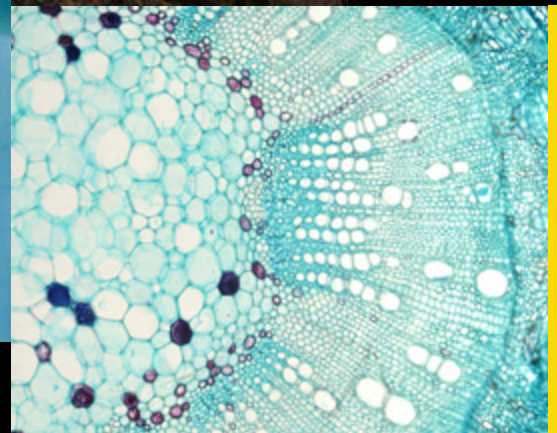
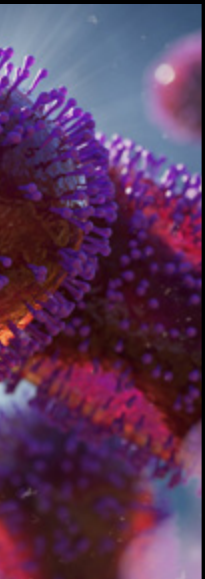


High School



BIOLOGY



PHENOMENA-BASED INSTRUCTION WITH NATIONAL GEOGRAPHIC RESOURCES

As teaching shifts towards multidisciplinary approaches to learning, *National Geographic Biology* is designed specifically to meet the needs of Phenomena-Based instruction. Deepen concept knowledge and inquiry skills by combining phenomena-based instruction with National Geographic resources. *Biology* empowers all students to investigate real-world scenarios and build skills towards academic and career success.



BUILT FOR 3-DIMENSIONAL INSTRUCTION

The 3-Dimensional approach to teaching is changing the way science and biology are taught. *National Geographic Biology* was created to guide teachers through 3D instruction by incorporating Disciplinary Core Ideas (DCI), Science and Engineering Practices (SEP), and Crosscutting Concepts (CCC) into each lesson to prepare students to master the Performance Expectations.

AUTHENTIC NATIONAL GEOGRAPHIC EXPERIENCE

National Geographic Biology connects students to the field of biology through content and features that showcase the experiences of diverse National Geographic Explorers and photographers. This engaging content consists of lessons with featured articles, videos, and Virtual Investigations in the digital platform hosted by the National Geographic explorers themselves.

Cengage MindTap

Online Learning Platform

National Geographic Explorer videos appear in MindTap. Explorers take students into the field introducing students to science phenomena.



With the help of the MindTap digital platform, students are transported into the world of biology with:

- realistic simulations allowing them to interact with data and graphs
- guided Virtual Investigations where they are immersed in field-relevant environments
- engaging videos embedded in the interactive eBook

ENGAGE STUDENTS WITH AUTHENTIC BIOLOGY STORIES

Diverse National Geographic Explorers share their personal backgrounds and exciting biology stories that engage students with relevant content that resonates!



National Geographic “On Assignment” photo features illuminate stories and transport students into the biological world around them.



A video series featuring National Geographic Explorers highlighting their unique biology stories and research supports the phenomena in the print text. Students see themselves reflected in these diverse biologists.



Digital Biology Explorations

Transport students into the field with simulations, engaging videos, and Virtual Investigations where a National Geographic Explorer guides students through a virtual biology research project.



Go Online
VIRTUAL INVESTIGATION

Sea Pigs on the Abyssal Plain
How do sea pigs survive in the deep ocean?

Take control of a remotely operated vehicle (ROV) to measure the population density of sea pigs on the ocean floor.

Go Online
VIRTUAL INVESTIGATION

Sea Pigs on the Abyssal Plain
How do sea pigs survive in the deep ocean?


Take control of a remotely operated vehicle (ROV) to observe organisms on the ocean floor.

