Photosynthesis and Cellular Respiration Kit for General Biology

Next Generation Science Standards* Alignment

The following table lists the Next Generation Science Standards Performance Expectations as well as the Science and Engineering Practices, Disciplinary Core Ideas, and Crosscutting Concepts that are addressed by the activities included in the Photosynthesis and Cellular Respiration Kit for General Biology. The table also provides details on how the activities align with those elements.

Standards	Description	Photosynthesis and Cellular Respiration Kit for General Biology Alignment Details	Lessons 1	Lessons 2	Lessons 3	Post-lab Questions
Performance Expectations			✓	✓	✓	✓
HS-LS1-5	Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.	Students create and revise successive models based on student-collected evidence to illustrate the process of photosynthesis in algae beads. Models include the basic inputs and outputs of photosynthesis and how those correspond to the inputs and outputs of cellular respiration.	✓	✓	✓	✓
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.	Students create and revise successive models based on student-collected evidence to illustrate the process of cellular respiration in algae beads. Models include the basic inputs and outputs of cellular respiration and how those correspond to the inputs and outputs of photosynthesis.	✓	✓	✓	✓

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General Biology: Curriculum Alignment

NGSS Dimension	Description	Photosynthesis and Cellular Respiration Kit for General Biology Alignment Details	Lessons 1	Lessons 2	Lessons 3	Post-Lab Questions
Science and Engineering Practices			✓	✓	✓	✓
Developing and Using Models	Develop and/or use a model based on evidence to illustrate the relationships between systems of between components of a system.	In each lesson students create or revise their previous models based on new evidence to illustrate photosynthesis and cellular respiration in algae beads and the connections between the processes. Students will use their models to make predictions.	✓	✓	✓	✓
Planning and Carrying out Investigations	Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g. number of trials, cost, risk, time), and refine the design accordingly.	After developing investigation questions, students will design their own experiment using algae beads to collect evidence to answer their questions.		✓	✓	
Constructing Explanations and Designing Solutions	Construct and/or revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.	Following observation of a simple pH indicator color change, students collaborate to explain the cause. After collecting data from their own experiments, students develop scientific explanations for their experimental questions.	✓		✓	✓
Engaging in Argument from Evidence	Evaluate the claims, evidence, and reasoning behind currently accepted explanations of solutions to determine the merits of arguments.	Students generate explanations for the results of their experiments and review the explanations of other groups.			✓	
Asking Questions and Defining Problems	Ask questions that arise from examining models or a theory to clarify relationships.	Students ask basic questions and develop investigation questions about how algae beads can be used to measure photosynthesis and cellular respiration.		✓		
Disciplinary Core Ideas			✓	✓	✓	✓
LS1.C: Organization for Matter and Energy Flow in Organisms	The process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide plus water into sugars plus released oxygen. As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products 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.	Students explain the color changes of a pH indicator in the presence of algae beads in terms of the basic inputs and outputs of photosynthesis and cellular respiration. Students make connections between these two processes and design experiments using algae beads to further investigate the effects of different conditions.	✓	✓	✓	✓
LS2.B: Cycles of Matter and Energy Transfer in Ecosystems	Photosynthesis and cellular respiration (including anaerobic processes) provide most of the energy for life processes. Photosynthesis and cellular respiration are important components of the carbon cycle, in which carbon is exchanged among the biosphere, atmosphere, ceans, and geosphere through chemical, physical, geological, and biological processes.	Students link the inputs and outputs of photosynthesis and cellular respiration which includes cycling of carbon in multiple forms. Students develop models during a post-lab activity to illustrate the cycling of matter and energy between autotrophs and heterotrophs in a closed system.	✓	✓	✓	✓

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Crosscutting Concepts			✓	✓	✓	✓
Cause and Effect	Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.	Students must justify their claims based on the evidence they have collected in their experiments. The instructor has the opportunity to discuss the differences between correlation and causation.	✓		✓	
Energy and Matter	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.	As a class and in groups, students identify the inputs and outputs of photosynthesis and cellular respiration and how they are linked. Students use their understanding of conservation of energy and matter to interpret the results of their experiments.	✓	✓	✓	✓
Systems and System Models	Models (e.g., physical, mathematical, computer) can be used to simulate systems and interactions — including energy, matter, and information flows--within and between systems at different scales.	Students generate models to illustrate their observations and understanding of the inputs and outputs of photosynthesis and cellular respiration.	✓	✓	✓	✓