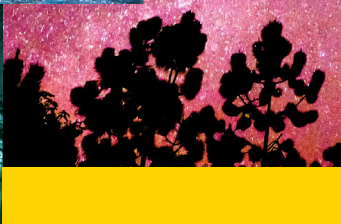
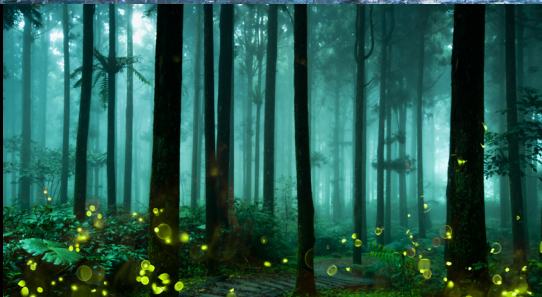
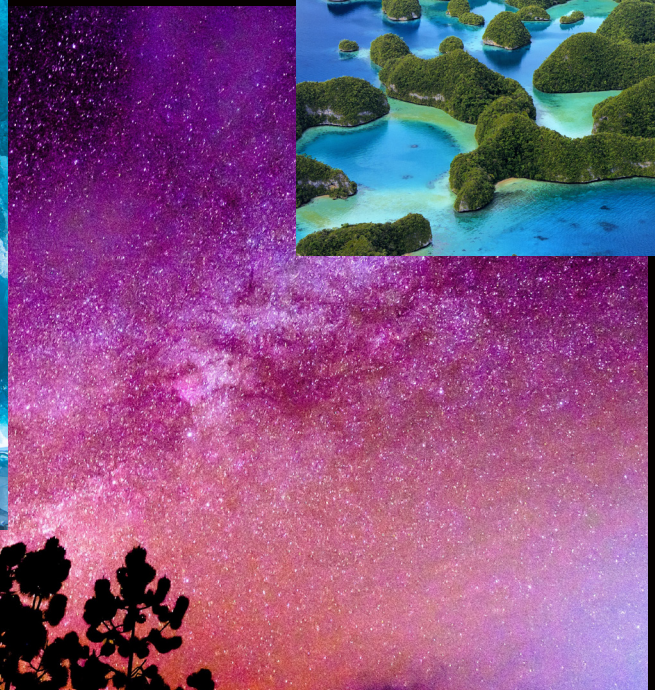


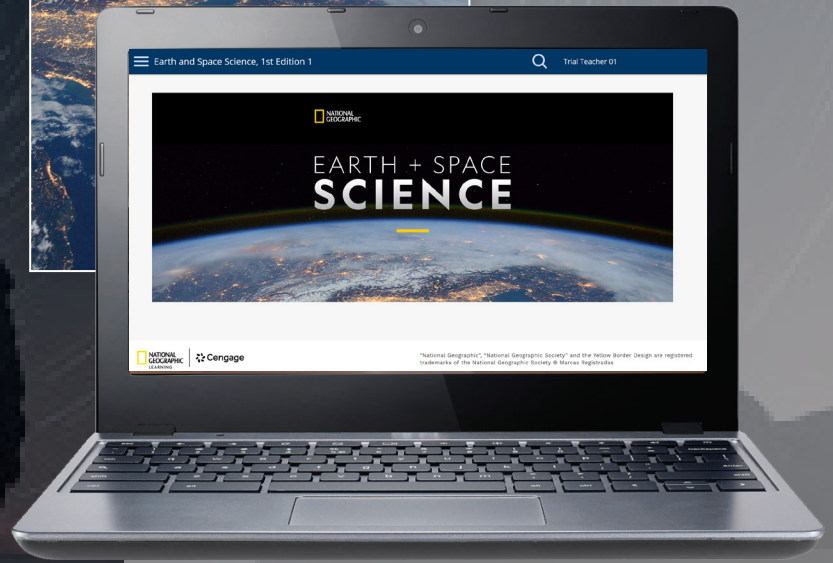
EARTH + SPACE SCIENCE

Florida 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 and Space Science, Florida 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.



