

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 for Tennessee Success

Crafted specifically for a high school environmental science course, *Tennessee 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.

64 PRINCIPLES OF ENVIRONMENTAL SCIENCE | UNIT 2 | Ecology and the Natural World

Chapter 3 | Environmental Systems: Matter, Energy, and Life 67

## 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 mouth, 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, she has found vast areas with oxygen concentrations below 2 parts per million (ppm). At 2 ppm, nearly all aquatic life, other than microorganisms and some worms, is eliminated. In 2017 the

Gulf's hypoxic (oxygen-starved) area was the largest ever, at 22,750 km<sup>2</sup> (8,776 mi<sup>2</sup>), an area the size of New Jersey.

What causes this huge dead zone? The summer periods of anoxia, visible in a Gulf of Mexico map 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 her team observed that each year, 7 to 10 days after large spring rains in the watershed 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, crabs, 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 process. Rotting 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 warms the upper layers warmer and less dense than lower layers, cold, denser 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 in the United States. Hypoxia is also common in the Black Sea, and China's Bohai Bay. But they have also been observed in ocean conditions.

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 communities coincided with local food processor fertilizer use (a halt, as fertilizer subsidies collapsed). The Black Sea dead zone disappeared, while former sea birds declined in their stop birds. But in the Gulf of Mexico, the same, farmers' operations are far from the Gulf and its fisheries. Mismanaged practices have shown little success at what happens to fisheries in Louisiana.

**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?

Movement of energy and matter within the parts of a system. Energy flows through systems, and matter is recycled. Energy flows from the sun to producers, then to consumers. Matter is recycled through the system because producers, for example, take up carbon dioxide from the atmosphere and release oxygen. Producers also take up water and release water vapor into the atmosphere. Energy flows from the sun to producers, then to consumers. Matter is recycled through the system because producers, for example, take up carbon dioxide from the atmosphere and release oxygen. Producers also take up water and release water vapor into the atmosphere.

#### 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 trophic level. Energy is lost through growth, heat, respiration, and excretion. This is why the biomass pyramid is inverted. The biomass pyramid is inverted because energy is lost through growth, heat, respiration, and excretion. This is why the biomass pyramid is inverted.

#### Why is there less energy in each successive trophic level?

Energy is lost through growth, heat, respiration, and excretion. This is why the biomass pyramid is inverted. The biomass pyramid is inverted because energy is lost through growth, heat, respiration, and excretion. This is why the biomass pyramid is inverted.

## 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 to improve the characteristics of domestic plants and animals. But selective breeding takes a long time and is often unpredictable. The development of molecular genetics, including genes and DNA, has opened the way to more predictable and efficient genetic engineering. This technology is being used to create crops that are more resistant to pests and diseases. The ability to edit genes is being used to create crops that are more resistant to pests and diseases. The ability to edit genes is being used to create crops that are more resistant to pests and diseases.

#### What Can YOU DO?

Working Locally for Ecological Diversity

You realize 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 interesting 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 modern domestic cats are also very successful predators. Migratory birds, especially those nesting on the ground, have not evolved defenses against these predators.
- Plant a butterfly garden. Use native plants that support a diverse insect population. Native bees with barbed or fringed tongues are also important.

### Exploring Science

#### Who Cares About Koi?

Koi are small, colorful fish that are popular in ponds and aquariums. They are a type of carp that has been selectively bred for their colors and patterns. Koi are a type of carp that has been selectively bred for their colors and patterns. Koi are a type of carp that has been selectively bred for their colors and patterns.

#### Can You Explain?

How do you think the genetic engineering of crops will affect the environment? Will it help or hurt? Why? How do you think the genetic engineering of crops will affect the environment? Will it help or hurt? Why?

### 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

How does fertilizer use affect the Gulf of Mexico? Fertilizer use in agriculture can lead to nutrient runoff, which can cause algal blooms in the Gulf of Mexico. Fertilizer use in agriculture can lead to nutrient runoff, which can cause algal blooms in the Gulf of Mexico.

