MIDDLE SCHOOL LIFE SCIENCE: ECOLOGY- ENERGY & RESOURCES

Standards Bundle

Standards are listed within the bundle. Bundles are created with potential instructional use in mind, based upon potential for related phenomena that can be used throughout a unit.

MS-LS2-1 Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem. (SEP:4;DCI:LS2.A; CCC:Cause/Effect) [Clarification Statement: Emphasis is on cause and effect relationships between resources and growth of individual organisms and the numbers of organisms in ecosystems during periods of abundant and scarce resources.]

MS-LS2-3 Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem. (SEP:2; DCI:LS2.B; CCC:Energy/Matter) [Clarification Statement: Emphasis is on describing the conservation of matter and flow of energy into and out of various ecosystems, and on defining the boundaries of the system.] *[Assessment Boundary: Assessment does not include the use of chemical reactions to describe the processes.]*

MS-LS1-6 Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms. (SEP: 6, Nature Science/Empirical Evidence; DCI: LS1.C, PS3.D; CCC: Energy/Matter) [Clarification Statement: Emphasis is on tracing movement of matter and flow of energy.] *[Assessment Boundary: Assessment does not include the biochemical mechanisms of photosynthesis.]*

Content Overview

This section provides a generic overview of the content or disciplinary core ideas as an entry point to the standards.

In any ecosystem, there are physical and biological factors that affect the size of the populations. Availability or changes in availability of any of the factors can lead to changes in the populations of all of its members. Matter and energy cycle through both living and nonliving parts of ecosystems. Almost all energy that drives the cycling of matter comes from the sun (photosynthesis). A change in one component of the living or nonliving components of an ecosystem can result in the rest of the components in the system being impacted. The availability of these resources in an ecosystem can affect individual organisms and their populations.

Phenomena

Phenomena can be used at varying levels of instruction. One could be used to anchor an entire unit, while another might be more supplemental for anchoring just a unit. Please remember that phenomena should allow students to engage in the SEP and use the CCC/DCI to understand and explain the phenomenon.

- *After the Elk Creek Canyon Fire, a larger variety and number of native grasses grew in Elk Creek Canyon than observed before.*
- *In 2013, the reemergence of the Mountain Pine Beetle in the Black Hills of South Dakota changed the population of not only pine trees, but also insects, birds, and mammals.*

- *Reintroducing wolves into the Yellowstone National Park changed the direction of the rivers.*
- *Pheasant numbers greatly decreased after a summer drought.*
- *Following a cold, dry winter and summer drought conditions, SD Game, Fish, and Parks offers half the number of mule deer tags for that hunting unit.*

Storyline

This section aims to decode not only the DCI connections, but also the SEP and CCC in a detailed account of how they possibly fit together in a progression for student learning, including both rationale and context for the bundle.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data ● Analyze and interpret data to provide evidence for phenomena. **Constructing Explanations and Designing Solutions** ● Construct an explanation that includes qualitative or quantitative relationships between variables that predict phenomena. **Developing and Using Models** ● Develop and use a model to describe phenomena.	**LS1.C: Organization for Matter and Energy Flow in Organisms** ● 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. **PS3.D: Energy in Chemical Processes and Everyday Life** ● 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. (secondary) LS2.A: Interdependent Relationships in Ecosystems **LS2.A: Interdependent Relationships in Ecosystems** ● Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors. ● In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with each other for limited resources, access to which consequently constrains their growth and reproduction. ● Growth of organisms and population increases are limited by access to resources. **LS2.B: Cycle of Matter and Energy Transfer in Ecosystems**	**Cause and Effect** ● Cause and effect relationships may be used to predict phenomena in natural or designed systems. **Energy and Matter** ● The transfer of energy can be tracked as energy flows through a natural system.

	• Food webs are models that demonstrate how matter and energy is transferred between producers, consumers, and decomposers as the three groups interact within an ecosystem. Transfers of matter into and out of the physical environment occur at every level. Decomposers recycle nutrients from dead plant or animal matter back to the soil in terrestrial environments or to the water in aquatic environments. The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem.	

