Phenomena-Driven Instruction

ANCHORING PHENOMENON

Launch every unit with an engaging Anchoring Phenomenon that introduces and unifies the upcoming environmental science concepts. Students ask questions and gather evidence about the phenomenon on their sense-making journey. At the end of the unit, students solidify their mastery of the concepts behind the Anchoring Phenomenon.

ANCHORING PHENOMENON

What are the effects of dead zones on both people and the environment?

NAME _____ DATE _____ CLASS _____

ANCHORING PHENOMENON PROJECT

Costs of Excess Nutrients Reaching Aquatic Ecosystems

When excess nutrients reach aquatic ecosystems, such as rivers, lakes, and oceans, it can set off a chain of events that impact the abiotic and biotic factors in the ecosystem, as well as people who depend on the ecosystem for income, food, or recreation. For example, large amounts of excess nutrients reach the Gulf of Mexico in spring each year. Algae take up the excess nutrients and reproduce in great numbers, resulting in an algal bloom. When the algae die, bacteria decompose their remains, using much or all of the oxygen in the water. An area of hypoxic, or low-oxygen, water called a dead zone is created. Fish, shellfish, and other aquatic organisms cannot survive in the hypoxic water and die in large numbers. Think about how these events affect people who rely on this ecosystem for income, whether it is from fishing or tourism; food; or recreation. These impacts are part of the external costs associated with excess nutrients in aquatic ecosystems.

Students build understanding with an **Anchoring Phenomenon Project** that accompanies every unit.

REVISIT

ANCHORING PHENOMENON

These questions will help you apply what you have learned in this Unit to the Anchoring Phenomenon.

1. **SEP Asking Questions** Research more information about harmful algal blooms (HABs). Suppose you plan to attend a public meeting about how your local or state government is working to reduce the environmental and economic impacts of HABs. Write a list of questions you would ask officials at the meeting.
2. **SEP Developing and Using Models** Make models of the carbon cycle, the phosphorus cycle, and the nitrogen cycle to show both the short-term and long-term effects of excess nitrogen and phosphorus in runoff. How does making the model help you visualize the impacts of excess nutrients on ecosystems?

GO ONLINE

For activities that will give you an opportunity to demonstrate what you have learned.

CLAIM-EVIDENCE-REASONING Revisit your Anchoring Phenomenon CER with the information you have learned in this unit.

ANCHORING PHENOMENON PROJECT Design a solution to reduce external costs associated with excess nutrients in oceans and waterways.

Revisit the Anchoring Phenomenon as more knowledge is uncovered.

NAME _____ DATE _____ CLASS _____

CLAIM-EVIDENCE-REASONING

What is Causing the Fish to Die?

Think about the Anchoring Phenomenon question. What is the science behind the phenomenon? To help you build an understanding of the phenomenon, you will construct and revise a scientific argument.

Build Your Argument Through Claim, Evidence, and Reasoning

1. **SEP Ask Questions** Write a question about the phenomenon or event that you would like to discuss with your classmates. (Your teacher may also provide you with one.)
2. **SEP Construct Written Arguments** Use the Claim-Evidence-Reasoning framework to build a scientific argument about the phenomenon. After stating your claim, support it with evidence and scientific reasoning.

Make a Claim Your claim should be a response to the

Students track their knowledge in a **Claims-Evidence-Reasoning or Modeling Worksheet** as they learn more about the phenomenon.

INVESTIGATIVE PHENOMENON

Introduce every chapter with an Investigative Phenomenon Central Case Study. This engaging real-world case encourages students to draw connections between environmental science and their life. Interacting with the central case provides opportunities for students to gather the knowledge necessary to make sense of the Anchoring Phenomenon.

INVESTIGATIVE PHENOMENON Can we reduce the ozone hole?

Scientists release ozonesondes into the atmosphere to measure the amount of ozone at various altitudes. The balloons transmit data to a receiving station on the ground.

INVESTIGATIVE PHENOMENON

Can we reduce the ozone hole?

Lesson 1 How does environmental science help us understand the natural world?

Lesson 2 What does it mean to "do science"?

Lesson 3 What happens to a scientific study after data have been gathered and the results are analyzed?

Connect to the Central Case

FIGURE 13 **Chlorine and Ozone: A Bad Combination** When a chlorine atom collides with ozone in the upper atmosphere, a chain reaction starts that results in the destruction of many—even tens of thousands—ozone molecules. **Interpret Diagrams** Where do the chlorine atoms in the upper atmosphere come from?

