Model Curriculum
Grade 7
Life Science (LS)

Topic: Cycles of Matter and Flow of Energy
This topic focuses on the impact of matter and energy transfer within the biotic component of ecosystems.

Content Statement
Matter is transferred continuously between one organism to another and between organisms and their physical environments.

Plants use the energy in light to make sugars out of carbon dioxide and water (photosynthesis). These materials can be used and immediately stored for later use. Organisms that eat plants break down plant structures to produce the materials and energy they need to survive. Then they are consumed by other organisms.

Energy can transform from one form to another in living things. Animals get energy from oxidizing food, releasing some of its energy as heat.

The total amount of matter and energy remains constant, even though its form and location change.

Note 1: Chemical reactions are presented as the rearrangement of atoms in molecules.

Note 2: Chemical reactions in terms of subatomic structures of atoms are not appropriate.

Content Elaboration
Prior Concepts Related to Cycles of Matter and Flow of Energy
Grades 3-5: Populations of organisms can be categorized by how they acquire energy. Food webs can be used to identify the relationships among organisms. Energy entering ecosystems as sunlight is transferred and transformed by producers into energy that organisms use through the process of photosynthesis. That energy then passes from organism to organism as illustrated in food webs.
Grade 6: Atomic Molecular Theory, Cell Theory and the function of cell organelles, including mitochondria and chloroplast, are studied.

Grade 7 Concepts
The basic concepts for matter and energy flow were introduced in grades 3-5. The grades 3-5 concepts are expanded to include a comparison of photosynthesis and cellular respiration.

The use of light energy to make food is called photosynthesis. The breakdown of food to release the stored energy is called respiration. General formulas are appropriate at this grade level, because atoms and molecules are taught in grade 6. Details of both processes are not grade appropriate. In grade 6, cellular organelles are introduced. It is appropriate to reinforce that the chloroplast (the plant cell organelle that contains chlorophyll) captures the sun's energy to begin the process of converting the energy from the sun into sugars and sugar polymers, such as starch.

As matter is cycled within the environment, it promotes sustainability. The emphasis is not on food webs, but on the transfer of matter and energy between organisms. The total amount of matter and energy remains constant in an ecosystem, even though the form and location undergo continual change. The concept of conservation of matter (introduced in PS grade 4) and conservation of energy are applied to ecosystems. An energy pyramid graphic can illustrate the flow of energy. At each stage in the transfer of energy within an ecosystem, some energy is stored in newly synthesized molecules and some energy is lost into the environment as heat produced by the chemical processes in cells. The elements that make up the molecules of living things are continuously recycled. Energy rich molecules that are passed from organism to organism are eventually recycled by decomposers back into mineral nutrients usable by plants.

	New discoveries, technology and research must be used to connect the concept of energy transfer and transformation within the ecosystem and between ecosystems. For example, the use of biomass as an alternative energy source for the local area can focus on different types of biomass, competition between human food crops and biomass crops, and biomass vs. other types of alternatives to fossil-fuels energy. **Future Application of Concepts** **High School:** The chemical flow of energy during reactions will be explored as the molecular structure of molecules is studied.

Expectations for Learning: Cognitive Demands

This section provides definitions for Ohio's science cognitive demands, which are intrinsically related to current understandings and research about how people learn. They provide a structure for teachers and assessment developers to reflect on plans for teaching science, to monitor observable evidence of student learning, and to develop summative assessment of student learning of science.

Visions into Practice: Classroom Examples

This section provides examples of tasks that students may perform; this includes guidance for developing classroom performance tasks. It is not an all-inclusive checklist of what should be done, but is a springboard for generating innovative ideas.

Designing Technological/ Engineering Solutions using Science Concepts	Demonstrating Science Knowledge	Interpreting and Communicating Science Concepts	Recalling Accurate Science
Ethanol, a plant product, is used in place of fossil fuels. Evaluate the pros and cons of using biomass products such as ethanol vs. traditional fossil fuels. Include in the evaluation anticipated real-world effects for production and usage of biomass products vs. traditional fossil fuels. 	Plan and conduct an investigation to determine what factors impact photosynthesis in plants that live in aquatic environments (Elodea). 	Distinguish between photosynthesis and respiration and illustrate how the two processes are connected. Create a chart that compares the reactants and products of both processes. 	Identify the cellular structures primarily responsible for photosynthesis and respiration. 

Instructional Strategies and Resources

This section provides additional support and information for educators. These are strategies for actively engaging students with the topic and for providing hands-on, minds-on observation and exploration of the topic, including authentic data resources for scientific inquiry, experimentation and problem-based tasks that incorporate technology and technological and engineering design. Resources selected are printed or Web-based materials that directly relate to the particular Content Statement. It is not intended to be a prescriptive list of lessons.

- The Annenberg Media series *Essential Science for Teachers: Life Science: Session 8* provides examples of material cycling in an ecosystem while illustrating the difference between the flow of energy and the cycling of materials.

Common Misconceptions

- Weber State University provides a list for misconceptions in biology. Scroll down to Standard I to address misconceptions about energy flow in an ecosystem.

Diverse Learners

Strategies for meeting the needs of all learners including gifted students, English Language Learners (ELL) and students with disabilities can be found at this site. Resources based on the Universal Design for Learning principles are available at www.cast.org.

Classroom Portals

These are windows into the classroom through webcasts, podcasts or video clips to exemplify and model classroom methods of teaching science using inquiry.

