Mc Graw Hill

Program Overview
High School Series

Pennsylvania

# Inspire Science

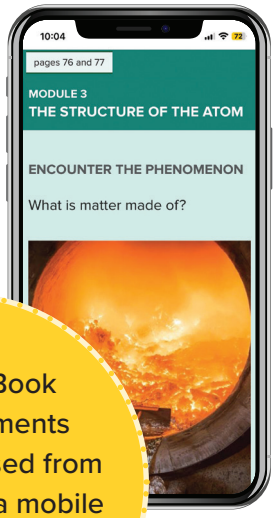
## High School Series

Biology • Chemistry • Physical Science
Earth Science • Physics

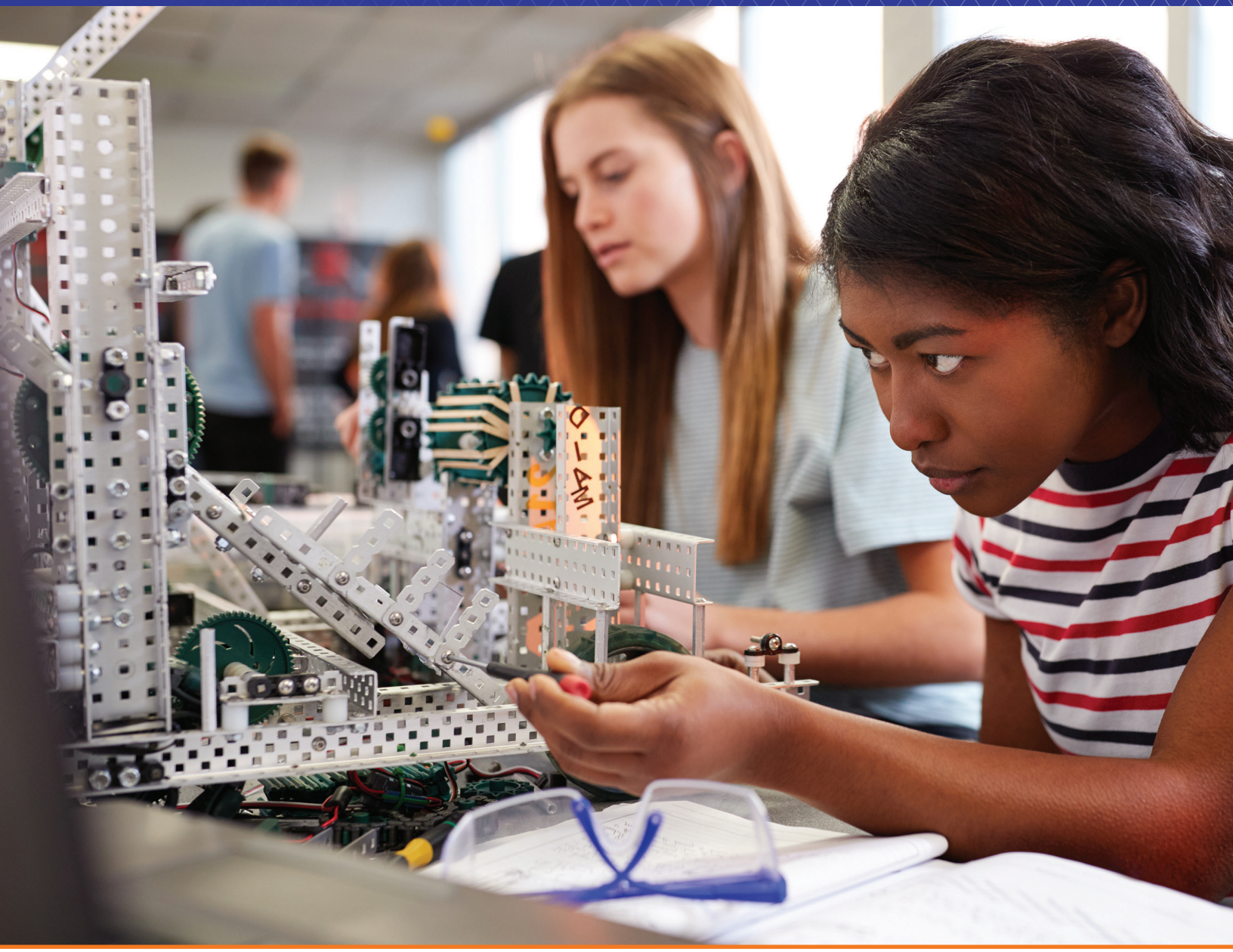

# Welcome to *Pennsylvania Inspire Science* High School Series

## Engaging, Flexible, Cross-Curricular Learning

Designed with the Pennsylvania Science, Technology & Engineering, Environmental Literacy & Sustainability (STEELS) Standards in mind, *Pennsylvania Inspire Science* provides the structure for students to develop a solid background of foundational science knowledge while they learn to practice problem solving and critical thinking skills inherent in science.




Student eBook and assignments can be accessed from anywhere on a mobile device using the K–12 Portal App!



# Develop Students to Become Critical Thinkers and Problem Solvers

Our *Pennsylvania Inspire Science* High School Series—including *Inspire Biology*, *Inspire Chemistry*, *Inspire Earth and Space Science*, *Inspire Physical Science*, and *Inspire Physics*—provides an in-depth, collaborative, and project-based learning experience designed to interest students and empower them to ask questions and think critically. A new generation of innovators is ready to take on today's challenges to become tomorrow's scientists. **Are you ready to help guide them to be prepared to meet the problem-solving demands of the 21st Century?**

# Aligned to the Rigor of the Pennsylvania STEELS Standards

*Pennsylvania Inspire Science* ensures that Pennsylvania educators have the resources and tools to deliver high-quality instruction to help students meet the rigor and challenge of the Pennsylvania STEELS Standards.

## Comprehensive Performance Expectation Planning

At the beginning of each module, NGSS codes and descriptions help teachers quickly see performance expectations addressed in the module.

## Three Dimensions at a Glance, Building to Performance Expectations

Use this chart to identify the focus of the three dimensions that build to the performance expectations within the module.

Module 2: **Principles of Ecology**

### Performance Expectations

Students will explore content and develop skills related to the following Performance Expectations. Mastery can be assessed using the associated online Applying Practices activities.

**Build to Performance Expectations**

**HS-LS1-5.** Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy. (Mastery in Module 8)

**HS-LS1-6.** Construct an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules. (Mastery in Module 6)

**HS-LS1-7.** Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed, resulting in a net transfer of energy. (Mastery in Module 8)

**HS-LS2-1.** Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales. (Mastery in Module 4)

**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. (Mastery in Module 5)

**HS-LS2-5.** Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere. (Mastery in Module 8)

**Master Performance Expectations**

**HS-LS2-3.** Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.

Assess this PE using **Applying Practices:** ***The Cycling of Matter and Flow of Energy in Aerobic and Anaerobic Conditions*** (Lesson 3)

| SEP Science and Engineering Practices | DCI Disciplinary Core Ideas | CCC Crosscutting Concepts |
|---|---|---|
| Constructing Explanations and Designing Solutions | LS2.B: Cycles of Matter and Energy Transfer in Ecosystems | Energy and Matter |

**HS-LS2-4.** Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.

Assess this PE using **Applying Practices:** ***Ecological Pyramids*** (Lesson 2)

| SEP Science and Engineering Practices | DCI Disciplinary Core Ideas | CCC Crosscutting Concepts |
|---|---|---|
| Using Mathematics and Computational Thinking | LS2.B: Cycles of Matter and Energy Transfer in Ecosystems | Energy and Matter |

22A Module 2 • Principles of Ecology

**DCI Organization for Matter and Energy Flow in Organisms**

**LS1.C** As **matter and energy flow through different organizational levels of living systems**, chemical elements are recombined in different ways to form different products.

***bold font** indicates the part of the DCI covered in this lesson.

**SEP Quick Practice**

**Engaging in Argument from Evidence** Have students study Figure 1 and discuss the following question: Which time line entry do students consider the most significant to ecological discoveries and why? Answers will vary, but encourage students to explain their reasoning.

## Lesson 1: Organisms and Their Relationships

**DCI Organization for Matter and Energy Flow in Organisms**

**LS1.C** As **matter and energy flow through different organizational levels of living systems**, chemical elements are recombined in different ways to form different products.

***bold font** indicates the part of the DCI covered in this lesson.

### Engage

Launch the Lesson Interactive Content can be assigned the night before class as a lesson preview, during class to spark discussion, as a resource during inquiry, or as homework.

**Driving Question Board**

Have students revisit the DQB to remind themselves of the Unit and Module questions. Have them identify the sticky note questions they think will be answered in this lesson. Then, have students read the **Focus Question** and add it to the DQB. Students will revisit the **Focus Question** at the end of the lesson.

### Explore and Explain

**Science Journal** Remind students to keep records of their investigations in their Science Journals. Additionally, be sure that each reading or activity is added to the class Summary table.

**Three-Dimensional Thinking** The activities called out in the Student Edition will allow students to practice three-dimensional thinking. Worksheets for these activities can be found online.

**Reading Strategy**

**Self-Monitor Comprehension** Have students ask themselves questions as they read. If they finish a paragraph and have a question that has not been answered, they should reread the text where the question may be answered. If they still cannot answer it, they should write down the question and ask the teacher or another student to help to answer it. This will help students understand the concepts. It may be useful to walk through the room and prompt students with questions while they read.

**Get It?**

Answers will vary, but should include reasonable and specific examples of biotic and abiotic factors and how they interact.


**GO ONLINE**

| PRESENTATION | INTERACTIVE CONTENT |
|---|---|
| Teacher Presentation: Organisms and Their Relationships | Launch the Lesson: Organisms and Their Relationships |

**IMPLEMENTATION OPTIONS**

**Presentation: Teacher-Facilitated Pathway**

Use the Teacher Presentation to support classroom instruction and spark discourse. Obtain data to inform your instruction by assigning the Interactive Content, Additional Resources, and Assessment.

**Interactive Content: Student-Led Pathway**

Students can use the online Interactive Content, along with the Student Edition, Science Notebook, projects, and labs, to collect evidence to support their claim. They can record their evidence in their Science Journals and the class Summary Table.





**SEP Quick Practice**

**Engaging in Argument from Evidence** Have students study Figure 1 and discuss the following question: Which time line entry do students consider the most significant to ecological discoveries and why? Answers will vary, but encourage students to explain their reasoning.

**Writing Support**

**Informal Writing** Have students write a short essay explaining how the work of Wangari Maathai helps both the environment and impoverished women and children in Africa.

**EL Support**

ELD PI.9/10.3

Guide students in negotiating with others in conversations using learned phrases to talk about which time line entry they consider the most significant to ecological discoveries and why.

**EMERGING LEVEL** While pointing and gesturing, model offering opinions and discussing using sentence frames such as: I think number _____ 2 is most significant. Why do you think so? Because the book warned about _____ pollution. Would you say that again? The book warned about pollution.

**EXPANDING LEVEL** Support students in expressing and defending their opinions. Provide sentence frames: I think ____ Number 2 ___is the most significant because _____ the book warned people about pollution. I see your point, but _____ in Number 6, Wangari Maathai won the Nobel prize.

