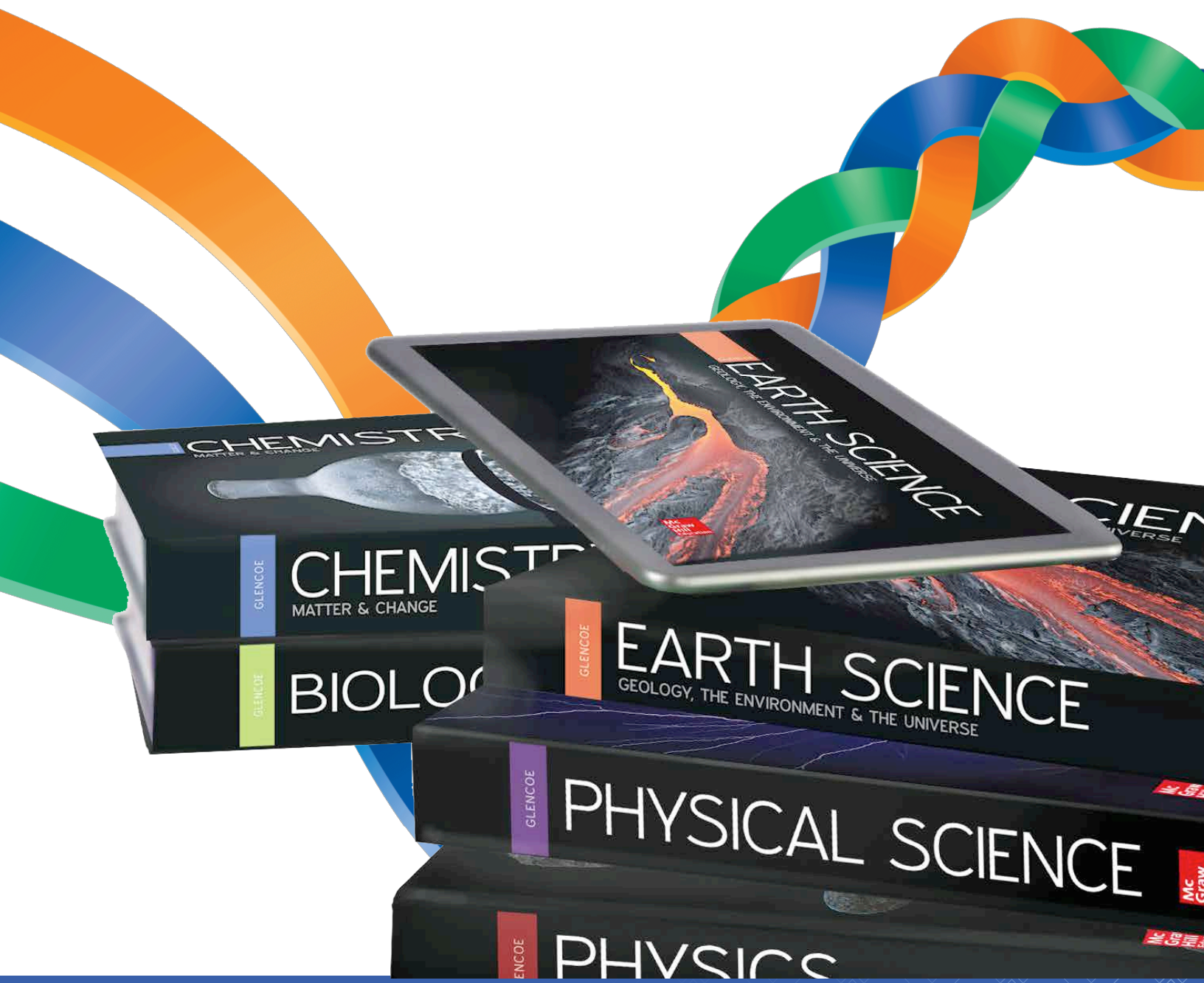
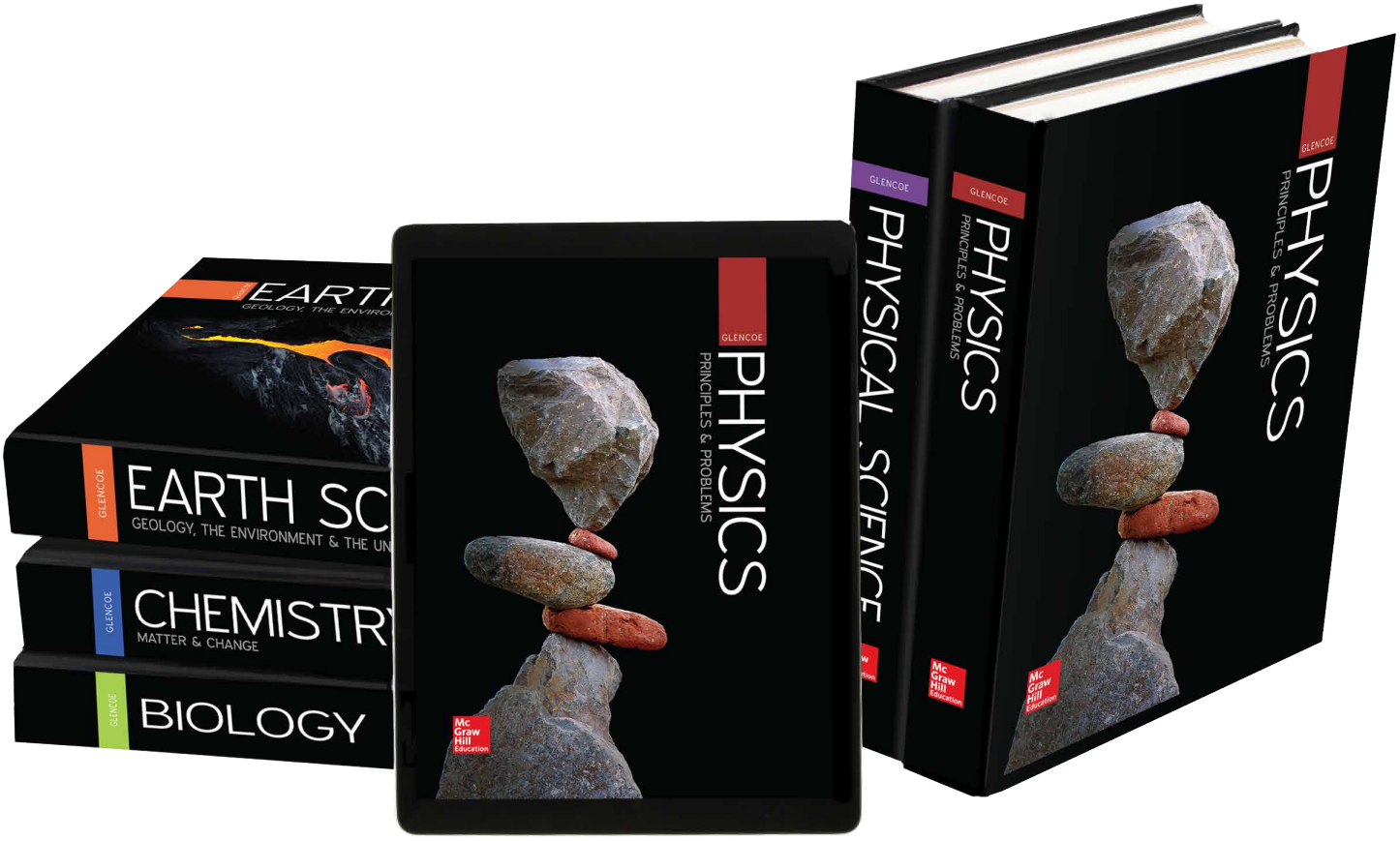
Mc Graw Hill Education

