HMH

HMH Science Dimensions®

GRADES 9–12

Chemistry

ENGINEERED for the
Next Generation

PROGRAM RESOURCES AND FEATURES

NEXT GENERATION SCIENCE STANDARDS

HMH Science Dimensions
Students Are

PHENOMENAL

Envision a classroom where students explore real-world phenomena, ask questions, state claims, test their ideas, and find resolutions through reasoning. With increased demand for science proficiency in the workplace, it is imperative to cultivate these creative problem solvers, who will go on to become the next generation of innovators.

This instructional shift is achievable now. With built-in support and a transformed lesson structure, teachers will empower their students to learn through self-directed exploration, analysis, application, and explanation—in short, to think and behave like scientists and engineers.

HMH Science Dimensions*® *Chemistry is more than just a curriculum; it is a vision for inspiring future scientists.

Featured Authors

BERNADINE OKORO
STEM Learning Advocate & Consultant

THOMAS O'BRIEN, PhD
Professor, Science Teacher Education, & Educational Leadership

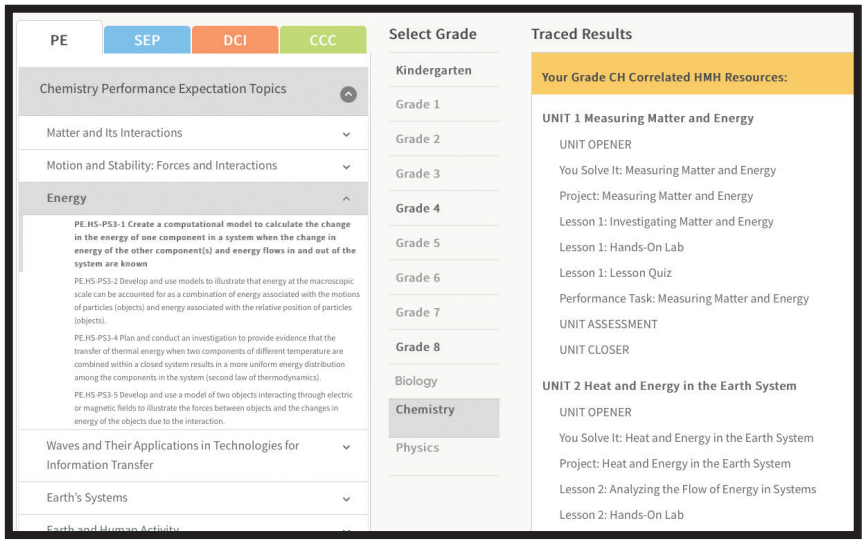
MICHAEL DISPEZIO
Global Educator

CARY I. SNEIDER, PhD
Engineering Consultant
Associate Research Professor

What's Inside

REASONS TO CHOOSE

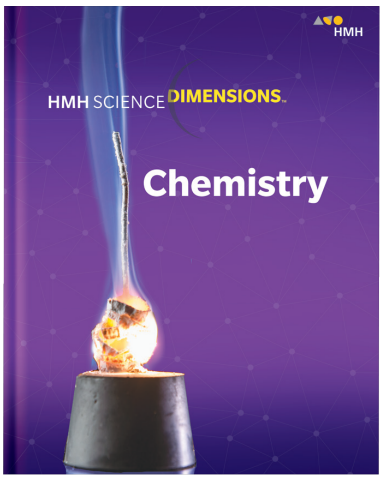
HMH Science Dimensions Chemistry



NEXT GENERATION SCIENCE STANDARDS

Full Coverage of the Letter and Spirit of the Next Generation Science Standards* (NGSS)

- *HMH Science Dimensions* is **built for NGSS**; it's not just a rebranding of older editions.
- **Investigation-driven activities** weave together the three dimensions of learning.
- The emphasis on **engineering** is carried throughout all of the program's units, and not just treated as an ancillary.



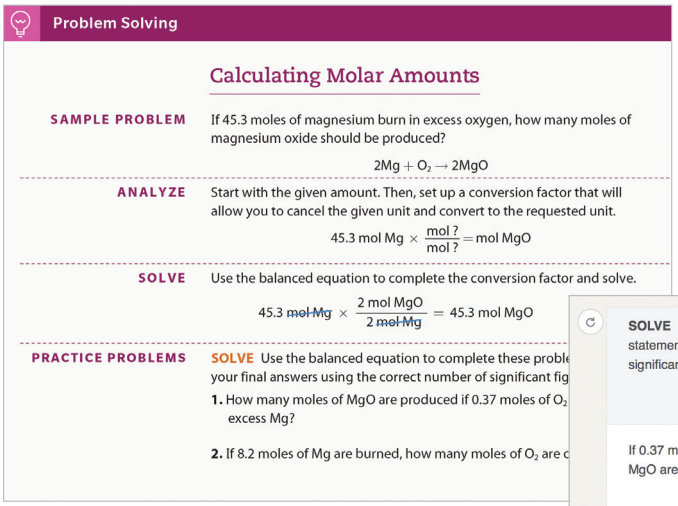
Post–High School Support

- *HMH Science Dimensions Chemistry* Student Editions are available in either hardcover or consumable worktext options.
- Students needing differentiation benefit from writing and taking notes directly in the consumable worktext.
- Students pursuing science careers benefit from the ability to keep their textbook as a resource throughout college.

* Next Generation Science Standards and logo are registered trademarks of Achieve. Neither Achieve nor the lead states and partners that developed the Next Generation Science Standards were involved in the production of this product, and they do not endorse it.

