# Carbon Cycle Part 3 - Fermentation Lab

## Summary

Over a multiple-day period, students will conduct an experiment with yeast to investigate the effects of different variables on carbon dioxide production. This series of lessons will focus on fermentation, or anaerobic respiration, which is a major proponent of the carbon cycle.

## Main Core Tie

Science - Biology

Standard 1 Objective 2

## Time Frame

6 class periods of 45 minutes each

## Materials

- powerpoint (yeast is beast)
- yeast
- multiple kinds of sugar (granulated, cubed, brown, splenda, etc)
- water
- weigh scale
- graduated cylinders
- 500mL plastic bottles
- rubber stoppers with hole
- lab quest with carbon dioxide probes
- timer
- graph paper
- calculators

## Background for Teachers

From the carbon cycle model you have created with your students, there are multiple lines/arrows pointing back to the atmosphere labeled "cellular respiration." This lab will investigate the process of respiration further. There are two types of cellular respiration: aerobic (requiring oxygen) and anaerobic (lacking oxygen).

Yeasts are heterotrophic organisms, meaning they need to acquire their food for energy. Classified as a type of fungus, yeasts obtain energy from sugar (glucose) in an aqueous environment by a specific anaerobic process called fermentation. There are two types of fermentation: lactic acid fermentation (which occurs in our muscle cells when they are oxygen deprived) and alcoholic fermentation (which is involved in food production, such as bread, cheese, beer and wine). Alcoholic fermentation begins once glucose diffuses into the yeast cell. The glucose is broken down into two 3-carbon molecules called pyruvic acid. The pyruvic acid is then broken down into carbon dioxide, ethanol and energy for the yeast cell. The carbon dioxide is released in a gaseous state and can be seen bubbling in a bottle or as the gas fills a balloon (which is why bread rises).

## Student Prior Knowledge

Students should have participated in the two previous Carbon Cycle lesson plans. In addition, experience with the scientific process (question, hypothesis, methods, data collection, graphing, conclusion) is highly suggested. If not, use this lab to provide an example of how a lab can be run, from question to conclusion.

## Intended Learning Outcomes

1. Use Science Process and Thinking Skills
   a. Observe objects, events and patterns and record both qualitative and quantitative information.
   d. Select and use appropriate technological instruments to collect and analyze data.
   e. Plan and conduct experiments
   3. Demonstrate Understanding of Science Concepts, Principles and Systems
   a. Know and explain science information specified for the subject being studied.
   c. Apply principles and concepts of science to explain various phenomena.
   4. Communicate Effectively Using Science Language and Reasoning
   a. Provide relevant data to support their inferences and conclusions
   b. Use precise scientific language in oral and written communication.
   c. Use proper English in oral and written reports.
   5. Demonstrate Awareness of Social and Historical Aspects of Science
   a. Cite examples of how science affects human life.

## Instructional Procedures

Day 1:

Spend 15 minutes presenting the powerpoint to students. Introduce information about yeast (heterotroph, "sugar-eating") and fermentation. Be sure to relate the respiration back to the carbon cycle model that students previously drew in their lab notebooks.

Tell students that they will be conducting an experiment over the next week to further investigate factors that can influence fermentation and yeast growth.

Break students up into groups. Allow groups to brainstorm questions they would like to investigate for the experiment. Be sure to have most of the materials for the experiment ready and visible. Allowing the students to see the variables they can change (ie, type of sugar) will help them complete these tasks more quickly.

By the end of the class period, groups should have a question and hypothesis written. For groups working more quickly, a procedure can be started for the experiment.

Day 2:

Before groups can start their experiments, a procedure, materials list and data table need to be made and approved by the teacher. The majority of this class period will be spent on completing this assignment. Everything should be written in the students' science notebooks.

Procedures that ALL groups need include adding yeast and sugar to their bottles first then adding water LAST; data to collect will be carbon dioxide amount (in parts per million / ppm); data will be collected every 30 seconds for 10 minutes; multiple trials should be conducted for each variable.

If time allows and groups have their procedure and data table approved by the teacher, then groups can begin their experiments. Students MUST have time to clean up their materials, as well!

By the end of the class period, students should have completed their materials list, procedure and data table. Some students may be able to finish one trial of their experiment as well.

Day 3-5:

Run the experiments. Each group should complete three trials for each variable they are testing. Once all data has been collected, an average should be calculated for each variable.

Each group should graph their results on a separate piece of graph paper. This assignment can be completed in class or as homework. Before assigning the graph, be sure to spend 5-10 minutes discussing the parts of a graph (ie, title, axes, intervals, legend, labels).

By the end of these class periods, each group should have finished collecting data, calculated the averages of their variables, and should be working on their graphs.

Day 6:

Spend the class period discussing the results of each groups' experiment. Each group should be able to provide their question, hypothesis, and variables. Each student in the group should also be able to summarize their results and graph. Have students practice summarizing their results by only saying one sentence about their data.
In addition, be sure to present the students' graphs to the rest of the classroom. Read the graphs as a class and make other observations.
As you review all the experiments as a class, make a list on the board of conclusions regarding yeast and fermentation.
To conclude the lesson, relate this experiment back to the carbon cycle. What arrow / process was this experiment representing? What are the factors that can affect carbon dioxide production? How do these changes affect the carbon cycle as a whole?
Provide the students with a small "cheat-sheet" outlining what should be included in a conclusion for an experiment. As a homework assignment, or for the remainder of the class period, have students write a conclusion for this experiment in their lab notebooks.

## Assessment Plan

Students will take notes in their science notebooks throughout the class period. Notebooks will be collected once a week and assessed based on a rubric.

## Rubrics

Science Notebook

## Bibliography


- A Swell Lab by the University of Missouri-St. Louis
- Root Beer Demonstration by Judith Simmons


## Authors


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