Nasco Education

LESSON PLAN

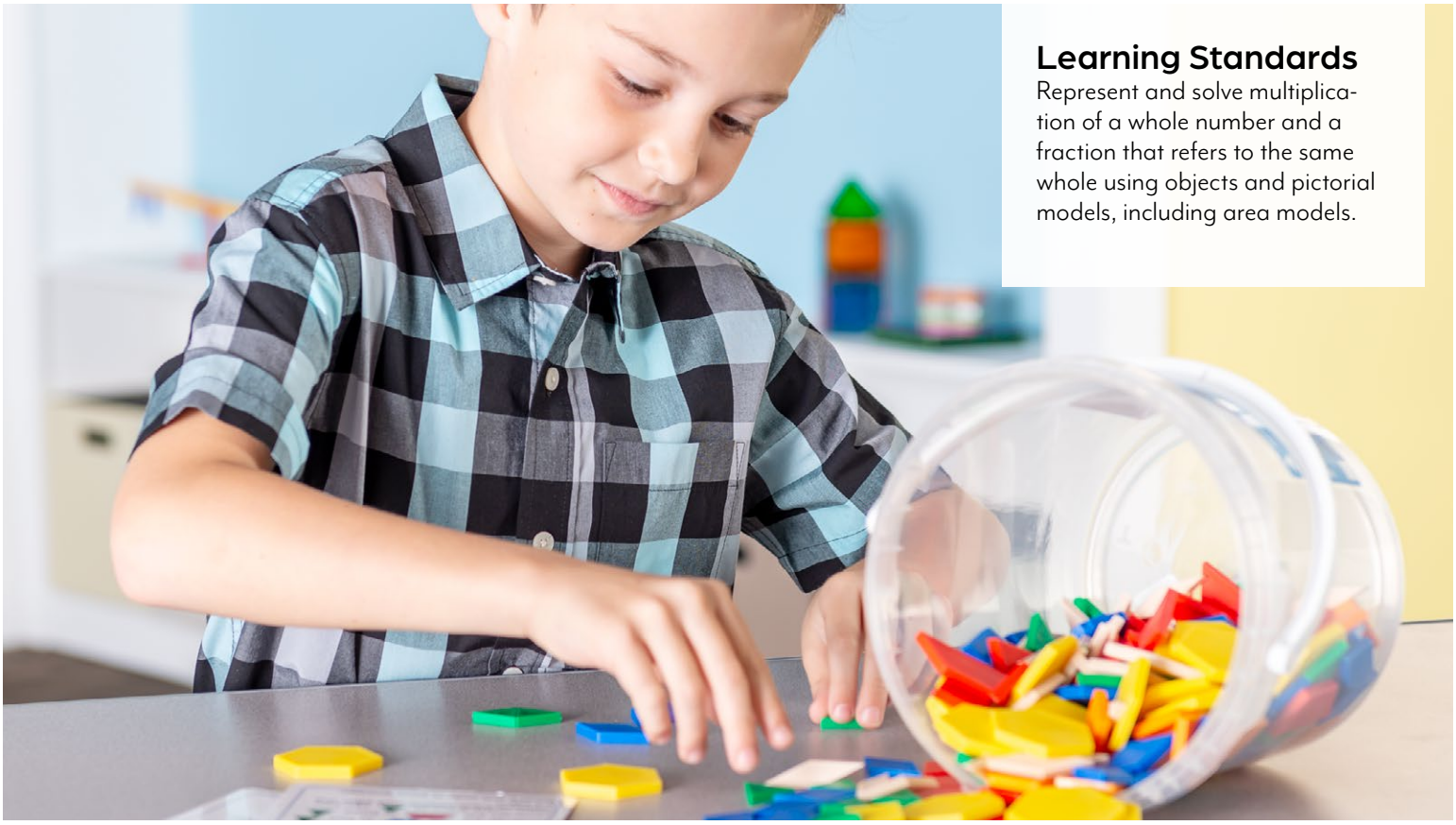
Math

Developed with Kristin Ulrich

Multiplication of a fraction and whole number using pictorial models

Volume 11 | Gr. 4

Time: 45-60 mins.



