



# STEM Learning Experiences for Every Student

Let students take an active role! Students learn best, and are more self-motivated, when they become active participants in their lessons. Savvas K12 Science programs engage students with real-world tasks, open-ended investigations, and the engineering design process.

Experience **IT!**

It's the Science of Doing.

# elevate<sup>science</sup>

Introduce students to the engineering design process by bringing STEM into your classroom with **Elevate Science** K-8. STEM activities are integrated in every topic. Simple, doable, and adaptable, the STEM activities fully align to new Science Standards. Fuel innovation, problem solving, and collaboration with **Elevate Science**. Experience *IT!* Its the science of doing!



## The Science Quest!

Students explore like scientists and engineers as they use STEM practices to solve Quest problems in every topic of **Elevate Science**.

## Classroom Materials Kits

Kits include consumable and nonconsumable materials. Each classroom kit is organized to make material distribution easy and efficient with clearly marked topic bags. Activity Placemats (K-5) for the labs aid students and teachers with a quick and simple 30-second set-up.



### littleBits™ STEM Invention Toolbox

Grades 3-8

Contains programmable electronic modules from our partner littleBits. Easy-to-use, color-coded electronic “Bits” snap together to create an endless array of inventions.



### MakerCrates

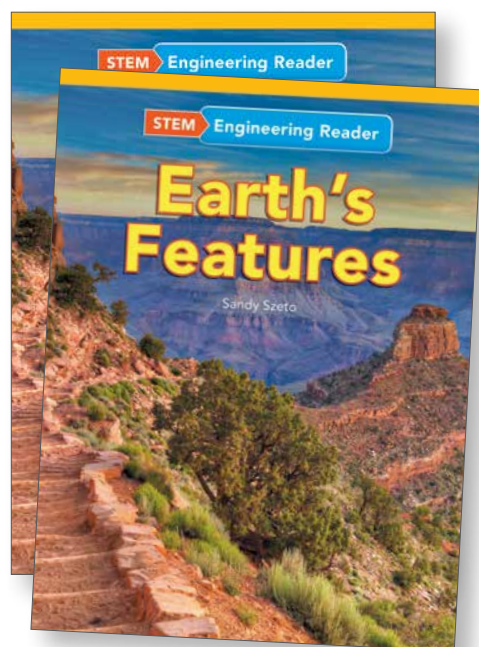
Grades K-2, 3-5, and 6-8

Create your own makerspace! Includes plenty of reusable materials for ongoing innovation, iteration, and design improvement. Tips are provided for starting your own makerspace, creating design challenges, and working in small groups.

### STEM Engineering Readers

Grades K-5

On-Level Readers help introduce the engineering design process to young students. These readers develop problem-solving skills, inspire natural curiosity and creative thinking while building engineering and design skills.



# Biology Miller & Levine

## DO MORE INQUIRY!

Throughout each lesson, students learn about real-life science problems—and take steps to solve them. Students are engaged with natural phenomena through case studies, labs, STEM activities, and research projects as they investigate key questions, apply science and engineering practices, and interpret data.

### UNIT 4 PROBLEM-BASED LEARNING

#### Teaching with Problem-Based Learning

While performing **Genetic Modification of Animals**, remind students to use their Explorer's Journal to take notes, answer questions, track their progress, and evaluate their work. The activities described on the next three pages are designed to help your students learn about how and why animals are genetically modified and whether or not this technology is ethical. Students will use their discoveries to explore the purposes for which humans should genetically modify animals.

For advice on implementing problem-based learning in your classroom, see pages 372-373 in this **Teacher's Edition**.

## Problem-Based Learning

*Miller & Levine Biology* students complete a Problem-based Learning project every unit! Students who can self-direct when faced with a problem show deeper understanding, better retention, and more creativity. Watch your class experience being scientists and engineers as they solve real-world problems.

## Performance-Based Assessments

Students demonstrate mastery of performance expectations through scientific inquiry and engineering design projects at the end of every chapter. They practice important STEM skills such as analyzing data, evaluating solutions, and constructing arguments.

## STEM STEM PROJECT

Design a rubric of criteria for evaluating specific uses of genetically modified animals.