ENSURING BIOLOGY STANDARDS ARE MET

National Geographic Biology was created specifically to teach 3-Dimensional standards and the NGSS to support high school life science standards core ideas, practices, and concepts.



FIGURE 4-3
A lion's head is shown in profile. The lion is looking towards the right. The lion's head is shown in profile. The lion is looking towards the right.



However, some individuals may have a higher rate of survival than others. For example, a lioness that is a better hunter may have a higher rate of survival than a lioness that is a poorer hunter. This is an example of **biotic potential**, the maximum rate of increase of a population.

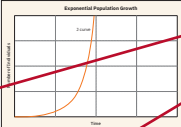
Cause and Effect How do competition and emigration affect the growth rate of a population?

Biotic Potential and Exponential Growth
A population's per capita growth rate can change over time for many reasons. Food resources or suitable habitats may become more or less available, or a population may be exposed to new predators or diseases. However, if neither food, nor other essential resources were unlimited and there were no external threats, the population would grow indefinitely as long as its birth rate was greater than its death rate.

Under ideal conditions, the population's per capita growth rate would be determined by the reproductive characteristics of its members, including the age at which individuals typically begin to reproduce, how long individuals are able to reproduce, and the number of offspring that are produced each year. This is the **biotic potential**. The biotic potential is a measure of the population's **biotic potential**. Different species have different biotic potentials. Species that have a high biotic potential have a high biotic potential, whereas large mammals with long lives have a low biotic potential.


Imagine a single bacterium in a laboratory flask that provides ideal conditions for survival and growth. After 20 minutes, the bacterium will divide in two. These two cells will divide, and so on, every 20 minutes. In this growth rate, a population of more than one billion can result from a single bacterium in just 10 hours. The graph of the number of individuals versus time for this bacterial population is shown in Figure 4-4. This is an example of **exponential growth**, which occurs when a population's per capita growth rate is positive (Figure 4-4).

FIGURE 4-4
Exponential growth rate is positive and resources are unlimited. The number of individuals increases exponentially over time.



Regardless of the species, populations with high biotic potential can grow rapidly under ideal conditions. However, in the real world, resources are limited, and growth is not unlimited. In a laboratory experiment, where conditions can be controlled and food resources are unlimited, the growth rate of a population is limited only by the biotic potential. In the real world, growth is limited by external factors, such as food, space, and other resources. This is an example of **exponential growth**, which occurs when a population's per capita growth rate is positive (Figure 4-4).

Construct an Explanation Describe the difference between the biotic potential of a population of organisms and the population's growth rate.



Questions and prompts throughout each chapter serve as 3D checkpoints, prompting students to engage with Disciplinary Core Ideas, Crosscutting Concepts, and Science and Engineering Practices.

SEP Construct an Explanation Describe the difference between the biotic potential of a population of organisms and the population's growth rate.

Connections to other disciplines in the student book and Teacher's Edition reinforce skills used throughout high school in all courses.


MATH AND ENGLISH LANGUAGE ARTS CONNECTIONS

3. **Write an Argument** Use your knowledge of population growth factors to explain why introducing a new population of a new species into a new habitat could be problematic. Use your understanding of biodiversity to frame your argument.

4. **Write a Function** Develop a formula to calculate the size of a population based on mark-recapture data. Use P for the estimated population size, n for the number of organisms captured the first time, or for the second time.

5. **Model with Mathematics** The expression $r = b - d$ describes the per capita growth rate r of a population with birth rate b and death rate d . How would immigration i and emigration e be included in the expression for r ?

LOOKING AT THE DATA
THE BIODIVERSITY CONSERVATION PARADOX



1. **Identify the Problem** The number of species in different groups is shown in the bar chart. Identify the problem.

2. **Identify the Data** The number of species in different groups is shown in the bar chart. Identify the data.

3. **Identify the Solution** The number of species in different groups is shown in the bar chart. Identify the solution.