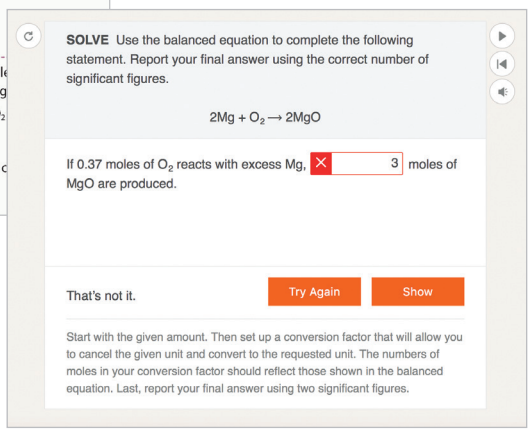
Phenomena-Based Learning and CER

- **Phenomena-based** explorations and engineering-based problems guide the flow of every unit and lesson.
- **Claims + Evidence + Reasoning** (CER) guides students to develop evidence-based explanations throughout the lessons and activities.



Exceptional Problem-Solving Support

Step-by-step and multimedia self-check practice problems reinforce problem-solving skills.



A Solution for a NEW GENERATION OF SCIENTISTS

The next generation of scientists will help save the planet, explore the far reaches of space, and invent technologies we can only dream of today. Our students' potential is limitless, but to meet it, they need to be quick thinkers, creative problem-solvers, and technology experts. That's why *HMH Science Dimensions Chemistry* leaves dated instructional strategies behind.

NEW WAYS of Teaching Science

- Student-centered format
- Learning in context
- Solving phenomena
- Doing science
- Active participation

1890s

1930s

"The goal of NGSS is to help students behave and think like scientists and engineers."

—Marjorie Frank, *HMH Science Dimensions* Author

How *HMH Science Dimensions Chemistry* **Changes the Game**

- Project-based, three-dimensional activities
- Claims + Evidence + Reasoning
- Phenomena-based storylines
- Embedded engineering
- Robust, interactive, digital options
- Hands-on assessment options for application of knowledge
- Standards-based data reporting for data-driven decision making
- Conceptual understanding and application of mathematical formulas

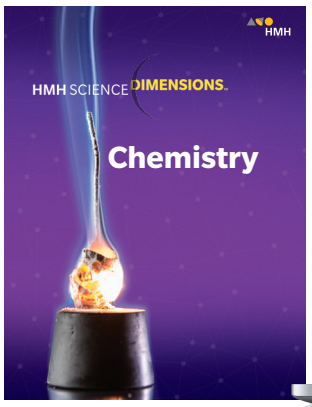
1980s

2020s

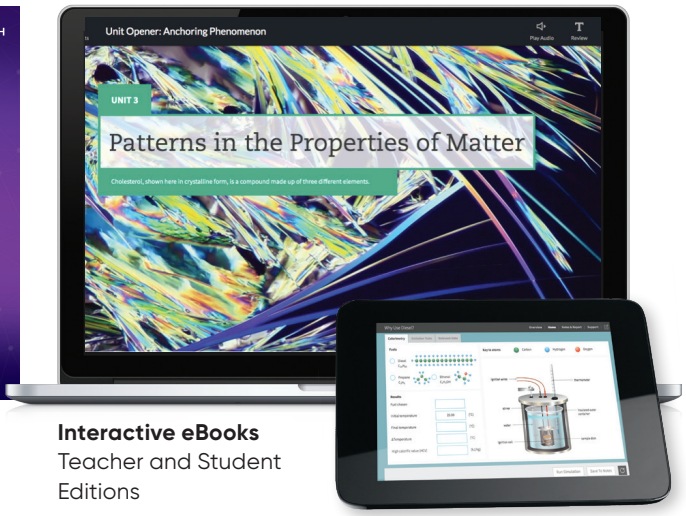
RESOURCES AND FEATURES

Core Resources

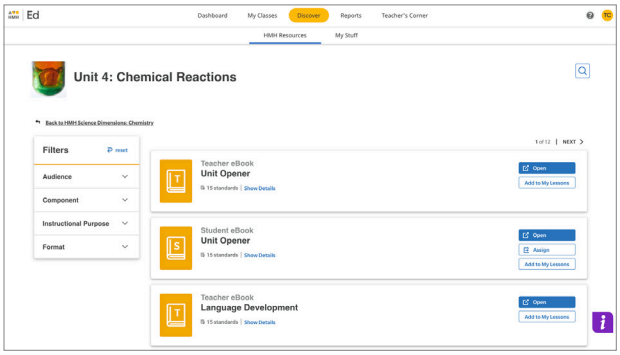
Teacher Edition
Hardcover



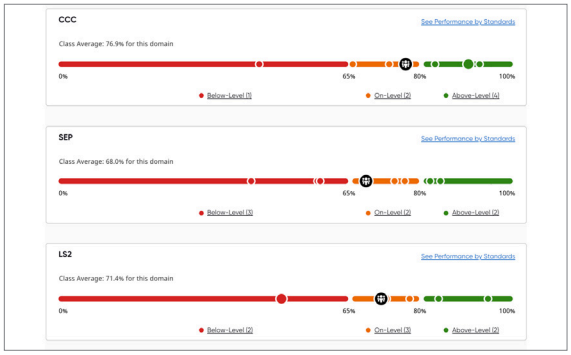
Student Edition
Hardcover or
Consumable Worktext



