Grade 6 Science, Unit 2

Ecosystems

Overview

Unit abstract

Upon completion of this unit of study, students will be able to analyze and interpret data, develop models, construct arguments, and demonstrate a deeper understanding of the cycling of matter, the flow of energy, and resources in ecosystems. They will also be able to study patterns of interactions among organisms within an ecosystem. They will consider biotic and abiotic factors in an ecosystem and the effects these factors have on populations. They will also understand that the limits of resources influence the growth of organisms and populations, which may result in competition for those limited resources. The crosscutting concepts of matter and energy, systems and system models, patterns, and cause and effect will be used to support understanding.

Essential questions

- What are the interdependent relationships in ecosystems?
- How does matter cycle and energy flow in an ecosystem?
- How does an ecosystem maintain its necessary resources?

Bristol–Warren, Central Falls, Cranston, Segue Institute for Learning, Tiverton, and Woonsocket, with process support from The Charles A. Dana Center at the University of Texas at Austin

Written Curriculum

Next Generation Science Standards

MS. Matter and Energy in Organisms and Ecosystems

Students who demonstrate understanding can:

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.** [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.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. ▪ Analyze and interpret data to provide evidence for phenomena. (MS-LS2-1)	**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. (MS-LS2-1) ▪ 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. (MS-LS2-1) ▪ Growth of organisms and population increases are limited by access to resources. (MS-LS2-1)	**Cause and Effect** ▪ Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-LS2-1)

Connections to other DCIs in this grade-band: **MS.ESS3.A** (MS-LS2-1); **MS.ESS3.C** (MS-LS2-1)

Articulation across grade-bands: **3.LS2.C** (MS-LS2-1); **3.LS4.D** (MS-LS2-1); **5.LS2.A** (MS-LS2-1); **HS.LS2.A** (MS-LS2-1); **HS.LS4.C** (MS-LS2-1); **HS.LS4.D** (MS-LS2-1); **HS.ESS3.A** (MS-LS2-1)

Common Core State Standards Connections:

ELA/Literacy –

RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. (MS-LS2-1)

RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-LS2-1)

MS. Interdependent Relationships in Ecosystems

Students who demonstrate understanding can:

MS-LS2-2. **Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.** [Clarification Statement: Emphasis is on predicting consistent patterns of interactions in different ecosystems in terms of the relationships among and between organisms and abiotic components of ecosystems. Examples of types of interactions could include competitive, predatory, and mutually beneficial.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. ▪ Construct an explanation that includes qualitative or quantitative relationships between variables that predict phenomena. (MS-LS2-2)	**LS2.A: Interdependent Relationships in Ecosystems** ▪ Similarly, predatory interactions may reduce the number of organisms or eliminate whole populations of organisms. Mutually beneficial interactions, in contrast, may become so interdependent that each organism requires the other for survival. Although the species involved in these competitive, predatory, and mutually beneficial interactions vary across ecosystems, the patterns of interactions of organisms with their environments, both living and nonliving, are shared. (MS-LS2-2)	**Patterns** ▪ Patterns can be used to identify cause and effect relationships. (MS-LS2-2)

Connections to other DCIs in this grade-band: **MS.LS1.B** (MS-LS2-2)

Articulation across grade-band: **1.LS1.B** (MS-LS2-2); **HS.LS2.A** (MS-LS2-2); **HS.LS2.B** (MS-LS2-2); **HS.LS2.D** (MS-LS2-2)

Common Core State Standards Connections:

ELA/Literacy –

RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. (MS-LS2-2)

WHST.6-8.2 Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (MS-LS2-2)

WHST.6-8.9 Draw evidence from literary or informational texts to support analysis, reflection, and research. (MS-LS2-2)

SL.8.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 8 topics, texts, and issues, building on others' ideas and expressing their own clearly. *(MS-LS2-2)*

SL.8.4 Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation. *(MS-LS2-2)*

Mathematics –

6.SP.B.5 Summarize numerical data sets in relation to their context. *(MS-LS2-2)*

MS. Matter and Energy in Organisms and Ecosystems

Students who demonstrate understanding can:

MS-LS2-3. **Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.** [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.]

The performance expectations above were developed using the following elements from the NRC document: *A Framework for K-12 Science Education*:

Science and Engineering Practices

Developing and Using Models

Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.

