

Principles of
**Environmental
SCIENCE**

Inquiry & Application

High School Edition

**OVERVIEW AND DIGITAL
REVIEW GUIDE**

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Principles of Environmental Science, High School Edition

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A Current and Applied Approach, Aligned with Alabama Success

Crafted specifically for a high school environmental science course, *Alabama Principles of Environmental Science: Inquiry & Application* is true to its title with an up-to-date, introductory view of the essential themes of the course and numerous opportunities for students to practice scientific thinking and active learning. Accessible pedagogical tools lead students to apply science and engineering practices, work with real-world data, and better understand environmental science and all of its complexities.

Presented in a single-column format for optimal readability and organized into four units with scientific and engineering practice integration, this feature-rich program was designed to support student success.

- Unit Projects, Case Studies, Data Analysis Labs, and Use the Practice activities apply science and engineering practices to real-world issues related to the field of study.
- Chapter Case Studies and Claim, Evidence, Reasoning boxes prompt students to develop and research their own claim to enhance investigation and reasoning skills.
- Math Connection provides opportunities to practice quantitative and computational thinking skills.
- Realistic, three-dimensional, instructional figures provide depth and orientation to complex structures and processes.
- The Teacher Manual, available in print and online, includes teaching strategies, pacing, activities with differentiated instruction, and EL and visual-literacy support.

UNIT 2

Ecology and the Natural World



Healthy environment: How do we solve complex problems?

Global challenges are often too large and complex to address as a single problem. When viewed as collections of challenges that are smaller in scope, the grander problems can feel more approachable, with solutions more achievable. Some solutions might need simultaneous implementation, while others might need to be completed in a step-wise fashion.

GO ONLINE to break down one of the many marine challenges currently facing society into a more manageable problem. In this project, you will break down a complex real-world problem facing the marine environment into sub-problems and identify their stakeholders and constraints through research.

Environmental Career Focus: Ecologist

During your education, have you found yourself specifically interested and curious about how life is intricately connected to other organisms and the environment around it? For example, if you have wondered how a chameleon has evolved very specific defense mechanisms that allow it to change the color of its body to match the immediate environment around it, you may enjoy studying ecology. Evolution, species interactions, biodiversity, and population dynamics are a few of the topics that ecologists study. Ecologists work in fields such as environmental consulting, education, and public service. Students interested in ecology benefit from the pursuit of a bachelor's degree in areas such as biology, chemistry, and environmental science. Filling the role as a volunteer or student assistant in a lab are great ways to learn about the practical application of ecology and to gain experience in the field.

Charles Darwin is considered by some to be the greatest biologist and contributor to ecology that we know. From his experiences on the famous HMS *Beagle* voyage, Darwin developed the theory of evolution through natural selection. Darwin's story is an excellent testament to the inherent necessity of observation required in ecology.

GO ONLINE to explore more environmental science careers with the Career Focus Inquiry Activities.

Chapter 3 Environmental Systems: Matter, Energy, and Life

Chapter 4 Evolution, Species Interactions, and Biological Communities

Chapter 5 Human Populations

Chapter 6 Biomes and Biodiversity

Putting Scientific Thinking Into Practice

Unit Projects are an opportunity for students to apply the science and engineering practices to real-life problems related to environmental science to understand the impacts on their own lives and how scientists study complex problems.

Environmental Career Focus


Career Focus features invite students to explore career options related to environmental science. Online focus activities allow students to explore career options in more depth.

Enhanced Pedagogy and Student Support

Each chapter begins with a **Case Study**. This allows students to encounter a phenomenon related to the chapter at hand, links to an online Claim, Evidence, Reasoning chart, and is revisited as part of the Chapter Review. As part of the Case Study, students are asked to make a claim, collect evidence, and explain their reasoning.

CHAPTER 3

Environmental Systems: Matter, Energy, and Life



Case Study: Death by Fertilizer: Hypoxia in the Gulf of Mexico

Crosscutting Concepts: Stability and Change

In the 1980s, fishing crews began observing large areas in the Gulf of Mexico, near the Mississippi River delta, that were nearly devoid of aquatic life in early summer (Fig. 3.1). This region supports shrimp, fish, and oyster fisheries worth \$250 to \$450 million per year and the "dead zone" was an economic disaster, as well as an ecological one. Marine biologists suspected that the Gulf ecosystem was collapsing because of oxygen deprivation.

To evaluate the problem, marine scientist Henry Rabalais began mapping areas of low oxygen concentrations along the Louisiana coast in 1985. Every summer since then, the fish had found vast areas with oxygen concentrations below 2 parts per million (ppm). At 2 ppm, nearly all aquatic life, other than microorganisms and prawn worms, is eliminated. In 2017 the

Gulf's hypoxic (oxygen-starved) area was the largest ever, at 22,750 km² (8,776 mi²), an area the size of New Jersey.