**BRIDGING LEVEL** Have students offer appropriate registers to express and defend their opinions. I think Number 2 is most significant because Silent Spring warned many people about pollution. I heard you say that the book warned many people about pollution and I hadn't thought about that before. However, I think Number 6 is most significant because Wangari Maathai helped slow the process of deforestation. And she won the Nobel Prize. That's a good point.




# Point of Use Standards-Based Instruction

Within the lesson, find the call outs focused on Disciplinary Core Ideas, to focus student learning by standard as well as call outs for Cross Cutting Concepts and Science and Engineering Practices.

# Optimized for Teacher Success and Student Content Mastery

Structured for flexibility, *Pennsylvania Inspire Science* supports experienced teachers to quickly assess what adaptations fit the needs of their classes, while new teachers or those with non-traditional certification will find a clear, recommended lesson path with necessary supporting information.

Pacing included for every lesson allow you to plan out modules.

**PROGRAM FEATURE!**

**Resource Overviews** in every module and lesson can help curriculum writers recommend specific resources to cover the Pennsylvania STEELS Standards.

## Module Planner

**GO ONLINE** to curate your presentations, interactive content, additional resources, and media library, and find answer keys, materials lists, rubrics, differentiated instruction, and more.

### Module Resources

| | Module Launch | Lesson 1 | Lesson 2 | Lesson 3 | Module Wrap-Up |
|---|---|---|---|---|---|
| Pacing (min) | 45 | 100 | 100 | 90 | 45 |
| CER Claim, Evidence, Reasoning | Encounter the Phenomenon<br>Make Your Claim | Collect Evidence | Collect Evidence | Collect Evidence | Revisit the Phenomenon<br>Go Further: Data Analysis Lab |
| Labs and Investigations | **LL:** Problems in *Drosophila* World? | **BioLab:** Explore Habitat Size and Species Diversity | **QI:** Construct a Food Web<br>**VI:** Model Ecosystems | **QI:** Test for Nitrates | |
| Media & OER | | | | Beyond the Classroom: Google Expedition<br>**PT:** Cycles | |
| Assess | Module Pretest | Lesson Check | Lesson Check | Lesson Check | Module Vocabulary Practice<br>Module Test |
| Applying Practices | | | Ecological Pyramids HS-LS2-4 | The Cycling of Matter and Flow of Energy in Aerobic and Anaerobic Conditions HS-LS2-3 | |

**KEY:** **LL:** Launch Lab **QI:** Quick Investigation **VI:** Virtual Investigation **PT:** Personal Tutor

### Three-Course Model

**GO ONLINE** If teaching a 3-course model, go online to find associated Earth and Space Science content.

**EARTH AND SPACE SCIENCE**
**Module: Relationships Between Humans and Earth**

- Earth's Surface Processes can be integrated after lesson 3 of this Module.

**Applying Practices** are tied to every standard to ensure mastery throughout the module.

View the **Labs, Investigations, and Media** associated with the module to think through which will most resonate in your classroom.

**Engage:** In the Engage phase, students are introduced to the science topic and establish links with their existing knowledge. This stage piques their interest and fosters their curiosity, motivating them to delve deeper into the subject matter.

**Explore and Explain:** The Explore and Explain phase encourages students to get involved and investigate through a related, common experience. Students will carry out an investigation and collect and interpret data as they reveal answers to their questions to build understanding using different types of inquiry activities.

**Elaborate:** Students will apply knowledge to new situations to develop a deeper understanding of the lesson concepts, use the skills they are learning, and make connections.

**Evaluate:** In the Evaluate phase, teachers gauge student progress. A question is provided to assess students' knowledge and offer remediation suggestions if additional help is needed.

## Lesson 1: **Organizations and Their Relationships**

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**Get It?**

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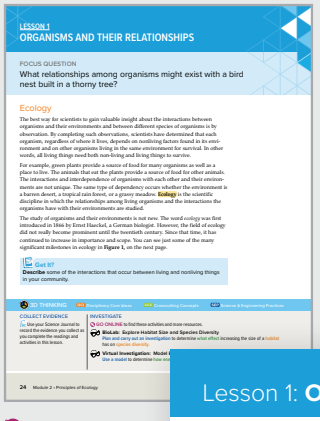

LESSON 1
ORGANISMS AND THEIR RELATIONSHIPS

FOCUS QUESTION
What relationships among organisms might exist with a bird nest built in a thorny tree?

Ecology

Got It?
**Describe** some of the interactions that occur between living and nonliving things in your community.

3D THINKING | DCI Disciplinary Core Ideas | CCC Crosscutting Concepts | SEP Science & Engineering Practices

COLLECT EVIDENCE | INVESTIGATE

GO ONLINE to find these activities and more resources.

**Mini-Lab:** Explore Habitat Size and Species Diversity
Plan and carry out an investigation to determine what effect increasing the size of a habitat has on species diversity.

**Virtual Investigation:** Model
Use a model to determine how

24 Module 2 • Principles of Ecology

GO ONLINE

PRESENTATION
Teacher Presentation: Organisms and Their Relationships

IMPLEMENTATIO

**Presentation: Teacher-Fa**
Use the Teacher Presentatio instruction and spark discou inform your instruction by as Content, Additional Resourc

**Interactive Content: Stu**
Students can use the online along with the Student Editio projects, and labs, to collect their claim. They can record Science Journals and the cla



## Lesson 1: **Organisms and Their Relationships**

### Elaborate

Return to the DQB and have students determine what questions they can answer. At this point, they should be able to answer the **Focus Question.**

### Evaluate

**Formative Assessment Check**

Have students differentiate between the three categories of symbiosis and give an example of each. The three categories are mutualism, commensalism, and parasitism. Examples will vary.

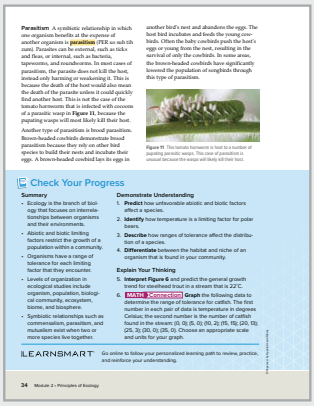
**Remediation** Give each student three index cards. Have them write the types of symbiosis explained in this lesson on one side and make a visual cue on the other side. One helpful way for students to visualize is to use plus and minus signs. For example, with mutualism, both organisms benefit, so it can be represented with +/+. Parasitism: +/−, and commensalism: +/0 (0 can represent no effect). Then allow students to trade cards with the code side up and identify the type of symbiosis. Have students use the cards to quiz each other on these relationships.

**Check Your Progress**

1. Unfavorable factors might restrict the population numbers and ability to reproduce. Some factors that are unfavorable to one species might be favorable to another.
2. Temperature defines a polar bear's community and ecosystem. The bear's food sources and its physiology are adapted to the cold temperatures.
3. Fewer organisms will be found in their zone of physiological intolerance than in their tolerance zone.
4. Answers will vary depending on student choices. All answers should clearly distinguish between a habitat (which is an area) and a niche (which is a role).
5. The steelhead trout will grow more slowly in their zone of physiological stress.
6. Catfish can tolerate a temperature from 10°C to 25°C.

**Formative Assessment: Lesson Check**

GO ONLINE You might want to assign from the Additional Resources the pre-made Lesson Check based on key concepts and disciplinary core ideas, or you can customize your own using the customization tool.


**Parasitism** A symbiotic relationship in which one organism benefits at the expense of another organism is **parasitism** (PER uh suh tih zum). Parasites can be external, such as ticks and fleas, or internal, such as bacteria, tapeworms, and roundworms. In most cases of parasitism, the parasite does not kill the host, instead only harming or weakening it. This is because the death of the host would also mean the death of the parasite unless it could quickly find another host. This is not the case of the tomato hornworm that is infected with cocoons of a parasitic wasp in **Figure 11**, because the pupating wasps will most likely kill their host.

Another type of parasitism is brood parasitism. Brown-headed cowbirds demonstrate brood parasitism because they rely on other bird species to build their nests and incubate their eggs. A brown-headed cowbird lays its eggs in another bird's nest and abandons the eggs. The host bird incubates and feeds the young cowbirds. Often the baby cowbirds push the host's eggs or young from the nest, resulting in the survival of only the cowbirds. In some areas, the brown-headed cowbirds have significantly lowered the population of songbirds through this type of parasitism.

**Figure 11** This tomato hornworm is host to a number of pupating parasitic wasps. This case of parasitism is unusual because the wasps will likely kill their host.

Check Your Progress

**Summary**
- Ecology is the branch of biology that focuses on interrelationships between organisms and their environments.
- Abiotic and biotic limiting factors restrict the growth of a population within a community.
- Organisms have a range of tolerance for each limiting factor that they encounter.
- Levels of organization in ecological studies include organism, population, biological community, ecosystem, biome, and biosphere.
- Symbiotic relationships such as commensalism, parasitism, and mutualism exist when two or more species live together.

**Demonstrate Understanding**
1. **Predict** how unfavorable abiotic and biotic factors affect a species.
2. **Identify** how temperature is a limiting factor for polar bears.
3. **Describe** how ranges of tolerance affect the distribution of a species.
4. **Differentiate** between the habitat and niche of an organism that is found in your community.

**Explain Your Thinking**
5. **Interpret Figure 6** and predict the general growth trend for steelhead trout in a stream that is 22°C.
6. MATH CONNECTION **Graph** the following data to determine the range of tolerance for catfish. The first number in each pair of data is temperature in degrees Celsius; the second number is the number of catfish found in the stream: (0, 0), (5, 0), (10, 2), (15, 15), (20, 13), (25, 3), (30, 0), (35, 0). Choose an appropriate scale and units for your graph.

LEARNSMART Go online to follow your personalized learning path to review, practice, and reinforce your understanding.

34 Module 2 • Principles of Ecology

GO ONLINE

ADDITIONAL RESOURCE
Vocabulary Flashcards: Organisms and Their Relationships
vocabulary

ADDITIONAL RESOURCE
Lesson Check: Organisms and Their Relationships

ADDITIONAL RESOURCE
Inspire Biology LearnSmart
LS LEARNSMART

# Teach Your Way With Phenomena-Driven 5E Lessons

The *Pennsylvania Inspire Science* High School Series provides two pathways for learning, teacher-facilitated and student-led. Each pathway provides teachers and students flexibility dependent on the preferred method of learning, day, or topic.

## Teacher-Facilitated Pathway

Use the Teacher Presentation to support classroom instruction and spark discourse. Obtain data to inform your instruction by assigning the Interactive Content, Additional Resources, and Assessment.

## Student-Led Pathway

Students can use the online Interactive Content, along with the Student Edition, Science Notebook, and printable projects and labs, to collect evidence to support their claims and demonstrate 3D thinking.

