

STEM



enVision K12 Math Series

The **enVision** K12 Math Series presents STEM Projects (“Math and Science Project” for grades K-5) in every topic, at every grade level. The objective of each project connects math to real social, economic, and environmental issues through a scientific lens—from Earth sciences to biology, engineering to physics, or astronomy to anatomy, just to name a few.

Engineering

Grade 3: Students are introduced to engineering design:

- Discuss different kite designs
- Discuss different kite materials and varying costs per material
- Find total cost per design
- Determine the cheaper design
- Write equation to show the cheaper design

TOPIC 11

Use Operations with Whole Numbers to Solve Problems

Essential Question: What are ways to solve 2-step problems?

Digital Resources

Use icons to find resources for this topic.

It's fun to build something that you designed! Here's a project on engineering.

☞ Kites come in many shapes and sizes.

☞ Engineers think about how much material, time, and money they need for a successful design.

Math and Science Project: Engineering Design

Do Research Use the Internet or other sources to find information about kites. Find two designs for building a kite. What materials do you need for each design? How much do those materials cost?

Journal: Write a Report Include what you found. Also in your report:

- Find the total cost for each design.
- Decide which design is cheaper.
- Write an equation to show how much cheaper that design is.

TOPIC 11

TOPIC OPENER

USE OPERATIONS WITH WHOLE NUMBERS TO SOLVE PROBLEMS

TOPIC ESSENTIAL QUESTION

What are ways to solve two-step problems?

Answer the Topic Essential Question throughout the topic, and use it as a guide about answering the question in the Teacher's Edition for the Topic Assessment.

It's fun to build something that you designed! Here's a project on engineering.

Math and Science Project: Engineering Design

Background: Use the Internet or other sources to find information about kites. Find two designs for building a kite. What materials do you need for each design? How much do those materials cost?

Journal: Write a Report Include what you found. Also in your report:

- Find the total cost for each design.
- Decide which design is cheaper.
- Write an equation to show how much cheaper that design is.

Home-School Connection

Use Questions with Whole Numbers to Solve Problems.

Send this page home at the start of Topic 11 to give families an overview of the content in the topic.

MATH AND SCIENCE PROJECT STEM

Science Theme The science theme for this project is **Engineering Design**. This theme will be revisited in the Math and Science Activities in Lessons 11-2 and 11-4 and in some lesson exercises.

Ask students to talk about different designs for kites.

Discuss different materials that kites can be made from. Talk about how the size of a kite and the different materials would change the cost of making the kite.

Sample Student Work for Math and Science Project

Kite Materials	Cost
bamboo skewers, tape, colored plastic bags, garbage bags, flying line, handle	\$2.50
rusty tin, nylon, fiberglass poles, tape, flying line, handle	\$8.50

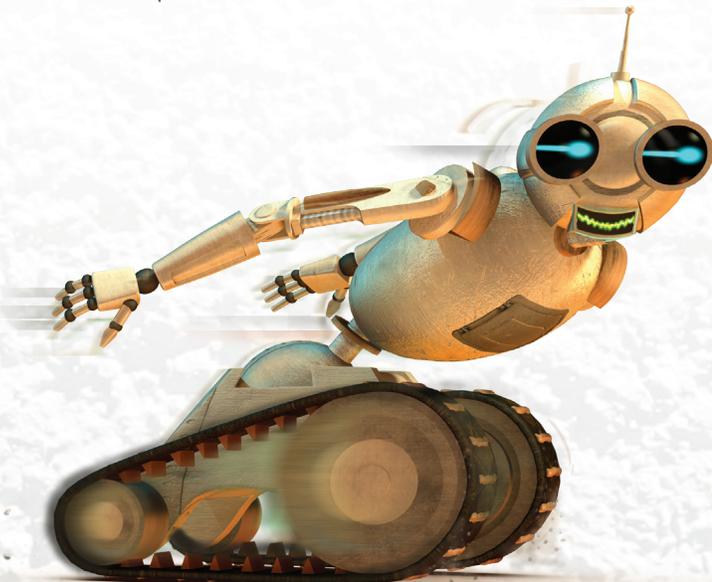
The kite made from plastic bags is \$6 cheaper.
 $\$8.50 - \$2.50 = \$6$

Where's the Math?

Students examine relationships between quantities in a two-step word problem by writing equations. They draw diagrams and write equations using different operations.

Where's the Science?

Students apply engineering design as they research possible kite construction solutions and modify as necessary. They determine which materials are most efficient yet cost effective.



