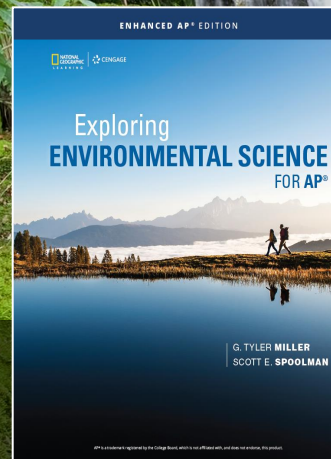


NATIONAL GEOGRAPHIC EXPLORING ENVIRONMENTAL SCIENCE



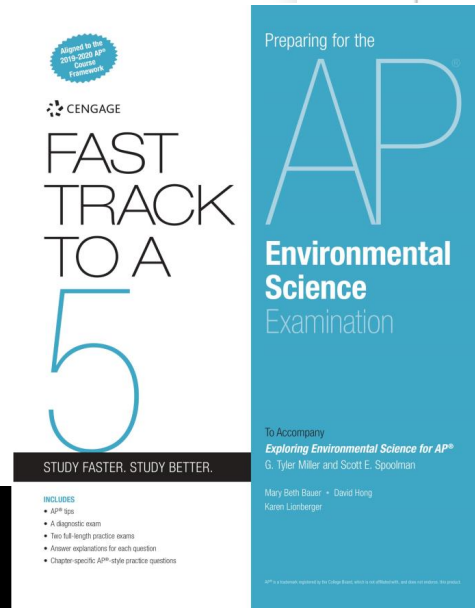
OUR AP[®] STORY

✓ Always Updated to the Latest Course Frameworks

✓ Student Test Prep

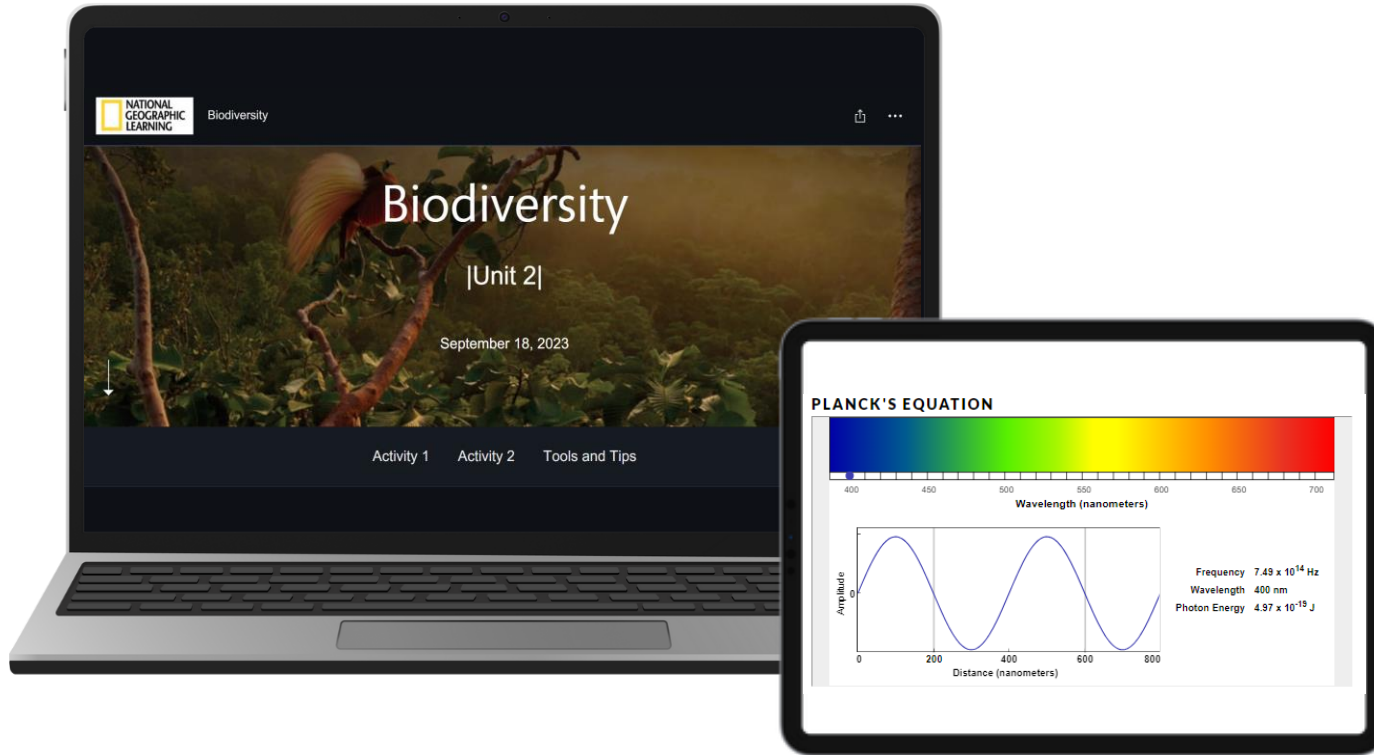
✓ Teacher Support

* Re-aligned Units and Chapters exactly match AP course



AP [®] Topics Correlation			
This table correlates the updated AP [®] Environmental Science course framework to the sections of this text.			
Unit 1: The Living World: Ecosystems			
Big Idea 1: (ENG) Energy Transfer; Big Idea 2: (ERT) Interactions Between Earth Systems			
Topic	Enduring Understanding and Learning Objective(s)	Essential Knowledge	Text Section(s)
1.1: Introduction to Ecosystems	ERT-1: Ecosystems are the result of biotic and abiotic interactions.	ERT 1.A.1: In a predator-prey relationship, the predator is an organism that eats another organism (the prey).	2.4
	ERT-1.A: Explain how the availability of resources influences species interactions.	ERT 1.A.2: Symbiosis is a close and long-term interaction between two species in an ecosystem. Types of symbiosis include mutualism, commensalism, and parasitism.	2.4
		ERT-1.A.3: Competition can occur within or between species in an ecosystem where there are limited resources. Resource partitioning—using the resources in different ways, places, or at different times—can reduce the negative impact of competition on survival.	2.4
1.2: Terrestrial Biomes	ERT-1: Ecosystems are the result of biotic and abiotic interactions.	ERT-1.B.1: A biome contains characteristic communities of plants and animals that result from, and are adapted to, its climate.	5.2
