STO-103

Yeast Respiration

IMPORTANT!

Before you begin this lab activity, you need to follow this recipe to "activate" the dry yeast.

Mix the following ingredients in the medium-sized cup:

- 1 small tube of dry yeast
- 1 packet of table sugar (food for the yeast)
- 60 mL of warm tap water – use the small measuring cup provided (Make sure that the water is NOT hot. It should be warm like bath water).

Use a stir stick to thoroughly mix the yeast, water and sugar. Allow approximately 10 minutes for the yeast to be activated. You should see a small amount of foam appear on the surface.

While you wait for the yeast to become active, read the Introduction and Part 1 procedure.

Introduction:

Yeast are microscopic one-celled organisms. To obtain the energy they need for their life activities, yeast carry out a process called cellular respiration. During respiration, yeast cells use sugar as an energy source. They release the energy stored in food (sugar) molecules and use this energy to produce ATP molecules that power the yeast cells' chemical reactions. The waste products of respiration in yeast are carbon dioxide and alcohol. The chemical reactions in cellular respiration are controlled by enzymes.

$$\underset{\text{(food)}}{\text{Sugar}} \xrightarrow{\text{enzymes}} \underset{\text{(waste)}}{\text{Carbon Dioxide}} + \underset{\text{(waste)}}{\text{Alcohol}} + \text{Energy to make ATP}$$

1. Why do living organisms carry out the process of respiration?

_____

_____

2. Why is measuring the amount of carbon dioxide an appropriate way to determine the amount of respiration in yeast?

_____

_____

3. What substance does yeast use in respiration? _____

4. What waste product of yeast respiration is useful in making wine? _____

5. What waste product of yeast respiration is useful in making bread? _____

Part 1: How Does Temperature Affect the Rate of Yeast Respiration?

Research Question: Yeast usually grows in warm temperatures. How does changing the environment to a cold environment affect the rate of yeast respiration?

Your hypothesis:

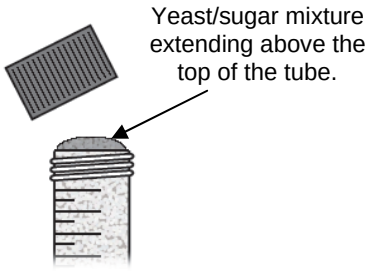
_____

_____

Test your hypothesis:

1. Label the two large graduated tubes and the two large cups –1 and 2.

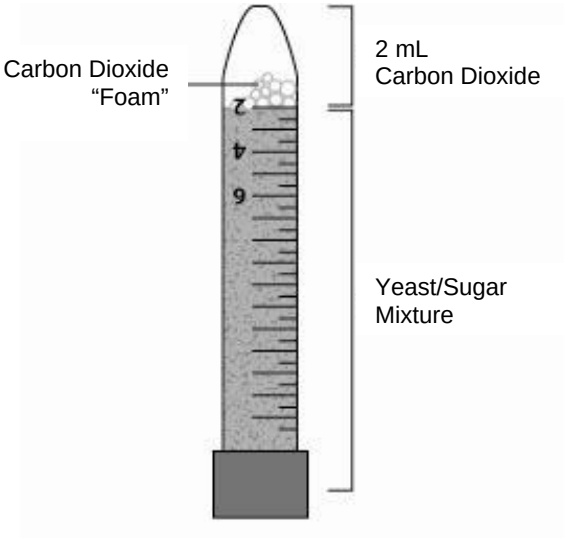
2. Fill cup 1 approximately three-quarters full with cold tap water. Fill cup 2 approximately three-quarters full with warm tap water.



3. Use a stir stick to stir the activated yeast/sugar mixture thoroughly.

4. Fill tube 1 and tube 2 with the yeast/sugar mixture. Fill the tubes all the way to the top, extending the fluid slightly above the top of the tubes (see picture on the right).

5. Screw the caps on the tubes. It is OK to have a few drops spurt out the holes in the caps.



6. Turn the tubes upside down and check to be sure that there is only a small bubble, or no bubbles, visible in the tubes. If there is a large bubble, it means that the tubes are not filled enough, and that you will need to add more yeast/sugar mixture to the tubes.

7. Keep the tubes turned upside down and place Tube 1 in cup 1 (the cup filled with cold water) and place Tube 2 in cup 2 (the cup filled with warm water). Be sure the pointed end of the tube is up and the cap is down.

