

## Teacher Guide: Identifying Nutrients



### Learning Objectives

Students will...

- Use a variety of lab tests to identify four kinds of nutrients: simple sugars, starches, proteins, and fat.
  - Identify monosaccharides with a Benedict test.
  - Identify polysaccharides with a Lugol test.
  - Identify proteins with a Biuret test.
  - Identify lipids with a Sudan Red test.
- Describe what nutrients are present in several common foods, such as meat, bread, juice, oil, and milk.



### Vocabulary

carbohydrate, disaccharide, lipid, monosaccharide, polysaccharide, protein, starch

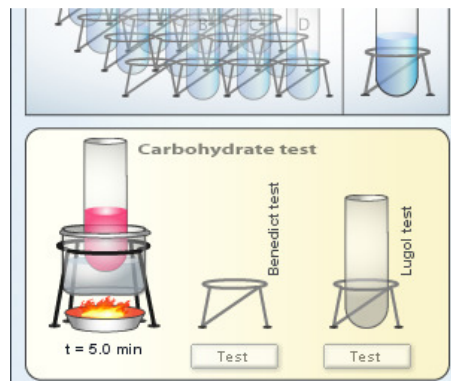


### Lesson Overview

If you look on the side of a cereal box, you will see a plethora of nutritional information. But how do they know what nutrients are in a cup of cereal? The *Identifying Nutrients* Gizmo™ introduces four tests that are used to determine what substances are present in food. These tests are used to detect monosaccharides (simple sugars), polysaccharides (starches), proteins, and lipids (fats).

The Student Exploration sheet contains two activities:

- Activity A – Students use four tests to determine what nutrients are present in a food sample.
- Activity B – Students identify nutrients in a variety of food samples.



Testing for monosaccharides



### Suggested Lesson Sequence

1. **Pre-Gizmo activity** (🕒 10 – 20 minutes)  
 Introduce and define the terms *monosaccharide*, *disaccharide*, *polysaccharide*, *protein*, and *lipid* to your class. Write these five terms on the board, with room below each term for examples. Ask your students to name at least five examples of foods that contain each type of nutrient. Bring up additional examples, and challenge students to classify foods by the nutrients they contain.
2. **Prior to using the Gizmo** (🕒 10 – 15 minutes)  
 Before students are at the computers, pass out the Student Exploration sheets and ask students to complete the Prior Knowledge Questions. Discuss student answers as a class, but do not provide correct answers at this point. Afterwards, if possible, use a projector to introduce the Gizmo and demonstrate its basic operations. Demonstrate how to take a screenshot and paste the image into a blank document.

3. **Gizmo activities** (🕒 15 – 20 minutes per activity)  
Assign students to computers. Students can work individually or in small groups. Ask students to work through the activities in the Student Exploration using the Gizmo. Alternatively, you can use a projector and do the Exploration as a teacher-led activity.

4. **Discussion questions** (🕒 15 – 30 minutes)  
In many ways, cells can be compared to the structures and institutions that keep a city running. As students are working or just after they are done, discuss the following questions:

- What does a positive Benedict test indicate?
- What does a positive Lugol test indicate?
- What does a positive Biuret test indicate?
- What does a positive Sudan Red test indicate?
- Is it possible for a food sample to have a positive result for every test? What kind of food do you think that would be?
- Is it possible for a food sample to have a negative result for every test? What kind of food would that be? [Disaccharides such as table sugar (sucrose) would have a negative result on every test. So would foods such as salt or diet soda.]

5. **Follow-up activity: Identify some nutrients!** (🕒 45 – 60 minutes)  
To identify nutrients in class, you will need a variety of food samples, Benedict's solution, Lugol's solution (iodine), Biuret solution, and Sudan Red solution. To test for disaccharides, you will need hydrochloric acid, baking soda, and pH paper as well.

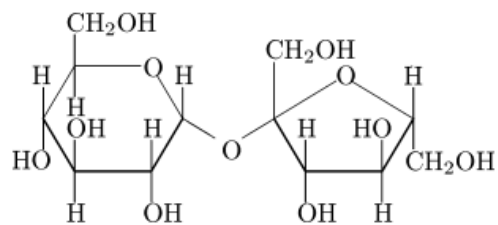
If you do not have access to these materials, you can do a modified lab activity that uses iodine to test for starch and a brown paper bag to test for lipids. (Lipids will turn paper transparent.) Lipids can also be detected by mixing a food sample in ethanol and water. See the **Selected Web Resources** on page 3 of this document for helpful links.



