Sussons, game reserve manager, give some cool facts about rhinos and why they need to protect them from poachers. (2 min)

### **Manatee: Crystal River National Wildlife Refuge**

Underwater cinematographer and VR filmmaker Adam Ravetch takes us on an adventure on Florida's Crystal River as he captures the river's wild manatees in their natural habitat at the Crystal River National Wildlife Refuge. (3 min)

## **360 Orangutan School**

Go inside the International Animal Rescue Sanctuary in the forests of Borneo to see what it takes to teach a baby orangutan... to be an orangutan. (9 min)

### **In the Presence of Animals**

Experience a dangerous world with some of the planet's most at-risk species: an endangered jaguar, a rainforest sloth, a massive bison, fluttering monarchs, and a mother olive ridley turtle. (5 min)

### **Kamchatka Volcano Eruption**

National Geographic VR takes you to the rim of a spectacular erupting volcano: Klyuchevskoy, one of the tallest and most active volcanoes on the planet. (2 min)

### **Earthquake VR Experience**

Simulation of a virtual earthquake to provide lifelike training experience without an actual earthquake. (2 min)

### **Expedition to the Heart of Active Volcano**

Join a group of climbers as they embark on a scientific exploration into an active volcano. (5 min)

### **Volcano**

Experience a model of an Erupting Volcano.

[IFX](#)

## **Life Science**

### **Attenborough and the Giant Dinosaur**

David Attenborough meets the biggest animal ever to walk on Earth - a Titanosaur. (4 min)

### **Rhomaleosaurus Sea Dragon: Back to Life in 360 VR**

Encounter the prehistoric sea dragon Rhomaleosaurus, as it roams the gallery over 180 million years after it died. (4 min)

### **VR Jurassic Dinosaur**

Explore what life was like during the age of the dinosaur. (3 min)

## **Giraffatitan Dinosaur: Back to Life in 360 VR**

Encounter the Jurassic giant Giraffatitan, one of the tallest dinosaurs that ever lived, and learn all about how it lived and who its descendants are. (4 min)

### **Glow Worm Caves of New Zealand**

Deep below ground, strange carnivorous worms' glow and twinkle like the night sky to attract their prey. (2 min)

### **Great Hammerhead Shark Encounter**

Dive into this 360° video and go face to face with a curious great hammerhead shark. (2 min)

### **Giraffe 1**

See a giraffe interacting with its natural habitat. (1 min)

### **Giraffe 2**

See a giraffe interacting with its natural habitat. (1 min)

### **How Animals See the World**

Experience how different animals see the world. Includes a human, cat, dog, fly, rat, and snake's point of view. (4 min)

### **360° Canadian Pig Farm Tour**

See inside a working Canadian pig farm and learn all about how pigs are cared for, what they eat, where they live, and how Canadian pig farmers keep their animals entertained and healthy. (10 min)

### **360 Illinois Farm Tour : It Starts with a Seed**

Follow a fifth-generation farmer and see the challenge, solutions that technology offers, and ultimately the fruits of our labor that will transform into food, feed and fuel used throughout the state, across the country and around the globe. Part 1 (6 min)

### **360 Farm Tour: As the Corn Grows**

Follow a fifth-generation farmer and see the challenge, solutions that technology offers, and ultimately the fruits of our labor that will transform into food, feed and fuel used throughout the state, across the country and around the globe. Part 2 (4 min)

## 360 Farm Tour: Harvesting the Corn

Follow a fifth-generation farmer and see the challenge, solutions that technology offers, and ultimately the fruits of our labor that will transform into food, feed and fuel used throughout the state, across the country and around the globe.

Part 3 (4 min)

## A 360 Look Inside Brooklyn's Farming Revolution

Visit a high-tech, hydroponic farm that's fueling a new food revolution that is breaking away from the traditional, transport-heavy, industrial food system and blazing the trail for the future of super-efficient urban farming. (3 min)

## Take a 360° Virtual Reality Tour of a Chicken Farm

Follow along with a farmer as he goes over how broiler chickens (meat chickens) are raised until they are big enough to be sold for meat. (5 min)

## Virtual 360° Farm Tour | Organic Valley 360°

Take a virtual tour into how Dairy cows are raised to produce organic milk. (1 min)

## Physical Science

### Electromagnet- Small Solenoid

Animated visualization of an electromagnetic solenoid with 15 coils. [IFX](#)

### Electromagnet – Large Solenoid

Animated visualization of an electromagnetic solenoid with 26 coils. [IFX](#)

### Magnet- Like Poles

Animated visualization of two bar magnets with like poles repelling each other. [IFX](#)

### Magnet – Opposite Poles

Animated visualization of two bar magnets attracting each other. [IFX](#)

### Magnet – Single Bar

Animated visualization of the electromagnetic field surrounding a single bar magnet. [IFX](#)

## Magnet – Two Bars

Animated visualization of the electromagnetic field surrounding two bar magnets. [IFX](#)

## Magnet – Horseshoe

Animated visualization of the electromagnetic field surrounding a horseshoe magnet. [IFX](#)

## Light Lab

This highly interactive classroom teaches students about the electromagnetic spectrum including activities like Double Slit Experiment, shining lights through a prism, building their own waves, stacking light, and playing with lenses. (unlimited) [E](#)

## Music Playground

Concert hall with interactive musical instruments that can be used to collaboratively play, teach, or learn about music. (unlimited) [E](#)

# Social Studies

## History

### Historic Jamestown

Interactive experience where students will experience the reason for the English Colonization and the significance of the location regarding resources, defensibility, and economic development. (unlimited) [E](#)

## US History

### Castillo Cannon Drill

Stand aboard the Castillo's gun deck and see what firing a cannon would be like in the 1740s. (6 min)

## Historic Jamestown

Interactive experience where students will witness the English Colonization and the significance of the location regarding resources, defensibility, and economic development. (unlimited) [E](#)

## Independence Hall

Join George Washington, John Adams, Thomas Jefferson, Benjamin Franklin, and John Hancock as they tell you stories about the founding of the United States. (unlimited) [E](#)

## Battle Road: The American Revolution

Be surrounded by scores of professional reenactors, organizers, onlookers, and photographers as they gather at Lexington, Concord, and Minute Man National Historical Park to honor the memory of this critical turning point in American history. (5 min)

## Civil War: A Letter from the Trenches

Get transported back to the 1860s to “experience” what life was like for a young cadet in the Confederate army, trekking through the mud and dodging enemy fire as you journey through the trenches. (5 min)

# 9th- 12th Grade

## Mathematics

### Algebra I: Geometry | Equations & Geometry

#### Equation Practice with Segment Addition

Solve for the value of  $x$  by splitting a line segment into two segments. (4 min) [E](#) [MM](#)

#### Equation Practice with Midpoints

Given information about the distance of a segment's midpoint from its endpoints, Sal forms and solves an equation to find the length of the segment. (3 min) [E](#) [MM](#)

#### Equation Practice with Vertical Angles

Given algebraic expressions that represent a pair of vertical angles, form and solve an equation. (2 min) [E](#) [MM](#)

#### Equation Practice with Complementary Angles

Given the algebraic expressions that represent a pair of complementary angles, learn how to form and solve an equation to find an unknown angle. (2 min) [E](#) [MM](#)

#### Equation Practice with Supplementary Angles

Given the algebraic expressions that represent a pair of supplementary angles, form and solve an equation. (2 min) [E](#) [MM](#)

### Algebra I: Geometry | Pythagorean Theorem

#### Intro to the Pythagorean Theorem 1

Discover that the Pythagorean theorem is a cornerstone of math that helps us find the missing side length of a right triangle. (11 min) [E](#) [MM](#)

#### Intro to the Pythagorean Theorem 2

Explore the Pythagorean Theorem in more depth. (13 min) [E](#) [MM](#)

#### Pythagorean Theorem Example

Learn to apply the theorem to find the missing side length of a right triangle, even when the missing length is one of the shorter sides. (4 min) [E](#) [MM](#)

#### Pythagorean Theorem with Isosceles Triangle

Find the value of a base ( $x$ ) in an isosceles triangle by splitting the triangle into two congruent right triangles by drawing an altitude. (3 min) [E](#) [MM](#)

#### Use Pythagorean Theorem to Find Area of an Isosceles Triangle

Find the area of an isosceles triangle using the Pythagorean theorem. (4 min) [E](#) [MM](#)

#### Pythagorean Theorem Word Problem: Carpet

Given the length and diagonal measurements, use the Pythagorean theorem to solve for the missing width of the carpet. (3 min) [E](#) [MM](#)

#### Pythagorean Theorem Word Problem: Fishing Boat

Model the length of a rope stretched between the mast and deck as the hypotenuse of a right triangle. (4 min) [E](#) [MM](#)

#### Pythagorean Theorem in 3D

Discover how to find the length of an edge in a 3D shape using the Pythagorean theorem. (6 min) [E](#) [MM](#)

#### Distance Formula

Learn how to find the distance between two points by using the distance formula, which is an application of the Pythagorean theorem. (9 min) [E](#) [MM](#)

#### Garfield's Proof of the Pythagorean Theorem

Explore former U.S. President James Garfield's proof of the Pythagorean theorem. (9 min) [E](#) [MM](#)

#### Bhaskara's Proof of the Pythagorean Theorem

Explore how Bhaskara uses a square and four congruent right triangles, rearranged in two ways, to prove this theorem. (9 min) [E](#) [MM](#)

#### Pythagorean Theorem Proof Using Similarity

Proof of the Pythagorean theorem using similarity. (10 min) [E](#) [MM](#)

#### Another Pythagorean Theorem Proof

Visually proving the Pythagorean theorem. (10 min) [E](#) [MM](#)

### Algebra I: Geometry | Similar Triangles

#### Intro to Triangle Similarity

Explore what it means for triangles to be similar, and how this follows from the definition of similarity. (9 min) [E](#) [MM](#)

#### Triangle Similarity Postulates & Criteria

Review all the different ways we can determine that two triangles are similar. (12 min) [E](#) [MM](#)

#### Determining Similar Triangles

Analyze multiple examples of the similarity of triangles. (9 min) [E](#) [MM](#)

#### Solving Similar Triangles

Solve two problems where a missing side length is found by proving that triangles are similar and using this to find the measure. (7 min) [E](#) [MM](#)

### Solving Similar Triangles: Same Side Plays Different Roles

Find a missing side length in a problem where the same side plays different roles in two similar triangles. (7 min) [E](#) [MM](#)

### Angles in a Triangle Sum to 180° Proof

Use transversals, vertical angles, and corresponding angles to rearrange those angle measures into a straight line, proving that they must add up to 180°. (5 min) [E](#) [MM](#)

## Algebra I: Algebra | Overview & History of Algebra

### Origins of Algebra

Explore how algebra began and where its underlying ideas come from. (7 min) [E](#) [MM](#)

### Abstract-Ness

Explore what abstraction is. (7 min) [E](#) [MM](#)

### The Beauty of Algebra

Learn why the abstraction of mathematics is so fundamental. (10 min) [E](#) [MM](#)

### Creativity Break: Why is Creativity Important in Algebra?

Students and professionals share what makes creativity so important in algebra. (2 min) [E](#) [MM](#)

### Intro to the Coordinate Plane

Learn about how Descartes created a system of two perpendicular axes (the x and y axes) which could be used to plot points in a plane. (11 min) [E](#) [MM](#)

### Why All the Letters in Algebra?

In algebra, we often want to work with general concepts instead of specific numbers. Using letters allows us to represent quantities that could change or that we don't know the value of yet. Letters can also be used to generalize formulas or equations. (3 min) [E](#) [MM](#)

## Algebra I: Algebra | Intro to Variables

### What is a Variable?

Variables in math are symbols, often letters, that represent different values in various situations. They help us understand and solve problems with changing values. (3 min) [E](#) [MM](#)

### Why Aren't We Using the Multiplication Sign?

In algebra, representing multiplication with variables can be tricky due to the similarity between the variable "x" and the multiplication symbol. (5 min) [E](#) [MM](#)

### Creativity Break: Why is Creativity Important in STEM Jobs?

Experts share why creativity plays an important role in STEM jobs. (2 min) [E](#) [MM](#)

### Evaluating an Expression with One Variable

Explore the expression  $5t+3$  to calculate the cost of participating in a hospital raffle fundraiser. (2 min) [E](#) [MM](#)

## Algebra I: Algebra | Combining Like Terms

### Intro to Combining Like Terms

Coefficients are the numbers in front of variables, and they can be added when the variables are the same. For example,  $2x + 3x$  equals  $5x$ . When dealing with different variables, such as  $x$  and  $y$ , add them separately, resulting in expressions like  $5x + 9y$ . (4 min) [E](#) [MM](#)

### Combining Like Terms with Negative Coefficients & Distribution

You've learned about order of operations and combining like terms. Let's layer the distributive property on top of this. (4 min) [E](#) [MM](#)

### Combining Like Terms with Negative Coefficients

This example of combining like terms in an expression gets a little hairy. Pay attention. (5 min) [E](#) [MM](#)

### Combining Like Terms with Rational Coefficients

Learn how to rewrite algebraic expressions by combining like terms. (5 min) [E](#) [MM](#)

### Equivalent Expressions

Learn how to find equivalent expressions by combining like terms and factoring. (2 min) [E](#) [MM](#)

## Algebra I: Algebra | Division by Zero

### Why Dividing by Zero is Undefined

Learn why dividing by zero is undefined. (4 min) [E](#) [MM](#)

### The Problem with Dividing Zero by Zero

Explore why  $0/0$  is undetermined. (3 min) [E](#) [MM](#)

### Undefined & Indeterminate Expressions

Using general mathematical considerations, we see why those are undefined and indeterminate problems. (8 min) [E](#) [MM](#)

## Algebra I: Algebra | Linear Equations with Variables on Both Sides

### Why We Do the Same Thing to Both Sides: Variable on Both Sides

Use a scale to try to achieve balance and help explain why we do the same thing to both sides of an equation, even when the variable appears on both sides. (3 min) [E](#) [MM](#)

## Intro to Equations with Variables on Both Sides

Learn to solve the equation  $2x + 3 = 5x - 2$ .  
(9 min) [E](#) [MM](#)

## Equations with Variables on Both Sides: $20 - 7x = 6x - 6$

Solve the equation  $20 - 7x = 6x - 6$ .  
(4 min) [E](#) [MM](#)

## Equation with Variables on Both Sides: Fractions

Solve the equation  $(3/4)x + 2 = (3/8)x - 4$ .  
(5 min) [E](#) [MM](#)

**Equation with the Variable in the Denominator** Solve the equation  $7 - 10/x = 2 + 15/x$ .  
(4 min) [E](#) [MM](#)

## Algebra I: Algebra | Analyzing Linear Equations

### Equations with Parentheses

Solve the equation  $-9 - (9x - 6) = 3(4x + 6)$  using the distributive property.  
(6 min) [E](#) [MM](#)

### Reasoning with Linear Equations

When we perform operations to manipulate equations, some operations produce equivalent equations, while others don't necessarily produce equivalent equations.  
(8 min) [E](#) [MM](#)

### Number of Solutions to Equations

Explore how some equations have one solution, others have no solutions, and still others have infinite solutions. (6 min) [E](#) [MM](#)

### Worked Example: Number of Solutions to Equations

Attempt to solve  $8(3x + 10) = 28x - 14 - 4x$  only to find that the equation has no solution. (2 min) [E](#) [MM](#)

## Creating an Equation with No Solutions

Explore how to complete the equation  $-11x + 4 = \_\_x + \_\_$  so that it has no solutions.  
(2 min) [E](#) [MM](#)

## Creating an Equation with Infinitely Many Solutions

Explore how to complete the equation  $4(x - 2) + x = 5x + \_\_$  so that it has infinitely many solutions. (2 min) [E](#) [MM](#)

## Linear Equations with Unknown Coefficients

Solve the equations  $ax + 3x = bx + 5$  and  $a(5 - x) = bx - 8$  for  $x$ . (6 min) [E](#) [MM](#)

## Algebra I: Algebra | Multi-Step Inequalities

### Inequalities with Variables on Both Sides

Solve the inequality  $-3p - 7 < p + 9$ , draw the solution on a number line, and check a few values to verify the solution. (6 min) [E](#) [MM](#)

### Inequalities with Variables on Both Sides (With Parentheses)

Solve the inequality  $5x + 7 > 3(x + 1)$ , draw the solution on a number line, and check a few values to verify the solution. (4 min) [E](#) [MM](#)

### Multi-Step Inequalities

Solve several multi-step linear inequalities. (8 min) [E](#) [MM](#)

### Using Inequalities to Solve Problems

Use inequalities to solve problems in each context. (4 min) [E](#) [MM](#)

## Algebra I: Algebra | Compound Inequalities

### Compound Inequalities: OR

Solve the compound inequality  $5z + 7 < 27$  OR  $-3z \leq 18$ . (4 min) [E](#) [MM](#)

### Compound Inequalities: AND

Solve the compound inequality  $3y + 7 < 2y$  AND  $4y + 8 > -48$ . (5 min) [E](#) [MM](#)

### A Compound Inequality with No Solution

Explore the compound inequality  $5x - 3 < 12$  AND  $4x + 1 > 25$  and find why there's no  $x$ -value that makes both inequalities true. (3 min) [E](#) [MM](#)

### Double Inequalities

Solve the double inequality  $-16 \leq 3x + 5 \leq 20$ , which is the same as the compound inequality  $-16 \leq 3x + 5$  AND  $3x + 5 \leq 20$ . (4 min) [E](#) [MM](#)

### Compound Inequalities Examples

Solve several compound linear inequalities. (12 min) [E](#) [MM](#)

## Algebra I: Algebra | Working with Units

### Intro to Dimensional Analysis

Explore how we can treat units of measurement algebraically and use these tools to convert between different units of the same quantity. (7 min) [E](#) [MM](#)

### Same Rate with Different Units

Explore how we can describe the rate 50 km per hour in a variety of different units, using dimensional analysis. (10 min) [E](#) [MM](#)

### Defining Appropriate Quantities for Modeling

Explore examples for different ways to define how quantities of interest are calculated in a modeling problem. (6 min) [E](#) [MM](#)

### Formulas and Units: Volume of a Pool

Explore how to use formulas to calculate real-world quantities and make them consistent. (3 min) [E](#) [MM](#)

### Formulas and Units: Comparing Rates

Explore how to use formulas to calculate real-world quantities and make them consistent. (4 min) [E](#) [MM](#)

**Reporting Measurements**

Discover the appropriate level of precision of different measurements in modeling problems. (6 min) [E](#) [MM](#)

**Using Units to Solve Problems: Toy Factory**

Find the value of toys produced at a factory using information that involves many different quantities, not all of which are useful for our problem. (3 min) [E](#) [MM](#)

**Using Units to Solve Problems: Road Trip**

Find the cost of fuel for a road trip, using information that involves many different quantities, not all of which are useful for our problem. (4 min) [E](#) [MM](#)

**Using Units to Solve Problems: Drug Dosage**

Explore this unit conversion word problem that deals with converting drug dosage units, something that is commonly done in hospitals. (11 min) [E](#) [MM](#)

**Algebra I: Algebra | Intro to 2-Variable Linear Equations****Two-Variable Linear Equations Intro**

Learn about a class of equations in two variables that's called "linear equations."

They are called that way because their graph is a line. (8 min) [E](#) [MM](#)

**Evaluating Expressions with Two Variables**

Explore how to evaluate expressions with multiple variables involves substituting given values for each variable and simplifying the expression. (3 min) [E](#) [MM](#)

**Evaluating Expressions with Two Variables: Fractions & Decimals**

Explore evaluating expressions with two variables involves substituting the given values for each variable and simplifying the expression. (3 min) [E](#) [MM](#)

**Solutions to 2-Variable Equations**

Learn more about ordered pairs and how to test solutions to 2-variable equations. (3 min) [E](#) [MM](#)

**Worked Example: Solutions to 2-Variable Equations**

Explore how to check if an ordered pair is a solution to a given equation. (3 min) [E](#) [MM](#)

**Completing Solutions to 2-Variable Equations**

Given a 2-variable equation and the x or y values of a solution, find the value of the other variable in the solution. (7 min) [E](#) [MM](#)

**Algebra I: Algebra | Slope****Intro to Slope**

Explore how to find the slope of a line. (7 min) [E](#) [MM](#)

**Positive & Negative Slope**

Analyze what it means for a slope to be positive or negative. (5 min) [E](#) [MM](#)

**Worked Example: Slope from Graph**

Learn how to calculate the slope of the line in a graph by finding the change in y and the change in x. (5 min) [E](#) [MM](#)

**Graphing a Line Given Point and Slope**

Practice graphing a line given its slope and a point the line passes through. (3 min) [E](#) [MM](#)

**Calculating Slope from Tables**

Practice calculating the slope of a line given some points on the line shown in a table. (3 min) [E](#) [MM](#)

**Slope of a Horizontal Line**

When two points have the same y-value, it means they lie on a horizontal line. The slope of such a line is 0, and you will also find this by using the slope formula. (5 min) [E](#) [MM](#)

**Horizontal & Vertical Lines**

Identify the equations and slope of horizontal and vertical lines. (5 min) [E](#) [MM](#)

**Algebra I: Algebra | X-Intercepts & Y-Intercepts****Intro to Intercepts**

Learn what x- and y-intercepts are. (7 min) [E](#) [MM](#)

**X-Intercept of a Line**

Determine the x-intercept of a linear equation from a graph. (2 min) [E](#) [MM](#)

**Intercepts from an Equation**

Find the x and y-intercepts of  $-5x + 4y = 20$ . (4 min) [E](#) [MM](#)

**Intercepts from a Table**

Find the y-intercept of the graph of a linear function given a table of values. (4 min) [E](#) [MM](#)

**Algebra I: Algebra | Applying Intercepts & Slopes****Slope, X-Intercept, Y-Intercept Meaning in Context**

Practice determining what each of the slope, x-intercept, and y-intercept represent in each linear relationship. (4 min) [E](#) [MM](#)

**Slope and Intercept Meaning in Context**

Practice determining which feature of a linear model (the slope, the x-intercept, or the y-intercept) is useful for answering a given question in context. (2 min) [E](#) [MM](#)

**Slope and Intercept Meaning from a Table**

Given a linear relationship in a table, graph the relationship to explore what the slope and intercepts mean in the given context. (7 min) [E](#) [MM](#)

### Finding Slope and Intercepts from Tables

Given a linear relationship in a table, practice finding the slope and intercepts.

(6 min) [E](#) [MM](#)

### Linear Functions Word Problem: Fuel

Draw the graph that represents this relationship when given a verbal description of a real-world relationship involving a truck's fuel consumption.

(6 min) [E](#) [MM](#)

### Comparing Linear Rates Example

Compare the positions of two creatures moving at constant speed and determine when one catches up with the other.

(8 min) [E](#) [MM](#)

## Algebra I: Algebra | Forms of Linear Equations

### Intro to Slope-Intercept Form

Learn about the slope-intercept form ( $y=mx+b$ ) of linear equations highlighting the slope ( $m$ ) and the y-intercept ( $b$ ) of a line. (9 min) [E](#) [MM](#)

### Slope and Y-Intercept from Equation

In an equation in slope-intercept form ( $y=mx+b$ ) the slope is  $m$  and the y-intercept is  $b$ . We can also rewrite certain equations to look more like slope-intercept form. For example,  $y=x$  can be rewritten as  $y=1x+0$ , so its slope is 1 and its y-intercept is 0.

(4 min) [E](#) [MM](#)

### Worked Examples: Slope-Intercept Intro

Explore and practice the relationship between slope, y-intercept, and linear equation in slope-intercept form.

(4 min) [E](#) [MM](#)

### Linear Equation Word Problems

Solve this linear equation word problem.

(4 min) [E](#) [MM](#)

### Graph from Slope-Intercept Equation

Graph a linear equation in slope-intercept form using the information given by that form. (3 min) [E](#) [MM](#)

### Slope-Intercept Equation from Graph

Learn to write equations in slope-intercept form for three different lines.

(11 min) [E](#) [MM](#)

### Slope-Intercept Equation from Slope & Point

Learn how to write an equation in slope-intercept form ( $y=mx+b$ ) for the line with a slope of  $-3/4$  that goes through the point  $(0,8)$ . (4 min) [E](#) [MM](#)

### Slope-Intercept Equation from Two Points

Explore how to write an equation of the line that passes through the points  $(-1,6)$  and  $(5,-4)$ . (7 min) [E](#) [MM](#)

### Constructing Linear Equations from Context

Given a written description of a linear relationship in some context, write an equation that represents the linear relationship described. (3 min) [E](#) [MM](#)

### Intro to Point-Slope Form

Learn about how point-slope is the general form  $y-y_1=m(x-x_1)$  for linear equations. It emphasizes the slope of the line and a point on the line (that is not the y-intercept). (6 min) [E](#) [MM](#)

### Point-Slope & Slope-Intercept Equations

Learn to rewrite an equation in point-slope form to be in slope-intercept form  $y=mx+b$ , to highlight the same line's slope and y-intercept. (7 min) [E](#) [MM](#)

### Intro to Linear Equation Standard Form

Explore the standard form for linear equations in two variables is  $Ax+By=C$ . (8 min) [E](#) [MM](#)

### Graphing a Linear Equation:

#### $5x+2y=20$

Graph graph a linear equation like  $5x + 2y = 20$  by rewriting it so  $y$  is isolated, then plugging in  $x$  values to find their corresponding  $y$ -values in a table.

(5 min) [E](#) [MM](#)

### Clarifying Standard Form Rules

Learn and clarify what standard form rules.

(5 min) [E](#) [MM](#)

### Converting from Slope-Intercept to Standard Form

Rewrite the slope-intercept equation  $y=2/3x+4/7$  in standard form.

(5 min) [E](#) [MM](#)

### Slope from Equation

Find the slope of a line given its equation, using many forms of equations.

(6 min) [E](#) [MM](#)

### Writing Linear Equations in all Forms

Find the equation of a line that passes through  $(-3,6)$  and  $(6,0)$  in point-slope, slope-intercept, and standard form.

(8 min) [E](#) [MM](#)

## Algebra I: Algebra | Intro to Systems of Equations

### Systems of Equations: Trolls, Tolls (Part 1)

Solve this troll of a problem by setting up a system of equations. (7 min) [E](#) [MM](#)

### Systems of Equations: Trolls, Tolls (Part 2)

Solve this troll of a problem by setting up a system of equations. (6 min) [E](#) [MM](#)

### Testing a Solution to a System of Equations

Check whether  $(-1,7)$  is a solution of the system:  $x+2y=13$  and  $3x-y=-11$ .

(3 min) [E](#) [MM](#)

**Systems of Equations with Graphing:**

**$y=7/5x-5$  &  $y=3/5x-1$**

Graph the following system of equations and solve it by looking for the intersection point:  $y=7/5x-5$  and  $y=3/5x-1$ . (2 min) [E](#) [MM](#)

**Systems of Equations with Graphing:****Exact & Approximate Solutions**

Solve a system of two linear equations in standard form, and then approximate the solution of a system whose solution isn't clearly visible. (6 min) [E](#) [MM](#)

**Setting up a System of Equations from Context Example (Pet Weights)**

Practice writing a system of linear equations that fits the constraints in a word problem. (2 min) [E](#) [MM](#)

**Setting up a System of Linear****Equations Example (Weight and Price)**

Practice writing a system of linear equations that fits the constraints in a word problem. (4 min) [E](#) [MM](#)

**Interpreting Points in Context of Graphs of Systems**

Given a graph of a system of equations and a context, practice interpreting what various points represent in that system. (6 min) [E](#) [MM](#)

## Algebra I: Algebra | Solving Systems of Equations with Substitution

**Systems of Equations with****Substitution: Potato Chips**

Learn to solve a system of equations using substitution. (5 min) [E](#) [MM](#)

**Systems of Equations with****Substitution:  $-3x-4y=-2$  &  $y=2x-5$** 

Learn to solve the system of equations  $-3x-4y=-2$  and  $y=2x-5$  using substitution. (4 min) [E](#) [MM](#)

**Systems of Equations with****Substitution: Coins**

Solve a word problem about the number of nickels and quarters in a piggy bank by creating a system of equations and solving it. (6 min) [E](#) [MM](#)

## Algebra I: Algebra | Solving Systems of Equations with Elimination

**Systems of Equations with****Elimination: King's Cupcakes**

Use simple elimination to figure out how many cupcakes children and adults eat. (9 min) [E](#) [MM](#)

**Elimination Strategies**

Practice identifying strategies for eliminating variables in a system of equations. (7 min) [E](#) [MM](#)

**Systems of Equations with****Elimination:  $x-4y=-18$  &  $-x+3y=11$** 

Solve the following system of equations by eliminating  $x$ :  $x-4y=-18$  and  $-x+3y=11$ . (6 min) [E](#) [MM](#)

**Systems of Equations with****Elimination: Potato Chips**

Solve another system of equations using elimination. (9 min) [E](#) [MM](#)

**Systems of Equations with Elimination and Manipulation**

Explore how to slightly manipulate a system of equations before we can solve it using the elimination method. (12 min) [E](#) [MM](#)

## Algebra I: Algebra | Equivalent Systems of Equations

**Why can We Subtract One Equation from the Other in a System of Equations?**

Revisit the example of the scale to help explain why we can subtract one equation from the other in a system of equations. (8 min) [E](#) [MM](#)

**Worked Example: Equivalent Systems of Equations**

Analyze a couple systems of equations and determine whether they have the same solution as a third given system. (6 min) [E](#) [MM](#)

**Worked Example: Non-Equivalent Systems of Equations**

Analyze a couple of systems of equations and determine whether they have the same solution as a third given system. (5 min) [E](#) [MM](#)

**Reasoning with Systems of Equations**

When we perform operations on a system of equations, some operations produce an equivalent system, while others don't necessarily produce an equivalent system. When we're solving a system of equations, we need to use operations that guarantee equivalence. (9 min) [E](#) [MM](#)

## Algebra I: Algebra | Number of Solutions to Systems of Equations

**Systems of Equations Number of Solutions: Fruit Prices (Part 1)**

Explore an example of a system of equations that has no solution. (9 min) [E](#) [MM](#)

## Systems of Equations Number of Solutions: Fruit Prices (Part 2)

Explore an example of a system of equations that has infinite solutions.

(7 min) [E](#) [MM](#)

## Solutions to Systems of Equations: Consistent vs. Inconsistent

Learn about a consistent system of equations that has at least one solution, and an inconsistent system that has no solution. (6 min) [E](#) [MM](#)

## Solutions to Systems of Equations: Dependent vs. Independent

Explore how a dependent system of equations has infinite solutions, and an independent system has a single solution. (5 min) [E](#) [MM](#)

## Number of Solutions to a System of Equations

Given three lines on the coordinate plane, identify one system of two lines that has a single solution and one system that has no solution. (3 min) [E](#) [MM](#)

## Number of Solutions to a System of Equations Graphically

Determine how many solutions the following system of equations has by considering its graph:  $10x - 2y = 4$  and  $10x - 2y = 16$ . (7 min) [E](#) [MM](#)

## Number of Solutions to a System of Equations Algebraically

Solve several examples where he reasons about the number of solutions of systems of equations using algebraic reasoning. (6 min) [E](#) [MM](#)

## How Many Solutions Does a System of Linear Equations Have if There are At Least Two?

Discover the answer to how many solutions a system of linear equations has. (2 min) [E](#) [MM](#)

## Algebra I: Algebra | Systems of Equations Word Problems

### Age Word Problem: Imran

Solve the following age word problem: In 40 years, Imran will be 11 times as old as he is right now. How old is he right now? (4 min) [E](#) [MM](#)

### Age Word Problem: Ben & William

Solve the following age word problem: William is 4 times as old as Ben. 12 years ago, William was 7 times as old as Ben. How old is Ben now? (6 min) [E](#) [MM](#)

### Age Word Problem: Arman & Diya

Solve the following age word problem: Arman is 18. Diya is 2. How many years will it take for Arman to be 3 times as old as Diya? (5 min) [E](#) [MM](#)

## System of Equations Word Problem: Walk & Ride

Solve a problem about walking and bus distances to school. (7 min) [E](#) [MM](#)

## System of Equations Word Problem: No Solution

Solve a problem about a toy factory that has no viable solution, which means the information describes an impossible situation. (5 min) [E](#) [MM](#)

## System of Equations Word Problem: Infinite Solutions

Solve a problem about a vegetable farmer that has infinite solutions, which means there's not enough information to find a single solution. (5 min) [E](#) [MM](#)

## Systems of Equations with Elimination: TV & DVD

Solve a word problem about the weights of TVs and DVDs by creating a system of equations and solving it. (6 min) [E](#) [MM](#)

## Systems of Equations with Elimination: Apples and Oranges

Solve a word problem about the price of apples and oranges by creating a system of equations and solving it. (5 min) [E](#) [MM](#)

## Systems of Equations with Substitution: Coins

Solve a word problem about the number of nickels and quarters in a piggy bank by creating a system of equations and solving it. (6 min) [E](#) [MM](#)

## Systems of Equations with Elimination: Coffee and Croissants

Solve a word problem about the price of coffee and a croissant by creating a system of equations and solving it. (4 min) [E](#) [MM](#)

## Algebra I: Algebra | Testing & Graphing Two-Variable Inequalities

### Testing Solutions to Inequalities

Check if the ordered pairs (3,5) and (1,-7) are solutions of the inequality  $5x - 3y \geq 25$ . (6 min) [E](#) [MM](#)

### Testing Solutions to Systems of Inequalities

Check whether the ordered pair (2,5) is a solution of the following system:  $y \geq 2x + 1$  and  $x > 1$ . (1 min) [E](#) [MM](#)

### Intro to Graphing Two-Variable Inequalities

Learn how to graph two-variable linear inequalities like  $y \leq 4x + 3$ . (8 min) [E](#) [MM](#)

### Graphing Two-Variable Inequalities

Graph the inequality  $y < 3x + 5$ . (3 min) [E](#) [MM](#)

### Two-Variable Inequalities from Their Graphs

Analyze the given graph to find the two-variable inequality it represents. (3 min) [E](#) [MM](#)

### Intro to Graphing Systems of Inequalities

Learn how to graph systems of two-variable linear inequalities, like " $y > x - 8$  and  $y < 5 - x$ ". (6 min) [E](#) [MM](#)

**Graphing Systems of Inequalities**

Graph the solution set of the system

" $y \geq 2x + 1$  and  $y < 2x - 5$  and  $x > 1$ ". (3 min) [E](#) [MM](#)

## Algebra I: Algebra | Modeling with Linear Inequalities

**Writing Two-Variable Inequalities****Word Problem**

Solve a word problem about scores in a

chess tournament by creating a

two-variable linear inequality. (2 min) [E](#) [MM](#)

**Solving Two-Variable Inequalities****Word Problem**

Given a two-variable linear inequality that

models a context about watering plants,

find how many flowers can be watered.

(4 min) [E](#) [MM](#)

**Interpreting Two-Variable Inequalities****Word Problem**

Analyze a two-variable linear inequality

that models a context about YouTube

videos. (4 min) [E](#) [MM](#)

**Modeling with Systems of Inequalities**

Model a real-world context into an

algebraic system of linear inequalities and

graph it. (10 min) [E](#) [MM](#)

**Writing Systems of Inequalities Word****Problem**

Model a word problem about baking

cupcakes and muffins by creating a system

of linear inequalities. (4 min) [E](#) [MM](#)

**Solving Systems of Inequalities Word****Problem**

Given a system of linear inequalities that

models a context about making chairs and

tables, find how many can be made.

(4 min) [E](#) [MM](#)

**Graphs of Systems of Inequalities****Word Problem**

Given the graph of a two-variable linear

inequality that models a context about

chopping vegetables, find if there is time to

chop them. (4 min) [E](#) [MM](#)

**Graphs of Two-Variable Inequalities****Word Problem**

Given the graph of a two-variable linear

inequality that models a context about dog

biscuits, find if the dog can get enough

biscuits. (5 min) [E](#) [MM](#)

## Algebra I: Algebra | Evaluating Functions

**What is a Function?**

Explore examples of various kinds of

functions. (8 min) [E](#) [MM](#)

**Worked Example: Evaluating****Functions from Equation**

Learn how to evaluate  $f(x) = 49 - x^2$  at  $x = 5$ .

(1 min) [E](#) [MM](#)

**Worked Example: Evaluating****Functions from Graph**

Evaluate a function at  $x = -1$  using the graph

of that function. (1 min) [E](#) [MM](#)

**Evaluating Discrete Functions**

Given the graph of a discrete function, show

how to evaluate the function for a few

different values. (3 min) [E](#) [MM](#)

**Worked Example: Evaluating****Expressions with Function Notation**

Evaluate  $-2 \cdot f(-6) + g(1)$  given the graphs of  $f$

and  $g$ . (1 min) [E](#) [MM](#)

**Worked Example: Matching an Input****to a Function's Output (Equation)**

Find the input value for which  $f(t) = 13$ ,

given that  $f(t) = -2t + 5$ . (1 min) [E](#) [MM](#)

**Worked Example: Matching an Input****to a Function's Output (Graph)**

Find the input value for which  $g(x) = -2$  given

the graph of  $g$ . (1 min) [E](#) [MM](#)

**Worked Example: Two Inputs with the Same Output (Graph)**

Find the input value other than  $-5$  for which  $f(x) = f(-5)$ , given the graph of  $f$ .

(2 min) [E](#) [MM](#)

**Equations vs. Functions**

Explore the difference between equations

and functions. (4 min) [E](#) [MM](#)

**Obtaining a Function from an****Equation**

Learn how to obtain a function from an

equation. (3 min) [E](#) [MM](#)

**Function Notation Word Problem:****Bank**

Learn how to interpret expressions that

contain a function within a real-world

context. (3 min) [E](#) [MM](#)

**Function Notation Word Problem:****Beach**

Learn how to interpret expressions that

contain a function within a real-world

context. (2 min) [E](#) [MM](#)

## Algebra I: Algebra | Intro to the Domain & Range of a Function

**Intervals and Interval Notation**

Learn about intervals, which are bounded

sets of numbers and are very useful when

describing domain and range. (9 min) [E](#) [MM](#)

**What is the Domain of a Function?**

Explore how functions assign outputs to

inputs. (7 min) [E](#) [MM](#)

**What is the Range of a Function?**

Learn the range of a function is the set of

all possible outputs the function can

produce. (7 min) [E](#) [MM](#)

**Worked Example: Domain and Range****from Graph**

Finding the domain and the range of a

function that is given graphically.

(4 min) [E](#) [MM](#)

### Determining Whether Values are in Domain of Function

Discover how to test whether a value is or isn't in the domain of a function.

(5 min) [E](#) [MM](#)

### Examples Finding the Domain of Functions

Discover how to algebraically find the domain of a few different functions.

(4 min) [E](#) [MM](#)

### Worked Example: Determining Domain Word Problem (Real Numbers)

Determine the domain of a function that models the height of a plant over time.

(3 min) [E](#) [MM](#)

### Worked Example: Determining Domain Word Problem (Positive Integers)

Determine the domain of a function that models the price of candy bars.

(3 min) [E](#) [MM](#)

### Worked Example: Determining Domain Word Problem (All Integers)

Determine the domain of a function that models going up and down a ladder.

(5 min) [E](#) [MM](#)

## Algebra I: Algebra | Recognizing Functions

### Recognizing Functions from Graph

Explore whether a given set of points can represent a function. (4 min) [E](#) [MM](#)

### Does a Vertical Line Represent a Function?

Explain why a vertical line doesn't represent a function (2 min) [E](#) [MM](#)

### Recognizing Functions from Table

Check whether a table of people and their heights can represent a function that assigns a height to a name. (5 min) [E](#) [MM](#)

### Recognizing Functions from Verbal Description

Check whether  $y$  can be described as a function of  $x$  if  $y$  is always three more than twice  $x$ . (2 min) [E](#) [MM](#)

### Recognizing Functions from Verbal Description Word Problem

Check whether a description of the price of an order can be represented as a function of the shipping cost. (3 min) [E](#) [MM](#)

## Algebra I: Algebra | Interpreting Properties & Features of Functions

### Introduction to Minimum and Maximum Points

Explain all about minimum and maximum points, both absolute and relative.

(6 min) [E](#) [MM](#)

### Worked Example: Absolute and Relative Extrema

How to identify relative and absolute extrema in the graph of a function.

(5 min) [E](#) [MM](#)

### Increasing, Decreasing, Positive or Negative Intervals

Function values can be positive or negative, and they can increase or decrease as the input increases. Here we introduce these basic properties of functions. (6 min) [E](#) [MM](#)

### Worked Example: Positive & Negative Intervals

Finding the positive or negative intervals of a function from its graph. (1 min) [E](#) [MM](#)

### Graph Interpretation Word Problem: Temperature

When a function models a real-world context, we can learn a lot about the content from the function's graph.

(4 min) [E](#) [MM](#)

### Graph Interpretation Word Problem: Basketball

Interpret the  $y$ -intercept of a graph that models a basketball free throw.

(4 min) [E](#) [MM](#)

## Algebra I: Algebra | Average Rate of Change

### Intro to Average Rate of Change

Explore the average rate of change of a function over an interval. (6 min) [E](#) [MM](#)

### Worked Example: Average Rate of Change from Graph

Finding the interval in a function's graph where the function has an average rate of change of  $-4$ . (2 min) [E](#) [MM](#)

### Worked Example: Average Rate of Change from Table

Finding the average rate of change of a function over the interval  $-5 < x < -2$ , given a table of values of the function.

(2 min) [E](#) [MM](#)

### Average Rate of Change Word Problem: Table

Compare the average rate of change of temperature over different time periods.

(4 min) [E](#) [MM](#)

### Average Rate of Change Word Problem: Graph

Find the average rate of descent of a skydiver over a specific time interval.

(7 min) [E](#) [MM](#)

## Algebra I: Algebra | Intro to Inverse Functions

### Intro to Inverse Functions

Explore how to algebraically find the inverse of a function and look at the graphical relationship between inverse functions. (9 min) [E](#) [MM](#)

**Inputs & Outputs of Inverse Functions**

Explore if  $f(a)=b$ , then  $f^{-1}(b)=a$ , or in other words, the inverse function of output  $a$  when its input is  $b$ . (6 min) [E](#) [MM](#)

**Graphing the Inverse of a Linear Function**

Given a line segment on the coordinate plane, and he graphs the inverse of the function represented by that segment. (2 min) [E](#) [MM](#)

**Finding Inverse Functions: Linear**

Find the inverses of  $f(x)=-x+4$  and  $g(x)=-2x-1$ . (7 min) [E](#) [MM](#)

**Algebra I: Algebra | Arithmetic Sequences****Sequences Intro**

Explore and discover how Sequences are ordered lists of numbers (called "terms"), like 2,5,8. (8 min) [E](#) [MM](#)

**Intro to Arithmetic Sequences**

Discover arithmetic sequences and their main features, the initial term and the common difference. (7 min) [E](#) [MM](#)

**Extending Arithmetic Sequences**

Discover how to extend the arithmetic sequences -8, -14, -20, -26,... and 2, -1, -4, -7, -10,... to find their next terms. (1 min) [E](#) [MM](#)

**Using Arithmetic Sequences Formulas**

Find the terms of arithmetic sequences using their explicit and recursive formulas. (4 min) [E](#) [MM](#)

**Worked Example: Using Recursive Formula for Arithmetic Sequence**

Practice finding the 4th term in a recursively defined arithmetic sequence. (3 min) [E](#) [MM](#)

**Recursive Formulas for Arithmetic Sequences**

Find the recursive formula of the arithmetic sequence 4,  $3\frac{1}{2}$ ,  $3\frac{3}{4}$ ,  $3\frac{1}{2}$ ,... (3 min) [E](#) [MM](#)

**Explicit Formulas for Arithmetic Sequences**

Find explicit formulas of arithmetic sequences given the first few terms of those sequences. (6 min) [E](#) [MM](#)

**Arithmetic Sequence Problem**

Find the 100th term in the sequence 15, 9, 3, -3... (6 min) [E](#) [MM](#)

**Converting Recursive & Explicit Forms of Arithmetic Sequences**

Find the solution when given an arithmetic sequence in explicit form and convert it to recursive form. (6 min) [E](#) [MM](#)

**Algebra I: Algebra | Geometric Sequences****Intro to Geometric Sequences**

Discover geometric sequences and their main features, the initial term and the common ratio. (11 min) [E](#) [MM](#)

**Extending Geometric Sequences**

Find the next term in the geometric sequence  $-1/32$ ,  $1/8$ ,  $-1/2$ , 2,... (2 min) [E](#) [MM](#)

**Using Explicit Formulas of Geometric Sequences**

Find the 5th term in the geometric sequence whose explicit formula is  $3(-\frac{1}{4})^{(i-1)}$ . (2 min) [E](#) [MM](#)

**Using Recursive Formulas of Geometric Sequences**

Find the 4th term in the sequence whose recursive formula is  $a(1)=-\frac{1}{8}$ ,  $a(i)=2a(i-1)$ . (4 min) [E](#) [MM](#)

**Explicit & Recursive Formulas for Geometric Sequences**

Find an explicit formula of a geometric sequence given the first few terms of the sequences. (6 min) [E](#) [MM](#)

**Converting Recursive & Explicit Forms of Geometric Sequences**

Solve the following problem: The explicit formula of a geometric sequence is  $g(x)=9\cdot 8^{(x-1)}$ . (6 min) [E](#) [MM](#)

**Algebra I: Algebra | More with Sequences****Sequences Word Problems**

Solve two-word problems about modeling real-world situations with arithmetic and geometric sequences. (6 min) [E](#) [MM](#)

**Evaluating Sequences in Recursive Form**

Show how to evaluate a sequence that is defined with a recursive formula. (9 min) [E](#) [MM](#)

**Sequences and Domain**

Learn how to generate the same sequence with different functions and different domains. (6 min) [E](#) [MM](#)

**Algebra I: Algebra | Absolute Value Functions****Shifting Absolute Value Graphs**

Explore how the graph of  $y=|x-h|+k$  is the graph of  $y=|x|$  shifted  $h$  units to the right and  $k$  units up. (6 min) [E](#) [MM](#)

**Scaling & Reflecting Absolute Value Functions: Equation**

Find the equation of an absolute value function from a description of the transformation performed on  $y=|x|$ . (4 min) [E](#) [MM](#)

**Scaling & Reflecting Absolute Value Functions: Graph**

Find the equation of an absolute value function from its graph. (3 min) [E](#) [MM](#)

**Graphing Absolute Value Functions**

Explore how to graph any absolute value equation of the form  $y=k|x-a|+h$  by thinking about function transformations (horizontal shifts, vertical shifts, reflections, and scalings). (6 min) [E](#) [MM](#)

**Algebra I: Algebra | Piecewise Functions****Introduction to Piecewise Functions**

Learn about how a piecewise function is a function built from pieces of different functions over different intervals.

(4 min) [E](#) [MM](#)

**Worked Example: Evaluating Piecewise Functions**

Learn to evaluate piecewise functions (find the value of the function) by using their formulas or their graphs. (4 min) [E](#) [MM](#)

**Worked Example: Graphing Piecewise Functions**

Learn to graph a piecewise function by graphing each individual piece.

(4 min) [E](#) [MM](#)

**Worked Example: Domain & Range of Step Function**

Learn to find the domain and range of a piecewise function that is constant in each segment. Such functions are called "step functions". (3 min) [E](#) [MM](#)

**Worked Example: Domain & Range of Piecewise Linear Functions**

Finding the domain and range of a piecewise function where each segment is linear. (7 min) [E](#) [MM](#)

**Algebra I: Algebra | Exponents & Radicals****Multiplying & Dividing Powers (Integer Exponents)**

Explore how any base and any integer exponents  $n$  and  $m$ ,  $a^n \cdot a^m = a^{n+m}$ . For any nonzero base,  $a^n / a^m = a^{n-m}$ . (5 min) [E](#) [MM](#)

**Powers of Products & Quotients (Integer Exponents)**

Explore for any integers  $a$  and  $b$  and for any exponents  $n$ ,  $(a \cdot b)^n = a^n \cdot b^n$  and  $(a/b)^n = a^n / b^n$ . (7 min) [E](#) [MM](#)

**Intro to Square Roots**

Learn about the square root symbol (the principal root) and what it means to find a square root. (6 min) [E](#) [MM](#)

**Understanding Square Roots**

Learn how square root means what number multiplied by itself will result in the given number. (1 min) [E](#) [MM](#)

**Square Root of Decimal**

Learn how to find the square root of a decimal number. (3 min) [E](#) [MM](#)

**Intro to Cube Roots**

Learn the meaning of cube roots and how to find them. Also learn how to find the cube root of a negative number.

(8 min) [E](#) [MM](#)

**5th Roots**

Learn about 5th roots and how to find them. (4 min) [E](#) [MM](#)

**Algebra I: Algebra | Exponential Growth & Decay****Intro to Exponential Functions**

An exponential function represents the relationship between an input and output, where we use repeated multiplication on an initial value to get the output for any given input. (8 min) [E](#) [MM](#)

**Exponential vs. Linear Growth**

For constant increments in  $x$ , a linear growth would increase by a constant difference, and an exponential growth would increase by a constant ratio.

(3 min) [E](#) [MM](#)

**Exponential vs. Linear Models: Verbal**

Explore how to look at the type of change over time to see if the given example represents linear or exponential growth.

(3 min) [E](#) [MM](#)

**Exponential vs. Linear Models: Table**

Determine whether real world model is linear or exponential, where the model is given as a table. (3 min) [E](#) [MM](#)

**Exponential Expressions Word Problems (Numerical)**

Given the description of a real-world context, learn to write a calculation of a certain measure. (5 min) [E](#) [MM](#)

**Initial Value & Common Ratio of Exponential Functions**

Explore how an exponential function of the form  $f(x) = a \cdot b^x$ , the initial value is usually taken to be the value of  $f(0)$ , or " $a$ ".

(5 min) [E](#) [MM](#)

**Exponential Expressions Word Problems (Algebraic)**

Given a real-world context that involves repeated multiplication, model it with an exponential function. (3 min) [E](#) [MM](#)

**Interpreting Exponential Expression Word Problem**

Given an exponential function that models a real-world context, interpret it to see what each part of the function represents in the real world. (3 min) [E](#) [MM](#)

**Exponential Function Graph**

Learn to graph an exponential function, like  $y=5^x$ , by picking a few inputs ( $x$ -values) and finding their corresponding outputs ( $y$ -values). (5 min) [E](#) [MM](#)

**Graphs of Exponential Growth**

Identifying which graph represents a given exponential function. (4 min) [E](#) [MM](#)

## Exponential vs. Linear Growth Over Time

Compare linear and exponential growth and see that over time, \*any\* exponential growth will surpass \*any\* linear growth, no matter how steep it is. (5 min) [E](#) [MM](#)

## Exponential Decay Intro

Explore how in an exponential growth function, the factor is greater than 1, so the output will increase (or "grow") over time. - In an exponential decay function, the factor is between 0 and 1, so the output will decrease (or "decay") over time.

(8 min) [E](#) [MM](#)

## Graphing Exponential Growth & Decay

Explore graphing the exponential functions  $y=27 \cdot (\frac{1}{3})^x$  and  $y=-30 \cdot 2^x$ . (4 min) [E](#) [MM](#)

## Writing Functions with Exponential Decay

Explore how to write a function to model exponential decay in a context.

(4 min) [E](#) [MM](#)

## Writing Exponential Functions

Learn to write the exponential function whose initial value is -2 and common ratio is  $\frac{1}{7}$ . (2 min) [E](#) [MM](#)

## Writing Exponential Functions from Tables

Explore the difference of a linear equation can be thought of as representing repeated addition on an initial value, while an exponential equation can be thought of as representing repeated multiplication on an initial value. (5 min) [E](#) [MM](#)

## Writing Exponential Functions from Graphs

Given a graph of an exponential curve, we can write an exponential function in the form  $y=ab^x$  by identifying the common ratio (b) and y-intercept (a) in the graph. (7 min) [E](#) [MM](#)

## Analyzing Tables of Exponential Functions

Learn how to write an equation for an exponential function from a table of values:

1. (7 min) [E](#) [MM](#)

## Analyzing Graphs of Exponential Functions

Given the graph of an exponential function, find the formula of the function and a value that is outside the graph. (4 min) [E](#) [MM](#)

## Analyzing graphs of Exponential Functions: Negative Initial Value

Given the graph of an exponential function with a negative initial value, find the formula of the function and solve an equation. (6 min) [E](#) [MM](#)

## Modeling with Basic Exponential Functions Word Problem

Solve a word problem where he models the growth of a speeding ticket fine over time as an exponential function, and then interprets this model. (6 min) [E](#) [MM](#)

## Linear vs. Exponential Growth: From Data (Example 1)

Construct functions that model the growth of trees over time and decide whether the function is linear or exponential.

(6 min) [E](#) [MM](#)

## Linear vs. Exponential Growth: From Data (Example 2)

Construct a function that models cooling water and decides whether the function is linear or exponential. (7 min) [E](#) [MM](#)

## Algebra I: Algebra | Intro to Polynomials

### Polynomials Intro

Polynomials are sums of terms of the form  $k \cdot x^n$ , where k is any number and n is a positive integer. For example,  $3x+2x-5$  is a polynomial. (11 min) [E](#) [MM](#)

## Multiply Monomials by Polynomials: Area Model

Use an area model to multiply a polynomial by a single term. (4 min) [E](#) [MM](#)

## Algebra I: Algebra | Multiplying Binomials

### Multiplying Binomials: Area Model

Express the area of a rectangle whose height is  $x+2$  and width is  $x+3$ .