	ERT-1.B: Describe the global distribution and principal environmental aspects of terrestrial biomes.	ERT-1.B.2: Major terrestrial biomes include taiga, temperate rainforests, temperate seasonal forests, tropical rainforests, shrubland, temperate grassland, savanna, desert, and tundra.	3.1
		ERT-1.B.3: The global distribution of nonmineral terrestrial natural resources, such as water and trees for lumber, varies because of some combination of climate, geography, latitude and altitude, nutrient availability, and soil.	5.2
		ERT-1.B.4: The worldwide distribution of biomes is dynamic; the distribution has changed in the past and may again shift as a result of global climate changes.	3.1, 6.3
	ERT-1: Ecosystems are the result of biotic and abiotic interactions.	ERT-1.C.1: Freshwater biomes include streams, rivers, ponds, and lakes. These freshwater biomes are a vital resource for drinking water.	4.4
	ERT-1.C: Describe the global distribution and principal environmental aspects of aquatic biomes.	ERT-1.C.2: Marine biomes include oceans, coral reefs, marshland, and estuaries. Algae in marine biomes supply a large portion of the Earth's oxygen, and also take in carbon dioxide from the atmosphere.	4.1–4.2
		ERT-1.C.3: The global distribution of nonmineral marine natural resources, such as different types of fish, varies because of some combination of salinity, depth, turbidity, nutrient availability, and temperature.	4.1–4.2

DIGITAL SUPPORT





National Geographic content engages students with relevant, real-world stories

Hands-on solutions to real-life problems with activities, labs, and data analysis

