

California HMH Science Dimensions™

The Living Earth

AVAILABLE IN SPANISH

Phenomena-Driven Instruction
Built for California NGSS

Grades 9–12



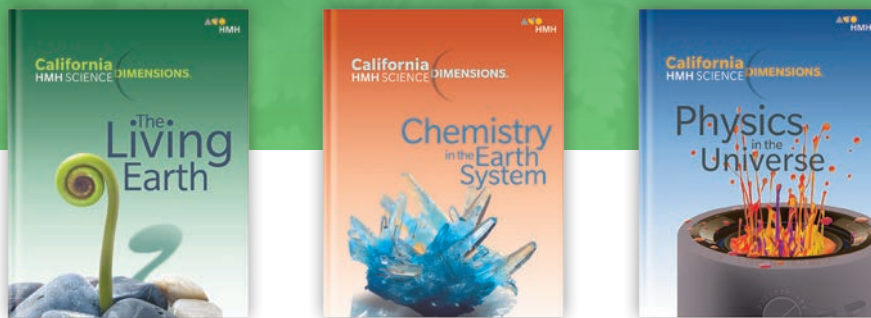
PROGRAM RESOURCES AND FEATURES

A quality TK–12 science curriculum
that helps students develop a
metacognitive mindset
to change the world.



California HMH Science Dimensions™

Phenomena-Driven Instruction



Integrated with earth and space science, **California HMH Science Dimensions™**: *The Living Earth*, *Chemistry in the Earth System*, and *Physics in the Universe* were designed to spark students' curiosity and inspire the next generation of scientists.

Students dive deep into phenomena through a hands-on, three-dimensional approach to learning science. They explore the world around them, think critically, defend their ideas, and reimagine their future.

Why choose **California HMH Science Dimensions**?

- ▶ **A "no guesswork involved" NGSS Trace Tool** systematically maps standards by PEs, SEPs, CCCs, and DCIs. See how they connect and spiral from one grade to another.
- ▶ **We provide, you decide customization** with unmatched flexibility allows teachers to customize units, lessons, and assessments.
- ▶ **Coherent storylines bring phenomena to life** and help students excel at the California Next Generation Science Standards* (CA NGSS) performance expectations and the California Science Test (CAST).
- ▶ **Academic language tools for long-term English learners** teach students to engage with academic discourse across the three dimensions of learning.
- ▶ **A California-based support team** that you can count on. We live and work right here in California.

Education Leaders You Can Trust



Stephen Nowicki, Ph.D.

**Dean and Vice Provost for Undergraduate Education,
Bass Fellow and Professor, Duke University**

Dr. Stephen Nowicki received his doctorate in neurobiology and behavior from Cornell University in 1985. He is now Dean and Vice Provost for Undergraduate Education, as well as Bass Fellow and Professor in the departments of Biology, Psychology, and Neurobiology at Duke University. In 2010, he was elected a Fellow of the American Association for the Advancement of Science.

Cary I. Sneider, Ph.D.

Associate Research Professor, Portland State University

Consulting author Dr. Cary Sneider developed his skills in curriculum development and teacher education throughout his teaching career and nearly three decades at the Lawrence Hall of Science in Berkeley. As a writing team leader for the Next Generation Science Standards, he has been instrumental in ensuring *California HMM Science Dimensions* meets the high expectations of the CA NGSS and provides an effective three-dimensional learning experience for all students.



Bernadine Okoro

STEM Learning Advocate & Consultant

A 12-year science educator and Albert Einstein Distinguished Fellow, Bernadine Okoro was one of the original authors of the Next Generation Science Standards. As a member of the Diversity and Equity Team, her focus on alternative education and community schools and on integrating social-emotional learning and brain-based learning into the NGSS is the vehicle she uses as a pathway to support underserved groups from elementary school to adult education.



The Living Earth Scope & Sequence

UNIT 1: Living Systems

Lesson 1: Life in the Earth System

Lesson 2: Analyzing Populations

Lesson 3: Changes in Ecosystems

Lesson 4: Environmental Engineering

Thing Explainer: How Forests Come Back

UNIT 2: Carbon in the Earth System

Lesson 1: Photosynthesis

Lesson 2: Cellular Respiration

Thing Explainer: Tiny Bags of Water You're Made Of

UNIT 3: Ecosystem Interactions and Energy Flow

Lesson 1: Energy and Matter in Ecosystems

Lesson 2: Cycling of Matter in Earth's Spheres

Thing Explainer: Tree

UNIT 4: Evidence for Evolution

Lesson 1: Geologic Time

Lesson 2: Lines of Evidence for Evolution

Lesson 3: Theory of Natural Selection

Thing Explainer: Earth's Past

UNIT 5: Mechanisms of Inheritance

Lesson 1: Meiosis

Lesson 2: Mendel and Heredity

Lesson 3: DNA Structure and Function

Lesson 4: Protein Synthesis

Lesson 5: Gene Expression and Regulation

Thing Explainer: Books Inside Us

UNIT 6: Genetic Variation and Evolution

Lesson 1: Mutations and Genetic Diversity

Lesson 2: Evolution of Populations

Lesson 3: Adaptive Value of Behavior

Thing Explainer: Tree of Life

UNIT 7: Structure and Function in Living Things

Lesson 1: Mitosis and the Cell Cycle

Lesson 2: Organisms: Cells to Body Systems

Lesson 3: Mechanisms of Homeostasis

Thing Explainer: Bags of Stuff Inside You

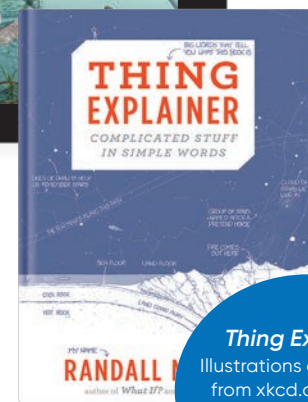
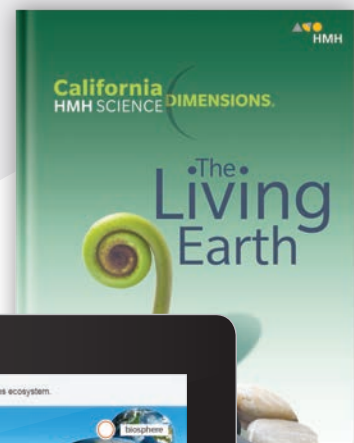
UNIT 8: Ecosystem Stability and the Response to Climate Change

Lesson 1: Human Impacts on Climate

Lesson 2: Human Impacts on Biodiversity

Lesson 3: Engineering Solutions to Environmental Impacts

Thing Explainer: Stuff in the Earth We Can Burn



A Simplified Approach to Exploring Phenomena

Through an exclusive partnership with author and internet sensation Randall Munroe, HMM® has incorporated highly engaging and educational material from Randall's latest book, *Thing Explainer*, into our print and digital editions. Randall's webcomic style, as seen on xkcd.com, humorously explains complex topics in easy-to-understand language.

Thing Explainer
Illustrations and content from xkcd.com author Randall Munroe are featured in the textbook!

Students dive deeper into inquiry with **coherent, 3D storylines**

With *California HMH Science Dimensions*, students approach each sequence of lessons with the three dimensions of learning and build upon investigations driven by their own questions, which arise from their personal interactions with authentic phenomena.