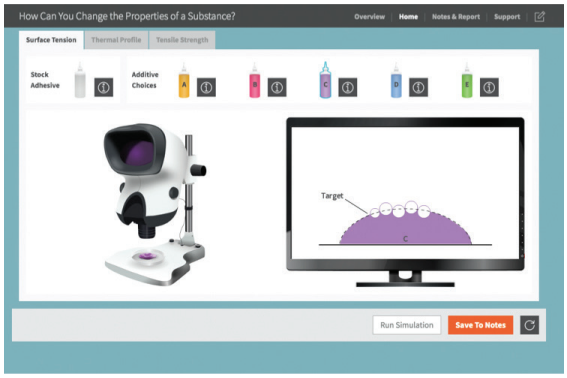
Interactive eBooks
Teacher and Student
Editions



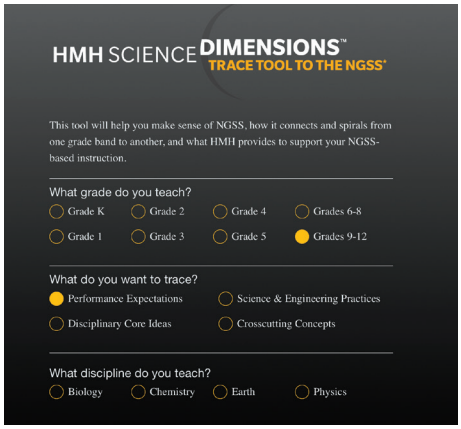
Digital Lesson Planning on *Ed*, the HMH® learning platform



Standards-Based Reporting Individual or Classroom Data

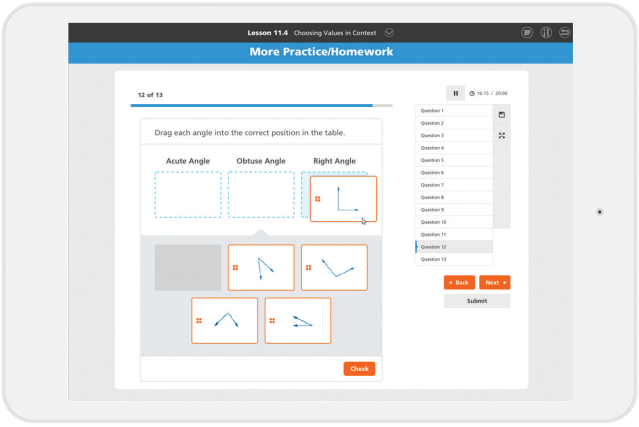


Open-Ended Computer Simulations You Solve It!

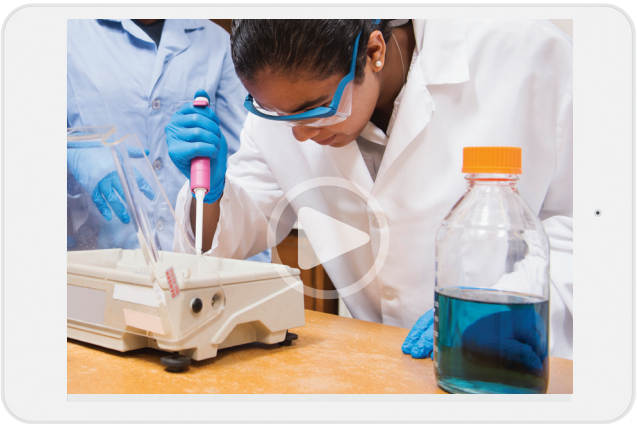


HMH Trace Tool NGSS Coverage Tracking

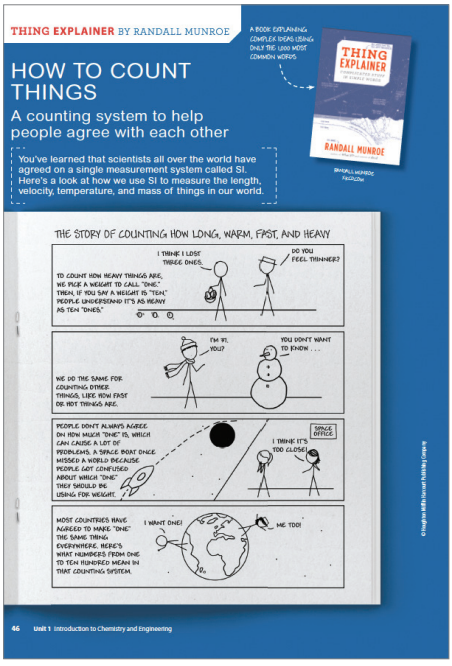
Differentiation Support



Customizable Assessments Digital or Hardcopy



On-the-Job STEM Videos Science Career Snapshots



Thing Explainer Humorous Explanations

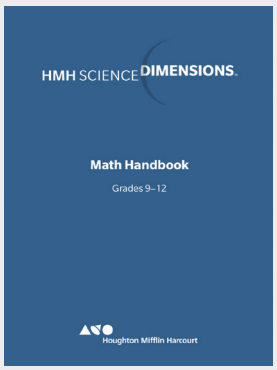
Handbooks for Student Support:

Math: Problem-Solving Support

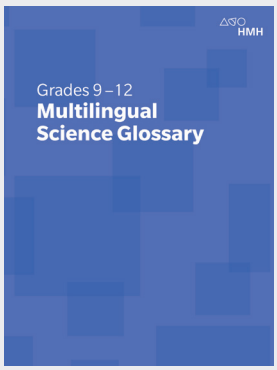
ELA: Writing and Comprehension Support

SEP: Science and Engineering Practices

CCC: Crosscutting Concepts



Multilingual Glossary Addressing Twelve Languages



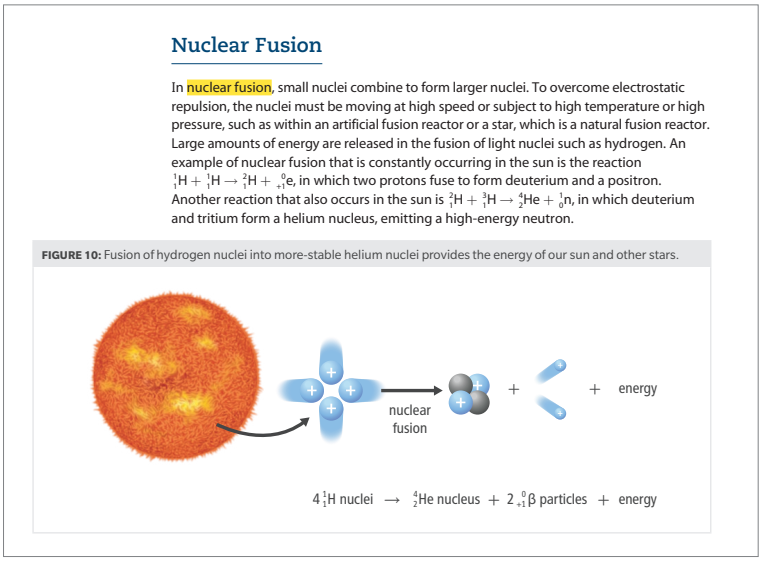
ACCESS AND EQUITY

All Standards, All Students

Recognizing that learning takes place both within and outside of the science classroom, *HMH Science Dimensions Chemistry* was designed so students learn to see themselves as scientists and engineers, and can connect their activities and the world around them to what they are learning.

MARJORIE FRANK

In developing *HMH Science Dimensions Chemistry*, we enlisted reading and English language development expert Marjorie Frank to ensure best practices are embedded throughout all worktexts and supplementary materials.



Nuclear Fusion

In nuclear fusion, small nuclei combine to form larger nuclei. To overcome electrostatic repulsion, the nuclei must be moving at high speed or subject to high temperature or high pressure, such as within an artificial fusion reactor or a star, which is a natural fusion reactor. Large amounts of energy are released in the fusion of light nuclei such as hydrogen. An example of nuclear fusion that is constantly occurring in the sun is the reaction ${}_{1}^{1}H + {}_{1}^{1}H \rightarrow {}_{1}^{2}H + {}_{+1}^{0}e$, in which two protons fuse to form deuterium and a positron. Another reaction that also occurs in the sun is ${}_{1}^{2}H + {}_{1}^{3}H \rightarrow {}_{2}^{4}He + {}_{0}^{1}n$, in which deuterium and tritium form a helium nucleus, emitting a high-energy neutron.

FIGURE 10: Fusion of hydrogen nuclei into more-stable helium nuclei provides the energy of our sun and other stars.

Supportive reading strategies Include:

- Text that is chunked
- Vocabulary learned in context
- Embedded comprehension questions
- Consumable worktext option, allowing students to write and take notes directly in their worktext
- Structured English learner support provided to support teachers

Differentiate Instruction

Understanding that in different cultures, different **vocabulary terms** can have more than one meaning, *HMH Science Dimensions Chemistry* provides teachers and students with **strategies for making meaning**.

MTSS/RTI Have students work in pairs to read each paragraph under the heading "Understanding Atoms." Partners should then collaborate to write a one-sentence summary of the main idea of each paragraph. Ask pairs to share and discuss their summaries.

Use this activity to provide an opportunity for students to develop and practice communication, social, and assertiveness skills. Try to balance pairs so that natural leaders can inspire the partners they are working with.

Careers in Science

Letting **student curiosity** lead the way promotes deeper knowledge of concepts and big ideas so that students have pathway choices they can select in our **"Take It Further"** feature. Students can complete the pathway in the worktext or they can select from additional learning options online.

Students will also see a diverse representation of cultures throughout the course.

TAKE IT FURTHER

Careers in Engineering

Environmental Engineer

Environmental engineers research efficient and cost-effective ways to clean up toxic material in the environment. Some environmental engineers research ways to remove radioactive waste from the environment.

In Figure 18, toxic waste is poured into a biomagnetic separator. The waste contains uranyl ions, a type of waste produced at sites where uranium ore was mined. A chemical is mixed into the separator and bacteria are added. The bacteria carry out chemical reactions that cause the uranyl ions to form a coating on the bacteria. This coating is magnetic, and so the uranyl coating can be separated from the rest of the sample with a magnetic field, decontaminating the sample.

In bioremediation processes, special strains of common bacteria such as *E. coli* that are resistant to radiation are added to hazardous waste to transform contaminants into forms that can be easily removed. These bacteria incorporate radioactive atoms of elements such as uranium or thorium dissolved in water into compounds that are not soluble in water, which can then be easily removed from the water. Such bacteria are very useful because they perform chemical reactions that would otherwise be expensive and time-consuming to carry out artificially.

Once radioactive material has been removed from the environment, it still needs to be sealed off for a long period of time while it is still radioactive. One approach to doing this is glass vitrification. In this process, radioactive waste is combined with glass powder, and the mixture is heated to a high enough temperature to melt it. The liquid glass is cooled, producing a solid, glassy material with the radioactive material locked within it. The glass material can then be stored underground. Environmental engineers are working to determine glass compositions that will best hold different types of radioactive waste. They also need to address concerns about the glass becoming cracked over time.

FIGURE 18: In this device, bacteria are used to remove nuclear waste ions from a biological sample.

