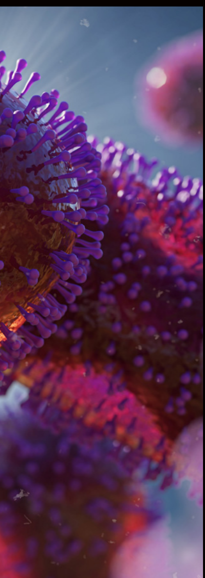
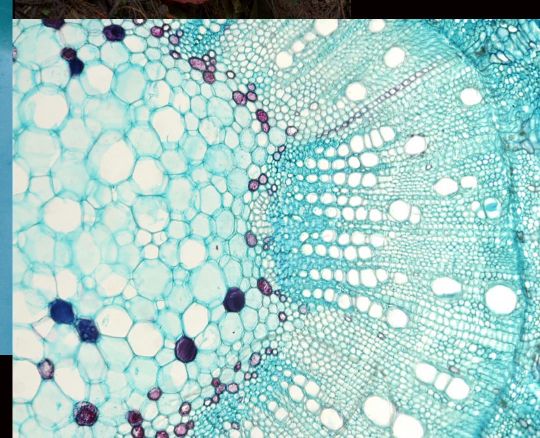
Texas Grades 9-12

NATIONAL GEOGRAPHIC



BIOLOGY

Texas Edition



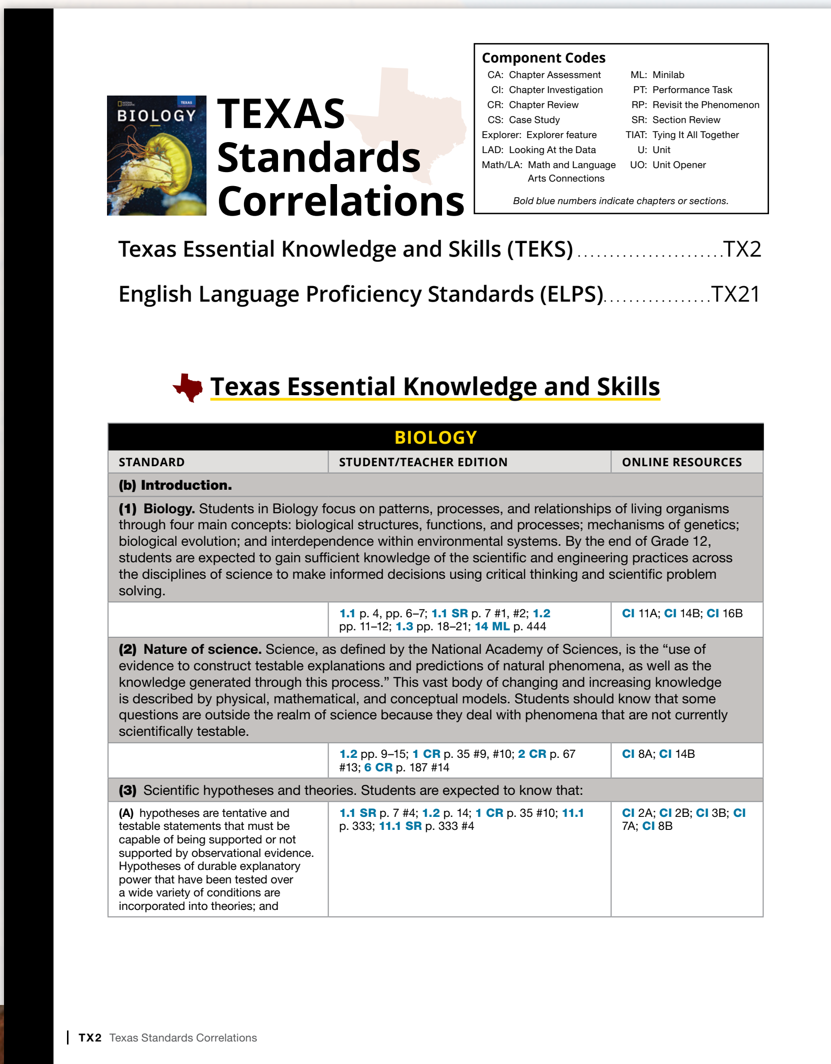
PHENOMENA-BASED INSTRUCTION WITH NATIONAL GEOGRAPHIC RESOURCES

As teaching shifts towards multidisciplinary approaches to learning, *National Geographic Biology, Texas Edition* is designed specifically to meet the needs of phenomena-based instruction. Deepen concept knowledge and inquiry skills by combining phenomena-based instruction with National Geographic resources. Empower all students to investigate real-world scenarios and build skills towards academic and career success.

IN ENGLISH
AND SPANISH

BUILT FOR 3-DIMENSIONAL INSTRUCTION

The 3-Dimensional approach to teaching is changing the way science and biology are taught. *National Geographic Biology, Texas Edition* was created to guide teachers through 3D instruction by incorporating support for teaching the core ideas of science, the scientific and engineering practices, and recurring themes and concepts. Each lesson is built to prepare students to master the Big Ideas and Benchmarks of all your Texas Essential Knowledge and Skills (TEKS) for Science.



BIOLOGY

TEXAS Standards Correlations

Component Codes

CA: Chapter Assessment
CI: Chapter Investigation
CR: Chapter Review
CS: Case Study
Explorer: Explorer feature
LAD: Looking At the Data
Math/LA: Math and Language Arts Connections
ML: Minilab
PT: Performance Task
RP: Revisit the Phenomenon
SR: Section Review
TIAT: Tying It All Together
U: Unit
UO: Unit Opener

Bold blue numbers indicate chapters or sections.

Texas Essential Knowledge and Skills

BIOLOGY		
STANDARD	STUDENT/TEACHER EDITION	ONLINE RESOURCES
(b) Introduction.		
(1) Biology. Students in Biology focus on patterns, processes, and relationships of living organisms through four main concepts: biological structures, functions, and processes; mechanisms of genetics; biological evolution; and interdependence within environmental systems. By the end of Grade 12, students are expected to gain sufficient knowledge of the scientific and engineering practices across the disciplines of science to make informed decisions using critical thinking and scientific problem solving.		
	1.1 p. 4, pp. 6–7; **1.1 SR** p. 7 #1, #2; **1.2** pp. 11–12; **1.3** pp. 18–21; **14 ML** p. 444	**CI** 11A; **CI** 14B; **CI** 16B
(2) Nature of science. Science, as defined by the National Academy of Sciences, is the "use of evidence to construct testable explanations and predictions of natural phenomena, as well as the knowledge generated through this process." This vast body of changing and increasing knowledge is described by physical, mathematical, and conceptual models. Students should know that some questions are outside the realm of science because they deal with phenomena that are not currently scientifically testable.		
	1.2 pp. 9–15; **1 CR** p. 35 #9, #10; **2 CR** p. 67 #13; **6 CR** p. 187 #14	**CI** 8A; **CI** 14B
(3) Scientific hypotheses and theories. Students are expected to know that:		
(A) hypotheses are tentative and testable statements that must be capable of being supported or not supported by observational evidence. Hypotheses of durable explanatory power that have been tested over a wide variety of conditions are incorporated into theories; and	**1.1 SR** p. 7 #4; **1.2** p. 14; **1 CR** p. 35 #10; **11.1** p. 333; **11.1 SR** p. 333 #4	**CI** 2A; **CI** 2B; **CI** 3B; **CI** 7A; **CI** 8B