What causes this huge dead zone? The summer periods of anoxic, viable (if not toxic) ponds and city parks, is responsible. Eutrophication is the explosive growth of phytoplankton (the floating algae and bacteria) that occur when excess nutrients become available. Normally, scarcity of nutrients limits algae, but a flush of nutrients allows explosive growth. The algae and phytoplankton then die and decay. During the decay process, decomposers use up nearly all the available oxygen, especially near the seabed where dead matter falls and collects. Rabalais and his team observed that each year, 7 to 10 days after large spring rains in the freshwater of the upper Mississippi watershed,

oxygen concentrations in the Gulf would drop from 5 ppm to less than 2 ppm. Spring rains are known to wash nutrient-rich soil, organic debris, and herbicides from farm fields. Pulses of agricultural runoff into the Gulf are followed by a profuse growth of algae and phytoplankton, which adds to the problem. Normally, shrimp, clams, oysters, and other filter feeders consume the debris, but they can't keep up with the sudden flood of nutrient-laden, decomposing bacteria in the sediment nearby and consume the dead material, using up most of the dissolved oxygen in the water near the seabed.

Decaying sediments also produce hydrogen sulfide, which further poisons the water near the seabed.

In well-oiled water bodies, such as the open ocean, oxygen from the surface mixes down into lower layers. But warm, polluted water bodies like the Gulf are often stratified. Abundant sunlight keeps the upper layers warmer and less dense than the lower, cold, darker layers. In states of depth, and fresh oxygen from the surface can't mix downward. Fish may be able to swim away from the hypoxic zone, but bottom dwellers often struggle die. Mismanaged fish kills are also associated with hypoxia in enclosed waters.

Fish observed in the 1990s, dead zones now occur along the coast of nearly every major populated coastal water body, including Chesapeake Bay, Long Island Sound, the Mediterranean Sea, the Black Sea, and China's Bohai Bay. They have also been observed in ocean gyres.

Can dead zones recover? Yes, if the influx of nitrogen stops, the system can return to normal. In 1995 in the Black Sea region, farmers' collapsing commitments coincided with fiscal discipline forcing fertilizer use to halt, as fertilizer subsidies collapsed. The Black Sea dead zone disappeared, while bottom sea life declined in other deep-sea beds. But in the Mississippi River watershed, farmers' operations are far from the Gulf and its fisheries. Mismanaged practices have shown little success at what happens to fisheries in Louisiana.




FIGURE 3.1 A typical "dead zone" about the size of New Jersey forms in the Gulf of Mexico each summer. The small red areas from the Mississippi River, St. Lawrence River, and other sources, that drain into a protected estuary of the ocean, extend across a large area.

The flow of nitrogen reaching U.S. coastal waters has grown by eightfold since the 1950s. Phosphorus, another key nutrient, has tripled. Despite decades of efforts to control nutrients upstream, the dead zone has continued to grow, as intensification of agriculture upstream continues.

The movement of nutrients and energy determines how ecosystems function and how organisms and biological communities flourish or collapse. These topics set the stage for much of the rest of your study of environmental science. In this chapter we examine forms of matter and energy, key elements in living systems, and how they contribute to ecosystems and communities.

Claim, Evidence, Reasoning

Make Your Claim: Use your CER chart to make a claim about how fertilizer use affects the Gulf of Mexico. Explain your reasoning.

Collect Evidence: Use the lessons in this chapter to collect evidence to support your claim. Record your evidence as you move through the chapter.

Explain Your Reasoning: You will revisit your claim and explain your reasoning at the end of this chapter.

GO ONLINE to access your CER chart and explore resources that can help you collect evidence.

Key Concepts

How do energy and matter move through systems?

Measurement of energy and matter within the park of a system. Energy flows through systems, and matter is recycled. But energy flows through systems, and matter is recycled. But energy flows through systems, and matter is recycled.

Why do we find a pyramid of biomass?

Each trophic level requires a great deal of biomass to create less biomass energy in the next level. This is because of the 10% rule, which states that only about 10% of the energy in one trophic level is available to the next higher level.

Why is there less energy in each successive trophic level?

Energy is lost at each trophic level due to metabolic processes, heat loss, and the energy used for growth and reproduction. This results in less energy being available to the next trophic level.

What happens if the pyramid is disrupted?

Disruptions can occur at any level of the pyramid, leading to changes in the flow of energy and matter. For example, the removal of a keystone species can have a cascading effect on the entire system.

Engaging Visuals

Key Concepts are beautifully displayed, two-page features which guide students through an often-complex network of issues. These features highlight the takeaway ideas from the chapter in a visually appealing way.

Real-World Connections

Boxed features make science accessible through the presentation of how and why data is collected, examples of technology and methods, and additional information that demystifies central principles and gives students realistic steps for applying their knowledge.

What Do You Think?

Gene Editing

Humans have been able to selectively breed crops and animals for thousands of years. But now, with the help of CRISPR, we can edit the DNA of organisms to create new traits.

What Can YOU DO?

Working Locally for Ecological Integrity

You might think that the diversity and complexity of ecological systems are too large or too abstract for you to have any influence. But you can contribute to a complex, resilient, and interacting ecosystem, whether you live in the inner city, a suburb, or a rural area.

