Grade 5: Life Science Module

Overview

In the Grade 5 Life Science Module, students study the cycle of energy and matter in an ecosystem as they construct and refine criteria for a healthy ecosystem.

The module begins with an anchoring phenomenon. Students view pictures of a forest ecosystem and are asked, "Is this a healthy ecosystem?" and more broadly, "How do we assess and improve the health of an ecosystem?" Students are introduced to several criteria for a healthy ecosystem, including that the health of an ecosystem can be assessed by looking at the movement of matter and energy within the ecosystem.

Then students build background knowledge about matter and energy. Through a series of demonstrations, close readings, and an original investigation, students learn about the basic properties of matter and how plants, through the process of photosynthesis, start the cycle of matter in an ecosystem. This means that plants take matter chiefly from the water and air and convert it into plant matter that is rich in energy. Then as animals eat plants and each other, the matter is cycled through their bodies. Finally, when animals die, decomposers return the matter back to the soil as nutrients to help plants grow.

Students then turn their attention to energy and—through a series of demonstrations and close readings—learn that energy is neither created nor destroyed but flows through an ecosystem by being transferred from plants to animals.

After acquiring the background knowledge about matter and energy, students turn their attention to the interaction of abiotic and biotic features in an ecosystem. By studying the abiotic (nonliving things like sunlight, water, and air) and biotic features (living things like plants and animals) of an ecosystem, students can see more concretely the cycle of matter and the flow of energy within an ecosystem. They become experts on one of three forest ecosystems (tropical, boreal, or temperate) and create a model that explains how the abiotic and biotic components of their expert ecosystem interact and move the matter and energy within the system.

Next, students look more specifically at the biotic (or living) features of an ecosystem, applying their knowledge about matter and energy to food webs. They learn that energy is passed along a food chain as plants collect and convert solar energy into usable chemical energy. As animals eat plants and other animals eat those animals, a food chain is formed and energy is transferred up the food chain. As the different food chains of an ecosystem intersect, they form a food web. This flow of energy is important to the health of an ecosystem. Students then revise their explanatory model to show the flow of energy within their expert forest ecosystem.

Finally, students learn about biodiversity and how multiple organisms and a complete and complex food web can help an ecosystem be balanced and stable. Balance and stability are important criteria for a healthy ecosystem. They study the return of wolves to Yellowstone National Park; and they study invasive species to see how a change in one aspect of an ecosystem can affect the interaction of biotic and abiotic features and the overall stability and balance of an ecosystem.

Throughout the module, students engage in the Science and Engineering Practices (things that scientists and engineers do) by making explanatory models, constructing explanations, and engaging in arguments. Students also consistently discuss Crosscutting Concepts (concepts that link across various scientific disciplines), especially matter and energy and systems, to deepen their understanding of content. Routinely, they track their learning in a student science notebook and practice articulating their understanding in Scientists Meetings.

This Grade 5 Life Science module was designed to work in concert with EL Education's Language Arts Grade 5 Module 2, although it can stand alone. The content of the Language Arts module complements the student learning about forest ecosystems in the Life Science Module. One of the forest ecosystems studied in the Life Science Module is the rainforest. In both the Language Arts and Life Science modules, students engage in similar protocols and do close reading.

Guiding Questions and Big Ideas

How do we assess and improve the health of an ecosystem?

- *An ecosystem's health can be assessed by looking at the interaction of abiotic and biotic features in the ecosystem and observing how effectively the matter and energy flow within the system.*
- *An ecosystem's health can be assessed by looking at how effectively the web of producers, consumers, and decomposers have their needs met and cycle energy and matter.*
- *An ecosystem can be made healthier by strengthening the web of producers, consumers, and decomposers. This can be done by increasing the biodiversity of the ecosystem without disrupting the balance or creating instability.*

The 4 T's

TOPIC	TASK
Developing Models: The Cycle of Matter and Energy in Healthy Ecosystems	Explanatory model that predicts a way to improve the health of an ecosystem
TARGETS	**TEXTS**
NGSS Performance Expectations fully and explicitly taught and formally assessed: **5-LS2-1**	*"Three States of Matter"* *"From Questions to Conclusions: The Experimental Process"* *"The Law of Conservation of Energy"* *"How Animals Use Energy"*

Performance Task

Improving the Health of an Ecosystem

In groups, students analyze data (pictures, research, tables) in order to assess the health of a sample schoolyard ecosystem. They then craft three suggestions that would help the ecosystem become healthier. Using the Engineering Design Cycle, students create an explanatory model that predicts how their suggestions would help the ecosystem more fully reach the criteria of a healthy ecosystem. **This performance task aligns with NGSS Performance Expectations 5-LS2-1 and 5-PS3-1.** *(Note: This task fully addresses* **5-LS2-1** *and partially addresses* **5-PS3-1**.)

Note: There is also an optional extension: Alternative Performance Task: Improving the Health of Our Schoolyard Ecosystem. This supporting document guides students to gather and analyze data to assess the health of their own schoolyard. They then craft suggestions and create an explanatory model as described above. This could be in addition to or in lieu of the Performance Task: Improving the Health of an Ecosystem.