Connect to Careers

Evolutionary Ornithologist Ornithology is the study of birds. Evolutionary ornithologists study how avian species have changed over time, using phylogenetics, evolutionary evidence of feathers from fossils, and a variety of other methods. They may use traditional field biology techniques, genetic testing, and technology such as drones and field cameras to collect data. Evolutionary ornithologists typically need a bachelor or master's degree in biology. Evolutionary ornithologists who lead research projects or work in specialized positions typically have a master's degree or higher degree. Universities, museums, and wildlife and conservation organizations hire evolutionary ornithologists to study birds in the field and in laboratory settings.

Wildlife Rehabilitator As environments continue to change, animals are more affected by human activities. Wildlife rehabilitators care for injured and ill animals and assist residents with animal conflicts. They work for nonprofit or governmental agencies to promote conservation of species and educate the public about wildlife. Wildlife rehabilitators are required to have knowledge about ecology, biology, and medical care, but a college degree is not always required.

Crosscurricular Connections

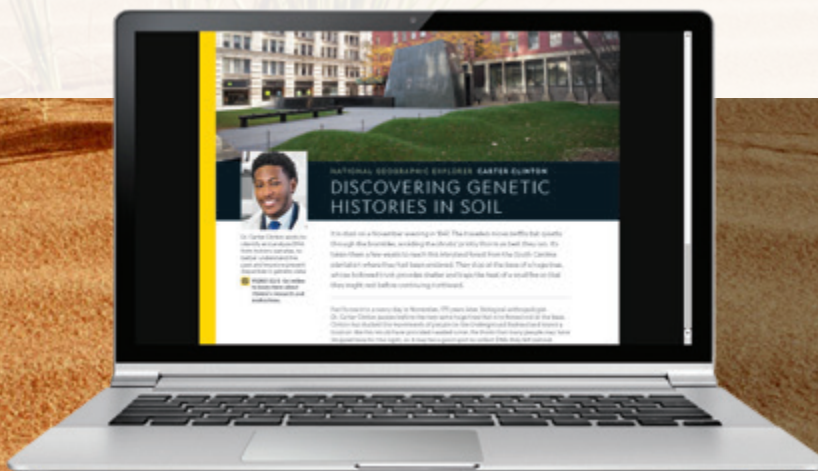
Chemistry Remind students of endo- and exothermic reactions, ones that absorb or release thermal energy. Show an instant hot pack, sealed in its package. When the package is opened and the pouch removed, the chemical inside, often iron, reacts with oxygen in the air to form iron (III) oxide, a reaction that releases heat. A simple demonstration of an endothermic reaction can be done by stirring baking soda into vinegar and measuring the temperature before and after.



PREPARE STUDENTS FOR COLLEGE AND CAREER

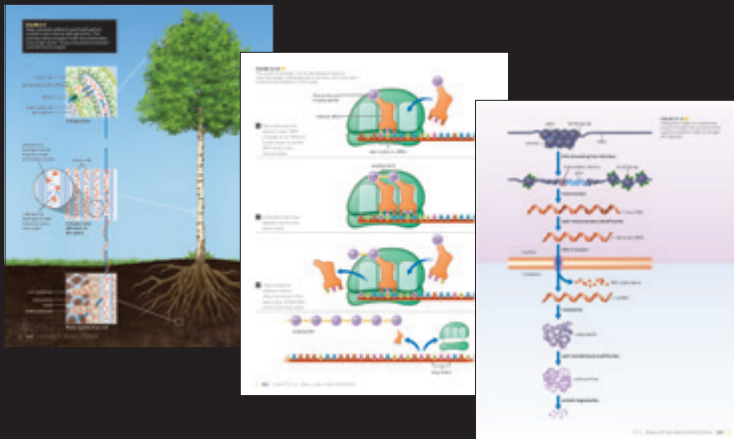
Skills introduced in *National Geographic Biology* build a foundation for other high school science courses and for other disciplines. Projects, assessments, and personal stories cultivate the problem solving and critical thinking skills needed for college and/or careers.