EXPLORERS AT WORK

INVESTIGATING EXOPLANETS

WITH NATIONAL GEOGRAPHIC EXPLORER MUNAZZA ALAM

Munazza Alam has spent her days and nights trying to find life on other planets like our own. Alam is pursuing a Ph.D. in astronomy at Harvard University. Her research focuses on exoplanets, planets orbiting stars beyond our solar system. Exoplanets are surprisingly common—there are more planets in the universe than there are stars. The question is: Are any of those distant planets capable of supporting life, as our planet does?

Alam investigates that question using data from the Kepler Space Telescope to study exoplanet atmospheres. “My long-term goal is to find an Earth-like planet with an atmosphere that can support life,” says Alam. With an estimated 500 billion exoplanets in our galaxy alone, the prospects are exciting. The first exoplanet was confirmed in 1995, and more than 3,500 exoplanets have been confirmed to date. About 2,500 more candidates await confirmation.

Once a planet is confirmed to exist, the next step is to study it. It’s difficult because the planet is so far away. It’s billions of kilometers away. In addition, light from exoplanets is so faint that it’s nearly impossible to see. Alam and other astronomers use the transit method to detect them. As an exoplanet travels, or passes in front of, its host star, the star appears to dim because the exoplanet blocks some of its light. Astronomers use this change in brightness to determine the exoplanet’s size. They measure time between transits to determine the exoplanet’s orbital period, including how far the exoplanet is from the host star, which tells them about conditions on the planet. Distance is critical, says Alam. “Too close, and the exoplanet may be too hot. Too far, and there’s

insufficient light to form. Neither condition conducive to life.” The key is to find exoplanets that orbit in the star’s “habitable zone,” says Alam. “That is a region at a distance from the star where liquid water could exist on the surface.” Early searches for exoplanets found mostly hot Jupiter-like planets because they are the brightest and biggest, but this type of planet is actually rare in the universe. Smaller planets called super-Earths, between the size of Earth and Neptunes, are the most common. One of those super-Earths might just have the right atmosphere: ingredients Alam is looking for—gases such as carbon dioxide, methane, and oxygen.

Transit gives information about an exoplanet’s atmosphere. As an exoplanet travels to find out some straight details through the exoplanet’s atmosphere. Various kinds of gas molecules in the atmosphere absorb light at different wavelengths. By looking at which wavelengths of sunlight the exoplanet absorbs, Alam can determine the presence or absence of particular gases in the atmosphere. She can even tell whether clouds are present.

We may never know whether planets beyond our solar system host life. But Alam’s work may help us to one day know at least whether it’s possible.

THINKING CRITICALLY

English Scientists often must make indirect studies of distant and processes that are too complex, too dangerous, or too physically difficult to observe directly. Explain how this applies to the work that Munazza Alam does as an astronomer.



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











National Geographic Earth and Space Science, Florida 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.

PROGRAM REVIEWERS















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FEATURED EXPLORERS

 Manazza Alam Assistant Manager National Geographic Grantee	 Saleem Ali Environmental Planner, Researcher, Educator National Geographic Emerging Explorer	 Karin Bowman Cartographer National Geographic Grantee	 Steve Boyes Cartographer Biologist National Geographic Fellow	 Marcello Calisti Rubbist National Geographic Grantee
 Sarah Carmichael Geochronologist National Geographic Grantee	 Knicole Colón Historian, Astrophysicist National Geographic Grantee	 Joe Cuffler Ecologist, Teacher National Geographic Explorer	 Bethany Ehmann Planetary Geologist National Geographic Emerging Explorer	 Jenny Glover Agricultural Ecologist National Geographic Emerging Explorer

FEATURED EXPLORERS

 Cynthia Lortues-Pierce Sedimentary Geologist National Geographic Grantee	 Stefano Lutz Microbiologist Ecologist National Geographic Grantee	 Paul Miller Composer, Multimedia Artist, Writer National Geographic Emerging Explorer	 Brendan Mullin Anthropologist Educator National Geographic Emerging Explorer	 Erin Pettit Glaciologist National Geographic Emerging Explorer
 Caroline Quaneback Geologist National Geographic Grantee	 Andrés Ruzo Geothermal Scientist, Conservationist National Geographic Explorer	 Austin Salmer Tomato Scientist, Geographer National Geographic Grantee	 Abdul-Muhsin Shah Earthquake Geologist National Geographic Grantee	 Kinosh Warneri Isotope Geologist National Geographic Grantee
 Arianna Soldati Volcanologist National Geographic Grantee	 D. Sarah Stamps Geophysicist National Geographic Grantee	 Alysson Tassin Geologist, Biogeochimist National Geographic Grantee	 Kathy Walker Anthony Aquatic Ecologist National Geographic Emerging Explorer	