Prepare students for AP® success with teacher support and student test prep

* Re-aligned Units and Chapters exactly match AP course

NATIONAL GEOGRAPHIC CONTENT

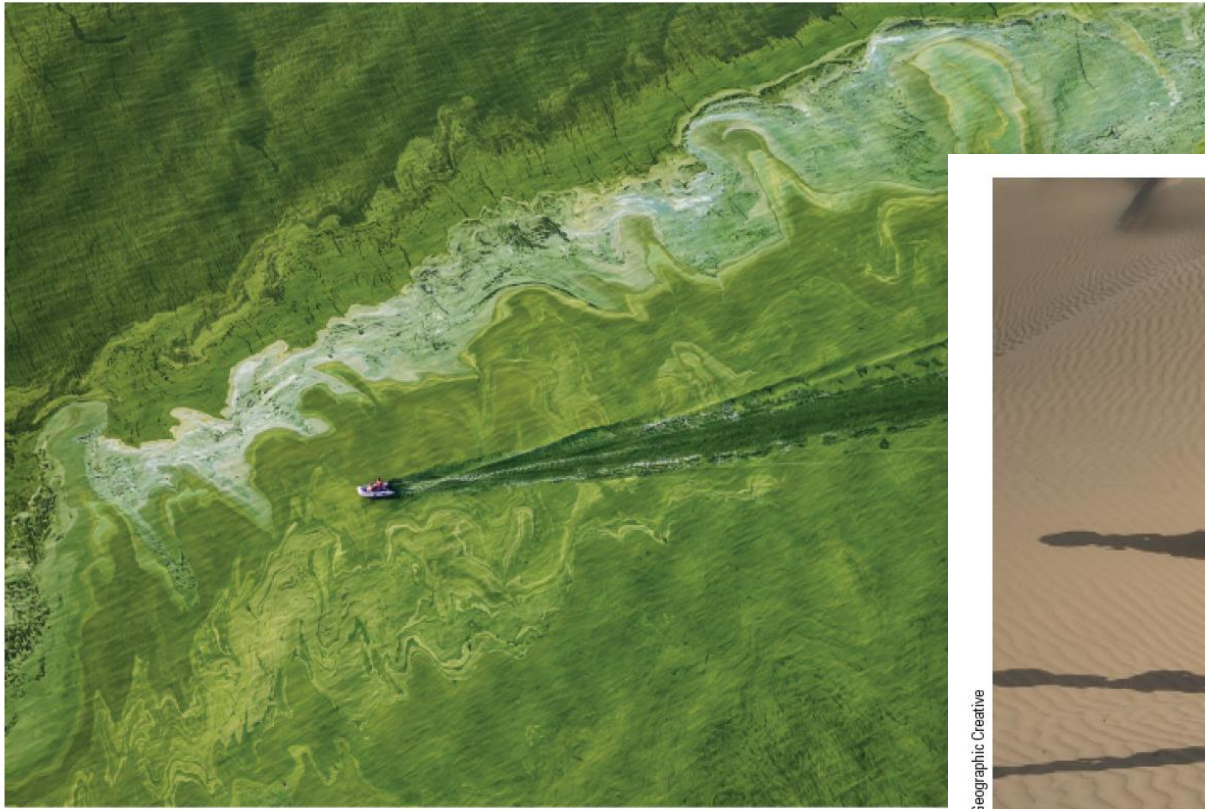


Figure 16.8 *Eutrophication*: This toxic algae bloom covered one-third of Lake Erie in 2011.



Figure 8.12 Each day these women carry water to their village in a dry area of India.

geographic

First Law of Ecology: Everything is connected to everything else.
Barry Commoner

NATIONAL GEOGRAPHIC CONTENT

Core Case Study

Growing Power—An Urban Food Oasis

A **food desert** is an urban area where people have little or no easy access to grocery stores or other sources of nutritious food. In the United States, an estimated 23.5 million people, including 6.5 million children, live in such urban neighborhoods. They tend to rely on convenience stores and fast-food restaurants that mainly offer high-calorie, highly processed foods that can lead to higher risks of obesity, diabetes, and heart disease.

Will Allen (Figure 12.1) was one of six children of a sharecropper and grew up on a farm in Maryland. He left the farm life for college and a professional basketball career, followed by a successful corporate marketing career. In 1993, Allen decided to return to his roots. He bought the last working farm within the city limits of Milwaukee, Wisconsin, and, in time, created a food oasis in a food desert.

On this small urban plot, Allen developed Growing Power, Inc. As an ecologically based farm, it is a showcase for forms of agriculture that apply all three **scientific**



principles of sustainability (see inside back cover of book). It is powered partly by solar electricity and solar hot water systems and makes use of several greenhouses to capture solar energy for growing food year-round. The farm produces an amazing diversity of crops with about 150 varieties of organic produce. It also produces organically raised chickens, turkeys, goats, fish, and honeybees. And the farm's nutrients are recycled in creative ways. For example, wastes from the farmed fish are used as nutrients to raise some of the crops.

The farm's products are sold locally at Growing Power farm stands throughout the region and to restaurants. Allen also worked with the city of Milwaukee to establish the Farm-to-City Market Basket program through which people can sign up for weekly deliveries of organic produce at modest prices.

In addition, Growing Power runs an educational program in which school children visit the farm and learn about where their food comes from. Allen also trains

about 1,000 people every year who want to learn organic farming methods. The farm has also partnered with the city of Milwaukee to create 150 green jobs for unemployed and low-income workers, building greenhouses, and growing food organically. Growing Power has expanded, opening another urban farm in a neighborhood of Chicago, Illinois, and setting up satellite training sites in five other states.

For his creative and energetic efforts, Allen has won several prestigious awards. However, he is most proud of the fact that his urban farm helps to feed more than 10,000 people every year and puts people to work raising good food.

In this chapter, we look at different ways to produce food, the environmental effects of food production, and how we can produce food more sustainably. ●

Critical Thinking

How is Growing Power farm a model of sustainable agriculture?



