GRADE 5

Building Blocks OF SCIENCE™ | 3D

Matter and Energy in Ecosystems

Program Highlights and Lesson Sampler

Phenomenon-Based Investigations with Digital Support—in 30-Minute Lessons

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Matter and Energy in Ecosystems

Teacher's Guide

3rd Edition

Building Blocks of Science™ | 3D

Kit Materials

Material	Quantity Needed From Kit	Lesson 1	Lesson 2	Lesson 3	Lesson 4	Lesson 5	Lesson 6
Binder clip	8	■					
Clay		■					
Cotton wick	15				■		
Gravel		■					
Hand lens	15		■				
Large plastic container, 16 oz	15				■		
Literacy Reader: *Matter and Energy in Ecosystems* (below grade level)	1	■	■		■	■	■
Literacy Reader: *Matter and Energy in Ecosystems* (on grade level)*	1	■	■		■	■	■
Liquid fertilizer	2 T					■	
Live Coupon for redworms	1				■		
Owl pellet	15		■				
Pair of disposable gloves	32		■				
Pair of forceps	15		■				
Plastic cup, 9 oz	16	■					
Plastic tank	1				■		
Radish seeds		■			■		
Resealable plastic bag	4	■					
Roll of string	8			■			
Salt	¼ C					■	
Sand		■					
Small plastic container with hole, 8 oz	15				■		
Soil		■			■		
Spray bottle	4	■					
Worm bedding					■		

* The below-grade literacy reader is distinguished from the on-grade literacy reader by a yellow dot near the bottom left corner of the back cover.

Needed But Not Supplied Materials

Material	Quantity Needed	Lesson 1	Lesson 2	Lesson 3	Lesson 4	Lesson 5	Lesson 6
Chart paper or whiteboard		■	■	■	■	■	
Cleaning supplies			■				
Dark location (to store plants)	1	■					
Glue stick	15			■			
Index card	80			■			
Large sheet of paper, about 11 x 17 in	15			■			
Liquid soap	2 T					■	
Marker		■	■	■	■	■	
Markers (blue, green, orange, red, yellow)	30 sets			■			
Markers or colored pencils		■		■	■	■	
Measuring cup, ½ cup	1					■	
Newspapers			■				
Pair of scissors	15			■		■	
Paper cup	8					■	
Paper plate or paper towel	15		■				
Paper towels			■				
Poster board	8						■
Projection system	1			■	■		
Ruler, 30 cm	15				■		
Science notebook	30	■	■	■	■	■	■
Sheet of chart paper	8					■	
Sheet of white paper	32	■					
Small resealable plastic bag	8					■	
Soda	1 C					■	
Sunny location (to store plants)	1	■			■		
Tablespoon scoop	1					■	
Tape		■				■	
Water					■		

NOTES

Unit Overview: *Matter and Energy in Ecosystems*

Ecosystems on Earth contain diverse forms of life and have unique needs to sustain these life-forms. An ecosystem is composed habitats, each made up of biotic and abiotic factors. Students should have an understanding that living things require the same basic resources: food, water, shelter, and air. However, they may not be aware of the interactions that occur when biotic factors compete to obtain these resources. Biotic factors depend on abiotic factors, such as the Sun, water, and air, and on other biotic factors, including plants and animals, to grow, reproduce, and survive. Through a series of six lessons in *Matter and Energy in Ecosystems*, students examine the movement of matter and cycling of energy within an ecosystem. They make connections to competition, interdependence, and Earth's spheres using models such as food webs, food pyramids, and ecocolumns. Students continuously build upon the idea that energy is constantly cycled on Earth.

Students begin by differentiating between the biotic and abiotic factors in different habitats. Plants become the primary focus as students review the life cycle of a plant and identify the Sun as the primary source of energy for the process of photosynthesis. Students plan an investigation using radish seeds to draw upon the idea that plants obtain most of their resources from air and water. The focus shifts to animals as students analyze food chains to examine the linear movement of energy from the Sun to animals in an ecosystem. Students dissect owl pellets, and use their findings to develop a food pyramid, demonstrating that there are multiple levels of consumers in an ecosystem. Food webs are introduced as a more complex model to demonstrate interdependence and competition. Students make predictions about the effects of removing biotic factors from an ecosystem. The focus is expanded to consider interactions across Earth. Students are introduced to Earth's four spheres: atmosphere, biosphere, geosphere, and hydrosphere. The water cycle acts as a model to demonstrate the interactions between these spheres. Pairs of students construct ecocolumns to simulate the movement of resources and energy between a terrestrial and an aquatic system. Human impact is the final focus of the unit as students use literacy to examine agriculture, fossil fuels, technology, and industry. Students define human needs and predict the resulting impact on an ecosystem. Conditions of the ecocolumns are manipulated to simulate water pollution. As a culmination, students are provided with scenarios for which they must design a solution to limit human impact. Students work in groups to develop solutions and then present their ideas to the class. Each group analyzes its own presentation and the presentations of the other groups.

Credit: Gail Johnson/Shutterstock.com

Next Generation Science Standards

The Building Blocks of Science unit *Matter and Energy in Ecosystems* integrates process skills as defined by the Next Generation Science Standards (NGSS).

Performance Expectations

- **5-LS1-1:** Support an argument that plants get the materials they need for growth chiefly from air and water.
- **5-LS2-1:** Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.
- **5-PS3-1:** Use models to describe that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun.
- **5-ESS2-1:** Develop a model using an example to describe the ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.
- **5-ESS3-1:** Obtain and combine information about ways individual communities use science ideas to protect the earth's resources and environment
- **3-5-ETS1-3:** Generate and compare multiple solutions to a problem based on how well each is likely to meet the criteria and constraints of a problem

Disciplinary Core Ideas

- **LS1.C:** Organization for Matter and Energy Flow in Organisms
- **LS2.A:** Interdependent Relationships in Ecosystems
- **LS2.B:** Cycles of Matter and Energy Transfer in Ecosystems
- **PS3.D:** Energy in Chemical Processes and Everyday Life
- **ESS2.A:** Earth Materials and Systems
- **ESS3.C:** Human Impacts on Earth Systems
- **ETS1.B:** Developing Possible Solutions

Science and Engineering Practices

- Developing and Using Models
- Analyzing and Interpreting Data
- Constructing Explanations and Designing Solutions
- Engaging in Argument from Evidence
- Obtaining, Evaluating, and Communicating Information

Crosscutting Concepts

- Patterns
- Cause and Effect
- Energy and Matter
- Systems and System Models

Important Terms Related to Science Instruction

Science and science instruction rely on specific terminology. Many scientific terms are likely to be new or unfamiliar to students. Below is a list of terms that are used throughout Building Blocks of Science units. Each is followed by a student-friendly definition to help students understand the meaning of the term in a scientific context. A brief description of how Building Blocks employs each of these scientific skills and tools is intended to help you help students model the behavior of scientists.

- **Analyze:** To examine. *Students are asked to examine (analyze) data they collect to help develop their understanding of core ideas and crosscutting concepts.*
- **Claim:** A statement. *To help students develop their understanding of concepts, they will make statements (claims) concerning various scenarios based on observations and data they have collected*.
- **Classify:** To arrange things in groups or categories. *As students investigate and collect data, they will arrange (classify) their data to look for patterns that may help to support claims that they make.*
- **Communicate:** To share information. *Students are continually asked to share experiences, questions, observations, data, and evidence (communicate) within their groups and with the class as a whole. Communication takes many forms, including discussions, the creation of models, designing solutions to problems, and formal presentations.*
- **Compare:** To note similarities and differences among things. *Like classifying, noting how things are alike and different (comparing) is another skill that students will use to analyze their data and look for patterns, cause and effect relationships, and other crosscutting concepts.*
- **Conclude:** To arrive at an opinion by reasoning. *The scientific practices of conducting investigations, collecting and analyzing evidence, and sharing and discussing information lead students to form opinions based on reasoning (to conclude). The conclusions that students develop during the unit will help you assess their understanding of the unit's core ideas.*
- **Evaluate:** To form an idea based on evidence. *Throughout each unit, students will look at (evaluate) the observations and data they collect and discuss their conclusions with classmates in order to form ideas about concepts based on evidence.*
- **Evidence:** Information to show whether something is true or valid. *Students will use the observations and data (evidence) they collect to support claims they make as being valid or true.*
- **Explain:** To describe in detail. *Throughout investigations, students will analyze the data they collect, make claims supported by evidence, and share their information with one another to make sense of (explain) core ideas and phenomena.*
- **Investigate:** To use a standard process to discover facts or information. *Students will carry out standard processes (investigate), sometimes developing those processes themselves, to discover facts or information related to scientific ideas.*
- **Model:** A representation of an object or idea. *Using a representation of an object or idea (a model) helps student scientists communicate and evaluate ideas regarding phenomena. Students will develop many types of models during a unit, including drawings, physical models, diagrams, graphs, and mathematical representations.*

- **Phenomena:** Occurrences or events that can be observed and cause one to wonder and ask questions. *Presenting occurrences or events (phenomena) related to the science concepts being studied engages students through real-world events and ensures common experiences for all students. Presenting phenomena also allows students to develop their own questions and take ownership of their learning.*

- **Predict:** To develop anticipated results of an event based on prior experience or knowledge. *Students are asked to anticipate (predict) the results of events based on experience and data from prior events.*

- **Reasoning:** Thinking about something in a logical way. *Students are asked to make claims, support them with evidence, and explain their claims in a logical fashion (with reasoning). Making claims supported with evidence and reasoning is scientific, or evidence-based, argumentation.*

- **Record:** To write down. *During investigations, students will keep track of their observations (record) by drawing or writing in their science notebooks or on student investigation sheets.*

- **Variable:** A factor that is able to be changed. *As students conduct investigations, they will consider which factors can be changed or manipulated (variables) to test something during the investigation.*

The 5E Instructional Model

Building Blocks of Science uses a constructivist approach to learning by encouraging students to build upon existing ideas using the 5Es. This instructional model cycles through five phases:

- **Engage:** Students draw upon prior knowledge to make connections to a new concept or topic.
- **Explore:** Students are provided with an activity related to a concept or topic and are encouraged to make claims and observations, collect evidence, and ask questions.
- **Explain:** Students use observations and discussion to construct an explanation for a concept or topic they are studying.
- **Elaborate:** Students must draw upon their experiences and apply their knowledge to a new situation in order to demonstrate understanding.
- **Evaluate:** Students assess their knowledge and review what they have learned.

In each Building Blocks of Science unit, students begin with an engaging pre-assessment activity, which allows the teacher to gauge levels of previous knowledge. The following lessons cycle through the explore, explain, and elaborate phases, and then in the final lesson, students are evaluated using project-based and summative assessments.

Incorporating Phenomena

Building Blocks of Science uses phenomena, or observable occurrences, to encourage students to develop questions that will lead to deeper understanding of the core ideas investigated in each unit and to support inquiry-based learning. Each unit includes both an anchoring phenomenon and lesson-specific investigative phenomena.

The unit's anchoring phenomenon, introduced to students in the first lesson, serves as the main focus of the unit. The anchoring phenomenon is introduced through a descriptive narrative in the Teacher's Guide and supported visually by a short online video. This visual teaser of the anchoring phenomenon piques students' interest and helps them to think more deeply and to develop questions. Viewing the video again at the end of the unit prompts students to make connections between the anchoring phenomenon and its applications beyond the scope of the unit's investigations.

An investigative phenomenon is presented to students at the beginning of each lesson to encourage them to develop additional questions. At the end of each lesson, the class revisits its questions and addresses them based on the evidence they collected during the lesson investigations, making connections to the lesson's investigative phenomenon.

As students begin to develop a deeper understanding of the unit's core ideas, they begin to make sense of the phenomena introduced throughout the unit. Students draw connections between what they have learned and how it applies to the world around them. In the last lesson, students engage in a performance task in which they are challenged to synthesize their knowledge to make connections to the unit's anchoring phenomenon. Students may be asked to build a model or design a solution to a problem. When communicating their designs and findings to their classmates, students explain their reasoning using evidence-based claims and answer questions during their presentation.

Each unit's literacy and digital components provide examples of connections between a concept and a phenomenon and ask students to make their own. Teachers are encouraged to support these connections by selecting related articles and videos or by engaging the class in discussion. Teacher Tips within the Teacher's Guide suggest other opportunities to identify related phenomena.

Anchoring phenomenon videos kick off each unit

The Engineering Cycle

Building Blocks of Science incorporates an engineering design process to support the engineering, technology, and application of science (ETS) core idea outlined in the National Research Council's "A Framework for K–12 Science Education" (NRC, 2012, pp. 201–202). This ETS core idea has been brought into action through the NGSS ETS performance expectations, which allow students to practice systematic problem solving as they apply scientific knowledge they have acquired.

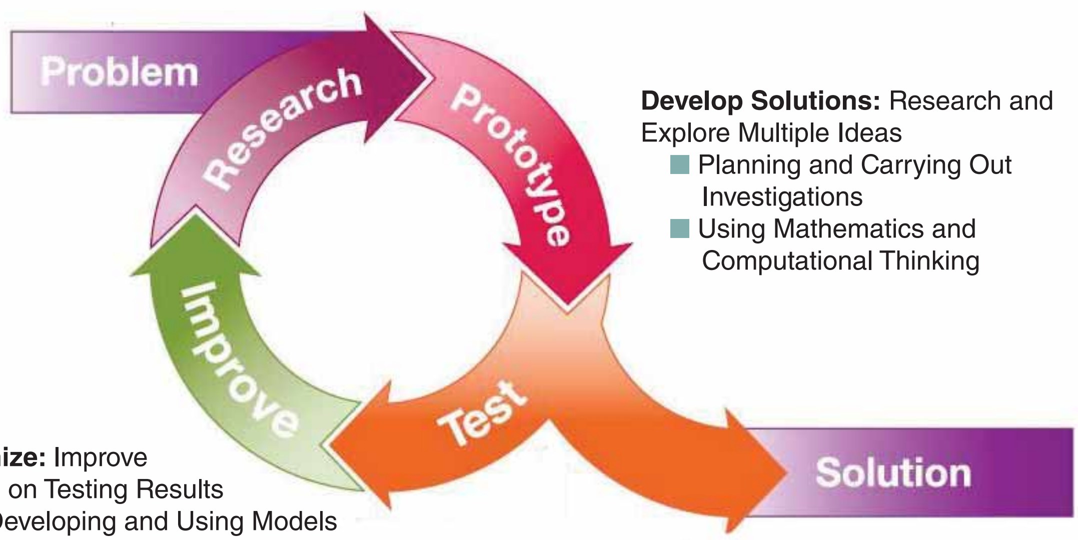
Through scientific engineering and design, students apply what they have learned to creatively solve real-world problems. This 21st-century skill encourages students to collaborate and exposes them to the idea that one problem can have multiple solutions.

An engineering design process can be thought of in three phases: defining a problem, developing solutions, and optimizing the design. Each phase can be correlated with NGSS Science and Engineering Practices as depicted in the graphic below.

Engineering Design Process

Define Problem: Identify Constraints and Criteria for Success

- Asking Questions and Defining Problems
- Obtaining and Evaluating Information



Develop Solutions: Research and Explore Multiple Ideas

- Planning and Carrying Out Investigations
- Using Mathematics and Computational Thinking

Optimize: Improve Based on Testing Results

- Developing and Using Models
- Analyzing and Interpreting Data

In each Building Blocks of Science unit, students employ this engineering cycle to assess their knowledge and build problem-solving skills. Depending on the activity, students may be creating a model, developing an experiment, or redesigning an existing product. To increase student engagement, relate the engineering process to a task, a phenomenon, or a career.