Summative Assessment

Assessing a Forest Ecosystem

Students carefully observe a diagram of a forest ecosystem. They analyze data about the food web depicted in the diagram. Then they construct two arguments. In the first one, they argue how well the ecosystem meets the criteria for a healthy ecosystem. In the second argument, they predict how the health of the ecosystem would be affected if one of the organisms (the white oak tree) was removed. For each argument, they explain whether or not the evidence is sufficient and, if not, what additional evidence is needed. **This assessment takes place in Lesson Sequence 11, and aligns with NGSS Performance Expectations 5-LS2-1.**

Original Student Investigations

Matter and Plant Growth

Students plan and carry out an original investigation in which they observe the effect of different types of matter on the growth of plants. They create their own observable question with prompting such as: "What type of matter do you think will affect plants' growth?" or "Do you think the amount of a particular type of matter will affect how the plant grows?" They observe their experiment over a period of seven days (or longer if time allows). At the conclusion of the investigation, students use their data to explain how plants convert matter (gas and liquid) into plant matter. **This original student investigation centers on NGSS Performance Expectations 5-LS1-1, as well as the Science and Engineering Practice of Planning and Carrying Out Investigations**.

CCSS ELA Connections

This module is designed to address NGSS standards. But the module intentionally incorporates content, protocols, and skills that align to EL Education's Language Arts Grade 5 Module 2. In both the Language Arts and Life Science modules, students study forest ecosystems. In the Life Science module, students who need additional support may benefit from becoming an expert in tropical rainforests, since they will bring considerable background knowledge from their Language Arts module. All students can make cross-curricular connections. For example, in Life Science they learn about the importance of biodiversity to the stability and balance of an ecosystem. In the Language Arts module, the tropical rainforest that students study is one of the most biodiverse ecosystems on the planet. In both modules, students use similar protocols and participate in close reading of complex texts.

In addition, in the Grade 5 Life Science Module, students routinely have opportunities to read informational texts (CCSS ELA RI.5.2 and RI.5.3) and write arguments and explanations (CCSS ELS W.5.1 and W.5.2). The student science notebook gives students an additional opportunity to practice informative writing and gathering evidence (CCSS ELA W.5.2, W.5.8). The Scientists Meetings, which students participate in throughout the Life Science Module, provide students the opportunity to formally practice their speaking and listening skills while collaborating in whole group discussions (CCSS ELA SL.5.1).

Texts (no purchase necessary, linked or included in the module materials)
“Three States of Matter” Written by Dave Roos for EL Education
“From Questions to Conclusions: the Experimental Process” Written by EL Education for instructional purposes
“The Law of Conservation of Energy” Written by Dave Roos for EL Education
“Forest” (video)
“The Food Chain” (video) Science Trek on PBS Learning Media
“Food Web” (video) Science Trek on PBS Learning Media
“How Animals Use Energy” Written by Dave Roos for EL Education
“The Forest and the Water Cycle” (video) WHRO on PBS Learning Media
“The Forest and the Air Cycle” (video) WHRO on PBS Learning Media
“Decomposers” (video) NOVA on PBS Learning Media
“Wolves of Yellowstone” (video) EARTH A New Wild on PBS Learning Media
“Indiana Expeditions | Invasive Insects” (video) Indiana Expeditions on PBS Learning Media

NGSS Standard 5-LS2-1 Ecosystems: Interactions, Energy, and Dynamics

Students who demonstrate understanding can:

5-LS2-1. Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment. [Clarification Statement: Emphasis is on the idea that matter that is not food (air, water, decomposed materials in soil) is changed by plants into matter that is food. Examples of systems could include organisms, ecosystems, and the Earth.] [Assessment Boundary: Assessment does not include molecular explanations.]

Science and Engineering Practices

Developing and Using Models: Modeling in 3–5 builds on K–2 models and progresses to building and revising simple models and using models to represent events and design solutions.

- Develop a model to describe phenomena.

Disciplinary Core Ideas

LS2.A: Interdependent Relationships in Ecosystems: The food of almost any kind of animal can be traced back to plants. Organisms are related in food webs in which some animals eat plants for food and other animals eat the animals that eat plants. Some organisms, such as fungi and bacteria, break down dead organisms (both plants or plants parts and animals) and therefore operate as "decomposers." Decomposition eventually restores (recycles) some materials back to the soil. Organisms can survive only in environments in which their particular needs are met. A healthy ecosystem is one in which multiple species of different types are each able to meet their needs in a relatively stable web of life. Newly introduced species can damage the balance of an ecosystem.

LS2.B: Cycles of Matter and Energy Transfer in Ecosystems: Matter cycles between the air and soil and among plants, animals, and microbes as these organisms live and die. Organisms obtain gases and water from the environment, and release waste matter (gas, liquid, or solid) back into the environment.

Crosscutting Concepts

Systems and System Models: A system can be described in terms of its components and their interactions.

For more information, see accompanying evidence statements. https://www.nextgenscience.org/pe/5-ls2-1-ecosystems-interactions-energy-and-dynamics

Note: This Life Science Module assesses this full performance expectation.

NGSS Standard 5-LS1-1 From Molecules to Organisms: Structures and Processes

Students who demonstrate understanding can:

5-LS1-1. Support an argument that plants get the materials they need for growth chiefly from air and water. [Clarification Statement: Emphasis is on the idea that plant matter comes mostly from air and water, not from the soil.]

Science and Engineering Practices

Engaging in Argument from Evidence: Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s).

- Support an argument with evidence, data, or a model.

Disciplinary Core Ideas

LS1.C: Organization for Matter and Energy Flow in Organisms: Plants acquire their material for growth chiefly from air and water.

Crosscutting Concepts

Energy and Matter: Matter is transported into, out of, and within systems.