Lesson 1

Life in the Earth System

SEP Developing and Using Models
SEP Using Mathematics and Computational Thinking
DCI LS1.A Structure and Function
DCI LS2.A Interdependent Relationships in Ecosystems
CCC Systems and System Models

Lesson 2

Analyzing Populations

SEP Using Mathematics and Computational Thinking
SEP Scientific Knowledge Is Open to Revision in Light of New Evidence
DCI LS2.A Interdependent Relationships in Ecosystems
DCI LS2.C Ecosystem Dynamics, Functioning, and Resilience
CCC Scale, Proportion, and Quantity

Lesson 3

Changes in Ecosystems

SEP Engaging in Argument from Evidence
DCI LS2.A.1 Interdependent Relationships in Ecosystems
DCI LS2.C.1 Ecosystem Dynamics, Functioning, and Resilience
CCC Stability and Change

Lesson 4

Environmental Engineering

SEP Constructing Explanations and Designing Solutions
DCI LS2.C Ecosystem Dynamics, Functioning, and Resilience
DCI ETS1.A Defining and Delimiting Engineering Problems
CCC Influence of Science, Engineering, and Technology on Society and the Natural World
CCC Stability and Change



Students explore science through:

- Hands-on activities
- Digital simulations
- Interdisciplinary activities
- Lessons enriched with digital media

LESSON 2

Analyzing Populations

Building to the Performance Expectations

The learning experiences in this lesson prepare students for mastery of

HS-LS2-1 Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.

HS-LS2-2 Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.

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

SEP Science & Engineering Practices
Using Mathematics and Computational Thinking
Use mathematical and/or computational representations of phenomena or design solutions to support explanations.
Scientific Knowledge is Open to Revision in Light of New Evidence
Most scientific knowledge is quite durable, but is, in principle, subject to change based on new evidence and/or reinterpretation of existing evidence.
These SEPs are focused on in this lesson. Additional SEPs are integrated throughout the units and lessons.

DCI Disciplinary Core Ideas
LS2.A Interdependent Relationships in Ecosystems
Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from the availability of living and nonliving resources, predation, competition, and disease. Finite environments and resources limit the capacity of organisms to produce populations of great size. This fundamental tension affects the abundance of species in any given ecosystem. (HS-LS2-1), (HS-LS2-2)
LS2.C Ecosystem Dynamics, Functioning, and Resilience
A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (for example, the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability. (HS-LS2-2)

CCC Crosscutting Concepts
Scale, Proportion, and Quantity
The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs.
Scale, Proportion, and Quantity
Using the concept of orders of magnitude allows one to understand how a model at one scale relates to a model at another scale.
These CCCs are focused on in this lesson. Additional CCCs are integrated throughout the units and lessons.

MATH STANDARDS
MP.2 Reason abstractly and quantitatively.
MP.4 Model with mathematics.
HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multistep problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.
HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

ELA STANDARDS
RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.
WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.

Lesson 2 Analyzing Populations 25A

In the Teacher Edition, each lesson:

- Progresses through the **5E instructional model**
- Has unique, interrelated **3D Learning Objectives**
- Clearly identifies each unit's anchor phenomena, investigative phenomena, and performance expectations
- Includes clear, consecutive objectives ensuring lessons cover 100% of the CA NGSS performance expectations.

California
HMH SCIENCE **DIMENSIONS™**
TRACE TOOL TO THE NGSS™

This tool will help you make sense of NGSS, how it connects and spirals from one grade band to another, and what HMH provides to support your NGSS-based instruction.

What grade do you teach?

☐ Grade K
 ☐ Grade 3
 ☐ Grade 6
 ☐ Living Earth

☐ Grade 1
 ☐ Grade 4
 ☐ Grade 7
 ☐ Chem/Earth

☐ Grade 2
 ☐ Grade 5
 ☐ Grade 8
 ☐ Physics/Universe

NGSS Trace Tool: Understand where your instruction fits

Using the *California HMH Science Dimensions Trace Tool* you can:

- Make sense of the standards
- Understand how the standards connect and spiral from one grade to another
- Trace the standards by PEs, SEPs, CCCs, or DCIs

Cross-Curricular Connections help students develop an understanding of science and engineering concepts.

- Multi-disciplinary connections are linked to **California Common Core Math, ELA, Physical Science, Chemistry**, and more.
- Connections to the **History of Science and Environmental Principles & Concepts** are provided at point of use.
- **Unit Connections** provide ideas for cross-curricular projects.

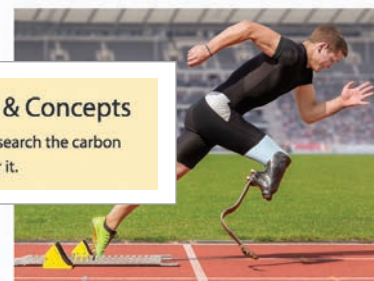


Environmental Principles & Concepts

Principle III Have small groups of students research the carbon cycle and how humans benefit from it and alter it.

Engineering Connection

Carbon Fiber Carbon fiber is stronger than steel, but weighs much less. These long chains of carbon atoms can be added to other materials, such as plastics, to increase their strength while keeping the material lightweight. Carbon fibers are used in airplanes, cars, and even electronics. The application of carbon fiber technology has been significant in the advancement of prostheses for athletes.



This carbon fiber prosthetic leg compresses like a spring and rebounds, mimicking a normal leg.



EVIDENCE NOTEBOOK

Write a magazine article about the history of prosthetics in sports and the influence of carbon fiber. Research ways that engineers use carbon fiber to design prostheses that more closely mimic the way a limb performs. How has carbon fiber changed the way athletes perform in competitive activities, such as sprinting?



Students engage with scientific phenomena through **hands-on investigations**

Students are more engaged and learn more meaningfully through student-centered investigative inquiry. *California HMH Science Dimensions* is built on this approach. Your students will learn to define questions, design and conduct **hands-on investigations**, **make claims**, and **identify evidence**. Watch as they take charge and fully engage in their learning!

3D Unit Planning

Lesson 1: Energy and Matter in Ecosystems pp. 143-158

Overview

Objective: Explain, analyze, and model the flow of matter and energy through trophic level using food chains, food webs, and pyramid models.

Hands-On Lab Planning

Modeling Biomagnification

30 minutes
Pairs

Objective: Students model biomagnification and apply what they have learned to relevant scenarios.

Materials:

- beads, large (16)
- beaker, 500 mL
- marker
- paper cup (4 small, 2 medium, 1 large)
- pencil, sharpened
- salt
- tape, masking
- tray, large

Advance Preparation: To save time, group all materials together for each pair of students.

Print and Online Student Editions

ENGAGE

Investigative Phenomenon p. 143
Can You Explain It? How might a toxic algae bloom affect ecosystems in the region?

EXPLORE/EXPLAIN

Flow of Energy and Matter in Ecosystems p. 144
Data Analysis: Population Size and Trophic Levels
Distribution of Energy and Matter in Ecosystems pp. 148
Problem Solving: Energy Calculations

ELA Handbook

Explore Online

What Do Alligators Eat?

Two 45-minute class periods
Individuals

Objective: Students view a video to analyze an alligator's food to determine where alligators fit in the Everglades food web.