- Develop a model to describe phenomena. (MS-LS2-3)

Disciplinary Core Ideas

LS2.B: Cycle of Matter and Energy Transfer in Ecosystems

- 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. (MS-LS2-3)

Crosscutting Concepts

Energy and Matter

- The transfer of energy can be tracked as energy flows through a natural system. (MS-LS2-3)

Connections to Nature of Science

Scientific Knowledge Assumes an Order and Consistency in Natural Systems

- Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation. (MS-LS2-3)

Connections to other DCIs in this grade-band: **MS.PS1.B** (MS-LS2-3); **MS.ESS2.A** (MS-LS2-3)

Articulation across grade-bands: **5.LS2.A** (MS-LS2-3); **5.LS2.B** (MS-LS2-3); **HS.PS3.B** (MS-LS2-3); **HS.LS1.C** (MS-LS2-3); **HS.LS2.B** (MS-LS2-3); **HS.ESS2.A** (MS-LS2-3)

Common Core State Standards Connections:

ELA/Literacy –

SL.8.5 Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. *(MS-LS2-3)*

Mathematics –

6.EE.C.9 Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation. *(MS-LS2-3)*

Clarifying the standards

Prior learning

The following disciplinary core ideas are prior learning for the concepts in this unit of study. By the end of Grade 5, students should know that:

- Populations live in a variety of habitats, and change in those habitats affects the organisms living there.
- 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.
- The food of almost any 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; eventually, decomposers restore some materials to the soil.
- Matter cycles between the air and soil and among organisms as they live and die 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.
- Adult plants and animals can have young.
- In many kinds of animals, parents and the offspring themselves engage in behaviors that help the offspring to survive.

Progression of current learning

Driving question 1
How does the availability of resources affect the growth of organisms and populations of organisms in an ecosystem?

Concepts	Practices
• Organisms and populations of organisms are dependent on their environmental interactions with other living things. • Organisms and populations of organisms are dependent on their environmental interactions with nonliving factors. • In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with others for limited resources. • Access to food, water, oxygen, or other resources constrain organisms' growth and reproduction.	• Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem. • Use cause-and-effect relationships to predict the effect of resource availability on organisms and populations in natural systems.

• Growth of organisms and population increases are limited by access to resources. • Cause-and-effect relationships may be used to predict effects of resource availability on organisms and populations of organisms in ecosystems during periods of abundant and scarce resources.	

Driving question 2
What patterns of interactions can be predicted among organisms across multiple ecosystems?

Concepts	Practices
• Predatory interactions may reduce the number of organisms or eliminate whole populations of organisms. • Mutually beneficial interactions may become so interdependent that each organism requires the other for survival. • The patterns of interactions of organisms with their environment, both its living and nonliving components, are shared. • Interactions within ecosystems have patterns that can be used to identify cause-and-effect relationships. • Patterns of interactions among organisms across multiple ecosystems can be predicted. • Patterns of interactions can be used to make predictions about the relationships among and between organisms and abiotic components of ecosystems.	• Construct an explanation about interactions within ecosystems. • Include qualitative or quantitative relationships between variables as part of explanations about interactions within ecosystems. • Make predictions about the impact within and across ecosystems of competitive, predatory, or mutually beneficial relationships as abiotic (e.g., floods, habitat loss) or biotic (e.g., predation) components change.

Driving question 3
How does matter cycle and energy flow among living and nonliving parts of an ecosystem?

Concepts	Practices
• Food webs are models that demonstrate how matter and energy are transferred among producers, consumers, and decomposers as the three groups interact within an ecosystem.	• Develop a model to describe the cycling of matter among living and nonliving parts of an ecosystem. • Develop a model to describe the flow of energy among living and nonliving parts of 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. • Decomposers recycle nutrients from dead plant or animal matter back 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. • The transfer of energy can be tracked as energy flows through an ecosystem. • Science assumes that objects and events in ecosystems occur in consistent patterns that are understandable through measurement and observation.	• Track the transfer of energy as energy flows through an ecosystem. • Observe and measure patterns of objects and events in ecosystems.

Integration of content, practices, and crosscutting concepts

Students will begin this unit of study by analyzing and interpreting data to provide evidence of how the availability of resources affects the growth of organisms and populations of organisms in an ecosystem. Students will learn that organisms and populations of organisms are dependent on their environmental interactions with nonliving factors. Students will identify essential biotic and abiotic resources such as food, water, oxygen, and shelter. By analyzing data about the impact of the availability of these resources, students can identify cause-and-effect relationships and predict the effect of resource availability on organisms and populations of organisms in ecosystems during times when resources are abundant and during times when they are scarce.