Three-Dimensional Learning Guide to

High School Science





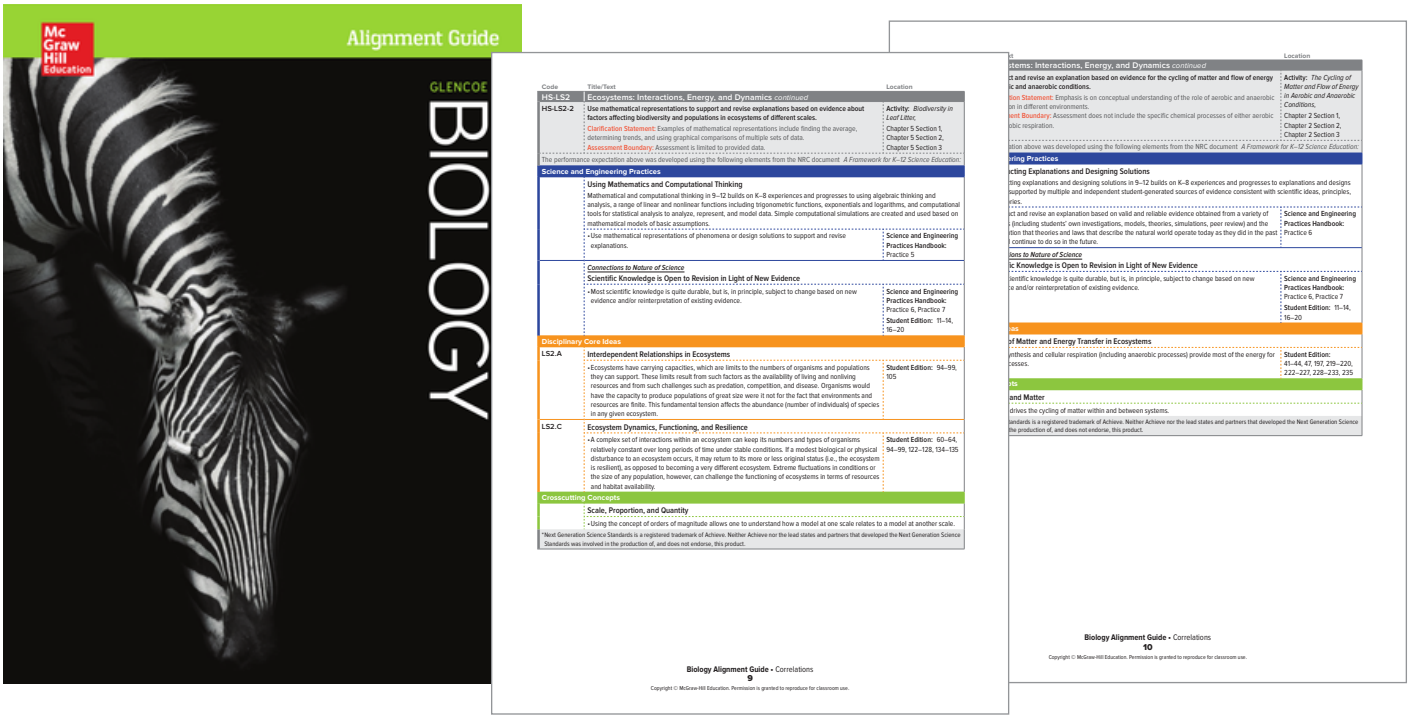
McGraw-Hill Education is your partner in delivering a balanced learning experience to meet the needs of your diverse 21st century classroom and students. This **Three-Dimensional Learning Guide** is your blueprint for a hands-on, student inquiry classroom to meet the new science standards.

This Guide will take you through the programs by highlighting how to implement **Inquiry** and **Student-led exploration**, disciplinary core ideas, crosscutting concepts, and science and engineering practices.

Each chapter starts with a visual phenomenon, online guiding questions in the Phenomenon Bank, and a Launch Lab to spark student inquiry. Multiple opportunities for Student Exploration and Investigation foster collaboration throughout each lesson. Formative assessment and student self-evaluation guide learning.

Look for these icons throughout this guide to show where to find the NGSS tools of the High School Programs.

Ease the Transition to Meeting the Next Generation Science Standards



High School Science helps ease the transition to **Next Generation Science Standards** (NGSS)*. Our high school science programs ensure you are fully aligned to:

- Performance Expectations
- Science and Engineering Practices
- Disciplinary Core Ideas (DCIs)
- Crosscutting Concepts

We are committed to ensuring that you have the tools and resources necessary to meet the expectations for the Next Generation Science Standards.

What is NGSS?

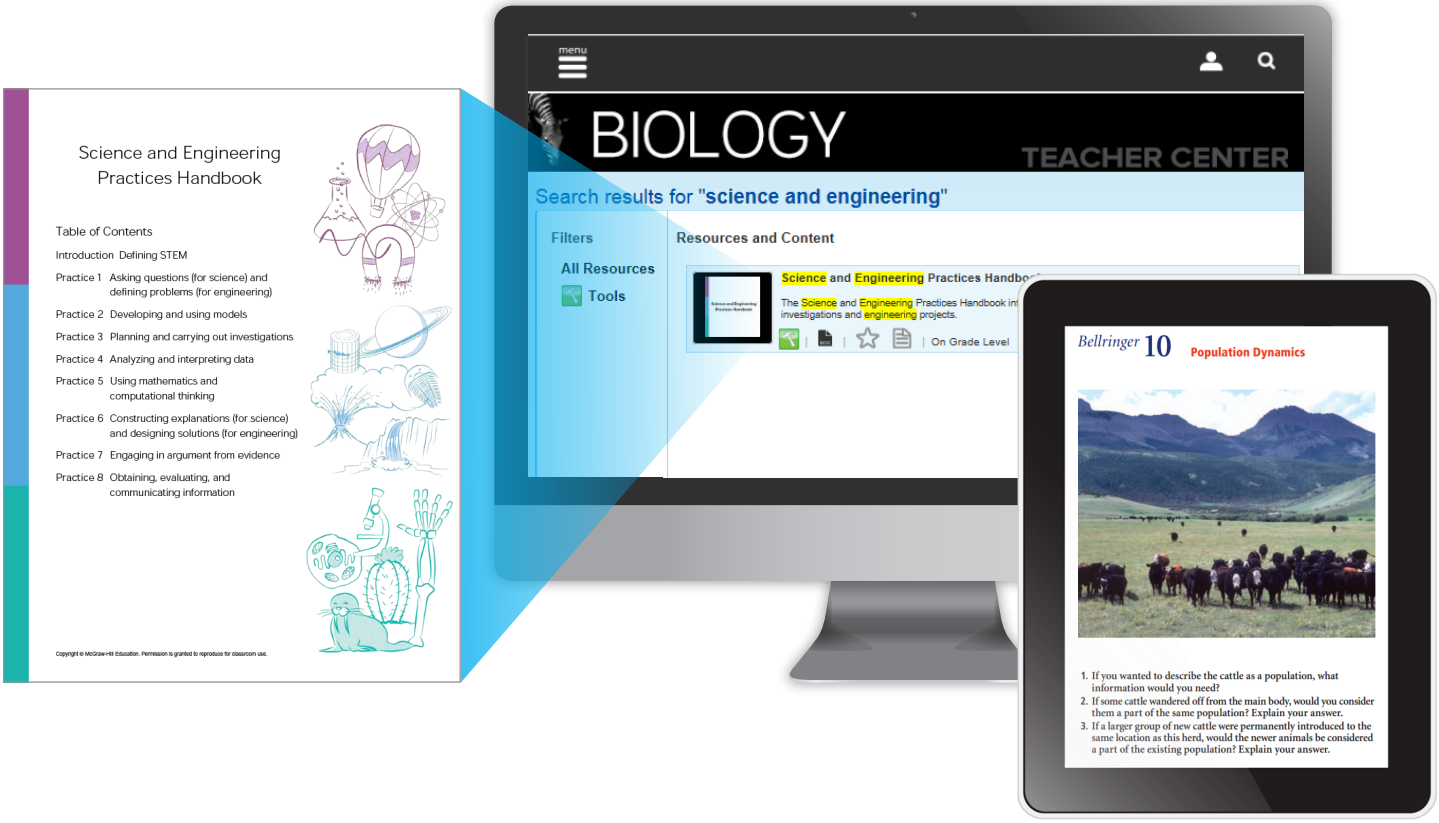
The purpose of *A Framework for K-12 Science Education* and the NGSS is to act as the foundation for science education while describing a vision of what it means to be proficient in science. It emphasizes the importance of the practices of science and engineering to learning critical thinking skills as well as content.

Why NGSS?

The NGSS were developed in an effort to create unified standards in science education that consider content, practices, pedagogy, curriculum, and professional development. The standards provide all students with an internationally benchmarked education in science.

*Next Generation Science Standards is a registered trademark of Achieve. Neither Achieve nor the lead states and partners that developed the Next Generation Science Standards was involved in the production of, and does not endorse, this product.

