Pre-AP® | CollegeBoard

Course launches in **Fall 2018**

Pre-AP® Biology

COURSE SAMPLER

About the College Board

The College Board is a mission-driven not-for-profit organization that connects students to college success and opportunity. Founded in 1900, the College Board was created to expand access to higher education. Today, the membership association is made up of more than 6,000 of the world's leading educational institutions and is dedicated to promoting excellence and equity in education. Each year, the College Board helps more than seven million students prepare for a successful transition to college through programs and services in college readiness and college success—including the SAT® and the Advanced Placement Program®. The organization also serves the education community through research and advocacy on behalf of students, educators, and schools.

For further information, visit www.collegeboard.org.

The information included in this guide is still subject to change, as Pre-AP courses are in the refinement and editing stage and still incorporating educator feedback. Pre-AP course materials, including the course framework, lessons, and unit assessments will be finalized in spring 2018. Pre-AP courses will launch in fall 2018.

Contents

About Pre-AP

Dear Educator:

Thank you for taking the time to review the sample instructional materials for the College Board's new Pre-AP Program.

Pre-AP Rationale

Less than 50% of U.S. high school students are ready for college. Over 300,000 high school students demonstrate AP potential based on their PSAT score, but do not take an AP exam. Teachers have told us that they want the College Board's assistance in helping define what a Pre-AP curriculum should look like. Given these statistics and feedback, the College Board developed the Pre-AP Program.

While the AP Program has helped prepare millions of students for college, data and educator feedback show that we need to reach more students, earlier, because all students deserve access to a challenging curriculum. By offering Pre-AP courses to all ninth-graders, with more grades to come, we hope to provide a new, consistent standard of high-quality instructional resources with the focus on supporting all students, so that more of them are ready for college and, when appropriate, able to access and complete college-level work before leaving high school.

Launching in fall 2018, Pre-AP will begin with five ninth-grade courses in World History and Geography, Algebra I, Biology, English, and Arts.

Goals

- Significantly increase the number of students who are able to access and complete college-level work before leaving high school
- Improve the college readiness of all students

Teacher Developed

We developed the Pre-AP Program in collaboration with educators and teachers like you. Teacher feedback helped us design a program that supplies effective resources and yet gives teachers the freedom and flexibility to teach the way they've always wanted to teach.

What We Provide

- **Instructional Resources:** Course frameworks, high-quality texts, and source materials paired with effective teaching strategies, model lessons, and shared routines
- **Assessments:** Digital unit assessments and performance-based tasks accompanied by scoring rubrics
- **Student practice:** Resources and tools to help students master content
- **Professional learning:** Training and teacher supports

We hope you find the sample instructional materials useful. As the Pre-AP Program develops, we anticipate that feedback from our school and educator partners will help us strengthen the program to better meet our mutual goal of preparing as many students as possible for success in college. Thank you!

Respectfully,

The Pre-AP Team

Getting to Know the Pre-AP Biology Course

Pre-AP Biology focuses deeply on the concepts and skills that have **maximum value for high school, college, and career.**

Overview

This course helps students and teachers prioritize and focus deeply in the core areas of ecological systems, evolution, cellular systems, and genetics while actively applying science practices to construct and revise their biological knowledge.

Students will make meaningful connections between the structures, processes, and interactions that exist across biological systems—from cells to ecological communities. Pre-AP Biology asks students to be active participants in analyzing real-world phenomena and to regularly collaborate with their peers in dialogue, investigations, and problem solving.

Within this course, the theories of evolution and inheritance help students see the story of how life has unfolded across Earth's vast history. They provide foundational lenses from which we begin to understand and appreciate the extraordinary diversity of life as well as the unity we see across that life. This course also focuses on the complex and dynamic processes that are required to sustain Earth's biodiversity to build student understanding of the intricate relationships of interdependence between living and nonliving systems.

Instructional Shifts for Pre-AP Biology

Pre-AP Biology instructional resources focus on the following key instructional shifts:

Emphasis on analytical reading and writing: Students engage in analytical reading and writing to gain, retain, and apply scientific knowledge.

Focus on applying mathematics: Students use mathematics to understand and express the quantitative aspects of biology, to record and interpret experimental data, and to solve problems as they arise.

Attention to modeling: Students go beyond just labeling diagrams to modeling biological processes to demonstrate and revise understanding of key patterns, interactions, and relationships.