Sensemaking: Developing Claims Supported with Evidence and Reasoning

Scientific argumentation, or evidence-based argumentation, is defined as making scientific explanations (claims) using empirical data (evidence) to justify an argument (reasoning). Scientists use this type of argumentation to make sense of phenomena and refine their ideas, explanations, and experimental designs. In the classroom, students should be introduced to scientific argumentation to guide them in sensemaking, or building an understanding of phenomena based on evidence gained through observations, investigations, and data analysis. Through sensemaking, students refine and revise their understanding as new evidence is acquired and information is shared through class discussions.

Building Blocks of Science units offer multiple opportunities for students to make sense of scientific concepts by developing claims and supporting their claims with evidence and reasoning. At the start of an investigation, students are presented with a question related to a scientific concept. To make sense of a phenomenon or concept, students must draw upon their previous knowledge and experiences to develop a statement or conclusion that answers the question. To support that claim, students must provide relevant and specific data as evidence. This data may come from previous investigations, inference clues, texts, or class discussions. Students may even reference personal experience. Reasoning provides justification for why the selected evidence supports the claim. Relevant scientific principles should be incorporated into this reasoning. After the investigation, students should revisit their initial claims and determine if they are supported by newly gathered evidence. If the available evidence does not support students' initial claims, students should identify misunderstandings and present a claim that is supported.

To support students who struggle with scientific argumentation, ask them to use sentence frames such as "I think _____ because ______" to help with sensemaking. Explain that the first blank is the claim and the second blank is the evidence and reasoning.

Science Notebooks

Science notebooks are an integral part of the process of learning science because they provide a location for students to record their ideas, questions, predictions, observations, and data throughout the unit. The science notebook is used for notes, Tell Me More responses, diagrams, and outlines. Student investigation sheets can be glued, taped, or stapled into the science notebook as well.

Spiral notebooks are recommended and can be purchased inexpensively. If you choose to pre-assemble notebooks, consider including blank sheets of centimeter graph paper and plain paper for writing and drawing. It is recommended to create tabs for each lesson and to have students date each entry.

NOTE: Student investigation sheets use a specific numbering sequence to make it easier for students and teachers to identify them. The first number calls out the lesson, and the letter references the investigation. For example, Student Investigation Sheet 1A supports Investigation A of Lesson 1. If there are multiple student investigation sheets in one investigation, a second number will indicate the order of use (Student Investigation Sheet 2A.1, 2A.2, etc.).

Take-Home Science Activities

Take-Home Science activities are included in each unit and are called out within the related lesson. These activities reflect the science concepts and vocabulary that students are learning about and extend that learning to the home.

A reproducible letter explains how Take-Home Science activities work. Topic-specific activity sheets include directions for the parent, simple background information, and a space for the student to record observations or data. It is recommended that students share their findings and compare experiences as a class after completing the activity. Take-Home Science resources are found with the student investigation sheets at the end of the lesson in which they are assigned.

Assessment

Building Blocks of Science units provide assessment opportunities that correspond to specific lesson objectives, general science process skills, communication skills, and a student's ability to apply the concepts and ideas presented in the unit to new situations. The Teacher's Guide includes strategies for both formative and summative assessment. Each unit includes:

- **Pre-Unit Assessment and Post-Unit Assessment Opportunities:** The pre-unit assessment asks students to draw upon previous knowledge, allowing you to gauge their levels of understanding. The post-unit assessment touches upon the topics and concepts from the entire unit and evaluates students' learning. It is a beneficial practice to ask students to compare the pre-unit assessment and post-unit assessment activities to evaluate growth.

- **Formative Assessment Strategies:** At the end of each lesson, specific strategies are listed for each investigation. These include ways to utilize Student Investigation Sheets and Tell Me More questions as assessment tools. In lower grades, an Assessment Observation Sheet lists things to look for as you work with small groups of students.

- **Literacy and Digital Components:** These resources can be assigned to differentiate assignments and to assess student progress as needed.

- **General Rubric:** Appendix A includes a rubric that provides an expected progression of skills and understanding of science content. You can use these guidelines to assess students throughout the course of the unit.

- **Summative Assessment:** This unit-specific, cumulative assessment allows students to demonstrate their understanding of content presented by responding to questions in a variety of formats. Each question is aligned to performance expectations and provides insight on students' understanding of the concepts addressed. An answer key is provided, as well as a chart that indicates the performance expectation addressed by each question and lessons to revisit if remediation is required.

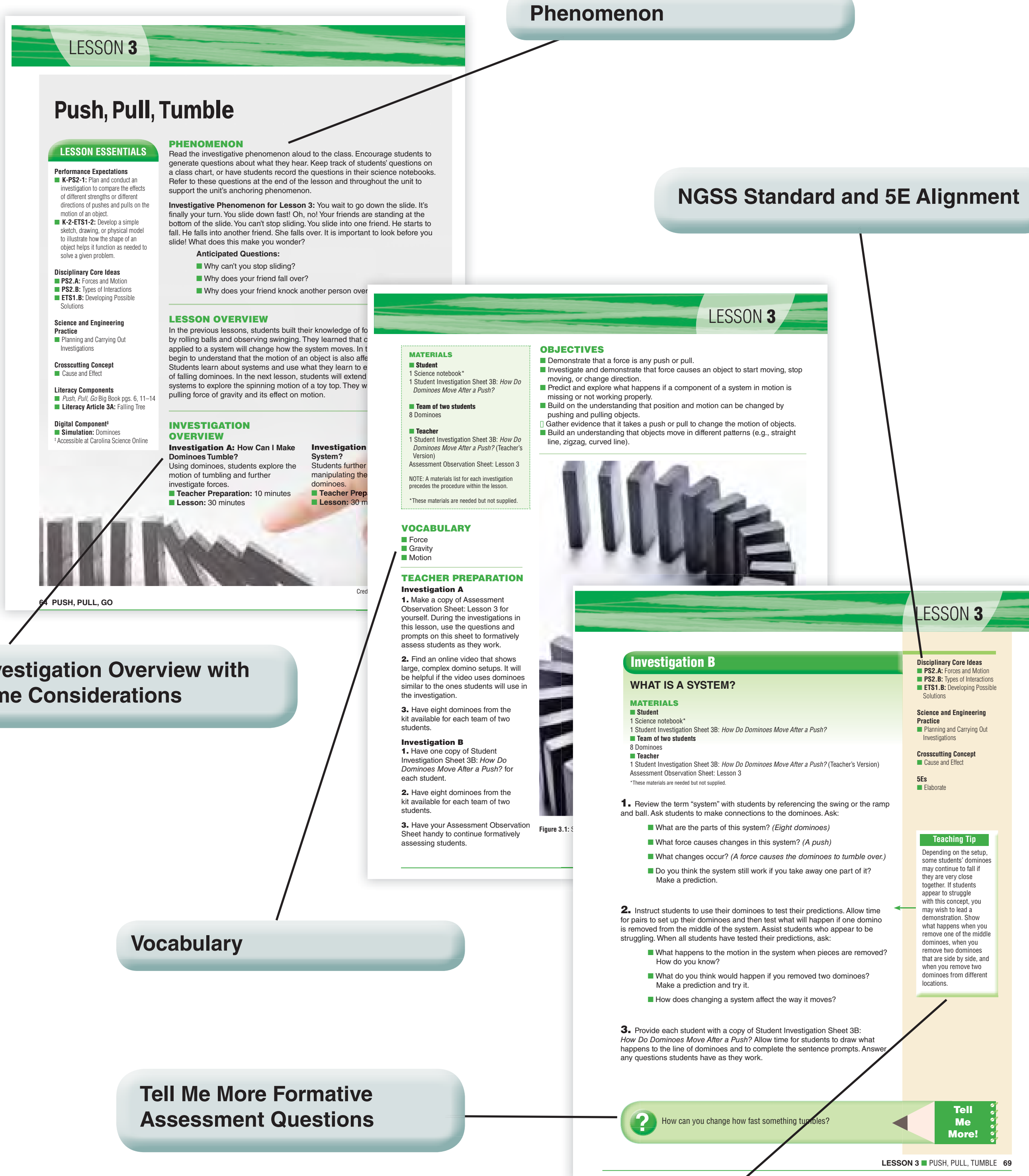
Additionally, there is a second end-of-unit assessment accessible only online. This digital summative assessment is **scenario-based** and touches upon all the standards from the unit. It includes both close-ended and open-ended questions.

Building Blocks of Science 3D—The Total Package

Phenomenon-Based Investigations with Digital Support—in 30-Minute Lessons

Hands-on materials are always included—not an extra purchase

Navigating the Teacher's Guide



LESSON 3

Push, Pull, Tumble

LESSON ESSENTIALS

Performance Expectations
- **K-PS2-1:** Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object.
- **K-2-ETS1-2:** Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.

Disciplinary Core Ideas
- **PS2.A:** Forces and Motion
- **PS2.B:** Types of Interactions
- **ETS1.B:** Developing Possible Solutions

Science and Engineering Practice
- Planning and Carrying Out Investigations

Crosscutting Concept
- Cause and Effect

Literacy Components
- *Push, Pull, Go* Big Book pgs. 6, 11–14
- **Literacy Article 3A:** Falling Tree

Digital Component[1]
- **Simulation:** Dominoes

[1] Accessible at Carolina Science Online

PHENOMENON
Read the investigative phenomenon aloud to the class. Encourage students to generate questions about what they hear. Keep track of students' questions on a class chart, or have students record the questions in their science notebooks. Refer to these questions at the end of the lesson and throughout the unit to support the unit's anchoring phenomenon.

Investigative Phenomenon for Lesson 3: You wait to go down the slide. It's finally your turn. You slide down fast! Oh, no! Your friends are standing at the bottom of the slide. You can't stop sliding. You slide into one friend. He starts to fall. He falls into another friend. She falls over. It is important to look before you slide! What does this make you wonder?

Anticipated Questions:
- Why can't you stop sliding?
- Why does your friend fall over?
- Why does your friend knock another person over

LESSON OVERVIEW
In the previous lessons, students built their knowledge of fo… by rolling balls and observing swinging. They learned that … applied to a system will change how the system moves. In t… begin to understand that the motion of an object is also affe… Students learn about systems and use what they learn to e… of falling dominoes. In the next lesson, students will extend … systems to explore the spinning motion of a toy top. They w… pulling force of gravity and its effect on motion.

INVESTIGATION OVERVIEW

Investigation A: How Can I Make Dominoes Tumble?
Using dominoes, students explore the motion of tumbling and further investigate forces.
- **Teacher Preparation:** 10 minutes
- **Lesson:** 30 minutes

Investigation … System?
Students further … manipulating the … dominoes.
- **Teacher Prep**…
- **Lesson:** 30 m…

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LESSON 3

MATERIALS
- **Student**
1 Science notebook*
1 Student Investigation Sheet 3B: *How Do Dominoes Move After a Push?*
- **Team of two students**
8 Dominoes
- **Teacher**
1 Student Investigation Sheet 3B: *How Do Dominoes Move After a Push?* (Teacher's Version)
Assessment Observation Sheet: Lesson 3

NOTE: A materials list for each investigation precedes the procedure within the lesson.

*These materials are needed but not supplied.

OBJECTIVES
- Demonstrate that a force is any push or pull.
- Investigate and demonstrate that force causes an object to start moving, stop moving, or change direction.
- Predict and explore what happens if a component of a system in motion is missing or not working properly.
- Build on the understanding that position and motion can be changed by pushing and pulling objects.
- Gather evidence that it takes a push or pull to change the motion of objects.
- Build an understanding that objects move in different patterns (e.g., straight line, zigzag, curved line).

VOCABULARY
- Force
- Gravity
- Motion

TEACHER PREPARATION

Investigation A
1. Make a copy of Assessment Observation Sheet: Lesson 3 for yourself. During the investigations in this lesson, use the questions and prompts on this sheet to formatively assess students as they work.
2. Find an online video that shows large, complex domino setups. It will be helpful if the video uses dominoes similar to the ones students will use in the investigation.
3. Have eight dominoes from the kit available for each team of two students.

Investigation B
1. Have one copy of Student Investigation Sheet 3B: *How Do Dominoes Move After a Push?* for each student.
2. Have eight dominoes from the kit available for each team of two students.
3. Have your Assessment Observation Sheet handy to continue formatively assessing students.

Figure 3.1: …

LESSON 3

Investigation B

WHAT IS A SYSTEM?

MATERIALS
- **Student**
1 Science notebook*
1 Student Investigation Sheet 3B: *How Do Dominoes Move After a Push?*
- **Team of two students**
8 Dominoes
- **Teacher**
1 Student Investigation Sheet 3B: *How Do Dominoes Move After a Push?* (Teacher's Version)
Assessment Observation Sheet: Lesson 3

*These materials are needed but not supplied.

1. Review the term "system" with students by referencing the swing or the ramp and ball. Ask students to make connections to the dominoes. Ask:
   - What are the parts of this system? *(Eight dominoes)*
   - What force causes changes in this system? *(A push)*
   - What changes occur? *(A force causes the dominoes to tumble over.)*
   - Do you think the system still work if you take away one part of it? Make a prediction.
2. Instruct students to use their dominoes to test their predictions. Allow time for pairs to set up their dominoes and then test what will happen if one domino is removed from the middle of the system. Assist students who appear to be struggling. When all students have tested their predictions, ask:
   - What happens to the motion in the system when pieces are removed? How do you know?
   - What do you think would happen if you removed two dominoes? Make a prediction and try it.
   - How does changing a system affect the way it moves?
3. Provide each student with a copy of Student Investigation Sheet 3B: *How Do Dominoes Move After a Push?* Allow time for students to draw what happens to the line of dominoes and to complete the sentence prompts. Answer any questions students have as they work.

Disciplinary Core Ideas
- **PS2.A:** Forces and Motion
- **PS2.B:** Types of Interactions
- **ETS1.B:** Developing Possible Solutions

Science and Engineering Practice
- Planning and Carrying Out Investigations

Crosscutting Concept
- Cause and Effect

5Es
- Elaborate

Teaching Tip
Depending on the setup, some students' dominoes may continue to fall if they are very close together. If students appear to struggle with this concept, you may wish to lead a demonstration. Show what happens when you remove one of the middle dominoes, when you remove two dominoes that are side by side, and when you remove two dominoes from different locations.

How can you change how fast something tumbles? **Tell Me More!**

LESSON 3 ■ PUSH, PULL, TUMBLE 69

Extensions

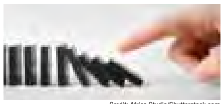
LESSON **3**

EXTENSIONS

Action Attraction
Challenge students to explore what might make the dominoes fall more slowly or more quickly. You might prompt students by asking:

- Does spacing make a difference in how a line of dominoes topples over?
- How might you test this question?
- Make a prediction and then try your ideas.

Domino Rally Events
Do a quick Internet search for videos that show domino challenges that people have set up. Share these videos with students, and encourage them to work together in small groups with all 96 dominoes to see how many dominoes they can set up to tumble with one push.



Credit: Africa Studio/Shutterstock.com

Counting and Setting Up Sets
Challenge pairs of students in a learning center to set up a line of dominoes that not only will fall down with one push but also is set up in sets of two or five. Have students offset the line of dominoes so that before the line is sent tumbling, they can identify and count the sets of two, three, or five.

ASSESSMENT STRATEGIES

1. Investigation A

- Use students' responses to the Tell Me More question to assess their understanding of domino motion. If students do not seem to understand this concept, you may wish to provide supplemental examples of motion and force.

2. Investigation B

- Use Student Investigation Sheet 3B: *How Do Dominoes Move After a Push?* to determine how well students understand force and motion using dominoes. Look for use of appropriate vocabulary and drawings that demonstrate motion.
- Use students' responses to the Tell Me More question to evaluate their understanding of forces. Students should recognize that adding force will increase the speed at which an object tumbles.

3. Refer to the Assessment Observation Sheet where you recorded observations during this lesson to formatively assess your class, and adjust instruction as needed.

