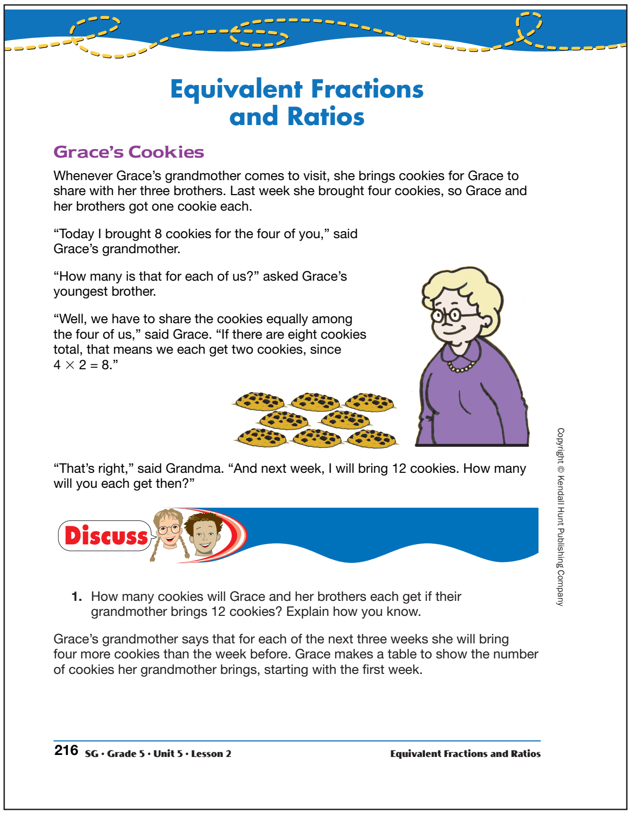

Equivalent Fractions and Ratios

Grace's Cookies

Whenever Grace's grandmother comes to visit, she brings cookies for Grace to share with her three brothers. Last week she brought four cookies, so Grace and her brothers got one cookie each.

"Today I brought 8 cookies for the four of you," said Grace's grandmother.

"How many is that for each of us?" asked Grace's youngest brother.

"Well, we have to share the cookies equally among the four of us," said Grace. "If there are eight cookies total, that means we each get two cookies, since 4 × 2 = 8."

"That's right," said Grandma. "And next week, I will bring 12 cookies. How many will you each get then?"

Discuss

1. How many cookies will Grace and her brothers each get if their grandmother brings 12 cookies? Explain how you know.

Grace's grandmother says that for each of the next three weeks she will bring four more cookies than the week before. Grace makes a table to show the number of cookies her grandmother brings, starting with the first week.

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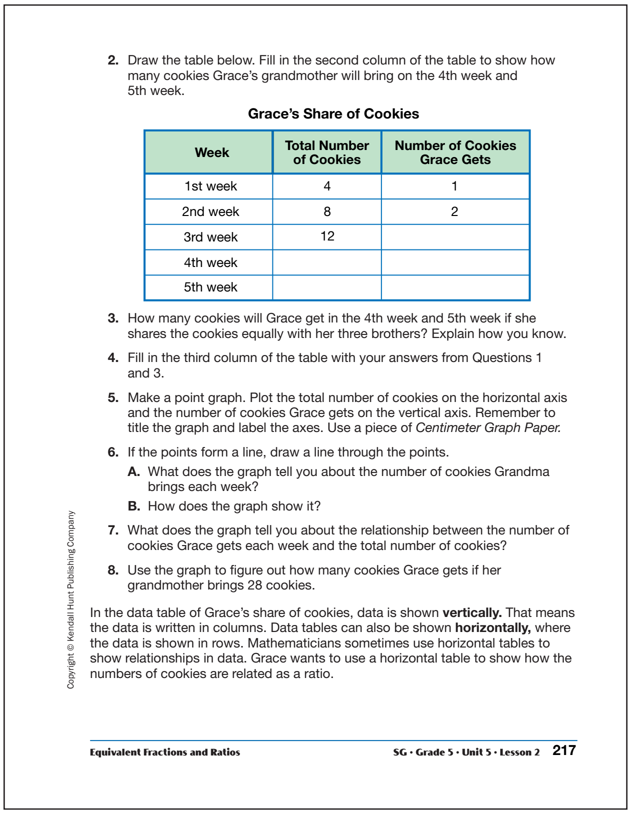

2. Draw the table below. Fill in the second column of the table to show how many cookies Grace's grandmother will bring on the 4th week and 5th week.

