

**Number Sentences**

**1. Pat is lining up baseballs for hitting practice. If 48 baseballs are arranged in 4 equal rows, how many baseballs are in each row?**



Can each number sentence be used to find the number of baseballs in each row?

Number Sentence	Explain why you chose Yes or No.
A)  $4 \div 48 = \square$  Circle One:  Yes    No	
B)  $\square \times 4 = 48$  Circle One:  Yes    No	
C)  $48 \div 4 = \square$  Circle One:  Yes    No	

Name \_\_\_\_\_

## Number Sentences

**2. Ari is making gift bags for her friends. If she puts 9 stickers in each bag and she has 54 stickers in all, how many gift bags can she make?**




Can each number sentence be used to find out how many gift bags?

Number Sentence	Explain why you chose yes or no.
A)  $54 - 9 = \square$  Circle One:  Yes    No	
B)  $9 \times \square = 54$  Circle One:  Yes    No	
C)  $9 \div 54 = \square$  Circle One:  Yes    No	

### Number Sentences: Multiplication and Division Problems

This resource guides you in using the ACT cycle to implement this probe with your students and use the findings to plan instructional next steps.

Here is one example from this 6-item representation probe:

**1. Pat is lining up baseballs for hitting practice. If 48 baseballs are arranged in 4 equal rows, how many baseballs are in each row?** 

Can each number sentence be used to find the number of baseballs in each row?

Number Sentence	Explain why you chose Yes or No.
<p>A)</p> <p><math>4 \div 48 = \square</math></p> <p>Circle One:</p> <p>Yes   No</p>	

The probe consists of 2 multiple selection items. Item 1 and 2 can be administered together or as two separate diagnostic assessments.



### Analyze the Assessment

#### What is the math?

This probe gathers information about the extent to which students can model multiplication and division situations using a number sentence.

Do Students...		
<ul style="list-style-type: none"> <li>▪ Recognize problem situations in which the quantities can be represented as groups of the same quantity and with multiplication or division?</li> <li>▪ Determine a correct number sentence to represent a problem?</li> </ul>	<b>OR</b>	<ul style="list-style-type: none"> <li>▪ Choose number sentences with incorrect operations?</li> <li>▪ Choose either multiplication sentences or division sentences but not both representations?</li> <li>▪ Choose sentences with the correct operation but incorrect order?</li> <li>▪ Rely solely on fact recognition?</li> </ul>

## Oklahoma Academic Standards for Mathematics

Below are the associated standards related to the intended content of the probe. This may mean a direct relationship (the content directly addresses the standard), but the content focus may instead be foundational for the standard—that is, the target may be necessary before the standard can be addressed.

**4.N.1** Solve real-world and mathematical problems using multiplication and division.

**4.A.2** Use multiplication and division with unknowns to create number sentences representing a given problem situation.



### Consider Students' Thinking

Examine their work

Each probe item requires a two-part response from the student: a selected response and a written explanation using words and/or pictures. Together, these two parts provide important information about the student's understanding and thinking. Four possible combinations of student responses are described below.

- correct selected response choice AND an explanation that provides sound reasoning
- correct selected response choice AND an explanation containing flawed or no reasoning
- incorrect selected response choice AND an explanation with reasoning that reflects some understanding
- incorrect selected response choice AND an explanation containing flawed or no reasoning

In preparation for examining your own student work, review the following:

1. the correct selected response answers;
2. student work samples showing correct selected response choices supported by sound reasoning and/or successful strategies; and
3. student work samples to illustrate common misconceptions.

#### 1. Correct selected response choices

Item 1:    A) No            B) Yes            C) Yes

Item 2:    A) No            B) Yes            C) No

2. Examples of correct selected response choices with sound reasoning and/or successful strategies

Student understands that the number sentence represents the context of the problem and describes each of the numbers in terms of the context.

$9 \times \boxed{6} = 54$  Circle One: <input checked="" type="radio"/> Yes    No	$9 \times 6 = 54$ 
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Student describes the number sentence correctly as dividing the total amount (48) into equal groups (4).

$48 \div 4 = \square$  Circle One: <input checked="" type="radio"/> Yes    No	I chose yes because if you divide 48 into four rows you get an equal number in each row.
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Student uses an array with 4 equal columns to model the problem.

