

## PLEASE DO NOT WRITE ON THIS SHEET. THIS IS A CLASS SET

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## FERMENTATION MAKING ROOT BEER



**Introduction:** Fermentation has been used by mankind for thousands of years for raising bread, fermenting wine and brewing beer. The products of the fermentation of sugar by yeast *Saccharomyces sp.* (a fungus) are ethyl alcohol and carbon dioxide. Carbon dioxide causes bread to rise and gives effervescent drinks their bubbles. This action of yeast on sugar is used to 'carbonate' beverages, as in the addition of bubbles to champagne).

**Respiration:** The breakdown of sugar (glucose) to form ATP (a form of energy for an organism). There are two types, aerobic and anaerobic (also called fermentation).

**History of Root Beer:** Root beer was made by our forefathers by soaking Sassafras (a type of tree) root in water, and adding sugar and yeast (yeast for carbonation). In the early 1900's however, scientists discovered that safrole, a chemical found in Sassafras root, was a carcinogen (which means it is a cancer causing agent.) Now, a mixture of other herbs and spices makes up "root beer extract" which is what we now use to make homemade root beer.

**Background Information:** There are two types of respiration: aerobic (requiring oxygen) and anaerobic (without oxygen.) Yeast cells (a type of fungus) obtain energy from glucose (sugar) by a specific anaerobic process called fermentation. There are two types of fermentation, lactic acid fermentation (which occurs in muscle cells when they are oxygen deprived), and alcoholic fermentation, which is involved in the making of food products. Alcoholic fermentation begins after glucose diffuses into the yeast cell. The glucose is broken down into 2, 3 carbon molecules called pyruvic acid. The pyruvic acid is then converted to CO<sub>2</sub>, ethanol, and energy for the yeast cell. Don't get excited, students, there is very little ethanol in this root beer. :) Fermentation is used to make a variety of food products, including the making of beer, wine, bread, cheese, sauerkraut, and baked goods. It is the carbon dioxide produced by the yeasts that give root beer its "fizz." This fizz is produced in store bought root beer by a carbonation machine that forces carbon dioxide into the root beer mixture, without the aid of our little yeast friends.

**Equation for alcoholic respiration:**  $C_6H_{12}O_6 \rightarrow CH_3-C-COO \rightarrow CO_2 + H_2O + CH_3CH_2OH$  (ethanol)

**Purpose:** To produce a root beer by the Fermentation of sugar. We will set up a fermentation in a closed system and capture the generated carbon dioxide to carbonate root beer.

### Materials:



2 liter plastic soft drink bottle with cap (CLEANED!)	Bottle sanitizer
Funnel	Cane (table) sugar [sucrose] (1 cup)
1 Cup measuring cup	Zatarain's Root Beer Extract (1 tablespoon)
1/4 tsp measuring spoon	Powdered yeast (1/4 teaspoon)
1 Tbl measuring spoon	Tap water (spring water preferred)

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**IMPORTANT:** Before starting the procedures below you need to **CLEAN** your bottle using a faucet spray nozzle. Make sure there is **NOTHING** in the bottle other than water. After cleaning you need to sanitize the bottle using **1 1/2 cups of water and a little (1/4 in the pouring chamber of the sanitizer bottle) sanitizer**. Then coat the entire inside of the bottle with the sanitizer and water solution. Pour the sanitizer over the cap and make sure to get sanitizer over the top of the bottle. Then drain the bottle. Do **NOT** rinse.

**FAILURE TO DO THE ABOVE PROPERLY COULD RESULT IN YOUR ROOTBEER GETTING CONTAMINATED!!**

### Procedures:

- 1) Assemble the necessary equipment and supplies
  - 2) With a dry funnel, add **1 level cup of table sugar (cane sugar)**
  - 3) Add: 1/4 teaspoon yeast** (You can see the yeast granules on top of the sugar.)
  - 4) Shake to distribute the yeast grains into the sugar.
  - 5) Swirl the sugar/yeast mixture in the bottom to make it concave (to catch the extract).
  - 6) **SHAKE ROOT BEER EXTRACT**
  - 7) Add with funnel: **1 Tbl of root beer extract** (on top of the dry sugar)
  - 8) The extract sticks to the sugar which will help dissolve the extract in the next steps.
  - 9) Half fill the bottle with fresh cool tap water (the less chlorine, the better). When filling rinse in the extract which sticks to the tablespoon and funnel. Swirl to dissolve the ingredients.
  - 10) Fill up to the neck of the bottle with fresh cool tap water**, leaving about an inch of head space, securely screw cap down to seal. Invert repeatedly to thoroughly dissolve.
  - 11) Place at room temperature in a dark spot for three to four days until the bottle feels hard to a forceful squeeze. Move to a cool place (below 65 F). Refrigerate for 2 more days. Refrigeration will stop the fermentation process and kill the yeast. Total aging of at least one week is recommended. Be sure to check the bottles every day for tightness, if they get too pressurized, they will explode. Crack the lid just a little to release the pressure slowly if need be (check with Mrs. Robson first).
- NOTE:** Do not leave the finished root beer in a *warm* place once the bottle feels hard. After a couple weeks or so at room temperature, especially in the summer when the temperature is high, enough pressure may build up to explode the bottle! There is no danger of this if the finished root beer is refrigerated.
- 12) Move to a refrigerator overnight before opening.

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**NOTE:** There will be a sediment of yeast at the bottom of the bottle, so that the last bit of root beer will be turbid.  
Decant carefully if you wish to avoid this sediment.

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Please answer in your lab notebook. Please use complete sentences that include the nature of the question.

**Analysis Questions**

*The first set of questions should be answered the day root beer was made.*

*The others should be answered when the root beer is ready.*

**PART 1: Answer the following questions the day you made the root beer:**

1. Describe the appearance of the root beer during the bottling process.
2. Why were the yeasts necessary in this experiment?
3. Why was the sugar necessary?
4. Explain how commercial (store bought) root beer is carbonated.
5. What is safrole? Why do we not use it anymore?
6. List the needed ingredients to make root beer.
7. Why did we need to refrigerate the root beer during fermentation? (other than making it cold to drink).
8. What is fermentation? (refer to chapter 6 if you are not clear on this). Please discuss the process in detail.

**PART 2: Answer the following questions the day the root beer is ready:**

9. Describe the appearance of the root beer after fermentation. How is it different from #1?
10. Explain how the root beer came to be carbonated.
11. How did your root beer taste compared to the root beer you buy at the store?
12. What might account for this difference?
13. How does this lab relate to what we have been studying in class?