For more information, see accompanying evidence statements. https://www.nextgenscience.org/pe/5-ls1-1-molecules-organisms-structures-and-processes

Note: This Life Science Module addresses this performance expectation, but students are not required to show independent mastery.

NGSS Standard 5-PS3-1 Energy

Students who demonstrate understanding can:

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. [Clarification Statement: Examples of models could include diagrams, and flow charts.]

Science and Engineering Practices

Developing and Using Models: Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions

- Use models to describe phenomena.

Disciplinary Core Ideas

PS3.D: Energy in Chemical Processes and Everyday Life: The energy released [from] food was once energy from the sun that was captured by plants in the chemical process that forms plant matter (from air and water).

LS1.C: Organization for Matter and Energy Flow in Organisms: Food provides animals with the materials they need for body repair and growth and the energy they need to maintain body warmth and for motion. (secondary)

Crosscutting Concepts

Energy and Matter: Energy can be transferred in various ways and between objects.

For more information, see accompanying evidence statements. https://www.nextgenscience.org/pe/5-ps3-1-energy

Note: This Life Science Module addresses this performance expectation, but students are not required to show independent mastery.

NGSS Standard 5-PS1-1 Matter and Its Interactions

Students who demonstrate understanding can:

5-PS1-1. Develop a model to describe that matter is made of particles too small to be seen. [Clarification Statement: Examples of evidence supporting a model could include adding air to expand a basketball, compressing air in a syringe, dissolving sugar in water, and evaporating salt water.] [Assessment Boundary: Assessment does not include the atomic-scale mechanism of evaporation and condensation or defining the unseen particles.]

Science and Engineering Practices

Developing and Using Models: Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.

- Use models to describe phenomena.

Disciplinary Core Ideas

PS1.A: Structure and Properties of Matter: Matter of any type can be subdivided into particles that are too small to see, but even then the matter still exists and can be detected by other means. A model showing that gases are made from matter particles that are too small to see and are moving freely around in space can explain many observations, including the inflation and shape of a balloon and the effects of air on larger particles or objects.

Crosscutting Concepts

Scale, Proportion, and Quantity: Natural objects exist from the very small to the immensely large.

For more information, see accompanying evidence statements. https://www.nextgenscience.org/pe/5-ps1-1-matter-and-its-interactions

Note: This Life Science Module partially addresses this performance expectation, and students are not expected to demonstrate independent mastery. Students apply this understanding specifically to the matter in ecosystems.

Module-at-a-Glance

Week 1

Approximately 3 hours of instruction

Lesson Sequence 1 (1 hour)

Instructional Focus

- Launch module with an anchoring phenomenon: a Healthy Ecosystem slide show
- Gather students' background knowledge about healthy ecosystems, food webs, and the cycling of matter and energy
- Start the Criteria for a Healthy Ecosystem anchor chart
- Introduce the student science notebook and Scientists Meeting protocol

NGSS Standards Addressed

Note: The purpose of Lesson Sequence 1 is to launch the module, build student engagement, and establish instructional routines. Therefore, it does not yet explicitly teach any of the Science and Engineering Practices, Crosscutting Concepts, or Disciplinary Core Ideas.

Ongoing Assessment

- Student science notebook: Anchoring Phenomenon entry
- Scientists Meeting: Gathering Ideas

Lesson Sequence 2 (2 hours)

Instructional Focus

- Introduce matter as a crosscutting concept
- Introduce the Concepts Scientists Think About anchor chart and the Scientists Do These Things anchor chart
- Gather baselines data about a student's ability to construct a scientific argument

NGSS Standards Addressed

- Construct an argument with evidence that some parts of an ecosystem are made of matter. (Based on NGSS 5-PS1-1)
- Science and Engineering Practices
  - Engaging in Argument from Evidence
  - Obtaining, Evaluating, and Communicating Information
- Crosscutting Concepts
  - Energy and Matter
- Disciplinary Core Ideas
  - PS1.A: Structure and Properties of Matter

Ongoing Assessment

- Student science notebook: Defining Matter entry
- Scientists Meeting: Building Understanding

Week 2

Approximately 1.5 hour of instruction

Lesson Sequence 3 (1.5 hour)

Instructional Focus

Note: The Plant Investigation began in this lesson sequence will require a week of observation before students may analyze the data in Section 3 of the lesson sequence. Students may go on to Lesson Sequence 4 while they wait for the investigation to finish.

- Build background on the investigation process and how plants get the matter they need for growth chiefly from air and water
- Plan and carry out original investigation about the effect of matter on plant growth

NGSS Standards Addressed

- Collaborate to develop a model that explains how plants use water (matter), air (matter), and energy from the sun to make matter with stored energy (food). (Based on NGSS 5-LS1-1)
- Science and Engineering Practices:
  - Developing and Using Models
  - Planning and Carrying Out an Investigation
- Crosscutting Concepts
  - Energy and Matter
- Disciplinary Core Ideas
  - LS1.C: Organization for Matter and Energy Flow in Organisms

Ongoing Assessment

- Scientists Meeting: Planning Investigation
- Scientists Meeting: Building Understanding
- Participation in Back-to-Back and Face-to-Face protocol
- Student science notebook: Plant Growth entry

Week 3

Approximately 2 hours of instruction

Lesson Sequence 4 (2 hours)

