Category III Life science examples

Providing variety of phenomena

Food, Energy, and Growth - Example 3
The module includes a phenomenon that could have been (but was not) used to support the idea that food provides the molecules that serve as building materials for organisms. In two different activities in the unit, students observe that a variety of foods contain the same basic components—starch, sugar, protein, and fat (pp. **4–11s** and **58–63s**), but the activities are not explicitly linked to the idea that these components are used to build human body structures. Rather, the first activity is linked only to the idea that people *need* these components, and the second activity is linked only to the idea that these components are *required* for a balanced diet (see highlighted parts of the pages noted above).

Similarly, two phenomena are provided to illustrate the idea that food *is* digested but not that it *must be* digested in order to get into cells. Students observe the digestion of starch in the mouth (pp. **19–21s**) and the digestion of proteins by meat tenderizer and pineapple (pp. **22–23s**). What the unit doesn't do is show students that digested food (e.g., sugar) is capable of passing through a membrane whereas undigested food is not. This observation could have illustrated the need for digestion, but the included phenomena do not.

WHAT IS IN VARIOUS FOODS?

Lesson 2

You probably know that children and young people need to eat healthful foods so that they will grow. But what are healthful foods? Is pizza healthful? Are hamburgers healthful? People have many different opinions about which foods are healthful. But there's one way to know for sure. Ask yourself two questions: Is this food a good source of energy? Is this food made up of the things that will help me grow?

But how can you know if a food is a good source of energy, or is made of the things you need to grow?

Key Questions	What's the difference between good foods and "junk" food? How could you find out which is which?

If you said that good foods help you grow big and strong, and junk foods don't, that's OK. But don't you want to know *why*?

If you said that we can't eat only junk foods like candy bars or cookies because they are mostly sugar and can cause cavities or because they have too much fat and that's bad for us—don't you want to know *why*? If you said that we can't eat just fruit because we won't get enough protein, or because maybe there's not enough of something in it that we need—don't you want to know *why* we need protein?

That's what this unit is about: finding out why we need to eat healthful foods.

The short answer is: **It's important to eat different kinds of foods because they contain different kinds of materials our bodies need for energy and for growing.**

What are these different kinds of materials? What are foods made of? We don't mean like a pizza is made of cheese, bread dough, tomato sauce and toppings, or like bread dough is made of flour, salt, sugar, baking soda, oil and yeast. But what are the components of flour, what are the components of cheese, what are the components of the basic foods we eat?

Discuss the Key Questions; perhaps write various answers on the board, brainstorming; or have students write their own answers. The purpose is to make students aware of the beliefs that they presently hold, and get them to begin to reflect on their adequacy. More-complete answers will be developed as the unit progresses.

Many students will say, at this point in the unit, that we need to eat healthful foods "because they help us grow," without giving any explanation of what they do inside our bodies (how we use food.) As the unit progresses, they need to improve their explanations to include the functions of food in our bodies.

Lesson 2

Lesson Statement: Students identify the appropriate test for each of four food components (sugar, starch, protein and fat) by testing samples that are clearly either starch, sugar, protein, or fat, and then use these tests to decide which of these components are present in various foods. The last page of the lesson presents the idea that only small quantities of some of these components (sugar and fat) are needed in our diet.

Purpose: To discover how a chemical test can show the presence of certain nutrients in food; to learn to use proper controls when designing their own tests for food components;

All foods are made up of a few different components. The three major components in food are carbohydrates (which include sugar and starch), **fats, and proteins.** Where have you heard of these before?

Can you think of some ways to tell which of these materials make up different foods?

Try This

Scientists have ways of telling whether or not carbohydrates, fats or proteins are a part of different kinds of food. They use special chemicals that turn color when carbohydrates, fats or proteins make up a certain food. You can do the same tests that scientists use to find out what kinds of substances are a part of the foods you eat.

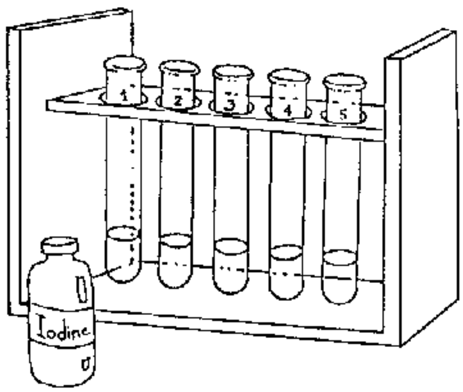
You will perform four different tests on several different foods. Two of these tests are for carbohydrates (one for sugar, and another for starch, both of which are carbohydrates), one is for fats, and one is for proteins. We won't tell you which one you're doing. You can figure out which is which as you go along.

Food Test #1

For all of these tests, we will start with four very simple foods, and then use a few more foods that you can bring from home. This will allow you to test some of your favorite foods.

You will need:

- safety goggles
- 5 test tubes
- a grease pencil
- iodine solution
- several foods:
  corn starch dissolved in water, glucose (sugar) dissolved in water, gelatin dissolved in water, cooking oil.
- *other foods for testing such as:*
  banana, oatmeal, cooked egg white, potato, cracker, apple, spaghetti or noodles, cheese, and any other foods you want to bring from home to test.