#### Review Questions

- What is a system balanced or closed? It is said to be in what state?
  - open
  - closed
  - balanced
  - all of these
- Which category do light, carbohydrates, proteins, and sulfur belong to?
  - biotic
  - abiotic
  - biotic and abiotic
  - neither
- Which of the following best describes the structure of DNA?
  - double helix
  - single helix
  - triple helix
  - quadruple helix

### Chapter Review Continued

#### Critical Thinking

- Describe what a system is and how feedback loops regulate it.
- Explain why water is considered to be essential to life and describe how 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 essential to life. It is a component of proteins, nucleic acids, and other important molecules.

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.

## Environmental SCIENCE

### LABORATORY MANUAL

McGraw Hill

# 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.

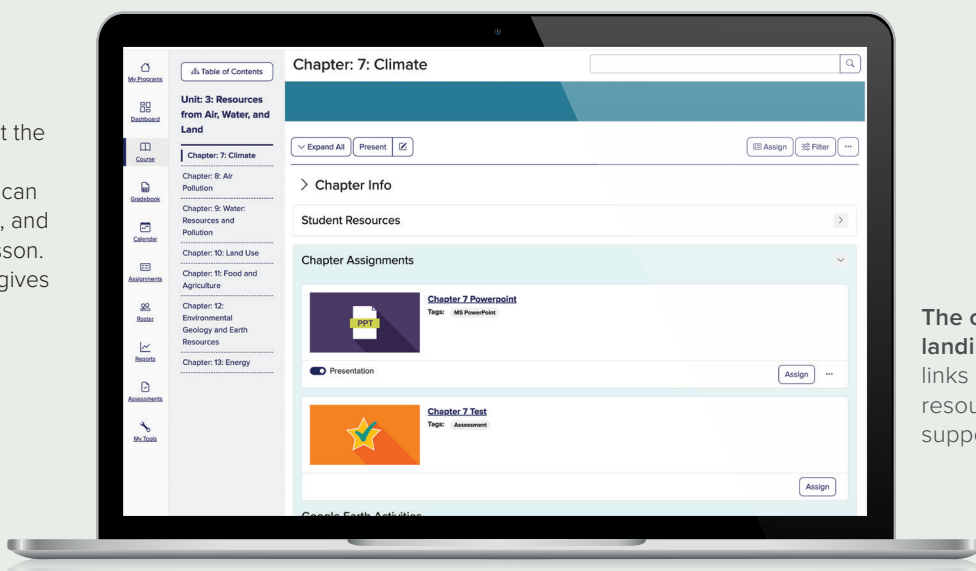
## Robust Digital Resources

- An interactive eBook tagged to the Tennessee 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.



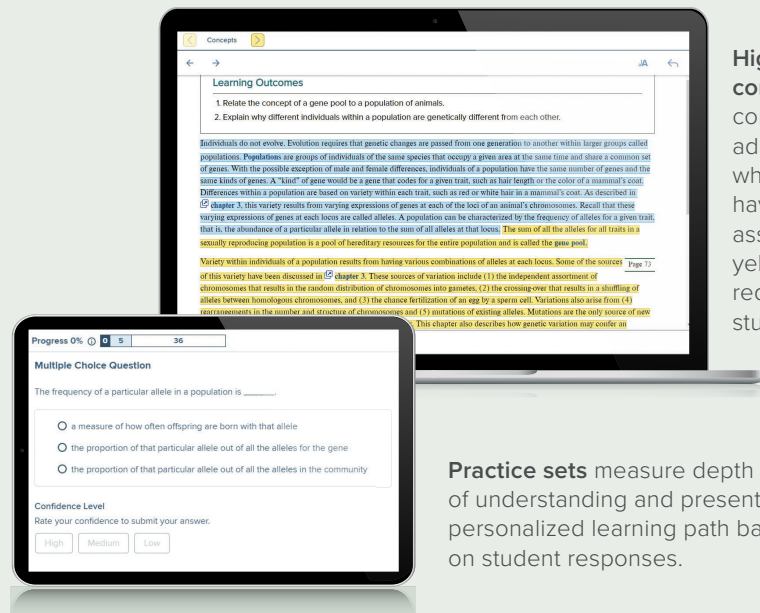
## Mobile Ready

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**<sup>®</sup> 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.



