

Performance Expectations (NGSS)

MS.Matter and Energy in Organisms and Ecosystems

Students who demonstrate understanding can:

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. [*Clarification Statement: Emphasis is on tracing movement of matter and flow of energy.*] [*Assessment Boundary: Assessment does not include the biochemical mechanisms of photosynthesis.*]

MS-LS1-7. Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism. [*Clarification Statement: Emphasis is on describing that molecules are broken apart and put back together and that in this process, energy is released.*] [*Assessment Boundary: Assessment does not include details of the chemical reactions for photosynthesis or respiration.*]

Disciplinary Core Ideas (NGSS)

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. (MS-LS1-6)
- 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. (MS-LS1-7)

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)

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)

LS2.C: Ecosystem Dynamics, Functioning, and Resilience

- Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations. (MS-LS2-4)

NYS Standards

Ecosystems Dynamics, Functioning and Resilience

LE 3.2a In all environments, organisms with similar needs may compete with one another for resources.

LE 5.1e Herbivores obtain energy from plants. Carnivores obtain energy from animals. Omnivores obtain energy from both plants and animals. Decomposers, such as bacteria and fungi, obtain energy by consuming wastes and/or dead organisms.

LE 6.1a Energy flows through ecosystems in one direction, usually from the Sun, through producers to consumers and then decomposers. This process may be visualized with food chains or energy pyramids.

LE6.1b Food webs identify feeding relationships among producers, consumers, and decomposers in an ecosystem.

LE6.1c Matter is transferred from one organism to another between organisms and their physical environment. Water, nitrogen, carbon dioxide, and oxygen are examples of substances cycled between the living and nonliving environment.

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.]

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.]*

MS-LS2-4. Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.

[Clarification Statement:

Emphasis is on recognizing patterns in data and making warranted inferences about

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 to MS-LS1-6)
- Cellular respiration in plants and animals involve chemical reactions with oxygen that release stored energy. In these processes, complex molecules containing carbon react with oxygen to produce carbon dioxide and other materials. (secondary to MS-LS1-7)

Science and Engineering Practices (NGSS)

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)
- Develop a model to describe unobservable mechanisms. (MS-LS1-7)

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)

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 knowledge, principles, and theories.

- Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (MS-LS1-6)

Engaging in Argument from Evidence

Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes

LE7.1a A population consists of all individuals of a species that are found together at a given place and time. Populations living in one place form a community. The community and the physical factors with which it interacts compose an ecosystem.

LE7.1b Given adequate resources and no disease or predators, populations (including humans) increase. Lack of resources, habitat destruction, and other factors such as predation and climate limit the growth of certain populations in the ecosystem.

LE7.1c In all environments, organisms interact with one another in many ways. Relationships among organisms may be competitive, harmful, or beneficial. Some species have adapted to be dependent upon each other with the result that neither could survive without the other.

LE7.1d Some microorganisms are essential to the survival of other things.

LE7.1e The environment may contain dangerous levels of substances (pollutants) that are harmful to organisms. Therefore, the good health of environments and individuals requires the monitoring of soil, air, and water, and taking steps to keep them safe.

changes in populations, and on evaluating empirical evidence supporting arguments about changes to ecosystems.]

- claims for either explanations or solutions about the natural and designed world(s).
- Construct an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. (MS-LS2-4)

Connections to Nature of Science

Scientific Knowledge is Based on Empirical Evidence

- Science knowledge is based upon logical connections between evidence and explanations. (MS-LS1-6)
- Science disciplines share common rules of obtaining and evaluating empirical evidence. (MS-LS2-4)

Crosscutting Concepts (NGSS)

Cause and Effect

- Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-LS2-1)

Energy and Matter

- Matter is conserved because atoms are conserved in physical and chemical processes. (MS-LS1-7)
- Within a natural system, the transfer of energy drives the motion and/or cycling of matter. (MS-LS1-6)
- The transfer of energy can be tracked as energy flows through a natural system. (MS-LS2-3)

Stability and Change

- Small changes in one part of a system might cause large changes in another part. (MS-LS2-4)

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)

LE7.2a In ecosystems, balance is the result of interactions between community members and their environment.

LE7.2b The environment may be altered through the activities of organisms. Alterations are sometimes abrupt. Some species may replace others over time, resulting in long-term gradual changes (ecological succession).

LE7.2c Overpopulation by any species impacts the environment due to the increased use of resources. Human activities can bring about environmental degradation through resource acquisition, urban growth, land-use decisions, waste disposal, etc.

LE 7.2d Since the industrial Revolution, human activities have resulted in major pollution of air, water, and soil. Pollution has cumulative ecological effects such as acid rain, global warming, or ozone depletion. The survival of things on our planet depends on the conservation and protection of Earth's resources.