Engage Students with Earth and Space Science Stories

EXPLORERS AT WORK

THE WORLD IS MY CLASSROOM

WITH NATIONAL GEOGRAPHIC EXPLORER ANDRÉS RUZO

When Andrés Ruzo talks about his childhood, it is with a fondness that is hard to believe. He grew up in a small town in Mexico, where he had a very close relationship with his father. He was a very good student and was always interested in science. He was a member of the school's science club and was always participating in experiments. He was always asking questions and was always trying to understand how things worked. He was always curious and was always trying to learn more. He was always a very good student and was always interested in science. He was a member of the school's science club and was always participating in experiments. He was always asking questions and was always trying to understand how things worked. He was always curious and was always trying to learn more. He was always a very good student and was always interested in science. He was a member of the school's science club and was always participating in experiments. He was always asking questions and was always trying to understand how things worked. He was always curious and was always trying to learn more.



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.

CASE STUDY THE STORY OF A MOUNTAIN CHAIN

Explorer Cay Richey studies the mountains in the Andes and the Himalayas. He is a geologist and is interested in how mountains are formed. He is studying the Andes in South America and the Himalayas in Asia. He is looking at the rocks and the fossils in the mountains and is trying to understand how they were formed. He is also looking at the climate and the vegetation in the mountains and is trying to understand how they have changed over time. He is a very good student and is always interested in science. He is a member of the school's science club and is always participating in experiments. He is always asking questions and is always trying to understand how things worked. He is always curious and is always trying to learn more.

TYING IT ALL TOGETHER CHAINS OF CHANGE

In this chapter, you will learn about the geology that has shaped the Earth's surface. You will learn about the forces that have shaped the Earth's surface and how they have changed over time. You will learn about the different types of mountains and how they are formed. You will learn about the different types of volcanoes and how they are formed. You will learn about the different types of earthquakes and how they are formed. You will learn about the different types of tsunamis and how they are formed. You will learn about the different types of hurricanes and how they are formed. You will learn about the different types of droughts and how they are formed. You will learn about the different types of floods and how they are formed. You will learn about the different types of wildfires and how they are formed. You will learn about the different types of ice ages and how they are formed. You will learn about the different types of climate change and how they are formed. You will learn about the different types of sea level rise and how they are formed. You will learn about the different types of ocean acidification and how they are formed. You will learn about the different types of ozone depletion and how they are formed. You will learn about the different types of air pollution and how they are formed. You will learn about the different types of water pollution and how they are formed. You will learn about the different types of land pollution and how they are formed. You will learn about the different types of noise pollution and how they are formed. You will learn about the different types of light pollution and how they are formed. You will learn about the different types of heat pollution and how they are formed. You will learn about the different types of radio frequency interference and how they are formed. You will learn about the different types of electromagnetic interference and how they are formed. You will learn about the different types of biological pollution and how they are formed. You will learn about the different types of chemical pollution and how they are formed. You will learn about the different types of physical pollution and how they are formed. You will learn about the different types of social pollution and how they are formed. You will learn about the different types of cultural pollution and how they are formed. You will learn about the different types of economic pollution and how they are formed. You will learn about the different types of political pollution and how they are formed. You will learn about the different types of legal pollution and how they are formed. You will learn about the different types of moral pollution and how they are formed. You will learn about the different types of spiritual pollution and how they are formed. You will learn about the different types of intellectual pollution and how they are formed. You will learn about the different types of emotional pollution and how they are formed. You will learn about the different types of psychological pollution and how they are formed. You will learn about the different types of physiological pollution and how they are formed. You will learn about the different types of environmental pollution and how they are formed. You will learn about the different types of ecological pollution and how they are formed. You will learn about the different types of evolutionary pollution and how they are formed. You will learn about the different types of developmental pollution and how they are formed. You will learn about the different types of degenerative pollution and how they are formed. You will learn about the different types of hereditary pollution and how they are formed. You will learn about the different types of acquired pollution and how they are formed. You will learn about the different types of idiopathic pollution and how they are formed. You will learn about the different types of symptomatic pollution and how they are formed. You will learn about the different types of asymptomatic pollution and how they are formed. You will learn about the different types of chronic pollution and how they are formed. You will learn about the different types of acute pollution and how they are formed. You will learn about the different types of recurrent pollution and how they are formed. You will learn about the different types of intermittent pollution and how they are formed. You will learn about the different types of persistent pollution and how they are formed. You will learn about the different types of transient pollution and how they are formed. You will learn about the different types of permanent pollution and how they are formed. You will learn about the different types of temporary pollution and how they are formed. You will learn about the different types of long-term pollution and how they are formed. You will learn about the different types of short-term pollution and how they are formed. You will learn about the different types of immediate pollution and how they are formed. You will learn about the different types of delayed pollution and how they are formed. You will learn about the different types of simultaneous pollution and how they are formed. You will learn about the different types of sequential pollution and how they are formed. You will learn about the different types of concurrent pollution and how they are formed. You will learn about the different types of coincidental pollution and how they are formed. You will learn about the different types of consequential pollution and how they are formed. You will learn about the different types of contributory pollution and how they are formed. You will learn about the different types of causative pollution and how they are formed. You will learn about the different types of necessary pollution and how they are formed. You will learn about the different types of sufficient pollution and how they are formed. You will learn about the different types of contributory pollution and how they are formed. You will learn about the different types of causative pollution and how they are formed. You will learn about the different types of necessary pollution and how they are formed. You will learn about the different types of sufficient pollution and how they are formed.