To keep track of which food you are testing, you will **need to put different foods** in separate test tubes and mark **each test tube to tell them apart.**

Many students have heard of these before in health class or by reading labels from food packaging. Some may have done the food tests before.

Other components of food beside carbohydrates, proteins, and fats include vitamins and minerals, and fiber. Vitamins and minerals make up much smaller percentages of food than carbohydrates, proteins and fats, but are still essential for many different body functions.

Each of the tests that follow have two parts. The first part uses samples of food that have only one component. The second part uses more complex "every day" foods. To save time, you could do the first part of each test as a class demo. We recommend that you still allow students to figure out which test is for which food component, rather than simply telling them this.

Most students do not think of the simple test substances (corn starch, glucose, gelatin and cooking oil) as *foods*. They might need to be reminded that, even though we don't eat them straight, they are also foods.

to begin to consider why some foods are "junk" foods, and others are more important for growth.

Approximate Time: 1 to 2 class periods for each test depending on whether the initial tests are done as demonstrations or student labs, and how many foods are used. Total time is 4 to 8 class periods.

See Advance Preparation for this lesson in the blue pages prior to this cluster.

Lesson 2

A. **Use a grease pencil to number five test tubes, 1 through 5. Then make a line 2 cm from the bottom on each of these test tubes.**

B. **Fill the test tubes** to the line with the following substances:
   - Test tube #1: water (used as a control)
   - Test tube #2: corn starch solution (starch)
   - Test tube #3: glucose solution (sugar)
   - Test tube #4: gelatin solution (protein)
   - Test tube #5: cooking oil (fat)

C. **Create a chart in your journal for recording your observations, something like this:**

The extra rows and columns are for additional foods (rows) and additional tests (columns). There are a total of four different food tests.

substance to be tested	iodine solution test results (color)	
water		
corn starch solution		
glucose solution		
gelatin solution		
cooking oil		

D. **Notice and record the color of the iodine solution.**

Lab Safety ***The test solutions can irritate your eyes and skin. Be very careful not to spill them on yourself or others. Rinse in plenty of water if you spill any. Get help from your teacher.***

E. **Test each food (and the control) by adding a few drops of the iodine solution to each of the five test tubes. Observe and record the color** of each food *after* the iodine has been added to it.

Lists of foods: Your class should begin to keep lists of foods that contain significant amounts of sugar, carbohydrates, protein and fat. We want students to develop a familiarity with the major components of food (for example, that chocolate candy contains sugar and fat; that bread, cereals and pasta contain starch or complex carbohydrates; that meats contain protein, etc.)

Lesson 2

Think, write, and discuss

1. The first test tube, which contained water, was used as a control. How did the color change when the iodine was added? Is this a new color?

2. Which test substances changed the color of the iodine solution? What color did it turn?

3. Based on your observations, which component of food (starch, sugar, protein, or fat) is the iodine test used to detect? Why do you think that?

4. How could you tell if this component is present in a food that you might eat for dinner?

The control did not change the color of the iodine — it only made it lighter because the water diluted the iodine a little. Water is used as a control because it shows what happens to the test solution when it is added to a test tube with no starch, protein, or carbohydrate.

* * *

Food Test #1 with Other Foods

Now try testing some other foods. Test foods that you like, or that you want to know more about.

Do, observe, and record

F. **Keep test tube #1 as a control.** Use it to compare colors to see if a reaction occured. Clean test tubes #2, #3, #4 and #5. You need clean test tubes to make sure that none of the first foods contaminate the next foods you test.

G. **Repeat the iodine test on four new foods.** You should use foods that are mostly white or pale, so you can see the color change easily. Try:
   mashed banana
   chopped cooked egg white
   oatmeal
   marshmallows
   Record your observations in your journal.

H. **Select at least three other foods** provided by your teacher or that you brought from home. Test them for the presence of starch. Record your observations on your journal.

1. The color got slightly lighter. It is not a new color, only diluted; no chemical change has taken place. Students may need to be told that—for these tests—it doesn't matter how dark or light a color is: dark blue and light blue are still blue, only the light blue is diluted by more water, which doesn't change the test.

2. Starch; the color changed to dark blue or black, depending on how much starch was present.

3. Starch. It reacts with the iodine—turns color in the iodine test.

4. You could test a sample of your food with iodine and look for a color change. (Some students may know that you can find this information on food labels.)

Make sure that you test oatmeal. It is used again in lesson 5.

How test solutions work: Indicator solutions work by actually reacting with the component of food that they test for, creating a new substance of a different color. This is a chemical reaction. If the substance that they test for is not present in the food, there will be no reaction, and therefore no color change—although if the substance being tested has a good deal of water in it, it may make the color of the test solution lighter, by diluting it. This is why a control is important: to see what color the test solution becomes when it is diluted with water, but when it does not react.

Lesson 2

5. Crackers, bread, pasta, oatmeal, marshmallows, etc. test positive for starch because the iodine solution turns to dark blue or black.

6. These foods contain starch.

7. They are already dark blue so the change in the color of the iodine would be very difficult to detect. Some students may think blueberries are blue because they contain starch. Not true. Blue is the color of the food.

