Math
PROBES

Uncover misconceptions to deepen understanding

Formative Assessment Math Probes, written by Cheryl R. Tobey, help you easily identify and target misconceptions in student understanding.

Reveal
MATH®

CHERYL TOBEY
MATH PROBES

Cheryl Tobey Math Probes appear in every unit of *Reveal Math* K–5, a core mathematics program. Use these third-grade samples in your classroom today, which cover multiplication, division, and place value.

Math Probes are designed to support teachers in identifying student misconceptions with a short assessment and metacognitive check.

The Math Probes are designed to ACT:

A   Analyze the Probe

C   Collect and Assess Student Work

T   Take Action

Reveal Math K–5
Contributing Author

Cheryl R. Tobey is an author and educational consultant. She has been project director for Formative Assessment in the Mathematics Classroom: Engaging Teachers and Students and a mathematics specialist for Differentiated Professional Development: Building Mathematics Knowledge for Teaching Struggling Students. Both projects are funded by the National Science Foundation. Cheryl's work, including published books, is primarily in the areas of formative assessment and professional development.

Ways to Show 3 × 6

CHERYL TOBEY
MATH PROBES

Name _____

Decide if the example shows a way to think about 3 × 6.
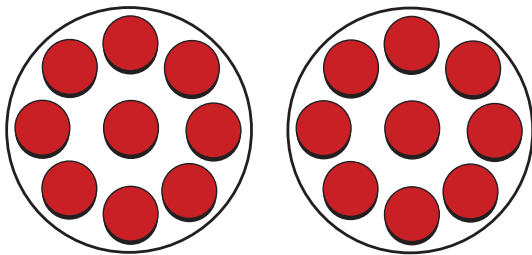**Circle Yes or No.**

1. 6 + 6 + 6

Does this show 3 ✕ 6?

Yes   No

Explain why you chose
Yes or No.

2.

Does this show 3 ✕ 6?
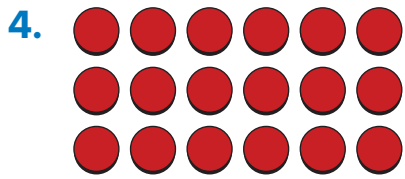
Yes   No

Explain why you chose
Yes or No.

---

3. 3, 6, 9, 12, 15, 18

Does this show 3 ✕ 6?

Yes   No

Explain why you chose
Yes or No.

4.

Does this show 3 × 6?

Yes   No

Explain why you chose Yes or No.

5.

Does this show 3 × 6?

Yes   No

Explain why you chose Yes or No.

Reflect On Your Learning

I am confused.	I'm still learning.	I understand.	I can teach someone else.
○	○	○	○

Math Probe

Analyze The Probe ✓ Formative Assessment

Targeted Concept Understand important multiplication ideas, such as "groups of," repeated addition, and skip counting. Recognize visual representations of multiplication, such as equal groups and arrays.

⚠️ **Targeted Misconceptions** Students may focus on the product and select any representation based on that alone. They might not think about the value of the factors and the multiple of the operation. They may also not recognize that the first factor represents the number of groups; the second factor represents the size of each group.

Authentic Student Work
Below are examples of correct student work and explanations.

Sample A

3. 3, 6, 9, 12, 15, 18
   Does this show 3 × 6?
   (Yes)   No

   Explain why you chose Yes or No.

   Cause it gos up 3's 6 times.

Sample B

4.
   Does this show 3 × 6?
   (Yes)   No

   Explain why you chose Yes or No.

   It's a grid or array of 3×6.

Unit 3
Ways to Show 3 × 6

CHERYL TOBEY
MATH PROBES

Name _____

Decide if the example shows a way to think about 3 × 6.
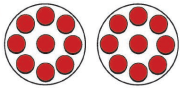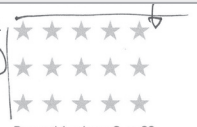Circle Yes or No.

1. 6 + 6 + 6
   Does this show 3 × 6?
   (Yes)   No

   Explain why you chose Yes or No.
   Explanations will vary.

2.
   Does this show 3 × 6?
   Yes   (No)

   Explain why you chose Yes or No.
   Explanations will vary.

3. 3, 6, 9, 12, 15, 18
   Does this show 3 × 6?
   (Yes)   No

   Explain why you chose Yes or No.
   Explanations will vary.

