Houghton Mifflin Harcourt

HMH SCIENCE DIMENSIONS™

ENGINEERED *for the* NEXT GENERATION

Effective NGSS Instruction

GRADES 6–8

Your Guide to the 5Es and Three-Dimensional Learning

NEXT GENERATION SCIENCE STANDARDS

Print & Digital Curriculum

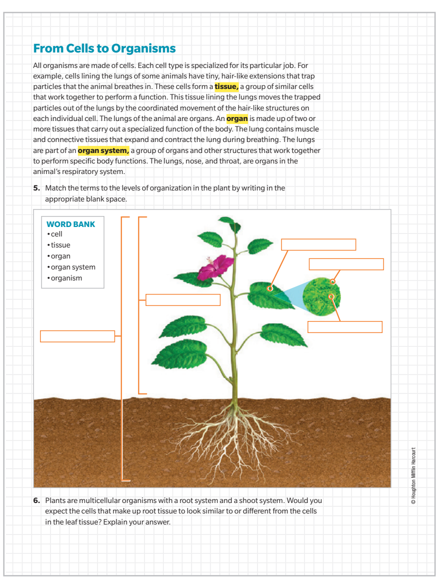
HMH Science Dimensions™ provides the richest NGSS-based 3D learning experiences available. Whether you choose print, digital, or a combination approach, students will be ready to succeed at the **Performance Expectations**.

BOTH PATHS OFFER

- Parallel Lesson Content
- Hands-on Investigations
- 5E Learning Model
- Math & ELA Connections
- Evidence Notebooking
- Engineering Activities
- Collaborative Learning
- Assessment
- Unit Performance Task
- Three-Dimensional Learning

PRINT PATH

At K–8, engage students with a write-in worktext that requires them to take ownership of their learning.



From Cells to Organisms

All organisms are made of cells. Each cell type is specialized for its particular job. For example, cells lining the lungs of some animals have tiny, hair-like extensions that trap particles that the animal breathes in. These cells form a **tissue,** a group of similar cells that work together to perform a function. This tissue lining the lungs moves the trapped particles out of the lungs by the coordinated movement of the hair-like structures on each individual cell. The lungs of the animal are organs. An **organ** is made up of two or more tissues that carry out a specialized function of the body. The lung contains muscle and connective tissues that expand and contract the lung during breathing. The lungs are part of an **organ system,** a group of organs and other structures that work together to perform specific body functions. The lungs, nose, and throat, are organs in the animal's respiratory system.

5. Match the terms to the levels of organization in the plant by writing in the appropriate blank space.

WORD BANK
- cell
- tissue
- organ
- organ system
- organism

6. Plants are multicellular organisms with a root system and a shoot system. Would you expect the cells that make up root tissue to look similar to or different from the cells in the leaf tissue? Explain your answer.

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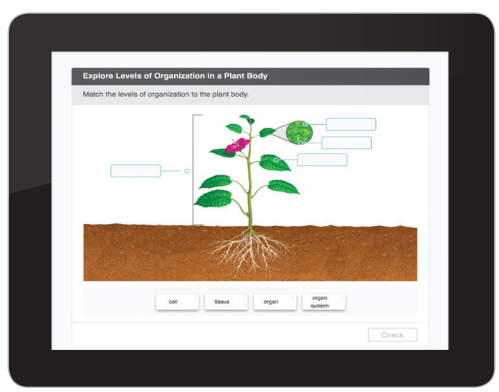
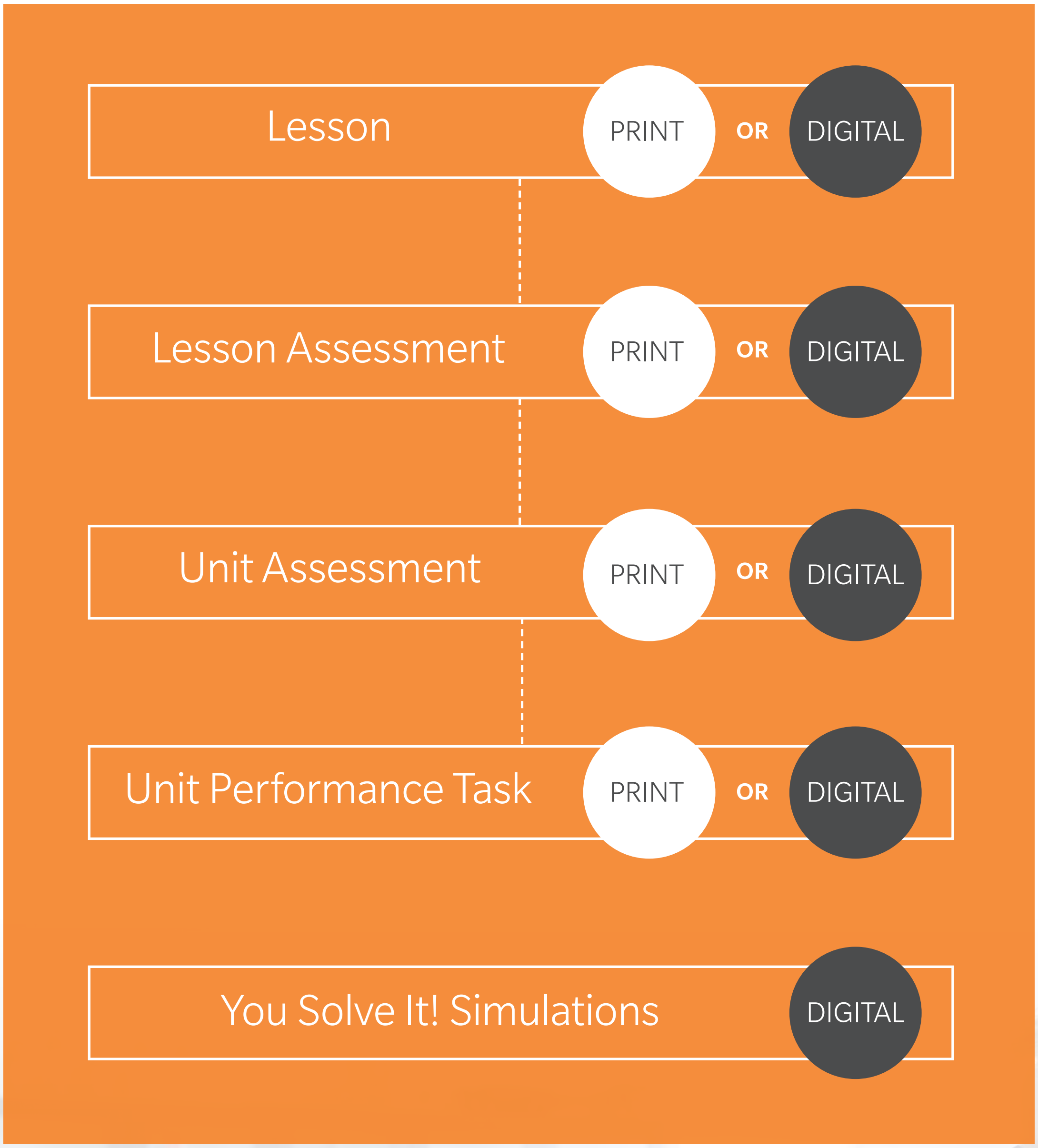
DIGITAL PATH

The robust interactive online Student Edition contains all the content from the print books, enhanced with high-interest interactive elements!