Students collect and use evidence to show that access to food, water, oxygen, and other resources constrains organisms' growth and reproduction. Students may investigate resource constraints on an organism's growth and reproduction using computer simulation that allows for observation of one organism's growth and reproduction as one variable at a time (space, food, water, etc.) in changed. To support their analysis, students will cite specific evidence found in texts. They will also use a model, flowchart, graph, or table to represent all or part of the quantitative or technical information found in the texts they use. Students will then present their findings in a focused, coherent manner with relevant evidence, solid valid reasoning, and well-chosen details. During their presentations, students must use appropriate eye contact, adequate volume, and clear pronunciation.

Students will learn that in any ecosystem, organisms and populations with similar resource requirements might compete with each other for limited resources. Students will investigate the cause and effect of natural fluctuations in populations due to the constant change in ecological systems. Students should construct a model, such as a food web, to demonstrate the effect on the ecosystem of adding or removing one population. The analysis of the model should include numerical data that students summarize to predict patterns of interactions among organisms. Variables will be used to represent two quantities in the ecosystem that change in relationship to one another. Students will write an equation to express one quantity of either matter or energy, thought of as the dependent variable, and the other quantity of matter or energy as the independent

variable. Students will analyze the relationship between the variables using graphs and tables, then relate graphs and tables to the equation they wrote. During this process, students will engage in a range of collaborative discussions with members of their class. These discussions could be in a small-group setting, one-on-one with another student or the teacher, or part of teacher-led discussions. Following these discussions, students will produce presentations about the cycling of matter and energy transfer in ecosystems. The presentation should include the integration of multimedia and visual displays.

Integration of DCI from prior units within this grade level

Use arguments based on empirical evidence and scientific reasoning to support an explanation of how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants, respectively.

Construct a scientific explanation based on evidence of how environmental and genetic factors influence the growth of organisms.

Integration of mathematics and/or English Language Arts/literacy

Mathematics

Use variables to represent two quantities in an ecosystem that change in relationship to one another. Write an equation to express one quantity of matter or energy, thought of as the dependent variable, in terms of the other quantity of matter or energy, thought of as independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation.

Summarize numerical data sets in order to predict patterns of interactions among organisms across multiple ecosystems in relation to their context.

English Language Arts/literacy

Cite specific textual evidence to support analysis and interpretation of data in science and in technical texts about cause-and-effect relationships between resources and the growth of individual organisms and the numbers of organisms in ecosystems during periods of abundant resources and periods of scarce resources.

Integrate quantitative or technical textual information on the effects of resource availability on organisms and populations of organisms in an ecosystem with a visually expressed version of that information.

Cite specific textual evidence to support analysis of science and technical texts that provide information on patterns of interactions among organisms across multiple ecosystems.

Write informative/explanatory text examining patterns of interactions among organisms across multiple ecosystems. Convey ideas, concepts, and information though the selection, organization, and analysis of relevant content.

Draw evidence from literary and informational texts to support analysis, reflection, and research used to construct an explanation of patterns of interactions among organisms across multiple ecosystems.

Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) about patterns of interactions among organisms across multiple ecosystems on grade 6 topics, texts, and issues; students should build on others' ideas in expressing their own ideas clearly.

Integrate multimedia components and visual displays into presentations about the cycling of matter and energy in ecosystems.

Present claims and findings that sequence ideas logically and use pertinent descriptions, facts, and details to predict patterns of interactions among organisms across multiple ecosystems. Accentuate main ideas or themes, using appropriate eye contact, adequate volume, and clear pronunciation.

Future learning

- Ecosystems have carrying capacities resulting from biotic and abiotic factors.
- The fundamental tension between resource availability and organism populations affects the abundance of species in any given ecosystem.
- Photosynthesis and cellular respiration provide most of the energy for life processes.
- Only a fraction of matter consumed at the lower level of a food web is transferred up, resulting in fewer organisms at higher levels.
- At each link in an ecosystem, elements are combined in different ways and matter and energy are conserved.
- Photosynthesis and cellular respiration are key components of the global carbon cycle.

Number of Instructional Days

Recommended number of instructional days: 25 (1 day = approximately 50 minutes)

Note—The recommended number of days is an estimate based on the information available at this time. Teachers are strongly encouraged to review the entire unit of study carefully and collaboratively to determine whether adjustments to this estimate need to be made.