Grace's Share of Cookies

Week	Total Number of Cookies	Number of Cookies Grace Gets
1st week	4	1
2nd week	8	2
3rd week	12	
4th week		
5th week		

3. How many cookies will Grace get in the 4th week and 5th week if she shares the cookies equally with her three brothers? Explain how you know.
4. Fill in the third column of the table with your answers from Questions 1 and 3.
5. Make a point graph. Plot the total number of cookies on the horizontal axis and the number of cookies Grace gets on the vertical axis. Remember to title the graph and label the axes. Use a piece of *Centimeter Graph Paper.*
6. If the points form a line, draw a line through the points.
   - **A.** What does the graph tell you about the number of cookies Grandma brings each week?
   - **B.** How does the graph show it?
7. What does the graph tell you about the relationship between the number of cookies Grace gets each week and the total number of cookies?
8. Use the graph to figure out how many cookies Grace gets if her grandmother brings 28 cookies.

In the data table of Grace's share of cookies, data is shown **vertically.** That means the data is written in columns. Data tables can also be shown **horizontally,** where the data is shown in rows. Mathematicians sometimes use horizontal tables to show relationships in data. Grace wants to use a horizontal table to show how the numbers of cookies are related as a ratio.

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Equivalent Fractions and Ratios Questions 1–20 (SG pp. 216–220)

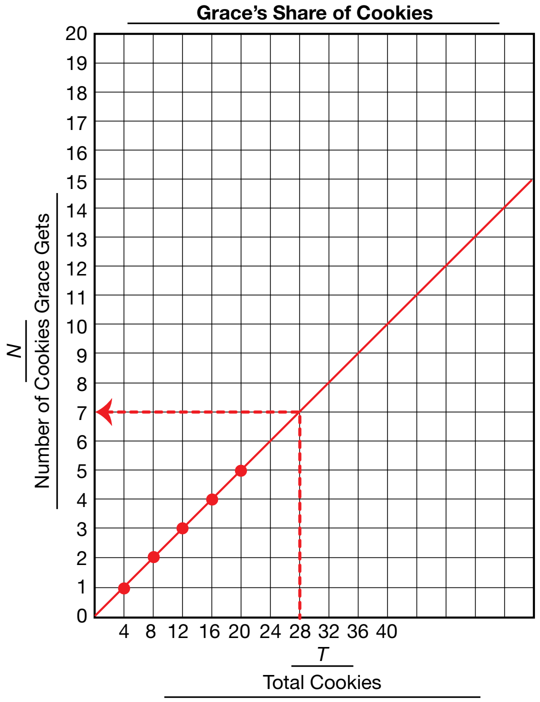
1. 3 cookies. Explanations may vary. 4 × 3 = 12.
2.

Grace's Share of Cookies

Week	Total Number of Cookies	Number of Cookies Grace Gets
1st week	4	1
2nd week	8	2
3rd week	12	3
4th week	16	4
5th week	20	5

3. In the 4th week Grace gets 4 cookies; in the 5th week, she gets 5 cookies. Explanations may vary. When Grandma makes 4 more cookies than she did the previous week, that means each child gets 1 more cookie than the previous week.
4. See table in Question 2.

5–6.



6. **A–B.** Grandma increases by 4 how many cookies she bakes each week. Explanations may vary.
7. As the total number of cookies increases by 4, the number of cookies Grace receives increases by 1.
8. 7 cookies

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9. **Grace's Share of Cookies**

Number of Cookies Grace Gets	1	2	3	4	5
Total Number of Cookies	4	8	12	16	20

10. Grace gets $\frac{1}{4}$ of the total cookies.

11. $\frac{1}{4}, \frac{2}{8}, \frac{3}{12}, \frac{4}{16}, \frac{5}{20}$

12. Explanations may vary. The denominator is 4 times greater than the numerator, or the numerator is $\frac{1}{4}$ the denominator.

13. Explanations may vary. Grace gets one more cookie each week that Grandma bakes 4 more cookies. The number increases.

14. The value of the fractions stays the same. $\frac{1}{4}, \frac{2}{8}, \frac{3}{12}$ etc. are equivalent fractions.

15.* No. Explanations may vary. Think of the benchmark $\frac{1}{2}$. $\frac{1}{4}$ is less than $\frac{1}{2}$. $\frac{6}{9}$ is greater than $\frac{1}{2}$.

16.* Yes. Explanations may vary. Josh needs to multiply 1 × 6 to get a numerator of six. Then he can multiply the denominator times 6. This way we will find the equivalent fraction.