Digital? Print? It's Your Choice!

Because both the digital and print paths include the same content, your learners can follow *any* path to the Performance Expectations that you designate. Leverage digital for small-group work, flipped classrooms, learning centers, and 1:1 technology situations.



Whether you use the print book or the online interactive Student Edition, your students will encounter plenty of opportunities for **science and engineering practices, small-group work,** and **collaborative projects!**

HMH Science Dimensions

Designed—not aligned—for NGSS!

HMH Science Dimensions™ was built for you from the ground up to authentically and effectively address both the spirit and the letter of the Next Generation Science Standards (NGSS)*.

The Digital Advantage

HMH Science Dimensions incorporates highly motivating interactive digital elements, like animations, videos, simulations, and more. This approach allows the program to harness the power of technology, so that students are more engaged, resulting in a more effective learning experience. Throughout this walkthrough, note the DIGITAL ADVANTAGE sections highlighting the interactive elements designed to optimize learning.

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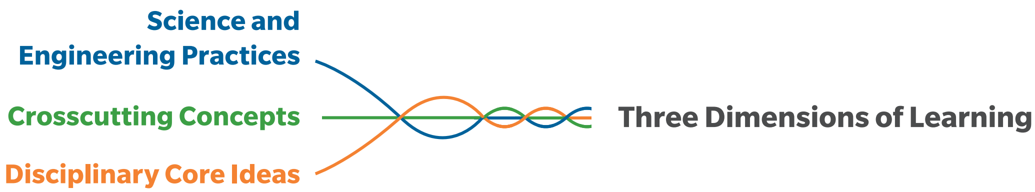
Three-Dimensional Learning

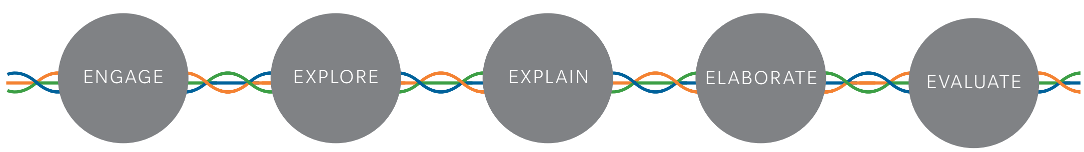
Any curriculum based on the NGSS must integrate the **Science and Engineering Practices, Crosscutting Concepts,** and **Disciplinary Core Ideas** (the Three Dimensions of Learning) throughout all lessons. ***HMH Science Dimensions*** intertwines the Three Dimensions into a cohesive, braided approach that ensures students will increase science proficiency.



Lesson Structure—the 5E Model

HMH Science Dimensions consists of units containing closely related lessons.

Each lesson is built around the familiar **5E instructional model**, endorsed by NGSS thought leaders. We've overlaid the **Claims/Evidence/Reasoning** learning model below with the 5Es to give you a better understanding of how a pedagogy driven by NGSS aligns to the 5Es.



ENGAGE Stimulated to engage with a discrepant phenomenon or puzzling question, students begin each lesson by making connections to the real world around them.

▶ **CLAIMS** Students hypothesize a model or explanation to the puzzle or problem presented. By evaluating their own mental models, students are prepared to study the phenomenon.

EXPLORE Inspired to explore new concepts and gather evidence, they learn actively through a variety of activities and resources.

▶ **EVIDENCE** Students perform experiments and pursue several methods of scientific inquiry to gather data and explore their model.

EXPLAIN Challenged to explain and test their ideas and claims, students become skilled at reasoning about how well their evidence supports their claims.

▶ **REASONING** Armed with real data related to the initial phenomenon or problem, students draw conclusions and adjust models.

ELABORATE Motivated to extend their new learning, students apply this knowledge in different situations to deepen understanding.

EVALUATE Enabled to evaluate how their understanding has changed, students are supported by a progression of formative and summative activities during the lesson.

ENGAGE

Every lesson starts with an Engage opportunity that asks: **Can You Explain It?** or **Can You Solve It?** The Engage section involves a **phenomenon to explain, a problem to solve**, or a **discrepant event** to spark students' curiosity.

As students state **claims**, they begin to analyze their assumptions and ideas, preparing for the learning experiences that follow.

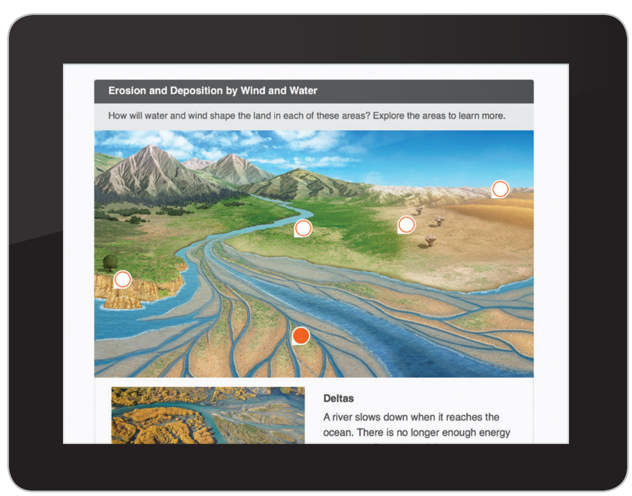
Module F: Geologic Processes & History

Module K: Forces, Motion & Fields

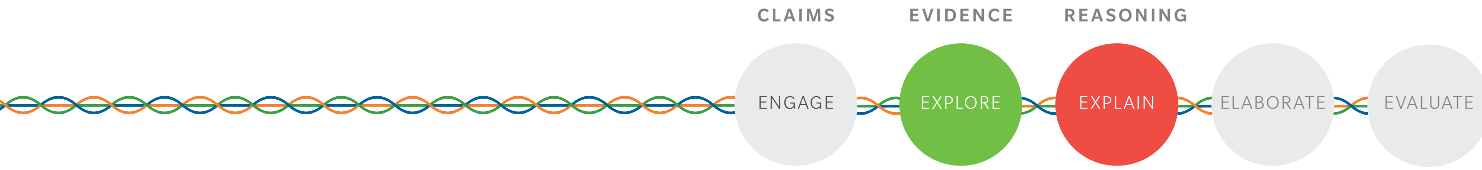
DIGITAL ADVANTAGE

Interactive Illustrations

The interactive nature of online illustrations maximizes student engagement. ***HMH Science Dimensions*** encourages learners to interact with images online. The digital delivery platform also allows students to collect evidence and **save it all online**. Students are also able to share their work with their teacher.