Chemistry in Your Community Scientists from diverse backgrounds are responsible for many of the advances in the field of environmental science, such as remediation of radioactive waste. Research an environmental engineer whose work has benefited your community. These may include, but are not limited to, the jobs of health and safety engineer, chemical engineer, microbiologist, and mining engineer. Integrate multiple sources to write a blog post that describes how this person's work has improved the environment in your area and assesses their solution.

UNIT PERFORMANCE TASK

Investigating the Viscosity of Oil

You have been contacted by an automotive service shop that received a shipment of bulk containers of motor oil. Conditions during the transport, however, caused the labels to peel off the cans. Before the shop uses this oil in cars, the service technicians must match the cans with the types of oil that were listed on the shipping invoice based on the viscosity and the Society of Automotive Engineers (SAE) rating of each oil. Viscosity is a measurement of a liquid's resistance to flow. A fluid with high viscosity flows more slowly than a fluid with low viscosity does. SAE ratings give relative viscosity values for the oils. A low SAE rating means the fluid flows more readily, so it has lower viscosity.

FIGURE 4: This mechanic tests the viscosity of an oil sample. If the viscosity of the oil is too high or too low, it could cause damage to the engine.

1. ASK QUESTIONS

Develop a set of questions you have about viscosity, SAE ratings, and how you could assign these ratings to a set of oil samples. Identify all the factors you will research to answer these questions.

2. CONDUCT RESEARCH

Oils of different viscosities are used under different conditions. Low-viscosity oils are meant to be used in cold climates because they flow more easily at low temperatures. High-viscosity oils are better used when the engine may experience high temperatures because the excessive heat thins the oil. Oils of different viscosities must be tested to ensure that the oil chosen will work properly under the conditions the engine

4. ANALYZE DATA

Using data you collected in the investigation, assign an SAE rating to each oil sample. Then, graph the relationships between SAE rating and flow time, density, and viscosity, as well as between viscosity and density.

5. COMMUNICATE

Present the results of your investigation to the automotive service shop. Explain how the SAE rating relates to recommendations for which oil to use at a given temperature. Your presentation should include evidence from your investigation and your analysis of this evidence.

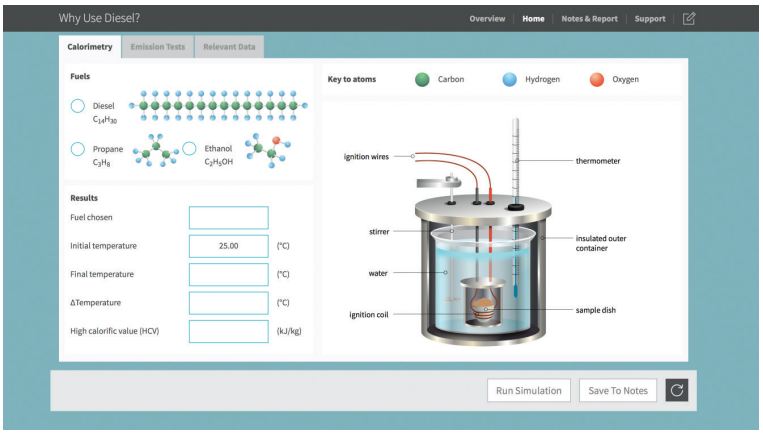
Unit Performance Tasks put the students in the role of a scientist or engineer so they can see themselves in STEM careers.

ASSESSING

Three-Dimensional Learning

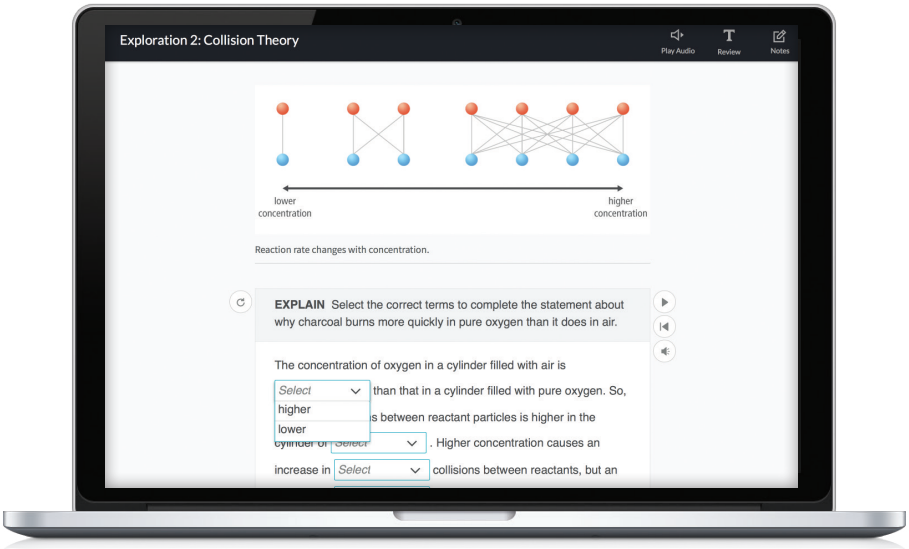
Scientists and engineers regularly assess their own and each other's work, data, findings, and conclusions so they can apply feedback and insights to future work. *HMH Science Dimensions Chemistry* is structured to use assessments to guide students in evaluating their own and each other's work, data, findings, and conclusions while providing teachers the means to provide meaningful feedback and insights.

