HMH

HMH Science Dimensions®

GRADES 9–12

Physics

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*® *Physics is more than just a curriculum; it is a vision for inspiring future scientists.

Featured Authors

JOHN GALISKY, MEd
Albert Einstein Distinguished Educator Fellow, Physics Teacher, Science Department Chair

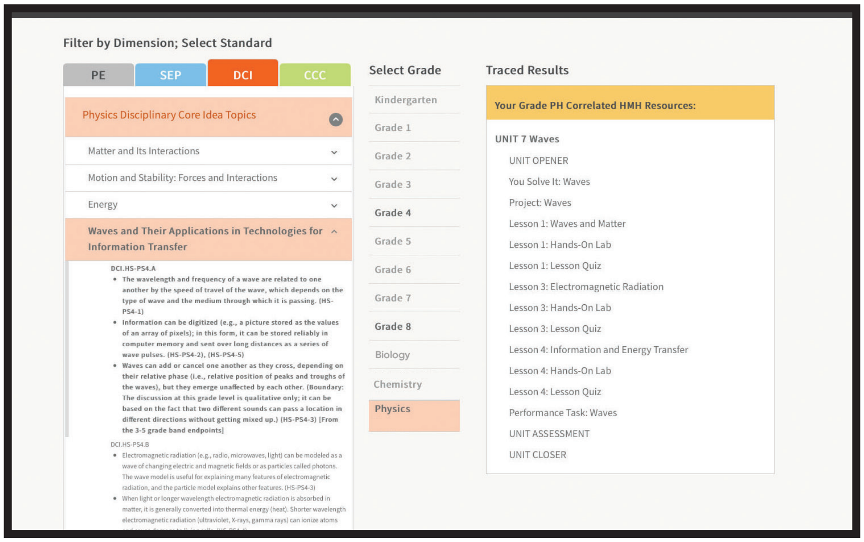
BERNADINE OKORO
STEM Learning Advocate & Consultant

JEFF RYLANDER
Physics Teacher, Instructional Supervisor of the Science Department

CARY I. SNEIDER, PhD
Engineering Consultant Associate Research Professor

What's Inside

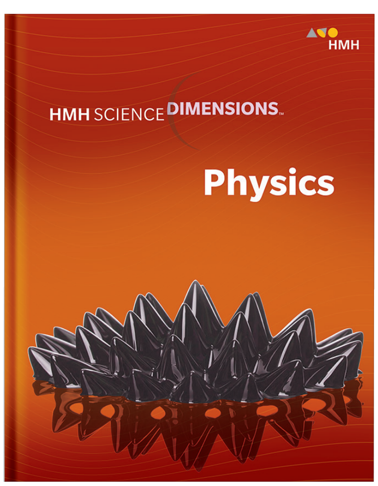
REASONS TO CHOOSE
HMH Science Dimensions Physics



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.



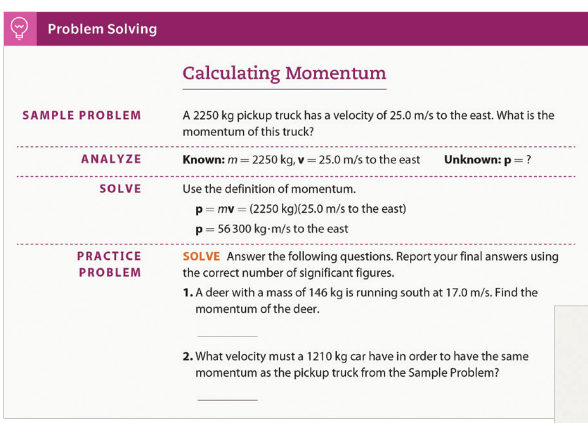
Post–High School Support

- *HMH Science Dimensions Physics* 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.

PREDICT
What are all the different ways that you could move an electric charge carrier?

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.



Problem Solving

Calculating Momentum

SAMPLE PROBLEM A 2250 kg pickup truck has a velocity of 25.0 m/s to the east. What is the momentum of this truck?

ANALYZE **Known:** $m = 2250$ kg, $\mathbf{v} = 25.0$ m/s to the east **Unknown:** $\mathbf{p} = ?$

SOLVE Use the definition of momentum.