4. Refer to the General Rubric in Appendix A to assess individual progress as needed.

Additional Features

- Lesson Overview Charts
- Guide to Instructional Scaffolding
- Teacher Preparation
- Background Information
- NGSS Standards by Lesson
- Literacy and Digital Components
- Summative Assessment

Assessment Strategies

Literacy Articles

Literacy Article 3A

Name: Date:

Falling Tree

You saw a tree in the forest. It was tall. It was wide. It was huge!

It rained hard. The wind blew.

The tree tumbled over! The tree fell onto smaller trees.

They had thin trunks. The smaller trees tumbled, too. The smaller trees fell on bushes. The bushes tumbled.

The rain stops. The Sun comes out. Birds start to sing.

Credit: Patrycja I

Take-Home Science Activities

Take-Home Science

Dear Family,

Our class is beginning an inquiry science unit. Inquiry science is all about questions, active explorations, drawing, writing, and recording what you see and do to build an understanding of science. Young children are natural scientists. Scientists question everything. Once scientists answer one question, they move without blinking to the next question.

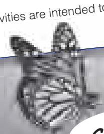
Take-Home Science is an exciting part of our program because it's one way we can better connect home and school. With everyone working together, we can reinforce the science concepts that your student is exploring in the classroom. Here's how Take-Home Science works.

Your student will bring home an investigation sheet that explains an activity related to the science unit the class is studying. The activity is designed so that everyone in the household—younger and older children alike—can work together to learn about science.

A section of the investigation sheet explains the science words and ideas that will be explored during the activity. These science words and ideas are not new to your student, because the activity follows a lesson in which those same concepts were explored.

The activities are simple and can be completed within 20 minutes using items normally found in the home. A section of the investigation sheet is for your student to complete and bring back to school. In class, your student will have the opportunity to share his or her experiences and results with other students.

The activities are intended to be quick, informal, and fun. Enjoy!



GO EXPLORING!

Credit: Cathy Keifer /Shutterstock

 Lesson 5 Take-Home Science Letter

Student Investigation Sheet 3B: How Do Domino

Name: Da

This is a line that moves.

Dominoes ______.

A push ______.

 Student Investigation Sheet 3B

Student Investigation Sheets

Matter and Energy in Ecosystems

Unit Overview

Ecosystems on Earth contain diverse forms of life and have unique needs to sustain these life-forms. An ecosystem is composed habitats, each made up of biotic and abiotic factors. Students should have an understanding that living things require the same basic resources: food, water, shelter, and air. However, they may not be aware of the interactions that occur when biotic factors compete to obtain these resources. Biotic factors depend on abiotic factors, such as the Sun, water, and air, and on other biotic factors, including plants and animals, to grow, reproduce, and survive. Through a series of six lessons in *Matter and Energy in Ecosystems*, students examine the movement of matter and cycling of energy within an ecosystem. They make connections to competition, interdependence, and Earth's spheres using models such as food webs, food pyramids, and ecocolumns. Students continuously build upon the idea that energy is constantly cycled on Earth.

Unit Anchoring Phenomenon

Energy is what drives activity, growth, repair, and reproduction for all living things. Students understand that they eat food to fuel their activities, like sports or studying, but they may not realize that their bodies are in constant need of energy. All living things require an energy source to survive. The anchoring phenomenon for *Matter and Energy in Ecosystems* is identifying the ways in which living things obtain energy and how they use that energy.

	LESSON 1	LESSON 2
INVESTIGATIVE PHENOMENA	Sometimes tree branches grow over houses, fences, or garages. To avoid potential danger, it is recommended to prune, or cut, tree branches before winter, usually early in November. Typically, a chainsaw is used to remove individual branches from a tree. This process is often repeated every three years. It is important to prune only the thinner branches at the sides of the tree and not the thick branches at the top of the tree. What does this make you wonder?	When flowering plants bloom in the spring, they can produce nectar. You might notice animals such as insects, birds, chipmunks, and rabbits around these flowering plants. If there are a lot of insects and birds, it is likely there will be a greater number of flowering plants by the end of summer. If there are more chipmunks and rabbits, there will likely be fewer flowering plants. What does this make you wonder?
OBJECTIVES	■ Differentiate between biotic and abiotic factors. ■ Identify different habitats as part of an ecosystem. ■ Develop a model of the plant life cycle. ■ Explain the importance of the Sun in photosynthesis. ■ Plan an investigation using a control and variables to determine what plants need to grow.	■ Define "interdependence" and provide examples of interdependence that are related to ecosystems. ■ Develop a food chain model to demonstrate the flow of energy in a specific habitat. ■ Use owl pellets to draw conclusions about an owl's diet. ■ Construct a food pyramid to illustrate energy transfers from the Sun to a tertiary consumer.
SCAFFOLDING Students should know:	↓ An ecosystem is composed of biotic (living) and abiotic (nonliving) factors. ↓ Ecosystems include different habitats, which are identified by their climate and the biotic factors within them. ↓ Plants use energy from the Sun to perform photosynthesis, the process by which they make their own food. ↓ Apart from sunlight, plants need water and air to perform photosynthesis.	↓ Within an ecosystem, biotic factors depend on abiotic factors and other biotic factors to meet their needs. ↓ Biotic factors need air, water, shelter, and food to survive, grow, and reproduce. ↓ Animals obtain their energy from eating plants or other animals. ↓ The Sun is the ultimate source of energy in an ecosystem. ↓ We can use models, like food chains or food pyramids, to demonstrate energy transfers among biotic factors in an ecosystem.

Concepts build from one lesson to the next

LESSON 3	LESSON 4	LESSON 5
Scientists have found connections between the populations of deer and wolves. When the population of deer begins to increase, the wolf population quickly follows. If the deer population decreases, the wolf population also begins to decrease. It is important that the deer population remains larger than the wolf population. What does this make you wonder?	Pigs produce a great deal of waste. During a heavy rainstorm, the waste can be carried by the rainwater into nearby lakes, ponds, and streams. This can cause an increase in plant growth; however, it may also lead to the death of fish, frogs, and other animals that live in the water. Populations of decomposers, including worms and bacteria, often increase as a result. What does this make you wonder?	Plastic bags are a threat to sea turtles. When they float in the ocean, they resemble jellyfish, which are a common food for sea turtles. Animals' stomachs cannot break down the plastic, and it remains in their stomachs. This has led to the death of many sea turtles. What does this make you wonder?
■ Construct food webs to explain the cycling of energy in an ecosystem. ■ Identify how biotic factors use energy. ■ Describe the effects of competition on the transfer of energy in an ecosystem. ■ Make predictions about the effects of removing a biotic factor from a habitat.	■ Recognize the biotic and abiotic factors that make up the atmosphere, biosphere, geosphere, and hydrosphere. ■ Make a claim about the interactions between the four spheres of Earth. ■ Use the water cycle as a model to describe the interdependence of Earth's spheres. ■ Construct an ecocolumn to model an ecosystem that contains terrestrial and aquatic habitats. ■ Analyze and draw conclusions about the cycling of energy in an ecosystem that includes terrestrial and aquatic habitats.	■ Identify human needs and human actions used to meet these needs. ■ Use readings to investigate human impact, and draw conclusions about the effect of human behaviors on the cycling of energy in an ecosystem. ■ Analyze images for evidence of human impact. ■ Make connections between human impact and the water cycle. ■ Simulate water pollution by using ecocolumns to draw conclusions about the effects of pollution on an ecosystem.
↓ Habitats include a diverse variety of biotic factors that depend on one another. ↓ Food webs are used to model the complex energy transfers that occur within an ecosystem. ↓ Biotic factors compete for access to resources. ↓ Removing an entire species from an ecosystem will affect other biotic factors. ↓ Energy, originating from the Sun, is cycled through an ecosystem.	↓ In order for an ecosystem to sustain life, it must have ample resources (food, water, shelter, air). ↓ Earth is composed of four spheres: atmosphere, biosphere, geosphere, and hydrosphere. ↓ An ecosystem relies on the interaction of Earth's spheres to obtain the resources it needs to exist. ↓ The water cycle employs all four of Earth's spheres to provide for biotic factors. ↓ Ecocolumns work as models to simulate the cycling of energy and resources in an ecosystem.	↓ Humans are biotic factors that rely on food, water, air, and shelter to grow, reproduce, and survive. ↓ Humans compete with other biotic factors for resources. ↓ Humans' use of technology, fossil fuels, and agriculture may have negative impacts on Earth's spheres and other biotic factors. ↓ Human activities can impact natural cycles, such as the water cycle. ↓ Water pollution can have immediate or long-term effects on the cycling of energy in an ecosystem.

Building Blocks OF SCIENCE™ 3D

Matter and Energy in Ecosystems

Unit Anchoring Phenomenon

Energy is what drives activity, growth, repair, and reproduction for all living things. Students understand that they eat food to fuel their activities, like sports or studying, but they may not realize that their bodies are in constant need of energy. All living things require an energy source to survive. The anchoring phenomenon for *Matter and Energy in Ecosystems* is identifying the ways in which living things obtain energy and how they use that energy.

LESSON 6

INVESTIGATIVE PHENOMENA

It's becoming more common to find composting bins in people's yards. You can compost items such as hair, eggs shells, coffee grounds, cotton fabric, fruit and vegetable peels, shredded paper, and the contents of your vacuum cleaner. Research has found that people who plant gardens using homemade compost have more success than those who use store-bought fertilizer. However, it is important to choose carefully the items that go in to a compost bin. Not all trash is good for composting. What does this make you wonder?

OBJECTIVES

- Analyze patterns of human behavior to identify negative effects on the ecosystem.
- Develop and organize potential solutions to decrease harmful human impact.
- Present ideas to classmates and evaluate the effectiveness of solutions.

SCAFFOLDING
Students should know:

- Human activity can have negative and positive effects on an ecosystem.
- Consistently negative impacts of human actions can have permanent effects on the health of the ecosystem.
- Developing solutions to limit negative human impact will have beneficial effects on Earths' spheres and on other biotic factors.

NOTES

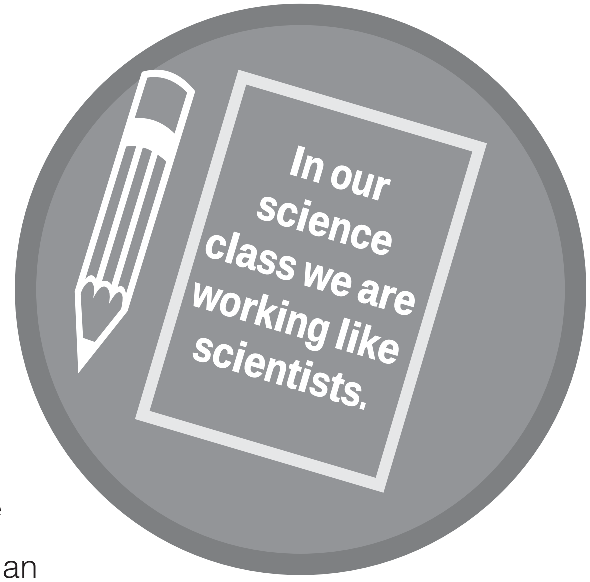
NGSS correlations by lesson

Lesson 3: Energy Flow in an Ecosystem

Investigation Overview	Standards	Resources
Investigation A: What Can We Conclude from Food Webs? **5Es:** Explore, Explain Students examine and construct food webs to explain the flow of energy in different habitats. ■ **Teacher Preparation:** 10 minutes ■ **Lesson:** 60 minutes **Tell Me More!** Hawks are found in woodland, wetland, grassland, desert, rain forest, and tundra habitats. Do you think the same kind of hawk is found in all these habitats? **Investigation B: How Does Competition Affect an Ecosystem?** **5Es:** Explore, Explain, Elaborate Students use food webs to learn about competition, and they make predictions about the effect of removing a biotic factor from an ecosystem. ■ **Teacher Preparation:** 10 minutes ■ **Lesson:** 45–60 minutes **Tell Me More!** Many types of plants live in the rain forest. Many animals, including monkeys, butterflies, and birds, eat passionfruit. However, passionfruit is not the only source of food for these animals. Describe the effect if all the passionfruit trees were removed from the rain forest.	**Next Generation Science Standards Performance Expectations** ■ **5-LS2-1:** Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment. ■ **5-PS3-1:** Use models to describe that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun. **Disciplinary Core Ideas** ■ **LS1.C:** Organization for Matter and Energy Flow in Organisms ■ **LS2.A:** Interdependent Relationships in Ecosystems ■ **LS2.B:** Cycles of Matter and Energy Transfer in Ecosystems ■ **PS3.D:** Energy in Chemical Processes and Everyday Life **Science and Engineering Practices** ■ Developing and Using Models ■ Analyzing and Interpreting Data ■ Constructing Explanations and Designing Solutions ■ Engaging in Argument from Evidence **Crosscutting Concepts** ■ Patterns ■ Cause and Effect ■ Energy and Matter **Language Arts and Math Standards** **Language Arts** ■ **RI.5.2:** Key Ideas and Details ■ **RI.5.3:** Key Ideas and Details ■ **RI.5.4:** Craft and Structure ■ **RI.5.5:** Craft and Structure ■ **RI.5.6:** Craft and Structure ■ **RI.5.8:** Integration of Knowledge and Ideas ■ **SL.5.1:** Comprehension and Collaboration ■ **SL.5.4:** Presentation of Knowledge and Ideas ■ **W.5.3:** Text Types and Purpose ■ **W.5.7:** Research to Build and Present Knowledge ■ **W.5.8:** Research to Build and Present Knowledge **Math** ■ **5.NF.A.1:** Use equivalent fractions as a strategy to add and subtract fractions. ■ **5.NF.A.2:** Use equivalent fractions as a strategy to add and subtract fractions. ■ **5.NF.B.3:** Apply and extend previous understandings of multiplication and division. ■ **5.NF.B.7:** Apply and extend previous understandings of multiplication and division. ■ **5.OA.A.1:** Write and interpret numerical expressions. ■ **5.OA.A.2:** Write and interpret numerical expressions.	**Student Investigation Sheets** ■ Student Investigation Sheet 3A: *What Is a Food Web?* ■ Student Investigation Sheet 3B: *Who Will Survive?* ■ Take-Home Science Activity: *Growing Decomposers* **Literacy Components** ■ *Matter and Energy in Ecosystems* Literacy Reader, pgs. 12–17 ■ Literacy Article 3B: The Recyclers of the Natural World **Digital Components** ■ Simulation: Competition ■ Simulation: Energy Cycles **Vocabulary** ■ Bacteria ■ Competition ■ Decomposer ■ Food web ■ Fungi ■ Organic ■ Predator ■ Prey

Integrated ELA and math

Safety Contract



In science class, I will:

- Listen to directions
- Complete each step of the experiment
- Look, feel, smell, and listen but never taste
- Wait to begin until my teacher tells me
- Wear safety goggles when my teacher tells me
- Ask my teacher to approve any experiment I plan on my own or with classmates
- Keep my hands away from my mouth and eyes as I work
- Tie back long hair
- Tuck in loose clothing
- Keep my workstation neat
- Put away materials after use
- Follow all safety rules

I have read this contract and will follow these safety rules in science class.

Student's signature ______________________________

Date ______________________________

I have read this safety contract and understand what is expected of my child during science class.

Parent/Guardian's signature ______________________________

Date ______________________________

Note to Parent/Guardian:
Science materials and activities are chosen for safety and age appropriateness.