Learning Standards

Represent and solve multiplication of a whole number and a fraction that refers to the same whole using objects and pictorial models, including area models.

Objectives

Students will...

- Use pictorial models to solve multiplication problems
- Solve multiple fraction times whole number problems
- Create and solve their own multiplication problems

Materials

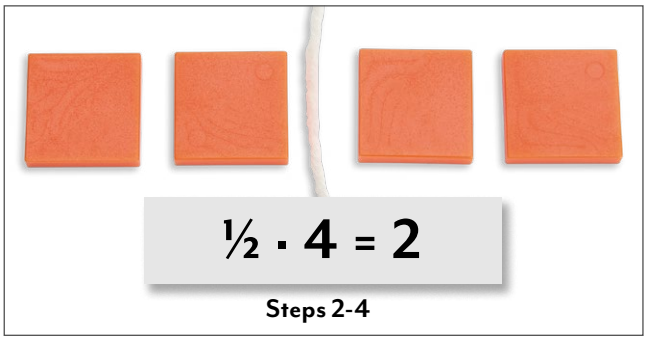
- Plastic Pattern Blocks [TB11454(A) **or** TB21920]
- Worksheet and answer key (attached with lesson plan download)
- 10 small pieces of string (about 4" L each) per student (optional)

Introduction

Students will use pattern blocks to help visualize and create pictorial models that represent a variety of multiplication problems that involve a whole number and a fraction. In the lesson, they'll commit to memory that $\frac{1}{7} \cdot 49$ means the same thing as $\frac{1}{7}$ of 49. You'll work on a variety of problems as a whole group. Students will then have an opportunity to explore in small groups. The small group exploration will allow them to see that the pattern continues even with larger numbers. They'll have a larger number of pattern blocks when they work in their small groups.

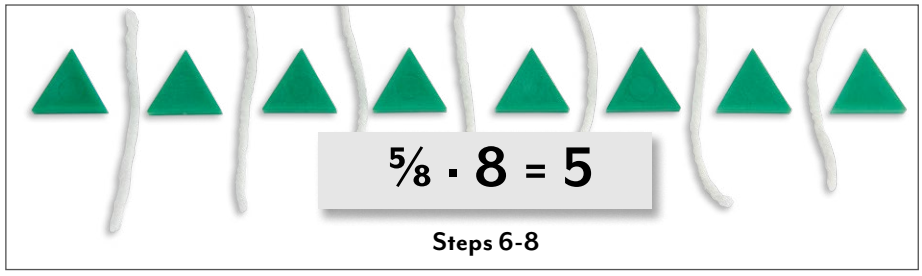
Activity

1. Tell students that the multiplication sign always means the word "of." To help them remember this, they will write it and say it often during the lesson. To begin that process, direct students to look at the top of their worksheet where it says "• = _____." Make sure they understand that the • is the times sign, then ask them what the times sign will always mean in their problems (*of*). Have them write "OF" in nice giant letters on the line.