$\mathbf{p} = m\mathbf{v} = (2250\text{ kg})(25.0\text{ m/s to the east})$

$\mathbf{p} = 56\,300\text{ kg}\cdot\text{m/s to the east}$

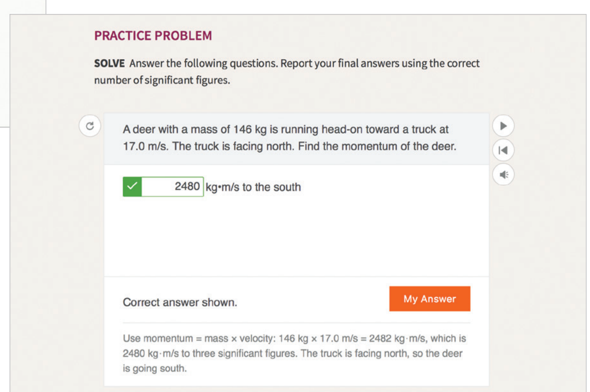
PRACTICE PROBLEM **SOLVE** Answer the following questions. Report your final answers using the correct number of significant figures.

1. A deer with a mass of 146 kg is running south at 17.0 m/s. Find the momentum of the deer.

2. What velocity must a 1210 kg car have in order to have the same momentum as the pickup truck from the Sample Problem?

Exceptional Problem-Solving Support

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



PRACTICE PROBLEM

SOLVE Answer the following questions. Report your final answers using the correct number of significant figures.

A deer with a mass of 146 kg is running head-on toward a truck at 17.0 m/s. The truck is facing north. Find the momentum of the deer.

2480 kg·m/s to the south

Correct answer shown. My Answer

Use momentum = mass x velocity: 146 kg x 17.0 m/s = 2482 kg·m/s, which is 2480 kg·m/s to three significant figures. The truck is facing north, so the deer is going south.

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 Physics* 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

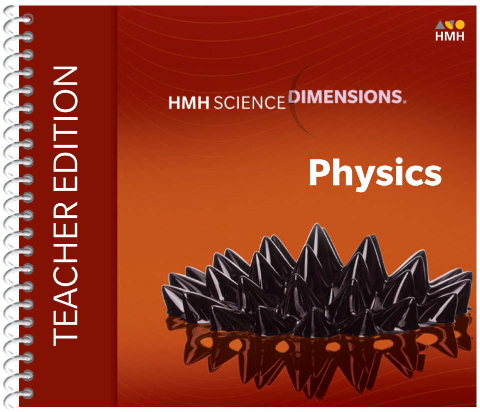
How *HMH Science Dimensions Physics* **Changes the Game**