A series of case studies of K-8 science classrooms by the Smithsonian and Harvard University can be found at http://www.learner.org/resources/series21.html. Teachers need to sign up to use this free site. The case study *Dotty–Grade 7* provides examples of how to use technology in the science classroom and develop higher-level thinking for science students.

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Model Curriculum
Grade 7
Life Science (LS)

Topic: Cycles of Matter and Flow of Energy
This topic focuses on the impact of matter and energy transfer within the biotic component of ecosystems.

Content Statement
In any particular biome, the number, growth and survival of organisms and populations depend on biotic and abiotic factors.

Biomes are regional ecosystems characterized by distinct types of organisms that have developed under specific soil and climatic conditions.

The variety of physical (abiotic) conditions that exists on Earth gives rise to diverse environments (biomes) and allows for the existence of a wide variety of organisms (biodiversity).

Ecosystems are dynamic in nature; the number and types of species fluctuate over time. Disruptions, deliberate or inadvertent, to the physical (abiotic) or biological (biotic) components of an ecosystem impact the composition of an ecosystem.

Note: Predator-prey and producer-consumer relations are addressed in grade 5.

Content Elaboration
Prior Concepts Related to Forces, Movement and Igneous Environments
PreK-2: Plants and animals have traits that improve their chances of living in different environments. Living things have basic needs, which are met by obtaining materials from the physical environment.
Grades 3-5: Populations of organisms can be categorized by how they acquire energy. Food webs can be used to identify the relationships among organisms. Energy entering ecosystems as sunlight is transferred and transformed by producers into energy that organisms use through the process of photosynthesis. That energy then passes from organism to organism as illustrated in food webs.

Grade 7 Concepts

Biomes are defined by abiotic components of the environment – topography, soil types, precipitation, solar radiation and temperature. Comparing the different biomes found on Earth is the focus of this content statement. Examples of the Earth's biomes include aquatic (freshwater, brackish water and marine water), forest (tropical and temperate), desert (cold and hot), grassland, taiga and tundra. Biomes must be linked to climate zones on a global level by using a variety of maps, models and technology (e.g., remote sensing, satellite images, LANDSAT). This content statement is connected to the ESS middle school content pertaining to global climate patterns.

An ecosystem is composed of linked and fluctuating interactions between biotic and abiotic factors. Given adequate resources and an absence of disease or predators, populations of organisms in ecosystems increase at rapid rates. Finite resources and other factors limit population growth. As one population proliferates, it is held in check by one or more environmental factors (e.g., depletion of food or nesting sites, increased loss to predators, invasion by parasites). If a natural disaster such as a flood or fire occurs, the damaged ecosystem is likely to recover in a succession of stages that eventually results in a system similar to the original one.

Future Application of Concepts
High School: The evolutionary mechanisms that build unity and diversity are studied.

Expectations for Learning: Cognitive Demands
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Visions into Practice: Classroom Examples

This section provides examples of tasks that students may perform; this includes guidance for developing classroom performance tasks. It is not an all-inclusive checklist of what should be done, but is a springboard for generating innovative ideas.

Designing Technological/ Engineering Solutions using Science Concepts	Demonstrating Science Knowledge	Interpreting and Communicating Science Concepts	Recalling Accurate Science
Analyze or critique the impact of Ohio's wetland mitigation plans on a local community or the state as a whole. Include real-world data from the sites in the analysis or critique. Anticipate future trends on the flora and fauna in the ecosystem based upon the real-world data 	Monitor the local environment (e.g., stream, river, construction site) for the impact Ohio's wetland mitigation plans have on water quality (e.g., oxygen levels, pH, phosphorus levels, nitrogen levels) and how the plans will impact living organisms (e.g., algae, diatoms, mussels, insect larvae). 	Trace and explain how matter and energy are transferred through an ecosystem. 	Identify the biotic and abiotic elements of the major biomes and describe how they are connected. 
		Research an endangered species and examine environmental conditions that may contribute to that organism's classification. Determine if any conservation efforts have been employed and document whether or not any efforts have been successful. Use evidence to support responses. 	

Instructional Strategies and Resources

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- Research a biome by monitoring changes in the biotic and abiotic factors of the ecosystem. Have students ask questions about how the habitat has changed over a given period of time (abiotic factors). Ask: *How have those changes impacted living things?* Select an organism and find data on the population. Determine what changes have occurred in that population and provide scientific reasons for those changes. Ask: *What efforts have been employed to protect the population?* WWF for a living planet has resources, data, reports and activities about the health of the world's biomes. NSTA Sci-Links, Missouri Botanical Garden, Freshwater Ecoregions of the World and the World Wildlife Organization provides information and data about the biomes of the world.
- The program One Species at a Time allows an audio tour of the wonders of nature by examining a variety of species around the world through stories. The Encyclopedia of Life and Atlantic Public Media developed this program.
- The Annenberg Media series Habitable Planet explores how changes in populations impact ecosystems. It also shows how data is collected in the field.
- Colorado University has information about how animal population data can be collected in the Arctic with unmanned aircraft.
- Conduct an interactive lab designed to build your own ecosystem and explore the interrelationships between biotic and abiotic factors and their changes.
- Play interactive games to help students become aware of the variety of organisms that exist in the world.
- The Virtual Nature Trail at Penn State New Kensington is an opportunity to observe photos of various species of plants interacting with one another and the environment and examine what changes result due to those interactions.

Common Misconceptions

- Weber State University provides a list for misconceptions in biology. Scroll down to Standard I to address misconceptions about interactions between organisms in an ecosystem.

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