Module F:
Geologic Processes & History



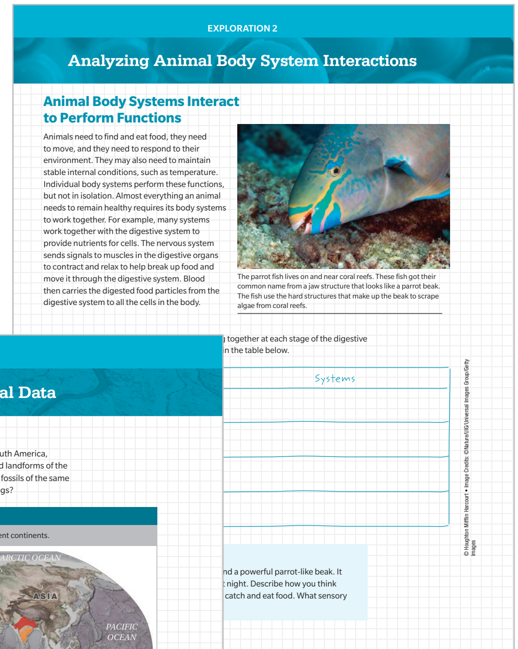
EXPLORE & EXPLAIN

In the next phases of the 5E model, a series of related Explore & Explain activities are organized as **Explorations**. During these activities, learners embark on a discovery process of gathering **evidence** to either support or challenge their **claims** through:

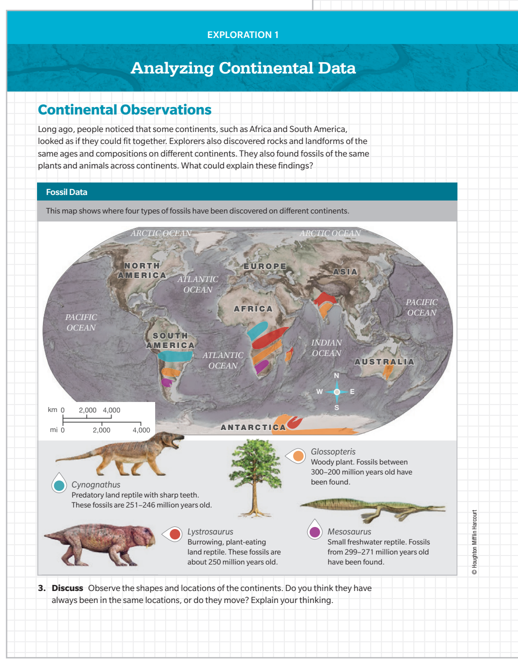
- activities
- data analysis
- interactive illustrations
- videos
- instructional animations

Throughout the lesson, students are prompted to record their evidence using **Evidence Notebooks** where appropriate.

Student-directed formative assessments embedded in the lesson help students assess the evidence they gather. They also share their evidence with peers and collaborate on the activities.



Module B: Cells & Heredity

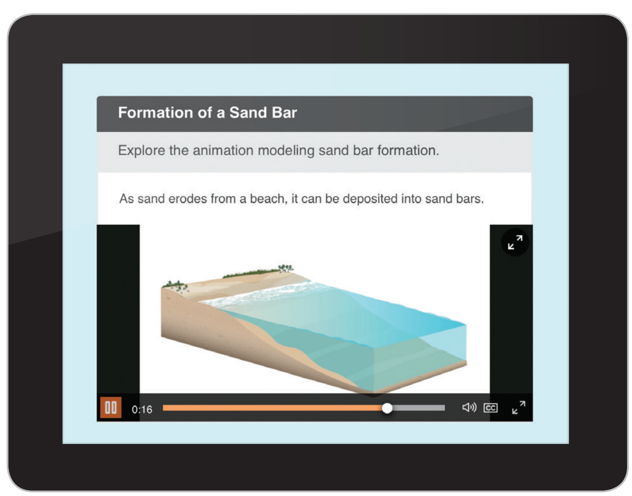


Module F: Geologic Processes & History

DIGITAL ADVANTAGE

Rich Media

The audio and motion aspects of multimedia help learners visualize and see the Three Dimensions of Learning in action. Adding motion and context helps learners **relate to and internalize** the concepts portrayed.

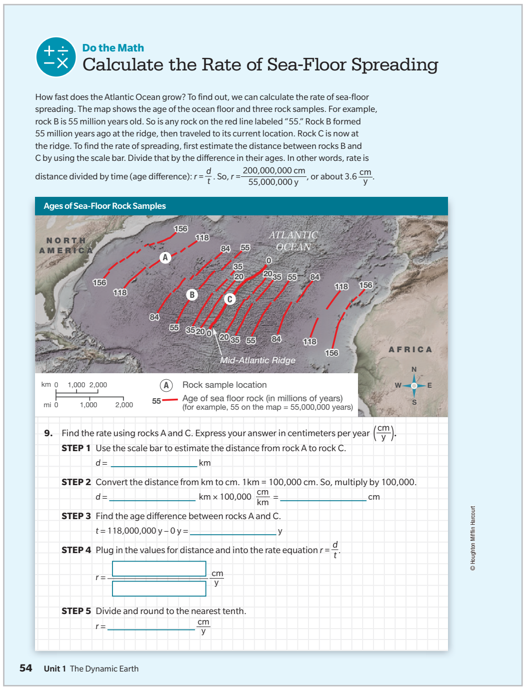


Module F:
Geologic Processes & History Animation

EXPLORE & EXPLAIN

Language SmArts & Do the Math

Being science literate requires a strong foundation in English language arts and math. So ***HMH Science Dimensions*** includes strong connections to these disciplines. These features, called **Language SmArts** and **Do the Math**, offer activities that are **integral to the core objectives** of the lesson.



Do the Math

Calculate the Rate of Sea-Floor Spreading

How fast does the Atlantic Ocean grow? To find out, we can calculate the rate of sea-floor spreading. The map shows the age of the ocean floor and three rock samples. For example, rock B is 55 million years old. So is any rock on the red line labeled "55." Rock B formed 55 million years ago at the ridge, then traveled to its current location. Rock C is now at the ridge. To find the rate of spreading, first estimate the distance between rocks B and C by using the scale bar. Divide that by the difference in their ages. In other words, rate is distance divided by time (age difference): $r = \frac{d}{t}$. So, $r = \frac{200{,}000{,}000\ \text{cm}}{55{,}000{,}000\ \text{y}}$, or about $3.6\ \frac{\text{cm}}{\text{y}}$.

Ages of Sea-Floor Rock Samples

9. Find the rate using rocks A and C. Express your answer in centimeters per year $\left(\frac{\text{cm}}{\text{y}}\right)$.

STEP 1 Use the scale bar to estimate the distance from rock A to rock C.

$d =$ ______ km

STEP 2 Convert the distance from km to cm. 1 km = 100,000 cm. So, multiply by 100,000.

$d =$ ______ km × 100,000 $\frac{\text{cm}}{\text{km}}$ = ______ cm

STEP 3 Find the age difference between rocks A and C.

$t = 118{,}000{,}000\ \text{y} - 0\ \text{y} =$ ______ y

STEP 4 Plug in the values for distance and into the rate equation $r = \frac{d}{t}$.

$r = \frac{\boxed{}}{\boxed{}}\ \frac{\text{cm}}{\text{y}}$

STEP 5 Divide and round to the nearest tenth.