- Take walks. The best way to learn about ecological systems in your area is to take walks and practice observing your environment. Go with friends and try to identify some of the species and keep a journal of your observations.
- Plant your own gardens. Our invasive domestic cats are also very successful predators. Migratory birds, especially those nesting on the ground, have seen population declines against these predators.
- Plant a butterfly garden. Use native plants that support a diverse insect population. Native bees with barbed or fuzzy hair support bees. (Be sure to avoid plants that are toxic to bees.)

Exploring Science

Who Cares About Koi?

Koi are a beautiful breed of ornamental fish that have become popular in many parts of the world. But their introduction to new environments can have significant impacts on local ecosystems.

Can You Explain?

How do you think the introduction of koi fish to new environments can impact local ecosystems? What are some ways to prevent this from happening?

3.9 Biogeochemical Cycles and Life Processes

Guiding Questions

What happens when water evaporates and condenses? How does water move through the atmosphere, land, and water? How does water move through the atmosphere, land, and water?

Claim, Evidence, Reasoning

Write your claim about how water moves through the atmosphere, land, and water. Support your claim with evidence and reasoning.

Review Questions

- What is a system? What is a boundary? What is an input? What is an output? What is a feedback loop?
- What is a feedback loop? How does it work? What are the components of a feedback loop?
- What is a feedback loop? How does it work? What are the components of a feedback loop?

Chapter Review Continued

Critical Thinking

- Describe what a system is and how feedback loops regulate them.
- Explain why water is considered to be essential to life and describe the properties that support your explanation.
- Differentiate between high-quality and low-quality energy and the benefits of each.

Data and Observation

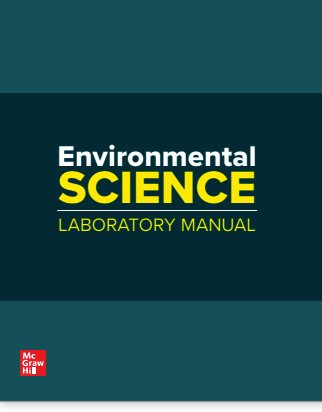
Observe the diagram of the nitrogen cycle shown below and use it to answer the following questions.

Go Further: Data Analysis Lab

How does the nitrogen cycle link different ecosystems? Nitrogen is essential to life. It is a component of proteins, nucleic acids, and other important molecules. Nitrogen is also a part of many important molecules, many of which are responsible for life's processes.

The end-of-chapter assessments help students master the content and practices included in each chapter. Multiple-choice and free-response questions ask students to recall and synthesize information covered in the course. The **Data Analysis Lab** allows students to apply what they've learned to real-world scenarios using current scientific data.

The **Lab Manual**, available in print and included with the digital resources, brings environmental science to life through hands-on activities and inquiry-based labs. The Teacher Manual provides hints and strategies to help with lab execution.



Robust, Adaptive, and Dynamic Digital Resources

Our digital solutions are enriched with multimedia content including videos, animations, and simulations that enhance the teaching and learning experience inside and outside of the classroom.

Authored by the world's leading subject matter experts and organized at the chapter level, the resources provide students with multiple opportunities to apply their understanding and master course content. Teachers can save time, customize lessons, monitor student progress, and make data-driven decisions in the classroom with flexible, easy-to-navigate instructional tools.

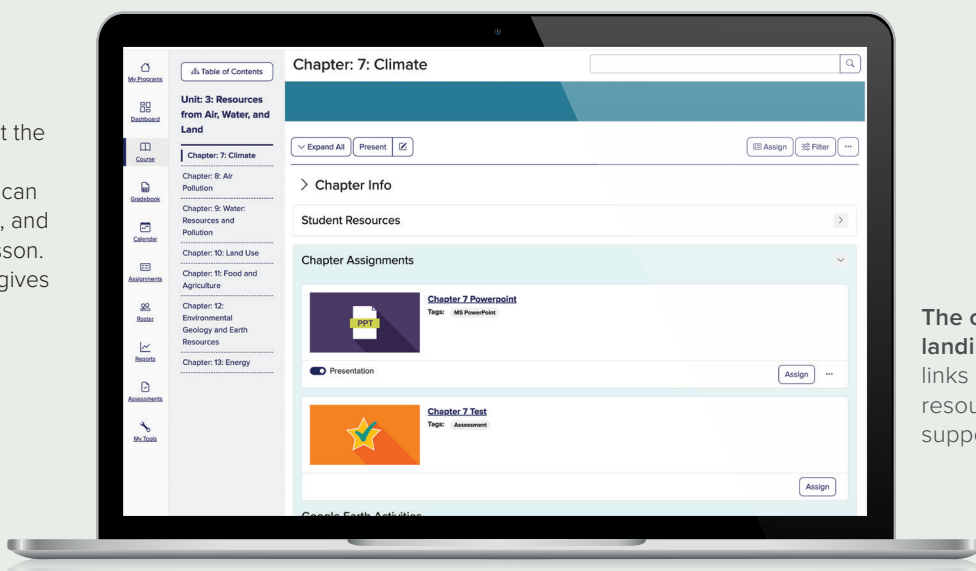
Robust Digital Resources

- An interactive eBook tagged to the Alabama standards and adaptive *SmartBook*® assignments.
- Google Earth, graphing, and mapping activities.
- Customizable, auto-graded test banks.
- Dozens of virtual labs.

