Student Explorations in Mathematics

Nutrition Facts
Serving Size 1-1/2 cups
Servings Per Container 6

Per Serving
Calories 250   Calories from Fat 70

	% Daily Value*
Total Fat 8g	12%
Saturated Fat 2g	10%
Trans Fat 0g	
	3%
	10%
	12%
	20%

• Vitamin C 70%
• Iron 8%

What's on Your Plate?

In this issue, teachers and students explore various facets of health and nutrition while using mathematics in the investigations of data from government sources on nutrition. The mathematics and mathematical thinking that are explored include basic operations, reading and interpreting data from charts and tables, predicting outcomes based on data, and combinatorics.

Use this exploration to promote collaboration, as it provides opportunities for students, teachers, and parents to investigate aspects of nutrition that can help lead everyone to healthier eating habits and lifestyles. Activities include reading and interpreting food product labels, analyzing daily requirements from the food groups and calories used in varieties of physical activities, and choosing healthy percentages to populate MyPlate. Suggestions are given for taking action on dietary guidelines.

TEACHER NOTES

🖎 **Suggested answers** are in **red**. Instructional notes are in **blue** and are preceded by the hand icon. These two features do not appear in the Student Version.

🖎 **Classroom materials:**
  • Internet access is helpful but is not required.

🖎 **Supplemental materials:**
  • Student version.PDF

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What's on Your Plate?

Press Release

WASHINGTON, Jan. 31, 2011—U.S. Department of Agriculture Secretary Tom Vilsack and Secretary of the Department of Health and Human Services Kathleen Sebelius announced the release of the *Dietary Guidelines for Americans*, 2010, the federal government's evidence-based nutritional guidance to promote health, reduce the risk of chronic diseases, and reduce the prevalence of overweight and obesity through improved nutrition and physical activity. Because more than one-third of children and more than two-thirds of adults in the United States are overweight or obese, the 7th edition of *Dietary Guidelines for Americans* places stronger emphasis on reducing calorie consumption and increasing physical activity.

You can be healthy and achieve your dreams. Armed with information about eating right and being active will help you do the following:

- Feel better about yourself.
- Be prepared to learn.
- Develop healthy muscles, bones, and joints.
- Enjoy life.

This *Student Explorations in Mathematics* activity will give you the tools you need to make better choices for a healthy lifestyle.

✏️ Before investigating the following questions, ask students to look at the label and share what they notice about the items listed, including any mathematics they find on the label.

1. Look at the label in **figure 1**. How many servings are in the container it refers to? How do you know?

This container has 2 servings. This information can be found at the top of the label.

2. What percentage of the total number of calories from 1 serving are from fat?

$\frac{110}{250}$ × 100, which equals 44 percent

3. What percentage of each serving size is made up of grams of fat?

$\frac{12}{228}$ × 100, which equals about 5 percent
(Remember, each cup has 2 servings.)

The amount immediately following each of the nutrient categories, for example Total Fat 12g, is the amount of that type of nutrient in **1 serving** of the given food item. For instance, this item has 30 mg of cholesterol in 1 serving.

4. What percentage of each serving size is made up of sodium? (Note: 1 g = 1000 mg)

470 mg = 0.47 g

So, $\frac{0.47}{228}$ × 100 would result in about 0.02 percent.

✏️ Questions 2–5 are samples of the type of questions that teachers might ask related to the numbers and information on the macaroni and cheese label (see
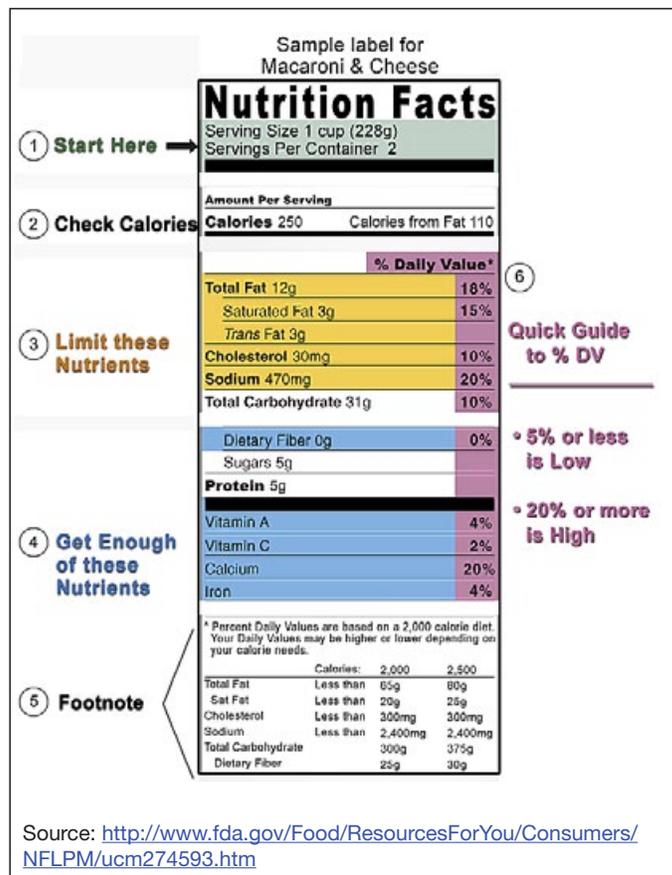