TX2 Texas Standards Correlations

AUTHENTIC NATIONAL GEOGRAPHIC EXPERIENCE

National Geographic Biology, Texas Edition connects students to the field of biology through content and features that showcase the experiences and diverse perspectives of National Geographic Explorers and photographers. This engaging content consists of lessons with featured articles, videos, and Virtual Investigations in the digital platform hosted by the National Geographic Explorers themselves.

Real People Make the Difference

Explorers help to set the stage of the Unit Anchoring Phenomena, they share their personal experiences in the field of Biology, and lead students through the virtual labs and simulations in order to make the learning relevant, purposeful and accessible.

In our programs, students hear real-world stories and diverse perspectives from scientists and National Geographic Explorers

Analyze *Describe how a human activity such as seabed mining might affect organisms that live in a deep-ocean ecosystem.*

UNIT VIDEO 2 Go online to watch our interview with Amon and learn more about her career and research.

WORK SIDE BY SIDE WITH NATIONAL GEOGRAPHIC EXPLORERS

National Geographic Biology Virtual Investigations

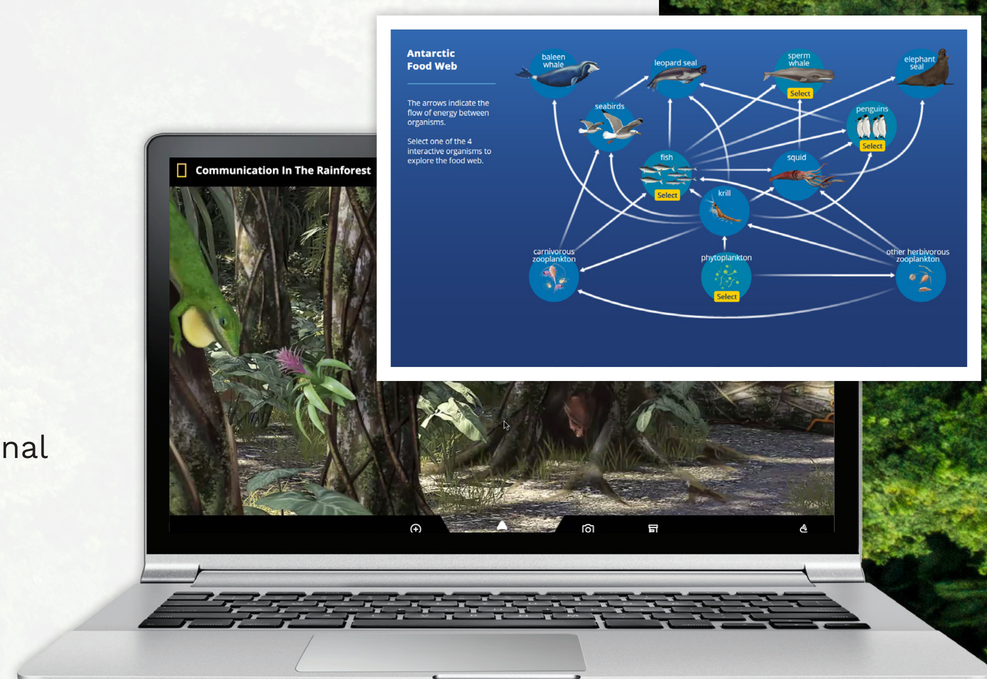
National Geographic Explorers embark on amazing adventures and students will follow in their footsteps to conduct Virtual Investigations in the deep ocean, rainforest canopy, and other locations around the world bringing the content to life in the real world. These labs have been designed exclusively for *National Geographic Biology, Texas Edition* and cannot be found anywhere else.

Virtual Investigations written exclusively for *National Geographic Biology*

Hosted by a National Geographic Explorer

Digital Biology Explorations

Transport students into the field with simulations, engaging videos, and Virtual Investigations where a National Geographic Explorer guides students through a virtual biology research project.



PHENOMENA-BASED LEARNING

Biology 5E Lesson Model

ENGAGE

- 3D Lesson Design
- Anchoring Phenomena
- Driving Question
- Case Study
- Explore Video

EXPLORE/EXPLAIN

- MindTap Simulation
- Explore Lesson/Video
- Minilab
- Virtual Investigation
- Connection Lesson
- Biotechnology Lesson
- Explorer Connect To Careers

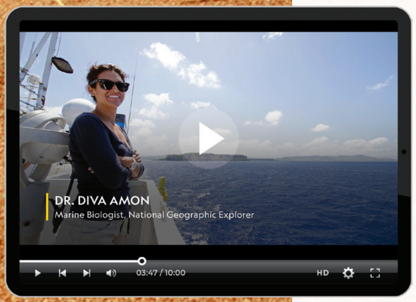
ELABORATE

- Tying it All Together
- Lesson Video
- Investigation Lab
- Phenomena Result

EVALUATE

- Unit Activity (CER)
- Formative Assessment
- Summative Assessment
- EOC Exam Prep

Every Unit begins with a Unit Explorer helping to launch the **Real World Anchoring Phenomena**. The **Driving Question** focuses students' observations into an investigable question they can answer at the end of the unit by using **evidence and reasoning** to apply biology concepts. These topics are current and relatable to students.



A video series featuring National Geographic Explorers highlighting their unique biology stories and research supports the phenomena in the print text. Students see themselves reflected in these diverse biologists.

2.1

ECOLOGICAL SYSTEMS

TEKS 13.B

EXPLORE/EXPLAIN

This section provides a review of Earth's interconnected systems, introduces the hierarchical organization of the biosphere, and describes the main processes through which energy and matter support organism survival.

Objectives

- Distinguish between the levels of ecological organization.
- Describe how matter and energy support the survival of organisms.

Pretest Use **Question 6** to identify gaps in background knowledge or misconceptions.