Grade 6: Students revisit engineering design in “Pack It,” which explores design for food packaging.

Project Overview

In this project, students explore how engineers design food packaging. They will use the engineering design process to develop packaging for food while considering constraints such as dimensions or materials.

What's the Engineering and Technology?

Students think like an engineer and apply the engineering design process as they work toward a proposed solution. The solution may develop and evaluate possible solutions, and redesign as needed.

Your Task: Pack It

Food packaging engineers consider many elements related to both form and function when designing packaging. How do engineers make decisions about package designs as they consider constraints, such as limited dimensions or materials? You and your classmates will use the engineering design process to explore and propose food packaging that satisfies certain criteria.

Next Generation Science Standards: MS-ETS1-1, MS-ETS1-2, MS-ETS1-3, MS-ETS1-4

Did You Know?

Food packaging is designed to identify products and to attract customers. Packaging also ensures food remains fresh and free from damage and contamination.

Common types of packaging are plastic and aluminum. Packaging design, for example, soup, could be rather complex.

Manufacturers consider several factors when designing packaging, such as cost, amount of material used, and potential environmental impact. Steel food cans are the most recycled food package in the United States.

Your Task: Pack It

Food packaging engineers consider many elements related to both form and function when designing packaging. How do engineers make decisions about package designs as they consider constraints, such as limited dimensions or materials? You and your classmates will use the engineering design process to explore and propose food packaging that satisfies certain criteria.

Where's the Math?

Students use geometry to determine how the volume of the packaging relates to the volume of the food item being packaged. Student use nets to illustrate possible solutions to the task.

Where's the Science?

Students investigate solutions through the engineering design process. They define the problem, identify constraints, brainstorm solutions, create prototypes, test, and evaluate.

Algebra 1: Students apply engineering design when asked to design a T-shirt launcher.

Did You Know?

Objects launched or thrown into the air follow a parabolic path. The force of gravity and the horizontal and vertical velocities determine a quadratic function for an object's path.

The weaker the gravity, the higher an object will fly and the longer it will remain airborne.

Gravity

Earth: 9.8 m/s²
 Mars: 3.7 m/s²
 Moon: 1.6 m/s²

NG Next Generation Science Standards HS-PS3-3

Common Core Standards HSA.CED.A.1, HSA.CED.A.2, HSA.SSE.A.1, HSA.REI.B.4

Your Task: Designing a T-Shirt Launcher

You and your classmates will design a t-shirt launcher and determine possible heights and distances on Earth and other planets.

Law of Universal Gravitation

$$F_g = G \frac{m_1 m_2}{r^2}$$

gravitational constant masses

Where's the Math?

Students will learn how to combine the vertical and horizontal velocities of a projectile to determine its path.

Where's the Science?

As students design their T-shirt launcher, they must determine possible heights and distances on Earth as they relate to gravity. Students may also consider physics by taking wind resistance into account.

Natural Resources

Grade 5: Students explore water usage and the importance of conservation:

- Identify sources of freshwater and the importance of conservation
- Distinguish between renewable and non-renewable resources
- Compare the cost of water in everyday activities and estimate weekly water usage

TOPIC 3 TOPIC OPENER
FLUENTLY MULTIPLY MULTI-DIGIT WHOLE NUMBERS

TOPIC ESSENTIAL QUESTION
 What are the standard procedures for estimating and finding products of multi-digit numbers?
 Revisit the Topic Essential Question throughout the topic, and use a note about answering the question in the Teacher's Edition for the Topic Assessment.

MATH AND SCIENCE PROJECT
Science Theme The science theme for this topic is **Water Usage**. This theme will be revisited in the Math and Science Activities in lessons 3-1 and 3-7 and in some lesson exercises.
 Have students help you list sources of fresh water. Then discuss the importance of conservation.
 Explain that renewable resources are natural resources that can be replenished over time. Ask for examples of other natural resources that are renewable and some that are non-renewable.
Project-Based Learning Have students work on the **Math and Science Project** over the course of several days.
EXTENSION
 Have students gather information about their family's water bills. Ask them to estimate the cost of the water used for the three household activities they researched and add this information to their report.
Sample Student Work for Math and Science Project

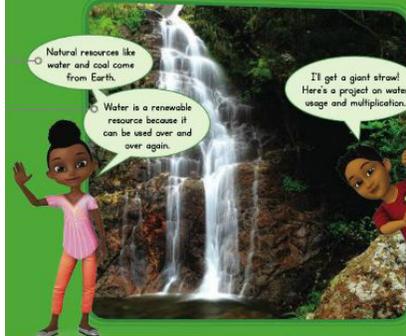
Sample Student Work for Math and Science Project

Activity	Water Used	Each Week	Total Water Used
Showering	2.5 gal per shower	2.5 showers	About 600 gal
Washing Car	140 gal per wash	2 washes	About 280 gal
Laundry	40 gal per load	12 loads	About 400 gal

TOPIC 3 **Fluently Multiply Multi-Digit Whole Numbers**
Essential Question: What are the standard procedures for estimating and finding products of multi-digit numbers?

