**Background**

Yeast are tiny single-celled (unicellular) fungi. The organisms in the Kingdom Fungi are not capable of making their own food. Fungi, like any other organism, need food for energy. They rely on sugar found in their environment to provide them with this energy in order to grow and reproduce.

Yeast, like bacteria, grow in or on their food source. They produce and release digestive proteins (enzymes) into their environment where the sugar molecules are found. Complex sugar molecules are broken down into monosaccharides that can be absorbed by the yeast and used for food (energy).

There are many species of yeast, and each has a particular food source. Certain yeast species feed on a variety of natural sources of sugar such as fruits, nectar from plants, and molasses from the plant crop called sorghum. Others break down wood and corn stalks. In doing this, a compound called ethanol is produced. This compound can be used in our cars like gasoline. Another species breaks down sugar from grain into alcohol. Others break down fruits into wine, which is another type of alcohol. Bread recipes rely on yeast to break down the sugars found in flour.

Yeast is a facultative anaerobe, meaning that it can participate in aerobic respiration when possible, but when this is impossible, it respires anaerobically. When using yeast in making dough, the yeast will use the initial oxygen up very quickly and then start to respire anaerobically. ATP will then be made via glycolysis, which requires no oxygen. Without oxygen present, the yeast will then undergo alcoholic fermentation, which produces CO₂ and ethyl alcohol. Overall, the final equation for glycolysis plus fermentation would be:

\[
\text{C}_6\text{H}_{12}\text{O}_6 \rightarrow 2\text{CO}_2 + 2\text{C}_2\text{H}_5\text{OH} + 2\text{ATP}
\]

For the yeast cell, this chemical reaction is necessary to produce the energy for life. The alcohol and the carbon dioxide are waste products produced by the yeast. It is these waste products that we, as humans, take advantage of. The chemical reaction, known as fermentation, can be watched and measured by the amount of carbon dioxide gas that is produced from the break down of glucose.

*Do you think that the rate of carbon dioxide production during fermentation would be affected by the availability of simple sugars? Explain.*
Objective
In this lab, we will observe the effect of food sources on the process of fermentation by yeast. You will attempt to determine the effect of sugar on the rate of CO$_2$ production. You will assess CO$_2$ production by measuring how much the bag rises in a set period of time.

Materials
- Three plastic bags per group
- Three types of cereal per group
- Yeast
- Warm water
- Timer

Procedure
1. Get three plastic bags and label them A, B, and C.
2. Place 5 grams of cereal (about one handful) into bag A.
3. Add 50 ml of warm water to bag A.
4. Add 5 grams of yeast (about one spoonful) to bag A.
5. Seal bag. (The bag must be sealed tightly!)
6. Measure the height of the bag in cm. (This is the “Before Height.”) Record in the Data Table on the next page.
7. Mix solution carefully with hands and set aside.
8. Repeat steps 2-7 for bags B and C, using a different cereal in each bag.

After Rising:
9. Measure the height of each bag in cm. (This is the “After Height.”) Record in the Data Table on the next page.
## Results

### Group Data Table

<table>
<thead>
<tr>
<th>Cereal Type</th>
<th>Grams of Sugar in Cereal</th>
<th>Before Height (cm)</th>
<th>After Height (cm)</th>
<th>Change in Height (cm)*</th>
<th>% Change in Height**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bag A</td>
<td>Cheerios</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bag B</td>
<td>Apple Jacks</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bag C</td>
<td>Honey Smacks</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

* To calculate Change in Height, you will subtract the Before Height from the After Height.

** To calculate the % Change in Height, you will divide the Change in Height by the Before Height and then multiply by 100.

### Class Data Table: Percent Change in Height

<table>
<thead>
<tr>
<th>Cereal Type</th>
<th>Group 1</th>
<th>Group 2</th>
<th>Group 3</th>
<th>Group 4</th>
<th>Group 5</th>
<th>Group 6</th>
<th>Group 7</th>
<th>Group 8</th>
<th>Group 9</th>
<th>Group 10</th>
<th>Average % Change***</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cheerios</td>
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</tr>
</tbody>
</table>

*** To calculate the Average % Change in Height, you will add all groups’ data and divide by the number of groups.

Average % Change = Sum of all Groups/Total Number of Groups
Conclusion

1. Sugar content was higher in some bags than others. What did the increase in sugar do to the size of the bag? *Explain you answer in terms of the energy source(s) available to the yeast.*

2. When did the bag stop growing? Why?

3. Was anything produced during the fermentation process? If so, where is it?

4. Why was it necessary to mix the bag?

5. What was the purpose of the warm water?

6. In thinking about making bread using yeast, most recipes for bread have you add a small amount of sugar or molasses to the mixture. Looking at the results, what purpose do you think these may serve?

7. Outline another method that you might have used to accomplish the same information about yeast fermentation.