Vocabulary Strategy

Word Families The Greek root *bio-* (life) should be familiar to students from *biology* and other common words, such as *biography*. It is also the root of five Key Terms in this chapter: *biome, biosphere, biomass, biomass pyramid,* and *biogeochemical cycle*. Suggest that students add each of these terms to a word tree or other graphic organizer. Students can also add other terms, such as *biomagnification*, which they will see in the Looking at the Data feature, and *symbiosis*, which they will encounter in Chapter 3.

Video

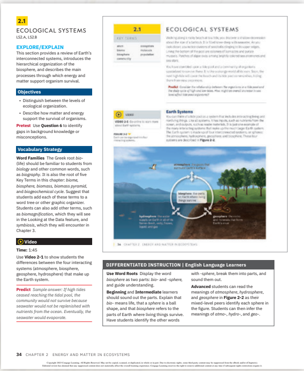
Time: 1:45

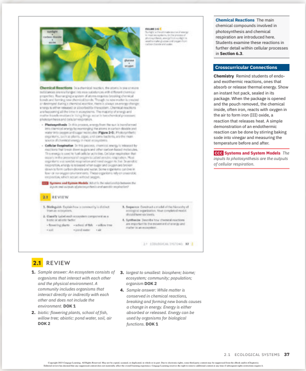
Use **Video 2-1** to show students the differences between the four interacting systems (atmosphere, biosphere, geosphere, hydrosphere) that make up the Earth system.

Predict *Sample answer: If high tides ceased reaching the tidal pool, the community would not survive because seawater would not be replenished with nutrients from the ocean. Eventually, the seawater would evaporate.*

Student Centered Learning

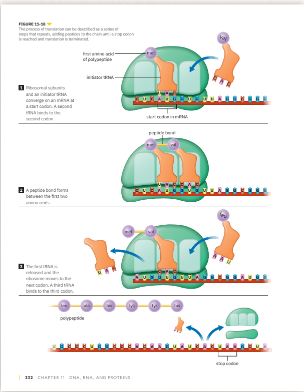
A highly visual 2-4 page spread supports the students' ability to absorb the content. The teacher notes follow the 5E model, clearly stating the objective of the lesson, vocabulary strategies and the exact video created specifically for this lesson. The teacher will also find the exact TEK this lesson is covering called out at the top.

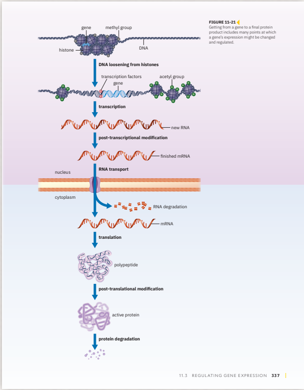




Visual Literacy

Careful thought is given to the layout of every page utilizing the expertise of National Geographic, ensuring every image and graphic set with the purpose of further deepening the students understanding, sparking interest, and increasing their retention of content details.

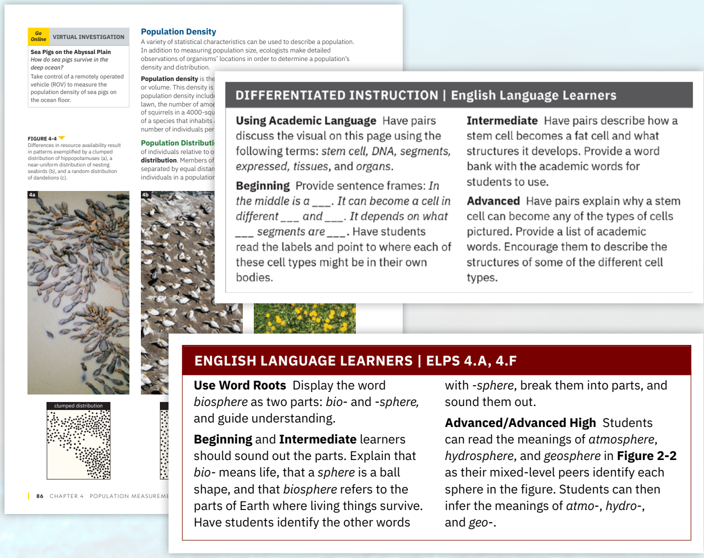




SUPPORT FOR ALL LEARNERS

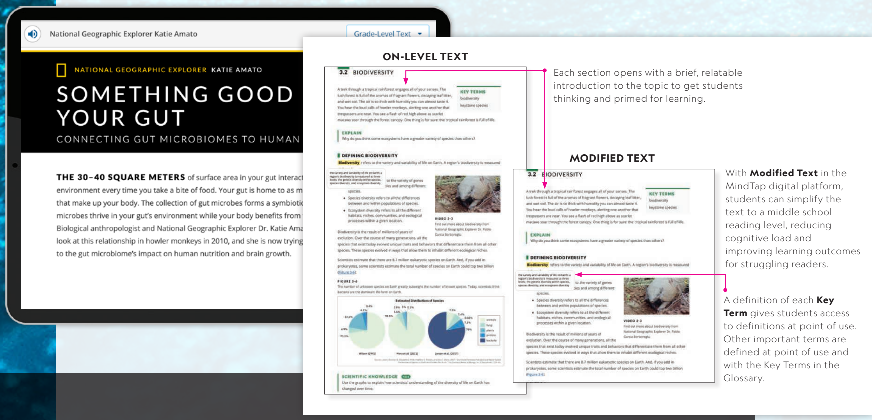
Differentiated Instruction and Support

Teachers are provided with helpful notes and support suggestions for **Differentiated Instruction**. These embedded supports help to unlock the content for all learners, giving equal access to rigorous content.



Modified Text

The eBook can instantly lower the reading level by two grade levels for Striving Readers.