PERFORMANCE-BASED ASSESSMENT
ENGINEERING PROJECT

### Bioremediation

Using Cells to Clean Up Pollution

**STEM** Do you need to fix a spill of oil? Break apart food molecules to gain energy. How do you see modified cells move across the cell's food, and which molecules are not used? For many cells, water flows into a water channel that you might guide.

Consider cellulose and lignin, two compounds that provide the toughness in wood, leaves, and other plant parts. Humans and most other animals lack the enzymes to break apart cellulose and lignin, which is why you cannot live on a diet of paper trees and wood shavings. However, both compounds are useful fuels for decomposers, such as bacteria, fungi, and archaea. Unlike other organisms, the decomposers make enzymes that can break apart the chemical bonds that hold cellulose and lignin together. Their actions cause them to digest wood, paper, leaves, and other discarded plant parts.

Today, scientists and engineers are finding new uses for the "live oil" abilities of bacteria, plants, and fungi. One of these uses is the cleaning up of pollutants and toxic wastes. The term **bioremediation** is used to describe any cleanup activity that involves living things. Some bacteria are able to use crude oil as food. Fungi are used for bioremediation because of the general, enzymatic response. The enzymes can break apart pesticides, dyes, and toxic byproducts from paper-making and other industrial processes. Fungi can also convert heavy metals, such as lead, into usable minerals.

In 2007, a shipping accident spilled over 50,000 gallons of oil into San Francisco Bay. Bioremediation was used to clean up oil that washed ashore. Study the steps of the process, and then answer the questions.

- Define the Problem:** What problem is this oil, sea oil causing?
- Ask Questions:** What questions might engineers ask to help them gather information about the problem and its potential solution?

Fungi are the only organisms that can break apart lignin, a tough compound that is normally added for strength to the walls of the water molecules of trees. While fungi feed on trees, you would use the enzymes!

**BIOREMEDIATION WITH OYSTER MUSHROOMS**

**3. Conduct Research:** Look online for more information about the use of bioremediation. Either clean up oil spills or for other purposes. Compare the benefits and drawbacks of bioremediation solution to other types of solutions that engineers are used to construct.

**4. Communicate:** Write a one-page essay or develop a complete presentation to share your findings. Address the following questions, as well as other questions that you researched.

- How well do you think bioremediation achieves the goal of cleaning up pollution?
- What are the costs and benefits of the bioremediation solution that you researched?
- Identify one real-world problem that is currently being solved by bioremediation that you researched. How do you evaluate the use of this technology for this problem?



# Experience Chemistry

Investigate the chemical potential energy in food. Develop models of energy conservation. Evaluate chemical engineering solutions that reduce climate change. This is the science of doing! *Experience Chemistry* uses cool, weird, and amazing phenomena to engage students in 3D science.

## The Flinn Lab Experience

Savvas is proud to partner with Flinn Scientific on the highest quality laboratory experiences for your chemistry class. Resources include four versions of every inquiry lab, videos, lab kits and virtual reality experiences.

## Real-World Science and Engineering Performance Tasks

The Engineering Design Challenges and Performance-Based Assessments take students through the engineering design process and build their science and engineering skills while assessing their mastery of the standards.



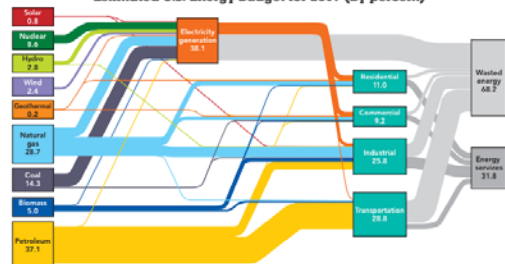
### SAMPLE PROBLEM

#### Analyzing United States Energy Needs

The tangled drawing here is a Sankey diagram that shows energy sources and services (end uses) in the United States for 2017. The size of each box or the width of each ribbon represents a percentage of the total energy use. Answering a few specific questions will help you understand the diagram.

An important consideration in energy use is efficiency, which is the energy for an end use divided by total amount of energy used. How efficient is overall U.S. energy use?