8. Purple grapes, raisins, chocolate, etc.

Think, write, and discuss

5. Which foods tested "positive"? How do you know?

6. What does the positive test tell you about the food you tested?

7. Why it would be difficult to use this test on blueberries?

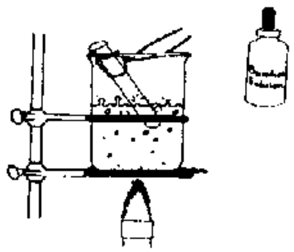
8. On what other foods might it be difficult to test?

* * *

Food Test #2: If it's not starch, then what is it?

Scientists use two other tests that are similar to the one you just did. These two other tests show if foods contain sugar (another kind of carbohydrate) or protein. Both use chemical solutions that change color if the sugar or protein is present.

Set up this next set of tests in the same way you set up the iodine solution tests. The only difference is that this new test solution—called Benedict's solution—works only when you heat the food to be tested in boiling water.



The test solutions can irritate your eyes and skin. Be very careful not to spill them on yourself or others. Rinse in plenty of water if you spill any. Get help from your teacher.

You will need:

- safety goggles
- 5 test tubes
- a grease pencil
- Benedict's solution
- a boiling water bath (water boiling in a beaker, to place test tubes in)
- several foods:
  corn starch dissolved in water
  glucose (sugar) dissolved in water
  gelatin dissolved in water
  cooking oil
- *other foods for testing such as* oatmeal, banana, cooked egg white, potato, apple, spaghetti or noodles, cheese, and any other foods you want to bring from home to test.

Lesson 2

Do, observe, and record

A. **Use a grease pencil to number five test tubes,** 1 through 5. Put your initials on the top of each test tube. Then make two lines, one 2 cm from the bottom on each of these test tubes and another line 4 cm from the bottom of the test tubes. You will add food to the first line and the test solution to the second line.

B. **Fill the test tube to the first line** with the following substances:
Test tube #1: water
Test tube #2: corn starch solution
Test tube #3: glucose (sugar) solution
Test tube #4: gelatin (protein) solution
Test tube #5: cooking oil (fat)

C. **Now add enough Benedict's solution** to each of the five test tubes to fill it to the second line.

D. **Place the test tubes in a boiling water bath for three to five minutes, or until you see a distinct color change.** Then observe the color in each of the five test tubes. Compare the color with that of your control (water.) **Record your observations in your journal.** You may simply add another column to your chart to record your observations.

E. **Now do the same test with four other foods**—mashed banana, chopped, cooked egg white, oatmeal, and marshmallow. Look back at the directions for using Benedict's solution, and follow them carefully.

F. **You may test other foods** if you like—some of your favorite foods, or foods you consider either healthful or "junk." Just keep a record of your tests in your journal.

Think, write, and discuss

9. The first test tube, which contained water, was used as a control. What color was it after adding the Benedicts solution?

10. a) Compare the color of the control test tube with each of the other test tubes. Which test substances changed the color of the Benedict's solution?

    b) What color did it turn?

11. Based on these observations, what component of food does the Benedict solution test for?

9. Light blue

10. a) Glucose or sugar
b) Red to orange to yellow to green to brown. All of these colors represent positive tests for sugar. In case someone asks, the different colors are caused by different kinds of sugars.

11. Glucose (sugar)

Lesson 2

12. a) bananas, crackers, marshmallows, etc.

b) No, some turn reddish, others greenish.

c) Actually, different kinds of sugar turn different colors. But students may suggest that different *amounts* of sugar or *heat* cause the different colors; or they may come up with other interesting ideas of their own.

13. They all contain glucose (sugar).

In letting students set up their own experiments here, we are trying to help them become more proficient in the "Constructing new knowledge" objective of "Design and construct scientific investigations."

Biuret solution tests for protein. It turns pink to purple to violet. You may need to place a piece of white paper behind the test tube to notice a color change.

12. a) Which foods in the second set reacted with the Benedict's solution?

    b) Did they all turn exactly the same color?

    c) Can you explain any differences?

13. What can you conclude about the foods that gave a positive test?

* * *

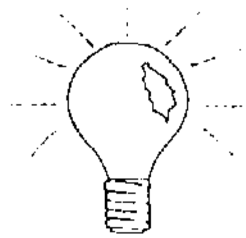
Food Test #3: If not for starch or sugar, then what?

There's one more test that scientists use that is similar to the one you just did. It uses a chemical test solution called **biuret solution.**

Think about the four main components of food that you have been testing: sugars, starches (both carbohydrates), proteins, and fats.

Which two have you already used a test for? Which two could this new test be for?

For this test, no written directions are provided. You have been through these **kinds of tests at least** four times now, and you can probably set up these tests fairly well yourself.



First, create a new record page for recording your **results**. Set it up with a table similar to the ones you've used already.

Then, set up the test foods, using the four simple substances in addition to the control (water). ***Remember that test solutions can can irritate your eyes and skin. Be very careful not to spill them on yourself or others. Rinse in plenty of water if you spill any. Get help from your teacher.***

You need to add **at least 10 drops** to each test tube, but you do not need to heat the foods in this test. If will be helpful if you use a **white piece of paper for a background** when comparing the colors of the foods to the color of the control.