Explorer stories and case studies inspire views into science careers



CONNECT ALL STUDENTS IN QUALITY LEARNING

Student and teacher resources provide tools and strategies allowing all students to access the text, experience biology concepts through various media, remediate where needed, and be challenged when ready.



Full page illustrations and photographs make the details of biology visible and tell visual stories



The Teacher's Edition includes support throughout each lesson to address the needs of all students including ELL, struggling, advanced, students with disabilities, and economically disadvantaged students.

DIFFERENTIATED INSTRUCTION | English Language Learners

Ask and Answer Questions Working in pairs, have students take turns reading an assigned paragraph from the Case Study out loud. Explain to students that asking and answering questions can help them understand the main idea and supporting details in the article.

Beginning Have each student in a pair ask one question about the article. They can then work together to find the answer, conferring in their native language if necessary.

Intermediate Have each student ask one question and then swap with their partner. Tell them to work together to find the answers. Encourage the use of English, using their native language only when needed.

Advanced Have each student ask one question and then swap with their partner. Encourage them to find the answer in English.

DIFFERENTIATED INSTRUCTION | Leveled Support

Struggling Students For students struggling with the concept of habitat destruction and recovery efforts for the El Rincon stream frog, have them look for local examples of habitat loss. Ask them to record what caused the habitat loss, such as clearing land for building, and what organisms were affected. They may then work in pairs to write their own species recovery plan.

Advanced Learners For students who easily grasp the concepts discussed here, assign them the role of an investigative reporter. Have them work in groups to develop a list of questions that they would like to pose to Dr. Kaccoliris about his work, his career, or other topics related to what they are learning in this chapter about interactions and relationships in ecosystems.

HANDS-ON BIOLOGY AND DATA ACTIVITIES



Applying Biology with Hands-on Science and Data Activities

Each chapter provides multiple opportunities for hands-on learning. Quick minilabs and full laboratory investigations give students practice with lab equipment and lab safety procedures. Data analysis activities give students practice reading data and identifying patterns in data sets.

Labs, Engineering Activities, and Research Projects

Chapter Investigations provide more in-depth laboratory experiences with Guided Inquiry, Open Inquiry, and Design-Your-Own approaches. Also included are Engineering Design activities, research and writing activities in the “Tying It All Together” lesson for each chapter, and Claims, Evidence, Reasoning (CER) activities for each unit. Lab guides, worksheets, and rubrics are available in the MindTap digital platform.

Support for All Learners

Student and teacher resources provide tools and strategies allowing all students to access the text, experience biology concepts through various media, review where needed, and be challenged when ready.



Teacher Support for All Levels

The Teacher’s Edition includes support throughout each lesson to address the needs of all students including ELL, struggling, advanced, students with disabilities, and economically disadvantaged students.

COURSE SUPPORT AND TEACHER TOOLS

National Geographic Biology supports teachers in the classroom with a thoughtfully designed Teacher's Edition and a wealth of teacher resources and assessments built in to the MindTap digital platform.



Teacher's Edition

The print and digital resources guide teachers through each unit and chapter to prepare students for 3-Dimensional skills, practices, and Performance Expectations including lessons built on the 5E lesson model, background information, and connections to math and English language arts.

CROSSCUTTING CONCEPTS | Energy and Matter

Modeling at Varied Scales This chapter focuses on modeling energy and matter transfer at ecological scales: between organisms in a community, between organisms and their environment, and among the biosphere, atmosphere, hydrosphere, and geosphere. Some fields of biology, such as physiology, cell biology, molecular biology, and biochemistry, essentially study how energy and matter enable life processes at various scales. Chapters 5 and 6 in Unit 2 addresses transformations of energy and matter at the molecular and cellular levels. Further reinforce this crosscutting concept throughout Unit 3 by having students organize information about living systems in terms of how they enable an organism to obtain energy and matter from its surroundings, transfer energy and matter within its body, and use energy and matter to survive.