$r =$ ______ $\frac{\text{cm}}{\text{y}}$

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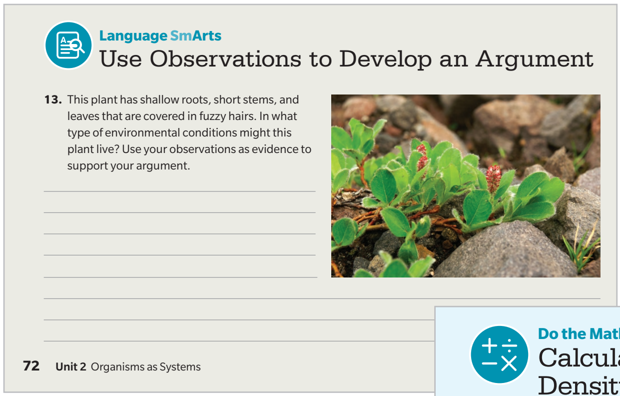
54 Unit 1 The Dynamic Earth

Module F:
Geologic Processes & History



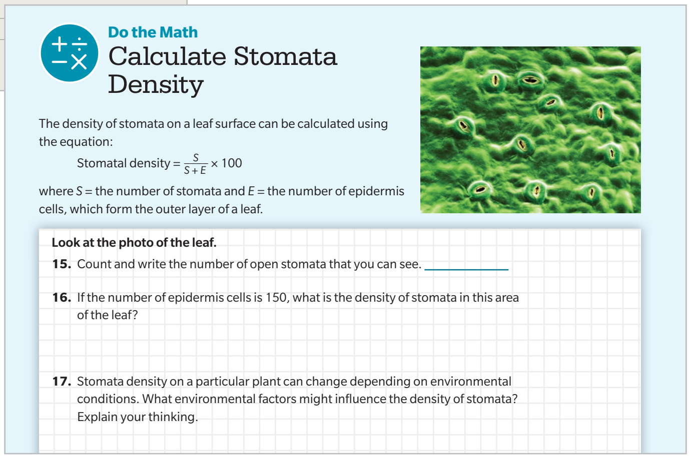
Language SmArts

Use Observations to Develop an Argument

13. This plant has shallow roots, short stems, and leaves that are covered in fuzzy hairs. In what type of environmental conditions might this plant live? Use your observations as evidence to support your argument.

72 Unit 2 Organisms as Systems

Module B:
Cells & Heredity



Do the Math

Calculate Stomata Density

The density of stomata on a leaf surface can be calculated using the equation:

Stomatal density $= \frac{S}{S+E} \times 100$

where S = the number of stomata and E = the number of epidermis cells, which form the outer layer of a leaf.

Look at the photo of the leaf.

15. Count and write the number of open stomata that you can see. ______

16. If the number of epidermis cells is 150, what is the density of stomata in this area of the leaf?

17. Stomata density on a particular plant can change depending on environmental conditions. What environmental factors might influence the density of stomata? Explain your thinking.

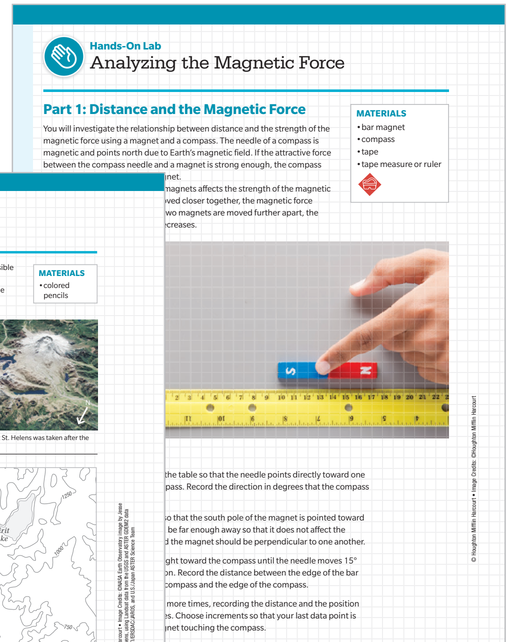
CLAIMS EVIDENCE REASONING

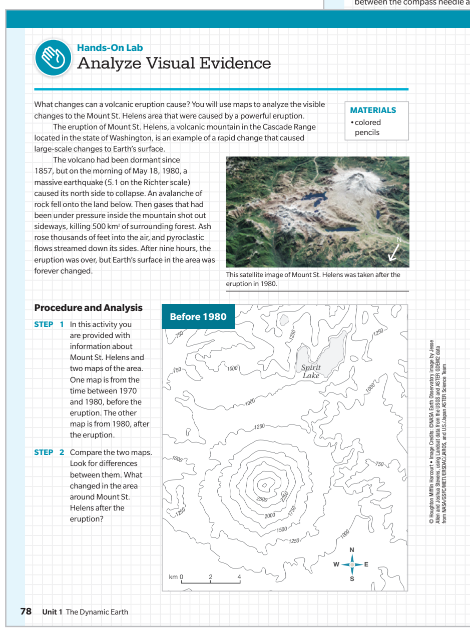
ENGAGE EXPLORE EXPLAIN ELABORATE EVALUATE

EXPLORE & EXPLAIN

Hands-On Investigations

Hands-On Investigations are one way of addressing the **Science and Engineering Practices** of NGSS*. ***HMH Science Dimensions*** offers plenty of **Hands-On Investigations** that encourage students to **gather their own evidence**.





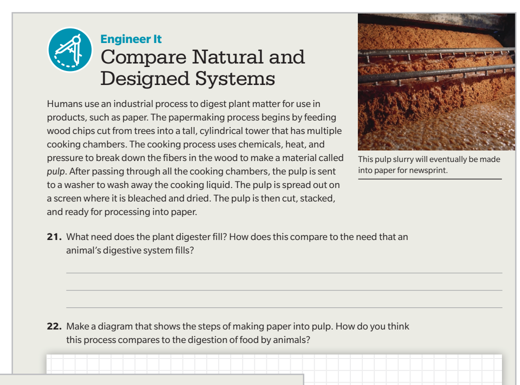
Module F: Geologic Processes & History

Module K: Forces, Motion & Fields

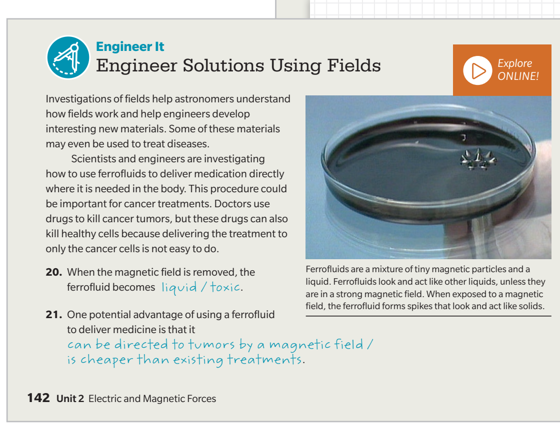
EXPLORE & EXPLAIN

Engineer It!

Engineering in ***HMH Science Dimensions*** goes far beyond just the engineering standards provided by NGSS. Nearly every lesson includes an **Engineer It!** feature. In each one, learners practice **thinking like engineers** and often engage in the Engineering Design Process.