When you have discovered which main food component the biuret solution tests for, make a note in your journal. Then conduct the biuret test again on new foods such as mashed banana, oatmeal, crackers, marshmallow, egg white, and any other foods you might have brought from home. **Record your observations and conclusions in your journal.**

Food Test #4: This one's different!

How can you test for another component of foods—fats? **The test for fats is much simpler to perform, but it only works well only with a high-fat content food sample.**

All you need is brown wrapping paper, a lamp, and food to test. **Begin by testing the simple substances you used earlier: glucose, corn starch, gelatin and cooking oil.**

Do, observe, and record

A. **Get samples of each of those foods.** Also obtain several small samples of other foods for testing, such as banana, cooked egg white potato, cracker, oatmeal, apple, peanut butter, cookies, spaghetti or noodles, cheese or other foods.

B. **Prepare five pieces of brown wrapping paper,** approximately 2" x 2". Label each piece of paper with the name of the food substance to be tested:

#1: water
#2: corn starch solution
#3: glucose (sugar) solution
#4: gelatin (protein) solution
#5: cooking oil (fat)

C. **Use a stirring rod or eye dropper** to transfer a few drops of each test solution to the appropriate piece of brown paper.

D. **Allow the test spots on each sheet of brown paper to dry.** When thoroughly dry, brush dried particles off the paper and hold the paper up to the light. Compare each of the papers with the control. The property of light passing through the paper is called translucence. Note whether light passes through the paper. **Record your observations in your journal.** Save the papers for comparison in the next part of this lab.

E. **Obtain several more sheets of brown paper.** Label them with the names of the following foods:
#6: mashed banana
#7: chopped, cooked egg white
#8: oatmeal
#9: marshmallow

How much fat is too much? A certain amount of fat is needed by our bodies for the production of certain cell structures. But "most health authorities recommend an American diet with less fat, saturated fat, and cholesterol. Populations like ours with diets high in fat have more obesity and certain types of cancer. The higher levels of saturated fat and cholesterol in our diets are linked to our increased risk of heart disease.

"A diet low in fat makes it easier for you to include the variety of foods you need for nutrients without exceeding your calorie needs, because fat contains over twice the calories of an equal amount of carbohydrates or protein." Home and Garden Bulletin No. 232, U.S. Department of Agriculture, U.S. Department of Health and Human Services, 1990.

Lesson 2

Teachers should encourage student speculation here, but should not provide answers at this point.

DIET AND NUTRITION: What do you eat?

Lesson 14

You know how important it is for your body to get enough proteins and carbohydrates from your food.

But how can you tell what's in the foods you eat?

How do you know *how much* proteins, carbohydrates, and fats are appropriate for you?

Key Question	How can you be sure that you get what you need from your food every day?

You will try to figure out whether or not your diet is healthy for you, whether it gives you what you need to grow and repair your body, and has the energy you need.

Try This

First, you need to have a complete list of what you eat—a diet diary.

A. List everything you ate yesterday, from memory, on one sheet of paper. Then, on another sheet, list today's breakfast and/or lunch, any snacks, everything you ate today. Take the list with you and keep recording all your food until you go to bed. Bring it in tomorrow. Don't cheat. Only you will see this list, so make it complete.

B. Then, you'll need some way of figuring out how much protein, carbohydrate, and fat you get from your food. How could you figure this out?

One way is to do food tests on everything you eat, like we did earlier in this unit. Were those tests able to tell you *how much* protein, for instance, was in a piece of cheese? Not really, not the way we did them. They could tell you *if* protein was in cheese, but not how much.

But it seems possible to construct a test like those to tell *how much* protein, or carbohydrate, or fat is in a certain amount of food. In fact, food and nutrition scientists have done this, and their results are on many packages of food you eat! Here's what a food analysis of bran flakes cereal looks like, taken right off the side of the box:

Lesson 14

Lesson Statement: Students compare foods based on nutrition information on food labels. They consider "common sense" guidelines for eating well, and compare these to the "Eating Right Pyramid." Then they examine their own diets and two make-believe diets.

Purpose: To enable students to use food labeling and other tools for constructing healthy diets.

Approximate Time: 4 class periods

	1 oz. bran flakes	with 1/2 cup *skim* milk	with 1/2 cup *whole* milk
calories	90	130	160
protein	3 g	7 g	7 g
carbohydrate	23 g	29 g	29 g
fat	0 g	0 g	4 g
cholesterol	0 mg	0 mg	15 mg

For comparison, here's what a food analysis of "crunchy" peanut butter looks like:

	2 tbs. peanut butter
calories	180
protein	9 g
carbohydrate	5 g
fat	16 g
cholesterol	0 mg

C. Compare bran flakes with skim milk to peanut butter. In your journal, enter the nutritional information for "bran flakes with milk" in one column and "peanut butter" in another, right next to it, to make it easier to compare.

1. Which would give you more protein?

2. Which would give you more fat?

3. Which would give you more carbohydrates?

D. Try serving yourself 1 oz. of bran flakes with 1/2 cup of milk, and 2 tablespoons of peanut butter (maybe on a slice of bread) to see if these nutritional analyses are really for what you would consider to be 1 serving.