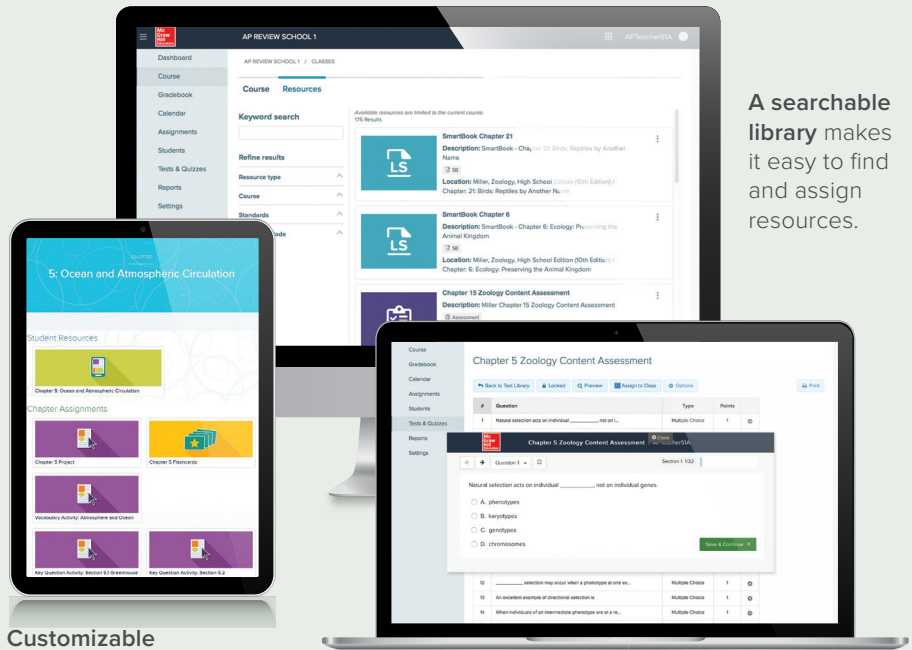
**Highlighted content** continuously adapts to show what students have been assigned in yellow and what requires further study in blue.

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

## Teacher Resources

Teachers have access to **SmartBook**<sup>®</sup>—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.

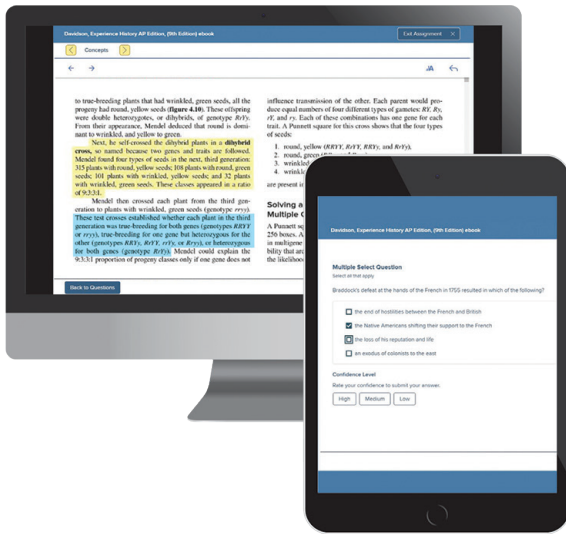


Harness technology to unlock success. Visit [my.mheducation.com](http://my.mheducation.com)