Module B: Cells & Heredity

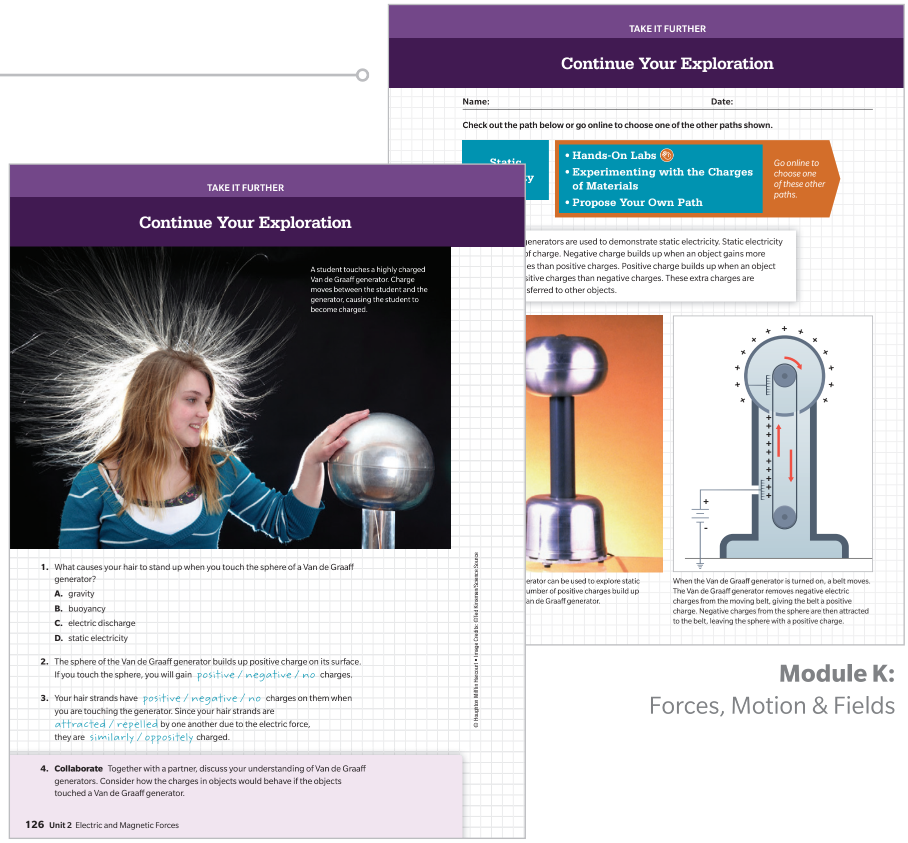


Module K: Forces, Motion & Fields

ELABORATE

Take It Further

To promote interest in science and prepare students for college and careers in engineering and science, we've added a **Take It Further** feature to EVERY lesson. These features **relate science to students' own lives and futures**, inspiring their interest in STEM.

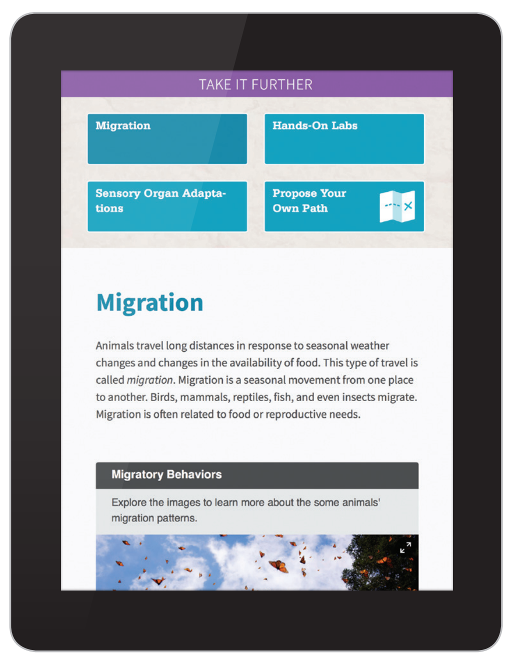


Module K: Forces, Motion & Fields

DIGITAL ADVANTAGE

Student's Choice: Take It Further

Digital delivery allows for more student choice than in print. Nowhere is this more evident than the **Take It Further** (Elaborate) portion of the lesson. Online, students have **several options to choose from**, one of which is sure to capture their interest.

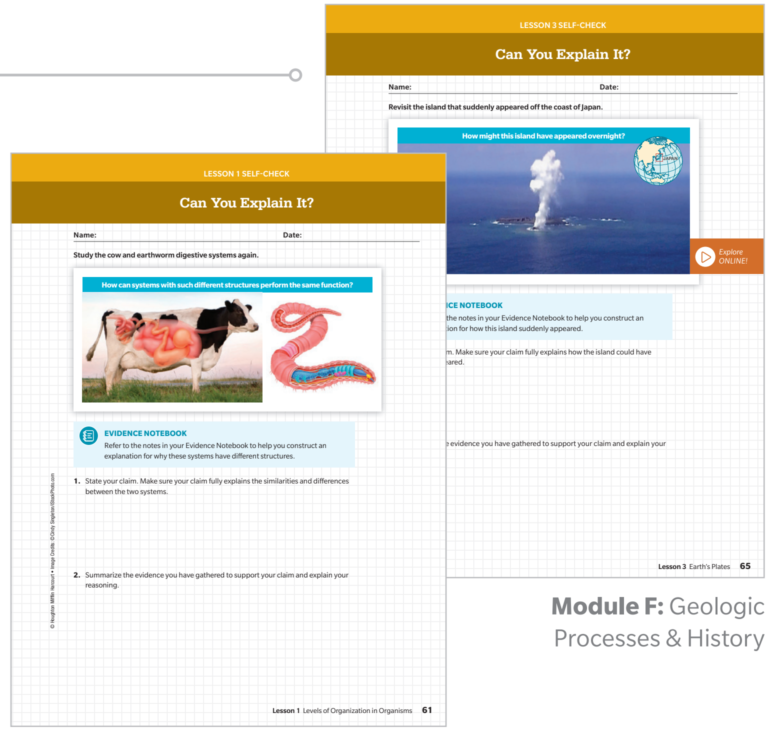


Module B: Cells & Heredity

EVALUATE

Lesson Self-Check

All the students' learning experiences come together in the Evaluate section. Students revisit the puzzling occurrence or intriguing problem they made a claim about in the Engage section. When they reach Evaluate, students return to their **claim** and evaluate the **evidence** they gathered throughout the lesson. They **reason** how the evidence supports or challenges their claim, thereby strengthening their understanding of the science.



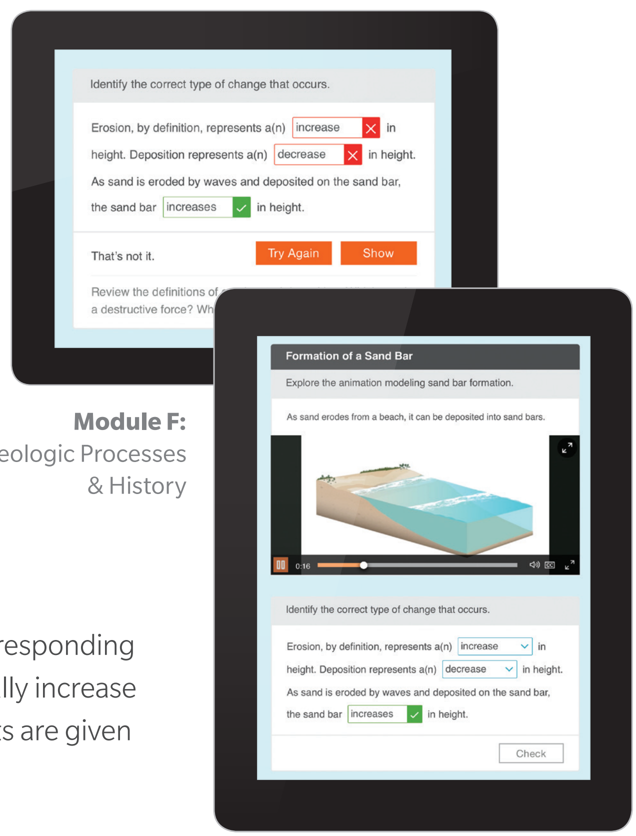
Module F: Geologic Processes & History

Module B: Cells & Heredity

DIGITAL ADVANTAGE

Assessment with Instant Feedback

Online delivery of assessments can provide **instant feedback**. This allows learners to truly take charge of their learning by monitoring their progress while actively engaging with the lesson.