4. Is 1 oz. of bran flakes with 1/2 cup of milk exactly what you would eat for breakfast? Is 2 tablespoons of peanut butter exactly how much you'd eat on a sandwich?

5. Are these comparisons true no matter how much you eat of either of these foods?

E. Now do this kind of comparison with other foods you eat. Create a chart to carry home with you, along with your record of what you eat, to collect nutrition information from the sides of food packages. Try to find information on many different foods, both ones that you think are healthy and ones that seem like junk foods. Try to get some that are high in protein, some that are

1. peanut butter

2. peanut butter

3. bran flakes with milk

4. Probably *no* for bran flakes. Probably *yes* for peanut butter.

5. No. The assumption underlying the comparisons of nutritional information on package labeling is that the amount indicated represents 1 serving. Often it doesn't.

Lesson 14

high in fat, some that are high in carbohydrates. Try to find information on the foods that you tested in Cluster 1.

6. What kinds of foods do you think *don't* come with nutritional labeling? How could you find out what a nutritional analysis of those foods would be?

6. Meat, eggs, bulk foods, soda pop, any foods that are already prepared, like from a deli, or food delivered to your home, like pizza. Also highly prepared foods, like cakes and pies. You might find out by calling a nutritionist at a university, a hospital, or the county extension 4-H office.

Tomorrow you'll look at the nutrition information you've gathered. But before you can really use this to help you know what kind of diet is good for you, you need to think about a few common sense rules.

What common sense rules do you know about eating healthy? Brainstorm them and list them on the board or on a piece of paper.

* * *

Here are a few:

- Don't eat too many sweets.
- Don't eat too many fatty foods, like lots of red meat, or lots of cheese, or lots of peanut butter.
- Eat lots of fruits and vegetables.

7. Why do we have these common sense rules? Explain why you think each one is important.

8. List any other rules you know about eating healthy. Try to make some up from what you've learned so far in this unit.

7. Common sense rules help us maintain healthy bodies, even though we don't fully understand why certain foods are good or bad for us. Sweets contain sugar, which gives you energy, but also causes cavities. Actually, the energy in sugar is released much faster than the energy in non-sugar carbohydrate foods (like cereals and pastas), so that non-sugar carbohydrate foods are actually better for continuing to get energy between meals. Fats in foods, especially saturated fats, tend to clog arteries and lead to heart disease. Fruits and vegetables contain lots of good vitamins and minerals.

8. Rules might include eating lots of carbohydrates for energy; eating protein foods when you're growing.

Day 2

Now that you've collected all this nutritional information about different foods, see if you can sort it out in some way.

F. Create several class charts for listing different types of foods -- one for foods that are relatively high in proteins, one for foods high in carbohydrates, and one for foods high in fats.

9. a) Look at your chart, and think about your eating rules. What foods should you stay away from, and why?

b) What foods should you eat, and why?

10. Are you surprised by any of these foods, that they have more protein, or more fats, or more carbohydrates than you thought (or less of any of these)?

9. a) Answers vary, but foods high in fats or concentrated sugars should be avoided.

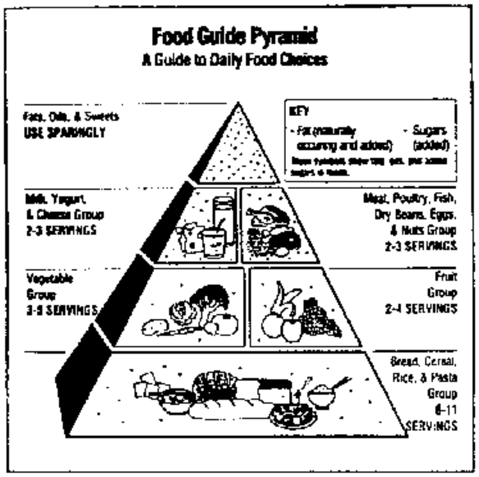
b) Answers vary but a healthy diet consists of plenty of grains, fruits and vegetables. (See #7.)

10. Answers vary.

Lesson 14

Nutrition information for common foods is listed in the appendix, in case you want to use some foods for comparison that no student brings back to class.

Here's a rule-of-thumb for the amount of fat in a healthy diet: Nutritionists recommend that no more than 30% of one's daily intake of calories come from fats. This can be estimated easily from the amount of grams of fat one eats: Each gram of fat has 9 calories (compared to about 4 calories each for a gram of protein or a gram of carbohydrate); multiply the number of grams of fat in the serving by 9 to get the total calories from fat, then divide this by the total calories for the serving. Try this using the nutrition info on a candy bar.



The U. S. Department of Agriculture has created a simple way to think about how much of different foods people should eat. It's called the Eating Right Pyramid. Let's see if you agree with their suggestions.

11. a) Which group(s) on the food pyramid are composed mostly of protein?

    b) Which group(s) are composed mostly of carbohydrates?

    c) Which group(s) contain the most fat and oil?

12. Look at the shape of the pyramid and the recommended number of servings for each group of foods and tell why breads, grains and cereals are at the bottom of the pyramid and fats, oils and sweets are at the top of the pyramid.

13. Do your ideas about eating well fit with this food pyramid? Why or why not?

Try This

Let's test out what you know about eating well by looking at three different diets and analyzing them for proteins, carbohydrates, and fats.