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

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 and Space Science, Florida 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 the Next Generation Sunshine State Standards for Science.

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 topics of the chapter—oceans and coastlines—and to drive student learning.

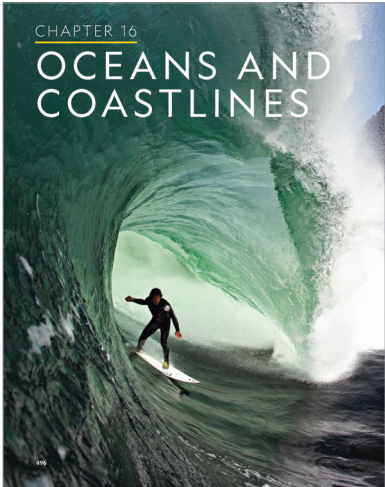
Student-Generated Questions. In small groups, have students discuss their initial thoughts and questions about the photo of the surfer riding the giant wave. To encourage discussion, ask questions such as:

- 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



CHAPTER 16

OCEANS AND COASTLINES

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 coast of Tasmania? (It is very jagged and especially on the eastern side.)
- How many bays and inlets, or peninsulas, jutting out into the sea are also a number of smaller islands off the coast of the main island?
- Based on this map and the Chapter Opener photo, how do you think surrounding seas have shaped coastline of Tasmania? (Samuilik waves have probably eroded the mountains along the coastline. The sea has probably flooded it inlets, resulting in bays, inlets, & islands.)

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.

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.

Lessons in the Teacher's Edition include 3-Dimensional support for the Florida Next Generation Sunshine State Standards.

CONNECT TO THE CHAPTER PHENOMENON

Display again the photo of Grand Prismatic Spring that you showed at the beginning of the chapter. Have students consider the components of the photo in light of what they have learned in this lesson. Ask:

- What parts of the photo show the geosphere? (mountains, rocky ground)
- What parts of the photo show the hydrosphere? (steam, water in the spring, snow)
- What parts show the atmosphere? (We cannot see the gases in air, but they are present. Water vapor in the air can be considered part of the atmosphere and hydrosphere.)
- What parts show the biosphere? (trees, microscopic organisms)

checkpoint Organisms take in gases from the air and require water. Terrestrial organisms ultimately depend on soil.