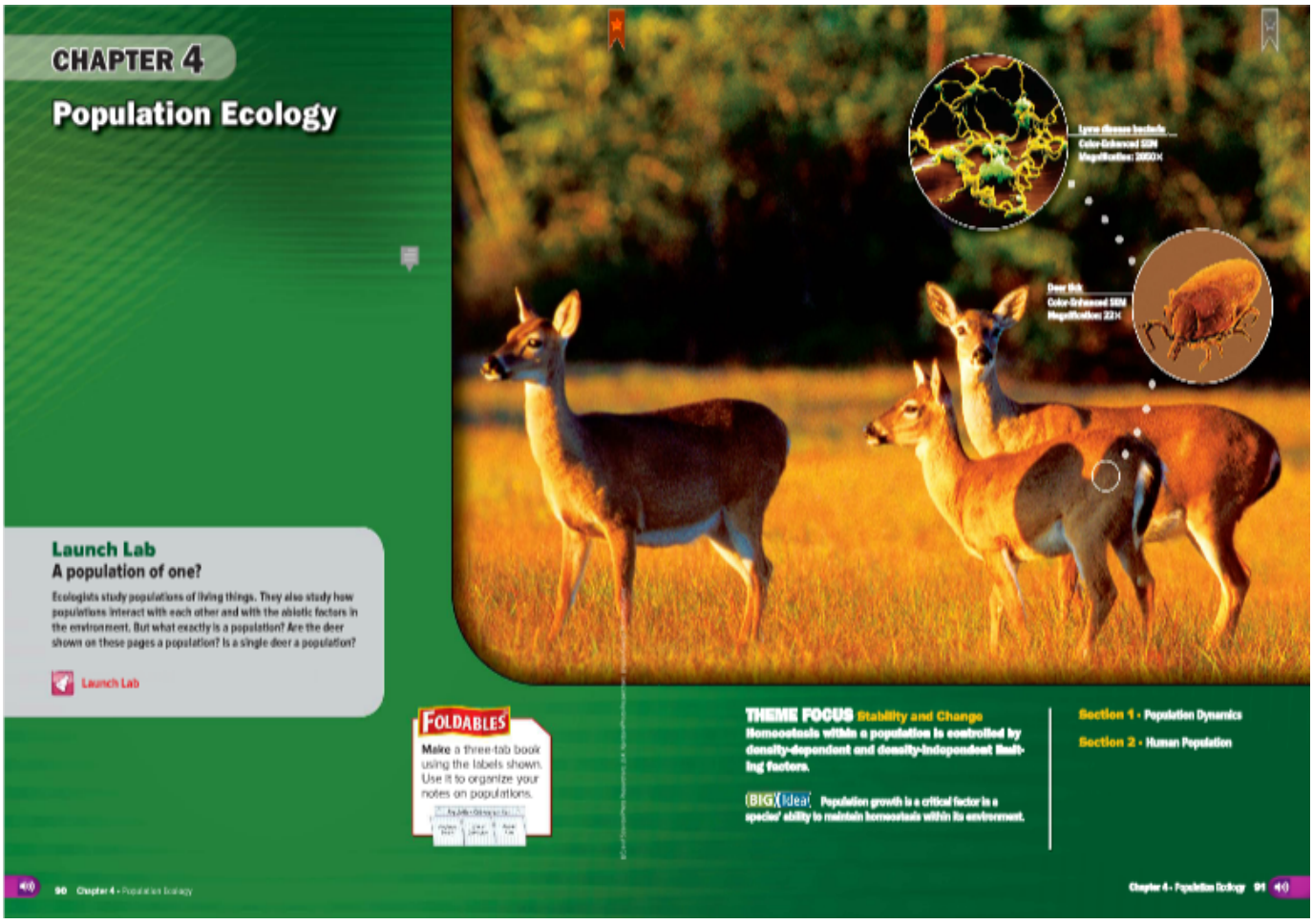
Science and Engineering Practices Handbook



The *Science and Engineering Practices Handbook*, found in the Student Center and Teacher Center online ConnectEd, introduces students to the skills they will use in science investigations and engineering projects. It explains the Crosscutting Concepts as well as the eight Science and Engineering Practices defined by *A Framework for K-12 Science Education*.

This useful tool eases the transition to the NGSS by providing definitions, examples, and Quick Practice activities to be used as reference while students develop their projects and meet performance expectations.

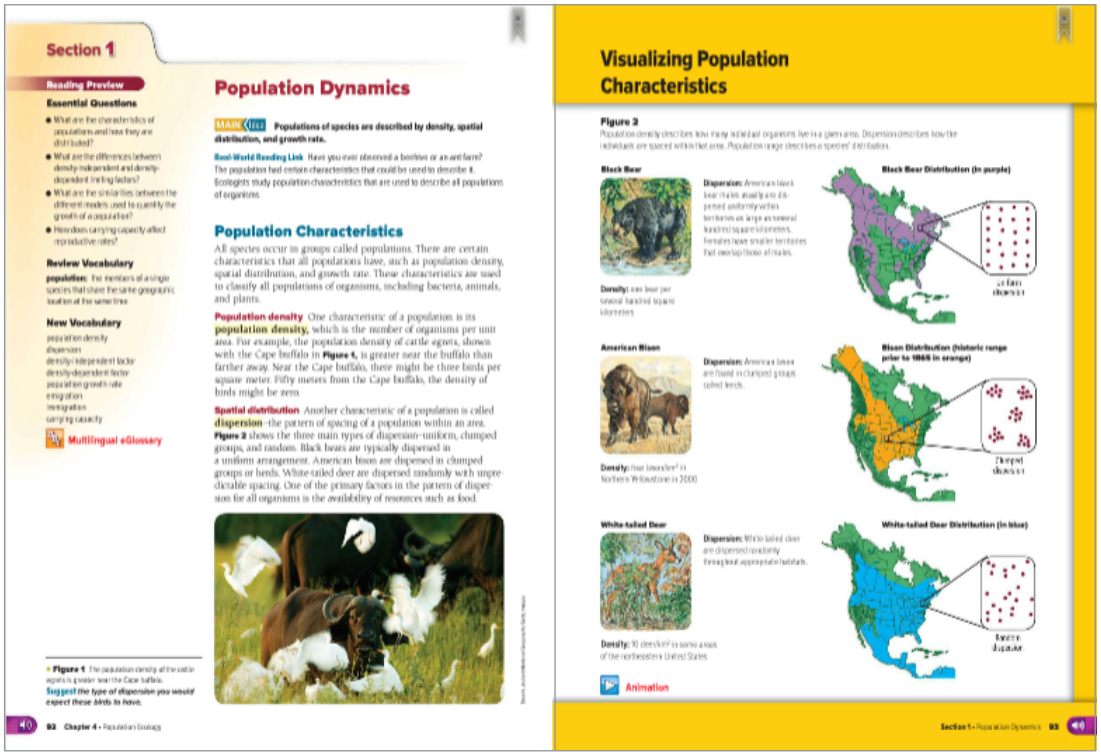
The **Big Idea** is the overarching concept for chapter. It helps provide the framework for understanding the details that follow. The **phenomenon photo** generates student interest, prompting them to ask their own questions. The **LaunchLab** provides a hands-on start to the inquiry process.



Start with the **Big Idea,** the hands-on **LaunchLab**, and an engaging phenomenon to spark student investigation and collaboration.

Section Opener

The **Reading Guide** supports student reading and literacy in science and technical subjects.



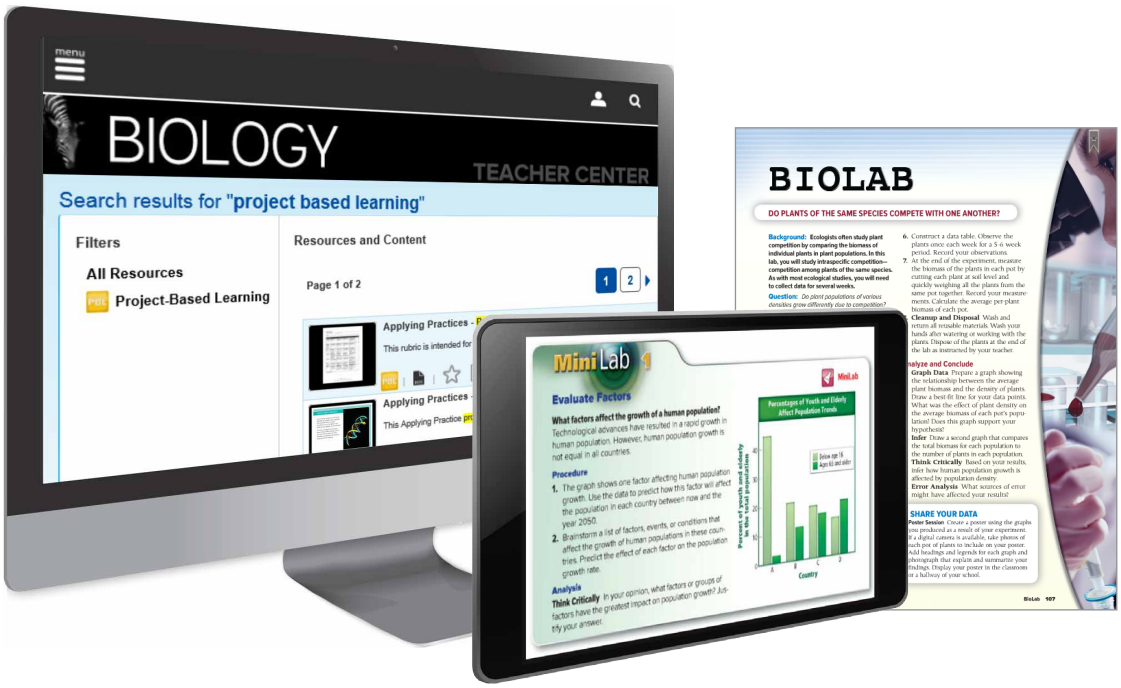
Each section provides multiple opportunities for student exploration, investigation, and collaboration with:

- PBLs
- Applying Practices
- WebQuests
- Mini Labs
- Labs
- Virtual Labs

Each section opener builds on the framework started by the Chapter Opener Big Idea with the Main Idea and Essential Questions. Reading begins with a link to the student's real-world or to prior knowledge.