You will need:
- **Your own diet diary for one day**
- **Blank charts for recording data**
- **Marta's diets *before* and *after* the food unit**

Here's what to do:
Basically, you will look at three different teen-age diets: Marta's (a fictitious character) *before* studying the unit, Marta's diet *after* studying the unit, and your own sample diet for a day. You will analyze each diet, using nutritional

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11. a) Meat products

b) Grains (Bread, cereal, rice and pasta)

c) Meat and dairy products. If students have trouble with this one, point out the key on the "Eating Right Pyramid" which shows fats by the small circles.

12. The bottom of the pyramid, which has the most space represents foods that you should consume in the largest amounts. Breads, grains and cereals are needed by bodies because they are good sources of long-lasting carbohydrates for energy. The top of the pyramid which has the smallest space represents food that you should consume in the smallest quantities. Fats and sweets are here because they can contribute to health problems, including heart disease and cavities.

13. Answers vary.

Lesson 14

You may need to help students figure out what the components of some prepared foods may be. They often have trouble with this since their familiarity with food is primarily from the supermarket rather than from any actual food production processes. Even foods as common as cereal leave some students totally mystified about where it comes from.

Students will need to estimate servings in all of these questions. They should have less difficulty with their own diet if they kept an accurate food diary and if they kept the packaging information whenever possible. The wrappers from snack foods and any others that they can get will be very helpful in estimating serving size as well as obtaining grams of saturated or unsaturated fat and cholesterol. You will probably need to remind them that they should make the best estimate they can.

information from food labels and the food pyramid, to see which components are present and at what levels.

Think, write, and discuss

A. Examine *Marta's diet diary for the day before* she studied this food unit. Obtain a blank copy of the food pyramid and for each food consumed at breakfast, lunch, dinner and for snacks, find the proper food group on the pyramid and write the name of the food in that space. Items such as butter or margarine, jam, syrup, topping, nuts, etc. should be entered separately.

MARTA'S SAMPLE DIETS

BEFORE FOOD UNIT:	AFTER FOOD UNIT:
Breakfast: 5 pancakes with butter and syrup, 4 strips of bacon, whole milk	Breakfast: 2 poached eggs, 2 slices of toast with honey, skim milk, orange
A.M. Snack: Sweet roll and soft drink	A.M. Snack: Cottage cheese and pear
Lunch: Hamburger, french fries, ice cream, soft drink	Lunch: Broiled chicken, baked potato, apple, skim milk
P.M. Snack: Candy bar and soft drink	P.M. Snack: Raisins, apple juice
Dinner: Steak, mashed potatoes with butter, peas, fruit cocktail, apple pie, whole milk	Dinner: Steak, baked potato with sour cream, peas, salad with lo-cal dressing, cantaloupe, cottage cheese, skim milk
Bedtime Snack: Potato chips and soft drink	Bedtime Snack: Yogurt and apple

B. Count the number of servings of *grain products* in Marta's diet. Use the information on the chart next to the "Eating Right Pyramid" as a guide in counting servings. If packaging from any of these foods are available, the nutrition information on it may help you, especially when evaluating your own diet.

C. In a similar manner, count the number of servings in the *fruit and vegetable group*.

D. Count the number of servings in the *dairy group* and in the meat products group.

E. Use the information in the "Eating Right Pyramid" to estimate how many *grams of fat* are in the diet. You will need to check through all the groups in the pyramid, but especially the dairy and meat products groups for fat and

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oil content since most fats and oils are consumed as part of other foods. For example, potato chips are a vegetable but have large amounts of oil as do all fried foods. Many meats and dairy products have high fat content as does chocolate and most candies.

F. Use the information in the "Eating Right Pyramid" to decide how many servings of *concentrated sugars* are in the diet. Again, you will need to check through all the groups in the pyramid but especially the carbohydrate and fruit groups. For example, pie is often a source of fruit but also contain concentrated sugars. Cookies and cakes have wheat or oats (grain) in the flour but also contain lots of concentrated sugars.

G. Now compare "Marta's Food Pyramid before food unit" with the "Eating Right Pyramid." Be sure to examine and compare every food group. Remember that the pyramid is a guide of what to eat each day and how many servings.

13. a) How healthy is her diet?

    b) What suggestions can you make that will improve it?

13. a) Not very

    b) Much less fat, meat, whole milk products, concentrated sweets and junk food

H. Now look at *Marta's diet diary for the day after* she had completed the study of this unit. Begin with a new blank copy of the food pyramid and repeat steps A through G.

I. Compare "Marta's Food Pyramid after food unit" with the "Eating Right Pyramid." Be sure to examine and compare every food group.

14. a) How healthy is her diet?

    b) Make suggestions if you can that will improve it.

14. a) Quite healthy

    b) Could eat less meat and more grains

It's one thing to criticize others for their eating habits. It's harder to look closely at what we eat ourselves.

J. Do the same kind of analysis on your own diet as you did on Marta's diets.

15. a) How healthy is your diet?

    b) What changes could you make in your own diet that would make it healthier?

    c) What might keep you from changing the way you eat?

15. Answers will vary.

16. a) Which diet was the healthiest? Give reasons to support your answers.

    b) Which one was most unhealthy? Give reasons to support your answers.

