

Key Concept 7: Cellular Respiration and Fermentation

Learning Objectives

Students will be able to ...

Essential Knowledge

Students need to know that ...

Cellular Respiration

CELLS 7.1(a) Explain why the processes of energy production in producers and consumers are dependent on one another.

CELLS 7.1(b) Create and/or use models to explain how consumers obtain usable energy from the products of photosynthesis.

CELLS 7.1(c) Describe how consumers store the energy produced during cellular respiration.

CELLS 7.1.1 Cellular respiration is a series of enzymatic reactions that utilize electron carrier molecules to synthesize ATP molecules that provide energy for cellular processes.

- Production of energy through cellular respiration begins with the carbon compounds generated by producers during photosynthesis.
- Glycolysis, an anaerobic process that occurs in the cytoplasm, uses glucose and two molecules of ATP to produce NADH, pyruvic acid, and four molecules of ATP.
- The Krebs cycle, an aerobic process that occurs in the mitochondria, uses pyruvic acid to produce ATP and electron carriers called NADH and FADH₂. Carbon dioxide is produced as a waste product during these chemical reactions.
- The electron transport chain transfers the high-energy electrons from NADH and FADH₂ to oxygen, producing H₂O.
- The build-up of hydrogen ions in the inner mitochondrial space produces a gradient that allows the production of 36–38 ATP molecules from each glucose molecule.

Fermentation

CELLS 7.2(a) Explain the biological importance of fermentation.

CELLS 7.2(b) Describe how consumers generate cellular energy in anaerobic conditions.

CELLS 7.2.1 Organisms have processes for producing energy under completely anaerobic conditions.

- Fermentation allows for production of two molecules of ATP during glycolysis if no oxygen is present.
- Two common forms of fermentation are alcohol and lactic acid.
 - Yeast use alcohol fermentation to obtain energy from glucose and release CO₂ as a byproduct. This is an economically important process because it is used to make many food products.
 - Bacterial and animal cells are able to utilize lactic acid fermentation to obtain energy from glucose in the absence of oxygen.

Content Boundary: The focus for this key concept is on the understanding of how the products from photosynthesis enable the process of cellular respiration. It is more important for students to be able to use reactants and products to explain the interdependence between photosynthesis and cellular respiration than to memorize a series of steps that occur during these processes.

Cross Connections: In discussing electron transport chain processes whereby intermembrane proteins (enzymatic) allow movement of hydrogen ions, students should make *connections to key concepts* involving the role of proteins, membrane structures, and diffusion from earlier in this unit.