Figure 12.1 Will Allen founded Growing Power—a world-renowned urban farm in Milwaukee, Wisconsin.

Copyright © Growing Power, Inc.

CRITICAL THINKING

Coral reefs provide many ecological and economic services. How would the loss of coral reefs affect humans?

NATIONAL GEOGRAPHIC CONTENT

Individuals Matter

Juan Martinez—Reconnecting People with Nature

National Geographic Explorer Juan Martinez learned firsthand about the value of connecting with nature. Now he is instilling that value in others, particularly disadvantaged youths.

Martinez grew up in a poor area of Los Angeles, California, where as a boy he was in danger of becoming absorbed by a gang culture. One of his teachers recognized Martinez's potential and gave him a chance to pass a class that he was failing by joining the school's Eco Club.

Martinez took that opportunity, and when the club planned a field trip to see the Grand Teton Mountains of Wyoming, he jumped at the chance. As a result, he says, "I still can't find words to describe the first moment I saw those mountains rising up in the valley. Watching bison, seeing a sky full of stars, and hiking through that scenery was overwhelming."

The experience transformed Martinez's life. Today, he spearheads the Natural Leaders Network of the Children and Nature Network, an organization creating links between environmental organizations, corporations, government, education, and individuals reconnect children with nature. His work as an environmental leader has inspired many others to do similar work.

Martinez has received a great deal of recognition for his efforts, including invitations to White House forums on environmental education. His greatest reward, however, is in seeing how his efforts help others.



Individuals Matter 13.1

Maria Gunnoe: Fighting to Save Mountains

In the 1800s, Maria Gunnoe's Cherokee ancestors arrived in what is now Boone County, West Virginia. Her grandfather bought the land where she now lives. In 2000 miners blew up the mountaintop above that land to extract underlying coal (Figure 11.12, p. 320). Gunnoe's land now sits below a 10-story-high pile of mine waste.

With the soil and vegetation gone, rains running off the mountain ridge flooded her land seven times since 2000. They covered her land with toxic sludge, contaminated her water well and the soil she used to grow food, and washed out two small bridges that linked her to the only road out. Gunnoe had to hike to and from the road for years. When she complained to the coal company officials, they called the floods "acts of God."

Gunnoe, a mother of two, refused to leave her land and decided to fight the powerful coal companies and to try to end mountaintop coal mining. Mining companies and miners who worried about losing their jobs viewed her as an enemy. She and her children received death threats and two family dogs were killed. People tried to run her off the road and fired shots around her house. For several years, Gunnoe wore a bulletproof vest when she went outside, but she kept up the fight.

With only a high school education, Gunnoe educated herself about complex mining and water pollution regulations and harmful chemicals found in streams and groundwater. She organized communities and argued in court and testified before Congress contending that the "valley fills" from mountaintop mining violate the federal Clean Water Act by burying streams and destroying aquatic and animal habitats. The EPA agreed and fined coal companies multiple times. She also pressured the president and federal government to ban mountaintop mining because of its harmful health effects.

In 2009 this courageous and inspiring woman won a Goldman Environmental Prize—considered the Nobel Prize equivalent for grassroots environmental leaders around the world.



Courtesy of Goldman Environmental Prize

Individuals Matter 18.1

Hayat Sindi: Health Science Entrepreneur

Growing up in a home of humble means in Saudi Arabia, Hayat Sindi was determined to get an education, become a scientist, and do something for humanity. She was the first Saudi woman to be accepted at Cambridge University. She earned a PhD and taught in the Cambridge's international medical program, and in 2012 she was named a National Geographic Explorer.

As a visiting scholar, Sindi worked with a team of scientists at Harvard University and co-founded a nonprofit company called *Diagnostics for All* to bring low-cost health monitoring to remote, poor areas of the world. The Harvard team sought to develop simple and inexpensive diagnostic tools that could be used to detect certain illnesses and medical problems in remote areas.

One such tool is a small piece of paper the size of a postage stamp, with tiny channels and wells etched into it. Technicians load it with various diagnostic chemicals and then put a drop of a patient's blood, urine, or saliva onto this paper where the chemicals react with the fluid to change its color. Results show up in a minute and can be easily be read to diagnose different medical infections and conditions such as declining liver function, which can result from taking anti-TB drugs. The test can be conducted by a technician



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PROBLEM-SOLVING AND CRITICAL THINKING SKILLS

MATH CONNECTION

Measuring Productivity in an Aquatic Ecosystem

Primary productivity measures the rate at which sunlight is stored by plants in the form of organic molecules, or, in other words, the rate of *carbon fixation*. By measuring the amount of oxygen (a byproduct of photosynthesis) at various depths within a water column, a depth profile can be constructed showing the relationship between turbidity (cloudiness) and productivity. From these data, researchers can compare the relative productivity of different bodies of water.

