Biology: Matter and Energy in Organisms and Ecosystems

Stage 1 Desired Results

ESTABLISHED GOALS:

Competencies:

- **Energy & Matter in Systems::** Students will demonstrate the ability to analyze evidence from a variety of sources (investigations, models) to predict, connect and/or evaluate the cycling of matter and flow of energy within and between systems in order to understand, describe, or predict possibilities and limitations of systems.
- **Stability & Change in Systems:** Students will demonstrate the ability to investigate and analyze static and dynamic conditions of natural and human designed systems in order to explain and predict changes over time.
- **Nature of Science:** Student will demonstrate the ability to work collaboratively and individually to generate testable questions or define problems, plan and conduct investigations using a variety of research methods in a various settings, analyze and interpret data, reason with evidence to construct explanations in light of existing theory and previous research, and effectively communicate the research processes and conclusions.
- ***Students will demonstrate the ability to analyze and summarize text and integrate knowledge to make meaning of discipline-specific materials.***
- ***Students will demonstrate the ability to produce coherent and supported writing in order to communicate effectively for a range of discipline-specific tasks, purposes, and audiences.***
- ***Students will demonstrate the ability to speak purposefully and effectively by strategically making decisions about content, language use, and discourse style.***

Content Standards:

- HS-LS1-5. Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.
- 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.
- 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.
- HS-LS2-3. Construct and revise an explanation based on evidence

Transfer

*Students will be able to independently use their learning to **make informed decisions and act responsibly based upon their knowledge of inter-related biological systems.***

Meaning

ENDURING UNDERSTANDINGS

Students will understand that…

- models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales.
- changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system.
- energy cannot be created or destroyed—it only moves between one place and another place, between objects and/or fields, or between systems.
- energy drives the cycling of matter within and between systems.

ESSENTIAL QUESTIONS

- *Which is more important, photosynthesis or respiration?*
- *Is there a class of biological molecule that is more important than any other class of biomolecule?*
- *Why is it important that living things be able to adjust their energy metabolism?*

for the cycling of matter and flow of energy in aerobic and anaerobic conditions. • HS-LS2-4. Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem. • 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.	***Acquisition***	
	Students will know… • that the main way that solar energy is captured and stored on Earth is through the complex chemical process known as photosynthesis. • that the process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide plus water into sugars plus released oxygen. • that as matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products. • that the sugar molecules thus formed contain carbon, hydrogen, and oxygen: their hydrocarbon backbones are used to make amino acids and other carbon-based molecules that can be assembled into larger molecules (such as proteins or DNA), used for example to form new cells. • that 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. • that photosynthesis and cellular respiration (including anaerobic processes) provide most of the energy for life processes. -that plants or algae form the lowest level of a 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 a 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 energy is stored in newly	*Students will be skilled at…* • developing and using models. • constructing and revising explanations based on evidence. • using mathematical representations to support claims.

	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 is conserved. *vocabulary:* photon, electron, lumen, granum, stroma, thylakoid, inner membrane layer, outer membrane layer, photosynthesis, chloroplast, chlorophyll, glucose, oxygen, water, carbon dioxide, solar energy, cellular respiration, mitochondria, ATP, fermentation, aerobic, ecological efficiency (10% rule), producer, consumer (primary, secondary, tertiary), autotroph, heterotroph, herbivore, carnivore, detrivore, decomposer, omnivore, predator, prey, host, parasitism, mutualism, commensalism, symbiosis. anaerobic, NADH, carbohydrate, lipid, protein, nucleic acid, ethyl alcohol, lactic acid,	

Content Area Literacy Standards	***21st Century Skills***
• RST.9-10.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. • RST.9-10.2 Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text. • RST.9-10.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text. • RST.9-10.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 9-10 texts and topics*. • RST.9-10.5 Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., *force, friction, reaction force, energy*). • RST.9-10.7 Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. • RST.9-10.8 Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem. • RST.9-10.9 Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts. • WHST.9-10.1 Write arguments focused on *discipline-specific content*. • WHST.9-10.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. • WHST.9-10.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.	• *use systems thinking* • *communicating clearly* • *collaborating with others* • *accessing and evaluating information* • *managing goals and time*

• WHST.9-10.5 Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience. • WHST.9-10.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. • WHST.9-10.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation. • WHST.9-10.9 Draw evidence from informational texts to support analysis, reflection, and research.	

Stage 2 - Evidence

Evaluative Criteria	*Assessment Evidence*
	PERFORMANCE TASK(S):
	OTHER EVIDENCE:

Stage 3 – Learning Plan

Summary of Key Learning Events and Instruction

Language Arts Integration	*Mathematics Integration*
•	• **HSN-Q.A.1** - Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays • **HSN-Q.A.2** - Define appropriate quantities for the purpose of descriptive modeling • **HSN-Q.A.3** - Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. • **MP.2** - Reason abstractly and quantitatively. • **MP.4** - Model with mathematics.
Technology Integration	***District Materials***

Science and Engineering Practices	
S&EP 2. Developing and using models S&EP 4. Analyzing and interpreting data S&EP 6. Constructing explanations (for science) and designing solutions (for engineering) S&EP 7. Engaging in argument from evidence S&EP 8. Obtaining, evaluating, and communicating information	