Instructional Focus

- Build background information on the crosscutting concept of energy and the Law of Conservation
- Refine an argument by evaluating evidence
- Synthesize learning about the flow of energy and the criteria for healthy ecosystems in a Scientists Meeting

NGSS Standards Addressed

- Construct an argument based on evidence that energy is neither created nor destroyed, but flows throughout living systems. (Based on NGSS 5-PS3-1)

- Science and Engineering Practices:
  - Engaging in Argument from Evidence
  - Obtaining, Evaluating, and Communicating Information
- Crosscutting Concepts
  - Energy and Matter
- Disciplinary Core Ideas
  - PS3.D: Energy in Chemical Processes and Everyday Life

Ongoing Assessment

- Scientists Meeting: Building Understanding
- Participation in Back-to-Back and Face-to-Face protocol
- Student science notebook: Flow of Energy entry

Week 4

Approximately 4 hours of instruction

Lesson Sequence 3 revisit (1.5 hours)

Instructional Focus

- Analyze data from Plant Investigation
- Develop model of photosynthesis
- Synthesize learning about the role of plants in the cycle of matter and energy and the criteria for healthy ecosystems in a Scientists Meeting

NGSS Standards Addressed

- Collaborate to develop a model that explains how plants use water (matter), air (matter), and energy from the sun to make matter with stored energy (food). (Based on NGSS 5-LS1-1)
- Science and Engineering Practices
  - Developing and Using Models
  - Planning and Carrying Out an Investigation
- Crosscutting Concepts
  - Energy and Matter
- Disciplinary Core Ideas
  - LS1.C: Organization for Matter and Energy Flow in Organisms

Ongoing Assessment

- Scientists Meeting: Building Understanding
- Participation in Back-to-Back and Face-to-Face protocol
- Student science notebook: Plant Growth entry

Lesson Sequence 5 (2.5 hours)

Instructional Focus

- Introduce the Crosscutting Concept of Systems and how the abiotic and biotic parts of an ecosystem work together
- Create Ecosystem in a Baggie
- Form expert groups and build background on one of the three forest ecosystems: temperate, boreal, or tropical
- Begin Ecosystem Explanatory Diagrams
- Synthesize learning about systems and the criteria for healthy ecosystems in a Scientists Meeting

NGSS Standards Addressed

- Develop a model to explain that an ecosystem is made of biotic (living) and abiotic (nonliving) features that interact with one another. (Based on NGSS 5-LS2-1)
- Science and Engineering Practices
  - — Developing and Using Models
- Crosscutting Concepts
  - — Systems and System Models
- Disciplinary Core Ideas
  - — LS2.A: Interdependent Relationships in Ecosystems

Ongoing Assessment

- Scientists Meeting: Building Understanding
- Student science notebook: Parts of an Ecosystem entry
- Expert ecosystem explanatory model

Week 5

Approximately 4.5 hours of instruction

Lesson Sequence 6 (2.5 hours)

Instructional Focus

- Build background knowledge about food webs in general and in one of the specific ecosystems
- Revise Ecosystem Explanatory Diagrams
- Synthesize learning about food webs and the criteria for healthy ecosystems in a Scientists Meeting

NGSS Standards Addressed

- Develop a model (food web) that describes phenomena that the energy that producers, consumers, and decomposers gain from food can be traced back to the sun. (Based on NGSS 5LS2-1 and 5-PS3-1)

- Science and Engineering Practices
  - Developing and Using Models
- Crosscutting Concepts
  - Energy and Matter
- Disciplinary Core Ideas
  - LS2.A: Interdependent Relationships in Ecosystems

Ongoing Assessment

- Scientists Meeting: Building Understanding
- Student science notebook: Producers, Consumers, and Decomposers entry
  - Food web sketch
- Expert ecosystem explanatory model

Lesson Sequence 7 (2 hours)

Instructional Focus

- Learn how energy transforms as it flows within a food chain through a simulation and a reading
- Revise Ecosystem Explanatory Diagrams to reflect the flow of energy in an ecosystem
- Synthesize learning about the flow of energy in an ecosystem and how to develop a model in a Scientists Meeting

NGSS Standards Addressed

- Use a model (food web) in explaining that food provides animals with the matter and energy they need for body repair, growth, motion, and maintaining body warmth and for motion. (Based on NGSS 5-LS2-1 and 5-PS3-1)
- Science and Engineering Practices
  - Developing and Using Models
- Crosscutting Concepts
  - Energy and Matter
- Disciplinary Core Ideas
  - LS2.B: Cycles of Matter and Energy Transfer in Ecosystems

Ongoing Assessment

- Scientists Meeting: Building Understanding
- Student science notebooks: Matter and Energy Transfer entry
  - Matter and energy transfer model
- Expert ecosystem explanatory model

Week 6

Approximately 2.5 hours of instruction

Lesson Sequence 8 (2.5 hours)

Instructional Focus

- Build background information on the cycle of carbon dioxide/oxygen, water and solid matter in an ecosystem through observation and video
- Revise Ecosystem Explanatory Diagrams to reflect flow of matter
- Synthesize learning about the flow of matter and energy and the criteria for healthy ecosystems in a Scientists Meeting

NGSS Standards Addressed

- Collaborate to develop a model that explains how water, air, and wastes are used and released by different organisms in an ecosystem. (Based on NGSS 5-LS2-1)
- Science and Engineering Practices
  - — Developing and Using Models
- Crosscutting Concepts
  - — Energy and Matter
- Disciplinary Core Ideas
  - — LS2.B: Cycles of Matter and Energy Transfer in Ecosystems