Support three-dimensional learning with opportunities question, explore, gather evidence, conclude, and apply.

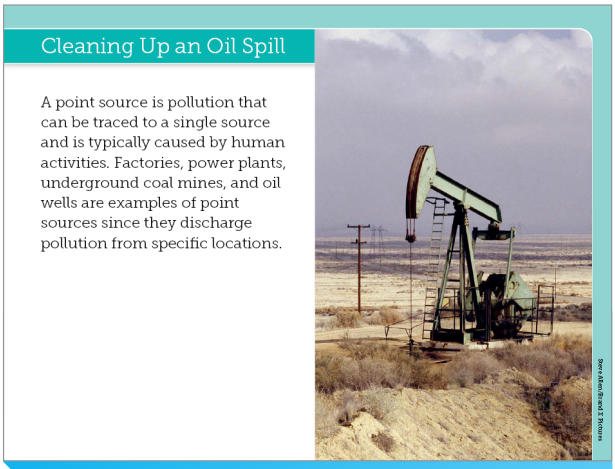
Student Investigation and Solution Design

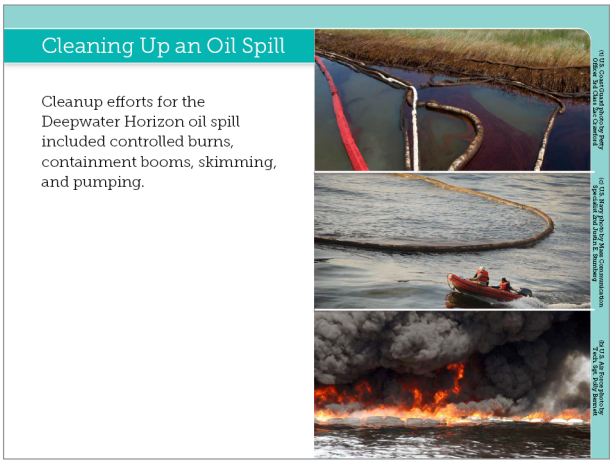


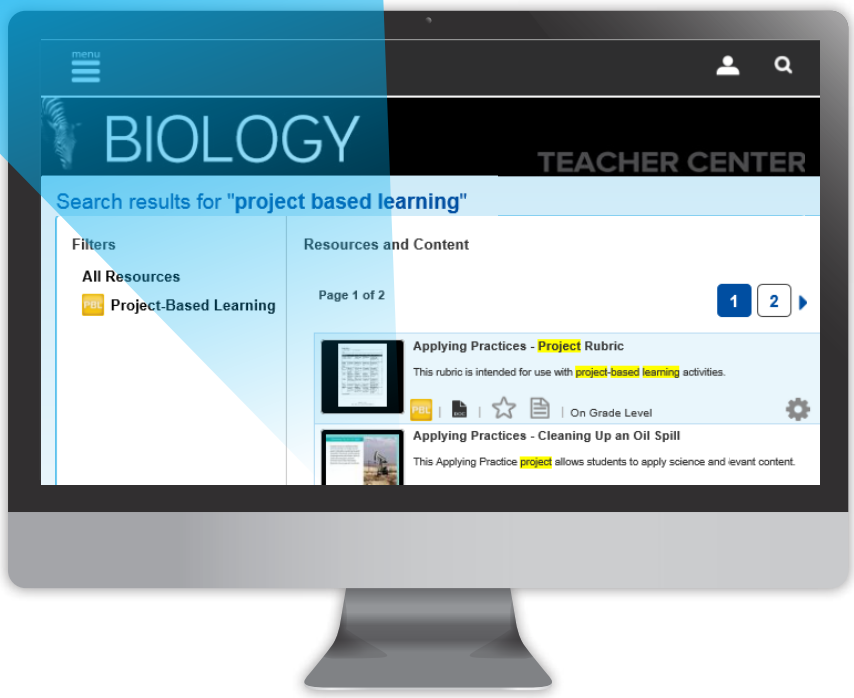
Student exploration, investigation, and solution design options are throughout the Student Edition and the online Student Center and Teacher Center.

1. Project Based Learning
2. Applying Pracices built on NGSS performance expectations
3. Labs and Mini Labs
4. Virtual Labs
5. Webquests
6. Research and writing activities on each chapter's feature
7. Document - based questions and data analysis activities

Real-world student-led projects, such as the PBL's found online in ConnectED, engage students to apply three-dimensional learning. Project rubrics provide key information for assessing students' work.

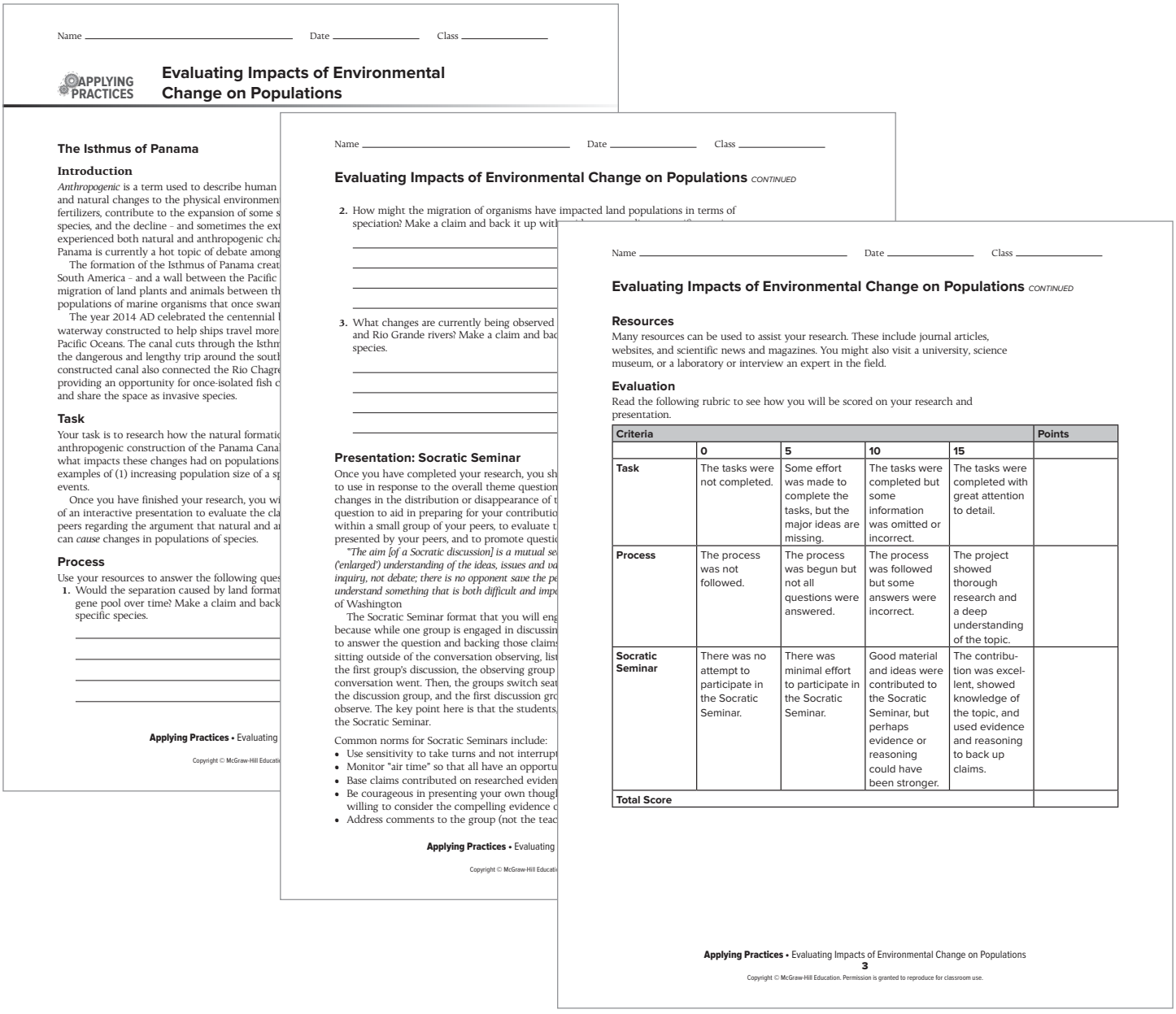






PBLs correlate to NGSS performance expectations and spark student inquiry and solutions design.

