

Unit 5: Stability and Change in Ecosystems

Standard(s):

8.3.1 Plan and conduct an investigation and use the evidence to construct an explanation of how photosynthetic organisms use energy to transform matter. Emphasize molecular and energy transformations during photosynthesis. (PS3.D, LS1.C)

8.3.2 Develop a model to describe how food is changed through chemical reactions to form new molecules that support growth and/or release energy as matter cycles through an organism. Emphasize describing that during cellular respiration molecules are broken apart and rearranged into new molecules, and that this process releases energy. (PS3.D, LS1.C)

8.3.3 Ask questions to obtain, evaluate, and communicate information about how changes to an ecosystem affect the stability of cycling matter and the flow of energy among living and nonliving parts of an ecosystem. Emphasize describing the cycling of matter and flow of energy through the carbon cycle. (LS2.B, LS2.C)

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Asking Questions Students engage in asking testable questions to pursue understandings of phenomena.	PS3.D Energy in Chemical Processes and Everyday Life LS1.C Organization for Matter and Energy Flow in Organisms LS2.B Cycles of Matter and Energy Transfer in Ecosystems LS2.C Ecosystem Dynamics, Functioning, and Resilience	Stability and Change Students evaluate how and why a natural or constructed system can change or remain stable over time. Systems and System Models Students use models to explain the parameters and relationships that describe complex systems.

Big Ideas:

- Naturally occurring food and fuel contain complex carbon-based molecules, chiefly derived from plant matter that has been formed by photosynthesis. The chemical reaction of these molecules with oxygen releases energy; such reactions provide energy for most animal life and for residential, commercial, and industrial activities.
- The energy needed for life is ultimately derived from the sun through photosynthesis. Plants, algae (including phytoplankton), and other energy-fixing microorganisms use sunlight, water, and carbon dioxide to facilitate photosynthesis, which stores energy, forms plant matter,

releases oxygen, and maintains plants' activities. Plants and algae—being the resource base for animals, the animals that feed on animals, and the decomposers—are energy-fixing organisms that sustain the rest of the food web.

- The carbon cycle provides an example of matter cycling and energy flow in ecosystems. Photosynthesis, digestion of plant matter, respiration, and decomposition are important components of the carbon cycle, in which carbon is exchanged between the biosphere, atmosphere, oceans, and geosphere through chemical, physical, geological, and biological processes.

Preceding Grade Bands:	Target Grade Bands:	Following Grade Bands:
• The energy released by burning fuel or digesting food was once energy from the sun that was captured by plants in the chemical process that forms plant matter (from air and water). • All animals need food in order to live and grow. They obtain their food from plants or from other animals. Plants need water and light to live and grow. • Animals and plants alike generally need to take in air and water, animals must take in food, and plants need light and minerals. • Food provides animals with the materials they need for body repair and growth and is digested to release the energy they need to maintain body warmth and for motion. • Plants acquire their material for growth chiefly from air and water and process matter they have formed to maintain their internal conditions. • Organisms obtain the materials they need to grow and survive from the environment. • Matter cycles between the air and soil and among plants, animals, and microbes as these organisms live and die. Organisms obtain gasses, water, and minerals from the environment and release waste matter (gas, liquid, or solid) back into the environment.	• The chemical reaction by which plants produce complex food molecules (sugars) requires an energy input (i.e., from sunlight) to occur. In this reaction, carbon dioxide and water combine to form carbon-based organic molecules and release oxygen. • Plants, algae (including phytoplankton), and many microorganisms use the energy from light to make sugars (food) from carbon dioxide from the atmosphere and water through the process of photosynthesis, which also releases oxygen. These sugars can be used immediately or stored for growth or later use. • Animals obtain food from eating plants or eating other animals. Within individual organisms, food moves through a series of chemical reactions in which it is broken down and rearranged to form new molecules, to support growth, or to release energy. • In most animals and plants, oxygen reacts with carbon-containing molecules (sugars) to provide energy and produce carbon dioxide. • Food webs are models that demonstrate how matter and energy is transferred between producers (generally plants and other organisms that engage in photosynthesis), consumers, and	• A variety of multistage physical and chemical processes in living organisms, particularly within their cells, account for the transport and transfer (release or uptake) of energy needed for life functions. • The process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide plus water into sugars plus released oxygen. • The sugar molecules thus formed contain carbon, hydrogen, and oxygen; their hydrocarbon backbones are used to make amino acids and other carbon-based molecules that can be assembled into larger molecules • Cellular respiration also releases the energy needed to maintain body temperature despite ongoing energy loss to the surrounding environment. • Photosynthesis and cellular respiration (including anaerobic processes) provide most of the energy for life processes. Plants or algae form the lowest level of the food web. At each link upward in a food web, only a small fraction of the matter consumed at the lower level is transferred upward, to produce growth and release energy in cellular respiration at the higher level.