- 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

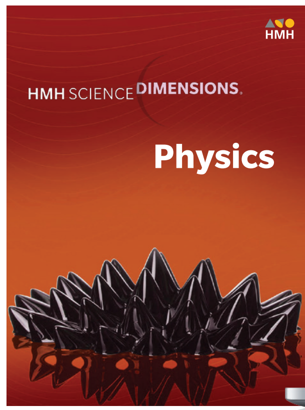
1980s

RESOURCES AND FEATURES

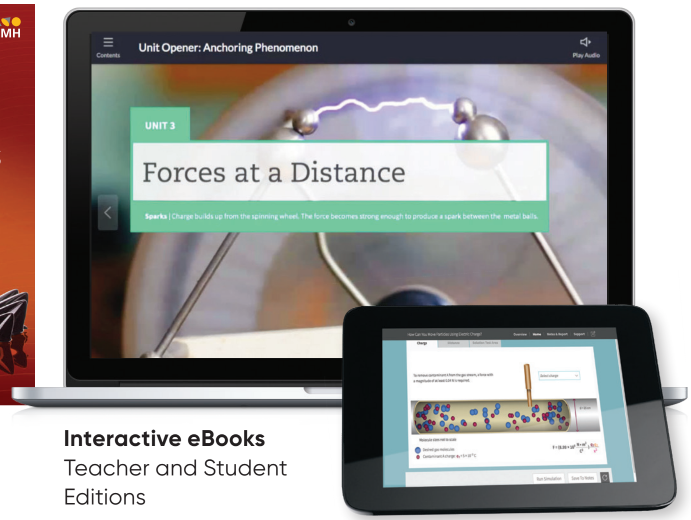
Core Resources



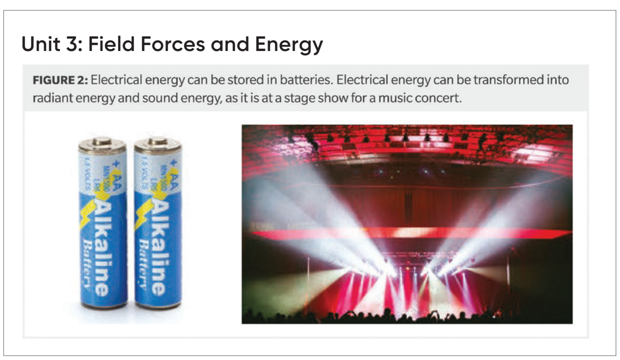
Teacher Edition
Hardcover



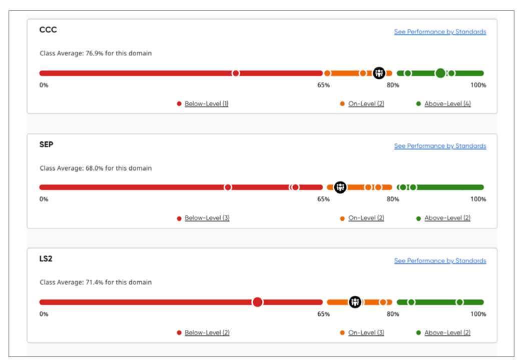
Student Edition
Hardcover or
Consumable Worktext



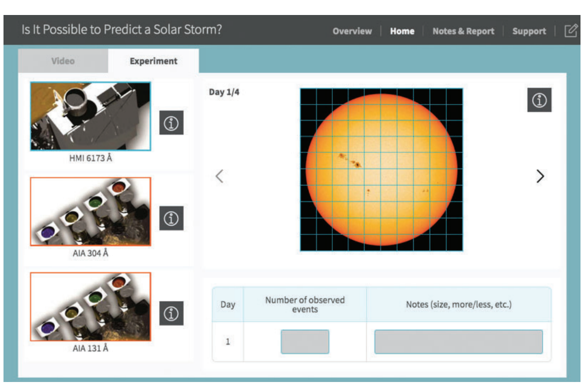
Interactive eBooks
Teacher and Student
Editions



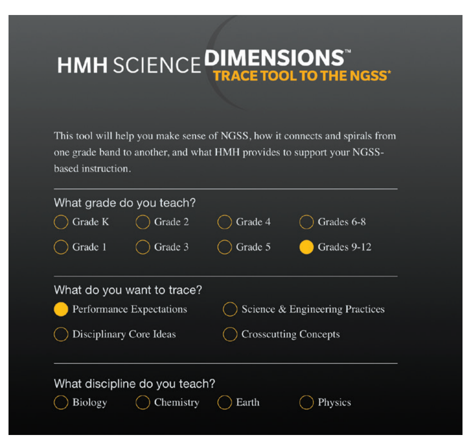
Digital Lesson Planning on *Ed*, the HMH® Learning Platform



Standards-Based Reporting Individual or Classroom Data



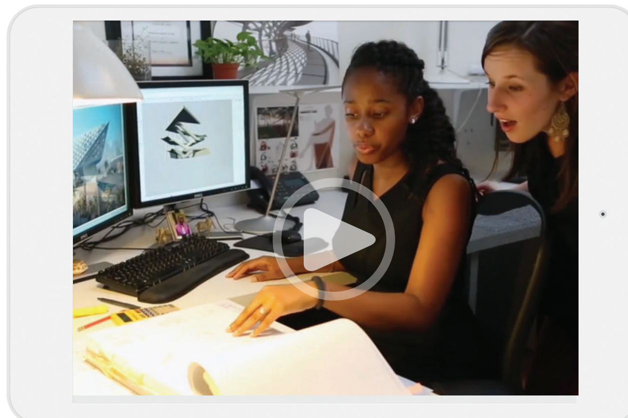
Open-Ended Computer Simulations You Solve It!