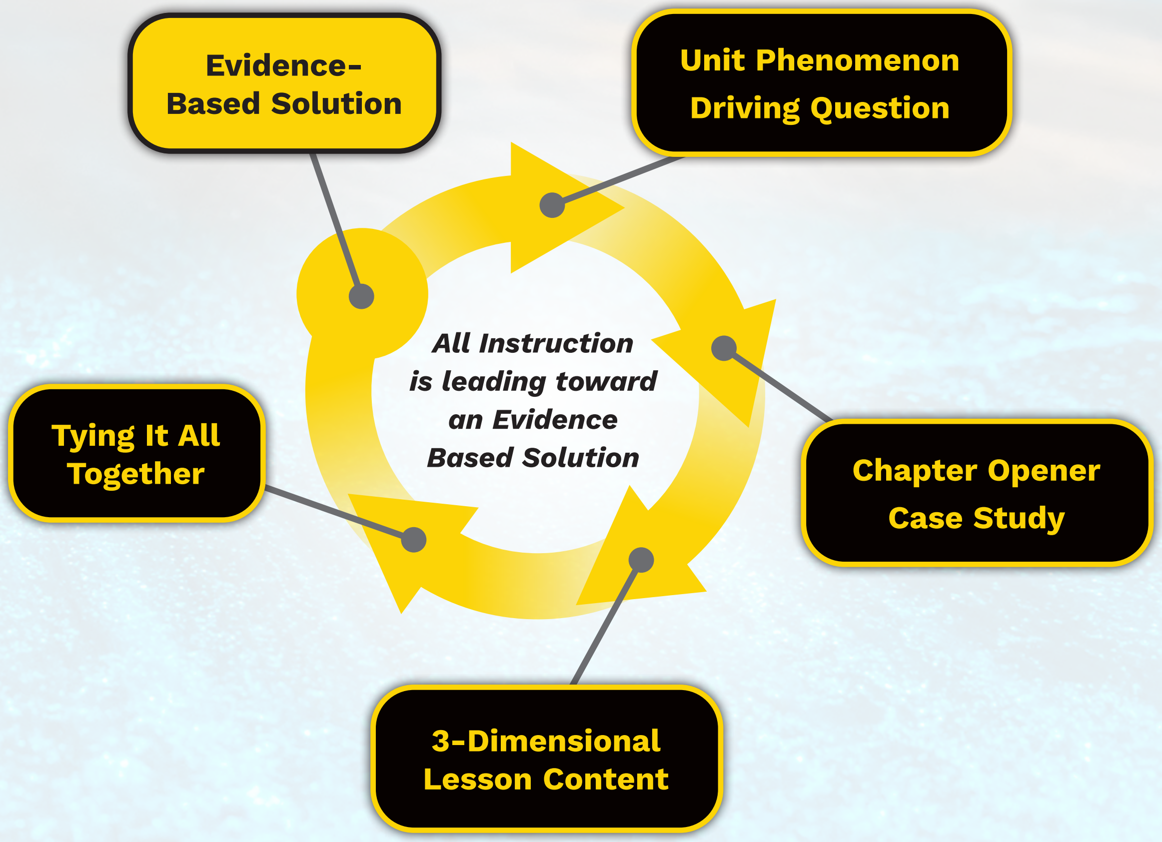
ELPS Standard Support

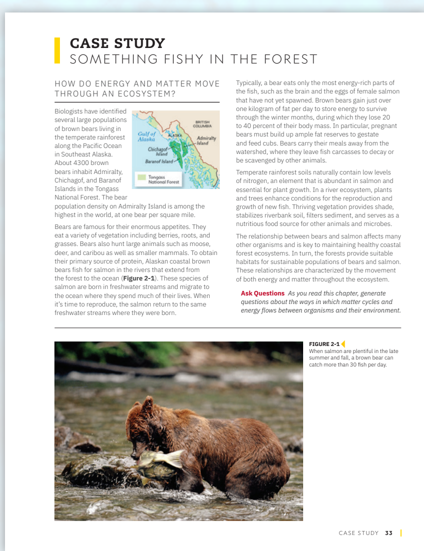
Teachers will find supports for meeting the ELPS standards. These embedded supports help to unlock the content for all learners, giving equal access to rigorous content.

Virtual Simulations

Virtual Simulations are an essential component integrating technology into the learning model. These interactive features bring figures and concepts from the print book to life.

EVIDENCE-BASED SOLUTIONS





CASE STUDY
SOMETHING FISHY IN THE FOREST

HOW DO ENERGY AND MATTER MOVE THROUGH AN ECOSYSTEM?

Biologists have identified several large populations of brown bears living in the temperate rainforest along the Pacific Ocean in Southeast Alaska. About 4300 brown bears inhabit Admiralty, Chichagof, and Baranof Islands in the Tongass National Forest. The bear population density on Admiralty Island is among the highest in the world, at one bear per square mile.

Bears are famous for their enormous appetites. They eat a variety of vegetation including berries, roots, and grasses. Bears also hunt large animals such as moose, deer, and caribou as well as smaller mammals. To obtain their primary source of protein, Alaskan coastal brown bears fish for salmon in the rivers that extend from the forest to the ocean (**Figure 2-1**). These species of salmon are born in freshwater streams and migrate to the ocean where they spend much of their lives. When it's time to reproduce, the salmon return to the same freshwater streams where they were born.

Typically, a bear eats only the most energy-rich parts of the fish, such as the brain and the eggs of female salmon that have not yet spawned. Brown bears gain just over one kilogram of fat per day to store energy to survive through the winter months, during which they lose 20 to 40 percent of their body mass. In particular, pregnant bears must build up ample fat reserves to gestate and feed cubs. Bears carry their meals away from the watershed, where they leave fish carcasses to decay or be scavenged by other animals.

Temperate rainforest soils naturally contain low levels of nitrogen, an element that is abundant in salmon and essential for plant growth. In a river ecosystem, plants and trees enhance conditions for the reproduction and growth of new fish. Thriving vegetation provides shade, stabilizes riverbank soil, filters sediment, and serves as a nutritious food source for other animals and microbes.

The relationship between bears and salmon affects many other organisms and is key to maintaining healthy coastal forest ecosystems. In turn, the forests provide suitable habitats for sustainable populations of bears and salmon. These relationships are characterized by the movement of both energy and matter throughout the ecosystem.

Ask Questions *As you read this chapter, generate questions about the ways in which matter cycles and energy flows between organisms and their environment.*

FIGURE 2-1 When salmon are plentiful in the late summer and fall, a brown bear can catch more than 30 fish per day.

