Multiplication and Division of Fractions

5.NF.B Conceptual Understanding Mini-Assessment by Student Achievement Partners

OVERVIEW

This mini-assessment is designed to illustrate cluster 5.NF.B, which sets an expectation for students to apply and extend previous understandings of multiplication and division to multiply and divide fractions. This mini-assessment is designed for teachers to use either in the classroom, for self-learning, or in professional development settings to:

- Evaluate students' understanding of 5.NF.B in order to prepare to teach this material or to check for student ability to demonstrate understanding and apply these concepts;
- Gain knowledge about assessing conceptual understanding of fraction multiplication and division; and,
- Illustrate CCSS-aligned assessment problems.

MAKING THE SHIFTS

This mini-assessment attends to focus as it addresses multiplication and division of fractions, which are at the heart of the grade 5 standards and a key component of the major work of the grade.[1] It addresses coherence across grades by extending grade 4 understanding of multiplication of fractions by whole numbers to grade 5 understanding of multiplication of fractions or whole numbers by fractions. Cluster 5.NF.B and this mini-assessment target *conceptual understanding*, one of the three elements of rigor.

A CLOSER LOOK

Students begin thinking about the meaning of fractions and fraction equivalence in grade 3, and build on those understandings in grade 4 by beginning to perform operations with fractions. In grade 5, students use previous understanding of multiplication and division, along with understanding from the Number and Operations—Fractions domain, to multiply and divide fractions. Key developments in grade 5 include connecting fractions to division (5.NF.B.3), multiplying a whole number or a fraction by a fraction (5.NF.B.4), and understanding multiplication as

> **5.NF.B**
> Apply and extend previous understanding of multiplication and division to multiply and divide fractions.

scaling (5.NF.B.5) in preparation for ratios and proportional relationships, which is introduced in grade 6. Students extend their understanding of division to divide unit fractions by whole numbers and to divide whole numbers by unit fractions (5.NF.B.7).

The questions on this mini-assessment address the conceptual understanding described in 5.NF.B mostly using short questions that are either free of context or have little context. In grade 5, to show conceptual understanding students may be asked to explain their reasoning, critique the reasoning of others, or complete short contextual problems to assess underlying concepts. The short contextual problems help students attach meaning to the operations and make sense of division problems. See the annotations in the answer key for discussion of how some of the questions assess conceptual understanding.

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[1] For more on the Major Work of the grade, see achievethecore.org/emphases.

For a direct link, go to: http://achievethecore.org/page/1034/multiplication-and-division-of-fractions-mini-assessment-detail-pg

Name:_____ Date:_____

1. Circle the letter for the column having a larger value.

A	B	Circle either A or B
$\dfrac{5}{17} \times \dfrac{2}{3}$	$\dfrac{5}{17} \times \dfrac{3}{2}$	A B
$\dfrac{27}{25} \times 36$	$\dfrac{30}{32} \times 36$	A B
$\dfrac{63}{54}$	$\dfrac{63}{54} \times \dfrac{62}{54}$	A B
$9 \times \dfrac{1}{3}$	$\dfrac{1}{3}$	A B

2. Write $11 \div 5$ as a fraction. Then, draw a point that shows this number on the number line diagram below.

Fraction:_____

0   1   2   3   4   5   6   7   8   9   10   11
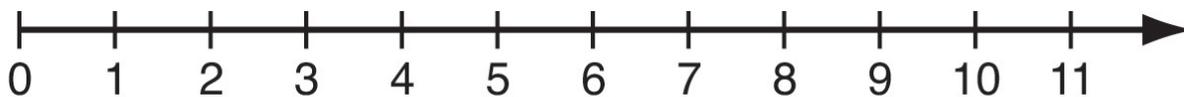
3. Write $>$, $=$, or $<$ to make each comparison true.