Source: http://www.fda.gov/Food/ResourcesForYou/Consumers/NFLPM/ucm274593.htm

Figure 1. Product Label and Serving Size

fig. 1). Teachers could request that students bring in labels from their favorite snack items to investigate and compare.

The percentages in the right-hand column of the label indicate how much of a person's suggested daily intake for the given nutrient is included in the labeled food. These percentages are based on a well-balanced diet of 2000 calories. For example, eating one serving of the macaroni and cheese (see **fig. 1**) will give us 10 percent of our suggested intake of cholesterol.

5. Use the values on the label to determine the recommended daily allowance (RDA) of sodium in milligrams (mg). Explain how you found the answer.

2350 mg. How to calculate: This food contains 20 percent of the suggested intake of sodium, which is $\frac{1}{5}$ of the suggested intake. Therefore, $\frac{1}{5}$ of what number is 470? Or, if this were 20 percent, or $\frac{1}{5}$, of the suggested intake, then the RDA would be 5 × 470, or 2350 mg.

✍ This answer may vary slightly with different products, but it should be close to the 2350 amount for the RDA of sodium.

6. This food has 10 percent of our suggested cholesterol for a day. Determine how many mg of cholesterol should be included in a balanced diet of 2000 calories.

300 mg. This food contains $\frac{1}{10}$ of the suggested intake, so the full amount would be 10 × 30 mg, or 300 mg.

7. How many boxes of macaroni and cheese would we need to get the suggested daily intake of iron?

We would need to eat the contents of 12.5 boxes.

✍ If necessary, remind students that this box has 2 servings. Therefore, eating the contents of the whole box would give us 8 percent of our iron for the day (0.04 × 2). Thus, we would need 12.5 boxes to get the RDA of iron (100 ÷ 8 = 12.5).

8. The total fat in one serving of macaroni and cheese is 12 g, which is 18 percent of the daily value. How much total fat is in the daily value?

If 12 g is 18 percent of the daily value, then the daily value is 12 g ÷ 18 percent, or about 67 g.

✍ This same question could be asked about each of the other nutrients listed on this label.

Food Group Needs

9. Describe the relationship between the daily recommendations for grains and the minimum RDA for whole grains (see **table 1**).

In most cases, the daily recommendation for all grains is about double the daily minimum amount for whole grains. This means that at least half of the grains you eat should be whole grains.

10. In which case is it OK for people to eat more than the recommended daily amount of fruits (see **table 2**)?

People might be able to consume more if they are more physically active than the average person.

✍ Students may say that anyone who exceeds the RDA needs more than 30 minutes of physical activity.

How Many Calories?

Table 3 shows about how many calories a 154 pound man who is 5 feet, 10 inches tall will use doing each activity. Those who weigh more will use more calories, and those who weigh less will use fewer. Assume that the caloric values listed include both calories used by the activity and calories used for a normal body to function.

✍ Questions 11–17 are samples of questions that teachers might ask related to the numbers and information on the Physical Activities chart (see **table 3**).

11. Colin, who weighs about 154 pounds, decided to spend 2 hours doing two different vigorous physical activities each day. What are the minimum number and maximum number of calories he could burn in 7 days?

Minimum: 440 × 2 × 7 = 6160 calories

Maximum: 590 × 2 × 7 = 8260 calories

12. Colin decided to focus on one hour each of dancing and hiking per day during one week. How many calories would he burn in this week?

