NATIONAL GEOGRAPHIC

Texas Grades 9–12

EARTH SYSTEMS

Texas Edition

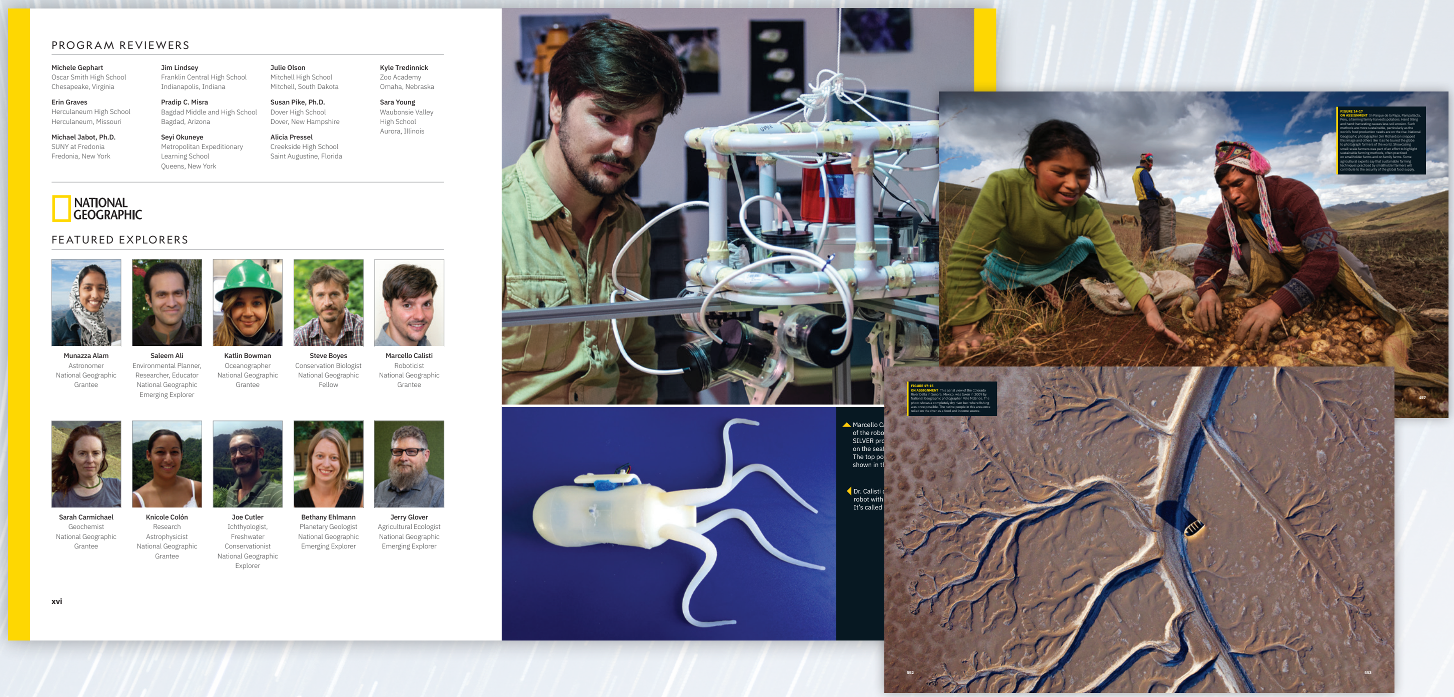
PRESENT EARTH SCIENCE AT THE CORE OF HIGH SCHOOL SCIENCE PRACTICES

Earth Science concepts are at the center of all sciences and ***National Geographic Earth Systems, Texas Edition*** shows students the importance of these connections to chemistry, biology, and physical science. Storytelling and stunning visuals tell how the balance of systems and the dynamics of the Earth are critical for sustainability.

Inspire students with images and videos from the National Geographic archives and build the earth science story with features of National Geographic Explorers.

Authentic National Geographic Experiences

Earth Systems, Texas Edition delivers real-world connections through the stories of National Geographic Explorers who share their diverse perspectives and scientific practices as they solve earth science problems. National Geographic images and illustrations provide a full picture of the earth science story.



Engage Students with Earth Systems Stories

Introduce phenomena to students through the stories and real-world experiences of National Geographic Explorers.

Case Studies for each chapter introduce a real-world earth science story. Each is paired with a *Tying It All Together* activity at the end of the chapter where students explain the phenomenon behind the case study.

