Session 4: Secret Formulas for Cola

Overview

In this session, students apply what they learned in the previous session about optimum amounts of sugar, and also add other ingredients to make their personal secret formula for cola. This time, they record their secret formula on a data sheet.

Students start with club soda, to which you add brown food coloring. They then choose from four additional ingredients: sugar, vanilla, cinnamon, and lime juice. Students use measuring, recording, and testing skills. When their colas are complete, students add ice cubes, and enjoy.

The final discussion centers on whether their cola would come out exactly the same if they used their secret formula again. If they change an ingredient or an amount, will the cola be different? The concept that results are repeatable (if we follow the same exact procedure, the same result will happen) may not yet be obvious to students. This is all right. You may find that they gain understanding of this important concept gradually, over the course of the entire Secret Formulas unit.

What You Need

For the class:

☐ 1 piece of large white construction paper to make class color key
☐ the list of cola attributes from Session 2
☐ the class graph of sugar amounts from Session 3
☐ a few colored dots in the colors used previously
☐ 1 wide-tipped, felt black marker
☐ 1 bag ice cubes (at least 1 cube per student)
☐ 1 teaspoon red food coloring
☐ 1/2 teaspoon green food coloring
☐ 2 bottles lime juice (8 oz. each)
☐ 2 bottles vanilla extract (8 oz. each—imitation vanilla is fine)
☐ 1 small container ground cinnamon (containers usually have about an ounce or a little less)
☐ 1 lb. sugar
3 or 4 cans club soda or salt-free, flavorless seltzer water* for demonstration and as extra for class
2 plastic cups (one with teacher's initials on it)
1 dump bucket (if no sink is available)
the students' personal plastic cups
(optional) 1 cooler for the ice cubes
(optional) 1 roll of plastic wrap (to cover vanilla extract if you need to pour it ahead of time)

*12 ounce cans of club soda are ideal because you'll be distributing one to each group of four students, who will then pour about three ounces into each of their personal cups. However, if you can't find cans, club soda is also sold in six-packs of small bottles, or large 2-liter bottles.

For each group of four students:
1 cafeteria tray
2 red-dot cups of sugar with spoons, popsicle sticks, and stirrers (from Session 3)
3 color-coded plastic cups emptied and rinsed from previous activities (one each of blue, green, and yellow)
2 flat toothpicks for cinnamon scoops
32 half-straws for droppers
1 can club soda or salt-free, flavorless seltzer water *
4 Cola data sheets (master on page 51)
4 pencils
tally sheet from Session 3
1 container (cottage cheese-type) for ice
(optional) crayons or markers (4 sets of red, blue, yellow, and green)

Getting Ready

1. Make a class color key. List sugar, lime juice, vanilla, and cinnamon on large white paper, using a marker. Next to each ingredient, put a colored dot to correspond with the cups listed in number 6, below.

2. Make the brown food coloring. Mix up brown food coloring in a cup. Mix 1 teaspoon red with a half teaspoon green. You'll use this at the beginning of the activity to color club soda.
3. **Prepare the ice.** Have a bag of ice on hand. Break up the ice in the bag if it is frozen solid. If possible, keep the ice in a cooler until the end of the session.

4. **Replenish the sugar.** Add sugar to the red-dot cups so that there is about half a cup of sugar in each. Leave the two spoons, two popsicle sticks, and two stirrers in each cup.

5. **Make straw droppers.** Cut straws in half to make four straw droppers for each group plus one for you, the teacher, to use with the brown food coloring.

6. **Set up ingredients on trays.** Put ingredients into color-coded cups for each group of students, and place cups and club soda on each group’s tray as follows:
   - **red-dot cups:** Use the two red-dot cups of sugar with spoons, popsicle sticks, and stirrers that you saved from Session 3
   - **green-dot cup:** Put in about ¼ cup of lime juice (2 ounces) with two droppers
   - **yellow-dot cup:** Put in about ¼ cup of vanilla (2 ounces) with two droppers
   - **blue-dot cup:** Put in one teaspoon cinnamon with two toothpicks to be used as scoops
   - 1 unopened can of club soda (12 ounces)

7. **Arrange additional materials.** Have handy—but not on trays—ice, one small container per team in which to put the ice, your personal cup with initials for demonstration, and all the students’ personal cups.