17. Answers may vary. $\frac{8}{12}, \frac{12}{16}$

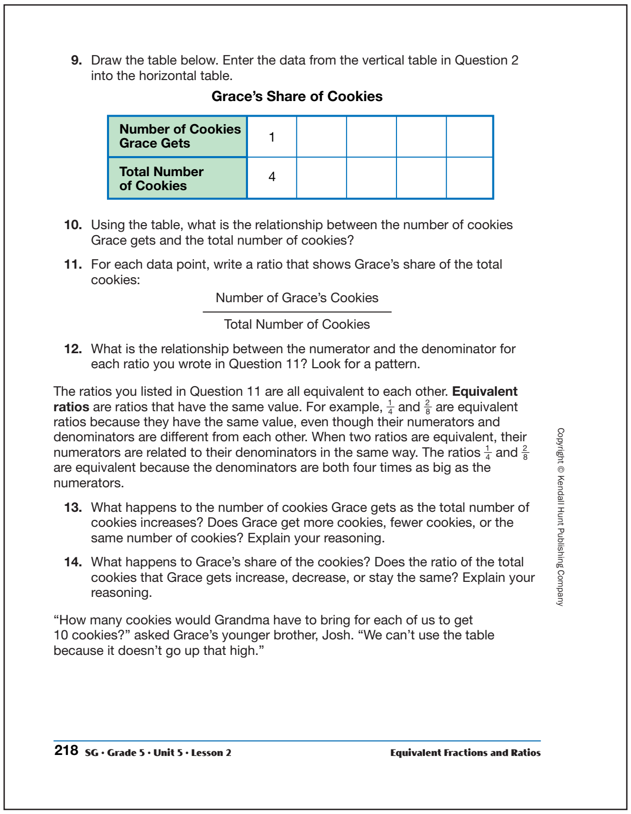
18. Answers may vary.

A. $\frac{4}{10}, \frac{6}{15}$

B. $\frac{6}{8}, \frac{9}{12}$

C. $\frac{4}{6}, \frac{2}{3}$

D. $\frac{6}{4}, \frac{9}{6}$



9. Draw the table below. Enter the data from the vertical table in Question 2 into the horizontal table.

Grace's Share of Cookies

Number of Cookies Grace Gets	1				
Total Number of Cookies	4				

10. Using the table, what is the relationship between the number of cookies Grace gets and the total number of cookies?

11. For each data point, write a ratio that shows Grace's share of the total cookies:

$$\frac{\text{Number of Grace's Cookies}}{\text{Total Number of Cookies}}$$

12. What is the relationship between the numerator and the denominator for each ratio you wrote in Question 11? Look for a pattern.

The ratios you listed in Question 11 are all equivalent to each other. **Equivalent ratios** are ratios that have the same value. For example, $\frac{1}{4}$ and $\frac{2}{8}$ are equivalent ratios because they have the same value, even though their numerators and denominators are different from each other. When two ratios are equivalent, their numerators are related to their denominators in the same way. The ratios $\frac{1}{4}$ and $\frac{2}{8}$ are equivalent because the denominators are both four times as big as the numerators.

13. What happens to the number of cookies Grace gets as the total number of cookies increases? Does Grace get more cookies, fewer cookies, or the same number of cookies? Explain your reasoning.

14. What happens to Grace's share of the cookies? Does the ratio of the total cookies that Grace gets increase, decrease, or stay the same? Explain your reasoning.

"How many cookies would Grandma have to bring for each of us to get 10 cookies?" asked Grace's younger brother, Josh. "We can't use the table because it doesn't go up that high."

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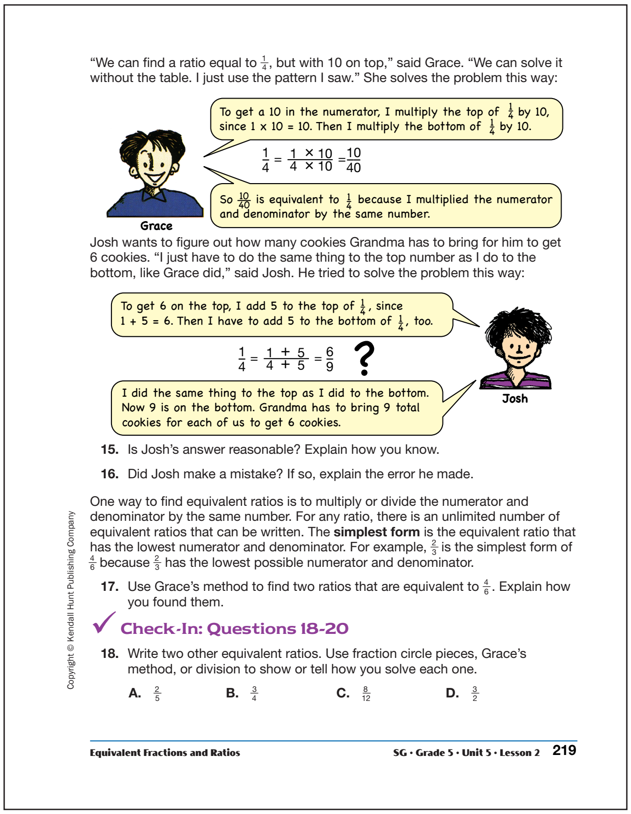