Investigative Phenomena Drive Every Lesson

Each lesson opens with **Can You Explain It?** or **Can You Solve It?**, a problem to solve or discrepant event to explain that focuses on an investigative phenomenon.



Evidence Notebook Investigating sea otters helped scientists identify a decline in the population. This, in turn, led to efforts to protect the sea otters and work to ensure that the population grows.

1. What methods might scientists have used to study the sea otter population in California?
2. How could these methods have helped scientists identify a problem with the sea otter population? Explain.

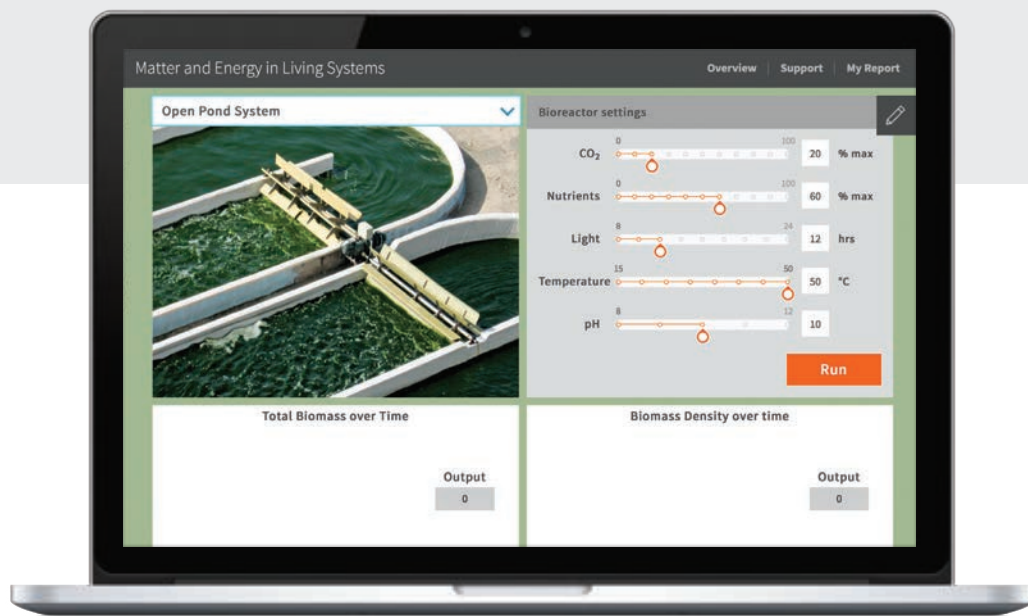


Evidence Notebook prompts help build metacognition by encouraging students to:

- keep their thoughts **organized** in context of the phenomena being explored,
- engage in **self-reflection** of their own learning, and
- consider how their learning experiences **shape their thinking**.

You Solve It! Student-Driven Simulations

You Solve It simulations are open-ended, interactive opportunities for students to run experiments, gather data, and analyze the impact of different variables on a closed system. Students explore and investigate real-world problems while developing in-depth explanations of scientific concepts and phenomena.



Hands-On Labs

- Labs guide students through designing and carrying out investigations, and through **analyzing and interpreting data**.
- Students actively “do science” as they make sense of everyday phenomena.
- They **think critically** about their observations, practice gathering evidence, and defend their claims, just like real scientists and engineers.

FIGURE 11: Two blue jays compete for a food source.



Collaborate With a partner, think of at least two reasons why an organism might compete with another organism of the same species for a limited resource. Explain why two organisms would compete for these limited resources rather than share them.

Cultivate Collaboration

Working as a team is an essential part of developing 21st-century skills. *California HMH Science Dimensions* provides ample opportunities for students to:

- Participate in groups to complete activities
- Partner with peers to discuss their findings
- Practice speaking and listening skills

Students connect learning to real-life issues and develop a **mindset** to solve STEM challenges

The CA NGSS has raised the engineering design process to the same level as scientific inquiry. In *California HMH Science Dimensions*, **science, technology, engineering, and math** are considered integral parts of the curriculum. Lessons are designed to help students develop a mindset to explore science and solve problems the same way scientists and engineers do.

Integrated Engineering

With *California HMH Science Dimensions*;

- Engineering and STEM are integrated throughout every unit
- Engineering design is elevated to the same level as scientific literacy
- A **Performance Task**, included in every unit, gives students multiple opportunities to apply the engineering design process by **defining a problem** and **designing a solution**

Tools That Build Scientific Literacy Skills

The online **Science and Engineering Practices Handbook** helps students achieve a higher level of understanding. They build their experience by applying the **Science and Engineering Practices** of the CA NGSS. Handbook includes:

- Asking questions
- Planning investigations
- Analyzing data
- Constructing explanations
- Exploring the nature of science
- And more!

Engineering

Building Artificial Coral Reefs

Earth's coral reefs are critical for the stability of marine ecosystems. Unfortunately, many are classified as threatened because of the effects of human activity. Living corals depend on the limestone deposited by their predecessors to get the minerals necessary to build their own bodies. However, the limestone is being dissolved from existing reefs due to increased ocean acidity caused by climate change. Marine ecologists are now combating this destruction by sinking artificial reefs, such as the one shown in Figure 16, which uses electrical currents to attract the limestone deposits needed by growing coral.



FIGURE 16: Artificial reef

Analyzing Water Pollution

The small town of Lakeview is located on the shores of Piper Lake. The town relies on the lake for trout fishing, eagle watching, and recreational activities. Recently, a fertilizer plant, H.T.C. Fertilizer, was built upstream on Eagle River, which feeds into Piper Lake. Townspeople have noticed an increase in algae blooms in the lake. They are concerned the fertilizer plant is dumping too much nitrogen into the lake, and wonder's livelihood could be affected. Are they right? Does the plant need to control the waste it puts into the river?

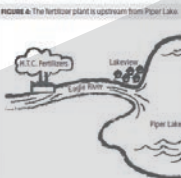


FIGURE A: The fertilizer plant is upstream from Piper Lake.

1. DEFINE THE PROBLEM

With your team, write a statement outlining the problem you've been asked to solve. Record any questions you have about the situation and the information you need to solve the problem.

2. CONDUCT RESEARCH

With your team, investigate the cause-and-effect relationship between nitrogen, algae blooms, and fish populations. Could the fertilizer plant be responsible for the changes the town is experiencing?

3. ANALYZE DATA

On your own, analyze the problem you have defined along with your research. Make a model that demonstrates how excess nitrogen cycles through the aquatic ecosystem. Your model should also show any effects the nitrogen may have on the ecosystem using a food web, energy pyramid, biomass pyramid, or pyramid of numbers.

4. COMMUNICATE

Present your findings to the town and the fertilizer company. Explain whether or not the runoff from the fertilizer plant is adversely affecting the lake ecosystem. Your presentation should include images and data to support your claims. Try to anticipate your audience's reaction and be ready to answer their questions.

CHECK YOUR WORK

A complete presentation should include the following information:

- A clearly defined problem with supporting questions that are answered in the final presentation.
- A model of the effect of the fertilizer runoff.
- A recommendation that explains how to solve the problem and uses evidence to support the solution.
- Images and data that further support your solution.

With your team, write a statement outlining the problem you've been asked to solve. Record any questions you have about the situation and the information you need to solve the problem.

