

Food Chemistry: You are what you eat

Main lesson points:

- People get energy from food. Where does that energy come from?
- There are different ways to store energy in food -- for example, as carbohydrates or fats
- Extra: Carbohydrates and lipids are two of four different types of macromolecules including, nucleic acids and proteins

Background:

There are four classes of biological macromolecules: Proteins, carbohydrates, lipids and nucleic acids. Today we will investigate the storage of lipids and carbohydrates in food.

CARBOHYDRATES are the body's most preferred source of energy. They make up, by far, the largest volume (60%) of our daily food. They are better known to students as sugar and starches.

FOOD SOURCES OF CARBOHYDRATE: We generally think of grains (Bread & Cereal group) as the only source of carbohydrates. In reality carbohydrates come from many other sources that also give us other essential nutrients.

SIMPLE CARBOHYDRATE: Sugar - fruit, fruit juice, table sugar, honey, soft drinks, other sweets

COMPLEX CARBOHYDRATE: Starch - bread, cereal, potatoes, pasta, rice, and legumes (dried peas and beans), Fiber - bran, whole-grain foods, raw vegetables and fruit (especially the seeds and skins), legumes, nuts, seeds and popcorn

LIPIDS: A lot of lipid function as long-term energy storage. Lipids are also an important component of the cell membrane. Students will better know lipids as fats. We will test for lipids doing grease and emulsion tests. An emulsion is a mixture of two or more liquids that are normally nonmixable.

PROTEINS: Proteins are complex, specialized molecules that have many important roles in organisms. Structural proteins provide support, regulatory proteins control cell processes and proteins also play an important role in the immune system. Another test, we won't do today, with Biuret's reagent, can test for the presence of proteins.

NUCLEIC ACIDS: Nucleic acids are composed of building blocks called nucleotides. Nucleic acids carry the genetic information within cells.

Introduction: Talk to the students about the different classes of biological macromolecules in food (you might skip nucleic acids if too confusing). Ask them what foods they eat have carbohydrates, fats, and proteins.

Part 1. Testing for Carbohydrates

Starch in Food Experiment (15 mins)

Many foods have starch in them – starch is one of the basic energy sources for most people. It is a complex carbohydrate. What foods have starch in them? We can try and find out by using iodine. Iodine mixes with starch in foods and turns them a purplish color. If the food does not contain starch, the iodine will remain its reddish color.

Materials: Iodine (aliquot into cup), Droppers, Water, Cornstarch, Potato, Other foods of choice

Discussion:

1. Introduce the difference between complex and simple carbs. For students, complex carbs are better known as starch and simple carbs are better known as sugar.
2. Have the students list carbohydrates that they've eaten in the last week. Try and categorize them as complex or simple carbohydrates.
3. Have the students predict which foods have starch in them, using their data table.

Procedure:

3. First we'll see what it should look like – put some water in a cup and mix in iodine. Put some cornstarch in a cup with water and add iodine. Compare the two colors.
4. Put the foods into a bowl or cups.
5. Using the eye dropper or sticks, try applying iodine to each food and see what color shows up
6. Note down your observations and compare to the cups of water and iodine. Record the amount of starch present (0, +, ++, +++,++++) in your data chart. The food that contains the most starch should be recorded as +++++. Which foods have the most starch?

Glucose in Food Experiment (15 mins)

Glucose is the major kind of simple sugar. Glucose is the basic source of energy for all living things. Glucose supplies the body with quick energy. It occurs naturally in some fruits and vegetables and is also produced in the body by breaking down other foods into glucose. Glucose is a simple carbohydrate. Simple carbohydrates are quick energy sources, but they do not usually supply any other nutrients or fiber. We will be using glucose test strips to test for the amount of sugar in food. These strips change color to indicate the concentration of glucose.

Amount of sugar in food	0 None	+ Trace	++ Little Sugar	+++ Moderate Sugar	++++ Much Sugar
Color	Blue	Blue/green	Green	Yellow	Orange/red

Materials Droppers, Water, Sugar, Apple Juice, Other foods of choice

Discussion:

1. Have the students name food that they've eaten recently that have glucose in them.
2. Predict which foods we are testing will have glucose in them, using the data table.

Procedure:

1. First test to see what the difference in strip colors should be. Put some water in a cup and slowly mix in sugar. As you add more and more sugar, test using the strips and compare to the color chart.
2. Put the foods into cups.
3. You can use a medicine dropper to drop liquid onto the test strips (if liquid) or directly press the strips onto the food (if solid).
4. Record the amount of glucose present (0, +, ++, +++,++++) in your data chart. The food that contains the most starch should be recorded as +++++.

Part 2. Testing for fat

Lipids in food experiment: Grease spot test (10 min)

Lipids consist of **fats** and **oils**. A lot of lipids function as long-term energy storage. One gram of fat stores more than twice as much energy as one gram of carbohydrates. Lipids are also an important component of the cell membrane.

Materials Droppers, Water, Vegetable oil, butter, Other foods of choice

Procedure:

1. Collect squares of brown paper bag.
2. Use a medicine dropper to drop liquid onto the paper bag squares or directly press on the food (if solid). Also, drop water onto one bag square.
3. Leave for a few minutes and then hold the paper against the light.
4. Record your observations. Were you right about which liquids had a lot of fat in them?

Ethanol emulsion test (10 min)

The Ethanol Emulsion Test is a food test which determines the presence of a broad group of naturally occurring compounds known as lipids. An emulsion is a mixture of two or more liquids that are normally unmixable. Think of salad dressing as a combination of oil and water.

Materials: Vegetable oil, Ethanol, Test tube, water.

Procedure: **Follow the liquid instructions for butter and vegetable oil. Then do food items of choice.**

Liquid sample:

1. Add a few drops of the liquid sample to a dry test tube.
2. Add 2 cm³ above the level of the sample and shake thoroughly.
3. Add 2 cm³ DI water.
4. Make observations.

Solid sample:

1. Crush the food sample and place in tube.
2. Add ethanol to about 2 cm³ above the level of the sample and shake thoroughly.
3. Allow the solid to settle (about 3 min) to allow the lipid to be extracted.
4. Decant the ethanol into another test tube.
5. Add 2 cm³ DI water into the second tube.
6. Make observations.

Observations/Interpretation:

1. Solution remains colorless. No emulsion is formed. Lipids are not present
2. A layer of cloudy white suspension forms at the top of the solution. Upon close inspection, you can see the tiny globules of fat suspended in the solution. This is an emulsion. Lipids are present.

Source: <http://brilliantbiologystudent.weebly.com/ethanol-emulsion-test-for-lipids.html>

http://www.cfep.uci.edu/cspi/docs/lessons_secondary/You%20Are%20What%20You%20Eat.pdf