08_Ecology

Content Area: **Science**
Course(s):
Time Period: **Full Year**
Length: **4-6 weeks**
Status: **Published**

General Overview, Course Description or Course Philosophy

Biology focuses on the diversity, complexity, and interdependence of life on Earth. Students will develop an understanding of how organisms evolve, reproduce, and adapt to their environments. This will include an exploration of how to relate the structure and function of molecules to their role in cell biology and metabolism. Further understanding of evolution and reproduction will be explored through the science of genetics. Knowledge of biodiversity and adaptation will be illustrated through the science of ecology.

OBJECTIVES, ESSENTIAL QUESTIONS, ENDURING UNDERSTANDINGS

- Photosynthesis and cellular respiration (including anaerobic processes) provide most of the energy for life processes.
- Plants or algae form the lowest level of the food web. At each link upward in a food web, only a small fraction of the matter consumed at the lower level is transferred upward, to produce growth and release energy in cellular respiration at the higher level. Given this inefficiency, there are generally fewer organisms at higher levels of a food web. Some matter reacts to release energy for life functions, some matter is stored in newly made structures, and much is discarded. The chemical elements that make up the molecules of organisms pass through food webs and into and out of the atmosphere and soil, and they are combined and recombined in different ways. At each link in an ecosystem, matter and energy are conserved.
- 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.
- A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability.
- The main way that solar energy is captured and stored on Earth is through the complex chemical process known as photosynthesis.
- Much of science deals with constructing explanations of how things change and how they remain stable.

CONTENT AREA STANDARDS

SCI.HS-ESS2-6	Develop a quantitative model to describe the cycling of carbon among the hydrosphere,

	atmosphere, geosphere, and biosphere.
SCI.HS-ESS2-4	Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.
SCI.HS-ESS2-5	Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.
SCI.HS-LS2-5	Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.
SCI.HS-LS2-4	Use a mathematical representation to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.

RELATED STANDARDS (Technology, 21st Century Life & Careers, ELA Companion Standards are Required)

MA.S-ID.A.1	Represent data with plots on the real number line (dot plots, histograms, and box plots).
MA.K-12.4	Model with mathematics.
LA.RI.9-10.1	Accurately cite strong and thorough textual evidence, (e.g., via discussion, written response, etc.) and make relevant connections, to support analysis of what the text says explicitly as well as inferentially, including determining where the text leaves matters uncertain.
LA.RI.9-10.7	Analyze various perspectives as presented in different mediums (e.g., a person's life story in both print and multimedia), determining which details are emphasized in each account.
MA.S-IC.B.6	Evaluate reports based on data.
SCI.HS-ESS2-6	Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.
SCI.HS-LS4-6	Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.
TECH.9.4.12.IML.3	Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions (e.g., S-ID.B.6a., 8.1.12.DA.5, 7.1.IH.IPRET.8).

STUDENT LEARNING TARGETS

Declarative Knowledge

Students will understand that:

- Energy from photosynthesis and respiration drives the cycling of matter and flow of energy under aerobic or anaerobic conditions within an ecosystem.
- Matter flows between organisms and their environment.
- Energy flows from one trophic level to another as well as through the environment.

Procedural Knowledge

Students will be able to:

- Students identify and describe the evidence to construct the explanation, including:
    - All organisms take in matter and rearrange the atoms in chemical reactions.
    - Photosynthesis captures energy in sunlight to create chemical products that can be used as food in cellular respiration.
    - Cellular respiration is the process by which the matter in food (sugars, fats) reacts chemically with other compounds, rearranging the matter to release energy that is used by the cell for essential life processes.
- Students describe how the claims can be expressed as a mathematical relationship in the mathematical representations of the components of an ecosystem.
- Students use the mathematical representation(s) of the food web to:
    - Describe the transfer of matter (as atoms and molecules) and flow of energy upward between organisms and their environment.
    - Identify the transfer of energy and matter between tropic levels.
    - Identify the relative proportion of organisms at each trophic level by correctly identifying producers as the lowest trophic level having the greatest biomass and energy and consumers decreasing in numbers at higher trophic levels.
- Students describe relationships between components of their model, including:
    - The exchange of carbon (through carbon-containing compounds) between organisms and the environment.
    - The role of storing carbon in organisms (in the form of carbon-containing compounds) as part of the carbon cycle.
- Plan and conduct an investigation of the properties of water and its effects on the environment

EVIDENCE OF LEARNING

Formative Assessments

- Checks for understanding during lesson.
- Do Now activities.
- Student-centered questioning and discussion that is facilitated by instructor.
- Exit Tickets.

Summative Assessments

- Exams/Unit Exams.
- Quizzes.
- Laboratory Activities.

RESOURCES (Instructional, Supplemental, Intervention Materials)

Miller & Levine Biology Textbook

- Unit 2 - Ecology
    - Chapter 4 - Ecosystems
        - Video: *Flow of Energy Through Producers and Consumers*
        - Analyzing Data: *Ocean Water and Oxygen Concentration*
        - Interactivity: *Food Web*
        - Animation: *The Water Cycle*
        - Case Study: *The Nitrogen Cycle*
        - Exploration Lab: *The Effect of Fertilizer on Algae*

POGIL Biology

- Energy Transfer in Living Organisms
- Ecological Pyramids
- Nutrient Cycle

Gizmos

- Carbon Cycle
- Cell Energy Cycle

Brainpop

NSTA

Data Nuggets

INTERDISCIPLINARY CONNECTIONS

ELA/Literacy

Mathematics

Technology

Earth Science

ACCOMMODATIONS & MODIFICATIONS FOR SUBGROUPS

See link to Accommodations & Modifications document in course folder.