FRQ Application

Productivity is expressed as mg C/m³/day. Therefore, if oxygen production is measured in mL O₂/liter/hour, these values must be converted. For every milliliter of O₂ produced, 0.536 mg of carbon is fixed.

Using these conversion units, productivity can be calculated at various depths in a pond:

$$1 \text{ mL O}_2 = 0.536 \text{ mg C} \quad 1 \text{ m}^3 = 1000 \text{ liters}$$

A water sample is taken at the surface of a pond. The amount of oxygen produced is measured at 0.14 mL O₂/liter/hour. Determine primary productivity by converting this measurement to mg C/m³/day.

First, convert the mL of O₂ to mg C:

$$0.14 \text{ mL O}_2/\text{liter}/\text{hour} \times \frac{0.536 \text{ mg C}}{1 \text{ mL O}_2} = 0.075 \text{ mg C}/\text{liter}/\text{hour} \quad (\text{mLs of O}_2 \text{ cancel})$$

Next, convert liters to cubic meters:

$$0.075 \text{ mg C}/\text{liter}/\text{hour} \times \frac{1000 \text{ L}}{\text{m}^3} = 75.04 \text{ mg C}/\text{m}^3/\text{hour} \quad (\text{liters cancel})$$

Since there are 24 hours in a day:

$$75.04 \text{ mg C}/\text{m}^3/\text{hour} \times 24 \text{ hours} = 1800.96 \text{ mg C}/\text{m}^3/\text{day}$$

BUILD CRITICAL THINKING SKILLS WITH REAL ENVIRONMENTAL DATA

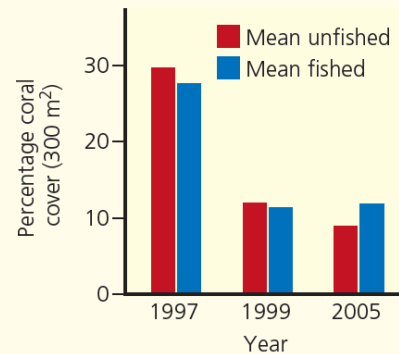
Data Analysis

Some 45–53% of the world's shallow coral reefs have been destroyed or severely damaged (**Core Case Study**). A number of factors have played a role in this serious loss of aquatic biodiversity, including ocean warming, sediment from coastal soil erosion, excessive algal growth from fertilizer runoff, coral bleaching, rising sea levels, ocean acidification, overfishing, and damage from hurricanes.

In 2005 scientists Nadia Bood, Melanie McField, and Rich Aronson conducted research to evaluate the recovery of coral reefs in Belize from the combined effects of mass bleaching and Hurricane Mitch in 1998. Some of these reefs are in protected waters where no fishing is allowed.

Effects of restricting fishing on the recovery of unfished and fished coral reefs damaged by the combined effects of mass bleaching and Hurricane Mitch in 1998.

(Compiled by the authors with data from Melanie McField, et al., *Status of Caribbean Coral Reefs after Bleaching and Hurricanes in 2005*, NOAA, 2008. Report available at www.coris.noaa.gov/activities/caribbean_rpt/.)



The researchers speculated that reefs in waters where no fishing is allowed should recover faster than reefs in waters where fishing is allowed. The graph to the left shows some of the data they collected from three highly protected (unfished) sites and three unprotected (fished) sites to evaluate their hypothesis. Study this graph and then answer the following questions.

1. By about what percentage did the mean coral cover drop in the protected (unfished) reefs between 1997 and 1999?
2. By about what percentage did the mean coral cover drop in the protected (unfished) reefs between 1997 and 2005?
3. By about what percentage did the coral cover drop in the unprotected (fished) reefs between 1997 and 1999?
4. By about what percentage did the coral cover change in the unprotected (fished) reefs between 1997 and 2005?
5. Do these data support the hypothesis that coral reef recovery should occur faster in areas where fishing is prohibited? Explain.

HANDS-ON SOLUTION TO REAL-LIFE PROBLEMS

Lab—Mining Simulation—Mining for Chocolate

Mining for chocolate simulates surface mining and challenges students to develop a mining strategy that allows them to make a profit. There are many versions of this exercise, but this one focuses on the impacts and externalities associated with mining.

Materials needed:

- Three types of cookies: Chips Ahoy, Keebler Chips Deluxe, and a soft cookie of some type. Archway is an example. The Chips Ahoy and Chips Deluxe have more chips in them, but fall apart easily, requiring more reclamation. The soft cookies tend to have fewer chips, but stay intact and are easier to mine.
- Mining tools: Flat toothpicks, round toothpicks, and paper clips. One tool holds the cookie in place, while the other tool is used to dig out the chips.
- Graph paper: Needed to determine the amount of land that must be reclaimed.