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

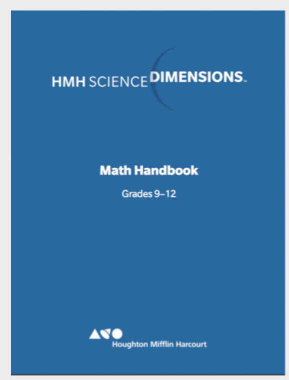
Handbooks for Student Support:

Math: Problem-Solving Support

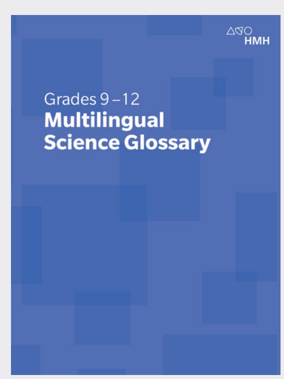
ELA: Writing and Comprehension Support

SEP: Science and Engineering Practices

CCC: Crosscutting Concepts



Multilingual Glossary Addressing Ten Languages



ACCESS AND EQUITY

All Standards, All Students

Recognizing that learning takes place both within and outside of the science classroom, *HMH Science Dimensions Physics* 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 Physics*, we enlisted reading and English language development expert Marjorie Frank to ensure best practices are embedded throughout all worktexts and supplementary materials.

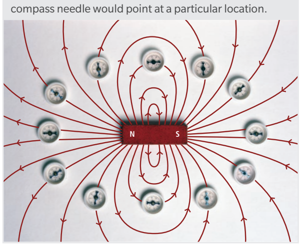


FIGURE 13: Magnetic field lines run from the north to the south pole of a magnet, indicating the direction that a compass needle would point at a particular location.

EXPLAIN If the compass needle to the right of the magnet were free to slide in any direction, how would it move? Use the direction and density of field lines to support your answer.

The lines of the magnetic field are drawn from north poles to south poles and form closed loops. As with the arrows in electric fields, this direction is a convention. The density of the field lines shows the relative strength of the field. For simplicity, field lines are typically shown in two dimensions for a plane through the magnet. A more complex model might show the field around the magnet in three dimensions.

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 Physics* provides teachers and students with **strategies for making meaning**.

MTSS/RTI Relate the force of many unaligned small magnetic fields to a large number of small forces in many directions pushing on a wadded-up ball of paper. When the ball of paper rests on the desk, air molecules collide with it from every direction, canceling one another out so the net force is zero. Blow on the ball of paper to demonstrate that when the small forces of many air molecules align with one another, they produce a net force that can move an object.

Careers in Science

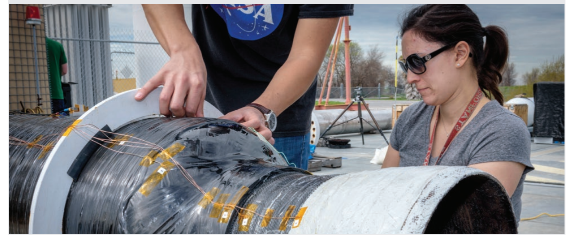
Letting **student curiosity** lead the way promotes deeper knowledge of concepts and big ideas so that students have pathway choices they can select in our **"Take It Further"** feature. Students can complete the pathway in the worktext or they can select from additional learning options online.

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

TAKE IT FURTHER

Careers in Engineering

FIGURE 14: Hunjoo Kim (left) and Ashley Karp (right) of NASA Jet Propulsion Laboratory, attach heat sensors to the Peregrine Hybrid Rocket Engine prior to its test at the Outdoor Aerodynamic Research Facility at NASA's Ames Research Center.



Rocket Engineer

Rocket engineers work on the design and manufacture of rocket-propelled spacecraft. They can specialize in particular fields such as fuel systems, acoustics, aerodynamics, or guidance systems. Some rocket engineers specialize in quality control inspections.

Rocket engineers who specialize in fuel systems evaluate design specifications to determine the amount of thrust that rocket engines produce. The product of force and time is the impulse. The impulse provided by the rocket engine is critical in causing a stationary rocket to start moving as it lifts off the launch pad and flies. A rocket engineer evaluates information from many different sources to help select criteria for choosing a rocket engine with enough thrust while keeping design constraints such as cost, mass, and availability in mind.