Steps 2-4

2. Ask students what problem 1 is (½ times 4), then what the times sign means again (*of*). Tell them that the problem is really asking the question, "What's ½ of 4?" To solve it, they will start with the whole number, which will tell them how many pattern blocks they will need. They should be able to identify 4 as the whole number. Have them pick out four square pattern blocks and place them in a row on their desk.
3. Next, direct students to look at the denominator of the fraction (2) and let them know that the denominator tells how many equal groups they will need to split the pieces into. In this case, they need to split the four pieces into two equal groups. Ask how many squares will be in each equal group (*2*). Students should now take one of their pieces of string and place it between the second and third square in their row of four square pattern blocks to split the row into two equal groups.
4. Finally, it's time to move on to the numerator (1). Tell students that the numerator indicates how many of their groups they will need to count. In this case, the numerator says that they will need to count the squares in just one of the groups. They should count two squares. Tell students that this means that ½ • 4 = 2. Point out that this also means that they solve the problem ½ of 4 equals 2, since • means "of." Have them write the answer on their worksheet.
5. Now that the problem is solved, it's time to draw the pictorial model of the problem. First, students should draw four squares in a line. Next, they should draw the piece of string, which symbolizes the squares being split into two equal groups. Remind students that this was done because the denominator told them to do so. Finally, they should shade all the squares in one of the equal groups, understanding that they are doing this because the numerator says to do this.
6. Move on to problem 2. Students should once again indicate that the • sign also means "of," and therefore the problem is really asking "What's ⅝ of 8?" Have students determine how many pattern blocks they should begin with for their whole group. They should say it's 8 because 8 is the whole number and they start with the whole number. Have students place eight triangle pattern blocks in a row on their desk.
7. See if students can remember which number will tell them how many equal groups they need to split their pattern blocks into. They should say they need to split their blocks into eight equal groups because the denominator is 8. To do this, they will need to use seven pieces of string. Before they actually use the string, see if they know how many triangles will be in each group (*1*).
8. Now it's time to determine how many of their equal groups they need to count. They should remember that the numerator will tell them this, and therefore count the triangles in five of their groups. Once they do this, they will know that ⅝ of 8, or ⅝ • 8, equals 5. Have them write the answer on their worksheet.
9. For the pictorial model, students should draw eight triangles in a line. They will then show the eight pieces of string dividing the triangles into eight equal groups. Finally, they will shade in the triangles in five of the equal groups. Reinforce that they divided the triangles into eight equal groups because of the denominator and that they shaded the five triangles because of the numerator.
10. For problem 3, students will require a partner. Each pair should use the triangle pattern blocks. Once again, make sure they understand that ⅔ • 18 is asking, "What's ⅔ of 18?" Guide them through the same steps they used in the previous two problems to solve this one. They should start with the whole number and line up 18 triangles on their desk, use the denominator and their pieces of string to determine that they need to split the triangles into three equal groups, know that each group should consist of six triangles, and use the numerator to determine how many of these groups should be included in their answer. They should come up with 12 for an answer.
11. For the pictorial model, students should first draw 18 triangles, then divide them into three equal groups by drawing the string in the appropriate places, and finally shade all of the triangles in two of the groups. Make sure to link the various stages of the model to the problem (denominator determines how many groups the triangles are split into; numerator determines how many groups of triangles get shaded). There should be 12 total triangles shaded.
12. Have each pair complete problem 4 on their own.



Steps 6-8

Practice

Before students solve the rest of the problems, explain to them that problems like problem 5, where the whole number comes first in the problem, are solved in exactly the same fashion as the other problems they have solved. Point out that this is possible because of the commutative property of multiplication. Remind them what this is with the example of $2 \cdot 3 = 6$ and $3 \cdot 2 = 6$. Once pairs have completed for problem 9, each pair will need to work together with another pair to complete problems 10-12. At the bottom of the worksheet is extra space where students can create their own problems and draw pictorial models of them. If they need more room, they may use a separate sheet of paper.

Check for understanding

After students have completed problem 4, check for understanding by using the following line of questioning:

1. How many triangles did you have in your group? *(20)*
2. How did you know? *(The whole number is 20.)*
3. How many equal groups did you split those 20 triangles into? *(5)*
4. How did you know? *(The denominator is 5.)*
5. How many triangles were in each of your five equal groups? *(4 triangles)*
6. How many groups of four need to be included in your answer? *(3)*
7. How did you know? *(The numerator is 3.)*
8. What is $\frac{3}{5} \cdot 20$? *(12)*
9. Did your pictorial model look like mine? *(Show students a pictorial model consisting of 20 triangles split into five equal groups of four. Three of those groups should be shaded, totaling 12 triangles shaded.)*