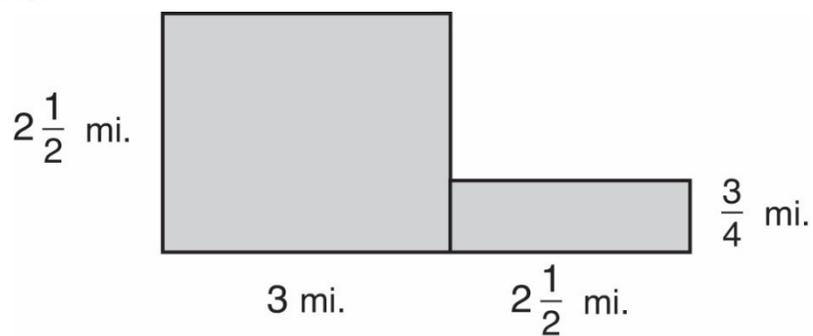   **a.** $2 \div 3$ _____ $2 \div \frac{1}{3}$

    b. $0.2 \times \frac{1}{4}$ _____ $\frac{2}{10} \times \frac{1}{3}$

    c. $\frac{1}{6} \div 4$ _____ $\frac{1}{6} \times \frac{1}{5}$

4. Create a story or diagram to show $\frac{2}{3} \times \frac{3}{4}$.

Compute the product of $\frac{2}{3} \times \frac{3}{4}$.

5. One square mile is equal to 640 acres. How many acres are in the piece of land shown in the diagram below?

$2\frac{1}{2}$ mi.

$\frac{3}{4}$ mi.

3 mi.

$2\frac{1}{2}$ mi.

Area = _____ acres

6. What is the product of $2\frac{1}{2} \times 3\frac{3}{4}$?

7. Fill in the blanks in the expression below to represent the following phrase:
2 parts when 6 is partitioned into 5 parts.

$$\frac{2}{\Box} \times \Box$$

8. Order the following numbers from greatest to least.

$\frac{5}{4} \times 15$ $\qquad$ $\frac{4}{3} \times 10$ $\qquad$ $\frac{2}{3} \times 15$ $\qquad$ $\frac{3}{2} \times 10$

Greatest: _____

_____

_____

Least: _____

9. Tina is making $\frac{1}{4}$ pound hamburgers. Write a **division** expression that shows the number of hamburgers she can make with 9 pounds of hamburger meat.

Name:_____ Date:_____

1. Circle the letter for the column having a larger number.

| **A**	**B**	**Circle either A or B**
$\dfrac{5}{17} \times \dfrac{2}{3}$	$\dfrac{5}{17} \times \dfrac{3}{2}$	A (B)
$\dfrac{27}{25} \times 36$	$\dfrac{30}{32} \times 36$	(A) B
$\dfrac{63}{54}$	$\dfrac{63}{54} \times \dfrac{62}{54}$	A (B)
$9 \times \dfrac{1}{3}$	$\dfrac{1}{3}$	(A) B

> The numbers used in these problems are intentionally "messy." They encourage students to think about the value of the factors being multiplied (whether they are greater or less than 1) and consider the results of multiplying by fractions that are greater or less than one. Students who reason in this way will have a more manageable problem than if they actually compute each product.
>
> In the first comparison, the first factor in column A is multiplied by an expression less than 1 while the same first factor in column B is multiplied by an expression greater than 1. Similarly, in the third comparison, the student should see the same fraction in both columns A and B, but in column B, that fraction is multiplied by an expression greater than 1, yielding a larger product. It is important to notice when students are relying on multiplying rather than seeing this structure.

2. Write $11 \div 5$ as a fraction. Then, draw a point that shows this number on the number line diagram below.

Fraction: $\dfrac{11}{5}$ *OR Equivalent*
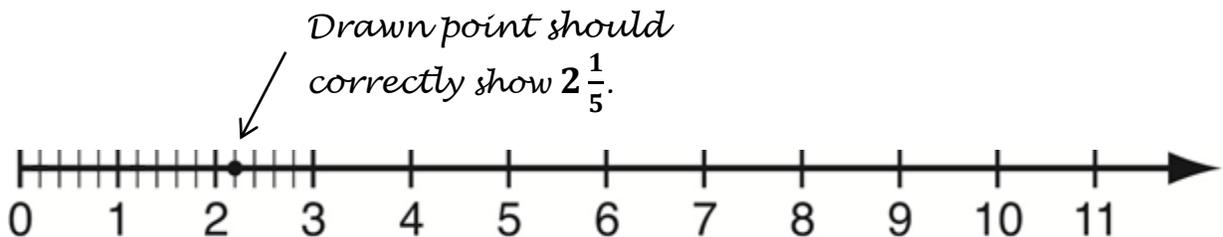
Drawn point should correctly show $2\dfrac{1}{5}$.