"We can find a ratio equal to $\frac{1}{4}$, but with 10 on top," said Grace. "We can solve it without the table. I just use the pattern I saw." She solves the problem this way:

To get a 10 in the numerator, I multiply the top of $\frac{1}{4}$ by 10, since 1 x 10 = 10. Then I multiply the bottom of $\frac{1}{4}$ by 10.

$$\frac{1}{4} = \frac{1 \times 10}{4 \times 10} = \frac{10}{40}$$

So $\frac{10}{40}$ is equivalent to $\frac{1}{4}$ because I multiplied the numerator and denominator by the same number.

Grace

Josh wants to figure out how many cookies Grandma has to bring for him to get 6 cookies. "I just have to do the same thing to the top number as I do to the bottom, like Grace did," said Josh. He tried to solve the problem this way:

To get 6 on the top, I add 5 to the top of $\frac{1}{4}$, since 1 + 5 = 6. Then I have to add 5 to the bottom of $\frac{1}{4}$, too.

$$\frac{1}{4} = \frac{1 + 5}{4 + 5} = \frac{6}{9} \ ?$$

I did the same thing to the top as I did to the bottom. Now 9 is on the bottom. Grandma has to bring 9 total cookies for each of us to get 6 cookies.

Josh

15. Is Josh's answer reasonable? Explain how you know.

16. Did Josh make a mistake? If so, explain the error he made.

One way to find equivalent ratios is to multiply or divide the numerator and denominator by the same number. For any ratio, there is an unlimited number of equivalent ratios that can be written. The **simplest form** is the equivalent ratio that has the lowest numerator and denominator. For example, $\frac{2}{3}$ is the simplest form of $\frac{4}{6}$ because $\frac{2}{3}$ has the lowest possible numerator and denominator.

17. Use Grace's method to find two ratios that are equivalent to $\frac{4}{6}$. Explain how you found them.

✓ **Check-In: Questions 18-20**

18. Write two other equivalent ratios. Use fraction circle pieces, Grace's method, or division to show or tell how you solve each one.

A. $\frac{2}{5}$ B. $\frac{3}{4}$ C. $\frac{8}{12}$ D. $\frac{3}{2}$

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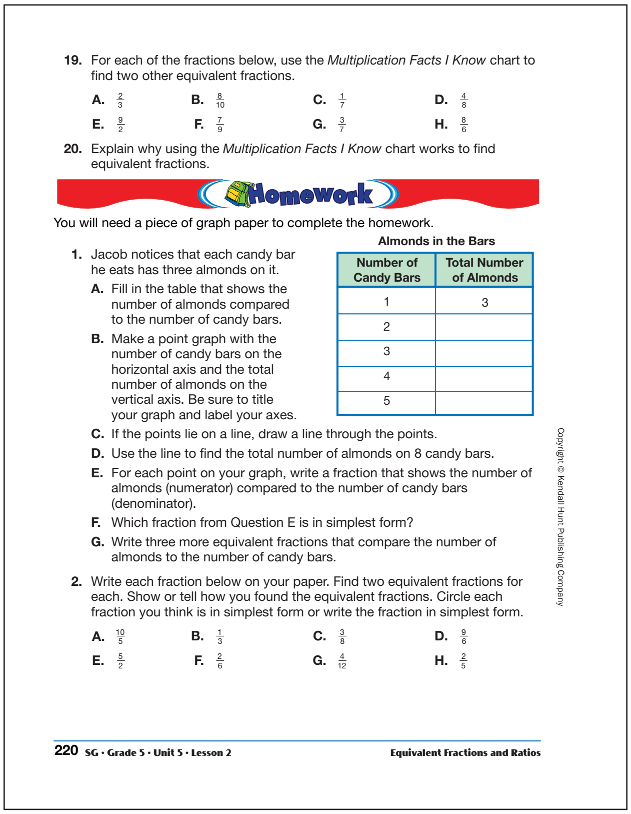

19. For each of the fractions below, use the *Multiplication Facts I Know* chart to find two other equivalent fractions.

A. $\frac{2}{3}$ B. $\frac{8}{10}$ C. $\frac{1}{7}$ D. $\frac{4}{8}$

E. $\frac{9}{2}$ F. $\frac{7}{9}$ G. $\frac{3}{7}$ H. $\frac{8}{6}$

20. Explain why using the *Multiplication Facts I Know* chart works to find equivalent fractions.

Homework

You will need a piece of graph paper to complete the homework.

