What Is in the Food You Eat?

Major Concept
Students will see that food contains energy in the form of several basic nutrients.

Overview
In this activity, students test representative food samples for the presence of certain types of matter (nutrients). This investigation allows students to discover some of the types of nutrients that occur in a variety of common foods.

Materials (per class of 30, teams of 5)
30 pairs of safety goggles
30 lab aprons
30 pairs of plastic gloves
6 dropping pipets
6 500-mL beakers
18 10-mL graduated cylinders
7218 × 150-mm test tubes
2 22 ½-gal waste pails
6 test tube clamps
18 test tube racks
12 glass-marking pencils
6 hot plates
6 lunch-sized, brown paper bags
6 dropping bottles of Benedict's solution labeled "*CAUTION: Irritant"* (total: 60 mL)
6 dropping bottles of Biuret solution labeled "*WARNING: Strong irritant"* (total: 24 mL)
6 dropping bottles of indophenol solution labeled "*CAUTION: Irritant"* **(Note: Indophenol must be fresh. Keep it refrigerated between uses, and order a new supply each year.)** (total: 24 mL)
6 screw-cap jars of isopropyl alcohol (99%) labeled "*WARNING: Flammable liquid"* (total: 120 mL)
6 dropping bottles of Lugol's iodine solution labeled "*WARNING: Poison if ingested, irritant"* (total: 24 mL)
50-mL food samples from each of the six food groups:
- fruits (e.g., apples, oranges, bananas)
- vegetables (e.g., potatoes, onions, broccoli stalks, squash, tomatoes)
- meats (e.g., egg whites, liver)
- milk (e.g., cheeses, milk)
- grains (e.g., breakfast cereals, fresh pasta, bread)
- fats, oils, and sweets (e.g., egg yolks, desserts, snack foods)

For positive controls (per class of 30):
6 spatulas or dropping pipets
30 100-mL beakers
30 10-mL graduated cylinders

300 mL of 1% ascorbic acid (vitamin C)
6 pats of regular margarine or small bottles (dropping-bottle size) of vegetable oil
300 mL of a 6% suspension of gelatin
300 mL of a 10% solution of glucose
300 mL of a 10% solution of sucrose
300 mL of a 6% suspension of starch

For negative controls (per class of 30):
6 100-mL beakers filled half-full with tap water

Outcomes and Indicators of Success
The following indicators allow you to assess the students' level of success with the activity, as well as their process of learning.

By the end of this activity, students should be able to demonstrate the following:
1. The ability to explore and develop an explanation for the nutrients in the foods they eat.
They will show this ability by:
- **a.** Predicting results of food tests
- **b.** Conducting controlled food tests using protocols and their own organizational abilities
- **c.** Comparing their predicted results with their actual results
- **d.** Explaining the importance of positive and negative controls
- **e.** Determining correlations between types of food and particular compounds

2. Knowledge of which common molecular compounds are found in various types of food.
They will show this knowledge by listing the foods they tested that contained protein, glucose, sucrose, starch, lipids, or vitamin C.

Safety
Remind students that alcohol is flammable and that its vapors can explode. Extinguish all flames before using any alcohol. Restrict the total amount of alcohol in the laboratory at any one time to 600 mL. Store it in bottles no larger than 100-mL capacity. Use screw-cap jars for storing isopropyl alcohol during the activity. Keep the hot plates in an area separate from where the tests are performed.

Preparations
To keep the quantities of materials to a minimum and still obtain meaningful results as a class, create six teams of five students for this activity. Provide the class with samples of two foods from each food group so that the students will have data for all six food groups. For ease in handling the foods, grind them in a blender to a mushy consistency. You may need to add water to some foods to make them mushy. Frozen liver is easier to use than fresh liver. If you have students from a minority ethnic group in class, consider selecting a food to test that is common to their culture and uncommon in the majority culture.

Label the waste pails, and tell the students where they are located. Warn students of the health hazards and consequences of tasting the food samples (stomach pumping if indicators are involved).

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Prepare the following solutions as positive controls, and place them in labeled 100-mL beakers. Provide a graduated cylinder for each solution for each team. Also, place a beaker with 50 mL of tap water labeled *Water* at each lab table.

6% gelatin suspension
Add 18 g dry gelatin to 300 mL of distilled water. Heat to suspend; do not boil. Store the suspension in a refrigerator if keeping it for more than a few hours. Dispense 50 mL to each of six 100-mL beakers, and label *Gelatin Suspension (Protein)*.

6% starch suspension
Add 18 g soluble starch or cornstarch to 300 mL of distilled water. Stirring constantly, heat until starch dissolves. If using cornstarch, filter. Dispense 50 mL to each of six 100-mL beakers, and label *Starch Suspension.*

10% glucose solution
Dissolve 30 g of glucose in 300 mL of distilled water. Dispense 50 mL to each of six 100-mL beakers, and label *Glucose Solution (Sugar).*

10% sucrose solution
Dissolve 30 g of sucrose in 300 mL of distilled water. Dispense 50 mL to each of six 100-mL beakers, and label *Sucrose Solution (Sugar).*

Vitamin C solution (1% ascorbic acid)
(Note: Indophenol must be fresh. Refrigerate it when not in use, and order fresh indicator each year. Use the following positive control to test the indophenol before conducting the activity.)
Crush six 500-mg tablets of vitamin C, and dissolve in 300 mL of distilled water. Filter if necessary. Dispense 50 mL to each of six 100-mL beakers, and label *Vitamin C Solution*.

Lipids
Place a small amount of margarine or vegetable oil at each lab table, and label *Lipids*. Provide a spatula or dropping pipet for each lab table.