Chapter content ties back to the **Central Case**, providing a storyline for students to follow.

Defend Your Case

The Central Case in this chapter explored how science led to the discovery of how certain chemicals were affecting the ozone layer. Use examples from the Central Case and throughout the chapter to provide evidence on how science often relies not only on individuals, but the entire scientific community and beyond to achieve its goals.

Students **Defend Their Case** at the end of the chapter – giving them the opportunity to gather evidence, analyze data, and use scientific reasoning to support their claim.

REVISIT

3. **INVESTIGATIVE PHENOMENON** Why is the process of science better represented by the diagram shown in **Figure 10** than by a diagram like the one seen here?

Observations → Questions → Hypothesis → Predictions → Test → Results

Assessment questions repeatedly encourage students to revisit the phenomenon.

EVERYDAY PHENOMENON

Every lesson begins with an Everyday Phenomenon, setting the stage for inquiry. Teacher materials provide optional activities to extend students' thinking.

Our Island, Earth

EVERYDAY PHENOMENON How does environmental science help us understand the natural world?

EVERYDAY PHENOMENON

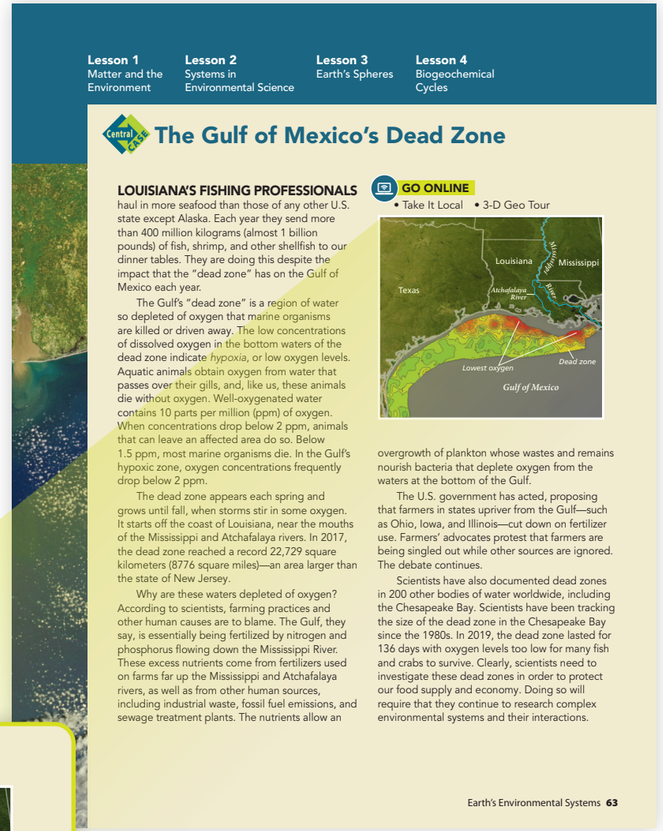
FOCUS Have students write for two minutes about the term *environmental science*. Then, have them review what they have written. Call on volunteers to share what they wrote with the class. Use students' responses to launch a class discussion on how environmental science can promote understanding of the natural world.

Student-Centered Experiences

Environmental Science combines high-interest, real-world content with cutting-edge digital support and a variety of hands-on inquiry investigations to help ensure student success in environmental science. Acclaimed author and active researcher Jay Withgott shows students why learning environmental science is vital.

The Central Case

The **Central Case** highlights real issues in today's world – issues students will be excited to investigate.



Lesson 1 Matter and the Environment | Lesson 2 Systems in Environmental Science | Lesson 3 Earth's Spheres | Lesson 4 Biogeochemical Cycles

The Gulf of Mexico's Dead Zone

LOUISIANA'S FISHING PROFESSIONALS haul in more seafood than those of any other U.S. state except Alaska. Each year they send more than 400 million kilograms (almost 1 billion pounds) of fish, shrimp, and other shellfish to our dinner tables. They are doing this despite the impact that the "dead zone" has on the Gulf of Mexico each year.

The Gulf's "dead zone" is a region of water so depleted of oxygen that marine organisms are killed or driven away. The low concentrations of dissolved oxygen in the bottom waters of the dead zone indicate *hypoxia*, or low oxygen levels. Aquatic animals obtain oxygen from water that passes over their gills, and, like us, these animals die without oxygen. Well-oxygenated water contains 10 parts per million (ppm) of oxygen. When concentrations drop below 2 ppm, animals that can leave an affected area do so. Below 1.5 ppm, most marine organisms die. In the Gulf's hypoxic zone, oxygen concentrations frequently drop below 2 ppm.