Shared Instructional Principles

In addition to instructional shifts that are central to the study of Biology, all Pre-AP courses share a common set of classroom routines and approaches that give students many opportunities to practice and strengthen their skills while building their confidence in the classroom.

Close Observation and Analysis

Pre-AP courses require careful examination of one object, text, or problem before requiring students to grapple with multiple. Students engage in deep observation to build, refine, or confirm their knowledge, thus developing a foundational skill that supports analysis and learning in each discipline. As students encounter texts, visual art, graphs, maps, problems, and other source materials, they will learn first to engage in deep close observation before being asked to explain, and then apply or evaluate.

Evidence-Based Writing

Pre-AP courses provide a scaffolded approach to writing that begins with a focus on the sentence before progressing to paragraph or essay writing. All courses will provide tools and supports (sentence frames, outlines, and graphic organizers) to support writing skills. In Biology, students will receive ample opportunities in crafting evidence-based scientific claims. Instructional strategies will help students first focus on developing evidence-based sentence-level claims. Students will then build on sentence-level claims to develop coherent paragraph-length justifications based on scientific reasoning and evidence.

Higher-Order Questioning

When examining texts, data, problems, and other sources of evidence, students will be guided to grapple with questions that spark curiosity, cultivate wonder, and promote productive lingering. Pre-AP lessons provide teachers with questions that motivate thought and support students to build evidence-based claims and to solve problems from multiple angles.

Academic Conversations

In Pre-AP classrooms, students have frequent opportunities for active, thoughtful participation in collaborative conversations about significant themes, topics, and texts. Through these discussions, students practice the skills of academic conversation that they will need to employ in college and career settings. Students regularly compare, critique, debate, and build upon others' ideas and arguments to advance their learning.

Course Framework

The Pre-AP Biology course framework is intended to provide a clear and focused description of what students should **know** and be able to **do** as a result of this course.

Based on the *Understanding by Design* (Wiggins & McTighe, 1998) model, the framework also serves as the blueprint for the instructional units and assessments that are part of the Pre-AP course and is structured in two parts:

Big Ideas and Enduring Understandings

Big Ideas and Enduring Understandings cut across all units of the course. The Big Ideas map out the core principles, theories, and processes of biology that offer students a broad way of thinking about the discipline. The Enduring Understandings represent the long-term takeaways that students should develop as a result of focused study of the key concepts in the course. By design, Pre-AP Biology is based on a small, focused set of Big Ideas and Enduring Understandings that can rest on a single page. This design supports deeper learning of concepts and skills and allows students to understand the connections across major principles, processes, and systems in biology.

Unit Outlines

Unit Concept Outlines articulate the key concepts and learning objectives for each of the four major units of this course. These unit outlines also include general pacing recommendations and mappings to Pre-AP instructional resources to support teacher planning.

The full course framework will be released in spring 2018, but the following section offers a preview.

Big Ideas and Enduring Understandings

Biological Evolution

Enduring Understanding 1.A:
The theory of evolution states that all organisms descend from a common ancestor, resulting in some shared characteristics.

Enduring Understanding 1.B:
Biological evolution is observable as phenotypic changes in a population over multiple successive generations.

Enduring Understanding 1.C:
Speciation and extinction occur in response to changes in environmental conditions.

Genetic Inheritance

Enduring Understanding 2.A:
The molecular structure of DNA enables its function of storing life's genetic information.

Enduring Understanding 2.B:
Encoded in DNA is the heritable information for RNA synthesis, which makes gene expression possible.

Enduring Understanding 2.C:
Organisms have diverse strategies for passing their genetic material on to the next generation.

Enduring Understanding 2.D:
Models can be used to illustrate and predict the inheritance of traits.

Biological Systems

Enduring Understanding 3.A:
Four classes of macromolecules serve as the building blocks to biological systems.

Enduring Understanding 3.B:
Biological systems have specialized structures that enable specific functions necessary to sustain life.

Enduring Understanding 3.C:
In order to sustain complex processes, biological systems must have mechanisms for growth and repair.

Enduring Understanding 3.D:
Biological systems must respond to changes in internal and external environments in order to maintain dynamic homeostasis.

Interdependence

Enduring Understanding 4.A:
Biological systems depend on the cycling of matter within and between Earth's systems.