# 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.

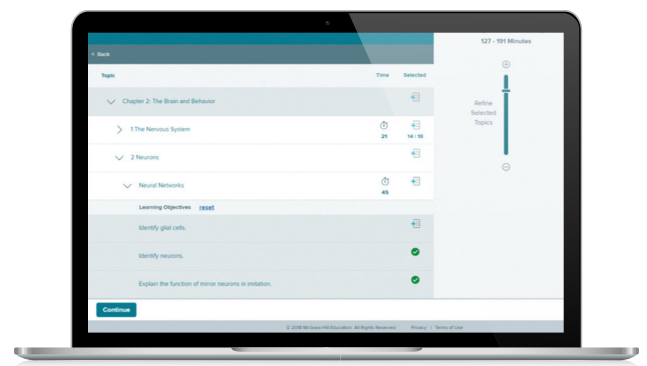
- **Focused Instruction:** Yellow highlights help students easily identify their assigned learning concepts.
- **Targeted Remediation:** Blue highlights bring focus to the contents and concepts that require additional study.
- **Meaningful Practice:** Practice sets with instant feedback allow students 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



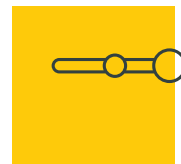
**Built with  
accessibility  
in mind**



**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.

**PHASE 1: Blood Pressure**  
Observe blood pressure after standing for 5 minutes.  
Complete the following steps:  
1. Close sphygmomanometer valve.  
2. Close bulb to inflate cuff 20-30 mmHg above estimated normal systolic pressure. (Exceeded pressure is 193 mmHg.)  
3. Click button to open valve halfway. Hold consistently at which the sound appears first and stop.  
4. Check buffer to clear valve to deflate cuff. Record systolic and diastolic pressures in Lab Data.

**PHASE 2: Blood Sample 3**  
Complete the following steps:  
1. Place microscope slide on lab bench and use pipette to take 1.  
2. Use pipette to add drop of blood from sample 3 to each labeled spot. Dispose of pipette in Sharps container.  
3. Add drop of each serum to labeled spot.  
4. Mix blood and serum using new toothpicks for each spot. Dispose of toothpicks in Sharps container. Wait 2 minutes.  
5. Use chart to determine blood type. Record in Lab Data.  
6. Capture image of blood sample on slide in Lab Data.

**OSMOSIS - MOVEMENT OF WATER ACROSS A SELECTIVELY PERMEABLE MEMBRANE**  
Question  
Why is this called a selectively permeable membrane?  
 Because it allows any molecule to selectively choose what side of the membrane to move toward.  
 Because it allows small molecules, such as water, to pass through but not larger molecules, such as those in corn syrup.  
Submit

**PHASE 1: 10% Corn Syrup**  
Complete the following steps:  
1. Attach selectively permeable membrane to bottom of thistle tube.  
2. Add 10% corn syrup to thistle tube.  
3. Add distilled water to beaker.  
4. Wait 10 minutes to measure volume of liquid inside tube. Record in Lab Data.



# 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.

## THE DIGITAL EXPERIENCE

### LOG IN

1. Contact your sales representative to get login credentials.

**Tracy Elliott**

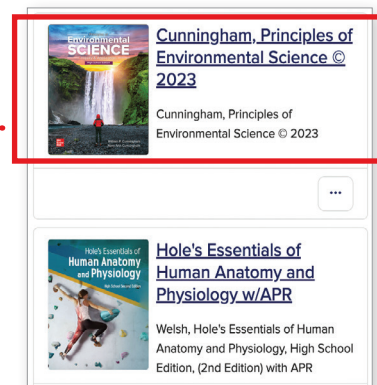
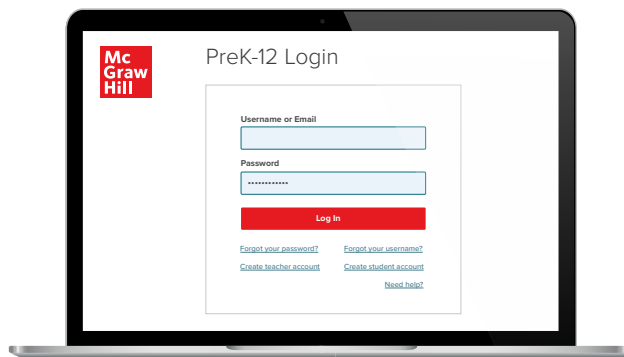
tracy.elliott@mheducation.com

