Biology Unit 3 - Photosynthesis & Respiration

Content Area: **Science**
Course(s): **Biology**
Time Period: **MP2**
Length: **30 days**
Status: **Published**

NJSLS - Science

SCI.HS-LS1-2	Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
SCI.HS-LS1-3	Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.
SCI.HS-LS1-5	Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.
SCI.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.
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.
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.
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-ETS1-2	Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

Science and Engineering Practices

Developing and Using Models

Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-LS1-2)

Use a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-LS1- 5), (HS-LS1-7)

Develop a model based on evidence to illustrate the relationships between systems or components of a system. (HS-LS2-5)

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. (HS-LS1-3)

Constructing Explanations and Designing Solutions

Construct and 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. (HS-LS1-6), (HS-LS2-3)

Design a solution to a complex real-world problem, based on scientific knowledge, student generated sources of evidence, prioritized criteria, and trade off considerations. (HS-ETS1-2)

Scientific Investigations Use a Variety of Methods

Scientific inquiry is characterized by a common set of values that include: logical thinking, precision, open-mindedness, objectivity, skepticism, replicability of results, and honest and ethical reporting of findings. (HS-LS1-3)

Scientific Knowledge is Open to Revision in Light of New Evidence

- Most scientific knowledge is quite durable, but is, in principle, subject to change based on new evidence and/or reinterpretation of existing evidence. (HS-LS2-3)

Disciplinary Core Ideas

LS1.A: Structure and Function

Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level. (HS-LS1-2)

Feedback mechanisms maintain a living system's internal conditions within certain limits and mediate behaviors, allowing it to remain alive and functional even as external conditions change within some range. Feedback mechanisms can encourage (through positive feedback) or discourage (negative feedback) what is going on inside the living system. (HS-LS1-3)

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. (HS-LS1-5)

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. (HS-LS1-6)

As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products. (HS-LS1-6), (HS-LS1-7)

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. (HS-LS1-7)

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. (HS-LS2-3)

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. (HS-LS2-5)

ETS1.C: Optimizing the Design Solution

Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade offs) may be needed. (HS-ETS1-2)

Crosscutting Concepts

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. (HS-LS1-5), (HS-LS1-6)

Energy cannot be created or destroyed—it only moves between one place and another place, between objects

and/or fields, or between systems. (HS-LS1-7)

Energy drives the cycling of matter within and between systems. (HS-LS2-3)

Stability and Change

Feedback (negative or positive) can stabilize or destabilize a system. (HS-LS1-3)

Scientific Investigations Use a Variety of Methods

Scientific inquiry is characterized by a common set of values that include: logical thinking, precision, open-mindedness, objectivity, skepticism, replicability of results, and honest and ethical reporting of findings.(HSLS1-2), (HS-LS1-3)

Systems and System Models

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. (HS-LS1-2), (HS-LS2-5)

Rationale and Transfer Goals

Early in this unit, students examine biogeochemical cycles and how chemical elements are cycled. Building on this knowledge, students will investigate how carbon compounds are exchanged among biosphere, atmosphere, oceans, and geosphere through chemical, physical, geological, and biological processes such as photosynthesis and cellular respiration. Students will learn how photosynthesis (the main way that solar energy is captured and stored on Earth) and cellular respiration are important components of the carbon cycle, in which carbon is exchanged between living and nonliving systems.

Enduring Understandings

- Students will learn about the carbon cycle and its significance in cycling matter throughout a changing ecosystem.
- Model photosynthesis and cellular respiration as complementary processes that cycle energy and matter.

- Contrast the flow of matter and energy in aerobic and anaerobic environments.

Essential Questions

How can an isolated ecosystem sustain life and maintain a cycling of matter/energy? 12 years in isolation .

Can algae be a food source that reduces our greenhouse emissions?
https://thewonderofscience.com/phenomenon/2018/6/10/algae-fuel-and-food

Content - What will students know?

- Carbon cycle
- Organelles involved in photosynthesis & respiration
- Leaf structure and function
- photosynthesis
- respiration
- aerobic/anaerobic respiration

Skills - What will students be able to do?

- Diagram the carbon cycle in an ecosystem.
- Identify and describe organelles found in eukaryotes (emphasis on chloroplast and mitochondria).
- How is a leaf designed to absorb sunlight, CO2, and water, while releasing ATP and O2?
- Compare and contrast light dependent and independent reactions.
- Describe the stages of aerobic cellular respiration.
- Contrast aerobic and anaerobic respiration.

Activities - How will we teach the content and skills?

- Students will draw and label the carbon cycle.
- Students will illustrate photosynthesis and respiration within a plant cell.
- Conduct leaf chromatography lab to study chlorophyll presence in leaves.
- Create a leaf model to illustrate how the specialized organelles and cells are utilized during photosynthesis.
- Conduct a floating disk lab to study the impact of light and carbon dioxide on photosynthesis.
- Create a graphic organizer showing the stages of respiration and detailing the events that occur.
- Students will analyze the impact exercise has on the rate of respiration in humans.