8. **Prepare the student data sheets.** Duplicate one Cola data sheet per student (master on page 51). If your students are non-readers and will need to color-code the ingredients on their data sheets, have red, blue, yellow, and green crayons or markers handy.

Try to pour vanilla just before the activity to minimize evaporation. If you have to pre-pour, place a piece of plastic wrap over vanilla cups to slow evaporation.

Color coding data sheets helps make identification of ingredients easier for students, especially for non-readers. Before the activity, the students can color code the data sheets with a crayon or marker to match your chart. For older students, it may not be necessary to color code data sheets.
Introducing the Ingredients

1. Ask the class to think back to when they made paste. What were the attributes of the paste? [sticky, gooey, etc.] What ingredients worked the best? Which powders did they use? How many spoonfuls of each ingredient did they use? How many squirts of water? Did they write it down? [no] Why is it important to write down formulas?

2. Tell students that they are now going to make their own secret formula for cola. This time, they will carefully record how much of each ingredient they use. If it turns out great, they will be able to make it again, exactly as great! If it turns out not so good, they can look at exactly what they put in and change the formula.

3. Introduce the new ingredients, using the class color key and holding up cups of ingredients from a tray.

4. It is helpful if students have an idea how the ingredients will taste. However, don't give them too much information about the ingredients, as students will be deciding for themselves what to add.

   a. Ask, "Have you ever tasted a lemon?" "How does it taste?" [sour!] Lime juice is like lemon juice. Ask, "What will happen to the taste of your cola if you add too much lime juice?" [very sour]

   b. Suggest that if they don't know how vanilla or cinnamon taste, they can smell them carefully, using the method of wafting. Show the class this method—bringing a smell to your nose through the air by using your hand.

   c. Ask what will happen if they use too much cinnamon. [The cola will taste more "cinnamon-y"] Stress that cinnamon is a strong spice so they should use only little toothpick scoops. Demonstrate how to tilt the cup a little, and scoop a little bit of cinnamon out on the flat end of the toothpick. Say that they will use the straw droppers to add the lime juice and vanilla—one drop at a time.
5. Refer to the class graph of how much sugar was in the cola water in Session 3, and mention that this information might be helpful in determining how much sugar to add to their own colas.

**Demonstrating How to Make Your Own Cola**

1. Point to the bottom of the letters marking your initials on your personal cup. Explain that each group will get one can of club soda to share, and each student will pour club soda into their cup until it touches the bottom of the letters. Add club soda to your personal cup. Mention that the bubbles are already in it and that it is clear.

2. Add a few drops of brown food coloring to your cup. Explain that you will add brown coloring to the cans of club soda for students at each table before they pour it.

3. Model adding and recording different ingredients. Explain that first they will add an ingredient and then record how much of it they added. Say that this time they will use their droppers to add drops, instead of squirts, of the vanilla and/or lime juice. Show how to squeeze the dropper gently to create drops. Encourage students to practice making drops in the lime juice or vanilla cup first if they want to further perfect their technique before creating their secret cola formulas.

4. Model how to record the amount of each ingredient added by circling the spoons, toothpicks, or drops pictured on the Cola data sheet. Ask why it's important to record what they put into the mixture. Point out that the sheet has only nine toothpick pictures for cinnamon because that is the most they can use.

5. Ask students if they can take out some lime juice if they put too much in? [No!] Emphasize that they should add little amounts at a time then taste the result. Let them know that they can, if they wish, decide not to use all the ingredients.

6. Encourage them to take little tastes. When they think their cola is perfect, they should raise their hands and you will bring ice to their group. They may then add an ice cube to their cola.
7. (Optional) Color code the data sheet. If your students are not readers, they need to color code their data sheets. Have them do this now, using the class color key as a reference. Have them color in the circle by the word “sugar” red, etc.

Let the Cola Making Begin!

1. Pass out trays of materials and data sheets to students, while two or three helpers pass out the personal cups. Add about 10 drops of food coloring to each group’s can of club soda as you open it. Have students begin when they have all their materials.

2. Fill up containers with four to eight ice cubes each and distribute them to the tables when students think they have made their own unique versions of “the real thing.”

3. When it’s time to clean up, show students where to dump cola they don’t like and where to put dirty cups for washing. Collect trays of materials. Have them keep their Cola data sheets.

Discussing the Attributes of a Good Cola

1. Refer to the list of the attributes of commercial cola brainstormed during Session 2. Help students compare their colas to commercial colas by reading each word as students give a silent thumbs up/thumbs down (yes/no) response about their own cola. “Was your cola sweet?” “Brown?” “Bubbly?” “Refreshing?”

2. Ask students for their ideas about making the same cola again. Ask, “If you were to follow your formula exactly again, do you think your cola would turn out the same way?”

3. Ask, “Are there any ingredients or amounts you would choose to change for next time?”

4. Explain to students that all of the ingredients they used are easy to get at a grocery store and that their secret formula can be made again at home. They can change their cola by changing the ingredients or the amounts of ingredients in their formulas. (The data sheet doesn’t include club soda or brown food coloring, so you should mention those ingredients as well.)
**Going Further**

1. Have your students design an advertisement for a cola. They could draw the cola can, invent a name, list ingredients, and write attributes of the cola (delicious, sparkling, tasty, sweet, etc.). Encourage them to use the data they collected during the activity to strengthen their advertisement. Invite them to explain what caused their cola to have the attributes it does. They could also write a slogan for their cola or a little advertising jingle to a familiar tune.

2. Homemade Lemonade: Give students the homework assignment of preparing their own lemonade at home. Spend time beforehand listing possible ingredients (sugar, lemons, water). You may choose to assign students a specified amount of water to begin with so their formulas are easy to compare. Ask students to record their formulas at home and bring the recipes back to school to share.
3. Making Brown: Students practice mixing primary colors to make brown. Begin with a styrofoam egg carton (or small reaction tray) and four cups filled with a bit of red, blue, green, and yellow food coloring. Instruct students to use small paint brushes to test color combinations in their egg carton dips. A data sheet showing how they filled in their choices \((\text{red} + \text{blue} = \text{green})\) might be helpful for students to keep track of which combinations they try.

4. Shopping for Cola: Compare costs of different cola brands. Agree upon a container size for a price survey (liters, six-packs, one 12-ounce can, etc.). On a shopping trip, have students record names and prices of different colas sold. Put a star next to any brand being sold at a sale price. Refer to the class graph of favorite colas. What is the cost of the favorite brand? Is there a range in price? Why might that be? Refer to the ingredients. Are there more costly ingredients in more expensive colas? What other factors might account for price differences? What brand(s) are the least expensive? The most expensive? Does the price of one brand vary depending upon where it is sold? How many brands of cola were on sale? Was a cola on sale at all the stores?

As students create and record their secret formulas for cola, they are doing a form of informal algebra (or generalized arithmetic). The equation that they all are working with could be expressed as:

\[
\_\_\_\_\_\text{ sugar} + \_\_\_\_\_\text{ lime juice} + \_\_\_\_\_\text{ vanilla} + \_\_\_\_\_\text{ cinnamon} = \_\_\_\text{ flavoring for cola recipe}
\]

The variables are the quantities of each ingredient they may add. As in the case of many algebraic equations, there are multiple solutions! In this case, students seek the optimal amount of each ingredient, based on their taste preferences. When the class shares their recipes, they can see if there are any common amounts for the various ingredients.
Name ____________________________

Cola

My secret formula for cola is:

- [ ] sugar
- [ ] lime juice
- [ ] vanilla
- [ ] cinnamon

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LHS GEMS—Secret Formula—
May be duplicated for classroom use.

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