Digital Resources
 Use the icons to access digital resources: Search, Save, Share, Print, Help, Answer Key, More.

Math and Science Project: Water Usage
 Do Research Use the Internet or other sources to find how much water is used for household activities like taking a shower or bath, using a dishwasher, hand washing dishes, and using a washing machine.
 Journal: Write a Report Include what you found. Also in your report:



Math and Science Project: Water Usage

Do Research Use the Internet or other sources to find how much water is used for household activities like taking a shower or bath, using a dishwasher, hand washing dishes, and using a washing machine.

Journal: Write a Report Include what you found. Also in your report:

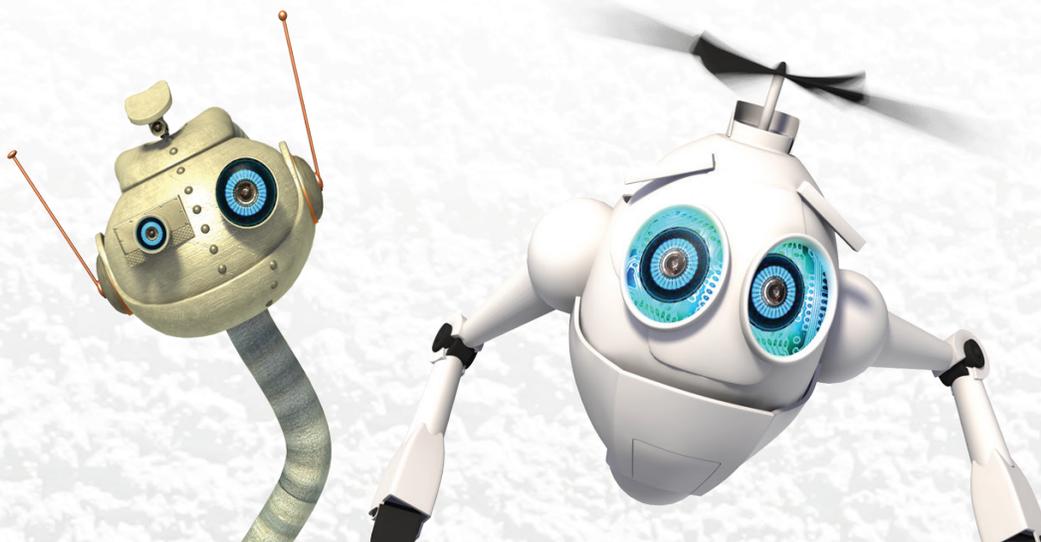
- Choose 3 of the activities. Estimate how many times each activity is done each week in your household.
- Estimate the weekly water usage for each activity. Organize your results in a table.
- Make up and solve multiplication problems based on your data.

Where's the Math?

Students will apply the standard procedures for estimating and finding products of multi-digit numbers.

Where's the Science?

Students identify sources of freshwater, learn the importance of water conservation, and natural resources that are renewable or non-renewable.

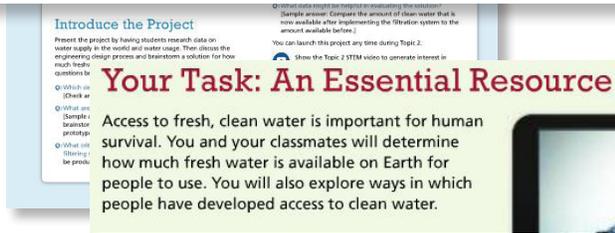


Grade 7: Students find ways to provide accessibility to clean fresh water for various populations.



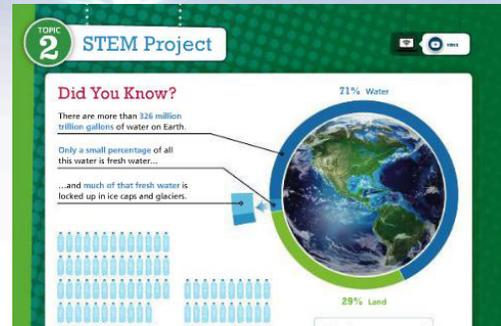
Project Overview

In this project, students design a large water collection and retention tub and then propose methods for transporting the water from the tub to villagers in need of water. They apply their understanding of ratio and proportionality to determine water needs and an equitable distribution of water among the villagers.



