

Honey as a Biomolecule

Name _____

Part 1: Introduction

In order to stay healthy, people need to eat a variety of nutritious foods. Food contains six nutrients that are necessary for good health. These nutrients include carbohydrates, proteins, lipids, minerals, vitamins, and water.

Carbohydrates, lipids, and proteins are called organic molecules. These molecules are called organic molecules because they are carbon based and should not be confused with certified organic products. The USDA defines organic agriculture as using methods that preserve the environment and avoid most synthetic material as pesticides and antibiotics.

Read each statement and check the appropriate box indicating if you think that the statement is true or false.

True	False	Statement
		A teaspoon of honey and a teaspoon of sugar have the same number of calories.
		A teaspoon of honey and a teaspoon of sugar have the same number of carbohydrates.
		A teaspoon of honey and a teaspoon of sugar have the same effect on a person's glycemic index (GI). GI is a measure of how carbohydrates affect a person's blood sugar level. High GI foods "spike" a person's blood sugar level which may increase a person's risk of coronary heart disease and Type 2 diabetes.
		Honey is added to certain baked goods to extend shelf life.
		Honey is not recommended for infants under one year of age.

Divide into groups of 2-3 students. Read the following articles. Discuss with your group if you learned anything new about honey or table sugar.

- "Carbohydrates and the Sweetness of Honey"
- "Is Honey the Same as Sugar?"

Honey as a Biomolecule (continued)

Part 2: Comparing Carbs

Carbohydrates are the main source of energy for living organisms. Glucose, fructose, and galactose are the three monosaccharides or single sugar molecules. Disaccharides are formed by two monosaccharides bonded together and include sucrose, also known as table sugar, and lactose, the sugar found in milk. Polysaccharides are large molecules formed by many monosaccharides bonded together. Animals store carbohydrates in the polysaccharide glycogen. Plants store carbohydrates in the polysaccharides, starch and in cellulose, which is used for structure and support. Whether simple or complex, all carbohydrates are made of sugar, but not all sugars are equally sweet.

Food scientists have rated the relative sweetness of carbohydrates as seen in the table.

Relative Sweetness Scale	
<i>Carbohydrate</i>	<i>Rating</i>
Glucose	70-80
Galactose	35
Fructose	140
Sucrose (glucose + fructose)	100
Lactose (glucose + galactose)	20
High Fructose Corn Syrup	120-160

1. Which monosaccharide is the sweetest?

Digestion: When a disaccharide breaks down into its component monosaccharides, the sweetness changes as well. The resulting sweetness can be determined by averaging the sweetness of the two monosaccharides.

Lactose is the disaccharide found in milk. Before lactose can be used by the body, it must be broken down into monosaccharides. The enzyme, lactase, breaks down lactose into the monosaccharides, glucose and galactose. When lactose is digested its sweetness changes, too. The new sweetness can be calculated by averaging the sweetness rating of the two monosaccharides; glucose (75) and galactose (35). The average value for glucose is shown in the example.

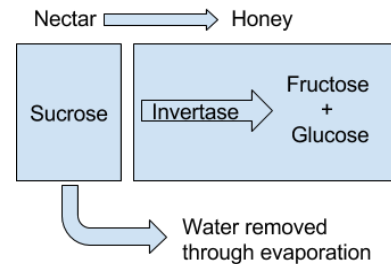
Example: $\frac{75+35}{2} = \frac{110}{2} = 55$

2. How does the sweetness of milk compare to the sweetness of milk that has been digested by lactase?

Honey as a Biomolecule (continued)

- Sucrose or table sugar is also a disaccharide. What two monosaccharides compose sucrose?
- Using the average value for glucose, calculate the sweetness of sucrose after it has been broken down into its component monosaccharides.
- How does the sweetness of sucrose compare to the sweetness of sucrose that has been digested by enzymes?
- Breaking down disaccharides into monosaccharides is necessary for digestion but food scientists see another benefit. Of what advantage is producing sucrose that has already been broken down by enzymes?

How Bees Process Nectar into Honey: Bees make honey by gathering nectar from certain flowering plants. Nectar is sucrose. Foraging bees carry the nectar to their hive where receiving bees unload the nectar load and begin to process the nectar into honey. During the processing, bees add invertase, an enzyme that breaks down sucrose.



- How do you think sweetness of honey compares to the sweetness of nectar? Explain your thinking.

Examine the ingredients on the label for Junior Mints to answer the questions below.



Ingredients: Sugar, Semi-Sweet Chocolate (Sugar, Chocolate Processed with Alkali, Cocoa Butter, Soy Lecithin-An Emulsifier, Vanillin-An Artificial Flavor), Corn Syrup, Confectioner's Glaze, Modified Food Starch, Peppermint Oil, Invertase (An Enzyme).

- What carbohydrates have been used?
- What enzyme has been added and how will that affect the sweetness of the carbohydrates?

Honey as a Biomolecule (continued)

Part 3: Developing a Food Product with Honey

Food scientists use their knowledge of biology, chemistry, and chemical engineering to better understand food processes and to improve food products for consumers. Imagine you are a food scientist developing a new food product using honey as an ingredient.

10. What is the name of your product?

11. Who is the core audience for your product?

12. What will your packaging look like?

13. What ingredients will be used in your product?

14. Draw a quick sketch of what your product will look like?

15. List three reasons why a food scientist might use honey instead of sugar in this recipe.
(You may want to refer to page 4 in Honey: A Reference Guide to Nature's Sweetener found here: <https://honey.com/files/general/refguide.pdf> to read about some of the applications for honey in food products.)