Intuitive Design

Resources are organized at the chapter level. To enhance the core content, teachers can add assignments, activities, and instructional aids to any lesson. The chapter landing page gives students access to:

- Adaptive *SmartBook*® assignments.
- Lab activities.
- Assignment calendar.
- An interactive eBook.



The chapter landing page links students to resources that support success.

Access to the Online Student Edition includes access to the eBook, SmartBook adaptive eBook, virtual labs and additional digital learning resources. Teacher resources include the eBook, SmartBook, Teacher Manual, PowerPoint presentations, assignable resources, Gradebook, Pacing Guides, and more.



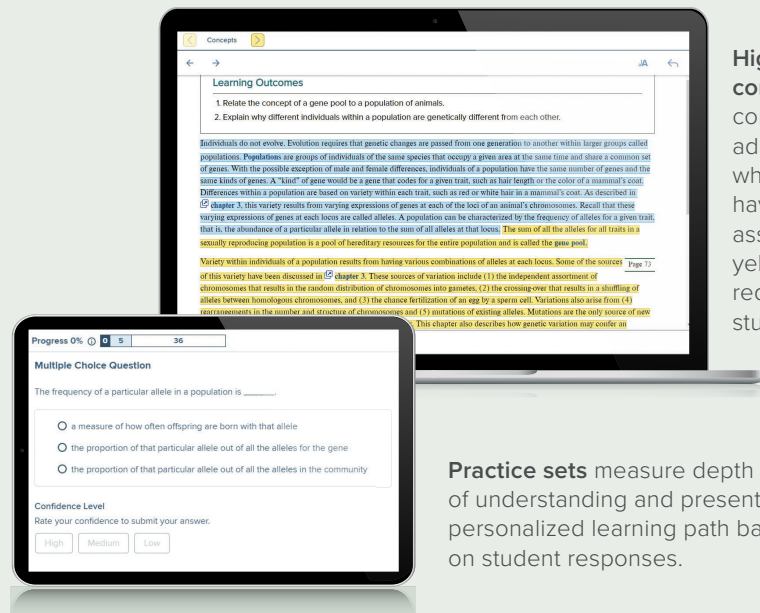
Mobile Ready

With the McGraw Hill K–12 Portal App, students can access their content any time on any device, with or without Internet access.

Adaptive Study Tools

SmartBook[®] is the online adaptive study tool. Its interactive features engage students and personalize the learning experience with self-guided tools that:

- Assess a student's proficiency and knowledge.
- Track which topics have been mastered.
- Identify areas that need more study.
- Improve reading comprehension by highlighting key content that needs additional study.
- Present focused content specific to the student's individual needs.



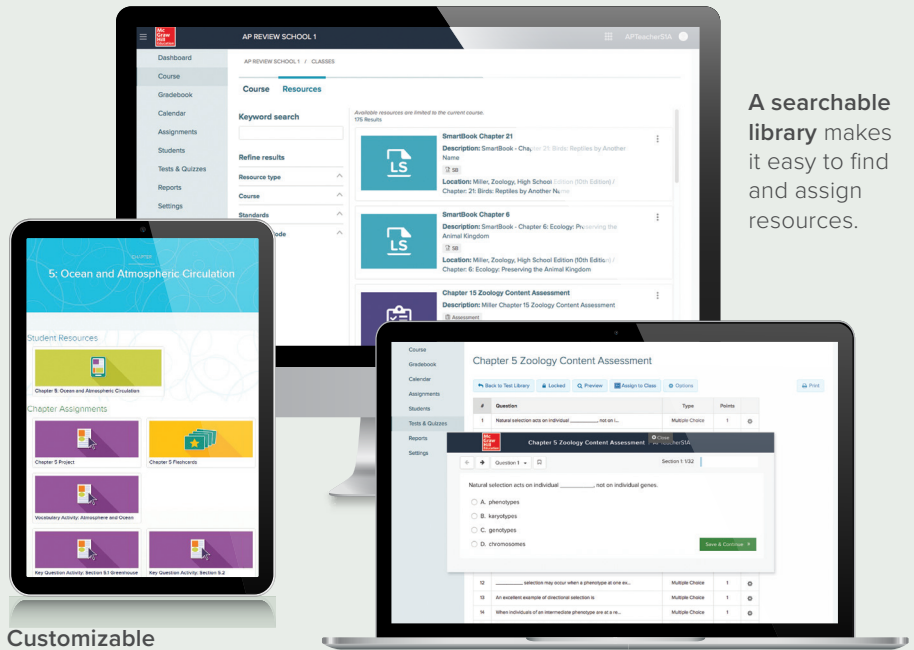
Highlighted content continuously adapts to show what students have been assigned in yellow and what requires further study in blue.