Enduring Understanding 4.B:
Most ecosystems rely on the conversion of solar energy into chemical energy for use in biological processes.

Enduring Understanding 4.C:
The dependence on the availability of abiotic and biotic resources results in complex and dynamic interactions between organisms and populations.

Enduring Understanding 4.D:
Human-induced changes to the environment can alter interactions between organisms.

Instructional Units

Pre-AP Biology is organized by four major units:

Unit 1	Unit 2	Unit 3	Unit 4
Ecology	**Evolution**	**Cellular Systems**	**Genetics**
4 weeks	4 weeks	10 weeks	10 weeks

We provide the following resources* to support teachers and students for each unit:

Launch Lessons: Short activities aligned to each key concept in the unit to launch that topic of investigation. These activities are designed around engaging real-world problems or natural phenomena that spark student interest in the key concepts.

Lessons: Three types of targeted lessons are designed to support the instructional shifts for the course—modeling, data analysis, and analytical reading and writing. Lessons include recommendations for student practice, including connections to Khan Academy practice to support foundational skills in math.

Laboratory Resources: One to two lab resources for each unit.

Performance Task: One performance task and scoring rubric for each unit.

Assessments: Two machine-scored, short objective assessments per unit, administered digitally to provide immediate performance feedback and score reporting.

*The course resources constitute less than 50% of instructional time for the course, and they are intended to be used alongside your Biology textbook and local district curriculum materials.

Unit Outlines

Unit 1: Ecology Key Concepts

- Cycling of Matter in the Biosphere
- Population Dynamics
- Defining Ecological Communities
- Ecological Community Dynamics
- Changes in Ecological Systems

Unit 2: Evolution Key Concepts

- Patterns of Evolution
- Mechanisms of Evolution
- Speciation

Unit 3: Cellular Systems Key Concepts

- Chemistry of Life
- Cellular Structure & Function
- Cellular Transport & Homeostasis
- Organisms Maintaining Homeostasis
- Photosynthesis
- Cell Respiration & Fermentation
- Cellular Growth & Division

Unit 4: Genetics Key Concepts

- Structure & Function of DNA
- RNA & Protein Synthesis
- Asexual and Sexual Passing of Genes
- Patterns of Inheritance
- Human Genome & Genetic Disorders
- Genetic Engineering

Pre-AP Biology Sample Lesson

Important Elements in Living Systems

Purpose: Before engaging students in activities involving biogeochemical cycles, such as water, carbon, and nitrogen cycles, they first should be motivated to explore why the cycling of matter is important for organisms. A great way to do this is to have them make predictions about the most common elements found in their own bodies. This is also a way to elicit students' prior knowledge about the importance of water, energy production (cellular respiration), and the structure/function of human body systems they learned in middle school.

Predicting Common Elements in Human Bodies

Students should work independently to make predictions about what they think the six most common elements in the human body are. They are also asked to provide some reasoning for their answers. Students may need a bit of help getting started with their reasoning. The following prompts may be helpful:

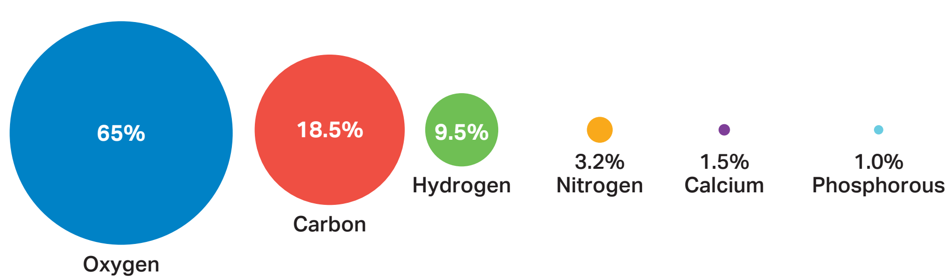
- What type of molecules or compounds do you think your body relies on to function properly? What about for support?
- Recall how the food you eat provides you with energy. What elements do you think that food is made of?

Next, students should work with a partner or in a small group and share their answers to (a) and (b) on the student handout. Students are encouraged to make revisions to their original predictions if their peer's reasoning is persuasive enough to warrant those changes.

