

Unit 3: Matter and Energy

Biology

14 Class Meetings

Rev. June 2019

Essential Questions

- What is the role of energy in our world?
- How do living organisms transform energy?

Enduring Understandings with Unit Goals

EU 1: Energy enters the Earth system primarily via solar radiation and is subsequently transformed by photosynthetic processes into chemical energy.

- Model the process of photosynthesis including reactants and products, with emphasis on the transformation of energy.

EU 2: Cellular respiration transforms energy-rich carbon compounds to produce succinct packets ATP for powering cell functions.

- Model the process of cellular respiration including reactants and products, with emphasis on the transformation of energy (1st Law of Thermodynamics).

EU 3: Energy and nutrients move within and between biotic and abiotic components of ecosystems.

- Describe how feeding relationships can have both direct and indirect effects on community members.

Standards

Next Generation Science 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.

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- **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.

Common Core State Standards

- **CCSS.ELA-Literacy.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.
- **CCSS.ELA-Literacy.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.
- **CCSS.ELA-Literacy.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.
- **CCSS.ELA-Literacy.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*.
- **CCSS.ELA-Literacy.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.
- **CCSS.ELA-Literacy.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.
- **CCSS.Math.Content.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.
- **CCSS.Math.Content.HSS.IC.B.6** Evaluate reports based on data.

MSMHS Academic, Civic and Social Competencies

Competency 1. Read and write effectively for a variety of purposes

Competency 2. Speak effectively with a variety of audiences in an accountable manner

Competency 3. Make decisions and solve problems independently and collaboratively

Competency 4. Apply scientific knowledge and concepts to a variety of investigative tasks

Competency 5. Contribute to a positive learning environment with respect and responsibility

Unit Content Overview

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- Unit Phenomena (such as: growing plants without oxygen)
- Plant Anatomy
- Photosynthesis: products, reactants, and processes
- Chloroplasts
- Cellular Respiration: products, reactants, and processes
- Mitochondria
- ATP and energy storage
- The Carbon Cycle
- Autotrophs versus heterotrophs
- Biotic versus abiotic factors
- Biomes

Interdisciplinary Connections

- Marine Studies I- biogeochemical cycles
- Algebra I- graphing

Learning Objectives with TWPS Activities

The student will be able to...

- Design a model that explains the unit phenomena
 - *How are living things able to survive on Mars?*
- Describe the inside structure of a plant
 - *How does the placement of veins help to carry out their function of transporting materials to and from the leaf?*
 - *What would be the advantage(s) to having no chloroplasts in the cells of the spongy mesophyll?*
- Identify the substances involved in the steps of photosynthesis.
 - *Explain how plants are able to stay alive without needing water added.*
- Characterize how photosynthetic organisms meet their needs.
 - *How will photosynthesis allow for living things to survive on Mars?*
- Diagram the process of photosynthesis including reactants and products.
 - *Create a short story that describes how glucose will be created through photosynthesis.*
- Diagram the process of cellular respiration including reactants and products.
 - *How does the food we chew and swallow fuel our cells?*
- Identify the substances involved in the steps of cellular respiration.
 - *You have just inhaled oxygen, how will your body's cell create carbon dioxide through cellular respiration.*

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- Investigate organisms that undergo cellular respiration and photosynthesis.
 - *Explain how plants are vital for survival in an **airtight biosphere**.*
- Explain the role of ATP in energy storage and transformation.
 - *Describe how ATP is produced during cellular respiration.*
- Compare and contrast the differences between autotrophs and heterotrophs.
 - *Explain how the way autotrophs obtains food is different than heterotrophs.*
- Identify carbon sources and sinks throughout ecosystems.
 - *Deforestation is an example that impacts the carbon cycle. Explain how it impacts the carbon cycle.*
- Explain the transformation of matter (carbon) from glucose to ATP and carbon dioxide.
 - *Let's say an ecosystem on Earth was placed in the deep ocean in a biosphere, what needs to be included for the survival of the ecosystem?*
- Research the proper components that make up a biome.
 - *Referring back to the unit phenomena, what are the essential requirements for a biome to survive on Mars?*
- Create a model to show how photosynthesis and cellular respiration are interdependent and provide the energy to sustain life.
 - *Based off the video, what things would you incorporate into a biosphere in the deep ocean. (Ted Talk: Life in Biosphere 2 video)*

Instructional Strategies/Differentiated Instruction

- **HLP:** Academically Productive Talk
- **HLP:** Writing to Learn (TWPS)
- **HLP:** Effective Feedback
- Entrance slips/activities
- Lecture with notes
- Close reading with annotations
- Accountable Talk discussions
- Graphic organizers
- Foldable
- Self-assessments
- Daily check ins with students
- Homework
- Student reflection
- Individual response board
- Exit slips
- Laboratory exercises

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- Guided notes
- Providing students with completed notes and outlines
- Rephrasing information for students
- Student choice
- Strategic grouping
- Flash cards for vocabulary
- Shortened/modified reading assignments

Assessments

FORMATIVE ASSESSMENTS:

- Yeast Respiration
 - MSMHS Rubric 4: Scientific Research
- Biosphere 3 Model
 - MSMHS Rubric 3: Problem Solving
- Written homework assignments
- Accountable Talk Discussions
- Daily Think-Write-Pair-Share (TWPS)
- Entrance and exit slips
- Graphic organizers
- Guided notes

SUMMATIVE ASSESSMENTS:

- Quiz on EU 1
- Quiz on EU 2
- Yeast Respiration
- Biosphere 3 Model and write-up

Unit Task

Unit Task Name: Biosphere 3 Model

Description: Students will work in small groups to design a self-sustaining habitat. Using information about photosynthesis (EU 1) and cellular respiration (EU 2), students will demonstrate the interdependence of these biological reactions. Students will choose autotrophs and heterotrophs (EU 3) to create the self-sustaining balance of the reactants and products of photosynthesis and cellular respiration. The students' will create a proper meal plan and determine the proper tools to make the biosphere sustainable. The final product will be the presentation of a poster with a detailed model of their biosphere.

Evaluation: MSMHS Rubric 3: Problem Solving

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Unit Resources

- Large format poster printer
- Microscopes
- Slides
- Plants
- POGIL: Photosynthesis, What's in a Leaf?
- POGIL: Cellular Respiration
- POGIL: Photosynthesis and Cellular Respiration
- Aquaculture Lab – hydroponics
- Science Takeout: Photosynthesis in a Bag
- Science Takeout: Yeast Respiration
- TedTalk: Life in Biosphere 2
https://www.ted.com/talks/jane_poynter_life_in_biosphere_2?language=en
- Internet databases
- Laptops