1. DEFINE THE PROBLEM

When biodiversity and ecosystem's stability?

system 19



TAKE IT FURTHER

Careers in Engineering

Environmental Engineer

Environmental engineering focuses on the relationship between humans and the environment to develop solutions to environmental problems. Environmental engineers may use concepts from biology, chemistry, physics, mathematics, or soil science. They solve problems related to solid waste and wastewater management, water supply and quality, air quality, and public health. For example, an environmental engineer might design desalination equipment to help provide more drinking water in an area.

Desalination removes salt from seawater or brackish groundwater. The water produced can be treated to meet water quality standards for human consumption. Desalination plants require a source of water to treat and a place to dispose of the salts and other contaminants removed during this process. Desalination plants help increase the water supply of an area. Water shortages due to drought led to the construction of a desalination plant in Carlsbad, California.

The first task in designing a desalination plant is to define the problem and identify the social, technical, and environmental criteria and constraints that could limit potential solutions. The engineer would research background information on the project site, past and current water supply issues, the government permits required for this type of project, potential community involvement, and much more.

Once the problem is defined, an environmental engineer may be asked to design potential solutions. Solutions often build off of existing technology. An engineer might study existing desalination plants and make adjustments based on the unique limitations for the project.

Next, modeling may be used to determine if the system will work as expected and what, if any, environmental or societal impacts can be expected from the solution. An engineer could make a mathematical model of the desalination process to determine the efficiency of the design.

FIGURE 12: This desalination plant in Carlsbad, California was built to provide fresh water to the San Diego region.

FIGURE 13: This desalination plant was built to provide fresh water to the San Diego region.

Finally, an environmental engineer communicates the solution through reports. For a desalination plant, an engineer would include an explanation of why the solution will be effective and suitable for the problem.

Environmental engineers may be involved in the design process, or they may be involved in the construction process from beginning to end.

Language Arts: Construct a 3-4 session project. The client needs a reliable source of water. Electricity is not readily available. The client is considering whether desalination is a possible option or if another method for accessing water is recommended. Present your solution as an email to the client.

- Identify the criteria and constraints.
- Include the steps you will take to solve the problem.
- Identify one or more solutions.
- Explain how your best proposed solution could be tested.

USING DRONES TO MONITOR WILDLIFE

DEVELOPING A LAND-USE MODEL

BIOMIMICRY

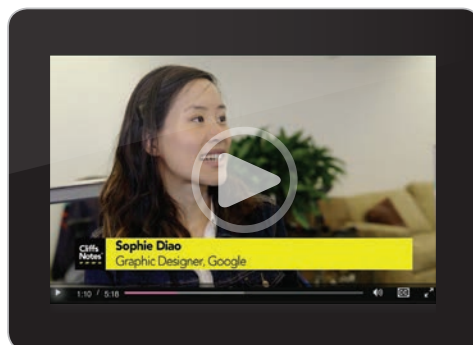
Go online to choose one of these other paths.

Inspire Students to Consider STEM Careers

The **Take It Further** sections of each unit feature diverse **People and Careers in Science & Engineering**. These features show students the **real-world applications** of what they're learning and spark their interest in science-based careers.

Additionally, 29 **On the Job STEM videos** profile STEM careers in today's fastest-growing industries, including jobs like:

- Civil engineer
- Biochemist
- Graphic designer
- Nurse
- Emergency medical technician
- Planetary scientist



Students demonstrate mastery of CA NGSS performance expectations

In *California HMH Science Dimensions*, assessments are specifically designed to ensure students can successfully apply what they have learned. Test items mimic the style of the CAST assessment items and, throughout every lesson, students are scaffolded towards deeper knowledge and ability to apply that knowledge in new situations.



Performance-Based Assessment

Name _____ Date _____

Carbon Dioxide and Photosynthesis

In this task, you will build a model that you can use to investigate photosynthesis. Then you will use the model to investigate the relationship between carbon dioxide and photosynthesis.

PROCEDURE

Set up the model.

1. Cut a 10 cm long strand of elodea (or other aquatic plant). Make sure to cut the stem at an angle, and then lightly crush the cut end.
2. Place a paper clip on the top of the elodea stem to weigh the elodea down, and place the elodea stem top down in a test tube containing sufficient water to submerge the elodea completely.
3. Fill a 500 mL or larger glass beaker most of the way with water. The beaker will act as a heat sink to prevent rapid temperature changes in the test tube.
4. Use a ring stand or test tube clamp to submerge most of the test tube into the beaker while keeping the test tube upright. The apparatus construction in steps 1 through 4 will be referred to as "the model," as it will be used to model the response of photosynthesis to external factors.
5. Place the clamp light/lab light where it will be for the experiment (this should not be near any other light source, and ideally it should be shielded from overhead or exterior light). Do not turn on the lamp yet. Your model should look something like this:

OBJECTIVE

Build and use a model to investigate the relationship between carbon dioxide and photosynthesis.

MATERIALS

For each group

- balance scale
- beaker, 500 mL (1)
- bench light/lamp
- elodea or other aquatic plant (1 stem)
- paper clip
- ring stand or test tube rack
- ruler, metric
- safety blade
- sodium bicarbonate
- tape
- test tube (1)
- timer
- water, dechlorinated

For each student

- notebook
- pencil

Performance-Based Assessment
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Biology • Assessment Guide

New Resource Available Online:

CAST Readiness: Practice and Review

This digital resource provides high-quality practice tests (Form A and Form B) consistent with the CAST for Grades 5, 8, and high school.

Performance-Based Assessment
Teacher Resources

Task 1 Performance Rubric	
Rating Scale	
3 Outstanding	1 Needs Improvement
2 Satisfactory	0 Did Not Demonstrate Skill

Skills	Rating
DCLHS-LS1.C.1 Organization for Matter and Energy Flow in Organisms The student explains how carbon dioxide is used in the process of converting light energy to chemical energy stored in sugars.	
SEP.HS.B.1 Developing and Using Models The student develops and uses a model to investigate the role of light as an input in the process of photosynthesis.	
CCC.HS.E.2 Energy and Matter The student demonstrates the effect of changes in the amount of energy and available matter available on the flow of matter through a plant.	
DCLHS-LS2.B.3 Cycles of Matter and Energy Transfer in Ecosystems The student explains that photosynthesis creates sugar and oxygen, and that these are inputs to the process of cellular respiration.	
SEP.HS.B.1 Developing and Using Models The student develops and uses a model to illustrate the relationship between carbon dioxide available to the plant and the rate of photosynthesis.	
CCC.HS.D.2 Systems and System Models The student uses a model to demonstrate the flow of matter in photosynthesis.	
Total	