Ongoing Assessment

- Scientists Meeting: Building Understanding
- Student science notebook: Water, Air, and Waste Matter entry
- Expert ecosystem explanatory model

Week 7

Approximately 4.5 hours of instruction

Lesson Sequence 9 (2.5 hours)

Instructional Focus

- Learn about the effect of biodiversity on the balance and stability of an ecosystem through a food web simulation
- Synthesize learning about stability and balance and the criteria for healthy ecosystems in a Scientists Meeting
- Practice developing arguments about the health of an ecosystem

NGSS Standards Addressed

- Compare and refine arguments based on an evaluation of evidence that in a healthy ecosystem, a diversity of species meets their needs, including the need for food, in a stable web of life. (Based on NGSS 5-LS2-1)

- Science and Engineering Practices
  - Engaging in Argument from Evidence
- Crosscutting Concepts
  - Systems and System Models
- Disciplinary Core Ideas
  - LS2.A: Interdependent Relationships in Ecosystems

Ongoing Assessment

- Scientists Meeting
- Student science notebooks: Stability and Balance entry
- Ecosystem explanatory model

Lesson Sequence 10 (2 hours)

Instructional Focus

- Learn how a change in an ecosystem can affect the balance and stability by studying the wolves of Yellowstone
- Learn more about invasive species
- Use Ecosystem Explanatory Diagrams to make predictions about a change in the ecosystem

NGSS Standards Addressed

- Use a model to predict that when a biotic or abiotic factor in an ecosystem changes, the entire ecosystem is affected. (Based on NGSS 5-LS2-1)
- Science and Engineering Practices
  - Developing and Using a Model
- Crosscutting Concepts
  - Systems and System Models
- Disciplinary Core Ideas
  - LS2.A: Interdependent Relationships in Ecosystems

Ongoing Assessment

- Student science notebooks: Changing Ecosystems entry
- Participation in Back-to-Back and Face-to-Face protocol
- Expert ecosystem explanatory model

Week 8

Approximately 3.5 hours of instruction

Lesson Sequence 11 (3.5 hours)

Instructional Focus

- Revisit the anchoring phenomenon and synthesize learning about the criteria for a healthy ecosystem
- Complete the Summative assessment
- Use the Engineering Design Cycle to complete the Performance Task
- Reflect on learning

NGSS Standards Addressed

- Develop an argument that the flow of matter and energy among the sun, plants, and animals indicates the health of an ecosystem. (Based on NGSS 5-LS2-1)
- Science and Engineering Practices
  - Developing and Using a Model
  - Engaging in Argument from Evidence
- Crosscutting Concepts
  - Systems and System Models
  - Energy and Matter
- Disciplinary Core Ideas:
  - LS2.A: Interdependent Relationships in Ecosystems
  - LS2.B: Cycles of Matter and Energy Transfer in Ecosystems

Ongoing Assessment

- Scientists Meeting: Making Meaning
- Student science notebook: Improving the Health of an Ecosystem entry
- Summative Assessment: Assessing a Forest Ecosystem
- Improving the Health of an Ecosystem Explanatory Model

Optional: Community, Experts, Fieldwork, Service, and Extensions

Community:

- If you have a number of English Language Learners speaking the same native language, invite family members to come in and talk about student plans to improve the health of a local ecosystem.
- If you have students who have lived or have family members who have lived near a temperate, boreal, or tropical forest ecosystem, invite them to give a first-hand account of the characteristics of these ecosystems.
- Team up with another grade level and share your discoveries about forest ecosystems, food webs, photosynthesis, and/or the role of plants in moving matter and energy.
- Join a citizen science group like NatureWatchers to find ways students can help the local environment and/or participate in the work of scientists. See https://www.fs.fed.us/ for more information.

Experts:

- Invite a biologist or botanist to come in to talk with the students about the role of plants in an ecosystem.
- Invite a local zoologist to come in and talk about plants and animals in a local food web.
- Invite a local physicist to come in and talk about the different types of energy and how they are used in our everyday life.
- Invite a landscape architect or engineer to come in and talk about designing public spaces that can be a healthy ecosystem where multiple organisms get their needs met.
- Contact your state's park service to learn more about the ecosystems in your area.

Fieldwork:

- Visit a local national forest or park. To find the one nearest you, go to: http://www.discovertheforest.org/
- Visit a local zoo, nature center, aquarium, or botanical garden to observe the abiotic and biotic features of an ecosystem working together.
- Go on virtual field trips by visiting online resources that are available through zoos, nature centers, aquariums, and botanical gardens.

Service:

- If you choose to use the alternate performance task, invite students to implement their suggestion to improve a local ecosystem.
- Invite students to volunteer to clean up a local forest, park, or wildlife area.
- Invite students to create a poster, pamphlet, radio ad, and/or online video to educate the public on issues affecting the health of local ecosystems.

Extension Opportunities for students seeking more challenge:

- In each lesson sequence, there are optional extensions.
- If students complete the alternate performance task, they could collect and analyze data on their local schoolyard or another nearby public space. Arrange for students to present their suggestions and explanatory model to an audience that may be able to implement their plan (e.g., the school board, park and recreation board, or neighborhood association). See Lesson Sequence 11 for additional information and an optional assignment description.

Preparation and Materials

For basic lesson preparation, refer to the materials list and Teaching Notes in each lesson sequence. The following are science-specific materials that will require significant advance preparation. More information on quantities and specific instruction is in the materials list in each lesson sequence.