Whole-Class Discussion

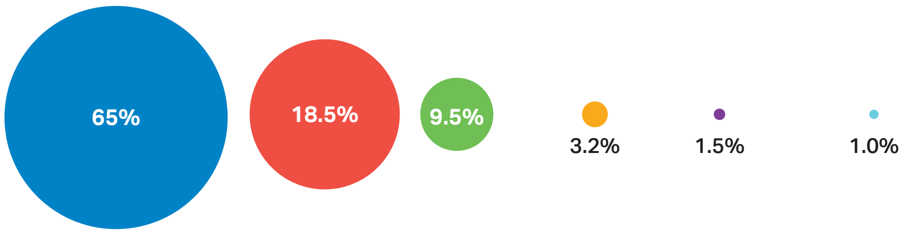
Once students have had time to work with their partners, engage them in a whole-class debrief of the six common elements. Have students/groups share their predictions about the six most commonly occurring elements in their bodies. Have students also share the reasoning they used to support their predictions. They may also share whether they made any modifications to their original predictions based on their partner's predictions and associated reasoning. As students share their ideas, generate a class list of solutions and reasoning for the six most common elements in the human body.

Next, share with the whole class the answers and have students discuss new reasoning for the most common elements if their answers still vary from the following:



Important Elements in Living Systems

What are the most commonly occurring elements in the human body?



These spheres represent the six most abundant elements in the human body. Their size is a visual representation of the percent of human body weight that they make up and their approximate relationship to one another. Let's see how well you know your body.

Making Predictions

a. Using the list of elements provided below, predict what you think are the six most abundant elements in the human body. Be sure to list them in the order that represents the percentages shown above.

Calcium, Hydrogen, Sulfur, Phosphorus, Oxygen, Carbon, Magnesium, Nitrogen, Sodium

1)______________________ 2)______________________ 3)______________________

4)______________________ 5)______________________ 6)______________________

b. Provide some reasoning for what elements you selected above. *(hint – What molecules or compounds commonly occur in human bodies?)*

c. Now work with a partner to compare and revise your predictions.

- After discussing your predictions and reasoning with your partner, make any changes that you feel will make your predictions more accurate.
- If you made any changes, what reasoning did your partner provide that persuaded you to change your answers?

d. Discuss with your partner whether you think these six elements, and their associated ratios, would be the same for all living organisms? Why or why not? Be sure to record at least 2-3 reasons for similarities or differences you discuss.

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Pre-AP Biology Sample Lesson

Symbiosis in Corals

Pre-AP Biology

Data Analysis

Purpose: This lesson asks students to apply and expand their proportional reasoning skills developed in middle school as they use those skills to analyze changes in a coral reef ecosystem. This lesson can be used to introduce or reinforce the concept of complex community interactions, such as the symbiotic relationship between coral and the algae in their cells. This task would be used after students are introduced to the quadrat sampling method, one of the most common methods of sampling used in ecological studies to assess species distribution and abundance.

Symbiosis in Coral Reefs

First, students engage in a whole-class guided reading and discussion on the opening except from NOAA on coral bleaching. This short reading is used to help set the context of the study from which students will be closely observing data. This is also a good opportunity to unearth any questions or terminology issues students may have prior to engaging in data analysis.

Students are now given time to independently read the summary of the coral bleaching study and closely observe the data in the pie graphs.

Next, lead a whole-class discussion on what students observe about the data provided. Prompts to promote student thinking may include:

- What similarities and differences do you notice first between the two data collections?
- What does a recorded percentage for a species in the data set actually mean?
- What would scientists look for to record the percent of bleaching of corals in their samples?
- Why was it important to collect data from the same 25m^2 of the reef in both 2004 and 2007?

After the opening discussion, students work with a partner to answer the questions about changes in species composition in the reef.

In question 5 students are asked to “Use the available data to support or refute this scientist’s statement” that is provided. They will use a “because-but-so” sentence-level writing routine to fully develop their thoughts. Teachers may need to support students in crafting their initial independent clause as well as expanding their sentences in a manner that incorporates use of evidence from the data. For example, a student might write the following:

- Staghorn is not as hardy as brain coral because when stressful conditions increased it decreased in percent coverage by 44%.
- Staghorn is not as hardy as brain coral, but is still the second most abundant species in the reef.
- Staghorn is not as hardy as brain coral, so I think brain coral will continue to have more percent coverage than staghorn while the reef is under stressful conditions.

