

# Unit 03: Energy, Body Systems, and Metabolism (Weeks 13-18)

Content Area: **Template**

Course(s):

Time Period: **Full Year**

Length: **6 weeks**

Status: **Published**

## Standards Alignment

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### New Jersey Student Learning Standards

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#### **Practice 1. Asking questions (for science) and defining problems (for engineering)**

**Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations.**

Ask questions that arise from careful observation of phenomena, or unexpected results, to clarify and/or seek additional information.

Ask questions that arise from examining models or a theory, to clarify and/or seek additional information and relationships.

Ask questions to determine relationships, including quantitative relationships, between independent and dependent variables.

Ask questions that can be investigated within the scope of the school laboratory, research facilities, or field (e.g., outdoor environment) with available resources and, when appropriate, frame a hypothesis based on a model or theory.

#### **Practice 3. Planning and carrying out investigations**

**Planning and carrying out investigations in 9–12 builds on K–8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models.**

Make directional hypotheses that specify what happens to a dependent variable when an independent variable is manipulated.

#### **Practice 4. Analyzing and interpreting data**

**Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data.**

Consider limitations of data analysis (e.g., measurement error, sample selection) when analyzing and interpreting data.

#### **Practice 6. Constructing explanations (for science) and designing solutions (for engineering)**

**Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.**

Make a quantitative and/or qualitative claim regarding the relationship between dependent and independent variables.

Apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects.

#### **Practice 8. Obtaining, evaluating, and communicating information**

**Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs.**

Communicate scientific and/or technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (i.e., orally, graphically, textually, mathematically).

### **Connections to the Nature of Science: Most Closely Associated with Practices 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.

Scientific investigations use a variety of methods, tools, and techniques to revise and produce new knowledge.

### **Scientific Knowledge is Based on Empirical Evidence**

Science disciplines share common rules of evidence used to evaluate explanations about natural systems.

### **Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena**

Models, mechanisms, and explanations collectively serve as tools in the development of a scientific theory.

Laws are statements or descriptions of the relationships among observable phenomena.

### **Crosscutting Statements**

**3. Scale, Proportion, and Quantity – In considering phenomena, it is critical to recognize what is relevant at different size, time, and energy scales, and to recognize proportional relationships between different quantities as scales change.**

Some systems can only be studied indirectly as they are too small, too large, too fast, or too slow to observe directly.

### **Connections to the Nature of Science: Most Closely Associated with Crosscutting Concepts Science is a Way of Knowing**

Science is both a body of knowledge that represents a current understanding of natural systems and the processes used to refine, elaborate, revise, and extend this knowledge.

### **LS1: From Molecules to Organisms: Structures and Processes**

#### **LS1.A: Structure and Function**

Systems of specialized cells within organisms help them perform the essential functions of life. (HS-LS1-1)

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 and

release energy to the surrounding environment and to maintain body temperature. Cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and new compounds are formed that can transport energy to muscles. (HS-LS1-7)

## **LS2: Ecosystems: Interactions, Energy, and Dynamics**

### **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)

Plants or algae form the lowest level of the 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 the 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 matter is stored in newly 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 are conserved. (HS-LS2-4)

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)

SCI.HS-LS1	From Molecules to Organisms: Structures and Processes
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-LS1-7	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	Ecosystems: Interactions, Energy, and Dynamics
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.

## **Integration of Career Readiness, Life Literacies and Key Skills**

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CRP.K-12.CRP1	Act as a responsible and contributing citizen and employee.
CRP.K-12.CRP2	Apply appropriate academic and technical skills.
CRP.K-12.CRP3	Attend to personal health and financial well-being.
CRP.K-12.CRP4	Communicate clearly and effectively and with reason.
CRP.K-12.CRP5	Consider the environmental, social and economic impacts of decisions.
CRP.K-12.CRP6	Demonstrate creativity and innovation.
CRP.K-12.CRP7	Employ valid and reliable research strategies.
CRP.K-12.CRP8	Utilize critical thinking to make sense of problems and persevere in solving them.
CRP.K-12.CRP9	Model integrity, ethical leadership and effective management.
CRP.K-12.CRP10	Plan education and career paths aligned to personal goals.
CRP.K-12.CRP11	Use technology to enhance productivity.

## **Technology / Integration of Computer Science and Design Thinking**

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CS.9-12.8.1.12.DA.6	Create and refine computational models to better represent the relationships among different elements of data collected from a phenomenon or process.
CS.9-12.8.2.12.EC.2	Assess the positive and negative impacts of emerging technologies on developing countries and evaluate how individuals, non-profit organizations, and governments have responded.

