



Biology - Unit 2 - Energy Flow in The Earth System

Unit Focus

In this unit students will explore the interconnected processes of photosynthesis and respiration, and how these processes play a crucial role in the cycle of matter within the biosphere. They will learn how matter is constantly moving and being recycled within ecosystems, and how it is essential for the survival of living organisms. Additionally, students will discover the cyclical nature of matter in contrast to the flow of energy, and how physiological changes in organisms can affect this balance. Through collaborative work, they will develop and revise a model to explain the Feeding Frenzy anchoring phenomenon, and use this model to make predictions about related phenomena. By the end of the unit, students will have a deeper understanding of the essential processes that sustain life on our planet and the delicate balance between matter and energy within ecosystems.

Stage 1: Desired Results - Key Understandings

Standard(s)	Transfer	
<p>Next Generation Science Standards Disciplinary Core Ideas: High School</p> <ul style="list-style-type: none"> Systems of specialized cells within organisms help them perform the essential functions of life. (HS-LS1-1) (HS.LS1.A.1) <p>Performance Expectations: High School Earth and Space Sciences</p> <ul style="list-style-type: none"> Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere. (HS-ESS2-6) <p>Performance Expectations: High School Life Sciences</p> <ul style="list-style-type: none"> Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis. (HSL1-3) Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy. (HS-LS1-7) Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales. (HS-LS2-1) Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales. (HS-LS2-2) Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem. (HS-LS2-6) Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some 	<p><i>Students will be able to independently use their learning to...</i></p> <p>T1 Analyze qualitative and quantitative data to interpret patterns, draw conclusions, and/or make predictions.</p> <p>T2 Create models to explore complex systems, show mastery of key science concepts, and/or develop solutions through creation of a product open to testing and redesign.</p>	
	Meaning	
	Understanding(s)	Essential Question(s)
	<p><i>Students will understand that...</i></p> <p>U1 The coevolution of plants and animals has led to the development of complex plant-animal relationships</p> <p>U2 Plants convert light energy from the sun into stored chemical energy through the process of photosynthesis</p> <p>U3 Unlike the linear flow of energy, the flow of matter is cyclical, and therefore recycled throughout the Earth system.</p>	<p><i>Students will keep considering...</i></p> <p>Q1 How have plants and animals evolved to become interdependent?</p> <p>Q2 Where does the energy in our food come from?</p> <p>Q3 How is matter cycled within the Earth system?</p>
	Acquisition of Knowledge and Skill	
Knowledge	Skill(s)	
<p><i>Students will know...</i></p> <p>K1 Biological influences on organisms within an ecosystem are called biotic factors. These</p>	<p><i>Students will be skilled at...</i></p> <p>S1 Construct a model that compares the interdependent inputs and outputs of matter</p>	

Stage 1: Desired Results - Key Understandings

species, (2) the emergence of new species over time, and (3) the extinction of other species. (HLSL4-5)

Next Generation Science Standards (DCI)

Science: 9

- The process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide plus water into sugars plus released oxygen. (LS1.9.C1)
- As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products. (LS1.9.C3)
- As a result of these chemical reactions, energy is transferred from one system of interacting molecules to another. Cellular respiration is a chemical process in which the bonds of food molecules and oxygen molecules are broken and new compounds are formed that can transport energy to muscles. Cellular respiration also releases the energy needed to maintain body temperature despite ongoing energy transfer to the surrounding environment. (LS1.9.C4)
- Photosynthesis and cellular respiration (including anaerobic processes) provide most of the energy for life processes. (LS2.9.B1)
- Photosynthesis and cellular respiration are important components of the carbon cycle, in which carbon is exchanged among the biosphere, atmosphere, oceans, and geosphere through chemical, physical, geological, and biological processes. (LS2.9.B3)
- Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems. (PS3.9.B2)
- The availability of energy limits what can occur in any system. (PS3.9.B4)
- Although energy cannot be destroyed, it can be converted to less useful forms- for example, to thermal energy in the surrounding environment. (PS3.9.D1)

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- Analyzing: Examining information/data/ evidence from multiple sources to identify possible underlying assumptions, patterns, and relationships in order to make inferences. (POG.1.2)
- Product Creation: Effectively use a medium to communicate important information. (POG.3.2)

can include living (biotic), and nonliving (abiotic)

K2 Plants convert light energy from the sun to stored chemical energy through the process of photosynthesis, where carbon dioxide and water, along with energy from sunlight is used to manufacture carbohydrates and release oxygen as a byproduct

K3 Animals that eat plants liberate the chemical energy stored by plants through the process of cellular respiration, where oxygen is used to help break down carbohydrate molecules and release carbon dioxide as a byproduct

K4 Matter and energy are transferred within the biosphere through complex feeding relationships called food chains

K5 The various amount of matter on the Earth system is fixed, and is recycled throughout the biosphere in various cyclical process such as the oxygen cycle, carbon cycle, water cycle, and nitrogen cycle.

K6 Vocabulary: Adaptive Mechanisms, Biogeochemical Cycles, Chlorophyll, Denitrification, Desiccation, Egested Waste, Homeostasis, Law of Conservation of Energy, N-fixing bacteria, Nitrates, Nitrites, Nitrogen Fixation, Photosynthesis - conceptual and the equation, Potential Energy, Stomata, Transpiration

and the transfer and transformation of energy by photosynthetic organisms with cellular respiration