***CARBOHYDRATE SCHOOL***

**A virtual tour of carbohydrates**

**By Sue Reber**

**Background:**

We are going on a virtual tour of the school. We will be going to the chemistry, English, music, science, health and foods departments.

*Chemistry Department:* **Carbohydrates** come from plants: grains, fruits, vegetables, nuts and seeds. They are made up of the elements **Carbon, Hydrogen** and **Oxygen.** The chemical abbreviation for **Carbon, Hydrogen,** and **Oxygen** is **CHO.** Hydrogen and Oxygen together make water, so carbohydrates are “water carbons.”

*English:* We talk about **prefixes**. **Mono** means 1; **di** means 2; **poly** means many.

*Food science:* We learn about **saccharides**. There are 3 common **monosaccharides,** or single sugars: **fructose** (fruit sugar), **glucose** (blood sugar), and **galactose** which is never found alone in nature.

There are three common **disaccharides**: **sucrose** = fructose + glucose (table sugar) **maltose** = glucose + glucose ( malt sugar) and **lactose** = glucose + galactose (milk sugar)

*Back to English department*: A **suffix** is a group of letters added to the end of a word changing the meaning. In Chemistry the suffix **-OSE** indicates some kind of sugar/carbohydrate.

*Food science*: **Polysaccharides** (many sugars) create **starch** and **fiber**. These polysaccharides are examples of **polymers,** large molecules made up of between 10 and hundreds of thousands of small molecules linked together.

Polysaccharides are **complex carbohydrates** *SO* starch and fiber are complex carbohydrates.

Mono- and disaccharides are simple carbohydrates *S0* sugar is a **simple carbohydrate**.

*Health Department*: Carbohydrates give your body energy: 4 kcal per gram. They also provide dietary fiber which helps your body digest your food. Carbohydrates should make up 45-65% of your daily food intake. Simple carbohydrates are digested faster and give you quick energy. So if you want quick energy you may have been told to eat a candy bar. If you want sustained energy then you eat complex carbohydrates. Like the long distance runner eating pasta.

*Now to the Music department*: Learn the carbohydrate song. The tune is Frere Jacques.

 **CARBOHYDRATE SONG** (Sung to “Frere Jacques”)

Carbohydrate Carbohydrate

Simple and Complex Simple and Complex

Sugars Are Simple Sugars Are Simple

Starch Is Complex Starch Is Complex

*[If the students learn and pass off the song to the teacher, I give them extra credit points for the test on carbohydrates.]*

*Drama Department:* We will say the word *saccharides* like a sumo wrestler, then as a southern belle.

*Science:* Last we do the lab (see below), a carbohydrate search with iodine.

**Vocabulary:**

*Carbon—*Element, atomic number 6 on the periodic table. It is a nonmetal and the basic element for all organic forms of life. Its symbol is **C.**

*Di*- --A prefix meaning two. Originally from Greek. (Note: the prefix bi- is originally from Latin, and also means two).

*Disaccharide—*A disaccharide is a sugar compound made up of two monosaccharides. The most common are glucose + fructose = sucrose (table sugar); glucose + galactose = lactose (milk sugar); glucose + glucose = maltose (malt sugar). Disaccharides are *simple carbohydrates.*

*Fiber*—Fiber is in the cell walls of plants, giving plants their structure. It is made up of cellulose (a form of glucose, but bonded differently so it is not easily digested by humans), and hemicellulose and pectin. It is a polysaccharide, so it is a *complex carbohydrate.*

*Fructose—*A common food monosaccharide. It is the sweetest tasting of the sugars. Fructose + glucose creates sucrose, or table sugar.

*Galactose*—A common food monosaccharide. It is never found alone in nature, but is always bonded to something else. Galactose + glucose creates lactose, found in dairy products.

*Glucose—*The most common monosaccharide. It is the basic sugar molecule from which all other carbohydrates are built. The human body breaks down food into units of glucose for energy in the body.

*Hydrogen*—Element, atomic number 1 on the periodic table. It is a gas that is highly unstable and always willing to bind to another atom. Its symbol is **H.**

*Mono-* --A prefix meaning single, one, alone, sole. Originally from Greek.

*Monosaccharide—*A single sugar compound, the most common monosaccharides are glucose, fructose and galactose. Monosaccharides are *simple carbohydrates*.