Where's the Math?

Students use unit rates and analysis of proportional relationships to calculate the average water usage and the minimum amount of water needed for survival everyday.



Where's the Science?

Students use the engineering design process to find possible solutions to the problem identified. They explore ways engineers can provide access to clean, fresh water to more people.

Geometry: Students analyze the properties of a parabola to design a parabolic solar reflector.



Your Task: Design a Solar Collector

Giant solar power plants are not the only place to see parabolic trough collectors—you might find a water purifier made from a single 6 ft-x-4 ft mirror in a neighbor's back yard! You and your classmates will analyze parabolas and design a solar collector for use in your school or community.



NG Next Generation Science Standards HS-PS3-3, HS-ETS1-2

CC Common Core Standards HSG.GPE.A.2

CP Mathematical Practices MP.1, MP.4, MP.5

Where's the Math?

Students use the properties of a parabola to design a parabolic solar reflector.

Where's the Science?

Students learn how parabolic solar reflectors build up heat and possible uses of the reflectors.

Analyzing Data

Grade 4: Students learn data representation:

- Analyze features on various types of maps
- Determine heights and depths of features on topography maps
- Collect data on specific Earth features, such as Pike's Peak, and analyze data, such as precipitation rates

TOPIC 3 TOPIC OPENER
USE STRATEGIES AND PROPERTIES TO MULTIPLY BY 1-DIGIT NUMBERS

TOPIC ESSENTIAL QUESTIONS
 How can you multiply by multiples of 10, 100, and 1,000?
 How can you estimate when you multiply?
 Review the Topic Essential Questions throughout the topic, and use a note about answering the questions in the Teacher's Edition for the Topic Assessment.

MATH AND SCIENCE PROJECT
Science Theme The science theme for this project is **Representing Data** in tables or maps. This theme will be revisited in the Math and Science Activities in Lessons 3-5 and 3-9 and in some lesson exercises.

MATH AND SCIENCE PROJECT STEM

Have students identify other features found on topographic maps.

Have students explore other types of maps including climate maps, physical maps, political maps, economic maps, or resource maps.

TOPIC 3 Use Strategies and Properties to Multiply by 1-Digit Numbers

Essential Questions: How can you multiply by multiples of 10, 100, and 1,000? How can you estimate when you multiply?

Digital Resources

Maps that show the natural features of Earth's landscape are called topographic maps. Mountains, plains, and oceans are some of the features the maps show.

Did you know that Pike's Peak is the most visited mountain in North America?

We should visit! In the mountains, here is a project on maps and multiplication.

Sample Student Work for Math and Science Project

Mountains	Heights	Estimated Height x 10
Mount Cook	4,194 m	42,000 m
Mount Morgan	4,193 m	42,000 m
Mount Powell	4,141 m	41,000 m

Include what you found.
 of each feature
 the heights or depths

Math and Science Project: Maps and Math

Do Research Use the Internet or other sources to find information about three of Earth's features on a topographic map, such as mountains or oceans. Write two facts about each of the features you researched.

Journal: Write a Report Include what you found. Also in your report:

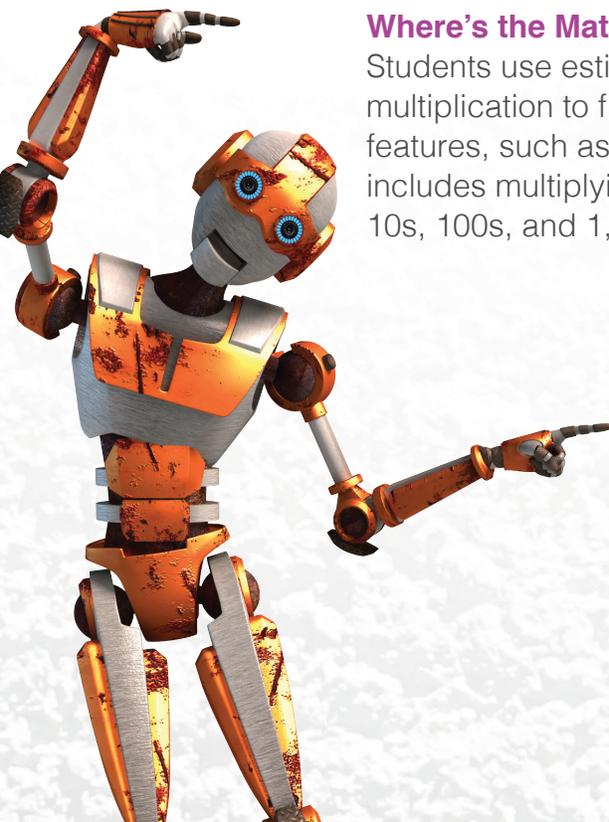
- Write the height or depth of each feature you researched.
- Estimate to find 10 times the heights or depths of the features you researched.

