Lesson 9: Multiplication & Division: Inverse Operations

Lesson Objectives

- Students will solve division facts as multiplication facts with missing factors.
- Students will represent division problems using an array model.

Instructional Materials

Material	Quantity	Description
Timer	1	
How Am I Doing? graph	1 per student	
Facts Practice graph	1 per student	
Colored pencils	1 per student	
Division Pass Around Cards Master	(1 per student or pair of students; make one set of cards per student or per student pair using the Division Pass Around Cards master.)	
Display Masters	1 each	• Key Idea: Multiplication & Division: Inverse Operations • Array Model • 48 ÷ 6 Array A • 48 ÷ 6 Array B • 48 ÷ 6 Array C • 21 ÷ 3 Array A • 21 ÷ 3 Array B • 21 ÷ 3 Array C
Handouts	1 per student	• Timed Fact Practice 9 • Cumulative Review • Practice • Independent Practice
Answer Keys	1 each	• Timed Fact Practice 9 • Cumulative Review • Practice • Independent Practice

Timed Fact Practice

Distribute the Timed Fact Practice 9 handout of the chosen set of facts; multiplication, division, or mixed. Remember to use the same set of facts throughout the module.

Say: *When I say, "begin," you will have one minute to complete the 20 multiplication/division/mixed facts. Start with the first one, going across the rows. If you make a mistake, cross out the wrong answer and write the correct answer next to it. When I say, "stop" or the timer goes off, put your pencil down.*

Say: *Ready? Begin.*

After the timer goes off, display the Timed Fact Practice 9 Answer Key and have the students use a colored pencil or marker to check their work and write the number correct on the score line on the Facts Practice Graph.

Then have students graph the number correct. As the lessons proceed, connect the new point with the previous lesson's point.

Cumulative Review

Have students answer the questions on the Cumulative Review handout. Go over the answers. Correct misconceptions. Have students use a colored pencil to make corrections as needed. Collect student papers to determine who needs additional instruction.

Preview

This lesson will build on students' conceptual knowledge of multiplication. Students will solve division facts as multiplication facts with missing factors, applying the idea that multiplication and division are inverse operations. Students will use the knowledge taught in this lesson to solve unknown division fact problems.

Display and introduce through a brief explanation the key idea for this lesson:

- Multiplication and division are inverse operations.

Use the Key Idea: Multiplication & Division: Inverse Operations DM display master as needed.

Engage Prior/Informal Knowledge

To open the lesson, present questions to activate students' background knowledge related to the content to be taught in this lesson. Ask questions such as:

- What are the numbers multiplied together in a multiplication problem called? (factors)
- When two factors are multiplied together, what is the result called? (product)
- What is one way to solve a division problem like 24 ÷ 6? (equal partitioning)
- What is another way to write 5 x 7 = 35? (7 x 5 = 35)
- What is another way to write 3 x 6 = 18? (6 x 3 = 18)
- What property tells us that these equations are equivalent? (the commutative property of multiplication)
- What is a quotient? (the result of a division problem)

If students cannot answer these questions, stop and explicitly teach the material.

Demonstrate

1. Introduce the inverse relationship between multiplication and division using an array model.

Say: *We have used an array model to represent multiplication problems in previous lessons. In this lesson, we are going to use the same model to solve division problems.*

Display the Array Model DM display master.

Say: *What multiplication problem is represented by this array? (6 x 8 = 48)*

2. Find the quotient of a division problem using an array model.

Display 48 ÷ 6.

Say: *This mathematical expression is 48 ÷ 6. I want to find the quotient of 48 ÷ 6.*

Display the 48 ÷ 6 Array A DM display master.

Say: *48 ÷ 6 can be described as 48 objects divided into 6 equal groups. Each group is represented by a row in the array. When we divide 48 by 6, the quotient is the number of objects in each group. This array represents the expression 48 ÷ 6.*

Say: *I could also think of this array as: 6 rows multiplied by an unknown number of objects equals 48. This is the same as asking 6 times what number equals 48. We can rewrite the expression 48 ÷ 6 as 6 x ? = 48.*

TEACHER NOTE
Relate the array representation of a division problem to the division notation of the expression[1].

Display 6 x ? = 48.