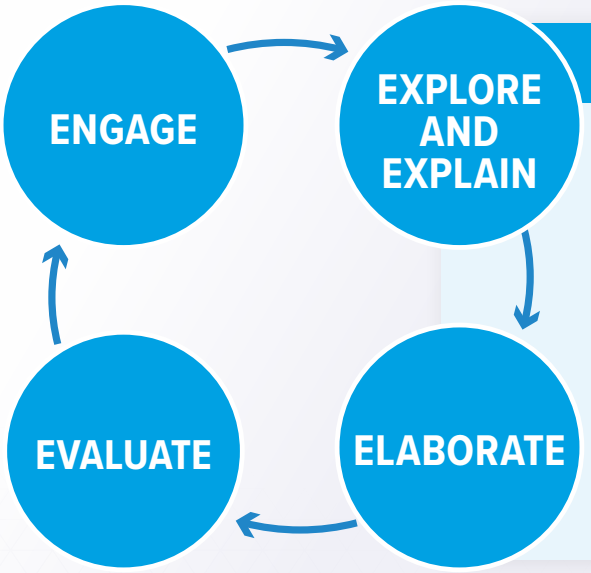
Each *Pennsylvania Inspire Science* High School Series unit phenomenon sets the stage for the STEM Unit Project. Each module within the unit supports the STEM Unit Project with phenomena-driven 5E lessons to support a variety of learning pathways.

## UNIT OPENER

Encounter the Phenomenon
STEM Unit Project Launch
Formative Assessment Science Probe

## MODULE OPENER

Encounter the Phenomenon
CER Claim, Evidence, Reasoning




## LESSON

**ENGAGE:**
Encounter the Phenomenon
Phenomenon Question

**EXPLORE/EXPLAIN:**
Virtual Labs
PhET Simulations
Labs
Applying Practices
Supporting Resources

**ELABORATE:**
Environmental Connection
STEM Career Connections

**EVALUATE:**
Lesson Review
Three-Dimensional Assessment

## MODULE CLOSE

Revisit the Phenomenon
State Assessment Practice
CER Claim, Evidence, Reasoning
Labs/Projects
Revisit STEM Unit Project
Module Test
Vocabulary Review

## UNIT CLOSE

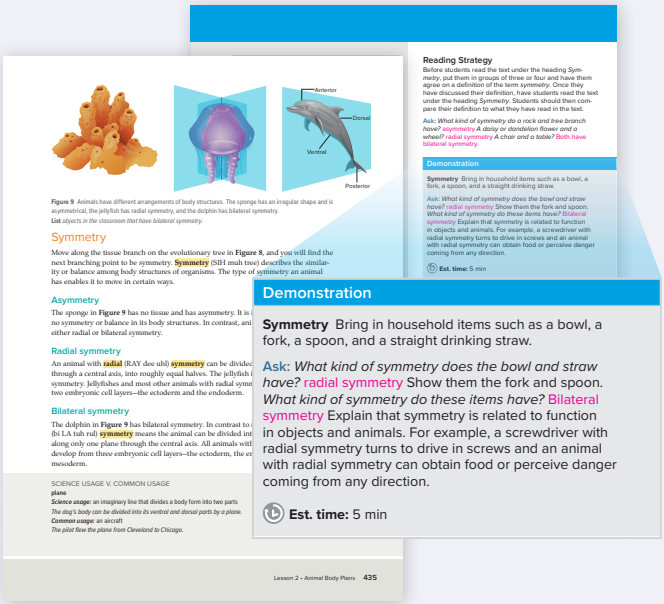
**Go Online**
Complete STEM Unit Project

# Empower Students With Inquiry-Based Learning

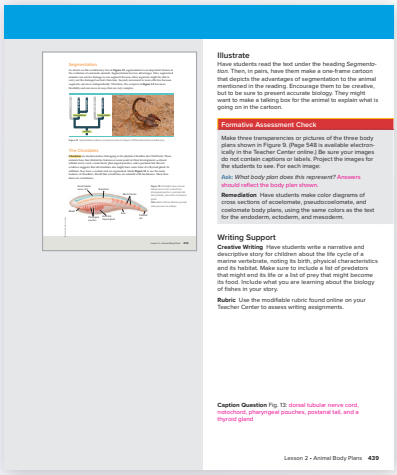
Investigate questions and solve problems from a variety of angles. Inquiry-driven instruction gives students the practice they need to succeed in developing solutions to whatever challenges they may encounter.

## Types of Inquiry Activities

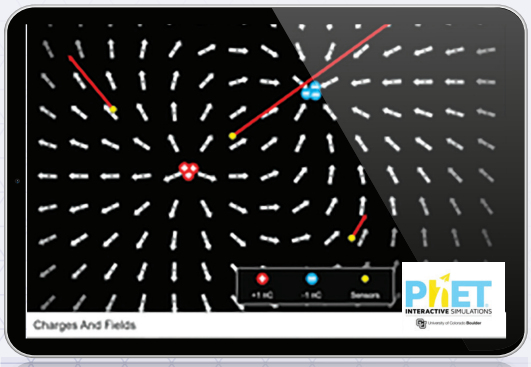
Each course in the High School Series of *Pennsylvania Inspire Science* includes inquiry that builds beyond hands-on activities. With *Pennsylvania Inspire Science*, students will investigate phenomena through several techniques reflective of the way science and engineering are done in the real world.



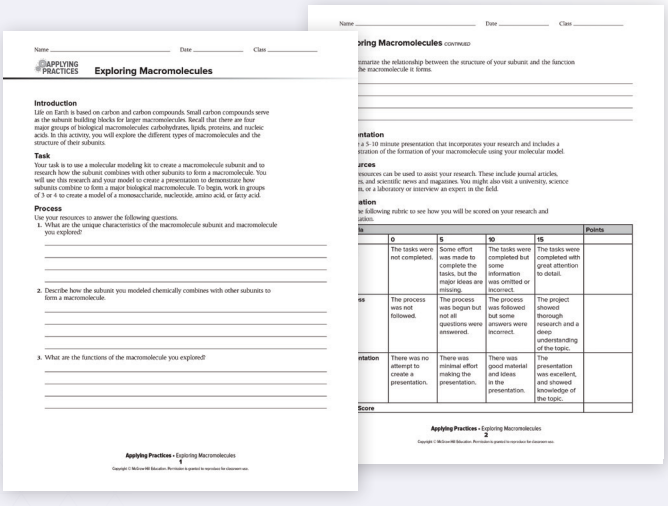

Demonstrations & Hands-on Activities




Engineering




Simulations



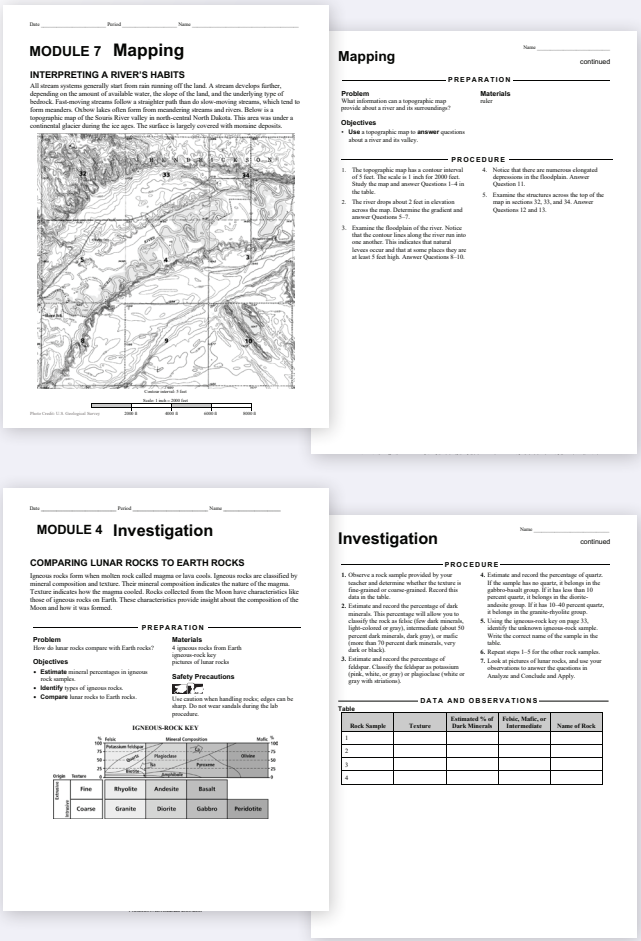

Research

## Hands-On Inquiry

*Pennsylvania Inspire Science* is centered around inquiry. The program provides several opportunities in each module for student exploration.

All inquiry activities in *Pennsylvania Inspire Science* promote student engagement and allow each student to develop inquiry, science, and engineering skills. Activities range from simple investigations to more complex lab explorations, and cover the full range of the inquiry spectrum.

Investigations offer students the ability to quickly dive into a topic with simple questions in single or group settings. Lab activities provide more complex explorations with hands-on approaches to learning.


MODULE 7 Mapping

INTERPRETING A RIVER'S HABITS

Mapping

PREPARATION

PROCEDURE

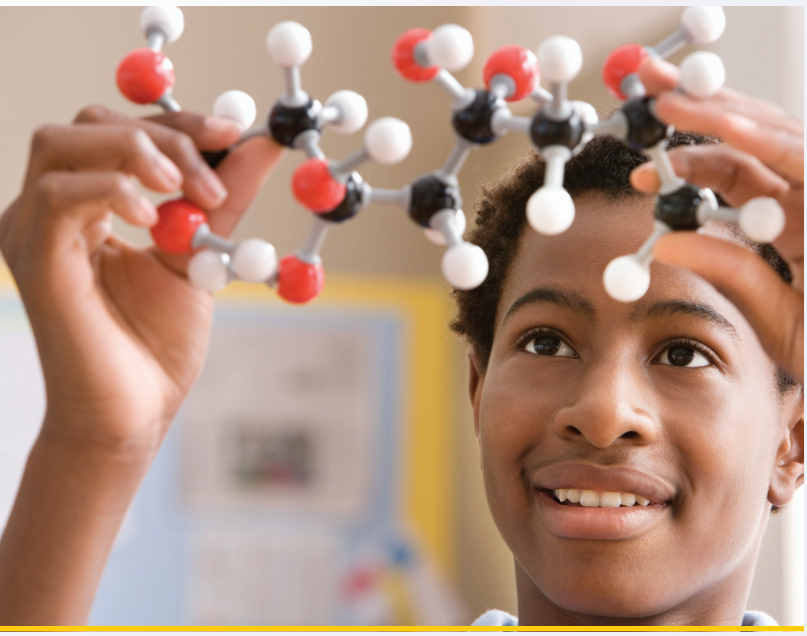
MODULE 4 Investigation

COMPARING LUNAR ROCKS TO EARTH ROCKS

Investigation

PROCEDURE

DATA AND OBSERVATIONS



## The *Pennsylvania Inspire Science* Inquiry Spectrum

Not all inquiry activities are the same. Depending upon the available time and student readiness, structured inquiry might be perfect, or your class may be ready for open inquiry. The *Pennsylvania Inspire Science* **Inquiry Spectrum** provides flexible options to adjust the inquiry level to align with the learning needs of each student.

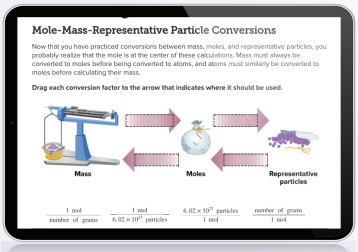
# Teach Your Way With Innovative Digital Resources

Transport students beyond the walls of your classroom with cutting-edge digital content, including interactives, simulations, videos, and more.