ENSURE EARTH SCIENCE STANDARDS ARE TAUGHT AS INTENDED

Lesson Design

ENGAGE

- Explorers At Work
- Explorer Video Series
- On Assignment Photo Lessons
- 3D Lesson Design
- Real World Issues & Phenomena
- Student-Generated Questions

EXPLORE/EXPLAIN

- Chapter Case Study
- Lesson Activities
- Video Library

ELABORATE

- Data Analysis Activities
- Tying It All Together
- Hands-On Labs
- Chapter Investigations

EVALUATE

- Lesson Checkpoints
- Formative Assessments
- Summative Assessments
- Chapter Performance Tasks

Earth Systems, Texas Edition is designed with 3-Dimensional lessons that are based on a phenomenon introduced in each chapter. These teaching strategies help students prepare for 3D assessments including TEKS.


CHAPTER 16

CHAPTER RESOURCES
- Chapter Pretest
- Video 16-1: Studying Ancient Coral Reefs
- Video 16-2: Sun, Earth, Moon, and Tide System
- Video 16-3: The Gulf Stream
- Video 16-4: The Coriolis Effect
- Spanish Chapter Summary
- Chapter Posttest
- Chapter Test
- Performance Task and Rubric

ENGAGE

INTRODUCE AN ANCHORING PHENOMENON

Project the Chapter Opener photo of a surfer riding a huge wave off the southeastern coast of Tasmania, Australia. Ask a volunteer to read the introductory text aloud. Have students observe this phenomenon of seawater interacting with the coastline. Use this phenomenon to engage student interest in the topic of the chapter—oceans and coastlines—and to drive student learning.

Student-Generated Questions In small groups, have students discuss their initial thoughts and questions about the photo of the surfer riding the giant wave. To encourage discussion, ask questions such as:
- What causes water in the ocean to move with such force?
- How do ocean waves and currents affect coastlines and beaches?
- How does the movement of seawater affect ocean ecosystems?

Also encourage students to explore and interact with the phenomenon directly by thinking about their own experiences involving coastlines and beaches. For example, **ask**:
- Have you ever experienced the force of an ocean wave?
- Have you ever observed the changes at a beach as the tide came in?
- Have you ever seen pictures of seaside buildings destroyed by waves?

Then, as a class, compile a list of all the questions students generated from their group discussions. Have the class select three questions they would like to answer by the end of their study of this chapter. Display these questions in the classroom in a place where they can remain visible. At appropriate points in the chapter, refer back to the questions, and invite students to address them. Students may not be able to fully answer the questions at any given point in time, but remind them that this is a process and that they are building their knowledge to explain the phenomenon.

ABOUT THE MAP

Display a map of Australia and point out the island of Tasmania south of the mainland. Explain that Tasmania is part of Australia. Point out the various seas and straits surrounding Tasmania. Then display another, smaller-scale map of only Tasmania, to show a more detailed view of the coastline. Lead a brief discussion in which you solicit observations from students and encourage them to engage with each other. **Ask**:

- How would you describe the coastline of Tasmania? *(It is very jagged and uneven, especially on the eastern side. There are many bays and inlets, as well as peninsulas jutting out into the sea. There are also a number of smaller islands not far off the coast of the main island.)*

CHAPTER 16

OCEANS AND COASTLINES

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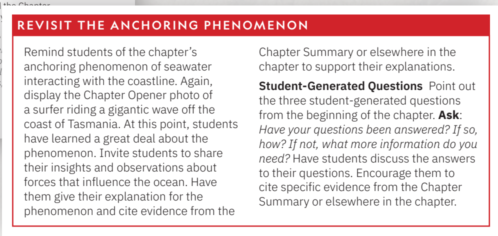
496 CHAPTER 16 OCEANS AND COASTLINES


REVISIT THE ANCHORING PHENOMENON

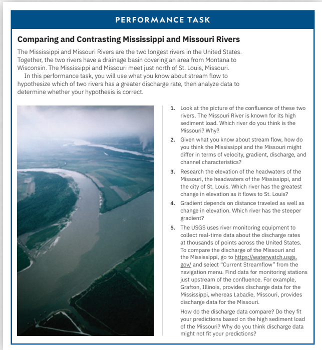
Remind students of the chapter's anchoring phenomenon of seawater interacting with the coastline. Again, display the Chapter Opener photo of a surfer riding a gigantic wave off the coast of Tasmania. At this point, students have learned a great deal about the phenomenon. Invite students to share their insights and observations about forces that influence the ocean. Have them give their explanation for the phenomenon and cite evidence from the

Chapter Summary or elsewhere in the chapter to support their explanations.