Investigation and Solution Design: Applying Practices



Name _____ Date _____ Class _____

APPLYING PRACTICES

Evaluating Impacts of Environmental Change on Populations

The Isthmus of Panama

Introduction

Anthropogenic is a term used to describe human
and natural changes to the physical environmen
fertilizers, contribute to the expansion of some s
species, and the decline – and sometimes the ext
experienced both natural and anthropogenic cha
Panama is currently a hot topic of debate among

The formation of the Isthmus of Panama creat
South America – and a wall between the Pacific
migration of land plants and animals between th
populations of marine organisms that once swan

The year 2014 AD celebrated the centennial
waterway constructed to help ships travel more
Pacific Oceans. The canal cuts through the Isthm
the dangerous and lengthy trip around the soutl
constructed canal also connected the Rio Chagre
providing an opportunity for once-isolated fish c
and share the space as invasive species.

Task

Your task is to research how the natural formatic
anthropogenic construction of the Panama Cana
what impacts these changes had on populations
examples of (1) increasing population size of a sp
events.

Once you have finished your research, you wi
of an interactive presentation to evaluate the cla
peers regarding the argument that natural and a
can *cause* changes in populations of species.

Process

Use your resources to answer the following ques

1. Would the separation caused by land format
gene pool over time? Make a claim and back
specific species.

_____
_____
_____
_____

Applying Practices • Evaluating

Name _____ Date _____ Class _____

Evaluating Impacts of Environmental Change on Populations *CONTINUED*

2. How might the migration of organisms have impacted land populations in terms of speciation? Make a claim and back it up wit

_____
_____
_____
_____

3. What changes are currently being observed
and Rio Grande rivers? Make a claim and bac
species.

_____
_____
_____
_____

Presentation: Socratic Seminar

Once you have completed your research, you sh
to use in response to the overall theme question
changes in the distribution or disappearance of t
question to aid in preparing for your contributio
within a small group of your peers, to evaluate t
presented by your peers, and to promote questi

*"The aim [of a Socratic discussion] is a mutual se
('enlarged') understanding of the ideas, issues and va
inquiry, not debate; there is no opponent save the pe
understand something that is both difficult and impe*
of Washington

The Socratic Seminar format that you will eng
because while one group is engaged in discussin
to answer the question and backing those claims
sitting outside of the conversation observing, list
the first group's discussion, the observing group
conversation went. Then, the groups switch seat
the discussion group, and the first discussion gro
observe. The key point here is that the students,
the Socratic Seminar.

Common norms for Socratic Seminars include:

- Use sensitivity to take turns and not interrupt
- Monitor "air time" so that all have an opportu
- Base claims contributed on researched eviden
- Be courageous in presenting your own thoug
willing to consider the compelling evidence o
- Address comments to the group (not the teac

Applying Practices • Evaluating

Name _____ Date _____ Class _____

Evaluating Impacts of Environmental Change on Populations *CONTINUED*

Resources

Many resources can be used to assist your research. These include journal articles, websites, and scientific news and magazines. You might also visit a university, science museum, or a laboratory or interview an expert in the field.

Evaluation

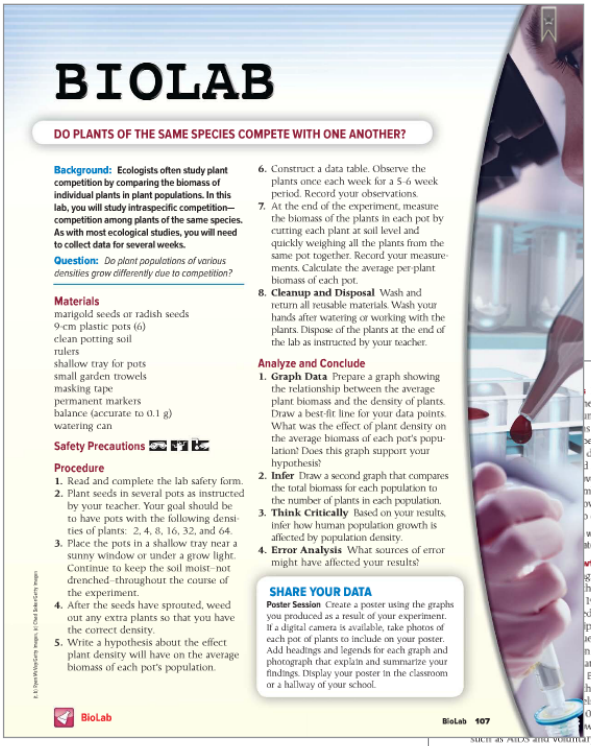
Read the following rubric to see how you will be scored on your research and presentation.

Criteria					Points
	0	5	10	15	
Task	The tasks were not completed.	Some effort was made to complete the tasks, but the major ideas are missing.	The tasks were completed but some information was omitted or incorrect.	The tasks were completed with great attention to detail.	
Process	The process was not followed.	The process was begun but not all questions were answered.	The process was followed but some answers were incorrect.	The project showed thorough research and a deep understanding of the topic.	
Socratic Seminar	There was no attempt to participate in the Socratic Seminar.	There was minimal effort to participate in the Socratic Seminar.	Good material and ideas were contributed to the Socratic Seminar, but perhaps evidence or reasoning could have been stronger.	The contribution was excellent, showed knowledge of the topic, and used evidence and reasoning to back up claims.	
Total Score					

Applying Practices • Evaluating Impacts of Environmental Change on Populations
3

Applying Practices activities correlate to NGSS performance expectations and apply specific science and engineering practices to DCIs.

Labs, **MiniLabs**, and **Data Analysis Labs** require students to use the science practices to investigate, explain, and apply disciplinary core ideas and cross-cutting concepts.



BIOLAB

DO PLANTS OF THE SAME SPECIES COMPETE WITH ONE ANOTHER?

Background: Ecologists often study plant competition by comparing the biomass of individual plants in plant populations. In this lab, you will study intraspecific competition—competition among plants of the same species. As with most ecological studies, you will need to collect data for several weeks.

Question: *Do plant populations of various densities grow differently due to competition?*

Materials
marigold seeds or radish seeds
9-cm plastic pots (6)
clean potting soil
rulers
shallow tray for pots
small garden trowels
masking tape
permanent markers
balance (accurate to 0.1 g)
watering can

Safety Precautions

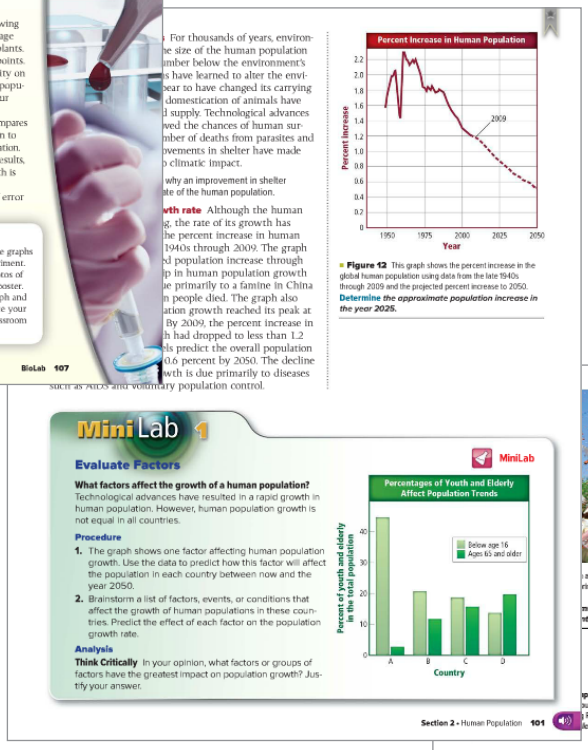
Procedure
1. Read and complete the lab safety form.
2. Plant seeds in several pots as instructed by your teacher. Your goal should be to have pots with the following densities of plants: 2, 4, 8, 16, 32, and 64.
3. Place the pots in a shallow tray near a sunny window or under a grow light. Continue to keep the soil moist–not drenched–throughout the course of the experiment.
4. After the seeds have sprouted, weed out any extra plants so that you have the correct density.
5. Write a hypothesis about the effect plant density will have on the average biomass of each pot's population.
6. Construct a data table. Observe the plants once each week for a 5–6 week period. Record your observations.
7. At the end of the experiment, measure the biomass of the plants in each pot by cutting each plant at soil level and quickly weighing all the plants from the same pot together. Record your measurements. Calculate the average per-plant biomass of each pot.
8. **Cleanup and Disposal** Wash and return all reusable materials. Wash your hands after watering or working with the plants. Dispose of the plants at the end of the lab as instructed by your teacher.