CASE STUDY 33

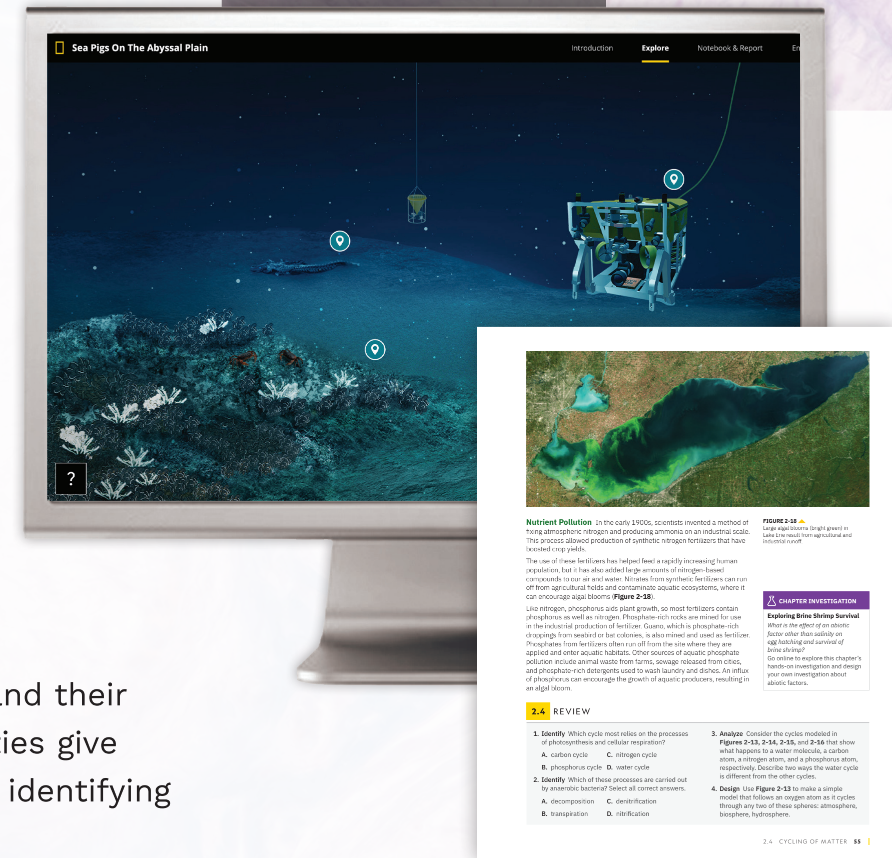
The Chapter Opener and Case Study

All learning opportunities work together to support the unit phenomenon carefully tied to the **Driving Question** and revisited again at the end of the chapter in the **Tying It All Together** activity. Callouts within the chapters prompt students to connect concepts back to the **Case Study** as they read and grow in their knowledge toward an evidence-based solution.

HANDS-ON BIOLOGY AND DATA ACTIVITIES

Applying Biology with Hands-on Science and Data Activities

Each Unit of *National Geographic Biology, Texas Edition* provides multiple opportunities for hands-on learning all supporting a deeper understanding of the **Anchoring Phenomena**. Minilabs have been carefully designed for your classroom along with full chapter investigations that give students opportunities to expand their understanding. Data analysis activities give students practice reading data and identifying patterns in data sets.



Nutrient Pollution In the early 1900s, scientists invented a method of fixing atmospheric nitrogen and producing ammonia on an industrial scale. This process allowed production of synthetic nitrogen fertilizers that have boosted crop yields.

The use of these fertilizers has helped feed a rapidly increasing human population, but it has also added large amounts of nitrogen-based compounds to our air and water. Nitrates from synthetic fertilizers can run off from agricultural fields and contaminate aquatic ecosystems, where it can encourage algal blooms (**Figure 2-18**).

Like nitrogen, phosphorus aids plant growth, so most fertilizers contain phosphorus as well as nitrogen. Phosphate-rich rocks are mined for use in the industrial production of fertilizer. Guano, which is phosphate-rich droppings from seabird or bat colonies, is also mined and used as fertilizer. Phosphates from fertilizers often run off from the site where they are applied and enter aquatic habitats. Other sources of aquatic phosphate pollution include animal waste from farms, sewage released from cities, and phosphate-rich detergents used to wash laundry and dishes. An influx of phosphorus can encourage the growth of aquatic producers, resulting in an algal bloom.

FIGURE 2-18 Large algal blooms (bright green) in Lake Erie result from agricultural and industrial runoff.

CHAPTER INVESTIGATION

Exploring Brine Shrimp Survival

What is the effect of an abiotic factor other than salinity on egg hatching and survival of brine shrimp?

Go online to explore this chapter's hands-on investigation and design your own investigation about abiotic factors.

2.4 REVIEW

1. **Identify** Which cycle most relies on the processes of photosynthesis and cellular respiration?
   A. carbon cycle
   B. phosphorus cycle
   C. nitrogen cycle
   D. water cycle
2. **Identify** Which of these processes are carried out by anaerobic bacteria? Select all correct answers.
   A. decomposition
   B. transpiration
   C. denitrification
   D. nitrification
3. **Analyze** Consider the cycles modeled in **Figures 2-13, 2-14, 2-15,** and **2-16** that show what happens to a water molecule, a carbon atom, a nitrogen atom, and a phosphorus atom, respectively. Describe two ways the water cycle is different from the other cycles.
4. **Design** Use **Figure 2-13** to make a simple model that follows an oxygen atom as it cycles through any two of these spheres: atmosphere, biosphere, hydrosphere.

2.4 CYCLING OF MATTER 55

CHAPTER INVESTIGATION

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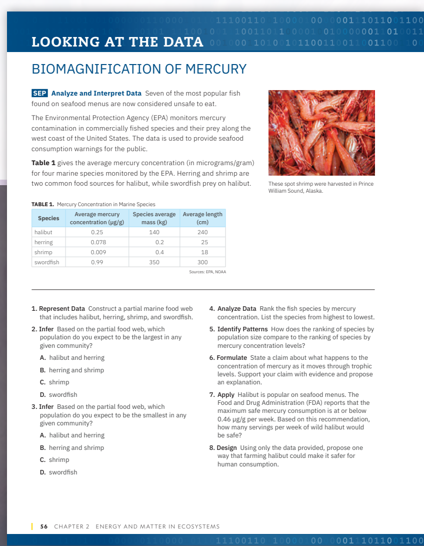


LOOKING AT THE DATA

BIOMAGNIFICATION OF MERCURY

SEP Analyze and Interpret Data Seven of the most popular fish found on seafood menus are now considered unsafe to eat.

The Environmental Protection Agency (EPA) monitors mercury contamination in commercially fished species and their prey along the west coast of the United States. The data is used to provide seafood consumption warnings for the public.

Table 1 gives the average mercury concentration (in micrograms/gram) for four marine species monitored by the EPA. Herring and shrimp are two common food sources for halibut, while swordfish prey on halibut.

These spot shrimp were harvested in Prince William Sound, Alaska.