16. Answers will vary.

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DIGESTING FOODS: Where does it start?

Lesson 5

Many of you probably know that food is digested as it travels down into your body. But what exactly does that mean? Does it mean that food is made into smaller pieces? Does it mean that it is changed somehow? Is digestion the process of releasing energy from food?

We'll explore the process of digestion in the first part of this cluster. We'll start in this lesson by exploring where digestion starts.

Where do you think digestion starts?

If you said "Digestion starts in your mouth," is there a way to find out for sure?

One way to explore what's going on in your mouth is to chew up some food, take it out, and see if it has changed in any way.

How can you tell if it's changed? In what ways might it change? Has it's temperature changed? Has it's size changed? Did it change into a new substance?

How could you tell if a new substance is produced? Remember the food tests you did for starch and sugar in Cluster 1? Did you test oatmeal? What was it composed of? If oatmeal changes in your mouth into a new substance, what experiment could you do to tell?

Try This

Talk among your group members about how to test chewed oatmeal to see if it changes in your mouth. Think through everything you might want to do. Then write a plan in your journal.

Your experiment might look like this:

1) Test the oatmeal before it's chewed, and record your results.
2) Test the oatmeal after it's been chewed, and record your results.
3) Try to explain your results.

In previous food tests, students found that oatmeal is composed only of starch—no sugar, protein, or fat.

An experiment should include

1) testing oatmeal for sugar—or protein or fat—*before* it's chewed to show that it contains none; these tests were done in Lesson 2

2) testing oatmeal *after* it's chewed to discover if it's changed into sugar, protein or fat

3) testing saliva by itself to rule out the possibility of saliva alone containing sugar. **Many students will not think of testing saliva. Page 21 is designed to help them figure this out. They can conduct the test on saliva after they read the top of p. 21.**

Lesson Statement: Students either design an experiment or use the given instructions to explore the part of digestion that occurs in the mouth. They perform the tests for sugar and starch on oatmeal before and after it has been chewed.

Purpose: To investigate both the chemical changes that occur in the mouth as food begins to undergo the process of digestion.

Approximate Time: 1 1/2 class periods.

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Are you thinking about testing the oatmeal (after chewing) for *all* of the components in food? A little thinking before the experiment might help you decide what tests to do. Remember that oatmeal is a starch. Starches and sugar are both carbohydrates. Maybe the starch in oatmeal could change into sugar. If this is true, you'd have to do only one test—for sugar.

To do this experiment, you'll need:

- uncooked oatmeal and a teaspoon to measure it
- Benedict's solution and an eye dropper (why Benedict's solution?)
- test tubes
- test tube holder
- a boiling water bath

Boiling water burns badly! Benedict's solution can irritate eyes and skin. If spilled, wash with plenty of water. Get help from your teacher.

Try your experiment. Use the directions below if you would like to follow step-by-step instructions.

Test the oatmeal before and after chewing:

A. Place approximately 1 teaspoon of oatmeal—out of the box—in test tube A (or you could label this the "before" test tube.) Using an eye dropper, add several drops of water to soften and moisten the oatmeal.

B. Next, chew on approximately 1 teaspoon of oatmeal without swallowing it. After 1 to 2 minutes, place the chewed oatmeal in test tube B (the "after" test tube.)

C. Place both test tubes in a beaker of boiling water. Wait 5 minutes.

D. Add about 20 drops of Benedict's solution to each test tube.

E. Heat each of the test tubes gently for 2 to 4 minutes or until a color change is noted.

F. Record your results in your journal.

Did you find that the oatmeal tested "positive" for sugar after it was chewed? How can you explain this?

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Is *chewing* a part of digestion? Many biology texts include the physical/mechanical process of chewing as a part of digestion. Others disagree, arguing that digestion is purely a chemical process. We have chosen to explain digestion in this unit as only the chemical process that uses enzymes to change food into new substances. We are purposefully not including chewing as part of digestion, because it is not a chemical change. Research suggests that many chemical changes are not really understood by students, who explain them instead as some sort of physical change. So we are searching for ways **not** to increase this confusion. Although chewing increases the surface area of food on which enzymes can act, it does not change food into a new substance.

I. One explanation is that the grinding of the oatmeal by your teeth produced the sugar. Do you agree? How could you test this?

II. Another possible explanation is that something in your mouth chemically reacted with the oatmeal to change it into a new substance. If this is true, what could there be in your mouth that could do that?

III. A third possible explanation is that the saliva in your mouth contains sugar, and it mixed in with the oatmeal as you chewed. What do you think about this? **How could you test this?**

1. Think over the three possible explanations above. Write in your journal *your* explanation for why sugar is produced when oatmeal is chewed.
2. Try any tests you can think of to prove or disprove any of the three possible explanations.
3. Do you think digestion starts in the mouth? If you said yes, what evidence do you have? If you said no, why?
4. Discuss your explanation with your group partners. After your discussion, make any changes that will make your explanation better.