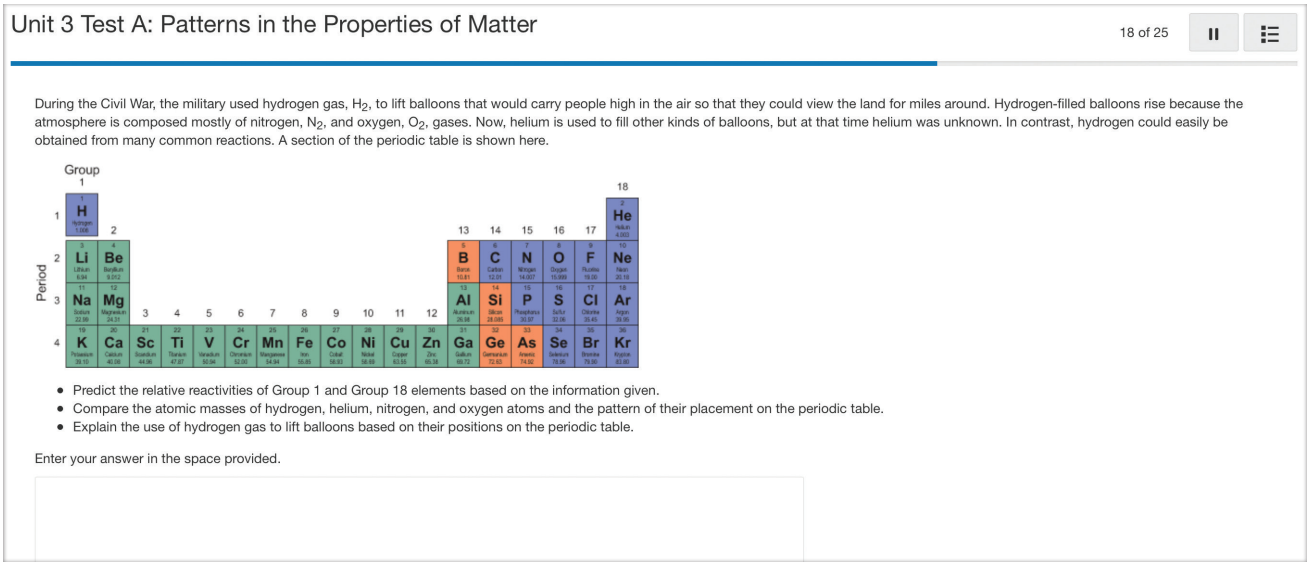
Pre-, Formative, Summative, and Self-Assessments



"Over the course of the program, a system of assessments coordinates the variety of ways student learning is monitored to provide information to students and teachers regarding student progress for all three dimensions of the standards."
– FROM PEEC ASSESSMENT

The interactive eBook provides immediate feedback for self-assessment. Lessons and activities are built on the CER method in which students make **Claims** about phenomena, gather **Evidence**, and apply **Reasoning** to determine whether the evidence supports or refutes the claim. Students and teachers alike see and measure growth as students revise their claims.





Pre- and Summative Assessments are available as printable PDFs, editable Word documents, or customizable online assessments with digitally enhanced test items similar to those found on high-stakes assessments—all designed to measure three-dimensional learning.

UNIT PROJECT

Modeling Heating Efficiency

Develop a model demonstrating how the energy released by burning fuel in a furnace is distributed throughout a building. Use your model to test where heat loss occurs in the building and refine your model to minimize that heat loss. Determine possible tradeoffs in using different types of fuels to heat buildings, such as cost and potentially harmful emissions.

UNIT PERFORMANCE TASK

Testing Water-Repellent Fabrics

You are working for a company that makes water-repellent materials. Water-repellent fabrics are often used in tents, garments such as coats and shoes, and tarps that protect valuable materials. Your challenge is to develop a procedure to test a fabric that repels water. Not only should the material keep water out, but it should be breathable, or allow air to flow through.

1. DEFINE THE PROBLEM

Describe the problem you will address in this activity. Include criteria and any constraints that you will consider in your design. How will you determine how well your design repels water and how breathable it is?

FIGURE 4: Water-repellent fabrics resist water but let air flow through.

4. EVALUATE DATA

Explain which parts of your testing procedure worked well and which could be improved. How might the

Unit Projects, Unit Performance Tasks, and hands-on **Performance-Based Assessments** aid in measuring student progress toward Performance Expectations and abilities in engineering.

Unmatched
PROFESSIONAL LEARNING

How can you get the professional learning support you need?

Connected learning means you continue to learn, too. Access HMH's best-in-class professional learning offerings live-online and in-person, which can work with any school or district no matter the size.

On-Demand Program Support

Teacher's Corner® puts real-world classroom videos and best practices at your fingertips, on your schedule. Plus, free **Live Events** give you the opportunity to build community around solutions to today's instructional challenges. Your subscription includes continuous implementation support all year long. Get energized about your new program and learn best practices to maximize your time.