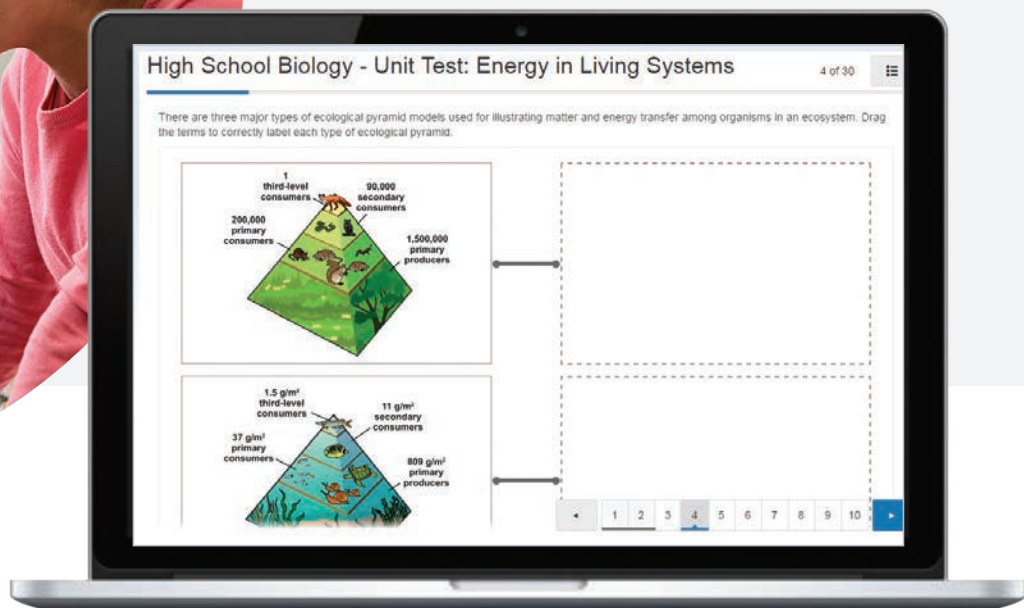
Performance-Based Assessments

Students will be able to perform the Science and Engineering Practices using the context of the **phenomenon** through investigations, experiments, and technologies that tie back to the **unit storyline**. These **hands-on assessments** provide teachers a means of truly assessing students' engineering skills.

Assess Each of the Three Dimensions

Formal assessment questions are aligned to multiple dimensions, and unique **3D Evaluation Rubrics** allow teachers to:

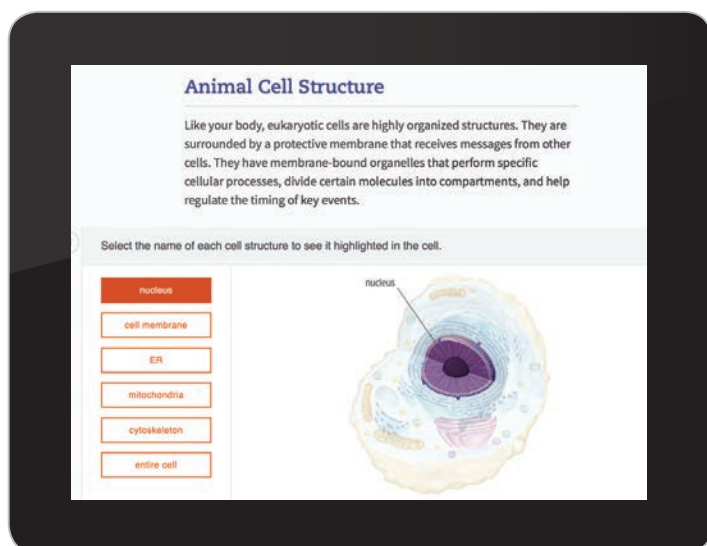
- Evaluate open-ended student responses
- Identify the underlying cause of student misunderstanding
- Target remediation where it is needed most



Formal Assessments

Adding depth to student learning, these assessments evaluate prior knowledge, address misconceptions, and inform remediation needs.

- **Unit Pretests** ensure students have the foundational knowledge they need for lessons.
- **Lesson Quizzes** quickly check that students understand the 3D concepts.
- **Unit Tests** measure understanding and challenge students to apply what they've learned.
- **Mid-Year and End-of-Year Benchmark Tests** help ensure students are on track to achieve the Performance Expectations.



Prepare for High-Stakes Tests

- Technology-enhanced assessment items, similar to the ones found on **CAST** (multi-select, drag and drop, short response, etc.), prepare students for modern **computer-based high-stakes tests**.
- Rigorous Mid-Year and End-of-Year Benchmarks help ensure that students perform with a high depth of knowledge.
- Leveled benchmark tests help make the assessment accessible for all students.

Students build self-awareness and confidence with equity resources that support differentiation

California HMH Science Dimensions was built to provide inclusiveness to students of different learning levels and styles, English learner status, cultural and ethnic backgrounds, socioeconomic or foster status, disability status, gender identity, and sexual orientation—ensuring educational equity for all California students.

Access and Equity

Within *California HMH Science Dimensions* you will find people represented that reflect California's **diverse population and cultures**. Individual spotlight features and integrated discussions within lessons explore historical and contemporary contributors to science and engineering who reflect the full range of ethnic and cultural groups in California, while paying heed to the **FAIR Education Act**.

UNIT 1 Living Systems
California Connections

California Floristic Province
The California Floristic Province is a biodiversity hotspot, or area with a particularly high level of biodiversity. The 73,500 km² that make up the province are found in a Mediterranean climate, which is distinguished by hot, dry summers and cool, wet winters. Of the plants that grow in the province, more than 2,100 species are found nowhere else in the world. These species include the giant sequoia and coastal redwood.

The California Condor
The California condor, which has a maximum wingspan of 2.9 m and a maximum weight of 11.3 kg, is the largest land bird in North America and a keystone species. Though the condor's range once extended across much of the continent, by 1982 only 23 condors existed in the wild, all in California. By 1987, the remaining endangered condors had been captured and placed in a captive breeding program. Captive birds began to be released back into the wild in 1992, and by 2016, the population had reached 446 individuals.

The Chaparral Plant Community
It is often thought that the chaparral plant community is adapted to fire, must burn frequently, and contains plants that possess combustible chemicals in their leaves or stems. However, fires that occur more than once in 20 years can reduce the biodiversity of the chaparral community through loss of species that are not adapted to a particular fire regime, and can transform the land into non-native weed lands.

Environmental Principles & Concepts
Principle II pp. 15, 27, 35, 45, 61, 71
Principle IV pp. 7, 49
For additional support, see the California Education and the Environment initiative (EEI) Curriculum: Ecosystem Change in California.

18 Unit 1 Living Systems

In the Teacher's Unit Planner, specific examples from California's different regions precede each unit to help **localize the learning** and foster student engagement.

Connections to Community
Use these opportunities for informal science learning to provide local context and to extend and enhance unit concepts.

At Home
SUPPORT BIODIVERSITY POPULATIONS: The decrease in monarch butterfly populations has led to grassroots efforts to provide habitat for monarchs within yards, with the hope that enough people participate to provide a path for monarch migration. Find a place to plant milkweed, and provide a butterfly "poodler" for monarch and other butterfly species to drink. [View with Lesson 2.](#)

In the Community
LINGUISTIC DIVERSITY: Language is a systematic form of communication with rules for combining sounds, words, and sentences. The relationship between language and culture is a profound one; as language is passed along from one generation to the next, it carries with it ideas, beliefs, and customs. Linguistic diversity is a measure of unique languages in a place, such as a country. Challenge students to choose a system (your school, your city, your state) and investigate the linguistic diversity represented within that system. Invite students to share their own language history, including languages they speak besides English. [View with Lesson 1.](#)

Culture
BIODIVERSITY AND CULTURAL DIVERSITY: Ask students to imagine a world in which we all look the same, speak the same language, and live in similar environments. Because Earth has such diverse ecosystems, that scenario is very unlikely. Humans adapt to the specific environment they inhabit, whether it is a tropical rain forest, an arid desert, or an icy tundra. Hold a discussion about the relationship between biodiversity and cultural diversity. Can disturbances in ecosystems lead to a loss of cultural connections? Elicit examples from students' home culture, as appropriate. [View with Lesson 3.](#)

Home Letters
Use these letters to engage family members with unit concepts.