I. You could test this by grinding up oatmeal outside of the mouth, in a mortar and pestle, and then testing it.

III. You could test for sugar already in your mouth by testing saliva. (It tests negative for sugar.)

1. Answers will vary, but most students will probably choose one of the three possibilities stated at top of page.

2. If students test chewed oatmeal for sugar, they should also test saliva to determine if it has any sugar itself (it doesn't.). This would allow them to decide on whether they believe the 3rd possible explanation (III). (It is often helpful to chew on a clean rubber band or paraffin to produce saliva. Students should not test their saliva after eating.)

3. Digestion is the *chemical* breakdown of foods. It begins in the mouth when saliva chemically reacts with starches to form sugars (simple and smaller molecules.)

4. If students chose I or III, they may change to II after testing saliva and discussing the test results with their group partners.

Lesson 5

MORE ON DIGESTING FOODS: Breaking down proteins

Lesson 6

Think back to your food tests. What kinds of foods have protein in them?

As these foods travel down into the stomach, they are bathed in digestive chemicals called enzymes. These are new enzymes, different from the ones in saliva. They help to break down the fats and proteins, as well as the carbohydrates.

Scientists have extracted these chemical enzymes from human bodies. They know what they're like. You can actually see what digestion of protein is like, using enzymes similar to ones in your stomach.

Try This

For a protein, use gelatin, the same protein you used in the food tests in Cluster 1. Gelatin is a protein that actually helps make up the tendons and ligaments of animals (the tissues that connect bones and muscles.)

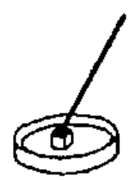
You will need:

- 2 Petri dishes without covers
- a stirring rod
- measuring spoon
- unflavored gelatin
- unseasoned meat tenderizer
- crushed fresh pineapple
- crushed canned pineapple

Do, observe, and record

A. Obtain a container of unseasoned meat tenderizer. Read the ingredients listed on the container. Record these ingredients in your journal.

B. Use two petri dishes (covers not needed). Use a grease pencil to number them 1 and 2.



C. Place one square (about 1/2" x 1/2") of set, unflavored gelatin in each petri dish. Observe the consistency of the gelatin by *gently* poking at it with a stirring rod. Record your observations.

Lesson 6

Lesson Statement: Students use meat tenderizer and pineapple as a source of enzymes to break down (digest) the protein present in gelatin. They relate this to the actual digestion of protein in the body.

Purpose: To use the digestion of protein in gelatin as a basis for understanding how protein and fat are digested in the human body.

Approximate Time: 2 class periods.

D. Use one **square of gelatin as the control** (what does that mean?) Then sprinkle **both sides of the other piece of gelatin** with one-quarter teaspoon of meat **tenderizer**.

E. After 2 minute**s**, **poke the gelatin** *gently* with a stirring **rod to** check its consistency. You may notice that water also **comes** out of the gelatin, but in this activity, you are mainly **concerned** with the consistency of the gelatin. Record your **observations**. Repeat this test at 5-minute intervals for at least four observations, more if time permits. Keep recording.

Think, write, and discuss

1. At the end of this experiment, how is the control gelatin different from the gelatin treated with meat tenderizer?

2. **Draw a conclusion from your observations:** In which case was the gelatin actually broken down or "digested"—the control or the one treated with meat tenderizer?

3. Look at the label on the meat tenderizer and decide which ingredient is responsible for this reaction. The chemical substance which actually breaks up the gelatin is—can you guess?—an enzyme.

4. Now think about real meat and how meat tenderizer works.
   a) Meat tenderizer reacts with which nutrient in meat?
   b) What does it do to that component?
   c) How do you think meat tenderizer works?

5. a) Explain, in your own words, using a couple of sentences, what happens to proteins in your body after you eat them. Talk about where the foods containing protein travel, what happens to them along the way, and what chemical substance is necessary for this to happen.

   b) Add to your drawing and explanation from Lesson 4, or start a new drawing, to show what you're learning that's new. Save your drawings for later use.

6. **Speculate:** Where in your body do you think the chemical substance—the enzyme—that breaks down protein could come from?

Step E requires students to check on the consistency of their gelatin every 5 minutes over a period of 20 minutes or so. During this time, you may want to have them write in their journals first a prediction about what they might see, and then their own speculation about what is happening. That is, their "observations" might include more than just a note about the appearance of the gelatin—they may also include some analysis of what might be happening. They should especially come to see the difference between any water that leaves the gelatin, and the product of the chemical reaction, which might look "watery." You may want to ask students to clarify their notes if they suggest that the gelatin is turning watery. Do they mean that it's turning into water, or simply changing to the *consistency* of water?

1. The control stayed very hard and firm while the one with the meat tenderizer got very soft and liquid-like.

2. The treated one.

3. Usually papain, a derivative of the papaya plant.

4. a) Protein.
   b) It helps digest the protein and make it soft and not so tough.
   c) It is an enzyme that chemically changes the protein so it can be used by cells.

5. The **key points** are:

- the protein enters your mouth (where it is crushed and ground as it is chewed).
- it goes through the esophagus to the stomach where the protein is mixed with enzymes that begin to chemically change it into simpler substances.
- it then leaves the stomach and goes into the small intestine where it is mixed with more enzymes that continue the process of chemically changing it into

6. Students' answers vary. It may be interesting to ask them why they think what they do. It comes from the walls of the stomach and small intestine and from the pancreas.

Lesson 6