

Subject: Science  
Grade/Course: Biology  
Unit of Study: Unit 4-Cellular Energy  
Length of Unit: 3 Weeks

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## Practices of Science and Engineering (NGSS)

- ✓ 1. Asking questions (for science) and defining problems (for engineering)
  - ✓ 2. Developing and using models
  - ✓ 3. Planning and carrying out investigations
  - ✓ 4. Analyzing and interpreting data
  - ☐ 5. Using mathematics and computational thinking
  - ✓ 6. Constructing explanations (for science) and designing solutions (for engineering)
  - ✓ 7. Engaging in argument from evidence
  - ✓ 8. Obtaining, evaluating, and communicating information
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## Performance Expectations for the Unit

- CO-LS.2.3c Develop, communicate, and justify an evidence-based explanation regarding the optimal conditions required for enzyme activity.
- CO-LS.2.3d Infer the consequences to organisms of suboptimal enzyme function - such as altered blood pH or high fever - using direct and indirect evidence.
- CO-LS.2.4a Develop, communicate, and justify an evidence-based scientific explanation the optimal environment for photosynthetic activity.
- NGSS-HS-LS1-5 Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.
- CO-LS.2.4c Explain how carbon compounds are gradually oxidized to provide energy in the form of adenosine triphosphate (ATP), which drives many chemical reactions in the cell.
- NGSS-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.

- NGSS-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.
- NGSS-HS-LS2-5/CO-LS.2.4b Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.
- CCCS.BIO111 I. Recognize terminology, specific facts, experimental methodologies, and general concepts related to basic chemistry, cell structure and function, cell reproduction, bio-energetics, and genetics.

(CO = Colorado Academic Standards, NGSS = Next Generation Science Standards, CCCS = Colorado Community College System)

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## Essential Questions

1. How do cells carry out chemical reactions?
  2. How do cells control each reaction so just enough product is produced?
  3. What is photosynthesis and how does it occur?
  4. What is cellular respiration and how does it occur?
  5. How is energy released when there is no oxygen available?
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## Big Ideas

1. Chemical reactions (metabolism) occur in organisms with the help of specialized helper molecules called enzymes that lower the energy requirement for reactions to occur.
  2. The concentration and activity of enzymes is tightly regulated in cells in order to maintain sufficient, but not excess, quantities of the molecules required for cellular actions.
  3. The process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide plus water into sugars plus released oxygen.
  4. 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 for cellular work.
  5. Energy can still be released from organic molecules in the absence of oxygen (anaerobic conditions) through the process of fermentation.
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## Key Vocabulary/Concepts

- 1st law of thermodynamics
- 2nd law of thermodynamics
- entropy
- metabolism
- catabolism
- anabolism
- enzyme
- active site
- activation energy
- ATP
- metabolic pathway
- competitive inhibition
- noncompetitive inhibition
- feedback inhibition
- photosynthesis
- photon
- energy carriers
- photosystem
- pigment molecule
- electron transport chain
- chloroplast
- chlorophyll
- thylakoid
- stroma
- Calvin Cycle
- respiration
- oxidation
- aerobic
- anaerobic
- mitochondria
- glycolysis
- chemiosmosis
- Krebs' Cycle/Citric Acid Cycle
- ATP synthase
- fermentation

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## Major Engaging Learning Experiences and Labs

- Phenylketonuria (PKU) Webquest [-Link](#)
  - Pick Your Poison research project: Poison, toxin, and venom effects on enzymes
  - Enzyme simulation lab - kinesthetic version
  - Enzyme Catalysis Lab - measure temperature, concentration, and pH effects on enzyme activity
  - Photosynthesis Dry Lab [-Link](#)
  - Green Human Project [-Link](#)
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