### Scientific Background

A *nutrient* is a substance found in food that an organism needs to live and grow. Organic nutrients include carbohydrates, proteins, lipids (fats), and vitamins. Inorganic nutrients include water, salt, and other minerals.

Carbohydrates can be classified into four categories: monosaccharides, disaccharides, oligosaccharides, and polysaccharides. The basic building block of a carbohydrate is a ring of five or six carbon atoms bonded to H and OH groups. Monosaccharides such as glucose and fructose consist of a single ring. Disaccharides such as sucrose (table sugar) and lactose (milk sugar) consist of a pair of rings. Sucrose, shown at right, consists of a glucose molecule bonded to a fructose molecule. Oligosaccharides such as maltodextrin are composed of three to ten rings, and polysaccharides (starches, cellulose, glycogen, and others) consist of long chains of more than 40 carbon rings.

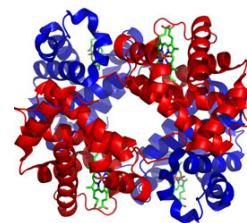


**Sucrose**

Carbohydrates are mainly used by the body for energy. In general, the more complex the carbohydrate, the longer it takes to digest. Simple sugars such as fructose will give the body a quick burst of energy but the energy will not last very long. Diets high in simple sugars are associated with obesity and diabetes. Dietary fiber, an indigestible form of complex carbohydrate, helps to maintain a healthy digestive tract.

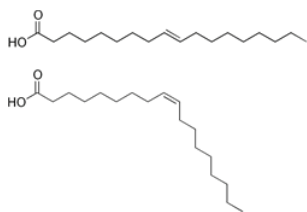
Two tests detect the presence of carbohydrates. A heated Benedict's solution turns from blue to yellow, orange, and red in the presence of monosaccharides. If a disaccharide or oligosaccharide is heated with acid, it will break down into its component monosaccharide molecules and can be detected by Benedict's solution. Lugol's iodine solution turns from brown to dark purple in the presence of starch.

Proteins are long chains of amino acids that are folded into a unique 3-D structure. Proteins have myriad functions in the body. Hemoglobin in red blood cells carries oxygen. Actin and myosin form the cytoskeleton that helps give cells their shape. These proteins are also the main components of muscle fibers. Enzymes are proteins that catalyze and regulate chemical reactions. Proteins are also primary components of skin, hair, cartilage, and many other structures in the body.



**Hemoglobin**

The Biuret test detects the peptide bonds that hold amino acids together. In the presence of proteins, the Biuret solution (sodium hydroxide and copper (II) sulfate) turns from blue to purple.



**Fatty acids**

Lipids are a broad group of compounds that include fats, oils, waxes, cholesterol, and others. The building blocks of most lipids are fatty acids, molecules that consist of an OH – C = O “head” and a long “tail” of carbon atoms bonded to hydrogen atoms. Lipids are found in cell membranes, the myelin that insulates nerve cells, and hormones such as steroids. Subcutaneous fat helps our bodies to retain heat and also provides a rich source of energy.

Several tests can be used to detect lipids. If rubbed on a paper bag, lipids will turn the paper transparent. You have probably noticed this effect if you have ever carried French fries or donuts in a paper bag! (Note: Moisture will also cause the paper to become transparent, but this effect will disappear as the paper dries.) If a lipid solution is mixed with ethanol and water, the solution will turn cloudy and opaque. The lipid test used in the *Identifying Nutrients* Gizmo is the Sudan Red test. Sudan Red is a lipid-soluble dye. When added to a solution containing lipids, the dye will be absorbed into the lipids, resulting in concentrated spots of red color.



### Selected Web Resources

Food tests: [http://www.mrothery.co.uk/bio\\_web\\_prac/practicals/2Food%20Tests.doc](http://www.mrothery.co.uk/bio_web_prac/practicals/2Food%20Tests.doc),  
<http://teacherweb.com/VE/ECA/DeVries/10FoodTests.doc>, <http://seplessons.ucsf.edu/node/362>,  
[http://www.saskschools.ca/curr\\_content/adhs/biology30/biomole.html](http://www.saskschools.ca/curr_content/adhs/biology30/biomole.html),  
<http://www.und.nodak.edu/dept/jcarmich/101lab/lab3/lab3.html>,  
Nutrients: <http://www.fags.org/nutrition/Met-Obe/Nutrients.html>,  
<http://www.linksnorth.com/nutrition/nutrients.html>

Related Gizmos:

*Mystery Powder*: <http://www.explorellearning.com/gizmo/id?433>

*Dehydration Synthesis*: <http://www.explorellearning.com/gizmo/id?464>