(4 min) [E](#) [MM](#)

### Multiplying Binomials Intro

Express  $(x-4)(x+7)$  as the standard trinomial  $x^2+3x-28$  and discusses how the general product  $(x+a)(x+b)$  can be written as  $x^2+(a+b)x+a \cdot b$ . (5 min) [E](#) [MM](#)

### Multiplying Binomials

Express the product  $(3x+2)(5x-7)$  as  $15x^2-11x-14$ . (6 min) [E](#) [MM](#)

### Special Products of the Form

#### $(x+a)(x-a)$

Explore the difference of square expressions. For example,  $(x+3)(x-3)$  is expanded as  $x^2-9$ . (5 min) [E](#) [MM](#)

### Squaring Binomials of the Form $(x+a)^2$

Explore the perfect square expressions. For example,  $(x+7)^2$  is expanded as  $x^2+14x+49$ . (6 min) [E](#) [MM](#)

### Special Products of the Form

#### $(ax+b)(ax-b)$

Explore the difference of squares  $(2x+8)(2x-8)$  as  $4x^2-64$ . (4 min) [E](#) [MM](#)

### Squaring Binomials of the Form

#### $(ax+b)^2$

Explore the perfect square  $(7x+10)^2$  as  $49x^2+140x+100$ . (3 min) [E](#) [MM](#)

## Algebra I: Algebra | Factoring Quadratics

### Intro to Factors & Divisibility

Discover what it means for a polynomial to be a factor of another polynomial, and what it means for a polynomial to be divisible by another polynomial. (5 min) [E](#) [MM](#)

### Factoring with the Distributive Property

Explore how to factor the expression  $4x+18$  into the expression  $2(2x+9)$ . (3 min) [E](#) [MM](#)

### Factoring Quadratics as $(x+a)(x+b)$ (Example 1)

Factor  $x^2-3x-10$  as  $(x+2)(x-5)$  using the sum-product form:

$$(x+a)(x+b)=x^2+(a+b)x+a*b. \text{ (6 min) } [E](#) [MM](#)$$

### Factoring Quadratics as $(x+a)(x+b)$ (Example 2)

Factor  $x^2-14x+40$  as  $(x-4)(x-10)$  and  $x^2-x-12$  as  $(x+3)(x-4)$ . (4 min) [E](#) [MM](#)

### More Examples of Factoring Quadratics as $(x+a)(x+b)$

Explore these different examples of factoring. (16 min) [E](#) [MM](#)

### Factoring Quadratics with a Common Factor

Learn to factor quadratics by first pulling out a common factor so the result looks like  $a(x+b)(x+c)$ . (3 min) [E](#) [MM](#)

### Factoring Completely with a Common Factor

Learn to factor quadratics by first pulling out a common factor so the result looks like  $a(x+b)(x+c)$ . (4 min) [E](#) [MM](#)

### Intro to Grouping

Explore the method of grouping, which is very useful in factoring quadratics whose leading coefficient is not 1. (14 min) [E](#) [MM](#)

### Factoring Quadratics by Grouping

Factor  $4y^2+4y-15$  as  $(2y-3)(2y+5)$  by grouping. (4 min) [E](#) [MM](#)

### Factoring Quadratics: Common Factor + Grouping

Factor  $35k^2+100k-15$  as  $5(k+3)(7k-1)$ . (5 min) [E](#) [MM](#)

### Factoring Quadratics: Negative Common Factor + Grouping

Factor  $-12f^2-38f+22$  as  $-2(2f-1)(3f+11)$ . (5 min) [E](#) [MM](#)

### Difference of Squares Intro

Learn that when an expression can be viewed as the difference of two perfect squares, i.e.  $a^2-b^2$ , then we can factor it as  $(a+b)(a-b)$ . (5 min) [E](#) [MM](#)

### Factoring Difference of Squares: Leading Coefficient $\neq 1$

Factor  $45x^2-125$  as  $5(3x+5)(3x-5)$ . (2 min) [E](#) [MM](#)

### Factoring Difference of Squares: Analyzing Factorization

Analyze the two different factorizations of  $16x^2-64$  and determine whether they are correct. (3 min) [E](#) [MM](#)

### Factoring Difference of Squares: Shared Factors

Find the binomial factor shared by  $m^2-4m-45$  and  $6m^2-150$ . (4 min) [E](#) [MM](#)

### Perfect Square Factorization Intro

Learn when an expression has the general form  $a^2+2ab+b^2$ , then we can factor it as  $(a+b)^2$ . (5 min) [E](#) [MM](#)

### Factoring Perfect Squares

Factor  $25x^2-30x+9$  as  $(5x-3)^2$  or as  $(-5x+3)^2$ . (5 min) [E](#) [MM](#)

### Identifying Perfect Square Form

Explore how we can identify that a trinomial has the "perfect square" form. (4 min) [E](#) [MM](#)

### Factoring Perfect Squares: Negative Common Factor

Learn to factor  $-4t^2-12t-9$  as  $-1(2t+3)^2$ . (4 min) [E](#) [MM](#)

### Factoring Perfect Squares: Missing Values

Analyze the factorization of  $x^2+5x+c$  as  $(x+d)^2$  to find the values of the missing coefficients  $c$  and  $d$ . (3 min) [E](#) [MM](#)

### Factoring Perfect Squares: Shared Factors

Find the binomial factor shared by  $4x^2+12x+9$  and  $4x^2-9$ . (5 min) [E](#) [MM](#)

### Strategy in Factoring Quadratics (Part 1)

Explore how to think strategically about which method is useful for a given quadratic expression we want to factor. (7 min) [E](#) [MM](#)

### Strategy in Factoring Quadratics (Part 2)

Explore how to think strategically about which method is useful for a given quadratic expression we want to factor. (8 min) [E](#) [MM](#)

## Algebra I: Algebra | Intro to Parabolas

### Parabolas Intro

Learn and explore all about parabolas and their shared characteristics. (8 min) [E](#) [MM](#)

### Interpreting a Parabola in Context

Given a parabola that models a context, learn to relate key features of the parabola, like the y-intercept, vertex, and x-intercepts. (3 min) [E](#) [MM](#)

### Interpret a Quadratic Graph

Interpret what the features of a graph of a quadratic model mean in terms of a given context. (3 min) [E](#) [MM](#)

## Algebra I: Algebra | Quadratics in Factored Form & Vertex Form

### Zero Product Property

Learn that the zero product property states that if  $a \cdot b = 0$  then either  $a$  or  $b$  equal zero. (7 min) [E](#) [MM](#)

**Graphing Quadratics in Factored Form**

Analyze the quadratic function in factored form to find the x-intercepts of the graph as well as the vertex. (6 min) [E](#) [MM](#)

**Quadratic Word Problems (Factored Form)**

Solve a problem where a quadratic function (given in factored form) models the height of a launched rocket. (6 min) [E](#) [MM](#)

**Vertex Form Introduction**

Discover one of the common forms for quadratic functions is called vertex form, because it highlights the coordinates of the vertex of the function's graph. (6 min) [E](#) [MM](#)

**Graphing Quadratics: Vertex Form**

Learn how to graph any quadratic function that is given in vertex form. (4 min) [E](#) [MM](#)

**Quadratic Word Problems (Vertex Form)**

Given a quadratic function that models the height of an object being launched from a platform, analyze the function to answer questions like "what is the height of the platform?" or "when does the object reach its maximum height?". (7 min) [E](#) [MM](#)

**Algebra I: Algebra | Solving Quadratics by Taking the Square Root****Solving Quadratics by Taking Square Roots**

Solve the equation  $2x^2+3=75$  by isolating  $x^2$  and taking the square root of both sides. (3 min) [E](#) [MM](#)

**Solving Quadratics by Taking Square Roots Examples**

Solve the equation  $(x+3)^2-4=0$  and finds the x-intercepts of  $f(x)=(x-2)^2-9$ . (5 min) [E](#) [MM](#)

**Quadratics by Taking Square Roots: Strategy**

Analyze a given solution of a quadratic equation and find where and what was the error in that process. (2 min) [E](#) [MM](#)

**Solving Quadratics by Taking Square Roots: With Steps**

Explore the exact order of steps in the process of solving the equation  $3(x+6)^2=75$ . (4 min) [E](#) [MM](#)

**Algebra I: Algebra | Solving Quadratics by Factoring****Solving Quadratics by Factoring**

Solve the equation  $s^2-2s-35=0$  by factoring the expression on the left as  $(s+5)(s-7)$  and finding the s-values that make each factor equal to zero. (6 min) [E](#) [MM](#)

**Solving Quadratics by Factoring: Leading Coefficient  $\neq 1$** 

Solve  $6x^2-120x+600=0$  by first dividing by 6 and then factoring. (4 min) [E](#) [MM](#)

**Solving Quadratics Using Structure**

Solve  $(2x-3)^2=4x-6$  by substituting p for  $2x-3$  and obtaining the simpler equation  $p^2=2p$ . (4 min) [E](#) [MM](#)

**Quadratic Equations Word Problem: Triangle Dimensions**

Solve a geometry problem using a quadratic equation. (8 min) [E](#) [MM](#)

**Quadratic Equations Word Problem: Box Dimensions**

Solve a volume problem using a quadratic equation. (6 min) [E](#) [MM](#)

**Algebra I: Algebra | The Quadratic Formula****The Quadratic Formula**

Learn about the quadratic formula and how it helps us solve any quadratic equation. (17 min) [E](#) [MM](#)

**Worked Example: Quadratic Formula**

Solve the equation  $-x^2+8x=1$  by first bringing it to standard form and then using the quadratic formula. (7 min) [E](#) [MM](#)

**Worked Example: Quadratic Formula (Negative Coefficients)**

Solve  $-3x^2+10x-3=0$  by plugging  $a=-3$ ,  $b=10$ ,  $c=-3$  in the quadratic formula. (5 min) [E](#) [MM](#)

**Using the Quadratic Formula: Number of Solutions**

Determine how many solutions the equation  $x^2+14x+49=0$  has by considering its quadratic formula, and more specifically, its discriminant. (5 min) [E](#) [MM](#)

**Strategy in Solving Quadratic Equations**

Based on the initial form of a quadratic equation, determine which solution methods are and aren't appropriate. (6 min) [E](#) [MM](#)

**Algebra I: Algebra | Completing the Square****Completing the Square**

Learn how to complete the square" by adding a constant number to a quadratic expression. (14 min) [E](#) [MM](#)

**Worked Example: Completing the Square (Intro)**

Discover how to complete  $x^2-44x$  into a perfect square. (3 min) [E](#) [MM](#)

**Worked Example: Rewriting****Expressions by Completing the Square**

Learn to rewrite  $x^2+16x+9$  as  $(x+8)^2-55$  by completing the square. (3 min) [E](#) [MM](#)

**Worked Example: Rewriting & Solving**

Equations by Completing the Square  
Solve  $x^2-2x-8=0$  by rewriting the equation as  $(x-1)^2-9=0$  by completing the square. (6 min) [E](#) [MM](#)

### Solve by Completing the Square: Integer Solutions

Use the strategy of completing the square to solve quadratic equations (6 min) [E](#) [MM](#)

### Solve by Completing the Square: Non-Integer Solutions

Use the strategy of completing the square to solve quadratic equations even when the solutions aren't integers. (4 min) [E](#) [MM](#)

### Worked Example: Completing the Square (Leading Coefficient $\neq 1$ )

Solve the equation  $4x^2 + 40x - 300 = 0$  by completing the square. (5 min) [E](#) [MM](#)

### Solving Quadratics by Completing the Square: No Solution

Try to solve the equation  $4x^2 + 40x + 280 = 0$  by completing the square, only to find there's no solution for this equation. (5 min) [E](#) [MM](#)

### Proof of the Quadratic Formula

Prove the quadratic formula using the method of completing the square. (8 min) [E](#) [MM](#)

## Algebra I: Algebra | Features & Forms of Quadratic Functions

### Finding the Vertex of a Parabola in Standard Form

Rewrite the equation  $y = -5x^2 - 20x + 15$  in vertex form (by completing the square) to identify the vertex of the corresponding parabola. (8 min) [E](#) [MM](#)

### Graphing Quadratics: Standard Form

Learn how to graph any quadratic function that is given in standard form. (6 min) [E](#) [MM](#)

### Quadratic Word Problem: Ball

Solve a word problem about a ball being shot in the air. (6 min) [E](#) [MM](#)

### Forms & Features of Quadratic Functions

Rewrite  $f(x) = x^2 - 5x + 6$  in factored form to reveal its zeros and in vertex form to reveal its vertex. (6 min) [E](#) [MM](#)

### Worked Examples: Forms & Features of Quadratic Functions

Learn to choose whether factored form, vertex form or standard form of a quadratic is best in different situations. (7 min) [E](#) [MM](#)

### Vertex & Axis of Symmetry of a Parabola

Rewrite a quadratic equation in vertex form and shows how it reveals the vertex of the corresponding parabola. (7 min) [E](#) [MM](#)

### Finding Features of Quadratic Functions

Find the zeros, the vertex, & the line of symmetry of quadratic functions given in vertex form, factored form, & standard form. (8 min) [E](#) [MM](#)

### Interpret Quadratic Models: Factored Form

Given a quadratic function that models a relationship, rewrite the function to reveal certain properties of the relationship. (4 min) [E](#) [MM](#)

### Interpret Quadratic Models: Vertex Form

Given a quadratic function that models a relationship, rewrite the function to reveal certain properties of the relationship. (6 min) [E](#) [MM](#)

## Algebra I: Algebra | Comparing & Transforming Quadratic Functions

### Comparing Features of Quadratic Functions

Compare the y-intercepts, the zeros, and the concavity of quadratic functions given graphically and algebraically. (4 min) [E](#) [MM](#)

### Comparing Maximum Points of Quadratic Functions

Given several quadratic functions represented in different forms, find the one with the lowest maximum value. (4 min) [E](#) [MM](#)

### Intro to Parabola Transformations

Discuss how we can shift and scale the graph of a parabola to obtain any other parabola, and how this affects the equation of the parabola. (8 min) [E](#) [MM](#)

### Shifting Parabolas

Explore how the graph of  $y = (x - k)^2 + h$  is the resulting of shifting (or translating) the graph of  $y = x^2$ ,  $k$  units to the right and  $h$  units up. (5 min) [E](#) [MM](#)

### Scaling & Reflecting Parabolas

Find the equation of a parabola from its graph. (5 min) [E](#) [MM](#)

## Algebra I: Algebra | Irrational Numbers

### Intro to Rational & Irrational Numbers

Learn the difference between rational and irrational numbers, learn how to identify them, and discover why some of the most famous numbers in mathematics, like  $\pi$  and  $e$ , are actually irrational. (6 min) [E](#) [MM](#)

### Classifying Numbers: Rational & Irrational

Learn to write any rational number as the ratio of two integers, and learn that irrational numbers, such as the square root of 8 and  $\pi$ , cannot be written this way. (3 min) [E](#) [MM](#)

### Proof: Sum & Product of Two Rationals is Rational

Prove that the sum, or the product, of any two rational numbers will always be a rational number. (3 min) [E](#) [MM](#)

**Proof: Product of Rational & Irrational is Irrational**

Learn that the product of any rational number and any irrational number will always be an irrational number.

(3 min) [E](#) [MM](#)

**Proof: Sum of Rational & Irrational is Irrational**

Learn that the sum of any rational number and any irrational number will always be an irrational number. (3 min) [E](#) [MM](#)

**Sums and Products of Irrational Numbers**

Explore how the sum of two irrational numbers can be rational and it can be irrational. (6 min) [E](#) [MM](#)

**Worked Example: Rational vs. Irrational Expressions**

Show how to determine whether the following expressions are rational or irrational:  $9 + \sqrt{45}$ ,  $\sqrt{45}/(3\sqrt{5})$ , and  $3\sqrt{9}$ . (3 min) [E](#) [MM](#)

**Worked Example: Rational vs. Irrational Expressions (Unknowns)**

Determine whether expressions with unknown rational/irrational numbers are rational or irrational. (6 min) [E](#) [MM](#)

**Proof:  $\sqrt{2}$  is Irrational**

Prove that the square root of 2 is an irrational number, i.e. it cannot be given as the ratio of two integers. (8 min) [E](#) [MM](#)

**Proof: Square Roots of Prime Numbers are Irrational**

Prove that the square root of any prime number must be an irrational number. (8 min) [E](#) [MM](#)

**Proof: There's an Irrational Number Between Any Two Rational Numbers**

Prove that when given any two rational numbers, no matter how close, we can find an irrational number that lies between them. (6 min) [E](#) [MM](#)

**Geometry****Rhombus Tile**

Simple geometry manipulables that can be used to teach about shapes and angles, or build tessellations. [IFX](#)

**Pentagon Tile**

Simple geometry manipulables that can be used to teach about shapes and angles, or build tessellations. [IFX](#)

**Octagon Tile**

Simple geometry manipulables that can be used to teach about shapes and angles, or build tessellations. [IFX](#)

**Obtuse Isosceles Triangle Tile**

Simple geometry manipulables that can be used to teach about shapes and angles, or build tessellations. [IFX](#)

**Narrow Rhombus Tile**

Simple geometry manipulables that can be used to teach about shapes and angles, or build tessellations. [IFX](#)

**Hexagon Tile**

Simple geometry manipulables that can be used to teach about shapes and angles, or build tessellations. [IFX](#)

**Equilateral Triangle Tile**

Simple geometry manipulables that can be used to teach about shapes and angles, or build tessellations. [IFX](#)

**Acute Isosceles Triangle Tile**

Simple geometry manipulables that can be used to teach about shapes and angles or build tessellations. [IFX](#)

**Wide Rhombus Tile**

Simple geometry manipulables that can be used to teach about shapes and angles, or build tessellations. [IFX](#)

**Trapezoid Tile**

Simple geometry manipulables that can be used to teach about shapes and angles, or build tessellations. [IFX](#)

**Square Tile**

Simple geometry manipulables that can be used to teach about shapes and angles, or build tessellations. [IFX](#)

**Protractor**

At-scale measuring tool for measuring angles. Designed to be used with geometric tiles, or as a general teaching/training tool.

[IFX](#)

**Geometry | Intro to Euclidean Geometry****Euclid as the Father of Geometry**

Euclid, often called the father of geometry, changed the way we learn about shapes with his 13-book series, Euclid's Elements. He used basic ideas called axioms or postulates to create solid proofs and figure out new ideas called theorems and propositions. (8 min) [E](#) [MM](#)

**Terms & Labels in Geometry**

Learn key geometric terms like colinear points, midpoints, and vertices, and enhance your knowledge of geometry. I (13 min) [E](#) [MM](#)

**Geometric Definitions Example**

Explore using precise language is important in geometry, as it allows for clear communication and understanding of geometric concepts. (9 min) [E](#) [MM](#)

**Geometry | Intro to Rigid Transformations****Rigid Transformations Intro**

Transformations in math involve changing a shape's position or which way the shape points. There are three main types: translations (moving the shape), rotations (turning the shape), and reflections (flipping the shape like a mirror image). Rigid transformations keep the shape's size and angles the same. (7 min) [E](#) [MM](#)

## Dilations Intro

Dilations are a type of non-rigid transformation. They change the size of a shape by scaling it up or down, making it bigger or smaller. Unlike rigid transformations, dilations do not keep the shape's size the same. (2 min) [E](#) [MM](#)

## Identifying Transformations

Explore the four types of transformations: rotations (spinning a shape around a point), translations (shifting a shape), reflections (flipping a shape over a line), and dilations (shrinking or expanding a shape). (4 min) [E](#) [MM](#)

## Geometry | Translations

### Translating Points

Explore how a translation is a way to move a point or shape by a certain number of units in a certain direction. (4 min) [E](#) [MM](#)

### Determining Translations

Learn to find the translation by figuring out how much the x- and y-coordinates need to change to map one triangle onto the other. (2 min) [E](#) [MM](#)

### Translating Shapes

Explore how in translations we move every point of the shape a certain distance left or right, and up or down, to create a new shape that's the same size and shape as the original. (2 min) [E](#) [MM](#)

### Challenge Problem: Translation

Explore the translation acting on the coordinate plane takes the point  $(-169, 434)$  to point  $(-203, -68)$ . (3 min) [E](#) [MM](#)

## Geometry | Rotations

### Rotating Points

Explore the different rotation angles and how positive angles rotate counterclockwise and negative angles rotate clockwise. (2 min) [E](#) [MM](#)

## Determining Rotations

Learn to see the angle of rotation, we draw lines from the center to the same point in the shape before and after the rotation. (3 min) [E](#) [MM](#)

## Rotating Shapes

Given a triangle on the coordinate plane and the definition of a rotation about the origin, manually draws the image of that rotation. (8 min) [E](#) [MM](#)

## Geometry | Reflections

### Reflecting Points

Reflections create mirror images of points, keeping the same distance from the line. When we reflect across the y-axis, the image point is the same height, but has the opposite position from left to right. (4 min) [E](#) [MM](#)

### Determining Reflections

Learn about how a line of reflection is an imaginary line that flips one shape onto another. (2 min) [E](#) [MM](#)

### Determining Reflections (Advanced)

Given two line segments on the coordinate plane, determine the reflection that maps one of them into the other. (6 min) [E](#) [MM](#)

### Reflecting Shapes

Explore how to reflect a quadrilateral across the x-axis. (3 min) [E](#) [MM](#)

### Reflecting Shapes: Diagonal Line of Reflection

Given two line segments on the coordinate plane and the definition of a reflection, draw the image of the segments under that reflection. (7 min) [E](#) [MM](#)

## Geometry | Dilations

### Dilating Points

Dilations are a way to stretch or shrink shapes around a point called the center of dilation. The amount we stretch or shrink is called the scale factor. If the scale factor is greater than 1, the shape stretches. If it's between 0 and 1, the shape shrinks. (3 min) [E](#) [MM](#)

### Dilations: Scale Factor

A scale factor tells us how much to multiply by the side lengths to change the size. The scale factor is the ratio of the side length in the new shape (image) to the side length in the corresponding side in the original shape (pre-image). (5 min) [E](#) [MM](#)

### Dilations: Center

Determining the center of dilation, given a figure and its image under a dilation. (3 min) [E](#) [MM](#)

### Dilating Shapes: Expanding

Let's dilate a rectangle around a point P using a scale factor  $1\frac{2}{3}$ . This changes the size of the rectangle while keeping its shape. Because  $1\frac{2}{3}$  is bigger than 1, most of the points get farther from P. Point P stays in place, because a distance of 0 times any scale factor is still 0. (3 min) [E](#) [MM](#)

### Dilating Shapes: Shrinking

Draw the image of the triangle under a dilation with scale factor  $\frac{1}{4}$  about the center of dilation on the coordinate plane. (3 min) [E](#) [MM](#)

### Dilating Triangles: Find the Error

Explore that dilating doesn't just shrink or grow a figure. The scale factor also changes the distance from each point to the center of dilation. (3 min) [E](#) [MM](#)

## Geometry | Properties of Transformations

### Finding Measures Using Rigid Transformations

Learn how to find the measures after a rigid transformation. (5 min) [E](#) [MM](#)

### Rigid Transformations: Preserved Properties

Rigid transformations preserve side lengths, angle measures, perimeter, and area, but they might not keep the same coordinates or relationships to lines outside the figure. (7 min) [E](#) [MM](#)

### Mapping Shapes

Find the right sequence of rigid transformations (like rotations, translations, and reflections) to map one triangle onto another. (9 min) [E](#) [MM](#)

### Dilations and Properties

Learn what properties of a shape are preserved or not preserved after a dilation. (6 min) [E](#) [MM](#)

### Sequences of Transformations

Determine whether segment lengths and angle measures are preserved under a given sequence of transformations. (4 min) [E](#) [MM](#)

### Defining Transformations

Given a description of the effect of a certain transformation, determine whether that transformation is a translation, a rotation, or a reflection. (6 min) [E](#) [MM](#)

### Identifying Type of Transformation

Determine what kind of transformation when given information in terms of a few pairs of points and their corresponding images. (5 min) [E](#) [MM](#)

### Proofs with Transformations

Explore this exercise about line and angle proofs. (9 min) [E](#) [MM](#)

## Geometry | Symmetry

### Intro to Reflective Symmetry

Discover the concept of an "axis of symmetry". (3 min) [E](#) [MM](#)

### Intro to Rotational Symmetry

Explore whether various figures are symmetrical under a 180 degrees rotation. (4 min) [E](#) [MM](#)

### Finding a Quadrilateral from its Symmetries (Example 1)

Draw and classify the quadrilateral. (3 min) [E](#) [MM](#)

### Finding a Quadrilateral from its Symmetries (Example 2)

Two of the points that define a certain quadrilateral are  $(-4, -2)$  and  $(0, 5)$ . The quadrilateral has a reflective symmetry over the lines  $y = x/2$  and  $y = -2x + 5$ . Draw and classify the quadrilateral. (7 min) [E](#) [MM](#)

## Geometry | Intro to Congruence

### Congruent Shapes & Transformations

Explore the differences between congruent shapes and transformations. (2 min) [E](#) [MM](#)

### Non-Congruent Shapes & Transformations

Learn what makes a shape non-congruent and how transformations affect congruency. (2 min) [E](#) [MM](#)

### Segment Congruence Equivalent to Having Same Length

Discover how two-line segments are congruent if and only if they have equal lengths. (7 min) [E](#) [MM](#)

### Angle Congruence Equivalent to Having Same Measure

Discover how two angles are congruent if and only if they have the same measure. (6 min) [E](#) [MM](#)

## Geometry | Congruent Triangles

### Corresponding Parts of Congruent Triangles are Congruent

Discover that when two triangles are congruent, that all their corresponding sides and angles are congruent too. (6 min) [E](#) [MM](#)

### Proving the SSS Triangle Congruence Criterion Using Transformations

Prove the side-side-side (SSS) triangle congruence criterion using the rigid transformation definition of congruence. (6 min) [E](#) [MM](#)

### Proving the SAS Triangle Congruence Criterion Using Transformations

Prove the side-angle-side (SAS) triangle congruence criterion using the rigid transformation definition of congruence. (4 min) [E](#) [MM](#)

### Proving the ASA and AAS Triangle Congruence Criteria Using Transformations

Prove the angle-side-angle (ASA) and angle-angle-side (AAS) triangle congruence criteria using the rigid transformation definition of congruence. (7 min) [E](#) [MM](#)

### Why SSA isn't a Congruence Postulate/Criterion

There are some cases when SSA can imply triangle congruence, but not always. This is why it's not like the other triangle congruence postulates/criteria. (7 min) [E](#) [MM](#)

### Triangle Congruence Postulates/Criteria

Explore and justify the SSS, SAS, ASA and AAS postulates for congruent triangles. (14 min) [E](#) [MM](#)

### Determining Congruent Triangles

Use the SSS, ASA, SAS, and AAS postulates to find congruent triangles. (7 min) [E](#) [MM](#)

### Calculating Angle Measures to Verify Congruence

Calculate missing angle measures to determine which triangles must be congruent. (4 min) [E](#) [MM](#)

### Proving Triangle Congruence

Given a figure composed of 2 triangles, prove that the triangles are congruent or determine that there's not enough information to tell. (4 min) [E](#) [MM](#)

## Geometry | Proofs & Properties of Triangles

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### Angles in a Triangle Sum to 180°

#### Proof

Learn to use transversals, vertical angles, and corresponding angles to rearrange those angle measures into a straight line, proving that they must add up to 180. (4 min) [E](#) [MM](#)

### Proofs Concerning Isosceles Triangles

Prove that the base angles in isosceles triangles are congruent, and conversely, that triangles with congruent base angles are isosceles. (9 min) [E](#) [MM](#)

### Proofs Concerning Equilateral Triangles

Prove that the angles of an equilateral triangle are all congruent (and therefore they all measure 60°), and conversely, that triangles with all congruent angles are equilateral. (7 min) [E](#) [MM](#)

### Triangle Exterior Angle Example

Explore that an exterior angle is formed outside a triangle by extending a side. Its measure is equal to the sum of the two non-adjacent interior angle measures, thanks to the fact that all angle measures in a triangle add up to 180 degrees. (6 min) [E](#) [MM](#)

### Corresponding Angles in Congruent Triangles

Use the Letters of congruent triangles to solve some angles. (4 min) [E](#) [MM](#)

### Isosceles & Equilateral Triangles Problems

Isosceles triangles have two congruent sides and two congruent base angles.

Equilateral triangles have all side lengths equal and all angle measures equal. We use these properties to find missing angles in composite figures. (6 min) [E](#) [MM](#)

### Finding Angles in Isosceles Triangles (Example 1)

The measures of two angles of an isosceles triangle are  $3x+5$  and  $x+16$ . Find all possible values of  $x$ . (6 min) [E](#) [MM](#)

### Finding Angles in Isosceles Triangles (Example 2)

Explore how isosceles triangles and parallel lines with the power of algebra to solve the angles of an isosceles triangle. (4 min) [E](#) [MM](#)

## Geometry | Proofs & Properties of Quadrilaterals

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### Proof: Opposite Sides of a Parallelogram

Prove that a figure is a parallelogram if and only if opposite sides are congruent. (8 min) [E](#) [MM](#)

### Proof: Diagonals of a Parallelogram

Discover that a quadrilateral is a parallelogram if and only if its diagonals bisect each other. (9 min) [E](#) [MM](#)

### Proof: Opposite Angles of a Parallelogram

Discover that opposite angles of a parallelogram are congruent. (4 min) [E](#) [MM](#)

### Proof: The Diagonals of a Kite are Perpendicular

Discover that the diagonals of a kite are perpendicular, by using the SSS and SAS triangle congruence criteria. (11 min) [E](#) [MM](#)

### Proof: Rhombus Diagonals are Perpendicular Bisectors

Discover that the diagonals of a rhombus are perpendicular, and that they intersect at the midpoints of both. (4 min) [E](#) [MM](#)

### Proof: Rhombus Area

Discover that we can find the area of a rhombus by taking half the product of the lengths of the diagonals. (5 min) [E](#) [MM](#)

## Geometry | Proofs of General Theorems

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### Geometry Proof Problem: Midpoint

Discover that a point is the midpoint of a segment using triangle congruence. (6 min) [E](#) [MM](#)

### Geometry Proof Problem: Congruent Segments

Prove that two pairs of segments are congruent using the ASA and AAS congruence criteria. (12 min) [E](#) [MM](#)

### Geometry Proof Problem: Squared Circle

Find a missing angle using triangle congruence in a diagram that contains sector of a circle inscribed within a square. (8 min) [E](#) [MM](#)

## Geometry | Constructing Lines & Angles

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### Geometric Constructions: Congruent Angles

Explore how to construct congruent angles with a compass and straight edge. They're congruent corresponding angles of congruent triangles. (4 min) [E](#) [MM](#)

### Geometric Constructions: Parallel Line

Explore how to construct parallel lines with compass and straightedge by creating a pair of congruent corresponding angles on a transversal. (2 min) [E](#) [MM](#)

**Geometric Constructions:****Perpendicular Bisector**

Explore how to construct a perpendicular bisector to a given line segment using compass and straightedge. (2 min) [E](#) [MM](#)

**Geometric Constructions:****Perpendicular Line Through a Point on the Line**

Explore how to construct a line perpendicular to a given line through a point on the line using compass and straightedge. (1 min) [E](#) [MM](#)

**Geometric Constructions:****Perpendicular Line Through a Point Not on the Line**

Learn to construct a perpendicular line through a point off the line. The lines must be perpendicular because a rhombus's diagonals are perpendicular. (3 min) [E](#) [MM](#)

**Geometric Constructions: Angle Bisector**

Learn to construct a line that bisects a given angle using compass and straightedge. (2 min) [E](#) [MM](#)

## Geometry | Similar Triangles

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**Similar Shapes & Transformations**

Explore how two shapes are similar after they have gone through transformation and what makes shapes not similar.

(2 min) [E](#) [MM](#)

**Intro to Triangle Similarity**

Discover what it means for triangles to be similar, and how this follows from the definition of similarity (9 min) [E](#) [MM](#)

**Triangle Similarity Postulates/Criteria**

Explore all the different ways we can determine that two triangles are similar.

(12 min) [E](#) [MM](#)

**Determining Similar Triangles**

Analyze multiple examples of the similarity of triangles. (9 min) [E](#) [MM](#)

**Solving Similar Triangles**

Solve two problems where a missing side length is found by proving that triangles are similar and using this to find the measure.

(7 min) [E](#) [MM](#)

**Solving Similar Triangles: Same Side Plays Different Roles**

Find a missing side length in a problem where the same side plays different roles in two similar triangles. (6 min) [E](#) [MM](#)

**Intro to Angle Bisector Theorem**

The angle bisector theorem states that when an angle in a triangle is split into two equal angles, it divides the opposite side into two parts. The ratio of these parts will be the same as the ratio of the sides next to the angle. (8 min) [E](#) [MM](#)

**Using the Angle Bisector Theorem**

Use the angle bisector theorem to solve for the sides of a triangle. (3 min) [E](#) [MM](#)

**Using Similar & Congruent Triangles**

Use the similarity of triangles and the congruence of others in this multi-step problem to find the area of a polygon.

(10 min) [E](#) [MM](#)

**Challenge Problem: Triangle****Similarity**

Learn to solve a similarity problem where we don't have a lot of information to work with. (10 min) [E](#) [MM](#)

## Geometry | Proofs & Problem-Solving with Similar Triangles

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**Pythagorean Theorem Proof Using Similarity**

Explore the Pythagorean theorem using similarity. (10 min) [E](#) [MM](#)

**Exploring Medial Triangles**

The three midsegments (segments joining the midpoints of the sides) of a triangle form a medial triangle. Find out the properties of the midsegments, the medial triangle and the other 3 triangles formed in this way. (12 min) [E](#) [MM](#)

**Proof: Parallel Lines Divide Triangle Sides Proportionally**

Discover that a line parallel to one triangle side divides other sides proportionately.

(7 min) [E](#) [MM](#)

**Proving Slope is Constant Using Similarity**

Use a clever proof involving similar triangles to show that slope is constant for a line. (8 min) [E](#) [MM](#)

**Proof: Parallel Lines have the Same Slope**

Discover that parallel lines have the same slope using triangle similarity. (6 min) [E](#) [MM](#)

**Proof: Perpendicular Lines have Opposite Reciprocal Slopes**

Learn to prove that perpendicular lines have opposite reciprocal slopes, draw the two lines and label key points.

(9 min) [E](#) [MM](#)

**Geometry Word Problem: The Golden Ratio**

Solve this word problem about triangle similarity, the golden ratio, and art.

(9 min) [E](#) [MM](#)

**Geometry Word Problem: Earth & Moon Radii**

Solve this word problem about triangle similarity, the golden ratio, and the Earth.

(7 min) [E](#) [MM](#)

**Geometry Word Problem: A Perfect Pool Shot**

Use triangle similarity to plan the perfect shot in a pool game. (7 min) [E](#) [MM](#)

## Geometry | Pythagorean Theorem & Its Proofs

### Pythagorean Theorem in 3D

Discover how to find the length of an edge in a 3D shape using the Pythagorean theorem. (6 min) [E](#) [MM](#)

### Pythagorean Theorem with Isosceles Triangle

Find the value of a base ( $x$ ) in an isosceles triangle by using the Pythagorean theorem to create an equation involving  $x$ .

(4 min) [E](#) [MM](#)

### Multi-Step Word Problem with Pythagorean Theorem

Use the Pythagorean theorem and proportional reasoning in context.

(5 min) [E](#) [MM](#)

### Pythagorean Theorem Proof Using Similarity

Explore this proof of the Pythagorean theorem using similarity. (10 min) [E](#) [MM](#)

## Geometry | Special Right Triangles & Ratios

### Special Right Triangles: 30-60-90

Learn how to prove the ratios between the sides of a 30-60-90 triangle. (7 min) [E](#) [MM](#)

### Special Right Triangles: 45-45-90

Showing the ratios of the sides of a 45-45-90 triangle are  $1:1:\sqrt{2}$ .

(6 min) [E](#) [MM](#)

### 30-60-90 Triangle Example Problem

Use 30-60-90 triangles to solve what at first seems to be a challenging problem.

(7 min) [E](#) [MM](#)

### Area of a Regular Hexagon

Find the area of a regular hexagon.

(8 min) [E](#) [MM](#)

### Using Similarity to Estimate Ratio Between Side Lengths

When two right triangles share an acute angle measure, the ratios of the corresponding side lengths within the triangles are equal. (5 min) [E](#) [MM](#)

### Using Right Triangle Ratios to Approximate Angle Measure

Because of similarity, all right triangles with a given acute angle measure have equal ratios between their side lengths.

(3 min) [E](#) [MM](#)

## Geometry | Intro to Trigonometric Ratios

### Triangle Similarity & the Trigonometric Ratios

Explore how the trigonometric ratios are derived from triangle similarity considerations. (9 min) [E](#) [MM](#)

### Trigonometric Ratios in Right Triangles

Use the two legs of a right triangle to find the trig ratios of one of the acute angles. (12 min) [E](#) [MM](#)

### Solving for a Side in Right Triangles with Trigonometry

Given a right triangle with an acute angle of  $65^\circ$  and a leg of 5 units, uses trigonometry to find the two missing sides (7 min) [E](#) [MM](#)

### Sine & Cosine of Complementary Angles

Show that the sine of any angle is equal to the cosine of its complementary angle.

(4 min) [E](#) [MM](#)

### Using Complementary Angles

Solve the following problem: Given that  $\cos(58^\circ)=0.53$ , find  $\sin(32^\circ)$ . (4 min) [E](#) [MM](#)

### Trig Word Problem: Complementary Angles

Solve a problem about a submerged pyramid using the fact that the sine of an angle is equal to the cosine of its complementary angle. (6 min) [E](#) [MM](#)

### Trig Challenge Problem: Trig Values & Side Ratios

Match different expressions with different trig values. (10 min) [E](#) [MM](#)

### Right Triangle Word Problem

Solve a modeling problem where he finds the necessary angle to shoot at a vicious alien. (4 min) [E](#) [MM](#)

## Geometry | Analyzing Line Segments

### Distance Formula

Learn how to find the distance between two points by using the distance formula, which is an application of the Pythagorean theorem. (9 min) [E](#) [MM](#)

### Midpoint Formula

Learn how to use the midpoint formula to find the midpoint of a line segment on the coordinate plane, or find the endpoint of a line segment given one point and the midpoint. (7 min) [E](#) [MM](#)

### Dividing Line Segments: Graphical

Figure out the coordinates of a point between two other points that give a certain ratio. (5 min) [E](#) [MM](#)

### Dividing Line Segments

Figure out the coordinates of a point between two other points that give a certain ratio. (4 min) [E](#) [MM](#)

### Proving Triangle Medians Intersect at a Point

Prove that for any triangle, the medians intersect at a point  $2/3$  of the way from each vertex to the midpoint of the opposite side. (7 min) [E](#) [MM](#)

## Geometry | Problem-Solving on the Coordinate Plane

### Area of Trapezoid on the Coordinate Plane

Find the area of a trapezoid using the distance formula and the trapezoid area formula. (7 min) [E](#) [MM](#)

### Points Inside/Outside/On a Circle

Use the distance formula to determine whether the point  $(-6, -6)$  is inside, outside, or on the circle centered at  $(-1, -3)$  with radius 6. (4 min) [E](#) [MM](#)

### Challenge Problem: Points on Two Circles

Solve a challenging problem where he must determine if points are on both, one, or neither of two circles. (10 min) [E](#) [MM](#)

### Coordinate Plane Word Problem

Solve an example where must determine which of the Minions a wizard can reach using the coordinate plane. (6 min) [E](#) [MM](#)

### Parallel & Perpendicular Lines Intro

Learn how to identify parallel and perpendicular lines. (2 min) [E](#) [MM](#)

### Parallel & Perpendicular Lines from Graph

Determine whether given lines are parallel or perpendicular. (7 min) [E](#) [MM](#)

### Classifying Quadrilaterals on the Coordinate Plane

Classify a quadrilateral as a square, rhombus, rectangle, parallelogram, or trapezoid given its four vertices. (5 min) [E](#) [MM](#)

### Classifying Figures with Coordinates

Use coordinates to determine the slopes of sides of a figure to classify it. (7 min) [E](#) [MM](#)

## Geometry | Equations of Parallel & Perpendicular Lines

### Parallel Lines from Equation (Example 1)

Determine which pairs out of a few given linear equations are parallel. (4 min) [E](#) [MM](#)

### Parallel Lines from Equation (Example 2)

Determine which pairs out of a few given linear equations are parallel. (3 min) [E](#) [MM](#)

### Parallel Lines from Equation (Example 3)

Determine which pairs out of a few given linear equations are parallel. (3 min) [E](#) [MM](#)

### Perpendicular Lines from Equation

Determine which pairs out of a few given linear equations are perpendicular. (3 min) [E](#) [MM](#)

### Writing Equations of Perpendicular Lines (Example 1)

Given line A and point P, find the equation of the line perpendicular to A that passes through P. (3 min) [E](#) [MM](#)

### Writing Equations of Perpendicular Lines (Example 2)

Find the equation of a line perpendicular to a line given in slope-intercept form that passes through a specific point. (2 min) [E](#) [MM](#)

### Proof: Parallel Lines have the Same Slope

Prove that parallel lines have the same slope using triangle similarity. (6 min) [E](#) [MM](#)

### Proof: Perpendicular Lines have Opposite Reciprocal Slopes

Explore how to show that two slopes are indeed opposite reciprocals of each other. (9 min) [E](#) [MM](#)

## Geometry | Conic Sections

### Intro to Conic Sections

Discover the four conic sections and show how they are derived by intersecting planes with cones in certain ways. (11 min) [E](#) [MM](#)

### Graphing Circles from Features

Learn to graph a circle given the center and either the radius or another point on the circle. (2 min) [E](#) [MM](#)

### Features of a Circle from its Graph

Given a circle on the coordinate plane, find its center and its radius. (4 min) [E](#) [MM](#)

### Features of a Circle from its Standard Equation

Find the center and the radius of the circle whose equation is  $(x+3)^2 + (y-4)^2 = 49$ . (4 min) [E](#) [MM](#)

### Graphing a Circle from its Standard Equation

Graph the circle whose equation is  $(x+5)^2 + (y-5)^2 = 4$ . (6 min) [E](#) [MM](#)

### Writing Standard Equation of a Circle

Given a circle on the coordinate plane, find its standard equation, which is an equation in the form  $(x-a)^2 + (y-b)^2 = r^2$ . (6 min) [E](#) [MM](#)

### Features of a Circle from its Expanded Equation

Find the center and the radius of a circle whose equation is  $x^2 + y^2 + 4x - 4y - 17 = 0$ , and then graph the circle. (4 min) [E](#) [MM](#)

### Intro to Focus & Directrix

Learn how a parabola is the set of all points equidistant from a point (called the "focus") and a line (called the "directrix"). (4 min) [E](#) [MM](#)

### Equation of a Parabola from Focus & Directrix

The equation of a parabola is derived from the focus and directrix, and then the general formula is used to solve an example. (10 min) [E](#) [MM](#)

## Geometry | Circle Basics

### Circles Glossary

Discover the formal definition of a circle, Tangent and secant lines, Diameters and radii, major and minor arcs. (11 min) [E](#) [MM](#)

### Area of a Circle Intuition

Use triangles to create an informal argument for the area of a circle formula. (9 min) [E](#) [MM](#)

### Proof: All Circles are Similar

Explore that all circles are similar by showing how we can translate then dilate any circle onto another. (2 min) [E](#) [MM](#)

## Geometry | Arc Measure, Arc Length, & Sectors

### Intro to Arc Measures

Learn about arc measures including that they must sum to 360, conventions of minor and major arcs, and a comparison to arc length. (6 min) [E](#) [MM](#)

### Finding Arc Measures

Solve a few problems where he finds a missing arc measure. (6 min) [E](#) [MM](#)

### Finding Arc Measures with Equations

Solve a few items where arc measures are given in equations, we must find a variable, then use it to find an arc measure. (7 min) [E](#) [MM](#)

### Arc Length from Subtended Angle

Find the length of an arc using the degree of the angle subtended by the arc and the perimeter of the circle. (5 min) [E](#) [MM](#)

### Subtended Angle from Arc Length

Solve an example where he finds the central angle given arc length. (2 min) [E](#) [MM](#)

### Area of a Sector

Find the area of a circle's sector using the area of the circle and the central angle of the sector. (2 min) [E](#) [MM](#)

## Radians as Ratio of Arc Length to Radius

Derive using similarity the fact that the length of the arc intercepted by an angle is proportional to the radius and define the radian measure of the angle as the constant of proportionality. (7 min) [E](#) [MM](#)

## Geometry | Intro to Radians

### Intro to Radians

Explore the definition and motivation for radians and the relationship between radians and degrees. (11 min) [E](#) [MM](#)

### Radians & Degrees

Discover the general approach to converting between radians and degrees and vice versa. (7 min) [E](#) [MM](#)

### Degrees to Radians

Learn how to convert from degrees to radians by multiplying the number of degrees by  $\pi/180$ . (7 min) [E](#) [MM](#)

### Radians to Degrees

Learn to change from radians to degrees by multiplying the number of radians by  $180/\pi$ . (3 min) [E](#) [MM](#)

### Arc Length as Fraction of Circumference

Find the fraction of an arc length out of the entire circumference using the radian measure of the central angle subtended by the arc. (3 min) [E](#) [MM](#)

### Arc Length from Subtended Angle: Radians

Find the length of an arc using the radius and the radian measure of the angle subtended by the arc. (3 min) [E](#) [MM](#)

## Geometry | Inscribed Angles & Shapes

### Inscribed Angles

Find a missing inscribed angle using the inscribed angle theorem. (1 min) [E](#) [MM](#)

### Inscribed Angle Theorem Proof

Prove that an inscribed angle is half of a central angle that subtends the same arc. (14 min) [E](#) [MM](#)

### Inscribed Shapes: Find Diameter

Find the diameter of a circle using an inscribed right triangle. (2 min) [E](#) [MM](#)

### Inscribed Shapes: Angle Subtended by Diameter

Explore one method using an inscribed angle intercepting a diameter of a circle. (6 min) [E](#) [MM](#)

### Inscribed Shapes: Find Inscribed Angle

Explore using either the inscribed angle theorem or the fact that two inscribed angles that intercept the same arc must be congruent. (2 min) [E](#) [MM](#)

### Solving Inscribed Quadrilaterals

Explore supplementary opposite angles in inscribed quadrilateral. (5 min) [E](#) [MM](#)

### Proof: Right Triangles Inscribed in Circles

Explore this proof showing that a triangle inscribed in a circle having a diameter as one side is a right triangle. (5 min) [E](#) [MM](#)

### Inscribed Quadrilaterals Proof

Use the inscribed angle theorem and some algebra to prove that opposite angles of an inscribed quadrilateral are supplementary. (4 min) [E](#) [MM](#)

## Geometry | Properties of Tangents

### Proof: Radius is Perpendicular to a Chord it Bisects

Prove that if a radius in a circle is drawn so it bisects a chord, then the radius is also perpendicular to that chord. The proof uses SSS congruence. (8 min) [E](#) [MM](#)

### Proof: Perpendicular Radius Bisects Chord

Explore this simple proof using right triangle-side-hypotenuse (RSH) congruence criterion to show that a radius perpendicular to a chord bisects it. (4 min) [E](#) [MM](#)

### Proof: Radius is Perpendicular to Tangent Line

Prove that the radius that connects the intersection point of a tangent line with the circle is perpendicular to the tangent line. (9 min) [E](#) [MM](#)

### Proof: Segments Tangent to Circle from Outside Point are Congruent

Prove that two tangent segments to a circle that are drawn from the same outside point are congruent. (4 min) [E](#) [MM](#)

### Tangents of Circles Problem (Example 1)

Find missing angles using the property that tangents are perpendicular to the radius. (4 min) [E](#) [MM](#)

### Tangents of Circles Problem (Example 2)

Find a missing angle using the property that tangents are perpendicular to the radius. (4 min) [E](#) [MM](#)

### Tangents of Circles Problem (Example 3)

Find a missing length using the property that tangents are perpendicular to the radius. (3 min) [E](#) [MM](#)

### Geometric Constructions: Circle Tangent (Example 1)

Construct a line tangent to a circle using compass and straightedge. (6 min) [E](#) [MM](#)

### Geometric Constructions: Circle Tangent (Example 2)

Construct a line tangent to a circle using compass and straightedge. (5 min) [E](#) [MM](#)

## Geometry | Constructing Inscribed & Circumscribed Shapes

### Geometric Constructions: Circle-Inscribed Square

Construct a square that is inscribed inside a given circle using compass and straightedge. (3 min) [E](#) [MM](#)

### Geometric Constructions:

#### Circle-Inscribed Equilateral Triangle

Construct an equilateral triangle that is inscribed inside a given circle using compass and straightedge. (4 min) [E](#) [MM](#)

### Geometric Constructions:

#### Circle-Inscribed Regular Hexagon

Construct a regular hexagon that is inscribed inside a given circle using compass and straightedge. (4 min) [E](#) [MM](#)

### Geometric Constructions:

#### Triangle-Inscribing Circle

Construct a circle that inscribes a given triangle using compass and straightedge. (3 min) [E](#) [MM](#)

### Geometric Constructions:

#### Triangle-Circumscribing Circle

Construct a circle that circumscribes a given triangle using compass and straightedge. (2 min) [E](#) [MM](#)

## Geometry | 2D vs. 3D Objects

### Dilating in 3D

The cross sections of 3D shapes are dilations of the original shape, centered at a specific point. The scale factor of the dilation depends on the height of the cross-section or the distance from the point on the base. (4 min) [E](#) [MM](#)

### Slicing a Rectangular Pyramid

Explore what happens when you slice vertically into a rectangular pyramid. (4 min) [E](#) [MM](#)

### Ways to Cross-Section a Cube

Learn about all the different ways we can obtain cross-sections of a cube. (7 min) [E](#) [MM](#)

### Rotating 2D Shapes in 3D

Explore rotating various 2D shapes and see what 3D objects you get. (4 min) [E](#) [MM](#)

## Geometry | Cavalieri's Principal & Dissection Methods

### Cavalieri's Principle in 3D

Cavalieri's principle tells us that if 2 figures have the same height and the same cross-sectional area at every point along that height, they have the same volume. (5 min) [E](#) [MM](#)

### Volume of Pyramids Intuition

Find out what that fraction is by cutting a prism into several pyramids. (8 min) [E](#) [MM](#)

### Volumes of Cones Intuition

Use Cavalieri's principle to establish that the formula for the volume of a cone is the same as the formula for the volume of a pyramid ( $\frac{1}{3} \times \text{base area} \times \text{height}$ ). (6 min) [E](#) [MM](#)

**Using Related Volumes**

Use related volumes (using the volume of one figure to determine the volume of another). (6 min) [E](#) [MM](#)

**Geometry | Volume & Surface Area****Volume of Triangular Prism & Cube**

Use the formulas for the volume of triangular prism and cube to solve some solid geometry problems. (4 min) [E](#) [MM](#)

**Volume of a Cone**

Learn the formula for the volume of a cone is  $V = \frac{1}{3}\pi r^2 h$ . (6 min) [E](#) [MM](#)

**Cylinder Volume & Surface Area**

Learn the cylinder's volume is  $\pi r^2 h$ , and its surface area is  $2\pi r h + 2\pi r^2$ . (8 min) [E](#) [MM](#)

**Volume of a Sphere**

The formula for the volume of a sphere is  $V = \frac{4}{3}\pi r^3$ , where  $V$  = volume and  $r$  = radius. The radius of a sphere is half its diameter. So, to calculate the surface area of a sphere given the diameter of the sphere, you can first calculate the radius, then the volume. (2 min) [E](#) [MM](#)

**Applying Volume of Solids**

Calculate the volume of a grain hopper and then use the given rate to solve an applied problem. (7 min) [E](#) [MM](#)

**Area Density**

Learn that area or surface density is the amount of a quantity (often mass) per unit of area.  $\text{Density} = \text{Quantity} / \text{Area}$ . (4 min) [E](#) [MM](#)

**Volume Density**

Learn that volume density is the amount of a quantity (often mass) per unit of volume.  $\text{Density} = \text{Quantity} / \text{Volume}$ . (4 min) [E](#) [MM](#)

**Algebra II | Polynomial Arithmetic****Polynomials Intro**

This introduction to polynomials covers common terminology like terms, degree, standard form, monomial, binomial and trinomial. Polynomials are sums of terms of the form  $k \cdot x^n$ , where  $k$  is any number and  $n$  is a positive integer. (11 min) [E](#) [MM](#)

**The Parts of Polynomial Expressions**

Learn to identify terms, coefficients, and exponents in a polynomial. (3 min) [E](#) [MM](#)

**Finding Average Rate of Change of Polynomials**

Learn how to calculate the average rate of change of a function over a specific interval. (4 min) [E](#) [MM](#)

**Sign of Average Rate of Change of Polynomials**

Discover how to find the average rate of change in polynomials. (5 min) [E](#) [MM](#)

**Adding Polynomials**

Learn how to simplify polynomials by combining like terms (2 min) [E](#) [MM](#)

**Subtracting Polynomials**

Learn how to distribute negative signs across terms, combine like terms, and simplify expressions. (2 min) [E](#) [MM](#)

**Polynomial Subtraction**

Discover how distributing a negative sign changes the signs of all terms in a polynomial. (3 min) [E](#) [MM](#)

**Multiplying Monomials**

Discover how to multiply numbers and variables separately, then combine them for the final answer. (3 min) [E](#) [MM](#)

**Multiplying Monomials by****Polynomials: Area Model**

By breaking down a rectangle into smaller parts, we can find the total area by multiplying the height and width of each part. This method introduces us to the concept of multiplying monomials by polynomials. (2 min) [E](#) [MM](#)

**Area Model for Multiplying****Polynomials with Negative Terms**

Discover how to multiply monomials by polynomials using area models. (5 min) [E](#) [MM](#)

**Multiplying Monomials by Polynomials**

Discover how to multiply monomials by polynomials using the distributive property. (3 min) [E](#) [MM](#)

**Binomials by Polynomials: Area Model**

By breaking down the big rectangle into smaller ones, we can find the area and thus the product of the polynomials. (7 min) [E](#) [MM](#)

**Multiplying Binomials by Polynomials**

Learn how to multiply binomials by polynomials by using the distributive property to multiply each term. (3 min) [E](#) [MM](#)

**Polynomial Special Products:****Difference of Squares**

Dive into the exciting world of special products of polynomials, focusing on the difference of squares. (4 min) [E](#) [MM](#)

**Polynomial Special Products: Perfect Square**

Explore how to use the perfect square pattern to square more complex binomials. (5 min) [E](#) [MM](#)

**Algebra II | Complex Numbers****Intro to the Imaginary Numbers**

Learn about the imaginary unit, "i", a unique number defined as the square root of -1. (5 min) [E](#) [MM](#)

**Simplifying Roots of Negative Numbers**

Explore how to simplifying the square root of negative numbers using 'i', the principal square root of -1. (4 min) [E](#) [MM](#)

**Powers of the Imaginary Unit**

Discover how the powers of 'i' cycle through values, making it possible to calculate high exponents of 'i' easily. (7 min) [E](#) [MM](#)

**i as the Principal Root of -1**

Explore the concept of 'i' is equal to the square root of -1, and every complex number can be expressed as  $a + bi$ , where  $a$  and  $b$  are real numbers. (7 min) [E](#) [MM](#)

**Intro to Complex Numbers**

Explain how we obtain complex numbers by adding real numbers and imaginary numbers. (5 min) [E](#) [MM](#)

**Classifying Complex Numbers**

Learn how real and imaginary numbers are subsets of complex numbers and study how to classify numbers as real, pure imaginary, or complex. (5 min) [E](#) [MM](#)

**Plotting Numbers on the Complex Plane**

Learn how to plot complex numbers on a unique two-dimensional grid known as the complex plane. (2 min) [E](#) [MM](#)

**Adding Complex Numbers**

Learn how to break down the process of adding complex numbers into simple steps. (2 min) [E](#) [MM](#)

**Subtracting Complex Numbers**

Learn how to break down the process of subtracting complex numbers into simple steps. (2 min) [E](#) [MM](#)

**Multiplying Complex Numbers**

Discover how to multiply complex numbers using the distributive property or FOIL method. (5 min) [E](#) [MM](#)

**Solving Quadratic Equations: Complex Roots**

Learn to break down the process of solving quadratic equations using the quadratic formula and standard form. (10 min) [E](#) [MM](#)

**Algebra II | Polynomial Factorization****Introduction to Factoring Higher Degree Polynomials**

Learn to simplify third-degree polynomials and tackle fourth-degree monomials. (6 min) [E](#) [MM](#)

**Introduction to Factoring Higher Degree Monomials**

Learn to factor monomials like  $6x^7$  as  $2x^3 \cdot 3x^4$  or as  $x^6 \cdot 6x$ . (5 min) [E](#) [MM](#)

**Which Monomial Factorization is Correct?**

Learn that factoring monomials involves breaking down an expression into two parts. (2 min) [E](#) [MM](#)

**Worked Example: Finding the Missing Monomial Factor**

Learn how to use exponent properties to rewrite complex expressions and get a firm grasp on the crucial role that coefficients and exponents play in this process. (3 min) [E](#) [MM](#)

**Worked Example: Finding Missing Monomial Side in Area Model**

Find the length of a rectangle whose area is  $42xy^3$  and whose height is  $14xy$ . (2 min) [E](#) [MM](#)

**Greatest Common Factor of Monomials**

Explore prime factorization and variable parts and learn how to break down monomials into their simplest forms. (3 min) [E](#) [MM](#)

**Taking Common Factor from Binomial**

Explore the process of factoring polynomials using the greatest common monomial factor. (5 min) [E](#) [MM](#)

**Taking Common Factor from Trinomial**

Learn how to identify the greatest common factor of a trinomial expression and use it to simplify the expression. (6 min) [E](#) [MM](#)

**Taking Common Factor: Area Model**

Learn how to find the greatest common monomial factor of terms and uses the area of a rectangle as a visual aid. (5 min) [E](#) [MM](#)

**Factoring Higher-Degree Polynomials: Common Factor**

Discover the art of factoring higher degree polynomials. (4 min) [E](#) [MM](#)

**Identifying Quadratic Patterns**

Determine whether the polynomial  $9x^8 + 6x^4y + y^2$  can be factored using the perfect square pattern or the difference of squares pattern (or neither). (6 min) [E](#) [MM](#)

**Factorization with Substitution**

Explore how to simplify complex expressions by identifying patterns and substituting variables. (5 min) [E](#) [MM](#)

**Factoring Using the Perfect Square Pattern**

Factor  $25x^4 - 30x^2 + 9$  as  $(5x^2 - 3)^2$ . (3 min) [E](#) [MM](#)