Where's the Math?

Students use estimation and multiplication to find heights for Earth features, such as mountains. This includes multiplying in multiples of 10s, 100s, and 1,000s.

Where's the Science?

Students learn how to identify features on types of maps and analyze the data represented.



Grade 7: Students analyze data from an activity data tracker to set fitness goals.



Project Overview

In this project, students extend the Topic 3 STEM project. They will research current activity and health recommendations, like target heart rate and steps per day. Students will set activity goals and write expressions and equations to represent these goals and to track progress.

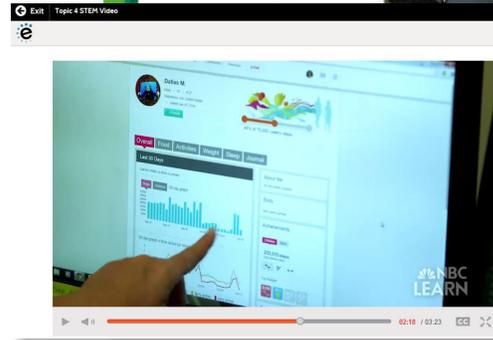
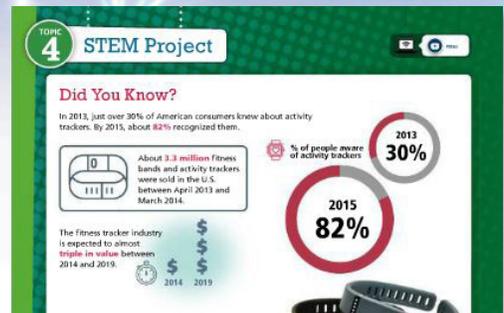
Students use the previous content of fitness tracking technology. They will apply the engineering design process to evaluate the usefulness and effectiveness of the data collected and displayed by activity trackers and recommend improvements.

Introduce the Project

Present the project by asking students about their experiences with activity trackers and to list exercises and activities that result in activity tracker data. The o

Your Task: Analyze Activity Tracker Data

The ways that data are communicated and presented to the user are just as important as the types of data collected. You and your classmates will continue your exploration of activity trackers and use data to develop models based on individual fitness goals.



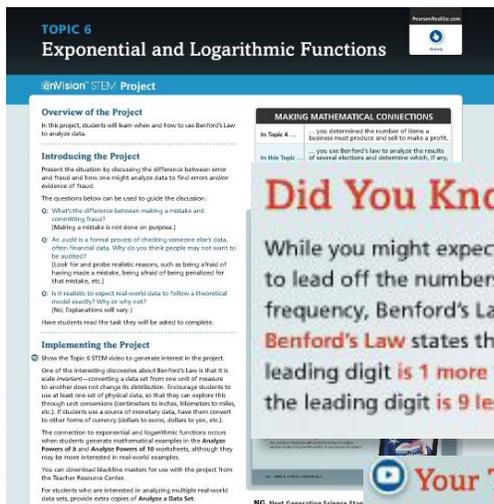
Where's the Math?

Students analyze activity data and goals and write linear expressions and equations to represent data. Data is shown in a variety of representations and used to make recommendations for useful and accurate tracker data displays.

Where's the Science?

Students consider how activities relate to physiological responses, including changes in heart rate, blood pressure, breathing rate, and other factors calculated by activity trackers.

Algebra 2: Students analyze election results using Benford's Law.



- NG Next Generation Science Standards HS-PS2-4, HS-ETS1-2
- Common Core Standards HSA.CED.A.1, HSF.IF.C.8, HSF.BF.B.5, HS.FLE.A.4, HSS.ID.A.1, HSS.ID.A.3
- Mathematical Practices MP.1, MP.2, MP.7

Did You Know?

While you might expect the digits 1 through 9 to lead off the numbers in a data set with equal frequency, Benford's Law shows that they do not. Benford's Law states that, in real-world data, the leading digit is 1 more than 30% of the time, while the leading digit is 9 less than 5% of the time.