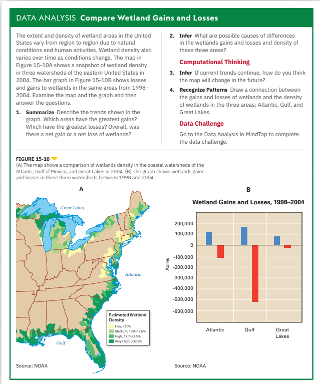
Student-Generated Questions Point out the three student-generated questions from the beginning of the chapter. **Ask**: *Have your questions been answered? If so, how? If not, what more information do you need?* Have students discuss the answers to their questions. Encourage them to cite specific evidence from the Chapter Summary or elsewhere in the chapter.

The Teacher's Edition provides support for introducing a phenomenon for each chapter, connecting to the phenomenon throughout the chapter, and revisiting it at the end of each chapter.

Lessons in the Teacher's Edition include 3-Dimensional support for TEKS.


PERFORMANCE TASK

Comparing and Contrasting Mississippi and Missouri Rivers


DATA ANALYSIS Compare Wetland Gains and Losses

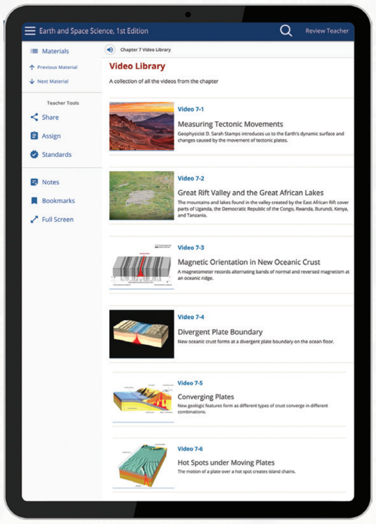
Hands-on activities including Minilabs and Data Analysis activities prepare students for the end of chapter Performance Task.

DIGITAL RESOURCES ENHANCE THE EARTH SCIENCE STORY

A series of videos featuring National Geographic Explorers builds upon the story and phenomenon in each chapter. These exclusive videos provide key content and vocabulary, while also inspiring students with stories of Explorers and their methods for solving problems.

Video Library and eBook Resources

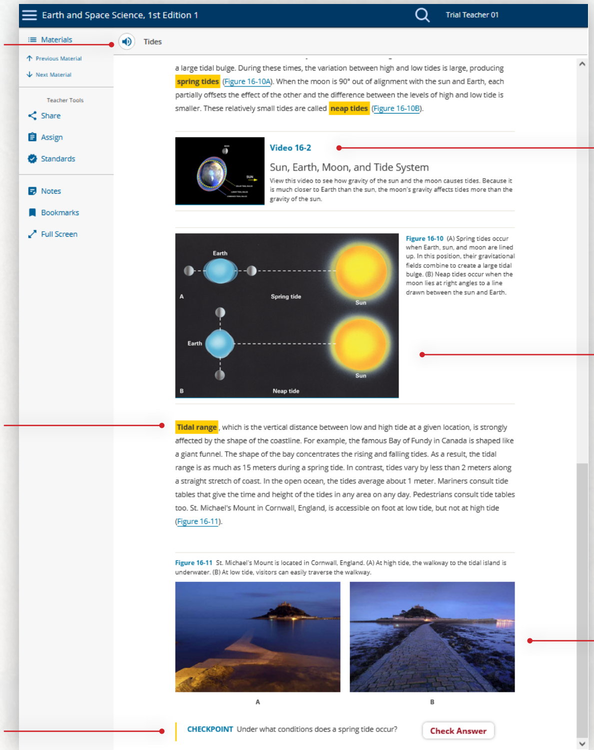
All videos are compiled into an easily accessible library for each chapter.



ReadSpeaker reads text aloud at varying speeds and voices

Interactive vocabulary with pop up definitions

Embedded assessment checkpoint questions with instant student feedback



Video links embedded at point of use for easy viewing

Clickable figures and images for larger viewing with zoom feature

PREPARE STUDENTS FOR COLLEGE AND CAREER

Skills introduced in *Earth Systems, Texas Edition* cultivate problem-solving and critical thinking that is needed for success in college and careers. Students make claims using evidence to build communication and group-work skills needed beyond high school. National Geographic Explorer features provide insight into science careers.