Estimated U.S. Energy Budget for 2017 (by percent)



Data from: Lawrence Livermore Labs and Department of Energy, [https://hybridgeoemetric.com/wordpress/wp-content/uploads/2018/06/sankey\\_101\\_04-20-us-energy-in-2017.jpg](https://hybridgeoemetric.com/wordpress/wp-content/uploads/2018/06/sankey_101_04-20-us-energy-in-2017.jpg)

## Data Analysis Activities and Math Support Videos

Students interact with math problems and math-related science and engineering practices throughout the program, to practice and become proficient with math and chemistry concepts. Look for Stepped-out Sample Problems in the Student Experience Notebook, Analyzing Data Activities and Worksheets on Savvas Realize™, Integrating Math and Quantitative Thinking prompts in the Teacher Guide, and a Math Problem Bank on the Savvas Realize™ digital platform.

# Physics

*Savvas Physics* is the only high school program that blends conceptual development and quantitative problem solving. The dual emphasis on concepts and math and numerous and varied examples —together with Mastering™ Physics — deliver a superior program.

## Inquiry Lab How do waves move in water?

### Explore

1. Fill a rectangular pan half full of water.
2. Hold a pencil horizontally between your thumb and forefinger. Gently dip the pencil into the water at one end of the pan, making sure that the whole length of the pencil strikes the water at the same time. Observe the result.

3. Repeat Step 2, this time dipping the pencil into the water more forcefully, but not so hard as to make a splash.
4. Repeat Step 2, this time continually dipping the pencil in the water about once per second for 10 s.

### Think

1. **Observe** What causes the initial disturbance in the water? In

which direction does the wave that forms move? What happens when the wave hits the end of the pan?

2. **Assess** Did anything affect the height of the wave or its speed? If so, identify each factor.
3. **Predict** Do you think the results would differ if the water were replaced by maple syrup? Explain your reasoning.

## Math Skills and Lab Explorations

Students gradually build their math skills by beginning with simple examples and building to more advanced skills. The program extends conceptual understandings and helps connect students to related equations and problem-solving skills. Hands-on lab explorations are found in the text itself and through a separate Lab Manual.

## STEM Activities

*Mastering™ Physics* STEM activities are an interdisciplinary approach to learning where rigorous academic concepts are coupled with real-world lessons. Students apply science, technology, engineering, and mathematics in contexts that make connections between school, community, work, and the global enterprise.

### Physics & You: Technology

The wheels on older cars often lock during panic braking, causing the car to skid uncontrollably. In general, sliding or skidding tires are subject to kinetic friction, whereas tires that roll experience static friction, as discussed in **Conceptual Example 5.13**. Since static friction is usually greater than kinetic friction, a car will stop in a shorter distance if its wheels are *rolling* (static friction) than if its wheels are *locked up* and skidding (kinetic friction)!

This is the idea behind antilock braking systems (ABS). When the brakes are applied in a car with ABS, an electronic rotation sensor at each wheel detects when the wheel is about to skid. To prevent the skidding, a small computer automatically begins to pump the brakes. This pumping allows the wheels to continue rotating, even in an emergency stop, and thus static friction determines the stopping distance. **Figure 5.17** shows a comparison of braking distances for cars with and without ABS.

**Physics & You** Careers

### Earthquake Scientists and Engineers

Literally able to move mountains, earthquakes are among nature's greatest hazards. Earthquake scientists and engineers investigate ways to protect lives and property during these events.

Seismologists study the build-up of stresses in the Earth's crust and the earthquakes that result when these stresses are released. They identify areas most at risk for earthquakes and hope in the near future to be able to make short-term predictions of impending quakes. Records of tremors, called seismograms, are made constantly at hundreds of stations around the world. Data from three or more stations can be combined to calculate the location and depth of a quake.

Earthquake engineers are usually civil or mechanical engineers who specialize in designing structures that can survive earthquakes. Such design work typically focuses on making these structures strong enough to handle the inertial forces that result when the underlying ground moves from side to side, dragging the building with it.

Sometimes, however, buildings are designed to sit on base isolators, which are usually synthetic rubber pads. During a tremor the pads can stretch horizontally and compress vertically, allowing the building to remain relatively still while the ground shakes beneath it. The use of base isolators greatly reduces the forces on the building.

**Figure 5.17** This seismogram of the 2010 Haiti earthquake was made by a seismograph 300 km away at the James Madison High School in Rochester, New York.