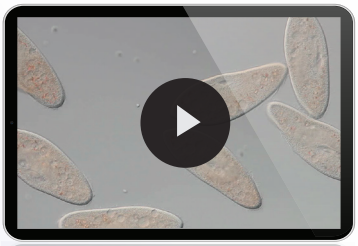
Fun and easy-to-use, these features align with lesson topics to spark scientific curiosity, support discussion, enhance review, and deepen understanding.

## Why Go Online?

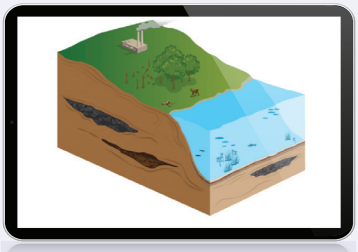
- Engaging Interactive Content
- Science Content Videos
- Text Read Aloud and Highlighting Features
- Dynamic Search Tools



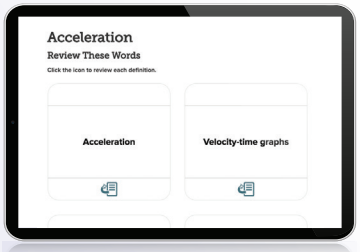

**Drag and Drop activities** offer students the chance to manipulate new concepts.



**Phenomena videos** showcase ultra-engaging, content-related examples of science in real life.

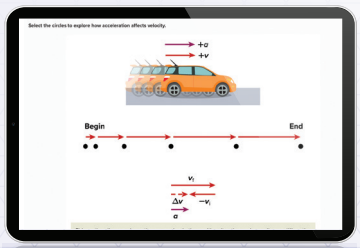


**Simulations** allow students to manipulate variables in a scenario beyond the limits of the classroom.




**Vocabulary flashcards** deliver focused support for key words.


**Infographics** provide an engaging graphic to foster collaborative and hands-on learning in the world surrounding them.

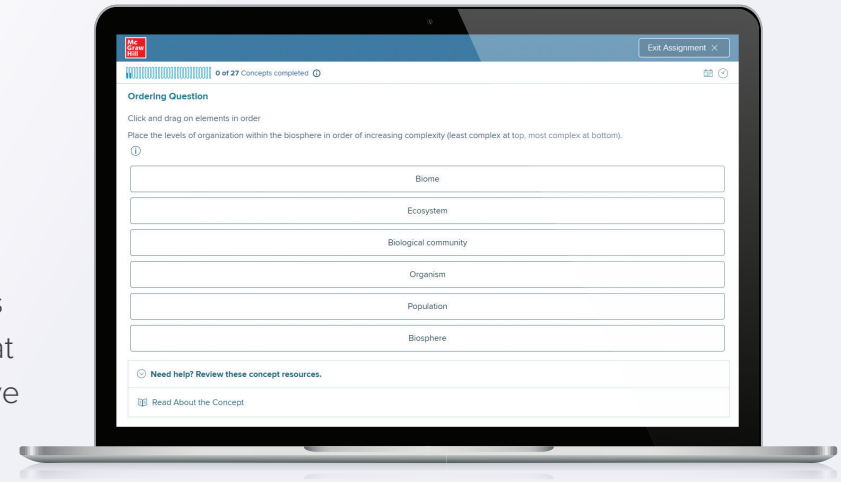



**Interactive Visual Literacy** features prepare students to identify visual representations of scientific phenomena.

# Adaptive Learning With *SmartBook*®

Each student enters the classroom with different strengths, interests, and abilities. Eliminate guesswork and get to the heart of their learning needs with adaptive, comprehensive differentiation.

**The secret is *SmartBook***, the first and only adaptive reading experience designed to change the way students read and learn. As the student progresses, *SmartBook* highlights the most impactful concepts the student needs to learn. When *SmartBook* detects what a student is most likely to forget, that content is presented for review to improve the student's knowledge retention.




See the duration students take to complete the assignment compared to the estimate.

Challenging concepts are revealed as students wrap up assignments, giving teachers the chance to reinforce topics before the next lesson.


Track progress on the assignment as students work through the questions.

Breakdown reporting to the individual student level.

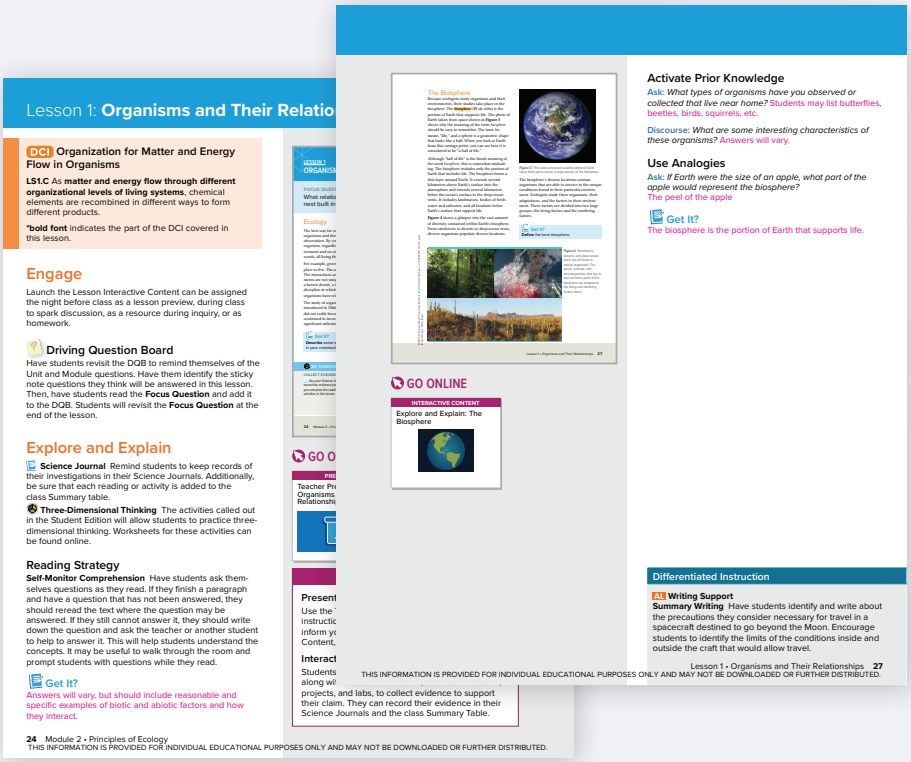
## Real-Time Reporting Tools

Find efficiencies by managing and tracking individual student progress and the progress of the whole class. Teachers can focus on what students don't understand or still need to learn, rather than what they've already mastered.

# Support Every Learner

*Pennsylvania Inspire Science* incorporates the research-based Universal Design Learning Principles to ensure that all students have access to rigorous curriculum.

Support with practical strategies is found at the module and lesson level at multiple points. The Leveled text aligns with the Lexile ranges appropriate for each grade level.




## Differentiated Instruction

Robust differentiation support including guiding questions for different student levels, as well as differentiation guidance is found in the Teacher's Edition. Module and lesson level practice strategies are also found at multiple points.

## English Language Support

*Pennsylvania Inspire Science* applies the best instructional practices for teaching EL students. Each module and lesson have scaffolded activities that offer students of any level of English language proficiency the opportunity to engage in academically challenging science and engineering content while supporting language acquisition.

### EL Support

**ELD PI.9/10.3**

Guide students in negotiating with others in conversations using learned phrases to talk about which time line entry they consider the most significant to ecological discoveries and why.

**EMERGING LEVEL** While pointing and gesturing, model offering opinions and discussing using sentence frames such as: I think number _____ 2 is most significant. Why do you think so? Because the book warned about _____ pollution. Would you say that again? The book warned about pollution.

**EXPANDING LEVEL** Support students in expressing and defending their opinions. Provide sentence frames: I think ____ Number 2 ____is the most significant because _____ the book warned people about pollution. I see your point, but _____ in Number 6, Wangari Maathai won the Nobel prize.

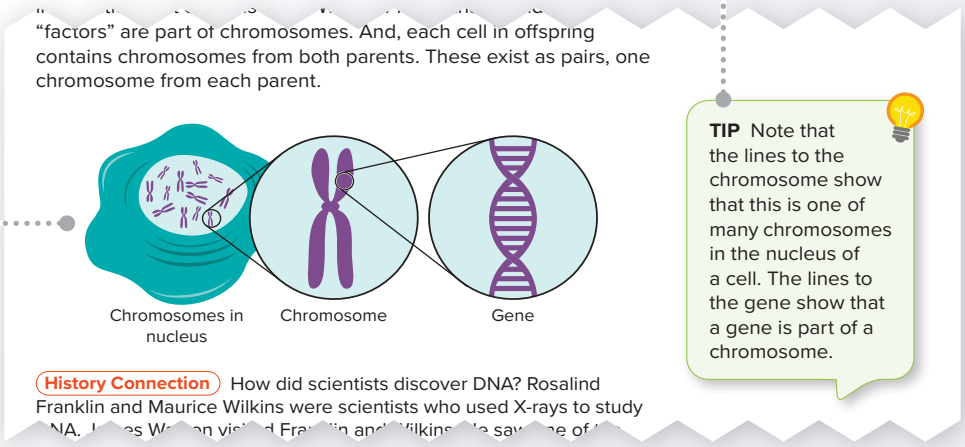
## Supporting Reading Comprehension in Science

*Pennsylvania Inspire Science* empowers all students to succeed in science—no matter their starting point. The Science Reading Essentials for *Inspire Biology* and *Inspire Physical Science* provide reading and writing support for students in need of a little extra help, including:

- Content written two Lexile levels lower than the on-level content
- Teacher tips to provide ample student support

**Tips** and questions throughout the margins of the lesson provide support for students at point of use.

**Reading Essentials** include visual supports to enhance learning for all types of students.



"factors" are part of chromosomes. And, each cell in offspring contains chromosomes from both parents. These exist as pairs, one chromosome from each parent.

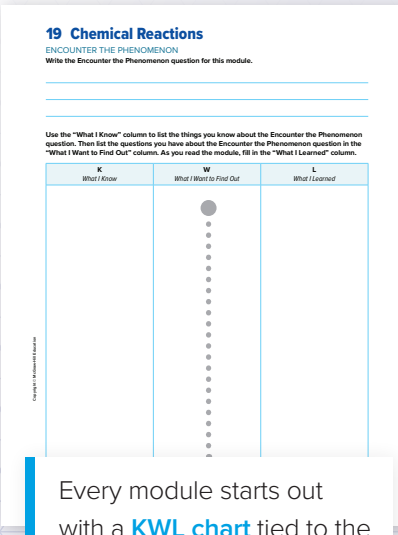
Chromosomes in nucleus | Chromosome | Gene

**History Connection** How did scientists discover DNA? Rosalind Franklin and Maurice Wilkins were scientists who used X-rays to study DNA. [illegible] on visited Franklin and Wilkins [illegible] say [illegible] of

**TIP** Note that the lines to the chromosome show that this is one of many chromosomes in the nucleus of a cell. The lines to the gene show that a gene is part of a chromosome.