**Factoring Using the Difference of Squares Pattern**

If we expand  $(a+b)(a-b)$  we will get  $a^2 - b^2$ . Factorization goes the other way: suppose we have an expression that is the difference of two squares, like  $x^2 - 25$  or  $49x^2 - y^2$ , then we can factor is using the roots of those squares. (2 min) [E](#) [MM](#)

**Polynomial Identities Introduction**

Discover that polynomial identities are equations that are true for all possible values of the variable. (5 min) [E](#) [MM](#)

**Analyzing Polynomial Identities**

Explore two cases of polynomial identities and their proofs. (8 min) [E](#) [MM](#)

**Describing Numerical Relationships with Polynomial Identities**

Explore how to use identities to prove that the differences between consecutive square numbers (1, 4, 9, ...) are consecutive odd numbers (1, 3, 5, ...). (5 min) [E](#) [MM](#)

## Algebra II | Geometric Series

### Geometric Series Introduction

Explore how a geometric series is the sum of the first few terms of a geometric sequence. (6 min) [E](#) [MM](#)

### Finite Geometric Series Formula

Explore the finite geometric series formula is  $a(1-r^n)/(1-r)$ . (7 min) [E](#) [MM](#)

### Worked Examples: Finite Geometric Series

Evaluate three geometric series (defined in various ways) using the finite geometric series formula  $a(1-r^n)/(1-r)$ . (7 min) [E](#) [MM](#)

### Geometric Series Word Problems:

#### Swing

Find an expression for the total length and calculate it for a specific number of swings. (6 min) [E](#) [MM](#)

### Geometric Series Word Problems: Hike

Modeling the length of a hike with a geometric series. (7 min) [E](#) [MM](#)

## Algebra II | Polynomial Division

### Polynomial Division Introduction

Explore how some quotients end up as a polynomial, while other times we have a remainder and cannot express the quotient as a polynomial. (5 min) [E](#) [MM](#)

### Dividing Polynomials by X (No Remainders)

Finding the quotient  $(x^4 - 2x^3 + 5x)/x$  is the same as asking "what should we multiply by  $x$  to get  $x^4 - 2x^3 + 5x$ ?" (5 min) [E](#) [MM](#)

### Divide Polynomials by X (With Remainders)

Learn how to divide  $(18x^4 - 3x^2 + 6x - 4)$  by  $6x$ . (5 min) [E](#) [MM](#)

### Intro to Long Division of Polynomials

Any quotient of polynomials  $a(x)/b(x)$  can be written as  $q(x) + r(x)/b(x)$ , where the degree of  $r(x)$  is less than the degree of  $b(x)$ . (12 min) [E](#) [MM](#)

### Dividing Quadratics by Linear Expressions (No Remainders)

Explore how you can divide polynomials similarly to how we divide integers. (4 min) [E](#) [MM](#)

### Dividing Quadratics by Linear Expressions with Remainders

Learn about dividing quadratics by linear expressions with remainders. (5 min) [E](#) [MM](#)

### Dividing Quadratics by Linear Expressions with Remainders: Missing X-Term

An interesting case in polynomial division is when one of the terms is missing. For example  $(x^2 + 1)$  divided by  $(x + 2)$ . Learn how to avoid any mistakes in such cases. (5 min) [E](#) [MM](#)

### Dividing Polynomials by Linear Expressions

Dividing  $(3x^3 + 4x^2 - 3x + 7)$  by  $(x + 2)$  using long division. (4 min) [E](#) [MM](#)

### Dividing Polynomials by Linear Expressions: Missing Term

Dividing  $(2x^3 - 47x - 15)$  by  $(x - 5)$  using long division. (5 min) [E](#) [MM](#)

### Factoring Using Polynomial Division

Use the fact that  $(x + 2)$  is a factor of  $(4x^3 + 19x^2 + 19x - 6)$  to completely factor the polynomial. (6 min) [E](#) [MM](#)

### Factoring Using Polynomial Division: Missing Term

Using the fact that  $(x + 6)$  is a factor of  $(x^3 + 9x^2 - 108)$  to completely factor the polynomial. (4 min) [E](#) [MM](#)

## Algebra II | Polynomial Remainder Theorem

### Intro to the Polynomial Remainder Theorem

The polynomial remainder theorem allows us to determine whether a linear expression is a factor of a polynomial expression easily. (7 min) [E](#) [MM](#)

### Remainder Theorem: Finding Remainder from Equation

Find the remainder of  $(-3x^3 - 4x^2 + 10x - 7)$  divided by  $(x - 2)$  using the PRT (Polynomial Remainder Theorem). (4 min) [E](#) [MM](#)

### Remainder Theorem Examples

Explore that the polynomial remainder theorem says that for a polynomial  $p(x)$  and a number  $a$ , the remainder on division by  $(x - a)$  is  $p(a)$ . (6 min) [E](#) [MM](#)

### Remainder Theorem: Checking Factors

Check whether  $(x - 3)$  is a factor of  $(2x^4 - 11x^3 + 15x^2 + 4x - 12)$  using the factor theorem. (4 min) [E](#) [MM](#)

### Remainder Theorem: Finding Coefficients

Determine the value of coefficient  $c$  in  $p(x) = x^3 + 2x^2 + cx + 10$ , for  $(x - 5)$  to be a factor of  $p$ . (4 min) [E](#) [MM](#)

### Proof of the Polynomial Remainder Theorem

Learn to use the PRT (Polynomial Remainder Theorem) to prove problems. (6 min) [E](#) [MM](#)

## Algebra II | Polynomial Graphs

### Zeros of Polynomials Introduction

Explore that the  $x$ -values of a polynomial  $p(x)$  are all the  $x$ -values that make the polynomial equal to zero. (5 min) [E](#) [MM](#)

**Zeros of Polynomials: Plotting Zeros**

When given a polynomial in factored form, find the polynomial's zeros, and represent them as the x-intercepts of the polynomial's graph. (3 min) [E](#) [MM](#)

**Zeros of Polynomials: Matching Equation to Zeros**

When given a list of the zeros of a polynomial, we can conclude the polynomial must have certain factors, which gives us information about the equation of the polynomial. (4 min) [E](#) [MM](#)

**Zeros of Polynomials: Matching Equation to Graph**

When we are given the graph of a polynomial, we can deduce what its zeros are, which helps us determine a few factors the polynomial's equation must include. (3 min) [E](#) [MM](#)

**Zeros of Polynomials (With Factoring): Grouping**

Follow along with this example of a 3rd degree polynomial we can factor using the method of grouping. (5 min) [E](#) [MM](#)

**Zeros of Polynomials (With Factoring): Common Factor**

Follow along with this example of a 3rd degree polynomial we can factor by first taking a common factor and then using the sum-product pattern. (4 min) [E](#) [MM](#)

**Positive and Negative Intervals of Polynomials**

Given the graph of a polynomial and looking at its x-intercepts, we can determine the factors the polynomial must have. (9 min) [E](#) [MM](#)

**Multiplicity of Zeros of Polynomials**

Multiplicity is a fascinating concept, and it is directly related to graphical behavior of the polynomial around the zero. (7 min) [E](#) [MM](#)

**Zeros of Polynomials (Multiplicity)**

Given the graph of a polynomial and looking at its x-intercepts, we can determine the factors the polynomial must have. (5 min) [E](#) [MM](#)

**Intro to End Behavior of Polynomials**

Explain what "end behavior" is and what affects the end behavior of polynomial functions. (8 min) [E](#) [MM](#)

**Algebra II | Rational Exponents & Radicals****Intro to Rational Exponents**

Explore what it means to take a number by a power which is a unit fraction. (5 min) [E](#) [MM](#)

**Rewriting Roots as Rational Exponents**

Solve several problems about the equivalence of expressions with roots and rational exponents. (4 min) [E](#) [MM](#)

**Exponential Equation with Rational Answer**

Solve for the unknown in  $3^a = \sqrt[5]{3^2}$ . (4 min) [E](#) [MM](#)

**Rewriting Quotient of Powers (Rational Exponents)**

Rewrite the expression  $m^{(7/9)} / m^{(1/3)}$  as a single exponential term  $m^{(4/9)}$ . (3 min) [E](#) [MM](#)

**Rewriting Mixed Radical and Exponential Expressions**

Rewrite  $(r^{(2/3)}s^3)^{2\sqrt{20r^4s^5}}$ , once as an exponential expression and once as a radical expression. (7 min) [E](#) [MM](#)

**Evaluating Fractional Exponents**

Show how to evaluate  $64^{(2/3)}$  and  $(8/27)^{-(-2/3)}$ . (6 min) [E](#) [MM](#)

**Evaluating Fractional Exponents: Negative Unit-Fraction**

Learn to evaluate powers that are negative unit fractions, like 9 raised to  $-1/2$  and 27 raised to  $-1/3$ . (3 min) [E](#) [MM](#)

**Evaluating Fractional Exponents: Fractional Base**

Show how to evaluate  $(25/9)^{(1/2)}$  and  $(81/256)^{-(-1/4)}$ . (4 min) [E](#) [MM](#)

**Evaluating quotient of Fractional Exponents**

Simplify the complicated expression  $256^{(4/7)} / 2^{(4/7)}$  until the expression is equal to 16. (4 min) [E](#) [MM](#)

**Evaluating Mixed Radicals and Exponents**

Explore this example of calculating an expression that has both a radical and an exponent. (3 min) [E](#) [MM](#)

**Rewriting Exponential Expressions as  $A \cdot B^t$** 

Simplify the expression  $10^9(0.5t+2)^5 5^{(3t)}$  as  $810 \cdot 375^t$ . (5 min) [E](#) [MM](#)

**Equivalent Forms of Exponential Expressions**

Explore how to rewrite  $(1/32) \cdot 2^t$  as  $32 \cdot 1024^t(t/10-1)$ . (9 min) [E](#) [MM](#)

**Solving Exponential Equations Using Exponent Properties**

Solve equations like  $26^{(9x+5)} = 1$  and  $2^{(3x+5)} = 64^{(x-7)}$ . (5 min) [E](#) [MM](#)

**Solving Exponential Equations Using Exponent Properties (Advanced)**

Solve equations like  $26^{(9x+5)} = 1$  and  $2^{(3x+5)} = 64^{(x-7)}$ . (7 min) [E](#) [MM](#)

**Algebra II | Exponential Models****Interpreting Change in Exponential Models**

Find the factor by which a quantity changes over a single time unit in various exponential models. (7 min) [E](#) [MM](#)

**Interpreting Time in Exponential Models**

Find the time interval over which a quantity changes by a given factor in various exponential models. (7 min) [E](#) [MM](#)

**Constructing Exponential Models**

Model the distribution of a chain letter using an exponential function.

(4 min) [E](#) [MM](#)

**Constructing Exponential Models: Half Life**

Model the decay of a Carbon-14 samples using an exponential function.

(4 min) [E](#) [MM](#)

**Constructing Exponential Models: Percent Change**

Model a population of narwhals using an exponential function. (5 min) [E](#) [MM](#)

**Interpreting Change in Exponential Models: With Manipulation**

Analyze the rate of change of various exponential models, where the function that models the situation needs some manipulation. (5 min) [E](#) [MM](#)

**Interpreting Change in Exponential Models: Changing Units**

Analyze the rate of change of various exponential models for different time units by manipulating the functions that model the situations. (4 min) [E](#) [MM](#)

**Algebra II | Intro to Logarithms****Intro to Logarithms**

Explain what logarithms are and gives a few examples of finding logarithms.

(7 min) [E](#) [MM](#)

**Evaluating Logarithms (Advanced)**

Evaluate  $\log_2(8)$ ,  $\log_8(2)$ ,  $\log_2(\frac{1}{8})$ , and  $\log_8(\frac{1}{2})$ . (4 min) [E](#) [MM](#)

**Exponentials & Logarithms: Graphs**

Given a few points on the graph of an exponential function, Sal plots the corresponding points on the graph of the corresponding logarithmic function.

(4 min) [E](#) [MM](#)

**Algebra II | The Constant E & the Natural Logarithm****e and Compound Interest**

Discover a very special number in the world of math: the constant  $e$ . (12 min) [E](#) [MM](#)

**e as a Limit**

Dig deeper into the mathematical definition of  $e$ . (6 min) [E](#) [MM](#)

**Evaluating Natural Logarithm with Calculator**

Evaluate  $\log_e(67)$  (which is more commonly written as  $\ln(67)$ ) using a calculator. (4 min) [E](#) [MM](#)

**Algebra II | Properties of Logarithms & Change of Base****Intro to Logarithm Properties (Part 1)**

Introduce the logarithm identities for addition and subtraction of logarithms.

(9 min) [E](#) [MM](#)

**Intro to Logarithm Properties (Part 2)**

Explore the logarithm identities for multiplication of logarithm by a constant, and the change of base rule. (10 min) [E](#) [MM](#)

**Using the Logarithmic Product Rule**

Learn to rewrite  $\log_3(27x)$  as  $\log_3(27) + \log_3(x)$ , which is simplified as  $3 + \log_3(x)$ . (5 min) [E](#) [MM](#)

**Using the Logarithmic Power Rule**

Learn to rewrite  $\log_5(x^3)$  as  $3\log_5(x)$ . (5 min) [E](#) [MM](#)

**Using the Properties of Logarithms: Multiple Steps**

Learn to rewrite  $\log_5([25^x]/y)$  as  $2x - \log_5(y)$  by using both the log subtraction property and the log multiplied by a constant property. (2 min) [E](#) [MM](#)

**Proof of the Logarithm Product Rule**

Explore how to prove the logarithm addition property,  $\log(a) + \log(b) = \log(ab)$ .

(7 min) [E](#) [MM](#)

**Proof of the Logarithm Quotient and Power Rules**

Explore how to prove logarithm addition property,  $\log(a) + \log(b) = \log(ab)$ .

(8 min) [E](#) [MM](#)

**Evaluating Logarithms: Change of Base Rule**

Approximate  $\log_5(100)$  by rewriting it as  $\log(100)/\log(5)$  using the change of base rule, then evaluates with a calculator.

(8 min) [E](#) [MM](#)

**Using the Logarithm Change of Base Rule**

Explore how to rewrite logarithmic expressions like  $1/(\log_4 4)$  or  $\log_4(16) \cdot \log_2(a)$  using the change of base rule. (7 min) [E](#) [MM](#)

**Proof of the Logarithm Change of Base Rule**

Explore how to prove the logarithmic change of base rule,  $\log_a(b) = \log_x(b)/\log_x(a)$ .

(5 min) [E](#) [MM](#)

**Algebra II | Solving Exponential Equations with Logarithms****Solving Exponential Equations Using Logarithms: Base-10**

Solve the equation  $10^{(2t-3)}=7$ .

(3 min) [E](#) [MM](#)

**Solving Exponential Equations Using Logarithms: Base-2**

Learn to use logarithms to solve "any" exponential equation of the form  $a \cdot b^{cx} = d$ .

(5 min) [E](#) [MM](#)

**Exponential Model Word Problem:****Medication Dissolve**

Solve an exponential equation to answer a question about an exponential model.

(4 min) [E](#) [MM](#)

**Exponential Model Word Problem:****Bacteria Growth**

Evaluate an exponential function at a specific value to answer a question about an exponential model. (2 min) [E](#) [MM](#)

## Algebra II | Transformations of Functions

**Shifting Functions Introduction**

Explore how the graph of  $y=f(x)+k$  (where  $k$  is a real number) is the same as the graph of  $y=f(x)$  only it's shifted up (when  $k>0$ ) or down (when  $k<0$ ). (6 min) [E](#) [MM](#)

**Shifting Functions Examples**

Analyze two cases where functions  $f$  and  $g$  are given graphically, and  $g$  is a result of shifting  $f$ . (8 min) [E](#) [MM](#)

**Graphing Shifted Functions**

Given the graph of  $f(x)=x^2$ , graphs  $g(x)=(x-2)^2-4$ , which is the graph of  $f$  shifted 2 units to the right and 4 units down. (3 min) [E](#) [MM](#)

**Reflecting Functions Introduction**

Learn to reflect the graph of  $y=f(x)$  over the  $x$ -axis by graphing  $y=-f(x)$  and over the  $y$ -axis by graphing  $y=f(-x)$ . (7 min) [E](#) [MM](#)

**Reflecting Functions: Examples**

We can reflect the graph of any function  $f$  about the  $x$ -axis by graphing  $y=-f(x)$  and we can reflect it about the  $y$ -axis by graphing  $y=f(-x)$ . (6 min) [E](#) [MM](#)

**Function Symmetry Introduction**

Learn about the two types of symmetry we call even and odd functions. (6 min) [E](#) [MM](#)

**Even and Odd Functions: Graphs**

Pick the function that is odd among three functions given by their graphs.

(4 min) [E](#) [MM](#)

**Even and Odd Functions: Tables**

Even functions are symmetrical about the  $y$ -axis:  $f(x)=f(-x)$ . Odd functions are symmetrical about the  $x$ - and  $y$ -axis:  $f(x)=-f(-x)$ . Let's use these definitions to determine if a function given as a table is even, odd, or neither. (4 min) [E](#) [MM](#)

**Even and Odd Functions: Equations**

When given the equation of a function  $f(x)$ , check whether the function is even, odd, or neither by evaluating  $f(-x)$ . (4 min) [E](#) [MM](#)

**Even and Odd Functions: Find the****Mistake**

See another student's work when trying to determine whether a function is even, odd, or either, and decide whether they made a mistake, and if so, where. (4 min) [E](#) [MM](#)

**Scaling Functions Introduction**

Explore how operations are classified as scaling. (6 min) [E](#) [MM](#)

**Scaling Functions Vertically: Examples**

See multiple examples of how we relate the two functions and their graphs, and determine the value of  $k$ . (5 min) [E](#) [MM](#)

**Scaling Functions Horizontally:****Examples**

Explore the function  $f(k \cdot x)$  is a horizontal scaling of  $f$ . (8 min) [E](#) [MM](#)

**Identifying Horizontal Squash from Graph**

Given the graphs of functions  $f$  and  $g$ , where  $g$  is the result of compressing  $f$  by a factor of 2, find  $g(x)$  in terms of  $f(x)$ .

(4 min) [E](#) [MM](#)

**Identifying Function Transformations**

Explore several examples of how to write  $g(x)$  implicitly in terms of  $f(x)$  when  $g(x)$  is a shift or a reflection of  $f(x)$ . (7 min) [E](#) [MM](#)

## Algebra II | Graphing Radical, Exponential, & Logarithmic Functions

**Graphing Square and Cube Root Functions**

Graph various square root and cube root functions by thinking of them as transformations of the parent graphs  $y=\sqrt{x}$  and  $y=\sqrt[3]{x}$ . (7 min) [E](#) [MM](#)

**Transforming Exponential Graphs (Example 1)**

Given the graph of  $y=2^x$ , graph  $y=2^{-x}-5$ , which is a horizontal reflection and shift of  $y=2^x$ . (3 min) [E](#) [MM](#)

**Transforming Exponential Graphs (Example 2)**

Given the graph of  $y=2^x$ , graph  $y=(-1)2^{x+3}+4$ , which is a vertical reflection and a shift of  $y=2^x$ . (5 min) [E](#) [MM](#)

**Graphing Exponential Functions**

Graph  $y=-2 \cdot 3^{x+5}$  using our interactive graphing widget. (4 min) [E](#) [MM](#)

**Graphical Relationship Between  $2^x$  and  $\log_2(x)$** 

Graph  $y=2^x$  and  $y=\log_2(x)$  on the same coordinate plane, showing how they relate as graphs of inverse functions. (6 min) [E](#) [MM](#)

**Graphing Logarithmic Functions (Example 1)**

Graph  $y=2\log_2(-x-3)$  by viewing it as a transformation of  $y=\log_2(x)$ . (6 min) [E](#) [MM](#)

**Graphing Logarithmic Functions (Example 2)**

Graph  $y=4\log_2(x+6)-7$  by viewing it as a transformation of  $y=\log_2(x)$ . (5 min) [E](#) [MM](#)

## Algebra II | More Types of Equations & Solutions

### Rational Equations Intro

Learn about rational equation which is when an equation where the variable is in the denominator of a quotient.

(3 min) [E](#) [MM](#)

### Equations with Rational Expressions (Example 1)

Solve  $(x^2-10x+21)/(3x-12)=(x-5)/(x-4)$ , which has one real solution and one extraneous solution. (5 min) [E](#) [MM](#)

### Equations with Rational Expressions (Example 2)

Solve  $(-2x+4)/(x-1)=3/(x+1)-1$ . (7 min) [E](#) [MM](#)

### Finding Inverses of Rational Functions

Find an expression for the inverse of  $f$  by solving the equation  $x=f(y)$  for the variable  $y$ . (4 min) [E](#) [MM](#)

### Intro to Square-Root Equations & Extraneous Solutions

Explore what square-root equations are and show an example of solving such an equation while checking for extraneous solutions. (11 min) [E](#) [MM](#)

### Square-Root Equations Intro

Explore an example of how an extraneous solution arises when solving  $2x-1=\sqrt{8-x}$ . (5 min) [E](#) [MM](#)

### Solving Square-Root Equations: One Solution

Solve the equation  $3+\sqrt{5x+6}=12$ .

(3 min) [E](#) [MM](#)

### Solving Square-Root Equations: Two Solutions

Solve the equation  $6+3w=\sqrt{2w+12}+2w$  which has two solutions. (5 min) [E](#) [MM](#)

### Solving Square-Root Equations: No Solution

Solve the equation  $\sqrt{3x-7}+\sqrt{2x-1}=0$ , only to find out that the single solution is extraneous, which means the equation has no solution. (4 min) [E](#) [MM](#)

### Extraneous Solutions

Explore how and why we get extraneous solutions, by understanding the logic behind the process of solving equations. (8 min) [E](#) [MM](#)

### Equation that has a Specific Extraneous Solution

Find the value of  $d$  for which  $\sqrt{3x+25}=d+2x$  has an extraneous solution at  $x=-3$ . (5 min) [E](#) [MM](#)

### Solving Cube-Root Equations

Solve the equation  $\sqrt[3]{y}=4\sqrt[3]{y}+5$ . (4 min) [E](#) [MM](#)

### Quadratic Systems: A Line and a Parabola

Explore how a system of equations that contains one linear equation, and one quadratic equation can be solved both graphically and algebraically. (6 min) [E](#) [MM](#)

### Quadratic Systems: A Line and a Circle

Solve the system  $y=x+1$  and  $x^2+y^2=25$ . (4 min) [E](#) [MM](#)

### Quadratic System with No Solutions

Solve a system of two quadratic equations algebraically and finds the system has no solutions. (7 min) [E](#) [MM](#)

### Solving Equations by Graphing

Explore how to solve a system of equations by graphing the equations and looking for intersection points. (4 min) [E](#) [MM](#)

### Solving Equations by Graphing: Intro

Learn that you can always solve an equation by graphing it, although the solution might not be exact. (5 min) [E](#) [MM](#)

### Solving Equations by Graphing:

#### Graphing Calculator

Learn to approximate the solutions to any equation by graphing both sides of the equation and looking for intersection points. (4 min) [E](#) [MM](#)

### Solving Equations by Graphing: Word Problems

Learn to approximate the solutions of any equation by graphing both sides of the equation and looking for intersection point. (9 min) [E](#) [MM](#)

## Algebra II | The Unit Circle, Radians, & Trig Identities

### Unit Circle

Learn how to use the unit circle to define sine, cosine, and tangent for all real numbers. (9 min) [E](#) [MM](#)

### The Trig Functions & Right Triangle Trig Ratios

Learn how, for acute angles, the two different definitions of the trigonometric values (SOH CAH TOA and the unit circle definition) result in the same values. (7 min) [E](#) [MM](#)

### Intro to Radians

Explain the definition and motivation for radians and the relationship between radians and degrees. (11 min) [E](#) [MM](#)

### Radians & Degrees

Discuss the general approach to converting between radians and degrees and vice versa. (7 min) [E](#) [MM](#)

### Degrees to Radians

Learn to convert from degrees to radians, multiply the number of degrees by  $\pi/180$ . (7 min) [E](#) [MM](#)

### Radians to Degrees

Learn to change from radians to degrees, you need to multiply the number of radians by  $180/\pi$ . (3 min) [E](#) [MM](#)

### Radian Angles & Quadrants

Determine the quadrant at which a ray falls after a rotation by a certain measure of radians. (4 min) [E](#) [MM](#)

### Trig Values of $\pi/4$

Find the trigonometric values of  $\pi/4$  using the unit-circle definition. (8 min) [E](#) [MM](#)

### Proof of the Pythagorean Trig Identity

Prove this identity using the Pythagorean theorem in the unit circle with  $x^2+y^2=1$ . (6 min) [E](#) [MM](#)

**Using the Pythagorean Trig Identity**

Explore the Pythagorean identity tells us that no matter what the value of  $\theta$  is,  $\sin^2\theta + \cos^2\theta$  is equal to 1. (6 min) [E](#) [MM](#)

## Algebra II | Features & Graphs of Trigonometric Functions

**Graph of  $y=\sin(x)$** 

Explore how the graph of  $y=\sin(x)$  is like a wave that forever oscillates between -1 and 1, in a shape that repeats itself every  $2\pi$  units. (9 min) [E](#) [MM](#)

**Intersection Points of  $y=\sin(x)$  and  $y=\cos(x)$** 

Draw the graphs of the sine and the cosine functions and analyze their intersection points. (12 min) [E](#) [MM](#)

**Graph of  $y=\tan(x)$** 

Draw the graph of the tangent function based on the unit circle definition of the function. (10 min) [E](#) [MM](#)

**Features of Sinusoidal Functions**

Explore the main features of sinusoidal functions: midline, amplitude, & period. (5 min) [E](#) [MM](#)

**Amplitude & Period of Sinusoidal Functions from Equation**

Find the amplitude and the period of  $y=-0.5\cos(3x)$ . (8 min) [E](#) [MM](#)

**Transforming Sinusoidal Graphs:****Vertical Stretch & Horizontal****Reflection**

Graph  $y=2\sin(-x)$  by considering it as a vertical stretch and a horizontal reflection of  $y=\sin(x)$ . (13 min) [E](#) [MM](#)

**Transforming Sinusoidal Graphs:****Vertical & Horizontal Stretches**

Graph  $y=-2.5\cos(1/3x)$  by considering it as a vertical stretch and reflection, and a horizontal stretch, of  $y=\cos(x)$ . (11 min) [E](#) [MM](#)

**Example: Graphing  $y=3\sin(\frac{1}{2}x)-2$** 

Graph  $y=3\sin(\frac{1}{2}x)-2$  by thinking about the graph of  $y=\sin(x)$  and analyzing how the graph (including the midline, amplitude, and period) changes as we perform function transformations to get from  $y=\sin(x)$  to  $y=3\sin(\frac{1}{2}x)-2$ . (4 min) [E](#) [MM](#)

**Example: Graphing  $y=-\cos(\pi x)+1.5$** 

Graph  $y=-\cos(\pi x)+1.5$  by thinking about the graph of  $y=\cos(x)$  and analyzing how the graph (including the midline, amplitude, and period) changes as we perform function transformations to get from  $y=\cos(x)$  to  $y=-\cos(\pi x)+1.5$ . (3 min) [E](#) [MM](#)

**Sinusoidal Function from Graph**

Find the equation of a sinusoidal function from its graph where the minimum point  $(-2,-5)$  and the maximum point  $(2,1)$  are highlighted. (5 min) [E](#) [MM](#)

**Interpreting Trigonometric Graphs in Context**

When a trigonometric function models a real-world relationship, we can assign meaning to its midline, amplitude and period. (6 min) [E](#) [MM](#)

**Trig Word Problem: Modeling Daily Temperature**

Solve a word problem about the daily change in temperature by modeling it with a sinusoidal function. (11 min) [E](#) [MM](#)

**Trig Word Problem: Modeling Annual Temperature**

Solve a word problem about the annual change in temperature by modeling it with a sinusoidal function. (7 min) [E](#) [MM](#)

**Trig Word Problem: Length of Day (Phase Shift)**

Solve a word problem about the annual change in the length of day by modeling it with a sinusoidal function that has a phase shift. (8 min) [E](#) [MM](#)

## Algebra II | Modeling & Analysis Using Functions

**Modeling with Function Combination**

Model the height of a tree on top of a tower, by adding the functions that model the growth of the tree and the tower separately. (3 min) [E](#) [MM](#)

**Periodicity of Algebraic Models**

Analyze the periodicity of graphs that model real world situations. (3 min) [E](#) [MM](#)

**End Behavior of Algebraic Models**

Analyze the end behavior of graphs that model real world situations. (3 min) [E](#) [MM](#)

**Symmetry of Algebraic Models**

Interpret the significance of modeling function being even. (3 min) [E](#) [MM](#)

**Manipulating Formulas: Perimeter**

Rewrite the formula for the perimeter of a rectangle so it is solved for width. (7 min) [E](#) [MM](#)

**Manipulating Formulas: Area**

Rewrite the formula for the area of a triangle so it is solved for height. (3 min) [E](#) [MM](#)

**Manipulating Formulas: Temperature**

Take the formula for converting from Fahrenheit temperature to Celsius and solve it for F so it serves to convert from Celsius to Fahrenheit. (3 min) [E](#) [MM](#)

**Graph Labels and Scales**

When graphing a real-world relationship, we need to pick labels and axis scales that are appropriate for the purpose of our model. (4 min) [E](#) [MM](#)

**Rational Equation Word Problem**

Model a context that concerns the number and price of pizza slices. (9 min) [E](#) [MM](#)

**Quadratic Inequality Word Problem**

Model a context that concerns a candy vending machine. (10 min) [E](#) [MM](#)

**Exponential Equation Word Problem**

Model a context that concerns a bank savings account. (9 min) [E](#) [MM](#)

**Modeling with Multiple Variables:****Pancakes**

Explore this example of a model that relates different quantities in the context of making pancakes. (3 min) [E](#) [MM](#)

**Modeling with Multiple Variables:****Roller Coaster**

Explore this example of a model that relates different quantities in the context of roller coaster rides. (3 min) [E](#) [MM](#)

**Modeling with Multiple Variables:****Taco Stand**

Explore this example of a model that relates different quantities related to the daily profits of a taco stand. (3 min) [E](#) [MM](#)

**Modeling with Multiple Variables: Ice Cream**

Explore this example of a model that relates different quantities related to two people walking to the same ice cream shop (3 min) [E](#) [MM](#)

**Interpreting Expressions with Multiple Variables: Resistors**

Given the expression for the total resistance in an electric circuit with two resistors, analyze the expression to tell what happens to the total resistance when the resistance of one resistor increases and the resistance of the other resistor stays the same. (3 min) [E](#) [MM](#)

**Interpreting Expressions with Multiple Variables: Cylinder**

Given the value and the expression for the radius of a cylinder, find the radius of a cylinder with the same volume and 100 times the height. (4 min) [E](#) [MM](#)

**Trigonometry | Right Triangles & Trigonometry****Using Similarity to Estimate Ratio Between Side Lengths**

When two right triangles share an acute angle measure, the ratios of the corresponding side lengths within the triangles are equal. (4 min) [E](#) [MM](#)

**Using Right Triangle Ratios to Approximate Angle Measure**

Explore how all right triangles with a given acute angle measure have equal ratios between their side lengths. (3 min) [E](#) [MM](#)

**Triangle Similarity & the Trigonometric Ratios**

Explain how the trigonometric ratios are derived from triangle similarity considerations. (9 min) [E](#) [MM](#)

**Trigonometric Ratios in Right Triangles**

Explore a few examples where that start with the two legs of a right triangle, and then find the trig ratios of one of the acute angles. (12 min) [E](#) [MM](#)

**Solving for a Side in Right Triangles with Trigonometry**

Given a right triangle with an acute angle of  $65^\circ$  and a leg of 5 units, use trigonometry to find the two missing sides. (7 min) [E](#) [MM](#)

**Intro to the Pythagorean Trig Identity**

Explore the identity  $(\sin\theta)^2 + (\cos\theta)^2 = 1$ , which arises from the Pythagorean theorem. (4 min) [E](#) [MM](#)

**Sine & Cosine of Complementary Angles**

Explore that the sine of any angle is equal to the cosine of its complementary angle. (4 min) [E](#) [MM](#)

**Using Complementary Angles**

Solve the following problem: Given that  $\cos(58^\circ) = 0.53$ , find  $\sin(32^\circ)$ . (4 min) [E](#) [MM](#)

**Trig Word Problem: Complementary Angles**

Solve a problem about a submerged pyramid using the fact that the sine of an angle is equal to the cosine of its complementary angle. (5 min) [E](#) [MM](#)

**Challenge Problem: Trig Values & Side Ratios**

Given a diagram with multiple right triangles and is asked to match different expressions with different trig values. (10 min) [E](#) [MM](#)

**Right Triangle Word Problem**

Solve a modeling problem where he finds the necessary angle to shoot at a vicious alien. (4 min) [E](#) [MM](#)

**Finding Reciprocal Trig Ratios**

Find all six trigonometric ratios (sine, cosine, tangent, secant, cosecant, and cotangent) of an angle in each right triangle. (5 min) [E](#) [MM](#)

**Using Reciprocal Trig Ratios**

Given two sides in a right triangle and the cotangent of one of the angles and use this information to find the missing side. (6 min) [E](#) [MM](#)

**Trigonometry | The Unit Circle, Radians, & Trig Identities****Unit Circle**

Learn how to use the unit circle to define sine, cosine, and tangent for all real numbers. (9 min) [E](#) [MM](#)

**The Trig Functions & Right Triangle Trig Ratios**

Show how, for acute angles, the two different definitions of the trigonometric values (SOH, CAH, TOA, and the unit circle definition) result in the same values. (7 min) [E](#) [MM](#)

## Intro to Radians

Explain the definition and motivation for radians and the relationship between radians and degrees. (11 min) [E](#) [MM](#)

## Radians & Degrees

Discuss the general approach to converting between radians and degrees and vice versa. (7 min) [E](#) [MM](#)

## Degrees to Radians

Learn to convert from degrees to radians, multiply the number of degrees by  $\pi/180$ . (7 min) [E](#) [MM](#)

## Radians to Degrees

Learn to change from radians to degrees, you need to multiply the number of radians by  $180/\pi$ . (3 min) [E](#) [MM](#)

## Radian Angles & Quadrants

Determine the quadrant at which a ray falls after a rotation by a certain measure of radians. (4 min) [E](#) [MM](#)

## Trig Values of $\pi/4$

Find the trigonometric values of  $\pi/4$  using the unit-circle definition. (8 min) [E](#) [MM](#)

## Proof of the Pythagorean Trig Identity

Prove this identity using the Pythagorean theorem in the unit circle with  $x^2+y^2=1$ . (6 min) [E](#) [MM](#)

## Using the Pythagorean Trig Identity

Explore the Pythagorean identity tells us that no matter what the value of  $\theta$  is,  $\sin^2\theta+\cos^2\theta$  is equal to 1. (6 min) [E](#) [MM](#)

## Cosine, Sine and Tangent of $\pi/6$ and $\pi/3$

With the unit circle and the Pythagorean theorem, we can find the exact sine, cosine, and tangent of the angles  $\pi/6$  and  $\pi/3$ . (9 min) [E](#) [MM](#)

## Sine & Cosine Identities: Symmetry

Find several trigonometric identities for sine and cosine by considering horizontal and vertical symmetries of the unit circle. (8 min) [E](#) [MM](#)

## Tangent Identities: Symmetry

Find several trigonometric identities for tangent by considering horizontal and vertical symmetries of the unit circle. (7 min) [E](#) [MM](#)

## Sine & Cosine Identities: Periodicity

Find trigonometric identities for sine and cosine by considering angle rotations on the unit circle. (6 min) [E](#) [MM](#)

## Tangent Identities: Periodicity

Solve a problem by considering the periodicity of the tangent function. (4 min) [E](#) [MM](#)

## Trigonometry | Features & Graphs of Trigonometric Functions

### Graph of $y=\sin(x)$

Find the graph of  $y=\sin(x)$  using the unit-circle definition of  $\sin(x)$ . (9 min) [E](#) [MM](#)

### Intersection Points of $y=\sin(x)$ and $y=\cos(x)$

Draw the graphs of the sine and the cosine functions and analyze their intersection points. (11 min) [E](#) [MM](#)

### Graph of $y=\tan(x)$

Draw the graph of the tangent function based on the unit circle definition of the function. (10 min) [E](#) [MM](#)

### Features of Sinusoidal Functions

Explore the main features of sinusoidal functions: midline, amplitude, & period. (5 min) [E](#) [MM](#)

### Amplitude & Period of Sinusoidal Functions from Equation

Find the amplitude and the period of  $y=-0.5\cos(3x)$ . (8 min) [E](#) [MM](#)

### Transforming Sinusoidal Graphs: Vertical Stretch & Horizontal

#### Reflection

Graph  $y=2\sin(-x)$  by considering it as a vertical stretch and a horizontal reflection of  $y=\sin(x)$ . (13 min) [E](#) [MM](#)

### Transforming Sinusoidal Graphs:

#### Vertical & Horizontal Stretches

Graph  $y=-2.5\cos(1/3x)$  by considering it as a vertical stretch and reflection, and a horizontal stretch, of  $y=\cos(x)$ . (11 min) [E](#) [MM](#)

#### Example: Graphing $y=3\sin(\frac{1}{2}x)-2$

Graph  $y=3\sin(\frac{1}{2}x)-2$  by thinking about the graph of  $y=\sin(x)$  and analyzing how the graph (including the midline, amplitude, and period) changes as we perform function transformations to get from  $y=\sin(x)$  to  $y=3\sin(\frac{1}{2}x)-2$ . (4 min) [E](#) [MM](#)

#### Example: Graphing $y=-\cos(\pi x)+1.5$

Graph  $y=-\cos(\pi x)+1.5$  by thinking about the graph of  $y=\cos(x)$  and analyzing how the graph (including the midline, amplitude, and period) changes as we perform function transformations to get from  $y=\cos(x)$  to  $y=-\cos(\pi x)+1.5$ . (3 min) [E](#) [MM](#)

### Sinusoidal Function from Graph

Find the equation of a sinusoidal function from its graph where the minimum point  $(-2,-5)$  and the maximum point  $(2,1)$  are highlighted. (5 min) [E](#) [MM](#)

### Interpreting Trigonometric Graphs in Context

When a trigonometric function models a real-world relationship, we can assign meaning to its midline, amplitude and period. (5 min) [E](#) [MM](#)

### Trig Word Problem: Modeling Daily Temperature

Solve a word problem about the daily change in temperature by modeling it with a sinusoidal function. (11 min) [E](#) [MM](#)

### Trig Word Problem: Modeling Annual Temperature

Solve a word problem about the annual change in temperature by modeling it with a sinusoidal function. (7 min) [E](#) [MM](#)

**Trig Word Problem: Length of Day (Phase Shift)**

Solve a word problem about the annual change in the length of day by modeling it with a sinusoidal function that has a phase shift. (8 min) [E](#) [MM](#)

**Trigonometry | Law of Sines & Law of Cosines****Solving for a Side with the Law of Sines**

Given a triangle with two angle measures and one side length, find all the missing side lengths and angle measures using the law of sines. (6 min) [E](#) [MM](#)

**Solving for an Angle with the Law of Sines**

Given a triangle with two side lengths and one angle measure, find all the missing angle measures using the law of sines. (5 min) [E](#) [MM](#)

**Proof of the Law of Sines**

Give a simple proof of the law of sines. (6 min) [E](#) [MM](#)

**Solving for a Side with the Law of Cosines**

Learn how to use the law of cosines to find the missing side length of a triangle when given two side lengths and the contained angle measure. (5 min) [E](#) [MM](#)

**Solving for an Angle with the Law of Cosines**

Given a triangle with all side lengths but no angle measure, find one of the angle measures using the law of cosines. (7 min) [E](#) [MM](#)

**Proof of the Law of Cosines**

Explore a simple proof of the law of cosines. (9 min) [E](#) [MM](#)

**Trig Word Problem: Stars**

Solve a word problem about the distance between stars using the law of cosines. (6 min) [E](#) [MM](#)

**Trigonometry | Inverse Trigonometric Functions****Intro to Arcsine**

Explore arcsine, which is the inverse function of sine, and discusses its principal range. (11 min) [E](#) [MM](#)

**Intro to Arctangent**

Explore arctangent, which is the inverse function of tangent, and discusses its principal range. (10 min) [E](#) [MM](#)

**Intro to Arccosine**

Explore arccosine, which is the inverse function of cosine, and discusses its principal range. (14 min) [E](#) [MM](#)

**Restricting Domains of Functions to Make them Invertible**

Given the graph of a trigonometric function and discuss ways in which he can change the function to make it invertible. (6 min) [E](#) [MM](#)

**Domain & Range of Inverse Tangent Function**

Find the formula for the inverse function of  $g(x) = \tan(x - 3\pi/2) + 6$ , and then determine the domain of that inverse function. (10 min) [E](#) [MM](#)

**Using Inverse Trig Functions with a Calculator**

Discuss the appropriate way to use the calculator to find an angle when its tangent value is given. (4 min) [E](#) [MM](#)

**Trigonometry | Sinusoidal Equations****Solving Sinusoidal Equations of the Form  $\sin(x)=d$** 

Find the expressions that together represent all possible solutions to the equation  $\sin(x)=1/3$ . (6 min) [E](#) [MM](#)

**Cosine Equation Algebraic Solution Set**

Solve a cosine equation with an infinite number of solutions. (6 min) [E](#) [MM](#)

**Cosine Equation Solution Set in an Interval**

Given the algebraic solution set for a cosine equation, find which solutions fall within an interval. (6 min) [E](#) [MM](#)

**Sine Equation Algebraic Solution Set**

Solve a sine equation with an infinite number of solutions. Use trig identities to represent the whole solution set. (5 min) [E](#) [MM](#)

**Solving  $\cos(\theta)=1$  and  $\cos(\theta)=-1$** 

Solve the equations  $\cos(\theta)=1$  and  $\cos(\theta)=-1$  using the graph of  $y=\cos(\theta)$ . (5 min) [E](#) [MM](#)

**Trigonometry | Sinusoidal Models****Interpreting Solutions of Trigonometric Equations**

Starting from a context represented by a trigonometric function, interpret equations based on the function. (4 min) [E](#) [MM](#)

**Trig Word Problem: Modeling Daily Temperature**

Solve a word problem about the annual change in temperature by solving a sinusoidal equation. (11 min) [E](#) [MM](#)

**Trig Word Problem: Modeling Annual Temperature**

Solve a word problem about the annual change in temperature by solving a sinusoidal equation. (7 min) [E](#) [MM](#)

**Trig Word Problem: Solving for Temperature**

Solve a word problem about the annual change in temperature by solving a sinusoidal equation. (8 min) [E](#) [MM](#)

**Trig Word Problem: Length of Day (Phase Shift)**

Solve a word problem about the annual change in the length of day by modeling it with a sinusoidal function that has a phase shift. (8 min) [E](#) [MM](#)

**Trigonometry | Angle Addition Identities****Trig Angle Addition Identities**

Review 6 related trigonometric angle addition identities:  $\sin(a+b)$ ,  $\sin(a-b)$ ,  $\cos(a+b)$ ,  $\cos(a-b)$ ,  $\cos(2a)$ , and  $\sin(2a)$ . (11 min) [E](#) [MM](#)

**Using the Cosine Angle Addition Identity**

Evaluate the cosine of the sum of  $60^\circ$  and another angle whose right triangle is given. (5 min) [E](#) [MM](#)

**Using the Cosine Double-Angle Identity**

The cosine double angle formula tells us that  $\cos(2\theta)$  is always equal to  $\cos^2\theta - \sin^2\theta$ . (4 min) [E](#) [MM](#)

**Proof of the Sine Angle Addition Identity**

Prove the identity  $\sin(x+y) = \sin(x)\cos(y) + \cos(x)\sin(y)$ . (8 min) [E](#) [MM](#)

**Proof of the Cosine Angle Addition Identity**

Prove the identity  $\cos(x+y) = \cos(x)\cos(y) - \sin(x)\sin(y)$ . (6 min) [E](#) [MM](#)

**Proof of the Tangent Angle Sum and Difference Identities**

Using the sine and cosine of the sum or difference of two angles, we can prove:  $\tan(x+y) = (\tan(x) + \tan(y)) / (1 - \tan(x)\tan(y))$ . (7 min) [E](#) [MM](#)

**Trigonometry | Using Trigonometric Identities****Finding Trig Values Using Angle****Addition Identities**

Find the value of  $\sin(7\pi/12)$  by rewriting it as  $\sin(\pi/3 + \pi/4)$  and then using the sine angle addition formula. (9 min) [E](#) [MM](#)

**Using the Tangent Angle Addition Identity**

Find the tangent of  $13\pi/12$  without a calculator using the tangent angle addition identity. (7 min) [E](#) [MM](#)

**Using Trig Angle Addition Identities:****Finding Side Lengths**

Given a drawing with two triangles and some side lengths, use the sine angle addition identity in order to find a missing side length. (5 min) [E](#) [MM](#)

**Using Trig Angle Addition Identities:****Manipulating Expressions**

Given that  $\cos(2\theta) = C$ , use the cosine double-angle identity to find an expression for  $\sin(\theta)$ . (6 min) [E](#) [MM](#)

**Using Trigonometric Identities**

Trigonometric identities like  $\sin^2\theta + \cos^2\theta = 1$  can be used to rewrite expressions in a different, more convenient way. (3 min) [E](#) [MM](#)

**Trigonometry | Challenging Trigonometry Problems****Trig Challenge Problem: Area of a Triangle**

Solve a very complicated geometrical trig problem that appeared as problem 11 in the 2003 AIME II exam. (16 min) [E](#) [MM](#)

**Trig Challenge Problem: Area of a Hexagon**

Solve a very complicated geometrical trig problem that appeared as problem 14 in the 2003 AIME II exam. (18 min) [E](#) [MM](#)

**Trig Challenge Problem: Cosine of Angle-Sum**

Given  $\cos(\theta)$  and  $\cos(\varphi)$  and find  $\cos(\theta + \varphi)$ . (7 min) [E](#) [MM](#)

**Trig Challenge Problem: Arithmetic Progression**

Solve a very complicated algebraic trig problem that appeared as problem 29 in the 2010 IIT JEE Paper I exam. (15 min) [E](#) [MM](#)

**Trig Challenge Problem: Maximum Value**

Solve a very complicated algebraic trig problem that appeared as problem 48 in the 2010 IIT JEE Paper I exam. (10 min) [E](#) [MM](#)

**Trig Challenge Problem: Multiple Constraints**

Solve a very complicated algebraic trig problem that appeared as problem 47 in the 2010 IIT JEE Paper I exam. (13 min) [E](#) [MM](#)

**Trig Challenge Problem: System of Equations**

Solve a very complicated algebraic trig problem that appeared as problem 55 in the 2010 IIT JEE Paper I exam. (11 min) [E](#) [MM](#)

## Statistics & Probability | Mean, Median, & Mode

### Statistics Intro: Mean, Median, & Mode

The mean (average) of a data set is found by adding all numbers in the data set and then dividing by the number of values in the set. The median is the middle value when a data set is ordered from least to greatest. The mode is the number that occurs most often in a data set.

(9 min) [E](#) [MM](#)

### Mean, Median, & Mode Example

Find the mean, median, and mode in this example. (4 min) [E](#) [MM](#)

### Comparing Means of Distributions

Compare the means of two different distributions given as dot plots.

(8 min) [E](#) [MM](#)

### Means and Medians of Different Distributions

Compare the mean and median based on a few different distributions. (7 min) [E](#) [MM](#)

### Impact on Median & Mean: Removing an Outlier

Explore the mean and median based on a few different distributions. (6 min) [E](#) [MM](#)

### Impact on Median & Mean: Increasing an Outlier

Explore the effects of modifying a value in a data set. (4 min) [E](#) [MM](#)

### Missing Value Given the Mean

Learn how to find the value of a missing piece of data if you know the mean of the data set. (5 min) [E](#) [MM](#)

### Median & Range Puzzlers

Solve an interesting median and range challenge problem. (7 min) [E](#) [MM](#)

## Statistics & Probability | Variance & Standard Deviation of Populations & Samples

### Measures of Spread: Range, Variance & Standard Deviation

Range, variance, and standard deviation all measure the spread or variability of a data set in different ways. The range is easy to calculate—it's the difference between the largest and smallest data points in a set. Standard deviation is the square root of the variance. Standard deviation is a measure of how spread out the data is from its mean.

(13 min) [E](#) [MM](#)

### Variance of a Population

Population variance is a measure of how spread out a group of data points is.

(8 min) [E](#) [MM](#)

### Population Standard Deviation

Explore that the population standard deviation is a measure of how much variation there is among individual data points in a population. (8 min) [E](#) [MM](#)

### Mean and Standard Deviation Versus Median and IQR

Learn to choose the "preferred" measures of center and spread when outliers are present in a set of data. (8 min) [E](#) [MM](#)

### Statistics: Alternate Variance

#### Formulas

Explore how this variance is calculated as  $\sigma^2 = (\sum (x-\mu)^2) / N$ . Another equivalent formula is  $\sigma^2 = ((\sum x^2) / N) - \mu^2$ .

(12 min) [E](#) [MM](#)

### Sample Variance

Estimate the variance of a population by looking at the data in a sample.

(11 min) [E](#) [MM](#)

### Sample Standard Deviation and Bias

Explore an example of calculating standard deviation and bias. (9 min) [E](#) [MM](#)

### Why We Divide by n - 1 in Variance

Explore this visualization providing evidence that dividing by n-1 truly gives an unbiased estimate of population variance.

(5 min) [E](#) [MM](#)

### Simulation Showing Bias in Sample Variance

Discover a better understanding of why we divide by (n-1) when calculating the unbiased sample variance. (6 min) [E](#) [MM](#)

### Simulation Providing Evidence that (n-1) Gives Us Unbiased Estimate

Explore that dividing by (n-1) gives us an unbiased estimate of population variance.

(5 min) [E](#) [MM](#)

### Review and Intuition: Why We Divide by n-1 for the Unbiased Sample Variance

Review the population mean, sample mean, population variance, sample variance and building an intuition for why we divide by n-1 for the unbiased sample variance.

(10 min) [E](#) [MM](#)

## Statistics & Probability | Box & Whisker Plots

### Worked Example: Creating a Box Plot (Odd Number of Data Points)

Learn how to create a box plot.

(3 min) [E](#) [MM](#)

### Worked Example: Creating a Box Plot (Even Number of Data Points)

Learn how to create a box plot.