4.
   Does this show 3 × 6?
   (Yes)   No

   Explain why you chose Yes or No.
   Explanations will vary.

5. ★ ★ ★ ★ ★
   ★ ★ ★ ★ ★
   ★ ★ ★ ★ ★
   Does this show 3 × 6?
   Yes   (No)

   Explain why you chose Yes or No.
   Explanations will vary.

Reflect On Your Learning

I am confused.   I'm still learning.   I understand.   I can teach someone else.

Collect and Assess Student Work

Collect and review student responses to determine possible misconceptions. See examples in If-Then chart.

IF incorrect...	THEN the student likely...	Sample Misconceptions
1. No	does not understand the relationship between repeated addition and the factors in the expression.	In this case, the student uses ✕ symbols rather than + symbols.
2. Yes	does not understand that equal grouping is a way to represent the factors in the expression.	In this case, the student correctly changes the representation from 2 groups of 9 to show 3 groups of 6.
3. No	does not recognize that skip counting by 3s is a way to represent the factors in the expression.	In this case, the student does not recognize the pattern shows skip counting by 3s.
4. No 5. Yes	does not understand the relationship between the rows and columns and the factors in the expression.	In this case, the student likely miscounts or misjudges the numbers of stars in each column.

Many of the above difficulties result in a combination of correct and incorrect responses.

For correct responses, be sure to check for sound reasoning.

Take Action

Choose from the following resources or suggestions:

- Revisit multiplication concepts in Lessons 3-1 and 3-2. Continue to pay particular attention to students' strategies and responses beyond Lesson 3-2 as they apply those concepts.
- Have students work with concrete materials, such as counters, to build understanding of multiplication as a number of groups of a particular quantity.
- Provide opportunities for students to solve multiplication in context by giving them word problems. The context of a situation can help students create a visual representation that shows the factors and the product.

Revisit the Probe After additional instruction, have students review their initial answers to the probe. Use these questions for discussion:

- Are there any answers you would like to change? Explain.
- Are there any questions you still have about any of the items on this probe?

Metacognitive Check *Reflect on Your Learning* allows students to think about their level of understanding of the lesson content on a scale of 1 to 4 with 4 being the highest confidence.

Rounding Numbers

Name _____

Circle *all* correct answers for the problem.

1. Suppose you rounded to the nearest 10. Which numbers below would round to 630? Circle *all* of them.

    a. 632

    b. 638

    c. 627

    d. 625

    e. 623

    f. 635

    g. 534

    h. 529

Explain your choices.

Circle *all* correct answers for the problem.

2. Suppose you rounded to the nearest 100. Which numbers below would round to 900? Circle *all* of them.

    a. 956

    b. 871

    c. 943

    d. 839

    e. 962

    f. 819

    g. 988

    h. 925

Explain your choices.

Reflect On Your Learning

I am confused.	I'm still learning.	I understand.	I can teach someone else.
◯	◯	◯	◯

Unit 2
Rounding Numbers

Name _____

Circle *all* correct answers for the problem.

1. Suppose you rounded to the nearest 10. Which numbers below would round to 630? Circle *all* of them.

   (a.) 632
   b. 638
   (c.) 627
   (d.) 625
   e. 623
   f. 635
   g. 534
   h. 529

   Explain your choices.
   Explanations may vary.

Circle *all* correct answers for the problem.

2. Suppose you rounded to the nearest 100. Which numbers below would round to 900? Circle *all* of them.

   a. 956
   (b.) 871
   (c.) 943
   d. 839
   e. 962
   f. 819
   g. 988
   (h.) 925

   Explain your choices.
   Explanations may vary.

Reflect On Your Learning

| I am confused. | I'm still learning. | I understand. | I can teach someone else. |

Analyze The Probe ✓ Formative Assessment

Students are given a number that has been rounded to the nearest 10 or to the nearest 100. Students must then select all numbers from a list of numbers that would produce the given number when rounded to the nearest 10 or to the nearest 100. Students circle their choices and justify their reasoning.

Targeted Concept Understand rounding concepts and conventions to identify numbers that would round to a given number when those numbers are rounded to the nearest 10 or to the nearest 100.

⚠️ **Targeted Misconceptions** Students may not understand that rounding relates to location relative to halfway points on a number line. They may not understand that multiple numbers can round to the same number when rounding to a given place.