Before beginning the Grade 5 Life Science Module

- In Lesson Sequence 3, students will design their own experiment with plants. A few weeks before starting the Life Science Module, seed bean plants or purchase bean plant seedlings from a local nursery. Continue to care for enough seedlings for each group of three or four students to have a seedling.
- Consider creating terrariums or mini ecosystems so students can observe the interaction of abiotic and biotic features. The terrariums could include small animals. See Additional Resources for more information.
- Consider growing plants hydroponically in your classroom so students can observe that plants get the matter they need for growth chiefly from water and air.

Week 1

Lesson Sequence 1

- Create a teacher science notebook.
- Copy and assemble the student science notebooks. *(Not needed if your school has purchased the bound Student Science Notebooks.)*
- Create the Assessing the Health of an Ecosystem slideshow.

Lesson Sequence 2

- Construct balance from a coat hanger.
- Gather materials for the demonstration of matter: balloons, classroom objects with very different weights, and tape.

Week 2

Lesson Sequence 3

- Gather materials for plant investigation, including seedlings, sandwich-size plastic bags, rubber bands, graduated cylinder, water and various other liquids, various solids (such as sawdust, sand, or fertilizer), and various gases (such as incense, hairspray, or air freshener).

Week 3

Lesson Sequence 4

- Gather materials for demonstrating energy, including, boiling water, electric tea kettle, soccer ball, and if available, Newton's cradle.

Week 4

Lesson Sequence 3 (revisit)

See above.

Lesson Sequence 5

- Prepare computers necessary for each student to gather information about forests on a specific website.
- Gather materials for an ecosystem in a baggie, including, bottom half of a 2-liter plastic bottle, pebbles, potting soil, seeds, resealable plastic bag, water, masking tape, and marker.
- Gather poster board for the expert ecosystem explanatory model.

Week 5

Lesson Sequence 6

- Create the Food Web Organism cards and the Forest Organism picture cards.

Lesson Sequence 7

- Gather materials for "Pass the Energy, Please," including, bottle of soda or colored water, plastic cups, 100 milliliter graduated cylinder, and eyedropper.

Week 6

Lesson Sequence 8

- Obtain hand mirrors (one for each pair of students).

Week 7

Lesson Sequence 9

- Gather materials for the food web activity, including balls of string or yarn and Food Web Name cards

Lesson Sequence 10

- Create the Invasive Species cards and the Ecosystem Scenario cards.

Week 8

Lesson Sequence 11

- Prepare materials for the summative assessment.
- Prepare materials for the Improving the Health of an Ecosystem Model (the performance task).

Student Science Notebooks

The student science notebook plays a central role in the science classroom. This notebook is a place for students to track their learning and organize their evidence. Encourage students to take ownership of the notebook and use it to record all of their ideas and questions throughout the module, in addition to writing in response to the formal prompts.

The science notebook is patterned after an "interactive notebook." When opened flat, the left-hand side of the notebook is primarily for instructions and prompts; the right-hand side is primarily for student responses and ideas. When copying and creating the notebook, be sure to staple correctly.

Students will use the notebook during every science class and return to it several times throughout the block. Consider the classroom systems and structures already in place to help students easily access and store their notebook.

Encourage students to use pencils, because they often will create detailed drawings and diagrams. As students return to and revise their ideas, have them lightly cross out changed thinking (rather than erasing) so their changes in thinking can be documented. Periodically, students may need to attach something to their science notebook. Use tape or staples (glue can make the pages stick together).

Periodically (once a week or so), collect the notebook to formatively assess students' understanding of the Disciplinary Core Ideas and Crosscutting Concepts as well as their ability to apply the Science and Engineering Practices. In each lesson sequence, the ongoing assessment box suggests parts of the notebook to focus on. Remember that the science notebook should not be used as a summative assessment. Rather, the notebook is a place where students are encouraged to try out new ideas, revise old ideas, and take risks.

For more information about the student science notebook, see the California Academy of Science, Teacher Perspectives: The Value of Science Notebooking: https://www.calacademy.org/educators/teacher-perspectives-value-science-notebooking

Living Organisms in the Classroom

Science comes alive for students when there are real plants and animals in the classroom. EL Education encourages teachers to use living organisms in their classroom, and each life science module includes both formal and informal learning opportunities that incorporate live plants and animals. When done with careful thought and preparation, the close observation and study of living organisms not only teaches students about science and nature, but fosters an attitude of respect and kindness toward all living things.

To ensure the best learning experience with living organisms, it's important to plan ahead. First, familiarize yourself with the NSTA guidelines for the responsible use of live animals in the classroom. See (http://www.nsta.org/about/positions/animals.aspx). Then check up on local and state laws and regulations concerning the handling and transportation of animals, particularly non-native species. Most importantly, learn as much as you can about the particular plant or animal that you want to study. Take the time to have your students help you build a clean, safe and attractive habitat for the organism. The more you and your students learn about the safe handling of the organism, the better you will treat and care for the classroom visitor.

When planning classroom activities with a live organism, remember that the highest purpose is to promote observation and scientific curiosity, and instill an appreciation for the value of life. Under no circumstances should an activity cause an animal pain, deprive it of food or comfort, or expose it to harmful substances. Instead of "experimenting" with living things, help students discover ways to improve the organism's life by learning what it needs to thrive. It's not always necessary to have a formal research question. Close observation of an animal—taking notes, asking questions, making hypotheses—can be a powerful learning experience all its own.

