Name _____ Class _____ Date _____

Exploration Lab

OBSERVATION

Explaining the Carbon Cycle in Fermentation

Carbon is a chemical element found in all organic molecules. Carbon is one of the main components of cells. Organisms get energy from carbon compounds, which they obtain from their environment. Plants use the sun's energy to synthesize carbohydrates from carbon dioxide and water. Animals get carbohydrates by eating plants or by eating organisms that ate plants.

So what do organisms do with carbon compounds? Through a process called *cellular respiration*, the cells of most organisms use oxygen to release the energy that is stored in food molecules. Fungi, because they lack chlorophyll, use a different process, called *fermentation*, which does not use oxygen to release energy. During both cellular respiration and fermentation, energy is released when the chemical bonds that hold the food molecules together are broken. All organisms then use elements such as carbon to build their own biological molecules. The molecules left after these processes are waste products.

One of the waste products is carbon dioxide, a molecule that contains carbon. As organisms conduct cellular respiration or fermentation, they release waste carbon dioxide as a gas into the atmosphere. Photosynthetic organisms, such as plants, absorb this carbon dioxide and use it in photosynthesis. Through photosynthesis, the carbon gets incorporated into parts of the plant (for example, as part of the starch in a potato) and may end up being consumed by yet another animal. The constant cycling of carbon through organisms to the atmosphere and back again is called the carbon cycle.

In this experiment you will be working with yeast, a single-celled organism that is a fungus. Yeast obtains energy from food through the process of fermentation. By providing the yeast with different sources of food, you will answer the following question: What substance is used by yeast as a source of energy?

OBJECTIVES

Analyze observations as they relate to the process of fermentation.
Distinguish between food sources that support fermentation and those that do not.
Explain the carbon cycle in the process of fermentation.

MATERIALS

- baker's yeast
- balance
- beaker, 100 mL
- beakers, 50 mL (3)
- graduated cylinder
- salt (0.5 g)
- stirring rod
- sugar (0.5 g)
- water, warm

Procedure

1. Using the 100 mL beaker, prepare a yeast solution by adding 1 g of dry baker's yeast to 100 mL of very warm water, stirring the mixture gently.
2. Label three 50 mL beakers "1," "2," and "3." Divide the yeast solution evenly between the three beakers.
3. Dissolve 0.5 g of sugar in beaker #2 and 0.5 g of salt in beaker #3.
4. Note what happens in each beaker, and record your observations in Table 1. Be sure to look for bubbles rising to form a foamy layer. This is evidence of carbon dioxide production. Be sure to use your sense of smell, also!

TABLE 1: REACTION OF YEAST TO DIFFERENT FOOD SOURCES

Beaker	Observations
1	
2	
3	

Analysis

1. **Explaining Events** Which beaker served as the control in this experiment?

_____

2. **Explaining Events** What food sources were tested in this experiment?

_____

3. **Analyzing Data** Distinguish the smells in the beakers. Did you smell alcohol in any beaker, and if so, which one? Using the word and chemical equations below for the fermentation carried out by yeast cells, explain what the smell indicates.

_____

_____

4. **Analyzing Data** Distinguish any visible indications in the beakers. In which of the beakers did you notice bubbling, and what does this mean?

_____

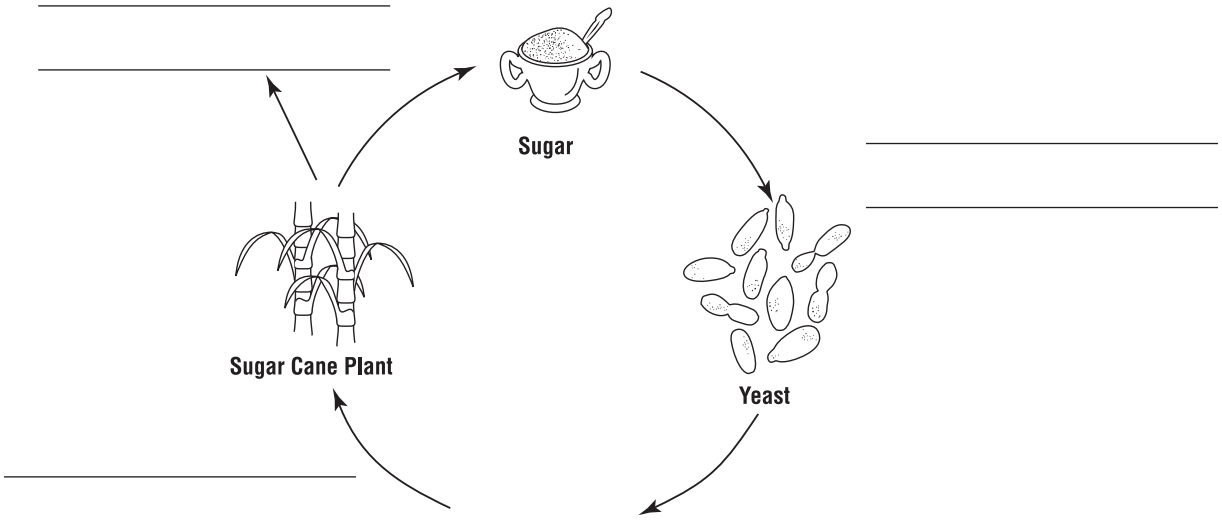
5. **Analyzing Results** Identify the cause-and-effect relationship associated with fermentation occurring in one of the beakers. Based on the chemical equation for fermentation and on what you observed, in which of the beakers do you think the process of fermentation occurred?

6. **Analyzing Results** Differentiate the beaker in which fermentation occurred from the other beakers. Why didn't fermentation happen in all of the beakers?

7. **Analyzing Results** Break down the chemical formula for fermentation into its sources (left side of arrow) and its byproducts (right side of arrow). What would you conclude is the source of the carbon in the carbon dioxide byproduct?

Conclusions

8. **Drawing Conclusions** Construct the path that a carbon atom follows in the carbon cycle, using the diagram below. Fill in the blanks to describe what is happening during each of the steps.



9. **Applying Conclusions** Construct another diagram in the space provided below of the carbon cycle, in which you are one of the organisms involved. Describe what is happening at each step. As a thought aid, think about a sugar-based food that you commonly eat, such as bread, and you become a part of the carbon cycle.

Extension

1. **Research and Communications** Analyze the combustion of gasoline that occurs in a car and answer the following questions: How is burning gas in a car similar to digestion in living organisms? Sugar acts as a fuel for living organisms. Gasoline, which comes from the remains of dead plants, provides the fuel for cars. In fact, with only 100 mL of gasoline, a typical automobile can travel approximately one kilometer (one thousand meters, which is about five-eighths of a mile). Why is there so much stored energy in these fuels?