Unit 4: Matter and Energy in Organisms and Ecosystems

Content Area: **Science**
Course(s): **Biology/Lab Honors**
Time Period: **2nd Marking Period**
Length: **6 Weeks**
Status: **Published**

Unit Overview

The role of energy in the cycling of matter is essential to the health of organisms and their ecosystems.

Transfer

Students will be able to independently use their learning to...

-Relate the roles of photosynthesis and cellular respiration.

-Explain the flow of energy through an ecosystem.

For more information, read the following article by Grant Wiggins.

http://www.authenticeducation.org/ae_bigideas/article.lasso?artid=60

Meaning

Understandings

Students will understand that...

-Biological molecules are recycled within ecosystems.

-Energy flows through trophic levels in an ecosystem.

Essential Questions

Students will keep considering...

-How do organisms obtain and use energy they need to live and grow?

-How do matter and energy move through ecosystems?

Application of Knowledge and Skill

Students will know...

Students will know...

-Photosynthesis produces carbohydrates and releases oxygen into the atmosphere.

-Carbohydrates are broken down into their atoms to recombine to form other carbon molecules.

-Cellular respiration is the breakdown of glucose for energy.

-Energy transfer among organisms is not 100% efficient.

-Biogeochemical cycles are essential to the wellbeing of the ecosystem.

Students will be skilled at...

Students will be skilled at...

-Describing the relationship between photosynthesis and cellular respiration.

-Explaining the loss of energy among trophic levels.

-Illustrating the cycle of essential organic molecules within an ecosystem.

Academic Vocabulary

photosynthesis

heterotroph

autotroph

biochemical pathway

cellular respiration

adenosine triphosphate

light reactions

thylakoid

grana

stroma

chloroplast

chlorophyll

accessory pigments

carotenoids

photosystems

electron transport chain

chemiosmosis

ATP synthase

adenosine diphosphate

calvin cycle/ dark reactions

carbon fixation

stomata

glycolysis

fermentation

anaerobic respiration

aerobic respiration

lactic acid fermentation

alcohol fermentation

pyruvic acid

Krebs cycle

mitochondrial matrix

cristae

mitochondria

ecology

biosphere

ecosystem

community

population

organism

habitat

abiotic factors

biotic factors

tolerance curve

acclimation

conformers

regulators

dormancy

migration

resources

niche

chemosynthesis

biomass

gross primary productivity

net primary productivity

herbivores

carnivores

omnivores

detritivores

decomposers

trophic level

food chain/web

biogeochemical cycle

evaporation

transpiration

precipitation

nitrogen fixation

Learning Goal 1

Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.

Proficiency Scale

SCI.HS-LS1-5	Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.

Target 1

SWBAT:

-Describe the structure of a chloroplast.

-Identify the steps of the light reaction.

-Identify the steps of the dark reaction.

-Identify the products and reactants of photosynthesis.

-Investigate how environmental factors influence photosynthesis.

-Relate the structure of the cell membrane to its role during the light and dark reactions.

- -Describe the structure of a chloroplast.
- -Identify the products and reactants of photosynthesis.
- -Identify the steps of the dark reaction.
- -Identify the steps of the light reaction.
- -Investigate how environmental factors influence photosynthesis.
- -Relate the structure of the cell membrane to its role during the light and dark reactions.

Further Inquiry

The molecule preceding the electron transport chains of photosystem I and II is an electron acceptor. What is the original molecule that is the electron donor for both of these systems? How would the light reactions be affected if there were no concentration gradient of protons across the thylakoid membrane?

Learning Goal 2

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.

Proficiency Scale

SCI.HS-LS1-7	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.

Target 1

SWBAT:

-Describe the structure of the mitochondria.

-Identify the steps of glycolysis.

-Identify the steps of anaerobic respiration.

-Identify the steps of aerobic respiration.

-Identify the products and reactants of cellular respiration.

-Differentiate between the ATP production of anaerobic versus aerobic respiration.

-Compare the structures of prokaryotic and eukaryotic cells as it relates to the types of cellular respiration.

- -Compare the structures of prokaryotic and eukaryotic cells as it relates to the types of cellular respiration.
- -Describe the structure of the mitochondria.
- -Differentiate between the ATP production of anaerobic versus aerobic respiration.
- -Identify the products and reactants of cellular respiration.
- -Identify the steps of aerobic respiration.
- -Identify the steps of anaerobic respiration.
- -Identify the steps of glycolysis.

Further Inquiry

Sometimes protons leak out of a cell or are used for purposes other than ATP production. How would this affect the production of ATP in aerobic respiration?

Learning Goal 3

Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere and geosphere.

Proficiency Scale

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.

Target 1

SWBAT:

-Define biosphere, atmosphere, hydrosphere and geosphere.

-Relate the products and reactants of photosynthesis and cellular respiration.

-Hypothesize the effects of human impact on biogeochemical cycles.

-Summarize the recycling of key elements within the biogeochemical cycles.

- -Define biosphere, atmosphere, hydrosphere and geosphere.
- -Hypothesize the effects of human impact on biogeochemical cycles.
- -Relate the products and reactants of photosynthesis and cellular respiration.
- -Summarize the recycling of key elements within the biogeochemical cycles.

Further Inquiry

When the sun's rays are blocked by a thick forest, clouds, or smoke from a large fire, what effect do you think there will be on photosynthesis? How might it affect the levels of atmospheric carbon dioxide and oxygen?

Learning Goal 4

Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.

Proficiency Scale

SCI.HS-LS2-3	Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.

Target 1

SWBAT:

-Identify conditions necessary for aerobic or anaerobic respiration.

-Describe the advantage of aerobic respiration compared to anaerobic respiration.

-Investigate environmental factors that influence anaerobic and aerobic respiration.

-Relate the type of cellular respiration to its complexity.

- -Describe the advantage of aerobic respiration compared to anaerobic respiration.
- -Identify conditions necessary for aerobic or anaerobic respiration.
- -Investigate environmental factors that influence anaerobic and aerobic respiration.
- -Relate the type of cellular respiration to its complexity.

Further Inquiry

In what kind of environment would you expect to find organisms that carry out fermentation?

Learning Goal 5

Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.

Proficiency Scale

SCI.HS-LS2-4	Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.

Target 1

SWBAT:

-Identify the energy needs within an ecosystem and the energy transfer among trophic levels.

-Explain the movement of carbon, nitrogen and phosphorus within their cycles.

-Explain the interdependence of organisms within food webs.

-Analyze an energy pyramid and hypothesize why the energy transfer is not 100% efficient.

-Analyze the energy transfer among organisms within trophic levels.

- -Analyze an energy pyramid and hypothesize why the energy transfer is not 100% efficient.
- -Analyze the energy transfer among organisms within trophic levels.
- -Explain the interdependence of organisms within food webs.

- -Explain the movement of carbon, nitrogen and phosphorus within their cycles.
- -Identify the energy needs within an ecosystem and the energy transfer among trophic levels.

Further Inquiry

Explain why the same area can support a greater number of herbivores than carnivores.

Formative Assessment and Performance Opportunities

-Science notebook

-Homework assignments

-Classwork assignments

-Lab activities/explorations

-Quizzes, Tests, Projects

-Unit Test Open-ended Response

Summative Assessment

Common unit assessment aligned to the NJSLS and differentiated for varied learners.

Common Assessments are administered through LinkIt.

Accommodations/Modifications

-504 accomodations

-IEP modifications

-Science notebook entries

-Videos, models, posters

Ex:

- provide students access to formulas for photosynthesis and cellular respiration
- demonstrate the products of each biochemical process

- demonstrate how to build a food web

Unit Resources

-Holt Modern Biology 2009

-Supplemental textbook materials

-Online resources

-Laptops

-Student Response Systems

-Lab materials

-POGIL: Activities for HS Biology

21st Century Life and Careers

CRP.K-12.CRP1.1	Career-ready individuals understand the obligations and responsibilities of being a member of a community, and they demonstrate this understanding every day through their interactions with others. They are conscientious of the impacts of their decisions on others and the environment around them. They think about the near-term and long-term consequences of their actions and seek to act in ways that contribute to the betterment of their teams, families, community and workplace. They are reliable and consistent in going beyond the minimum expectation and in participating in activities that serve the greater good.
CRP.K-12.CRP2.1	Career-ready individuals readily access and use the knowledge and skills acquired through experience and education to be more productive. They make connections between abstract concepts with real-world applications, and they make correct insights about when it is appropriate to apply the use of an academic skill in a workplace situation.
CRP.K-12.CRP4.1	Career-ready individuals communicate thoughts, ideas, and action plans with clarity, whether using written, verbal, and/or visual methods. They communicate in the workplace with clarity and purpose to make maximum use of their own and others' time. They are excellent writers; they master conventions, word choice, and organization, and use effective tone and presentation skills to articulate ideas. They are skilled at interacting with others; they are active listeners and speak clearly and with purpose. Career-ready individuals think about the audience for their communication and prepare accordingly to ensure the desired outcome.

CRP.K-12.CRP5.1	Career-ready individuals understand the interrelated nature of their actions and regularly make decisions that positively impact and/or mitigate negative impact on other people, organization, and the environment. They are aware of and utilize new technologies, understandings, procedures, materials, and regulations affecting the nature of their work as it relates to the impact on the social condition, the environment and the profitability of the organization.
CRP.K-12.CRP6.1	Career-ready individuals regularly think of ideas that solve problems in new and different ways, and they contribute those ideas in a useful and productive manner to improve their organization. They can consider unconventional ideas and suggestions as solutions to issues, tasks or problems, and they discern which ideas and suggestions will add greatest value. They seek new methods, practices, and ideas from a variety of sources and seek to apply those ideas to their own workplace. They take action on their ideas and understand how to bring innovation to an organization.
CRP.K-12.CRP7.1	Career-ready individuals are discerning in accepting and using new information to make decisions, change practices or inform strategies. They use reliable research process to search for new information. They evaluate the validity of sources when considering the use and adoption of external information or practices in their workplace situation.
CRP.K-12.CRP8.1	Career-ready individuals readily recognize problems in the workplace, understand the nature of the problem, and devise effective plans to solve the problem. They are aware of problems when they occur and take action quickly to address the problem; they thoughtfully investigate the root cause of the problem prior to introducing solutions. They carefully consider the options to solve the problem. Once a solution is agreed upon, they follow through to ensure the problem is solved, whether through their own actions or the actions of others.
CRP.K-12.CRP9.1	Career-ready individuals consistently act in ways that align personal and community-held ideals and principles while employing strategies to positively influence others in the workplace. They have a clear understanding of integrity and act on this understanding in every decision. They use a variety of means to positively impact the directions and actions of a team or organization, and they apply insights into human behavior to change others' action, attitudes and/or beliefs. They recognize the near-term and long-term effects that management's actions and attitudes can have on productivity, morals and organizational culture.
CRP.K-12.CRP12.1	Career-ready individuals positively contribute to every team, whether formal or informal. They apply an awareness of cultural difference to avoid barriers to productive and positive interaction. They find ways to increase the engagement and contribution of all team members. They plan and facilitate effective team meetings.