Engineering in Your Community Engineers from diverse backgrounds are responsible for many advances in the fields of rocket science and propulsion. Research an engineer whose work has benefited your community.

Language Arts Connection
Gather information about model rocket engines, the amount of thrust they produce, and the mass of the rocket they can launch. Use the following questions to guide your research:

- What is the range of mass of the model rocket?
- How are model rocket engines rated based on thrust and mass of the rocket?
- What other considerations are necessary when choosing a model rocket engine?

Next, use the Internet to gather charts or tables of model rocket engine data. Include examples from different manufacturers of model rocket engines.

Last, write a brief essay that explains the selection criteria for at least two model rocket engines. As you write, be sure to address the following points:

- the specifications of the model rocket engines selected
- the criteria used to evaluate the suitability for model rocket engines
- the manufacturer and model numbers for the model rocket engines you chose

UNIT PERFORMANCE TASK

Designing a Firework

The key to a successful fireworks show is to awe the audience with a colorful display. Energy is transformed into flashes of light that look like a variety of shapes, including balls and flowers. The firework shells must be designed and manufactured so that the shape appears reliably. Each firework shell holds many explosives called *stars* that produce the flashes. As each star flies from the shell into the air, the momentum of the star must carry it to the correct location.

Imagine you are an engineer working for a fireworks manufacturer. Design a firework shell to make a new pattern. How will the solution meet a customer need?

FIGURE 4: Designers arrange the parts of the shell carefully to make the desired pattern.

1. DEFINE THE PROBLEM
With your team, write a problem statement that describes what the solution must accomplish.

2. CONDUCT RESEARCH
Research what you need to design a firework shell. Questions to answer could include:

- What are the standard shapes and sizes of shells?
- Why are most firework displays symmetric?
- How are individual streamers of light produced?
- How are the individual stars arranged so that they all appear at the right time?
- How can the arrangement and timing of explosions produce a desired pattern?

5. COMMUNICATE
Prepare a written or multimedia report with one or more labeled diagrams to present your solution to the fireworks display operators and to explain how your design meets their specifications. Describe how energy is stored in the firework, and how that energy is transferred and transformed as the firework is launched and explodes.

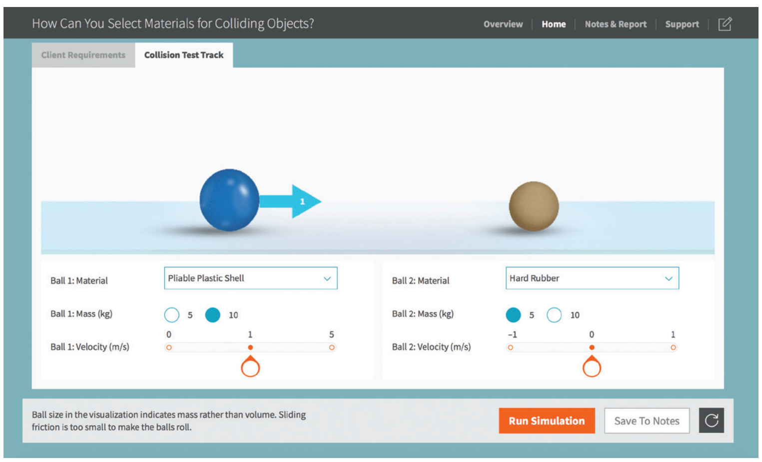
CHECK YOUR WORK

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 Physics* 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.

