



Chapter 7 Project

Aerobic and Anaerobic Respiration in Yeast

Project Goal + Timeline

In this project, we will be reviewing your knowledge on cellular respiration and fermentation by performing a simple experiment with yeast. This project should be completed within a group of two to three students in a two-hour time frame.

Yeasts are unicellular eukaryotic organisms that can undergo either aerobic respiration or fermentation. Yeasts have exceptional commercial importance, largely due to their fermentation ability. Applications of yeast fermentation range from the brewing of spirits to the production of biofuel.

In this project, you will first perform an experiment to examine how supplementation with sugar affects fermentation in yeast. Then, you'll graph your data and use it to draw conclusions. You'll finish by reviewing your knowledge of respiration and fermentation.

Directions

Part 1: The Yeast Respiration Experiment

Follow the steps to complete your experiment.

A. Yeast Activation

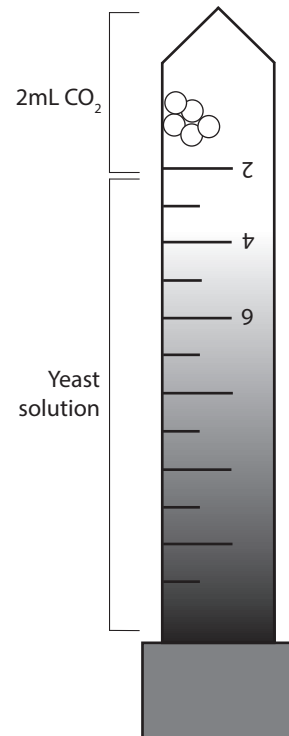
1. Label one 10 mL graduated plastic tube "+sugar" and one "-sugar."
2. In one of the empty cups, combine $\frac{1}{4}$ teaspoon of dry yeast and 20 mL (4 teaspoons) of warm water (-sugar).
3. Mix thoroughly with the stir stick.
4. In the other empty cup, combine $\frac{1}{4}$ teaspoon of dry yeast, 1 teaspoon of sugar, and 20 mL (4 teaspoons) of warm water (+sugar).
5. Mix thoroughly with the stir stick.
6. Wait 5 to 10 minutes to allow the yeast to activate.

B. Measurement of CO₂ Production

7. Pour the -sugar mixture into the tube labeled "-sugar" and the +sugar mixture into the tube labeled "+sugar". Fill each tube to the top if possible. Screw the cap on slowly.
8. Turn both tubes upside down. Make sure the tubes are completely filled with the mixture. If the tube is not completely filled, add more of the correct solution to the tube. Place both upside-down tubes inside of an empty plastic cup.
9. Every 2 minutes, measure the volume at the tip of the test tube that is occupied by bubbles (CO₂). Record the volume in Table 1.

TABLE 1: Volume of CO₂ Produced by Yeast in the Presence and Absence of Sugar

Time (minutes)	Volume of CO ₂ Produced (mL)	
	-sugar	+sugar
2		
4		
6		
8		
10		
12		

**Part 2: Data Analysis**

Use the data in the table to make two graphs. Make sure to include a title for each graph. For each graph, plot the time (in minutes) on the *x*-axis and the volume of CO₂, in milliliters on the *y*-axis.

1. Graph 1: Plot the results of the -sugar treatment.
2. Graph 2: Plot the results of the +sugar treatment.

Part 3: Post-experiment Questions

1. Describe how aerobic respiration and fermentation are related.
2. What was the purpose of covering each tube with a lid in the experiment?
3. Define the control group, the independent variable (what was changed), and the dependent variable (what was measured) in the experiment.
4. Describe how you measured the rate of cellular respiration during the experiment.
5. Summarize your results and state the overall conclusion from your experiment.
6. Explain any sources of error in this experiment. How could you correct those errors?

Part 4: Review Questions

1. What is the purpose of cellular respiration? Why do living organisms carry out the process of respiration?
2. In what part of the cell does cellular respiration occur?
3. What are the two types of fermentation and what is produced in each?
4. What are the equations for cellular respiration and fermentation? In each equation, label the reactions and products.
5. What type of fermentation do yeast perform?
6. What is a facultative anaerobe? How is being a facultative anaerobic advantageous to an organism?

Project Materials

- 2 graduated laboratory (Falcon) 15 mL tubes with screw-on caps
- 4 small clear plastic cups
- Warm water
- Sugar
- Active dry yeast
- 2 stir sticks
- $\frac{1}{4}$ teaspoon
- Teaspoon or graduated cylinder
- Fine-tipped marker
- Tape
- Stopwatch
- Pen or pencil
- Graphing software or graph paper
- Table for recording data

Student Checklist

- ☐ Perform the experiment as stated in the instructions
- ☐ Complete Table 1 with experimental data
- ☐ Create the two graphs
- ☐ Complete all questions