Analyze and Conclude
1. **Graph Data** Prepare a graph showing the relationship between the average plant biomass and the density of plants. Draw a best-fit line for your data points. What was the effect of plant density on the average biomass of each pot's population? Does this graph support your hypothesis?
2. **Infer** Draw a second graph that compares the total biomass for each population to the number of plants in each population.
3. **Think Critically** Based on your results, infer how human population growth is affected by population density.
4. **Error Analysis** What sources of error might have affected your results?

SHARE YOUR DATA
Poster Session Create a poster using the graphs you produced as a result of your experiment. If a digital camera is available, take photos of each pot of plants to include on your poster. Add headings and legends for each graph and photograph that explain and summarize your findings. Display your poster in the classroom or a hallway of your school.

BioLab

BioLab 107



...For thousands of years, environ-...he size of the human population ...mber below the environment's ...s have learned to alter the envi-...ear to have changed its carrying ...domestication of animals have ...d supply. Technological advances ...ved the chances of human sur-...mber of deaths from parasites and ...ovements in shelter have made ...climatic impact.

...why an improvement in shelter ...ate of the human population.

...wth rate Although the human ...g, the rate of its growth has ...he percent increase in human ...1940s through 2009. The graph ...d population increase through ...p in human population growth ...e primarily to a famine in China ...n people died. The graph also ...ation growth reached its peak at ...By 2009, the percent increase in ...h had dropped to less than 1.2 ...ls predict the overall population ...0.6 percent by 2050. The decline ...wth is due primarily to diseases ...such as AIDS and voluntary population control.

Percent Increase in Human Population

Percent increase

Year

2009

Figure 12 This graph shows the percent increase in the global human population using data from the late 1940s through 2009 and the projected percent increase to 2050. **Determine** *the approximate population increase in the year 2025.*

MiniLab 1

Evaluate Factors

MiniLab

What factors affect the growth of a human population?
Technological advances have resulted in a rapid growth in human population. However, human population growth is not equal in all countries.

Procedure
1. The graph shows one factor affecting human population growth. Use the data to predict how this factor will affect the population in each country between now and the year 2050.
2. Brainstorm a list of factors, events, or conditions that affect the growth of human populations in these countries. Predict the effect of each factor on the population growth rate.

Analysis
Think Critically In your opinion, what factors or groups of factors have the greatest impact on population growth? Justify your answer.

Percentages of Youth and Elderly Affect Population Trends

Below age 16
Ages 65 and older

Percent of youth and elderly in the total population

Country

Section 2 • Human Population 101

Carrying capacity In **Figure 8** on the previous page, notice that logistic growth levels off at the line on the graph identified as the carrying capacity. The maximum number of individuals in a species that an environment can support for the long term is the **carrying capacity.** Carrying capacity is limited by the energy, water, oxygen, and nutrients available. When populations develop in an environment with plentiful resources, there are more births than deaths. The population soon reaches or passes the carrying capacity. As a population nears the carrying capacity, resources become limited. If a population exceeds the carrying capacity, deaths outnumber births because adequate resources are not available to support all of the individuals. The population then falls below the carrying capacity as individuals die. The concept of carrying capacity is used to explain why many populations tend to stabilize.

Reproductive patterns The graph in **Figure 8** shows the number of individuals increasing until the carrying capacity is reached. However, there are several additional factors that must be considered for real populations. Species of organisms vary in the number of births per reproduction cycle, in the age that reproduction begins, and in the life span of the organism. Both plants and animals are placed into groups based on their reproductive factors.

Members of one of the groups are called the *r*-strategists. The rate strategy, or *r*-strategy, is an adaptation for living in an environment where fluctuation in biotic or abiotic factors occur. Fluctuating factors might be availability of food or changing temperatures. An *r*-strategist is generally a small organism such as a fruit fly, a mouse, or the locusts shown in **Figure 9.** *R*-strategists usually have short life spans and produce many offspring.

DATA ANALYSIS LAB 1

Based on Real Data*

Recognize Cause and Effect

Do parasites affect the size of a host population?
In 1994, the first signs of a serious eye disease caused by the bacterium *Mycoplasma gallisepticum* were observed in house finches that were eating in backyard bird feeders. Volunteers collected data beginning three different years on the number of finches infected with the parasite and the total number of finches present. The graph shows the abundance of house finches in areas where the infection rate was at least 20 percent of the house finch population.

Think Critically
1. **Compare** the data from the three areas.
2. **Hypothesize** why the house finch abundance stabilized in 1995 and 1996.

*Data obtained from Gregory, R. et al. 2000. Parasites take control. *Nature* 403: 33–34.

Data and Observations

House Finches and Mycoplasma gallisepticum Infection

1994 1995 1996

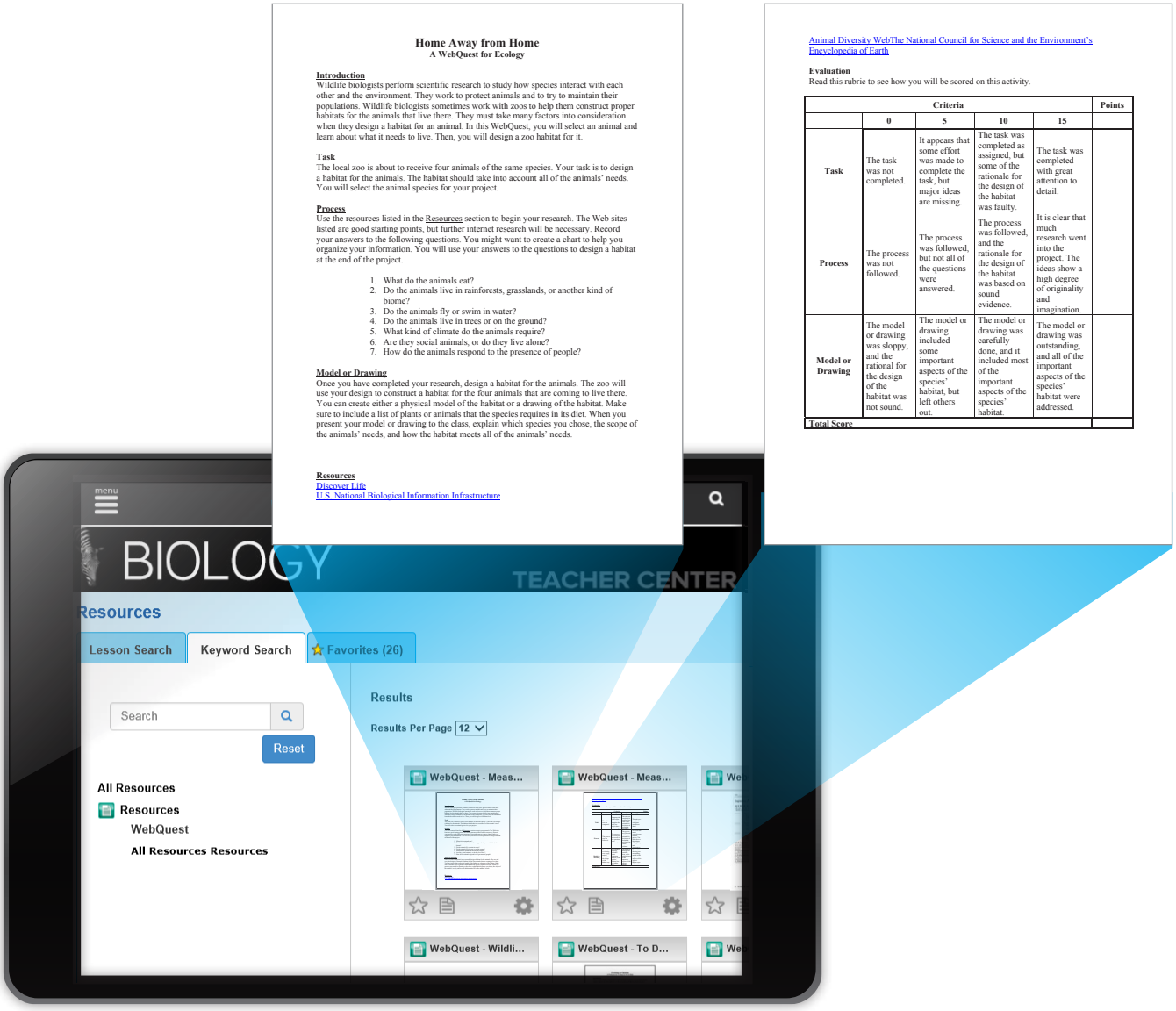
House finch index

Years after infection rate reached 20 percent

3. **Infer** whether the parasite, *Mycoplasma gallisepticum*, is effective in limiting the size of house finch populations. Explain.