(3 min) [E](#) [MM](#)

### Constructing a Box Plot

Explore this word problem that's perfectly suited for a box and whiskers plot to help analyze data. (8 min) [E](#) [MM](#)

### Reading Box Plots

Discover how box and whisker plots seek to explain data by showing a spread of all the data points in a sample. (3 min) [E](#) [MM](#)

**Interpreting Box Plots**

Learn how to evaluate what we know and what we don't know about a dataset given its box plot. (8 min) [E](#) [MM](#)

**Judging Outliers in a Dataset**

Using the inter-quartile range (IQR) to judge outliers in a dataset. (8 min) [E](#) [MM](#)

## Statistics & Probability | Other Measures of Spread

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**Interquartile Range (IQR)**

Discover that the IQR describes the middle 50% of values when ordered from lowest to highest. (6 min) [E](#) [MM](#)

**Range and Mid-Range**

Discover how the midrange is the average of the largest and smallest data points. (2 min) [E](#) [MM](#)

**Mean Absolute Deviation (MAD)**

Discover mean absolute deviation (MAD) of a data set is the average distance between each data value and the mean. (9 min) [E](#) [MM](#)

**Mean Absolute Deviation Example**

Find the mean absolute deviation of a data set that's given in a bar chart. (6 min) [E](#) [MM](#)

## Statistics & Probability | Modeling Data Distributions

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**Calculating Percentile**

Learn how to calculate the percentile rank for a given data point. (4 min) [E](#) [MM](#)

**Analyzing a Cumulative Relative Frequency Graph**

Learn how to calculate the percentile rank for a given data point. (6 min) [E](#) [MM](#)

**Normal Distribution Problem: Z-Scores**

Explore Z-score practice. (8 min) [E](#) [MM](#)

**Comparing with Z-Scores**

Use standardized scores—also called z-scores—to compare data points from different distributions. (4 min) [E](#) [MM](#)

**How Parameters Change as Data is Shifted and Scaled**

See how transforming a data set by adding, subtracting, multiplying, or dividing a constant affects measures of center and spread. (7 min) [E](#) [MM](#)

**Density Curves**

Explore this introduction to density curves for visualizing distributions. (10 min) [E](#) [MM](#)

**Median, Mean and Skew from Density Curves**

Analyze how median, mean, left skew, and right skew effects density curves. (6 min) [E](#) [MM](#)

**Density Curve Worked Example**

Analyze skew, median, mean and height of a density curve. (4 min) [E](#) [MM](#)

**Worked Example Finding Area Under Density Curves**

Explore this example finding area under density curves. (5 min) [E](#) [MM](#)

**Qualitative Sense of Normal Distributions**

Explore how "normal" a distribution might be. (11 min) [E](#) [MM](#)

**Normal Distribution Problems:****Empirical Rule**

Explore the empirical rule (also called the "68-95-99.7 rule") is a guideline for how data is distributed in a normal distribution. (11 min) [E](#) [MM](#)

**Standard Normal Distribution and the Empirical Rule**

Use the empirical rule with a standard normal distribution. (8 min) [E](#) [MM](#)

**More Empirical Rule and Z-Score Practice**

Explore the empirical rule and z-score practice. (6 min) [E](#) [MM](#)

**Standard Normal Table for Proportion Below**

Finding the proportion of a normal distribution that is below a value by calculating a z-score and using a z-table. (4 min) [E](#) [MM](#)

**Standard Normal Table for Proportion Above**

Finding the proportion of a normal distribution that is above a value by calculating a z-score and using a z-table. (5 min) [E](#) [MM](#)

**Standard Normal Table for Proportion Between Values**

Finding the proportion of a normal distribution that is between two values by calculating z-scores and using a z-table. (7 min) [E](#) [MM](#)

**Finding Z-Score for a Percentile**

Given a particular normal distribution with some mean and standard deviation, use that z-score to find the actual cutoff for that percentile. (4 min) [E](#) [MM](#)

**Threshold for Low Percentile**

Find the cutoff for a given lower percentile in a normal distribution. (6 min) [E](#) [MM](#)

**Deep Definition of the Normal Distribution**

Explore how normal distribution to explore the parent function that generates normal distributions, and how to modify parameters in the function to produce a normal distribution with any given mean and standard deviation. (26 min) [E](#) [MM](#)

**Normal Distribution Excel Exercise**

Show that the normal distribution approximates the binomial distribution for many. (26 min) [E](#) [MM](#)

## Statistics & Probability | Study Design

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**Statistical Questions**

Explore what makes a question a "statistical question." (9 min) [E](#) [MM](#)

### Statistical and Non-Statistical Questions

Learn that a statistical question is one that can be answered by collecting data and where there will be variability in that data. (8 min) [E](#) [MM](#)

### Reasonable Samples

To make a valid conclusion, you'll need a representative, not skewed, sample. (4 min) [E](#) [MM](#)

### Identifying a Sample and Population

Learn to identify a sample and population. (2 min) [E](#) [MM](#)

### Examples of Bias in Surveys

Explore examples of bias in surveys. (6 min) [E](#) [MM](#)

### Example of Undercoverage

### Introducing Bias

Given the description of a study, we can think about potential sources of bias, and how they may have impacted the results of the study. (4 min) [E](#) [MM](#)

### Correlation and Causality

Understand why correlation does not imply causality (even though many in the press and some researchers often imply otherwise). (11 min) [E](#) [MM](#)

### Picking Fairly

Determine if a few different methods of a magician choosing a volunteer are fair. (7 min) [E](#) [MM](#)

### Techniques for Generating a Simple Random Sample

Explore techniques for generating a simple random sample. (6 min) [E](#) [MM](#)

### Techniques for Random Sampling and Avoiding Bias

Explore techniques for random sampling and avoiding bias. (9 min) [E](#) [MM](#)

### Types of Statistical Studies

Explore these different types of statistical studies. (11 min) [E](#) [MM](#)

### Worked Example Identifying

### Experiment

Explore this example identifying experiment. (5 min) [E](#) [MM](#)

### Worked Example Identifying Observational Study

Explore this example identifying observational study. (7 min) [E](#) [MM](#)

### Worked Example Identifying Sample Study

Explore this example identifying sample study. (3 min) [E](#) [MM](#)

### Appropriate Statistical Study Example

Determine if a statistical study was a sample study, an experiment, or an observational study. (6 min) [E](#) [MM](#)

### Introduction to Experiment Design

Explore experiment design, explanatory and response variables, control and treatment groups. (11 min) [E](#) [MM](#)

### Matched Pairs Experiment Design

Explore matched pairs experiment design. (6 min) [E](#) [MM](#)

## Statistics & Probability | Basic Theoretical Probability

### Intro to Theoretical Probability

Explore probability through the example of flipping a quarter and rolling a die. (8 min) [E](#) [MM](#)

### Simple Probability: Yellow Marble

Determine the number of possible outcomes, and then how many of them meet our constraints. (3 min) [E](#) [MM](#)

### Simple Probability: Non-Blue Marble

Figure out the probability of randomly picking a non-blue marble from a bag. (10 min) [E](#) [MM](#)

### Intuitive Sense of Probabilities

Explore what probabilities really mean. (9 min) [E](#) [MM](#)

### The Monty Hall Problem

Analyze the famous thought experiment: the "Monty Hall" problem. (8 min) [E](#) [MM](#)

## Statistics & Probability | Probability Using Sample Spaces

### Probability with Counting Outcomes

Explore the probability of getting exactly 2 heads when flipping three coins. (2 min) [E](#) [MM](#)

### Example: All the Ways You Can Flip a Coin

Explore manually going through the combinatorics to determine the probability of an event occurring. (2 min) [E](#) [MM](#)

### Die Rolling Probability

Explore the probability of rolling doubles on a pair of dice and grid out the possible outcomes. (5 min) [E](#) [MM](#)

### Subsets of Sample Spaces

Solve an example about subsets. (6 min) [E](#) [MM](#)

## Statistics & Probability | Basic Set Operations

### Intersection and Union of Sets

Learn to find the intersection and union of sets. (8 min) [E](#) [MM](#)

### Relative Complement or Difference Between Sets

Show an example finding the relative complement or difference of two sets A and B. (6 min) [E](#) [MM](#)

### Universal Set and Absolute Complement

Explore the universal set and absolute complement. (6 min) [E](#) [MM](#)

**Subset, Strict Subset, and Superset**

A subset of a set A is any set B such that every element of B is also an element of A. A strict subset is a subset that isn't equal to the original set (i.e. B must have at least one fewer element than A). A superset of A is any set C such that A is a subset of C. (4 min) [E](#) [MM](#)

**Bringing the Set Operations Together**

Summarize the set operations that he has discussed in the previous videos. (7 min) [E](#) [MM](#)

## Statistics & Probability | Probability, Randomness, & Simulation

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**Experimental Probability**

Explore reasonable estimates of the likelihood of future events. (7 min) [E](#) [MM](#)

**Theoretical and Experimental Probabilities**

Compare expected probabilities to what really happens when we run experiments. (7 min) [E](#) [MM](#)

**Making Predictions with Probability**

Predict the number of times a spinner will land on an elephant. (5 min) [E](#) [MM](#)

**Experimental Versus Theoretical Probability Simulation**

Explore experimental versus theoretical probability simulation. (5 min) [E](#) [MM](#)

**Random Number List to Run****Experiment**

Use a list of random numbers to simulate multiple trials of an experiment. (8 min) [E](#) [MM](#)

**Random Numbers for Experimental Probability**

Use a list of random number to calculate an experimental probability. (8 min) [E](#) [MM](#)

**Statistical Significance of Experiment**

Determine if the results of an experiment about advertising are statistically significant. (8 min) [E](#) [MM](#)

## Statistics & Probability | Addition Rule for Probability

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**Probability with Venn Diagrams**

Use a Venn diagram to illustrate the concept of overlapping events and how to calculate the combined probability. (10 min) [E](#) [MM](#)

**Addition Rule for Probability**

Explore Venn diagrams and the addition rule for probability. (11 min) [E](#) [MM](#)

**Addition and Multiplication Rule for Probability**

Explore the notion of a "sample space". See a sample space represented as a tree diagram, table, and list. (10 min) [E](#) [MM](#)

## Statistics & Probability | Multiplication Rule for Independent Events

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**Sample Spaces for Compound Events**

Learn how to calculate probabilities of coin flips using two methods: listing all possible outcomes or multiplying independent events. (9 min) [E](#) [MM](#)

**Compound Probability of Independent Events**

Learn how to calculate probabilities of coin flips using two methods: listing all possible outcomes or multiplying independent events. (6 min) [E](#) [MM](#)

**Probability of a Compound Event**

Learn how to use sample space diagrams to find probabilities. (5 min) [E](#) [MM](#)

**"At Least One" Probability with Coin Flipping**

Explore the probability of getting at least one head in multiple flips of a fair coin. (9 min) [E](#) [MM](#)

**Free-Throw Probability**

Determine the probability of making 10 free throws in a row. (7 min) [E](#) [MM](#)

**Three-Pointer vs. Free-Throw Probability**

Determine if there's a high probability of making three free throws in a row or one three-pointer. (6 min) [E](#) [MM](#)

**Probability without Equally Likely Events**

Explore probabilities surrounding only equally likely events. (9 min) [E](#) [MM](#)

**Independent Events Example: Test Taking**

Consider the probability of two independent events occurring. (5 min) [E](#) [MM](#)

**Die Rolling Probability with Independent Events**

Figure out the probability in this problem. (3 min) [E](#) [MM](#)

## Statistics & Probability | Multiplication Rule for Dependent Events

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**Dependent Probability Introduction**

Explore dependent probability using a scenario involving a casino game. (7 min) [E](#) [MM](#)

**Dependent Probability: Coins**

How the probability of an event can be dependent on another event occurring in this example problem. (9 min) [E](#) [MM](#)

**Dependent Probability Example**

Practice these probability problems as they get more complex eventually. (7 min) [E](#) [MM](#)

**Independent & Dependent Probability**

Identify whether the problem is independent or dependent. (3 min) [E](#) [MM](#)

**Dependent Probability**

Find dependent probabilities like  $P(A | B)$  using an example rolling dice.

(10 min) [E](#) [MM](#)

## Statistics & Probability | Conditional Probability & Independence

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**Calculating Conditional Probability**

Explore how Conditional probabilities are written like  $P(A|B)$ , which can be read to mean, "the probability that A happens GIVEN b has happened." (7 min) [E](#) [MM](#)

**Conditional Probability Explained****Visually**

Visualize how to do conditional probability.

(5 min) [E](#) [MM](#)

**Conditional Probability Tree Diagram****Example**

Use a tree diagram to work out a conditional probability question.

(11 min) [E](#) [MM](#)

**Conditional Probability and****Independence**

Use conditional probability to see if events are independent or not. (4 min) [E](#) [MM](#)

**Analyzing Event Probability for****Independence**

Use an example about shirts, scarves, hats, and pants to explain how to use probabilities to figure out if two events are independent. (7 min) [E](#) [MM](#)

## Statistics & Probability | Counting Principal, Factorial, & Permutations

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**Count Outcomes Using Tree Diagram**

Use tree diagrams to find the number of possible outcomes and calculate the probability of possible outcomes.

(5 min) [E](#) [MM](#)

**Counting Outcomes: Flower Pots**

Find the number of ways you can put four types of flowers into three types of pots.

(3 min) [E](#) [MM](#)

**Permutation Formula**

Learn about the permutation formula by solving seating arrangement problems with factorial notation and a general formula.

(8 min) [E](#) [MM](#)

**Zero Factorial or 0!**

Learn how Factorials are a quick way to represent multiplying a number by all the smaller positive integers down to one.

(5 min) [E](#) [MM](#)

**Factorial and Counting Seat****Arrangements**

Learn how to use permutations to solve problems involving ways to arrange things.

(6 min) [E](#) [MM](#)

**Possible Three Letter Words**

Explain how to find all the possible three letter words when we can use each letter as many times as we want, and when each letter can only be used once. (6 min) [E](#) [MM](#)

**Ways to Arrange Colors**

Explore about how many ways you can pick four colors from a group of 6. (4 min) [E](#) [MM](#)

**Ways to Pick Officers**

Explore how many ways you can pick an officer. (2 min) [E](#) [MM](#)

## Statistics & Probability | Combinations & Probability

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**Intro to Combinations**

Learn the difference between permutations and combinations, using the example of seating six people in three chairs.

(7 min) [E](#) [MM](#)

**Combination Formula**

Learn the difference between permutations and combinations, and how to calculate them using factorials. (11 min) [E](#) [MM](#)

**Handshaking Combinations**

Figure out how different combinations of people can shake hands. (7 min) [E](#) [MM](#)

**Combination Example: 9 Card Hands**

Explore how many ways we can construct a hand of 9 cards. (8 min) [E](#) [MM](#)

**Probability using Combinations****(Part 1)**

Explore the Probability of getting exactly 3 heads in 8 flips of a fair coin. (9 min) [E](#) [MM](#)

**Probability using Combinations****(Part 2)**

Explore the Probability of getting exactly 3 heads in 8 flips of a fair coin.

(11 min) [E](#) [MM](#)

**Example: Different Ways to Pick****Officers**

Explore the different ways we can pick officers in order to find the probability of one situation in particular. (3 min) [E](#) [MM](#)

**Example: Combinatorics and****Probability**

Explore the Probability of getting a set of cards. (12 min) [E](#) [MM](#)

**Getting Exactly Two Heads****(Combinatorics)**

Explore a different way to think about the probability of getting 2 heads in 4 flips.

(10 min) [E](#) [MM](#)

**Exactly Three Heads in Five Flips**

Discover the Probability of exactly 3 heads in 5 flips using combinations. (7 min) [E](#) [MM](#)

### Generalizing with Binomial Coefficients (Advanced)

Conceptual understanding of where the formula for binomial coefficients come from. (12 min) [E](#) [MM](#)

#### Example: Lottery Probability

Explore the the probability of winning a 4-number lottery. (5 min) [E](#) [MM](#)

### Conditional Probability and Combinations

Find the probability that a coin is flipped 4 heads out of 6 tosses. (17 min) [E](#) [MM](#)

#### Mega Millions Jackpot Probability

Explore the probability of winning the Mega Millions jackpot. (6 min) [E](#) [MM](#)

#### Birthday Probability Problem

Explore the probability that at least 2 people in a room of 30 share the same birthday. (13 min) [E](#) [MM](#)

## Statistics & Probability | Random Variables: Discrete vs. Continuous

### Random Variables

Discover the Basic idea and definitions of random variables. (6 min) [E](#) [MM](#)

### Discrete and Continuous Random Variables

Discrete random variables can only take on a finite number of values. Continuous random variables, on the other hand, can take on any value in each interval.

(12 min) [E](#) [MM](#)

#### Constructing a Probability

Distribution for Random Variable

Learn how to create the probability distribution of the number of "heads" after 3 flips of a fair coin. (7 min) [E](#) [MM](#)

#### Probability Models Example: Frozen

##### Yogurt

Model the probability of a frozen yogurt line having 0, 1, or 2 people in it. (8 min) [E](#) [MM](#)

### Valid Discrete Probability Distribution

#### Examples

Explore examples on identifying valid discrete probability distributions. (4 min) [E](#) [MM](#)

### Probability with Discrete Random Variable Example

Explore example analyzing discrete probability distribution. (4 min) [E](#) [MM](#)

### Mean (Expected Value) of a Discrete Random Variable

Learn to calculate the mean (or expected value) of a discrete random variable as the weighted average of all the outcomes of that random variable based on their probabilities. (4 min) [E](#) [MM](#)

### Variance and Standard Deviation of a Discrete Random Variable

Find the variance and standard deviation of a discrete random variable. (6 min) [E](#) [MM](#)

#### Probability Density Functions

Explore Probability density functions for continuous random variables. (10 min) [E](#) [MM](#)

#### Probabilities from Density Curves

Explore Examples finding probabilities from probability distributions for continuous random variables. (5 min) [E](#) [MM](#)

## Statistics & Probability | Transforming & Combining Random Variables

### Impact of Transforming (Scaling and Shifting) Random Variables

Linear transformations (addition and multiplication of a constant) and their impacts on center (mean) and spread (standard deviation) of a distribution. (7 min) [E](#) [MM](#)

### Example: Transforming a Discrete Random Variable

Explore an example of transforming a discrete random variable. (4 min) [E](#) [MM](#)

### Mean of Sum and Difference of Random Variables

Discover the Mean of sum and difference of random variables. (4 min) [E](#) [MM](#)

### Variance of Sum and Difference of Random Variables

Intuition for why the variance of both the sum and difference of two independent random variables is equal to the sum of their variances. (8 min) [E](#) [MM](#)

#### Intuition for Why Independence

##### Matters for Variance of Sum

Intuition for why independence matters for variance of sum. (5 min) [E](#) [MM](#)

### Deriving the Variance of the Difference of Random Variables

Derive the variance of the difference of random variables. (11 min) [E](#) [MM](#)

### Example: Analyzing Distribution of Sum of Two Normally Distributed Random Variables

Find the probability that the total of some random variables exceeds an amount by understanding the distribution of the sum of normally distributed variables. (6 min) [E](#) [MM](#)

### Example: Analyzing the Difference in Distributions

Find the probability that a randomly selected woman is taller than a randomly selected man by understanding the distribution of the difference of normally distributed variables. (10 min) [E](#) [MM](#)

## Statistics & Probability | Binomial Random Variables

### Binomial Variables

Explore a special class of random variables called binomial random variables.

(8 min) [E](#) [MM](#)

### Recognizing Binomial Variables

Explore examples and counterexamples of binomial variables. (7 min) [E](#) [MM](#)

### 10% Rule of Assuming

#### "Independence" Between Trials

Discover the 10% rule of assuming "independence" between trials.

(7 min) [E](#) [MM](#)

### Binomial Distribution

Learn about binomial distribution with an example. (12 min) [E](#) [MM](#)

### Visualizing a Binomial Distribution

Graph a binomial distribution and connects it back to how to calculate binomial probabilities. (10 min) [E](#) [MM](#)

### Binomial Probability Example

Use the binomial distribution to find the probability of getting a certain number of successes, like successful basketball shots, out of a fixed number of trials.

(10 min) [E](#) [MM](#)

### Generalizing K Scores in N Attempts

Generalize 2 scores in 6 attempts to k scores in n attempts. (4 min) [E](#) [MM](#)

### Free Throw Binomial Probability Distribution

Use the binomial distribution to calculate the probability of making different number of free throws. (9 min) [E](#) [MM](#)

### Graphing Basketball Binomial Distribution

Graph the results of using the binomial distribution to find the probabilities of making different numbers of free throws.

(5 min) [E](#) [MM](#)

### Binompdf and Binomcdf Functions

Explore how to use a TI-84 (very similar for TI-85 or TI-89) calculator for making calculations regarding binomial random variables. (6 min) [E](#) [MM](#)

### Mean and Variance of Bernoulli

#### Distribution Example

Calculate the mean and variance of a Bernoulli distribution (in this example the responses are either favorable or unfavorable). (9 min) [E](#) [MM](#)

### Bernoulli Distribution Mean and Variance Formulas

Learn to derive the mean and variance formulas for the Bernoulli distribution. (7 min) [E](#) [MM](#)

### Expected Value of a Binomial Variable

Explore how to derive and use the expected value (mean) formula for binomial random variables. (7 min) [E](#) [MM](#)

### Variance of a Binomial Variable

Derive the variance of a binomial variable to be  $p(1-p)$ , and the standard deviation is the square root of the variance.

(7 min) [E](#) [MM](#)

### Finding the Mean and Standard Deviation of a Binomial Random Variable

For a binomial random variable, the mean is  $n$  times  $p$  ( $np$ ), where  $n$  is the sample size and  $p$  is the probability of success. The standard deviation is the square root of  $np(1-p)$ . We can use them to make predictions in a binomial setting.

(5 min) [E](#) [MM](#)

## Statistics & Probability | Geometric Random Variables & Expected Value

### Geometric Random Variables

#### Introduction

Distinguishing between geometric and binomial random variables. (7 min) [E](#) [MM](#)

### Probability for a Geometric Random Variable

Find the probability for a single outcome of a geometric random variable. (3 min) [E](#) [MM](#)

### Cumulative Geometric Probability (Greater than a Value)

Find the probability for a geometric random variable being greater than a certain value.

(6 min) [E](#) [MM](#)

### Cumulative Geometric Probability (Less than a Value)

Find the probability for a geometric random variable being less than a certain value.

(4 min) [E](#) [MM](#)

### Calculator Functions: Geometpdf and Geometcdf

Use a TI-84 (very similar for TI-85 or TI-89) calculator for making calculations regarding geometric random variables. (6 min) [E](#) [MM](#)

### Proof of Expected Value of Geometric Random Variable

Explore the Proof of expected value of geometric random variable. (4 min) [E](#) [MM](#)

### Getting Data from Expected Value

Explore how expected value refers to the average outcome you would expect from repeating an experiment over and over.

(10 min) [E](#) [MM](#)

### Expected Profit from Lottery Ticket

Multiply the outcomes by probabilities to find the expected value of a lottery ticket.

(9 min) [E](#) [MM](#)

### Expected Value while Fishing

Explore example where he multiplies probability by values and sums to find expected value. (9 min) [E](#) [MM](#)

### Comparing Insurance with Expected Value

Use expected value to compare a couple of different insurance policies. (9 min) [E](#) [MM](#)

### Law of Large Numbers

Explore the magic behind the law of large numbers. (9 min) [E](#) [MM](#)

## Statistics & Probability | (Advanced) Poisson Distribution

### Introduction to Poisson Distribution

Explore the Poisson Processes and the Poisson Distribution. (16 min) [E](#) [MM](#)

### Poisson Process (Part 1)

Explore the Poisson Processes and the Poisson Distribution more in-depth. (11 min) [E](#) [MM](#)

### Poisson Process (Part 2)

Explore the Poisson Processes and the Poisson Distribution more in-depth. (13 min) [E](#) [MM](#)

## Statistics & Probability | Sampling Distributions

### Introduction to Sampling Distributions

Learn about sampling distributions. (7 min) [E](#) [MM](#)

### Sample Statistic Bias Worked Example

Determine bias of sample statistics based on approximate sampling distributions example. (3 min) [E](#) [MM](#)

### Sampling Distribution of Sample Proportion (Part 1)

Explore the formulas for the mean and standard deviation of a sampling distribution of sample proportions. (10 min) [E](#) [MM](#)

### Sampling Distribution of Sample Proportion (Part 2)

Learn to build intuition for the sampling distribution of sample proportions using a simulation. (5 min) [E](#) [MM](#)

### Normal Conditions for Sampling

Distributions of Sample Proportions  
Explore conditions for roughly normal sampling distribution of sample proportions. (6 min) [E](#) [MM](#)

### Probability of Sample Proportions

#### Example

Explore this probability of sample proportions example. (7 min) [E](#) [MM](#)

### Inferring Population Mean from

#### Sample Mean

Discover how to infer things about the greater population mean from a sample mean. (10 min) [E](#) [MM](#)

### Central Limit Theorem

Explore the central limit theorem and the sampling distribution of the mean. (10 min) [E](#) [MM](#)

### Sampling Distribution of the Sample Mean (Part 1)

Explore the main idea of the central limit theorem – the sampling distribution of the sample mean is approximately normal for "large" samples. (11 min) [E](#) [MM](#)

### Sampling Distribution of the Sample Mean (Part 2)

Examine the central limit theorem and the sampling distribution of the sample mean. (13 min) [E](#) [MM](#)

### Standard Error of the Mean

Explore what the standard error of the mean measures. (15 min) [E](#) [MM](#)

### Example: Probability of Sample Mean Exceeding a Value

Estimate the probability that the sample mean exceeds a given value in the sampling distribution of the sample mean. (15 min) [E](#) [MM](#)

## Statistics & Probability | Confidence Intervals: Population Proportion

### Confidence Intervals and Margin of Error

Use what we know about sampling distributions and margin of error to build a confidence interval to estimate the true value of the percentage in the population. (12 min) [E](#) [MM](#)

### Confidence Interval Simulation

Explore confidence interval simulation. (5 min) [E](#) [MM](#)

### Interpreting Confidence Level

#### Example

Explore how to Interpret confidence level example. (5 min) [E](#) [MM](#)

### Confidence Interval Example

Calculate a 99% confidence interval for the proportion of teachers who felt computers are an essential tool. (19 min) [E](#) [MM](#)

### Margin of Error (Part 1)

Find the 95% confidence interval for the proportion of a population voting for a candidate. (16 min) [E](#) [MM](#)

### Margin of Error (Part 2)

Find the 95% confidence interval for the proportion of a population voting for a candidate. (10 min) [E](#) [MM](#)

### Conditions for Valid Confidence Intervals for a Proportion

Discover the conditions to satisfy the random, normal, and independent conditions for these confidence intervals to be valid. (7 min) [E](#) [MM](#)

### Conditions for Confidence Interval for a Proportion Worked Examples

Discover the conditions for confidence intervals for a population proportion worked examples--random condition, independence condition and normal condition. (5 min) [E](#) [MM](#)

### Critical Value ( $z^*$ ) for a Given Confidence Level

Learn to calculate a critical value  $z^*$  for any given confidence level using normal distribution calculations. (6 min) [E](#) [MM](#)

### Example Constructing and Interpreting a Confidence Interval for P

Learn to check conditions, calculate, and interpret a confidence interval to estimate a population proportion. (7 min) [E](#) [MM](#)

### Determining Sample Size Based on Confidence and Margin of Error

Determine sample size based on confidence level and margin of error. (8 min) [E](#) [MM](#)

## Statistics & Probability | Confidence Intervals: Population Mean

### Introduction to T Statistics

Discover why we use t statistics. (5 min) [E](#) [MM](#)

### Simulation Showing Value of T Statistic

Explore why we use t statistics when building confidence intervals for a mean using the sample standard deviation in place of the population standard deviation. (3 min) [E](#) [MM](#)

### Conditions for Valid T Intervals

Explore example showing how to determine if the conditions have been met for making a t interval to estimate a mean. (5 min) [E](#) [MM](#)

### Example Finding Critical T Value

Given a confidence level, we can calculate a critical value ( $t^*$ ) in a t-distribution with  $n-1$  degrees of freedom. (4 min) [E](#) [MM](#)

### Example Constructing a T Interval for a Mean

Explore example showing how to calculate a one-sample t interval for a mean. (6 min) [E](#) [MM](#)

### Confidence Interval for a Mean with Paired Data

Explore Confidence interval for a mean difference with paired data. (10 min) [E](#) [MM](#)

### Sample Size for a Given Margin of Error for a Mean

Calculate the approximate sample size required to obtain a desired margin of error in a confidence interval for a mean. (8 min) [E](#) [MM](#)

### T-Statistic Confidence Interval

Compute a confidence interval for the emission from an engine with a new design. (12 min) [E](#) [MM](#)

### Small Sample Size Confidence Intervals

Construct small sample size confidence intervals using t-distributions. (11 min) [E](#) [MM](#)

## Statistics & Probability | The Idea of Significance Tests

### Simple Hypothesis Testing

Explore an example about who should do the dishes that gets at the idea behind hypothesis testing. (6 min) [E](#) [MM](#)

### Idea Behind Hypothesis Testing

Discover the idea behind hypothesis testing. (8 min) [E](#) [MM](#)

### Examples of Null and Alternative Hypotheses

Explore examples of how the null hypothesis and alternative hypothesis are used. (6 min) [E](#) [MM](#)

### P-Values and Significance Tests

Compare a P-value to a significance level to make a conclusion in a significance test. (8 min) [E](#) [MM](#)

### Comparing P-Values to Different Significance Levels

Explore examples comparing P-values to different significance levels, and why it's important to set the significance level before a test. (5 min) [E](#) [MM](#)

### Estimating a P-Value from a Simulation

Solve this example of estimating a P-value based on a simulation to approximate a sampling distribution assuming the null hypothesis is true. (5 min) [E](#) [MM](#)

## Statistics & Probability | Error Probabilities & Power

### Introduction to Type I and Type II Errors

Learn how both type 1 and type 2 errors are mistakes made when testing a hypothesis. (5 min) [E](#) [MM](#)

### Type 1 Errors

Discover that a Type 1 error occurs when the null hypothesis is true, but we reject it because of a usual sample result. (3 min) [E](#) [MM](#)

### Examples Identifying Type I and Type II Errors

Explore these examples identifying Type I and Type II errors. (6 min) [E](#) [MM](#)

### Introduction to Power in Significance Tests

Explore the power in significance tests. (10 min) [E](#) [MM](#)

### Examples Thinking About Power in Significance Tests

Explore these examples thinking about power in significance tests. (4 min) [E](#) [MM](#)

## Statistics & Probability | Tests About a Population Proportion

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### Constructing Hypotheses for a Significance Test About a Proportion

Explore how to construct a hypothesis for a significance test about a proportion.

(4 min) [E](#) [MM](#)

### Conditions for a Z Test About a Proportion

Explore how to check whether the conditions have been met for doing a z test about a proportion. (5 min) [E](#) [MM](#)

### Calculating a Z Statistic in a Test About a Proportion

Explore how to calculate a z statistic in a one-sample z test about a proportion.

(5 min) [E](#) [MM](#)

### Calculating a P-Value Given a Z Statistic

Calculate a test statistic based on our sample results. (5 min) [E](#) [MM](#)

### Making Conclusions in a Test About a Proportion

Explore this example of how to make a conclusion in a test about a proportion.

(5 min) [E](#) [MM](#)

## Statistics & Probability | Tests About a Population Mean

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### Writing Hypotheses for a Significance Test About a Mean

Explore this example of constructing hypotheses for a test about a mean.

(3 min) [E](#) [MM](#)

### Conditions for a T Test About a Mean

Explore examples showing how to check which conditions have been met for a t test about a mean. (6 min) [E](#) [MM](#)

### When to Use Z or T Statistics in Significance Tests

Discover when to use z or t statistics in significance tests. (5 min) [E](#) [MM](#)

### Example Calculating T Statistic for a Test About a Mean

Explore an example of how to calculate t statistic for test about a mean.

(5 min) [E](#) [MM](#)

### Using TI Calculator for P-Value from T Statistic

Calculate a test statistic based on our sample results. (3 min) [E](#) [MM](#)

### Using a Table to Estimate P-Value from T Statistic

Use a table to estimate the p-value based on that test statistic using a t distribution with n-1 degrees of freedom. (4 min) [E](#) [MM](#)

### Comparing P-Value from T Statistic to Significance Level

Explore this example showing how to compare the P-value to a significance level to make a conclusion in a t test.

(4 min) [E](#) [MM](#)

## Statistics & Probability | More on Significance Testing

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### Hypothesis Testing and P-Values

Explore an example about a neurologist testing the effect of a drug to discuss hypothesis testing and p-value.

(11 min) [E](#) [MM](#)

### One-Tailed and Two-Tailed Tests

Discover the effect of a drug to one-tailed and two-tailed hypothesis tests.

(7 min) [E](#) [MM](#)

### Z-Statistics vs. T-Statistics

Discover the difference between Z-statistics and T-statistics. (7 min) [E](#) [MM](#)

### Small Sample Hypothesis Test

Explore an example of a hypothesis test where we determine if there is sufficient evidence to conclude that a new type of engine meets emission requirements.

(9 min) [E](#) [MM](#)

### Large Sample Proportion Hypothesis Testing

Use a large sample to test if more than 30% of US households have internet access.

(15 min) [E](#) [MM](#)

## Statistics & Probability | Two-Sample Inference for the Difference Between Groups

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### Comparing Population Proportions (Part 1)

Use an election example to compare population proportions. (11 min) [E](#) [MM](#)

### Comparing Population Proportions (Part 2)

Use an election example to compare population proportions. (10 min) [E](#) [MM](#)

### Hypothesis Test Comparing Population Proportions

Use election results to run a hypothesis test comparing population proportions.

(17 min) [E](#) [MM](#)

### Statistical Significance of Experiment

Determine if the results of an experiment about advertising are statistically significant. (9 min) [E](#) [MM](#)

### Statistical Significance on Bus Speeds

Determine if the results of an experiment about bus speeds are statistically significant. (11 min) [E](#) [MM](#)

### Difference of Sample Means Distribution

Explore the difference of sample means distribution. (12 min) [E](#) [MM](#)

### Confidence Interval of Difference of Means

Use a confidence interval to help figure out if a low-fat diet helps obese people lose weight. (16 min) [E](#) [MM](#)

### Clarification of Confidence Interval of Difference of Means

Discover what clarification of confidence interval of difference of means covers. (3 min) [E](#) [MM](#)

### Hypothesis Test for Difference of Means

Explore what the Hypothesis Test for Difference of Means is. (10 min) [E](#) [MM](#)

## Statistics & Probability | Inference for Categorical Data (Chi-Square Tests)

### Chi-Square Distribution Introduction

Explore what chi-square distribution is. (11 min) [E](#) [MM](#)

### Pearson's Chi Square Test (Goodness of Fit)

Use the chi square test to the hypothesis that the owner's distribution is correct. (12 min) [E](#) [MM](#)

### Chi-Square Statistic for Hypothesis Testing

Explore the chi-square statistic for hypothesis testing (chi-square goodness-of-fit test). (9 min) [E](#) [MM](#)

### Chi-Square Goodness-of-Fit Example

Solve this chi-square goodness-of-fit example. (7 min) [E](#) [MM](#)

### Filling out Frequency Table for Independent Events

Given the row and column totals, fill in the cells of a frequency table so that the events are independent. (5 min) [E](#) [MM](#)

### Contingency Table Chi-Square Test

Use the contingency table chi-square test to see if a couple of different herbs prevent people from getting sick. (17 min) [E](#) [MM](#)

### Introduction to the Chi-Square Test for Homogeneity

Discover the chi-square test for homogeneity. (8 min) [E](#) [MM](#)

### Chi-Square Test for Association (Independence)

Explore the Chi-square test for association/independence. (11 min) [E](#) [MM](#)

## Statistics & Probability | Advanced Regression (Inference & Transforming)

### Introduction to Inference About Slope in Linear Regression

Explore sample slopes and use them to make confidence intervals or do a test about the population slope in least-squares regression. (7 min) [E](#) [MM](#)

### Conditions for Inference on Slope

Discover the conditions for making a confidence interval or doing a test about slope in least-squares regression. (5 min) [E](#) [MM](#)

### Confidence Interval for the Slope of a Regression Line

Learn about confidence interval for the slope of a regression line. (7 min) [E](#) [MM](#)

### Calculating T Statistic for Slope of Regression Line

Calculate the test statistic in a test about the slope of a regression line. (7 min) [E](#) [MM](#)

### Using a P-Value to Make Conclusions in a Test About Slope

Make conclusions in a hypothesis test about the slope of a least-squares regression line. (6 min) [E](#) [MM](#)

### Using a Confidence Interval to Test Slope

Use confidence interval for hypothesis test on regression slope. (4 min) [E](#) [MM](#)

### Comparing Models to Fit Data

#### Example

Determine if a quadratic or exponential model fits the data better, then uses the model to make a prediction. (4 min) [E](#) [MM](#)

### Transforming Nonlinear Data

Use logarithms to transform nonlinear data into a linear relationship so we can use least-squares regression methods. (3 min) [E](#) [MM](#)

### Worked Example of Linear

Regression Using Transformed Data  
Solve this example of linear regression using transformed data (8 min) [E](#) [MM](#)

## Statistics & Probability | Analysis of Variance (ANOVA)

### ANOVA 1: Calculating SST (Total Sum of Squares)

Analysis of variance 1 - calculating SST (total sum of squares). (8 min) [E](#) [MM](#)

### ANOVA 2: Calculating SSW and SSB (Total Sum of Squares Within and Between)

Analysis of variance 2 - calculating SSW and SSB (total sum of squares within and between). (14 min) [E](#) [MM](#)

### ANOVA 3: Hypothesis Test with F-Statistic

Analysis of variance 3 - hypothesis test with f-statistic. (10 min) [E](#) [MM](#)

## Statistics & Probability: Measurement & Data | Charts & Graphs: Analyzing One Categorical Variable

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### Identifying Individuals, Variables and Categorical Variables in a Data Set

Identifying individuals, variables and categorical variables in a data set.

(3 min) [E](#) [MM](#)

### Reading Pictographs

Explore how pictograph is basically a way to represent data with pictures that relate to the data. (3 min) [E](#) [MM](#)

### Reading Bar Graphs

Explore how to read a bar graph.

(3 min) [E](#) [MM](#)

### Reading Bar Graphs: Harry Potter

Interpret a bar graph. (1 min) [E](#) [MM](#)

### Creating a Bar Graph

Create a bar chart using data from a survey.

(1 min) [E](#) [MM](#)

### Reading Bar Charts: Comparing Two Sets of Data

Explore how a bar chart is especially useful with comparing two sets of data.

(2 min) [E](#) [MM](#)

### Reading Bar Charts: Putting it Together with Central Tendency

Look at bar charts and using the information to determine the measures of central tendency. (5 min) [E](#) [MM](#)

### Reading Pie Graphs (Circle Graphs)

Explore how to read pie graphs (circle graphs). (3 min) [E](#) [MM](#)

## Statistics & Probability: Measurement & Data | Two-Way Tables

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### Two-Way Frequency Tables and Venn Diagrams

Explore how to use Venn diagrams and two-way tables to categorize data.

(6 min) [E](#) [MM](#)

### Two-Way Relative Frequency Tables

Explore how relative frequencies show how often something happens compared to the total number of times it could happen.

(5 min) [E](#) [MM](#)

### Interpreting Two-Way Tables

Explore how two-way tables help us understand how categories relate.

(2 min) [E](#) [MM](#)

### Categorical Data Example

Explore the relationship between two categorical variables with two-way tables to see if there is an association between the variables. (3 min) [E](#) [MM](#)

### Analyzing Trends in Categorical Data

Solve an example where he is asked to calculate relative frequencies and analyze trends in categorical data. (9 min) [E](#) [MM](#)

### Marginal and Conditional Distributions

Marginal distributions are totals for each row or column in a two-way table (or joint distribution table), showing the distribution of one variable. (5 min) [E](#) [MM](#)

## Statistics & Probability: Measurement & Data | Displaying Quantitative Data with Graphs

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### Representing Data

Explore a few of the many ways to look at data. (8 min) [E](#) [MM](#)

## Frequency Tables & Dot Plots

Learn to organize data into frequency tables and dot plots (sometimes called line plots).

(7 min) [E](#) [MM](#)

### Histograms

Explore how a histogram is a graphical display of data using bars of different heights. (6 min) [E](#) [MM](#)

### Creating a Histogram

Explore how to create a histogram.

(7 min) [E](#) [MM](#)

### Interpreting a Histogram

Learn how to read and interpret histograms, which summarize data by sorting it into buckets. (5 min) [E](#) [MM](#)

### Stem-and-Leaf Plots

A stem and leaf is a table used to display data. The 'stem' is on the left and displays the first digit or digits. The 'leaf' is on the right and displays the last digit.

(6 min) [E](#) [MM](#)

### Reading Stem and Leaf Plots

A stem and leaf plot display data by breaking each data point into two parts: the "stem" and the "leaf." (3 min) [E](#) [MM](#)

## Statistics & Probability: Measurement & Data | Describing & Comparing Distributions

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### Shapes of Distributions

Some distributions are symmetrical, with data evenly distributed about the mean. Other distributions are "skewed," with data tending to the left or right of the mean. We sometimes say that skewed distributions have "tails". (5 min) [E](#) [MM](#)

### Clusters, Gaps, Peaks & Outliers

Examples looking at different features of distributions, such as clusters, gaps, peaks, and outliers for distributions. (7 min) [E](#) [MM](#)

## Comparing Distributions with Dot Plots (Example Problem)

Examine two distributions in dot plots to draw conclusions about the times of Olympic swimmers. (4 min) [E](#) [MM](#)

## Comparing Dot Plots, Histograms, and Box Plots

Solve practice problems where he thinks about which data displays would be helpful in which situations. (5 min) [E](#) [MM](#)

## Example: Comparing Distributions

Compare distributions using the features of shape, center, spread, and outliers. (7 min) [E](#) [MM](#)

## Reading Line Graphs

Explore how a line graph is a way to visually represent data, especially data that changes over time. (3 min) [E](#) [MM](#)

## Misleading Line Graphs

Explore misleading line graphs. (5 min) [E](#) [MM](#)

## Statistics & Probability: Measurement & Data | Intro to Scatterplots

### Constructing a Scatter Plot

Explore how to construct a scatter plot from this model. (3 min) [E](#) [MM](#)

### Example of Direction in Scatter Plots

Explore this example of scatter plots. (3 min) [E](#) [MM](#)

### Scatter Plot: Smokers

In a negative linear association, as one variable goes up, the other variable goes down at a constant rate. (3 min) [E](#) [MM](#)

### Bivariate Relationship Linearity, Strength and Direction

Describe a bivariate relationship's linearity, strength, and direction. (9 min) [E](#) [MM](#)

## Statistics & Probability: Measurement & Data | Correlation & Trend Lines

### Example: Correlation Coefficient Intuition

Explain the intuition behind correlation coefficients and does a problem where he matches correlation coefficients to scatter plots. (7 min) [E](#) [MM](#)

### Calculating Correlation Coefficient

The most common way to calculate the correlation coefficient ( $r$ ) is by using technology, but using the formula can help us understand how  $r$  measures the direction and strength of the linear association between two quantitative variables. (13 min) [E](#) [MM](#)

### Fitting a Line to Data

Create a scatter plot and then fit a line to data on the median California family income. (8 min) [E](#) [MM](#)

### Estimating the Line of Best Fit Exercise

The "line of best fit" is a line that shows the pattern of data points. If we can find a good line, it means there is a linear trend. If not, it means there is no linear trend. (1 min) [E](#) [MM](#)

### Estimating with Linear Regression (Linear Models)

A line of best fit is a straight line that shows the relationship between two sets of data. We can use the line to make predictions. (3 min) [E](#) [MM](#)

### Line of Best Fit: Smoking in 1945

Explore this scatter plot that shows how many adults in America smoked from year to year. (5 min) [E](#) [MM](#)

## Statistics & Probability: Measurement & Data | Least-Squares Regression & Fit

### Introduction to Residuals and Least Squares Regression

Explore this introduction to residuals and least squares regression. (8 min) [E](#) [MM](#)

### Calculating Residual Example

Explore how to calculate residual example. (5 min) [E](#) [MM](#)

### Calculating the Equation of a Regression Line

Calculate the equation of a least-squares regression line. Intuition for why this equation makes sense. (8 min) [E](#) [MM](#)

### Interpreting Slope of Regression Line

Interpret the slope of regression line. (3 min) [E](#) [MM](#)

### Interpreting Y-Intercept in Regression Model

Interpret the y-intercept in regression model. (3 min) [E](#) [MM](#)

### Interpreting a Trend Line

Explore this graph shows how studying affects test scores. (4 min) [E](#) [MM](#)

### Residual Plots

Create and analyze residual plots based on regression lines. (6 min) [E](#) [MM](#)

### R-Squared or Coefficient of Determination

In linear regression,  $r$ -squared (also called the coefficient of determination) is the proportion of variation in the response variable that is explained by the explanatory variable in the model. (13 min) [E](#) [MM](#)

### Standard Deviation of Residuals or Root-Mean-Square Error (RMSD)

Standard deviation of the residuals are a measure of how well a regression line fits the data. It is also known as root mean square deviation or root mean square error. (7 min) [E](#) [MM](#)

### Interpreting Computer Regression Data

Explore how to interpret computer generated regression data to find the equation of a least-squares regression line. (5 min) [E](#) [MM](#)

### Impact of Removing Outliers on Regression Lines

Explore the impact of removing outliers on slope, y-intercept and r of least-squares regression lines. (6 min) [E](#) [MM](#)

## Statistics & Probability: Measurement & Data | More on Regression

### Squared Error of Regression Line

Explore the idea that one can find a line that minimizes the squared distances to the points. (7 min) [E](#) [MM](#)

### Proof (Part 1) Minimizing Squared Error to Regression Line

Explore this proof minimizing squared error to regression line. (11 min) [E](#) [MM](#)

### Proof (Part 2) Minimizing Squared Error to Regression Line

Explore this proof minimizing squared error to regression line. (10 min) [E](#) [MM](#)

### Proof (Part 3) Minimizing Squared Error to Regression Line

Explore this proof minimizing squared error to regression line. (11 min) [E](#) [MM](#)

### Proof (Part 4) Minimizing Squared Error to Regression Line

Explore this proof minimizing squared error to regression line. (4 min) [E](#) [MM](#)

### Regression Line Example

Explore this regression line example. (10 min) [E](#) [MM](#)

### Second Regression Example

Explore this second regression example. (9 min) [E](#) [MM](#)

### Calculating R-Squared

Learn to calculate r-squared to see how well a regression line fits data. (10 min) [E](#) [MM](#)

### Covariance and the Regression Line

Explore covariance, variance and the slope of the regression line. (15 min) [E](#) [MM](#)

## Pre-Calculus: Geometry | Special Trig Values & Identities

### Trig Values of $\pi/4$

Find the trigonometric values of  $\pi/4$  using the unit-circle definition. (8 min) [E](#) [MM](#)

### Cosine, Sine and Tangent of $\pi/6$ and $\pi/3$

Use the unit circle and the Pythagorean theorem, and find the exact sine, cosine, and tangent of the angles  $\pi/6$  and  $\pi/3$ . (9 min) [E](#) [MM](#)

### Proof of the Pythagorean Trig Identity

The Pythagorean identity tells us that no matter what the value of  $\theta$  is,  $\sin^2\theta + \cos^2\theta$  is equal to 1. We can prove this identity using the Pythagorean theorem in the unit circle with  $x^2 + y^2 = 1$ . (6 min) [E](#) [MM](#)

### Using the Pythagorean Trig Identity

The Pythagorean identity tells us that no matter what the value of  $\theta$  is,  $\sin^2\theta + \cos^2\theta$  is equal to 1. This follows from the Pythagorean theorem, which is why it's called the Pythagorean identity! We can use this identity to solve various problems. (6 min) [E](#) [MM](#)

### Sine & Cosine Identities: Symmetry

Find several trigonometric identities for sine and cosine by considering horizontal and vertical symmetries of the unit circle. (8 min) [E](#) [MM](#)

### Tangent Identities: Symmetry

Find several trigonometric identities for tangent by considering horizontal and vertical symmetries of the unit circle. (7 min) [E](#) [MM](#)

### Sine & Cosine Identities: Periodicity

Find trigonometric identities for sine and cosine by considering angle rotations on the unit circle. (6 min) [E](#) [MM](#)

### Tangent Identities: Periodicity

Solve a problem by considering the periodicity of the tangent function. (4 min) [E](#) [MM](#)

## Pre-Calculus: Geometry | Inverse Trigonometric Functions

### Intro to Arcsine

Explore arcsine, which is the inverse function of sine, and discusses its principal range. (10 min) [E](#) [MM](#)

### Intro to Arctangent

Explore arctangent, which is the inverse function of tangent, and discusses its principal range. (10 min) [E](#) [MM](#)

### Intro to Arccosine

Explore arccosine, which is the inverse function of cosine, and discusses its principal range. (14 min) [E](#) [MM](#)

### Restricting Domains of Functions to Make Them Invertible

Given the graph of a trigonometric function, we discuss ways to change the function to make it invertible. (6 min) [E](#) [MM](#)

### Domain & Range of Inverse Tangent Function

Find the formula for the inverse function of  $g(x) = \tan(x - 3\pi/2) + 6$  and determine the domain of that inverse function. (10 min) [E](#) [MM](#)

### Using Inverse Trig Functions with a Calculator

Explore the appropriate way to use the calculator to find an angle when its tangent value is given. (4 min) [E](#) [MM](#)

## Pre-Calculus: Geometry | Law of Sines & Law of Cosines

### Solving for a Side with the Law of Sines

Given a triangle with two angle measures and one side length, find all the missing side lengths and angle measures using the law of sines. (6 min) [E](#) [MM](#)

### Solving for an Angle with the Law of Sines

Given a triangle with two side lengths and one angle measure, find all the missing angle measures using the law of sine. (6 min) [E](#) [MM](#)

### Proof of the Law of Sines

Explore a simple proof of the Law of Sines. (7 min) [E](#) [MM](#)

### Solving for a Side with the Law of Cosines

Learn how to use the law of cosines to find the missing side length of a triangle when given two side lengths and the contained angle measure. (4 min) [E](#) [MM](#)

### Solving for an Angle with the Law of Cosines

Given a triangle with all side lengths but no angle measure, find one of the angle measures using the law of cosines. (7 min) [E](#) [MM](#)

### Proof of the Law of Cosines

Explore a simple proof of the Law of Cosines. (9 min) [E](#) [MM](#)

### Trig Word Problem: Stars

Solve a word problem about the distance between stars using the law of cosines. (6 min) [E](#) [MM](#)

## Pre-Calculus: Geometry | Sinusoidal Equations & Models

### Solving Sinusoidal Equations of the Form $\sin(x)=d$

Find the expressions that together represent all possible solutions to the equation  $\sin(x)=1/3$ . (6 min) [E](#) [MM](#)

### Cosine Equation Algebraic Solution Set

Solve a cosine equation with an infinite number of solutions. Use trig identities to represent the whole solution set. (6 min) [E](#) [MM](#)

### Cosine Equation Solution Set in an Interval

Given the algebraic solution set for a cosine equation, find which solutions fall within an interval. (6 min) [E](#) [MM](#)

### Sine Equation Algebraic Solution Set

Solve a sine equation with an infinite number of solutions. Use trig identities to represent the whole solution set. (5 min) [E](#) [MM](#)

### Solving $\cos(\theta)=1$ and $\cos(\theta)=-1$

Solve the equations  $\cos(\theta)=1$  and  $\cos(\theta)=-1$  using the graph of  $y=\cos(\theta)$ . (5 min) [E](#) [MM](#)

### Interpreting Solutions of Trigonometric Equations

Starting from a context represented by a trigonometric function, interpret equations based on the function. (4 min) [E](#) [MM](#)

### Trig Word Problem: Modeling Daily Temperature

Solve a word problem about the annual change in temperature by solving a sinusoidal equation. (11 min) [E](#) [MM](#)

## Pre-Calculus: Geometry | Angle Addition Identities

### Trig Angle Addition Identities

Review 6 related trigonometric angle addition identities:  $\sin(a+b)$ ,  $\sin(a-b)$ ,  $\cos(a+b)$ ,  $\cos(a-b)$ ,  $\cos(2a)$ , and  $\sin(2a)$ . (11 min) [E](#) [MM](#)

### Using the Cosine Angle Addition Identity

Evaluate the cosine of the sum of  $60^\circ$  and another angle whose right triangle is given. (5 min) [E](#) [MM](#)

### Using the Cosine Double-Angle Identity

Explore how to use cosine double angle formula tells us that  $\cos(2\theta)$  is always equal to  $\cos^2\theta - \sin^2\theta$ . (4 min) [E](#) [MM](#)

### Proof of the Sine Angle Addition Identity

Prove the identity  $\sin(x+y) = \sin(x)\cos(y) + \cos(x)\sin(y)$ . (8 min) [E](#) [MM](#)

### Proof of the Cosine Angle Addition Identity

Prove the identity  $\cos(x+y) = \cos(x)\cos(y) - \sin(x)\sin(y)$ . (6 min) [E](#) [MM](#)

### Proof of the Tangent Angle Sum and Difference Identities

Using the sine and cosine of the sum or difference of two angles, prove:  
 $\tan(x+y) = (\tan(x) + \tan(y)) / (1 - \tan(x)\tan(y))$ . (7 min) [E](#) [MM](#)

## Pre-Calculus: Geometry | Using Trigonometric Identities

### Finding Trig Values Using Angle Addition Identities

Find the value of  $\sin(7\pi/12)$  by rewriting it as  $\sin(\pi/3 + \pi/4)$  and then using the sine angle addition formula. (9 min) [E](#) [MM](#)

### Using the Tangent Angle Addition Identity

Find the tangent of  $13\pi/12$  without a calculator using the tangent angle addition identity. (6 min) [E](#) [MM](#)

### Using Trig Angle Addition Identities: Finding Side Lengths

Given a drawing with two triangles and some side lengths, uses the sine angle addition identity in order to find a missing side length. (5 min) [E](#) [MM](#)

### Using Trig Angle Addition Identities: Manipulating Expressions

Given that  $\cos(2\theta)=C$  and he uses the cosine double-angle identity to find an expression for  $\sin(\theta)$ . (6 min) [E](#) [MM](#)

### Using Trigonometric Identities

Learn how trigonometric identities like  $\sin^2\theta+\cos^2\theta=1$  can be used to rewrite expressions in a different, more convenient way. (3 min) [E](#) [MM](#)

## Pre-Calculus: Geometry | Conic Sections

### Intro to Conic Sections

Explore the four conic sections and shows how they are derived by intersecting planes with cones in certain ways. (11 min) [E](#) [MM](#)

### Intro to Ellipses

Learn all about ellipses. (14 min) [E](#) [MM](#)

### Ellipse Standard Equation from Graph

Given an ellipse on the coordinate plane, find its standard equation, which is an equation in the form  $(x-h)^2/a^2+(y-k)^2/b^2=1$ . (4 min) [E](#) [MM](#)

### Ellipse Graph from Standard Equation

Explore how to graph an ellipse when given its equation in standard form. (2 min) [E](#) [MM](#)

### Foci of an Ellipse from Equation

Explore how the radii and the foci of an ellipse relate to each other, and how we can use this relationship to find the foci from the equation of an ellipse. (14 min) [E](#) [MM](#)

### Intro to Hyperbolas

Explore the standard equation for hyperbolas, and how it can be used to determine the direction of the hyperbola and its vertices. (14 min) [E](#) [MM](#)

### Vertices & Direction of a Hyperbola (Example 1)

Pick the graph of  $y^2/9-x^2/4=1$  based on the hyperbola's center, direction, & vertices. (5 min) [E](#) [MM](#)

### Vertices & Direction of a Hyperbola (Example 2)

Match an equation to a given graph of a hyperbola, based on the hyperbola's direction & vertices. (3 min) [E](#) [MM](#)

### Graphing Hyperbolas

Given the hyperbola equation  $y^2/4-x^2/9=1$ , determine the direction to which it opens and its vertices to draw its graph. (8 min) [E](#) [MM](#)

### Foci of a Hyperbola from Equation

Explore the foci of hyperbolas and show how they relate to hyperbola equations. (16 min) [E](#) [MM](#)

### Proof of the Hyperbola Foci Formula

Explore how to prove why, for the general hyperbola equation  $x^2/a^2-y^2/b^2=1$ , the focal length  $f$  forms the equation  $f^2=a^2+b^2$  with the parameters  $a$  and  $b$ . (15 min) [E](#) [MM](#)

### Equation of a Hyperbola not Centered at the Origin

Analyze the hyperbola whose equation is  $(x-1)^2/16-(y+1)^2/4=1$ , and graphs. (11 min) [E](#) [MM](#)

## Pre-Calculus: Algebra | Composite Functions

### Intro to Composing Functions

Learn how to evaluate the composition of functions step by step, using examples with three different function definitions:  $f(x)$ ,  $g(t)$ , and  $h(x)$ . (6 min) [E](#) [MM](#)

### Evaluating Composite Functions

Evaluate  $(h \circ g)(-6)$  for  $g(x)=x^2+5x-3$  and  $h(y)=3(y-1)^2-5$ . (4 min) [E](#) [MM](#)

### Evaluating Composite Functions: Using Tables

Given tables of values of the functions  $f$  and  $g$ , evaluate  $f(g(0))$  and  $g(f(0))$ . (4 min) [E](#) [MM](#)

### Evaluating Composite Functions: Using Graphs

Given the graphs of the functions  $f$  and  $g$ , evaluate  $g(f(-5))$ . (3 min) [E](#) [MM](#)

### Finding Composite Functions

Through a worked example involving  $f(x)=\sqrt{x^2-1}$  and  $g(x)=x/(1+x)$ , learn about function composition: the process of combining two functions to create a new function. (3 min) [E](#) [MM](#)

### Evaluating Composite Functions (Advanced)

Given that  $h(x)=3x$  and  $g(t)=-2t-2-h(t)$ , find  $h(g(8))$ . (4 min) [E](#) [MM](#)

### Modeling with Composite Functions

Determine the correct functions to compose (and the correct order) to model a given relationship, and vice versa. (7 min) [E](#) [MM](#)

### Modeling with Composite Functions: Skydiving

Model the maximum speed of a skydiver, by using composing given formulas for the maximum speed as a function of parachute area and parachute area as a function of width. (4 min) [E](#) [MM](#)

### Meaningfully Composing Functions

Decide which composed functions make sense by checking that the value that one function passes to the other is the right kind of input. (4 min) [E](#) [MM](#)

## Pre-Calculus: Algebra | Inverse Functions

### Determining if a Function is Invertible

Learn how to build a mapping diagram for a finite function, and how to use this diagram to determine if the function is invertible.

(4 min) [E](#) [MM](#)

### Restricting Domains of Functions to Make Them Invertible

Given the graph of a trigonometric function, determine ways to change the function to make it invertible. (6 min) [E](#) [MM](#)

### Reading Inverse Values from a Graph

Learn how to find the inverse of a function and how to graph it. (4 min) [E](#) [MM](#)

### Reading Inverse Values from a Table

Given a table of inputs and outputs for a function, evaluate the inverse function for a certain input. (2 min) [E](#) [MM](#)

### Verifying Inverse Functions from Tables

Explore Functions  $s$  and  $t$  are inverses if and only if  $s(t(x))=x$  and  $t(s(x))=x$  for every  $x$ -value in the domains. (5 min) [E](#) [MM](#)

### Using Specific Values to Test for Inverses

Learn how to determine if two functions are inverses. (4 min) [E](#) [MM](#)

### Verifying Inverse Functions by Composition

Compose  $f(x)=(x+7)^3-1$  and  $g(x)=\sqrt[3]{(x+1)-7}$ , and determine if  $f(g(x))=g(f(x))=x$  are inverses. (7 min) [E](#) [MM](#)

### Verifying Inverse Functions by Composition: Not Inverse

Compose  $f(x)=2x-3$  and  $g(x)=\frac{1}{2}x+3$  and discover that  $f(g(x)) \neq g(f(x)) \neq x$ , which means the functions are not inverses.

(4 min) [E](#) [MM](#)

## Pre-Calculus: Algebra | Complex Numbers

### Plotting Numbers on the Complex Plane

Discover the real and imaginary parts of complex numbers and see how they correspond to the horizontal and vertical axes. (2 min) [E](#) [MM](#)

### Distance & Midpoint of Complex Numbers

Find the distance between  $(2+3i)$  and  $(-5-i)$  and then he finds their midpoint on the complex plane. (6 min) [E](#) [MM](#)

### Intro to Complex Number Conjugates

Learn about the conjugate of complex numbers, how to add and divide using conjugates, and the key property that multiplying a complex number by its conjugate produces a real number.

(8 min) [E](#) [MM](#)

### Complex Number Conjugates

Explore how to find the conjugate of a complex number, which is simply changing the sign of the imaginary part.

(4 min) [E](#) [MM](#)

### Dividing Complex Numbers

Divide  $(6+3i)$  by  $(7-5i)$ . (5 min) [E](#) [MM](#)

### Complex Numbers & Sum of Squares Factorization

Learn how expressions of the form  $x^2+y^2$  can be factored into linear factors.

(5 min) [E](#) [MM](#)

### Factoring Sum of Squares

Factor  $36a^8+2b^6$  as  $(6a^4-i\sqrt{2}b^3)(6a^4+i\sqrt{2}b^3)$ .

(3 min) [E](#) [MM](#)

### Factoring Polynomials Using Complex Numbers

Show how to factor a fourth degree polynomial into linear factors using the sum-product rule and the sum of squares identity. (3 min) [E](#) [MM](#)

## Absolute Value of Complex Numbers

Find the absolute value of  $(3-4i)$ .