## Science Notetaking Support

Note booking is vital to success in the science classroom. The digital Science Notebook is your students' Cornell Notetaking Guide, ensuring they are writing down and keeping track of the important vocabulary, new ideas, and all of the progress along the way!



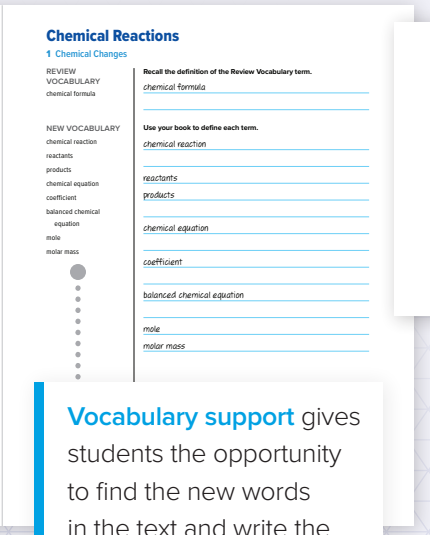
**19 Chemical Reactions**

ENCOUNTER THE PHENOMENON

**Write the Encounter the Phenomenon question for this module.**

**Use the "What I Know" column to list the things you know about the Encounter the Phenomenon question. Then list the questions you have about the Encounter the Phenomenon question in the "What I Want to Find Out" column. As you read the module, fill in the "What I Learned" column.**

| K<br>*What I Know* | W<br>*What I Want to Find Out* | L<br>*What I Learned* |
|---|---|---|
| | | |



**Chemical Reactions**

1 Chemical Changes

REVIEW VOCABULARY
chemical formula

NEW VOCABULARY
chemical reaction
reactants
products
chemical equation
coefficient
balanced chemical equation
mole
molar mass

**Recall the definition of the Review Vocabulary term.**

*chemical formula*

**Use your book to define each term.**

*chemical reaction*

*reactants*

*products*

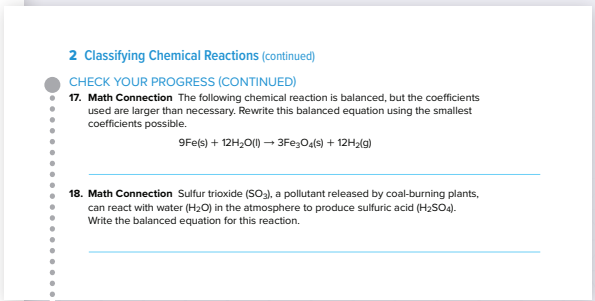
*chemical equation*

*coefficient*

*balanced chemical equation*

*mole*

*molar mass*



**2 Classifying Chemical Reactions** (continued)

CHECK YOUR PROGRESS (CONTINUED)

**17. Math Connection** The following chemical reaction is balanced, but the coefficients used are larger than necessary. Rewrite this balanced equation using the smallest coefficients possible.

$$9Fe(s) + 12H_2O(l) \rightarrow 3Fe_3O_4(s) + 12H_2(g)$$

**18. Math Connection** Sulfur trioxide ($SO_3$), a pollutant released by coal-burning plants, can react with water ($H_2O$) in the atmosphere to produce sulfuric acid ($H_2SO_4$). Write the balanced equation for this reaction.

Every module starts out with a **KWL chart** tied to the new module phenomena.

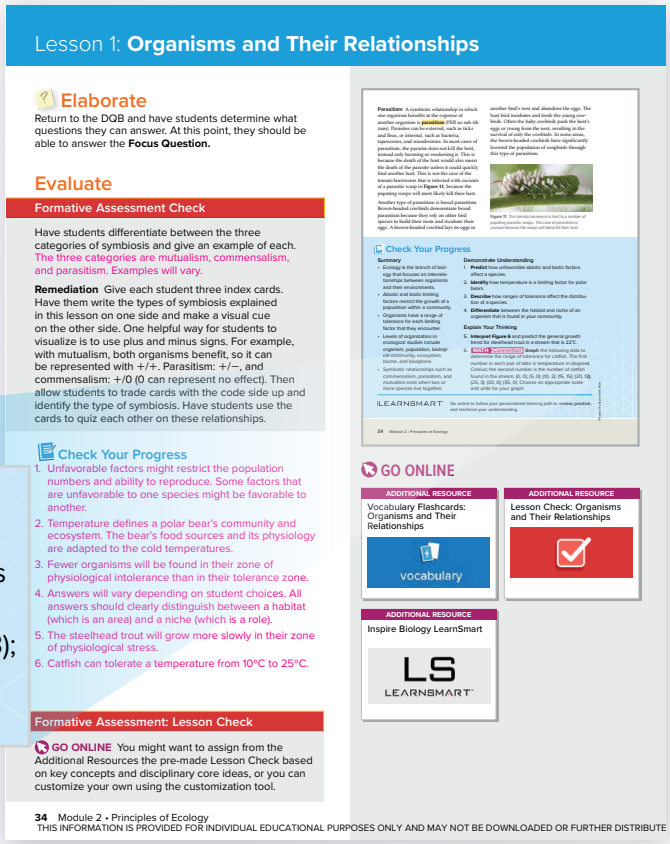
**Vocabulary support** gives students the opportunity to find the new words in the text and write the definitions themselves.

**Check Your Progress** asks questions reflecting on the new content covered in the lesson.

# Cross-Curricular Connections

*Pennsylvania Inspire Science* has been designed to seamlessly integrate science content across disciplines within each course to help students make connections within them.

By integrating Literacy and Mathematics, STEM Careers, and integrated Engineering students approach a single phenomenon from different perspectives.



Lesson 1: **Organisms and Their Relationships**

**Elaborate**

Return to the DQB and have students determine what questions they can answer. At this point, they should be able to answer the **Focus Question.**

**Evaluate**

**Formative Assessment Check**

Have students differentiate between the three categories of symbiosis and give an example of each. The three categories are mutualism, commensalism, and parasitism. Examples will vary.

**Remediation** Give each student three index cards. Have them write the types of symbiosis explained in this lesson on one side and make a visual cue on the other side. One helpful way for students to visualize is to use plus and minus signs. For example, with mutualism, both organisms benefit, so it can be represented with +/+. Parasitism: +/−, and commensalism: +/0 (0 can represent no effect). Then allow students to trade cards with the code side up and identify the type of symbiosis. Have students use the cards to quiz each other on these relationships.

**Check Your Progress**

1. Unfavorable factors might restrict the population numbers and ability to reproduce. Some factors that are unfavorable to one species might be favorable to another.
2. Temperature defines a polar bear's community and ecosystem. The bear's food sources and its physiology are adapted to the cold temperatures.
3. Fewer organisms will be found in their zone of physiological intolerance than in their tolerance zone.
4. Answers will vary depending on student choices. All answers should clearly distinguish between a habitat (which is an area) and a niche (which is a role).
5. The steelhead trout will grow more slowly in their zone of physiological stress.
6. Catfish can tolerate a temperature from 10°C to 25°C.

**Formative Assessment: Lesson Check**

GO ONLINE You might want to assign from the Additional Resources the pre-made Lesson Check based on key concepts and disciplinary core ideas, or you can customize your own using the customization tool.

34 Module 2 • Principles of Ecology





Check Your Progress

GO ONLINE

ADDITIONAL RESOURCE
Vocabulary Flashcards: Organisms and Their Relationships
vocabulary

ADDITIONAL RESOURCE
Lesson Check: Organisms and Their Relationships

ADDITIONAL RESOURCE
Inspire Biology LearnSmart
LEARNSMART

**MATH Connection** **Graph** the following data to determine the range of tolerance for catfish. The first number in each pair of data is temperature in degrees Celsius; the second number is the number of catfish found in the stream: (0, 0); (5, 0); (10, 2); (15, 15); (20, 13); (25, 3); (30, 0); (35, 0). Choose an appropriate scale and units for your graph.

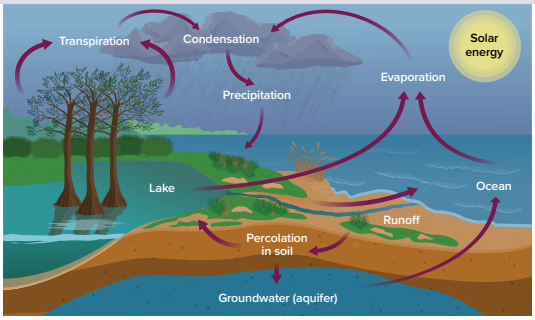



**Figure 18** The water cycle is the process by which water is continuously cycled through the biosphere.

**The water cycle**

Water moves through the biosphere through the water cycle, shown in **Figure 18.**

EARTH SCIENCE Connection Energy from the Sun causes water to constantly evaporate from the Earth's surface. Water enters the atmosphere in a form called water vapor. Approximately 90 percent of water vapor evaporates from oceans, lakes, and rivers; about 10 percent evaporates from the surfaces of plants through a process called transpiration. Clouds form when water vapor rises, cools, and condenses into droplets around dust particles in the atmosphere. Water falls from clouds to the Earth's surface as precipitation in forms such as rain or snow. Some surface water percolates, or moves through, the soil, and enters groundwater. Other water flows over the Earth's surface as runoff, and enters streams, rivers, lakes, and oceans. The cycle then continues.

**Get It?**
**Identify** three processes in the water cycle.

CCC CROSSCUTTING CONCEPTS
**Systems and Systems Models** Describe the boundaries and specifications for a model of an ecosystem at your school. How do the parameters of your model help make it useful? Write the specifications into a proposal for the model.

STEM CAREER Connection
**Water Resource Engineer**
Civil engineers who create systems that ensure that people have a continuous supply of clean, uncontaminated water are called water resource engineers.

40 Module 2 • Principles of Ecology



**EARTH SCIENCE Connection** Energy from the Sun causes water to constantly evaporate from the Earth's surface. Water enters the atmosphere in a form called water vapor. Approximately 90 percent of water vapor evaporates from oceans, lakes, and rivers; about 10 percent evaporates from the surfaces of plants through a process called transpiration. Clouds form when water vapor rises, cools, and condenses into droplets around dust particles in the atmosphere. Water falls from clouds to the Earth's surface as precipitation in forms such as rain or snow. Some surface water percolates, or moves through, the soil, and enters groundwater. Other water flows over the Earth's surface as runoff, and enters streams, rivers, lakes, and oceans. The cycle then continues.


INTRODUCTION

**Defining STEM**

Television, radio, magazines, and Web sites are flooded with advertisements and headlines that all fight for your attention. Some try to pull you in with amazing claims: *Lose 25 pounds in 2 days! Giant meteorite headed for Earth! New "wonder fruit" cures the common cold!* They might seem to have scientific data to back them up. To decide whether the product is worth your money or whether the claim is valid, you need to examine the data that can tell you the truth. Thinking logically about sensational statements can keep you from wasting your time–and sometimes your money.

The fields of science, technology, engineering, and mathematics, known as STEM, all involve careful collection of data and logical thinking. The microscope shown below is technology, which was engineered through careful mathematical calculations and based on scientific knowledge of lenses. Because STEM is a part of your daily life, learning to analyze and evaluate–and being able to think logically–are important. This handbook will help you become familiar with the methods that scientists, engineers, and mathematicians use.