CROSS-CURRICULAR CONNECTIONS

There are many opportunities for students to connect the concepts they explore in this chapter to other disciplines. Here are a few examples.

- **Mathematics** After students learn about methods for measuring earthquake activity in Lesson 8.1, ask them to research the quantity of energy released that correlates to each moment magnitude. Have students graph energy versus moment magnitude value and discuss the exponential relationship between these two.
- **English Language Arts** Have students read Chapter 6 of Jules Verne's *Journey to the Center of the Earth*. This science fiction novel was written in 1864, long before tectonic plate theory was developed. Lead a class discussion in which students compare and contrast ideas mentioned in the chapter about the center of Earth with current thinking about Earth's interior as described in Lesson 8.4.

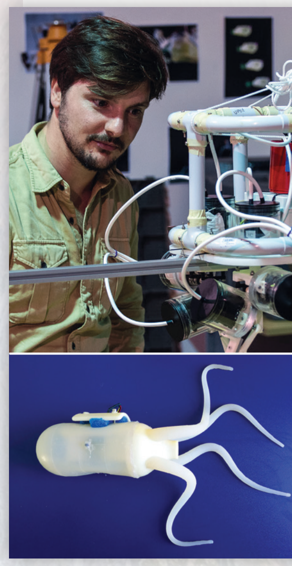
CAREER CONNECTIONS

Lead a discussion in which students identify other careers that are connected in some way to the Explorer's work or field of study. If students need prompting, select one of the careers below. Ask students what they know about the career and how it relates to the Explorer's work.

- **Oceanographer** Oceanographers study various properties of ocean ecosystems: chemical, physical, ecological, and geological, often specializing in one of these areas. In the Arctic, oceanographers might examine ocean currents, wind patterns, ocean nutrients, annual climate patterns, and many other factors.
- **Information Technology (IT) Specialist** IT specialists are responsible for managing computer systems. Major scientific investigations such as those exploring climate change often generate vast amounts of data used to develop computer models. The success of these models relies on the expertise of IT specialists who monitor software and hardware technology.

Connect Earth Science lessons to careers in a wide variety of science and non-science fields, and to many other high school disciplines.

Students meet dozens of National Geographic Explorers as inspiring figures for careers in science



▲ Marcello Calisti examines part of the robot developed for the SILVER project. This robot walks on the seafloor with four legs. The top portion of the robot is shown in this photograph.

◀ Dr. Calisti developed a soft robot with arms like an octopus. It's called PoseiDRONE.

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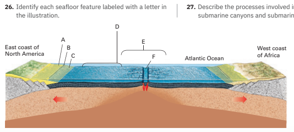
26. Identify each seafloor feature labeled with a letter in the illustration.

27. Describe the processes involved in the formation of submarine canyons and submarine fans.



Think Critically
Write a response to each question on a separate sheet of paper. Use concepts from the chapter to support your reasoning.
28. In 2012, scientist Conel Alexander analyzed the chemical composition of comets in our solar system and found that it differs from that of rocks on Earth that formed from ancient bolides. Does this evidence support or weaken any current hypotheses about the source of Earth's water? Explain.
29. Sampling and remote sensing tools such as the rock dredge and the echo sounder are not useful for exploring the deepest parts of the seafloor. Explain why you think these tools are not suited to deep-sea exploration. Then identify any technological innovations that are being used or could be developed in the future that could advance deep-sea exploration.
30. Is the rock on volcanic islands more similar to the rock on the seafloor or the rock on the continents? Explain your reasoning.
31. Dams can be placed on rivers in order to divert water to do useful work, such as generating electricity and irrigating fields. How do you think the construction of a dam would affect the evolution of submarine canyons and fans downstream of the rivers? Explain your reasoning.