Practice sets measure depth of understanding and present a personalized learning path based on student responses.

Teacher Resources

Teachers have access to **SmartBook**[®]—an interactive, adaptive eBook—plus a wealth of customizable chapter resources and powerful gradebook tools. Resources include:

- An online Teacher Manual with chapter outlines, teaching suggestions, reading strategies, and pacing guides.
- Student performance reports to help teachers identify gaps, make data-driven decisions, and adjust instruction.
- Customizable PowerPoint presentations.
- Labeled diagrams, visual aids, animations, and additional ideas.



A searchable library makes it easy to find and assign resources.

Customizable assignments and quiz banks provide automated grading that populates easy-to-read reports.

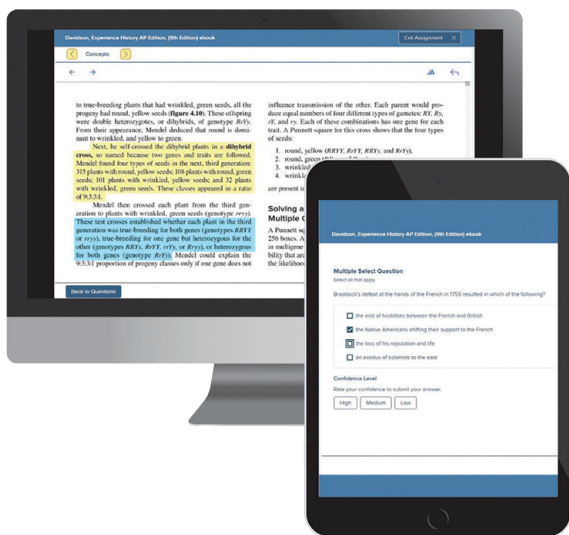


Harness technology to unlock success. Visit my.mheducation.com

The Learning Is Always Personalized

SmartBook®

All core programs include *SmartBook* within the digital course. *SmartBook* delivers personalized, adaptive learning tailored to each student's individual needs by pinpointing knowledge gaps and focusing instruction on the concepts that require additional study. Teachers can assign a specific chapter, topic, or concept and access advanced reporting features with actionable insights to inform in-class instruction.



FOR STUDENTS

More Personalized. More Productive.

As students move through the material, multiple data points are captured to sequence and pace individual instruction.

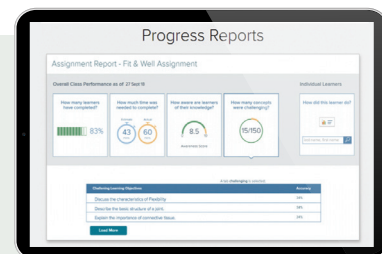
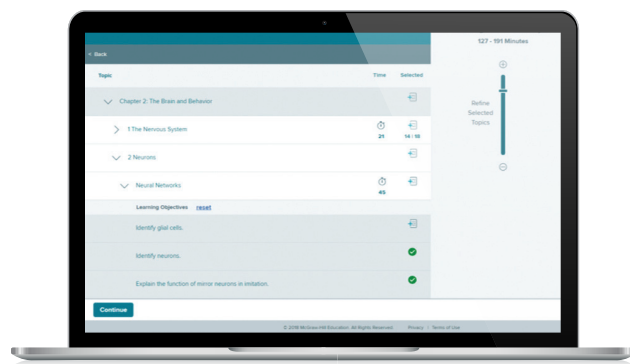
- **Focused Instruction:** Yellow highlights help students easily identify their assigned learning concepts.
- **Targeted Remediation:** Blue highlights bring focus to the contents and concepts that require additional study.
- **Meaningful Practice:** Practice sets with instant feedback allow students to ask for guidance and rate their confidence level.
- **Recharged Learning:** Students can access previously completed assignments with personalized recommendations.
- **Mobile Ready:** Assignments are accessible both online and offline with the McGraw Hill K–12 Portal app.

FOR TEACHERS

More Control. More Prepared. More Actionable.

Teachers can organize assignments to suit their students' needs and align to their course outcomes while easily tracking student progress.

- **Flexible Assignments:** Assign homework down to the subtopic level and time-on-task.
- **Manageable Content:** Assign content across multiple chapters to make connections between chapters, topics, and concepts.
- **Results-Based Support:** Provide personalized review assignments that target each student's areas of weakness.
- **Actionable Reports:** Advanced reporting features track individual and class progress with data-driven insights.



“Using *SmartBook* has been a game changer! It is like having a co-teacher! I can see how much they read. I can see how much they comprehended! I can see, specifically, what challenging concepts exist. Students can see their progress. Students can see that they are being held accountable in a much more realistic and targeted manner. Students are much more engaged in the class and better prepared to interact with a deeper level of academic conversation.”