*Oxygen*—Element, atomic number 8 on the periodic table. It is a gas. Its symbol is **O.**

*Poly- --*A prefix meaning many, or multiple. Originally from Greek.

*Polymer—*Large molecule made up of ten to hundreds of thousands of small, like molecules chained together.

*Polysaccharide—*A sugar molecule made up of many sugar compounds. Polysaccharides are *complex carbohydrates.*

*Prefix—*A prefix is a word or letters that are added to the front of a word, changing its meaning. For example, if the prefix mono- is added to the word saccharide, it changes saccharide (sugar) to monosaccharide (one sugar).

*Saccharide—*A chemistry term meaning sugar or a substance made from sugar.

*Starch—*The form of energy storage in plants, usually stored in granular form in the seeds and roots of a plant. Starch is made up of amylose (long, linear chains of glucose molecules) and amylopectin (dense, branched chains of glucose molecules). Most plants contain both types, just in different proportions. Starch is a polysaccharide and so is a *complex carbohydrate.*

*Suffix*—A letter or group of letters added to the end of a word to change the meaning or form a different meaning of a word. For example, in chemistry adding the suffix –ose to a word indicates a kind of sugar: fructose = fruit sugar; maltose = malt sugar.

**This lesson addresses the following USOE Core Standards:**

**Foods & Nutrition Sciences 1**

Standard 3, Objective 1a: Define simple carbohydrates, complex carbohydrates and fiber.

Standard 3, Objective 2a: Identify fiber, its sources and functions.

**Biology:**

Standard 2, Objective 1b: Identify the function of the four major macromolecules (carbohydrates).

**Materials per group:**

1 custard cup

2 or 3 foam plates

1/2 teaspoon Iodine

1 Tablespoon water

1 teaspoon flour

1 sugar cube

1 slice apple

1 marshmallow, cut in half

1 vanilla wafer

1 slice potato

1 slice very ripe banana

1 slice very green banana

1 tablespoon honey

1 slice bread

**Instructions** *(with teacher notes)***:**

This experiment will help you determine if a food is a simple or complex carbohydrate. If a food is a simple carbohydrate, the iodine will turn a brown-tan. If a food is a complex carbohydrate, the food will turn a dark, blue-black. Test each food below to determine if it is a simple or complex carbohydrate. Record your results in the box below.

 1. In a custard cup put one teaspoon of iodine and 1 tablespoon water. (It should be dark brown color. Be careful, because iodine can stain your hands, clothes and table.)

* *I have the iodine in custard cups on the supply table for them to pick up.*

2. Put the flour and sugar on your foam plate. Use a plastic spoon to put a few drops of the iodine solution on the flour and the sugar. Record the results.

***Sugar is a simple carbohydrate. Flour is a complex carbohydrate.***

***Compare the other foods to the sugar and flour.***

3. Lay the foods on the 2nd foam plate leaving plenty of space between items.

4. Put a few drops of the iodine solution on each one of the food items.

5. Record the color each food changes to and determine which foods are simple carbohydrates and which foods are complex carbohydrates.

|  |  |  |
| --- | --- | --- |
| FOOD SAMPLE | COLOR | SIMPLE OR COMPLEX |
| 1. Flour |  |  |
| 2. Sugar |  |   |
| 3. Apple |  |  |
| 4. Potato |  |  |
| 5. Bread |  |  |
| 6. Honey |  |  |
| 7. Vanilla wafer |  |  |
| 8. Marshmallow outside |  |  |
| 9. Marshmallow inside |  |  |
| 10. Green banana |  |  |
| 11. Ripe banana |  |  |

**Discussion Points/questions:**

 1. Why does the outside of the marshmallow test differently than the inside?

* *The explanation for the iodine test in marshmallows is this: Cornstarch is used to keep the marshmallows from sticking together and to absorb extra moisture—it is applied to the outside of the finished and formed marshmallows. The marshmallows themselves are mostly sugar and gelatin, so there would be no complex carbohydrates inside. Another interesting thing to bring into the discussion would be to show other food labels, for example baking powder (not soda). In this, the cornstarch is mixed in with the sodium bicarbonate and the acids (usually monocalcium phosphate and sodium aluminum phosphate). It's added to absorb moisture so the acid & base don't react, and to help maintain "flowability" so the baking powder doesn't clump. Powdered (confectioners) sugar also has cornstarch added to help flowability.*