## **Interdisciplinary Connections: NJSL for ELA, Social Studies, Science and/or Math Section**

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LA.RL.9-10.1	Cite strong and thorough textual evidence and make relevant connections to support analysis of what the text says explicitly as well as inferentially, including determining where the text leaves matters uncertain.
LA.RL.9-10.2	Determine a theme or central idea of a text and analyze in detail its development over the course of the text, including how it emerges and is shaped and refined by specific details and provide an objective summary of the text.
LA.RL.9-10.3	Analyze how complex characters (e.g., those with multiple or conflicting motivations) develop over the course of a text, interact with other characters, and advance the plot or develop the theme.
LA.RL.9-10.4	Determine the meaning of words and phrases as they are used in the text, including figurative and connotative meanings; analyze the cumulative impact of specific word choices on meaning and tone (e.g., how the language evokes a sense of time and place; how it sets a formal or informal tone).
LA.RL.9-10.5	Analyze how an author's choices concerning how to structure a text, order events within it (e.g., parallel plots), and manipulate time (e.g., pacing, flashbacks) create specific effects (e.g., mystery, tension, or surprise).
LA.RL.9-10.6	Analyze a particular point of view or cultural experience reflected in a work of literature from outside the United States, drawing on a wide reading of world literature.

## **Integration of Diversity, Equity and Inclusion; Climate Change; Informational and Media Literacy**

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see Crosswalks

## **21st Century Life and Careers**

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## **Stage I: Desired Results**

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## Transfer/Overview/Rationale

### Transfer / Overview / Rationale

#### Unit Rationale

The purpose of this unit...

The first law of Thermodynamics, Conservation of Energy, states that energy cannot be created nor destroyed in a closed system; energy can only be transferred or changed from one form to another. All living things need a source of energy in order to sustain life and that energy is an example of how one source of energy is converted during the processes of photosynthesis and cellular respiration.

## Meaning

## Essential Questions

### Essential Questions

- What are the reactants and products of photosynthesis and how are they converted through the different steps of the process?
- What are the reactants and products of cellular respiration and how are they converted through the different steps of the process?
- How are carbohydrates, lipids, and proteins in food broken down into smaller molecules and how are they transferred into the cell?
- What is the relationship between photosynthesis and cellular respiration?

## Enduring Understanding/Indicators of Understanding

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- The sun is the ultimate source of energy for all living things on Earth
- The process of photosynthesis creates carbohydrates, which are used by both plants and animals as an energy source.
- Mammals have complex body systems that intake and breakdown molecules that are used to harness energy by the cells.
- Cellular respiration is the process where molecules are transformed into useable cellular energy within the mitochondria.
- The products of photosynthesis are used as the reactants in cellular respiration and the products of cellular respiration are used as the reactants in photosynthesis.

## Acquisition (Student Learning Objectives)

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### Knowledge

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Knowledge

Students will know...

- Photosynthesis happens in the chloroplasts of plants and uses sunlight, water, and carbon dioxide to convert into oxygen and glucose
- Cellular respiration happens either with(aerobic) or without oxygen (anaerobic) in the mitochondria of cells.
- Aerobic cellular respiration requires oxygen and glucose to create useable molecules of energy for the cell known as ATP
- Mammals have similar respiratory, digestive, and circulatory systems
- The organs of the digestive system, including both primary and accessory organs, and their functions
- The organs of the respiratory system, including both primary and accessory organs, and their functions
- The parts and functions of the heart and blood vessels
- Diffusion of glucose occurs from inside of the small intestine, then into the bloodstream, before entering into cells.
- Diffusion of oxygen occurs inside of alveoli of the lungs, then into the bloodstream, before entering into cells.

## **Skills**

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### Skills

Student will be skilled at ...

- Collaborate with a team to design and produce a cohesive diagram to demonstrate the steps of cellular respiration
- Use dissecting tools properly to carefully expose the internal organs of a fetal pig
- Identify both internal and external anatomical features of a fetal pig
- Execute an experiment and collect data that demonstrates human physiological processes and cellular respiration
- Write a proper lab report

## **Stage 3: Learning Plan**

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## **Resource and Mentor Texts**

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Resources and Mentor Texts

- Teacher derived notes
- Powerpoint/Google Slides presentation
- Worksheets
- Articles
- Lab materials

## **Formative Assessment Strategies**

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Formative Assessment Strategies

- Informal assessments (All call, thumbs up, Kahoot)
- Daily Do-Nows
- Exit tickets (Short answer responses, feedback forms)
- Quizzes
- Lab reports

## **Learning Activities/Unit of Study**

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### Learning Activities/Unit of Study