SCIENTIFIC THEMES

Models Emphasize that any given map is a model designed to represent a particular set of data or information, such as political boundaries, weather data, natural resource deposits, landform features, and geologic structures. To drive home the point, gather a variety of maps of your local area, ideally including all of the types of maps shown in Figure 2-16 as well as other types of maps you may be able to find. Display them one at a time and ask students to discuss the various types of data modeled on each map. Ask:

- What set(s) of data or information is/are modeled in this map? (Answers will vary for each map.)
- What events, features, or phenomena can this map help us explain about our area? (Answers will vary for each map.)
- What predictions can this map help us make? (Answers will vary for each map.)

checkpoint Isolines on a weather map connect areas that have similar atmospheric pressure, temperature, or amount of precipitation.

PERFORMANCE TASK

Comparing and Contrasting the Mississippi and Missouri Rivers

The Mississippi and Missouri Rivers are the two longest rivers in the United States. Together, the two rivers have a drainage basin covering an area from Montana to Wisconsin. The Mississippi and Missouri meet just north of St. Louis, Missouri.

In this performance task, you will use what you know about stream flow to hypothesize which of the two rivers has a greater discharge rate. Then analyze data to determine whether your hypothesis is correct.



1. Look at the picture of the cutaway. The Missouri River is a sediment load. Which river is the Missouri River? Why?

2. Given what you know about you think the Missouri and Mississippi rivers differ in terms of velocity, discharge, and sediment load.

3. Research the elevation of the Missouri and Mississippi rivers. How do you think the elevation change or elevation in a river affects discharge?

4. Consider the discharge of the Missouri and Mississippi rivers. How do you think the discharge of the Missouri and Mississippi rivers differ in terms of discharge? How do you think the discharge of the Missouri and Mississippi rivers differ in terms of discharge? How do you think the discharge of the Missouri and Mississippi rivers differ in terms of discharge?

DATA ANALYSIS Compare Wetland Gains and Losses

The greatest wetland density of wetland areas in the United States vary from region to region due to natural conditions and human activities. Wetland density varies over time as conditions change. The map in Figure 12-28 shows a comparison of wetland density in the wetlands of the eastern United States in 1996. The bar graph in Figure 12-29 shows how gains and losses in wetland density in the same area from 1996-2004. Examine the map and the graph and then answer the questions.

1. Summarize Describe the trends shown in the graph. Which area has the greatest gain? Which area has the greatest loss? Which area has a net gain or a net loss of wetland?

2. Infer What are possible causes of differences in the wetland gains and losses and density of these areas?

3. Infer If current trends continue, how do you think the map will change in the future?

4. Recognize Patterns Draw a connection between the gains and losses of wetlands and the density of wetlands in the three areas: Atlantic, Gulf, and Great Lakes.

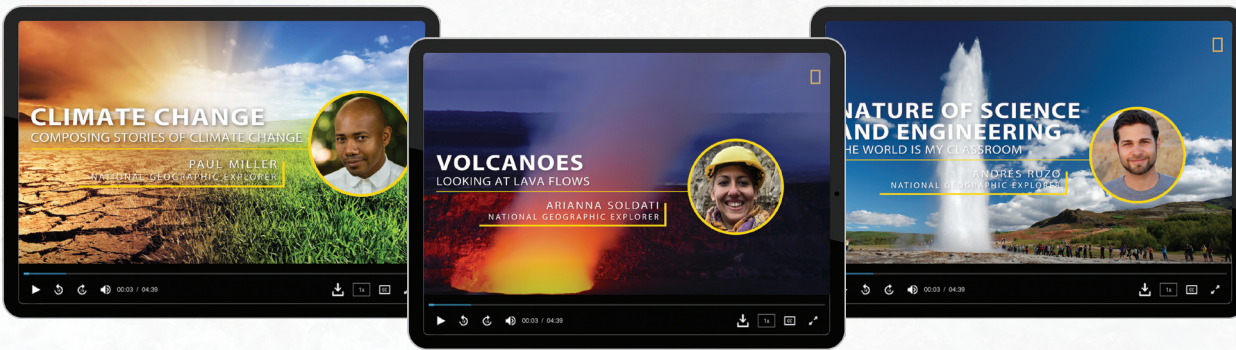
Data Challenge Go to the Data Analysis in MindTap to complete the data challenge.