	decomposers as the three groups interact—primarily for food—within an ecosystem. • The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem.	• The chemical elements that make up the molecules of organisms pass through food webs and into and out of the atmosphere and soil and are combined and recombined in different ways. At each link in an ecosystem, matter and energy are conserved; some matter reacts to release energy for life functions, some matter is stored in newly made structures, and much is discarded. • Photosynthesis and cellular respiration are important components of the carbon cycle, in which carbon is exchanged between the biosphere, atmosphere, oceans, and geosphere through chemical, physical, geological, and biological processes.
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Proficiency Scale:

4 Advanced	3 Proficient	2 Approaching Proficiency	1 Beginning Proficiency
I can: Develop a model based on evidence and scientific principles that shows how photosynthesis and cellular respiration cause matter to cycle and energy to flow through an <u>ecosystem</u>. AND Ask questions to obtain, evaluate and communicate information about what would happen to the <u>stability</u> of an ecosystem if there was a <u>change</u> to the availability of energy or matter resources. AND Propose a solution to mitigate the effects of human impact on the <u>stability</u> of an <u>ecosystem</u>.	I can: Develop a model based on evidence and scientific principles that shows how photosynthesis and cellular respiration cause matter to cycle and energy to flow through an <u>ecosystem</u>. AND Ask questions to obtain, evaluate and communicate information about what would happen to the <u>stability</u> of an ecosystem if there was a <u>change</u> to the availability of energy or matter resources.	I can: Develop a model that shows how photosynthesis and cellular respiration cause matter to cycle and energy to flow through an <u>ecosystem</u>. AND Ask questions to obtain information about what would happen to the <u>stability</u> of an ecosystem if there was a <u>change</u> to the availability of energy or matter resources.	I can: Develop a model that shows relationships between organisms in an <u>ecosystem</u>. AND Obtain information about the <u>stability</u> of an ecosystem.

Anchoring Phenomenon: Yellowstone - Photos of Yellowstone before and after the reintroduction of wolves.
Essential Question: What affects the stability of matter cycles and energy flow through an ecosystem?
Learning Goals: Students will be able to . . . 5A: Plan and conduct an investigation and use the evidence to explain how plants use energy from the sun to change matter and store energy in glucose molecules. 5B: Develop a model that shows how food molecules are changed through cellular respiration to release energy and support growth. 5C: Ask questions to obtain information about how a change to an ecosystem might affect the stability of the cycling of matter and flow of energy in an ecosystem. Describe the cycling of matter and flow of energy through the carbon cycle.

	Learning Opportunities	Formative Assessments
Engage	Yellowstone - Students look at several before and after photos of areas in Yellowstone showing how the plants have changed in Yellowstone in the past 100 years. Students make observations about the photos, generate an explanation of what they think caused the dramatic changes in the plant life and record questions they have about what is going on.	Unit 5 Notebook - This document contains all of the activities described below for this unit.
Learning Goal 5A: Plan and conduct an investigation and use the evidence to explain how plants use energy from the sun to change matter and store energy in glucose molecules.		

Engage	<u>Activity 1</u> - I'm Rooting for You! Students watch a time lapse video of a plant sprouting and growing. They record observations and ask questions about what they are seeing. The students then make predictions about what a plant needs to grow, what a plant makes and where the mass of a tree comes from.	Students record observations, explanations and questions in their digital notebook.
Explore	<u>Activity 2</u> - Energy and Plant Growth Experiment In order to answer some of the questions the students have from activity 1, the students will plan and conduct an experiment to determine how energy affects plant growth. NOTE: This will need to be set up and run a few weeks before you are ready to teach this learning goal. After discussing that light is one factor students believe a plant needs, explain that you will be running an experiment to see how light affects the plant growth. Each group chooses one factor about light to change, and then plant seeds to test it.	
Explain	<u>Conclusion and Class Discussion</u> from Energy and Plant Growth Experiment Once the students have run their experiment for several weeks they will write an analysis and conclusion explaining the results of their experiment and what they have learned about light and plant growth.	Conclusion from Plant Experiment in Activity 2 of the notebook
Explore	<u>Activity 3</u> - What do Plants Need to Grow?	Important Information about Plant Growth Table in Notebook