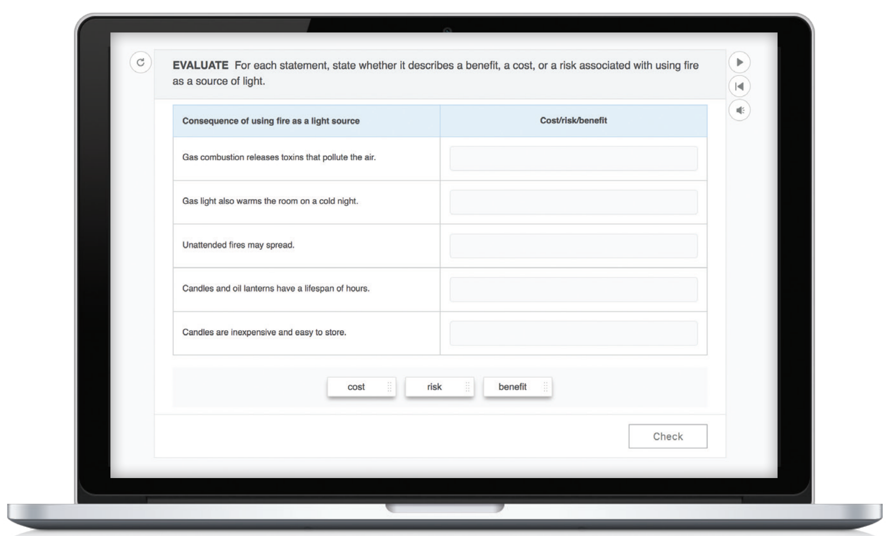
Pre-, Formative, Summative, and Self-Assessments

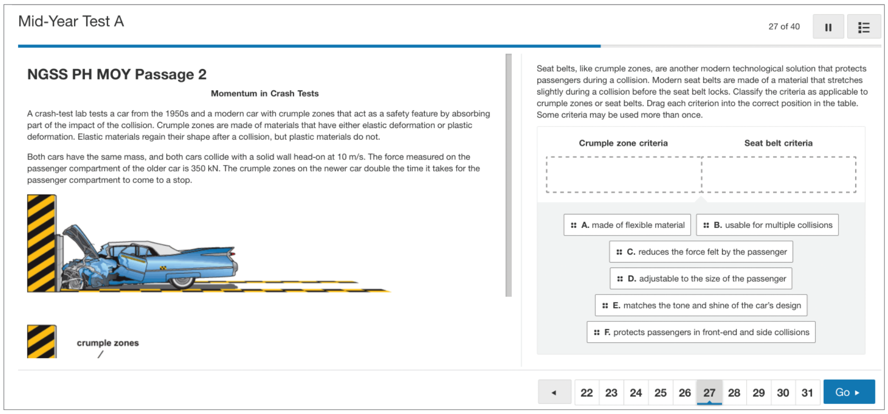


"Over the course of the program, a system of assessments coordinates the variety of ways student learning is monitored to provide information to students and teachers regarding student progress for all three dimensions of the standards."

— 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

Impractical Machines

When would you want to make a process as complex as possible, rather than simplify it? Rube Goldberg was a Pulitzer Prize–winning cartoonist with a degree in engineering. His cartoons show designs for multistep, overly complicated processes to perform simple tasks, such as buttering toast or wiping one's mouth with a napkin. One device triggers the next in a cascade of steps. Research Rube Goldberg designs, both the original cartoons and videos of physical machines. Then design and build such a device, using as many different steps and as many types of energy as feasible.

UNIT PERFORMANCE TASK

Modeling a Building Design

Architects design buildings to meet a variety of aesthetic and functional criteria. In each design, the buildings must be stable and safe for use. To achieve this stability, buildings must be constructed such that forces are balanced in each part of the structure. The buildings must be able to withstand weather and geologic conditions for the area, as well as any other conditions required by the use of the building.

Build and use a model to explore how forces might be balanced in a building design. Consider how real-world buildings might use balanced forces or more complex designs to achieve stability.

FIGURE 4: A building that includes a cantilever design

1. DEFINE THE PROBLEM

The building in Figure 4 has a cantilever, which is a part that projects out and is unsupported on one end. Examine Figure 4 or another building with an interesting structure and identify what aesthetic or functional criteria the building was designed to meet. Describe why the building was designed with the cantilever or other interesting characteristic and what challenges the construction team might have faced.

4. COMMUNICATE

Make a poster or digital presentation that includes the labeled diagram of the model and a real-world building design. For both the model and the real-world design, describe how forces are balanced at different places on the structure. Describe how the model is relevant to the real-world design, and then identify challenges and criteria the real-world design had to meet that cannot be represented in the model.

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.

