

SMALL AND MIGHTY: INTRODUCTION TO MICROBIOLOGY

HOME PRACTICAL

Testing how the amount of sugar affects
the rate of fermentation



INTRODUCTION

Yeast is a single celled fungus that is used in food production. Yeast likes to ferment sugars to produce energy. When yeast ferments sugar it creates ethanol and carbon dioxide gas (CO_2) as a by-product. These CO_2 bubbles are what makes bread rise and champagne fizz.

When yeast is mixed with sugar and water in a bottle, the production of CO_2 can be monitored by capturing it in a balloon and measuring how much the balloon inflates over a period of time. The faster the rate of fermentation, the faster the balloon will inflate.

In this Step, you are going to perform a simple microbiology experiment using everyday items that you can buy in a supermarket.

There are many variables that could be considered. You could hypothesise that the rate of fermentation will be affected by the amount of yeast, amount and type of sugar, and the environmental temperature that the experiment is conducted at. The measurements taken could also be affected by the volume of water in the bottles, the size of the bottles, and the size of the balloons.

For this experiment, you are going to set up 5 bottles but only make changes to one of these variables to see how it affects the production of CO_2 . It is important that you only change one of the conditions and ensure all the other conditions are the same in order to draw conclusions from the results.

It's a good idea to read through all the instructions at least once before starting the experiment.



Image 1: The equipment you will need to carry out the experiment.

WHAT YOU WILL NEED

- 4 tablespoons of fast action yeast or dried yeast (not live yeast)
- 5 empty 500 ml water bottles - it is a good idea to use fresh bottles and pour the water into a glass before you drink it so that you don't contaminate the bottles with your own microbes! They all need to be the same size
- Round, standard size balloons - they all need to be the same size
- 5 teaspoons of granulated sugar
- Water
- Measuring spoons
- Measuring jug with spout
- Funnel
- String
- Scissors
- Ruler
- Sticky labels, post-it notes or tape and paper
- Marker pen
- Timer
- And importantly, a notepad and pen (this will be your lab book to record your results)

INSTRUCTIONS

1. Write the date you perform the experiment in your lab book and make a list of everything you use so that you can replicate the experiment another day.
2. It's important to first decide on the experimental condition you would like to test. In this experiment, you will be testing how the amount of sugar affects the rate of fermentation. In experiments it is important to have a control to show that what you are measuring is not due to something unexpected. You will be proving that the yeast is responsible for producing the gas, so you should set up a control without yeast.
3. Label your bottles A, B, C, D, E so that you don't mix them up. Draw the table below in your lab book so you can record your results (or use the template in **appendix 1**).

TIME (MIN)	A (CM)	B (CM)	C (CM)	D (CM)	E (CM)
0					
15					
30					
45					
60					

Table 1: A table to record the results.

4. In stages, you will be adding the quantities of water, sugar and yeast from **table 2** below into each of the 5 bottles. **Stage 1: 200ml of water into each bottle.**

	Stage 1	Stage 2	Stage 3
Bottle	Water (ml)	Sugar (tsp)	Yeast (tbsp)
A	200	0	1
B	200	½	1
C	200	1	1
D	200	4	1
E	200	4	0

Table 2: The amount of water, sugar and yeast in each bottle.

INSTRUCTIONS (CONTINUED)

5. **Stage 2: Add the sugar.** Follow the amounts in **table 2**, so for example, bottle A will have no sugar, bottle B will have half a teaspoon (tsp) of sugar and so on.



Image 2: The 5 bottles labelled and Table 1 drawn in a notepad.



Image 3: Using a funnel to pour sugar into bottle C.

6. Shake each bottle so that the sugar dissolves.

7. **Stage 3: Add a tablespoon of yeast to bottles A,B,C,D but importantly not to bottle E which is the control.**



Image 4: Measuring out 1 tablespoon of yeast four times using a measuring spoon.



Image 5: Using a funnel to pour yeast into bottle B. This needs to be repeated for bottles A, B, C and D.

INSTRUCTIONS (CONTINUED)

8. Stretch a balloon over each bottle opening, making sure the seal is tight. It's a good idea to stretch the plastic and make it easier to inflate by blowing them up a few times before.



Image 6: Stretching the balloon.



Image 7: Pulling a balloon over the bottle B to ensure the seal is tight.

9. Now take your first measurement of each balloon diameter. The easiest way is to wrap a piece of string around the balloon, cutting it with the scissors at the point where the ends meet and then measuring the length of the string with a ruler. It might be easier to ask a friend to help with this! You can then record this zero time point measurement in your lab book.

INSTRUCTIONS (CONTINUED)



Image 8: Using a string to measure the diameter of the balloon.



Image 9: Recording the measurement in the lab book.

10. Using a timer, you will need to take the measurements of all 5 balloons every 15 minutes to record how much the balloons inflate. You should record each measurement in your lab book. Over the course of a few hours you will see how the amount of sugar affects how quickly and how much the balloons inflate.



Images 10 and 11: Using a timer to record how much the balloon inflates over a period of time and recording the measurement in the lab book.

11. To get a more accurate result, you should repeat this experiment at least more (ideally three times) to check that it is repeatable.