Module F: Geologic Processes & History

Scaffolded Assessment

Online learning allows scaffolded formative assessment. By responding to questions with limited-response options, students gradually increase their understanding of concepts. In these examples, students are given a choice of answers or an example of a possible answer.

EVALUATE

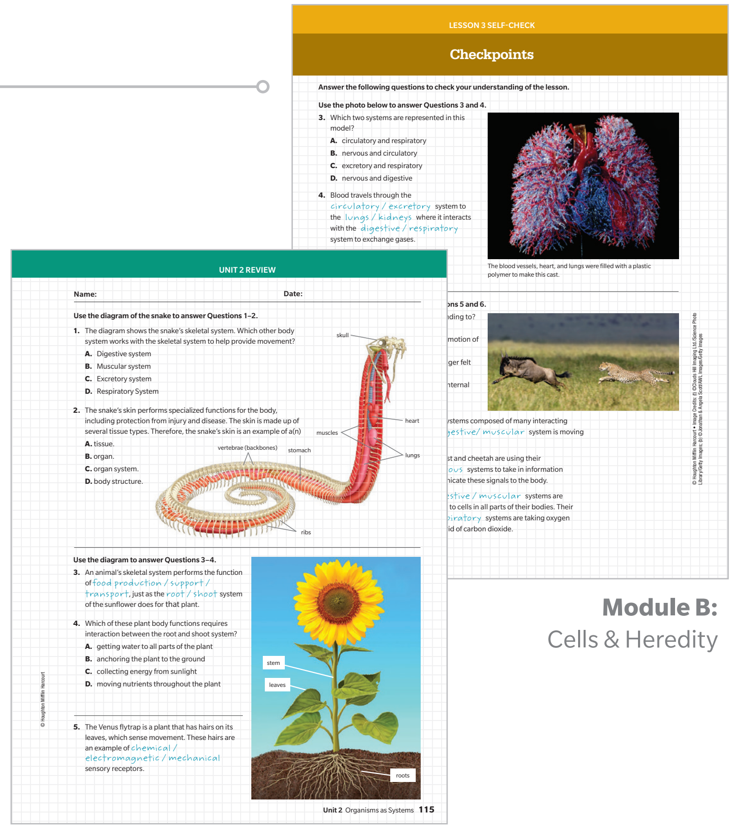
Formative Assessment

Lesson Formative Assessment

The interactive nature of the lessons provides constant formative assessment, but additional formative assessment is provided in the **Self-Check** at the end of each lesson. As is true throughout the program's lessons, the assessment **fully integrates all three dimensions** of science learning—Crosscutting Concepts, Disciplinary Core Ideas, and Science and Engineering Practices.

Unit Formative Assessment

At the end of each Unit, learners have access to the **Unit Review**. This formative assessment covers the same three dimensions of learning for the entire Unit.


LESSON 3 SELF-CHECK

Checkpoints

Answer the following questions to check your understanding of the lesson.

Use the photo below to answer Questions 3 and 4.

3. Which two systems are represented in this model?
A. circulatory and respiratory
B. nervous and circulatory
C. excretory and respiratory
D. nervous and digestive

4. Blood travels through the circulatory / excretory system to the lungs / kidneys where it interacts with the digestive / respiratory system to exchange gases.

The blood vessels, heart, and lungs were filled with a plastic polymer to make this cast.

UNIT 2 REVIEW

Name: Date:

Use the diagram of the snake to answer Questions 1–2.

1. The diagram shows the snake's skeletal system. Which other body system works with the skeletal system to help provide movement?
A. Digestive system
B. Muscular system
C. Excretory system
D. Respiratory System

2. The snake's skin performs specialized functions for the body, including protection from injury and disease. The skin is made up of several tissue types. Therefore, the snake's skin is an example of a(n)
A. tissue.
B. organ.
C. organ system.
D. body structure.

Use the diagram to answer Questions 3–4.

3. An animal's skeletal system performs the function of food production / support / transport, just as the root / shoot system of the sunflower does for that plant.

4. Which of these plant body functions requires interaction between the root and shoot system?
A. getting water to all parts of the plant
B. anchoring the plant to the ground
C. collecting energy from sunlight
D. moving nutrients throughout the plant

5. The Venus flytrap is a plant that has hairs on its leaves, which sense movement. These hairs are an example of chemical / electromagnetic / mechanical sensory receptors.

Unit 2 Organisms as Systems 115

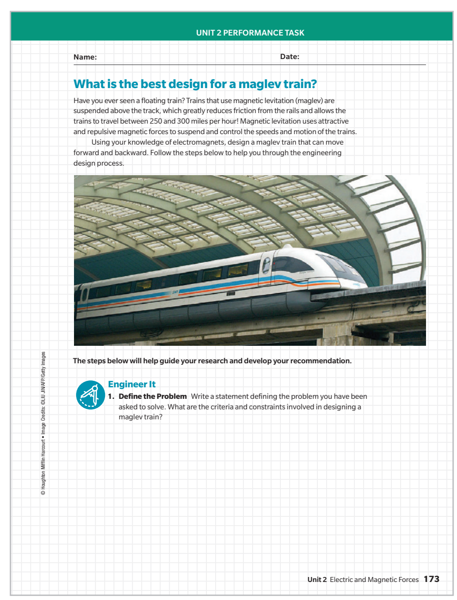
Module B: Cells & Heredity

Summative Assessment

Each Unit includes a **Unit Project** and a separate **Performance Task** so students can demonstrate the **NGSS* Performance Expectation** competency using the **Claims/Evidence/Reasoning** approach they practiced using in the lessons.

The authentic and practical application of student learning creates a full three-dimensional science learning experience, addressing Science and Engineering Practices, Disciplinary Core Ideas, and Crosscutting Concepts.

Many performance-based activities are designed around STEM applications and the Engineering Design Process.


UNIT 2 PERFORMANCE TASK

Name: Date:

What is the best design for a maglev train?

Have you ever seen a floating train? Trains that use magnetic levitation (maglev) are suspended above the track, which greatly reduces friction from the rails and allows the trains to travel between 250 and 300 miles per hour! Magnetic levitation uses attractive and repulsive magnetic forces to suspend and control the speeds and motion of the trains.

Using your knowledge of electromagnets, design a maglev train that can move forward and backward. Follow the steps below to help you through the engineering design process.

The steps below will help guide your research and develop your recommendation.

Engineer It

1. Define the Problem Write a statement defining the problem you have been asked to solve. What are the criteria and constraints involved in designing a maglev train?