All lessons are anchored in phenomena

Energy Flow in an Ecosystem

LESSON ESSENTIALS

Performance Expectations
- **5-LS2-1:** Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.
- **5-PS3-1:** Use models to describe that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun

Disciplinary Core Ideas
- **LS1.C:** Organization for Matter and Energy Flow in Organisms
- **LS2.A:** Interdependent Relationships in Ecosystems
- **LS2.B:** Cycles of Matter and Energy Transfer in Ecosystems
- **PS3.D:** Energy in Chemical Processes and Everyday Life

Science and Engineering Practices
- Developing and Using Models
- Analyzing and Interpreting Data
- Constructing Explanations and Designing Solutions
- Engaging in Argument from Evidence

Crosscutting Concepts
- Patterns
- Cause and Effect
- Energy and Matter

Literacy Components
- *Matter and Energy in Ecosystems* Literacy Reader, pgs. 12–17
- **Literacy Article 3B:** The Recyclers of the Natural World

Digital Components‡
- **Simulation:** Competition
- **Simulation:** Energy Cycles

‡ Accessible at Carolina Science Online

PHENOMENON

Read the investigative phenomenon aloud to the class. Encourage students to generate questions about what they hear. Keep track of students' questions on a class chart, or have students record the questions in their science notebooks. Refer to these questions at the end of the lesson and throughout the unit to support the unit's anchoring phenomenon.

Investigative Phenomenon for Lesson 3: Scientists have found connections between the populations of deer and wolves. When the population of deer begins to increase, the wolf population quickly follows. If the deer population decreases, the wolf population also begins to decrease. It is important that the deer population remains larger than the wolf population. What does this make you wonder?

Anticipated Questions:

- Why do wolf and deer populations affect each other?
- Why is it important that the deer population is larger than the wolf population?
- Do animals besides wolves consume deer?

LESSON OVERVIEW

In the previous lessons, students examined plants and animals and their interdependence within an ecosystem. Using food chains and food pyramids, students examined how the Sun's energy is transferred among organisms. In this lesson, students support this idea by examining food webs. Competition among organisms is discussed, and students make predictions about the effect of removing a biotic factor from an ecosystem. Students are introduced to decomposers and their central role in the cycling of energy through an ecosystem. Habitats are compared, and students draw conclusions about interdependence and the need for resources. In the next lesson, students will further examine the common needs of biotic factors by constructing a simple ecocolumn. Students use this model to explore the cycling of energy through the atmosphere, biosphere, hydrosphere, and geosphere.

INVESTIGATION OVERVIEW

Investigation A: What Can We Conclude from Food Webs?
Students examine and construct food webs to explain the flow of energy in different habitats.
- **Teacher Preparation:** 10 minutes
- **Lesson:** 60 minutes

Investigation B: How Does Competition Affect an Ecosystem?
Students use food webs to learn about competition, and they make predictions about the effect of removing a biotic factor from an ecosystem.
- **Teacher Preparation:** 10 minutes
- **Lesson:** 45–60 minutes

Credit: LAND/Shutterstock.com

VOCABULARY

- Bacteria
- Competition
- Decomposer
- Food web
- Fungi
- Organic
- Predator
- Prey

MATERIALS

Student

1 Science notebook*
1 Student Investigation Sheet 3B: *Who Will Survive?*
1 Take-Home Science Letter
1 Take-Home Science Activity: *Growing Decomposers*
Markers (blue, green, orange, red, yellow)*

Team of two students

1 Student Investigation Sheet 3A: *What Is a Food Web?*
1 Glue stick*
1 Large sheet of paper (about 11 x 17 in)*
1 Pair of scissors*
String

Team of four students

10 Index cards
1 Pair of scissors*
1 Roll of string

Class

Markers or colored pencils*

Teacher

1 Teacher Sheet 3A: *Example Food Web*
1 Student Investigation Sheet 3A: *What Is a Food Web?* (Teacher's Version)
1 Student Investigation Sheet 3B: *Who Will Survive?* (Teacher's Version)
1 Projection system*
Chart paper or whiteboard*
Marker*

NOTE: A materials list for each investigation precedes the procedure within the lesson.

*These materials are needed but not supplied.

OBJECTIVES

- Construct food webs to explain the cycling of energy in an ecosystem.
- Identify how biotic factors use energy.
- Describe the effects of competition on the transfer of energy in an ecosystem.
- Make predictions about the effects of removing a biotic factor from a habitat.

TEACHER PREPARATION

Investigation A

1. Make one copy of Student Investigation Sheet 3A: *What Is a Food Web?* for each pair of students.

2. You will need to share Teacher Sheet 3A: *Example Food Web* with the class. Prepare to use a digital projection system to display the image, or make a copy for each student.

3. Each pair of students will need one pair of scissors and a sheet of paper that is about 11 x 17 inches.

4. Eight rolls of string are provided in the kit. In the first part of this investigation, each pair of students will need access to string. Choose to cut each pair a 1-meter piece of string or provide a roll of string and a pair of scissors for two pairs of students to share. In the second half of the investigation, students will work in groups of four, and each group will need a pair of scissors and a roll of string.

5. Have available 10 index cards for each group of four students.

6. Assign each group of four students a habitat for which they will create a food web. Depending on the ability levels of your students, you may wish to provide images for them to use to construct a food web rather than ask them to draw their own images. The examples below will help you find appropriate images but are by no means the only options. Provide at least 10 images for each group. Be sure to have a mix of producers, primary consumers, secondary consumers, and tertiary consumers in the images you provide for each habitat.

A. Desert: cactus, grass, rodent, bird, rabbit, snake, lizard, scorpion, mountain lion, vulture, fox, hawk

B. Ocean: algae, seaweed, crab, small fish, seagull, large fish, pelican, squid, shark, seal, killer whale

C. Tundra: moss, liverworts, Arctic hare, caribou, Arctic fox, owl, polar bear, wolf, hawk

D. Rain forest: tropical plants, nuts, insects, frog, lizard, capybara, anaconda, monkey, jaguar, tiger, alligator

E. Woodland: dandelions, tree, mouse, rabbit, squirrel, spider, bird, hawk, owl, weasel, fox

F. Wetland: lily pad, dragonfly, crawfish, crab, fish, duck, snake, heron, otter, crocodile, owl

G. Grassland: grass, gazelle, prairie dog, zebra, mouse, hyena, elephant, coyote, cheetah, lion

7. Have markers or colored pencils available for the class.

Investigation B

1. Make one copy of Student Investigation Sheet 3B: *Who Will Survive?* for each student.

2. Student pairs will need access to the food webs they made using Student Investigation Sheet 3A: *What Is a Food Web?*

3. Make one copy of Take-Home Science Letter and Take-Home Science Activity: *Growing Decomposers* for each student.

4. Each student will need a set of five markers (one each of the following colors: blue, green, orange, red, and yellow).

5. Have a marker available to write new terms and definitions on chart paper or a whiteboard.

Just-in-time background information

BACKGROUND INFORMATION

Food webs provide a complex yet accurate model of the flow of energy in an ecosystem. Each habitat has its own unique food web. Though the organisms within the food web may be similar, each type of habitat tends to have its own distinct species. For example, hawks living in the desert are very different from hawks living in the tundra.

Food webs illustrate the interdependence within an ecosystem. **Competition** between organisms becomes clearer, but consumer levels may cause confusion. Some animals in a food web can be identified as both secondary and tertiary consumers based on what prey they eat and what preys upon them. **Prey** is what an animal eats. The **predator** is the animal looking for food.

Without the Sun, no life could exist. Students will be prompted to consider the effects if biotic factors from a food web are removed. Removing a single organism might not have a tremendous impact, but the extinction of an entire species will affect all other species in the web. Whatever preys upon the extinct species will need to find alternative sources of food, therefore increasing competition among existing consumers and lowering the populations of prey. However, the number of producers may increase in this scenario because there are fewer animals to eat the plants, which allows more opportunities for the plants to grow and reproduce. The removal of a producer often has a negative impact on all the animals in the food web because primary consumers will have limited food sources. The competition to find producers increases and, in time, the population of primary consumers decreases, causing a domino effect on the populations of animals that prey upon primary consumers.

Students will be prompted to consider the effects if an entire level of a food pyramid (producers or consumers) is removed, which will lead them to extend their thinking to recognize the importance of producers. Animals cannot photosynthesize to create their own food. Without plants, there is no foundation of energy in an ecosystem.

The introduction of ***decomposers*** supports the idea that energy is cycled through an ecosystem. Decomposers, including worms, **fungi**, **bacteria**, and other small organisms, help break down dead **organic** material and create soil. In turn, this soil provides fertile shelter for seeds to germinate and grow, therefore providing more food sources for primary consumers. This fuels reproduction and results in more young for secondary and tertiary consumers to eat. Some habitats have more decomposers than others; however, decomposers are a vital part of every ecosystem. Consider a desert: There are few plants that can survive in the desert, but there are also few animals living there, so the need for decomposers and fertile soil is lower than in a rain forest, where there is a wide variety of species in constant competition with one another. Much like the water cycle, which will be covered in the next lesson, our ecosystems depend on these energy cycles.

3-dimensional learning

Investigation A

WHAT CAN WE CONCLUDE FROM FOOD WEBS?

MATERIALS

- **Student**

1 Science notebook*

- **Team of two students**

1 Student Investigation Sheet 3A: *What Is a Food Web?*
1 Large sheet of paper (about 11 x 17 in)*
1 Glue stick*
1 Pair of scissors*
String

- **Team of four students**

10 Index cards
1 Pair of scissors*
1 Roll of string

- **Class**

Markers or colored pencils*

- **Teacher**

1 Teacher Sheet 3A: *Example Food Web*
1 Student Investigation Sheet 3A: *What Is a Food Web?* (Teacher's Version)
1 Projection system*

*These materials are needed but not supplied.

1. Prompt students to think about the owl pellet from the previous lesson. Ask:

- What did you observe in your owl pellet? What did the owl consume? *(Answers may include mouse bones, feathers from birds, shells from insects.)*
- Based on what you learned from the owl pellet, what can you conclude about the diet of a consumer? Does it eat just one type of thing? *(Students should recognize that consumers have variety in their diets.)*
- Think about the food pyramid and the food chains you constructed. What can we conclude by studying these models? *(Students should recognize that energy is transferred, or flows, among biotic factors in an ecosystem. The primary source of energy for all biotic factors is the Sun.)*
- What are some limitations of these models? *(Food chains and food pyramids do not consider the different things that a consumer will eat.)*

ELA connection SL.5.1

2. Display Teacher Sheet 3A: *Example Food Web* using a projection system, or distribute a copy of the teacher sheet to each student. Introduce the term "food web." Explain that this model shows the many interactions that occur within a specific habitat. Ask:

- How is a food web different from the other models we have used? *(Students should recognize that the food web shows a variety of biotic factors and their interactions. This model shows a more complex flow of energy.)*

Disciplinary Core Ideas

- **LS1.C:** Organization for Matter and Energy Flow in Organisms
- **LS2.A:** Interdependent Relationships in Ecosystems
- **LS2.B:** Cycles of Matter and Energy Transfer in Ecosystems
- **PS3.D:** Energy in Chemical Processes and Everyday Life

Science and Engineering Practices

- Developing and Using Models
- Engaging in Argument from Evidence

Crosscutting Concepts

- Patterns
- Energy and Matter

5Es

- Explore
- Explain

Literacy Component

- *Matter and Energy in Ecosystems* Literacy Reader, pgs. 12–17

Digital Component

- **Simulation:** Energy Cycles

Teaching Tip

Depending on the ability levels of your students, you may wish to introduce the terms "predator" and "prey." Support these terms by identifying the owl as the predator and the mouse as its prey. Apply these terms throughout the unit.

ELA connection SL.5.1

Differentiation

Differentiation Strategy

Challenge students to label each picture as biotic or abiotic and to distinguish between the producers and consumers. You may wish to provide markers and encourage students to use a different color to define producer, primary, secondary, and tertiary consumers.

Teaching Tip

Depending on the time allotted for your class, you may wish to break here and complete the habitat food webs during another session. Make sure to keep each pair's food web to discuss in Investigation B.

3. Instruct students to work with a partner to complete the following:

- Create an argument for which model is best: food chain, food pyramid, or food web. *(Accept all answers.)*
- Is anything missing from this food web? How would you change this food web? *(Answers will vary. Students might suggest that the Sun could be added to the food web or that the biotic factors could be labeled as producers or consumers.)*
- What type of habitat could this food web belong to? *(Possible answers include woodland, wetland, and tundra.)*

Review students' responses as a class. If students do not suggest it, guide them to label each biotic factor as a producer, primary consumer, secondary consumer, or tertiary consumer. Some organisms may be both a secondary and tertiary consumer.

4. Distribute a pair of scissors, a large sheet of paper, string, and a copy of Student Investigation Sheet 3A: *What Is a Food Web?* to each pair of students. Review the directions as a class. Allow time for students to cut out the pictures and build a food web on the sheet of paper. When students have completed their webs, provide a glue stick to each pair, and instruct students to glue their strings and images to the paper.

5. When all pairs have completed their food webs, facilitate a class discussion. Encourage students to share their food webs with the class, and discuss the similarities and differences among them. Draw attention to the energy transfers that the food web represents.

6. Engage students in the next activity by asking:

- Does each type of habitat have the same food web? *(No, habitats have different biotic factors and therefore different food webs.)*
- Do all biotic factors use energy in the same way? *(No, biotic factors will use energy for different activities, such as hunting, flying, running, growing, and reproducing.)*

7. Divide the class into groups of four students, and assign each group a habitat. Encourage the students in each group to create a list of the biotic and abiotic factors in their habitat in their science notebooks.

8. When students have constructed their list, prompt them to think about how the biotic factors they listed interact within the habitat. Have students identify the producers, primary consumers, secondary consumers, and tertiary consumers on their list.

9. Provide each group with 10 index cards, a roll of string, and a pair of scissors. Instruct them to choose 10 of the biotic factors from their list and then draw each factor and describe how the biotic factor uses its energy. Make sure students understand that all the information for each factor should be on one side of the index card. To demonstrate energy transfer, students should cut pieces of string and use them to connect the images of the organisms, thus creating a web. Allow ample time for this step.

Differentiation Strategy

Ask students label each index card with the name of the biotic or abiotic factor.

10. When groups have completed their food webs, provide time for students to make observations of the other groups' food webs. As they do, ask students to write questions about each food web in their science notebooks

11. Facilitate a class discussion about food webs, and draw comparisons between the habitats. Ask:

- What is one factor that could be found in all the habitat food webs? Why is this important? *(The Sun should be a part of each group's food web. The Sun is important because it is the primary energy source for all life on Earth.)*
- I want to add the Sun to the food web to demonstrate energy transfer. Should I make a connection from the Sun to all the living things in the web? Why or why not? *(No, the Sun should be connected only to the plants because the plants use the energy from the Sun for photosynthesis. Animals cannot directly access the Sun's energy.)*
- How do most living things use their energy? Compare plants and animals. *(Both plants and animals use energy to reproduce, grow, and survive. Animals use energy to move and find resources.)*
- Think about the number of plants found in a habitat. How could this affect the number of animals? Make a prediction about what would happen if many of the plants in a habitat were removed. *(If there are fewer plants, there will be fewer animals because the primary consumers need the plants for food. Secondary and tertiary consumers need the primary consumers for food, so there will be fewer of them if there is a low number of primary consumers.)*

Digital Tip

To prepare students for the next investigation, share the Energy Cycles simulation with the class. Challenge students to think about how energy cycles through an ecosystem.

Formative assessment

?

Hawks are found in woodland, wetland, grassland, desert, rain forest, and tundra habitats. Do you think the same kind of hawk is found in all these habitats?

Tell Me More!

Investigation B

HOW DOES COMPETITION AFFECT AN ECOSYSTEM?

MATERIALS

Student
1 Science notebook*
1 Student Investigation Sheet 3B: *Who Will Survive?*
1 Take-Home Science Letter
1 Take-Home Science Activity: *Growing Decomposers*
Markers (blue, green, orange, red, yellow)*

Team of two students
1 Completed food web (from Student Investigation Sheet 3A)

Teacher
Chart paper or whiteboard*
Marker*

*These materials are needed but not supplied.

