

Rational Number Project

Fraction Operations and Initial Decimal Ideas Lesson 17: Overview

Students use pictures and fraction circles to find the product of a whole number and a fraction. Students explain that the expression $a \times b$ can be read as “a groups of b”.

Materials

- Fraction circles
- Student Pages A and B
- Transparencies 1-3

Teaching Actions

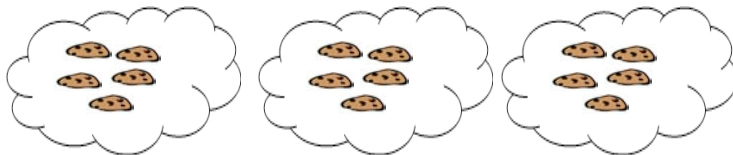
Warm Up

Draw a picture that you can use to solve the following word problem. Write a number sentence for the problem.

Riley wants to give five cookies to each of his three friends. How many cookies will he need?

Large Group Introduction

1. Go over the warm up problem asking students to share their pictures and number sentences. A possible picture might look like this.



Students' pictures should show three groups of five cookies

2. Write $2 \times 4 = \underline{\quad}$ on the board or overhead. Ask the students to explain what the 2 and the 4 stand for in

Comments

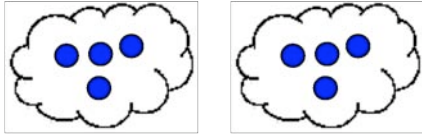
It is important for students to notice that this problem can be modeled using the multiplication sentence: $3 \times 5 = 15$. Many students will have trouble with this notation, especially when using fractions. Help students make connections between the words **3 groups of 5** and the mathematical expression 3×5 . These connections will have to be developed throughout the next few lessons.

Some students may write $5 \times 3 = 15$. This notation is correct but you may want your class to adopt the convention that 3×5 means “3 groups of 5” and 5×3 means “5 groups of 3”. This language helps give a deeper understanding of the mathematics involved in multiplying numbers and the vocabulary “groups of” will be emphasized throughout the lessons.

Some students may suggest writing $5 + 5 + 5 = 15$ which is correct and should be introduced by the teacher if no student suggests this notation. Explain that $5 + 5 + 5$ is equivalent to 3×5 . Students should be able to go forward and backwards when solving this

Teaching Actions

this problem. The 2 should stand for the number of groups and the 4 should stand for the number of objects in each group. Ask students to draw a picture to find the answer $2 \times 4 = \underline{\quad}$.



Possible student picture

A few students may draw a picture similar to the one below.



If you see this, ask the student how this picture shows two groups of four. You might ask, "Where are the two groups?"

- Ask the students to solve the following problem with their fraction circles. Have them also write a multiplication sentence that would answer this problem. (Transparency 1)

Seth wants to give each of his 4 friends $\frac{2}{5}$ of a pizza. How much pizza will he give away?

The mathematical sentence will be $4 \times \frac{2}{5} = \frac{8}{5} = 1\frac{3}{5}$ where the 4 represents the number of groups, the $\frac{2}{5}$ represents the amount in each group, and $\frac{8}{5}$ or $1\frac{3}{5}$ represents the total amount of pizza given away. Emphasize that the multiplication sentence means there are 4 groups of $\frac{2}{5}$. Write the words underneath the multiplication sentence.

Ask: How is this problem similar to the cookie problem we did previously?

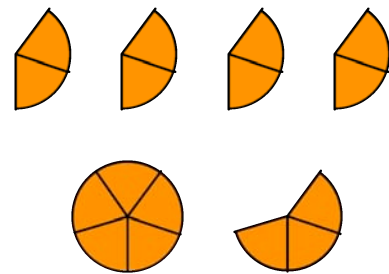
Comments

problem. Question 1 asks students to go from real-world situation to picture and written symbols. This question asks them to go from written symbol to picture.

Walk around as students work and ask two or three students to prepare transparencies showing their pictures. Have the students show and explain their work. Be sure to emphasize that they draw 2 groups of 4 objects.

The picture to the left is a picture of the symbolic number sentence and does not model two groups of four. The students only need to show two groups of four, not an equation.

The students should put 4 groups of $\frac{2}{5}$ as shown below and the sum should be $\frac{8}{5}$ or $1\frac{3}{5}$.