– **Marion Chase**
Instructional Coach and AP Teacher

The Lab Is Always Open

Virtual Labs

Virtual Labs empower students outside the classroom and outside the laboratory with 24/7 access. The labs are compatible with screen readers and keyboard navigation to ensure an accessible experience for all learners. The easy-to-follow on-screen instructions guide students through each part of their lab journey and their progress is automatically saved and always visible to help them take ownership of their learning.



Available 24/7
—even if the lab
space isn't



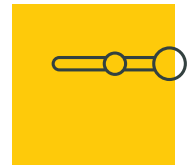
**Built with
accessibility
in mind**



**Easy-to-follow
on-screen
instructions**



**Student progress
is automatically
saved**



**Visible
progress
bar**

Virtual Labs, included in select courses,* deliver a realistic, simulated lab experience that better prepares students with the fundamental skills for hands-on lab work. If needed, these labs can even supplant hands-on lab work.

These simulations help students learn practical and conceptual skills; they check for understanding, and provide feedback. With adaptive pre-lab and post-lab assessments available, teachers can customize each assignment.

The Virtual Lab Experience

In each lab experience, students are guided through the step-by-step phases. They use their mouse to manipulate the materials and are prompted with checks for understanding that deliver instant and guided feedback.

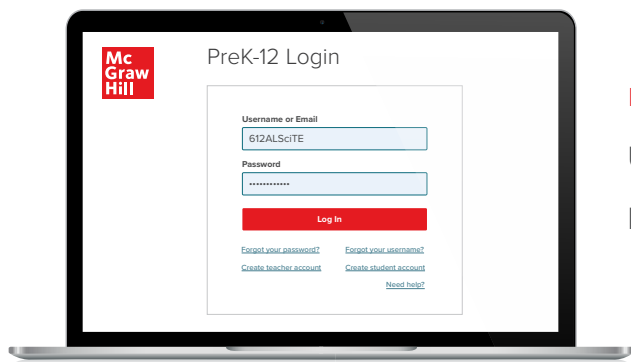
Students also have access to tools for notetaking, resetting the lab, labeling, and reviewing the list of methods at point of use. Once complete, the lab is automatically submitted to the teacher and students can save their work, print, or download a PDF for their records.

The screenshots illustrate the interactive nature of the Virtual Labs. The top image shows a 'CARDIOVASCULAR PHYSIOLOGY - BLOOD PRESSURE' simulation where a student uses a sphygmomanometer on a patient. The middle image shows a 'BLOOD - BLOOD TYPING' simulation with a lab bench setup and a 'Blood Sample 3' instruction panel. The bottom image shows an 'OSMOSIS - MOVEMENT OF WATER ACROSS A SELECTIVELY PERMEABLE MEMBRANE' simulation with beakers of 10% Corn Syrup and Distilled Water, and a 'Question' pop-up asking why a membrane is selectively permeable.



Take a Tour and Explore

Use this guide to help you get familiar with a variety of digital tools, resources, and support to meet the needs of your classroom and students.



my.mheducation.com

User Name: 612ALSciTE

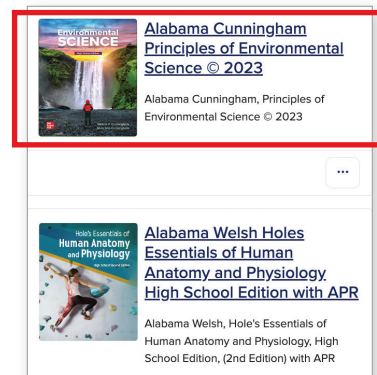
Password: Camellia1

LOG IN TO THE DIGITAL EXPERIENCE

Log in to **my.mheducation.com** using the credentials above.

Locate and click on the course you wish to review.

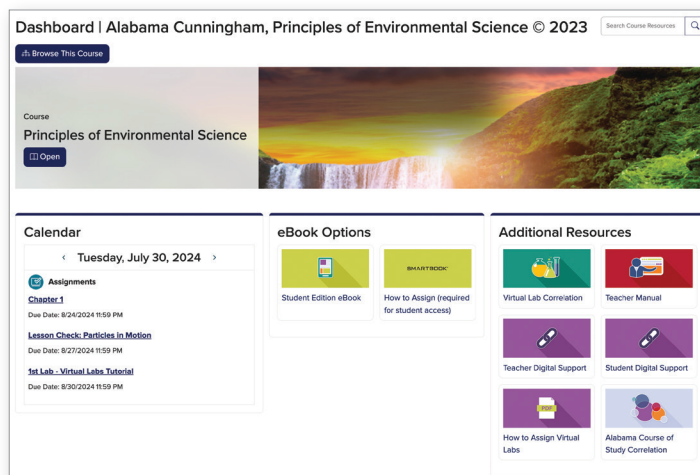
Note: All courses function similarly. You can explore any title within the demo account.