1. Have students pair up as they did in Investigation A, and return to each pair the food web they created using Student Investigation Sheet 3A: *What Is a Food Web?* Review the webs, and draw attention to the worm. Have several students share where they placed the worm in their food web and provide reasoning. Ask:

- Where are worms usually found? *(In dirt, soil, or water.)*
- What do worms eat? *(Accept all reasonable answers. Students may suggest that worms eat plants or dirt.)*

2. Write the word "decomposer" on the board or on a sheet of chart paper. Ask them to copy the term into their science notebooks. Ask students to individually think about what this word means or where they have heard it before. After allowing time for students to brainstorm, invite them to share their ideas.

3. Explain that a decomposer is a biotic factor that breaks down the remains of dead plants and animals and turns them into soil. Write this definition on the board, and instruct students to copy it into their science notebooks beside the term. Identify bacteria, fungi, and sea slugs as decomposers, but continue to use a worm as the primary example. Ask:

- What types of things do you think the worm in your food web eats? (Answers may include dead leaves or plants, or remains of animals.)
- When a fox preys on a rabbit, it may leave some remains behind, lik e bones. How does this benefit the worms? *(Students should recognize that the worms can break down the bones of the rabbit to obtain energy.)*
- Why do you think worms and other decomposers are an important part of an ecosystem? *(Students should recognize that decomposers break down the remains of biotic factors into soil, which can be used to stimulate plant growth, and that this activity makes them important.)*

Be sure that students understand the concept that decomposers break down dead things to stimulate a healthy ecosystem.

Disciplinary Core Ideas
- **LS1.C:** Organization for Matter and Energy Flow in Organisms
- **LS2.A:** Interdependent Relationships in Ecosystems
- **LS2.B:** Cycles of Matter and Energy Transfer in Ecosystems
- **PS3.D:** Energy in Chemical Processes and Everyday Life

Science and Engineering Practices
- Developing and Using Models
- Engaging in Argument from Evidence

Crosscutting Concepts
- Cause and Effect
- Energy and Matter

5Es
- Explore
- Explain
- Elaborate

Literacy Component
- **Literacy Article 3B:** The Recyclers of the Natural World

Digital Component
- **Simulation:** Competition

Differentiation Strategy

Assign a Science in the News Article Report to allow students to further explore the kinds of decomposers that are part of different habitats and the roles that they play in the cycling of energy. See Appendix B for more information on selecting articles.

ELA connection RI.5.7 RI.5.8

Literacy Tip

Ask students to read Literacy Article 3B: The Recyclers of the Natural World to review bacteria and fungi as decomposers.

4. Direct students' attention back to the food web they created using Student Investigation Sheet 3A. Ask them to make a prediction about the following.

- What would happen if all the rabbits were removed from the habitat represented by your food web?

Allow time for students to work with a partner and formulate ideas. After some time, have pairs share their ideas with the class. Guide students to recognize the impact that the absence of rabbits would have on the other organisms in the habitat:

- Secondary and tertiary consumers (owl and fox) would rely on the frog and butterfly for food.
- There would be more producers for the primary and secondary consumers (butterfly and frog) to eat.
- The decomposer (worm) could have less dead material to break down. Also, if frogs are hunted by the owl and fox, the number of worms may increase because there would be fewer frogs to eat them.

Teaching Tip

Students may struggle to understand how a consumer can be both secondary and tertiary. Assist them by drawing attention to the connections in their food webs. Point out the living things that are consumed by more than one type of animal.

5. Write the word "competition" on the board or on a sheet of chart paper. Ask students to copy the term into their science notebooks. Ask students to think individually about what this word means or where they have heard it before. After some time to think, ask students to share their ideas and explain how the term applies to a food web. Ask:

- What is competition? *(Allow students to share their ideas.)*

Define "competition" as a relationship between organisms that need the same resources within one environment. Write the definition on the board for students to copy into their science notebooks. Ask:

- Which living things compete in your food web? *(The rabbit, butterfly, and frog may compete for producers. The fox and owl compete for rabbits, frogs, and butterflies.)*
- Does competition occur in all habitats? Provide examples. *(Students' examples will vary, but they should realize that competition occurs in all habitats.)*
- Explain how competition is a natural part of any ecosystem. *(Competition is a natural part of the ecosystem. All living things require the same resources, but there are limited amounts of them, so individuals have to compete.)*

Digital simulations to encourage discourse

Digital Tip

As you discuss competition, use the Competition simulation to engage students in the concept that the population of animals affects the competition between them.

6. Distribute a copy of Student Investigation Sheet 3B: *Who Will Survive?* to each student. Review the directions as a class. Allow students to work with a partner to complete the investigation sheet by reading the scenario, creating and labeling a food web, answering questions, and making predictions. Allow ample time for students to complete the investigation sheet.

ELA connection SL.5.4

7. When students have completed Student Investigation Sheet 3B, review it as a class. Have students share their food webs and their analyses of those food webs from Part C. Then have students share their predictions from Part D. If students' responses differ, encourage them to argue their response by providing evidence and reasoning to support their position.

8. Distribute a copy of the Take-Home Science Activity: *Growing Decomposers* to each student. Explain that students will do an investigation at home with their families to explore decomposers.

Tell Me More!

Many types of plants live in the rain forest. Many animals, including monkeys, butterflies, and birds, eat passionfruit. However, passionfruit is not the only source of food for these animals. Describe the effect if all the passionfruit trees were removed from the rain forest.

Connecting science to home

Take-Home Science

Growing Decomposers
Students will grow three types of decomposers at home. After setting up simple cultures with gelatin and food scraps, students record their observations over a two-week period. Once students have completed the activity, facilitate a classroom discussion and allow students to share their observations. Compare the growth rates of mold, bacteria, and yeast to draw conclusions about decomposers in nature. Send home a copy of the Take-Home Science Letter with the activity sheet.

Phenomenon

Review students' questions about the investigative phenomenon from the beginning of this lesson. Guide students in applying the concepts explored in this lesson and connecting them to the anchoring phenomenon: identifying the different ways living things obtain energy and how they use that energy. By the end of the lesson, students should be able to explain that:

- The wolves prey on the deer. If the population of deer increases, there is more food available for the wolves. This in turn will provide more energy to the wolves so they can survive, grow, and reproduce.
- The deer population must remain larger than the wolf population because this ensures that deer will be able to reproduce. If the population of wolves exceeds the deer, then the wolves may prey on all the deer, preventing the birth of new generations.
- Depending on the ecosystem, other animals, such as bears or mountain lions, may compete with wolves for deer.

Connecting ideas about phenomena to evidence

Math connection
5.NF.A.1, 5.NF.A.2, 5.NF.B.3, 5.NF.B.7, 5.OA.A.2

EXTENSIONS

African Plains Ecosystems Math
Challenge students to solve the following word problem: In one ecosystem in the African plains, there are 10 lions, 30 zebras, 40 antelopes, and 20 elephants. Determine what fraction of the population is represented by each animal in this ecosystem. Next, convert all the fractions to decimals.

Solution: Students can present their answers in a two- or three-column chart or in a list as shown below. Students should:

Determine that the total amount of animals in the ecosystem is 100.

Determine the fraction of the population represented by each animal in the ecosystem.

Simplify and convert to decimals:

- Lions = 10/100 = 1/10 = 0.1
- Zebras = 30/100 = 3/10 = 0.3
- Antelopes = 40/100 = 4/10 = 0.4
- Elephants = 20/100 = 2/10 = 0.2

Habitats on the Bookshelf
Have available some or all of the following books or other titles that explore some of the habitats mentioned in the lesson. Have each student select and read two books, and then compare and share about two habitats with a partner.

- *What If There Were No Lemmings?* A Book About the Tundra Ecosystem (Food Chain Reactions) by Suzanne Slade
- *What Can Live in a Desert?* by Sheila Anderson
- *Life in a Coral Reef* by Wendy Pfeffer and Steve Jenkins
- *Here Is the African* Savanna by Madeleine Dunphy

ELA connection
W.5.7

Nature's Recyclers
Read aloud *Composting: Nature's Recyclers* by Robin Michal Koontz. Challenge students to compare the information in the text with their observations from the investigation in this lesson.

ASSESSMENT STRATEGIES

1. Investigation A

- Review each pair's food web from Student Investigation Sheet 3A: *What Is a Food Web?* and the index-card food webs that each group developed to determine students' ability to create a food web. Look for an understanding that some animals can be secondary and tertiary consumers. Make sure students recognize that most animals have a varied diet.
- Use students' responses to the Tell Me More question to assess their understanding of different species. Students should recognize that there is a different kind of hawk in each type of habitat. These hawks have different preferences, such as climate and diet.

2. Investigation B

- Review Student Investigation Sheet 3B: *Who Will Survive?* to gauge students' understanding of the interdependence of plants and animals in a habitat. Students should be able to draw a food web and make predictions about the impact of removing a biotic factor.
- Use students' responses to the Tell Me More question to determine if they recognize the importance of producers in an ecosystem. Students should realize that removing one food source may increase competition for other resources, but that animals typically consume a variety of foods.

3. Use the General Rubric in Appendix A to assess individual progress as needed.

Formative assessment—How are they progressing?

PLANNING AHEAD

Preparing for Lesson 4
Investigation B
Students will explore the water cycle in Lesson 4, Investigation B. If your students do not have prior knowledge of evaporation and condensation, you may wish to prepare a demonstration. See the "Demonstrating Evaporation and Condensation" extension at the end of Lesson 4 for directions on setting up and conducting the demonstrations for the class. You will need two small plastic cups (about 9 oz each), an ice cube, a marker, and some water. You will need to set up for the evaporation demonstration at least two days before beginning Lesson 4, Investigation B.

Investigation C
If you have not already done so, follow the directions on the Live Coupon for redworms provided in your materials kit to order the organisms. Request a delivery date for the day before you plan to start Lesson 4, Investigation C. When the redworms arrive, you will need to set up a habitat for the worms. Directions for setup and care are provided in Appendix D: Redworm Care Guide.

NOTES

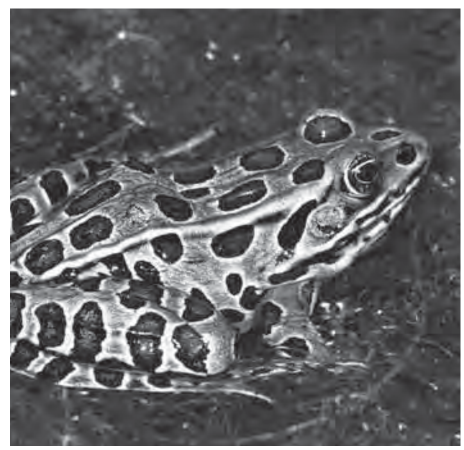
Student Investigation Sheet 3A

What Is a Food Web?

Name ____________________

Date ____________________

Directions: Cut out the pictures of the organisms from a woodland ecosystem. Connect the organisms using string to show the flow of energy in the ecosystem.



ELA connection
RI.5.3, RI.5.4, RI.5.5,
W.5.3

Name ____________________

Date ____________________

The Recyclers of the Natural World

Decomposers have a pretty gross job. As the last link on a food chain or food web, decomposers break down dead, organic matter. This matter includes dead animals, decaying roots, dead leaves, and wastes such as feces. As decomposers "eat" organic matter, they break down the materials into nitrogen, carbon dioxide, and other nutrients and return them to the soil, air, and water. These nutrients are then used by plants and animals.

There are two main groups of decomposers—bacteria and fungi. Bacteria are found everywhere, even inside your body and on your skin! Bacteria live in soil, in water, and in the air. They can even live in boiling water, frozen ground, volcanoes, and the bottom of the ocean. Most bacteria found in soil are decomposers. A spoonful of soil can contain up to a billion bacteria! Rich compost can have ten times that number.

Fungi are found mostly in moist, dark places. Many fungi grow in forests. You may have seen fungi growing on fallen logs or among dead leaves on the forest floor. The fungi give off chemicals that break down the dead matter. The fungi use some of the released nutrients for their own growth. The rest of the nutrients are released to the environment so that other organisms can use them.

Other organisms help break down organic matter, but they don't do as complete a job as the decomposers. Scavengers are animals that find dead plants and animals to consume. Slugs are not picky eaters. They eat anything that is digestible. This includes everything from fungi to dead plants. They will even eat cardboard! Worms consume organic material as they move through the soil. What they do not use for their life processes is excreted as a cast. Bacteria then break down the casts into even smaller molecules. Turkey vultures are scavengers that consume dead animals. They use their sense of smell to locate their next meal from high in the sky. They then land and rip the meat off the dead carcass. In fact, the word "vulture" comes from a Latin word that means to pluck or tear.

Decomposers are part of every ecosystem. They do the dirty work of keeping the environment clean and recycling materials for other organisms to use.

Questions:

1. What would happen if all the decomposers were suddenly to die off?

2. Why might a gardener add earthworms to a compost pile?

3. Scavengers eat dead organisms, but they are not decomposers. What happens to the bodies of scavengers after they die?

Credit: Patila/Shutterstock.com

Credit: Papa Bravo/Shutterstock.com

Student Investigation Sheet 3B

Who Will Survive?

Name ______________________

Date ______________________

Equipment: 1 Blue marker, 1 Green marker, 1 Orange marker, 1 Red marker, 1 Yellow marker

Directions: Read the scenario and complete the tasks.

ELA connection RI.5.3, W.5.8

Scenario

In a wetland habitat, the climate is warm and humid. Some days are cloudy, but there is enough sunlight to fuel many different types of plants. Cottonwood trees are common in this wetland. Reed grass and sedges are found around the edges of many ponds. The ponds are home to many different animals, including alligators, snails, worms, fish, insects, otters, crawfish, snakes, and frogs. Small fish, insects, and snails eat algae that lives in the pond. The otters, snakes, frogs, large fish, and crawfish prefer to eat the other animals in the pond. However, otters enjoy snacking on crawfish and on frogs when they can find them. Mice, hawks, and heron can be found outside the pond. When they can't find mice, the birds fly over the pond and search for snakes, frogs, or fish. However, they must stay alert because the alligators sit below the surface of the water waiting to

A. Food Web

Using the scenario described above, create a food web to show the energy transfer between abiotic and biotic factors in the wetland. Write the name of each factor, and draw arrows to show the energy transfers.

B. Label

Use the key below to label the biotic factors on your food web. Remember that some animals may be both secondary and tertiary consumers.

- ■ Green = producer
- ■ Yellow = primary consumer
- ■ Red = secondary consumer
- ■ Blue = tertiary consumer
- ■ Orange = decomposer

C. Analyze

1. Based on the scenario in Part A, are biotic factors competing with one another? List them below, and describe what they are competing for. ______________________________

____

____

2. Which biotic factors compete the most? The least? ______________________________

____

____

3. How does competition affect this habitat? ______________________________

____

____

4. What does the worm consume in this scenario? ______________________________

____

____

5. Why is the worm important in this habitat? ______________________________

____

____

D. Predict

1. Make a prediction about the effects of each of the following situations. Draw an upward arrow (🡅) if you think the population would increase. Draw a downward arrow (🡇) if you think the population would decrease. Draw a circle (○) if you think the population would stay the same or be unaffected.

	Producers	Primary Consumers	Secondary Consumers	Tertiary Consumers
All snails are removed				
All otters are removed				
All cottonwood trees are removed				
All tertiary consumers are removed				
All secondary consumers are removed				
All primary consumers are removed				
All producers are removed				

2. Describe any patterns you observe in the chart above. ______________________________

____

____

Take-Home Science

Connecting science to families

Dear Family,

Our class is beginning an inquiry science unit. Inquiry science is all about questions, active explorations, drawing, writing, and recording what you see and do to build an understanding of science. Young children are natural scientists. Scientists question everything. Once scientists answer one question, they move without blinking to the next question.