1. Jacob notices that each candy bar he eats has three almonds on it.
   - A. Fill in the table that shows the number of almonds compared to the number of candy bars.
   - B. Make a point graph with the number of candy bars on the horizontal axis and the total number of almonds on the vertical axis. Be sure to title your graph and label your axes.
   - C. If the points lie on a line, draw a line through the points.
   - D. Use the line to find the total number of almonds on 8 candy bars.
   - E. For each point on your graph, write a fraction that shows the number of almonds (numerator) compared to the number of candy bars (denominator).
   - F. Which fraction from Question E is in simplest form?
   - G. Write three more equivalent fractions that compare the number of almonds to the number of candy bars.

Almonds in the Bars

Number of Candy Bars	Total Number of Almonds
1	3
2	
3	
4	
5	

2. Write each fraction below on your paper. Find two equivalent fractions for each. Show or tell how you found the equivalent fractions. Circle each fraction you think is in simplest form or write the fraction in simplest form.

A. $\frac{10}{5}$ B. $\frac{1}{3}$ C. $\frac{3}{8}$ D. $\frac{9}{6}$

E. $\frac{5}{2}$ F. $\frac{2}{6}$ G. $\frac{4}{12}$ H. $\frac{2}{5}$

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19. Answers may vary.
   - A.* $\frac{4}{6}, \frac{6}{9}, \frac{8}{12}$
   - B. $\frac{16}{20}, \frac{24}{30}, \frac{32}{40}$
   - C. $\frac{2}{14}, \frac{3}{21}, \frac{4}{28}$
   - D. $\frac{8}{16}, \frac{12}{24}, \frac{16}{32}$
   - E. $\frac{18}{4}, \frac{27}{6}, \frac{32}{8}$
   - F. $\frac{14}{18}, \frac{21}{27}, \frac{28}{32}$
   - G. $\frac{6}{14}, \frac{12}{28}, \frac{18}{42}$
   - H. $\frac{16}{12}, \frac{24}{18}, \frac{32}{24}$

20.* Explanations may vary. If you look at any row or column of the *Multiplication Facts I Know* chart, you will see that a number increases by its multiples. Choose a fraction. Find its numerator and its denominator. If from the numerator you move 1 box to the right, do the same for the denominator, and you will have the numbers to create an equivalent fraction.

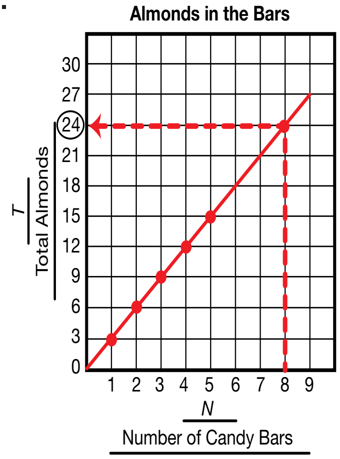
Homework (SG p. 12)
Questions 1–2

1. A.

Almonds in the Bars

Number of Candy Bars	Total Number of Almonds
1	3
2	6
3	9
4	12
5	15

B–C.



D. 24 almonds

E. $\frac{3}{1}, \frac{6}{2}, \frac{9}{3}, \frac{12}{4}, \frac{15}{5}$

F. $\frac{3}{1}$

G. Answers may vary.
$\frac{18}{6}, \frac{21}{7}, \frac{24}{8}, \frac{30}{10}$

2. Answers may vary.
   - A. $\frac{10}{5}, \boxed{\frac{2}{1}}, \frac{20}{10}$
   - B. $\boxed{\frac{1}{3}}, \frac{2}{6}, \frac{10}{30}$
   - C. $\boxed{\frac{3}{8}}, \frac{6}{16}, \frac{9}{24}$
   - D. $\frac{9}{6}, \boxed{\frac{3}{2}}, \frac{90}{60}$
   - E. $\boxed{\frac{5}{2}}, \frac{10}{4}, \frac{15}{6}$
   - F. $\frac{2}{6}, \boxed{\frac{1}{3}}, \frac{10}{9}, \frac{4}{12}$
   - G. $\frac{4}{12}, \boxed{\frac{1}{3}}, \frac{100}{300}$
   - H. $\boxed{\frac{2}{5}}, \frac{4}{10}, \frac{8}{20}$

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