Students then work in pairs or as a group to share the sentences they developed individually for question 5. As a group, they collaborate on development of final sentences to refute or support the scientist’s claim. Student pairs/groups will share-out their sentences as the teacher encourages peer-to-peer feedback on students’ statements.

Practice with KHAN ACADEMY

This activity utilizes percent, ratios, and general proportional reasoning skills students gained in middle school. If you recognize that students are struggling to apply these mathematical skills in the context of this biology data set, assign these Khan Academy resources before or during instruction:

- Percent Problems (from 6th grade)

https://www.khanacademy.org/math/cc-sixth-grade-math/cc-6th-ratios-prop-topic#cc-6th-percent-problems

- Ratio & Proportion Problems (from 7th grade)

https://www.khanacademy.org/math/cc-seventh-grade-math?t=practice#cc-7th-ratio-proportion

Symbiosis in Corals

What Is Coral Bleaching?

> "Corals have a symbiotic relationship with microscopic algae, called zooxanthellae, which live in their tissues. These algae are the coral's primary food source and give them their color. When corals are stressed by changes in conditions such as temperature, light, or nutrients, they expel the symbiotic algae living in their tissues, causing them to turn completely white. In 2005, the U.S. lost half of its coral reefs in the Caribbean in one year due to a massive bleaching event. Comparison of satellite data from the previous 20 years confirmed that thermal stress from the 2005 event was greater than the previous 20 years combined."
>
> – *Adapted from the National Oceanic and Atmospheric Administration (NOAA)*

Coral Bleaching Study

A four-year study, which began in the summer of 2004, collected the first comprehensive time series of measurements from a fringing reef in the Gulf of Suez, in the Red Sea. In 2004, initial sampling results showed the reef to be fairly healthy. However, since that time the reef has been subjected to many new stresses, including a newly built major shipping port, rapid coastal urbanization, and an oil spill in 2005. Of the approximately 40 known coral species hardy enough to survive in this region, only five species make up 94% of the reef's coral cover. Scientists examined the total percent coverage of these species using a $0.25m^2$ quadrat sampling procedure across $25m^2$ of the reef (see **Figure 1**).

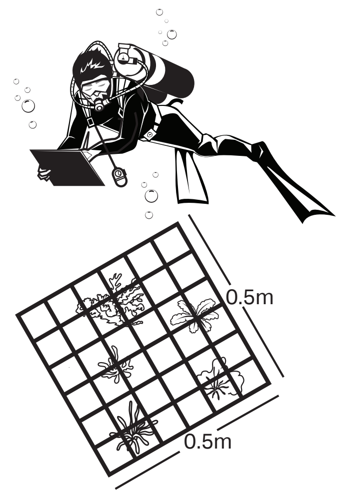
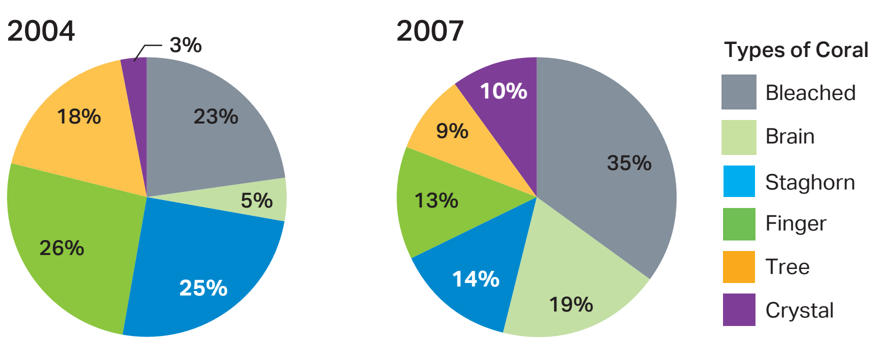


Figure 1 – Quadrat Sampling Method

The data below shows the percent coverage for each of the five coral species in 2004 and 2007.



– Data based on findings from "Resilience of a Red Sea Fringing Coral Reef under Extreme Environmental Conditions: A Four Year Study," American Museum of Natural History.