VIEW YOUR COURSE DASHBOARD

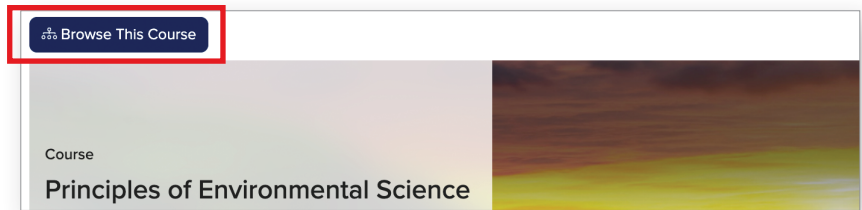
This is the **Digital Dashboard**. It's your home base for resources, such as:

- Full Teacher Manual
- Quick eBook Access
- Virtual Labs
- Correlations
- Digital Teacher Support
- Digital Student Support



BROWSE YOUR COURSE

Click **Browse This Course** to expand the menu and explore units, chapters, assignments, activities, assessments, and more.

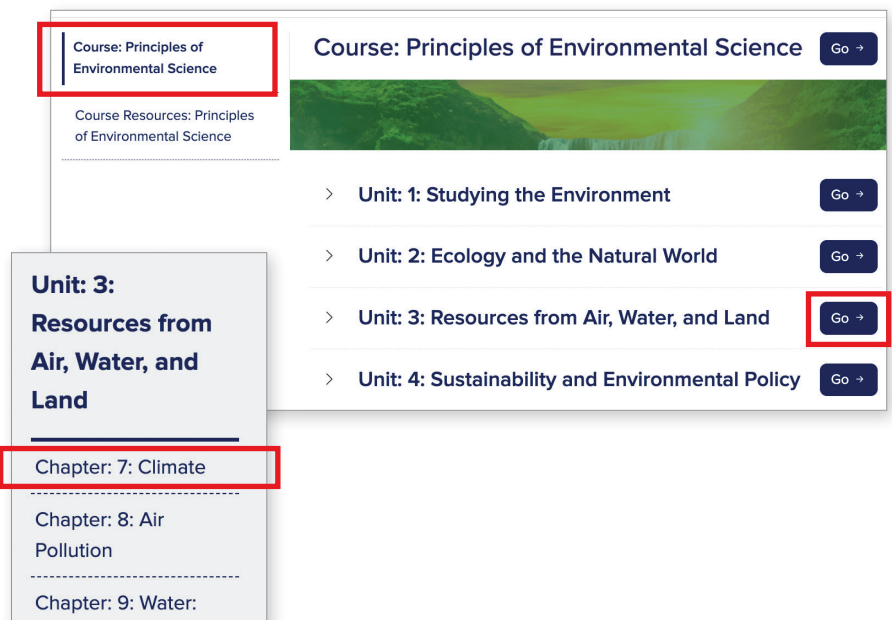


BROWSE UNITS AND CHAPTERS

Select **Course: Principles of Environmental Science**.

Navigate to a unit and click the **Go** button to drill down to the unit's chapters.

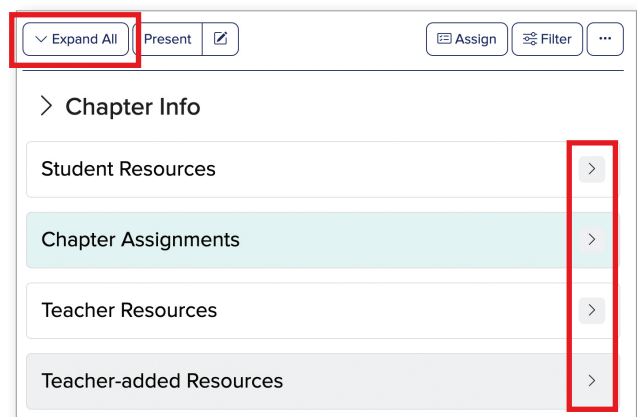
Select a **chapter** from the left hand navigation to review the chapter-level resources.



BROWSE CHAPTER CONTENTS

Select **Expand All** to open all of the chapter contents for both students and teachers.

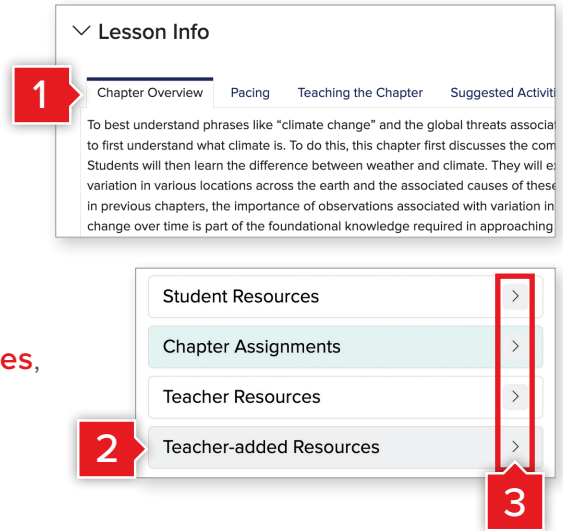
You can also click the **arrows** to the right of the blades to open one resource type at a time.