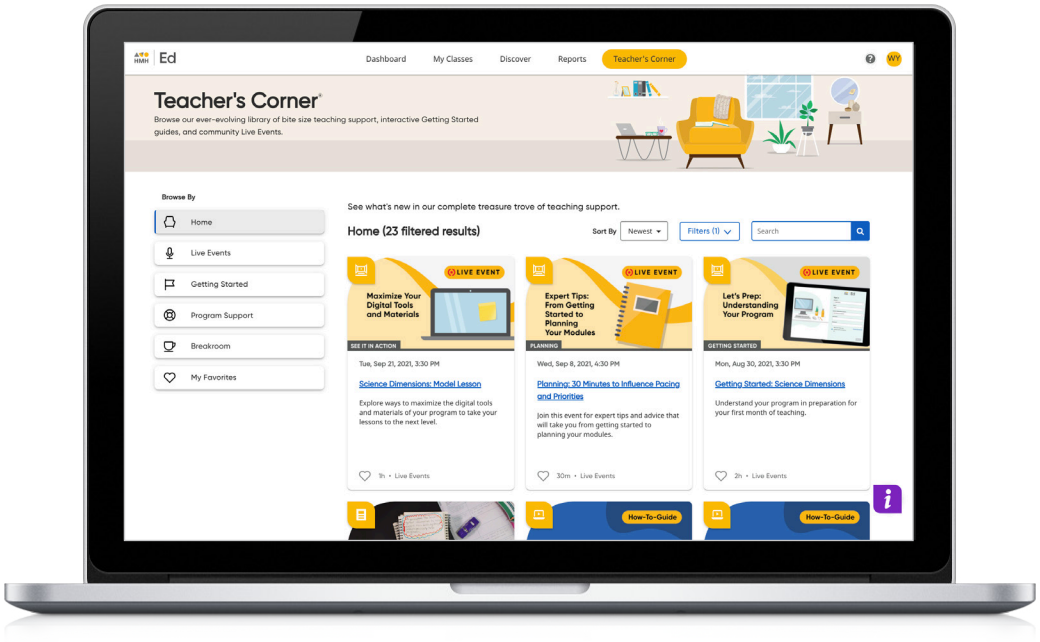
Teachers benefit from:

- On-demand, solution-specific teaching resources
- Live events with your colleagues
- Printable parent and caregiver letters in English and Spanish to help with at-home support and more!

What types of resources are included?

- **Getting Started** resources are the perfect refresher for a returning teacher or a thorough introduction for someone teaching a new program.
- **Program Support** features in-depth teaching support and professional learning based on the programs a teacher is using.
- **Breakroom** was designed to be a place where teachers can extend their learning beyond their program(s). It includes teacher reflections and ideas, inspirational videos from prominent researchers, speakers and practitioners, practical support for relevant or hot topics, and self-care advice.

For more information, please visit us at **mathsolutions.com/science**.



HMH | Professional Services

Flexible Professional Development

The **Coaching Membership**, available at an additional cost, allow you to partner with an HMH Instructional coach to meet your district's specific needs. New and veteran teachers alike will benefit from collaborative sessions that meet them where they are and provide support from day 1 to 180. Driven by the award winning platform, **HMH Coaching Studio**, HMH Professional Services provides the perfect opportunity to focus upon standards-aligned instruction and practice.

The **Coaching Studio** is your online collaboration center. Meet with your coach and your team to boost communication and collaboration. Engage with videos and resources shared by your Coach and team, or upload your own videos or resources to share. Coaches help translate theory into practice and ideas into behaviors.

TECH & LEARNING AWARDS OF EXCELLENCE WINNER

//CODiE// 2021 SIIA CODiE FINALIST

THE EDTECH AWARDS COOL TOOL FINALIST 2020

PLPG CERTIFIED PROVIDER

Did you know HMH Professional Services has been nationally recognized for our ability to support implementation and provide ongoing teacher and leader professional development?

PHENOMENA-BASED
Storylines

Your students need to see the interconnectedness of the world around them through the eyes of scientific phenomena.

The *HMH Science Dimensions Chemistry* **storyline** clearly connects concepts within and across units for a complete integration of the three dimensions of learning.

Use the following in every unit:

ANCHOR PHENOMENA

INVESTIGATIVE PHENOMENA

EVERYDAY PHENOMENA

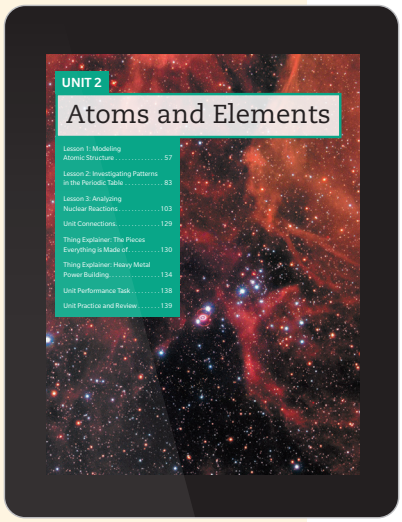
UNIT 2: Atoms and Elements

ANCHOR PHENOMENON

Supernovae

Anchor phenomena for each unit inspire students to ask questions and lead detailed investigations on science-related problems that matter to them, their community, and their society.

This unit example has three lessons that all relate to this anchor phenomenon in which students consider the processes that may have occurred in stars, and supernovae to produce the atoms that make up everything on Earth. Students begin with a Unit Project in which they design, construct and develop explanations for their own atomic model.

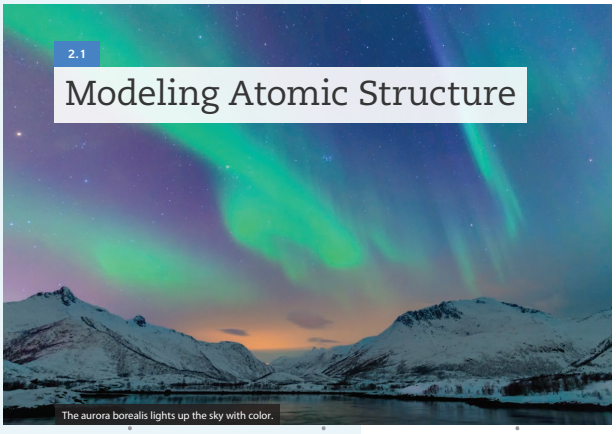


LESSON 1: Modeling Atomic Structure

INVESTIGATIVE PHENOMENON

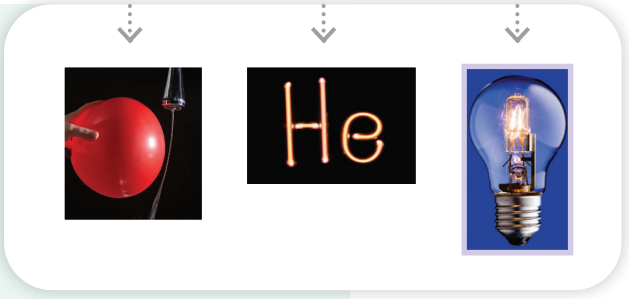
Aurora Polaris

An **investigative phenomenon** focuses the lesson to explore one concept of the anchor phenomenon. In this example, students begin exploring properties of elements by considering how atmospheric matter can cause a phenomenon like the northern lights. As they explore reactivity, atomic structure, electron configurations, and patterns of the periodic table, they both build an explanation of the investigative phenomenon and add to the accuracy of their Unit Project.