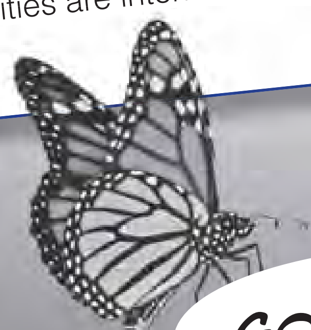
Take-Home Science is an exciting part of our program because it's one way we can better connect home and school. With everyone working together, we can reinforce the science concepts that your student is exploring in the classroom. Here's how Take-Home Science works.

Your student will bring home an investigation sheet that explains an activity related to the science unit the class is studying. The activity is designed so that everyone in the household—younger and older children alike—can work together to learn about science.

A section of the investigation sheet explains the science words and ideas that will be explored during the activity. These science words and ideas are not new to your student because the activity follows a lesson in which those same concepts were explored.

The activities are simple and can be completed within 20 minutes using items normally found in the home. A section of the investigation sheet is for your student to complete and bring back to school. In class, students will have the opportunity to share their experiences and results with one another.

The activities are intended to be quick, informal, and fun. Enjoy!



GO EXPLORING!

Credit: Cathy Keifer/Shutterstock.com

Take-Home Science

Growing Decomposers

Location: Your kitchen.

Challenge: Cultivate and observe changes to three decomposers over a two-week period.

Who: You and any person who will help (like brothers, sisters, parents, or friends).

What you need:

- 1 C Boiling water
- 1 Box of gelatin
- 1 C Cold water
- 1 Marker
- 1 Sample from each list in the chart on the next page
- 3 Small, shallow, disposable containers with lids (plastic storage containers, yogurt containers, etc.)
- 1 Spoon
- Masking tape

What to look for: Changes to the decomposer cultures. Do they all look the same? Do they take the same amount of time to grow?

What to record: Draw and/or write about what you see. Be sure to record the date every time you make an entry. Use the chart provided to do so.

What to report: After two weeks, bring your completed chart to class. Be prepared to share what you have found.

Science Words

Bacteria: Microscopic decomposers that break down organisms. Some bacteria break down waste from carnivores while others break down decaying plants.

Fungi: A decomposing organism that breaks down dead materials to return them back into the ecosystem.

Mold: A type of decomposer that commonly forms on rotting food.

Yeast: A type of fungus and a decomposer that breaks down dead materials.

⚠ If you have allergies to mold, have a parent or sibling assist you in making sure the containers are tightly sealed. Alternatively, you might choose not to complete the activity. Be sure to wash your hands thoroughly after preparing, handling, or disposing of the cultures.

Take-Home Science

Growing Decomposers

How to set up:

1. Obtain one food sample from each column in the chart below.

To Grow Mold	To Grow Yeast	To Grow Bacteria
■ Small pieces of bread, moistened ■ Orange or apple slice ■ Vegetable peels or pieces of raw vegetables ■ A slice of cheese or a bit of cheese-based salad dressing (such as blue cheese)	■ ½ teaspoon of dry yeast	■ Cottage cheese ■ Yogurt ■ Decaying wood pieces, twigs, or leaves from the yard or local forest ■ Young or tender plant tissue such as stems and leaves ■ Soil from a wooded area, a compost pile, or a garden, moistened

2. Prepare three cultures for growing your decomposers by adding one box of gelatin to one cup of boiling water. Stir until the gelatin is fully dissolved, then add one cup cold water. Divide the gelatin mixture among your three small containers. Allow time for the gelatin to set. Do not place cultures in the refrigerator.

3. Once the gelatin is set, place the one food or material you selected for each type of decomposer onto a separate gelatin culture. Tightly seal each container with a tight-fitting lid. Use masking tape and a marker to and label each "Mold," "Yeast," or "Bacteria," according to the table above.

4. Place the containers in a warm, dry place away from direct light.

NOTE: ⚠ Once you seal the containers, do not open them.

5. In the first row of the chart on the next page, list the material you chose to grow each type of decomposer. In the second row, record the date and your initial observations of the contents of each container. You might draw a picture, write a description, or both.

6. After two days, observe each sample and record your observations again. Be sure to include the date. Do this every two days for two weeks.

7. At the end of two weeks, bring your completed chart back to class and discuss with the class what you observed.

NOTE: ⚠ To dispose of the decomposers safely, place the unopened containers in a resealable plastic bag and place in the trash.

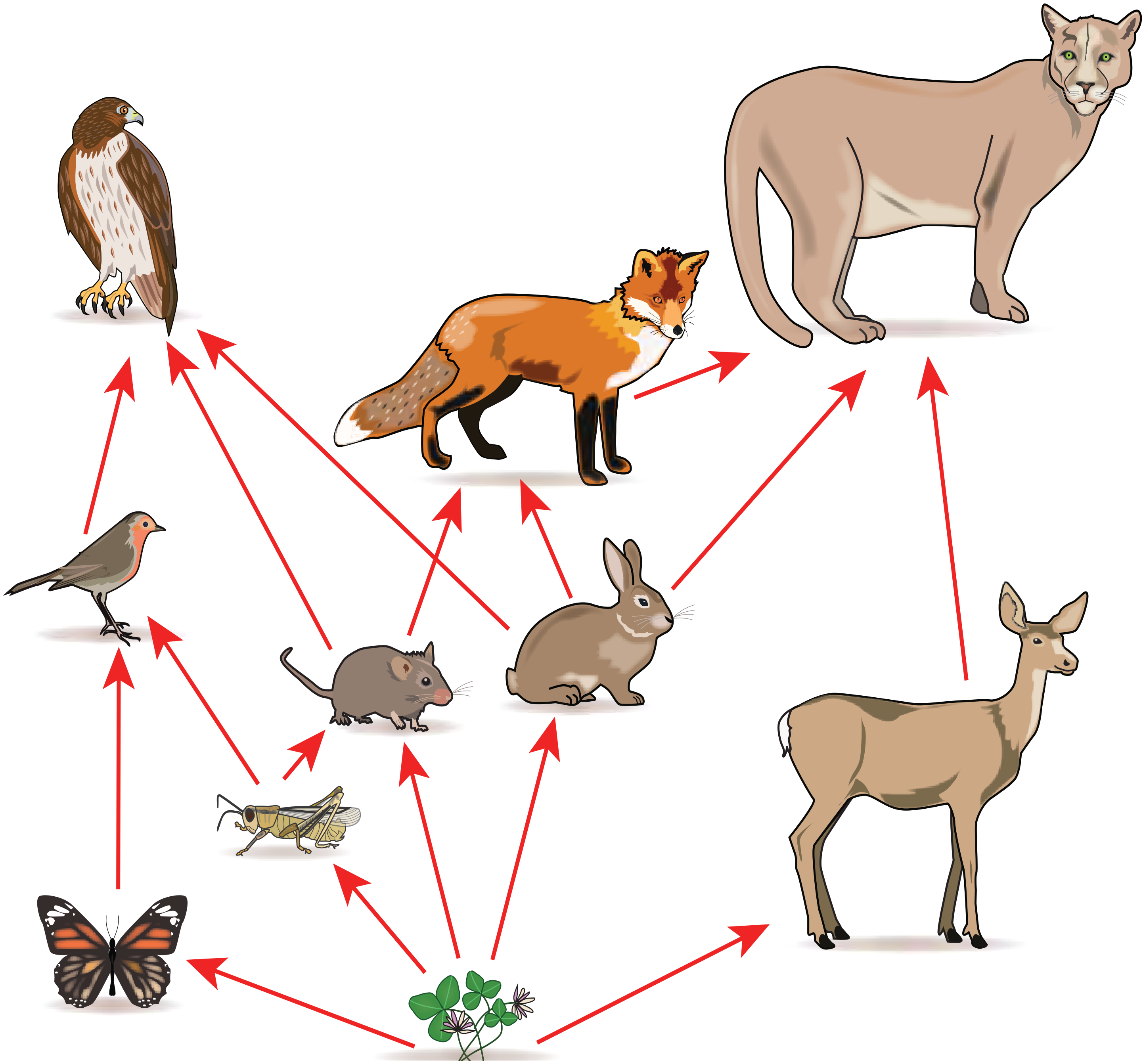
Take-Home Science

Growing Decomposers

Date	Observations of Mold Material used: ______________	Observations of Yeast Material used: ______________	Observations of Bacteria Material used: ______________

Teacher Sheet 3A

Example Food Web



Student Investigation Sheet 3A: Teacher's Version

What Is a Food Web?

Directions: Cut out the pictures of the organisms from a forest ecosystem. Connect the organisms using string to show the flow of energy in the ecosystem.

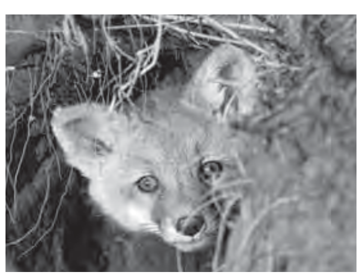
Abiotic Factor
(connected only to plants)

Producers

Primary Consumers

Secondary Consumer

Secondary/Tertiary Consumers



Decomposer

Photo credits:
Producers: ovidiu iordache/Shutterstock.com; Lina Valunaite/Shutterstock.com
Primary Consumers: Leena Robinson/Shutterstock.com; Jacob Hamblin/Shutterstock.com
Secondary Consumer: Jason Patrick Ross/Shutterstock.com
Secondary/Tertiary Consumers: Pictureguy/Shutterstock.com; David Davis/Shutterstock.com
Decomposer: clearviewstock/Shutterstock.com
Sun image: Vibrant Image Studio/Shutterstock.com

The Recyclers of the Natural World

Decomposers have a pretty gross job. As the last link on a food chain or food web, decomposers break down dead, organic matter. This matter includes dead animals, decaying roots, dead leaves, and wastes such as feces. As decomposers "eat" organic matter, they break down the materials into nitrogen, carbon dioxide, and other nutrients and return them to the soil, air, and water. These nutrients are then used by plants and animals.

There are two main groups of decomposers—bacteria and fungi. Bacteria are found everywhere, even inside your body and on your skin! Bacteria live in soil, in water, and in the air. They can even live in boiling water, frozen ground, volcanoes, and the bottom of the ocean. Most bacteria found in soil are decomposers. A spoonful of soil can contain up to a billion bacteria! Rich compost can have ten times that number.

Fungi are found mostly in moist, dark places. Many fungi grow in forests. You may have seen fungi growing on fallen logs or among dead leaves on the forest floor. The fungi give off chemicals that break down the dead matter. The fungi use some of the released nutrients for their own growth. The rest of the nutrients are released to the environment so that other organisms can use them.

Other organisms help break down organic matter, but they don't do as complete a job as the decomposers. Scavengers are animals that find dead plants and animals to consume. Slugs are not picky eaters. They eat anything that is digestible. This includes everything from fungi to dead plants. They will even eat cardboard! Worms consume organic material as they move through the soil. What they do not use for their life processes is excreted as a cast. Bacteria then break down the casts into even smaller molecules. Turkey vultures are scavengers that consume dead animals. They use their sense of smell to locate their next meal from high in the sky. They then land and rip the meat off the dead carcass. In fact, the word "vulture" comes from a Latin word that means to pluck or tear.

Decomposers are part of every ecosystem. They do the dirty work of keeping the environment clean and recycling materials for other organisms to use.

Questions:

1. What would happen if all the decomposers were suddenly to die off? *(Decomposers return nutrients to the soil and plants use these nutrients to grow and survive. Without decomposers to provide these nutrients, there would be fewer plants, which would result in increased competition among animals. With more competition, there would be fewer animals.)*

2. Why might a gardener add earthworms to a compost pile? *(Earthworms move through the compost, eating organic matter as they go. Their wastes are quickly broken down by bacteria, adding nutrients to the compost and making it a rich material for plants to grow in.)*

3. Scavengers eat dead organisms, but they are not decomposers. What happens to the bodies of scavengers after they die? *(When these scavengers die, decomposers break down their bodies and return nutrients to the soil.)*

Student Investigation Sheet 3B: Teacher's Version

Who Will Survive?

Scenario

In a wetland habitat, the climate is warm and humid. Some days are cloudy, but there is enough sunlight to fuel many different types of plants. Cottonwood trees are common in this wetland. Reed grass and sedges are found around the edges of many ponds. The ponds are home to many different animals, including alligators, snails, worms, fish, insects, otters, crawfish, snakes, and frogs. Small fish, insects, and snails eat algae that lives in the pond. The otters, snakes, frogs, large fish, and crawfish prefer to eat the other animals in the pond. However, otters enjoy snacking on crawfish and on frogs when they can find them. Mice, hawks, and heron can be found outside the pond. When they can't find mice, the birds fly over the pond and search for snakes, frogs, or fish. However, they must stay alert because the alligators sit below the surface of the water waiting to grab the birds from the air.

A. Food Web

Using the scenario described above, create a food web to show the energy transfer between abiotic and biotic factors in the wetland. Write the name of each factor, and draw arrows to show the energy transfers.

B. Label

Use the key below to label the biotic factors on your food web. Remember that some animals may be both secondary and tertiary consumers.

- Green = producer *(reed grass, algae, sedges, cottonwood trees)*
- Yellow = primary consumer *(small fish, insects, snails, mouse)*
- Red = secondary consumer *(otter, snakes, frogs, large fish, crawfish, hawks, heron)*
- Blue = tertiary consumer *(hawks, heron, alligator, otter)*
- Orange = decomposer *(worm)*

C. Analyze

1. Based on the scenario in Part A, are biotic factors competing with one another? List them below, and describe what they are competing for. *(Producers do not experience great competition but may compete for access to resources like the Sun or water. The primary consumers are competing for the producers. The secondary consumers compete for the primary consumers and sometimes the producers. The tertiary consumers compete for both primary and secondary consumers.)*

2. Which biotic factors compete the most? The least? *(The animals have the most competition. The plants have the least competition.)*

2. Which biotic factors compete the most? The least? *(The animals have the most competition. The plants have the least competition.)*

3. How does competition affect this habitat? *(Competition can affect the ability of biotic factors to grow, live, and reproduce. Competition is important to limit the number of organisms in a habitat.)*

4. What does the worm consume in this scenario? *(The worm consumes the remains of other living things.)*

5. Why is the worm important in this habitat? *(The worm is a decomposer that breaks down the dead plants and animals in the habitat so new soil can be formed and plants can continue to grow and provide food for the primary consumers.)*

D. Predict

1. Make a prediction about the effects of each of the following situations. Draw an upward arrow (🡅) if you think the population would increase. Draw a downward arrow (🡇) if you think the population would decrease. Draw a circle (○) if you think the population would stay the same or be unaffected.

	Producers	**Primary Consumers**	**Secondary Consumers**	**Tertiary Consumers**
All snails are removed	🡅	🡇	🡇	🡇
All otters are removed	🡅	🡅	🡇	🡇
All cottonwood trees are removed	🡇	🡇	🡇	🡇
All tertiary consumers are removed	🡅	🡅	🡅	🡇
All secondary consumers are removed	🡅	🡅	🡇	🡇
All primary consumers are removed	🡅	🡇	🡇	🡇
All producers are removed	🡇	🡇	🡇	🡇

2. Describe any patterns you observe in the chart above. *(Overall, removing biotic factors that are higher in the food pyramid will cause the biotic factors below [or the things it consumes] it to increase in population. Removing a biotic factor lower on the pyramid [producer] will have a negative impact on all other biotic factors and decrease their population.)*

Summative Assessment

Name ______________________

Date ______________________

1. Anita grew two different plants under the same conditions. She wonders how Plant 1 can grow if it doesn't have large leaves like Plant 2. Explain why both plants can grow successfully.

Plant 1

Credit: Tamara Kulikova/Shutterstock.com

Plant 2

Credit: Vahe 3D/Shutterstock.com

a. Plant 1 is receiving more sunlight than Plant 2.
b. Plant 1 has deeper roots than Plant 2.
c. Both Plant 1 and Plant 2 are receiving air and water.
d. Plant 2 does not have leaves that are able to absorb sunlight.

2. Which model would be the best to demonstrate competition and interdependence in the ocean?

a. Food chain
b. Food web
c. Food pyramid
d. Ecocolumn

What have they learned?