**Base Isolators** Like this one made of rubber, older residential buildings were better protected from earthquake damage.

### Take It Further

1. **Infer** Why are some of the most catastrophic quakes generally caused more damage to older buildings?
2. **Hypothesize** Why are buildings much more resilient to horizontal shaking than to vertical shaking?

# Environmental SCIENCE

Using real-world case studies and a wide range of inquiry activities, *Environmental Science: Your World, Your Turn* puts the world in context by empowering your students to take an active role in their learning—and the world in which they live.

### Quick Lab

#### Successful Succession?

- Obtain a clean jar with a cover and place a handful of dried plant material inside.
- Fill the jar with boiled pond water or sterile spring water. Determine the initial pH of the water with pH paper.
- Cover the jar with a lid and place it in a sunny location.
- Examine the jar daily for signs of life.
- When the jar is full of life, determine the pH of the water.
- View the jar under a microscope.

#### Analyze and Conclude

- Infer** Why did you use boiled or sterile water?
- Infer** Where did the organisms you saw come from?

### Go Outside

#### What's in the Air?

- Cut a 4 cm × 4 cm square of cardboard.
- Completely cover the cardboard square with aluminum foil. Make sure that the foil is flat and smooth.
- Use tape to attach one end of a piece of string to your square.
- Using a paper towel, cover both sides of the square with petroleum jelly. Be sure to wipe your hands clean.

#### Analyze and Conclude

- Observe** What did you find on your square? Make a list of what you observed.
- Infer** Where did the particles and materials you saw come from?
- Infer** How would your results have been different if you had hung the square inside your classroom?

Name \_\_\_\_\_ Class \_\_\_\_\_ Date \_\_\_\_\_

Inquiry Activity • Paper and Pencil

## Chapter 14 Watershed Boundaries

### Problem *How do you define the boundaries of a watershed?*

### Background

#### Why Watersheds?

Not all of the water that flows out of the mouth of a river started at its source. Tributaries, surface runoff, and even some groundwater contribute to a river's flow. Along the way, this water can pick up pollutants and concentrate them in the river. Because of this, ecologists studying river

## Unit Project

Students design a project that demonstrates a thorough understanding of the interaction of environmental factors. They develop arguments and positions based on facts they have uncovered through research and activities.

## Lab Manual

This editable, online manual supports your STEM and inquiry needs with:-

- **In Your Neighborhood:** research-based activities that connect students with their local environment
- **Outdoor Labs and Activities:** inquiry labs and activities that take students into the field as they explore chapter concepts
- **Modeling Labs:** classroom labs that simulate environmental processes and concepts

## UNIT 2 Ecology Unit Project

### Seeing the Past, Foreseeing the Future

**Invasive and nonnative species can alter habitats over time. Landscapes can change so much that they become unrecognizable. Birds and fishes that used to be plentiful disappear. A leaf-eating insect species invades a forest and an entire species of trees could perish. What happens to the animals that inhabited the forest and relied on those particular trees? What plants grow there now?**

**Your Task**  
Your task is to present an illustrated species impact report on the effect of one or more invasive species. You are to show the environmental changes that happen as a result of invasive and nonnative species. You may deliver your report in any format—for example, a booklet illustrated with photos or drawings, a flipchart, a series of storyboards, a dramatization, or an oral report accompanied by photos and illustrations. Your report is a way of providing a glimpse in time. You can see into the past and also predict how the species you chose might affect the environment in the future.

**Learn about the environmental changes that occur when an invasive or nonnative species thrives in a new habitat.**

- First, choose an invasive species to research.
- Find out what areas the species has invaded.
- In your report, explain how the invasive species was introduced into the environment.
- Describe its effect on the environment. Explain what the environment was like before and after the species was introduced. Has the invasive species affected biodiversity?
- Predict the future effect of the species.

**Reflection Questions**

- Score your species impact report using the rubric below. What score did you give yourself?
- What did you do well in this project?
- What needs improvement?
- What do you think people who live and work in the affected environment could learn from your report?
- 21st-Century Learning** **Flexibility and Adaptability** Has producing this report changed the way you will interact with your environment?