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

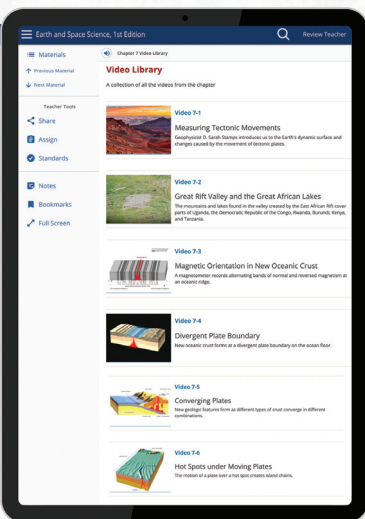
DIGITAL RESOURCES ENHANCE THE EARTH SCIENCE STORY

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

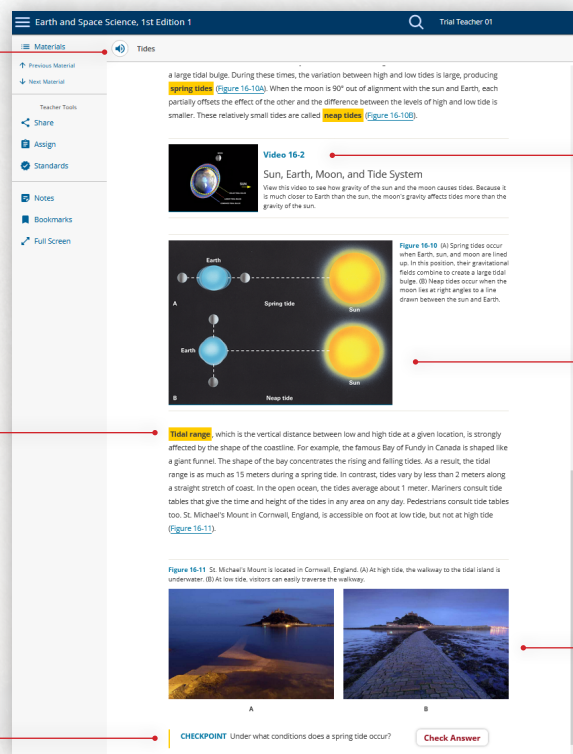
All videos are compiled into an easily accessible library for each chapter.



ReadSpeaker reads text aloud at varying speeds and voices

Interactive vocabulary with pop up definitions

Embedded assessment checkpoint questions with instant student feedback



PREPARE STUDENTS FOR COLLEGE AND CAREER

Skills introduced in *Earth and Space Science, Florida 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.

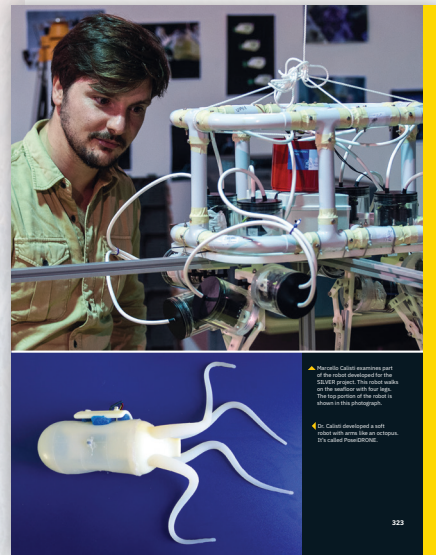
- Mathematics** After students learn about methods for measuring earthquake activity in Lesson 8.1, ask them to research the quantity of energy released that correlates to each moment magnitude. Have students graph energy versus moment magnitude value and discuss the exponential relationship between 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.

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



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

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 river? 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.

- 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.
- 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.
- 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 355

Think Critically

Write a response to each question on a separate sheet of paper. Use concepts from the chapter to support your reasoning.