3. There are very few decomposers in the tundra. Which reasoning best explains why?

a. Few biotic factors die in the tundra so there is nothing for decomposers to break down.
b. The cold temperatures cause the dead plant and animal matter to break down naturally.
c. The tundra is composed of only producers and primary consumers.
d. Decomposers like worms or bacteria cannot survive in cold climates.

Building Blocks of Science Student Literacy

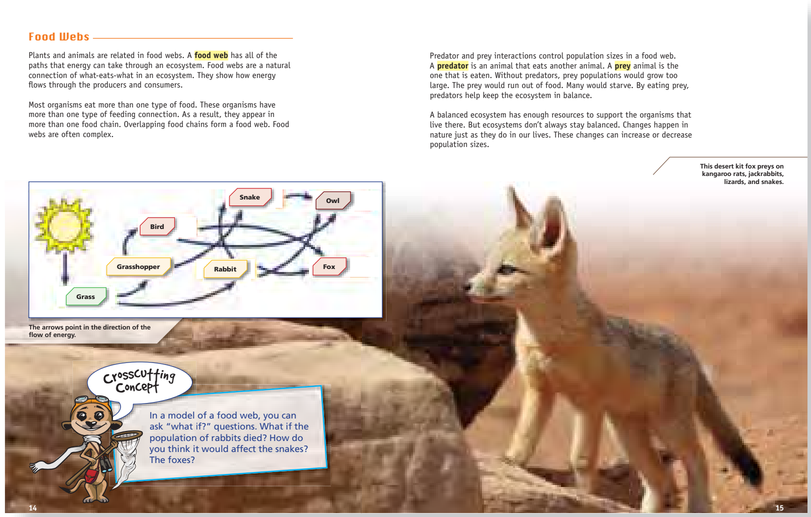
Build students' literacy skills with literacy components found within lessons and Literacy Readers.

Building Blocks of Science Literacy Components can be used to:

- Introduce a new lesson
- Support an investigation
- Incorporate science connections into your language arts sessions
- Differentiate instruction
- Review previously learned concepts

Literacy Readers—**on-level and below-level** readers in **English and Spanish** and available in **print or digital format**—provide informational text that:

- Incorporates English language arts and literacy standards
- Uses supporting text with graphs, vocabulary, charts, data, illustrations, and photographs to address **science concepts** related to lessons
- Provides opportunities to practice skills such as analysis and reasoning, and communication of ideas through **crosscutting concept** questions
- Challenges students to exercise and apply knowledge to a **science and engineering practice** activity
- Features a career that provides real-world insight into related science content



Food Webs

Plants and animals are related in food webs. A **food web** has all of the paths that energy can take through an ecosystem. Food webs are a natural connection of what-eats-what in an ecosystem. They show how energy flows through the producers and consumers.

Most organisms eat more than one type of food. These organisms have more than one type of feeding connection. As a result, they appear in more than one food chain. Overlapping food chains form a food web. Food webs are often complex.

The arrows point in the direction of the flow of energy.

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Predator and prey interactions control population sizes in a food web. A **predator** is an animal that eats another animal. A **prey** animal is the one that is eaten. Without predators, prey populations would grow too large. The prey would run out of food. Many would starve. By eating prey, predators help keep the ecosystem in balance.

A balanced ecosystem has enough resources to support the organisms that live there. But ecosystems don't always stay balanced. Changes happen in nature just as they do in our lives. These changes can increase or decrease population sizes.

This desert kit fox preys on kangaroo rats, jackrabbits, lizards, and snakes.

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What else to look for?

Literacy Articles—These encourage students to elaborate upon unit topics, discuss real-world applications and phenomena, and ask students to connect this to concepts in the unit. Corresponding questions ask students to access high-level thinking and draw upon previous knowledge. (See page 33 of this sampler for an example.)

Science in the News Article Report—Students analyze a content-relevant reading or current event article, developing literacy skills as students identify important information, apply vocabulary, and draw connections to science content.

Building Blocks OF SCIENCE™ | 3D

Matter and Energy in Ecosystems

Student literacy–
available in
digital and print

How Energy Moves Through Ecosystems

ELA connection RI.5.6

All energy in an ecosystem begins with producers. Energy flows from producers to the consumers that eat them. A model of this path of energy through an ecosystem is called a **food chain**.

Food Chains

Remember that producers use the energy of sunlight to make sugars. These sugars are stored in the plant. When a consumer eats a plant, the food energy moves from the producer to the consumer.

A food chain always begins with a **producer**.

The producer is eaten by an **herbivore** or an **omnivore**.

The herbivore is eaten by another consumer—another omnivore or a **carnivore**.

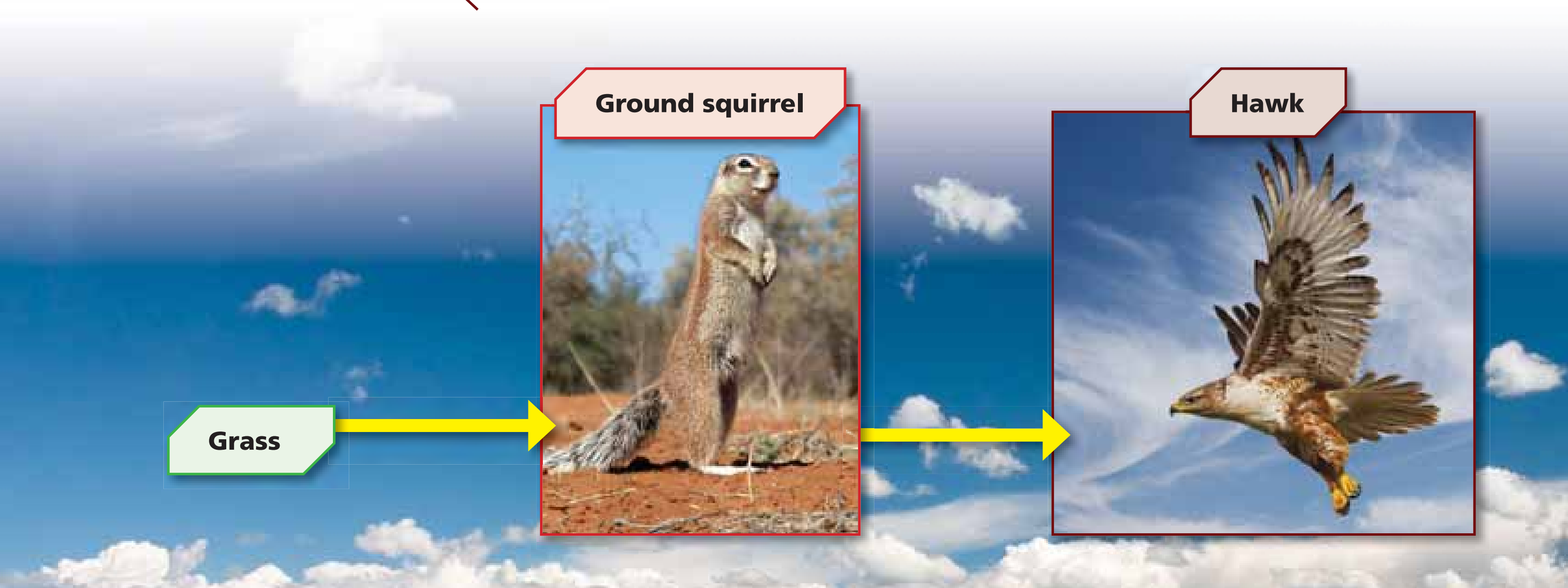
An ecosystem has more than one food chain. Grasses, ground squirrels, and hawks form one grassland food chain. Here are some others.

Grass → Grasshopper → Toad → Snake → Owl

Daisies → Beetles → Wren → Snake

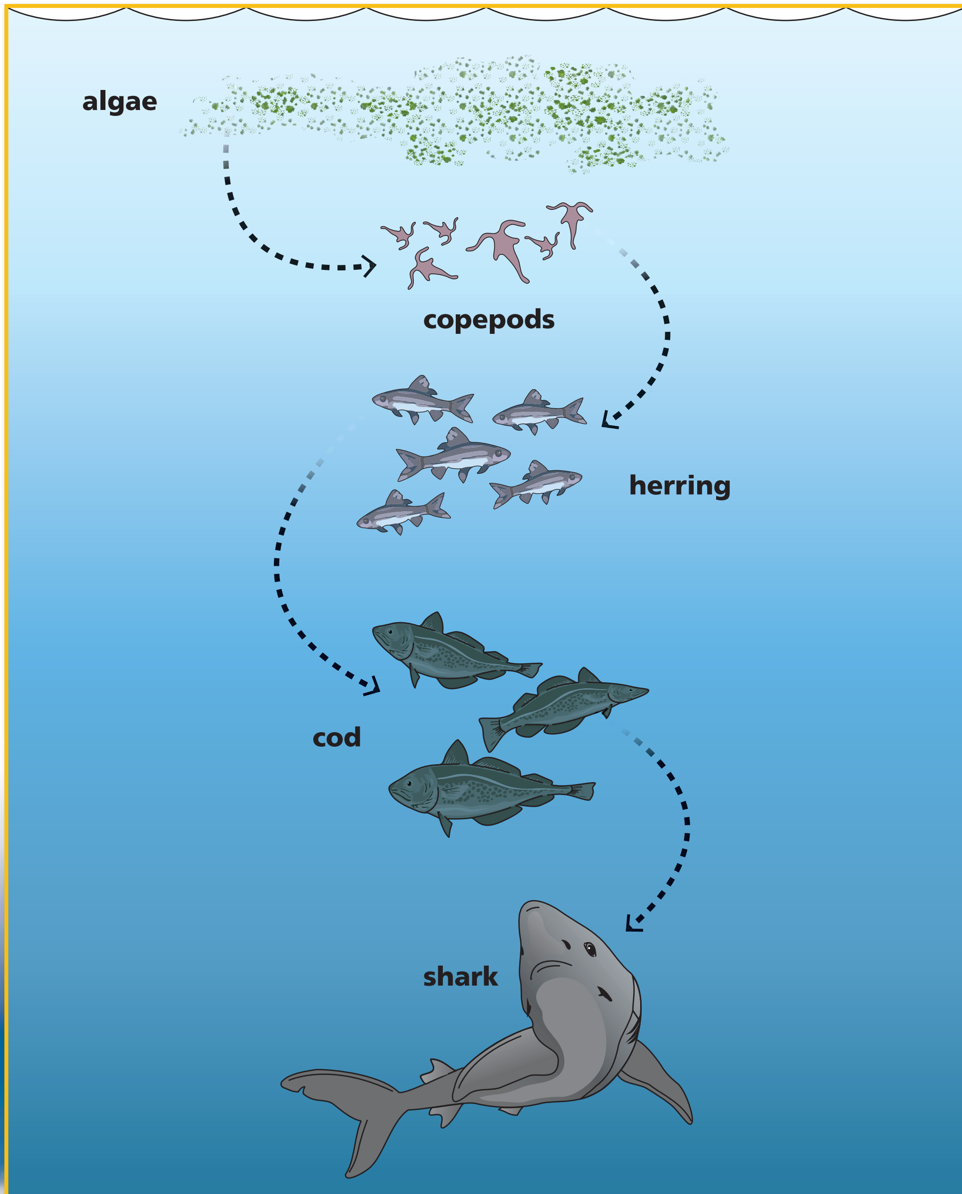
Raspberries → Raccoon → Fox

A Grassland Food Chain



Food chains are found in all ecosystems—desert, polar, rain forest, and aquatic ecosystems such as swamps, rivers, and oceans. Oceanic and other aquatic food chains are a lot like food chains in land ecosystems. But, sometimes aquatic food chains look upside down because they are organized based on population. For example, there is far more algae in the ocean than sharks.

Ocean producers are usually near the water's surface, where there is plenty of sunlight. Ocean herbivores, like copepods, stay near the producers. The other consumers are nearby, too. In fact, more than 90 percent of ocean life is within 180 meters (600 feet) of the ocean surface.



Marine plants are food for small fish, which are food for larger fish.

Careers

Science in the world

Marine Biologist

A marine biologist is a person who studies the world's oceans and other bodies of water. Marine biologists may study ocean currents and waves. They may study how marine animals interact with plants in ocean food webs. Or they may study how humans can use the ocean's many resources.

Would I like this career?	You might like this career if • you like to do research. • you like learning about different organisms and how they survive.
What would I do?	• You would learn how to perform experiments and investigations.
How can I prepare for this career?	• Study biology and ecology. • Develop skills used in scientific research, such as making models and designing solutions.

A marine biologist studies animals such as whales and other marine life.

Profesiones

Spanish literacy–available in digital and print

Biólogo marino

Los biólogos marinos estudian los océanos del mundo y otras masas de agua. Algunos estudian las corrientes oceánicas, las olas y cómo interactuan los animales marinos con las plantas en las redes alimentarias del océano. Otros estudian cómo utilizan los seres humanos los recursos del océano.

¿Me gustaría esta profesión?	Te gustaría esta profesión si • te gusta hacer investigaciones. • te gusta estudiar organismos diferentes y aprender cómo sobreviven.
¿Qué tendría que hacer?	• Aprenderías a realizar experimentos e investigaciones.
¿Cómo puedo prepararme para esta profesión?	• Estudia biología y ecología. • Desarrolla destrezas que se usan en la investigación científica, tal como hacer modelos y diseñar soluciones.

Un biólogo marino estudia animales, tales como ballenas y otra vida marina.

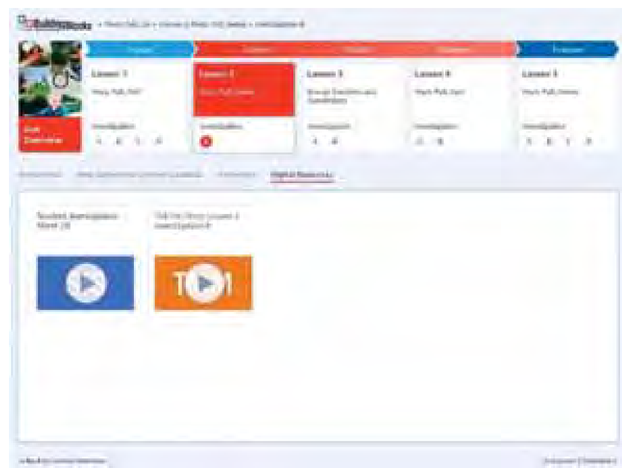
The Right Blend of Hands-On Investigation and Technology

Along with hands-on learning, Building Blocks of Science provides digital resources to enhance the classroom experience, offering an additional method of delivering content and support for teachers.