Unit 2 Electric and Magnetic Forces 173

Module K: Forces, Motion & Fields

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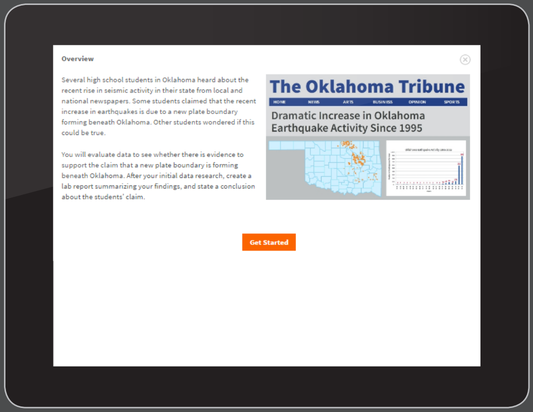
Unique Digital Simulations Reinforce Three-Dimensional Learning and Claims/Evidence/Reasoning

DIGITAL ADVANTAGE

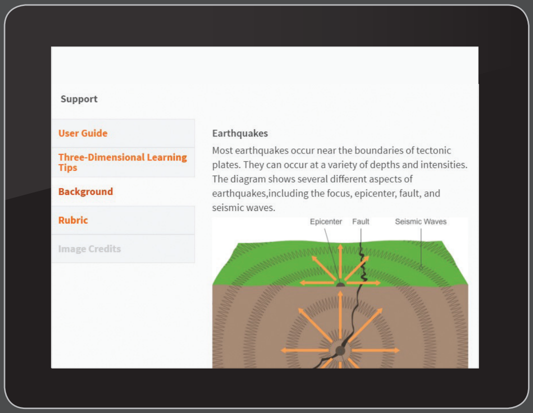
You Solve It! Open-ended Simulations

You Solve It! simulations involve a rich data-gathering or problem-solving exploration that goes far beyond requiring merely a single right answer. Available as part of the digital path, these unparalleled NGSS-centric open-ended simulations support the **Claims/Evidence/Reasoning** instructional model and allow students to answer questions and solve problems in their own way.



Overview

This provides context and some basic instructions on using the open-ended simulation.



Support

The Support section reminds students of the NGSS connections, such as relevant SEPs, DCIs, and CCCs.

Simulation

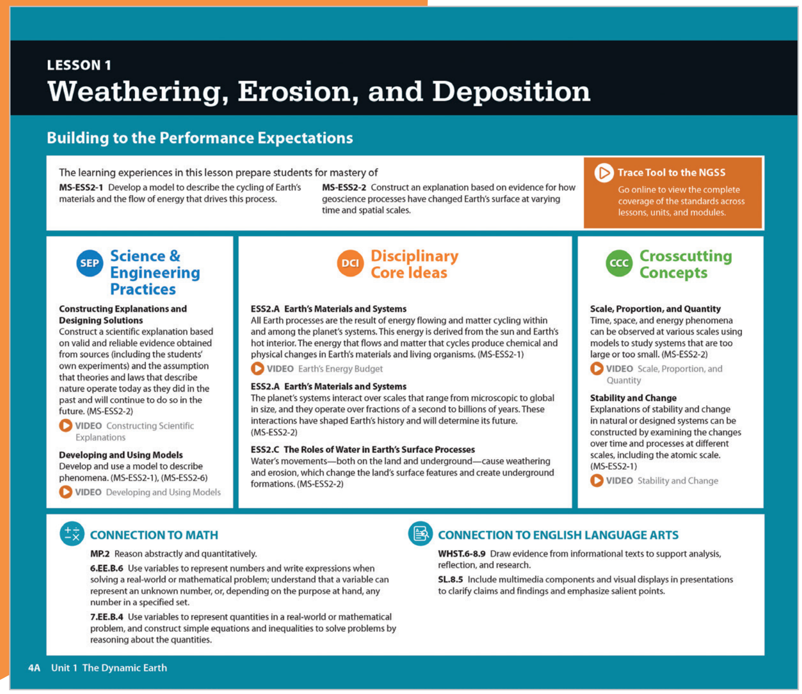
This open-ended simulation gives students FULL control. They make their own choices on how to gather evidence or achieve a solution.

Notes/Report

Students can jot notes about their evidence and reasoning for later creating a report about their claim. They can restart their work at home or on the go when they log into their online Student Edition with any compatible device.

The Teacher Edition—Your NGSS Companion

The Teacher Edition is designed to easily guide you through an NGSS* lesson organized around the 5E model.


LESSON 1
Weathering, Erosion, and Deposition

Building to the Performance Expectations

The learning experiences in this lesson prepare students for mastery of

MS-ESS2-1 Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.

MS-ESS2-2 Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.

Trace Tool to the NGSS
Go online to view the complete coverage of the standards across lessons, units, and modules.

SEP Science & Engineering Practices

Constructing Explanations and Designing Solutions
Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe nature operate today as they did in the past and will continue to do so in the future. (MS-ESS2-2)
VIDEO Constructing Scientific Explanations

Developing and Using Models
Develop and use a model to describe phenomena. (MS-ESS2-1), (MS-ESS2-6)
VIDEO Developing and Using Models

DCI Disciplinary Core Ideas

ESS2.A Earth's Materials and Systems
All Earth processes are the result of energy flowing and matter cycling within and among the planet's systems. This energy is derived from the sun and Earth's hot interior. The energy that flows and matter that cycles produce chemical and physical changes in Earth's materials and living organisms. (MS-ESS2-1)
VIDEO Earth's Energy Budget

ESS2.A Earth's Materials and Systems
The planet's systems interact over scales that range from microscopic to global in size, and they operate over fractions of a second to billions of years. These interactions have shaped Earth's history and will determine its future. (MS-ESS2-2)

ESS2.C The Roles of Water in Earth's Surface Processes
Water's movements—both on the land and underground—cause weathering and erosion, which change the land's surface features and create underground formations. (MS-ESS2-2)

CCC Crosscutting Concepts

Scale, Proportion, and Quantity
Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. (MS-ESS2-2)
VIDEO Scale, Proportion, and Quantity

Stability and Change
Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and processes at different scales, including the atomic scale. (MS-ESS2-1)
VIDEO Stability and Change

CONNECTION TO MATH

MP.2 Reason abstractly and quantitatively.

6.EE.B.6 Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set.

7.EE.B.4 Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.

CONNECTION TO ENGLISH LANGUAGE ARTS

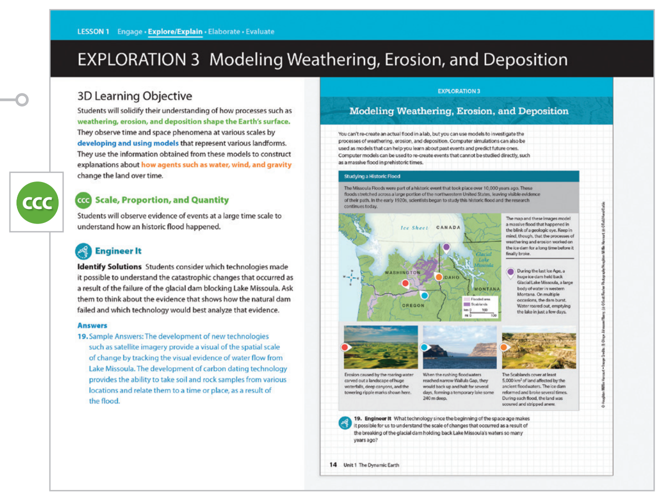
WHST.6-8.9 Draw evidence from informational texts to support analysis, reflection, and research.

SL.8.5 Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points.

4A Unit 1 The Dynamic Earth

3D Learning Objectives

Using the program's customized 3D Learning Objective and clearly labeled Disciplinary Core Ideas, Crosscutting Concepts, and Science and Engineering Practices, educators can keep track of the specific standards that students are covering at any given point in the lesson.