BROWSE INSTRUCTIONAL RESOURCES

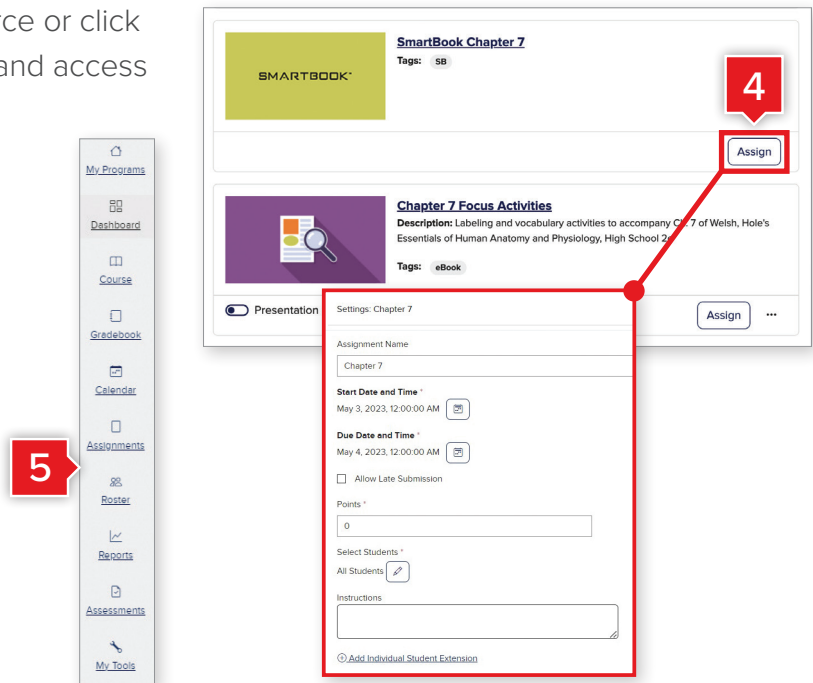
Selecting a chapter will take you to the **Chapter Landing Page**.

1. Click **Lesson Info** and use the tabs to explore Overviews, Pacing, Instructional Strategies, Suggested Assignments, and Benchmarks.
2. Your own materials can be uploaded and assigned to students in **Teacher-added Resources**.
3. The arrows to the right open to reveal **Student Resources**, **Chapter Assignments**, and **Teacher Resources**.



ASSIGN RESOURCES

4. Click on the tile to preview the resource or click **Assign** to open the course calendar and access options for assigning.
5. As you navigate your program, the Program Menu is always visible at the left side of the screen to help you navigate quickly to the **Gradebook**, **Calendar**, **Assignments**, **Roster**, **Reports**, and **Assessments**.



READ OFFLINE ANYTIME, ANYWHERE

Mobile ready! With the **McGraw Hill K–12 Portal app**, students can access their content any time on any device, with or without Internet access.

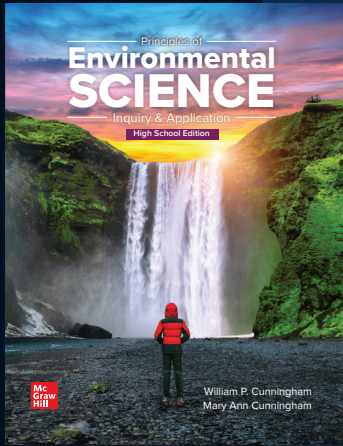


There's Even More To Explore

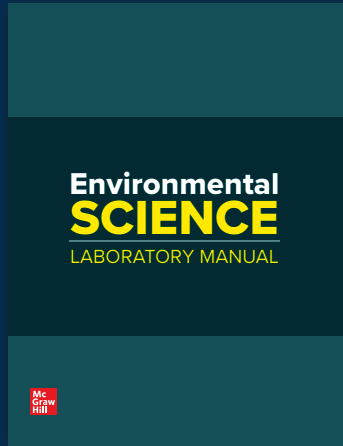
Find the right solutions to ensure students develop the academic and real-world skills they need to make the successful transition to college and/or the workforce. Provide meaningful experiences with purposeful lessons, extensive practice, and a variety of opportunities for concept mastery to lead them to success in college and beyond.



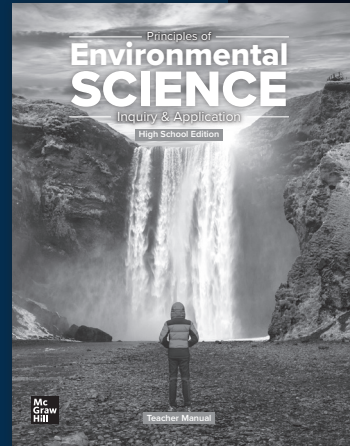
Scan the QR code to explore the resources that support Alabama AP®, Honors, and Electives teacher and student success!
Password: AL_APElectives



STUDENT EDITION



STUDENT LAB MANUAL



PRINTED TEACHER MANUAL

Learn more at mheducation.com/Alabama