SCIENCE AND ENGINEERING PRACTICES
Developing and Using Models

Limits of Models Students should recognize that food chains generally do not represent all members of a community and that they are subsets of food webs that can be constructed to represent the whole community (with more than one species at each trophic level). Students may notice that detritivores and decomposers are not represented in **Figure 2-8**. Ask students how they would refine the food web model shown here to include these types of organisms. You may wish to draw students' attention back to the Anchoring Phenomenon by encouraging them to build a food web based on the sea pig's deep-sea ecosystem. Students can do a similar analysis of the limitations of the pyramid models presented in the next section.

Connect to English Language Arts

Integration of Knowledge and Ideas Systems models introduced in Chapter 2, such as the food web, ecological pyramids, and matter cycles, typically depict specific ecosystems as illustrative examples. When reading to understand how energy flows and matter transfers through ecosystems, students should be able to apply information from the model illustrations to apply the same concepts to different ecosystems.

Have students translate between specific detail information and general text by writing a label for each arrow in **Figures 2-2, 2-6, 2-7, or 2-8**. Their labels should describe each transfer or transformation in terms of energy and matter.

CHAPTER INVESTIGATION A

Guided Inquiry *Salinity and Brine Shrimp Survival*

Time: 130 minutes over 3 days

Students will follow a step-by-step procedure to investigate how different salinities affect the hatching of brine shrimp.

Connect to Mathematics

Define Quantities for Modeling Have students return to **Figure 2-8** and apply estimated quantities to a pyramid of biomass and a pyramid of numbers for an Antarctic food web. For example, students can research the average mass of an elephant seal and the number of elephant seals in an average Antarctic colony. They can then work backwards to estimate the average mass and numbers of squid, krill, and phytoplankton to support that food chain.

Physical Science Some students may need a refresher on basic chemistry concepts. Remind students that the atomic number of an element is the number of protons in the nucleus. The number of protons does not vary for the atoms of a specific element; however, the number of neutrons can vary. Atoms of the same element that differ in the number of neutrons are called isotopes. The mass number of an isotope is the total number of protons and neutrons in the nucleus. For example, the mass number of the most common carbon isotope is 12. This isotope has six protons and six neutrons and is written as carbon-12.

Interpret Data 25 percent

Teachers are provided with targeted support for 3D instruction and cross-curricular connections to Math, English Language Arts, and other science disciplines.

ASSESSMENTS IN A VARIETY OF FORMATS

Biology prepares students for end of course exams through frequent formative assessment and through activity-based summative assessments getting students to master higher level depths of knowledge on biology content and science practice skills.



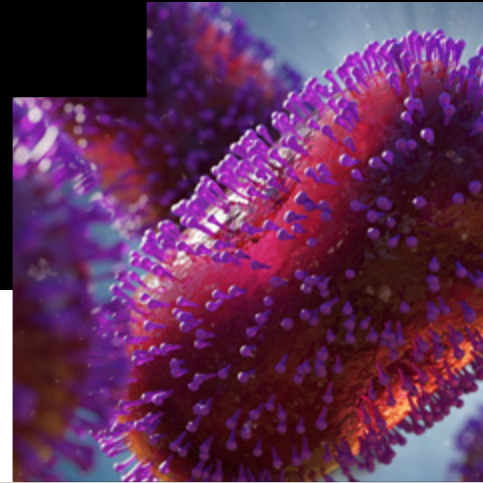
SUMMATIVE ASSESSMENT

Chapter Assessments offer a combination of open-response and machine-scored items carefully designed to measure students' understanding and retention of the content. **Unit Performance Tasks** assess bundled Performance Expectations.




Cengage
MindTap





For more information, visit
NGL.Cengage.com/NGBiology

@NatGeoLearning

@ExploreInside

@NatGeoLearning



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.

"National Geographic", "National Geographic Society" and the Yellow Border Design are registered trademarks of the National Geographic Society ® Marcas Registradas