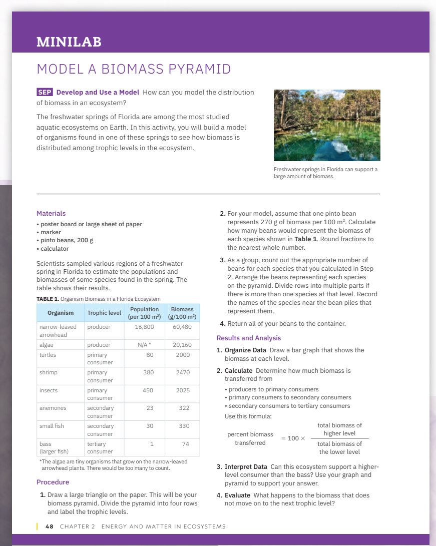
TABLE 1. Mercury Concentration in Marine Species

Species	Average mercury concentration (μg/g)	Species average mass (kg)	Average length (cm)
halibut	0.25	140	240
herring	0.078	0.2	25
shrimp	0.009	0.4	18
swordfish	0.99	350	300

Sources: EPA, NOAA

1. **Represent Data** Construct a partial marine food web that includes halibut, herring, shrimp, and swordfish.
2. **Infer** Based on the partial food web, which population do you expect to be the largest in any given community?
   A. halibut and herring
   B. herring and shrimp
   C. shrimp
   D. swordfish
3. **Infer** Based on the partial food web, which population do you expect to be the smallest in any given community?
   A. halibut and herring
   B. herring and shrimp
   C. shrimp
   D. swordfish
4. **Analyze Data** Rank the fish species by mercury concentration. List the species from highest to lowest.
5. **Identify Patterns** How does the ranking of species by population size compare to the ranking of species by mercury concentration levels?
6. **Formulate** State a claim about what happens to the concentration of mercury as it moves through trophic levels. Support your claim with evidence and propose an explanation.
7. **Apply** Halibut is popular on seafood menus. The Food and Drug Administration (FDA) reports that the maximum safe mercury consumption is at or below 0.46 μg/g per week. Based on this recommendation, how many servings per week of wild halibut would be safe?
8. **Design** Using only the data provided, propose one way that farming halibut could make it safer for human consumption.

56 CHAPTER 2 ENERGY AND MATTER IN ECOSYSTEMS



MINILAB

MODEL A BIOMASS PYRAMID

SEP Develop and Use a Model How can you model the distribution of biomass in an ecosystem?

The freshwater springs of Florida are among the most studied aquatic ecosystems on Earth. In this activity, you will build a model of organisms found in one of these springs to see how biomass is distributed among trophic levels in the ecosystem.

Freshwater springs in Florida can support a large amount of biomass.

Materials
- poster board or large sheet of paper
- marker
- pinto beans, 200 g
- calculator

Scientists sampled various regions of a freshwater spring in Florida to estimate the populations and biomasses of some species found in the spring. The table shows their results.

TABLE 1. Organism Biomass in a Florida Ecosystem

Organism	Trophic level	Population (per 100 m^2)	Biomass (g/100 m^2)
narrow-leaved arrowhead	producer	16,800	60,480
algae	producer	N/A *	20,160
turtles	primary consumer	80	2000
shrimp	primary consumer	380	2470
insects	primary consumer	450	2025
anemones	secondary consumer	23	322
small fish	secondary consumer	30	330
bass (larger fish)	tertiary consumer	1	74

*The algae are tiny organisms that grow on the narrow-leaved arrowhead plants. There would be too many to count.

Procedure

1. Draw a large triangle on the paper. This will be your biomass pyramid. Divide the pyramid into four rows and label the trophic levels.
2. For your model, assume that one pinto bean represents 270 g of biomass per 100 m^2. Calculate how many beans would represent the biomass of each species shown in **Table 1**. Round fractions to the nearest whole number.
3. As a group, count out the appropriate number of beans for each species that you calculated in Step 2. Arrange the beans representing each species on the pyramid. Divide rows into multiple parts if there is more than one species at that level. Record the names of the species near the bean piles that represent them.
4. Return all of your beans to the container.

Results and Analysis

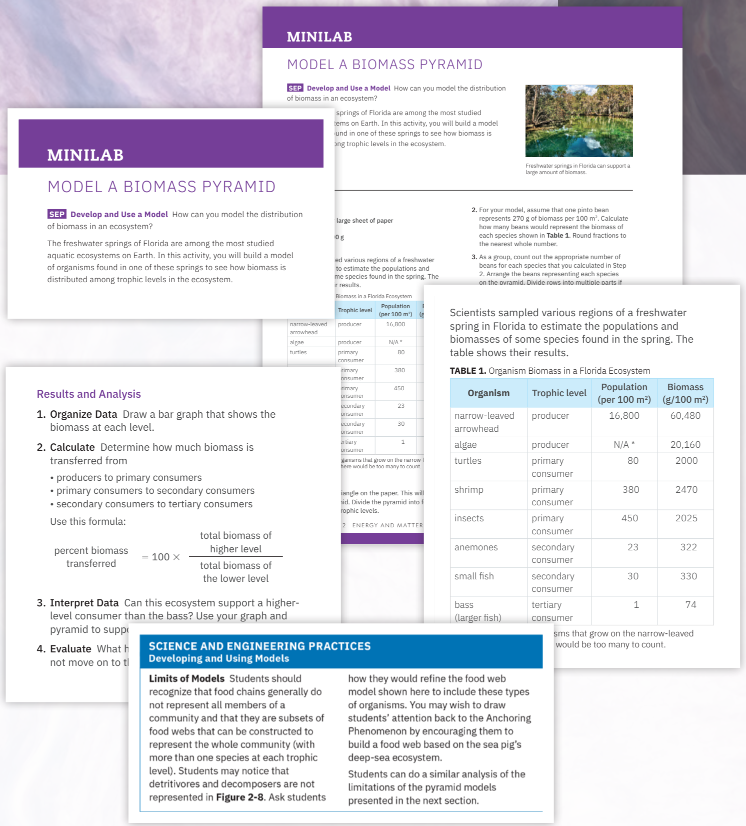
1. **Organize Data** Draw a bar graph that shows the biomass at each level.
2. **Calculate** Determine how much biomass is transferred from
   - producers to primary consumers
   - primary consumers to secondary consumers
   - secondary consumers to tertiary consumers

   Use this formula:

$$\text{percent biomass transferred} = 100 \times \frac{\text{total biomass of higher level}}{\text{total biomass of the lower level}}$$

3. **Interpret Data** Can this ecosystem support a higher-level consumer than the bass? Use your graph and pyramid to support your answer.
4. **Evaluate** What happens to the biomass that does not move on to the next trophic level?