A critical part of the planning process is deciding what to do with an animal after it leaves your classroom. If it's a native species, you could send the animal home with a student or release it into the wild. Non-native species require more forethought. If you buy the animal from a biological supply company, ask if they will take the animal back when you are done. If that's not possible, ask the supply company exactly where the animal was raised or collected. Contact a school in that area and see if a local science teacher would be willing to release the animal for you. The safe return of an animal to its home is an important lesson for your students to learn.

Letter Home

Dear Families,

Soon we will begin our Grade 5 Life Science Module. We will be learning about what makes a healthy ecosystem. We are going to investigate how living (like plants and animals) and non-living things (like water and sunlight) interact in healthy ecosystems. We will study food webs and learn how energy and matter are cycled through an ecosystem as plants and animals grow, breathe, eat, die, and decompose.

The ecosystem we will use as our example is a forest ecosystem. Have you ever been to a forest? We would love for you to share your experience with us. Come in and give us a first-hand account. Or consider sending in photos or artifacts. Anything you have that would help us get a sense of what these fascinating ecosystems are really like would be appreciated.

Finally, we will be discussing ways we can keep local ecosystems healthy. We're going to learn about the importance of balance and stability in an ecosystem and ways that balance can be lost. To do this, we will study a changing ecosystem. Do you have any experience with a local ecosystem that has changed? If you have any before or after photos for us to study, that would be great. Then we will study invasive species. Do you have any experience with or expertise in local invasive species? Once again, we would love for you to share your knowledge with us.

We will also be creating ecosystems in a baggie. To do this, we need 2-liter plastic bottles. If you have some you'd like to donate, please wash them out, remove the labels, and send them into school.

Thanks for your support as we become better scientists.

Science Background Information for Teachers

Below is science background information about the cycle of matter and energy and food webs. Also included is information about forest ecosystems. Use this information to help you effectively teach the science content of the Grade 5 Life Science Module. For further information, see the additional resources listed at the end of this document.

The main idea of the Grade 5 Life Science Module is that the health of an ecosystem can be assessed and improved. Matter and energy are cycled through healthy ecosystems by a diversity of organisms including *producers*, *consumers*, and *decomposers*. Ecosystems are made up of *abiotic* and *biotic* parts. The biotic parts are the living parts of the ecosystem, all of the plants and animals. The abiotic parts are the nonliving parts, the soil, water, oxygen, sunlight, and temperature of the ecosystem. The abiotic and biotic factors must interact in a balanced way in order for the ecosystem to be healthy.

Biodiversity refers to the variety of plants and animals found in a specific environment. It is often used as a lens to measure the health of an ecosystem. Healthy ecosystems contain a high degree of biodiversity, which results in a large number of species interacting in a variety of ways. This web of interactions makes it less likely that a critical species will be eliminated. If one species is removed from the ecosystem, the diversity within the system provides alternative options for interactions and meeting needs for survival. The introduction of a new species, however, can damage this intricate web of life.

Forest Ecosystems

An ecosystem is a community of organisms interacting with each other and their environment. There are many types of ecosystems, including tundra, desert, grasslands, aquatic, forest ecosystems, and even urban ecosystems. The boundaries of an ecosystem are conceptual. Therefore, one can refer to a grove of trees as a temperate forest ecosystem and also the forests covering acres of North America as a temperate forest ecosystem. Students study ecosystems at both levels in this module. They study forest ecosystems but also consider a small schoolyard ecosystem.

Students become experts in either a tropical, temperate, or boreal forest ecosystem.

- Tropical forests
  - Have the greatest diversity of species.
  - They are found near the equator and have only two seasons, rainy and dry.
  - Temperatures generally range from 70° to 85°F (21–30° C).
  - A typical day is approximately 12 hours long with little variation throughout the year.
  - Annual rainfall is high and exceeds 79 inches (200 cm). The tropical rainforest canopy has numerous layers that filter out much of the sunlight before it can reach the forest floor. The soil tends to be acidic and nutrient-poor due to significant leaching caused by heavy tropical rainfall.

- Temperate forests
  - Found in eastern North America, northeastern Asia, and western and central Europe.
  - Their seasons are well-defined with four to six frost-free months and a distinct winter. Temperatures vary significantly with lows being near -22°F (-30°C) and highs reaching 86°F (30°C).
  - Precipitation occurs throughout the year, and the average ranges from 30 to 59 inches (75–150 cm).
  - The forest floor is littered with decaying matter, making the soil very fertile. The moderately dense canopy allows sunlight to pass through and results in a diversified understory of vegetation.
- Boreal forests (sometimes referred to as taiga)
  - Form a broad belt across Eurasia and North America.
  - Long, dry, and extremely cold winters along with short, moist, and moderately warm summers characterize these forests.
  - Precipitation mainly falls as snow.
  - The soil is nutrient-poor and acidic. Because of the density of the canopy created by evergreen conifers, the understory has limited growth.

Matter and Energy

Matter is what makes up everything in the world that has weight and takes up space. It can be in the form of a solid, liquid, or gas. Water, air, and rocks are examples of matter. Organisms are also composed of matter. The bodies of organisms are more than just "stuff" that has weight and takes up space. Living things differ from nonliving, however, because they have the ability to take in food—or, in the case of plants, create food—that is converted into energy to support life processes. Organisms also are able to perform functions necessary for survival as a result of complex chemical reactions that occur internally.