(3 min) [E](#) [MM](#)

## Complex Numbers with the Same Modulus (Absolute Value)

Show how to determine which members in a set of complex numbers have the same modulus (or absolute value). (3 min) [E](#) [MM](#)

## Absolute Value & Angle of Complex Numbers

Find the modulus (which is the absolute value) and the argument (which is the angle) of  $\sqrt{3}/2+1/2i$ . (13 min) [E](#) [MM](#)

## Polar & Rectangular Forms of Complex Numbers

Learn how to convert a complex number from rectangular form to polar form.

(12 min) [E](#) [MM](#)

## Converting a Complex Number from Polar to Rectangular Form

Given a complex number in polar form, we can convert that number to rectangular form and plot it on the complex plane.

(3 min) [E](#) [MM](#)

## Multiplying Complex Numbers

### Graphically Example: $-3i$

Learn to multiply complex numbers graphically on the complex plane by rotating and scaling. Multiplying a complex number  $z$  by  $-3i$  rotates and scales  $z$ .

(2 min) [E](#) [MM](#)

## Multiplying Complex Numbers

### Graphically Example: $-1-i$

Learn to multiply complex numbers graphically on the complex plane.

(4 min) [E](#) [MM](#)

## Multiplying Complex Numbers in Polar Form

Learn to multiply two complex numbers in polar form by multiplying their moduli and adding their arguments. (3 min) [E](#) [MM](#)

## Dividing Complex Numbers in Polar Form

Learn to divide two complex numbers in polar form by dividing their moduli and subtracting their arguments. (3 min) [E](#) [MM](#)

### Taking and Visualizing Powers of a Complex Number

Given a complex number in rectangular form, we can convert it to polar form to show how to visualize powers of the complex number by scaling and rotating it by its own modulus and argument.

(7 min) [E](#) [MM](#)

### Complex Number Equations: $x^3=1$

Find all complex solutions to the equation  $x^3=1$ . (12 min) [E](#) [MM](#)

## Pre-Calculus: Algebra | The Fundamental Theorem of Algebra

### The Fundamental Theorem of Algebra

Explore the fundamental theorem of algebra, which, as is reflected in its name, is a very important theorem about polynomials. (6 min) [E](#) [MM](#)

### Quadratics & the Fundamental Theorem of Algebra

Explore the proof of the fundamental theorem of algebra for any degree of polynomial. (7 min) [E](#) [MM](#)

### Number of Possible Real Roots of a Polynomial

Explore how the fundamental theorem of algebra can be used to determine how many real roots a given polynomial has. (4 min) [E](#) [MM](#)

## Pre-Calculus: Algebra | Properties of Rational Functions

### Reducing Rational Expressions to Lowest Terms

Learn how to simplify rational expressions, which are fractions with variable expressions in the numerator and denominator. (8 min) [E](#) [MM](#)

### End Behavior of Rational Functions

Analyze the end behavior of several rational functions, that together cover all case types of end behavior. (10 min) [E](#) [MM](#)

### Discontinuities of Rational Functions

Analyze two rational functions to find their vertical asymptotes & removable discontinuities. He distinguishes those from the zeros of the functions. (7 min) [E](#) [MM](#)

## Pre-Calculus: Algebra | Graphs of Rational Functions

### Graphing Rational Functions According to Asymptotes

Learn how to find removable discontinuities, horizontal asymptotes, and vertical asymptotes of rational functions. (11 min) [E](#) [MM](#)

### Graphs of Rational Functions:

#### Y-Intercept

Pick the graph that matches  $f(x)=(ax^m+bx+12)/(cx^m+dx+12)$  based on its y-intercept. (3 min) [E](#) [MM](#)

### Graphs of Rational Functions:

#### Horizontal Asymptote

Pick the graph that matches  $f(x)=(-x^2+ax+b)/(x^2+cx+d)$  based on its horizontal asymptote. (3 min) [E](#) [MM](#)

### Graphs of Rational Functions: Vertical Asymptotes

Pick the graph that matches  $f(x)=g(x)/(x^2-x-6)$  (where  $g(x)$  is a polynomial) based on its discontinuities. (6 min) [E](#) [MM](#)

### Graphs of Rational Functions: Zeros

Pick the graph that matches  $f(x)=(2x^2-18)/g(x)$  (where  $g(x)$  is a polynomial) based on its zeros. (8 min) [E](#) [MM](#)

## Pre-Calculus: Algebra | Modeling with Rational Functions

### Analyzing Structure Word Problem: Pet Store (Part 1)

Solve a word problem about the unknown number of bears, cats, and dogs in a pet store using visual reasoning. (6 min) [E](#) [MM](#)

### Analyzing Structure Word Problem: Pet Store (Part 2)

Solve a word problem about the unknown number of bears, cats, and dogs in a pet store using algebraic reasoning. (3 min) [E](#) [MM](#)

### Combining Mixtures Example

Figure out how much of two gasoline mixtures to combine to get gasoline with a certain concentration of ethanol. (6 min) [E](#) [MM](#)

### Rational Equations Word Problem: Combined Rates (Example 1)

Solve a word problem about the combined leaf-bagging rates of Ian and Kyandre, by creating a rational equation that models the situation. (6 min) [E](#) [MM](#)

### Rational Equations Word Problem: Combined Rates (Example 2)

Solve a word problem about the combined deck-staining rates of Anya and Bill, by creating a rational equation that models the situation. (6 min) [E](#) [MM](#)

### Rational Equations Word Problem: Eliminating Solutions

Solve a word problem about the combined pool-filling rates of two water hoses by creating a rational equation that models the situation. (8 min) [E](#) [MM](#)

### Reasoning About Unknown Variables

Given that  $a > 0$ ,  $b < 0$ , and  $a/b > a \cdot b$ , explore what we can determine from the variables. (6 min) [E](#) [MM](#)

### Reasoning About Unknown Variables: Divisibility

Given the positive integers  $a$ ,  $b$ , and  $c$ , where  $a$  is a multiple of  $c$  and  $(a+b)/c$  is an integer. Is  $b$  necessarily a multiple of  $c$ ? (4 min) [E](#) [MM](#)

### Structure in Rational Expression

Analyze this expression to determine what's bigger: the value of that expression at some unknown  $c$ , or the number of times the expression is equal to 0. (5 min) [E](#) [MM](#)

## Pre-Calculus: Algebra | Operations with Rational Expressions

### Multiplying & Dividing Rational Expressions: Monomials

Multiply  $(6x^3/5) \times (2/3x)$  and divides  $(2x^4/7) \div (5x^4/4)$ . (6 min) [E](#) [MM](#)

### Multiplying Rational Expressions

Multiply rational expressions, we multiply both numerators and multiply both denominators. (6 min) [E](#) [MM](#)

### Dividing Rational Expressions

Learn the steps to divide rational expressions. (7 min) [E](#) [MM](#)

### Adding & Subtracting Rational Expressions: Like Denominators

Add  $6/(2x^2-7) + (-3x-8)/(2x^2-7)$  and subtracts  $(9x^2+3)/(14x^2-9) - (-3x^2+5)/(14x^2-9)$ . (4 min) [E](#) [MM](#)

### Intro to Adding Rational Expressions with Unlike Denominators

Rewrite  $a/b+c/d$  as a single rational expression. (3 min) [E](#) [MM](#)

### Adding Rational Expression: Unlike Denominators

Learn how to add rational expressions with different denominators by finding a common denominator, multiplying the numerators and denominators by the same factors, and simplifying the result. (5 min) [E](#) [MM](#)

### Subtracting Rational Expressions: Unlike Denominators

Rewrite  $(-5x)/(8x+7) - (6x^3)/(3x+1)$  as  $(-48x^4 - 42x^3 - 15x^2 - 5x)/(8x+7)(3x+1)$ . (5 min) [E](#) [MM](#)

### Least Common Multiple of Polynomials

Find the least common multiple (LCM) of  $3z^3-6z^2-9z$  and  $7z^4+21z^3+14z^2$ . (7 min) [E](#) [MM](#)

### Subtracting Rational Expressions: Factored Denominators

Subtract two rational expressions whose denominators are factored. (5 min) [E](#) [MM](#)

### Subtracting Rational Expressions

Subtract and simplifies  $(a-2)/(a+2) - (a-3)/(a^2+4a+4)$ . (5 min) [E](#) [MM](#)

## Pre-Calculus: Algebra | Intro to Vectors

### Intro to Vectors and Scalars

Explore some examples of scalars and vectors, including distance, displacement, speed, and velocity. (9 min) [E](#) [MM](#)

### Representing Quantities with Vectors

Vectors can represent real-world quantities where it's important to have both a magnitude and a direction. (3 min) [E](#) [MM](#)

### Interpreting Statements about Vectors

Interpret a mathematical statement about two vector quantities in terms of the real-world quantities they represent. (3 min) [E](#) [MM](#)

### Introduction to Vector Components

In the two-dimensional plane, we can describe them in an equivalent way, by thinking about the changes in  $x$  and  $y$  from the vector's tail to its head. (5 min) [E](#) [MM](#)

### Finding the Components of a Vector

Find the  $x$  and  $y$ -components of a vector given its graph. (3 min) [E](#) [MM](#)

### Comparing the Components of Vectors

Figure out which vectors have the same  $x$ -component given the graphs of 4 different vectors. (3 min) [E](#) [MM](#)

### Vector Magnitude from Graph

Find the magnitude of a vector given its graph. (4 min) [E](#) [MM](#)

### Vector Magnitude from Components

Find the magnitude of a vector given its components of  $(5, -3)$ . (3 min) [E](#) [MM](#)

### Vector Magnitude from Initial & Terminal Points

Explore the magnitude of a vector when what we're given about the vector is where it starts and where it ends. (6 min) [E](#) [MM](#)

## Pre-Calculus: Algebra | Operations with Vectors

### Scalar Multiplication: Component Form

Explore what happens graphically and to the components of a vector when we multiply it by a scalar. (6 min) [E](#) [MM](#)

### Scalar Multiplication: Magnitude and Direction

Analyze the magnitude and direction of vectors that are a result of scalar multiplication of a vector whose magnitude is given. (5 min) [E](#) [MM](#)

**Adding & Subtracting Vectors**

Explore how to add vectors by adding their components, then explain the intuition behind adding vectors using a graph.

(8 min) [E](#) [MM](#)

**Adding & Subtracting Vectors****End-to-End**

Build intuition behind adding and subtracting vectors visually and the "end-to-end" method. (7 min) [E](#) [MM](#)

**Parallelogram Rule for Vector****Addition**

The parallelogram rule says that if we place two vectors, so they have the same initial point, and then complete the vectors into a parallelogram, then the sum of the vectors is the directed diagonal that starts at the same point as the vectors. (3 min) [E](#) [MM](#)

**Subtracting Vectors End-to-End**

Determine which diagram represents vector subtraction graphically. (2 min) [E](#) [MM](#)

**Subtracting Vectors with****Parallelogram Rule**

Learn to subtract two vectors, we simply add the first vector and the opposite of the second vector, i.e.,  $a+b=a+(-b)$ . (3 min) [E](#) [MM](#)

**Vector Addition & Magnitude** Explain some interesting properties of the magnitude of vector sums. (6 min) [E](#) [MM](#)

## Pre-Calculus: Algebra | Vector Direction & Magnitude

**Direction of Vectors from****Components: 1st & 2nd Quadrants**

Find the direction angle of a vector in the first quadrant, then moves onto a trickier one in the second quadrant. (9 min) [E](#) [MM](#)

**Direction of Vectors from****Components: 3rd & 4th Quadrants**

Find the direction angle of a vector in the third quadrant and a vector in the fourth quadrant. (7 min) [E](#) [MM](#)

**Vector Components from Magnitude & Direction**

Find the components of a couple of vectors given in magnitude and direction form. (10 min) [E](#) [MM](#)

**Vector Components from Magnitude & Direction: Word Problem**

Given the magnitudes and directions of the forces two people are applying to a box, find the overall force that is applied in the direction of the target. (9 min) [E](#) [MM](#)

**Adding Vectors in Magnitude and****Direction Form**

Take two vectors given by magnitude and direction and finds the magnitude and direction of their sum. (8 min) [E](#) [MM](#)

## Pre-Calculus: Algebra | Vector Word Problems

**Vector Word Problem: Resultant Velocity**

Find the resultant velocity vector of a boat. (11 min) [E](#) [MM](#)

**Vector Word Problem: Hiking**

Solve a word problem with vectors where he finds the total straight-line distance traveled over a few days. (7 min) [E](#) [MM](#)

**Vector Word Problem: Resultant Force**

Find a resultant force vector using geometry, specifically the laws of sines and the laws of cosines. (8 min) [E](#) [MM](#)

## Pre-Calculus: Algebra | Intro to Matrices

**Intro to Matrices**

Discover what matrices are and what they do. (5 min) [E](#) [MM](#)

**Using Matrices to Represent Data:****Networks**

Explore how Matrices are basically tables of numeric values. (6 min) [E](#) [MM](#)

**Using Matrices to Represent Data:****Payoffs**

Represent a game's payoffs: we represent the points each player gets in an elaborate version of rock, paper, scissors.

(7 min) [E](#) [MM](#)

**Multiplying Matrices by Scalars**

Define what it means to multiply a matrix by a scalar (in the world of matrices, a scalar is simply a regular number).

(3 min) [E](#) [MM](#)

**Adding & Subtracting Matrices**

Define what it means to add or subtract matrices. (6 min) [E](#) [MM](#)

**Using Matrices to Manipulate Data:****Pet Store**

Explore how we can use matrices. (4 min) [E](#) [MM](#)

**Using Matrices to Manipulate Data:****Game Show**

Learn how to manipulate matrices that represent the possible prizes in a game show. (4 min) [E](#) [MM](#)

## Pre-Calculus: Algebra | Using Matrices for Transformation

### Matrices as Transformations of the Plane

By telling us where the vectors  $[1,0]$  and  $[0,1]$  are mapped to, we can figure out where any other vector is mapped to.

(8 min) [E](#) [MM](#)

### Working with Matrices as Transformations of the Plane

Learn how to connect geometric transformations like rotations, reflections, and dilations to specific matrices.

(4 min) [E](#) [MM](#)

### Intro to Determinant Notation and Computation

Learn to define matrix determinant and learn about related notation. (4 min) [E](#) [MM](#)

### Interpreting Determinants in Terms of Area

The determinant of a  $2 \times 2$  matrix tells us what the area of the image of a unit square would be under the matrix transformation. This, in turn, allows us to tell what the area of the image of any figure would be under the transformation. (4 min) [E](#) [MM](#)

### Finding Area of Figure After Transformation Using Determinant

Find the area of the image of a rectangle after a transformation defined by a given matrix. (2 min) [E](#) [MM](#)

### Proof: Matrix Determinant Gives Area of Image of Unit Square Under Mapping

Proof that the determinant of a  $2 \times 2$  matrix gives the area of the image of the unit square under the mapping defined by the matrix. (4 min) [E](#) [MM](#)

### Using Matrices to Transform the Plane: Mapping a Vector

Explore how to find the image of a given vector under the transformation defined by a given matrix. (4 min) [E](#) [MM](#)

### Using Matrices to Transform the Plane: Composing Matrices

Explore how to find a single matrix that defines the same transformation as the composition of two other matrices.

(5 min) [E](#) [MM](#)

### Using Matrices to Transform a 4D Vector

Explore how to find the image of a given 4D vector under the transformation defined by a given matrix. (6 min) [E](#) [MM](#)

### Composing $3 \times 3$ Matrices

Explore how to find the matrix transformation that is the composition of two other matrices. (4 min) [E](#) [MM](#)

## Pre-Calculus: Algebra | Matrix Multiplication

### Intro to Matrix Multiplication

Explain what it means to multiply two matrices and give an example.

(6 min) [E](#) [MM](#)

### Multiplying Matrices

Explore an example of a multiplication of two matrices that don't have the same dimensions. (6 min) [E](#) [MM](#)

### Defined Matrix Operations

Discuss the conditions of matrix dimensions for which addition or multiplication are defined. (4 min) [E](#) [MM](#)

### Intro to Identity Matrix

Learn as any number remains the same when multiplied by 1, any matrix remains the same when multiplied by the identity matrix. (8 min) [E](#) [MM](#)

### Dimensions of Identity Matrix

Explain why the identity matrix is always a square matrix, even though it works with non-square matrices. (4 min) [E](#) [MM](#)

### Is Matrix Multiplication Commutative?

Explore whether the commutative property applies for matrix multiplication. In other words, he checks whether for any two matrices  $A$  and  $B$ ,  $A \cdot B = B \cdot A$  (the answer is NO, by the way). (8 min) [E](#) [MM](#)

## Pre-Calculus: Algebra | Matrix Inverses

### Inverse Matrix Introduction

Explore how the inverse of a square matrix is another matrix (of the same dimensions), where the multiplication (or composition) of the two matrices results in the identity matrix (7 min) [E](#) [MM](#)

### Invertible Matrices and Determinants

Investigate the relationship between a matrix's determinant, and whether that matrix is invertible. (5 min) [E](#) [MM](#)

### Invertible Matrices and Transformations

Compare the effect of two transformations, one defined by an invertible matrix and one by a non-invertible matrix. (6 min) [E](#) [MM](#)

### Inverse Matrices and Matrix Equations

Explore how we can solve systems of equations with matrices. (8 min) [E](#) [MM](#)

### Finding Inverses of $2 \times 2$ Matrices

Give an example of how to find the inverse of a given  $2 \times 2$  matrix. (3 min) [E](#) [MM](#)

## Pre-Calculus: Algebra | Matrices & System of Equations

### Representing Systems of Equations with Matrices

Given a system of 3 linear equations with 3 variables, we can represent it with the equation  $Ax=b$ , where  $A$  is a  $3 \times 3$  matrix,  $x$  is a 3D vector with the variables, and  $b$  is a constant 3D vector. (7 min) [E](#) [MM](#)

### Representing Systems of Any Number of Equations with Matrices

Explore how to represent a system of  $n$  equations and variables. The resulting equation will be  $Ax=b$ , where  $A$  is an  $n \times n$  matrix,  $x$  is an  $n \times 1$  unknown vector, and  $b$  is the  $n \times 1$  constant vector. (5 min) [E](#) [MM](#)

### Inverse Matrices and Matrix Equations

Explore how we can solve systems of equations with matrices. (8 min) [E](#) [MM](#)

### Solving Linear Systems with Matrices

Solve that matrix equation using the inverse of the coefficient matrix. (7 min) [E](#) [MM](#)

## Pre-Calculus: Algebra | Geometric Series

### Geometric Series Introduction

Learn about geometric series and explore an example where a geometric series helps us describe a savings account balance. (6 min) [E](#) [MM](#)

### Geometric Sequence vs. Series

Explore how a geometric series is the sum of the terms of a geometric sequence (3 min) [E](#) [MM](#)

### Finite Geometric Series Formula

Explore what the finite geometric series formula is  $a(1-r^n)/(1-r)$  and learn why it works. (7 min) [E](#) [MM](#)

### Worked Examples: Finite Geometric Series

Evaluate three geometric series (defined in various ways) using the finite geometric series formula  $a(1-r^n)/(1-r)$ . (7 min) [E](#) [MM](#)

### Geometric Series Word Problems:

#### Swing

Find an expression for the total length and calculate it for a specific number of swings. (6 min) [E](#) [MM](#)

### Geometric Series Word Problems: Hike

Explore how to model the length of a hike with a geometric series. (7 min) [E](#) [MM](#)

## Pre-Calculus: Algebra | Geometric Series with Summation Notation

### Summation Notation

Learn how Sigma,  $\Sigma$ , is the standard notation for writing long sums. (4 min) [E](#) [MM](#)

### Geometric Series with Sigma Notation

Learn about geometric series and how they can be written in general terms and using sigma notation. (4 min) [E](#) [MM](#)

### Worked Example: Finite Geometric Series (Sigma Notation)

Evaluate the geometric series  $\Sigma 2(3^k)$  for  $k=0$  to 99 using the finite geometric series formula  $a(1-r^n)/(1-r)$ . (3 min) [E](#) [MM](#)

### Finite Geometric Series Word

#### Problem: Social Media

Solve an example of using a geometric series to answer a fun word problem. (8 min) [E](#) [MM](#)

### Finite Geometric Series Word

#### Problem: Mortgage

Figure out the formula for fixed mortgage payments using the sum of a geometric series. (18 min) [E](#) [MM](#)

## Pre-Calculus: Algebra | The Binomial Theorem

### Intro to the Binomial Theorem

The binomial theorem tells us how to expand expressions of the form  $(a+b)^n$ , for example,  $(x+y)^7$ . (13 min) [E](#) [MM](#)

### Pascal's Triangle and Binomial Expansion

Learn about Pascal's triangle and how we use it to figure out the coefficients in binomial expansions. (8 min) [E](#) [MM](#)

### Expanding Binomials

Expand  $(3y^2+6x^3)^5$  using the binomial theorem and Pascal's triangle. (9 min) [E](#) [MM](#)

### Expanding Binomials without Pascal's Triangle

Discover this "trick" for expanding large powers of binomials, without using Pascal's triangle. (5 min) [E](#) [MM](#)

### Binomial Expansion & Combinatorics

Explore why we use the combinatorial formula for  $(n \text{ choose } k)$  to expand binomial expressions. (5 min) [E](#) [MM](#)

### Pascal's Triangle & Combinatorics

Discover how generating the values in Pascal's triangle is related to the combinatorial formula  $(n \text{ choose } k)$ . (4 min) [E](#) [MM](#)

## Pre-Calculus: Algebra | Arithmetic Series

### Arithmetic Series Intro

Explore the formula for the sum of a finite arithmetic series. (4 min) [E](#) [MM](#)

### Arithmetic Series Formula

Learn how to write an arithmetic sequence in general terms, using a common difference  $d$  and a first term  $a$ . (8 min) [E](#) [MM](#)

### Worked Example: Arithmetic Series (Sigma Notation)

Evaluate the arithmetic series  $\Sigma(2k+50)$  for  $k=1$  to 550. (7 min) [E](#) [MM](#)

### Worked Example: Arithmetic Series (Sum Expression)

Evaluate the arithmetic sum  $(-50)+(-44)+(-38)+\dots+2044$ . (7 min) [E](#) [MM](#)

### Worked Example: Arithmetic Series (Recursive Formula)

Evaluate the sum of the first 650 terms in the sequence defined recursively as  $\{a_i=a_{i-1}+11, a_1=4\}$ . (6 min) [E](#) [MM](#)

### Proof of Finite Arithmetic Series Formula

Prove the expression for the sum of all positive integers up to and including  $n$ . (4 min) [E](#) [MM](#)

## Pre-Calculus: Algebra | Intro to Limits

### Limits Intro

Learn about limits, a fundamental concept in calculus. (12 min) [E](#) [MM](#)

### Estimating Limit Values from Graphs

Learn to estimate limit values from graphs by observing the function's behavior as  $x$  approaches a value from both left and right sides. (6 min) [E](#) [MM](#)

### Unbounded Limits

Explore estimating limit values from graphs, focusing on two functions:  $y = 1/x^2$  and  $y = 1/x$ . (3 min) [E](#) [MM](#)

### One-Sided Limits from Graphs

Discover a one-sided limit is the value the function approaches as the  $x$ -values approach the limit from "one side only". (10 min) [E](#) [MM](#)

### One-Sided Limits from Graphs:

#### Asymptote

Explore estimating one-sided limit values from graphs. (3 min) [E](#) [MM](#)

### Connecting Limits and Graphical Behavior

Explore how a description of a limit can apply to multiple different functions. (6 min) [E](#) [MM](#)

### Approximating Limits Using Tables

Learn about estimating limit values from tables. (5 min) [E](#) [MM](#)

### Estimating Limits from Tables

Given a table of values for a function, estimate the limit at a certain point by observing the values the function approaches from both sides. (4 min) [E](#) [MM](#)

### One-Sided Limits from Tables

Explore one-sided limits using tables, focusing on estimating the value a function approaches from either the left or right. (7 min) [E](#) [MM](#)

## Pre-Calculus: Algebra | Methods for Finding Limits

### Limit Properties

Discover limit properties, which are intuitive rules that help simplify limit problems. (5 min) [E](#) [MM](#)

### Limits of Combined Functions

Learn how to find the limit of combined functions using algebraic properties of limits. (4 min) [E](#) [MM](#)

### Limits of Combined Functions:

#### Piecewise Functions

Analyze left and right-hand limits, determine if the limit of the combined functions exists and find its value. (4 min) [E](#) [MM](#)

### Theorem for Limits of Composite Functions

Find the limit of composite functions, specifically the limit as ' $x$ ' approaches ' $a$ ' of  $f(g(x))$ . (3 min) [E](#) [MM](#)

### Theorem for Limits of Composite Functions: When Conditions Aren't Met

Learn to find limit of the composite function  $f(g(x))$  at  $x=a$ . (4 min) [E](#) [MM](#)

### Limits of Composite Functions:

#### Internal Limit Doesn't Exist

Find the limit of  $g(h(x))$  at  $x=-1$  when the limit of  $h(x)$  at  $x=-1$  doesn't exist. (4 min) [E](#) [MM](#)

### Limits of Composite Functions:

#### External Limit Doesn't Exist

Find the limit of  $g(h(x))$  at  $x=1$  when the limit of  $h(x)$  at  $x=1$  is 2 and the limit of  $g(x)$  at  $x=2$  doesn't exist. (4 min) [E](#) [MM](#)

### Limits by Direct Substitution

Learn to find the limits of functions at points where the functions are continuous: simply plug in the  $x$ -value into the function. (2 min) [E](#) [MM](#)

## Undefined Limits by Direct

### Substitution

Explore an example of a limit where direct substitution ends in a quotient with 0 in the denominator and non-0 in the numerator. (2 min) [E](#) [MM](#)

### Limits of Trigonometric Functions

Explore limits of trigonometric functions, focusing on sine, cosine, and tangent. (6 min) [E](#) [MM](#)

### Limits of Piecewise Functions

Explore limits of piecewise functions using algebraic properties of limits and direct substitution. (4 min) [E](#) [MM](#)

### Limits of Piecewise Functions:

#### Absolute Value

Find the limit of  $|x-3|/(x-3)$  at  $x=3$  by rewriting it and examining it as a piecewise function. (6 min) [E](#) [MM](#)

### Limits by Factoring

Explore the limit of  $(x^2+x-6)/(x-2)$  as  $x$  approaches 2. (6 min) [E](#) [MM](#)

### Limits by Rationalizing

Explore how to find the limit of a function as  $x$  approaches -1. (10 min) [E](#) [MM](#)

### Trig Limit Using Pythagorean Identity

Explore finding the limit as  $\theta$  approaches 0 for the expression  $(1-\cos\theta)/(2\sin^2\theta)$ . (7 min) [E](#) [MM](#)

### Trig Limit Using Double Angle Identity

Find the limit at  $\theta=-\pi/4$  of  $(1+\sqrt{2}\sin\theta)/(\cos 2\theta)$  by employing trigonometric identities. (11 min) [E](#) [MM](#)

### Strategy in Finding Limits

Explore strategies for determining which technique to use when finding limits. (13 min) [E](#) [MM](#)

### Squeeze Theorem (Sandwich Theorem) Intro

Discover that the squeeze (or sandwich) theorem states that if  $f(x) \leq g(x) \leq h(x)$  for all numbers, and at some point  $x=k$  we have  $f(k)=h(k)$ , then  $g(k)$  must also be equal to them. (7 min) [E](#) [MM](#)

**Limit of  $\sin(x)/x$  as  $x$  Approaches 0**

Prove that the limit of  $\sin(\theta)/\theta$  as  $\theta$  approaches 0 is equal to 1. (9 min) [E](#) [MM](#)

**Limit of  $(1-\cos(x))/x$  as  $x$** **Approaches 0**

Explore the limit of  $(1-\cos(x))/x$  as  $x$  approaches 0 and show that it equals 0. (4 min) [E](#) [MM](#)

**Pre-Calculus: Algebra | Limits & Continuity****Types of Discontinuities**

Explore how a function being continuous at a point means that the two-sided limit at that point exists and is equal to the function's value. (7 min) [E](#) [MM](#)

**Continuity at a Point**

Discover how saying a function  $f$  is continuous when  $x=c$  is the same as saying that the function's two-side limit at  $x=c$  exists and is equal to  $f(c)$ . (8 min) [E](#) [MM](#)

**Worked Example: Continuity at a Point (Graphical)**

Explore the necessary conditions for continuity at a point using graphical representations of functions. (7 min) [E](#) [MM](#)

**Worked Example: Point Where a Function is Continuous**

Find the limit of a piecewise function at the point between two different cases of the function. (4 min) [E](#) [MM](#)

**Worked Example: Point Where a Function Isn't Continuous**

Find the limit of a piecewise function at the point between two different cases of the function. (4 min) [E](#) [MM](#)

**Continuity Over an Interval**

Explore how function  $f$  is continuous over the open interval  $(a,b)$  if and only if it's continuous on every point in  $(a,b)$ . (9 min) [E](#) [MM](#)

**Functions Continuous on All Real Numbers**

Discover how to determine if a function is continuous on all real numbers by examining two examples:  $e^x$  and  $\sqrt{x}$ . Generally, common functions exhibit continuity within their domain. (3 min) [E](#) [MM](#)

**Functions Continuous at Specific X-Values**

Determine the continuity of two functions,  $\ln(x-3)$  and  $e^{(x-3)}$ , at  $x=3$ . Explore the concept of continuity, highlighting that common functions are continuous within their domain. (4 min) [E](#) [MM](#)

**Removing Discontinuities (Factoring)**

Find the value the function  $f(x)=(6x^2+18x+12)/(x^2-4)$  should have at  $x=-2$  so it's continuous at that point. (4 min) [E](#) [MM](#)

**Removing Discontinuities (Rationalization)**

Find the value the function  $f(x)=(\sqrt{x+4}-3)/(x-5)$  should have at  $x=5$  so it's continuous at that point. (5 min) [E](#) [MM](#)

**Pre-Calculus: Algebra | Infinite Limits & Asymptotes****Introduction to Infinite Limits**

Explore the notation of infinite limits. (4 min) [E](#) [MM](#)

**Infinite Limits and Asymptotes**

Discover that Unbounded limits are represented graphically by vertical asymptotes and limits at infinity are represented graphically by horizontal asymptotes. (4 min) [E](#) [MM](#)

**Analyzing Unbounded Limits: Rational Function**

Analyze the behavior of  $f(x)=-1/(x-1)^2$  around its asymptote at  $x=1$ . (5 min) [E](#) [MM](#)

**Analyzing Unbounded Limits: Mixed Function**

Analyze the behavior of  $f(x)=x/[1-\cos(x-2)]$  around its asymptote at  $x=2$ . (6 min) [E](#) [MM](#)

**Introduction to Limits at Infinity**

Explore the idea and notion of limits at infinity (and negative infinity). (3 min) [E](#) [MM](#)

**Functions with Same Limit at Infinity**

Explore how a limit at infinity (like any other limit) describes the behavior of a function but it isn't unique to that function. (4 min) [E](#) [MM](#)

**Limits at Infinity of Quotients (Part 1)**

Find the limits at positive and negative infinity of  $(4x^5-3x^2+3)/(6x^5-100x^2-10)$ . (4 min) [E](#) [MM](#)

**Limits at Infinity of Quotients (Part 2)**

Analyze the limits at infinity of three different rational functions. (4 min) [E](#) [MM](#)

**Limits at Infinity of Quotients with Square Roots (Odd Power)**

Find the limits at positive and negative infinity of  $x/\sqrt{x^2+1}$ . (5 min) [E](#) [MM](#)

**Limits at Infinity of Quotients with Square Roots (Even Power)**

Discover the Limit at infinity of rational expression with radical. (4 min) [E](#) [MM](#)

**Pre-Calculus: Algebra | Intermediate Value Theorem****Intermediate Value Theorem**

Discover the intermediate value theorem, a fundamental concept in calculus that states if a function is continuous over a closed interval  $[a, b]$ , it encompasses every value between  $f(a)$  and  $f(b)$  within that range. (8 min) [E](#) [MM](#)

**Worked Example: Using the Intermediate Value Theorem**

Discover how the intermediate value theorem guarantees specific outcomes for continuous functions. (7 min) [E](#) [MM](#)

**Justification with the Intermediate****Value Theorem: Table**

Explore this example justifying the use of the intermediate value theorem (where the function is defined with a  $le$ ). (6 min) [E](#) [MM](#)

**Justification with the Intermediate****Value Theorem: Equation**

Explore this example justifying use of intermediate value theorem (where function is defined with an equation). (4 min) [E](#) [MM](#)

## Pre-Calculus: Statistics & Probability | Addition & Multiplication Rules for Probability

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**Probability with Venn Diagrams**

Explore the probability of drawing a Jack or a Heart from a deck of 52 cards. It uses a Venn diagram to illustrate the concept of overlapping events and how to calculate the combined probability. (10 min) [E](#) [MM](#)

**Addition Rule for Probability**

Explore Venn diagrams and the addition rule for probability. (11 min) [E](#) [MM](#)

**Compound Probability of Independent Events**

Learn how to calculate probabilities of coin flips using two methods: listing all possible outcomes or multiplying independent events. (6 min) [E](#) [MM](#)

**Independent Events Example: Test Taking**

Discover the probability of two independent events occurring. (5 min) [E](#) [MM](#)

**General Multiplication Rule Example: Independent Events**

Use the general multiplication rule to find the probability that two events both occur when the events are independent. (3 min) [E](#) [MM](#)

**Dependent Probability Introduction**

Explore dependent probability using a scenario involving a casino game. (7 min) [E](#) [MM](#)

**General Multiplication Rule Example: Dependent Events**

Use the general multiplication rule to find the probability that two events both occur when the events are not independent. (3 min) [E](#) [MM](#)

**Interpreting General Multiplication Rule**

Express the probability that two events both occur symbolically using the general multiplication rule, and we can interpret probability statements that are expressed symbolically. (5 min) [E](#) [MM](#)

**Using Probabilities to Make Fair****Decisions Example**

Determine whether probabilities are being used to make a fair decision. (4 min) [E](#) [MM](#)

## Pre-Calculus: Statistics & Probability | Permutations

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**Factorial and Counting Seat Arrangements**

Learn how to use permutations to solve problems involving ways to arrange things. (6 min) [E](#) [MM](#)

**Permutation Formula**

Explore this useful technique by solving seating arrangement problems with factorial notation and a general formula. (8 min) [E](#) [MM](#)

**Possible Three Letter Words**

Explain how to find all the possible three letter words when we can use each letter as many times as we want, and when each letter can only be used once. (6 min) [E](#) [MM](#)

**Zero Factorial or 0!**

Learn that factorials are a quick way to represent multiplying a number by all the smaller positive integers down to one. This video also shows why mathematicians have defined zero factorial as one, instead of zero, to make the formula for permutations work in all cases. (5 min) [E](#) [MM](#)

**Ways to Arrange Colors**

Explore how many ways you can pick four colors from a group of 6. (4 min)

**Ways to Pick Officers**

Explore how many ways we can pick officers for our organization in this problem. (3 min) [E](#) [MM](#)

## Pre-Calculus: Statistics & Probability | Combinations

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**Intro to Combinations**

Learn the difference between permutations and combinations, using the example of seating six people in three chairs. (7 min) [E](#) [MM](#)

**Combination Formula**

Learn the difference between permutations and combinations, and how to calculate them using factorials. (12 min) [E](#) [MM](#)

**Handshaking Combinations**

Explore how different combinations of people can shake hands. (8 min) [E](#) [MM](#)

**Combination Example: 9 Card Hands**

Explore how many ways we can construct a hand of 9 cards. (8 min) [E](#) [MM](#)

## Pre-Calculus: Statistics & Probability | Probability Using Combinatorics

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**Probability Using Combinations**

Explore the probability of getting exactly 3 heads in 8 flips of a fair coin. (9 min) [E](#) [MM](#)

**Example: Lottery Probability**

Discover what the probability of winning a 4-number lottery is. (5 min) [E](#) [MM](#)

**Example: Different Ways to Pick Officers**

Explore the different ways we can pick officers to find the probability of one situation in particular. (2 min) [E](#) [MM](#)

**Probability with Permutations & Combinations Example: Taste Testing**

Learn to use combinations (when order does not matter) and permutations (when order does matter) to find probabilities. (4 min) [E](#) [MM](#)

**Probability with Combinations****Example: Choosing Groups**

Use two combinations (when order does not matter) to find the probability of someone being included in the group that's chosen at random from a larger group created. (4 min) [E](#) [MM](#)

**Probability with Combinations****Example: Choosing Cards**

Use combinations (when order does not matter) to find the probability of drawing two aces and two kings in a draw of four cards. (3 min) [E](#) [MM](#)

**Mega Millions Jackpot Probability**

Explore the probability of winning the mega millions jackpot. (6 min) [E](#) [MM](#)

**Pre-Calculus: Statistics & Probability | Probability Distributions****Constructing a Probability**

Distribution for Random Variable

Learn how to create the probability distribution of the number of "heads" after 3 flips of a fair coin. (7 min) [E](#) [MM](#)

**Valid Discrete Probability Distribution****Examples**

Explore examples on identifying valid discrete probability distributions. (4 min) [E](#) [MM](#)

**Probability with Discrete Random****Variable Example**

Analyze discrete probability distribution. (4 min) [E](#) [MM](#)

**Theoretical Probability Distribution****Example: Tables**

Learn to create the probability distribution for rolling two dice by creating a table to represent the events that make up the sample space. (3 min) [E](#) [MM](#)

**Theoretical Probability Distribution****Example: Multiplication**

Learn to create a probability distribution for the number of times someone wins a prize using the multiplication rule. (3 min) [E](#) [MM](#)

**Probability Distributions from****Empirical Data**

Learn to approximate a probability distribution by using empirical or observed data. (3 min) [E](#) [MM](#)

**Pre-Calculus: Statistics & Probability | Expected Value****Mean (Expected Value) of a Discrete Random Variable**

Learn to calculate the mean (or expected value) of a discrete random variable as the weighted average of all the outcomes of that random variable based on their probabilities. (5 min) [E](#) [MM](#)

**Interpreting Expected Value**

Explore how to interpret expected value as a long-term average outcome. (3 min) [E](#) [MM](#)

**Expected Payoff Example: Lottery Ticket**

Find the expected payoff (or the expected net gain) of a certain lottery ticket by taking the weighted average the outcomes. (4 min) [E](#) [MM](#)

**Expected Payoff Example: Protection Plan**

Find the expected payoff (or the expected net gain) of a protection plan offered by a store by taking the weighted average of the outcomes. (3 min) [E](#) [MM](#)

**Calculus****CalcVR**

Interactive app that allows students to explore the geometric meaning of three-dimensional objects, concepts and notions. (unlimited)

**Calculus: Limits | Intro to Limits****Limits Intro**

Learn about limits, a fundamental concept in calculus. (12 min) [E](#) [MM](#)

**Estimating Limit Values from Graphs**

Learn to estimate limit values from graphs by observing the function's behavior as  $x$  approaches a value from both left and right sides. (7 min) [E](#) [MM](#)

**Unbounded Limits**

Explore estimating limit values from graphs, focusing on two functions:  $y = 1/x^2$  and  $y = 1/x$ . For  $y = 1/x^2$ , the limit is unbounded as  $x$  approaches 0, since the function increases without bound. (3 min) [E](#) [MM](#)

**One-Sided Limits from Graphs**

Explore how a one-sided limit is the value the function approaches as the  $x$ -values approach the limit from "one side only".

(9 min) [E](#) [MM](#)

**One-Sided Limits from Graphs:****Asymptote**

Explore estimating one-sided limit values from graphs. (3 min) [E](#) [MM](#)

**Connecting Limits and Graphical****Behavior**

Analyze a function's limits from its graph, we are looking at the more "interesting" points. (5 min) [E](#) [MM](#)

**Approximating Limits Using Tables**

Analyze various 1- and 2-sided limits of a function given graphically. (5 min) [E](#) [MM](#)

**Estimating Limits from Tables**

Given a table of values for a function, estimate the limit at a certain point by observing the values the function approaches from both sides. (4 min) [E](#) [MM](#)

**One-Sided Limits from Tables**

Explore one-sided limits using tables, focusing on estimating the value a function approaches from either the left or right. (6 min) [E](#) [MM](#)

## Calculus: Limits | Methods for Finding Limits

**Limit Properties**

Discover limit properties, which are intuitive rules that help simplify limit problems. (5 min) [E](#) [MM](#)

**Limits of Combined Functions**

Learn how to find the limit of combined functions using algebraic properties of limits. (4 min) [E](#) [MM](#)

**Limits of Combined Functions:****Piecewise Functions**

Discover that even when individual limits of functions  $f(x)$  and  $g(x)$  don't exist, the limit of their sum or product might still exist. (4 min) [E](#) [MM](#)

**Theorem for Limits of Composite Functions**

Find the limit of composite functions, specifically the limit as ' $x$ ' approaches ' $a$ ' of  $f(g(x))$ . (3 min) [E](#) [MM](#)

**Theorem for Limits of Composite Functions: When Conditions Aren't Met**

Find the limit of the composite function  $f(g(x))$  at  $x=a$ . (3 min) [E](#) [MM](#)

**Limits of Composite Functions:****Internal Limit Doesn't Exist**

Find the limit of  $g(h(x))$  at  $x=-1$  when the limit of  $h(x)$  at  $x=-1$  doesn't exist. (4 min) [E](#) [MM](#)

**Limits of Composite Functions:****External Limit Doesn't Exist**

Find the limit of  $g(h(x))$  at  $x=1$  when the limit of  $h(x)$  at  $x=1$  is 2 and the limit of  $g(x)$  at  $x=2$  doesn't exist. (3 min) [E](#) [MM](#)

**Limits by Direct Substitution**

Discover how to find limits of functions at points where the functions are continuous: simply plug in the  $x$ -value into the function. (2 min) [E](#) [MM](#)

**Undefined Limits by Direct****Substitution**

Explore an example of a limit where direct substitution ends in a quotient with 0 in the denominator and non-0 in the numerator. (2 min) [E](#) [MM](#)

**Limits of Trigonometric Functions**

Discover limits of trigonometric functions, focusing on sine, cosine, and tangent. (6 min) [E](#) [MM](#)

**Limits of Piecewise Functions**

Explore limits of piecewise functions using algebraic properties of limits and direct substitution. (4 min) [E](#) [MM](#)

**Limits of Piecewise Functions:****Absolute Value**

Find the limit of  $|x-3|/(x-3)$  at  $x=3$  by rewriting it and examining it as a piecewise function. (6 min) [E](#) [MM](#)

**Limits by Factoring**

Explore the limit of  $(x^2+x-6)/(x-2)$  as  $x$  approaches 2. (6 min) [E](#) [MM](#)

**Limits by Rationalizing**

Explore how to find the limit of a function as  $x$  approaches -1. (10 min) [E](#) [MM](#)

**Trig Limit Using Pythagorean Identity**

Explore finding the limit as  $\theta$  approaches 0 for the expression  $(1-\cos\theta)/(2\sin^2\theta)$ . (7 min) [E](#) [MM](#)

**Trig Limit Using Double Angle Identity**

Find the limit at  $\theta=-\pi/4$  of  $(1+\sqrt{2}\sin\theta)/(\cos 2\theta)$  by employing trigonometric identities. (11 min) [E](#) [MM](#)

**Strategy in Finding Limits**

Explore strategies for determining which technique to use when finding limits. (13 min) [E](#) [MM](#)

**Squeeze Theorem (Sandwich Theorem) Intro**

Discover that the squeeze (or sandwich) theorem states that if  $f(x) \leq g(x) \leq h(x)$  for all numbers, and at some point,  $x=k$  we have  $f(k)=h(k)$ , then  $g(k)$  must also be equal to them. (7 min) [E](#) [MM](#)

**Limit of  $\sin(x)/x$  as  $x$  Approaches 0**

Prove that the limit of  $\sin(\theta)/\theta$  as  $\theta$  approaches 0 is equal to 1. (9 min) [E](#) [MM](#)

**Limit of  $(1-\cos(x))/x$  as  $x$** **Approaches 0**

Explore the limit of  $(1-\cos(x))/x$  as  $x$  approaches 0 and show that it equals 0. (4 min) [E](#) [MM](#)

## Calculus: Limits | Limits & Continuity

### Types of Discontinuities

Explore the different types of discontinuities. (7 min) [E](#) [MM](#)

### Continuity at a Point

Discover how saying a function  $f$  is continuous when  $x=c$  is the same as saying that the function's two-side limit at  $x=c$  exists and is equal to  $f(c)$ . (8 min) [E](#) [MM](#)

### Worked Example: Continuity at a Point (Graphical)

Explore the necessary conditions for continuity at a point using graphical representations of functions.

(7 min) [E](#) [MM](#)

### Worked Example: Point Where a Function is Continuous

Find the limit of a piecewise function at the point between two different cases of the function. (4 min) [E](#) [MM](#)

### Worked Example: Point Where a Function Isn't Continuous

Find the limit of a piecewise function at the point between two different cases of the function. (4 min) [E](#) [MM](#)

### LIM-2.B Continuity Over an Interval

Discover that A function  $f$  is continuous over the open interval  $(a,b)$  if and only if it's continuous on every point in  $(a,b)$ .

(9 min) [E](#) [MM](#)

### Functions Continuous on All Real Numbers

Discover how to determine if a function is continuous on all real numbers by examining two examples:  $e^x$  and  $\sqrt{x}$ .

(3 min) [E](#) [MM](#)

### Functions Continuous at Specific X-Values

Explore the concept of continuity, highlighting that common functions are continuous within their domain.

(4 min) [E](#) [MM](#)

### Removing Discontinuities (Factoring)

Find the value the function  $f(x)=(6x^2+18x+12)/(x^2-4)$  should have at  $x=-2$  so it's continuous at that point.

(5 min) [E](#) [MM](#)

### Removing Discontinuities (Rationalization)

Find the value the function  $f(x)=(\sqrt{x+4}-3)/(x-5)$  should have at  $x=5$  so it's continuous at that point. (5 min) [E](#) [MM](#)

## Calculus: Limits | Infinite Limits & Asymptotes

### Introduction to Infinite Limits

Discover the notation of infinite limits.

(4 min) [E](#) [MM](#)

### Infinite Limits and Asymptotes

Explore unbounded limits are represented graphically by vertical asymptotes and limits at infinity are represented graphically by horizontal asymptotes. (4 min) [E](#) [MM](#)

### Analyzing Unbounded Limits: Rational Function

Analyze the behavior of  $f(x)=-1/(x-1)^2$  around its asymptote at  $x=1$ . (5 min) [E](#) [MM](#)

### Analyzing Unbounded Limits: Mixed Function

Analyze the behavior of  $f(x)=x/[1-\cos(x-2)]$  around its asymptote at  $x=2$ . (6 min) [E](#) [MM](#)

### Introduction to Limits at Infinity

Explore the idea and notion of limits at infinity (and negative infinity). (3 min) [E](#) [MM](#)

### Functions with Same Limit at Infinity

Discover that a limit at infinity (like any other limit) describes the behavior of a function but it isn't unique to that function.

(4 min) [E](#) [MM](#)

### Limits at Infinity of Quotients (Part 1)

Find the limits at positive and negative infinity of  $(4x^5-3x^2+3)/(6x^5-100x^2-10)$ .

(4 min) [E](#) [MM](#)

### Limits at Infinity of Quotients (Part 2)

Analyze the limits at infinity of three different rational functions. (5 min) [E](#) [MM](#)

### Limits at Infinity of Quotients with Square Roots (Odd Power)

Find the limits at positive and negative infinity of  $x/\sqrt{x^2+1}$ . (5 min) [E](#) [MM](#)

### Limits at Infinity of Quotients with Square Roots (Even Power)

Discover the Limit at infinity of rational expression with radical. (4 min) [E](#) [MM](#)

## Calculus: Limits | Intermediate Value Theorem

### Intermediate Value Theorem

Discover the intermediate value theorem, a fundamental concept in calculus that states if a function is continuous over a closed interval  $[a, b]$ , it encompasses every value between  $f(a)$  and  $f(b)$  within that range. (8 min) [E](#) [MM](#)

### Worked Example: Using the Intermediate Value Theorem

Discover how the intermediate value theorem guarantees specific outcomes for continuous functions. (7 min) [E](#) [MM](#)

### Justification with the Intermediate Value Theorem: Table

Explore this example justifying the use of the intermediate value theorem (where the function is defined with a  $le$ ). (6 min) [E](#) [MM](#)

### Justification with the Intermediate Value Theorem: Equation

Explore this example justifying use of intermediate value theorem (where function is defined with an equation). (4 min) [E](#) [MM](#)

## Calculus: Limits | Formal Definition of Limits

### Formal Definition of Limits Part 1:

#### Intuition Review

Enhance your understanding of this fundamental concept by reviewing how function values approach a specific limit as the input variable gets closer to a certain point. (4 min) [E](#) [MM](#)

### Formal Definition of Limits Part 2:

#### Building the Idea

Explore the rigorous mathematical definition of a limit as  $x$  approaches  $c$ , and understand how to get  $f(x)$  as close to  $L$  as desired by finding a range around  $c$ .

(6 min) [E](#) [MM](#)

### Formal Definition of Limits Part 3: The Definition

Explore the epsilon-delta definition of limits, which states that the limit of  $f(x)$  at  $x=c$  equals  $L$  if, for any  $\epsilon > 0$ , there's a  $\delta > 0$  ensuring that when the distance between  $x$  and  $c$  is less than  $\delta$ , the distance between  $f(x)$  and  $L$  is less than  $\epsilon$ . (7 min) [E](#) [MM](#)

### Formal Definition of Limits Part 4:

#### Using the Definition

Explore the epsilon-delta definition of limits in calculus, as we rigorously prove a limit exists for a piecewise function.

(9 min) [E](#) [MM](#)

## Calculus: Differentiation | Defining Average & Instantaneous Rates of Change at a Point

### Newton, Leibniz, and Usain Bolt

Uncover the connection between Newton and Leibniz's pioneering work and Usain Bolt's impressive sprinting speeds, while grasping the significance of determining instantaneous velocity in diverse situations (9 min) [E](#) [MM](#)

### Derivative as a Concept

Learn about derivatives as the instantaneous rate of change and the slope of the tangent line. (7 min) [E](#) [MM](#)

### Secant Lines & Average Rate of Change

Learn how to calculate the average rate of change for a function and its connection to the slope of a secant line. (5 min) [E](#) [MM](#)

### Derivative as Slope of Curve

Explore how to interpret the derivative of a function at a specific point as the curve's slope or the tangent line's slope at that point. (6 min) [E](#) [MM](#)

### The Derivative & Tangent Line

#### Equations

Discover how the derivative of a function reveals the slope of the tangent line at any point on the graph. (8 min) [E](#) [MM](#)

## Calculus: Differentiation | Defining the Derivative of a Function & Using Derivative Notation

### Formal Definition of the Derivative as a Limit

Discover how to define the derivative of a function at a specific point using the limit of the slope of the secant line.

(16 min) [E](#) [MM](#)

## Formal and Alternate Form of the Derivative

Discover the two methods for defining the derivative of a function at a specific point using limit expressions. (5 min) [E](#) [MM](#)

### Worked Example: Derivative as a Limit

Discover how to apply the formal and alternate forms of the derivative in real-world scenarios. (6 min) [E](#) [MM](#)

### Worked Example: Derivative from Limit Expression

Explore a limit expression and discover that it represents the derivative of the function  $f(x) = x^3$  at the point  $x = 5$ . (5 min) [E](#) [MM](#)

### The Derivative of $x^2$ at $x=3$ Using the Formal Definition

Learn to calculate the slope of the tangent line at a specific point on the curve  $y=x^2$  by applying the limit as the change in  $x$  approaches zero. (9 min) [E](#) [MM](#)

### The Derivative of $x^2$ at Any Point Using the Formal Definition

Learn to apply the limit as  $h$  approaches 0 to determine the slope of the tangent line at a given point on the curve  $y = x^2$ . (11 min) [E](#) [MM](#)

### Estimating Derivatives

Estimate the derivative at a point using the slope of a secant line connecting points around that point. (6 min) [E](#) [MM](#)

## Calculus: Differentiation | Differentiability & Continuity

### Differentiability and Continuity

Explore differentiability and get an intuition for the relationship between differentiability and continuity.

(10 min) [E](#) [MM](#)

**Differentiability at a Point: Graphical**

Explore examples of functions and their graphs, focusing on finding points where the function isn't differentiable.