Lab—Sustaining Fisheries

To save instructional time, this lab can be assigned as a weekend assignment in lieu of classroom lecture. This assignment requires little guidance from the instructor.

The Sustaining Fisheries lab uses data collected by the National Oceanic and Atmospheric Administration (NOAA) for commercial fishing landings in metric tons. Students create and analyze a graph of a commercially harvested fish and calculate the rate of decreasing fish landings. Students also evaluate different commercial fishing methods and evaluate the impacts of aquaculture, an alternative to commercial fishing.

DEFEND AND DEBATE

**ENVIRONMENTAL SCIENCE | DEBATE AND DEFEND**

**SMALL GROUP
ACTIVITY #2**
30 minutes

Small Group Activity 2

Activity Name:

Human Population Growth: Mitigating the effects of affluence: How to curb overconsumption

Activity Overview:

Students work in groups to propose workable strategies for mitigating the effects of affluence on the environment.

Activity Learning Objectives and Assessment:

Learning Objectives:

1. Evaluate the potential impacts of affluence on sustainability.
2. Design strategies for reducing overconsumption.

Assessment:

1. Students are able to evaluate the relationship between wealth and consumption or environmental impact.
2. Students are able to formulate relevant strategies for reducing overconsumption and enhancing sustainability.

Detailed Activity Description:

In addressing the impact humans have on the environment, we commonly focus on population reduction strategies such as family planning and education. Less commonly do we focus on the other important variable in the human impact equation, which is affluence.

Since there is a correlation between affluence and environmental impact, what strategies could be developed to mitigate those effects? In other words, what outreach strategies minimize the impact of the human population in wealthy nations, given that this impact is largely determined by behaviors rather than fertility rates?

Work together in groups to propose workable strategies, while assessing any obstacles to their implementation. Consider narrowing the scope to a specific aspect of overconsumption, such as consumerism, transportation, housing, or food.

Share your results with the class.

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**ENVIRONMENTAL SCIENCE**

**RESEARCH
PROJECT**

Research Project for Debate and Defend

Project Name:

Human Population Growth: Exploring impacts on sustainability: A comparative analysis between nations

Project Overview:

Students will research fertility rates for two countries, one with a relatively high rate and another with a relatively low rate. Students will then research the reasons for the discrepancy and explore any relevant strategies or programs that have been implemented to reduce fertility rates. Findings will be presented in a research paper or oral presentation.

Project Learning Objectives and Assessment

Learning Objectives:

1. Compare the relative fertility rates and environmental impact of different countries.
2. Evaluate the specific parameters that impact the relative sustainability of nations.

Assessment:

1. Students identified relevant aspects of different societies that determine fertility rates and environmental impact.
2. Students presented a clear comparison and drew relevant conclusions.

Detailed Project Description:

Students will be assigned a category, either developing nations or developed nations.

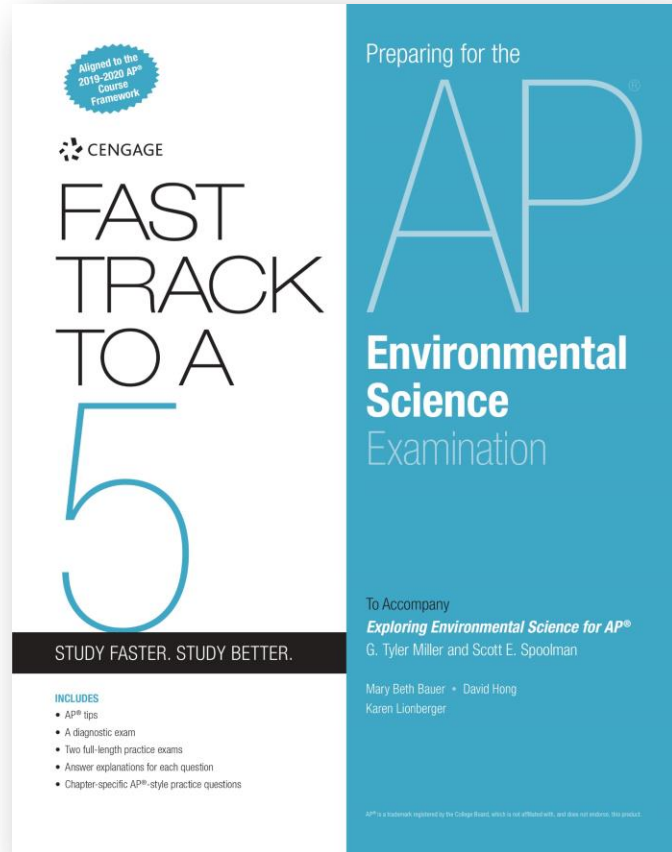
For developing nations, students will research fertility rates for two countries, one with a relatively high rate and another with a relatively low rate. Students will then research the reasons for the discrepancy and explore any relevant strategies or programs that have been implemented to reduce fertility rates.

