

Name: _____

Date: _____

Life Science

Period: _____

Section 2.2: *Cells capture and release energy.*

Investigation: Fermentation

Fermentation is the process by which cells release energy **without oxygen**. In cellular respiration, the cell first breaks glucose into smaller molecules. This releases a small amount of energy. Without oxygen cellular respiration cannot continue. Instead of entering the mitochondria, the smaller molecules stay in the cytoplasm, where fermentation occurs.

There are two main types of fermentation: **alcoholic fermentation** and **lactic acid fermentation**. Both types of fermentation start with the small molecules made from sugars at the beginning of cellular respiration. Without oxygen, different reactions occur that produce either alcohol and carbon dioxide or lactic acid. In both cases, a small amount of energy is released.

Many everyday foods are produced using either alcoholic or lactic acid fermentation. The bread products that you eat are a result of alcoholic fermentation. Flour, egg and sugar mixed with the microorganism yeast results in an **anaerobic** environment as the yeast runs out of oxygen when kept warm and converts the sugar into carbon dioxide and alcohol. The bread rises due to the production of carbon dioxide gas bubbles. The baking process evaporates the alcohol and kills the yeast, giving bread its light, airy texture.



When lactose (found in milk) is the sugar present, lactic acid fermentation occurs. Certain bacteria release energy this way, producing lactic acid as a by-product. Lactic acid fermentation changes milk into yogurts and cheeses. This type of fermentation also occurs in your muscles during prolonged or hard exercise. If you use up the available oxygen during this time, fermentation occurs in your muscle cells, releasing lactic acid. Lactic acid burns, resulting in pain and soreness in the affected muscles. The pain goes away when the lactic acid is finally converted into carbon dioxide and water.

Pre-Lab Questions:

1. How do cells release energy without oxygen?

2. What are some common foods that include fermentation in their production?

How can you tell if fermentation releases material?

Investigation Activity:

The procedure was already set up for you:

- **Both bottles** have been filled $\frac{3}{4}$ of the way with warm water and $\frac{1}{2}$ teaspoon of yeast.
 - **Bottle A** received a cube of sugar
 - **Bottle B** did not receive a cube of sugar
- A balloon was placed securely around the mouths of both bottles and the solution was swirled.
- After observing both bottles, draw the balloons on the top of each bottle. Inside the bottle, explain what is happening.

Bottle A

Bottle B

Analysis Questions:

1. What **observation** can you make about what is going on with each container?

2. What provided the energy for fermentation to occur in one bottle and not the other?

3. What do you think is contained within Bottle A's balloon?