Intervention

1. Only solve problems that have the fraction followed by the whole number.
2. Work with fractions that have smaller denominators.
3. Here are a few examples of intervention problems:

   $\frac{1}{2} \cdot 10$
   $\frac{2}{3} \cdot 9$
   $\frac{3}{4} \cdot 8$
   $\frac{2}{7} \cdot 7$

Extension

Students can create their own problems using the same procedures used throughout the lesson. This is outlined in the Challenge directions at the end of the worksheet. A pictorial model drawing should be included with each created problem.

Multiplication of a fraction and whole number using pictorial models — **worksheet 1**

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Name: _____ Date: _____

Directions: Use pattern blocks and pieces of string to solve each problem, then draw a pictorial model that represents the problem in the space provided below.

1. $\frac{1}{2} \cdot 4 =$ _____ • = _____

2. $\frac{5}{8} \cdot 8 =$ _____

3. $\frac{2}{3} \cdot 18 =$ _____

4. $\frac{3}{5} \cdot 20 =$ _____

5. $14 \cdot \frac{5}{7} =$ _____

6. $\frac{7}{9} \cdot 18 =$ _____

7. $16 \cdot \frac{3}{4} =$ _____

8. $\frac{4}{5} \cdot 10 =$ _____

cont. next page

9. $\frac{5}{11} \cdot 11 =$ _____

10. $33 \cdot \frac{6}{11} =$ _____

11. $35 \cdot \frac{2}{5} =$ _____

12. $\frac{3}{7} \cdot 28 =$ _____

Challenge: Create your own problems where a fraction and a whole number are multiplied together. Draw a pictorial model for each problem. You may use the space below or another sheet of paper to create as many problems as you would like.

Multiplication of a fraction and whole number using pictorial models — **answer key**

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1. ½ • 4 = 2
   Pictorial model should consist of four triangles separated into two equal groups with two triangles in each group.
   One set of two triangles is shaded.

2. ⅝ • 8 = 5
   Pictorial model should consist of eight triangles separated into eight equal groups with one triangle in each group.
   Five sets of one triangle are shaded.

3. ⅔ • 18 = 12
   Pictorial model should consist of 18 triangles separated into three equal groups with six triangles in each group.
   Two sets of six triangles are shaded.

4. ⅗ • 20 = 12
   Pictorial model should consist of 20 triangles separated into five equal groups with four triangles in each group.
   Three sets of four triangles are shaded.

5. 14 • ⅤⅦ = 10
   Pictorial model should consist of 14 triangles separated into seven equal groups with two triangles in each group.
   Five sets of two triangles are shaded.

6. ⅞ • 18 = 14
   Pictorial model should consist of 18 triangles separated into nine equal groups with two triangles in each group.
   Seven sets of two triangles are shaded.

7. 16 • ¾ = 12
   Pictorial model should consist of 16 triangles separated into four equal groups with four triangles in each group.
   Three sets of four triangles are shaded.

8. ⅘ • 10 = 8
   Pictorial model should consist of 10 triangles separated into five equal groups with two triangles in each group.
   Four sets of two triangles are shaded.

9. ⅝ • 11 = 5
   Pictorial model should consist of 11 triangles separated into 11 equal groups with one triangle in each group.
   Five sets of one triangle are shaded.

10. 33 • ⅙ = 18
    Pictorial model should consist of 33 triangles separated into 11 equal groups with three triangles in each group.
    Six sets of three triangles are shaded.

11. 35 • ⅖ = 14
    Pictorial model should consist of 35 triangles separated into five equal groups with seven triangles in each group.
    Two sets of seven triangles are shaded.

12. ⅜ • 28 = 12
    Pictorial model should consist of 28 triangles separated into seven equal groups with four triangles in each group.
    Three sets of four triangles are shaded.