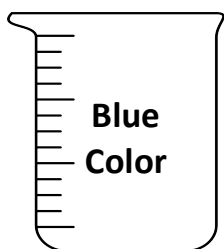


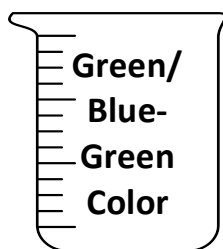
Lab 11: Cell Respiration of Different Sugars

Introduction:

Cellular respiration occurs in all living cells. Respiration is necessary to release chemical energy from carbohydrates. In this process carbohydrate molecules are necessary as reactants, and CO₂ gas and high-energy ATP molecules are released as products. In this lab, you will indirectly observe the generation of CO₂ from cellular respiration by yeast cells. You will provide the yeast with various carbohydrates to identify which types yeast has the ability to utilize for cellular respiration. To identify whether or not yeast was able to utilize the different types of saccharides (sugars), you will use the acid indicator Bromothymol blue. Bromothymol blue is blue in color when put in a basic solution and green in neutral solutions, but it will turn yellow in the presence of an acid. As CO₂ gas is produced by respiring yeast, it will dissolve in the water containing Bromothymol blue. CO₂ gas dissolved in water creates a weak acid called Carbonic acid, and this will turn the Bromothymol blue indicator yellow signifying acid. The diagram below illustrates this:



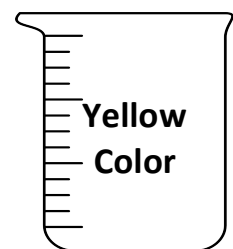
Indicates basic solution, no CO₂ produced by yeast



Indicates neutral solution, no CO₂ produced by yeast

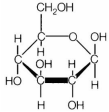
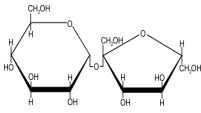
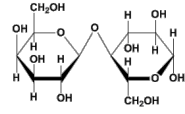
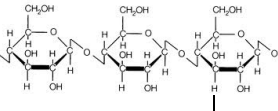


Indicates slightly acidic solution, small amount of CO₂ produced by yeast



Indicates acid solution, CO₂ produced by yeast

The information in the table below provides information about each of the saccharides or sugars that we are using and comparing in this lab:

Assigned to Group	Sugar Type	Where Found	Monomer/Polymer	Diagram	Enzyme Needed to Breakdown
1, 5, 9	Glucose	Dextrose food supplement	Monosaccharide: Glucose only		None (glucose is smallest unit)
2, 6	Sucrose	Table sugar, cane sugar, sugar beet	Disaccharide: Glucose + Fructose		Sucrase Enzyme
3, 7	Lactose	Milk (powder)	Disaccharide: Galactose + Lactose		Lactase Enzyme
4, 8	Starch	Corn starch, potatoes, grains	Polysaccharide: Thousands of glucose bonded together		Amylase Enzyme

Materials:

Yeast
Warm distilled water
Room temperature tap water
Two small plastic cups
Two large plastic containers with lids

Four test tubes, two with caps
Stirring stick
100mL Graduated cylinder
Tape and Sharpie
Wax paper

Glucose sugar
Sucrose sugar
Lactose sugar
Starch sugar
Bromothymol blue acid indicator

Procedure:

- Using the **tape** and sharpie label the two large containers. Label one "Control", and label the other with whichever sugar you are assigned (either "Glucose", "Sucrose", "Lactose", or "Starch"). Also, please label with one person's initials and the period number.
- *Note: you will only be setting up a control container and a container with **one** of the listed sugars, BUT you will be collecting the information for ALL the sugars by sharing information with other lab groups!
- In the Control Container (make this container FIRST):**
 - Using one of the small plastic cups, measure 1 gram of yeast into the cup.
 - Add 50mL of warm distilled water to the yeast in the plastic cup.
 - Use the stirring stick to mix the yeast in the warm distilled water.
 - Take two test tubes and fill approximately 2/3 full with room temperature tap water, use graduated cylinder to fill.
 - Add 15 drops of Bromothymol blue to each of the test tubes. (Note: Bromothymol blue is not toxic, but it can stain clothing!)
 - Cap ONE of the test tubes tightly to prohibit any gases from entering the water in the test tube.
 - In the large container labeled "Control", carefully put the yeast/water mixture cup in the bottom. Then carefully place both test tubes in as well standing up right or leaning against the side.
 - Place a piece of wax paper on the open container and then cover and seal with the container lid to create an airtight seal.
 - Carefully place this container on the back counter under your correct period number.
- In the Sugar (Glucose, Sucrose, Lactose, or Starch) Container:**
 - Follow the instructions for your assigned sugar (see front!). DO NOT COMPLETE ALL OF THESE, JUST ONE:**
 - Glucose:
 - Using one of the small plastic cups, measure 1 gram of yeast into the cup, then zero out the scale.
 - Measure 2 grams of glucose powder.
 - Add 50mL of warm distilled water to the yeast and glucose in the plastic cup.
 - Use the stirring stick to mix the yeast in the warm distilled water.
 - Sucrose
 - Using one of the small plastic cups, measure 1 gram of yeast into the cup, then zero out the scale.
 - Measure 2 grams of sucrose.
 - Add 50mL of warm distilled water to the yeast and glucose in the plastic cup.
 - Use the stirring stick to mix the yeast in the warm distilled water.
 - Lactose
 - Using one of the small plastic cups, measure 1 gram of yeast into the cup, then zero out the scale.
 - Measure 2 grams of milk powder.
 - Add 50mL of warm distilled water to the yeast and glucose in the plastic cup.
 - Use the stirring stick to mix the yeast in the warm distilled water.
 - Corn Starch
 - Using one of the small plastic cups, measure 1 gram of yeast into the cup, then zero out the scale.
 - Measure 2 grams of corn starch.
 - Add 50mL of warm distilled water to the yeast and glucose in the plastic cup.
 - Use the stirring stick to mix the yeast in the warm distilled water.
 - Use the stirring stick (popsicle stick) to mix the yeast in the sugar solution.
 - Take two test tubes and fill approximately 2/3 full with room temperature tap water, use graduated cylinder to fill.
 - Add 15 drops of Bromothymol blue to each of the test tubes. (Note: Bromothymol blue is not toxic, but it can stain clothing!)
 - Cap ONE of the test tubes tightly to prohibit any gases from entering the water in the test tube.
 - In the large container labeled with one of the sugars, carefully put the yeast/water mixture cup in the bottom. Then carefully place both test tubes in as well standing up right or leaning against the side.
 - Place a piece of wax paper on the open container and then cover and seal with the container lid to create an airtight seal.
 - Carefully place this container on the back counter under your correct period number.
- Both containers will be kept in the classroom at room temperature for 24 hours. After 24 hours, the test tubes will be observed for a color change in the Bromothymol blue indicating the presence of acid, which indicates the production of CO₂ gas by yeast's cellular respiration of each type of sugar.