The goal for this part of the lesson is for students to see that we are modeling a multiplication problem using fraction circles.

The number of groups for all the problems in this lesson will be whole numbers because it can be difficult for students to imagine a fractional number of groups. The amount in each group can be a whole number

Teaching Actions

4. Ask the students to solve the following problem with their fraction circles. Again they will need two sets of fraction circles to be able to find an answer. (Transparency 2)

$$5x\frac{1}{3}$$

Ask what the 5 means in the sentence and what the $\frac{1}{3}$ means.

5. Ask the students to individually find the product below using fraction circles. Make sure that they show 3 groups of $\frac{2}{3}$.

$$3x\frac{2}{7}$$

Small Group/Partner Work

6. Assign Student Pages A and B.

Wrap Up

7. Review select problems from Student Pages A & B after most of the students are done. Be sure to emphasize the different representations (i.e. words, multiplication sentence, picture, real-world situation) for each multiplication problem. Students can come up and show how they did select problems.
8. Close the lesson by trying to get the students to find multiplication and addition sentences for both problems below, if appropriate. (Transparency 3)

Comments

or a fraction as is done in this example.

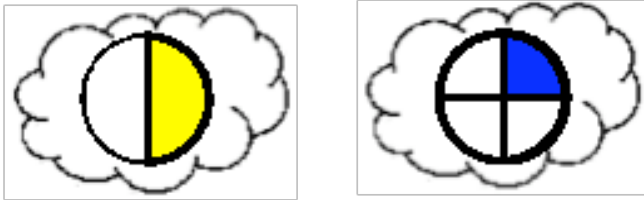
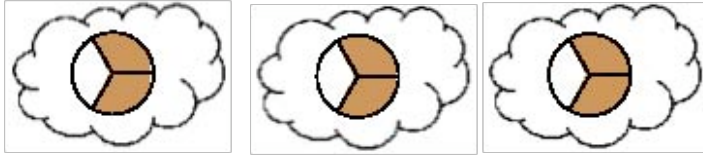
Students should see this as 5 groups of $\frac{1}{3}$. The final answer is $\frac{5}{3}$ or $1\frac{2}{3}$. It is OK if students use improper fractions here. Have students record the answer both as an improper fraction and a mixed number.

Be sure to emphasize that they are showing 3 groups of $\frac{2}{3}$.

Make a transparency for both pages. Make sure to note some of the problems they struggle with so you can review at the end.

Look at the drawings the students are using for Student Page B. Some students may use circles while others may use rectangles. Be sure to show examples of each when reviewing. Emphasize that the unit for each picture needs to stay the same throughout a problem.

Teaching Actions



Translations:

- Real-world to picture
- Real-world to written symbol
- Picture to written symbol
- Real-world to manipulative
- Written symbol to manipulative

Comments

Addition Sentence: $\frac{2}{3} + \frac{2}{3} + \frac{2}{3} = \frac{6}{3} = 2$

Multiplication Sentence:

$$3 \times \frac{2}{3} = \frac{6}{3} = 2$$

Addition Sentence: $\frac{1}{2} + \frac{1}{4} = \frac{3}{4}$

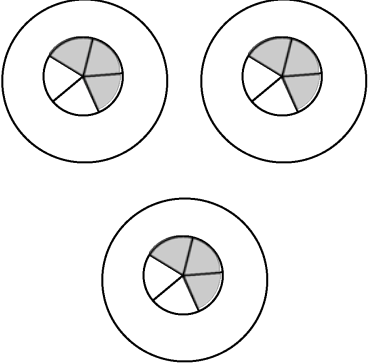
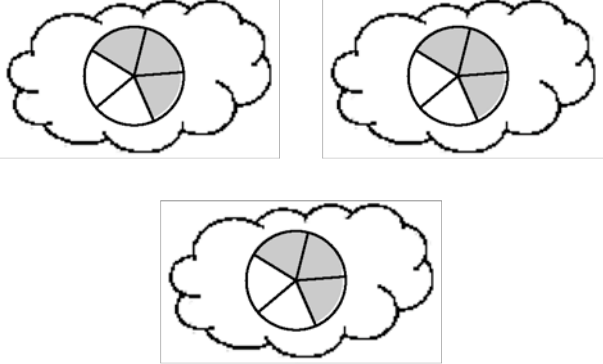
Multiplication Sentence:

Not appropriate. The amount in each group needs to be the same.