$48 \div 4 = \boxed{12}$  Circle One: <input checked="" type="radio"/> Yes    No	
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Student recognizes that 54 is the dividend and that the number sentence incorrectly uses 9 as the dividend.

$9 \div 54 = \boxed{?}$ <del>X</del>  Circle One: Yes <input checked="" type="radio"/> No	Because she has 54 to divide not 9. 9 is the #Bags
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### 3. Examples that reflect common misconceptions

#### Order doesn't matter

Students may think of division as commutative, incorrectly choosing both  $48 \div 4$  and  $4 \div 48$  to represent the problem.

$$4 \div 48 = \square$$

Circle One:

Yes No

I said yes because four divided by forty eight or four equal rows of forty eight are relatively similar.

$$4 \div 48 = \boxed{12}$$

Circle One:

Yes No

I chose yes cause this tells you that there is 12 in each row.

#### Responding to a different question

Students may correctly connect the number sentence with a context from the problem without considering whether the number sentence can be used to represent the solution to the problem.

$$54 - 9 = \boxed{45}$$

Circle One:

Yes No

$$54 - 9 = 45$$

1 gift bag

#### Difficulty with facts

If students rely only on known facts, they may not attempt a different strategy to represent the problem.

$$\boxed{8} \times 4 = 48$$

Circle One:

Yes No

No because nothing can times to get to 48 (times)

## Examples that reflect common misconceptions

### Division only

Students may think about the problem in only one way. For example, this student recognized the problem as a division problem and therefore chose no for the multiplication number sentence.

$\boxed{70} \times 4 = 48$  Circle One:  Yes <input checked="" type="radio"/> No	It can only be divided to get the right answer.
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### The answer is after the equal sign

Students sometimes think of the equal sign as meaning "the answer is" and therefore choose only number sentences set up in that way.

$9 \times \boxed{6} = 54$  Circle One:  Yes <input checked="" type="checkbox"/> No	The answer should be over here  $54 \div 9 = \boxed{6}$
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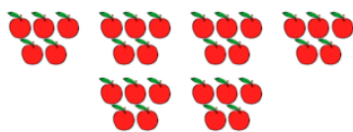
## Take Action

Move student learning forward

### Instructional ideas to consider

- Prior to working on representing multiplication and division problems with unknowns, students should have experiences with writing multiplication and division equations to model a situation and describing how the equation connects back to the model.

For example:



$6 \times 5 = 30$	6 groups of 5 apples
$5 \times 6 = 30$	5 apples in each of 6 groups
$30 \div 6 = 5$	30 apples distributed equally among 6 groups
$30 \div 5 = 6$	30 apples divided into groups of 5

- Use contexts to explore and model situations involving multiplication and division with an unknown. Be sure to use and discuss each of the problem types: unknown product ( $4 \times 3 = ?$ ), group size unknown ( $12 \div 3 = ?$  or  $4 \times ? = 12$ ), and number of groups unknown ( $12 \div 4 = ?$  or  $? \times 3 = 12$ ).
- Provide a variety of equations that do and do not model a situation and ask students to determine which ones correctly represent the situation. Ensure that students repeatedly encounter situations in which the same numbers appear in different contexts.

- Have students create their own story problems for each of the problem types.
- As always, consider which of the Mathematics Actions and Processes will be the focus of your instruction. (i.e. have students defend their choices to other students to support ability to communicate using mathematical reasoning).

### Sample Hinge-point Question to Assess Progress

Here is one example. You will likely need to create additional hinge-point questions as you implement targeted instruction to address learning needs.

**7 students are sharing some grapes. If each student gets 12 grapes, how many grapes were shared in all?**

Which number sentences can be used to show how many grapes?

- a)  $12 \times 7 = \square$                       b)  $\square \times 12 = 7$                       c)  $\square \div 7 = 12$
- d)  $\square \times 7 = 12$                       e)  $12 \div 7 = \square$                       f)  $\square \div 12 = 7$

**Correct selected response choices for Hinge-point question.**

a, c, f



Attributed to the work of Rose Tobey, Arline, Fagan.  
[https://padlet.com/MathProbes/OK\\_Map](https://padlet.com/MathProbes/OK_Map)