98 Chapter 4 • Population Ecology

Labs require students to use the science practices and apply claim, evidence, and reasoning skills.

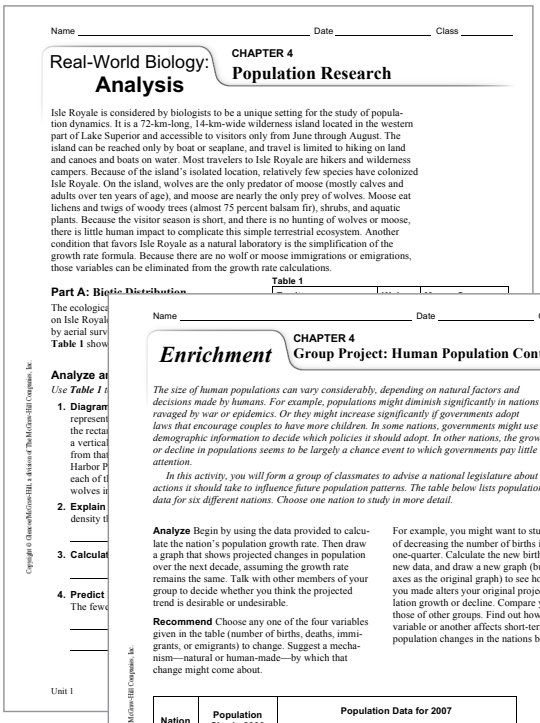


WebQuests require students to apply select **Science and Engineering Practices** (SEPs), DCIs, and Cross-cutting Concepts to new situations. WebQuests also are found online within ConnectED.

WebQuests are found within our online resources in ConnectED.

Additional Student Activities

Optional student activities such as Enrichment Resources, Real-World Biology, Environmental Explorations, and other help further understanding of the core disciplinary ideas..



Name _____ Date _____ Class _____

Real-World Biology: **Analysis**

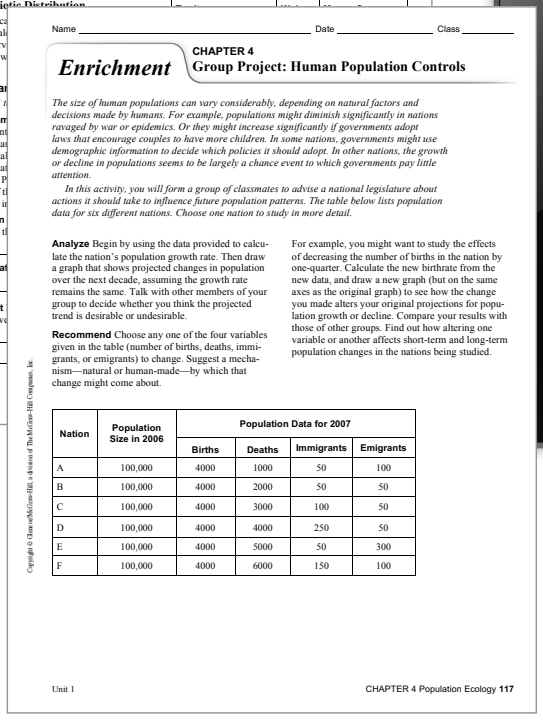
CHAPTER 4
Population Research

Isle Royale is considered by biologists to be a unique setting for the study of population dynamics. It is a 72-km-long, 14-km-wide wilderness island located in the western part of Lake Superior and accessible to visitors only from June through August. The island can be reached only by boat or seaplane, and travel is limited to hiking on land and canoes and boats on water. Most travelers to Isle Royale are hikers and wilderness campers. Because of the island's isolated location, relatively few species have colonized Isle Royale. On the island, wolves are the only predator of moose (mostly calves and adults over ten years of age), and moose are nearly the only prey of wolves. Moose eat lichens and twigs of woody trees (almost 75 percent balsam fir), shrubs, and aquatic plants. Because the visitor season is short, and there is no hunting of wolves or moose, there is little human impact to complicate this simple terrestrial ecosystem. Another condition that favors Isle Royale as a natural laboratory is the simplification of the growth rate formula. Because there are no wolf or moose immigrations or emigrations, those variables can be eliminated from the growth rate calculations.

Part A: Biotic Distribution

Table 1

Unit 1



Name _____ Date _____ Class _____

Enrichment

CHAPTER 4
Group Project: Human Population Controls

The size of human populations can vary considerably, depending on natural factors and decisions made by humans. For example, populations might diminish significantly in nations ravaged by war or epidemics. Or they might increase significantly if governments adopt laws that encourage couples to have more children. In some nations, governments might use demographic information to decide which policies it should adopt. In other nations, the growth or decline in populations seems to be largely a chance event to which governments pay little attention.

In this activity, you will form a group of classmates to advise a national legislature about actions it should take to influence future population patterns. The table below lists population data for six different nations. Choose one nation to study in more detail.

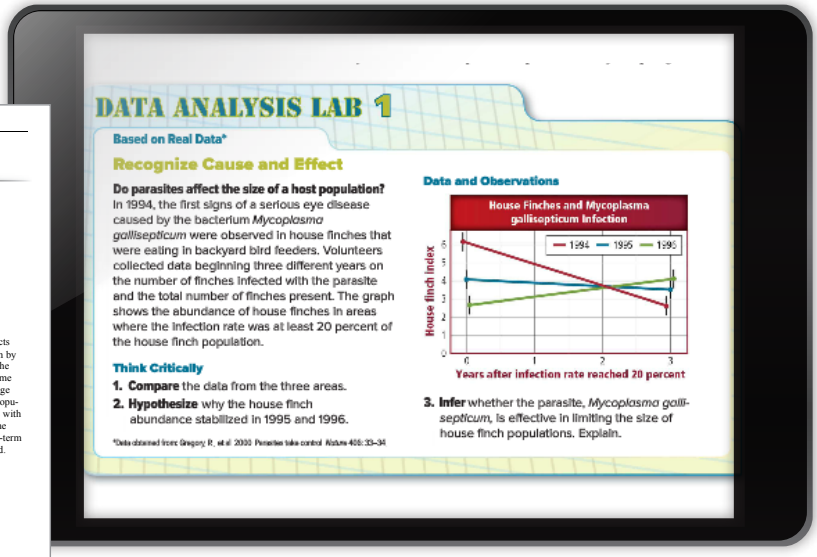
Analyze Begin by using the data provided to calculate the nation's population growth rate. Then draw a graph that shows projected changes in population over the next decade, assuming the growth rate remains the same. Talk with other members of your group to decide whether you think the projected trend is desirable or undesirable.

Recommend Choose any one of the four variables given in the table (number of births, deaths, immigrants, or emigrants) to change. Suggest a mechanism—natural or human-made—by which that change might come about.

For example, you might want to study the effects of decreasing the number of births in the nation by one-quarter. Calculate the new birthrate from the new data, and draw a new graph (but on the same axes as the original graph) to see how the change you made alters your original projections for population growth or decline. Compare your results with those of other groups. Find out how altering one variable or another affects short-term and long-term population changes in the nations being studied.

Nation	Population Size in 2006	Population Data for 2007			
		Births	Deaths	Immigrants	Emigrants
A	100,000	4000	1000	50	100
B	100,000	4000	2000	50	50
C	100,000	4000	3000	100	50
D	100,000	4000	4000	250	50
E	100,000	4000	5000	50	300
F	100,000	4000	6000	150	100

Unit 1 CHAPTER 4 Population Ecology **117**



DATA ANALYSIS LAB 1

Based on Real Data*

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Data and Observations

House Finches and Mycoplasma gallisepticum Infection

1994 1995 1996

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Years after infection rate reached 20 percent

Think Critically

1. **Compare** the data from the three areas.
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3. **Infer** whether the parasite, *Mycoplasma gallisepticum*, is effective in limiting the size of house finch populations. Explain.