8. After 2, 5, 10, and 15 minutes, record the volume of the carbon dioxide (CO_2) gas collected at the top of the tubes on the data table on the next page. The volume of carbon dioxide includes any foam bubbles (see the diagram to the right). *Note: Some of the cloudy yeast sugar may leak out of the hole in the cap. This is OK!*

As you wait to take readings, you should answer questions 9 through 14.

Data Table:

Time (minutes)	Total Volume of Carbon Dioxide Produced (mL)	
	In Cold Water Environment	In Warm Water Environment
2		
5		
10		
15		

9. What is the research question for this experiment?

   _____

10. The **independent variable** (manipulated variable) for an experiment is the factor that you change on purpose in an experiment. What is the independent variable for your experiment?

    Independent variable = _____

11. The **dependent variable** (responding variable) is the variable that may change as a result of a change in the independent variable. The dependent variable is the data that is observed and measured in an experiment. What is the dependent variable for this experiment?

    Dependent variable = _____

12. In a **controlled experiment** (fair test), the experimental group (which receives a treatment) is compared to a control group (which does not receive a treatment). Hint: Yeast usually need warm temperatures to grow.

    - Which setup is the control group? _____
    - Which setup is the experimental group? _____

13. In a **controlled experiment** (fair test) all other factors should be kept the same so that you can fairly compare the results from the control group and the experimental group. List three **controlled variables** – factors that were kept constant in both of the setups for this experiment.

    - _____
    - _____
    - _____

14. What data are you collecting in this experiment?

    _____

15. What results would you expect if your experiment supported your hypothesis?

_____

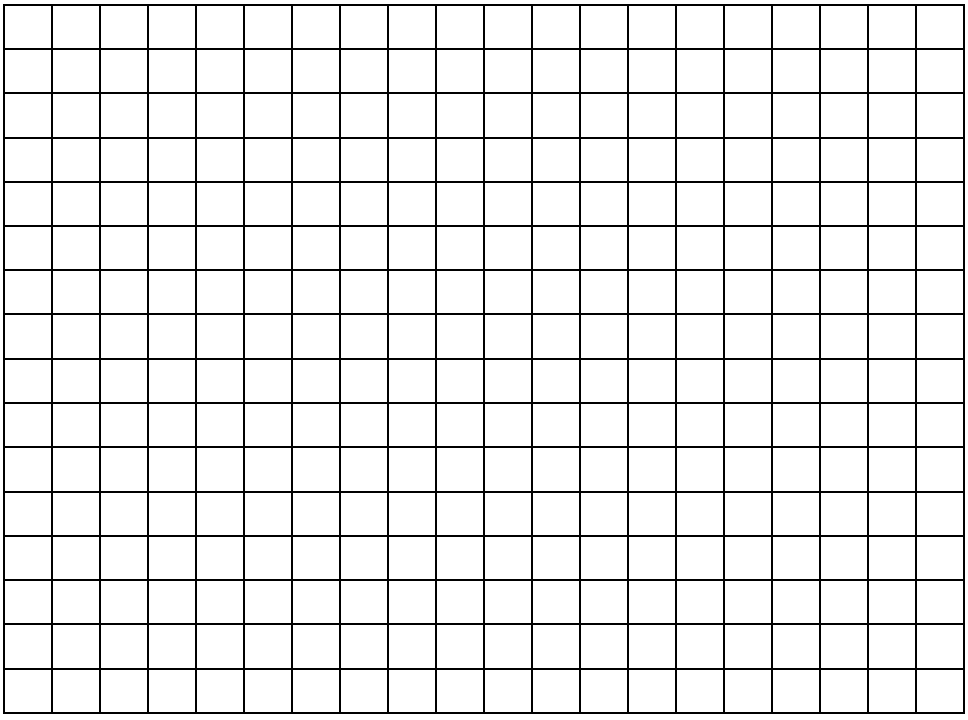
16. Once you have collected and recorded the data from your experiment, discard the yeast solution, water, and empty sugar packets. **Rinse and dry all other materials (tubes, cups, and stirrers) and return them to your laboratory kit for use in Part 2 of this lab.**

17. Prepare a graph to summarize the data you recorded in your data table.

- Label the vertical axis. Include appropriate measurement units.
- Mark an appropriate scale on each axis.
- Plot the data for the amount of carbon dioxide produced in cold water. Surround each point with a small circle (○) and connect the points.
- Plot the data for the amount of carbon dioxide produced in hot water. Surround each point with a small triangle (△) and connect the points.