Check Your Understanding

1. Describe the ecological relationship between the coral and the zooxanthellae algae.
2. How many total quadrats were needed to examine the percent coverage of the coral species across $25m^2$ of the reef?
3. How many square meters does the crystal coral cover in the experimental sample ($25m^2$) in 2007?
4. If the percent of crystal coral coverage in 2007 remained constant for the entire reef, how many square meters of crystal coral coverage would you expect for an area of reef totaling $100m^2$?
5. When asked about the shift in biodiversity of coral in the reef system from 2004 to 2007, a marine ecologist stated, “The shift in biodiversity really isn’t too surprising given that brain coral is a hardier species whereas staghorn is much more vulnerable to stressful environmental conditions. I believe staghorn will continue to decline in percent coverage.” Use the available data to support or refute this scientist’s statement.
    - Use the sentence expansion routine to write three separate sentences to support or refute the scientist’s claim using evidence from the data. Start with a short independent clause that you generate from the data. Next, expand that clause into three separate sentences using the conjunctions *because*, *but* and *so*.
6. Predict what changes in the reef ecosystem might occur if coral bleaching continues to increase in this reef ecosystem.

Keystone Species in Prairie Ecosystems

Pre-AP Biology

Modeling Lesson

Purpose: This lesson engages students in the science practice of modeling. Students will build on and extend their understanding of the flow of energy through the ecosystem via predator-prey interactions. It builds on middle school prior knowledge of biomes as it asks student to develop a model of a food web for a specific ecosystem – the North American prairie ecosystem. They will use their model to make predictions about how the flow of energy in this ecosystem would be disrupted without a keystone species – the prairie dog.

Developing and Using Models of a Prairie

Students independently read a short opening excerpt from the *New York Times* about the importance of the prairie dog in the Badlands National Park ecosystem. To help elicit students' prior knowledge about the flow of energy in terrestrial food webs, engage the whole class in a discussion about their reading. Some prompts to promote discussion and student thinking are:

- What evidence from the opening text supports the author's description of the prairie dog as an "architect and custodian" of its environment?
- What organism(s) serve as the base for this prairie food web?
- Which organisms that have more than one predator or consume more than one prey? Describe the benefits of being able to feed on more than one type of prey?
- Why don't organisms gain all of the energy stored in a prey's body when they consume it?

Next, students will work in pairs to develop a model of the food web in this prairie ecosystem by using the species cards provided to each student pair. Students can use classroom reference materials, including their textbooks, as well as online resources as additional support in developing their models. Models can be built in various ways, including via technology, with chart paper, or on mini-whiteboards. As students develop their models, they must provide evidence for each organism's role from their resources. They should also apply scientific principles about ecological roles (e.g. apex predators have no natural predators) to provide appropriate reasoning for their claims and evidence.

Next, students revise their model to show what changes would occur in this ecosystem if the prairie dog were removed.

Students evaluate each other's models and written explanations to compare and contrast ideas presented. As students share their models and evaluate their peers' models, monitor student discussions to provide appropriate feedback and guidance on their predictions, explanations, and connections.

Whole-Class Discussion

Finally, facilitate a whole-class discussion on the possible ecosystem changes that could occur if the prairie dog were removed from the ecosystem. Use the student-generated models and predictions to illustrate those changes and how the evidence supports the role of keystone species for prairie dogs.

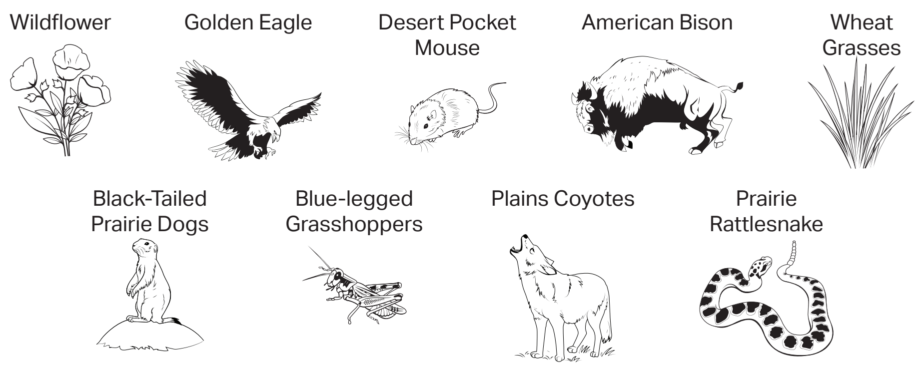
Keystone Species in Prairie Ecosystems

Excerpt from "Prairie Dog Colonies Bolster Life in the Plains" by William Stevens, *New York Times (1995)*.

