# Boot Reer Root Beer

## Summary

Activities involving dry ice and root beer help students understand the chemical and physical changes that occur in matter.

## Group Size

Small Groups

## Materials

- *Physical/Chemical Change Rhyme*
- *Question/Prediction Chart*
- *Compare/Contrast*
- *Yeast Root Beer Recipe*
- *Dry Ice Root Beer Recipe*
- *Dry Ice Facts*

Homemade root beer kit
Root beet extract
Sugar
Water
Dry yeast
Dry ice
Digital Scale
Gloves
2 Empty 2-liter bottle for each group (cleaned and sanitized)
Measuring cups
Measuring spoons

- *The Root Beer Book: A Celebration of America's Best-Loved Soft Drink*
- *Root Beer Lady: The Dorothy Molter Story*

Additional Resources
Books
*The Root Beer Book: A Celebration of America's Best-Loved Soft Drink*, by Laura E. Quarantiello; ISBN 0936653787
*A Flying Needs Lots of Root Beer*, by Charles M. Schulz; ISBN 0694010464
*Root Beer Lady: The Dorothy Molter Story*, by Bob Cary; ISBN 0938586688

## Background for Teachers

A physical change involves the changes that can be observed without changing the identity of substances. A chemical change is a process in which reactants are changed into one or more different products. A chemical change occurs whenever compounds are formed or decomposed. During this reaction, there is a rearrangement of atoms that makes or breaks chemical bonds. This change is usually not reversible.
Another way in which the distinction between chemical and physical changes is often expressed is to state that only chemical reactions involve the rearrangement of atoms within the molecule, which leads to the creation of a new molecule (new substance). Physical change does not create anything new; there is no change in the identity of the material (substance).
Changes in *state* but not chemical composition are not considered chemical changes. For example,

while boiling water involves a change in *temperature* and the release of a *gas* (water vapor), a chemical change did not take place.

## Intended Learning Outcomes

1. Use science process and thinking skills.

## Instructional Procedures

Invitation to Learn

Which Soda Pop Contains the Most Fizz?

In this activity the class will be split up into five or six different groups. Each group will be given a different brand 24 oz. bottle of soda pop. The groups will predict which soda has the most fizz and tell why they think that. The groups will be instructed to equally disperse about 12 of their bottle to the members of their group using small cups. As the students drink their soda, instruct them to think about descriptive words to describe how the soda pop tastes. The students will write these words on 3x5 cards. The groups will then take the remainder of their soda in the bottle and put a balloon over the opening. Have the students will take turns shaking the bottle lightly. The balloon will begin to fill with carbon dioxide. Then, have the groups will then take the carbon dioxide filled balloons and tie them off. The groups measure their balloons on the scale provided to see how much carbon dioxide was released from their soda. The groups will then compare their findings.

Instructional Procedures

Hand out the *Dry Ice Root Beer Recipe*. Read through the recipe with the class. (Because handling dry ice can be dangerous I have chosen to make the root beer with the class assisting me.) Hand out the *Physical/Chemical Change Rhymes*. Point out that in the following recipe a physical change will be used to add fizz to the root beer.

As you follow the recipe, point out to the class some facts about dry ice. Hand out *Dry Ice Facts* and talk about some of the things dry ice is used for, how it is manufactured, and what it is made of.

When finished, put dry ice in the root beer and have the students observe the effect. Discuss sublimation. Sublimation is the change from solid to gas while at no point becoming a liquid. When you place dry ice into some warm or hot water, clouds of white fog are created. This white fog is not the CO 2 gas, but rather it is condensed water vapor mixed in with the invisible CO 2. Also discuss that the carbon dioxide is mixing and attaching to the liquid root beer mixture.

Ask the class: What type of a change is occurring to the root beer mixture? A physical change is occurring. This is because no new substances are being made, and we can easily reverse the change. The carbon dioxide existed as a solid before we placed it in the root beer and it exists in a gaseous form to create fizz in our root beer.

As the dry ice sublimates in the root beer (10-15 min), take this time to use some of your leftover dry ice chunks to do a couple of experiments.