The Effect of Temperature on Respiration in Yeast

Key
○ Yeast Respiration in **Cold** Water
△ Yeast Respiration in **Warm** Water



Time (minutes)

18. State ONE conclusion you can draw from this experiment.

_____

_____

19. Does the experiment support your hypothesis? Why or why not?

_____

_____

_____

20. Predict will happen to the amount of carbon dioxide produced if you let the experiment run for an additional hour? Explain your answer.

_____

_____

_____

21. Describe two specific things that you could have done to improve the reliability of this experiment.

- _____
- _____

Part 2: Design Your Own Experiment

In this laboratory activity, you will design, conduct, and report on an experiment to determine the answer to this research question:

How does using honey as a food, instead of table sugar, affect the rate of yeast respiration?

1. What is your hypothesis for this experiment?

   _____

   _____

2. What is the independent variable? _____

3. What is the dependent variable? _____

4. What is the control group for your experiment? _____

5. What is the experimental group for your experiment? _____

6. List three controlled factors that you kept the same in both the experimental and the control groups.
   - _____
   - _____
   - _____

7. Write a procedure to describe how you will set up your experiment. *Hint: Refer to the procedure from Part 1 of this lab, and modify the procedure so that is appropriate for your research question.*

   _____

   _____

   _____

   _____

   _____

   _____

8. Make the activated yeast/food mixtures that you will need for the experiment that you design. You will need to modify the basic recipe you used before to make yeast/food mixtures that are appropriate for your experiment.

9. Explain how you modified the recipe.

_____

_____

_____

10. Explain how you will collect data during your experiment.

_____

_____

_____

11. Construct a data table and record the results for your experiment.

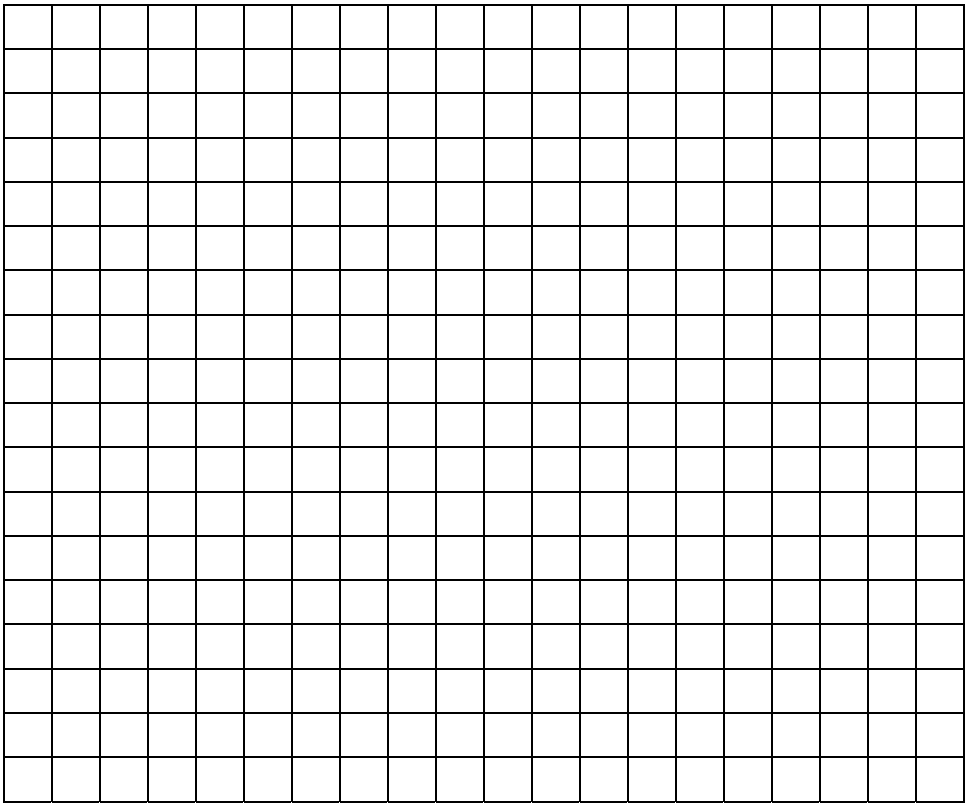
12. Set up and conduct your experiment. Record the data from your experiment in your data table.

13. Once you have collected and recorded the data from your experiment, discard all lab materials in the kit bag.

14. Prepare a line graph to summarize the results of your experiment.

Title: _____

Key
○
△



15. What conclusions can you draw based on the results of your experiment?

_____

_____

_____

_____

16. Did your experiment support your hypothesis? Explain why or why not.

_____

_____

_____

_____

17. Describe two specific things that you could have done to improve the reliability of your experiment.

- _____
- _____