PERFORMANCE TASK
Seafloor Features Model
In this chapter, you have learned about the origin of Earth's ocean basins, the sampling and remote sensing techniques that oceanographers use to study and map the seafloor, and the major types of geologic features of the seafloor.
In this performance task, you will work with a partner to create a slideshow or a stop-motion animation video to share what you have learned with the class.
1. Review the different seafloor features you learned about in Lessons 11.3 and 11.4. With a partner, choose one of these features to model.
A. Using your textbook and other resources, research how this seafloor feature changes over time. Make sure to document how it forms, what variables are required for its formation, how it changes over time, and what factors cause these changes. Consider factors such as tectonic forces, volcanism, weathering, and erosion.
B. Create a slideshow or stop-motion animation video to model how the feature evolves over time. You may draw pictorial models or use clay to form physical models of the feature. In your model, demonstrate how the feature develops and changes. Accompanying your slideshow or animation, include text to explain how it is affected by the environment.

CHAPTER 11 ASSESSMENT 351

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Critical Thinking exercises appear throughout the chapter and with each Explorer feature to extend student knowledge.

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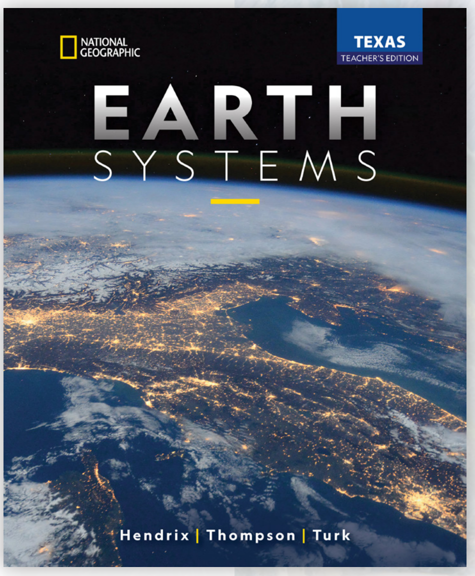
Students practice problem-solving skills during hands-on projects and Performance Tasks.

COURSE SUPPORT AND TEACHING TOOLS

The print and digital resources guide teachers through Unit and Chapter planning to prepare students for 3-Dimensional skills, practices, and student expectations including lessons built on the 5E model, phenomena, and differentiated instruction to meet the needs of all students.

Additional downloadable resources include lecture slides, chapter summaries in English and Spanish, and assessments including chapter pre- and post-tests and the Cognero customizable assessment generator.



DIFFERENTIATED INSTRUCTION

Model Glacier Movement A mixture of corn starch and water about the consistency of toothpaste can help students understand and explore plastic flow of glaciers.

- **Students with Disabilities** Kinesthetic learners will benefit from creating a landscape out of rocks in a small cardboard tray or box, then setting the box on a slope and adding the corn... the...

of what happens and experiment with different slopes to see how slope affects the rate of flow.

- **Gifted and Talented Students** Have students try to recreate the experiment in Figure 13-4 using small objects placed on top of the cornstarch mixture. Have them research and explain why cornstarch and water is considered a non-Newtonian fluid and...

ENGLISH LANGUAGE LEARNERS

Academic Language To help students discuss the content in this section, give them oral and written practice with the academic vocabulary words *stable, stability, unstable,* and *destabilize*. Write and read aloud each word, and have students point out the part that all the words share. Point out that this shows the words are all related. Explain that *stable* means "secure" or "unchanging." When sediment is stable , it will not move downward.

Then give simple definitions of the remaining words: *stability*: the state of being stable; *unstable:* not stable; *destabilize:* cause to be unstable. Have students work with partners to use the four terms in oral and written sentences, drawing on content from the section. For example:

- *If the slope becomes steeper than the angle of repose, the sediment could become unstable.*
- *When the slope is less than the angle of repose, the sediment is stable.*
- *An earthquake can destabilize a hillside.*

DIFFERENTIATED INSTRUCTION

Girls Many students will find Caroline Quanbeck a particularly relatable role model. She is relatively young and still at the beginning of her career as a geologist, yet her research is already having a large impact on the field. Have the class read Quanbeck's profile on the National Geographic Society website (www.nationalgeographic.org) to learn more about her education, training, and research. Ask students to discuss what motivates Quanbeck to pursue her research, even when it means spending a great deal of time in remote locations. Challenge students to put themselves in Quanbeck's shoes and reflect on both the rewards and sacrifices scientists make in order to maintain a commitment to their research.

The Teacher's Edition includes support for reaching all students including English Language Learners, Students with Disabilities, Gifted and Talented, Girls, and others.

Assessment in a Variety of Formats

CHAPTER 7 ASSESSMENT

Review Key Terms

Select the key term that best fits the definition. Not all terms will be used, and no term will be used more than once.

