# Ideal Gas Law Yeast Lab (Student Guide)

*Please type up your lab report with the following headings indicated. Remember to delete instructions in red italics.*

### Purpose

Here is the chemical equation that represents the breakdown of sugar:

C12H22O11(s) + H2O(l) → 4CO2(g) + 4C2H5OH(l)

For this lab, you will compare experimental and theoretical results for the volume of carbon dioxide (CO2) produced when sugar (C12H22O11) is broken down in water (H20), using yeast as a catalyst.

### Hypothesis

*Complete Procedure A below to calculate the theoretical volume of carbon dioxide produced using stoichiometry and the ideal gas law. Show your calculations here and use that information to write a hypothesis.*

### Materials

*Update this list to represent YOUR reality.*

* 2 packets of quick rise yeast (1 packet for the lab + a back-up)   
  *Please note: 1 packet of yeast is equivalent to 7g or 2 1/4 tsp of yeast.*
* a small and clear soda or water bottle (500 mL)
* 1/4 cup of white sugar (we will use 1 tsp = 5 mL, but it is good to have extra on hand just in case)
* 2 balloons (1 balloon for the lab + a back-up)
* 1 meter of string
* 1 teaspoon measuring spoon
* a balance for measuring mass (optional)
* a meter stick

### Procedure A *(complete before the hypothesis)*

1. Measure out 1 teaspoon of sugar, which is equal to 5 mL. Make sure that you measure it **flat across the top** of your measuring spoon and set it aside.
2. Determine the mass of the sugar and set aside the sugar for later. Record it here: \_\_\_\_\_\_\_
   1. If you have a balance, you can measure the mass of the sugar.
   2. If you don't have a balance, you can estimate the mass using the density of sugar (1.59 g/mL) *Recall:*  *mass = density \* volume*
3. Calculate the volume of CO2 that you will expect to produce. Use the mass of sugar from Step 2 and assume that you are working at SATP (P = 101.3 kPa and T = 25 °C).

C12H22O11(s) + H2O(l) → 4CO2(g) + 4C2H5OH(l)

This value is the theoretical volume.

1. Write your calculations for the theoretical volume from step 3 in the Hypothesis section of your lab report. Include a statement for your hypothesis. How much CO2 do you expect to produce?

### Procedure B *(complete on lab day)*

*The materials and chemicals used in this investigation do not require any special handling or disposal. It is recommended that you work in a space that is easy to clean up in case there is a mishap involving the balloon slipping off of the bottle neck (which can be messy and smelly but not hazardous).*

1. Follow the instructions under "What To Do" on the [**Blow Up a Balloon with Yeast**](http://www.sciencebob.com/experiments/yeast.php) webpage (<https://sciencebob.com/blow-up-a-balloon-with-yeast>/).
2. After the balloon starts to inflate:

* Hold on to the mouth of the balloon so that it doesn't come off.
* Gently swirl the bottle to make sure that the contents have completely reacted.

1. Use a piece of string to measure the circumference of the balloon at its largest point. Place the string on a meter stick to find the length in centimeters (cm). Record your measurement in a data table in the Observations section.
2. Continue measuring the circumference every two minutes until the data shows you that the **reaction is complete**.
3. Clean up. Rinse out the bottle and recycle it (or set it aside for future experiments). Throw out the balloon.

### Observations

*Add a data table like the one provided to show how the balloon’s circumference is changing over time. Adjust the length of the table as needed.*

*Insert digital photos or add a link to a video of your lab set-up.*

### Analysis

Answer the following questions in your report and show all of your calculations:

1. Calculate the actual volume of the fully inflated balloon in cm3. Here are two equations to help you:

|  |  |
| --- | --- |
| Radius of a sphere:  *(given circumference)* |  |
| Volume of a sphere: *(given radius)* |  |

1. Convert the actual volume to litres (1000 cm3 = 1 L)
2. Compare the theoretical volume (from your hypothesis) to the actual volume (calculated in step 2). Did you get as much CO2 as you were expecting? What was the percentage of error?



1. What observable sources of error occurred in the lab? How could you improve the accuracy of the results? *Hint: Take your time with this question! Think about possible sources of error!*

### Conclusions

*Summarize what you learned in this experiment. Was your hypothesis correct?*