(370 + 330) × 7 = 4900 calories

13. Colin likes to hike, swim, and do light yard work. How can he combine these three activities to burn close to 2000 calories in one week?

Answers will vary. One solution might be to do a total of three hours of hiking, one hour of light yard work, and one hour of swimming for the week:
(370 × 3) + 330 + 510 = 1950 calories

✍ Some students will likely determine this answer by using other combinations that result in approximatley 2000 calories.

Table 1. Daily Grain Needs

Source: http://www.choosemyplate.gov/food-groups/grains-amount.html

How many grains are needed daily?

The amount of grains you need to eat depends on your age, sex, and level of physical activity. Recommended daily amounts are listed in the chart. Most Americans consume enough grains, but few are whole grains. At least half of all grains eaten should be whole grains.

		Daily recommendation*	Daily minimum amount of whole grains
Children	2–3 years old 4–8 years old	3 ounce equivalents 5 ounce equivalents	1 $\frac{1}{2}$ ounce equivalents 2 $\frac{1}{2}$ ounce equivalents
Girls	9–13 years old 14–18 years old	5 ounce equivalents 6 ounce equivalents	3 ounce equivalents 3 ounce equivalents
Boys	9–13 years old 14–18 years old	6 ounce equivalents 8 ounce equivalents	3 ounce equivalents 4 ounce equivalents

*These amounts are appropriate for individuals who get less than 30 minutes per day of moderate physical activity, beyond normal daily activities. Those who are more physically active may be able to consume more while staying within calorie needs.

Table 2. Daily Fruit Needs

Source: http://www.choosemyplate.gov/food-groups/fruits-amount.html

How much fruit is needed daily?

The amount of fruit you need to eat depends on your age, sex, and level of physical activity. Recommended daily amounts are shown in the chart.

	Daily recommendation*	
Children	2–3 years old 4–8 years old	1 cup 1 to 1 $\frac{1}{2}$ cups
Girls	9–13 years old 14–18 years old	1 $\frac{1}{2}$ cups 1 $\frac{1}{2}$ cups
Boys	9–13 years old 14–18 years old	1 $\frac{1}{2}$ cups 2 cups
Women	19–30 years old 31–50 years old 51+ years old	2 cups 1 $\frac{1}{2}$ cups 1 $\frac{1}{2}$ cups
Men	19–30 years old 31–50 years old 51+ years old	2 cups 2 cups 2 cups

*These amounts are appropriate for individuals who get less than 30 minutes per day of moderate physical activity, beyond normal daily activities. Those who are more physically active may be able to consume more while staying within calorie needs.

14. Based on the Physical Activities chart (see **table 3**), how many calories would a 154 pound man who biked moderately (less than 10 miles per hour) use in 2.75 hours?

797.5 calories. Using **table 3**, this man would burn 145 calories in 30 minutes, or 290 calories per hour. Thus, a man would burn 2.75 × 290 = 797.5 calories.

15. Based on the Physical Activities chart (see **table 3**), find several different combinations of three activities that you would enjoy doing in one day.

For example, students could choose dancing, hiking, and aerobics for one day, and golf, basketball, and heavy yard work for another day.

✏️ For questions 16 and 17, have students determine how many different combinations of three activities exist. Students could create combination charts using abbreviations for the various activities (e.g., HLD, HLW, HAS, etc.). They might also use a formula for finding possible combinations. The number of combinations of r objects from a set of n objects can be calculated as follows:

$$\frac{n!}{r!(n-r)!}$$

Note: The "!" symbol means *factorial*. For example, $5! = 5 \times 4 \times 3 \times 2 \times 1$.

16. Based on the Physical Activities chart (see **table 3**), determine how many ways three activities could be chosen from the sixteen activities listed if the order in which the choices were made is not important.

The number of combinations of sixteen activities taken three at a time would be

$$\frac{16!}{3!(16-3)!},$$

or 560 possible combinations. Students may also calculate similar possible combinations of just the moderate or the vigorous physical activities.

17. Based on the Physical Activities chart (see **table 3**), find how many different ways four vigorous activities could be selected.

The solution could be calculated by this expression:

$$\frac{8!}{4!(8-4)!},$$

or seventy possible combinations of four vigorous activities from the eight vigorous activities listed.

Table 3. Physical Activities
Source: http://www.choosemyplate.gov/food-groups/physicalactivity_calories_used_table.html.