2. Why would you use ripe bananas in banana bread?

* *As fruit ripens, biochemical changes cause a decrease in acid and an increase in sugars. Enzymes in the ripening fruit break down the starch into sugar. There can be a sucrose increase in bananas from 0.3 to 11 percent when fully ripe while the starch content can decrease from 25 to 1 percent (Charley and Weaver, p. 479). Biochemical changes during ripening also break down the cell walls, softening the fruit. Naturally occurring ethylene gas emitted by the fruit is responsible for ripening. One of the techniques for ripening fruit at home is to place unripened fruit in a closed paper bag in order to trap ethylene gas and speed up the ripening (Vaclavik and Christian, p. 122).*

3. List at least three other foods that were not tested but are simple carbohydrates:

4. List at least three other foods that were not tested but are complex

 carbohydrates:

Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Period \_\_\_\_\_\_\_

**A Virtual Tour of Carbohydrates**

1. FOODS CLASS - Carbohydrates is a nutrient that provides \_\_*ENERGY*\_\_\_\_\_\_\_\_\_\_.

2. CHEMISTRY - CHO the chemicals are C*ARBON*\_\_\_\_ H*YDROGEN*\_\_\_ O*XYGEN*\_\_\_\_\_\_

3. ENGLISH -What is a prefix? *A syllable at the beginning of a word changing the meaning.*

What do these prefixes mean?

 MONO \_*ONE*\_\_\_\_\_\_ DI \_\_*TWO*\_\_\_\_\_\_ POLY \_\_*MANY\_*\_\_\_\_

4. CHEMISTRY - Fructose \_\_*FRUIT*\_\_\_ sugar Glucose \_*BLOOD*\_\_ sugar

MONO

 **Glucose \_\_Galactose\_\_**

 \_Fructose\_\_

**DI**

 Sucrose \_*TABLE SUGAR* Maltose \_*\_MALT*\_\_\_\_\_\_ Lactose \_\_*MILK*\_\_\_\_\_

Fructose, glucose and galactose are \_*MONO*\_\_\_\_\_\_\_ saccharides.

Sucrose, Maltose and Lactose are \_\_*DI\_*\_\_\_\_ saccharides.

5. ENGLISH *–* What is a suffix? *A syllable at the end of the word that changes the meaning of the word.*

 Whatdoes the suffix -OSE mean? \_\_a sugar\_\_

**POLY**

6. \_\_\_*STARCH\_*\_\_\_\_\_\_\_\_\_\_\_\_\_\_ AND \_\_\_\_*FIBER*\_\_\_\_\_\_\_\_\_\_\_are Polysaccharides

CHEMISTRY - SIMPLE AND COMPLEX CARBOHYDRATES

7. Polysaccharides are \_\_\_*COMPLEX*\_\_\_\_ carbohydrates…SO Starch and fiber are \_\_*COMPLEX\_*\_carbohydrates.

8. Mono- and di-saccharides are \_\_*SIMPLE*\_\_\_\_\_\_ carbohydrates … SO Sugar is a \_\_*SIMPLE*\_\_\_\_\_carbohydrate.

9. HEALTH - Would simple carbohydrates or complex carbohydrates be digested quicker? \_\_\_\_\_*SIMPLE\_\_Starches have to be broken down to sugars to be digested*

10. DRAMA – Say saccharides like a Sumo wrestler. Now like a southern belle.

11. CHOIR **CARBOHYDRATE SONG** (Sung to “Frere Jacques”)

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4. CHEMISTRY - Fructose \_\_\_\_\_\_\_\_\_\_ sugar Glucose \_\_\_\_\_\_\_\_\_ sugar

MONO

 **Glucose \_\_\_\_\_\_\_\_\_\_\_\_\_**

 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**DI**

 Sucrose \_\_\_\_\_\_\_\_\_\_\_\_\_\_ Maltose \_\_\_\_\_\_\_\_\_\_\_\_ Lactose \_\_\_\_\_\_\_\_\_\_\_

Fructose, glucose and galactose are \_\_\_\_\_\_\_\_ saccharides.

Sucrose, Maltose and Lactose are \_\_\_\_\_\_\_ saccharides.

5. ENGLISH *–* What is a suffix? What does the suffix -OSE mean? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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