3. Write >, =, or < to make each comparison true.

> a. $2 \div 3$ ___<___ $2 \div \frac{1}{3}$
>
> b. $0.2 \times \frac{1}{4}$ ___<___ $\frac{2}{10} \times \frac{1}{3}$
>
> c. $\frac{1}{6} \div 4$ ___>___ $\frac{1}{6} \times \frac{1}{5}$

The numbers chosen encourage students to use reasoning strategies to compare expressions without computation. Part (a) encourages students to compare division by a whole number and division by a fraction. In part (b), students can recognize 0.2 equals 2/10, and then compare the effect of multiplying by 1/4 and 1/3. In part (c) students compare the effect of dividing by 4 and multiplying by 1/5.

4. Create a story or diagram to show $\frac{2}{3} \times \frac{3}{4}$.

Example Story: I had two-thirds of a candy bar left over from earlier today. I told my little brother he could have three quarters of it.
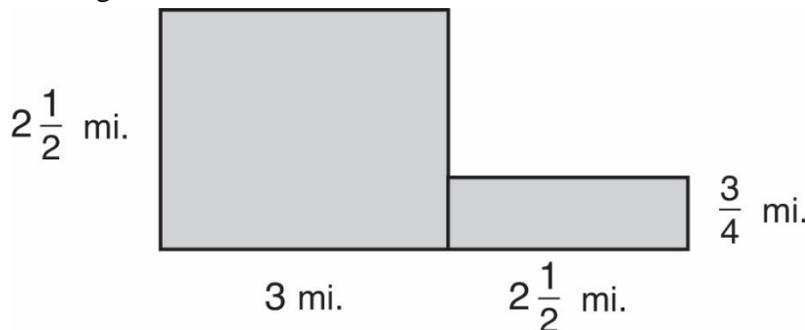
Example Diagram:
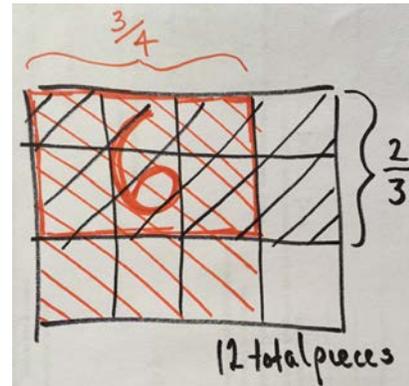
Compute the product of $\frac{2}{3} \times \frac{3}{4}$.

$\frac{6}{12}$ *OR Equivalent*

5. One square mile is equal to 640 acres. How many acres are in the piece of land shown in the diagram below?

This problem builds on the relationship between multiplication and area. Students may see this as the sum of two products (2 ½ x 3 + 2 ½ x ¾) or an instance of the distributive property (2 ½ x 3 ¾) by reconstructing the pieces.

Area = __6,000__ acres *OR Equivalent*

6. What is the product of $2\frac{1}{2} \times 3\frac{3}{4}$?

$9\frac{3}{8}$ OR Equivalent

Students may recognize that this product has been solved in the previous question by the distributive property. Students who struggle with either #5 or #6 can be asked to look at the two problems together to compare what is being asked.

7. Fill in the blanks in the expression below to match the following phrase:

2 parts when 6 is partitioned into 5 parts.

$$\frac{2}{\boxed{5}} \times \boxed{6}$$

This problem directly assesses the interpretation of a product $\frac{a}{b} \times q$ as a parts of a partition of q into b equal parts and directly leads to a general understanding of the multiplication of two fractions as $\frac{a}{b} \times \frac{c}{d} = \frac{ac}{bd}$.

8. Order the following numbers from greatest to least.

$\frac{5}{4} \times 15$ $\frac{4}{3} \times 10$ $\frac{2}{3} \times 15$ $\frac{3}{2} \times 10$

The numbers in the expressions allow students to use reasoning about multiplication as scaling. Students should quickly see that 5/4 x 15 will be greater than 2/3 x 15 because the product will be more than 15 and the other will be less than 15. Similarly, students can reason that 3/2 x 10 = 1 ½ x 10 = 15.

Greatest: $\frac{5}{4} \times 15$

$\frac{3}{2} \times 10$

$\frac{4}{3} \times 10$

Least: $\frac{2}{3} \times 15$

Although some students may compute the product of each expression, teachers can use this problem to identify which students apply reasoning when approaching fraction scaling.

9. Tina is making $\frac{1}{4}$ pound hamburgers. Write a **division** expression that shows the number of hamburgers she can make with 9 pounds of hamburger meat.

$$9 \div \frac{1}{4}$$