**Corrie Carroll**

corrie.carroll@mheducation.com

2. Go to **my.mheducation.com** and log in using the credentials provided by your sales representative.
3. Locate and click on the course you wish to review.

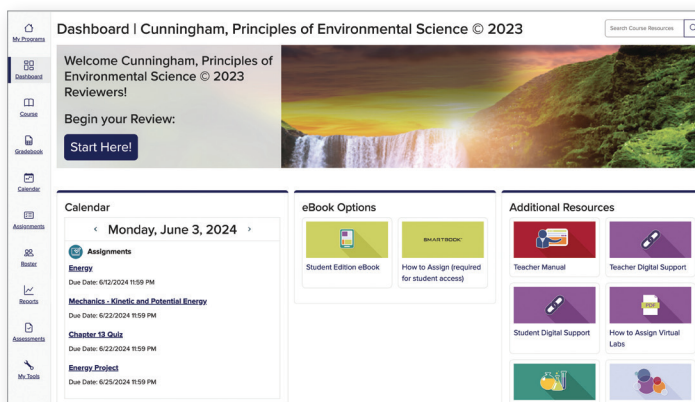
**Note:** All courses function similarly. You can explore any title within the demo account.



## VIEW YOUR COURSE DASHBOARD

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

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





## BROWSE YOUR COURSE

Click **Start Here!** to expand the menu and explore units, chapters, assignments, activities, assessments, and more.

Welcome Cunningham, Principles of Environmental Science © 2023 Reviewers!

Begin your Review:

**Start Here!**



## BROWSE UNITS AND CHAPTERS

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.

**Unit: 3:  
Resources from  
Air, Water, and  
Land**

Chapter: 7: Climate

Chapter: 8: Air  
Pollution

Chapter: 9: Water:

- > Unit: 1: Studying the Environment **Go →**
- > Unit: 2: Ecology and the Natural World **Go →**
- > **Unit: 3: Resources from Air, Water, and Land** **Go →**
- > Unit: 4: Sustainability and Environmental Policy **Go →**

## 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.

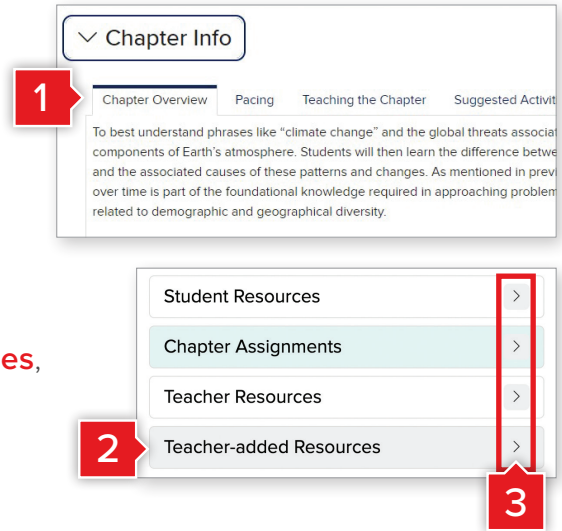
▼ **Expand All** Present

- > Chapter Info
- Student Resources **>**
- Chapter Assignments **>**
- Teacher Resources **>**
- Teacher-added Resources **>**

