

Course: Biology  
Unit #2: Life Processes and Energy Transfer

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Curriculum Team Members: Kellie Balkus ([kbalkus@lrhsd.org](mailto:kbalkus@lrhsd.org)), Leanne DeBlieu ([ldeblieu@lrhsd.org](mailto:ldeblieu@lrhsd.org)), Amanda Fitchett ([afitchett@lrhsd.org](mailto:afitchett@lrhsd.org)), Mary Pallis ([mpallis@lrhsd.org](mailto:mpallis@lrhsd.org)), Darcy Roth ([droth@lrhsd.org](mailto:droth@lrhsd.org))

### Stage One - Desired Results

Link(s) to New Jersey Student Learning Standards for this course:

<https://www.state.nj.us/education/cccs/2016/science/HS-LS1.pdf>  
<https://www.state.nj.us/education/cccs/2016/science/HS-LS2.pdf>  
<https://www.state.nj.us/education/cccs/2016/science/HS-LS3.pdf>  
<https://www.state.nj.us/education/cccs/2016/science/HS-LS4.pdf>

Unit Standards:

#### **NJ Student Learning Standards**

- HS-LS1-3. Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.**  
[Clarification Statement: Examples of investigations could include heart rate response to exercise, stomate response to moisture and temperature, and root development in response to water levels.] [Assessment Boundary: Assessment does not include the cellular processes involved in the feedback mechanism.]
- HS-LS1-5. Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.**  
[Clarification Statement: Emphasis is on illustrating inputs and outputs of matter and the transfer and transformation of energy in photosynthesis by plants and other photosynthesizing organisms. Examples of models could include diagrams, chemical equations, and conceptual models.] [Assessment Boundary: Assessment does not include specific biochemical steps.]
- HS-LS1-6. Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.** [Clarification Statement: Emphasis is on using evidence from models and simulations to support

explanations.] *[Assessment Boundary: Assessment does not include the details of the specific chemical reactions or identification of macromolecules.]*

- 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.** [Clarification Statement: Emphasis is on the conceptual understanding of the inputs and outputs of the process of cellular respiration.] *[Assessment Boundary: Assessment should not include identification of the steps or specific processes involved in cellular respiration]*
- 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.** [Clarification Statement: Emphasis is on conceptual understanding of the role of aerobic and anaerobic respiration in different environments.] *[Assessment Boundary: Assessment does not include the specific chemical processes of either aerobic or anaerobic respiration.]*
- CRP5. Consider the environmental, social and economic impacts of decisions.** 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.
- CRP6. Demonstrate creativity and innovation.** 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.
- CRP7. Employ valid and reliable research strategies.** 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.
- CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.** 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

**9.3.12.AG-NR.1 Plan and conduct natural resource management activities that apply logical, reasoned and scientifically based solutions to natural resource issues and goals.**

**9.3.12.AG-NR.2 Analyze the interrelationships between natural resources and humans.**

**9.3.12.AG-PL.1 Develop and implement a crop management plan for a given production goal that accounts for environmental factors.**

**Transfer Goal(s):** Students will be able to independently use their learning to determine how living things obtain, transfer, and utilize energy at the cellular level to make predictions on interdependence within a system and/or organisms.

*Enduring Understandings*

Students will understand that . . .

EU1

single celled and/or multicellular organisms work to maintain homeostasis

EU2

the survival of organisms is affected by interactions with each other and their environment, and can be altered by human manipulation.

EU3

both matter and energy are necessary to build and maintain structures within the organism.

*Essential Questions*

EU1

- How do cells get what they need?
- Why is it important for living organisms to maintain internal balance?
- How do multicellular organisms work together to maintain homeostasis?

EU2

- How are organisms dependent on each other?
- How do earth's living and non-living entities interact and affect the survival of organisms?
- How does the addition or removal of a species affect the flow of energy within an ecosystem?
- How does a human's ecological footprint play a role in altering an ecosystem?

EU3

- Where does energy come from and how do our cells/systems get it?

	<ul style="list-style-type: none"> <li>• What is the relationship between photosynthesis and cellular respiration?</li> <li>• How do organisms transfer and convert energy from one to another?</li> </ul>
<p><i>Knowledge</i> Students will know. . .</p> <p>EU1</p> <ul style="list-style-type: none"> <li>• feedback mechanisms maintain a living system’s internal conditions.</li> <li>• cells are able to import and export materials in a variety of ways.</li> <li>• cellular transport is the means by which homeostasis and cellular efficiency is maintained.</li> <li>• feedback mechanisms can encourage (through positive feedback) or discourage (through negative feedback) what is going on inside the living system.</li> </ul> <p>EU2</p> <ul style="list-style-type: none"> <li>• biological communities in ecosystems are based on stable interrelationships and interdependence of organisms.</li> <li>• producers utilize the sun’s energy to create the foundation of every ecosystem.</li> <li>• only a portion of usable energy is transferred from one trophic level to the next trophic level within a system.</li> </ul> <p>EU3</p> <ul style="list-style-type: none"> <li>• plants have the capability to absorb energy from light and store it in sugar molecules by bonding together carbon, hydrogen, and oxygen (from water and carbon dioxide) in a set ratio.</li> <li>• in both plant and animal cells, sugar is a source of energy and can be used to make other carbon-containing (organic) molecules.</li> </ul>	<p><i>Skills</i> Students will be able to. . .</p> <p>EU1</p> <ul style="list-style-type: none"> <li>• plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis. HS-LS1-3</li> <li>• demonstrate cellular transport mechanisms of different substances within a cell. HS-LS1-3</li> </ul> <p>EU2</p> <ul style="list-style-type: none"> <li>• analyze the interrelationships and interdependencies among different organisms, and explain how these relationships contribute to the stability of the ecosystem. HS-LS1-7; HS-LS2-5</li> <li>• construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions. HS-LS2-3</li> </ul> <p>EU3</p> <ul style="list-style-type: none"> <li>• explain how environmental factors using models (such as temperature, light intensity, and the amount of water available) can affect photosynthesis as an energy storing process. <b>HS-LS1-6; HS-LS2-3; HS-LS-1-5</b></li> <li>• use molecular models to investigate and describe the complementary relationship (cycling of matter and flow of energy) between photosynthesis and cellular respiration.</li> </ul>

- all organisms must break the high-energy chemical bonds in food molecules during cellular respiration to obtain the energy needed for life processes.

- **HS-LS1-7**  
explain how the process of cellular respiration is similar to the burning of fossil fuels. **HS-LS1-6; HS-LS2-3**

## Stage Two - Assessment

### Other Evidence:

- Tests
- Quizzes
- Evaluation of Data Collected by Experimentation
- Evaluation of Data from Prepared Prompts
- Lab Reports
- Class Discussions
- Teacher-monitored Peer Tutoring
- Microscope Use Evaluation
- Creation of a Food Web Using Pre-set Parameters

## Stage Three - Instruction

Learning Plan: **Suggested Learning Activities to Include Differentiated Instruction and Interdisciplinary Connections: Each learning activity listed must be accompanied by a learning goal of A= Acquiring basic knowledge and skills, M= Making meaning and/or a T= Transfer.**

- **PHENOMENON:** Add sugar cubes then tea bags to beakers of cold vs. hot water and have students explain the results.  
(A/M) (EU1)
  - Discussion on the question, "How do cells maintain homeostasis?" to include: (A)
    - Chemistry of lipids
    - Cellular transport

- Functions of cellular transport organelles used to maintain homeostasis
- Lab activity: Use model kits to build monomers and polymers of lipids (M)
- Lab activity: Use microscope to observe osmosis in red onion cells and also view cell walls, cell membranes, central vacuoles (M)
- Lab activity: Use microscope to view pseudopods, food vacuoles, and contractile vacuoles in amoeba and paramecium (M)
  
- **PHENOMENON:** Show a food chain then a food web and have students explain the significance of these. (A/M) (EU2)
  - Discussion on the question, “How do organisms within an ecosystem rely on each other to transfer energy?” to include: (A)
    - Food webs
    - Biomass and energy pyramids
  - Lab activity: Construct, share, and analyze food webs (may use pine barrens as target ecosystem) (M/T)
  
- **PHENOMENON:** Germinate radish seeds in light vs dark and explain the results (A/M) (EU3)
  - Discussion on the question, “How does energy enter and flow through ecosystems?” to include the chemistry of carbohydrates (A)
  - Lab activity: Use the reactants of photosynthesis ( $\text{CO}_2$ ,  $\text{H}_2\text{O}$ ) to build carbohydrates using model kits (M)
  
- **PHENOMENON:** Where did the mass of General Sherman (the largest tree in the world), come from? (A/M) (EU3)
  - Discussion on the question, “How do plants and other photosynthetic organisms convert solar energy to food energy?” to include (A)
    - ATP cycle (ADP to ATP stores energy) (ATP to ADP releases energy)
    - Mass of organisms comes from carbon dioxide (carbon based life / organic molecules)
    - Photosynthesis

- What goes in? (CO<sub>2</sub>, H<sub>2</sub>O, sunlight)
- What comes out? (organic compounds, O<sub>2</sub>)
- Discuss the organelles/plant parts in terms of photosynthesis
- Lab activity: Use microscope to view chloroplasts, central vacuoles, chromoplasts, leucoplasts in euglena, elodea, tomato, potato (M)
- Lab activity: Expose plants to various conditions to determine the effects on the rate of photosynthesis (M)
  
- **PHENOMENON:** Add sugar to one of two test tubes of yeast and explain the results. (A/M) (EU3)
  - Discussion on the question, “How do all organisms convert food energy to cell energy (ATP)?” to include: (A)
    - Cell Respiration (aerobic and anaerobic)
    - What goes in? (glucose, O<sub>2</sub>, H<sub>2</sub>O)
    - What comes out? (CO<sub>2</sub>, H<sub>2</sub>O, ATP)
    - Fermentation (lactic acid, alcoholic)
  - Discuss the following organelle in terms of cellular respiration
    - Mitochondria
  - Lab activity: Measure/Observe the amount of carbon dioxide produced by respiration using bromothymol blue (M)
  - Data Evaluation: Using the NJ Performance Assessment Alliance’s “What’s Killing the Fish?” student prompt, students will graph and evaluate data then propose a solution to the problem of dead fish caused by eutrophication in a lake.