Additional Notes to the Teacher
Lesson 17

One goal of this lesson is for students to use pictures and fraction circles to multiply a whole number and a fraction. Another goal for this lesson is to help students make a connection between the notation $a \times b$ and the phrase “a groups of b”.

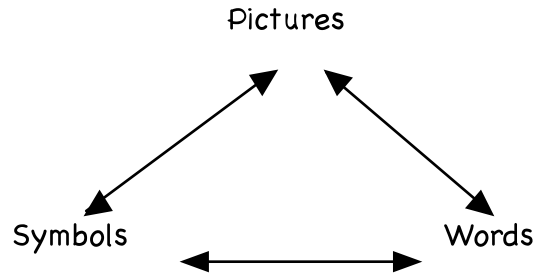
In this lesson we introduce clouds as a way to separate groups. We originally used circles for the groups and put fraction circles inside. Students seem to confuse the circle denoting the groups with the circles used for the fraction circle picture.

	
<p style="text-align: center;">3 groups of $\frac{3}{5}$ using circles (some students found this confusing)</p>	<p style="text-align: center;">3 groups of $\frac{3}{5}$ using clouds</p>

We created on a 10 by 12 piece of paper 6 blank pictures of clouds. Students used this sheet when they solved problems in lessons 17 and 18. The sheet provides an easy way for the students to keep track of groups and an easy place to organize their fraction circle pieces as they model multiplication problems. You may want to make up a similar page.

It is important for students to notice that a multiplication problem can be modeled using a multiplication sentence as for example: $2 \times 4 = 8$. Many students will have trouble with this notation when using fractions. Make sure you emphasize the connections between the words “2 groups of 4” and the mathematical expression 2×4 . These connections will be developed throughout the next few lessons.

A convention that is typically used in classrooms in the United States is that the mathematical expression 3×5 represents “3 groups of 5”. In many European countries the expression 3×5 means “3 five times” or 5 groups of 3. This curriculum adopts the convention $a \times b$ means “a groups of b” but students who say that $a \times b$ means “b groups of a” are technically correct. You may want to explain that conventions are used in mathematics so that we communicate the same idea when using mathematical notation.



The three representations for multiplication in this and the next lesson are pictures, words, and symbols. The goal is for students to make connections among these representations as well as using these representations to make sense of situations involving multiplication.

A few students may draw a picture similar to the one below when you ask them to draw a picture for 2×4 . This is a picture of the symbolic number sentence and does not model two groups of four. The students only need to show two groups of four, not an equation.



If you see this, ask the student how this picture shows two groups of four. You might ask, "Where are the two groups?" Some students may be able to correctly explain that the right hand side of the equation shows two groups of 4. The left hand side does not show this clearly and the notation should be discouraged.

Use Fraction Circles

Seth wants to give each of his 4 friends $\frac{2}{5}$ of a pizza. How much pizza will he give away?

Words:

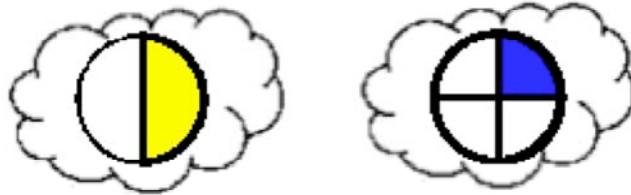
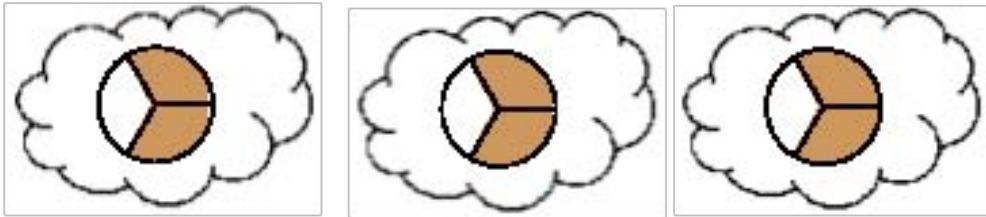
Multiplication Sentence:

Find Using Fraction Circles

$$5 \times \frac{1}{3} = \underline{\hspace{2cm}}$$

$$3 \times \frac{2}{7} = \underline{\hspace{2cm}}$$

Write a multiplication sentence and an addition sentence for each problem below, if appropriate:




Draw a Picture

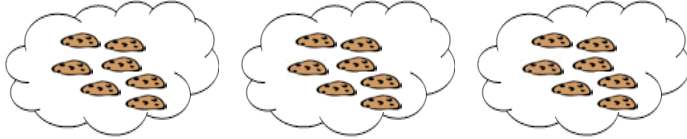
Riley wants to give five cookies to each of his three friends. How many cookies will he need?