	In this activity the students will collect evidence about some of the factors other than light that plants need. They will watch videos or run demonstrations about water, soil, and air.	
Explain	Activity 4 - The Photosynthesis Reaction Students will obtain information about what a plant makes and the type of energy the light energy turns into during photosynthesis. Using cards of all of the molecules and energy types that are involved, they will use what they have learned to put together the photosynthesis chemical reaction. The students will draw a model of the photosynthesis reaction. Revisit the Yellowstone Phenomenon - Students use what they have learned in the learning goal to revisit the Yellowstone phenomenon, identifying what questions we have answered and what questions we still have.	Learning Ticket 5A.1 - Matter and Energy Transformation in Plants Learning Ticket 5A.2 - Photosynthesis

Learning Goal 5B: Develop a model that shows how food molecules are changed through cellular respiration to release energy and support growth.		
Engage	Activity 1 - Don't Call Me Chicken! The mass of chickens were measured from the time they were put in an incubator until the chickens hatched and several weeks afterwards. The students will make observations about this data and come up with an explanation for what they are seeing, focusing on where the increase of mass is coming from. They will record questions they have about what they are seeing.	Students record observations, explanations and questions in their digital notebook.
Explore	Activity 2 - Digestion	Learning Ticket 5B.1 - Digestion

	The students will obtain information about the basics of an animal's digestive system, including the main function of the digestive system, some of the macromolecules involved and the main organs that are part of the process.	
Explain	<u>Activity 3</u> - Digestion and Cellular Respiration Model Using what they have learned, the students will draw a model of Cellular Respiration and the digestive system, explaining how molecules are broken apart and rearranged to make new molecules and the energy transformations involved. <u>Activity 4</u> - Cellular Respiration Game The students will play a game to review cellular respiration and how it is connected to photosynthesis. Revisit <u>Don't Call Me Chicken Phenomenon</u> - Using what they have learned the students will explain the chicken phenomenon. Revisit <u>Yellowstone Phenomenon</u> - Students use what they have learned in the learning goal to revisit the Yellowstone phenomenon, identifying what questions we have answered and what questions we still have.	<u>Learning Ticket 5B.2</u> - Photosynthesis and Respiration

Learning Goal 5C: Ask questions to obtain information about how a change to an ecosystem might affect the stability of the cycling of matter and flow of energy in an ecosystem. Describe the cycling of matter and flow of energy through the carbon cycle.

Explore	<u>Activity 1 - Wasatch Food Web</u> In this activity the students take on the role of an organism in the Wasatch Food Web. With information about what the organism eats and what eats it, they work with their classmates to create food chains involving their organisms. As a class all of the organisms are connected together to create a food web. The class discusses what ecosystems, food chains, and food webs are. They discuss how food chains and food webs show how energy flows and matter cycles through an ecosystem. <u>Activity 2 - Grass → Rabbit → Fox</u> Students will ask questions about how changing one organism in a food web affects all of the other organisms and answer their questions by playing an online simulation.	<u>Learning Ticket 5C.1 - Food Webs and Food Chains</u>
Explain	<u>Activity 3 - Wasatch Energy Pyramid</u> Students build an energy pyramid using their organisms from the Wasatch Food Web activity. They explain what happens to the energy in the ecosystem as matter moves from one level of the pyramid to the next. They explain how disruptions to the food pyramid affect the whole food web.	<u>Learning Ticket 5C.2 - Energy Flows/Matter Cycles</u> <u>Learning Ticket 5C.3 - Matter and Energy</u>

Explore	Activity 4 - The Circle of Life/The Carbon Cycle In this activity the students play a game in which they track the path a carbon atom might take as it moves through an ecosystem.	
Explain	Activity 4 (Continued) - The Circle of Life/The Carbon Cycle The students summarize their experience with the Carbon Cycle game and explain how the cycle may be disrupted by the actions that humans take in an ecosystem. They explain how non living things can affect living things. Revisit the Yellowstone Phenomenon - Students use what they have learned in the learning goal to revisit the Yellowstone phenomenon, identifying what questions we have answered and what questions we still have.	• Ecology (whole unit) Levels 1 and 2 - Google Doc • Ecology (whole unit) Level 3 Rough Draft (complete quiz is in MasteryConnect) - Google Doc • Information for Level 3 - Google Doc • Ecology (whole unit) Level 4 - Google Doc
Elaborate	Activity 5 (LG5C Notebook) - Endangered Species Research To further explore how plants and animals in ecosystems are affected by changes to the ecosystem the students will obtain information about an endangered animal and how its disappearance will affect other organisms. They share what they discover with other students in the class.	Endangered animal research is recorded in tables in the LG5C notebook.
Evaluate		

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