"Look at that landscape out there," said Dr. Glenn E. Plumb, the wildlife biologist for Badlands National Park, as he gazed out across the prairie-dog town. "That's a real concentration of biological activity, a lot of complex nature."

Its verdant carpet produces more new growth in a given year than is produced in similarly sized patches of the surrounding plains, attracting a crowd of plant and seed eaters from insects to mice to birds to bison. Predators like hawks, coyotes and bug-eating birds follow.

The prairie dogs, as architects and custodians of their immediate environment, are largely responsible for this concentration of life. Their constant cropping of vegetation stimulates faster and more nutritious growth, while their burrows provide homes and hunting grounds for many organisms, large and small. The resulting patches of habitat make the Plains ecosystem more complex, diverse and biologically active than it would otherwise be.



Common organisms found in the Badlands National Park ecosystem.

Developing & Using Models

1. Why does the author describe prairie dogs as "architects and custodians" of their environment? What evidence from the text supports this description?
2. Use information from the introductory text and species cards to develop a model of a food web that shows the ecological connections between prairie dogs and other organisms in this community.
3. The prairie dog is considered a keystone species in the Plains ecosystems due to the number of organisms that depend on it. Unfortunately, prairie dog numbers in the Plains have declined rapidly due to habitat loss. What would happen if prairie dogs became extinct? Use your model to make predictions about how the flow of energy in the ecosystem would be affected if the prairie dogs became extinct.

Predicting Changes in Prairie Ecosystems

Species Cards

Wildflowers

There are numerous species of wildflowers found in Badlands National Park. Wildflower species serve as important food sources for many herbivores and omnivores, especially the abundant rodent population in the park that feeds on the seeds of these plants.

Golden Eagle

This nimble raptor relies on its powerful beak and talons in order to successfully capture its common prey of small to medium mammals including rodents, ground squirrels, and prairie dogs.

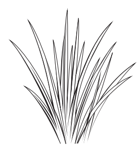
Desert Pocket Mouse

This small rodent is nocturnal, whereby it spends the nighttime foraging under the protection of vegetation such as grasses. It also feeds primarily on the seeds of grasses, shrubs, and wildflowers.

American Bison

Even though bison are the largest mammal in N. America, their diet consists primarily of grasses found on the prairie. Like cows and elk that are also herbivores, they have four stomachs to digest all the cellulose that makes up the grasses.

Wheat Grasses

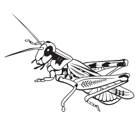


Western wheat grass is the dominant grass in Badlands National Park. It is an important food source to many of the organisms in the park such as bison, prairie dogs, other small rodents, and some insects.

Black-Tailed Prairie Dogs

Black-tailed prairie dogs live in colonies with complex networks of tunnels with multiple openings. They mainly consume grasses, flowering plants, roots, and seeds, though they are also known to eat insects.

Blue-legged Grasshoppers

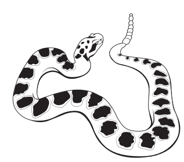


This species of insect is well known for feeding on the green leaves of Western wheat grass. While they are also known to eat some sagebrush species, they primarily feed on grasses.

Plains Coyotes

The coyote is often considered the most opportunistic of all North American predators. They will hunt any small mammal as prey, including prairie dogs.

Prairie Rattlesnake



These western rattlesnakes prey upon any small mammal or rodent. They have even been known to enter the tunnels of prairie dog habitats in order to capture their prey.

Termites – Guardians of the Soil

Adapted from the *New York Times,* "Termites: Guardians of the Soil" by Natalie Angier, 2015.

The giant termite mounds that rise up from the sands of the African savanna are so distinctive it's tempting to give them names, like "Art Deco Skyline" or "Trumpeting Elephant."

Researchers at Princeton University and their colleagues recently reported in the journal *Science* that termite mounds may serve as oases in the desert, allowing the plants that surround them to persist on a fraction of the annual rainfall otherwise required to bounce back after a withering drought.