For developed nations, the focus will be on ecological footprints. Students will choose two nations within the category of developed nations (one with a larger per capita footprint and one with a smaller per capita footprint) and research and evaluate the reasons for the discrepancy.

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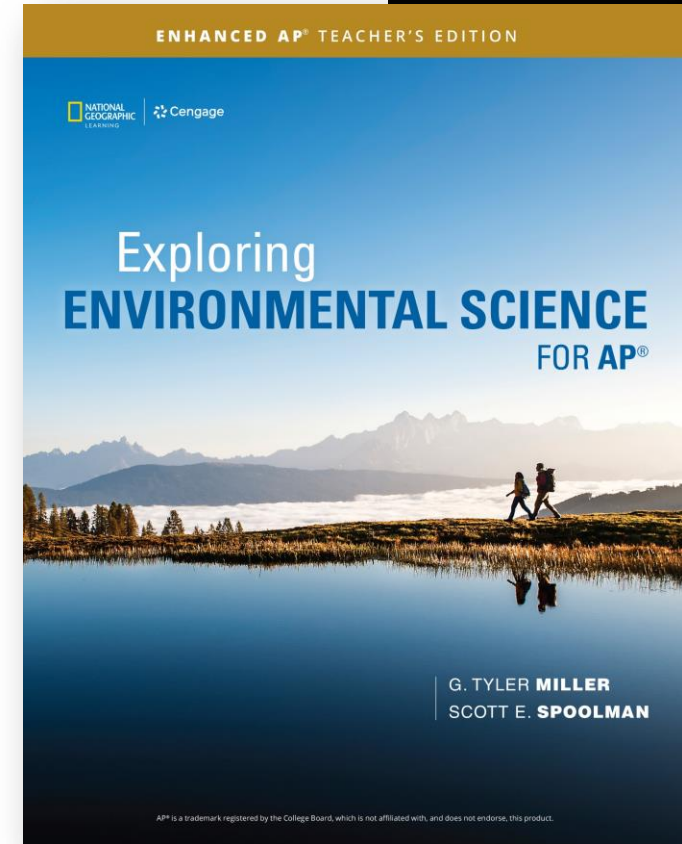
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- Two Full Practice Tests