Collaborate
Discussion pp. 22, 26, 32, 36, 46, 68
Numbered Heads Together pp. 29, 64
Take a Stand p. 44
Think-Pair-Share pp. 6, 16
Write Fast p. 69

Connections to Other Disciplines
Opportunities to connect to other content areas in this unit:
Chemistry Connection p. 17
Earth Science Connection p. 50
Geography Connection p. 18
Language Arts Connection pp. 49, 55, 61, 73
Math Connection pp. 9, 14, 27, 28, 33, 37, 45, 53

Unit 1 Living Systems 1C

UNIT 1 Living Systems
California Access and Equity

California Diversity
Students with Disabilities: Pair a student who needs assistance with hands-on activities with a lab buddy. The buddy can explain step-by-step what is happening, which also will enhance his or her own learning.
Girls and Young Women: As a class, research female scientists in the area. Find out what their stances are on protecting the environment, if that information is not available, have students draft an e-mail to the politicians and send it. Consider inviting a politician to speak to your class about her opinions on protecting the environment and preserving ecosystems.
Ethnically Diverse Learners: Ask volunteers to share where they or their families have lived. As a class, research examples of threatened ecosystems or an animal whose population has been restored in these areas. Invite students to share any personal experiences related to this topic.
Additional support for California's diverse population can be found throughout the unit in Support for All Learners features.

Language and Science Literacy
Unit Vocabulary
system [Lesson 1](#)
ecosystem [Lesson 1](#)
biotic factor [Lesson 1](#)
abiotic factor [Lesson 1](#)
biodiversity [Lesson 1](#)
carrying capacity [Lesson 2](#)
density-dependent factors [Lesson 2](#)
density-independent factors [Lesson 2](#)
resilience [Lesson 3](#)
resistance [Lesson 3](#)
ecological succession [Lesson 3](#)
engineering design process [Lesson 4](#)
tradeoff [Lesson 4](#)

Reinforcing Vocabulary
To help students build vocabulary knowledge for this unit, have them find words they already have some familiarity with and define them in their own words. Then have students look up the scientific meaning of each word and compare it with their own definitions. Some examples:
• system
• model

Greek and Latin Word Parts
Encourage students to look for common Greek and Latin roots as they encounter new vocabulary. For this unit, you might point out these word parts: bio- (life) and eco- (household).

Academic Vocabulary
Understanding the meaning of the similar words biotic and abiotic is important for the content of this unit. Biotic refers to something that is living. Abiotic refers to something that is not living. It may help students to remember that the prefix e- means "without" and bio- means "life." Therefore, abiotic means "without life."

Integrated ELD
In this unit, there are many vocabulary terms that include more than one word. Students may struggle with identifying the meaning of the term as a whole if they do not understand each word. Ask students to write down all such vocabulary terms. As a class, discuss the meaning of each word individually, and then discuss how to combine the meanings of each word into one idea that makes up the vocabulary term.

Integrated ELD
Integrated ELD teaching strategies in this unit include:
Lesson 1 pp. 9, 17
Lesson 2 p. 37
Lesson 3 p. 47
Lesson 4 pp. 65, 71

MTSS Tier 2
Strategies for students who need extra support in this unit include:
Lesson 1 pp. 11, 15
Lesson 2 pp. 27, 29, 33
Lesson 3 pp. 45, 51, 55
Lesson 4 pp. 65, 67, 73

Advanced/Gifted
Strategies for students who have mastered core content in this unit include:
Lesson 1 p. 11
Lesson 2 pp. 29, 33
Lesson 3 p. 51
Lesson 4 p. 65

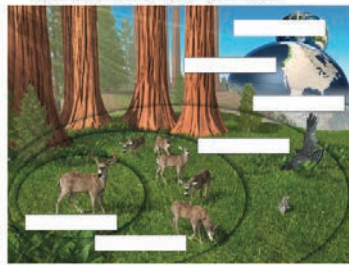
1D Unit 1 Living Systems

Organization of the Biosphere

Earth's biosphere is made up of ecosystems. An **ecosystem** includes all of the biotic and abiotic components in a given area. The biotic components in an ecosystem are called **biotic factors**. The nonliving components of an ecosystem are called **abiotic factors**. Energy and matter cycle through these various components. Similar to other systems, an ecosystem also has feedback mechanisms that help it balance and transfer it to a balanced state when disrupted.

2. **Order** the other factors from the appropriate box.

biome biosphere community ecosystem organism population



Prokaryotes are early organisms at different scales. They may study on individual organisms, such as a mold, or even more about factors that affect that species. They may also study an entire population of mold. A **population** is a group of the same species that lives in the same area. Multiple populations of different species form a **community**. In the same biome, an **ecosystem** may study how a community of mold, deer, grass, and other organisms, and how they interact with each other.

Not all ecosystems are terrestrial, or land-based. About 71 percent of Earth's surface is covered with water, and it is home to living organisms. These water-based ecosystems are called **aquatic ecosystems**. There are two main categories of aquatic ecosystems: salt water, or marine, and fresh water.

CALIFORNIA

Support for All Learners

MTSS Tier 2: Provide guidance for students as they work on understanding the organization of the biosphere. Draw and label circles on the board to show that an organism is part of a population, different populations are part of a community, a community and the nonliving components in an area are part of an ecosystem, and so on.

Advanced/Gifted: Have students work in a small group to brainstorm some components of an aquatic ecosystem. Then have them draw that ecosystem with the components labeled.

DCI L51.A Structure and Function

Students learn about the hierarchical structural organization among individuals in an ecosystem and make connections to the biotic and abiotic components that function in that system.

Exploring Visuals

System Relationships: Be sure students understand that the model shown on this page is a simplification.

Ask: How does a biome compare with an ecosystem? Answer: A biome includes many ecosystems.

Ask: How does a population compare with a community? Answer: A population is a group of the same species. There can be many populations in a community.

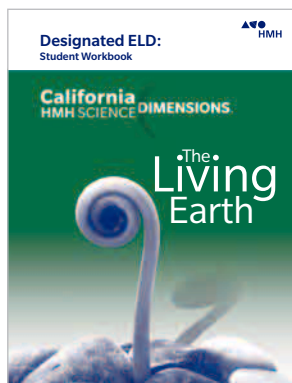
Ask: Why is this an effective type of model for showing the different components of the system? Answer: The model shows the hierarchy of the components of the system. It also shows how the size of the components increases in the hierarchy.

2. From the top down: biosphere, biome, ecosystem, community, population, organism.

Point-of-Use Support

Strategies for the many diverse categories of learners are embedded throughout the **Teacher Edition** and in the Teacher's Unit Planner.

Tips and suggestions for supplementing instruction provide a **Multi-Tiered System of Support (MTSS)**.