The dead zone appears each spring and grows until fall, when storms stir in some oxygen. It starts off the coast of Louisiana, near the mouths of the Mississippi and Atchafalaya rivers. In 2017, the dead zone reached a record 22,729 square kilometers (8776 square miles)—an area larger than the state of New Jersey.

Why are these waters depleted of oxygen? According to scientists, farming practices and other human causes are to blame. The Gulf, they say, is essentially being fertilized by nitrogen and phosphorus flowing down the Mississippi River. These excess nutrients come from fertilizers used on farms far up the Mississippi and Atchafalaya rivers, as well as from other human sources, including industrial waste, fossil fuel emissions, and sewage treatment plants. The nutrients allow an overgrowth of plankton whose wastes and remains nourish bacteria that deplete oxygen from the waters at the bottom of the Gulf.

The U.S. government has acted, proposing that farmers in states upriver from the Gulf—such as Ohio, Iowa, and Illinois—cut down on fertilizer use. Farmers' advocates protest that farmers are being singled out while other sources are ignored. The debate continues.

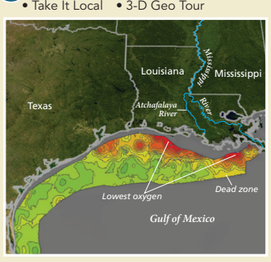
Scientists have also documented dead zones in 200 other bodies of water worldwide, including the Chesapeake Bay. Scientists have been tracking the size of the dead zone in the Chesapeake Bay since the 1980s. In 2019, the dead zone lasted for 136 days with oxygen levels too low for many fish and crabs to survive. Clearly, scientists need to investigate these dead zones in order to protect our food supply and economy. Doing so will require that they continue to research complex environmental systems and their interactions.

GO ONLINE
• Take It Local • 3-D Geo Tour

Louisiana, Mississippi, Texas, Atchafalaya River, Mississippi River, Lowest oxygen, Dead zone, Gulf of Mexico

Earth's Environmental Systems 63

GO ONLINE
• Take It Local • 3-D Geo Tour



Learn About Local Issues

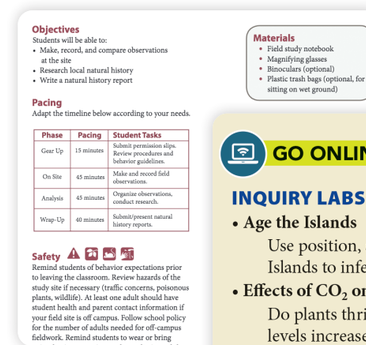
Take It Local activities on Realize encourage students to find a similar situation in their local environment. This extension personalizes the case for students and leads to deeper understanding.

More Practice!

Students can study and reinforce their knowledge with lesson-level vocabulary and activities such as Skill Builder, Think Visually, Central Case activities, and 21st Century Skills in the Study Workbook.

Hands-On Inquiry

Editable hands-on inquiry activities, such as In Your Neighborhood labs, Modeling labs, and Claim-Evidence-Reasoning documents support student understanding of the anchoring and investigative phenomenon under study. The Teachers Guide to Fieldwork provides suggestions for outdoor lab studies.



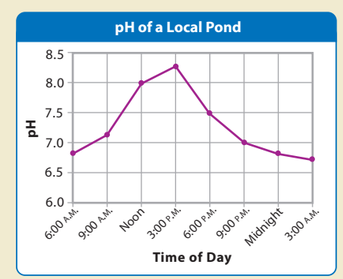
GO ONLINE

INQUIRY LABS AND ACTIVITIES

- **Age the Islands**
  Use position, shape, and size of the volcanic Galápagos Islands to infer which are older or younger.
- **Effects of CO_2 on Plants**
  Do plants thrive or decline when atmospheric CO_2 levels increase? Graph a sample dataset to find out.

Analyze Data

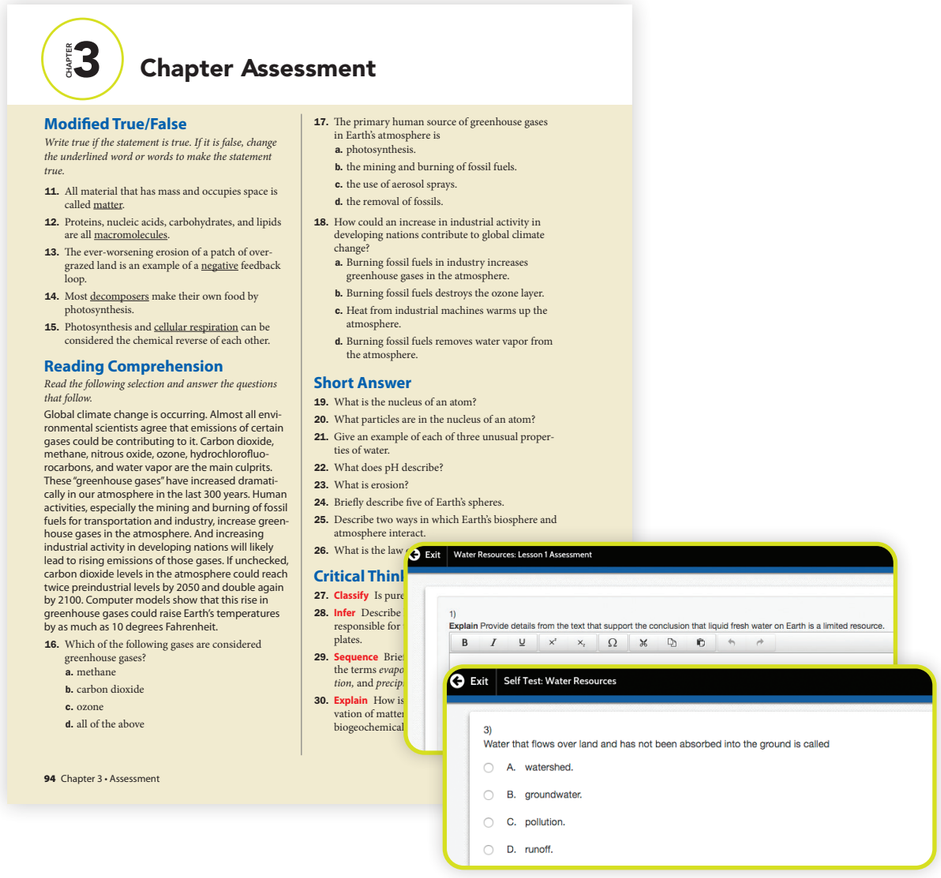
A student took water samples from a small pond every three hours and measured their pH. The results are plotted on the graph. Use the graph to answer the questions.



Reinforce Math Skills

- Real data in activities and graphs make the math problems more relevant.
- The Skills Handbook at the back of this book is an easy-to-use refresher for "must-know" math concepts and applications.
- Graphing tutorials on Realize encourage real-world practice.
- Additional math support in the Study Workbook provides more clarity.

Assessment and e-Learning



CHAPTER 3 **Chapter Assessment**

Modified True/False

Write true if the statement is true. If it is false, change the underlined word or words to make the statement true.

11. All material that has mass and occupies space is called matter.
12. Proteins, nucleic acids, carbohydrates, and lipids are all macromolecules.
13. The ever-worsening erosion of a patch of overgrazed land is an example of a negative feedback loop.
14. Most decomposers make their own food by photosynthesis.
15. Photosynthesis and cellular respiration can be considered the chemical reverse of each other.

Reading Comprehension

Read the following selection and answer the questions that follow.

Global climate change is occurring. Almost all environmental scientists agree that emissions of certain gases could be contributing to it. Carbon dioxide, methane, nitrous oxide, ozone, hydrochlorofluorocarbons, and water vapor are the main culprits. These "greenhouse gases" have increased dramatically in our atmosphere in the last 300 years. Human activities, especially the mining and burning of fossil fuels for transportation and industry, increase greenhouse gases in the atmosphere. And increasing industrial activity in developing nations will likely lead to rising emissions of those gases. If unchecked, carbon dioxide levels in the atmosphere could reach twice preindustrial levels by 2050 and double again by 2100. Computer models show that this rise in greenhouse gases could raise Earth's temperatures by as much as 10 degrees Fahrenheit.

16. Which of the following gases are considered greenhouse gases?
    a. methane
    b. carbon dioxide
    c. ozone
    d. all of the above
17. The primary human source of greenhouse gases in Earth's atmosphere is
    a. photosynthesis.
    b. the mining and burning of fossil fuels.
    c. the use of aerosol sprays.
    d. the removal of fossils.
18. How could an increase in industrial activity in developing nations contribute to global climate change?
    a. Burning fossil fuels in industry increases greenhouse gases in the atmosphere.
    b. Burning fossil fuels destroys the ozone layer.
    c. Heat from industrial machines warms up the atmosphere.
    d. Burning fossil fuels removes water vapor from the atmosphere.

Short Answer

19. What is the nucleus of an atom?
20. What particles are in the nucleus of an atom?
21. Give an example of each of three unusual properties of water.
22. What does pH describe?
23. What is erosion?
24. Briefly describe five of Earth's spheres.
25. Describe two ways in which Earth's biosphere and atmosphere interact.
26. What is the law

Critical Thinl

27. **Classify** Is pure
28. **Infer** Describe responsible for plates.
29. **Sequence** Brie the terms *evapo tion,* and *precip*
30. **Explain** How is vation of matte biogeochemical

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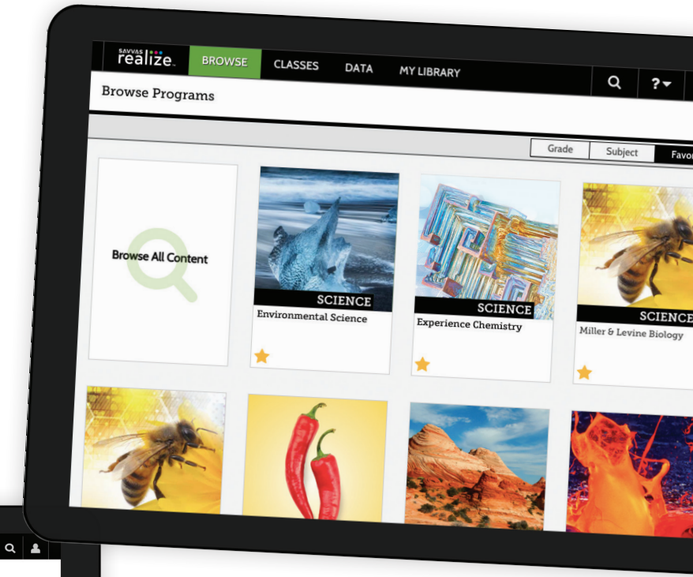
Customizable Assessment Tools

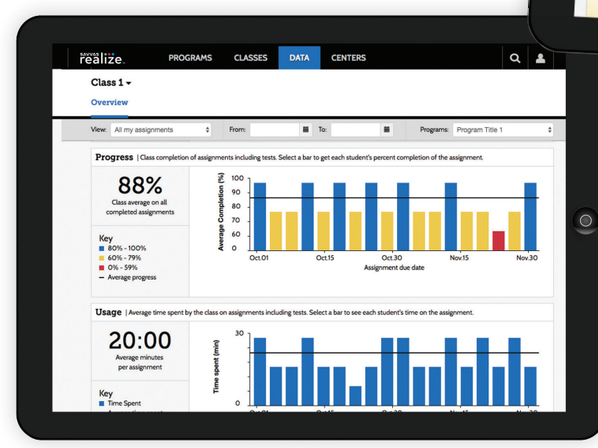
- Lesson and chapter assessments in the Student Edition require students to think critically, apply chapter concepts, and connect to the phenomena.
- Differentiate with two levels of unit and chapter assessments. Customize assessments with editable documents.
- Students self-assess with chapter self-tests on SavvasRealize.com. These pre-tests give students and teachers an opportunity to gauge their knowledge before an exam.
- ExamView® Assessment Suite lets teachers create and print custom tests in minutes to meet specific needs.

An Interactive Digital Experience

SavvasRealize.com is your online digital platform for Environmental Science. With Savvas Realize™, you can go digital with the online Student Edition, online Teacher Edition, and editable Teacher Resources.

Access a wealth of interactive content, editable lesson plans, and assessment tools in one location. The Realize Reader app allows for **offline access**– giving students and teachers even more flexibility to learn anywhere they want.





Data-Driven Decisions

- Access data on standards mastery by student, small group, or whole class.
- Monitor student progress with online quizzes and chapter tests.
- Get real-time data on student activity and usage.

Premier Partner

Google for Education

Google Partnership

Realize is a partner with Google Classroom™. Sharing content, assessments, and rosters is now easier than ever when working with both Realize and Google G Suite™ for Education.

OpenEd

OpenEd Resources

Search and assign OpenEd resources, making it quick and easy to add thousands of reliable, vetted resources.