	Approximate calories used by a 154 pound man	
Moderate physical activities	**In 1 hour**	**In 30 minutes**
Hiking	370	185
Light gardening/yard work	330	165
Dancing	330	165
Golf (walking and carrying clubs)	330	165
Bicycling (less than 10 miles per hour)	290	145
Walking (3 1/2 per hour)	280	140
Weight training (general light workout)	220	110
Stretching	180	90
Vigorous physical activities	**In 1 hour**	**In 30 minutes**
Running/jogging (5 miles per hour)	590	295
Bicycling (more than 10 miles per hour)	590	295
Swimming (slow freestyle laps)	510	255
Aerobics	480	240
Walking (4 1/2 miles per hour)	460	230
Heavy yard work (chopping wood)	440	220
Weight lifting (vigorous effort)	440	220
Basketball (vigorous)	440	220

✍ Students could see that the different combinations of eight activities taken two at a time is actually something they could try to accomplish over slightly more than a couple of months.

My Plate

In June 2011, MyPlate (http://www.choosemyplate.gov) replaced MyPyramid as the government's primary food-group symbol. MyPlate is an easy-to-understand visual cue to help consumers adopt healthy eating habits by encouraging them to build a healthy plate, consistent with the 2010 *Dietary Guidelines for Americans*.

Source: http://www.choosemyplate.gov/printmaterials-ordering/graphic-resources.html.

Figure 2. My Plate

✍ Questions 18–20 will likely generate a variety of responses. You might have students share and compare their responses with their classmates.

18. If you were to write a letter to a younger sibling, what advice would you give, based on the MyPlate icon, regarding balanced eating habits? For helpful ideas, see **figure 2**.

Answers will vary by grade level, but most students should see that each of the food-circle parts, not including the dairy, are close to 25 percent of the plate. Students may see that the vegetables and grains sections are slightly larger than the fruits and protein sections, and that the dairy section is slightly smaller than the others.

19. You have eaten six chicken nuggets, two baby carrot sticks, and a scoop of rice. What else could you eat so that your meal closely matches MyPlate?

Answers will vary, but students should include fruit, dairy, and likely more vegetables.

20. Write a journal entry in which you describe how well you meet these dietary guidelines.

Answers will vary. Student journal entries should make specific connections to their lives and include reference to the dietary guidelines.

21. Design your own MyPlate icon that roughly maintains the percentage of each item in the ChooseMyPlate.gov icon (see **fig. 2**).

Answers will vary. Student depictions should approximate the portions on the MyPlate graphic. They could split the plate into five sections and include dairy on it.

22. Track and record your food intake over one or two days and create a MyPlate icon that represents your current intake. Compare it with what is recommended.

Answers will vary.

Did you know that …

- researchers at Oxford University have discovered that fat in foods can be converted into tissue around the plumpest parts of the body within hours? For a large meal containing 30 g of fat, two to three teaspoons of the substance can be added to waists much more quickly than previously thought. By the time three or four hours have passed, researchers found, most of the fat has been incorporated into the adipose tissue, much of which lies in the short-term fat stores in the waist.

- Spot the Block is catching on all across the United States? This award-winning outreach campaign challenges nine- to thirteen-year-olds to use nutrition facts labels ("the block") to make healthy food choices. There is even a Spot the Block rap song to download, "Dishin' the Nutrition" (www.cartoonnetwork.com/promos/201004_fda/htmlsite/music.html).

- the *Dietary Guidelines for Americans* document, released on January 31, 2011, emphasizes three major goals for Americans? The goals are to (1) balance calories with physical activity to manage weight; (2) consume more of certain foods and nutrients, such as fruits, vegetables, whole grains, fat-free and low-fat dairy products, and seafood; and (3) consume fewer foods with sodium (salt), saturated fats, *trans* fats, cholesterol, added sugars, and refined grains.

- in 1990, the Nutrition Labeling and Education Act (NLEA) was passed? It requires all packaged foods to bear nutrition labeling and all health claims for foods to be consistent with terms defined by the Secretary of Health and Human Services.

- the Food and Drugs Act condemns every statement, design, or device on a product's label that may mislead or deceive, even if it is technically true? This was a Supreme Court ruling in 1924.

• in 1862, President Lincoln launched the Department of Agriculture and the Bureau of Chemistry, predecessors of the Food and Drug Administration?

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