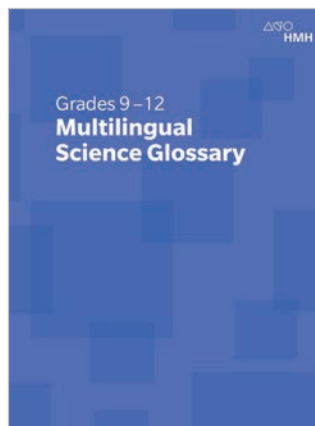
Designated ELD Resources Include

- Word Network
- Vocabulary Cards for each lesson
- Blank Vocabulary Cards for students to create their own study words
- Sentence Frames for class discussion of:
 - Hands-On Labs
 - Claims, Evidence, and Reasoning
 - DCIs, SEPs, and CCCs
- Language X-Rays for each lesson, including Vocabulary Building support and Unpacking the Text
- Bibliography of recent research on ELD topics
- Developing and Using Models
- Constructing Explanations and Designing Solutions

Multilingual Glossary

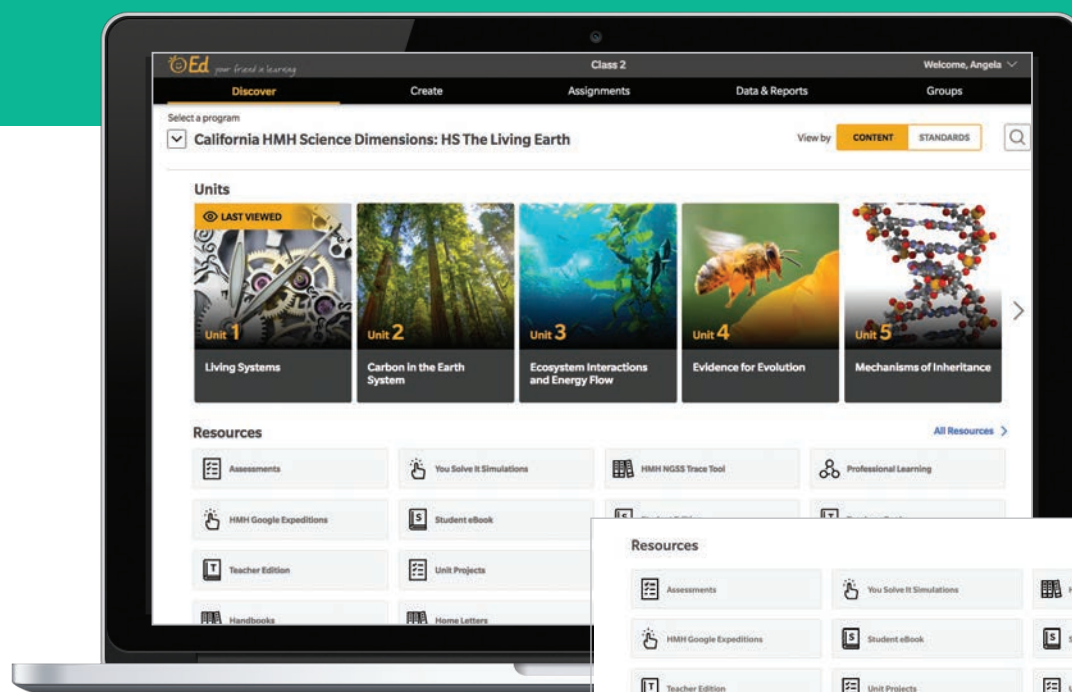
Understanding the need for support of diverse languages, the **Multilingual Science Glossary** provides translation of common high school science terms and definitions in:

- | | |
|--------------|------------------|
| • English | • Arabic |
| • Spanish | • Korean |
| • Chinese | • Haitian Creole |
| • Vietnamese | • Russian |
| • Hmong | • Punjabi |
| • Tagalog | • Portuguese |

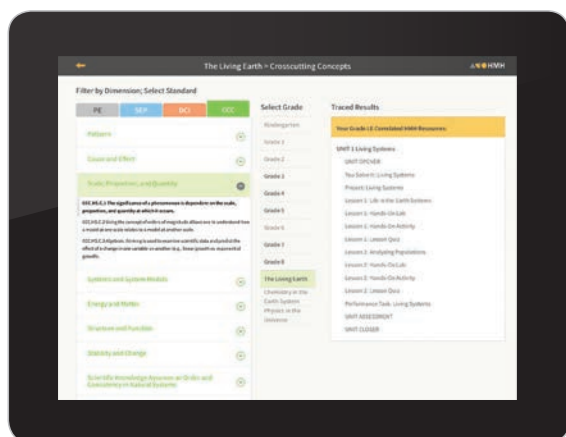
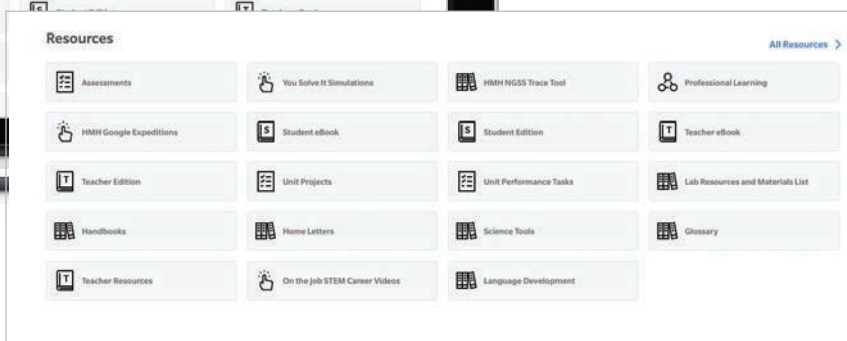


Bring science to life with our digital platform, **Ed: Your Friend in Learning**

Ed: Your Friend in Learning® is a new online learning system that combines powerful digital media content and accessibility resources to customize teaching and learning experiences. Teachers can implement a flexible, **blended approach to teaching science**—or go completely digital supporting the next generation of science leaders. *Ed* is user-friendly and provides teachers with the support they need to foster a student-centered learning environment.



Program content can be accessed offline, allowing maximum compatibility in 1:1 or Bring Your Own Device learning environments, and also supports the wide variety of technology that students have at home.



Start with the CA NGSS Trace Tool

- The Trace Tool identifies HMH resources, allowing teachers to customize their CA NGSS–based instruction.
- Teachers see exactly what students should already know and the concepts they are about to learn.

The Trace Tool shows how and where each of the PEs, SEPs, DCIs, and CCCs are addressed in *California HMH Science Dimensions*.

Data and Reporting

Student Growth Measure

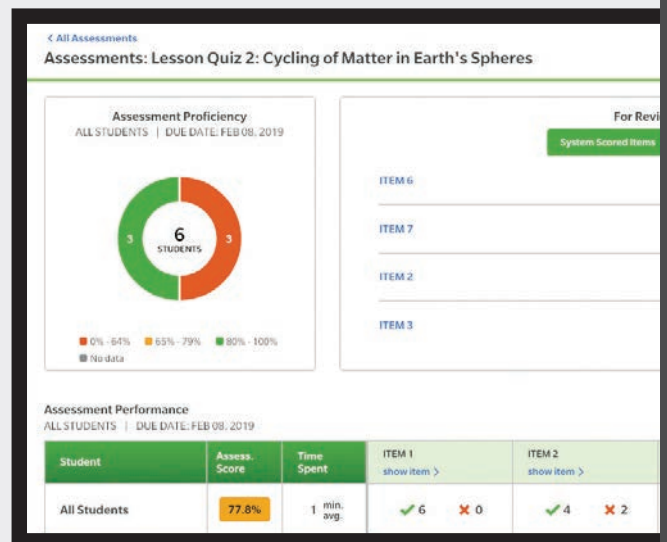
- Easily identify where students are now and where they've made progress based on data insights at the student, class, and district level.
- Administrative leaders receive the insight to drive student growth and identify strengths and weaknesses across their district.

