

BRAIN CHEMISTRY
TEACHER'S GUIDE

FOOD FOR THE BRAIN

WRITTEN BY

NANCY P. MORENO, PHD

BARBARA Z. THARP, MS

TADZIA GRANDPRÉ, PHD

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and online versions of these lessons are
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Authors: Nancy P. Moreno, PhD, Barbara Z. Tharp, MS, and Tadzja GrandPré, PhD.

Editor: James P. Denk, MA.

Creative Director: Martha S. Young, BFA.

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Center for Educational Outreach, Baylor College of Medicine
One Baylor Plaza, BCM411, Houston, Texas 77030 | 713-798-8200 | 800-798-8244 | edoutreach@bcm.edu
www.bioedonline.org | www.bcm.edu/edoutreach

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Page 4: Healthy Eating Plate © 2011, Harvard University. For more information about The Healthy Eating Plate, please see The Nutrition Source, Department of Nutrition, Harvard School of Public Health, www.thenutritionsource.org/, and Harvard Health Publications, health.harvard.edu/.



OVERVIEW:

Students will learn about nutrients important for health by dissecting a slice of pizza.

FOOD FOR THE BRAIN

CONCEPTS

- The brain needs many different kinds of raw materials from food.
- Breakfast is important.
- Recommended serving sizes are often smaller than the size actually served or the amounts people eat.

SCIENCE & MATH SKILLS

Observing, recording, inferring and drawing conclusions

TIME

Preparation: 30 minutes (to bake and cool pizza)

Class: 45 minutes for pizza dissection and class discussion

THE BRAIN NEEDS BREAKFAST

According to the American Dietetic Association, it is important for children to start their days with a healthy breakfast. In general, children who regularly eat breakfast perform better in school, and may even score higher on tests. Breakfast eaters have better attendance records and fewer behavior problems in school. They concentrate better, solve problems more easily and have better muscle coordination. Also, students who eat breakfast are less likely to be overweight.

The brain needs many different kinds of nutrients. Glucose, a kind of sugar, is the main source of energy for the brain. While all carbohydrates can serve as sources of glucose, some are better than others. Breads, pastas, cereals and other foods made with whole grains provide the brain with steady supplies of glucose. Foods that contain white sugar or corn syrup, white rice, white flour (found in white bread and most cakes, crackers and cookies) and other refined carbohydrates also supply energy. However, they cause glucose levels in the bloodstream to rise rapidly and then crash.

Proteins from food provide the amino acids used to make neurotransmitter molecules. Meat, fish, poultry, dairy products, eggs and beans (including soy beans) are good sources of proteins. The cell membranes of neurons are made of fats. The healthiest fats are liquid at room temperature. Olive, flaxseed and canola oils are examples of healthy fats. In addition, oils from coldwater fish, such as mackerel, salmon and trout are good sources of a kind of fat needed to build cell membranes in the brain.

Minerals such as calcium, sodium and potassium are vital for the generation and conduction of electrical impulses in neurons and are involved in the release of neurotransmitters from axon terminals. Vitamins are essential molecules needed in small amounts by cells throughout the body, including neurons. For example, choline, a vitamin found in egg yolks and leafy green vegetables, is the basis for the chemical messenger, acetylcholine, that transmits signals to muscles.

The diets of many adolescents are high in sugars and unhealthy fats. In addition, the “supersized portions” of snack and fast foods eaten by many students supply too many calories. Calories measure the amount of energy provided by food. They can be obtained from the breakdown of many different kinds of molecules, particularly fats, carbohydrates and proteins. The body needs a certain amount of calories each day as fuel.

Excess calories are stored as body fat. Unfortunately, even though many American children consume several times the amount of calories they actually need, they are not supplying their bodies with nutrients needed for optimum growth and development.



UNIT LINKS

Legacy of Lost Canyon

Chapter 11
Science box, p. 13

Brain Chemistry Explorations

“Fueling the Signals,” p. 4



FOOD AND HEALTH

- A child's brain grows rapidly before birth and for about two years after birth. Malnutrition during these periods can affect development of the nervous system.
- Chocolate contains about 380 chemicals. Some of these are stimulants, which may make you feel more alert. Other chemicals in chocolate may affect the pathways of neurotransmitters related to feelings of well-being.
- Vitamin A deficiencies can lead to night blindness (inability to adjust from light to dark environments) and other vision problems. Vitamin A is found in yellow and orange vegetables, dairy products and beef liver.

WHAT IS IN FOOD?

CARBOHYDRATES, a major source of energy, are found in fruits, vegetables and grains (including flour). Fiber, starches and sugars are carbohydrates. Most US students tend to eat too many snacks and prepared foods that are high in refined sugars and flours.

FATS are rich sources of energy. Cooking oils, lard, butter, margarine and shortening are almost pure fat. Foods that contain large amounts of fat include some red meats, bacon, dairy products, chocolate, cakes, cookies, fried snacks (chips, crackers, etc.) and nuts. Fatty foods should be eaten sparingly, because the body will store any unused energy as additional body fat. Fats from plants (like olive or canola oil) or fish generally are healthier than butter, fatty meat or lard.

PROTEINS are building blocks for the body. Muscles, hair, skin and nails are mostly protein, as is the flexible collagen network within bones. Proteins

help to carry out essential chemical reactions within every cell. The body can use protein as a source of energy. Lean meats, fish, poultry, eggs, low-fat dairy products, beans, peas and nuts are good sources of protein.

VITAMINS are substances needed by the body in small amounts. Vitamin C is necessary for the development of connective tissue and helps to prevent cell damage. Vitamin A is important for vision. Eating a variety of fruits and vegetables every day helps ensure that the body has the vitamins it needs.

MINERALS have many roles. Calcium, the most abundant mineral in the body, makes bones hard and is important in muscles and the nervous system. Good sources of calcium are low-fat dairy products, dark green leafy vegetables, tofu, sardines with bones and calcium-fortified juices and cereals.

DID YOU KNOW?

Fats account for more than half of the dry weight of the human brain.

This activity is designed to promote student awareness of portion sizes, nutrient content of food, and the brain's nutritional needs.

MATERIALS

Per Group of Students (See setup)

- 2 craft sticks
- 18-in. sheet of wax paper
- Prepared and cooled slice of frozen "supreme" pizza
- Copy of "Dissect That Pizza!" sheet

Per Student

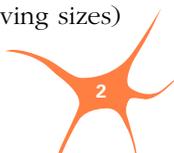
- Copy of the "Nutrition Facts"

label from the pizza package

- Copy of the student sheets
- Optional:** Demonstration
- 2 slices of cheese
 - Apple or orange (medium)
 - Cup of raw, chopped carrots
 - Deck of cards
 - Slice of sandwich bread
 - Teaspoon of margarine

SETUP

Before class, bake one or more medium or large frozen pizzas with mixed or "supreme" toppings. Let the pizzas cool (refrigerate if necessary). Cut each pizza into the number of slices (serving sizes)



EXTENSIONS

- Encourage students to create or find recipes that include many nutrients needed by the brain. Share these with the class OR have a “Brain Food Day,” during which students (or parents) bring different foods to share in class, or prepare one or more of the students’ recipes in class.
- Have students use an online Calorie counter or App to investigate the caloric, fat and nutrient content of common fast foods.

recommended by the Nutrition Facts label on the pizza package. You will need at least one slice per group. Make one copy of the Nutrition Facts label from the pizza package for each student. Photocopy “Dissect That Pizza!” (one per group), and the remaining student pages (one per student).

Optional. If possible, bring the following items to use for demonstration with Step 2 below: 2 slices of presliced, prepackaged sandwich cheese (milk products); 1 slice of sandwich bread (carbohydrates); 1 cup raw, chopped carrots (vegetables); 1 medium apple or orange (fruit); 1 teaspoon of butter or margarine (fats and oils); and 1 deck of cards (in place of 1 portion for meats, fish and poultry).

Have students conduct this activity in groups of 2–4.

PROCEDURE

1. Ask students, *What do you think your brain needs to function?* Students might respond that it needs some sort of food or fuel. Tell students that they will conduct an investigation of a popular food item to examine portion size and the amount and quality of brain food (or fuel) it provides.
2. Give each student a copy of the “Healthy Plates,” and “Estimates & Servings” pages. If time allows, have students complete the questions at the top of the “Healthy Plates” sheet. Discuss the portion sizes shown by the “Quick Hand Measures” and the recommendations on the “Healthy Eating Plate.”

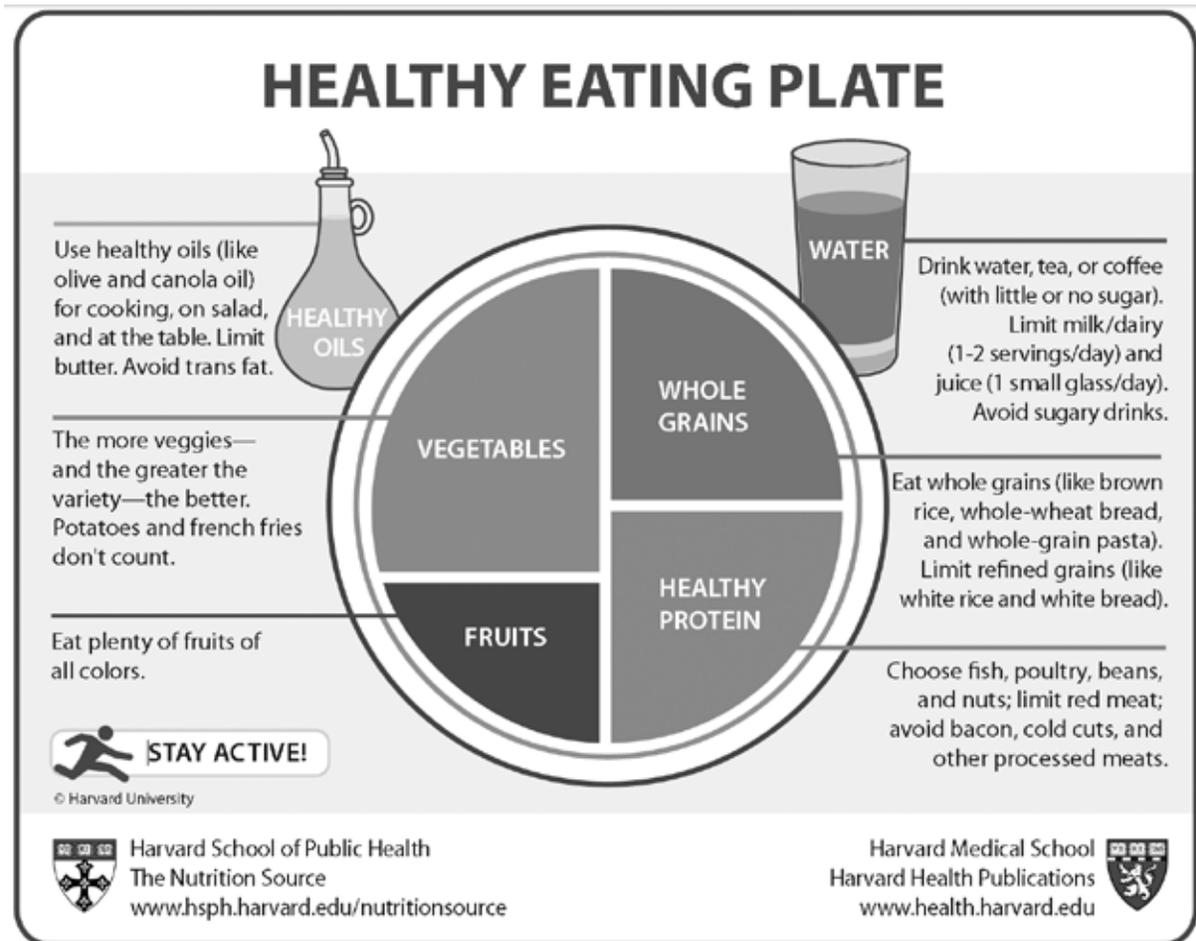
Optional. Show students actual serving size samples from each of the food groups.
3. Tell students that they are going to examine and dissect a popular food, pizza. But first, ask students, *What are the ingredients in a pizza?* Students probably will respond—crust, meat (various kinds), cheese, sauce and vegetables. Ask, *Do you think pizza is good for you or meets some of your daily nutritional requirements? Why or why not?* Record responses on the board.
4. Next, give each group of students a “Dissect That Pizza!” student sheet, a serving of pizza, a large piece of wax paper for a work surface, 2 craft sticks to use for the dissection and a copy of the “Nutrition Facts” label from the pizza package.
5. Have each group follow the directions on the student sheet and answer the questions. Next, have groups share their conclusions with the class. Ask, *How does pizza rate as a healthy food?*
6. Explain that fats and calories are only part of the story. To function at an optimal level, the brain needs specific nutrients. Give each student a copy of “Fueling the Signals” page.
7. Instruct students to write a paragraph explaining why pizza is or is not a good “brain food.” OR have students address the question, *Would you eat pizza for breakfast before an important test?*
8. Encourage students to share answers within their groups and then let each group present to the class.



HEALTHY PLATES



1. List all the foods you have eaten in the past 24 hours, by meal (including snacks), on a separate sheet of paper.
2. Compare the foods in each meal to the recommendations in the Healthy Eating Plate below. Keep in mind that many foods combine items from two or more groups.
3. On separate sheet of paper, make a chart with each food group shown in the diagram. List the foods you ate under the appropriate food groups.
4. Write an explanation of how closely the amounts and kinds of food you ate matched the recommendations in the Healthy Eating Plate.





ESTIMATES & SERVINGS

Serving sizes often are smaller than the portions we actually eat.

Look for low levels of saturated, hydrogenated and trans fats. These are unhealthy.

Cholesterol is found in foods of animal origin.

Look for foods that have more carbohydrates as fiber and fewer as sugar. Only foods from plants provide fiber.

Protein is important for muscles and growth. It is found in animal and plant foods.

Vitamins and minerals are essential for health. Calcium is important for bones and teeth.

Use this section as a guide for daily planning. The amount of calories needed by each person depends on many factors, including exercise. Foods with high amounts of saturated fats or sugars may not represent the best choices.

Refried Beans Fat Free

Nutrition Facts

Serving Size 1/2 cup (125g)
Servings Per Container 3.5

Amount Per Serving

Calories 130 Calories from Fat 0

% Daily Value*

Total Fat 0g	0%
Saturated Fat 0g	
Trans Fat 0g	0%
Cholesterol 0mg	0%
Sodium 490mg	20%
Total Carbohydrate 24g	8%
Dietary Fiber 7g	28%
Sugars 0g	0%
Protein 9g	16%
Vitamin A	0%
Vitamin C	0%
Calcium	6%
Iron	15%

* Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:

	Calories:	2,000	2,500
Total Fat	Less than	65g	80g
Sat Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g

QUICK HAND MEASURES



A closed fist

=

Piece of fruit or cup of raw vegetables



Two fingers

=

Ounce of cheese



A cupped hand

=

Cup of dry cereal



An open palm

=

Single serving of meat



Tip of thumb

=

Teaspoon of butter



Use the Quick Hand Measures to estimate the size of one serving of different foods. Use the Healthy Eating Plate to guide meal planning.



FUELING THE SIGNALS



A healthy nervous system requires many different kinds of raw materials. These raw materials come from food. Amazingly, glucose (a kind of sugar) is the main source of energy for the brain and the rest of the nervous system. Under normal conditions, the brain depends on a continuous supply of glucose provided by the blood. Have you ever felt cranky after missing a meal or had trouble concentrating on a test when you skipped breakfast? Your brain probably was running low on glucose.

High carbohydrate foods such as bread, pasta and potatoes are important sources of glucose. Your body also can manufacture glucose from proteins and other energy-rich foods. The best kinds of carbohydrates are digested slowly and provide an even supply of energy. Breads, cereals and pastas, when made from whole grains, provide healthy carbohydrates. Candy and other sugary foods actually deprive your brain of fuel because they cause glucose levels in the bloodstream to rise rapidly and then crash.

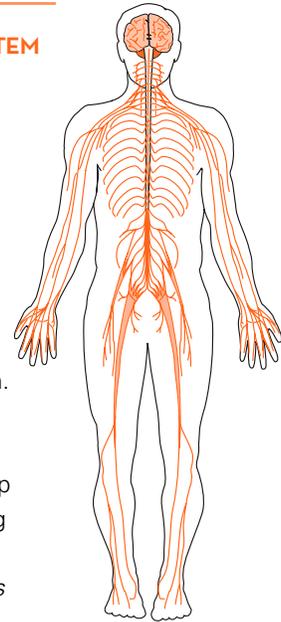
Remember the electrical signals that are carried along neurons? The signals travel through the outer membrane (covering) of nerve cells. The cell membrane is made of fats. Certain kinds of fats and oils are healthier than others. Try to avoid saturated fats (found mainly in animal products) and fats that are solid at room temperature (such as shortening, butter and lard). Instead, choose healthier fats, such as olive, flax or canola oils. Some people call fish “brain food” because oily, cold-water fish like

mackerel, salmon and trout supply a kind of fat needed to build cell membranes in the brain.

CENTRAL NERVOUS SYSTEM

Virtually all functions of the nervous system—and thus, the whole body—are based on electrical and chemical communications inside and among neurons.

The foods you eat provide fuel for your brain and the rest of your nervous system. They also supply the nutrients, such as fats, proteins and vitamins needed to keep the nervous system working efficiently. When selecting foods to eat, ask yourself, *Is this a good brain food?*



Proteins from food provide amino acids that are used to make neurotransmitters (chemical messengers between neurons). Meat, fish, poultry, dairy products, eggs and beans are good sources of protein. In addition, choline, a substance found in egg yolks, whole wheat products and leafy vegetables, is the basis for the neurotransmitter, acetylcholine, which carries signals to muscles and also is important for memory.





DISSECT THAT PIZZA!

1. You have been given one slice of pizza. Using the craft sticks provided, carefully separate the pizza slice into as many different kinds of foods as possible.
2. List each pizza ingredient in the “Food Part” column below. For example, you might find pepperoni, tomato sauce, cheese, olives, etc.
3. Use the information on the “Estimates & Servings” sheet to:
 - a. identify and record the Food Group or Groups to which each part belongs; and
 - b. estimate the Number of Servings of each food group represented by the parts of the pizza.

	FOOD PART	FOOD GROUP(S) IN WHICH IT BELONGS	NUMBER OF SERVINGS (APPROXIMATE)
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

4. Use the information listed on the Nutrition Facts label from the pizza package to fill in the blanks.
 - a. List the total number of Calories in one slice. _____ Calories
 - b. List the total number of Calories from fat in one slice. _____ Calories from fat
5. How does the serving size, listed on the Nutrition Facts label from the pizza package, compare with the serving sizes recommended by The Food Pyramid? What does this imply? Write your answer on the back of this sheet.
6. Considering all the ingredients in a slice of pizza, could it make a good breakfast? Why or Why not? Write your answer on the back of this sheet.