**Go Online** to find the Science and Engineering Handbook to learn more about each of the eight SEPs.

## Integrated Engineering

*Pennsylvania Inspire Science* High School Series supports teachers and students with the integration of engineering into the science curriculum. For broad support, teachers and students can access the Science and Engineering Handbook, which provides simple, approachable descriptions of science and engineering practices. Students can also practice these skills as they read through the handbook.

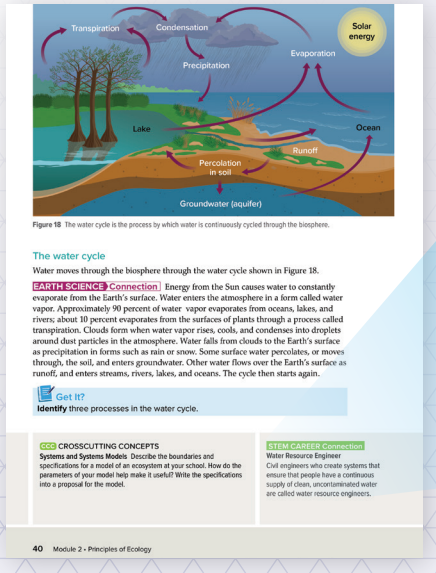



**Figure 18** The water cycle is the process by which water is continuously cycled through the biosphere.

The water cycle

Water moves through the biosphere through the water cycle shown in Figure 18.

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Get It?
**Identify** three processes in the water cycle.

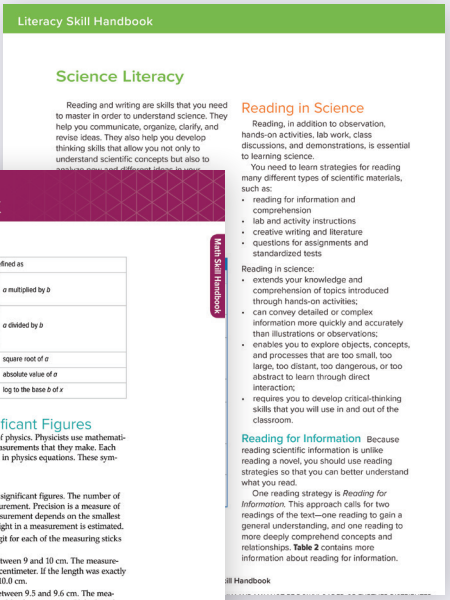
CCC CROSSCUTTING CONCEPTS
**Systems and Systems Models** Describe the boundaries and specifications for a model of an ecosystem at your school. How do the perimeters of your model help make it useful? Write the specifications into a proposal for the model.

STEM CAREER Connection
Water Resource Engineer
Civil engineers who create systems that ensure that people have a continuous supply of clean, uncontaminated water are called water resource engineers.

40 Module 2 • Principles of Ecology

## Math and Literacy

*Pennsylvania Inspire Science* High School Series supports students with literacy and math access through the Literacy Handbook and the Math Handbook. Each of these handbooks provides background information, student support, and examples that get students ready to make the connections they need to science.


Literacy Skill Handbook

Science Literacy

Reading and writing are skills that you need to master in order to understand science. They help you communicate, organize, clarify, and revise ideas. They also help you develop thinking skills that allow you not only to understand scientific concepts but also to

Reading in Science

Reading, in addition to observation, hands-on activities, lab work, class discussions, and demonstrations, is essential to learning science.

You need to learn strategies for reading many different types of scientific materials, such as:

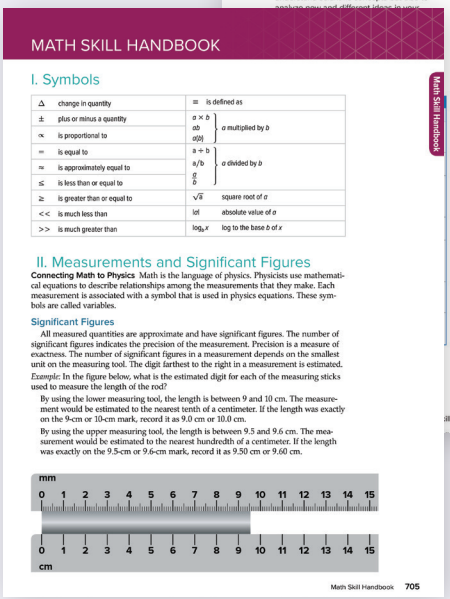
- reading for information and comprehension
- lab and activity instructions
- creative writing and literature
- questions for assignments and standardized tests

Reading in science:

- extends your knowledge and comprehension of topics introduced through hands-on activities;
- can convey detailed or complex information more quickly and accurately than illustrations or observations;
- enables you to explore objects, concepts, and processes that are too small, too large, too distant, too dangerous, or too abstract to learn through direct interaction;
- requires you to develop critical-thinking skills that you will use in and out of the classroom.

Reading for Information Because reading scientific information is unlike reading a novel, you should use reading strategies so that you can better understand what you read.

One reading strategy is *Reading for Information*. This approach calls for two readings of the text—one reading to gain a general understanding, and one reading to more deeply comprehend concepts and relationships. **Table 2** contains more information about reading for information.


MATH SKILL HANDBOOK

I. Symbols

| | | | |
|---|---|---|---|
| Δ | change in quantity | = | is defined as |
| ± | plus or minus a quantity | $a \times b$, $ab$, $a(b)$ | $a$ multiplied by $b$ |
| ∝ | is proportional to | | |
| = | is equal to | $a \div b$, $a/b$, $\frac{a}{b}$ | $a$ divided by $b$ |
| ≈ | is approximately equal to | | |
| ≤ | is less than or equal to | | |
| ≥ | is greater than or equal to | $\sqrt{a}$ | square root of $a$ |
| << | is much less than | $\lvert a \rvert$ | absolute value of $a$ |
| >> | is much greater than | $\log_b x$ | log to the base $b$ of $x$ |

II. Measurements and Significant Figures

**Connecting Math to Physics** Math is the language of physics. Physicists use mathematical equations to describe relationships among the measurements that they make. Each measurement is associated with a symbol that is used in physics equations. These symbols are called variables.

Significant Figures

All measured quantities are approximate and have significant figures. The number of significant figures indicates the precision of the measurement. Precision is a measure of exactness. The number of significant figures in a measurement depends on the smallest unit on the measuring tool. The digit farthest to the right in a measurement is estimated.

*Example:* In the figure below, what is the estimated digit for each of the measuring sticks used to measure the length of the rod?

By using the lower measuring tool, the length is between 9 and 10 cm. The measurement would be estimated to the nearest tenth of a centimeter. If the length was exactly on the 9-cm or 10-cm mark, record it as 9.0 cm or 10.0 cm.

By using the upper measuring tool, the length is between 9.5 and 9.6 cm. The measurement would be estimated to the nearest hundredth of a centimeter. If the length was exactly on the 9.5-cm or 9.6-cm mark, record it as 9.50 cm or 9.60 cm.



Math Skill Handbook 705

**Go Online** to find the Math and Literacy Handbook.

**STEM Career Connections** allow students to connect with science by seeing potential career paths, as well as how what they're studying connects to the real world.

# Bring Science to Life

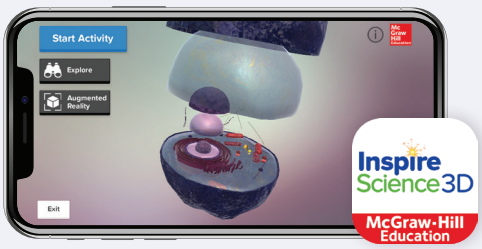
*Pennsylvania Inspire Science* transports students beyond the walls of your classroom with cutting-edge digital content, including interactives, simulations, videos, and more.

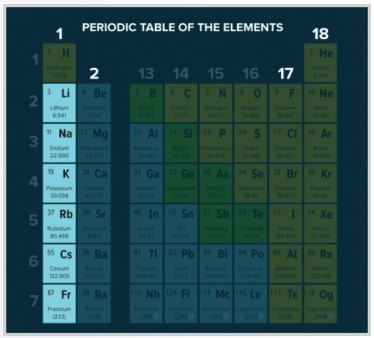
Fun and easy-to-use, these features align with lesson topics to spark scientific curiosity, support discussion, enhance review, and deepen understanding.

## Student Advantages

### Simulations

Simulations offer a chance to experience real-life scenarios that depict true events. These proven tools improve learning and create safe and engaging learning environments where failure is possible–something that is often missed when students are learning.

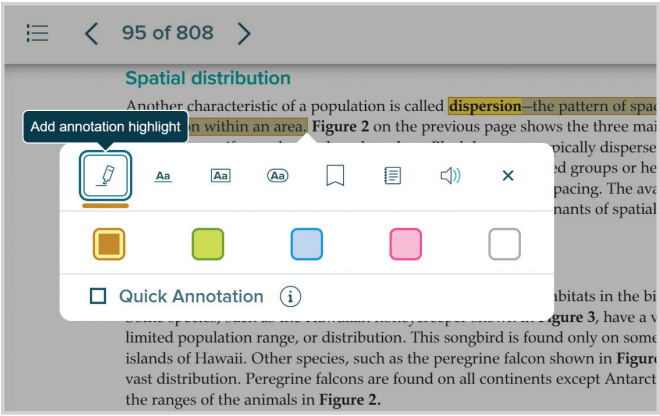




### *Inspire Science* 3D App

The *Inspire Science* 3D application provides students the ability to explore through the wonders of augmented virtual reality and provides students the opportunity to engage with science topics in a 3D environment rather than just a 2D image found on a page.

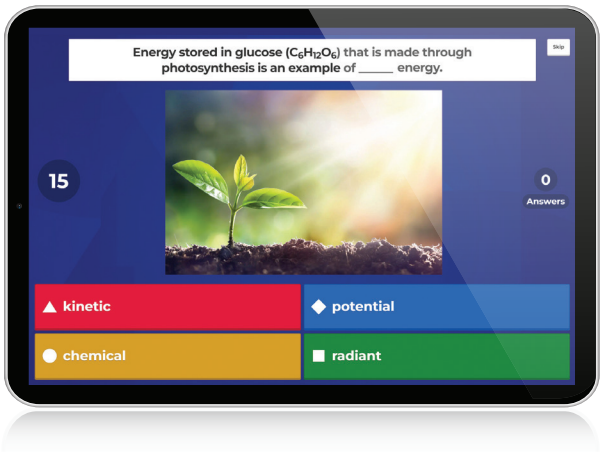
### Poptips Plus

Poptips Plus is an interactive tool with a single image or an array of text and images with markers that define clickable hot spots. This engaging resource allows students to interact with images and connect them to related information to support understanding of core content.