Your Task: Analyze Elections

You and your classmates will use Benford's law to analyze election results and determine which, if any, may be fraudulent.

Benford's Law Distribution

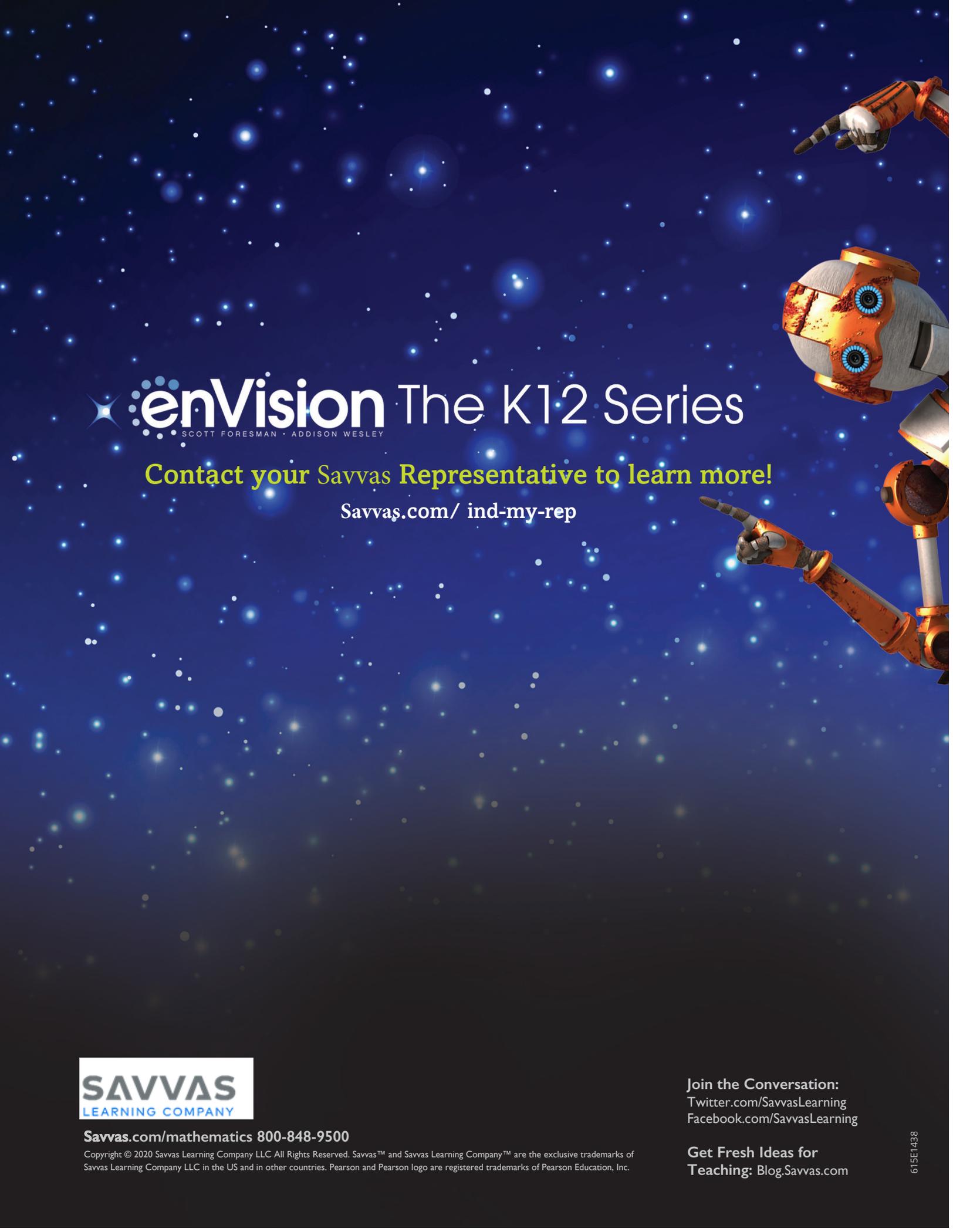
Digit	Percent
1	30
2	18
3	12
4	8
5	6
6	5
7	4
8	3
9	2

Where's the Math?

Students use Bedford's Law to analyze election results and determine, if any, are fraudulent.

Where's the Science?

Through the use of Benford's Law, students find a real-world data set to analyze, such as the masses of objects in space or the area of lakes and rivers.



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