EVERYDAY PHENOMENA

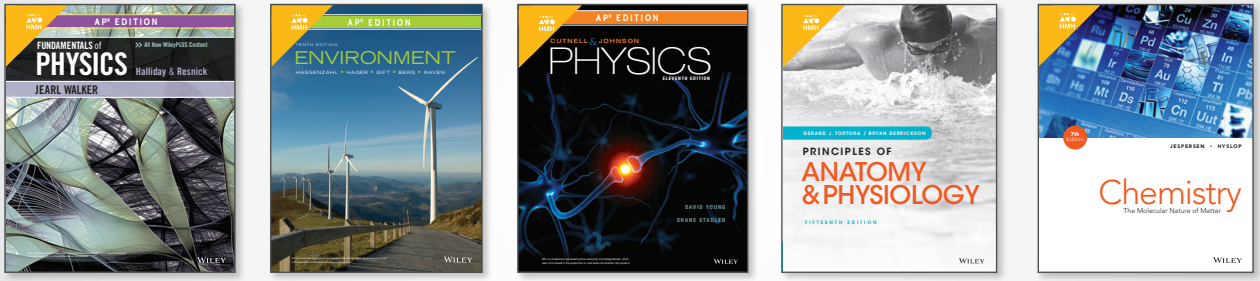
Everyday phenomena connect students to events with which they have personal connection or experience. This lesson uses the phenomena of static electricity, neon signs, and halogen light bulbs to help students connect with atomic properties and add to the construction of a complete explanation of the lesson's investigative phenomenon. The everyday phenomena also add to the depth of knowledge students need to complete the Unit Project to address the anchor phenomenon.



HMH AP® and Honors solutions support college readiness for your students.

Through our partnership with John Wiley® & Sons College Division, we are able to act on our belief in equity and provide quality solutions for Advanced Placement®, honors, and elective courses in Grades 9–12. At HMH, we aim to deliver great outcomes for our students, teachers, and learning communities. Together, we are shaping the future of education, one learning moment at a time.

Proven Content. No Exception.



WILEY

HMH is the exclusive distributor of college-level materials published by John Wiley & Sons to high schools for Advanced Placement, college-prep, honors, and elective courses.

Contact us to learn more:
hmhco.com/advancedandelectives

Notes

Program Components

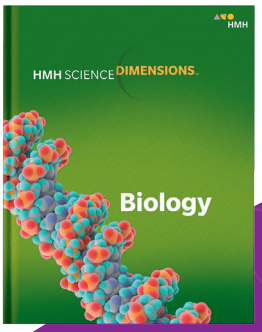
With its cohesive, spiraled approach to meeting the new standards, *HMH Science Dimensions* provides a consistent and engaging experience from kindergarten through high school.

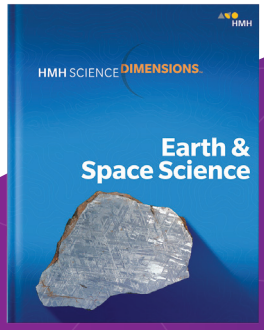
GRADES K–5
Available as a softcover, consumable write-in worktext for each grade

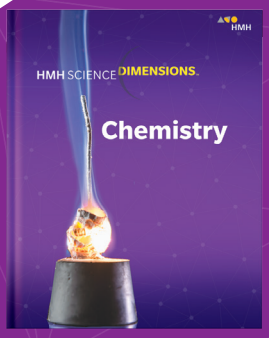
GRADES 6–8
Available as 12 modules for Life Science, Earth & Space Science, Physical Science, and Engineering

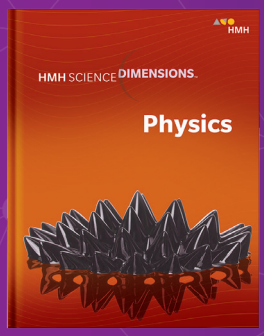
HIGH SCHOOL
Includes *Biology, Earth & Space Science, Chemistry,* and *Physics*

Student Resources	Print	Online
Student Edition (choice of hardcover or consumable)	•	•
Student Edition, Interactive Online Edition		•
Math Handbook		•
English Language Arts Handbook		•
Science and Engineering Practices Handbook		•
Crosscutting Concepts Handbook		•
You Solve It! Simulations		•
CliffsNotes® On the Job Videos		•
Thing Explainer Illustrations from Randall Munroe	• (SE)	•
Teacher Resources	**Print**	**Online**
Teacher Edition	•	•
Teacher Edition, Interactive Online Edition		•
Assessment Guide (including Performance-Based Assessments)		•
Customizable Online Assessments		•
NGSS Trace Tool		•
Multilingual Glossary	•	•









Learn more and get an online preview:

- Visit **hmhco.com/ScienceDimensions**
- Contact your HMH Account Executive: **hmhco.force.com/replocator**

#HMHScience