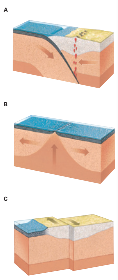
asthenosphere	Mid-Ocean Ridge
continental drift	normal magnetic polarity
continental rifting	plate boundary
convection	plate tectonics
convergent boundary	seafloor spreading
divergent boundary	subduction
isostasy	supercontinent
magnetic reversal	transform boundary
mantle plume	

1. a theory stating that the lithosphere is segmented into several plates that move about relative to one another by floating on and sliding over the upper mantle
2. the hypothesis that segments of oceanic crust are separating at the Mid-Ocean Ridge
3. the hypothesis proposed by Alfred Wegener that Earth's continents were once joined together and later split and drifted apart
4. the upward and downward flow of fluid material in response to density changes produced by heating and cooling, which occurs slowly in Earth's mantle and much more quickly in the oceans and atmosphere
5. a relatively small rising column of mantle rock that is hotter than surrounding rock
6. the concept of balance between gravity and buoyancy that causes the lithosphere to float on the asthenosphere at different elevations
7. the process in which two lithospheric plates of different densities converge and the denser one sinks into the mantle beneath the other
8. a change in Earth's magnetic field in which the north magnetic pole becomes the south magnetic pole and vice versa, which has occurred on average every 500,000 years over the past 65 million years
9. a magnetic orientation the same as that of Earth's current magnetic field
10. an undersea mountain chain that forms at the boundary between divergent tectonic plates within oceanic crust
11. the portion of the upper mantle just beneath the lithosphere, extending from about 100–350 kilometers below the surface and consisting of weak, plastic rock where magma may form

Review Key Concepts

Answer each question on a separate sheet of paper to demonstrate your understanding of key concepts from the chapter.

12. Use a model to explain the role of convection in the movement of tectonic plates.
13. Identify the similarities and differences between the lithosphere and the asthenosphere.
14. Explain the evidence for seafloor spreading that was discovered using magnetometers in the mid 1900s.
15. Describe how mud and fossil deposits support the hypothesis of seafloor spreading.
16. Explain how the different properties of basaltic a... granitic rock result in rift valleys.
17. Identify each type of plate boundary shown.



224 CHAPTER 7 PLATE TECTONICS

7.1 ASSESSMENT

1. **Use Evidence** Explain how Wegener supported his continental drift hypothesis with fossil evidence.
2. **Explain** Why were Wegener's ideas largely dismissed until the 1960s?
3. **Describe** How does Earth's interior structure lend support to the concept of a floating lithosphere?
4. **Relate** Explain how technology led to the hypothesis of seafloor spreading.

Computational Thinking

5. **Abstract Information** Use one or more analogies to describe how Earth's layers result in a moving lithosphere.

Critical Thinking

6. **Synthesize** Use the findings of Vine, Matthews, and Morley to defend the claim that it is important for geologists to have a background in physical science.

Each chapter section includes formative assessment that increase Depth of Knowledge while end of chapter assessments review key terms and concepts (available in print and digitally).

PERFORMANCE TASK

Create a Scientific Illustration

Suppose you are a scientist tasked with explaining to the public how a natural phenomenon has occurred on Earth's surface. The phenomenon is a result of plate tectonics, such as a chain of mountains, a volcanic eruption, a basin, or an earthquake. For this task, you will create a scientific illustration of Earth's layers and use it to explain a phenomenon that has occurred on Earth's surface. A scientific illustration is a two-dimensional model that can be used to explain or predict actual scientific phenomena.

TABLE 7-3 Depths and Densities of Earth's Layers

	Average Depth from Earth's Surface to Base of Layer (kilometers)	Average Density (g/cm^3)
Crust	70	2.6
Lithosphere	125	3.3
Mantle	2,900	4.5
Outer Core	5,150	11.1
Inner Core	6,370	12.5

Materials

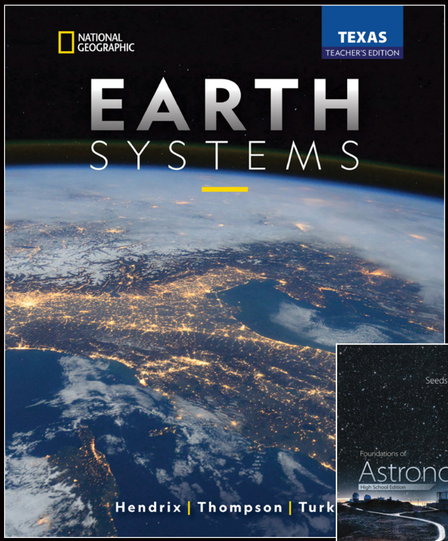
ruler	watercolor paints
compass	colored paper scraps
waterproof fine line pen	scissors
watercolor paper	glue stick