Energy is the ability to do work. In science, "work" means that a force is applied to something and moves it. Work can involve an opposing force, like gravity. When you do push-ups, you push your body up against the opposing force of gravity. A force is applied and your body moves; therefore, work has occurred. Work can also change the speed of an object. The flapping wings and movement of a hummingbird are examples of work.

Energy manifests itself in many different ways, such as light, heat, motion, and sound. It can move from one place to another through moving objects, such as colliding balls, or through phenomena including sound, light, or electric currents. Energy cannot be destroyed (law of conservation of energy), but it can be transferred through a system. The total energy within a system changes only by the amount of energy that transfers into or out of the system. Solar energy as well as chemical or stored energy is the focus of this module.

Cycling of Matter

Through the process of photosynthesis, plants use solar energy to convert water and *carbon dioxide* into plant matter and *oxygen*. Plant matter, food in the form of sugars, contains energy that the plant can use immediately for growth or store for later use. Additionally, nutrients in the soil or water from decomposed matter help promote healthy growth in plants. Organisms that eat plants benefit from the stored energy in plants. They also rely on plants for oxygen production during photosynthesis, with animals cycling gas back to plants in the form of exhaled carbon dioxide.

All energy contained in the food that animals eat can be traced back to the sun. Plants use energy from the sun to convert water and carbon dioxide into food. Plants are then eaten by herbivores, animals that eat only plants, or omnivores, animals that eat both plants and animals. Carnivores, meat eaters, devour other animals that have ingested plants. All of these consumers get their energy either directly or indirectly from plants that initially captured energy from the sun. The energy that animals get from eating food (either plants and/or other animals) is converted into different types of energy within the body. Sometimes it is converted into kinetic energy (when the animal moves). Part of the energy is stored in the body matter of animals and, in the case of warm-blooded animals, some energy is released to the surrounding environment as heat energy.

Water cycles through an ecosystem as organisms take in and release water. Animals drink water and release water in urine and perspiration. Plants absorb water and release water into the air around them through *transpiration*, essentially the evaporation of water from plant leaves.

Decomposers, fungi and bacteria, have an important role in cycling matter and energy through an ecosystem. They break down the remains of dead organisms and animal waste into carbon dioxide released to the air and nutrients, which are released into the soil. The nutrients are then available to support new plant growth. Decomposers are essential for cycling matter and energy within an ecosystem.

Sources

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Additional Resources

For more science background information:

- Bozeman Science has a series of videos that clearly explain many of the Disciplinary Core Ideas addressed in this module. The Bozeman Science YouTube channel is:
  - https://www.youtube.com/channel/UCEik-U3T6u6JA0XiHLbNbOw
  - For more specific videos on matter and energy: https://www.youtube.com/watch?v=U22h55dHIi0, https://www.youtube.com/watch?v=P_RQuRzp7SE
  - For more specific videos on matter and energy in an ecosystem: https://www.youtube.com/watch?v=x37DJLcJ0dI

Forest ecosystem background information

- University of California Museum of Paleontology: http://www.ucmp.berkeley.edu/exhibits/biomes/forests.php
- Biomes of the World: http://www.thewildclassroom.com/biomes/taiga.html
- http://www.eoearth.org/view/article/152248/
- http://www.calacademy.org/explore-science/ecosystems-and-ecological-networks

For information on terrariums in the classroom:

- http://www.yale.edu/ynhti/curriculum/units/1992/5/92.05.02.x.html
- Terra/Aqua Column: http://www.bottlebiology.org/investigations/terraqua_main.html
- Annenberg Learning: https://www.learner.org/courses/essential/life/bottlebio/ecocol/build.html

For pictures of landscape change over time:

- The Landscape Change Program, The University of Vermont: http://www.uvm.edu/landscape/menu.php
- For information on vendors:
- Living organisms can be purchased at:
- Carolina Biological at http://tinyurl.com/glt9u75
- Connecticut Valley Biological at https://www.connecticutvalleybiological.com/

For more information on the NGSS Performance Expectations, including the evidence statements:

- http://www.nextgenscience.org/next-generation-science-standards
- http://www.nap.edu/catalog/13165/a-framework-for-k-12-science-education-practices-crosscutting-concepts

For more information on science instruction in the elementary classroom:

- Engineering Is Elementary Video Snippets illustrate the teaching and learning processes that support hands-on engineering in the classroom: http://eie.org/engineering-elementary/eie-video-snippets
- National Research Council, Ready, Set SCIENCE! Putting Research to Work in K–8 Science Classrooms describes the kinds of learning experiences and instructional practices that are necessary for students to develop a deep understanding of science: http://www.nap.edu/catalog/11882/ready-set-science-putting-research-to-work-in-k-8
- The Inquiry Project—Talk Science Primer provides guidance for developing a culture of productive talk in classrooms: http://inquiryproject.terc.edu/shared/pd/TalkScience_Primer.pdf
- Tools for Ambitious Science Teaching provides a constantly evolving set of tools aimed at improving student participation and learning: http://ambitiousscienceteaching.org/
- NGSS@NSTA provides NGSS curriculum planning resources as well as professional learning materials: http://ngss.nsta.org/Default.aspx
- NGSS Resources contain a variety of materials to support implementation of NGSS, including links to the Evidence Statements that help clarify the standards: http://www.nextgenscience.org/resources