Accessibility

- Education must be accessible to all learners, and we are committed to meeting WCAG 2.0 AA standards on *Ed: Your Friend in Learning* for those using assistive technologies.

Anytime, Anywhere Access

- With the ability to connect to quality content both online and offline, all learners have equal access to resources.



Explore Immersive Virtual Worlds with Google Expeditions

- As a Google® content partner, HMH has developed **HMH Field Trips powered by Google Expeditions**. Students are swept away into **360-degree 3D experiences** in fascinating locations directly tied to science content.
- A correlated HMH Teacher Guide provides ideas for incorporating Field Trips into your lessons, as well as tips on how to **guide and customize** the experience.
- Featured **virtual field trips** include California State Parks, Natural Bridge Caverns, the Great Barrier Reef, and more!



HMH Field Trips

powered by



Google Expeditions



Unmatched **professional support** helps you transition with ease

A CA NGSS curriculum requires a significantly different approach to teaching science, and although this new approach involves a lot of change, its rewards are immediate. HMH provides the support you need to make the transition to a student-centered, CA NGSS–style of teaching.



SEE CA NGSS IN ACTION

Embedded professional development videos guide teachers through the key approaches that ensure CA NGSS success.

- **Foundation** videos help educators and parents better understand the CA NGSS, as well as the background that led up to their development.
- **Labs & Classroom Practice** videos for Grades 9–12 provide suggestions for educators on how to implement CA NGSS curriculum.
- **Engineering** videos support educators as they incorporate the design process into their classrooms.
- **Challenging Content** videos for Grades 9–12 help educators learn how to address specific content areas that students tend to struggle with in a CA NGSS curriculum.



Your California-based support team lives and works right here in California.

Contact your HMH Account Executive today:
hmhco.force.com/relocator

Create Long-Term, Sustainable Growth

Our blended professional learning model moves beyond the one-size-fits-all approach to include in-person and online support that is flexible, collaborative, and personalized to meet your needs.

Comprehensive Implementation Support

Your implementation will begin with a **Getting Started with CA HMH Science Dimensions** course and a **Professional Learning Guide**, which provides suggestions for prioritizing content with manageable milestones.

Getting Started Modules and **Classroom Videos** on *Ed: Your Friend in Learning*, along with **Author 3D videos**, will help you hone your craft and discover new strategies and techniques for teaching.

Personalized Follow-Up

Our in-person and live online **Follow-Up** sessions focus on supporting key *California HMH Science Dimensions* topics. Choose from these relevant, 90-minute videos to create a personalized follow-up experience:

- Maximize Learning with the Digital Resources
- Plan and Prioritize Instruction
- Make Science Accessible to ALL Learners
- Integrate Meaningful STEM Experiences
- Build Literacy and Science Content Knowledge
- Use Data to Monitor Progress and Inform Science Instruction

Blended Coaching

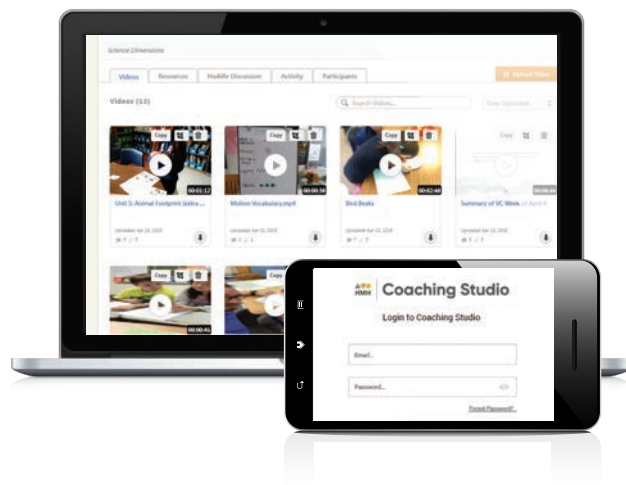
Our blended coaching not only focuses on a successful *California HMH Science Dimensions* implementation, but also offers instructional strategies that will help students collaborate, test ideas, state claims, find resolutions, and think like scientists.

Our coaches will work with you in person and online to analyze and set your goals, learn new instructional practices, and apply them in your classroom. And, you will receive ongoing support from your coach through the **Coaching Studio**.

For more information, please visit us at hmhco.com/professionalservices



Coaching Studio



Program Components

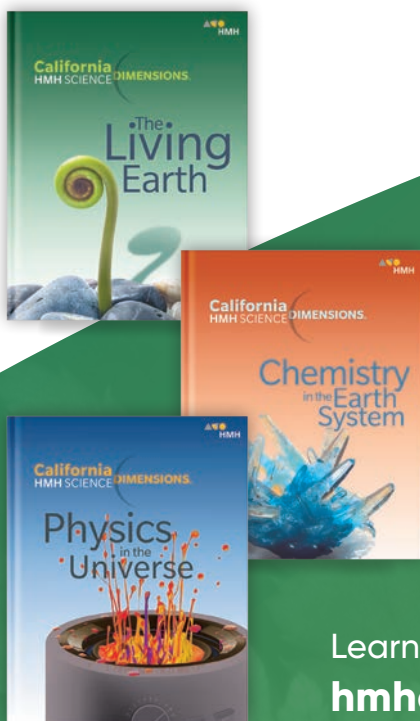
With its cohesive, spiraled approach to meeting the new standards, *California HMH Science Dimensions* provides a consistent and engaging curriculum from transitional kindergarten through high school.

GRADES K–12

Student Edition available as a softcover, consumable write-in worktext for each grade.

HIGH SCHOOL

Follows the CA NGSS three-course model, and includes *The Living Earth*, *Chemistry in the Earth System*, and *Physics in the Universe*.



Student Resources	Print	Online
Student Edition (includes <i>Thing Explainer</i> content and illustrations)	•	•
Math Handbook		•
English Language Arts Handbook		•
Science and Engineering Practices Handbook		•
Designated ELD: Student Workbook	•	•
Multilingual Science Glossary	•	•
Lab Safety Handbook		•
Crosscutting Concepts Handbook		•
You Solve It! Simulations		•
CliffsNotes® On the Job videos		•
CAST Readiness: Practice and Review		•
Teacher Resources	Print	Online
Teacher Edition	•	•
Google Expeditions Teacher Guide		•
Assessment Guide (Includes Performance-Based Assessments)		•
Online Assessment with Item Banks		•
Designated ELD in Your Science Classroom Teacher Guide	•	•
Professional Learning Videos		•
Home Letters (multilingual)		•
CA NGSS Trace Tool		•

Learn more about *California HMH Science Dimensions* at hnhco.com/CAScience

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