Say: *Because we know 6 x 8 = 48, we can complete the array to show 6 rows of 8 objects, which equals 48 total objects.*

Display the 48 ÷ 6 Array B Array DM display master.

Say: *By solving the multiplication problem 6 x ? = 48, we can*

answer the division problem 48 ÷ 6. Multiplication and division are inverse operations because 6 x 8 = 48, 48 ÷ 6 = 8. The array model helps us to see why this is true.

Display the 48 ÷ 6 Array C DM display master to address any misunderstandings or uncertainty about the relationship between multiplication and division facts.

Repeat this process with additional division facts, such as 21 ÷ 3.

First, display the array. Then, rewrite the problem as a multiplication fact (3 x ? = 21). Complete the array, showing that 3 x 7 = 21. Relate the solved multiplication problem to the original division problem. Use the 21 ÷ 3 Array A, B, and C DM display masters.

TEACHER NOTE

Students may have a difficult time understanding the relationship between 6 x 8 = 48 and 48 ÷ 6 = 8. Use the array model with various examples to increase understanding. Have students give the mathematical expressions that represent different arrays.

Practice

For each practice activity, provide detailed feedback to students, highlighting what was done correctly and what needs improvement. Provide opportunities for students to correct their errors. Collect student work to review and monitor student progress.

Activity 1: Have students practice solving division problems by rewriting them as multiplication problems.

Say: *We used an array model to show the relationship between multiplication and division facts. Now, we are going to rewrite division facts as multiplication facts as a strategy to solve them.*

Display 30 ÷ 6 = ?.

Say: *How can we rewrite this division problem as a multiplication problem? (6 x ? = 30) What factor is missing? (5) What is the answer to the division problem? (5)*

TEACHER NOTE
Some students may not yet be fluent with their multiplication facts. If so, remind them to use the strategies for multiplication taught in earlier lessons, or allow them to use a multiplication table.

Repeat this process with several other examples such as 36 ÷ 4, 27 ÷ 9, and 48 ÷ 12.

Have the students complete the Practice handout on their own. Circulate and answer questions as necessary.

TEACHER NOTE
This activity can be done in small groups or as a class—make additional sets as necessary. Students can use their completed multiplication table, if needed.

Activity 2: In this activity, have students practice solving division problems using the Division Pass Around Cards.

Have students fold their paper into 8 sections by folding in half vertically and then in half horizontally twice. Have students number the sections 1–8 on the front and 9–16 on the back.

Explain that students should record the problem in the matching section of their papers, rewrite the problem as a 'missing factor' problem, and then write the missing factor.

Students may benefit from seeing 1 complete example.

1.	2.
3. Problem: 24 ÷ 4 = ? Student writes: 4 x ? = 24 Fill in product: ? = 6 Answer: 24 ÷ 4 = 6	4.
5.	6.
7.	8.

Let students know that the problems may not come in order. Students should complete each problem in the space designated for the number.

Students will pass the problem card to the next person and receive a new problem card on a given signal.

WATCH FOR Students may believe the commutative property of multiplication also applies to division. For example, because 15 ÷ 3 = 5, then 3 ÷ 15 = 5. Demonstrate an example. Have 15 sheets of paper to share among 3 people. Ask students, how many sheets of paper does each person get? (5) Have 3 sheets of paper to share among 15 people. How many sheets of paper does each person get? (1/5) For each demonstration, write the equation on the board. Draw attention to the quotients, which are different.

Independent Practice

1. Have students work independently to complete the activity on the Independent Practice handout.

2. Go over the answers (students self-check and correct, using a colored pencil).

3. Have students record the number correct in the box and complete their How Am I Doing? graph.

4. Collect the papers to review and monitor student progress.

Closure

Review the key idea. Have students provide examples from the lesson.

Have students discuss their answer to the following questions.

- How would you describe the relationship between multiplication and division to someone who doesn't know?
- How would you use multiplication to solve 28 ÷ 4? 18 ÷ 3?

Clear up any misconceptions. Students who believe division problems cannot be rewritten as a multiplication problem with a missing factor or who apply the commutative property of multiplication to division facts need additional instruction.

1. **Beckman, Sybilla. (2011).** ***Mathematics for elementary teachers with activity manual, 3rd Edition.*** **Boston, MA: Addison-Wesley.**