48 CHAPTER 2 ENERGY AND MATTER IN ECOSYSTEMS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SCIENCE AND ENGINEERING PRACTICES
Developing and Using Models

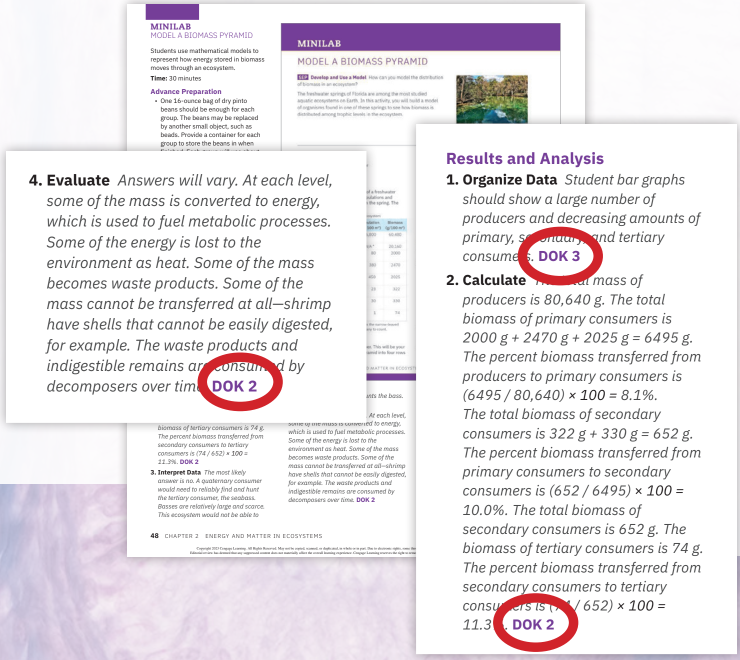
Limits of Models Students should recognize that food chains generally do not represent all members of a community and that they are subsets of food webs that can be constructed to represent the whole community (with more than one species at each trophic level). Students may notice that detritivores and decomposers are not represented in **Figure 2-8**. Ask students how they would refine the food web model shown here to include these types of organisms. You may wish to draw students' attention back to the Anchoring Phenomenon by encouraging them to build a food web based on the sea pig's deep-sea ecosystem.

Students can do a similar analysis of the limitations of the pyramid models presented in the next section.

Labs, Engineering Activities, and Research Projects

Minilabs are an essential part of each chapter enabling a quick investigation supporting conceptual development.

Each lab is tied to a Science and Engineering Practices. Students will discuss how they have come to grow their knowledge using evidence from the text and labs advancing their critical thinking skills.


4. Evaluate *Answers will vary. At each level, some of the mass is converted to energy, which is used to fuel metabolic processes. Some of the energy is lost to the environment as heat. Some of the mass becomes waste products. Some of the mass cannot be transferred at all—shrimp have shells that cannot be easily digested, for example. The waste products and indigestible remains are consumed by decomposers over time.* DOK 2

Results and Analysis

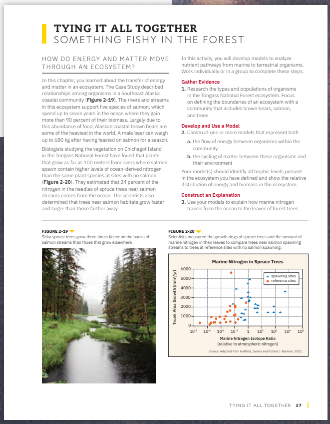
1. Organize Data *Student bar graphs should show a large number of producers and decreasing amounts of primary, secondary, and tertiary consumers.* DOK 3

2. Calculate *The total mass of producers is 80,640 g. The total biomass of primary consumers is 2000 g + 2470 g + 2025 g = 6495 g. The percent biomass transferred from producers to primary consumers is (6495 / 80,640) × 100 = 8.1%. The total biomass of secondary consumers is 322 g + 330 g = 652 g. The percent biomass transferred from primary consumers to secondary consumers is (652 / 6495) × 100 = 10.0%. The total biomass of secondary consumers is 652 g. The biomass of tertiary consumers is 74 g. The percent biomass transferred from secondary consumers to tertiary consumers is (74 / 652) × 100 = 11.3%.* DOK 2

Rigorous Practice

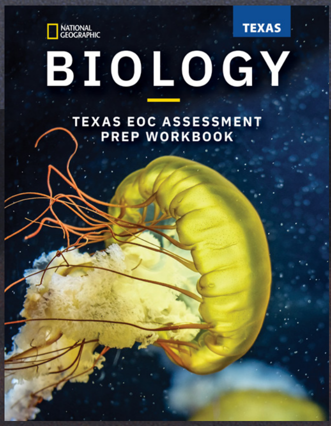
In the Teacher's Edition, the **Depth of Knowledge** Question level is called out. *National Geographic Biology, Texas Edition* has carefully constructed learning opportunities to allow continued practice in Levels 1–3 higher order thinking questions, so students are not stumped when it comes time for the Texas Biology End of Course Exam.

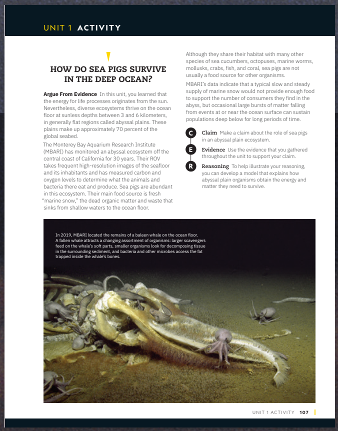
ASSESSMENT IN A VARIETY OF FORMATS



Tying It All Together

Students will wrap up the learning with **Tying it all together Lessons.** Students will obtain information, propose solutions and evaluate the solutions. No longer will you have to supplement your current curriculum to reach this level of authentic assessment opportunities. Everything you need is here!





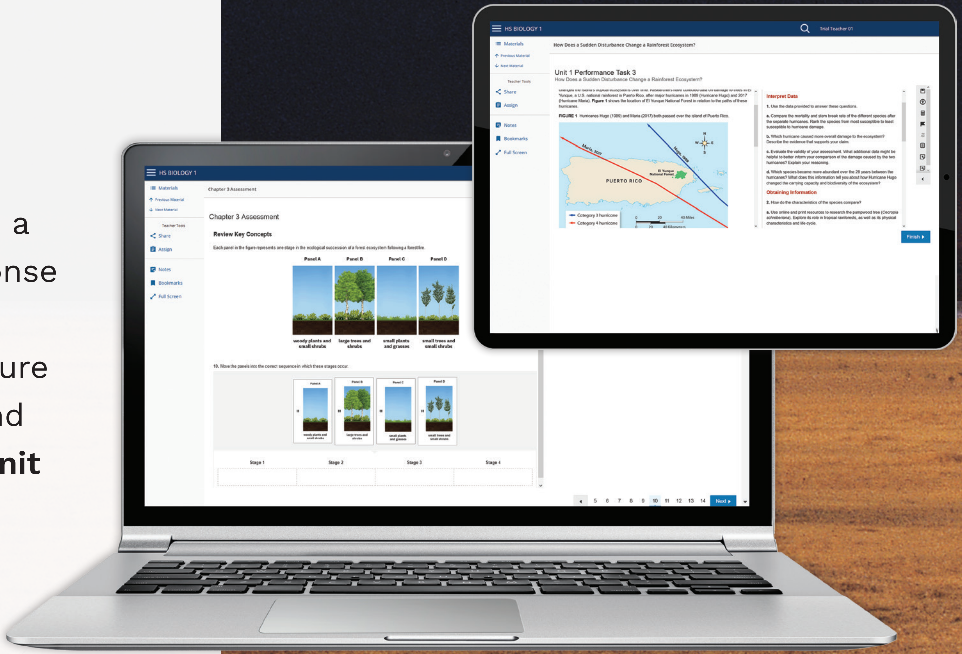
Texas End of Course Exam Test Prep Workbook

Unit Activity

Every unit also offers an opportunity for students to share their claim based on the **Unit Anchoring Phenomenon**.