And while the public may view termites as pale, blind, half-inch vermin, only a handful of them are actually pests. "They're the ultimate soil engineers," said David Bignell, a termite expert and emeritus professor of zoology at Queen Mary University of London. By poking holes, or macropores, as they dig through the ground, termites allow rain to soak deep into the soil rather than running off or evaporating. Termites artfully mix inorganic particles of sand, stone and clay with organic bits of leaf litter, discarded exoskeletons and the occasional squirrel tail, a blending that helps the soil retain nutrients, such as nitrogen and phosphorous, and resist erosion.

The stickiness of a termite's feces and other bodily excretions lend structure and coherence to the soil, which also prevents erosion. Bacteria in the termite's gut are avid nitrogen fixaters, able to extract the vital element from the air and convert it into a usable sort of fertilizer in the soil, benefiting the termite host and the vast plant community.

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1. Write three sentences about the role termites play in modifying the natural process of the water, carbon, or nitrogen cycle. Use the following words in order at the beginning of your claims: *although, when, if.*

   Although ____

   When ____

   If ____

2. Use evidence from the text to support (agree with) or refute (disagree with) the following claim:

   Termite activities influence the cycling of matter in ways that are beneficial their ecosystem.

   Do you support or refute this claim?

Evidence from Text	Scientific Reasoning
1	
2	

3. Describe two ways that humans influence the cycling of matter in ecosystems.

Termites – Guardians of the Soil

<table>
<tr><th>Question</th><th>Possible Points</th><th colspan="2">Possible Solutions</th></tr>
<tr><td>1</td><td>3 points

1 pt for each appropriate sentence.

[Note – while it would be ideal if students used the three sentences together to form one idea, it is not necessary at this point. Each sentence could represent a different idea, as this is just an opening question to get them into the text.]</td><td colspan="2">There are numerous solutions to this first question. Some possible answers include:

Example 1:
Although some termites are considered pests, most termites are beneficial to the ecosystem.
When termites dig into the soil, they help plants get more water.
If termites were not in the ecosystem, the plants would suffer.

Example 2:
Although termites are very small, they play a big role in the ecosystem.
When termites convert nitrogen into fertilizer, they help provide nutrients to plants.
If termites did not tunnel into the soil, more water would evaporate or runoff.</td></tr>
<tr><td>2</td><td>4 points

1 pt for each piece of evidence pulled from text that aligns to an impact in a cycle.

1 pt for each appropriate reasoning statement attached to the evidence.</td><td>Evidence from Text
▪ Allowing the plants that surround them to persist on a fraction of the annual rainfall otherwise required to bounce back after a withering drought
▪ Poking holes, or macropores, as they dig through the ground
▪ Allow rain to soak deep into the soil rather than running off or evaporating
▪ Artfully mix inorganic particles of sand, stone and clay with organic bits of leaf litter
▪ Blending that helps the soil retain nutrients and resist erosion
▪ Stickiness of a termite's feces and other bodily excretions lend structure and coherence to the soil, which also prevents erosion
▪ Bacteria in the termite's gut are avid nitrogen fixaters, able to extract the vital element from the air and convert it into a usable sort of fertilizer</td><td>Scientific Reasoning
Each piece of evidence should be adequately paired with a reason as to why this is beneficial to a particular cycle. Some examples include:

Example 1:
Evidence: "allow rain to soak deep into the soil rather than running off or evaporating"
Reasoning: This impact the water cycle in a beneficial way to plants since less water will evaporate and more will be available in the soil to use.

Example 2:
Evidence: "artfully mix inorganic particles of sand, stone and clay with organic bits of leaf litter"
Reasoning: This impacts the carbon and nitrogen cycle since it speeds up deposition and helps the soil hold more nutrients such as nitrogen and phosphorous.</td></tr>
<tr><td>3</td><td>2 points

1 pt for each correct description of a human activity that affects the cycling of matter.

1 pt for each appropriate sentence.</td><td colspan="2">▪ Removing water from storage for drinking impacts the water cycle.
▪ Farming practices increase evaporation from soil, and runoff impacts the water and nitrogen cycle.
▪ Using fossil fuels for energy releases carbon dioxide and ammonia into the atmosphere, which impacts the carbon cycle and nitrogen cycle.
▪ Using nitrogen-based fertilizers in farming impacts the nitrogen cycle.</td></tr>
</table>

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The information included in this sampler is still subject to change, as Pre-AP courses are still being developed with teacher feedback. Pre-AP course materials, including the course framework, lessons, and unit assessments will be finalized in spring 2018. Pre-AP courses will launch in fall 2018.