Strategies for Guiding Learners

PROCESS AND PROCEDURES
As a class, orally or silently read all introductory materials for the activity and the "Process and Procedures" to help students build connections between concepts and activities. Use the time spent reading to bring the students' attention into focus.

1. Assemble into teams of five students, as assigned by your teacher. Obtain the five food samples that your team is to test.

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If necessary, adjust the number of food samples tested by each team so that each team member tests a different food.

2. In your journal, create a table for recording the foods that the class will test, your predictions about what nutrients each food contains, and the actual test results.

Each team will test five foods, but your table should have space to record your predictions and the class results of five tests for each of twelve foods. Indicators are available to test for the following nutrients: starch, sugar (glucose and sucrose), vitamin C, fats and oils, and protein. *Indicators* are chemical or physical methods used to test for the presence of certain substances.

Have the learners assemble in teams of five (or fewer, if necessary). (If they are in teams of five, have them test five foods so that each student can conduct all the tests for one food.) Move around the classroom, and make sure that the tables they create are suitable for recording the foods tested, predictions for the nutrients each food contains, and the results of the tests. Students need to allow space for the 12 foods the class will test. The tables might look similar to Figure 1.

Foods	Glucose		Lipids		Protein	
	Prediction	Result	Prediction	Result	Prediction	Result
(name)						
(name)						
(name)						

Foods	Starch		Sucrose		Vitamin C	
	Prediction	Result	Prediction	Result	Prediction	Result
(name)						
(name)						
(name)						

FIGURE 1. Sample nutrient checklist.

3. Begin to fill in your table. Enter your predictions about what nutrients you will find in each of the twelve foods that will be tested. Discuss your predictions with the other members of your team.

You may need to remind the students that some foods contain several nutrients.

4. Review the protocol for nutrient testing. Each member of your team will test one food for each of the five nutrients.

Be sure to use the correct indicator for each test. Follow the directions carefully for its use.

5. Read the information in the "Need to Know" box to help you understand the role of indicators in certain types of investigations.

See the "Need to Know" box in the student text. As the students decide what nutrients to test for and they read about indicators, ask questions to assess whether they understand what indicators are, as well as the importance of positive and negative controls. If students do not know this information, review the fundamental ideas.

6. As a team, make a complete set of positive and negative controls to be shared.

Be sure to label each test tube clearly with the nutrient that the indicator tests for. Use a plus sign (+) if it is the positive control or a minus sign (–) if it is the negative control.

7. Complete your tests. Follow the instructions in "Protocol for Nutrient Tests." Record a plus sign (+) in the results column of your table if the food contains a given nutrient. Use a minus sign (–) in the same column if it does not contain the nutrient. Also, record your observations about the color of the material in the test tube. Indicate how sure you were about your interpretation of each test result for later reference.

Remember, compare the appropriate negative and positive controls each time you test a food for a nutrient.

Pay particular attention to the warning/caution statements for each of the indicators.

As the learners perform their tests, remind them to follow the instructions in "Protocol for Nutrient Tests" in the student handout and to heed all safety warnings. They should realize the need to test the same amount of positive and negative controls as they test for the food. For example, if they use 5 mL of ground-up food, they should use 5 mL of positive control and 5 mL of negative control. They must treat all samples the same when performing indicator tests.

8. Wash your hands thoroughly with soap and water.

Follow your teacher's instructions for disposing of all waste materials.

Instruct students to discard all food wastes in the waste pails when they have completed their tests. Take the waste to the school cafeteria for proper disposal.

9. Share your results with the other members of your team. Then enter their test results in your data table.

Be sure that you understand the results of each test.

10. In the class data table, list the foods that your team tested. Enter your test results.

11. Complete your table by entering the data from the rest of the class.

Some foods may have been tested by more than one team. Enter all results in your table. Discuss any discrepancies in the results as a class.

Create a large data table in which teams can enter the foods they tested and the results for each nutrient test. This needs to be done as a class exercise, otherwise some teams will record incorrect information in the class data table without being asked to explain their reasons for their unusual results. You might lead off with a question such as, "Which teams got a positive result for proteins when testing the hamburger?" Some students may be inclined to change their results to match the majority; encourage discussion about anomalous results—they may reveal interesting secondary nutrients, contamination, or misunderstandings. For example, some liver may test positive for vitamin C, apparently because of the role liver plays in vitamin C metabolism. Your class also may discover unexpected results that are not caused by errors. Remind the students that each of them should have a complete data table.

12. Discuss the following questions with your teammates. Record your answers in your journal.

Walk around the room and listen as teams discuss the questions. The first question will reveal whether students had prior misconceptions about what types of nutrients would be found in particular foods. If a large number of learners had a similar misconception, you may wish to address predictions, results, and current conceptions in a brief class discussion.

a. How did the predictions that you made in Step 3 compare with the test results? Which results were the most surprising? Why?

Predictions will depend on each student's preconceptions and the variety of foods tested. Each team's answers should reflect the degree to which its predictions correlated with its experimental results.

b. How might the natural colors of the foods affect the results?

A blue result may give a green color on a yellow surface. The natural coloring of some materials, such as tomatoes, may mask the test results.

c. Why was it important to test each indicator using water as the negative control substance?

Water contains none of the nutrients being tested for. A negative control helps researchers interpret their results by illustrating what a negative test should look like. (An ideal negative control would be the same color and consistency as the food sample, without the nutrient of interest.)

d. Why was it important to test each indicator with a substance known to contain the nutrient in question?

These substances acted as positive controls. Positive controls help researchers interpret their results by illustrating what a positive test should look like.