Summative Assessments

Chapter Assessments offer a combination of open-response and machine-scored items carefully designed to measure students' understanding and retention of the content. **Unit Performance Tasks** assess Big Ideas expectations.

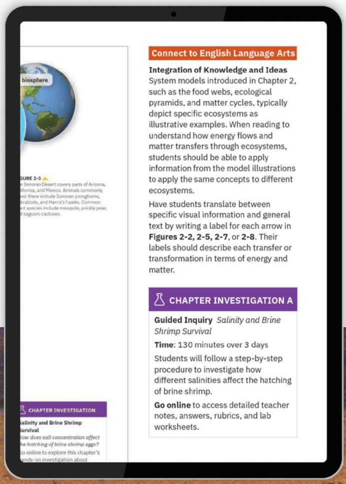


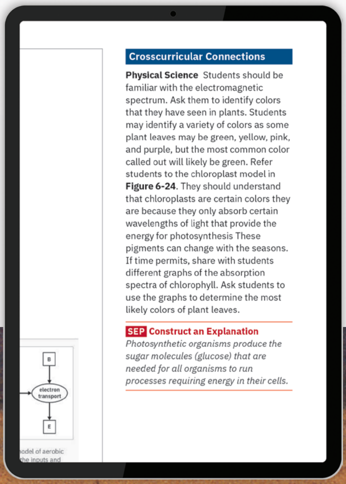
COURSE SUPPORT AND TEACHER TOOLS

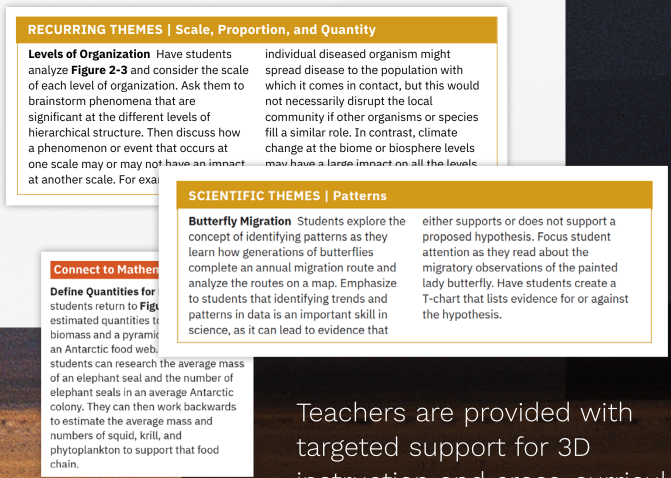
National Geographic Biology, Texas Edition supports teachers in the classroom with a thoughtfully designed Teacher's Edition and a wealth of teacher resources and assessments built in to the MindTap digital platform.

Teacher's Edition

The print and digital resources guide teachers through each unit and chapter to prepare students for 3-Dimensional skills, practices, and assessments including lessons built on the 5E lesson model, background information, and connections to Math and English Language Arts.







Teachers are provided with targeted support for 3D instruction and cross-curricular connections to Math, English Language Arts, and other science disciplines with the Recurring Themes and Concepts clearly called out.

A LOOK INSIDE *NATIONAL GEOGRAPHIC BIOLOGY*

Table of Contents

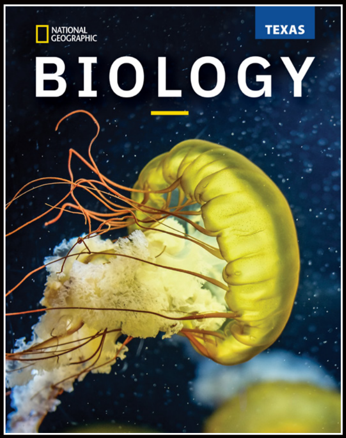
Features

- 3-Dimensional lessons with scientific and engineering practices and recurring themes and concepts.
- Phenomena-based instruction geared towards students figuring out how the phenomenon works in through investigation and discovery
- National Geographic Explorers, photography, and graphics show real-world phenomena and inspire students to think like real scientists
- Data analysis and data literacy activities promote critical thinking and analysis skills
- Literacy and language support including modified text English and Spanish text and assessments available

Technology

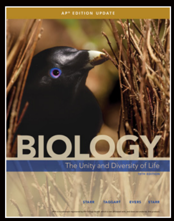
- MindTap is a cloud-based, highly personalized learning environment that combines student learning tools—readings, multimedia, activities, and assessments—into a single learning path
- Teachers can customize content for their students to introduce their own content, and teachers have access to powerful class reports to measure progress and improve outcomes
- MindTap for Biology offers unique videos featuring National Geographic Explorers, interactive simulations, and immersive virtual labs to simulate real-world research

Visit **NGL.Cengage.com/TX-Science** to learn more.

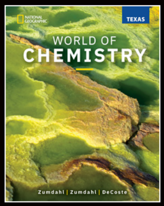


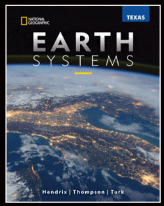
National Geographic Biology, Texas Edition is part of our biology series to meet the needs of on-level, honors, and AP® Biology. Help students become expert problem-solvers and think like biologists with our high school biology solutions.

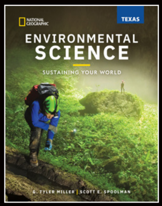
Honors



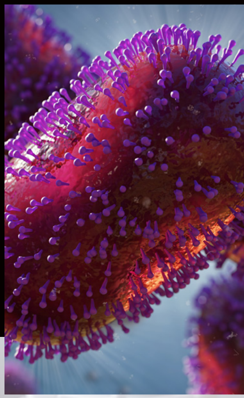
AP®







*Let **National Geographic** engage all of your learners. Explore our other high school solutions, and bring the world to your classroom.*



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ISBN-13: 979-8-214-08323-0
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MAY / 2023