(6 min) [E](#) [MM](#)

**Differentiability at a Point: Algebraic (Function is Differentiable)**

Examine a piecewise function to determine its continuity and differentiability at an edge point. (5 min) [E](#) [MM](#)

**Differentiability at a Point: Algebraic (Function Isn't Differentiable)**

Examine a piecewise function to determine its differentiability and continuity at an edge point. (6 min) [E](#) [MM](#)

**Calculus: Differentiation | Basic Derivative Rules****Power Rule**

Discover the power rule, a handy tool for finding the derivative of  $x^n$ . (4 min) [E](#) [MM](#)

**Power Rule (With Rewriting the Expression)**

Discover how the power rule helps us find derivatives of functions like  $1/x$ ,  $\sqrt[3]{x}$ , or  $\sqrt[3]{x^2}$ . (5 min) [E](#) [MM](#)

**Basic Derivative Rules**

Explore how to find the derivative of any polynomial using the power rule and additional properties. (10 min) [E](#) [MM](#)

**Basic Derivative Rules: Find the Error**

Analyze two students' attempts to differentiate linear functions using basic rules. (5 min) [E](#) [MM](#)

**Basic Derivative Rules: Table**

Explore a problem involving two functions,  $f$  and  $g$ , and their derivatives at specific points. (9 min) [E](#) [MM](#)

**Differentiating Polynomials**

Explore how to differentiate polynomials using the power rule and derivative properties. (7 min) [E](#) [MM](#)

**Differentiating Integer Powers (Mixed Positive and Negative)**

Explore how to differentiate the function  $g(x) = 2/(x^3) - 1/(x^2)$  and evaluate the derivative at  $x = 2$ . (5 min) [E](#) [MM](#)

**Tangents of Polynomials**

Find the equation of the line tangent to the graph of  $f(x) = x^3 - 6x^2 + x - 5$  at  $x = 1$ . (5 min) [E](#) [MM](#)

**Calculus: Differentiation | Derivatives of  $\cos(x)$ ,  $\sin(x)$ ,  $e^x$ , &  $\ln(x)$** **Derivatives of  $\sin(x)$  and  $\cos(x)$** 

Explore the intuition behind the derivatives of trigonometric functions, discovering that the derivative of  $\sin(x)$  is  $\cos(x)$  and the derivative of  $\cos(x)$  is  $-\sin(x)$ . (4 min) [E](#) [MM](#)

**Worked Example: Derivatives of  $\sin(x)$  and  $\cos(x)$** 

Discover the derivative of the function  $g(x) = 7\sin(x) - 3\cos(x) - (\pi/\sqrt[3]{x})^2$ . (5 min) [E](#) [MM](#)

**Derivative of  $e^x$** 

Explore the properties of the derivative of  $e^x$ . (3 min) [E](#) [MM](#)

**Derivative of  $\ln(x)$** 

Discover the derivative of  $\ln(x)$  is  $1/x$ . (2 min) [E](#) [MM](#)

**Calculus: Differentiation | Product Rule & Quotient Rule****Product Rule**

Discover the product rule, a fundamental technique for finding the derivative of a function expressed as a product of two functions. (3 min) [E](#) [MM](#)

**Differentiating Products**

Explore the product rule by finding the derivative of  $e^x \cos(x)$ . (4 min) [E](#) [MM](#)

**Worked Example: Product Rule with Table**

Explore how to evaluate the derivative of the product of two functions,  $f(x)$  and  $h(x)$ , at  $x = 3$ , using given values for  $f$ ,  $h$ , and their derivatives. (3 min) [E](#) [MM](#)

**Worked Example: Product Rule with Mixed Implicit & Explicit**

Explore how to calculate the derivative of  $F(x) = f(x)g(x)$  at  $x = -1$ , given the values of  $f$  and  $f'$  at  $x = -1$  and  $g(x) = 1/x$ . (3 min) [E](#) [MM](#)

**Quotient Rule**

Discover the quotient rule, a powerful technique for finding the derivative of a function expressed as a quotient. (4 min) [E](#) [MM](#)

**Worked Example: Quotient Rule with Table**

Explore how to find the derivative of  $F(x) = f(x)/g(x)$  at  $x = -1$ , given the values of  $f$  and  $f'$  at  $x = -1$  and  $g(x) = 2x^3$ . (6 min) [E](#) [MM](#)

**Differentiating Rational Functions**

Discover the differentiation of the rational function  $(5-3x)/(x^2+3x)$  using the Quotient Rule. (7 min) [E](#) [MM](#)

**Derivatives of  $\tan(x)$  and  $\cot(x)$** 

Find the derivatives of  $\tan(x)$  and  $\cot(x)$  by rewriting them as quotients of  $\sin(x)$  and  $\cos(x)$ . (5 min) [E](#) [MM](#)

**Derivatives of  $\sec(x)$  and  $\csc(x)$** 

Explore the derivatives of  $\sec(x)$  and  $\csc(x)$  by expressing them as  $1/\cos(x)$  and  $1/\sin(x)$ , respectively, and applying the quotient rule. (4 min) [E](#) [MM](#)

**Calculus: Differentiation | Intro to the Chain Rule****Chain Rule**

Discover that the chain rule states that the derivative of  $f(g(x))$  is  $f'(g(x)) \cdot g'(x)$ . (5 min) [E](#) [MM](#)

**Common Chain Rule****Misunderstandings**

Explore these three common student misconceptions when applying the chain rule. (7 min) [E](#) [MM](#)

**Identifying Composite Functions**

Review of composite functions and how to recognize them. (8 min) [E](#) [MM](#)

**Worked Example: Derivative of  $\cos^3(x)$** **Using the Chain Rule**

Examine this example of composite functions, using the example  $f(x) = \cos^3(x)$ . (9 min) [E](#) [MM](#)

**Worked Example: Derivative of** **$\sqrt{3x^2-x}$  Using the Chain Rule**

Discover the process of differentiating a composite function, specifically  $f(x) = \sqrt{3x^2-x}$ , using the chain rule. (6 min) [E](#) [MM](#)

**Worked Example: Derivative of  $\ln(\sqrt{x})$** **Using the Chain Rule**

Examine and dissect the composite function  $f(x) = \ln(\sqrt{x})$  into its parts,  $\ln(x)$  and  $\sqrt{x}$ . (7 min) [E](#) [MM](#)

## Calculus: Differentiation

### | The Chain Rule: More Practice

**Worked Example: Chain Rule with Table**

Explore the Chain rule with a table. (3 min) [E](#) [MM](#)

**Derivative of  $a^x$  (For Any Positive Base  $a$ )**

Explore the derivative of  $a^x$  for any positive base  $a$ . (6 min) [E](#) [MM](#)

**Derivative of  $\log_a x$  (For Any Positive Base  $a \neq 1$ )**

Find the derivative of  $\log_a x$  for any positive base  $a \neq 1$ . (5 min) [E](#) [MM](#)

**Worked Example: Derivative of  $7^{(x^2-x)}$  Using the Chain Rule**

Explore the process of differentiating the exponential function  $7^{(x^2-x)}$ . (4 min) [E](#) [MM](#)

**Worked Example: Derivative of  $\log_4(x^2+x)$  Using the Chain Rule**

Explore a worked example of differentiating the logarithmic function  $\log_4(x^2+x)$  using the chain rule. (4 min) [E](#) [MM](#)

**Worked Example: Derivative of  $\sec(3\pi/2-x)$  Using the Chain Rule**

Explore the process of differentiating the function  $\sec(3\pi/2-x)$  in this worked example. (7 min) [E](#) [MM](#)

**Worked example: Derivative of  $\sqrt[4]{(x^3+4x^2+7)}$  Using the Chain Rule**

Explore the challenge of differentiating the fourth root of a polynomial expression in this worked example. (6 min) [E](#) [MM](#)

## Calculus: Differentiation

### | Implicit Differentiation

**Implicit Differentiation**

Explore how Implicit differentiation helps us find  $dy/dx$  even for relationships like that. (8 min) [E](#) [MM](#)

**Worked Example: Implicit Differentiation**

Use implicit differentiation to solve the equation  $(x-y)^2 = x + y - 1$  in this worked example. (5 min) [E](#) [MM](#)

**Worked Example: Evaluating**

Derivative with Implicit Differentiation  
Calculate the slope of a tangent line at a specific point on a curve using implicit differentiation. (5 min) [E](#) [MM](#)

**Showing Explicit and Implicit****Differentiation Gives Same Result**

Discover the connection between implicit and explicit differentiation. (8 min) [E](#) [MM](#)

## Calculus: Differentiation

### | Differentiating Inverse Functions

**Derivatives of Inverse Functions**

Learn that Functions  $f$  and  $g$  are inverses if  $f(g(x)) = x = g(f(x))$  and see how it applies to  $e^x$  and  $\ln(x)$ . (5 min) [E](#) [MM](#)

**Derivatives of Inverse Functions: From Equation**

Explore the relationship between a function and its inverse, focusing on the function  $f(x) = \frac{1}{2}x^3 + 3x - 4$ . (5 min) [E](#) [MM](#)

**Derivatives of Inverse Functions: From Table**

Discover inverse functions, exploring how to evaluate the derivative of an inverse function,  $h'$ , at a specific  $x$ -value. (5 min) [E](#) [MM](#)

**Derivative of Inverse Sine**

Learn to find the derivative of inverse sine. (5 min) [E](#) [MM](#)

**Derivative of Inverse Cosine**

Learn to find the inverse cosine function. (4 min) [E](#) [MM](#)

**Derivative of Inverse Tangent**

Learn to find the derivative of the inverse tangent function. (6 min) [E](#) [MM](#)

## Calculus: Differentiation

### | Strategies for Calculating Derivatives

**Differentiating Functions: Find the Error**

Examine the work of students differentiating various functions to see if they made a mistake, and if so, what mistake. (11 min) [E](#) [MM](#)

### Manipulating Functions Before Differentiation

Explore how to rewrite a function before differentiating it so the process of differentiation is faster and easier. (11 min) [E](#) [MM](#)

### Differentiating Using Multiple Rules: Strategy

Analyze the structure of an elaborate expression to determine which derivative rules to use, and (not less important) in what order. (6 min) [E](#) [MM](#)

### Applying the Chain Rule and Product Rule

Explore this example showing multiple strategies for taking a derivative that involves both the product rule and the chain rule. (6 min) [E](#) [MM](#)

### Applying the Chain Rule Twice

Solve this example applying the chain rule twice. (3 min) [E](#) [MM](#)

### Derivative of $e^{\cos x} \cdot \cos(e^x)$

Differentiate  $e^{\cos x} \cdot \cos(e^x)$  by applying both the product rule and the chain rule. (6 min) [E](#) [MM](#)

### Derivative of $\sin(\ln(x^2))$

Differentiate  $\sin(\ln(x^2))$  by applying the chain rule twice. (5 min) [E](#) [MM](#)

### LIM-3.A | Disguised Derivatives

Differentiates the product of three different functions and generalizes for the derivative of the product of any number of functions. (5 min) [E](#) [MM](#)

## Calculus: Differentiation | Higher-Order Derivatives

### Second Derivatives

Find the second derivative of  $y=6/x^2$ .  
Second derivative is the derivative of the derivative of  $y$ . (3 min) [E](#) [MM](#)

### Second Derivatives (Implicit Equations): Find Expression

Given an implicit equation in  $x$  and  $y$ , find the expression for the second derivative of  $y$  with respect to  $x$ . (5 min) [E](#) [MM](#)

### Second Derivatives (Implicit Equations): Evaluate Derivative

Given the first derivative of an implicit equation in  $x$  and  $y$ , evaluate the second derivative at a certain point. (5 min) [E](#) [MM](#)

## Calculus: Differentiation | Proofs of Derivative Rules

### Proof: Differentiability Implies Continuity

Discover that if a function is differentiable at a point, it is also continuous at that point. (12 min) [E](#) [MM](#)

### Justifying the Power Rule

Explore the power rule's validity by examining the derivatives of  $x^1$  and  $x^2$ . (7 min) [E](#) [MM](#)

### Proof of Power Rule for Positive Integer Powers

Explore the formula for the derivative of  $x^n$  by skillfully applying the binomial theorem. (7 min) [E](#) [MM](#)

### Proof of Power Rule for Square Root Function

Explore a proof of the power rule for the special case when  $n=1/2$ , focusing on the derivative of  $\sqrt{x}$ . (5 min) [E](#) [MM](#)

### Limit of $\sin(x)/x$ as $x$ Approaches 0

Prove that the limit of  $\sin(\theta)/\theta$  as  $\theta$  approaches 0 is equal to 1. (9 min) [E](#) [MM](#)

### Limit of $(1-\cos(x))/x$ as $x$ Approaches 0

Explore the limit of  $(1-\cos(x))/x$  as  $x$  approaches 0 and show that it equals 0. (4 min) [E](#) [MM](#)

### Proof of the Derivative of $\sin(x)$

Discover the proof that the derivative of  $\sin(x)$  equals  $\cos(x)$ . (6 min)

### Proof of the Derivative of $\cos(x)$

Examine that the derivative of  $\sin(x)$  equals  $\cos(x)$  to visually demonstrate that the derivative of  $\cos(x)$  equals  $-\sin(x)$ . (4 min) [E](#) [MM](#)

### Product Rule Proof

Explore the proof of the product rule, a key concept in calculus. (9 min) [E](#) [MM](#)

### If Function $u$ is Continuous at $x$ , Then $\Delta u \rightarrow 0$ as $\Delta x \rightarrow 0$

Discover that if a function is continuous, the difference in the function's values approaches 0 as the difference in the  $x$ -values approaches 0. (7 min) [E](#) [MM](#)

### Chain Rule Proof

Use the formal properties of continuity and differentiability to see why the chain rule is true. (6 min) [E](#) [MM](#)

### Quotient Rule from Product & Chain Rules

Explore how you can derive the quotient rule using the product rule and the chain rule. (5 min) [E](#) [MM](#)

## Calculus: Differentiation | Straight-Line Motion: Connecting Position, Velocity, & Acceleration

### Introduction to One-Dimensional Motion with Calculus

Discover that straight-line motion can be modeled by giving position as a function of time. (7 min) [E](#) [MM](#)

### Interpreting Direction of Motion from Position-Time Graph

Given the position-time graph of a linear motion, interpret whether the moving object moves forward or backward. (3 min) [E](#) [MM](#)

### Interpreting Direction of Motion from Velocity-Time Graph

Given the velocity-time graph of a linear motion, interpreting whether the moving object moves forward or backward.

(2 min) [E](#) [MM](#)

### Interpreting Change in Speed from Velocity-Time Graph

Explore this example thinking about speed from velocity-time graph. (4 min) [E](#) [MM](#)

### Worked Example: Motion Problems with Derivatives

Find and interpret the velocity and acceleration given position as a function of time. (5 min) [E](#) [MM](#)

## Calculus: Differentiation | Rates of Change in Other Applied Contexts

### Interpreting the Meaning of the Derivative in Context

Discover how to make sense of derivatives when they are used to describe real-world situations. (5 min) [E](#) [MM](#)

### Applied Rate of Change: Forgetfulness

Explore applied rate of change in this problem about forgetfulness. (5 min) [E](#) [MM](#)

### Marginal Cost & Differential Calculus

In economics, the idea of marginal cost can be nicely captured with the derivative. (5 min) [E](#) [MM](#)

## Calculus: Differentiation | Related Rates

### Related Rates Intro

Examine the relationship between how fast a circle's radius changes, and how fast its area changes. (8 min) [E](#) [MM](#)

### Analyzing Related Rates Problems: Expressions

Explore and understand all the involved quantities in a related rates problem. (8 min) [E](#) [MM](#)

### Analyzing Related Rates Problems: Equations (Pythagoras)

Discover that a crucial part of solving related rates problems is picking an equation that correctly relates the quantities. (4 min) [E](#) [MM](#)

### Analyzing Related Rates Problems: Equations (Trig)

Find the rate of change of an angle that a falling ladder forms with the ground. (8 min) [E](#) [MM](#)

### Differentiating Related Functions

#### Intro

Use the chain rule, find the derivatives of those functions with respect to that variable. (4 min) [E](#) [MM](#)

### Worked Example: Differentiating Related Functions

Learn how to use implicit differentiation to find the derivatives of the functions with respect to that variable. (8 min) [E](#) [MM](#)

### Related Rates: Approaching Cars

Explore how the rate of change of the distance between them changes as two cars approach the same intersection from different roads. (7 min) [E](#) [MM](#)

### Related Rates: Falling Ladder

Discover the rate of change in this problem. (6 min) [E](#) [MM](#)

### Related Rates: Water Pouring into a Cone

As you pour water into a cone, discover how the rate of change of the depth of the water relate to the rate of change in volume. (12 min) [E](#) [MM](#)

### Related Rates: Shadow

Solve a related rates problem about the shadow an owl casts as it's hunting a mouse. (11 min) [E](#) [MM](#)

### Related Rates: Balloon

Analyze the rate of change of a balloon's altitude based on the angle you must crane your neck to look at it. (8 min) [E](#) [MM](#)

## Calculus: Differentiation | Local Linearity

### Local Linearity

Explore the idea of approximating curves using their tangent line equations. (10 min) [E](#) [MM](#)

### Local Linearity and Differentiability

Learn how local linearity relates to differentiability using the Desmos graphing calculator. (7 min) [E](#) [MM](#)

### Worked Example: Approximation with Local Linearity

Find the equation of a tangent line at a point of a curve by knowing the derivative at that point. (4 min) [E](#) [MM](#)

### Linear Approximation of a Rational Function

Find a linear expression that approximates  $y=1/(x-1)$  around  $x=-1$ . (7 min) [E](#) [MM](#)

## Calculus: Differentiation | L'Hôpital's Rule: Limits of Indeterminate Forms

### L'Hôpital's Rule Introduction

When you are solving a limit, and get  $0/0$  or  $\infty/\infty$ , L'Hôpital's rule is the tool you need. (9 min) [E](#) [MM](#)

### L'Hôpital's Rule: Limit at 0 Example

Use L'Hôpital's rule to find the limit at 0 of  $(2\sin(x)-\sin(2x))/(x-\sin(x))$ . (8 min) [E](#) [MM](#)

### L'Hôpital's Rule: Limit at Infinity

#### Example

Use L'Hôpital's rule to find the limit at infinity of  $(4x^2-5x)/(1-3x^2)$ . (5 min) [E](#) [MM](#)

## Calculus: Differentiation | Using the Mean Value Theorem

### Mean Value Theorem

The Mean Value Theorem states that if a function  $f$  is continuous on the closed interval  $[a,b]$  and differentiable on the open interval  $(a,b)$ , then there exists a point  $c$  in the interval  $(a,b)$  such that  $f'(c)$  is equal to the function's average rate of change over  $[a,b]$ . (7 min) [E](#) [MM](#)

### Mean Value Theorem Example: Polynomial

Find the number that satisfies the Mean value theorem for  $f(x)=x^2-6x+8$  over the interval  $[2,5]$ . (5 min) [E](#) [MM](#)

### Mean Value Theorem Example: Square Root Function

Find the number that satisfies the Mean value theorem for  $f(x)=\sqrt{4x-3}$  over the interval  $[1,3]$ . (7 min) [E](#) [MM](#)

### Justification with the Mean Value Theorem: Table

Explore this example justifying use of mean value theorem (where function is defined with a table). (4 min) [E](#) [MM](#)

### Justification with the Mean Value Theorem: Equation

Explore this example justifying use of mean value theorem (where function is defined with an equation). (3 min) [E](#) [MM](#)

### Mean Value Theorem Application

Explore how to apply the mean value theorem in this speeding problem. (7 min) [E](#) [MM](#)

## Calculus: Differentiation | Extrema, Critical Points, & Intervals

### Extreme Value Theorem

The extreme value theorem states that if a function is continuous on a closed interval  $[a,b]$ , then the function must have a maximum and a minimum on the interval. (8 min) [E](#) [MM](#)

### Critical Points Introduction

Discover the "critical points" of a function and discuss their relationship with the extremum points of the function. (8 min) [E](#) [MM](#)

### Finding Critical Points

Find the critical points of  $f(x)=xe^{(-2x^2)}$ . (6 min) [E](#) [MM](#)

### Finding Decreasing Interval Given the Function

Find the intervals where the function  $f(x)=x^6-3x^5$  is decreasing by analyzing the intervals where  $f'$  is positive or negative. (5 min) [E](#) [MM](#)

### Finding Increasing Interval Given the Derivative

Given that the derivative of function  $g$ , is  $g'(x)=x^2/(x-2)^3$ , find the intervals where  $g$  is increasing, by looking for the intervals where  $g'$  is positive. (6 min) [E](#) [MM](#)

### Introduction to Minimum and Maximum Points

Discover all about minimum and maximum points, both absolute and relative. (6 min) [E](#) [MM](#)

### Finding Relative Extrema (First Derivative Test)

Discover how to find a critical point and tell if it is a minimum, maximum or neither. (5 min) [E](#) [MM](#)

## Worked Example: Finding Relative Extrema

Find the relative maximum point of  $g(x)=x^4-x^5$  by analyzing the intervals where its derivative,  $g'$ , is negative or positive. (8 min) [E](#) [MM](#)

### Analyzing Mistakes when Finding Extrema (Example 1)

Examine the work of someone who tried to find extrema of a function, to see whether they made mistakes. (5 min) [E](#) [MM](#)

### Analyzing Mistakes when Finding Extrema (Example 2)

Examine the work of someone who tried to find extrema of a function, to see whether they made mistakes. (5 min) [E](#) [MM](#)

### Finding Absolute Extrema on a Closed Interval

Find the absolute maximum value of  $f(x)=8\ln(x)-x^2$  over the interval  $[1,4]$ . (7 min) [E](#) [MM](#)

### Absolute Minima & Maxima (Entire Domain)

Discover the absolute minimum and maximum points of  $g(x)=x^2\ln(x)$  over its entire domain. (10 min) [E](#) [MM](#)

### Second Derivative Test

Explore an example of the second derivative test, which is a way of determining relative minima & maxima. (6 min) [E](#) [MM](#)

## Calculus: Differentiation | Concavity & Points of Inflection

### Concavity Introduction

Explore the concept of concavity, what it means for a graph to be "concave up" or "concave down," and how this relates to the second derivative of a function. (10 min) [E](#) [MM](#)

**Analyzing Concavity (Graphical)**

Solve an exercise where you are asked to recognize the concavity of a function in certain regions. (3 min) [E](#) [MM](#)

**Inflection Points Introduction**

Discover that Inflection points are points where the function changes concavity, i.e. from being "concave up" to being "concave down" or vice versa. (3 min) [E](#) [MM](#)

**Inflection Points (Graphical)**

Analyze the graph of a function  $g$  to find all the inflection points of  $g$ . (4 min) [E](#) [MM](#)

**Analyzing Concavity (Algebraic)**

Find the intervals where  $g(x) = -x^4 + 6x^2 - 2x - 3$  is concave down/up by finding where its second derivative,  $g''$ , is positive/negative. (9 min) [E](#) [MM](#)

**Inflection Points (Algebraic)**

Analyze the points of inflection of  $g(x) = \frac{1}{4}x^4 - 4x^3 + 24x^2$  by looking for values where the second derivative  $g''$  changes signs. (6 min) [E](#) [MM](#)

**Mistakes When Finding Inflection****Points: Second Derivative Undefined**

Candidates for inflection points are points where the second derivative is zero \*and\* points where the second derivative is undefined. (6 min) [E](#) [MM](#)

**Mistakes When Finding Inflection****Points: Not Checking Candidates**

Explore how to test  $x$ -values and see if they really are inflection points. (4 min) [E](#) [MM](#)

**Horizontal Tangent to Implicit Curve**

Find the equation of a horizontal tangent to a curve that is defined implicitly as an equation in  $x$  and  $y$ . (3 min) [E](#) [MM](#)

## Calculus: Differentiation

### | Sketching Curves of Functions & Their Derivatives

**Curve Sketching with Calculus:****Polynomial**

Visualize a graph of  $f(x) = 3x^4 - 4x^3 + 2$  including extremum and inflection points. (20 min) [E](#) [MM](#)

**Curve Sketching with Calculus:****Logarithm**

Visualize a graph of  $f(x) = \ln(x^4 + 27)$  including extremum and inflection points. (25 min) [E](#) [MM](#)

**Analyzing a Function with its Derivative**

Taking the derivative of  $f(x) = x^3 - 12x + 2$  and graphing the derivative, find when  $f$  is increasing or decreasing, and where is its relative extremum points. (10 min) [E](#) [MM](#)

## Calculus: Differentiation

### | Connecting a Function, Its First Derivative, & Its Second Derivative

**Calculus-Based Justification for Function Increasing**

Discover that a calculus-based justification is when we explain a property of a function  $f$  based on its derivative  $f'$ . (4 min) [E](#) [MM](#)

**Justification Using First Derivative**

Explore why a function is increasing, decreasing, or having a relative maximum using information about its first derivative. This is called calculus-based justification. (6 min) [E](#) [MM](#)

**Inflection Points from Graphs of Function & Derivatives**

Identify inflection points from graphs of function, first derivative and second derivative. (5 min) [E](#) [MM](#)

**Justification Using Second Derivative: Inflection Point**

Justify whether a function has an inflection point by looking at where the second derivative changes its sign. (4 min) [E](#) [MM](#)

**Justification Using Second Derivative: Maximum Point**

Given that the derivative of a function is zero, justify whether the function has a relative maximum point by looking at the second derivative. (4 min) [E](#) [MM](#)

**Connecting  $f$ ,  $f'$ , and  $f''$  Graphically (Example 1)**

Examine three graphs to see which describes the derivative of which another graph. (6 min) [E](#) [MM](#)

**Connecting  $f$ ,  $f'$ , and  $f''$  Graphically (Example 2)**

Examine three graphs to see which describes the derivative of which another graph. (4 min) [E](#) [MM](#)

## Calculus: Differentiation

### | Solving Optimization Problems

**Optimization: Sum of Squares**

Discover what the minimum possible value of  $x^2 + y^2$  is given that their product must be fixed at  $xy = -16$ . (8 min) [E](#) [MM](#)

**Optimization: Box Volume (Part 1)**

Explore how to maximize the volume in this box problem. (10 min) [E](#) [MM](#)

**Optimization: Box Volume (Part 2)**

Examine the formulas needed to solve this box problem. (9 min) [E](#) [MM](#)

**Optimization: Profit**

Explore how to maximize profits in this optimization problem about a shoe factory. (12 min) [E](#) [MM](#)

**Optimization: Cost of Materials**

Explore optimization as you figure out how to minimize the cost of storage. (13 min) [E](#) [MM](#)

### Optimization: Area of Triangle & Square (Part 1)

Construct an equilateral triangle & a square whose bases are 100m (about 328.08 ft) together, such that their area is the smallest possible. (6 min) [E](#) [MM](#)

### Optimization: Area of Triangle & Square (Part 2)

Construct an equilateral triangle & a square whose bases are 100m (about 328.08 ft) together, such that their area is the smallest possible. (5 min) [E](#) [MM](#)

### Motion Problems: Finding the Maximum Acceleration

The speed of a particle moving along the  $x$ -axis is given by  $v(t) = -t^3 + 6t^2 + 2t$ , find the time when the particle's acceleration attains its maximum value. (4 min) [E](#) [MM](#)

## Calculus: Integration | Intro to Integrals: Accumulation of Change

### Introduction to Integral Calculus

Discover that the basic idea of Integral calculus is finding the area under a curve. (4 min) [E](#) [MM](#)

### Definite Integrals Intro

Explore that Definite integrals represent the area under the curve of a function and above the  $x$ -axis. (8 min) [E](#) [MM](#)

### Worked Example: Accumulation of Change

Examine this example relating rates of change with a leaky bathtub. (7 min) [E](#) [MM](#)

## Calculus: Integration | Riemann Sums

### Riemann Approximation Introduction

Discover how Riemann sum approximates the area under a curve using some rectangles. (7 min) [E](#) [MM](#)

### Over- and Under-Estimation of Riemann Sums

Explore the difference between overestimation and underestimation when using Riemann sums. (4 min) [E](#) [MM](#)

### Worked Example: Finding a Riemann Sum Using a Table

Given a table of values of a function, use it to find a Riemann sum approximation of that function. (7 min) [E](#) [MM](#)

### Worked Example: Over- and Under-Estimation of Riemann Sums

Examine how to order different areas from least to greatest. (5 min) [E](#) [MM](#)

### Midpoint Sums

Explore approximating area under a curve using rectangle where the heights are the value of the function at the midpoint of each interval. (6 min) [E](#) [MM](#)

### Trapezoidal Sums

Discover that the area under a curve is commonly approximated using rectangles (e.g. left, right, and midpoint Riemann sums), but it can also be approximated by trapezoids. (9 min) [E](#) [MM](#)

### Summation Notation

Learn how to use Sigma,  $\Sigma$ , which is the standard notation for writing long sums. (5 min) [E](#) [MM](#)

### Worked Examples: Summation Notation

Explore examples of how we read expressions in summation notation. (6 min) [E](#) [MM](#)

### Riemann Sums in Summation Notation

Generalize the technique of approximating area under a curve with rectangles. (9 min) [E](#) [MM](#)

### Worked example: Riemann Sums in Summation Notation

Express the approximation of the area under a curve in sigma notation. (7 min) [E](#) [MM](#)

### Definite Integral as the Limit of a Riemann Sum

Learn to use Riemann sums with infinite rectangles of infinitely small width (using limits), we get the exact area, i.e. the definite integral. (5 min) [E](#) [MM](#)

### Worked Example: Rewriting Definite Integral as Limit of Riemann Sum

Given a definite integral expression, write the corresponding limit of a Riemann sum with infinite rectangles. (6 min) [E](#) [MM](#)

### Worked Example: Rewriting Limit of Riemann Sum as Definite Integral

Given a limit of Riemann sum with infinite rectangles, analyze the expression to find the corresponding definite integral. (7 min) [E](#) [MM](#)

## Calculus: Integration | The Fundamental Theorem of Calculus: Accumulation Functions

### The Fundamental Theorem of Calculus and Accumulation Functions

Explore how the fundamental theorem of calculus shows how, in some sense, integration is the opposite of differentiation. (8 min) [E](#) [MM](#)

### Functions Defined by Definite Integrals (Accumulation Functions)

Discover that a function can be defined using a definite integral. (4 min) [E](#) [MM](#)

### Finding Derivative with Fundamental Theorem of Calculus: Chain Rule

Explore how to incorporate the chain rule into the fundamental theorem of calculus.

(3 min) [E](#) [MM](#)

### Interpreting the Behavior of Accumulation Functions

Given the graph of function  $f$ , reason about the graph of its antiderivative  $g$  (so  $g' = f$ ).

(9 min) [E](#) [MM](#)

### Proof of Fundamental Theorem of Calculus

Explore the fundamental theorem of calculus and learn that if we define  $F(x)$  to be the definite integral of function  $f$  from some constant  $a$  to  $x$ , then  $F$  is an antiderivative of  $f$ . (14 min) [E](#) [MM](#)

### Intuition for Second Part of Fundamental Theorem of Calculus

Explore that the second part of the fundamental theorem of calculus tells us that to find the definite integral of a function  $f$  from  $a$  to  $b$ , we need to take an antiderivative of  $f$ , call it  $F$ , and calculate  $F(b) - F(a)$ . (13 min) [E](#) [MM](#)

## Calculus: Integration | Applying Properties of Definite Integrals

### Negative Definite Integrals

Learn that definite integrals give us the area under the curve and above the  $x$ -axis.

(5 min) [E](#) [MM](#)

### Finding Definite Integrals Using Area Formulas

Discover that definite integrals are the net area between a curve and the  $x$ -axis, we can sometimes use geometric area formulas to find definite integrals. (4 min) [E](#) [MM](#)

### Definite Integral Over a Single Point

Discover what happens when the bounds of your integral are the same. (3 min) [E](#) [MM](#)

### Integrating Scaled Version of Function

Use a graph to explain why we can take a constant out of a definite integral.

(5 min) [E](#) [MM](#)

### Switching Bounds of Definite Integral

Discover what happens when you swap the bounds on an integral. (5 min) [E](#) [MM](#)

### Integrating Sums of Functions

Given the integrals of two functions, find the integral of their sum. (7 min) [E](#) [MM](#)

### Worked Examples: Finding Definite Integrals Using Algebraic Properties

Evaluate definite integrals of functions given their graphs. (3 min) [E](#) [MM](#)

### Definite Integrals on Adjacent Intervals

Learn how to break up an integral by subdividing the stretch of numbers where you are integrating. (3 min) [E](#) [MM](#)

### Worked Example: Breaking up the Integral's Interval

Find a definite integral by breaking it down to smaller intervals that are adjacent to each other. (7 min) [E](#) [MM](#)

### Worked Example: Merging Definite Integrals Over Adjacent Intervals

Discover how to evaluate the sum of definite integrals over adjacent intervals. (4 min) [E](#) [MM](#)

### Functions Defined by Integrals: Switched Interval

Evaluate a function defined by the integral of a graphed function. (3 min) [E](#) [MM](#)

### Finding Derivative with Fundamental Theorem of Calculus: $x$ is on Lower Bound

Discover how to swap the bounds of integration before applying the fundamental theorem of calculus. (3 min) [E](#) [MM](#)

### Finding Derivative with Fundamental Theorem of Calculus: $x$ is on Both Bounds

Explore how to apply the fundamental theorem of calculus when both integral bounds are a function of  $x$ . (5 min) [E](#) [MM](#)

### The Fundamental Theorem of Calculus and Definite Integrals

Explore the two versions of the fundamental theorem of calculus, and the connection between them. (5 min) [E](#) [MM](#)

### Antiderivatives and Indefinite Integrals

Explore what the "indefinite integral" is and how it is the opposite of a derivative. (4 min) [E](#) [MM](#)

## Calculus: Integration | Indefinite Integrals: Basic Rules & Notation

### Reverse Power Rule

Find a function whose derivative is  $x^n$ . (6 min) [E](#) [MM](#)

### Indefinite Integrals: Sums & Multiples

Discover that an indefinite integral of a sum is the same as the sum of the integrals of the component parts. (5 min) [E](#) [MM](#)

### Rewriting Before Integrating

Explore how some indefinite integrals are much simpler to integrate by algebraically rewriting the integrand first. (5 min) [E](#) [MM](#)

### Indefinite Integral of $1/x$

Explore how Integration goes the other way: the integral (or antiderivative) of  $1/x$  should be a function whose derivative is  $1/x$ . As we just saw, this is  $\ln(x)$ . However, if  $x$  is negative then  $\ln(x)$  is undefined. (8 min) [E](#) [MM](#)

### Indefinite Integrals of $\sin(x)$ , $\cos(x)$ , and $e^x$

Learn why  $\int \sin(x) dx = -\cos(x) + C$ ,  $\int \cos(x) dx = \sin(x) + C$ , and  $\int e^x dx = e^x + C$ . (4 min) [E](#) [MM](#)

## Calculus: Integration | Definite Integrals: Basic Rules & Notation

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### Definite Integrals: Reverse Power Rule

Explore examples of calculating definite integrals of polynomials using the fundamental theorem of calculus and the reverse power rule. (4 min) [E](#) [MM](#)

### Definite Integral of Rational Function

Find the definite integral of  $(16-x^3)/x^3$  between -1 and -2 using the reverse power rule. (5 min) [E](#) [MM](#)

### Definite Integral of Radical Function

Find the definite integral of  $12\sqrt[3]{x}$  between -1 and 8 using the reverse power rule. (4 min) [E](#) [MM](#)

### Definite Integral of Trig Function

Find the definite integral of  $9\sin(x)$  between  $11\pi/2$  and  $6\pi$ . (5 min) [E](#) [MM](#)

### Definite Integral Involving Natural Log

Find the definite integral of  $(6+x^2)/x^3$  between 2 and 4. (8 min) [E](#) [MM](#)

### Definite Integral of Piecewise Function

Evaluate definite integral of a piecewise function over an interval that goes through the two cases of the function. (7 min) [E](#) [MM](#)

### Definite Integral of Absolute Value Function

Evaluate the definite integral of  $f(x)=|x+2|$  between -4 and 0. (7 min) [E](#) [MM](#)

## Calculus: Integration | Integrating Using Substitution

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### $u$ -Substitution Intro

Discover how to use  $u$ -substitution to find the anti-derivative of a function. (5 min) [E](#) [MM](#)

### $u$ -Substitution: Multiplying by a Constant

Learn how to manipulate the expression to make  $u$ -substitution a little more obvious. (6 min) [E](#) [MM](#)

### $u$ -Substitution: Defining $u$

Examine a common challenge when performing  $u$ -substitution is to realize which part should be our  $u$ . (4 min) [E](#) [MM](#)

### $u$ -Substitution: Defining $u$ (More Examples)

Examine a common challenge when performing  $u$ -substitution is to realize which part should be our  $u$ . (5 min) [E](#) [MM](#)

### $u$ -Substitution: Rational Function

Work through another example of using  $u$ -substitution. (4 min) [E](#) [MM](#)

### $u$ -Substitution: Logarithmic Function

Explore doing  $u$ -substitution with  $\ln(x)$ . (4 min) [E](#) [MM](#)

### $u$ -Substitution: Definite Integrals

Discover that when using  $u$ -substitution in definite integrals, we must make sure we take care of the boundaries of integration. (6 min) [E](#) [MM](#)

### $u$ -Substitution: Definite Integral of Exponential Function

Find the definite integral from 0 to 1 of  $x^2 \cdot 2^x(x^3)$ . (8 min) [E](#) [MM](#)

## Calculus: Integration | Other Methods of Integration

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### Revisiting Polynomial Long Division

Learn how to divide polynomials, also known as algebraic long division. (12 min) [E](#) [MM](#)

### Integration Using Long Division

Explore how to do polynomial long division to make an integral more computable. (5 min) [E](#) [MM](#)

### Integration Using Completing the Square and the Derivative of $\arctan(x)$

Discover how to integrate rational functions by using the method of completing the square in the denominator and then integrating using  $u$ -substitution and our knowledge about the derivative of  $\arctan(x)$ . (6 min) [E](#) [MM](#)

## Calculus: Integration | Average Value of a Function on an Interval

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### Average Value Over a Closed Interval

Discover the average value of a function over a closed interval. (5 min) [E](#) [MM](#)

### Calculating Average Value of Function Over Interval

Find the average value of  $x^2+1$  on the interval between 0 and 3. (5 min) [E](#) [MM](#)

### Mean Value Theorem for Integrals

Discover the connection between the mean value theorem and integration. (9 min) [E](#) [MM](#)

## Calculus: Integration | Connecting Position, Velocity, & Acceleration Using Integrals

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### Motion Problems with Integrals: Displacement vs. Distance

Discover how the definite integral of a velocity function gives us the displacement. (8 min) [E](#) [MM](#)

### Analyzing Motion Problems: Position

Find the appropriate expression to use when looking for the position at a certain time. (3 min) [E](#) [MM](#)

### Analyzing Motion Problems: Total Distance Traveled

Find the appropriate expression to use when looking for the total distance traveled over a certain time interval. (3 min) [E](#) [MM](#)

### Worked Example: Motion Problems (With Definite Integrals)

Discover the velocity and position of a particle given its acceleration. (9 min) [E](#) [MM](#)

### Average Acceleration Over Interval

Explore an example of finding a mean value, we find an average acceleration. (5 min) [E](#) [MM](#)

## Calculus: Integration | Accumulation Functions & Definite Integrals in Context

### Area Under Rate Function Gives the Net Change

When given a function representing rate, explore what the area under its curve represents. (8 min) [E](#) [MM](#)

### Interpreting Definite Integrals as Net Change

Explore how to interpret definite integrals in a real-world context. (5 min) [E](#) [MM](#)

### Worked Examples: Interpreting Definite Integrals in Context

Explore how to interpret expressions involving definite integrals in a real-world context. (4 min) [E](#) [MM](#)

### Analyzing Problems Involving Definite Integrals

Explore example of how to find the appropriate expression to use to solve word problems using definite integrals. (6 min) [E](#) [MM](#)

### Worked Example: Problem Involving Definite Integral (Algebraic)

Use definite integral to solve a word problem about the growth in the population of a town. (8 min) [E](#) [MM](#)

## Calculus: Integration | Finding the Area Between Curves

### Area Between a Curve and the X-Axis

Based on the fundamental theorem of calculus, use antiderivatives to compute integrals. (6 min) [E](#) [MM](#)

### Area Between a Curve and the X-Axis: Negative Area

Explore the idea of introducing the notion of "negative area" with integrals. (8 min) [E](#) [MM](#)

### Area Between Curves

Explore how to integrate the difference of two functions to find the area between them. (7 min) [E](#) [MM](#)

### Composite Area Between Curves

Discover how to break the area into multiple different areas because the enclosing functions change. (7 min) [E](#) [MM](#)

### Area Between a Curve and the Y-Axis

Use a definite integral in terms of  $y$  to find the area between a curve and the  $y$ -axis. (4 min) [E](#) [MM](#)

### Horizontal Area Between Curves

Use a definite integral in terms of  $y$  to find the horizontal area between curves of two functions of  $y$ . (8 min) [E](#) [MM](#)

## Calculus: Integration | Volume with Cross Sections

### Volume with Cross Sections: Intro

Use definite integration to find volume of a solid whose base is given as a region between function and whose cross sections are squares. (6 min) [E](#) [MM](#)

### Volume with Cross Sections: Squares and Rectangles (No Graph)

Learn to express the volume of a 3-D figure as a definite integral (where the area of cross sections are functions of  $x$ ). (6 min) [E](#) [MM](#)

### Volume with Cross Sections Perpendicular to Y-Axis

Explore this example expressing the volume of a figure based on cross sections perpendicular to the  $y$ -axis as a definite integral (integrating with respect to  $y$ ). (5 min) [E](#) [MM](#)

### Volume with Cross Sections: Semicircle

Discover the volume of a solid with semi-circular cross sections and a triangular base. (9 min) [E](#) [MM](#)

### Volume with Cross Sections: Triangle

Explore the cross section of our solid is given as the area between two curves. (9 min) [E](#) [MM](#)

## Calculus: Integration | Volume with the Disc Method

### Disc Method Around X-Axis

Find the solid of revolution (constructed by revolving around the  $x$ -axis) using the disc method. (9 min) [E](#) [MM](#)

### Generalizing Disc Method Around X-Axis

Generalize  $f(x)$  to get the "formula" for using the disc method around the  $x$ -axis. (3 min) [E](#) [MM](#)

### Disc Method Around Y-Axis

Find the volume of a figure that is rotated around the  $y$ -axis using the disc method. (8 min) [E](#) [MM](#)

### Disc Method Rotation Around Horizontal Line

Explore volume of the solid of revolution constructed by rotating around a line that is not an axis. (10 min) [E](#) [MM](#)

### Disc Method Rotating Around Vertical Line

Discover the Volume of solid created by rotating around vertical line that is not the y-axis using the disc method. (5 min) [E](#) [MM](#)

### Calculating Integral Disc Around Vertical Line

Calculate the integral from around the vertical line. (6 min) [E](#) [MM](#)

## Calculus: Integration | Volume with the Washer Method

### Solid of Revolution Between Two Functions (Leading Up to the Washer Method)

Find the volume of a solid of revolution that is defined between two functions. (9 min) [E](#) [MM](#)

### Generalizing the Washer Method

Explore this example of generalizing the washer method. (9 min) [E](#) [MM](#)

### Washer Method Rotating Around Horizontal Line (Not X-Axis), Part 1

Discover the Washer method when rotating around a horizontal line that is not the x-axis. (7 min) [E](#) [MM](#)

### Washer Method Rotating Around Horizontal Line (Not X-Axis), Part 2

Evaluate the definite integral from the of the washer method. (8 min) [E](#) [MM](#)

### Washer Method Rotating Around Vertical Line (Not Y-Axis), Part 1

Set up the definite integral for the volume of a solid of revolution around a vertical line using the "washer" or "ring" method. (8 min) [E](#) [MM](#)

### Washer Method Rotating Around Vertical Line (Not Y-Axis), Part 2

Evaluate the integral set up in the last video using washer method. (6 min) [E](#) [MM](#)

## Calculus: Differential Equations | Intro to Differential Equations

### Differential Equations Introduction

Discover that Differential equations are equations that relate a function with one or more of its derivative. (8 min) [E](#) [MM](#)

### Writing a Differential Equation

Explore how differential equations describe relationships that involve quantities and their rates of change. (3 min) [E](#) [MM](#)

### Verifying Solutions to Differential Equations

Explore how to check whether a potential solution to a differential equation is indeed a solution. (6 min) [E](#) [MM](#)

## Calculus: Differential Equations | Intro to Slope Fields

### Slope Fields Introduction

Learn how to draw and use slope fields, which allows us to analyze differential equations graphically. (6 min) [E](#) [MM](#)

### Worked Example: Equation from Slope Field

Given a slope field and a few differential equations, determine which equation corresponds to the slope field by considering specific slopes. (6 min) [E](#) [MM](#)

### Worked Example: Slope Field from Equation

Given a differential equation in x and y, draw a segment with  $dy/dx$  as slope at any point (x,y). (4 min) [E](#) [MM](#)

### Worked Example: Forming a Slope Field

Given a differential equation in x and y, draw a segment with  $dy/dx$  as slope at any point (x,y). (4 min) [E](#) [MM](#)

### Approximating Solution Curves in Slope Fields

Given the slope field of a differential equation, sketch various solutions to the equation. (7 min) [E](#) [MM](#)

### Worked Example: Range of Solution Curve from Slope Field

Given the slope field of a differential equation, sketch various solutions to the equation. (3 min) [E](#) [MM](#)

## Calculus: Differential Equations | Separation of Variables

### Separable Equations Introduction

Explore how "separation of variables" allows us to rewrite differential equations so we obtain an equality between two integrals we can evaluate. (9 min) [E](#) [MM](#)

### Addressing Treating Differentials Algebraically

Explore how to address treating differentials algebraically. (5 min) [E](#) [MM](#)

### Worked Example: Separable Differential Equations

Explore these two worked examples of finding general solutions to separable differential equations. (4 min) [E](#) [MM](#)

### Worked Example: Identifying Separable Equations

Analyze various differential equations to see if they are separable. (5 min) [E](#) [MM](#)

### Particular Solutions to Differential Equations: Rational Function

Find  $f(-1)$  given that  $f'(x)=24/x^3$  and  $f(2)=12$ . (5 min) [E](#) [MM](#)

## Particular Solutions to Differential Equations: Exponential Function

Find  $f(0)$  given that  $f'(x)=5e^x$  and  $f(7)=40+5e^7$ . (4 min) [E](#) [MM](#)

## Worked Example: Finding a Specific Solution to a Separable Equation

Solve a separable differential equation given initial conditions. (6 min) [E](#) [MM](#)

## Worked Example: Separable Equation with an Implicit Solution

Discover that sometimes the solution of a separable differential equation can't be written as an explicit function.

(4 min) [E](#) [MM](#)

## Calculus: Differential Equations | Exponential Models with Differential Equations

### Exponential Models & Differential Equations

#### (Part 1)

Assuming a quantity grows proportionally to its size results in the general equation  $dy/dx=ky$ , solve it with separation of variables results in the general exponential function  $y=Ce^{kx}$ . (8 min) [E](#) [MM](#)

### Exponential Models & Differential Equations

#### (Part 2)

Given the general solution  $P=Ce^{kt}$  and the conditions  $P(0)=100$  and  $P(50)=200$ , find the solution to an exponential modeling problem. (5 min) [E](#) [MM](#)

## Worked Example: Exponential Solution to Differential Equation

Examine the solution of the general differential equation  $dy/dx=ky$  (for some  $k$ ) is  $C \cdot e^{kx}$  (for some  $C$ ). (4 min) [E](#) [MM](#)

## Science

### Biology I

#### Ocean to Plate: A Journey into the Seafood Supply Chain

As populations and appetites grow, global fisheries are reaching their ecological capacity, yet at least a third of harvested fish and seafood is lost or wasted along the supply chain. (7 min)

#### Cell Classroom

Interactive classroom located inside an animal cell. Infographics help students learn about the parts of a cell, alongside animations of the protein synthesis process. (unlimited)

#### In the Presence of Animals

Experience a dangerous world with some of the planet's most at-risk species: an endangered jaguar, a rainforest sloth, a massive bison, fluttering monarchs, and a mother olive ridley turtle. (5 min)

#### Playful Elephants Swim

A family of elephants decide to take a break from the hot South Africa sun and swim in the local watering hole as Vicky Brooker, elephant curator, talks about the animals. (2 min)

#### Explore the Coral Restoration

Students will research the ecology of coral reefs, natural and human threats to corals, and the science of coral restoration. (4 min)

#### Fox's Point of View at Night- Planet

##### Earth II: Cities

Through the eyes of an urban fox, can you find food, spot the hazards, and track down a mate in a bustling city at night? (4 min)

#### Climbing the Redwoods- Fight for the Forests

Climb 200 feet up 'Grandfather,' the highest Redwood in a Northern California Grove, while learning about the Redwood Forest and preservation efforts. (2 min)

### Biology II

#### The Eye of the Tiger

Look at the day in the life of tiger at the Dierenpark Amersfoort Zoo. (2 min)

#### 360 Orangutan School

Go inside the International Animal Rescue Sanctuary in the forests of Borneo to see what it takes to teach a baby orangutan... to be an orangutan. (9 min)

#### Rescuing Rhinos- Racing Extinction

Orphaned at 2 weeks old in November 2014, Matimba was found next to her mother who had been killed by poachers for her horn. Weighing only 35 pounds at the time, she has been protected and nursed back to health in South Africa. (5 min)

#### Lioness 1

A curious Lioness sniffs at the camera. (1 min)

#### Lioness 2

Lioness sniffs at food. (1 min)

#### Rhino 1

Watch a Rhino wallow in a mud hole. (1 min)

#### Rhino 2

Watch a baby rhino enjoy a bottle. (1 min)

#### Rhino 3

Watch a baby rhino frolic around. (1 min)

#### Baboon 1

See how a group of Baboons interact. Part 1 (1 min)

#### Baboon 2

See how a group of Baboons interact. Part 2 (1 min)

#### Baboon 3

See how a group of Baboons interact. Part 3 (1 min)

#### What it's like to be Surrounded by Wild Dogs

See how Wild dogs differ from domesticated and how they interact within a herd. (1 min)

## Wild Dolphins VR

Over 6 years ago, our production team filmed unique footage of wild dolphins in the Sataya Reef in Egypt's Red Sea. (2 min)

## Virtual Dive with Sea Lions in the Channel Islands

On a visit to Channel Islands National Marine Sanctuary, students will explore the plants and animals that live and thrive in the cold-water marine environment that they encountered. They will also learn about specific adaptations necessary for survival in this habitat. (3 min)

## Chengdu Panda Base, China

Get an in-depth look at the pandas that call Chengdu Panda Base their home and learn about their habitat, diet, and daily life. (11 min)

## Play with Meerkats: Animals with Cameras

Get up close and personal with Meerkats as they investigate the camera. (1 min)

## Lion Whisperer- Racing Extinction

Kevin Richardson, also known as the "lion whisperer", explains the complexities of his relationship to his pride, and summarizes his life's work of protecting these amazing animals from the game hunting trade. (4 min)

## Surrounded by Wild Elephants

Come face to face with the largest land animal on the planet, the African elephant. Follow along as this herd of giants take a detour to investigate a stranger in their midst. (3 min)

## Lemur 1

Watch lemurs climb and play in a zoo. Part 1. (1 min)

## Lemur 2

Watch lemurs climb and play in a zoo. Part 2. (1 min)

## Lemur 3

Watch lemurs climb and play in a zoo. Part 3. (1 min)

## Zebra 1

Watch a herd of Zebras graze. (1 min)

## Zebra 2

Watch how zebras move as a herd. (1 min)

## Lions 360

National Geographic Explorer Martin Edström, you will come face to face with Gibson and his mother, as they struggle with their pride's alpha male. (5 min)

## Gorillas in the Congo: A Jump VR Video

Experience gorillas in their natural habitat of the Congo Jungle. (2 min)

## Elephants on the Brink

A herd of African elephants curiously investigates its surroundings in South Africa and happens to notice cameras filming their behavior. (3 min)

## Bears of Kamchatka, Kambalnaya River

Follow along as you experience the Bears of Kamchatka and learn about their habitat, daily life, and mating season. (5 min)

## Diving Exploration of Kelp Forest Aquarium

Explore the Kelp Forest at Monterey Bay Aquarium. (3 min)

## Kelp

Swim through a kelp forest. (1 min)

## Red Kite Bird Feeding Frenzy

Watch the once endangered Red Kite Bird feeding while learning about them. (1 min)

## Shoaling in the Deep

Dive down deep into the heart of a shoal of fish, follow a manta ray as it skims the ocean floor, and lock eyes with a moray eel lurking in an underwater cave. (3 min)

## Elephant 1

See a herd of elephants graze about. Part 1 (1 min)

## Elephant 2

See a herd of elephants graze about. Part 2 (1 min)

## Elephant 3

See a herd of elephants graze about. Part 3 (1 min)

## Elephant 4

See a herd of elephants graze about. Part 4 (1 min)

## Anatomy Lab

Highly interactive anatomy classroom that allows Students assemble the human body piece by piece with over 90 separate body parts to learn about. (unlimited) [E](#)

## Microscope

Highly interactive science lab microscope with 4 different, insertable slides that they can view at 3 different zoom levels. [IFX](#)

## 360 Mink Farm Tour

In this 360 video tour, you'll get to see inside a working Canadian mink farm and learn all about how mink are cared for, what they eat, where they live and how Canadian mink farmers produce high quality products for the industry. (7 min)

## 360° Canadian Pig Farm Tour

See inside a working Canadian pig farm and learn all about how pigs are cared for, what they eat, where they live, and how Canadian pig farmers keep their animals entertained and healthy. (10 min)

## AeroFarms: The Future of Farming

AeroFarms in Newark, NJ grows over 2 million pounds of greens a year without sunlight, soil or pesticides, making it the world's largest indoor vertical farm. (2 min)

## 360 Illinois Farm Tour : It starts with a Seed

Follow a fifth-generation farmer and see the challenge, solutions that technology offers, and ultimately the fruits of our labor that will transform into food, feed and fuel used throughout the state, across the country and around the globe. Part 1 (6 min)

## 360 Farm Tour: As the Corn Grows

Follow a fifth-generation farmer and see the challenge, solutions that technology offers, and ultimately the fruits of our labor that will transform into food, feed and fuel used throughout the state, across the country and around the globe. Part 2 (4 min)

## 360 Farm Tour: Harvesting the Corn

Follow a fifth-generation farmer and see the challenge, solutions that technology offers, and ultimately the fruits of our labor that will transform into food, feed and fuel used throughout the state, across the country and around the globe.

Part 3 (4 min)

## 360 Farm Tour: Protecting the Corn

Follow a fifth-generation farmer and see the challenge, solutions that technology offers, and ultimately the fruits of our labor that will transform into food, feed and fuel used throughout the state, across the country and around the globe.

Part 4 (4 min)

## Smithfield Wean-to-Finish Farm 360°

### Virtual Tour

Step inside one of Smithfield Farm's wean-to-finish farms, a combination of the nursery and finishing stages of hog production, where piglets live and grow until they reach market weight. (5 min)

### Anatomy Lab

Highly interactive anatomy classroom that allows Students assemble the human body piece by piece with over 90 separate body parts to learn about. (unlimited) [E](#)

### Brain

Realistic model of the Human Brain. [IFX](#)

### Heart

Realistic model of a Human Heart. [IFX](#)

### Liver

Realistic model of a Human Liver. [IFX](#)

### Lungs

Realistic model of the Human Lungs. [IFX](#)

### Cell Classroom

Interactive classroom located inside an animal cell. Infographics help students learn about the parts of a cell, alongside animations of the protein synthesis process. (unlimited) [E](#)

### Plant Cell

Interactive classroom located inside a plant cell. Explore the different organelles and components of the cell and explore the photosynthesis process. (unlimited) [E](#)

## Back to Nature- Rainforest

Escape to the lush temperate rainforest of Southern Australia. (4 min)

### Diving Under Icebergs with a Seal in Antarctica

Take a 360 journey under an iceberg with a crabeater seal and Gentoo Penguins in Antarctica. (2 min)

### Elephant Seals and King Penguin Chicks

These King Penguin chicks get our (elephant) seal of approval. (2 min)

### In the Presence of Animals

Experience a dangerous world with some of the planet's most at-risk species: an endangered jaguar, a rainforest sloth, a massive bison, fluttering monarchs, and a mother olive ridley turtle. (5 min)

### Protecting Ocean Anchor Species- Racing Extinction

Join marine biologist Luke Tipple as he swims alongside manta rays and whale sharks while sharing why they are vital to the survival of our oceans. (3 min)

### Underwater National Park

Plunge into a Caribbean gem with National Geographic photographer Brian Skerry to explore the Buck Island Reef – America's first protected marine monument. (6 min)

### Great Hammerhead Shark Encounter

Dive into this 360° video and go face to face with a curious great hammerhead shark. (2 min)

## Botany

### 360 Farm Tour : It Starts with a Seed

Follow a fifth-generation farmer and see the challenges farmers face, solutions that technology offers, and ultimately the fruits of labor that will transform into food, feed, and fuel. Part 1 (6 min)

## 360 Farm Tour: As the Corn Grows

Follow a fifth-generation farmer and see the challenges farmers face, solutions that technology offers, and ultimately the fruits of labor that will transform into food, feed, and fuel. Part 2 (4 min)

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Follow a fifth-generation farmer and see the challenges farmers face, solutions that technology offers, and ultimately the fruits of labor that will transform into food, feed, and fuel. Part 3 (4 min)

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Follow a fifth-generation farmer and see the challenges farmers face, solutions that technology offers, and ultimately the fruits of labor that will transform into food, feed, and fuel. Part 4 (4 min)

## Back to Nature- Rainforest

Escape to the lush temperate rainforest of Southern Australia. (4 min)

### Climbing the Redwoods- Fight for the Forests

Climb 200 feet up 'Grandfather,' the highest Redwood in a Northern California Grove while learning about the Redwood Forest and preservation efforts. (2 min)

### Diving Exploration of Kelp Forest Aquarium

Explore the Kelp Forest at Monterey Bay Aquarium. (3 min)

### Forest

View a tranquil forest and the plant life throughout it. (1 min)

### Kelp

Swim through a kelp forest. (1 min)

## Chemistry I

### Covalent Bonding- H2

Simple visualization of the covalent bond between two hydrogen atoms. [IFX](#)

**Covalent Bonding – Glucose****Hybridized**

Visualization of a covalently bonded glucose molecule with hybridized orbitals.