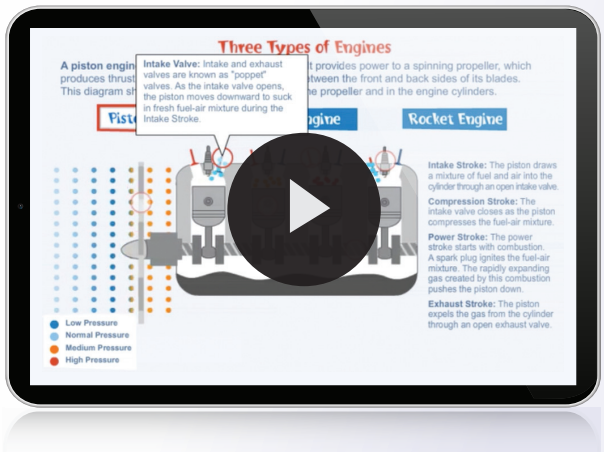

## Interactive Text

Engage students in online literacy learning with tools like text-to-speech, note-taking, and text highlighting, and text highlighting. Interacting with learning creates a dynamic experience that's more engaging and will improve student learning and retention.



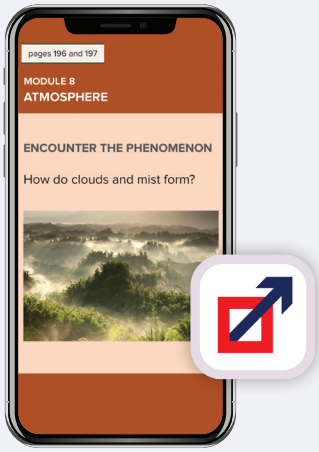

## Kahoot!

Help students review important material in an engaging way with fun, game show-like quizzes using Kahoot!




## Videos

Enhance teaching and learning with videos that reinforce concepts and spark discussion. Videos encourage students to hone their analytical skills by analyzing media using the theories and concepts they are studying while experiencing worlds beyond their own.



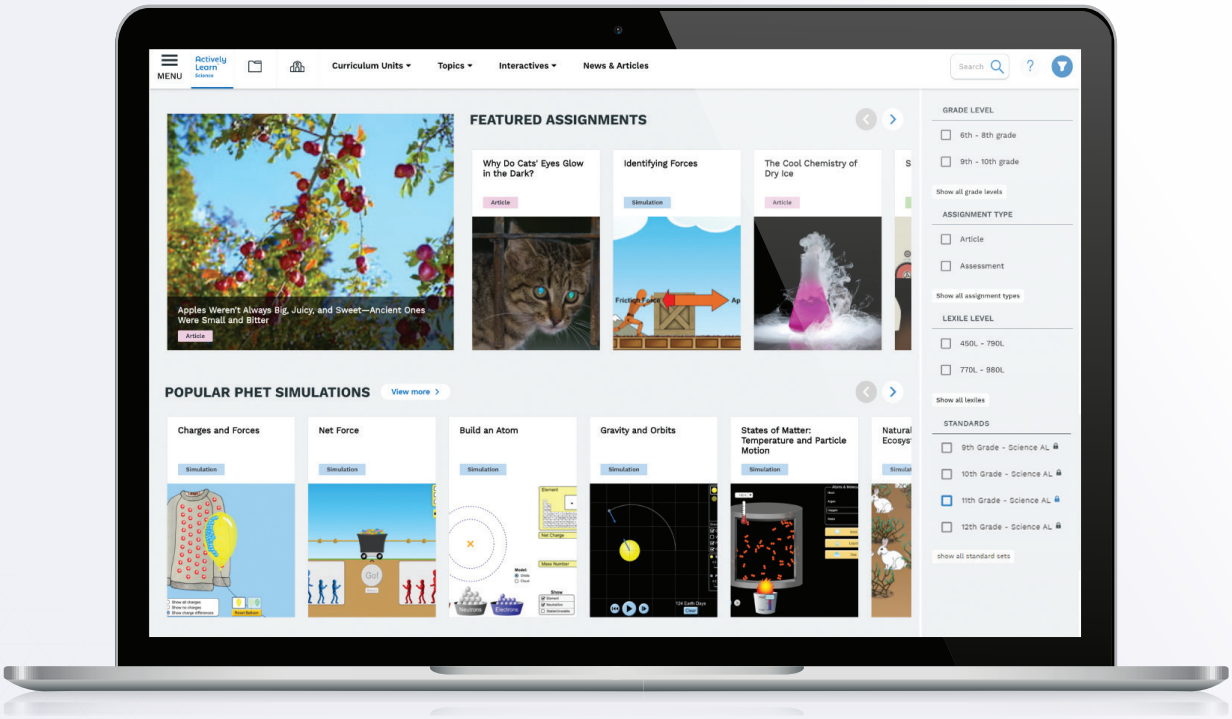

## McGraw Hill K–12 Portal App

Students can access their content anywhere, any time, on any device—with or without internet access—using the McGraw Hill K–12 Portal App.

# Drive Deeper Science Learning With *Actively Learn*

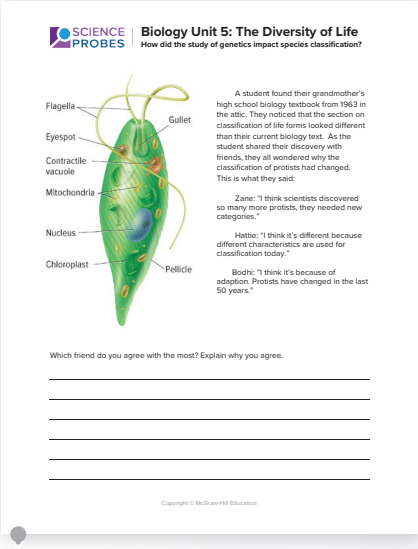
As educators, we know how important it is to keep students engaged.

That's why each *Pennsylvania Inspire Science* module and lesson is designed to tap into students' natural curiosity about the world around them through the investigation of real-world phenomena. Student engagement is further fueled through an innovative digital experience, and connections to real-world applications.




- **Engaging, relevant, standards-based content** for all learners
- **Science texts, articles, and videos** at each student's level
- **Inquiry-driven science simulations** that bring natural phenomena to life
- **Interactive reading and study aids** that promote active collaboration
- **Rich, cross-curricular connections** to literature and history
- **Powerful tools** that let teachers customize content or upload their own
- **Access to student data** to inform instructional decisions

# Fuel Student Engagement Using the World Around Them


SCIENCE PROBES | Biology Unit 5: The Diversity of Life
How did the study of genetics impact species classification?




A student found their grandmother's high school biology textbook from 1963 in the attic. They noticed that the section on classification of life forms looked different than their current biology text. As the student shared their discovery with friends, they all wondered why the classification of protists had changed. This is what they said:

Zane: "I think scientists discovered so many more protists, they needed new categories."

Hattie: "I think it's different because different characteristics are used for classification today."

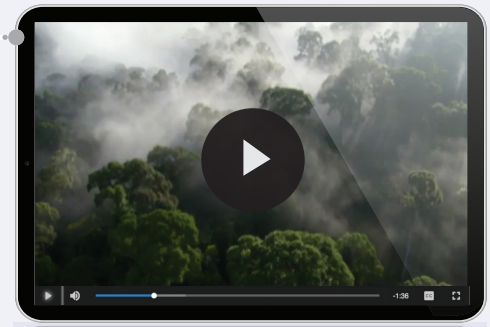
Bodhi: "I think it's because of adaption. Protists have changed in the last 50 years."

Which friend do you agree with the most? Explain why you agree.



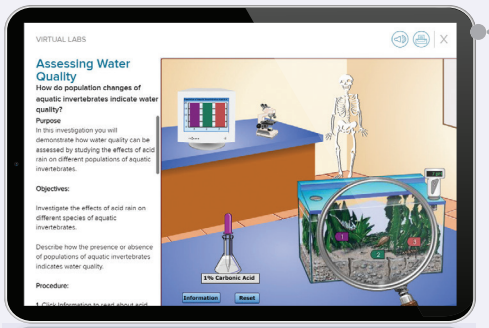
## Science Probes

Science Probes are module launch questions centered around relevant phenomena designed to interest and get students talking about their ideas. When students do the talking, it is evidence that they are thinking and provides you an avenue to uncover and resolve commonly-held preconceptions or misconceptions.



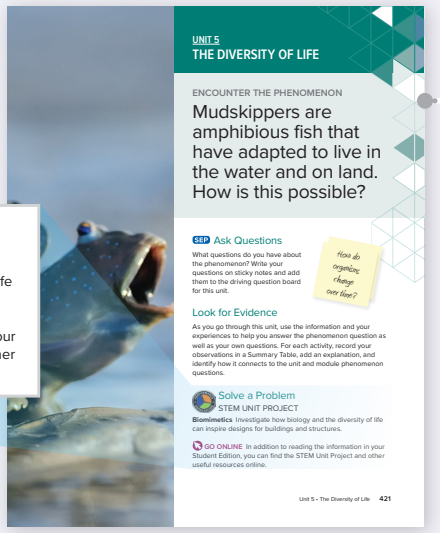
## Visualizing Phenomena in Action

Encounter the Phenomenon Videos enable students to observe scientific topics in action, providing a visual experience that encourages thinking and collaborative conversations.




## Virtual Investigations

Extend experiments beyond the classroom setting. With Virtual Lab, students have an engaging, alternative, digital interaction to interact with an experiment.


UNIT 5
THE DIVERSITY OF LIFE

ENCOUNTER THE PHENOMENON
Mudskippers are amphibious fish that have adapted to live in the water and on land. How is this possible?

SEP Ask Questions
What questions do you have about the phenomenon? Write your questions on sticky notes and add them to the driving question board for this unit.

How do organisms change over time?

Look for Evidence
As you go through this unit, use the information and your experiences to help you answer the phenomenon question as well as your own questions. For each activity, record your observations in a Summary Table, add an explanation, and identify how it connects to the unit and module phenomenon questions.

Solve a Problem
STEM UNIT PROJECT
**Biomimetics** Investigate how biology and the diversity of life can inspire designs for buildings and structures.

GO ONLINE In addition to reading the information in your Student Edition, you can find the STEM Unit Project and other useful resources online.

Unit 5 • The Diversity of Life 421

Solve a Problem
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## STEM Unit Projects

Students assume the role of a scientist or engineer and are charged with the task of designing a solution in the STEM Unit Project. Each project relates to a specific standard correlating to the unit.

# Pennsylvania Assessment Strategies

*Pennsylvania Inspire Science* includes a variety of assessment options to support teachers with differentiation strategies and support students on their journey to mastery of the Pennsylvania STEELS Standards and culminating with success on the End of Course Assessment and the ACT.