- Popping Film Cans
  A fun (and often wild) activity vividly demonstrates the sublimation process. Place a piece of dry ice into a plastic 35mm film container - the kind that has the snap-on cap. Then wait. The cap will pop off, and sometimes fly several meters. The clear Fuji brand containers shoot farther than the gray and black Kodak type. Warn anyone performing this experiment not to aim for anyone's eyes.
- Singing Spoon
  Press a warm spoon firmly against a chunk of dry ice. The spoon will scream loudly as the heat of the spoon causes the dry ice to instantly turn to gas where the two make contact. The pressure of this gas pushes the spoon away from the dry ice, and without contact, the dry ice stops sublimating. The spoon falls back into contact again, and the cycle repeats.

This all happens so quickly that the spoon vibrates, causing the singing sound you hear.

- Fog Effects

When you place dry ice into some warm or hot water, clouds of white fog are created. This white fog is not the CO 2 gas, but rather it is condensed water vapor, mixed in with the invisible CO 2. The extreme cold causes the water vapor to condense into clouds. The fog is heavy, being carried by the CO 2, and will settle to the bottom of a container, and can be poured.

In this last step, the students will taste the root beer and write down some of the characteristics of the root beer on the *Venn Diagram* . (Focus on descriptive words and the fizz of the root beer. I like to ask the class to rate the fizz on a 1-10 scale.)

Hand out the *Yeast Root Beer Recipe* to the groups. (Each of these recipes are different from one another.) Read through the recipe with the class, and distribute the tools needed to make this type of root beer. It should be explained to the students that the recipes are different to allow comparing and contrasting. Discuss with the class that zymology is the study of fermentation. Fermentation is the chemical conversion of carbohydrates (sugars) into alcohols or acids. Basically, the yeast eats the sugar and a chemical change occurs, creating carbon dioxide. The students will then fill out their *Question/ Prediction* handout. The students will try to rate which root beer recipe will have the most fizz.

I have found it more exciting to let the students follow the recipe and make it themselves. Sometimes the students make errors or alterations to the recipe and the outcome is valuable in discussing the scientific process. Make sure to rotate through the class offering help as the class follows their recipe.

After the groups have made their root beer, make sure they label their bottles. Then put the bottles somewhere in the sun where they will not be disturbed for at least 4 hours. Then chill the bottles overnight.

In this last step, have the students taste test their root beer. Make sure the students get a chance to taste each of the root beer recipes. Using the Venn Diagram, have the class describe how the recipes are the same and how they are different. Focus on descriptive words and similes and metaphors.

## Extensions

Curriculum Extensions/Adaptations/ Integration

Explore zymology on the Internet/PowerPoint. What types of jobs use zymology and what types of products are made using zymology? Provide ideas for extension for advanced learners.

Explain and predict the effects that would occur if various changes were made to the root beer recipes

Supply students with vocabulary and definitions.

Extend time limit for students with special needs.

Use pictures in a Power Point presentation to show the steps of the recipe.

Include ideas for integration for other curricular areas Have the students describe what other things taste like using similes and metaphors.

Family Connections

Have the students take a copy of *Root Beer Lady: The Dorothy Molter Story* home to read with their parents.

Have students make a list with their parents of household products that have yeast/carbon dioxide in them. Then have them write what characteristics the yeast/carbon dioxide has upon the products.

## Assessment Plan

Rubric: Were the objectives reached? Was Root Beer Created?
Non-Fiction Vocab-u-Write
K.W.L.

## Bibliography

Research Basis

Maryland State Dept. of Education, Baltimore Div. of Instruction (1988). *Better Thinking and Learning: Building Effective Teaching through Educational Research*. 1-98.
Instruction in 30 program areas, this paper is designed as a resource to assist teachers in expanding and refining teaching strategies. Topics included in the article include: activating prior knowledge, cooperative learning, critical thinking, graphic organizers, and metacognitive strategies.
Bathajthy, Ernest. (1988). From Metacognition to Whole Language: The Spectrum of Literacy in Elementary School Science. 26p.
This article considers the integration of reading and writing into elementary science. The article discusses the use of graphic organizers for teaching text structure, and the use of semantic feature analysis for teaching vocabulary concepts.

## Authors

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