[IFX](#)

**Covalent Bonding – O<sub>2</sub> Hybridized**

Visualization of two covalently bonded oxygen atoms with hybridized orbitals. [IFX](#)

**Covalent Bonding – H<sub>2</sub>O Hybridized**

Visualization of a covalently bonded water molecule with hybridized orbitals. [IFX](#)

**Ionic Bonding – NaCl**

Animated visualization of the ionic bond between a sodium atom and a chlorine atom. [IFX](#)

**Ionic Bonding – NaOH**

Animated visualization of the ionic bond between a sodium atom and a hydroxide anion. [IFX](#)

**Ionic Bonding– NaF**

Animated visualization of the ionic bond between a sodium atom and a fluorine atom. [IFX](#)

**Ionic Bonding – MgSO<sub>4</sub>**

Animated visualization of the ionic bond between a magnesium atom and a sulfate anion. [IFX](#)

**Periodic Table**

Interactive classroom that teaches students about the periodic table of elements, their chemical and physical properties, and their atomic structures. (unlimited) [E](#)

**Bunsen Burner and Breaker**

Interactive model of a Bunsen burner, beaker, and ring stand. Toggling the valve turns on the burner flame and starts a chemical reaction in the beaker. [IFX](#)

**Chemistry II****Hydrogen and Helium Formation**

Protons, neutrons, and electrons that move around randomly and then collide to form hydrogen and helium atoms. [IFX](#)

**Periodic Table**

Interactive classroom that teaches students about the periodic table of elements, their chemical and physical properties, and their atomic structures. (unlimited) [E](#)

**Earth & Space Science****360 Degree Video of the Milky Way**

Interactive time-lapse of the moving night sky. (1 min)

**Enter the Black hole**

Enter a black hole and explore the area around it. (5 min)

**Explore the Solar System**

Take a virtual tour of our Solar System, with the help of Crash Course Astronomy host Phil Plait. (5 min)

**First-Ever 360 VR filmed in Space:****One Strange Rock**

Fly side-by-side with astronauts and experience weightlessness, the speed of traveling at 17 thousand miles per hour, and take in a stunning view of Earth. (5 min)

**Journey to the Edge of Space**

Experience what it's like to leave Earth, traveling to over 90,000 feet into the stratosphere. (5 min)

**Mars- The Red Planet VR****Documentary**

Explore the planet Mars and see its history of exploration. (12 min)

**The Night Sky and Milky Way:****Visualize Astronomy**

Enjoy a panoramic video of the night sky and Milky Way. (1 min)

**Solar System 360 Degree Tour**

Take a 360-degree virtual tour of our Solar system with Crash Course host Phil Plait. (5 min)

**Space Experience**

View Earth from Space below the International Space Station, but beware... meteorites have been forecast. (1 min)

**Sample Asteroid Benu**

Follow along on NASA's first asteroid sample return mission as they make a daring attempt to collect samples from an asteroid. (4 min)

**Star Visualization- Exponential**

Visualization of the number of stars in the universe using color-coded exponential groups. [IFX](#)

**1. Cool VR Walk on the Moon/ 2.****Yosemite**

EXP.1: Walk on the Moon from the Project Apollo Archive. (2 min)

EXP.2: Experience a guided tour of some of Yosemite's majestic spots. (4 min)

**The Aurora Borealis over Alaska's****Chatanika River**

Explore a timelapse of the Aurora Borealis filmed during a geomagnetic storm by William Briscoe Photography. (5 min)

**Solar Eclipse**

Watch a total solar eclipse that took place in Casper, Wyoming on August 21<sup>st</sup>, 2017. (5 min)

**Earth Magnetic Field**

Animated visualization of the electromagnetic field surrounding Planet Earth. [IFX](#)

**Climbing the Redwoods- Fight for the Forests**

Climb 200 feet up 'Grandfather', the highest Redwood in a Northern California Grove while learning about the Redwood Forest and preservation efforts. (2 min)

**Lion Whisperer- Racing Extinction**

Kevin Richardson, also known as the "lion whisperer", explains the complexities of his relationship to his pride, and summarizes his life's work of protecting these amazing animals from the game hunting trade. (4 min)

**Protecting Ocean Anchor Species- Racing Extinction**

Join marine biologist Luke Tipple as he swims alongside manta rays and whale sharks while sharing why they are vital to the survival of our oceans. (3 min)

## Rescuing Rhinos: Racing Extinction

Join a conservation biologist on an interactive mission to learn how animals critical to the world's ecosystem thrive and survive in the wild. (5 min)

## Solar System Model

Animated model of the solar system.

Rotation and revolution speeds are scaled accurately. [IFX](#)

## VR Solar System Space Video

This amazing 360 virtual reality video will transport you through our galactic neighborhood, the solar system. (18 min)

## Panoramic Video of the Night Sky and Milky Way: Visualize Astronomy

Enjoy a panoramic video of the night sky and Milky Way. (1 min)

## Big Bang Explosion

Explosion particle effect with fire, smoke, and plasma. [IFX](#)

## Big Bang Sound

Sound effect of what scientists estimate the big bang would have sounded like. [IFX](#)

## Sun Formation

See lots of Particles colliding to form the Sun. [IFX](#)

## Solar System

Interactive classroom that allows students to visit each planet, watch them orbit, and learn about each one. (unlimited) [E](#)

## Journey into the Orion Nebula

This visualization journeys into the famous star-forming region of the Orion Nebula based on an image from the Hubble Space Telescope. (2 min)

## Mars- The Red Planet VR

### Documentary

Explore the planet Mars and see its history of exploration. (12 min)

## NASA's Curiosity Mars Rover at Namib Dune

View the Namib Dune and portions of Mount Sharp through the eyes of the Mars Rover. (2 min)

## Take a VR Tour of 6 Real Exoplanets- We the Curious

What would it be like to stand on the surface of another planet? Team up with astrophysicists to experience a scientifically accurate, VR tour of 6 exoplanets. (11 min)

## Curiosity Mars Rover

View the Glen Torridon area of Mars from the eyes of the Mars Rover. (2 min)

## Cloud Climb

Explore how clouds, the atmosphere and weather all come together to create different aspects of the Earth's sky. (unlimited) [E](#)

## Inside Hurricane Maria

See inside Hurricane Maria and see how it changes from a category 1 to a category 5 in about 24 hours. (5 min)

## Earth Cutaway

A model of Earth with a section cut away to expose its layers. [IFX](#)

## Earth Cutaway info

An Infographic model of Earth with a section cut away to expose its layers. [IFX](#)

## Earthquake VR Experience

Simulation of a virtual earthquake to provide lifelike training experience without an actual earthquake. (2 min)

## Volcano

Experience a model of an Erupting Volcano. [IFX](#)

## Expedition to the Heart of Active Volcano

Join a group of climbers as they embark on a scientific exploration into an active volcano. (5 min)

## Kamchatka Volcano Eruption

National Geographic VR takes you to the rim of a spectacular erupting volcano: Klyuchevskoy, one of the tallest and most active volcanoes on the planet. (2 min)

## Ace Center @ Hermitage Greenhouse

Join students from Hermitage High School as they explain how a greenhouse works and the different features within it. (3 min)

## Life in Haiti: After a Devastating Natural Disaster

In the early-morning hours of October 4th, 2016, Hurricane Matthew struck Haiti, leaving widespread damage to the island nation in its wake. (5 min)

## After the Floods: Rebuilding Ellicott City

An immersive journey through the flooding, aftermath and reconstruction of Ellicott City, Maryland to give a new perspective to the damage done by the flooding. (6 min)

## Chennai Floods Aftermath

The documentary emphasizes the impact, rescue and the reason for the floods that occurred in December 2015 in Chennai, India. (6 min)

## Damming the Nile: Episode 1

Africa's largest hydroelectric power project is two thirds finished and the dam can already control the flow of the Blue Nile, which is deeply upsetting downstream Egypt who they didn't consult before building started. (13 min)

## Damming the Nile: Episode 2

Africa's largest hydroelectric power project is two thirds finished and the dam can already control the flow of the Blue Nile, which is deeply upsetting downstream Egypt who they didn't consult before building started. (16 min)

## Ecology

### Explore the World in 4K

Venture around the world and see different aspects of the natural world and various cities and wildlife. (3 min)

### Antarctica – Unexpected Snow

See how a Penguin and Seal colony as a winter storm moves in. (2 min)

### Antarctica- Part II

See Antarctica from aboard a ship as it sails around Antarctica and see the different wildlife. (6 min)

## Back to Nature- Rainforest

Escape to the lush temperate rainforest of Southern Australia. (4 min)

### Reef 2

Swim along an active thriving reef. (1 min)

### Reef 3

Swim along an active thriving reef. (1 min)

### Reef 4

Swim along an active thriving reef. (1 min)

## Scuba in the Maldives

Dive into the waters of Maldives and experience the aquatic life and environment. (2 min)

## Virtual Dive with Sea Lions in the Channel Islands

On a visit to Channel Islands National Marine Sanctuary, students will explore the plants and animals that live and thrive in the cold-water marine environment that they encountered. They will also learn about specific adaptations necessary for survival in this habitat. (3 min)

## Explore the Coral Restoration

Students will research the ecology of coral reefs, natural and human threats to corals, and the science of coral restoration. (4 min)

## Explore the MalloWS Ghost Fleet

Students are introduced to MalloWS Bay-Potomac River National Marine Sanctuary and the "Ghost Fleet." Students make inferences about how human actions affect the environment. (4 min)

## Okinawa 360 - VR Sea Tour

Explore the diverse aquatic life surrounding Okinawa. (5 min)

## Explore the Blue Hawaiian Adventure

Students learn about the diversity of life found in the Hawaiian Islands, and will explore the ecology of three different species, their importance to Native Hawaiian culture, and the conservation measures in place for their protection. (4 min)

## Hyena 1

Watch a hyena feed on a fresh kill. (1 min)

## Hyena 2

Watch a hyena approach cautiously for a snack. (1 min)

## Leopard

Watch a leopard munch on a meal. (1 min)

## Lioness 1

A curious Lioness sniffs at the camera. (1 min)

## Lioness 2

Lioness sniffs at food. (1 min)

## Diving with Great White Shark

Experience a Great white shark up close and personal while learning about the majestic creatures. (2 min)

## Mythbusters: Shark Shipwreck

Explore the sunken wreckage of the Ray of Hope with the MythBusters. (4 min)

## Mythbusters: Sharks Everywhere!

MythBuster Adam Savage takes you underwater and face-to-face with a shiver of sharks. (5 min)

## Great Hammerhead Shark Encounter

Dive into this 360° video and go face to face with a curious great hammerhead shark. (2 min)

## Great White Sharks

Get up close with Great White Sharks on an actual dive while learning more about them. (2 min)

## Arctic Orca

Orca Foraging in a school fish with free divers. (1 min)

## Tiger Shark Encounter in the Bahamas- SharkFest

Come face to face with massive tiger sharks as you plunge into the crystal-clear waters of the Bahamas. (3 min)

## What it's like to be Surrounded by Wild Dogs

See how Wild dogs differ from domesticated and how they interact within a herd. (1 min)

## Lions 360

National Geographic Explorer Martin Edström, you will come face to face with Gibson and his mother, as they struggle with their pride's alpha male. (5 min)

## Shoaling in the Deep

Dive down deep into the heart of a shoal of fish, follow a manta ray as it skims the ocean floor, and lock eyes with a moray eel lurking in an underwater cave. (3 min)

## Deer

See Antelope deer feeding on a plain. (1 min)

## Elephant 1

See a herd of elephants graze about. Part 1. (1 min)

## Elephant 2

See a herd of elephants graze about. Part 2. (1 min)

## Elephant 3

See a herd of elephants graze about. Part 3. (1 min)

## Elephant 4

See a herd of elephants graze about. Part 4. (1 min)

## Zebra 1

Watch a herd of Zebras graze. (1 min)

## Zebra 2

Watch how zebras move as a herd. (1 min)

## 360 Orangutan School

Go inside the International Animal Rescue Sanctuary in the forests of Borneo to see what it takes to teach a baby orangutan... to be an orangutan. (9 min)

## Surrounded by White Lions

Experience White lions at a preserve. (10 min)

## Chengdu Panda Base, China

Get an in-depth look at the pandas that call Chengdu Panda Base their home and learn about their habitat, diet, and daily life. (11 min)

## **Rescuing Rhinos- Racing Extinction**

Orphaned at 2 weeks old in November 2014, Matimba was found next to her mother who had been killed by poachers for her horn. Weighing only 35 pounds at the time, she has been protected and nursed back to health in South Africa. (5 min)

## **Surrounded by Wild Elephants**

Come face to face with the largest land animal on the planet, the African elephant. Follow along as this herd of giants take a detour to investigate a stranger in their midst. (3 min)

## **Bears of Kamchatka, Kambalnaya River**

Follow along as you experience the Bears of Kamchatka and learn about their habitat, daily life, and mating season. (5 min)

## **Caring for Rhinos**

A herd of nine rhinos graze in the South African bush while we hear Chris Sussons, game reserve manager, give some cool facts about rhinos and why they need to protect them from poachers. (2 min)

## **Elephants on the Brink**

A herd of African elephants curiously investigates its surroundings in South Africa and happens to notice cameras filming their behavior. (3 min)

## **Fox's Point of View at Night- Planet Earth II: Cities**

Through the eyes of an urban fox, can you find food, spot the hazards, and track down a mate in a bustling city at night? (4 min)

## **Gorillas in the Congo: A Jump VR Video**

Experience gorillas in their natural habitat of the Congo Jungle. (2 min)

## **Lion Whisperer- Racing Extinction**

Kevin Richardson, also known as the "lion whisperer", explains the complexities of his relationship to his pride, and summarizes his life's work of protecting these amazing animals from the game hunting trade. (4 min)

## **Surrounded by Lemurs- Perth Zoo- Australia**

Take a private tour of Lemur Island and encounter these critically endangered species. (4 min)

## **The Fight to save Threatened Species**

Get closer than ever before to the most extraordinary creatures on the planet...before they disappear. Whale sharks, rhinos, elephants, manta rays and lions are all threatened with extinction. (2 min)

## **In the Presence of Animals**

Experience a dangerous world with some of the planet's most at-risk species: an endangered jaguar, a rainforest sloth, a massive bison, fluttering monarchs, and a mother olive ridley turtle. (5 min)

## **Protecting Ocean Anchor Species- Racing Extinction**

Join marine biologist Luke Tipple as he swims alongside Anchor species like manta rays and whale sharks and shares why they are vital to the survival of our oceans and why they need to be protected. (3 min)

## **1. VR Pearl Harbor Attack**

## **Reenactment, Japanese Midget**

## **Submarine/ 2. Explore South Dakota's Badlands**

EXP.1: The Japanese midget submarine, manned by Ensign Kazuo Sakamaki, failed in its mission to attack and destroy American warships. (6 min)

EXP.2: The Badlands is home to the largest mixed grass prairie where bison and other wildlife graze freely. (2 min)

## **Rescuing Rhinos- Racing Extinction**

Orphaned at 2 weeks old in November 2014, Matimba was found next to her mother who had been killed by poachers for her horn. Weighing only 35 pounds at the time, she has been protected and nursed back to health in South Africa. (5 min)

## **Surrounded by White Lions**

Experience White lions at a preserve. (10 min)

## **Chengdu Panda Base, China**

Get an in-depth look at the pandas that call Chengdu Panda Base their home and learn about their habitat, diet, and daily life. (11 min)

## **Manatee: Crystal River National Wildlife Refuge**

Underwater cinematographer and VR filmmaker Adam Ravetch takes us on an adventure on Florida's Crystal River as he captures the river's wild manatees in their natural habitat at the Crystal River National Wildlife Refuge. (3 min)

## **Explore the Coral Restoration**

Students will research the ecology of coral reefs, natural and human threats to corals, and the science of coral restoration. (4 min)

## **Cool VR Walk on the Moon with NASA/ Yosemite**

EXP.1: Experience a walk on the Moon from the Project Apollo Archive. (2 min)

EXP.2: Experience a guided tour of some of Yosemite's majestic spots. (4 min)

## **The Hidden World of National Parks**

Follow rangers on a journey to places most people never go. Experience the sights, sounds, and adventures of Kenai Fjords, Hawai'i Volcanoes, Carlsbad Caverns, Bryce Canyon, and Dry Tortugas in stunning 360° video. (5 min)

## **Climbing the Redwoods- Fight for the Forests**

Climb 200 feet up 'Grandfather,' the highest Redwood in a Northern California Grove, while learning about the Redwood Forest and preservation efforts. (2 min)

## **Underwater National Park**

Plunge into a Caribbean gem with National Geographic photographer Brian Skerry to explore the Buck Island Reef – America's first protected marine monument. (6 min)

## Virtual Dive with Sea Lions in the Channel Islands

On a visit to Channel Islands National Marine Sanctuary, students will explore the plants and animals that live and thrive in the cold-water marine environment that they encountered. They will also learn about specific adaptations necessary for survival in this habitat. (3 min)

## Explore the Blue Hawaiian Adventure

Students learn about the diversity of life found in the Hawaiian Islands, and will explore the ecology of three different species, their importance to Native Hawaiian culture, and the conservation measures in place for their protection. (4 min)

## Explore the Blue Shipwreck Alley

Tied to the virtual dive on the wreck of D.M. Wilson, students research the historical, ecological, and economic importance of Thunder Bay National Marine Sanctuary. Students create a digital infographic that communicates the importance of preserving a shipwreck. (3 min)

## Explore Lake Ontario Schooner: St. Peter

Explore the wreck of schooner St. Peter, which lies Lake Ontario National Marine Sanctuary. Students research the technologies used by maritime archaeologists to locate and image shipwrecks and participate in simulations of the use of two of these technologies, sonar, and photogrammetry. (4 min)

## Explore the Mallows Ghost Fleet

Students are introduced to Mallows Bay-Potomac River National Marine Sanctuary and the "Ghost Fleet." Students make inferences about how human actions affect the environment. (4 min)

## Environmental Science

### Iceland

Soar over Iceland and take in the different views that Iceland has to offer. (3 min)

### Forest

View a tranquil forest and the plant life throughout it. (1 min)

### Hidden World of National Parks

Follow rangers on a journey to places most people never go. Experience the sights, sounds, and adventures of Kenai Fjords, Hawai'i Volcanoes, Carlsbad Caverns, Bryce Canyon, and Dry Tortugas in stunning 360° video. (5 min)

### Explore the World in 4K

Venture around the world and see different aspects of the natural world and various two girls as they travel for up to 6 hours a day to school and back in cities and wildlife. (3 min)

### Himalayas: a Trek to School

Follow two girls as they travel for up to 6 hours a day to school and back in a remote Himalayan village. (8 min)

### Zebra 1

Watch a herd of Zebras graze. (1 min)

### Zebra 2

Watch how zebras move as a herd. (1 min)

### Play with Meerkats: Animals with Cameras

Get up close and personal with Meerkats as they investigate the camera. (1 min)

### Cows

See a group of African Cows roam in search of food. (1 min)

### Deer

See Antelope deer feeding on a plain. (1 min)

### Elephant 1

See a herd of elephants graze about. Part 1. (1 min)

### Elephant 2

See a herd of elephants graze about. Part 2. (1 min)

### Elephant 3

See a herd of elephants graze about. Part 3. (1 min)

### Elephant 4

See a herd of elephants graze about. Part 4. (1 min)

### Back to Nature- Rainforest

Escape to the lush temperate rainforest of Southern Australia. (4 min)

### Lions 360

National Geographic Explorer Martin Edström, you will come face to face with Gibson and his mother, as they struggle with their pride's alpha male. (5 min)

### Giraffe 1

See a giraffe interacting with its natural habitat. (1 min)

### Giraffe 2

See a giraffe interacting with its natural habitat. (1 min)

### Antarctica – Unexpected Snow

See how a Penguin and Seal colony as a winter storm moves in. (2 min)

### Lion Whisperer- Racing Extinction

Kevin Richardson, also known as the "lion whisperer", explains the complexities of his relationship to his pride, and summarizes his life's work of protecting these amazing animals from the game hunting trade. (4 min)

### Red Kite Bird Feeding Frenzy

Watch the once endangered Red Kite Bird feeding while learning about them. (1 min)

### Kamchatka Volcano Eruption

National Geographic VR takes you to the rim of a spectacular erupting volcano: Klyuchevskoy, one of the tallest and most active volcanoes on the planet. (2 min)

### Surrounded by Lemurs- Perth Zoo- Australia

Take a private tour of Lemur Island and encounter these critically endangered species. (4 min)

### Glow Worm Caves of New Zealand

Deep below ground, strange carnivorous worms' glow and twinkle like the night sky to attract their prey. (2 min)

## **Surrounded by Lemurs- Perth Zoo- Australia**

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## **The Fight to save Threatened Species**

Get closer than ever before to the most extraordinary creatures on the planet...before they disappear. Whale sharks, rhinos, elephants, manta rays and lions are all threatened with extinction. (2 min)

## **Whale Sharks at Risks- Racing Extinction**

Experience a close encounter with a Whale Shark- the largest fish on the Planet. (4 min)

## **Virtual Dive with Sea Lions in the Channel Islands**

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## **Elephant Seals and King Penguin Chicks**

These King Penguin chicks get our (elephant) seal of approval. (2 min)

## **Antarctica- Part II**

See Antarctica from aboard a ship as it sails around Antarctica and see the different wildlife. (6 min)

## **Ocean to Plate: A Journey into the Seafood Supply Chain**

As populations and appetites grow, global fisheries are reaching their ecological capacity, yet at least a third of harvested fish and seafood is lost or wasted along the supply chain. (7 min)

## **Playful Elephants Swim**

A family of elephants decide to take a break from the hot South Africa sun and swim in the local watering hole as Vicky Brooker, elephant curator, talks about the animals. (2 min)

## **Explore the Mollusks Ghost Fleet**

Students are introduced to Mollusks Bay-Potomac River National Marine Sanctuary and the "Ghost Fleet." Students make inferences about how human actions affect the environment. (4 min)

## **Rescuing Rhinos- Racing Extinction**

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## **Climbing the Redwoods- Fight for the Forests**

Climb 200 feet up 'Grandfather,' the highest Redwood in a Northern California Grove, while learning about the Redwood Forest and preservation efforts. (2 min)

## **Diving Under Icebergs with a Seal in Antarctica**

Take a 360 journey under an iceberg with a crabeater seal and Gentoo Penguins in Antarctica. (2 min)

## **In the Presence of Animals**

Experience a dangerous world with some of the planet's most at-risk species: an endangered jaguar, a rainforest sloth, a massive bison, fluttering monarchs, and a mother olive ridley turtle. (5 min)

## **The Eye of the Tiger**

Look at the day in the life of tiger at the Dierenpark Amersfoort Zoo. (2 min)

## **Iceland**

Soar over Iceland and take in the different views that Iceland has to offer. (3 min)

## **Kamchatka Volcano Eruption**

National Geographic VR takes you to the rim of a spectacular erupting volcano: Klyuchevskoy, one of the tallest and most active volcanoes on the planet. (2 min)

## Earthquake VR Experience

Simulation of a virtual earthquake to provide lifelike training experience without an actual earthquake. (2 min)

## Expedition to the Heart of Active Volcano

Join a group of climbers as they embark on a scientific exploration into an active volcano. (5 min)

## Volcano

Experience a model of an Erupting Volcano.

[IFX](#)

## Earth Cutaway

A model of Earth with a section cut away to expose its layers. [IFX](#)

## Earth Cutaway Info

An Infographic model of Earth with a section cut away to expose its layers. [IFX](#)

## Sun

Rotating model of the Sun. [IFX](#)

## 360 Degree Video of the Milky Way

Interactive timelapse of the moving night sky. (1 min)

## Solar Eclipse 2017 Casper, Wyoming

On August 21<sup>st</sup>, 2017 a total solar eclipse took place. See the view of it from Casper, Wyoming. (5 min)

## Solar System 360 Degree Tour

Take a 360 degree virtual tour of our Solar system with Crash Course host Phil Plait. (5 min)

## Solar System Model

Animated model of the solar system.

Rotation and revolution speeds are scaled accurately. [IFX](#)

## Space Experience

View Earth from Space below the International Space Station, but beware... meteorites have been forecast. (1 min)

## VR Solar System Space

This amazing 360 virtual reality video will transport you through our galactic neighborhood, the solar system. (18 min)

## Cloud Climb

Explore how clouds, the atmosphere and weather all come together to create different aspects of the Earth's sky. (unlimited) [E](#)

## 360° Tour of Gotham Greens' Urban Rooftop Farm | Food Network

Go behind the scenes at Gotham Greens in Brooklyn, New York, where all kinds of leafy greens are grown in their state-of-the-art urban rooftop greenhouse. (2 min)

## Damming the Nile: Episode 1

Africa's largest hydroelectric power project is two thirds finished and the dam can already control the flow of the Blue Nile, which is deeply upsetting downstream Egypt who they didn't consult before building started. (13 min)

## Damming the Nile: Episode 2

Africa's largest hydroelectric power project is two thirds finished and the dam can already control the flow of the Blue Nile, which is deeply upsetting downstream Egypt who they didn't consult before building started. (16 min)

## AeroFarms: The Future of Farming

AeroFarms in Newark, NJ grows over 2 million pounds of greens a year without sunlight, soil or pesticides, making it the world's largest indoor vertical farm. (2 min)

## A 360 Look Inside Brooklyn's Farming Revolution

Visit a high-tech, hydroponic farm that's fueling a new food revolution that is breaking away from the traditional, transport-heavy, industrial food system and blazing the trail for the future of super-efficient urban farming. (3 min)

## George the Farmer Forestry – VR

Join George the Farmer and his mates Simone and Ben as they investigate some of the products made from Pine Trees in sustainable pine plantations! (4 min)

## 360 Illinois Farm Tour : It Starts with a Seed

Follow a fifth-generation farmer and see the challenge, solutions that technology offers, and ultimately the fruits of our labor that will transform into food, feed and fuel used throughout the state, across the country and around the globe.

Part 1 (6 min)

## 360 Farm Tour: As the Corn Grows

Follow a fifth-generation farmer and see the challenge, solutions that technology offers, and ultimately the fruits of our labor that will transform into food, feed and fuel used throughout the state, across the country and around the globe.

Part 2 (4 min)

## 360 Farm Tour: Harvesting the Corn

Follow a fifth-generation farmer and see the challenge, solutions that technology offers, and ultimately the fruits of our labor that will transform into food, feed and fuel used throughout the state, across the country and around the globe.

Part 3 (4 min)

## 360 Farm Tour: Protecting the Corn

Follow a fifth-generation farmer and see the challenge, solutions that technology offers, and ultimately the fruits of our labor that will transform into food, feed and fuel used throughout the state, across the country and around the globe.

Part 4 (4 min)

## Virtual 360° Farm Tour | Organic Valley 360°

Take a virtual tour into how Dairy cows are raised to produce organic milk. (1 min)

## Take a 360° Virtual Reality Tour of a Chicken Farm

Follow along with a farmer as he goes over how broiler chickens (meat chickens) are raised until they are big enough to be sold for meat. (5 min)

## **360° Canadian Free-Run Egg Farm Tour**

In this 360° tour, you'll learn what makes eggs "Free Run", what the hens eat, how hens are cared for, as well as how solar power is generated to meet this farm's needs. (5 min)

## **360° Canadian Pig Farm Tour**

See inside a working Canadian pig farm and learn all about how pigs are cared for, what they eat, where they live, and how Canadian pig farmers keep their animals entertained and healthy. (10 min)

## **360° Farming Part 1 - BIG BUD**

### **Tractors - Welker Farms Inc**

Follow along with an employee of Welker Farms, Inc as they go through the spraying season for their crops. Part 1 (16 min)

## **360° Farming Part 2 - BIG BRUTE -**

### **Welker Farms Inc**

Follow along with an employee of Welker Farms, Inc as they go through the spraying season for their crops. Part 2 (19 min)

## **360° Farming Part 3 - Harvest -**

### **Welker Farms Inc**

Follow along with an employee of Welker Farms, Inc as they go through Harvesting season for their crops. Part 3 (15 min)

## **FarmFood360° - Voluntary Milking**

### **System Dairy Farm**

This Canadian family dairy farm uses a Voluntary Milking System which enables their cows to decide when they would like to be milked. (6 min)

## **Back to Nature- Rainforest**

Escape to the lush temperate rainforest of Southern Australia. (4 min)

## **The Hidden World of National Parks**

Follow rangers on a journey to places most people never go. Experience the sights, sounds, and adventures of Kenai Fjords, Hawai'i Volcanoes, Carlsbad Caverns, Bryce Canyon, and Dry Tortugas in stunning 360° video. (5 min)

## **Explore the Blue Hawaiian Adventure**

Students learn about the diversity of life found in the Hawaiian Islands, and will explore the ecology of three different species, their importance to Native Hawaiian culture, and the conservation measures in place for their protection. (4 min)

## **Explore the Coral Restoration**

Students will research the ecology of coral reefs, natural and human threats to corals, and the science of coral restoration. (4 min)

## **Nuclear Control Room**

Replica of the nuclear control room found at Three Mile Island. (unlimited) [E](#)

## **Nuclear Power Plant**

Recreation of a nuclear power plant that students can explore. The interactive map allows students to tour the entire facility while illustrating how the different components are connected in the process of nuclear power generation. (unlimited) [E](#)

## **Foundation of Biology**

### **Microscope**

Highly interactive science lab microscope with 4 different, insertable slides that they can view at 3 different zoom levels. [IFX](#)

### **Glow Worm Caves of New Zealand**

Deep below ground, you will learn about strange carnivorous worms. (2 min)

### **Giraffe 1**

See a giraffe interacting with its natural habitat. (1 min)

### **Giraffe 2**

See a giraffe interacting with its natural habitat. (1 min)

## **Attenborough and the Giant Dinosaur**

Learn all about the Titanosaur with David Attenborough. (4 min)

## **Giraffatitan Dinosaur: Back to Life in 360 VR**

Encounter the Jurassic giant Giraffatitan, one of the tallest dinosaurs that ever lived, and learn all about how it lived and who its descendants are. (4 min)

## **Rhomaleosaurus Sea Dragon: Back to Life in 360 VR**

Encounter the prehistoric sea dragon Rhomaleosaurus, as it roams the gallery over 180 million years after it died. (4 min)

## **VR Jurassic Dinosaur**

Explore what life was like during the age of the dinosaur. (3 min)

## **Foundations of Science Literacy**

### **Explore the Blue Shipwreck Alley**

Tied to the virtual dive on the wreck of D.M Wilson, students research the historical, ecological, and economic importance of Thunder Bay National Marine Sanctuary. Students create a digital infographic that communicates the importance of preserving a shipwreck. (3 min)

### **NASA Astronaut Training: Space Walk**

The stunning NASA VR/360 video, produced by Harmonic, offers a variety of perspectives - in the pool and out - as astronauts complete space-walk training for future missions to the International Space Station. (3 min)

### **Curiosity Mars Rover**

View the Glen Torridon area of Mars from the eyes of the Mars Rover. (2 min)

## **Wind Tunnel Test of NASA's Most Powerful Rocket**

Follow NASA as they test their most powerful rocket in a wind tunnel test. (3 min)

## **Space Engine in Immersive 360 Video**

Experience a Space engine as it flies and looks at different interesting locations in Space. (5 min)

## Rocket Launch: DeltaIV NROL-45

Experience one of the most powerful activities in spaceflight- Launch. (4 min)

### 1. Cool VR Walk on the Moon/

### 2. Yosemite

EXP.1: Walk on the Moon from the Project Apollo Archive. (2 min)

EXP.2: Experience a guided tour of some of Yosemite's majestic spots. (4 min)

## NASA's Curiosity Mars Rover at Namib Dune

View the Namib Dune and portions of Mount Sharp through the eyes of the Mars Rover. (2 min)

## Microscope

Highly interactive science lab microscope with 4 different, insertable slides that they can view at 3 different zoom levels. [IFX](#)

## Category 3 Hurricane Landfall Simulation

Experience a category 3 hurricane through a simulation with guided popups. (1 min)

## Mars- The Red Planet VR

### Documentary

Explore the planet Mars and see its history of exploration. (12 min)

## Explore an underwater mountain from a submarine

Ride along as you dive in a submarine and explore the ocean floor. (4 min)

## Explore the Deep Ocean

Follow along in a Submarine and see the ocean from a new view. (2 min)

## Explore Lake Ontario Schooner: St. Peter

Explore the wreck of the Schooner St. Peter, which lies in Lake Ontario National Marine Sanctuary. Students research the technologies used by maritime archaeologists to locate and image shipwrecks and participate in simulations of the use of two of these technologies, sonar, and photogrammetry. (4 min)

## Genetics

### Giraffe 1

See a giraffe interacting with its natural habitat. (1 min)

### Giraffe 2

See a giraffe interacting with its natural habitat. (1 min)

## Glow Worm Caves of New Zealand

Deep below ground, you will learn about strange carnivorous worms. (2 min)

## Great Hammerhead Shark Encounter

Dive into this 360° video and go face to face with a curious great hammerhead shark. (2 min)

## Geology

### Big Bang Explosion

Explosion particle effect with fire, smoke, and plasma. [IFX](#)

### Antarctica- Part II

See Antarctica from aboard a ship as it sails around Antarctica and see the different wildlife. (6 min)

### Kamchatka Volcano Eruption

National Geographic VR takes you to the rim of a spectacular erupting volcano: Klyuchevskaya, one of the tallest and most active volcanoes on the planet. (2 min)

### Iceland

Soar over Iceland and take in the different views that Iceland has to offer. (3 min)

## Human Anatomy & Physiology

### Autism Virtual Reality

Become a student with autism in the daily fight for survival. (7 min)

## A Walk-Through Dementia- Walking Home

A unique experience designed to put you in the shoes of someone living with dementia. (4 min)

## Oesophageal Cancer Operation Filmed

The operation to remove a tumor from Janet Jenkins, 65, at Southampton General Hospital was carried out by Professor Tim Underwood who is currently undertaking the research. The surgery lasted eight hours. (2 min)

## VR Surgery – Brain Aneurysm

Immerse the general public, patients, medical students, and allied healthcare professionals into what a real brain operation is like. (6 min)

## Resuscitation of a Covid-19 Patient w/ Respiratory Failure Best Practices Demonstration

This immersive 360-degree video takes you inside a hospital emergency department and shows you - using "pop-up text" - the best practices learned by medical staff in New York City and Philadelphia for treating critically ill COVID-19 patients with respiratory failure. (11 min)

## Inside Anxiety

Anxiety can make you feel on edge, unable to concentrate, fearful, irritable and like you have lost control. Step inside the mind of someone who experiences anxiety and see the world from their point of view. (9 min)

## What Happens Inside Your Body?

The human body is an amazing and unique machine that triggers thousands of processes every second, learn about them on this adventure. (5 min)

## Anatomy of Hearing

Take a deep dive into the different parts that make up the Human Ear, and see how we use our sense of hearing. (unlimited)

## Anatomy Lab

Highly interactive anatomy classroom that allows Students to assemble the human body piece by piece with over 90 separate body parts to learn about. (unlimited) [E](#)

## VR Bone Resorption

Watch bone resorption at the cellular level in action. (1 min)

### Heart

Realistic model of a Human Heart. [IFX](#)

### Brain

Realistic model of the Human Brain. [IFX](#)

### Lungs

Realistic model of the Human Lungs. [IFX](#)

### Liver

Realistic model of the Human Liver. [IFX](#)

## 360 Video of a Heart Valve Operation the Heart Center Leipzig

Experience exclusive insights into surgery in full 360 degree video. Head of Cardiac Surgery Prof. Michael Borger explains what happens during a mitral valve Operation. (4 min)

## Cardiac Arrest (Code Blue) Advanced Life Support

This 360-degree training video demonstrates how to manage a cardiac arrest (code blue) using an automated defibrillator. (7 min)

## Patient Point of View in Advanced Life Support (Code Blue)

This 360-degree video is filmed from a patient's point of view and demonstrates what happens if you have a cardiac arrest in the hospital. (7 min)

## Choking and Cardiac Arrest (Code Blue) Advanced Life Support

This 360-degree training video demonstrates how to manage a cardiac arrest (code blue) due to choking. (3 min)

## Experience a Heart Transplant in 360

Filmed recently at William P. Clements Jr. University Hospital, the video details the process of a heart transplant and all its intricacies, with narration from our Transplant team, including Drs. Matthias Peltz, Pietro Bajona, and John Murala. (5 min)

## Human Digestive System in VR

Take an amazing 360 VR journey through the body and find out what happens to your food as it travels through the digestive system. (5 min)

### Miracle of Life

Experience the epic moment we are all conceived in. Our DNA is passed on from our parents, our first cells grow and we begin the miraculous journey of life. (5 min)

## Marine & Aquatic Science

### Pond

Explore a freshwater pond and the plants that surround it. (1 min)

### Reef 2

Swim along an active thriving reef. (1 min)

### Reef 3

Swim along an active thriving reef. (1 min)

### Reef 4

Swim along an active thriving reef. (1 min)

### Waterfall 1

View a waterfall and the surrounding plant life. (1 min)

### Waterfall 2

View a waterfall and the surrounding plant life. (1 min)

### Waterfall 3

View a waterfall and the surrounding plant life. (1 min)

## Explore the Blue Hawaiian Adventure

Learn about the diversity of life found in the Hawaiian Islands, and explore the ecology of three different species, their importance to Native Hawaiian culture, and the conservation measures in place for their protection. (4 min)

## Explore the Malloves Ghost Fleet

Learn about the Malloves Bay-Potomac River National Marine Sanctuary and the "Ghost Fleet" and explore how human actions affect the environment by interpreting data and evidence about the impact of turbidity on submerged aquatic vegetation. (4 min)

## Explore an Underwater Mountains in a Submarine

Ride along as you dive in a submarine and explore the ocean floor. (4 min)

## Explore the Deep Ocean

Follow along in a Submarine and see the ocean from a new view. (2 min)

## Underwater National Park

Plunge into a Caribbean gem with National Geographic photographer Brian Skerry to explore the Buck Island Reef – America's first protected marine monument. (6 min)

## Explore the Coral Restoration

Learn about the ecology of coral reefs, natural and human threats to corals, and the science of coral restoration. (4 min)

## Diving Exploration of Kelp Forest Aquarium

Explore the Kelp Forest at Monterey Bay Aquarium. (3 min)

## Diving Under Icebergs with a Seal in Antarctica

Take a 360 journey under an iceberg with a crabeater seal and Gentoo Penguins in Antarctica. (2 min)

## Elephant Seals and King Penguin Chicks

These King Penguin chicks get our (elephant) seal of approval. (2 min)

## Great White Sharks

Get up close with Great White Sharks on an actual dive while learning more about them. (2 min)

## Isle of Jaws

Suit up and join the team on the search for the mysterious "Isle of Jaws" in Discovery's first-ever full virtual reality act. (7 min)

## Manatee: Crystal River National Wildlife Refuge

Underwater cinematographer and VR filmmaker Adam Ravetch takes us on an adventure on Florida's Crystal River as he captures the river's wild manatees in their natural habitat at the Crystal River National Wildlife Refuge. (3 min)

## Ocean to Plate: A Journey into the Seafood Supply Chain

As populations and appetites grow, global fisheries are reaching their ecological capacity, yet at least a third of harvested fish and seafood is lost or wasted along the supply chain. (7 min)

## Protecting Ocean Anchor Species- Racing Extinction

Join marine biologist Luke Tipple as he swims alongside manta rays and whale sharks while sharing why they are vital to the survival of our oceans. (3 min)

## Shoaling in the Deep

Dive down deep into the heart of a shoal of fish, follow a manta ray as it skims the ocean floor, and lock eyes with a moray eel lurking in an underwater cave. (3 min)

## Swimming with Giants 360

Earth's oceans have been home to giant animals for hundreds of millions of years. Have you ever wondered what it would be like to swim with some of these giants? (5 min)

## Kelp

Swim through a kelp forest. (1 min)

## Scuba in the Maldives

Dive into the waters of Maldives and experience the aquatic life and environment. (2 min)

## Arctic Orca

Orca Foraging in a school fish with free divers. (1 min)

## Diving with Great White Shark

Experience a Great white shark up close and personal while learning about the majestic creatures. (2 min)

## Great Hammerhead Shark Encounter

Dive into this 360° video and go face to face with a curious great hammerhead shark. (2 min)

## Mythbusters: Shark Shipwreck

Explore the sunken wreckage of the Ray of Hope with the MythBusters. (4 min)

## Mythbusters: Sharks Everywhere!

MythBuster Adam Savage takes you underwater and face-to-face with a shiver of sharks. (5 min)

## The Blu: Whale Encounter

Go deep under the ocean, onto the deck of a sunken ship, and face to face with the largest species on Earth. (2 min)

## Tiger Shark Encounter in the Bahamas- SharkFest

Come face to face with massive tiger sharks as you plunge into the crystal clear waters of the Bahamas. (3 min)

## Whale Sharks at Risk- Racing Extinction

Experience a close encounter with a Whale Shark- the largest fish on the Planet. (4 min)

## Whale Sharks: Giants of the Deep

Encounter a group of Whale Sharks feeding as they migrate south. (2 min)

## Wild Dolphins VR

Over 6 years ago, our production team filmed unique footage of wild dolphins in the Sataya Reef in Egypt's Red Sea. (2 min)

## Sharks

Explore an aquarium of sharks. (1 min)

## Physical Science

### Gas in Tank

Three colored liquids of different densities that flow out of pipes and stack on top of each other in a tank. [IFX](#)

### Liquid Particles in Tank

Liquid particles that move randomly inside a tank. [IFX](#)

## Solid Particle Arrangement

Rotating cube of crystalline atomic structure. [IFX](#)

## Bunsen Burner and Breaker

Interactive model of a Bunsen burner, beaker, and ring stand. Toggling the valve turns on the burner flame and starts a chemical reaction in the beaker. [IFX](#)

## Elementary Particle Swarm

Protons, Neutrons, and Electrons that move around randomly. [IFX](#)

## Hydrogen and Helium Formation

Protons, neutrons, and electrons that move around randomly and then collide to form hydrogen and helium atoms. [IFX](#)

## Covalent Bonding- H2

Simple visualization of the covalent bond between two hydrogen atoms. [IFX](#)

## Covalent Bonding – Glucose Hybridized

Visualization of a covalently bonded glucose molecule with hybridized orbitals. [IFX](#)

## Covalent Bonding – O2 Hybridized

Visualization of two covalently bonded oxygen atoms with hybridized orbitals. [IFX](#)

## Covalent Bonding – H2O Hybridized

Visualization of a covalently bonded water molecule with hybridized orbitals. [IFX](#)

## Ionic Bonding – NaCl

Animated visualization of the ionic bond between a sodium atom and a chlorine atom. [IFX](#)

## Ionic Bonding – NaOH

Animated visualization of the ionic bond between a sodium atom and a hydroxide anion. [IFX](#)

## Ionic Bonding- NaF

Animated visualization of the ionic bond between a sodium atom and a fluorine atom. [IFX](#)

## Ionic Bonding – MgSO4

Animated visualization of the ionic bond between a magnesium atom and a sulfate anion. [IFX](#)

**Periodic Table**

Interactive classroom that teaches students about the periodic table of elements, their chemical and physical properties, and their atomic structures. (unlimited) [E](#)

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Three colored liquids of different densities that flow out of pipes and stack on top of each other in a tank. [IFX](#)

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Animated visualization of the ionic bond between a sodium atom and a hydroxide anion. [IFX](#)

**Ionic Bonding- NaF**

Animated visualization of the ionic bond between a sodium atom and a fluorine atom. [IFX](#)

**Ionic Bonding – MgSO4**

Animated visualization of the ionic bond between a magnesium atom and a sulfate anion. [IFX](#)

**Electromagnet- Small Solenoid**

Animated visualization of an electromagnetic solenoid with 15 coils. [IFX](#)

**Electromagnet – Large Solenoid**

Animated visualization of an electromagnetic solenoid with 26 coils. [IFX](#)

**Music Playground**

Concert hall with interactive musical instruments that can be used to collaboratively play, teach, or learn about music. (unlimited) [E](#)

**Music Note- A**

Interactive music notes spanning 4 octaves and using 10 different instrument sounds. [IFX](#)

**Music Note- A Sharp**

Interactive music notes spanning 4 octaves and using 10 different instrument sounds. [IFX](#)

**Music Note- B**

Interactive music notes spanning 4 octaves and using 10 different instrument sounds. [IFX](#)

**Music Note- C**

Interactive music notes spanning 4 octaves and using 10 different instrument sounds. [IFX](#)

**Music Note- C Sharp**

Interactive music notes spanning 4 octaves and using 10 different instrument sounds. [IFX](#)

**Music Note- D**

Interactive music notes spanning 4 octaves and using 10 different instrument sounds. [IFX](#)

**Music Note- D Sharp**

Interactive music notes spanning 4 octaves and using 10 different instrument sounds. [IFX](#)

**Music Note- E**

Interactive music notes spanning 4 octaves and using 10 different instrument sounds. [IFX](#)

**Music Note- F**

Interactive music notes spanning 4 octaves and using 10 different instrument sounds. [IFX](#)

**Music Note- F Sharp**

Interactive music notes spanning 4 octaves and using 10 different instrument sounds. [IFX](#)

**Music Note- G**

Interactive music notes spanning 4 octaves and using 10 different instrument sounds. [IFX](#)

**Music Note- G Sharp**

Interactive music notes spanning 4 octaves and using 10 different instrument sounds. [IFX](#)

**Light Lab**

This highly interactive classroom teaches students about the electromagnetic spectrum including activities like Double Slit Experiment, shining lights through a prism, building their own waves, stacking light, and playing with lenses. (unlimited) [E](#)

**X- Ray Machine**

Interactive model of an x-ray machine. [IFX](#)

**Physical World Concepts****Elementary Particle Swarm**

Protons, Neutrons, and Electrons that move around randomly. [IFX](#)

**Periodic Table**

Interactive classroom that teaches students about the periodic table of elements, their chemical and physical properties, and their atomic structures. (unlimited) [E](#)

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Protons, neutrons, and electrons that move around randomly and then collide to form hydrogen and helium atoms. [IFX](#)

**Fluid Densities**

Three colored liquids of different densities that flow out of pipes and stack on top of each other in a tank. [IFX](#)

**Nuclear Power Plant**

Recreation of a nuclear power plant that students can explore. The interactive map allows students to tour the entire facility while illustrating how the different components are connected in the process of nuclear power generation. (unlimited) [E](#)

**Nuclear Control Room**

Replica of the nuclear control room found at Three Mile Island. (unlimited) [E](#)

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**Physics****Light Lab**

This highly interactive classroom teaches students about the electromagnetic spectrum including activities like Double Slit Experiment, shining lights through a prism, building their own waves, stacking light, and playing with lenses. (unlimited) [E](#)

**Bridge Builder**

An interactive module that allows for the building of bridges to scale using architectural applications. (unlimited) [E](#)

**Music Playground**

Concert hall with interactive musical instruments that can be used to collaboratively play, teach, or learn about music. (unlimited) [E](#)

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Interactive music notes spanning 4 octaves and using 10 different instrument sounds. [IFX](#)

## Music Note- F Sharp

Interactive music notes spanning 4 octaves and using 10 different instrument sounds.

[IFX](#)

## Music Note- G

Interactive music notes spanning 4 octaves and using 10 different instrument sounds.

[IFX](#)

## Music Note- G Sharp

Interactive music notes spanning 4 octaves and using 10 different instrument sounds.

[IFX](#)

## Scientific Research

### Google Data Center Tour

Take a Google data center tour and learn about the massive scale, the incredible attention to security and privacy, and the amazing efforts to make the data center extremely efficient and green. (9 min)

### Journey into the Orion Nebula

This visualization journeys into the famous star-forming region of the Orion Nebula based on an image from the Hubble Space Telescope. (2 min)

### Mars- The Red Planet VR

#### Documentary

Explore the planet Mars and see its history of exploration. (12 min)

### Rocket Launch: DeltaIV NROL-45

Experience one of the most powerful activities in spaceflight- Launch. (4 min)

### Explore Lake Ontario Schooner: St. Peter

Explore the wreck of schooner St. Peter, which lies Lake Ontario National Marine Sanctuary. Students research the technologies used by maritime archaeologists to locate and image shipwrecks and participate in simulations of the use of two of these technologies, sonar, and photogrammetry. (4 min)

## First-Ever 360 VR filmed in Space:

### One Strange Rock

Fly side-by-side with astronauts and experience weightlessness, the speed of traveling at 17-thousand miles per hour and take in a stunning view of Earth. (5 min)

### NASA Astronaut Training: Space Walk

The stunning NASA VR/360 video, produced by Harmonic, offers a variety of perspectives - in the pool and out - as astronauts complete space-walk training for future missions to the International Space Station. (3 min)

### Curiosity Mars Rover

View the Glen Torridon area of Mars from the eyes of the Mars Rover. (2 min)

### Inside Hurricane Maria

See inside Hurricane Maria and see how it changes from a category 1 to a category 5 in about 24 hours. (5 min)

### International Space Station

Model of the exterior of the International Space Station. (unlimited)

## Zoology

### Attenborough and the Giant Dinosaur

Learn all about the Titanosaurus with David Attenborough. (4 min)

### Rhomaleosaurus Sea Dragon: Back to Life in 360 VR

Encounter the prehistoric sea dragon Rhomaleosaurus, as it roams the gallery over 180 million years after it died. (4 min)

### Diving with Great White Shark

Experience a Great white shark up close and personal while learning about the majestic creatures. (2 min)

### Elephant Seals and King Penguin Chicks

These King Penguin chicks get our (elephant) seal of approval. (2 min)

## Great Hammerhead Shark Encounter

Dive into this 360° video and go face to face with a curious great hammerhead shark. (2 min)

## Great White Sharks

Get up close with Great White Sharks on an actual dive while learning more about them. (2 min)

## Isle of Jaws

Suit up and join the team on the search for the mysterious "Isle of Jaws" in Discovery's first-ever full virtual reality act. (7 min)

## Manatee: Crystal River National Wildlife Refuge

Underwater cinematographer and VR filmmaker Adam Ravetch takes us on an adventure on Florida's Crystal River as he captures the river's wild manatees in their natural habitat at the Crystal River National Wildlife Refuge. (3 min)

## Mythbusters: Shark Shipwreck

Explore the sunken wreckage of the Ray of Hope with the MythBusters. (4 min)

## Mythbusters: Sharks Everywhere!

MythBuster Adam Savage takes you underwater and face-to-face with a shiver of sharks. (5 min)

## Ocean to Plate: A Journey into the Seafood Supply Chain

As populations and appetites grow, global fisheries are reaching their ecological capacity, yet at least a third of harvested fish and seafood is lost or wasted along the supply chain. (7 min)

## Protecting Ocean Anchor Species- Racing Extinction

Join marine biologist Luke Tipple as he swims alongside manta rays and whale sharks while sharing why they are vital to the survival of our oceans. (3 min)

## Shoaling in the Deep

Dive down deep into the heart of a shoal of fish, follow a manta ray as it skims the ocean floor, and lock eyes with a moray eel lurking in an underwater cave. (3 min)

## Swimming with Giants 360

Earth's oceans have been home to giant animals for hundreds of millions of years. Have you ever wondered what it would be like to swim with some of these giants? (5 min)

### The Blu: Whale Encounter

Go deep under the ocean, onto the deck of a sunken ship, and face to face with the largest species on Earth. (2 min)

### Tiger Shark Encounter in the Bahamas- SharkFest

Come face to face with massive tiger sharks as you plunge into the crystal clear waters of the Bahamas. (3 min)

### Whale Sharks at Risks- Racing Extinction

Experience a close encounter with a Whale Shark- the largest fish on the Planet. (4 min)

### Whale Sharks: Giants of the Deep

Encounter a group of Whale Sharks feeding as they migrate south. (2 min)

### Sharks

Explore an aquarium of sharks. (1 min)

### Reptile Room- Discovery Nature and Animal

Take a virtual tour inside a reptile room at a zoo. (1 min)

### Red Kite Bird Feeding Frenzy

Watch the once endangered Red Kite Bird feeding while learning about them. (1 min)

### VR Jurassic Dinosaur

Explore what life was like during the age of the dinosaur. (3 min)

### 360 Orangutan School

Go inside the International Animal Rescue Sanctuary in the forests of Borneo to see what it takes to teach a baby orangutan... to be an orangutan. (9 min)

### Arctic Orca

Orca Foraging in a school fish with free divers. (1 min)

## Bears of Kamchatka, Kambalnaya River

Follow along as you experience the Bears of Kamchatka and learn about their habitat, daily life, and mating season. (5 min)

### Caring for Rhinos

A herd of nine rhinos graze in the South African bush while we hear Chris Sussons, game reserve manager, give some cool facts about rhinos and why they need to protect them from poachers. (2 min)

### Chengdu Panda Base, China

Get an in-depth look at the pandas that call Chengdu Panda Base their home and learn about their habitat, diet, and daily life. (11 min)

### Diving Under Icebergs with a Seal in Antarctica

Take a 360 journey under an iceberg with a crabeater seal and Gentoo Penguins in Antarctica. (2 min)

### Elephants on the Brink

A herd of African elephants curiously investigates its surroundings in South Africa and happens to notice cameras filming their behavior. (3 min)

### Getting Licked by a Cow in Ireland

Get up close and personal with cows. Now you'll know what it's like to be licked and sniffed by them. (1 min)

### Gorillas in the Congo: A Jump VR Video

Experience gorillas in their natural habitat of the Congo Jungle. (2 min)

### Lion Whisperer- Racing Extinction

Kevin Richardson, also known as the "lion whisperer", explains the complexities of his relationship to his pride, and summarizes his life's work of protecting these amazing animals from the game hunting trade. (4 min)

### Lions 360

National Geographic Explorer Martin Edström, you will come face to face with Gibson and his mother, as they struggle with their pride's alpha male. (5 min)

## Play with Meerkats: Animals with Cameras

Get up close and personal with Meerkats as they investigate the camera. (1 min)

### Playful Elephants Swim

A family of elephants decide to take a break from the hot South Africa sun and swim in the local watering hole as Vicky Brooker, elephant curator, tells about the animals. (2 min)

### Rescuing Rhinos- Racing Extinction

Join a conservation biologist on an interactive mission to learn how animals critical to the world's ecosystem thrive and survive in the wild. (5 min)

### Surrounded by Lemurs- Perth Zoo- Australia

Take a private tour of Lemur Island and encounter these critically endangered species. (10 min)

### Surrounded by White Lions

Experience White lions at a preserve. (4 min)

### Surrounded by Wild Elephants

Come face to face with the largest land animal on the planet, the African elephant. Follow along as this herd of giants take a detour to investigate a stranger in their midst. (3 min)

### The Eye of the Tiger

Look at the day in the life of a tiger at the Dierenpark Amersfoort Zoo. (2 min)

### What it's like to be Surrounded by Wild Dogs

See how Wild dogs differ from domesticated ones and how they interact within a herd. (1 min)

### Wild Dolphins VR

Over 6 years ago, our production team filmed unique footage of wild dolphins in the Sataya Reef in Egypt's Red Sea. (2 min)

### Baboon 1

See how a group of Baboons interact. Part. 1. (1 min)

## Baboon 2

See how a group of Baboons interact.  
Part. 2. (1 min)

## Baboon 3

See how a group of Baboons interact.  
Part. 3. (1 min)

## Cows

See a group of African Cows roam in search of food. (1 min)

## Deer

See Antelope deer feeding on a plain.  
(1 min)

## Elephant 1

See a herd of elephants graze about.  
Part 1 (1 min)

## Elephant 2

See a herd of elephants graze about.  
Part 2 (1 min)

## Elephant 3

See a herd of elephants graze about.  
Part 3 (1 min)

## Elephant 4

See a herd of elephants graze about.  
Part 4 (1 min)

## Giraffe 1

Get up close with a giraffe as it feeds.  
Part 1. (1 min)

## Giraffe 2

Get close to a giraffe as it feeds.  
Part 1. (1 min)

## Hyena 1

Watch a hyena feed on a fresh kill. (1 min)

## Hyena 2

Watch a hyena approach cautiously for a snack. (1 min)

## Lemur 1

Watch lemurs climb and play in a zoo.  
Part 1. (1 min)

## Lemur 2

Watch lemurs climb and play in a zoo.  
Part 2. (1 min)

## Lemur 3

Watch lemurs climb and play in a zoo.  
Part 3. (1 min)

## Leopard

Watch a leopard munch on a meal. (1 min)

## Lioness 1

A curious Lioness sniffs at the camera.  
(1 min)

## Lioness 2

Lioness sniffs at food. (1 min)

## Monkey 1

Monkeys steal a sweet treat. (1 min)

## Monkey 2

Watch a monkey enjoy a fun treat. (1 min)

## Monkey Cage

See two playful monkeys in a zoo. (1 min)

## Rhino 1

Watch a Rhino wallow in a mud hole.  
(1 min)

## Rhino 2

Watch a baby rhino enjoy a bottle. (1 min)

## Rhino 3

Watch a baby rhino frolic around. (1 min)

## Zebra 1

Watch a herd of zebras grazing. (1 min)

## Zebra 2

Watch how zebras move as a herd. (1 min)

# Social Studies

## African American History

### Traveling while Black

This film offers a revealing view of the Green Book era as told through Ben's Chili Bowl, a black-owned restaurant in Washington, and reminds us that the humiliations heaped upon African Americans during that period. (20 min)