## Formative Assessment

Formative assessment, embedded at many points throughout each module and lesson, facilitates student reflection on their thinking (metacognition) and allows teachers to dynamically differentiate instruction. The table below shows the types of formative assessment resources in *Pennsylvania Inspire Science* found online and in print.

| FEATURE | INSTRUCTIONAL PURPOSE |
|---|---|
| **Science Probes** | Found at the beginning of each unit in the online resources, Science Probes reveal student preconceptions to guide instruction. |
| **Claim, Evidence, Reasoning** | With the CER Framework (Claim, Evidence, Reasoning) students will make claims and document their reasoning during the EXPLORE phase and add evidence and adjust their claims as needed later in the lesson. |
| **Three-Dimensional Thinking Questions** | Students will encounter questions that address the 3 dimensions of the Pennsylvania STEELS Standards check progress with the SEPs, DCIs, CCCs, and Performance Expectations. |
| **Applying Practices** | Within each lesson you will find Applying Practices Projects to help you apply the Science and Engineering Practices and build understanding of the Disciplinary Core Ideas so that you can complete each STEM Unit Project. |

## Summative Assessment

Summative assessment tools at the module and lesson level help ensure lasting learning and alignment of student skills to the Performance Expectations with the following summative assessment tools found in *Pennsylvania Inspire Science* in print Student Editions and online.

| FEATURE | INSTRUCTIONAL PURPOSE |
|---|---|
| **Module Pretest** | The Module Pretests, found at the beginning of each module, assess prerequisite knowledge of Disciplinary Core Ideas from prior grades to evaluate student readiness are ready for the module. |
| **Three-Dimensional Thinking Questions** | At the end of the lessons, students will demonstrate their understanding of at least two of the three dimensions of Pennsylvania STEELS Standards to develop three-dimensional thinking skills. |
| **Lesson Check** | Found in every lesson online, Lesson Checks determine how students are building a progression of learning toward the performance expectations. |
| **Module Test** | Found at the end of each module online, Module Tests evaluate student proficiency against the performance of the module with multiple choice, extended response, constructed response, and performance-task items. |
| **STEM Unit Project** | With each STEM Module Project, found at the end of each module, students will complete performance-based rubrics and answer summative questions to demonstrate how they've applied their knowledge and understanding of the performance expectations to their project. |
| **Module Vocabulary Practice** | Through online interactives, students practice and check their understand of science language. Immediate feedback from the system provided! |

# Three-Dimensional Assessment Guide

Organized by the *Pennsylvania Inspire Science* High School Series scope and sequence for each program, the Three-Dimenional State Assessment Guide provides guided and independent practice for both discrete items and performance tasks with teacher support for each. Also included are standards alignment correlations, DOK levels, evidence statements, answer keys with rationale for correct and incorrect answers, and scoring rubrics for performance tasks.

Use this guide in your classroom in a variety of ways to meet the needs of your students.

- ✓ Use the Guided Practice and Practice sections prior to a Module Test to provide extra support or as preassessment to serve as a benchmark.
- ✓ Use the Guided Practice and Practice sections after a Lesson Check, but prior to a Module Test for remediation.
- ✓ Choose an approach by administering the Guided Practice section first and then give students the Practice section.

# Seamless Integration Services

We are proud to work with schools across Pennsylvania to implement our programs into a range of classroom environments using different platforms. Both our Integration team and our Digital Technical Support team are ready to support you and your implementation.

To learn more, visit **mheducation.com/pennsylvania**.

Google Classroom

Clever

PowerSchool

CANVAS BY INSTRUCTURE

schoology

# Preparing Students for the ACT

*Pennsylvania Inspire Science* is an inquiry-based program that leads students to be able to think, reason, and problem solve. The science portion of the ACT measures the interpretation, analysis, evaluation, reasoning, and problem solving skills.

## Interpretation of Data 40–50%

Applying Practices, Go Further Activities, and Practice Problems all give students opportunities to interpret data to answer questions.

## Scientific Investigation 20–30%

With well over 100 Labs, Projects, and Demos in the *Pennsylvania Inspire Science* program, students will have a thorough understanding of experimental tools, procedures, and design and compare, extend, and modify experiments.

## Evaluation of Models, Inferences, and Experimental Results 25–35%

With real-world articles and data, students are able to make inferences, think critically and problem solve.

# Continued Professional Learning

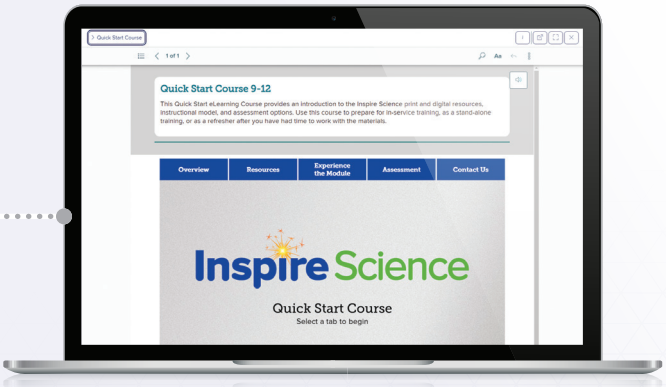
## Professional Development

We know it can be a challenge to implement a new science program with new standards. That's why *Pennsylvania Inspire Science* comes with a library of relevant, self-paced, professional learning videos and modules to support you from implementation through instructional progression and mastery, all available 24/7, from any device.

### Program Implementation Support

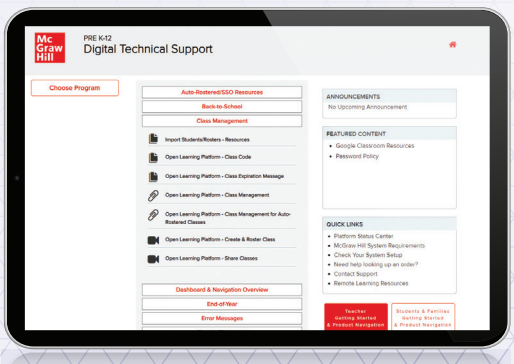
Implementation support provides everything you need to know to get up to speed on the first day of school.

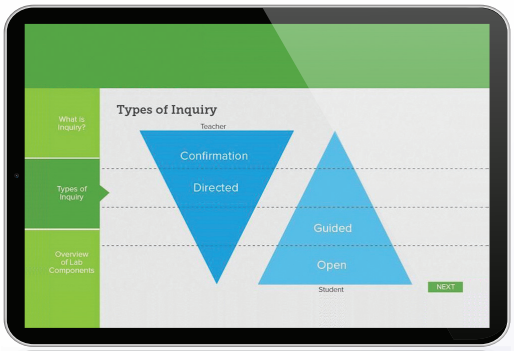
**Quick Start Videos** explain program basics to help get you started.

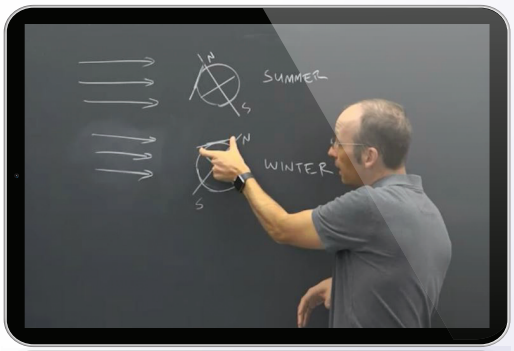



### Digital Platform Support

In the Technical Support Resource Library, you will find step-by-step instructions for each of your digital tools to help you feel confident planning, teaching, and assessing in the digital experience. Step-by-step instructions for each of your digital tools help you feel confident planning, teaching, and assessing with digital.



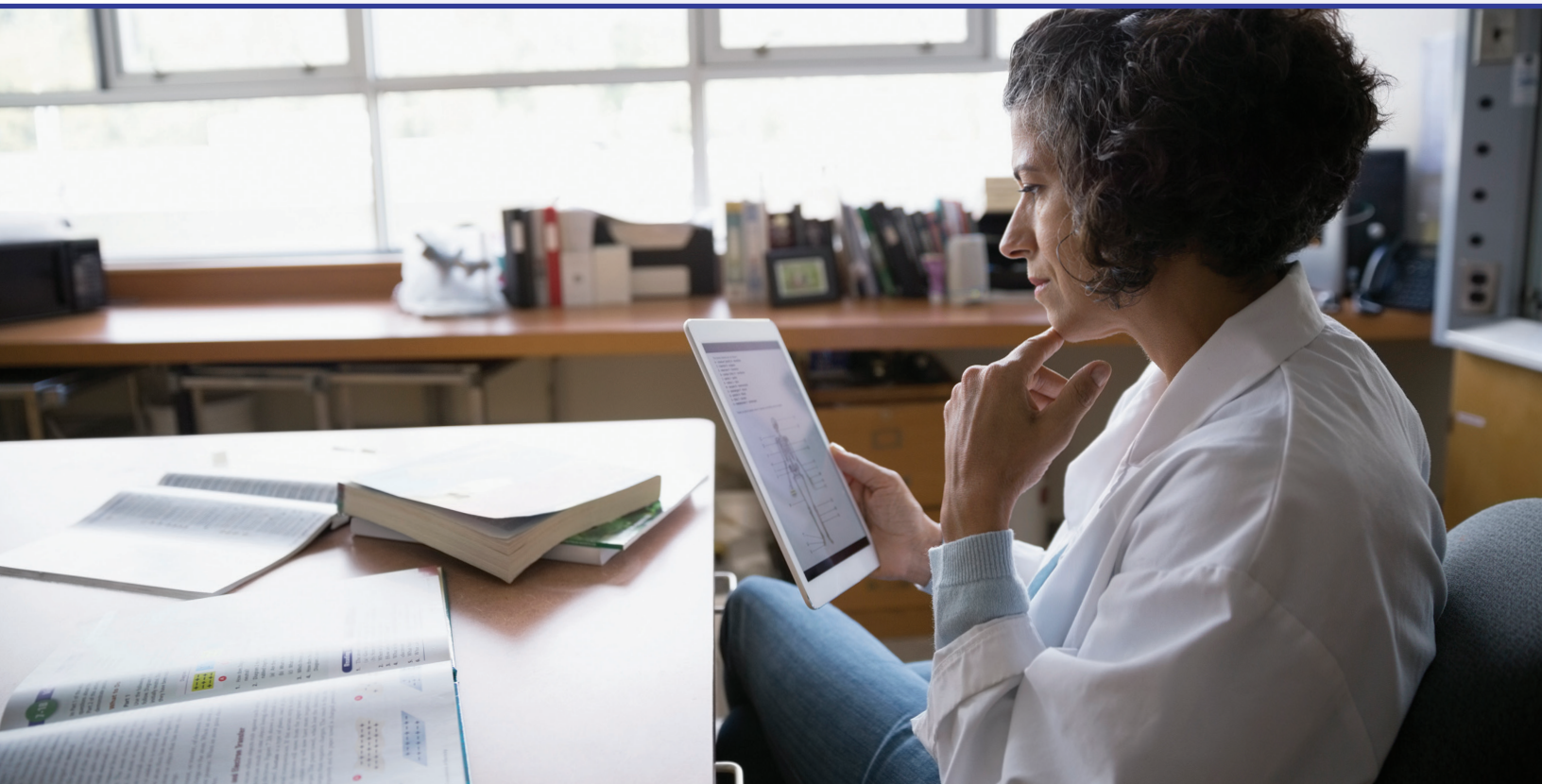



## Ongoing Pedagogy Support

With *Pennsylvania Inspire Science*, you will find a wide range of resources on key instructional and pedagogical topics, including videos from our program authors and consultants.

- **STEM Classroom Videos** model lessons from real classrooms
- **Science Preconceptions Videos** review common preconceptions and strategies to overcome them
- **Instructional Coaching Videos** discuss best practice strategies and the "Why" behind the success
- **Teacher Activity Videos** show planning tips and expected results to help with hands-on activity time
- **Science Pedagogy Micro-Courses** provide facilitation guides for both self-guided or small group courses



Pennsylvania

# Inspire Science

Learn more at
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