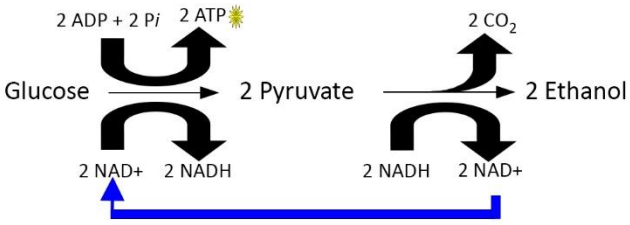
Respiration and Fermentation: Fermentation by Yeast

Most eukaryotic organisms derive cellular energy from either aerobic cellular respiration or fermentation. As explained in the introduction to this module, fermentations start with pyruvate, the end-product of glycolysis and then regenerate NAD^+ and some other organic intermediate. There are many products of fermentation, but the most commonly discussed are ethanol and lactic acid. Ethanol fermentation is performed by fungi, like baker's yeast (*Saccharomyces cerevisiae*). The summary reaction is shown below:

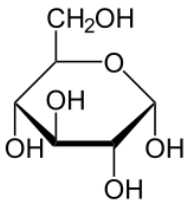


Summary Reaction of Ethanol Fermentation

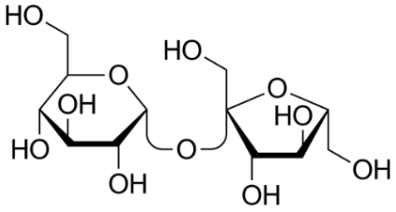
The products of this fermentative process are ethanol, carbon dioxide and NAD+. NAD+ is a carrier molecule which transports a hydrogen ion and electrons stripped from glucose to the electron transport chain. Without NAD+, glycolysis stops. Fermentation regenerates NAD+ which can then cycle back to glycolysis which allows the cell to make more ATP. Carbon dioxide is released as a gas. Ethanol is also excreted.

In this activity, you will test the ability of yeast to ferment different sugars. Galactose, is a monosaccharide with the same chemical formula as glucose. Glucose is also a monosaccharide and simple sugar. Sucrose (table sugar) is a disaccharide formed by dehydration synthesis of glucose and fructose.

Galactose



Glucose



Sucrose

Materials

Yeast suspension (1 packet of yeast per 250 mL warm water)
Empty water bottle (16 oz or .5 L) – 4
Distilled water
Graduated cylinder – 250 mL
Sucrose solution
Glucose solution
Galactose solution
Balloons – 4

Procedure

1. Label the 4 empty water bottles as follows: water, sucrose, glucose, and galactose.

2. Add 150 mL of distilled water to the bottle marked ‘water’. Use the graduated cylinder to dispense 150 mL of each sugar solution into the correspondingly named water bottle. Rinse the graduated cylinder between solutions.
3. Add 100 mL of yeast suspension to each bottle. Swirl the bottle to mix the solutions.
4. Stretch the balloons. Then attach a balloon to the mouth of each bottle.
5. Allow the reaction to continue of 2 hours. Qualitatively assess gas production in the bottles every 30 minutes. Record your results below.
6. Swirl the bottles gently at each half hour mark.

	Gas Production at each Time Interval (Rank gas production using a scale of 1 to 4, with 1 representing the largest balloon, i.e., most gas produced)					
Bottle	0	30	60	90	120	Was the sugar fermented?
Water						
Sucrose						
Glucose						
Galactose						

What gas is accumulating in the balloon/s?

Which sugar or sugars were fermented?

Why was/were the other sugar/s not fermented?