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

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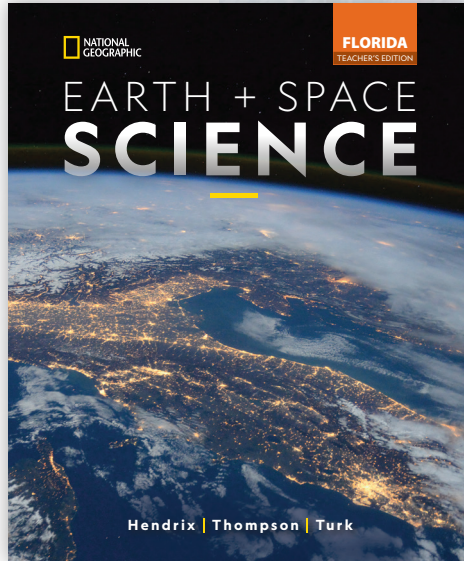
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Students practice problem-solving skills during hands-on projects and Performance Tasks.

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 Performance 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 starch.

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

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

DIFFERENTIATED INSTRUCTION

Girls Many students will find Caroline Quanebeck 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 Quanebeck'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 Quanebeck to pursue her research, even when it means spending a great deal of time in remote locations. Challenge students to put themselves in Quanebeck's shoes and reflect on both the rewards and sacrifices scientists make in order to maintain a commitment to their research.

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

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.

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 1960s.

15. Describe how mid and fault systems support the hypothesis of seafloor spreading.

16. Explain how the different properties of basaltic igneous rock result in rift valleys.

17. Identify each type of plate boundary shown.

18. 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

19. the hypothesis that segments of oceanic crust are separating at the Mid-Ocean Ridge

20. the hypothesis proposed by Alfred Wegener that Earth's continents were once joined together and later split and drifted apart

21. 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

22. a relatively small rising column of mantle rock that is hotter than surrounding rock

23. the concept of balance between gravity and buoyancy that causes the lithosphere to float on the asthenosphere at different elevations

24. the process in which two lithospheric plates of different densities converge and the denser one sinks into the mantle beneath the other

25. 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

26. a magnetic orientation the same as that of Earth's current magnetic field

27. an underwater mountain chain that forms at the boundary between divergent tectonic plates within oceanic crust

28. 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

224 CHAPTER 7 PLATE TECTONICS

74 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.

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.

Materials
ruler
compass
waterproof fine line pen
watercolor paper
watercolor paints
colored paper scraps
scissors
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 7-3 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.

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

Layer	Average Depth from 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

Rubric

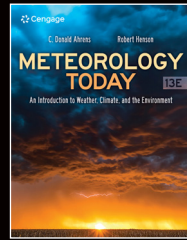
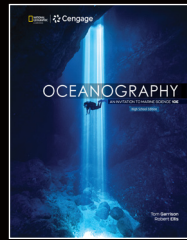
	3	2	1	0
1. The illustration is drawn to scale and includes a key.	3	2	1	0
2. Captions and labels accurately represent Earth's layers, their composition, and their properties. (Refer to Table 7-1.)	3	2	1	0
3. The illustration depicts at least one convection cell.	3	2	1	0
4. The student used the illustration 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.

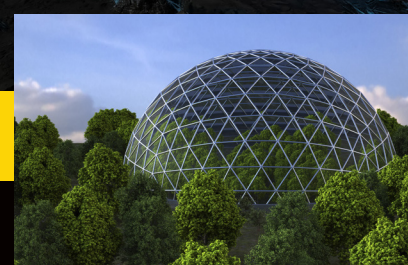
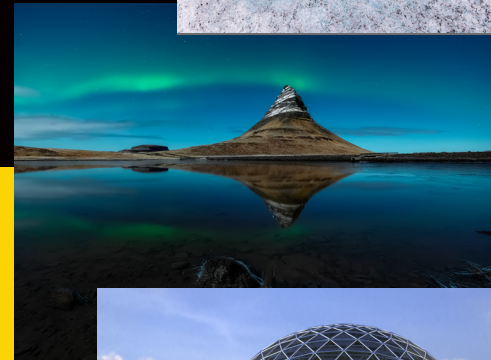
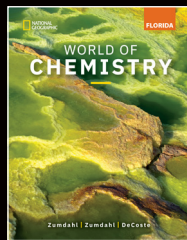
Each chapter section includes formative assessment increasing in Depth of Knowledge while end of chapter assessments review key terms and concepts (available in print and digitally).



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