LESSON 1 Engage • Explore/Explain • Elaborate • Evaluate

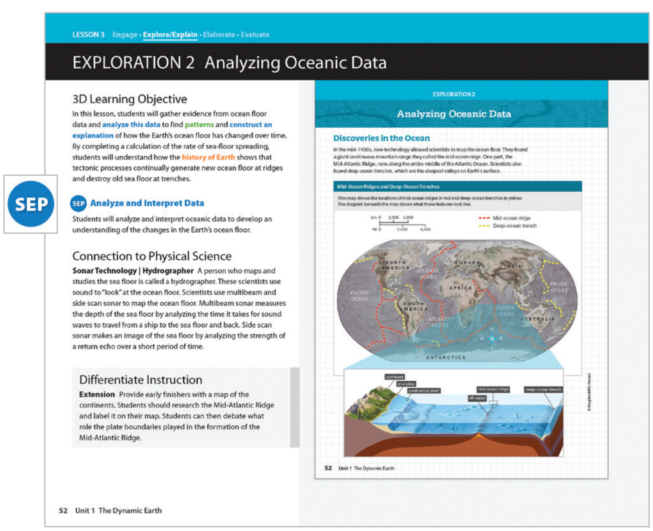
EXPLORATION 3 Modeling Weathering, Erosion, and Deposition

3D Learning Objective
Students will solidify their understanding of how processes such as weathering, erosion, and deposition shape the Earth's surface. They observe time and space phenomena at various scales by developing and using models that represent various landforms. They use the information obtained from these models to construct explanations about how agents such as water, wind, and gravity change the land over time.

CCC Scale, Proportion, and Quantity
Students will observe evidence of events at a large time scale to understand how an historic flood happened.

Engineer It
Identify Solutions Students consider which technologies made it possible to understand the catastrophic changes that occurred as a result of the failure of the glacial dam blocking Lake Missoula. Ask them to think about the evidence that shows how the natural dam failed and which technology would best analyze that evidence.

Answers
19. Sample Answers: The development of new technologies such as satellite imagery provide a visual of the spatial scale of change by tracking the visual evidence of water flow from Lake Missoula. The development of carbon dating technology provides the ability to take soil and rock samples from various locations and relate them to a time or place, as a result of the flood.


LESSON 3 Engage • Explore/Explain • Elaborate • Evaluate

EXPLORATION 2 Analyzing Oceanic Data

3D Learning Objective
In this lesson, students will gather evidence from ocean floor data and analyze this data to find patterns and construct an explanation of how the Earth's ocean floor has changed over time. By completing a calculation of the rate of sea-floor spreading, students will understand how the history of Earth shows that tectonic processes continually generate new ocean floor at ridges and destroy old sea floor at trenches.

SEP Analyze and Interpret Data
Students will analyze and interpret oceanic data to develop an understanding of the changes in the Earth's ocean floor.

Connection to Physical Science
Sonar Technology | Hydrographer A person who maps and studies the sea floor is called a hydrographer. These scientists use sound to "look" at the ocean floor. Scientists use multibeam and side scan sonar to map the ocean floor. Multibeam sonar measures the depth of the sea floor by analyzing the time it takes for sound waves to travel from a ship to the sea floor and back. Side scan sonar makes an image of the sea floor by analyzing the strength of a return echo over a short period of time.

Differentiate Instruction
Extension Provide early finishers with a map of the continents. Students should research the Mid-Atlantic Ridge and label it on their map. Students can then debate what role the plate boundaries played in the formation of the Mid-Atlantic Ridge.

52 Unit 1 The Dynamic Earth

3D Learning Objective

Students will solidify their understanding of how processes such as **weathering, erosion, and deposition shape the Earth's surface.** They observe time and space phenomena at various scales by **developing and using models** that represent various landforms. They use the information obtained from these models to construct explanations about **how agents such as water, wind, and gravity** change the land over time.

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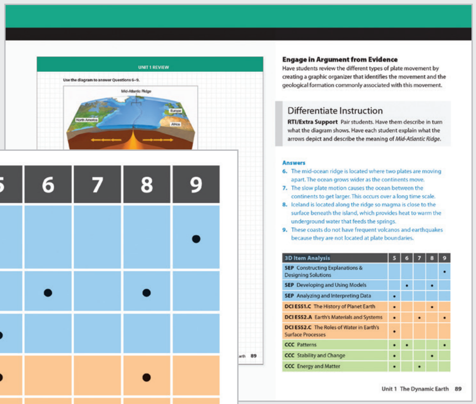
3D Item Analysis

The 3D Item Analysis in the Unit Review identifies the associated Three Dimensions of Learning for EACH review question. This helps educators assess students' knowledge of each component of the Next Generation Science Standards.



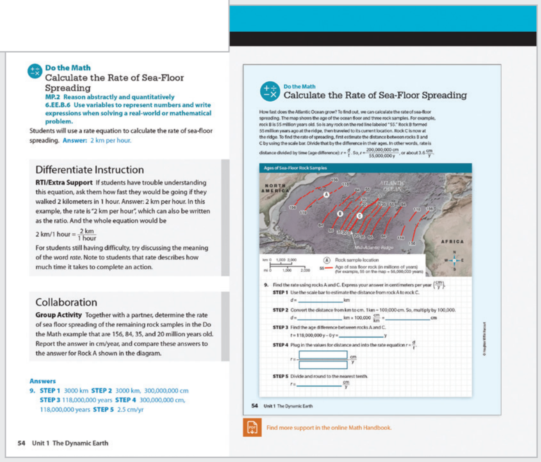
3D Item Analysis	5	6	7	8	9
SEP Constructing Explanations & Designing Solutions					•
SEP Developing and Using Models		•		•	
SEP Analyzing and Interpreting Data	•				
DCI ESS1.C The History of Planet Earth	•			•	
DCI ESS2.A Earth's Materials and Systems	•		•		•
DCI ESS2.C The Roles of Water in Earth's Surface Processes	•				
CCC Patterns	•	•			•
CCC Stability and Change	•			•	
CCC Energy and Matter	•		•		

Common Core State Standards

For added convenience, many of the Math and ELA features in the lessons identify the Common Core State Standards that are referenced by NGSS.

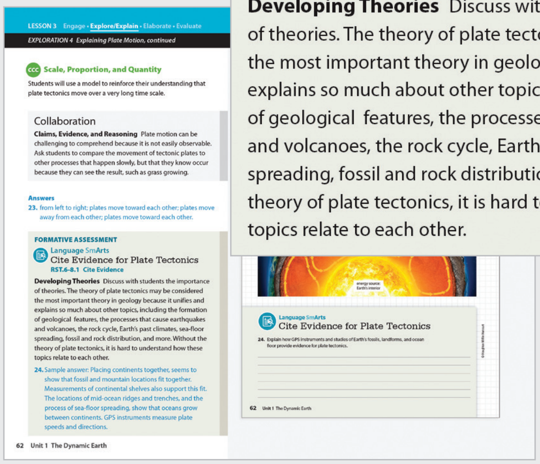
Do the Math
Calculate the Rate of Sea-Floor Spreading
MP.2 Reason abstractly and quantitatively
6.EE.B.6 Use variables to represent numbers and write expressions when solving a real-world or mathematical problem.

Students will use a rate equation to calculate the rate of sea-floor spreading. **Answer:** 2 km per hour.



FORMATIVE ASSESSMENT
Language SmArts
Cite Evidence for Plate Tectonics
RST.6-8.1 Cite Evidence

Developing Theories Discuss with students the importance of theories. The theory of plate tectonics may be considered the most important theory in geology because it unifies and explains so much about other topics, including the formation of geological features, the processes that cause earthquakes and volcanoes, the rock cycle, Earth's past climates, sea-floor spreading, fossil and rock distribution, and more. Without the theory of plate tectonics, it is hard to understand how these topics relate to each other.



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