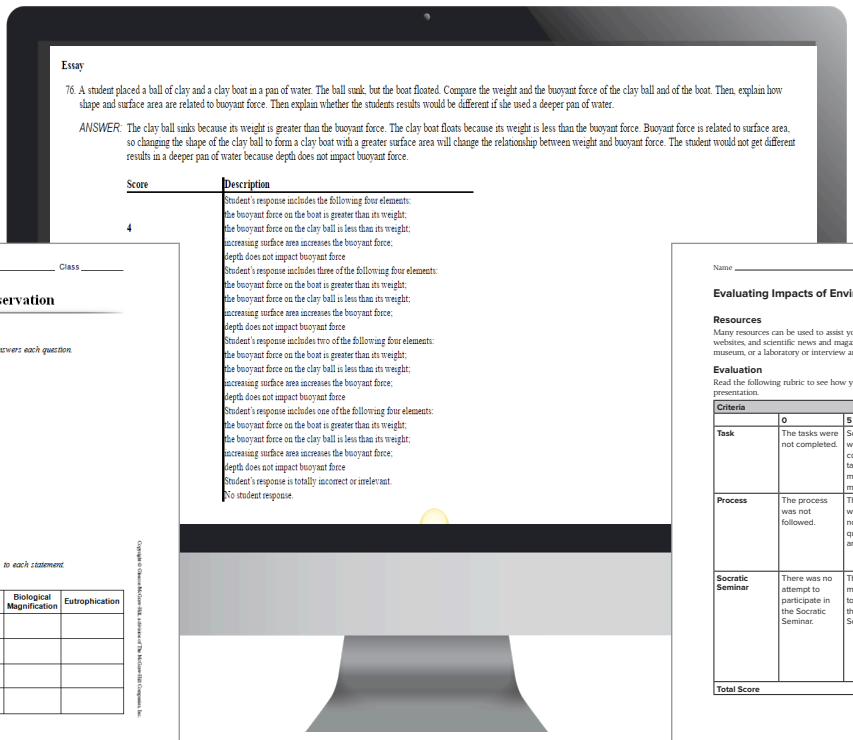
*Data obtained from: Gregory R, et al. 2000. Parasites take control. Nature 406: 33–34

These are all found online in ConnectED in the chapter and lesson resources.

Student Activities online help students foster engagement, and extend understanding.

Assessment

A variety of assessment types offer “pen and paper” assessment, online quizzes and tests, and performance task assessment.



Essay

76. A student placed a ball of clay and a clay boat in a pan of water. The ball sank, but the boat floated. Compare the weight and the buoyant force of the clay ball and of the boat. Then, explain how shape and surface area are related to buoyant force. Then explain whether the students results would be different if she used a deeper pan of water.

ANSWER: The clay ball sinks because its weight is greater than the buoyant force. The clay boat floats because its weight is less than the buoyant force. Buoyant force is related to surface area, so changing the shape of the clay ball to form a clay boat with a greater surface area will change the relationship between weight and buoyant force. The student would not get different results in a deeper pan of water because depth does not impact buoyant force.

Score	Description
4	Student's response includes the following four elements: the buoyant force on the boat is greater than its weight; the buoyant force on the clay ball is less than its weight; increasing surface area increases the buoyant force; depth does not impact buoyant force
	Student's response includes three of the following four elements: the buoyant force on the boat is greater than its weight; the buoyant force on the clay ball is less than its weight; increasing surface area increases the buoyant force; depth does not impact buoyant force
	Student's response includes two of the following four elements: the buoyant force on the boat is greater than its weight; the buoyant force on the clay ball is less than its weight; increasing surface area increases the buoyant force; depth does not impact buoyant force
	Student's response includes one of the following four elements: the buoyant force on the boat is greater than its weight; the buoyant force on the clay ball is less than its weight; increasing surface area increases the buoyant force; depth does not impact buoyant force
	Student's response is totally incorrect or irrelevant.
	No student response.

Name _____ Date _____ Class _____

Chapter Test A Biodiversity and Conservation

Part A: Multiple Choice

In the space at the left, write the letter of the phrase or sentence that best answers each question.

_____ 1. Which defines *extinction*?
A. A species disappears.
B. An ecosystem vanishes.
C. Biodiversity decreases.
D. Genetic diversity drops.

_____ 2. Which defines *background extinction*?
A. an accelerated extinction rate
B. extinctions of unknown species
C. mass extinctions in the past
D. the natural extinction rate

_____ 3. Which is an example of habitat fragmentation?
A. building several roads through wetlands
B. cutting down an entire section of forest
C. dumping chemical pollutants into a lake
D. removing the predators from a rain forest

Part B: Matching

Place a check in the correct box to identify the type of pollution that applies to each statement. More than one box may be checked for each statement.

Statement	Acid Precipitation	Biological Magnification	Eutrophication
1. Fertilizers cause excess algae to grow, which lower aquatic oxygen levels.			
2. Sulfur dioxide reacts with water in the atmosphere to make sulfuric acid.			
3. Pesticides accumulate in the bodies of organisms higher on the food chain.			
4. The accumulation of DDT in tissues of eagles and ospreys in the 1970s.			

Name _____ Date _____ Class _____

Evaluating Impacts of Environmental Change on Populations *CONTINUED*

Resources

Many resources can be used to assist your research. These include journal articles, websites, and scientific news and magazines. You might also visit a university, science museum, or a laboratory or interview an expert in the field.

Evaluation

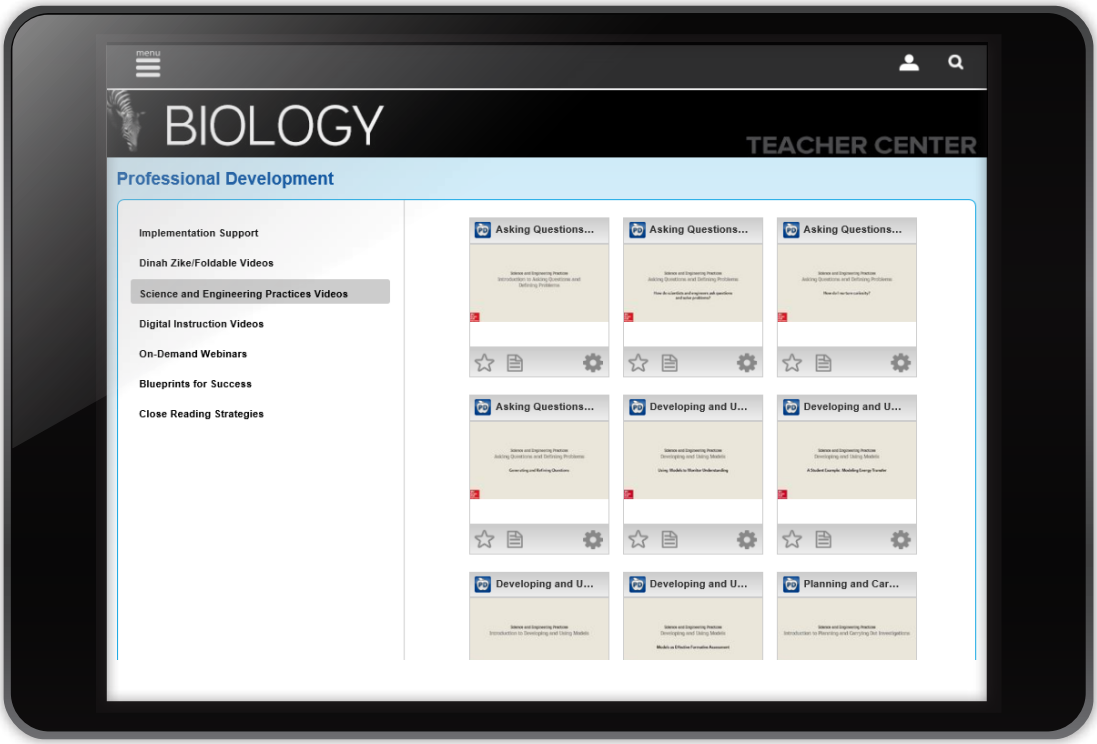
Read the following rubric to see how you will be scored on your research and presentation.

Criteria					Points
	0	5	10	15	
Task	The tasks were not completed.	Some effort was made to complete the tasks, but the major ideas are missing.	The tasks were completed but some information was omitted or incorrect.	The tasks were completed with great attention to detail.	
Process	The process was not followed.	The process was begun but not all questions were answered.	The process was followed but some answers were incorrect.	The project showed thorough research and a deep understanding of the topic.	
Socratic Seminar	There was no attempt to participate in the Socratic Seminar.	There was minimal effort to participate in the Socratic Seminar.	Good material and ideas were contributed to the Socratic Seminar, but perhaps evidence or reasoning could have been stronger.	The contribution was excellent, showed knowledge of the topic, and used evidence and reasoning to back up claims.	
Total Score					

Numerous options for formative and summative assessment help provide comprehensive insight into student learning.

Built-in assessment strands throughout the High School Science programs will inform instruction and keep students on track.

Professional Development around NGSS is Found under the Professional Development menu item in ConnectED.



NGSS Implementation videos provide guidance for teaching **Science and Engineering Practices**. These valuable videos are found online within the Professional Development menu in ConnectED.

Professional development resources provide teaching strategies and implementation support.

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