- Lectures and notes on the digestive, respiratory, and circulatory systems, cellular respiration, and photosynthesis.
- Follow that food writing assignment
- Body system diagrams
- Cyanide murders case study
- Cell resp. Group diagrams
- Pig dissection
- Exercise cellular respiration lab (With extended lab questions)
- Concept maps
- Internet interactive activity
- Elodea photosynthesis lab (With extended lab questions)
- Energy relationship essay

## **Modifications and/or Accommodations**

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### **Suggested Modifications (ELL, Sp. Ed, Gifted, At-risk of Failure)**

#### **English Language Learners**

Native language support: The teacher provides auditory or written content to students in their native language.

Adjusted Speech: The teacher changes speech patterns to increase student comprehension. This could include facing the students, paraphrasing, clearly indicating the most important ideas, and speaking more slowly.

Visuals: The teacher uses graphics, pictures, visuals, and manipulatives. This helps ELL students better understand and comprehend the subjects at hand.

Front-Loading Vocabulary: The teacher front loads vocabulary. This means providing students with a list of important vocabulary words they will need to know for a book, lesson, etc. prior to the lesson being taught. Including pictures to go with the vocabulary words is also very beneficial for the students.

#### **Special Education Students**

**Chunking:** The teacher presents information in a way that makes it easy for students to understand and remember. Chunking is based on the presumption that our working memory is easily overloaded by excessive detail. The best way to deliver information is to organize it into meaningful units. Because students with special needs get overloaded easily, chunking is an effective strategy to use with them.

**Checking for Understanding:** It is important to constantly check for understanding, especially for students who have accommodations. Teachers want to make sure students understand the concepts being covered in a way that makes sense to them.

**Extra time:** The teacher provides students with special needs extra time to complete work or answer questions. It is important to give students enough time to process their thoughts.

**Oral Reading:** The teacher will read work orally to students. Class work such as tests and literature circles may need to be read aloud to the student.

**Timers:** The teacher will use timers as an instructional tool. The use of timers is beneficial for students who have trouble completing tasks. Timers can be helpful so the student is aware of how much time they have to complete an assignment.

## **Students with 504 Plans**

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## **Gifted & Talented Strategies**

**Extensions/Enrichments:** Teachers will provide gifted and talented students with extension/enrichment projects. Students will be challenged to further their understanding, to apply acquired knowledge, and/or to produce something in reference to acquired knowledge.

**Modify/Change Activities:** Teachers will monitor and modify activities to accommodate those students who need to be challenged further. Additional reading, problem-solving, writing, or project work is necessary for those students who are ready to move on at a rate more accelerated than their peers. In this way, G & T students are provided the same opportunity for support as special needs

students.

## Students at Risk of School Failure

**Directions or Instructions:** Make sure directions and/or instructions are given in limited numbers. Give directions/instructions verbally and in simple written format. Ask students to repeat the instructions or directions to ensure understanding occurs. Check back with the student to ensure he/she hasn't forgotten.

**Peer Support:** Peers can help build confidence in other students by assisting in peer learning. Many teachers use the 'ask 3 before me' approach. This is fine, however, a student at risk may have to have a specific student or two to ask. Set this up for the student so he/she knows who to ask for clarification before going to you.

**Alternate or Modified Assignments:** Always ask yourself, "How can I modify this assignment to ensure the students at risk are able to complete it?" Sometimes you'll simplify the task, reduce the length of the assignment or allow for a different mode of delivery. For instance, many students may hand something in, the at-risk student may jot notes and give you the information verbally. Or, it just may be that you will need to assign an alternate assignment.

**Increase One to One Time:** When other students are working, always touch base with your students at risk and find out if they're on track or needing some additional support. A few minutes here and there will go a long way to intervene as the need presents itself.

**Contracts:** It helps to have a working contract between you and your students at risk. This helps prioritize the tasks that need to be done and ensure completion happens. Each day write down what needs to be completed, as the tasks are done, provide a checkmark or happy face. The goal of using contracts is to eventually have the student come to you for completion sign-offs.

**Hands On:** As much as possible, think in concrete terms and provide hands-on tasks. This means a child doing math may require a calculator or counters. The child may need to tape record comprehension activities instead of writing them. A child may have to listen to a story being read instead of reading it him/herself.

**Tests/Assessments:** Tests can be done orally if need be. Break tests down in smaller increments by having a portion of the test in the morning, another portion after lunch and the final part the next day.

**Seating:** Seat students near a helping peer or with quick access to the teacher. Those with hearing or sight issues need to be close to the instruction which often means near the front.