Assessment Rubric	
Score	Scientific Content
4	Your report reveals a thorough understanding of the interaction of environmental factors. Your prediction is widely based on facts you have presented.
3	Your report reveals an understanding of the environmental issues. Your prediction is mostly based on facts you have presented.
2	Your report reveals some understanding of the issue, but there are a few misconceptions. Your prediction is based only loosely on facts.
1	You present few relevant facts, and your explanation is confusing. Your prediction is not based on facts.

Assessment Rubric	
Score	Quality of Species Impact Report
4	Your impact report is highly organized and informative. It uses visuals to clarify the issues in a compelling way.
3	Your impact report is organized, mostly clear, and informative. Your pictures and use of graphics successfully convey the issues.
2	Your impact report is somewhat informative but not well organized. You included some visuals, but their significance was not always clear.
1	Your impact report is confusing. You did not include informative visuals.

What in the World?™  
A World Under the Microscope™

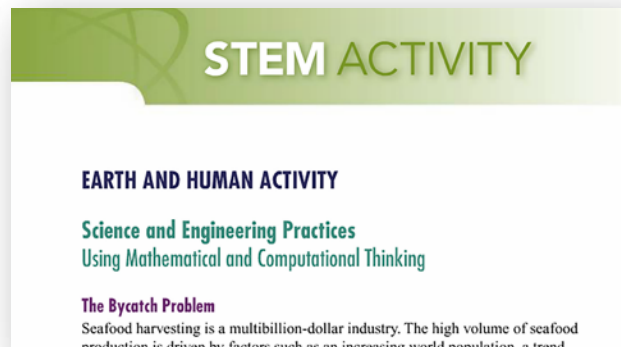
234 Unit 2 Project

# EARTH SCIENCE

Invite students on a journey of observation, explanation, and participation in the study of Earth's processes. An accessible writing style, coupled with powerful technology, support your high school curriculum through STEM activities with teacher support.

## STEM Activities

Excite students with real-world engineering design problems and hands-on inquiry. These new activities promote higher-order critical thinking skills and result in improved student performance.

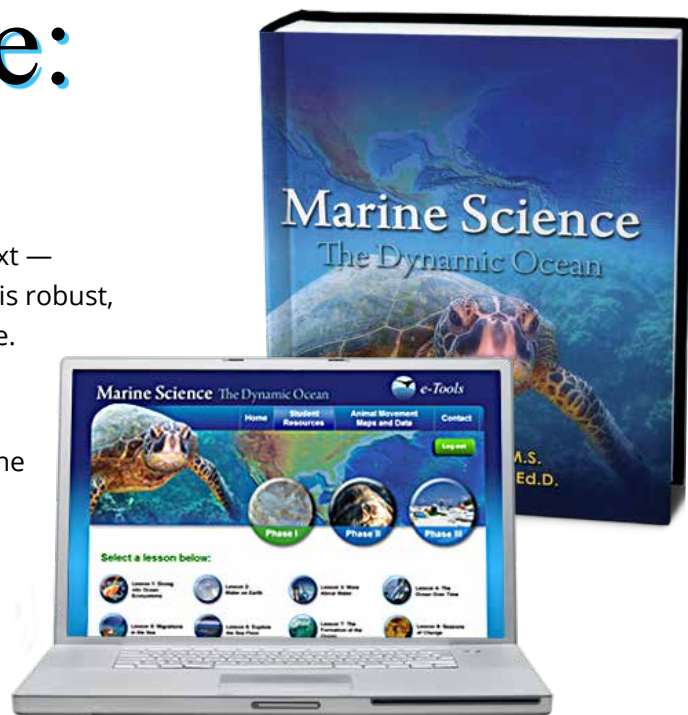


# Marine Science: The Dynamic Ocean

Marine Science offers STEM in context. Provide students with a unique way to learn about marine science in context — tracking the paths of animals in the ocean in real time. This robust, high school course blends Life, Earth, and Physical Science.

## STEM Pedagogical Strategies

Help students understand integrated science content in the context of the ocean—Earth's greatest resource.



**For more info** about **STEM solutions**, contact us at [Savvas.com/find-my-rep](http://Savvas.com/find-my-rep)



**Savvas.com/Science**  
**800-848-9500**