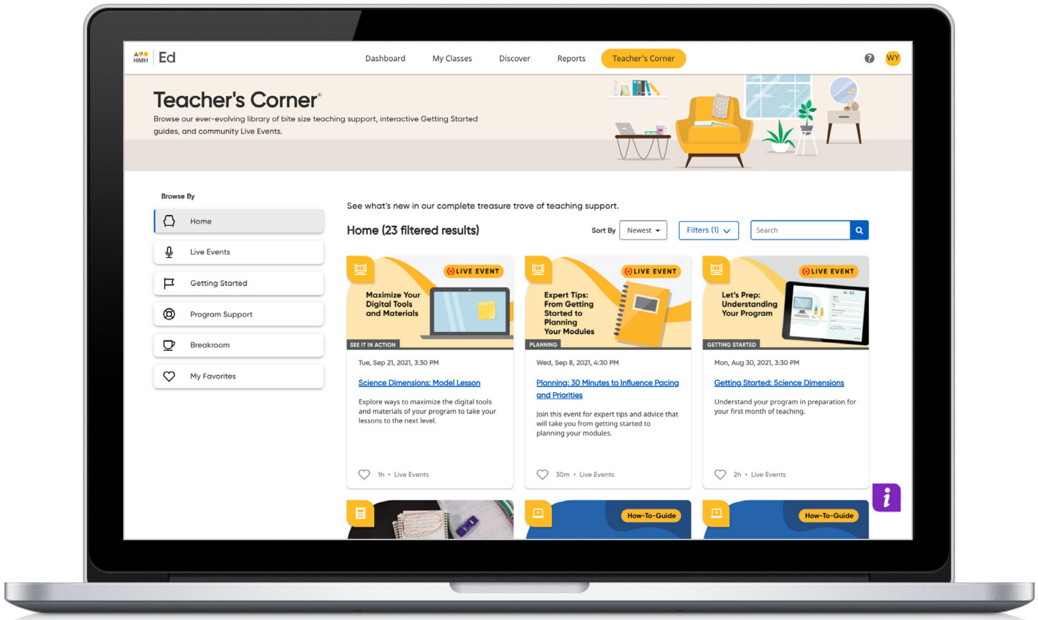
Teachers benefit from:

- 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

TECH & LEARNING AWARDS OF EXCELLENCE WINNER

//CODiE// 2021 SIIA CODiE FINALIST

THE EDTECH AWARDS COOL TOOL FINALIST 2020

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.

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?

*Available for purchase

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 Physics* **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

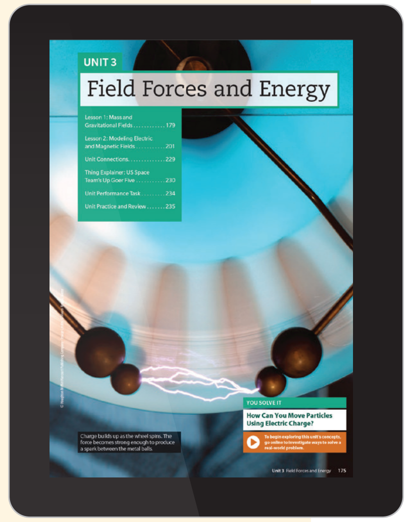
UNIT 3: Field Forces and Energy

ANCHOR PHENOMENON

Electric, Magnetic, and Gravitational Forces

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 two lessons that both relate to this anchor phenomenon in which students consider how electric, magnetic, and gravitational fields interact. Students begin with a Unit Project in which they test materials and designs to use electric, magnetic, and gravitational forces to create a hovering toy.