With this bundle, students can explore how matter and energy are cycled in both living and nonliving parts of an ecosystem. Both matter and energy continually cycle through Earth's various systems. Carbon and nitrogen are cycled through ecosystems and are utilized by living organisms at different levels within ecosystems. These cycles work together within Earth's ecosystems to support life and transfer matter and energy throughout our planet. Within ecosystems, different organisms utilize energy from sources that are unique to them. Food webs are an example of a model that demonstrates how matter and energy are transferred between producers, consumers, and decomposers as the three groups interact within an ecosystem. Plants, algae (including phytoplankton), and many other microorganisms are considered producers because they produce their own food. Animals are considered consumers because they have to consume other animals and/or plants for energy. Decomposers recycle nutrients such as nitrogen from dead plant or animal matter back into the soil in terrestrial environments or into the water in aquatic environments.

Students can use models to describe the transfer of energy and the movement of matter among organisms within an ecosystem. The emphasis should be on students developing models that include depictions of the interactions among components in the ecosystem and depictions of the components entering (inputs) and exiting (outputs) the ecosystem. The individual atoms that make up the organisms in an ecosystem are cycled repeatedly and move between the living and nonliving parts of the ecosystem. Producers use the process of photosynthesis to cycle matter and energy. Through this process, the chemical reaction by which plants produce complex food molecules requires energy input to occur. During photosynthesis these organisms undergo a chemical reaction, driven by energy from sunlight to take carbon dioxide from the air and water from the soil, and react to form carbon-based organic molecules (sugars) and release oxygen. These sugars may be stored for later use or used immediately. Students should be able to construct a scientific explanation to demonstrate the process of photosynthesis and design a model to trace the movement of matter and flow of energy. In developing a model students should gain an understanding of how carbon cycles through ecosystems, understanding should not focus on memorizing equations related to the carbon cycle. In all of Earth's systems, energy and matter is transferred in and out as well as cycled among the components of these various systems.

Formative Assessment

Formative assessment is crucial because all learners benefit from timely and focused feedback from others. It promotes self-reflection, self-explanation, and social learning. It can also make learning more relevant. Each of the questions below might be used throughout the formative assessment process. Specific prompts may focus on individual practices, core ideas, or crosscutting concepts, but, together, the components need to support inferences about students' three-dimensional science learning as described in a given bundle, standard or lesson-level performance expectation.

CCC Cause and Effect

- How can the removal or addition of one population in an ecosystem affect another population in the same ecosystem? **Note: Use populations and ecosystems known by students.*
- How do patterns in the data allow you to decide whether increased resource availability caused the reproduction rate of a population to increase?
- How does the rate of photosynthesis affect the amount of stored sugars (increased biomass)?
- What do you predict would happen to the rate of photosynthesis if the wavelength of available light changes?

CCC Energy and Map

- Create a model of food web from a prairie ecosystem.

SEP Analyzing and Interpreting Data

- Analyze data from a bio survey to determine the effects of resource availability influenced by weather or climate events (natural or artificially caused).

SEP Constructing Explanations and Designing Solutions

- Construct an investigation to prove sunlight is required in photosynthesis.
- Create a diagram that tracks how changes to one organism affects other species not directly related in an ecosystem.

SEP Developing and Using Models

- Form a model of an ecosystem representing all trophic levels (producers, consumers, decomposers) as well as abiotic factors and identifying the type of ecosystem (desert, marine, forest, etc.) with labels and a description of processes shown in the model.

Performance Outcomes

These are statements of how students use knowledge and are similar to the standards in how they blend DCI, SEP, and CCC, but at a smaller grain-size. These are potential outcomes for instruction as it plays out in lessons and activities in the classroom. It is important to also think of these as smaller outcomes that build toward the larger goal of mastering the standards.

- **Plan and carry out an investigation** to demonstrate that in order for plants to produce complex food molecules, *energy from the sun* is required.
- **Analyze and interpret data** that *energy stored in the form of sugar* during the process of photosynthesis (glucose) may be used by producers immediately or stored for their later use, or stored and later used by consumers.
- **Develop a model** of a food web to describe how *matter and energy is transferred* between producers, consumers, and decomposers as the three groups interact within an ecosystem.
- **Engage in argument** from evidence that changes to the biotic and abiotic components of an ecosystem can *affect* all of the populations in an ecosystem.
- **Interpret data and show patterns** to demonstrate that populations are *affected* by the availability of resources like food, water, oxygen, carbon dioxide

and sunlight.

- **Construct an explanation** that includes quantitative evidence that competition for available resources (both living and nonliving) can *affect* the size of a given population(s).
- **Engage in argument from evidence** to exhibit that reproduction rates and thus populations are *affected* by the availability of living and nonliving resources.