Multiplying Fractions

(whole number x fraction)

Write a multiplication sentence for each picture shown below. Each cloud contains a group.

1. Unit is one cookie ()



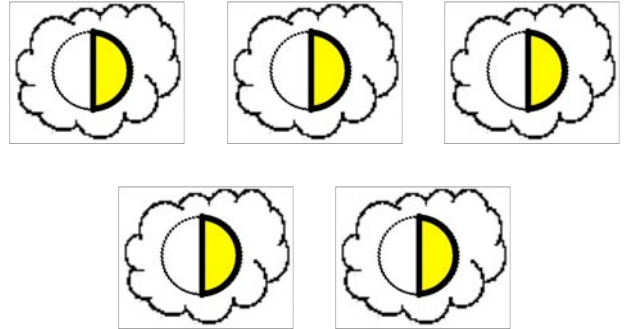
Words:

3 groups of _____

Multiplication Sentence:

_____ x _____ = _____

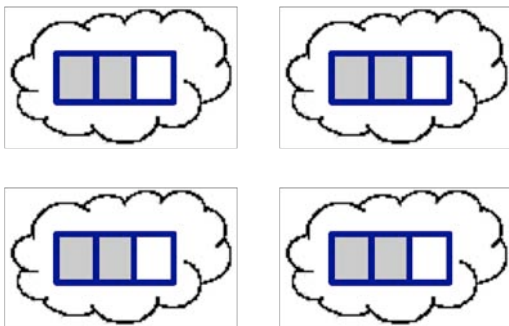
2. Unit is 



Words:

Multiplication Sentence:

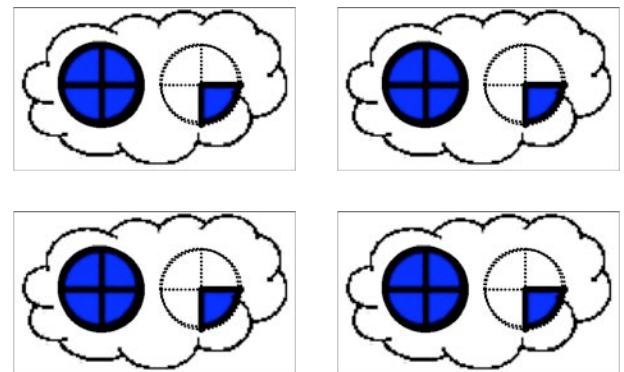
3. Unit is 



Words:

Multiplication Sentence:

4. Unit is 



Words:

Multiplication Sentence:

Show how to find a solution by drawing a picture, writing out in words, and writing a multiplication sentence. Use fraction circles when necessary.

5. Ginger the dog buries 4 bones in each hole that she digs. How many bones does she bury in all if she digs 6 holes?

Picture:

Words:

Multiplication Sentence:

6. Ming uses $\frac{1}{4}$ a cup of brown sugar for each batch of chocolate chip cookies she makes. How much brown sugar will she need if she makes 3 batches?

Picture:

Words:

Multiplication Sentence:

7. Each serving of Brown-Sugar Oatmeal contains $\frac{3}{8}$ grams of sodium. How many grams of sodium will be in 4 servings of oatmeal?

Picture:

Words:

Multiplication Sentence:

8. Mia swims $\frac{3}{2}$ of a mile every day. How many miles will she swim in 4 days?

Picture:

Words:

Multiplication Sentence:

Post Lesson Reflection

Lesson _____

1) Number of class periods allocated to this lesson: _____

2) Student Pages used: _____

3) Adaptations made to lesson: (For example: added extra examples, eliminated certain problems, changed fractions used)

4) Adaptations made on Student Pages:

5) To improve the lesson I suggest: