Sugar Content in Beverages and Its Effects on Human Health

Exploring Food Science, Safety, and Nutrition

Oregon State University

Grade Level
6th to 8th

Lesson Time
45 - 60 minutes

Content Areas
Chemical Reactions and Everyday Life

Next Generation Science Standards
PS1B: Chemical Reactions
LS1A: Structure & Function
LS1D: Information Processing

Crosscutting Concepts
Cause and Effect

Scale Proportion and Quantity

Structures and Functions

Systems System Models

Objectives

After completing the lesson, Students will be able to:

- Visibly quantify the amount of sugar present in frequently consumed fruit juice.
- Thoroughly understand sugar component in diets.
- Experiment with different concentrations of solute in solution.
- Understand how chemical compositions of a solution (water) changes with the addition of solutes (sugar).

Overview

This lesson plan will have two activities associated with it.

In the first activity, students will measure different kinds of sugars and compare the sweetness level with a fruit juice sample. This will introduce how different sugars affect taste and students will learn which sugar has the highest sweetness level.

The second activity will allow students to compare the sweetness level between different concentrations of sugar and its taste to their fruit juice sample. Students will learn how different concentrations of sugar affect taste and be able to visually quantify the amount of sugar present in fruit juice.

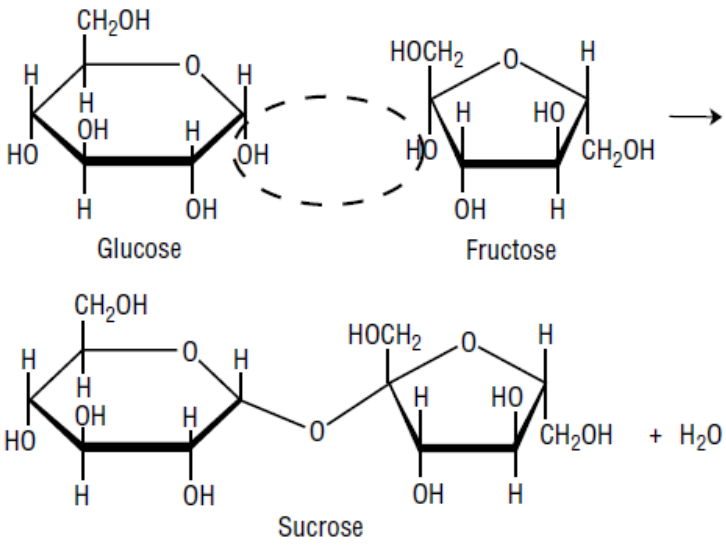
After each activity, students will be given questions to help understand the reasoning behind the activities. These questions will help students understand the role of sugar in beverages and how it relates to human health.

Background Information

In the past decade there has been a surge of new beverage products. Among all the innovation and risk taking, there remains one ingredient that is commonly seen and used throughout all of these products. Sugar.

Sugar has been a commodity that dates back from the beginning of the spice trade. Once a valuable ingredient, it now finds itself in every household, food, and even beverages. Sugar consumption is at it's all time high and the responsibility of that falls on popular beverages that we consume daily. In beverages, it is the leading source of added sugar in our diets, representing almost more than half of all the added sugar we consume in other foods like cereal, candy, and bread. It's no wonder that sugar has become a modern public health concern. Added sugars are the main culprit in causing obesity and diabetes epidemics.

Despite its essential source of energy in our diet, drinking a large amount of sugary beverages increases the risk of becoming obese by 60% in children when it is consumed daily. Increased and continuous sugar consumption can increase the amount of insulin in our blood which can have lasting repercussions like diabetes or obesity. Additionally, sugar in food and beverages we consume can feed bad bacteria in our oral microbiome which in turn contributes to tooth decay. However, people will keep buying these beverages since they are tasty and refreshing. So, it is important to know that the relationship between the sugar attributes found in our daily beverages and its effects in our health.



Source: https://www.acs.org/content/dam/acsorg/education/resources/highschool/chemmatters/archive/chemmatters-oct2011-sweeteners-brownlee.pdf \

Fruit juice is a beverage that is consumed by people of all ages. Whether it's orange juice for breakfast, apple juice for the kids, or even in milk, fruit juice remains a popular choice for many.Fruits naturally contain a mixture of sucrose, glucose, and fructose, but fruit juices often have additional sugars added, such as high fructose corn syrup. However, not all fruit juice is created equal and not all sugars are equal either. Sugar comes in many forms and can range from simple sugars such as monosaccharides (like glucose and fructose) to more complex disaccharides like sucrose, which contains both glucose and fructose.

Some specific examples of FDA's definition of added sugars include:

- agave nectar
- brown rice syrup
- brown sugar
- coconut sugar
- glucose*
- sugar
- fructose*
- honey
- invert sugar
- lactose*
- maltose*
- corn syrup
- sucrose*
- maple sugar
- molasses
- nectars
- raw sugar
- dextrose
- malt sugar
- rice syrup
- high-fructose corn syrup
- white granulated sugar

*also naturally occurring sugars founds in whole foods

Image retrieved from: https://www.sugar.org/sugar/sugars/

While we may think that the main reason why sugar is added to beverages is for the taste (though it often is the main reason), there are other reasons why sugar is added. Much like the human body, food and beverages are a complex system and sugar contributes more to these than just taste. Texture and color of the food or beverage are greatly influenced by sugar and finding a healthier alternative can be difficult to formulate.

In this lesson, we will explore the effects of sugar concentration and different types of sugars in water and fruit juices.

Set Up

Students can work independently at home for more hands on experience or work with a group.

Divide students into groups of two or three. One student can be in charge of labeling containers used, one can measure out the sugars, another can record observations and results.

Materials

Any kind of fruit juice (although unsweetened cranberry juice or cran-apple is recommended for the experiment)

Clear cups

Sugar (cane sugar, brown sugar, corn syrup, stevia, honey, etc)

Water

Weighing Scale (or measuring cups if no balance)

Tablespoon/ teaspoon set

Activity One

Comparing Types of Sugars

Procedure

1. Select any three of the sugars listed in the materials section.
2. Obtain 946mL of water (the equivalent of 946 grams or 4 cups).
3. measure 23g (1.5 tablespoons) of each of the three sugar types and label each container to distinguish each sample.
4. Measure 217g of water three separate times and transfer into appropriately labeled containers. In another container place 1 cup of water. There will be water leftover after all measurements are completed.
5. Transfer each sugar type into the labeled water container for that type and mix well. If using honey, you may need to microwave it briefly (15 seconds) to liquefy before mixing.
6. Use Table 1. (shown below) to record taste test results of each solution and compare to the juice. In the first column state the overall taste that you perceive: is it flavorful, sweet, bland... and in the second column rank the 5 different beverages in order (1 being the most sweet, 4 being the least sweet).

Table 1:

	Overall Taste	Sweetness ranking (circle)
Sugar #1: _____		1 2 3 4
Sugar #2: _____		1 2 3 4
Sugar #3: _____		1 2 3 4
Water		1 2 3 4
Fruit Juice: _____		1 2 3 4

Set Up

Students can work independently at home for more hands on experience or work with a group.

Divide students into groups of two or three. One student can be in charge of labeling containers used, one can measure out the sugars, another can record observations and results.

Materials

Clear cups

Cane Sugar

Water

Weighing Scale (or measuring cups if no balance)

Tablespoon/ teaspoon set

Activity Two

Comparing Concentrations of Sugars

Procedure

1. Measure 3 cups of water and label 3 containers with the following percentages: 5%, 25%, 50%.
2. Measure 12 g (or a heaping tablespoon) of cane sugar and 225 g (1 cup) of water; add both to the 5% container. Mix well.
3. Measure 60 g (⅓ cup) of cane sugar and 177 g (¾ cup) of water; add both to the 25% container. Mix well.
4. Measure 120 g (or ½ cup and just under 2 TBSP) of cane sugar and 120 g (½ cup) water; add both to the 50% container. Mix well.
5. Once all solutions are thoroughly mixed (so you can no longer see granules of sugar in the water) complete Table 2 Shown below.
6. Bonus step: if you have a family member willing to help with this assignment, relabel the 5% mixture "734", the 25% mixture "391", and the 50% mixture "201" and without telling your assistant which container is which and ask them to rank them in order of sweetness. (This coding system is used frequently in sensory tests so you can identify the item without revealing its actual identity.)
7. They should have ranked: 201 as 1st (most sweet), 391 as 2nd and 734 as 3rd (least sweet). Compare how you and your family members ranked them!

Table 2:

Sugar Type	Concentration 1 (% w/v)	Concentration 2 (% w/v)	Concentration 3 (% w/v)
Cane Sugar Concentration	5	25	50
Sweetness Ranking (circle)	1 2 3	1 2 3	1 2 3

Experiment/Activity Questions

Pre-activity Questions

1. How much sugar do you think is added to the juice?
2. If you have more than one juice sample, could you rank them from what you think is the most to the least sugar before you test them?
3. In your own words, why are added sugars necessary in the juice?

Part 1: Comparing Type of Sugar

1. Which has the highest ranking of sweetness?
2. Do they taste different or about similar?
3. Is there a noticeable difference when you compare the three sugars to your fruit juice sample? Was it sweeter or less sweet?

Part 2: Comparing Concentration of Sugar

1. Which has the highest sweetness ranking?
2. How did the different concentration affect its taste?
3. Which concentration level of sugar do you think is in the fruit juice based on its taste?

Post-activity Questions

1. Look at your answer to pre-activity question 1. How did this answer compare to what you learned in the activity? Was it higher or lower?
2. Do you think you will look at sugar content in fruit juices the next time you get to choose a drink? Why or why not?
3. What was one surprising or interesting thing you learned during today's lesson?

Additional Resources

https://www.acs.org/content/dam/acsorg/education/resources/highschool/chemmatters/archive/chemmatters-oct2011-sweeteners-brownlee.pdf

https://www.sugar.org/sugar/sugars/

https://sugarscience.ucsf.edu/latest-sugarscience-research.html

https://www.health.harvard.edu/heart-health/the-sweet-danger-of-sugar

This lesson plan was created by Food Science students from the Department of Food Science & Technology at Oregon State University as part of the class FST385 - Communicating Food & Fermentation Science.

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