### Civil Rights Museum

Five Civil Rights leaders - Rosa Parks, John Lewis, Martin Luther King Jr., Thurgood Marshall, and Medgar Evers - come to life and teach you their stories on interactive stages. (unlimited) [E](#)

## Ancient History

### Crawl Inside a 3,500-Year-Old Egyptian Tomb

Descend 7 meters under the sandy hills of southern Egypt to become one of the first modern humans to explore a newly discovered ancient Egyptian tomb. (3 min)

### The Dream of Egypt's Tuthmosis IV

A tour around the statue of the Sphinx temple and the pyramids of Giza. (4 min)

### Dholavira: Archaeological site that contains ruins of the Ancient Indus Valley Civilization

Dholavira is an archaeological site that contains one of the five largest Harappan sites and most prominent archaeological sites in India belonging to the Indus Valley Civilization. (2 min)

### Ancient Egypt- Hall of Pharaohs

Visit the Hall of Pharaohs and interact and learn from 5 of Egypt's most well-known pharaohs of all time: Ramesses the Great, Nefertiti, King Tut, Alexander the Great, and Cleopatra. (unlimited) [E](#)

### Ancient Egypt- The Great Pyramids

Explore the hidden passageways of the Great Pyramid of Giza as you learn about the famous structure and its significance to Ancient Egyptian culture and traditions. (unlimited) [E](#)

### Leshan Giant Buddha- Leshan, China

Go on a tour of the Entire Leshan scenic area, including the famous stone Buddha statue. (9 min)

### Immerse yourself in a tour around the Forbidden City of China

With red walls and yellow tiles, the resplendent and magnificent Forbidden City is a treasure of China's ancient palace architecture. (5 min)

### Machu Picchu Tour- Panorama Field Trip

A panoramic photo sphere with 5 images of Machu Picchu that the user can toggle through as a slideshow. (unlimited)

## **Walking Tours of Japan- Kiyomizudera Temple in Kyoto**

Experiences a walking tour of Kiyomizudera Temple in Kyoto, Japan. (17 min)

## **Let's Go Rickshaw Ride Around Japan 1**

Learn about traditional Japanese cuisine and take in sites. (3 min)

## **Let's Go Rickshaw Ride Around Japan 2**

See the bridge, Togetsu-kyo which means "The moon crossing bridge," over the Katsura River which flows through the center of Arashiyama. (2 min)

## **Let's Go Rickshaw Ride Around Japan 3**

The path leading to Okochi Sanso Garden from Nonomiya Shrine is about 400m long. (2 min)

## **Japan - Where Tradition Meets the Future**

Explore Japanese tradition, modernity and nature as you venture around Japan. (3 min)

## **Athens, Parthenon, Parthenonas, Acropolis- VR Walk**

Go on a journey through Athens and its main attractions from Ancient Greece. (5 min)

## **Amphora Jar- Greek Artifact**

A collection of artifacts from Ancient Greece. [IFX](#)

## **Aphrodite Statue- Greek Artifact**

A collection of artifacts from Ancient Greece. [IFX](#)

## **Discobolus Statue- Greek Artifact**

A collection of artifacts from Ancient Greece. [IFX](#)

## **Hercules and Calliope Statue- Greek Artifact**

A collection of artifacts from Ancient Greece. [IFX](#)

## **Lebes Gamikos Vassel- Greek Artifact**

A collection of artifacts from Ancient Greece. [IFX](#)

## **Pelike Jar- Greek Artifact**

A collection of artifacts from Ancient Greece. [IFX](#)

## **Ancient Greek Amphitheater Section**

Modular building pieces designed to have students design/recreate Ancient Greek amphitheaters. These can be used to build scenes for reenacting plays, studying Ancient Greek culture, or learning about architecture and design principles. [IFX](#)

## **Ancient Greek Decorated Wall- Corner**

Modular building pieces designed to have students design/recreate Ancient Greek amphitheaters. These can be used to build scenes for reenacting plays, studying Ancient Greek culture, or learning about architecture and design principles. [IFX](#)

## **Ancient Greek Decorated Wall- Inside Corner**

Modular building pieces designed to have students design/recreate Ancient Greek amphitheaters. These can be used to build scenes for reenacting plays, studying Ancient Greek culture, or learning about architecture and design principles. [IFX](#)

## **Ancient Greek Decorated Wall- Top Corner**

Modular building pieces designed to have students design/recreate Ancient Greek amphitheaters. These can be used to build scenes for reenacting plays, studying Ancient Greek culture, or learning about architecture and design principles. [IFX](#)

## **Ancient Greek Decorated Wall- Top Side**

Modular building pieces designed to have students design/recreate Ancient Greek amphitheaters. These can be used to build scenes for reenacting plays, studying Ancient Greek culture, or learning about architecture and design principles. [IFX](#)

## **Ancient Greek Doorway**

Modular building pieces designed to have students design/recreate Ancient Greek amphitheaters. These can be used to build scenes for reenacting plays, studying Ancient Greek culture, or learning about architecture and design principles. [IFX](#)

## **Ancient Greek Doric Column**

Modular building pieces designed to have students design/recreate Ancient Greek amphitheaters. These can be used to build scenes for reenacting plays, studying Ancient Greek culture, or learning about architecture and design principles. [IFX](#)

## **Ancient Greek Doric Column- Fluted**

Modular building pieces designed to have students design/recreate Ancient Greek amphitheaters. These can be used to build scenes for reenacting plays, studying Ancient Greek culture, or learning about architecture and design principles. [IFX](#)

## **Ancient Greek Tiled Floor Plane**

Modular building pieces designed to have students design/recreate Ancient Greek amphitheaters. These can be used to build scenes for reenacting plays, studying Ancient Greek culture, or learning about architecture and design principles. [IFX](#)

## **Ancient Greek Roof- Corner 1**

Modular building pieces designed to have students design/recreate Ancient Greek amphitheaters. These can be used to build scenes for reenacting plays, studying Ancient Greek culture, or learning about architecture and design principles. [IFX](#)

## **Ancient Greek Roof- Corner 2**

Modular building pieces designed to have students design/recreate Ancient Greek amphitheaters. These can be used to build scenes for reenacting plays, studying Ancient Greek culture, or learning about architecture and design principles. [IFX](#)

## Ancient Greek Roof- Pediment

Modular building pieces designed to have students design/recreate Ancient Greek amphitheaters. These can be used to build scenes for reenacting plays, studying Ancient Greek culture, or learning about architecture and design principles. [IFX](#)

## Ancient Greek Roof- Center

Modular building pieces designed to have students design/recreate Ancient Greek amphitheaters. These can be used to build scenes for reenacting plays, studying Ancient Greek culture, or learning about architecture and design principles. [IFX](#)

## Ancient Greek Semicircle Wall

Modular building pieces designed to have students design/recreate Ancient Greek amphitheaters. These can be used to build scenes for reenacting plays, studying Ancient Greek culture, or learning about architecture and design principles. [IFX](#)

## Ancient Greek Steps- Short

Modular building pieces designed to have students design/recreate Ancient Greek amphitheaters. These can be used to build scenes for reenacting plays, studying Ancient Greek culture, or learning about architecture and design principles. [IFX](#)

## Ancient Greek Steps- Side Detail

Modular building pieces designed to have students design/recreate Ancient Greek amphitheaters. These can be used to build scenes for reenacting plays, studying Ancient Greek culture, or learning about architecture and design principles. [IFX](#)

## Ancient Greek Wall- Medium

Modular building pieces designed to have students design/recreate Ancient Greek amphitheaters. These can be used to build scenes for reenacting plays, studying Ancient Greek culture, or learning about architecture and design principles. [IFX](#)

## Ancient Greek Wall- Short

Modular building pieces designed to have students design/recreate Ancient Greek amphitheaters. These can be used to build scenes for reenacting plays, studying Ancient Greek culture, or learning about architecture and design principles. [IFX](#)

## Ancient Greek Wall- Short Painted

Modular building pieces designed to have students design/recreate Ancient Greek amphitheaters. These can be used to build scenes for reenacting plays, studying Ancient Greek culture, or learning about architecture and design principles. [IFX](#)

## Pompeii Amazing Tour in VR- Italy

Pompeii was an ancient Roman town-city near modern Naples, that was mostly destroyed and buried under 4 to 6 m (13 to 20 ft) of volcanic ash and pumice in the eruption of Mount Vesuvius in 79 AD. (15 min)

## Bruegel: a fall with The Rebel Angels

In partnership with the Royal museums of Fine Arts of Belgium, the Google Cultural Institute has designed an immersive experience which lets you explore The Fall of the Rebel Angels (1562) like never before. (4 min)

## Contemporary Issues

### Damming the Nile Episode 1

Africa's largest hydroelectric power project is two thirds finished and the dam can already control the flow of the Blue Nile, which is deeply upsetting downstream Egypt who they didn't consult before building started. (13 min)

### Damming the Nile: Episode 2

Africa's largest hydroelectric power project is two thirds finished and the dam can already control the flow of the Blue Nile, which is deeply upsetting downstream Egypt who they didn't consult before building started. (16 min)

## Weaving Around the World

From Venice to Addis Ababa, the West Bank to the Navajo Nation Reservation, follow the process of weaving that has been developed across cultures for thousands of years. (4 min)

## World Religions

See the different major religions of the world and how they are dispersed across the world. (9 min)

## Himalayas: a Trek to School

Follow two girls as they travel for up to 6 hours a day to school in a remote Himalayan village. (8 min)

## Syrians "Have to survive having no rights" in Lebanon

Syrian refugees are living in makeshift settlements under harsh conditions, with no legal rights in Lebanon's Bekaa Valley. (3 min)

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## Seeking Home: Life Inside the Calais Migrant Camp

This documentary of a migrant camp in northern France follows the residents as the "Jungle", migrants have turned the rugged landscape into a makeshift town with churches, mosques, restaurants, and even a beauty salon while waiting on hoping to migrate across the English Channel. (6 min)

## Hajj- Experience the Journey to Mecca

Walk with Al Jazeera's Basma Atassi in Mecca and see the major landmarks that millions of Muslims visit during the period of Hajj, the annual Islamic pilgrimage. (8 min)

## **Out of Syria- Back to School**

Step into the lives of two teenagers from war-torn Syria, Mustafa and Sarah. They both fled the fighting with their families. They left their homelands - and their schools - behind. Now they live in Lebanon, but while Sarah is back in school with the help of UK aid, Mustafa must help support his family. (4 min)

## **Travel-Dream-Imagine- A VR Journey from the desert floor to the Sea**

Travel with us as we step into the Judea desert, bathe in a waterfall in a hidden oasis, wet our feet in the red sea, dive among corals and finally float in one of the wonders of the world - the dead sea. (2 min)

## **Let's Go Rickshaw Ride Around Japan 1**

Learn about traditional Japanese cuisine and take in sites. (3 min)

## **Let's Go Rickshaw Ride Around Japan 2**

See the bridge, Togetsu-kyo which means "The moon crossing bridge," over the Katsura River which flows through the center of Arashiyama. (2 min)

## **Let's Go Rickshaw Ride Around Japan 3**

The path leading to Okochi Sanso garden from Nonomiya Shrine is about 400m long. (2 min)

## **Taj Mahal 360 Degree (VR) Tour in India**

As one of the 7 wonders of the world, explore the Taj Mahal in India. (2 min)

## **Chennai Floods Aftermath**

The documentary emphasizes the impact, rescue and the reason for the floods that occurred in December 2015 in Chennai, India. (6 min)

## **Discover the Taj Mahal, India**

Join Asha Leo as she ventures around India and explores the Taj Mahal. (5 min)

## **Explore the World in 4K**

Venture around the world and see different aspects of the natural world and various cities and wildlife. (3 min)

## **Walking Tours of Japan- Kiyomizudera Temple in Kyoto**

Experiences a walking tour of Kiyomizudera Temple in Kyoto, Japan. (17 min)

## **Pompeii Amazing Tour in VR- Italy**

Pompeii was an ancient Roman town-city near modern Naples, that was mostly destroyed and buried under 4 to 6 m (13 to 20 ft) of volcanic ash and pumice in the eruption of Mount Vesuvius in 79 AD. (15 min)

## **Dholavira: Archaeological site that contains ruins of the Ancient Indus Valley Civilization**

Dholavira is an archaeological site that contains one of the five largest Harappan sites and most prominent archaeological sites in India belonging to the Indus Valley Civilization. (2 min)

## **New York City 8k**

Times Square is one of the world's most visited tourist attractions, with 50 million visitors annually. Brightly adorned with billboards and advertisements, Times Square is sometimes referred to as "The Crossroads of the World" and "The Center of the Universe". (15 min)

## **North Korea**

Tour throughout the Northeastern parts of North Korea including Rason, Namyang, Hoeryong, Chongjin, Kyongson and Chilbo. (19 min)

## **Life in Haiti: After a Devastating Natural Disaster**

In the early-morning hours of October 4th, 2016, Hurricane Matthew struck Haiti, leaving widespread damage to the island nation in its wake. (5 min)

## **Athens, Parthenon, Parthenonas, Acropolis- VR Walk**

Go on a journey through Athens and its main attractions from Ancient Greece. (5 min)

## **The Dream of Egypt's Tuthmosis IV**

A tour around the statue of the Sphinx temple and the pyramids of Giza. (4 min)

## **Civil War: A Letter from the Trenches**

Get transported back to the 1860's to "experience" what life was like for a young cadet in the Confederate army, trekking through the mud and dodging enemy fire as you journey through the trenches. (5 min)

## **Battle Road: The American Revolution**

Two hundred and forty-one years after the original battle, scores of professional reenactors, organizers, onlookers and photographers gather at Lexington and Concord and Minute Man National Historical Park to honor the memory of this critical turning point in American history. (5 min)

## **A London City Guided Tour**

Guided tour of some of London's most iconic landmarks. (5 min)

## **Beyond the Map | A Day in a Favela**

In Rio, one out of every five residents live in a favela, that's more than one and a half million people. (3 min)

## **Japan - Where Tradition Meets the Future**

Explore Japanese tradition, modernity and nature as you venture around Japan. (3 min)

## **1941 Battle Reenactment**

Watch the reenactment of this World War II battle from 1941. In this video, you'll see operating German vehicles, such as the Pz.Kpfw. III medium tank as well as the StuG III self-propelled gun. The tanks on the Soviet side are the T-34-76 and the BT-7. (3 min)

## **Honor Everywhere**

See the World War II Memorial, Arlington National Cemetery, US Marines Corps War Memorial, US Air Force Memorial and the Korean Memorial. (9 min)

## Remembering Pearl Harbor VR:

### Experience History

Follow Lt. James Downing, who at 103 is the second-oldest living American veteran to have witnessed that day, who recounts his time as postmaster of the USS West Virginia. (2 min)

### Explore a WWI Trench in VR

Explore and discover how WWI soldiers lived in the trenches, view across No Man's Land, explore an officer's quarters, step inside the first aid field hospital and navigate the wet and muddy trench system. (2 min)

### The Fight for Falluja

Experience firsthand the battles Iraqi forces endured to retake the important strategic city of Fallujah from ISIS. (11 min)

### VR Pearl Harbor Attack Reenactment, Japanese Midget Submarine/ Explore South Dakota's Badlands

EXP.1: The Japanese midget submarine, manned by Ensign Kazuo Sakamaki, failed in its mission to attack and destroy American warships. (6 min)

EXP.2: The Badlands is home to the largest mixed grass prairie where bison and other wildlife graze freely. (2 min)

### Women's March in Chicago

Women's March in Chicago on January 21, 2017. (1 min)

### March for our Lives

Pioneer Valley's March for our Lives on March 24, 2018. (1 min)

### Protest Alt Left & Right at Berkley

Experience a political division march from August 29, 2017. (1 min)

### Civil Rights Museum

Five Civil Rights leaders - Rosa Parks, John Lewis, Martin Luther King Jr., Thurgood Marshall, and Medgar Evers - come to life and teach you their stories on interactive stages. (unlimited) [E](#)

### Nuclear Bunker

Replica of an underground nuclear bunker to be used as a shelter from potential disasters. (unlimited) [E](#)

## Protest

Experience a Protest firsthand. (1 min)

## Economics

### 360 Illinois Farm Tour: It Starts with a Seed

Follow a fifth-generation farmer and see the challenge, solutions that technology offers, and ultimately the fruits of our labor that will transform into food, feed and fuel used throughout the state, across the country and around the globe.

Part 1 (6 min)

### 360 Farm Tour: As the Corn Grows

Follow a fifth-generation farmer and see the challenge, solutions that technology offers, and ultimately the fruits of our labor that will transform into food, feed and fuel used throughout the state, across the country and around the globe.

Part 2 (4 min)

### 360 Farm Tour: Harvesting the Corn

Follow a fifth-generation farmer and see the challenge, solutions that technology offers, and ultimately the fruits of our labor that will transform into food, feed and fuel used throughout the state, across the country and around the globe.

Part 3 (4 min)

### 360 Farm Tour: Protecting the Corn

Follow a fifth-generation farmer and see the challenge, solutions that technology offers, and ultimately the fruits of our labor that will transform into food, feed and fuel used throughout the state, across the country and around the globe.

Part 4 (4 min)

### 360° Tour of Gotham Greens' Urban

#### Rooftop Farm | Food Network

Go behind the scenes at Gotham Greens in Brooklyn, New York, where all kinds of leafy greens are grown in their state-of-the-art urban rooftop greenhouse. (2 min)

### A 360 Look Inside Brooklyn's Farming Revolution

Visit a high-tech, hydroponic farm that's fueling a new food revolution that is breaking away from the traditional, transport-heavy, industrial food system and blazing the trail for the future of super-efficient urban farming. (3 min)

### A Vertical Farm Grows In Newark | The Daily 360 | The New York Times

AeroFarms is a farming company that grows produce indoors without sun, soil or pesticides. In this 360j video, step inside one of their vertical farms, which grows kale, arugula and other greens in Newark. (2 min)

### GoPro VR: New York City Jump

There's no better way to see New York City in 360 than through the eyes of a born and bred NY photographer. (3 min)

### Story of Oats: 360

Beginning with planting, growing, and harvesting the oats on a family farm to the processing of the raw product at a milling facility. (6 min)

### Iceland

Soar over Iceland and take in the different views that Iceland has to offer. (3 min)

### Visit Hamilton Island Virtual Reality with Qantas

Fly over Hamilton Island and explore the resort from a Qantas Jet. (8 min)

### Witness the Mysterious World of West African Voodoo

Journey to Togo, a tiny nation in West Africa, that contains the region's largest Voodoo market- 'Marche des Fetches' and learn about the rich history that surrounds this religion. (5 min)

### North Korea

Tour throughout the Northeastern parts of North Korea including Rason, Namyang, Hoeryong, Chongjin, Kyongson and Chilbo. (19 min)

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Times Square is one of the world's most visited tourist attractions, with 50 million visitors annually. Brightly adorned with billboards and advertisements, Times Square is sometimes referred to as "The Crossroads of the World" and "The Center of the Universe". (15 min)

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In the early-morning hours of October 4th, 2016, Hurricane Matthew struck Haiti, leaving widespread damage to the island nation in its wake. (5 min)

## Syrians "Have to survive having no rights" in Lebanon

Syrian refugees are living in makeshift settlements under harsh conditions, with no legal rights in Lebanon's Bekaa Valley. (3 min)

## Humanities

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With red walls and yellow tiles, the resplendent and magnificent Forbidden City is a treasure of China's ancient palace architecture. (5 min)

## Leshan Giant Buddha- Leshan, China

Go on a tour of the Entire Leshan scenic area, including the famous stone Buddha statue. (9 min)

## Dholavira: Archaeological Site That Contains Ruins of the Ancient Indus Valley Civilization

Dholavira is an archaeological site that contains one of the five largest Harappan sites and most prominent archaeological sites in India belonging to the Indus Valley Civilization. (2 min)

## Ancient Egypt- Hall of Pharaohs

Visit the Hall of Pharaohs and interact and learn from 5 of Egypt's most well-known pharaohs of all time: Ramesses the Great, Nefertiti, King Tut, Alexander the Great, and Cleopatra. (unlimited) [E](#)

## Ancient Egypt- The Great Pyramid

Explore the hidden passageways of the Great Pyramid of Giza as you learn about the famous structure and its significance to Ancient Egyptian culture and traditions. (unlimited)

## Crawl Inside a 3,500-Year-Old Egyptian Tomb

Descend 7 meters under the sandy hills of southern Egypt to become one of the first modern humans to explore a newly discovered ancient Egyptian tomb. (3 min)

## The Dream of Egypt's Tuthmosis IV

A tour around the statue of the Sphinx temple and the pyramids of Giza. (4 min)

## Athens, Parthenon, Parthenonas, Acropolis- VR Walk

Go on a journey through Athens and its main attractions from Ancient Greece. (5 min)

## Bruegel: A Fall With The Rebel Angels

In partnership with the Royal Museums of Fine Arts of Belgium, the Google Cultural Institute has designed an immersive experience that lets you explore The Fall of the Rebel Angels (1562) like never before. (4 min)

## Introduction to Geography

### Grand Canyon

Explore the Grand Canyon from different observation decks around the natural wonder. (unlimited) [E](#)

### 1. VR Pearl Harbor Attack | 2. Explore South Dakota's Badlands

EXP.1: The Japanese midget submarine, manned by Ensign Kazuo Sakamaki, failed in its mission to attack and destroy American warships. EXP.2: The Badlands is home to the largest mixed-grass prairie where bison and other wildlife graze freely. (6 min/2 min)

### 1. Cool VR Walk on the Moon | 2. Yosemite

EXP.1 Walk on the Moon from the Project Apollo Archive. EXP.2 Experience a guided tour of some of Yosemite's majestic spots. (2 min/4 min)

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Take a guided tour to view some of London's most iconic landmarks. (5 min)

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### Japan: Where Tradition Meets the Future

Explore Japanese tradition, modernity, and nature. (3 min)

## **Taj Mahal 360 Degree (VR) Tour in India**

Explore one of the 7 Wonders of the World, the Taj Mahal in India. (2 min)

## **The Aurora Borealis over Alaska's Chatanika River**

Explore a timelapse of the Aurora Borealis filmed during a geomagnetic storm by William Briscoe Photography. (5 min)

## **Walking Tours of Japan: Kiyomizudera Temple in Kyoto**

Experience a walking tour of Kiyomizudera Temple in Kyoto, Japan. (17 min)

## **Immerse yourself in a tour around the Forbidden City of China**

With red walls and yellow tiles, the resplendent and magnificent Forbidden City is a treasure of China's ancient palace architecture. (5 min)

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Go on a tour of the Entire Leshan scenic area, including the famous stone Buddha statue. (9 min)

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See the different major religions of the world and how they are dispersed across the world. (9 min)

## **Canyon**

Peer down into a canyon from the top. (1 min)

## **Earth Cutaway**

A model of Earth with a section cut away to expose its layers. [IFX](#)

## **Earth Cutaway info**

An Infographic model of Earth with a section cut away to expose its layers. [IFX](#)

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See the bridge, Togetsu-Kyo which means "The moon crossing bridge," over the Katsura River which flows through the center of Arashiyama. (2 min)

## **Let's Go Rickshaw Ride Around Japan 3**

The path leading to Okochi Sanso garden from Nonomiya Shrine is about 400m long. (2 min)

## **Witness the Mysterious World of West African Voodoo**

Journey to Togo, a tiny nation in West Africa, that contains the region's largest Voodoo market- 'Marche des Fetches' and learn about the rich history that surrounds this religion. (5 min)

## **The Fight for Falluja**

Experience firsthand the battles Iraqi forces endured to retake the important strategic city of Fallujah from ISIS. (11 min)

## **Beyond the Map | A Day in a Favela**

In Rio, one out of every five residents lives in a favela, that's more than one and a half million people. (3 min)

## **Damming the Nile: Episode 1**

Journey from the sacred source of the Blue Nile, down waterfalls, and through canyons to see this giant dam being built. Travel on East Africa's first metro train, go for a traditional Ethiopian lunch, and hear the government's view on the political crisis the dam project has created. (13 min)

## **Damming the Nile: Episode 2**

Journey to the great farming projects of Sudan, fly to a festival on the banks of the Nile and explore the ancient Sudanese pyramid. Then launch in a balloon over Luxor to find out how much this river means to the land of the pharaohs. (16 min)

## **The Hidden World of National Parks**

Follow rangers on a journey to places most people never go. Experience the sights, sounds, and adventures of Kenai Fjords, Hawai'i Volcanoes, Carlsbad Caverns, Bryce Canyon, and Dry Tortugas. (5 min)

## **Climbing the Redwoods: Fight for the Forests**

Climb 200 feet up 'Grandfather,' the highest Redwood in a Northern California Grove while learning about the Redwood Forest and preservation efforts. (2 min)

## **Ocean to Plate: A Journey into the Seafood Supply Chain**

As populations and appetites grow, global fisheries are reaching their ecological capacity, yet at least a third of harvested fish and seafood is lost or wasted along the supply chain. (7 min)

## **Protecting Ocean Anchor Species:**

### **Racing Extinction**

Join marine biologist Luke Tipple as he swims alongside manta rays and whale sharks while sharing why they are vital to the survival of our oceans. (3 min)

## **Minority Studies**

### **Seeking Home: Life Inside the Calais Migrant Camp**

This documentary of a migrant camp in northern France follows the residents as the "Jungle", migrants have turned the rugged landscape into a makeshift town with churches, mosques, restaurants, and even a beauty salon while hoping to migrate across the English Channel. (6 min)

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This film offers a revealing view of the Green Book Era as told through Ben's Chili Bowl, a black-owned restaurant in Washington, to remind us of the hardships that African-Americans faced during that time period. (20 min)

## Chennai Floods Aftermath

Take an immersive journey through the impact, rescue, and reason for the floods that occurred in Chennai, India, in December 2015. (6 min)

## Himalayas: A Trek to School

Follow two girls as they travel up to 6 hours a day to school in a remote Himalayan village. (8 min)

## Life in Haiti: After a Devastating Natural Disaster

Join filmmaker Dylan Roberts on a journey to the Haitian city of Jérémie, and the small village of Manish, to witness the aftermath of a colossal storm. (5 min)

## Out of Syria- Back to School

Step into the lives of two teenagers from war-torn Syria, Mustafa and Sarah. They both fled the fighting with their families. They left their homelands and their schools behind. (4 min)

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Experience firsthand the battles Iraqi forces endured to retake the important strategic city of Fallujah from ISIS. (11 min)

## Problems in American Democracy

### Independence Hall

Join George Washington, John Adams, Thomas Jefferson, Benjamin Franklin, and John Hancock as they come to life to tell you their stories about the founding of the United States. (unlimited) [E](#)

## Civil Rights Museum

Five Civil Rights leaders - Rosa Parks, John Lewis, Martin Luther King Jr., Thurgood Marshall, and Medgar Evers - come to life and teach you their stories on interactive stages. (unlimited) [E](#)

## Psychology

### Brain

Realistic model of the Human Brain. [IFX](#)

### Anatomy Lab

Highly interactive anatomy classroom that allows Students assemble the human body piece by piece with over 90 separate body parts to learn about. (unlimited) [E](#)

### How Babies See the World

Follow along as you see through the eyes of a baby how their eyesight changes over the first year of life. (2 min)

### A Walk-Through Dementia- At Home

A unique experience designed to put you in the shoes of someone living with dementia. (3 min)

### A Walk-Through Dementia- Walking

### Home

A unique experience designed to put you in the shoes of someone living with Dementia. (4 min)

### Autism Virtual Reality

Become a student with autism in the daily fight for survival. (7 min)

### Inside Anxiety

Anxiety can make you feel on edge, unable to concentrate, fearful, irritable and like you have lost control. Step inside the mind of someone who experiences anxiety and see the world from their point of view. (9 min)

## Sociology

### Walking Tours of Japan- Kiyomizudera Temple in Kyoto

Experiences a walking tour of Kiyomizudera Temple in Kyoto, Japan. (17 min)

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The path leading to Okochi Sanso Garden from Nonomiya Shrine is about 400m (about 1312.34 ft) long. (2 min)

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## GoPro VR: New York City Jump

There's no better way to see New York City in 360 than through the eyes of a born and bred NY photographer. (3 min)

## Immerse yourself in a tour around the Forbidden City of China

With red walls and yellow tiles, the resplendent and magnificent Forbidden City is a treasure of China's ancient palace architecture. (5 min)

## Weaving Around the World

From Venice to Addis Ababa, the West Bank to the Navajo Nation Reservation, follow the process of weaving that has been developed across cultures for thousands of years. (4 min)

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In Rio, one out of every five residents live in a favela, that's more than one and a half million people. (3 min)

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## New York City 8k

Times Square is one of the world's most visited tourist attractions, with 50 million visitors annually. Brightly adorned with billboards and advertisements, Times Square is sometimes referred to as "The Crossroads of the World" and "The Center of the Universe". (15 min)

## North Korea

Tour throughout the Northeastern parts of North Korea including Rason, Namyang, Hoeryong, Chongjin, Kyongson and Chilbo. (19 min)

## US History

### Civil Rights Museum

Five Civil Rights leaders - Rosa Parks, John Lewis, Martin Luther King Jr., Thurgood Marshall, and Medgar Evers - come to life and teach you their stories on interactive stages. (unlimited) [E](#)

## Explore a WWI Trench in VR

Explore and discover how WWI soldiers lived in the trenches, view across No Man's Land, explore an officer's quarters, step inside the first aid field hospital and navigate the wet and muddy trench system. (2 min)

## Remembering Pearl Harbor VR: Experience History

Follow Lt. James Downing as he recounts his time as postmaster of the USS West Virginia. (2 min)

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## 1941 Battle Reenactment

Watch the reenactment of this World War II battle from 1941. In this video, you'll see operating German vehicles, such as the Pz.Kpfw. III medium tank as well as the StuG III self-propelled gun. The tanks on the Soviet side are the T-34-76 and the BT-7. (3 min)

## Honor Everywhere

See the World War II Memorial, Arlington National Cemetery, US Marines Corps War Memorial, US Air Force Memorial, and the Korean Memorial. (9 min)

## Nuclear Bunker

Replica of an underground nuclear bunker to be used as a shelter from potential disasters. (unlimited) [E](#)

## The JFK Assassination

Follow along as you get an in-depth look into the assassination of JFK. (4 min)

## Medgar Evers House

Explore a recreation of the Medgar Evers House and National Monument. Made in collaboration with the Evers family. (unlimited) [E](#)

## Traveling While Black

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## The Fight for Falluja

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## Women's March in Chicago

Experience a women's rights march in Chicago on Jan 21, 2017. (1 min)

## March for our Lives

Pioneer Valley's March for our Lives on March 24, 2018. (1 min)

## Protest Alt Left & Right at Berkley

Experience a political division march from August 29, 2017. (1 min)

## US Government

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## World Geography

### Grand Canyon

Explore the Grand Canyon from different observation decks around the natural wonder. (unlimited)

## Explore the World in 4K

Venture around the world and see different aspects of the natural world and various cities and wildlife. (3 min)

### Forest

View a tranquil forest and the plant life throughout it. (1 min)

### Cool VR Walk on the Moon with NASA/ Yosemite

EXP.1- Experience a walk on the Moon from the Project Apollo Archive. (2 min)

EXP.2-Experience a guided tour of some of Yosemite's majestic spots. (4 min)

### Canyon

Peer down into a canyon from the top. (1 min)

### Pond

Explore a freshwater pond and the plants that surround it. (1 min)

### Waterfall 1

View a waterfall and the surrounding plant life. Pt.1 (1 min)

### Waterfall 2

View a waterfall and the surrounding plant life. Pt.2 (1 min)

### Waterfall 3

View a waterfall and the surrounding plant life. Pt.3 (1 min)

### Antarctica- Part II

See Antarctica from aboard a ship as it sails around Antarctica and see the different wildlife. (6 min)

### The Hidden World of National Parks

Follow rangers on a journey to places most people never go. Experience the sights, sounds, and adventures of Kenai Fjords, Hawai'i Volcanoes, Carlsbad Caverns, Bryce Canyon, and Dry Tortugas in stunning 360° video. (5 min)

### Back to Nature- Rainforest

Escape to the lush temperate rainforest of Southern Australia.(4 min)

## Travel-Dream-Imagine- A VR Journey from the desert floor to the Sea

Travel with us as we step into the Judea desert, bathe in a waterfall in a hidden oasis, wet our feet in the red sea, dive among corals and finally float in one of the wonders of the world - the dead sea. (2 min)

### Antarctica – Unexpected Snow

See how a Penguin and Seal colony as a winter storm moves in. (2 min)

### Kamchatka Volcano Eruption

National Geographic VR takes you to the rim of a spectacular erupting volcano: Klyuchevskoy, one of the tallest and most active volcanoes on the planet. (2 min)

### Iceland

Soar over Iceland and take in the different views that Iceland has to offer. (3 min)

### Accelerant Turbine

Model of a steam turbine set in a warehouse location. (unlimited)

### Insane 360 Video of Close-Range

### Tornado near Wray, CO

360 Video of close-range tornado near Wray, CO May 7<sup>th</sup>, 2016. (8 min)

### Expedition to the Heart of Active Volcano

Join a group of climbers as they embark on a scientific exploration into an active volcano. (5 min)

### Boston Snowstorm from Bunker Hill Monument

Watch a major winter storm on December 16 and 17, 2020 move through the city of Boston in this time-lapse from the top of Bunker Hill Monument. (3 min)

### Inside Hurricane Maria

See inside Hurricane Maria and see how it changes from a category 1 to a category 5 in about 24 hours. (5 min)

## **Pompeii Amazing Tour in VR- Italy**

Pompeii was an ancient Roman town-city near modern Naples, that was mostly destroyed and buried under 4 to 6 m (13 to 20 ft) of volcanic ash and pumice in the eruption of Mount Vesuvius in 79 AD. (15 min)

## **Life in Haiti: After a Devastating Natural Disaster**

In the early-morning hours of October 4th, 2016, Hurricane Matthew struck Haiti, leaving widespread damage to the island nation in its wake. (5 min)

## **After the Floods: Rebuilding Ellicott City**

An immersive journey through the flooding, aftermath and reconstruction of Ellicott City, Maryland to give a new perspective to the damage done by the flooding. (6 min)

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The documentary emphasizes the impact, rescue and the reason for the floods that occurred in December 2015 in Chennai, India. (6 min)

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Tour throughout the Northeastern parts of North Korea including Rason, Namyang, Hoeryong, Chongjin, Kyongson and Chilbo. (19 min)

## **Category 3 Hurricane Landfall Simulation**

Experience a category 3 hurricane through a simulation with guided popups. (1 min)

## **Earthquake VR Experience**

Simulation of a virtual earthquake to provide lifelike training experience without an actual earthquake. (2 min)

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## **The Fight for Falluja**

Experience firsthand the battles Iraqi forces endured to retake the important strategic city of Fallujah from ISIS. (11 min)

## **360 Illinois Farm Tour: It Starts with a Seed**

Follow a fifth-generation farmer and see the challenge, solutions that technology offers, and ultimately the fruits of our labor that will transform into food, feed and fuel used throughout the state, across the country and around the globe.

Part 1 (6 min)

## **360 Farm Tour: As the Corn Grows**

Follow a fifth-generation farmer and see the challenge, solutions that technology offers, and ultimately the fruits of our labor that will transform into food, feed and fuel used throughout the state, across the country and around the globe.

Part 2 (4 min)

## **360 Farm Tour: Harvesting the Corn**

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Part 3 (4 min)

## **360 Farm Tour: Protecting the Corn**

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Part 4 (4 min)

## **FarmFood 360° Virtual Food Tour: Cheese Processing**

In this 360° virtual tour video, you’ll find out how cheese is processed - from the time the milk leaves a Canadian family dairy farm to the time it reaches your table (6 min)

## **FarmFood 360° Virtual Food Tour: Milk Processing**

In this 360° Virtual Food Tour, you’ll learn how milk travels from a Canadian family dairy farm to a processing facility where it is made ready for your family’s table. (6 min)

## **Story of Oats: 360**

Beginning with planting, growing, and harvesting the oats on a family farm to the processing of the raw product at a milling facility. (6 min)

## **GoPro VR: New York City Jump**

There’s no better way to see New York City in 360 than through the eyes of a born and bred NY photographer. (3 min)

## **World History**

### **Explore a WWI Trench in VR**

Explore and discover how WWI soldiers lived in the trenches, view across No Man’s Land, explore an officer’s quarters, step inside the first aid field hospital and navigate the wet and muddy trench system. (2 min)

### **1941 Battle Reenactment**

Watch the reenactment of this World War II battle from 1941. In this video, you’ll see operating German vehicles, such as the Pz.Kpfw. III medium tank as well as the StuG III self-propelled gun. The tanks on the Soviet side are the T-34-76 and the BT-7. (3 min)

### **Honor Everywhere**

See the World War II Memorial, Arlington National Cemetery, US Marines Corps War Memorial, US Air Force Memorial, and the Korean Memorial. (9 min)

### **Remembering Pearl Harbor VR:**

#### **Experience History**

Follow Lt. James Downing, as he recounts his time as postmaster of the USS West Virginia. (2 min)

### **VR Pearl Harbor Attack Reenactment, Japanese Midget Submarine**

The Japanese midget submarine, manned by Ensign Kazuo Sakamaki, failed in its mission to attack and destroy American warships. (6 min)

## **Virtually Inside the First Tank**

Join Richard “The Challenger” Cutland and Nicholas “Chieftain” Moran as they explore the oldest members of the collection at The Tank Museum at Bovington, UK, including the world’s last surviving Mark I tank: the oldest surviving combat tank in the world. (7 min)

## **Nuclear Bunker**

Replica of an underground nuclear bunker to be used as a shelter from potential disasters. (unlimited) [E](#)

# IFX - Interactable Objects

## Mathematics

### US Money - 1 Dollar Bill | 2 Dollar Bill | 5 Dollar Bill | 10 Dollar Bill | 20 Dollar Bill | 50 Dollar Bill | 100 Dollar Bill

Realistic representations of US paper money that can be used to teach about currency, decimals, and making change. [IFX](#)

### 10 × 10 Array

This interactive math tool can be used to help students understand fractions, decimals, percents, and ratios by toggling 100 individual cubes on or off. [IFX](#)

### Abacus

This interactive math tool lets students toggle individual beads back and forth, which they can use to learn about place value, perform basic calculations, or represent large numbers. [IFX](#)

### Cone - Scalable

Dynamically scale the base and height of this cone, and learn to calculate its volume. [IFX](#)

### Cube - Scalable

Dynamically scale the edge length of this cube, and learn to calculate its volume. [IFX](#)

### Cylinder - Scalable

Dynamically scale the base and height of this cylinder, and learn to calculate its volume. [IFX](#)

### Rectangular Prism - Scalable

Dynamically scale the length, width, and height of this rectangular prism, and learn to calculate its volume. [IFX](#)

### Rectangular Pyramid - Scalable

Dynamically scale the base and height of this rectangular pyramid, and learn to calculate its volume. [IFX](#)

### Sphere - Scalable

Dynamically scale the radius of this sphere, and learn to calculate its volume. [IFX](#)

### Triangular Prism - Scalable

Dynamically scale the base and height of this triangular prism, and learn to calculate its volume. [IFX](#)

### Triangular Pyramid - Scalable

Dynamically scale the base and height of this triangular pyramid, and learn to calculate its volume. [IFX](#)

### Exponents Visualizer

A visualization of how exponents work using colorful cubes for numbers 1-10.

### Ferris Wheel - Sine & Cosine Demo

Learn about the sine and cosine functions by plotting your position as you ride on a Ferris Wheel. [IFX](#)

### Math Words (37 separate IFX)

3D representation of words for math and numbers. [IFX](#)

### Metric Volumes - 1000 mL Beaker | 1-Kiloliter Tank | 1-Liter Bottle | 2-Liter Bottle

Visualize and compare volumes with these 3D models. [IFX](#)

### US/Imperial Volumes - Cup | Gallon | Pint | Quart | Tablespoon | Teaspoon

Visualize and compare volumes with these 3D models. [IFX](#)

### Money Pallet - One Billion Dollars

A visualization of a billion dollars when counted using US hundred dollar bills. [IFX](#)

### Multiplication Table

An interactive 10x10 multiplication table that visualizes multiplication in rows and columns. Individual numbers can be toggled on or off to allow for quizzing. [IFX](#)

### Number Builder

This interactive math tool lets students explore place value up to the trillions place, and down to the trillionths place. The value of each place can be set, allowing users to create any number big or small. Teachers can also use this as a quizzing tool by hiding the place value labels. [IFX](#)

### Number Line - Whole Numbers (Positive)

This interactive math tool shows whole numbers 1-100, grouped in sections of 10 at a time. Students can use this tool to practice counting up or down by 1, 2, 3, 4, 5, or 10. [IFX](#)

### Place Value Blocks - 1 | 10 | 100 | 1000

Students can learn about place value with these 3D blocks representing 1, 10, 100, and 1000. [IFX](#)

### Place Value Whiteboard

This interactive whiteboard is labeled with boxes for representing the place value of numbers. Students can use this as a tool to learn about place value, then compare the values of two different numbers. [IFX](#)

### Point Plotter

Plot up to 12 line segments on a grid by defining each point's position and rotation. [IFX](#)

### Protractor - 360° (Interactive)

This interactive measuring tool can be used to measure angles of any object in any scene. The measuring arm can be moved in 1°, 5°, 10°, 15°, 20°, 30°, or 45° increments, allowing students to dynamically measure angles of any value. [IFX](#)

### Pythagorean Theorem Visualizer

Interactive visualization of the Pythagorean Theorem. Select values for sides A and B to generate a triangle, then apply the theorem for side C. [IFX](#)

### Revolved Cone

Visualization of how a 2D right triangle can be revolved into a 3D cone. [IFX](#)

## Mathematics (cont.)

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### Revolved Cylinder

Visualization of how a 2D rectangle can be revolved into a 3D cylinder. [IFX](#)

### Revolved Sphere

Visualization of how a 2D semicircle can be revolved into a 3D sphere. [IFX](#)

### Tens Frame

Students can use the interactive Tens Frame to explore the concepts of basic addition, subtraction, and representation of numbers 1-10. [IFX](#)

## Science

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### Sun Formation

See lots of Particles colliding to form the Sun. [IFX](#)

### Star Visualization- Sand Pile 1

Visualization of the number of stars in the universe as grains of sand on a map of the US. [IFX](#)

### Star Visualization- Sand Pile 2

Visualization of the number of stars in the universe as grains of sand on a partial map of the US. [IFX](#)

### Particle collision with Sparks

Two swarms of particles colliding with each other and forming sparks. [IFX](#)

### Bunsen Burner

Interactive model of a Bunsen burner with toggleable flame. [IFX](#)

### Erlenmeyer Flask

Flask/beaker with a chemical reaction taking place inside. [IFX](#)

### Hazardous Waste Disposal

Interactive model of a fire extinguisher. [IFX](#)

### Fire Extinguisher

Interactive model of a fire extinguisher. [IFX](#)

### Lab Safety Manual

Interactive at-scale measuring tool. [IFX](#)

### Emergency Eye Wash

Interactive model of an emergency eyewash and shower station as found in a science lab. [IFX](#)

### Tape Measure

Interactive at-scale measuring tool. Users can extend the tape in 1-ft segments up to 10 feet. [IFX](#)

### Face Mask

Photorealistic model of a blue disposable face mask. [IFX](#)

### Fume Hood

Interactive science lab fume hood. [IFX](#)

### International Space Station

Model of the exterior of the International Space Station. [IFX](#)

### Fire Extinguisher- Network

Interactive model of a fire extinguisher that allows for the user to pull the pin, aim the handle, and squeeze the trigger to produce the foam. [IFX](#)

### Accelerant Turbine

Model of a steam turbine set in a warehouse location. [IFX](#)

### X- Ray Machine

Interactive model of an x-ray machine. [IFX](#)

## Miscellaneous

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### Trolley Barn

Mockup of a proposed design for a trolley bar in Belmont, NC. [IFX](#)

### Painting Tool

Select the color you want to paint the other objects, then touch one painting tool to the other to change its color. [IFX](#)

## ADDITIONAL OFFERINGS

### Other Content

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#### Museum of Science Fiction

A VR Sci-Fiction Museum. (unlimited) [E](#)

#### Picto Puzzle

Multiplayer game where one participant designs a maze, one level at a time, and the other participants must race to solve it before the next level is created. (unlimited) [E](#)

#### EMU Multicultural Center

Multi-use space featuring a community center, art gallery, and a café. (unlimited) [E](#)

#### Google Data Center Tour

Take a Google data center tour and learn about the massive scale, the incredible attention to security and privacy, and the amazing efforts to make the data center extremely efficient and green. (9 min)

#### Letter A - 360 3D Animated VR Kids Video

Try out our 360 degree video where you can turn all around to find the objects that begin with the Letter A. (2 min)

#### Letter B - 360 3D Animated VR Kids Video

Try out our 360 degree video where you can turn all around to find the objects that begin with the Letter B. (2 min)

#### Letter C - 360 3D Animated VR Kids Video

Try out our 360 degree video where you can turn all around to find the objects that begin with the Letter C. (2 min)

#### Letter D - 360 3D Animated VR Kids Video

Try out our 360 degree video where you can turn all around to find the objects that begin with the Letter D. (2 min)

## Letter E - 360 3D Animated VR Kids Video

Try out our 360 degree video where you can turn all around to find the objects that begin with the Letter E. (2 min)

## Letter F - 360 3D Animated VR Kids Video

Try out our 360 degree video where you can turn all around to find the objects that begin with the Letter F. (2 min)

## Letter G - 360 3D Animated VR Kids Video

Try out our 360 degree video where you can turn all around to find the objects that begin with the Letter G. (2 min)

## Letter H - 360 3D Animated VR Kids Video

Try out our 360 degree video where you can turn all around to find the objects that begin with the Letter H. (2 min)

## Letter I - 360 3D Animated VR Kids Video

Try out our 360 degree video where you can turn all around to find the objects that begin with the Letter I. (3 min)

## Letter J - 360 3D Animated VR Kids Video

Try out our 360 degree video where you can turn all around to find the objects that begin with the Letter J. (5 min)

## Letter K - 360 3D Animated VR Kids Video

Try out our 360 degree video where you can turn all around to find the objects that begin with the Letter K. (5 min)

## Letter L - 360 3D Animated VR Kids Video

Try out our 360 degree video where you can turn all around to find the objects that begin with the Letter L. (7 min)

## Letter M - 360 3D Animated VR Kids Video

Try out our 360 degree video where you can turn all around to find the objects that begin with the Letter M. (6 min)

## Letter N - 360 3D Animated VR Kids Video

Try out our 360 degree video where you can turn all around to find the objects that begin with the Letter N. (4 min)

## Backstage with an Elite Ballerina

Go behind the scenes with Sarah Lane, a soloist at the American Ballet Theatre, as she prepares to dance the title role in "The Sleeping Beauty" at Lincoln Center. (5 min)

## Explore the World in 4k

Venture around the world and see different aspects of the natural world and various cities and wildlife. (3 min)

## GoPro VR: New York City Jump

There's no better way to see New York City in 360 then through the eyes of a born and bred NY photographer. (3 min)

## Okinawa 360 - VR Sea Tour

Explore the diverse aquatic life surrounding Okinawa. (5 min)

## Visit Hamilton Island Virtual Reality with Qantas

Fly over Hamilton Island and explore the resort from a Qantas Jet. (8 min)

## How Babies See The World

Follow along as you see through the eyes of a baby how their eyesight changes over the first year of life. (2 min)

## Wreck Diving Time Lapse

Scuba dive one of the Caribbean's most iconic shipwrecks. (1 min)

## A Skateboard Ride to STEM Learning | 360° VR video

University of Washington Professor Kristen Missall discusses her research partnership with Iowa Children's Museum and leads a tour of its "Notion of Motion" exhibit. (3 min)

## NYC 360 Time Warp

Time lapse of a day in New York City. (1 min)

## All Skippers Invited

Join a short selling trip on a sunny day. (1 min)

## Panoramic Experiences

### The Alamo

Alamo 1  
Alamo 2  
Alamo 3  
Alamo 4  
Alamo 5  
Alamo 6  
Alamo Cenotaph Monument

### The Forbidden City

Forbidden City 1  
Forbidden City 2  
Forbidden City 3  
Forbidden City 4  
Forbidden City 5  
Forbidden City 6  
Forbidden City 7  
Forbidden City 8

### The Louvre

Jardin de l'Oratoire  
Louvre 1  
Louvre 2  
Louvre 3  
Louvre 4  
Louvre 5  
Louvre 6  
Louvre 7  
Louvre 8  
Louvre 9  
Louvre 10  
Louvre 11  
Louvre 229  
Louvre 307-309  
Louvre Front  
Louvre Outside 2  
Louvre Outside  
Louvre Pyramid  
Louvre Rivoli

### The Vatican

Altar of the Fatherland  
Basilica di San Giovanni in Laterano  
Basilica di San Giovanni in

## The Vatican (cont.)

Laterano 2  
 Basilica Papale di Santa Maria  
 Maggiore  
 Basilica Papale di Santa Maria  
 Maggiore 2  
 Baths of Caracalla  
 Baths of Diocletian  
 Borghese Gallery and Museum  
 Borghese Gallery and Museum 2  
 Borghese Gallery and Museum 3  
 Borghese Gallery and Museum  
 Entrance  
 Campidoglio  
 Capitoline Museums 1  
 Capitoline Museums 2  
 Capitoline Museums 3  
 Capitoline Museums 4  
 Capitoline Museums Exterior  
 Castel Sant'Angelo  
 Castel Sant'Angelo 2  
 Castel Sant'Angelo 3  
 Circus Maximus  
 Colosseum  
 Colosseum 2  
 Doria Pamphilj Gallery  
 Fiumi Fountain  
 Fontana di Trevi  
 Hadrian's Villa  
 Largo di Torre Argentina  
 Largo Romolo e Remo  
 Ludus Magnus  
 National Roman Museum  
 Palatine Hill  
 Pantheon  
 Pantheon Entrance  
 Piazza del Popolo  
 Piazza Navona  
 Pyramid of Caius Cestius  
 Roman Forum  
 Roman Forum 2  
 Spanish Steps  
 St. Clemens Basilica  
 Temple of Asclepius  
 Trajan's Column  
 Trajan's Market  
 Villa d'Este 1  
 Villa d'Este 2

## Jerusalem

Ben Yehuda St 1  
 Ben Yehuda St 2  
 Chords Bridge  
 Church of All Nations  
 Church of the Holy Sepulchre 1  
 Church of the Holy Sepulchre 2  
 Church of the Holy Sepulchre 3  
 City of David  
 Damascus Gate  
 Davidka Square  
 Dome of the Rock 1  
 Dome of the Rock 2  
 Dome of the Rock Exterior  
 Dormition Abbey  
 Gethsemane  
 Hall of Names, Yad Vashem  
 Lions' Gate  
 Mahane Yehuda Market  
 Model of Jerusalem in 2nd Temple  
 Period 1  
 Model of Jerusalem in 2nd Temple  
 Period 2  
 Montefiore Windmill  
 Mount of Olives  
 Museum on the Seam  
 National Hall for Israel's Fallen  
 Pool of Siloam  
 Rockefeller Archaeological  
 Museum  
 Sacher Park  
 The Garden Tomb Jerusalem 1  
 The Garden Tomb Jerusalem 2  
 The Israel Museum  
 The Israel Museum Exterior  
 The Jaffa Gate  
 Tomb of the Prophets  
 Tomb of the Virgin  
 Tower of David  
 Warsaw Ghetto Monument  
 Western Wall  
 Wohl Rose Garden  
 Zedekiah's Cave  
 Zion Gate

## Mount Rushmore

Lincoln Borglum Visitor Center 1  
 Lincoln Borglum Visitor Center 2  
 Lincoln Borglum Visitor Center 3  
 Lincoln Borglum Visitor Center 4  
 Mount Rushmore 1  
 Mount Rushmore 2  
 Mount Rushmore 3  
 Mount Rushmore 4  
 Presidential Trail 1  
 Presidential Trail 2  
 Presidential Trail 3  
 Sculptor's Studio  
 SD 244 1  
 SD 244 2  
 SD 244 3

## Yosemite National Park

Bridalveil Falls View  
 Cathedral Beach  
 El Capitan Picnic Area  
 Glacier Point Trail  
 Glacier Point  
 Lost Arrow Spire  
 Lower Yosemite Falls Bridge  
 Lower Yosemite Falls Trailhead  
 Merced River 1  
 Merced River 2  
 Merced River 3  
 North Dome  
 Sentinel Beach  
 Tunnel View  
 Upper Yosemite Falls Trail  
 Upper Yosemite Falls  
 Washburn Point  
 Yosemite Falls  
 Yosemite Mountaintop  
 Yosemite Valley View

## London, England

Barbican Centre  
 Big Ben  
 Borough Market 1  
 Borough Market 2  
 Buckingham Palace  
 Canary Wharf  
 Churchill War Rooms  
 Cutty Sark

## London, England (cont.)

Hyde Park  
Kensington Palace  
Kyoto Garden Holland Park  
London Bridge 1  
London Bridge 2  
London Bridge 3  
London Eye  
London Eye Waterloo Pier  
London Wall  
Memorial Garden  
Millenium Bridge  
Monument of the Great Fire of London  
National Gallery 1  
National Gallery 2  
National Gallery 3  
National Gallery 4  
National Gallery Exterior  
Palace of Westminster 1  
Palace of Westminster 2  
Palace of Westminster 3  
Palace of Westminster Exterior  
Piccadilly Circus  
Princess Diana Memorial Garden  
Royal Albert Hall  
Shaftesbury Memorial Fountain  
St. James's Palace  
St. Mary's Axe  
St. Paul's Cathedral  
Tate Modern  
Tate Modern Viewing Level  
The British Museum 1  
The British Museum 2  
The British Museum 3  
The British Museum 4  
The British Museum 5  
The British Museum 6  
The British Museum Exterior  
Tower Bridge  
Tower of London  
Trafalgar Square

## Virtual Museums & Field Trips

### Smithsonian National Museum of Natural History

Explore and learn from the many exhibits in the Smithsonian. (unlimited)

### The Vatican Museum

Raphael's Rooms, Pio Clementino Museum, Niccoline Chapel, Room of Chiaroscuro. (unlimited)

### George Washington's Mount Vernon

Explore George Washington's historic home. (unlimited)

### The Met 360 Project

Great Hall (2 min), The Met Cloisters (2 min), The Temple of Dendur (2 min), The Met Breuer (2 min), The Charles Engelhard Court (3 min), Arms and Armor Galleries (3 min), Collection (6min)

### Kennicott Glacier

Explore the Kennicott Glacier in the Wrangell-St. Elias National Park and Preserve in Alaska. (unlimited)

### Access Mars

Explore the Planet of Mars from the Mars Rover. (unlimited)

### National Museum of the US Air Force

Explore the Museum of the US Air Force and learn about its history. (unlimited)

### Antietam National Battlefield

Explore this historic battlefield from the Civil War. (unlimited)

### Gettysburg National Battlefield

Explore this historic Battlefield from the Civil War. (unlimited)

### Fredericksburg National Battlefield

Explore this historic battlefield from the Civil War. (unlimited)

### Charleston and Fort Sumter

Explore this historic battlefield from the American Revolution. (unlimited)

### Shiloh National Battlefield

Explore this historic Battlefield from the Civil War. (unlimited)

## Chattanooga National Military Park

Explore this historic Battlefield from the Civil War. (unlimited)

### Yorktown Battlefield

Explore this historic Battlefield from the Revolutionary War. (unlimited)

### Vicksburg National Military Park

Explore this historic Battlefield from the Civil War. (unlimited)

### Appomattox Courthouse

Explore this historic Courthouse where the end of the Civil War happened. (unlimited)

### Chancellorsville Battlefield

Explore this historic Battlefield from the Civil War. (unlimited)

### Guilford Courthouse

Explore this historic site from the Revolutionary War. (unlimited)

### Eutaw Springs Battlefield

Explore this historic Battlefield from the Revolutionary War. (unlimited)

### Mount Everest

Explore the impressive heights of Mount Everest. (unlimited)