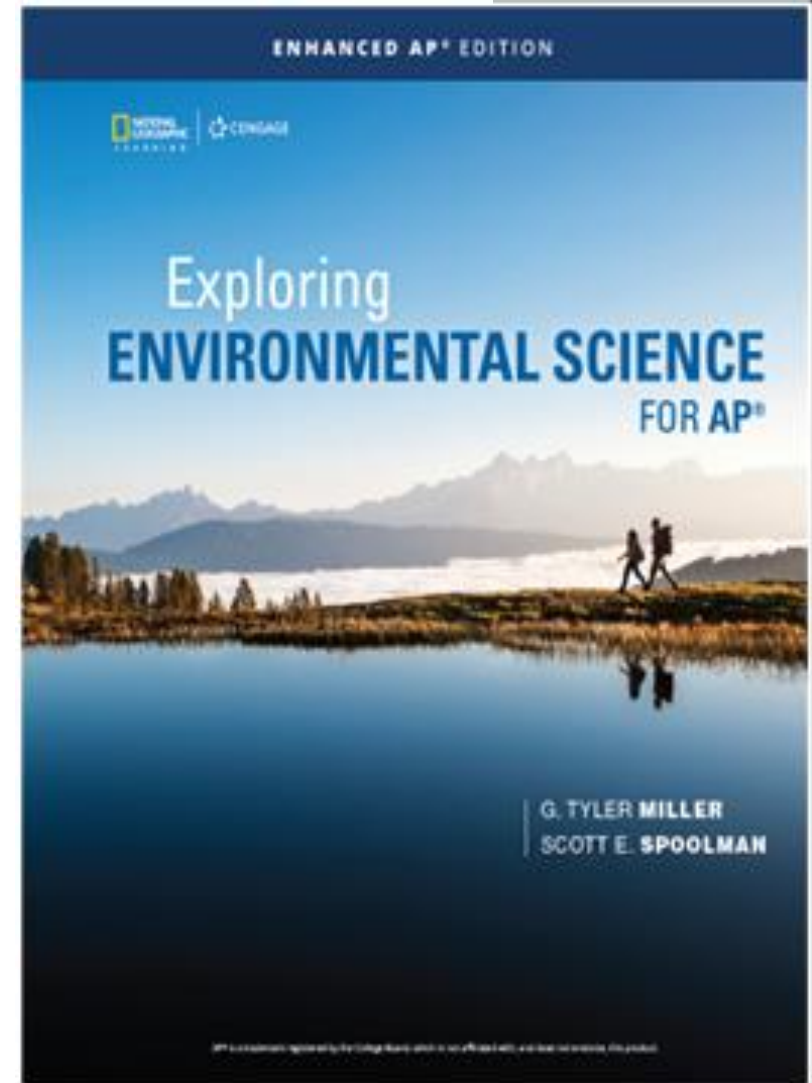
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- Pacing guide
- Focus on AP Big Ideas
- Activities, labs, projects
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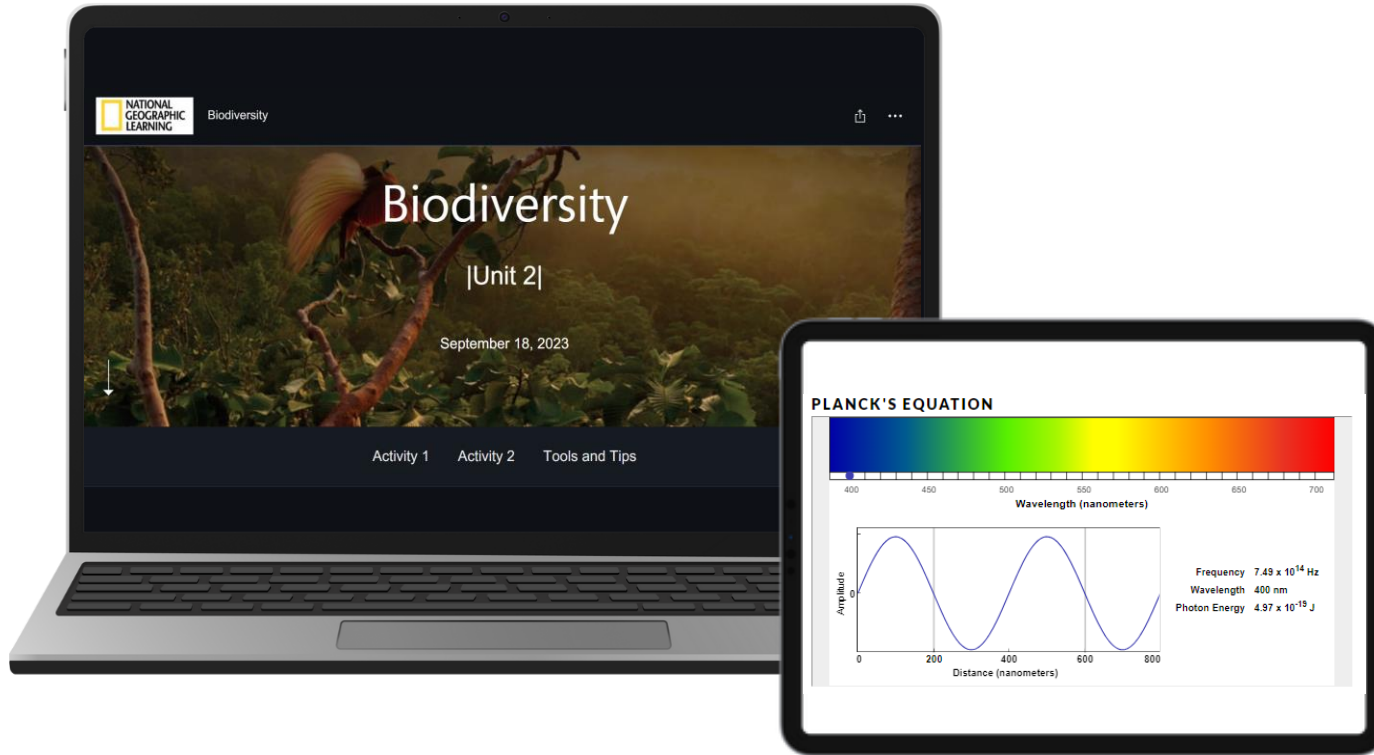


BOOK WALK THROUGH

Ch. 7: Populations



DIGITAL INTEGRATION AND SUPPORT



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1:1 ON-DEMAND SESSIONS





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PREPARING STUDENTS FOR COLLEGE AND CAREER SUCCESS THROUGH THE STUDY OF ENVIRONMENTAL SCIENCE...

- Problem Solving
- Research Skills
- Organization
- Analytical Skills
- Teamwork
- Communication Skills
- Build Arguments
Based On Evidence



THANK YOU

