Lesson 5: A Closer Look at Cellular Respiration

Introduction

In the last lesson, you explored how plants use glucose as food. Through the chemical reactions of cellular respiration, glucose reacts with oxygen to produce carbon dioxide and water. The reactions of cellular respiration provide a net output of energy, some of which is used by the plant to rearrange molecules to form starch and other compounds used in the plant's body. Other energy is used for movement, growth, and reproduction.

In this lesson, you will consider how other organisms use the chemical reactions of cellular respiration to stay alive.

Lesson Question

Process and Procedure

1. Write your best ideas about the lesson focus question in the space below. Leave space to revise your ideas as you learn throughout this lesson. As you have new ideas, record them in a different color.

2. To think more about how animals and other organisms use cellular respiration to obtain the energy needed to stay alive, read and annotate the article, *Cellular Respiration in Other Organisms*.

Cellular Respiration in Other Organisms

We have learned that plants use glucose produced through the process of photosynthesis as food. This glucose reacts with oxygen in the chemical reactions of cellular respiration to produce carbon dioxide and water. Cellular respiration results in a net release of energy which plants use to perform life functions including growth and reproduction.

Like plants, all other organisms, including animals, bacteria, and fungi, require matter and energy to stay alive. These organisms obtain matter from consuming food, which is broken down through digestion into small molecules, including glucose. In both plants and animals, glucose reacts with oxygen in the chemical reactions of cellular respiration to produce carbon dioxide and water. Cellular respiration results in a net release of energy which all organisms, including animals, bacteria, and fungi use to perform life functions including growth and reproduction.

In both plants and animals, the chemical reactions of cellular respiration involve glucose reacting with oxygen. These reactions are often referred to as aerobic (with oxygen) respiration. Aerobic respiration produces carbon dioxide and water as output molecules along with a release of energy.

Yeast and some bacteria are living microorganisms that conduct an anaerobic (without oxygen) process called fermentation. In these reactions, glucose is the input molecule, and the output molecules are lactic acid or carbon dioxide and ethanol. In anaerobic reactions, there is a net release of energy. However, the amount of energy released is much smaller because the energy released by the formation of ethanol is much less than the energy released when water is formed.

3. Yeast are single-celled microorganisms that are classified as fungi. You may know that yeast is commonly used in the production of bread and fermented beverages such as kombucha, beer, and wine. These beverages are called fermented because, in the process of making them, the yeast cells use only fermentation to supply their energy needs.

   The carbon dioxide produced by yeast during fermentation causes bread to rise and results in the carbonation of some fermented beverages. The ethanol produced by yeast during fermentation evaporates when the bread is baked. It remains when alcoholic beverages are produced; thus, the alcohol in these beverages is ethanol.

   As you learned in previous lessons, bromothymol blue can be used to indicate the presence of carbon dioxide. Follow your teacher's directions to set up a demonstration to confirm that carbon dioxide is produced during fermentation. Draw a labeled diagram of the demonstration in the space below.

4. Yeast and other microorganisms break down many large molecules in addition to glucose in both respiration and (anaerobic) fermentation. Remember that aerobic respiration also produces carbon dioxide. But do they break down these molecules at the same rate? We can determine the rate of cellular respiration indirectly by measuring the amount of carbon dioxide produced.

   Follow your teacher's directions to set up a demonstration that will explore the production of carbon dioxide by yeast during fermentation. Draw a labeled diagram of the demonstration in the space below.

5. Record your data in the chart below.

Flask Components	Balloon Circumference (cm)		Observations
	After 20 minutes	After 24 hours	
Water + Yeast			
Water + Glucose			
Water + Yeast + Glucose			
Water + Yeast + Sucrose			
Water + Yeast + Starch			

Add notes from the class discussion in the space below.

6. In this and previous lessons, we have been considering how matter and energy interact in a system. In Mr. Latimer's terrarium system, he planted a spiderwort plant in compost. Read and annotate the article below to learn more about compost.

Decomposition and Compost

What happened to all the spiderwort leaves that died and fell to the bottom of Mr. Latimer's terrarium? Without the process of decomposition, the dead leaves would have filled the terrarium. Decomposition is a naturally occurring process that begins at the death of an organism, or part of an organism. Large molecules, such as the starch in leaves, are broken down by worms and microorganisms into smaller molecules such as glucose. Organisms that break down the matter of once-living organisms are called decomposers.

Decomposers use aerobic respiration to gain energy from the chemical reactions of glucose and oxygen, producing carbon dioxide and water. The decomposition of leaves by microorganisms releases carbon dioxide and water back into the atmosphere. Other chemical substances, such as nitrogen and phosphorus are returned to the soil. These chemicals are taken up by plants and incorporated into plant body structures.

Composting is a human-driven decomposition process. People combine dead plant materials such as leaves and food scraps in a pile or bin. Naturally occurring microorganisms grow and consume the plant materials, releasing carbon dioxide and water. In the process of aerobic respiration, heat is released. In compost piles where decomposition is rapidly occurring, the temperature at the center of the compost pile is between $135^{o} – 165^{o}$ F.

Record notes from your class discussion in the space below.

Synthesize and Summarize Ideas

7. Add your ideas about cellular respiration conducted by the microorganisms in the compost to your model of the terrarium system. Add labels to help others understand your model.

8. Reread your initial response to the lesson focus question. Consider the ideas from the activities you completed. If you would like to add to or revise your ideas, do so in a different color.