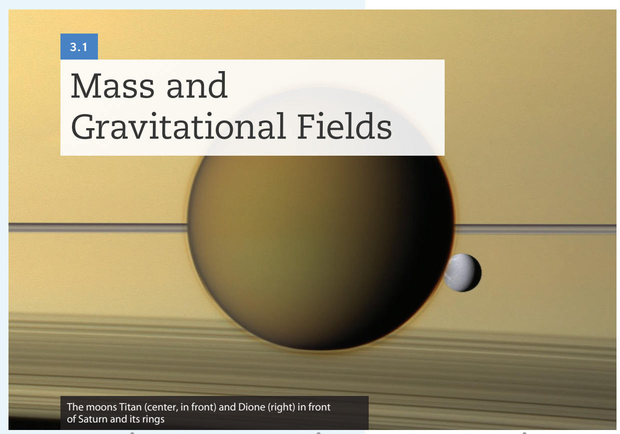


LESSON 1: Mass and Gravitational Fields

INVESTIGATIVE PHENOMENON

Planetary Mass

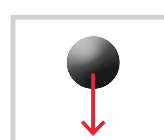
An **investigative phenomenon** focuses the lesson to explore one concept of the anchor phenomenon. In this example, students begin exploring gravitational fields by considering how to calculate the mass of planets by observing gravitational interactions. As they explore inertia, acceleration, and Newton's and Kepler's laws, they both build an explanation of the investigative phenomenon and add to the accuracy of their Unit Project.

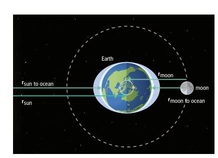


The moons Titan (center, in front) and Dione (right) in front of Saturn and its rings

EVERYDAY PHENOMENA

Everyday phenomena connect students to events with which they have personal connection or experience. This lesson uses the phenomena of inertia of different sized animals, gravitational acceleration of different massed balls, and the cause of changing tides to help students connect with gravitational forces and add to the construction of a complete explanation of the lesson's phenomenon. The everyday phenomena also add to the depth of knowledge students need to complete the Unit Project to address the anchor phenomenon.

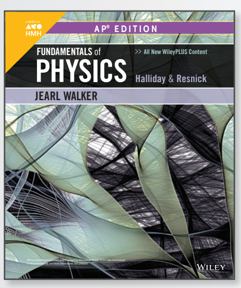


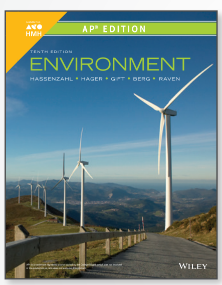


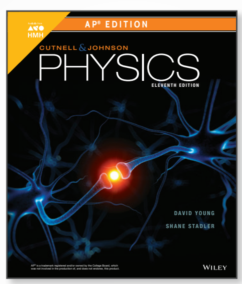
HMH AP® and Honors solutions support college readiness for your students.

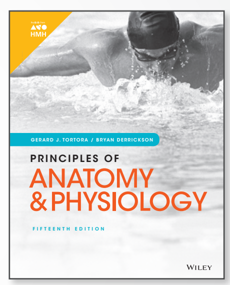
Through our partnership with John Wiley® & Sons College Division, we are able to act on our belief in equity and provide quality solutions for Advanced Placement®, honors, and elective courses in Grades 9–12. At HMH, we aim to deliver great outcomes for our students, teachers, and learning communities.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

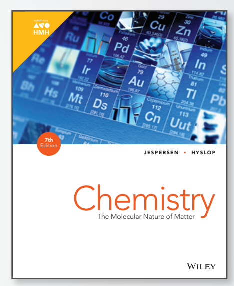
Proven Content. No Exception.











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

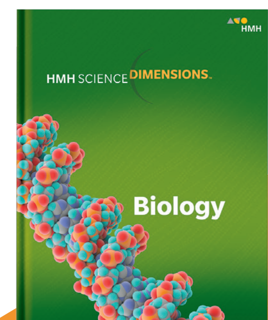
With its cohesive, spiraled approach to meeting the new standards, *HMH Science Dimensions* provides a consistent and engaging experience from kindergarten through high school.

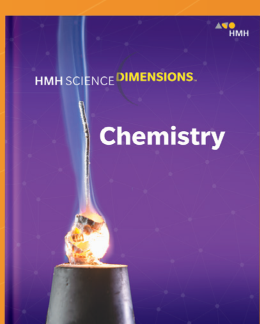
GRADES K–5
Available as a softcover, consumable write-in worktext for each grade

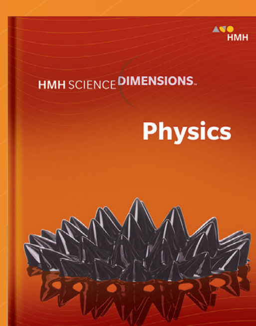
GRADES 6–8
Available as 12 modules for Life Science, Earth & Space Science, Physical Science, and Engineering

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	•	•







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