## BROWSE INSTRUCTIONAL RESOURCES

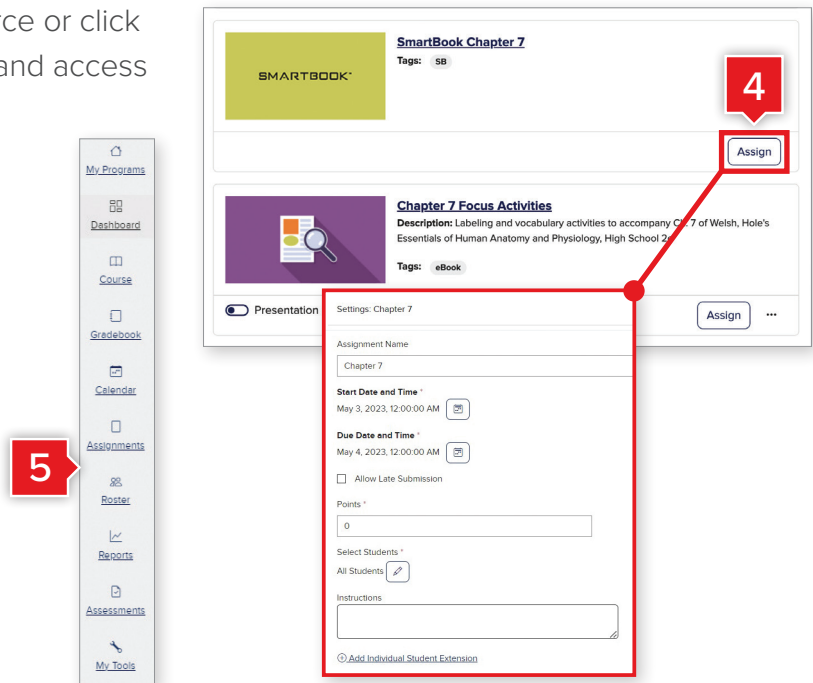
Selecting a chapter will take you to the **Chapter Landing Page**.

1. Click **Chapter 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.

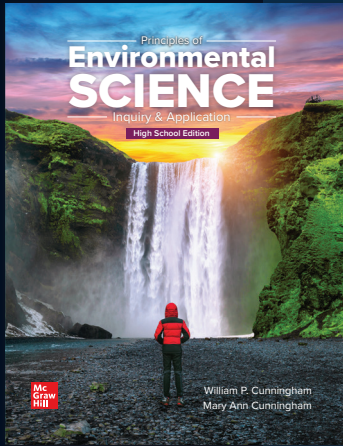


# There's Even More To Explore

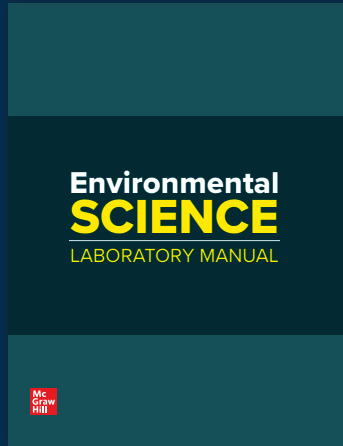
Find the right solutions to ensure students develop the academic and real-world skills they need to make the successful transition to college and/or the workforce. Provide meaningful experiences with purposeful lessons, extensive practice, and a variety of opportunities for concept mastery to lead them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



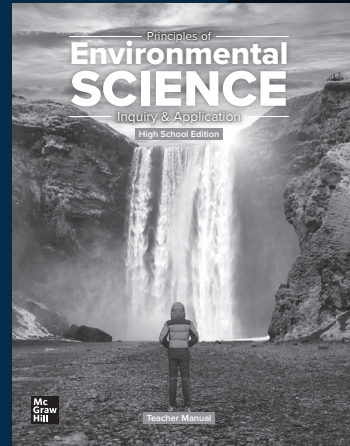
Scan the QR code to explore the resources that support Tennessee AP®, Honors, and Electives teacher and student success!



**STUDENT EDITION**



**STUDENT LAB MANUAL**



**PRINTED TEACHER MANUAL**

Learn more at [mheducation.com/tennessee](https://mheducation.com/tennessee)