Support for Teachers

Everything you need to teach the lesson

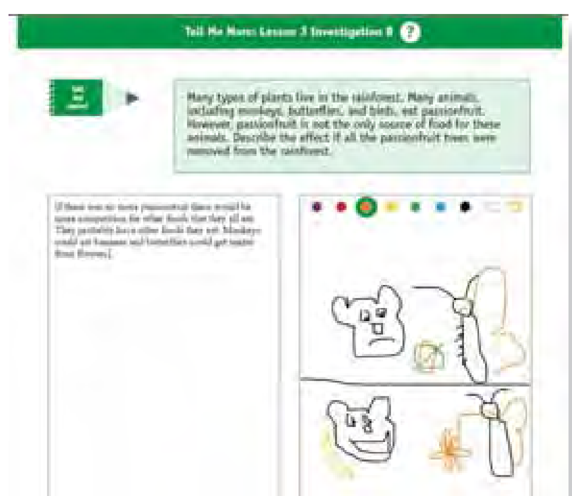
- Identification of where a lesson falls within the **5E Learning Cycle**
- Preparation—Includes investigation overview, materials list, and step-by-step teacher preparation instructions
- **NGSS Standards**—Includes the PEs, DCIs, SEPs, and CCCs that will be addressed within the investigation
- **Lesson Procedure**—Step-by-step instruction for each investigation within a lesson
- **Digital Resources**—All the digital resources available in one place, by lesson and by individual investigations within each lesson



Digital resources by lesson

Everything you need to teach ALL your students

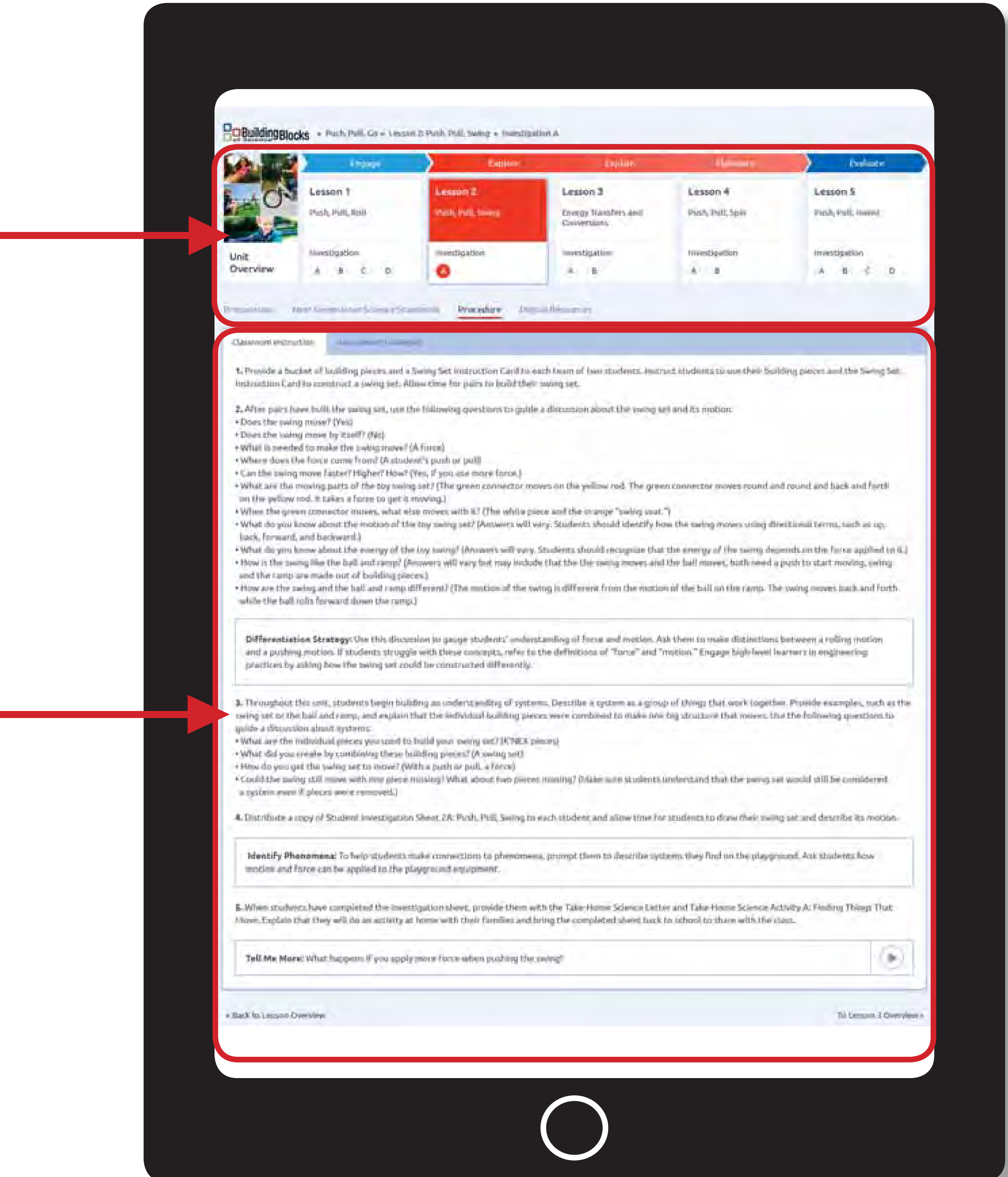
- Step-by-step instruction including guiding questions and anticipated responses
- Differentiation strategies at point of use within each investigation
- **Identify Phenomena** provides teachers with prompts to help students make connections to phenomena addressed within an investigation
- Assessment Strategies including **Tell Me More** formative assessment to help gauge student understanding



Tell Me More, a formative assessment strategy

For a closer look, visit:

www.carolina.com/bbs3dreview


Unit Overview
Lesson 1
Lesson 2
Lesson 3
Lesson 4
Lesson 5
Procedure
1. Provide a bucket of building pieces and a Swing Set Instruction Card to each team of two students. Instruct students to use their building pieces and the Swing Set Instruction Card to construct a swing set. Allow time for pairs to build their swing set.
2. After pairs have built the swing set, use the following questions to guide a discussion about the swing set and its motion:
• Does the swing move? (Yes)
• Does the swing move by itself? (No)
• What is needed to make the swing move? (A force)
• Where does the force come from? (A student's push or pull)
• Can the swing move faster? Higher? How? (Yes, if you use more force.)
• What are the moving parts of the toy swing set? (The green connector moves on the yellow rod. The green connector moves round and round and back and forth on the yellow rod. It takes a force to get it moving.)
• When the green connector moves, what else moves with it? (The white piece and the orange "swing seat.")
• What do you know about the motion of the toy swing set? (Answers will vary. Students should identify how the swing moves using directional terms, such as up, back, forward, and backward.)
• What do you know about the energy of the toy swing? (Answers will vary. Students should recognize that the energy of the swing depends on the force applied to it.)
• How is the swing like the ball and ramp? (Answers will vary but may include that the the swing moves and the ball moves, both need a push to start moving, swing and the ramp are made out of building pieces.)
• How are the swing and the ball and ramp different? (The motion of the swing is different from the motion of the ball on the ramp. The swing moves back and forth while the ball rolls forward down the ramp.)
Differentiation Strategy: Use this discussion to gauge students' understanding of force and motion. Ask them to make distinctions between a rolling motion and a pushing motion. If students struggle with these concepts, refer to the definitions of "force" and "motion." Engage high-level learners in engineering practices by asking how the swing set could be constructed differently.
3. Throughout this unit, students begin building an understanding of systems. Describe a system as a group of things that work together. Provide examples, such as the swing set or the ball and ramp, and explain that the individual building pieces were combined to make one big structure that moves. Use the following questions to guide a discussion about systems:
• What are the individual pieces you used to build your swing set? (K'NEX pieces)
• What did you create by combining these building pieces? (A swing set)
• How do you get the swing set to move? (With a push or pull, a force)
• Could the swing still move with one piece missing? What about two pieces missing? (Make sure students understand that the swing set would still be considered a system even if pieces were removed.)
4. Distribute a copy of Student Investigation Sheet 2A: Push, Pull, Swing to each student and allow time for students to draw their swing set and describe its motion.
Identify Phenomena: To help students make connections to phenomena, prompt them to describe systems they find on the playground. Ask students how motion and force can be applied to the playground equipment.
5. When students have completed the investigation sheet, provide them with the Take-Home Science Letter and Take-Home Science Activity A: Finding Things That Move. Explain that they will do an activity at home with their families and bring the completed sheet back to school to share with the class.
Tell Me More: What happens if you apply more force when pushing the swing?
« Back to Lesson Overview
To Lesson 3 Overview »

Digital Components to Support Instruction and Assessment

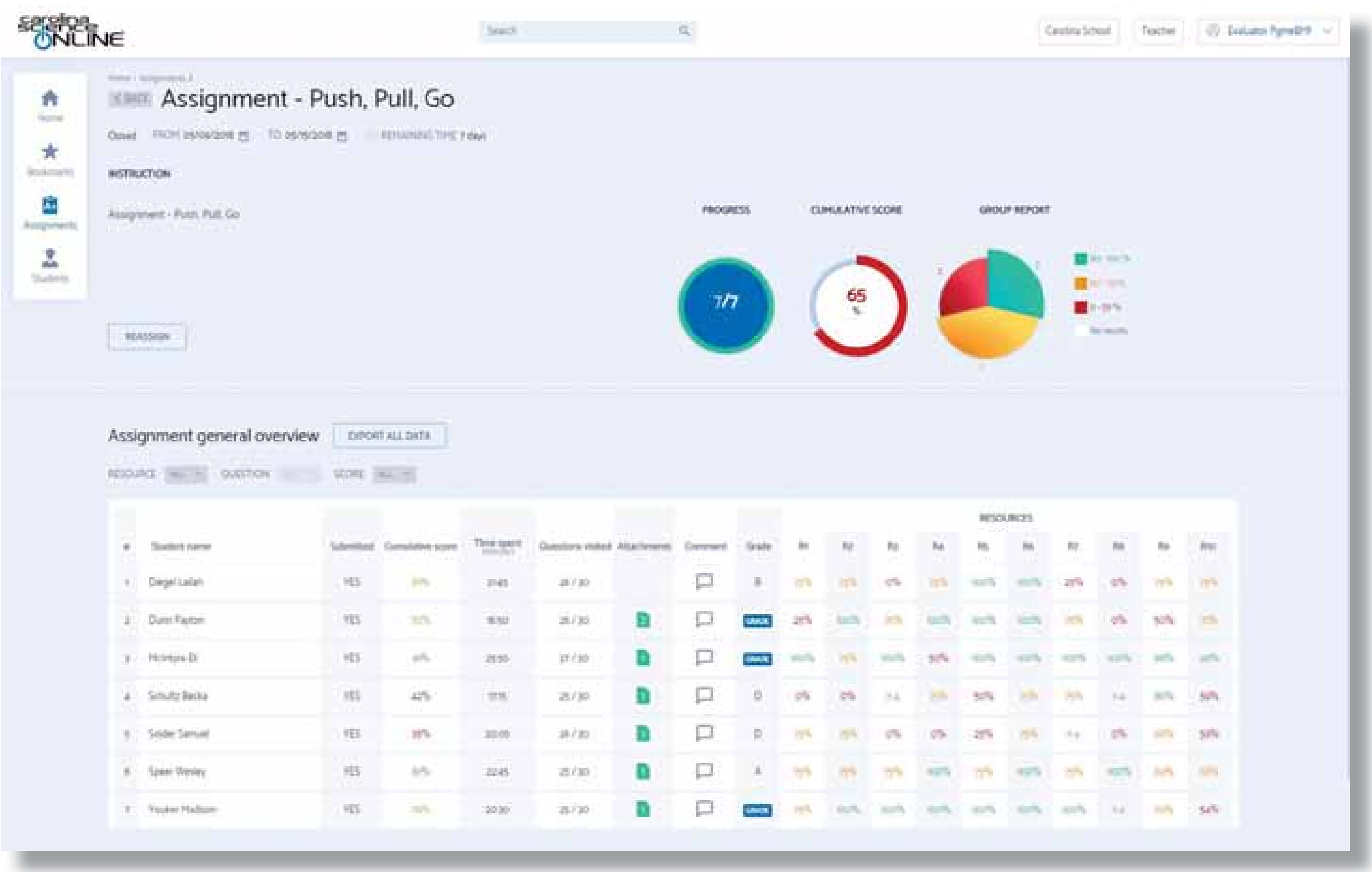
For the Teacher—Customizable Digital Planning at Your Fingertips

Building Blocks of Science 3D goes beyond just providing you access to your content. You can also:

- Use the assignment management system to create and grade custom assignments for classes and individual students to help differentiate instruction
- Create customizable bookmarks that include your student and instruction resources as well as URL links, PDF files, PowerPoint® presentations, and video files

The assignment management system dashboard allows you to:

- Track the progress of your classes and individual students
- See student assignment results for the class at a glance and by individual student in detail
- Automatically grade close-ended questions (e.g., multiple choice, matching, fill-in-the-blank)
- Adjust student grades based on individual student performance and open-ended responses
- Assign remediation to student groups that need additional support or enrichment to groups that need a challenge



Digital components for students enhance and deepen student understanding, differentiate learning, and provide multiple modalities for delivering information.

"Digital Tips" take the guesswork out of integrating the following digital resources with hands-on investigations:

Simulations: Flexible enough to be used to introduce, support, or review a topic or concepts. Simulations are manipulative and provide a visual for differentiation.

Interactive Whiteboard Activities: With typing and drawing capabilities, IWB activities bring investigation-aligned classroom charts to life and are perfect for individual student review.

Student Investigation Sheets: Students record their observations and data digitally when completing investigations.

Interactive Literacy Readers: These enhanced versions of the printed student readers include check-for-understanding questions and animations to support the concepts covered in the text, enforce literacy skills, and provide additional practice.

NOTES

NOTES

Building Blocks OF SCIENCE™ | 3D

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Learning Framework

Grade			
Kindergarten	**Push, Pull, Go** *K-PS2-1; K-PS2-2; K-2-ETS1-1;K-2-ETS1-2*	**Living Things and Their Needs** *K-LS1-1; K-ESS2-2;K-ESS3-1;K-ESS3-3; K-2-ETS1-2*	**Weather and Sky** *K-PS3-1;K-PS3-2;K-ESS2-1; K-ESS3-2; K-2-ETS1-1; K-2-ETS1-2*
1st Grade	**Light and Sound Waves** *1-PS4-1; 1-PS4-2; 1-PS4-3; 1-PS4-4; K-2-ETS1-1; K-2-ETS1-2*	**Exploring Organisms** *1-LS1-1; 1-LS1-2; 1-LS3-1; K-2-ETS1-2*	**Sky Watchers** *1-ESS1-1; 1-ESS1-2*
2nd Grade	**Matter** *2-PS1-1; 2-PS1-2; 2-PS1-3; 2-PS1-4; K-2-ETS1-1; K-2-ETS1-2*	**Ecosystem Diversity** *2-LS2-1; 2-LS2-2; 2-LS4-1; K-2-ETS1-2; K-2-ETS1-3*	**Earth Materials** *2-PS1-1; 2-ESS1-1; 2-ESS2-1; 2-ESS2-2; 2-ESS2-3; K-2-ETS1-1; K-2-ETS1-2*
3rd Grade	**Forces and Interactions** *3-PS2-1; 3-PS2-2; 3-PS2-3; 3-PS2-4; 3-5-ETS1-1; 3-5 ETS1-2*	**Life in Ecosystems** *3-LS1-1; 3-LS2-1; 3-LS3-1; 3-LS3-2; 3-LS4-1; 3-LS4-2; 3-LS4-3; 3-LS4-4; 3-5-ETS1-2*	**Weather and Climate Patterns** *3-ESS2-1; 3-ESS2-2;3-ESS3-1; 3-5-ETS1-2*
4th Grade	**Energy Works** *4-PS3-1; 4-PS3-2; 4-PS3-3; 4-PS3-4; 4-PS4-1; 4-PS4-3; 4-ESS3-1; 3-5 ETS1-2; 3-5-ETS1-3*	**Plant and Animal Structures** *4-LS1-1; 4-LS1-2; 4-PS4-2; 3-5-ETS1-2*	**Changing Earth** *4-ESS1-1; 4-ESS2-1; 4-ESS2-2; 4-ESS3-2; 3-5-ETS1-2*
5th Grade	**Structure and Properties of Matter** *5-PS1-1; 5-PS1-2; 5-PS1-3; 5-PS1-4; 3-5-ETS1-2*	**Matter and Energy in Ecosystems** *5-PS3-1; 5-LS1-1; 5-LS2-1; 5-ESS2-1; 5-ESS3-1; 3-5-ETS1-3*	**Earth and Space Systems** *5-PS2-1; 5-ESS1-1; 5-ESS1-2; 5-ESS2-1; 5-ESS2-2; 5-ESS3-1; 3-5-ETS1-2*

Phenomenon-based investigations with digital support in 30-minute lessons!
For more information, visit www.carolina.com/bbs

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