Authentic Student Work

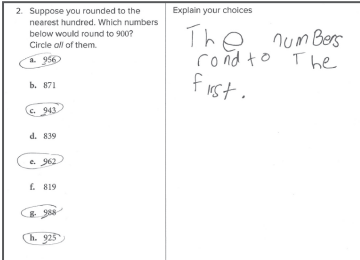Below are examples of correct student work and explanations.
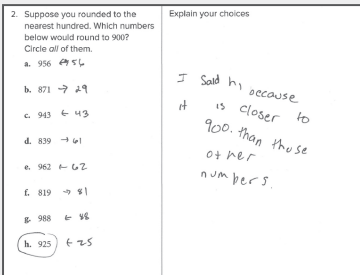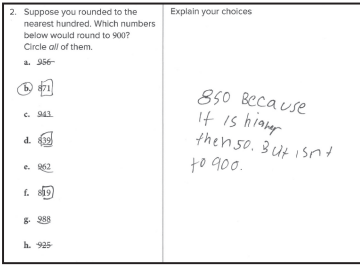
Sample A

1. Suppose you rounded to the nearest ten. Which numbers below would round to 630? Circle *all* of them.

   a. 632   (630)
   b. 638   640
   c. 627   (630)
   d. 625   (630)
   e. 623   620
   f. 635   640
   g. 534   530
   h. 529   530

   Explain your choices
   a, c, d
   I rounded each one.

Sample B

2. Suppose you rounded to the nearest hundred. Which numbers below would round to 900? Circle *all* of them.

   a. 956
   b. 871 ✓
   c. 943 ✓
   d. 839
   e. 962
   f. 819
   g. 988
   h. 925 ✓

   Explain your choices

   850 ⟵————— 950
   NOT   In here   NOT

Collect and Assess Student Work

Collect and review student responses to determine possible misconceptions. See examples in If-Then chart.

IF incorrect...	THEN the student likely...	Sample Misconceptions
1. b, f 2. a, e, g	thinks about rounding as rounding off at the given place rather than rounding to the nearest given place. The student may not apply the convention that when the digit to the right of the place being rounded to is 5 or greater, you round up.	In this case, the student rounds off each number in the 900 range. 2. Suppose you rounded to the nearest hundred. Which numbers below would round to 900? Circle *all* of them. a. 956 ⃝ Explain your choices b. 871 c. 943 ⃝ d. 839 e. 962 ⃝ f. 819 g. 988 ⃝ h. 925 ⃝ The numbers rond to the first.
1. a 2. h	finds the closest number to rather than all numbers.	In this case, the student finds the number closest to 900. 2. Suppose you rounded to the nearest hundred. Which numbers below would round to 900? Circle *all* of them. a. 956 ← 56 b. 871 → 29 c. 943 ← 43 d. 839 → 61 e. 962 ← 62 f. 819 → 81 g. 988 ← 48 h. 925 ⃝ ← 25 I said h, because it is closer to 900. than those other numbers.
1. only c and d 2. only b	only considers rounding up to the number.	In this case, the student only considers numbers below 900. 2. Suppose you rounded to the nearest hundred. Which numbers below would round to 900? Circle *all* of them. a. 956 b. 871 ⃝ c. 943 d. 839 ⃝ e. 962 f. 819 ⃝ g. 988 h. 925 850 Because It is higher then 50. But isn't to 900.

Many of the above difficulties result in a combination of correct and incorrect responses.
For correct responses, be sure to check for sound reasoning.

Take Action

Choose from the following resources or suggestions:

- Have students make and walk on a physical number line to build understanding that rounding is related to proximity to a value shown on the number line.

- Use base-ten blocks to build numbers and discuss rounding to the nearest 10 and nearest 100. Have students use base-ten blocks to build a number that when rounded would be the number you have represented with the blocks.

- Move away from concrete materials and a number line to support students in reasoning about rounding by visualizing numbers without physically representing them.

Revisit the Probe After additional instruction, have students review their initial answers to the probe. Use these questions for discussion:

- *Are there any answers you would like to change? Explain.*
- *Are there any questions that you still have about any of the items on this probe?*

Metacognitive Check *Reflect on Your Learning* allows students to think about their level of understanding of the lesson content on a scale of 1 to 4 with 4 being the highest confidence.