Evidence/Assessments - How will we know what students have learned?

- **Assessments can be reviewed for each course in this folder.**
- Chapter tests
- Biology Unit 4 Benchmark
- Lab assignments
- Small group projects
- Chromatography Lab
- Floating Leaf Disks
- Exercise and respiration lab
- Leaf Model - photosynthesis

Spiraling for Mastery

Content or Skill for this Unit	Spiral Focus from Previous Unit	Instructional Activity
• HS-LS1-3: Plan and conduct an investigation to provide evidence that	• MS-LS1-3 Use argument supported by evidence for how the body is a system	• Review parts of a eukaryotic cell when focusing on chloroplasts

feedback mechanisms maintain homeostasis. • 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.	of interacting subsystems composed of groups of cells. • MS-LS1-6 Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms. • MS-LS1-7 Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism.	and mitochondria to explain photosynthesis and respiration. • Carbon cycle diagram to illustrate matter cycling through organisms in an ecosystem. • Have students construct the photosynthesis and respiration equations using chemical names on a whiteboard or an interactive smartboard activity.

Key Resources

Chromatography Lab

Floating Leaf Disks

Exercise and respiration lab

Leaf Model - photosynthesis

21st Century Life and Careers

WRK.9.2.12.CAP.2	Develop college and career readiness skills by participating in opportunities such as structured learning experiences, apprenticeships, and dual enrollment programs.
WRK.9.2.12.CAP.3	Investigate how continuing education contributes to one's career and personal growth.
WRK.9.2.12.CAP.4	Evaluate different careers and develop various plans (e.g., costs of public, private, training schools) and timetables for achieving them, including educational/training requirements, costs, loans, and debt repayment.

Career Readiness, Life Literacies, & Key Skills

TECH.9.4.12.CT.3	Enlist input from a variety of stakeholders (e.g., community members, experts in the field) to design a service learning activity that addresses a local or global issue (e.g., environmental justice).
TECH.9.4.12.CT.4	Participate in online strategy and planning sessions for course-based, school-based, or other project and determine the strategies that contribute to effective outcomes.
TECH.9.4.12.GCA.1	Collaborate with individuals to analyze a variety of potential solutions to climate change effects and determine why some solutions (e.g., political. economic, cultural) may work better than others (e.g., SL.11-12.1., HS-ETS1-1, HS-ETS1-2, HS-ETS1-4, 6.3.12.GeoGI.1, 7.1.IH.IPERS.6, 7.1.IL.IPERS.7, 8.2.12.ETW.3).
TECH.9.4.12.IML.2	Evaluate digital sources for timeliness, accuracy, perspective, credibility of the source, and relevance of information, in media, data, or other resources (e.g., NJSLSA.W8, Social Studies Practice: Gathering and Evaluating Sources.
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).
TECH.9.4.12.IML.4	Assess and critique the appropriateness and impact of existing data visualizations for an intended audience (e.g., S-ID.B.6b, HS-LS2-4).
TECH.9.4.12.IML.5	Evaluate, synthesize, and apply information on climate change from various sources appropriately (e.g., 2.1.12.CHSS.6, S.IC.B.4, S.IC.B.6, 8.1.12.DA.1, 6.1.12.GeoHE.14.a, 7.1.AL.PRSNT.2).
TECH.9.4.12.IML.6	Use various types of media to produce and store information on climate change for different purposes and audiences with sensitivity to cultural, gender, and age diversity (e.g., NJSLSA.SL5).

Interdisciplinary Connections

RL.CR.9–10.1. Cite a range of thorough textual evidence and make relevant connections to strongly support analysis of multiple aspects of what a literary text says explicitly and inferentially, as well as including determining where the text leaves matters uncertain.

RI.CR.9–10.1. cite a range and thorough textual evidence and make clear and relevant connections, to strongly support an analysis of multiple aspects of what an informational text says explicitly and inferentially, as well as interpretations of the text.

W.AW.9–10.1. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient textual and non-textual evidence.

W.IW.9–10.2. Write informative/explanatory texts (including the narration of historical events, scientific procedures/ experiments, or technical processes) to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content.

Math

S.ID.A. Summarize, represent, and interpret data on a single count or measurement variable

- Represent data with plots on the real number line (dot plots, histograms, and box plots).
- Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.
- Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).
- Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages.
- Recognize that there are data sets for which such a procedure is not appropriate. Use calculators, spreadsheets, and tables to estimate areas under the normal curve.

Health/PE

2.2.12.PF.1: Compare the short- and long-term benefits of physical activity and the impact on wellness associated with physical, mental, emotional fitness through one's lifetime