1. Construct and use a model.
   A. Make an accurate cross-section illustration of Earth's layers. Start with a pencil sketch before adding permanent ink and color.
      - Your illustration must be drawn to scale. That is, it must show relative thicknesses of Earth's actual layers. Use the information in Table 7-1 to guide you. The radius of Earth is 6,370 kilometers.
      - Your illustration must include the following information (and may include more):
        - Key showing the scale; for example, "Key: 1 cm = X" (Replace *X* with quantity represented by each centimeter in the illustration.)
        - Names of layers
        - Primary composition of each layer (for example, "basaltic")
        - General properties of each layer (for example, "hot, weak")
        - At least one convection cell
   B. Use your illustration to explain an actual event or feature that has occurred on Earth as a result of plate tectonics. You may use text, arrows, labels, and captions in your explanation. Explain what happened, how it happened, and roughly when it occurred.

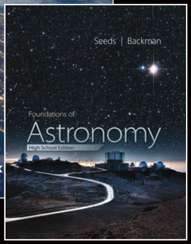
Rubric	Scale			
1. The illustration is drawn to scale and includes a key.	3	2	1	0
2. Captions and labels accurately represent Earth's layers, their composition, and their properties. (Refer to Table 7-1.)	3	2	1	0
3. The illustration depicts at least one convection cell.	3	2	1	0
4. The student used the illustration to accurately explain an actual geological event or feature.	3	2	1	0
5. The student's explanation includes how and when the event occurred or the feature was formed.	3	2	1	0
6. The student's work demonstrates understanding of the Core Ideas and Skills of Chapter 7.	3	2	1	0
7. The student's work is logically organized.	3	2	1	0
Overall Score				

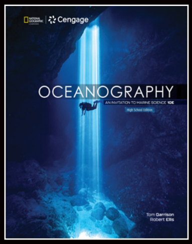
All hands-on activities from Minilabs to Data Analysis include assessment questions while Rubrics for all Performance Tasks measure student 3-Dimensional practices.

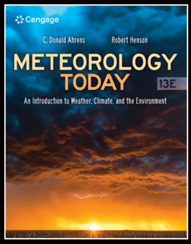
Texas Edition



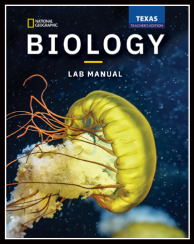
Earth Systems, Texas Edition is one of several solutions available for earth and space-related courses. Extend student learning with these additional options.

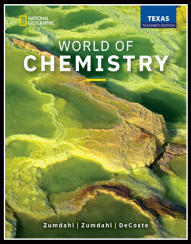


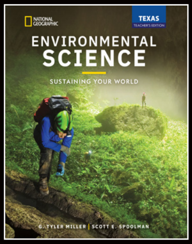


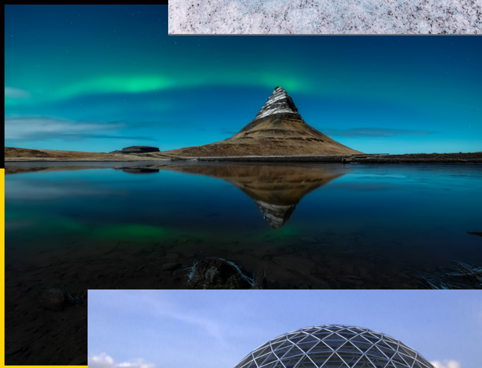


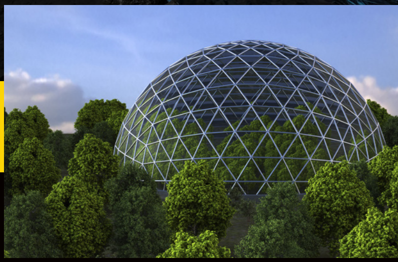
Get the power of National Geographic for all your core and on-level science needs. See our other high school solutions for a true National Geographic experience.











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