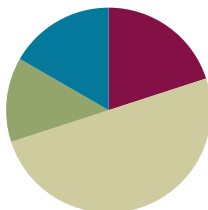# Lesson 14

Objective: Use fraction and decimal multiplication to express equivalent measurements.

Suggested Lesson Structure

■ Fluency Practice   (12 minutes)
■ Application Problem   (8 minutes)
■ Concept Development   (30 minutes)
■ Student Debrief   (10 minutes)

   Total Time   **(60 minutes)**

Fluency Practice (12 minutes)

- Divide by Multiples of 10 **5.NBT.2**   (3 minutes)
- Unit Conversions **5.MD.1**   (4 minutes)
- Multiply Unit Fractions **4.NF.4**   (5 minutes)

Divide by Multiples of 10 (3 minutes)

Materials: (S) Personal white board

Note: This fluency review prepares students to approximate quotients with two-digit divisors in Lesson 17.

   T: (Write 420 ÷ 10 = _____.) Say the division sentence.
   S: 420 ÷ 10 = 42.
   T: (Write 42 ÷ 2 = _____ below 420 ÷ 10 = 42.) Say the division sentence.
   S: 42 ÷ 2 = 21.
   T: (Write 420 ÷ 20 = _____ below 42 ÷ 2 = 21.) Say 420 ÷ 20 as a three-step division sentence, taking out the ten.
   S: 420 ÷ 10 ÷ 2 = 21.
   T: (Write 420 ÷ 20 = 21.)

Direct students to solve using the same method for 960 ÷ 30 and 680 ÷ 20.

420 ÷ 10 = 42   42 ÷ 2 = 21

420 ÷ 20 = 21

÷ 10   ÷ 2

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Unit Conversions (4 minutes)

Materials: (S) Personal white board

> T: 1 foot is the same as how many inches?
> S: 12 inches.
> T: (Write 1 ft 1 in = _____ in.) On your personal white board, write the conversion.
> S: (Write 1 ft 1 in = 13 in.)

Repeat the process for the following possible sequence: 1 ft 2 in, 1 ft 3 in, 1 ft 10 in, 1 ft 8 in, 2 ft, 2 ft 1 in, 2 ft 10 in, 2 ft 6 in, 3 ft, 3 ft 10 in, 3 ft 4 in.

> T: 12 inches is the same as what single unit?
> S: 1 foot.
> T: (Write 13 in = _____ ft _____ in.) On your personal white board, write the conversion.
> S: (Students write 13 in = 1 ft 1 in.)

Repeat the process for the following possible sequence: 14 in, 22 in, 24 in, 34 in, 25 in, 36 in, 46 in, 40 in, 48 in, 47 in, 49 in, 58 in.

Multiply Unit Fractions (5 minutes)

Materials: (S) Personal white board

Note: This fluency activity reviews the multiplication of unit fractions from Grade 4 to be used in today's Concept Development.

> T: (Write 4 × 1 banana.) Say the complete number sentence.
> S: 4 × 1 banana = 4 bananas.
> T: (Write 4 × 1 seventh.) Say the complete number sentence.
> S: 4 × 1 seventh = 4 sevenths.
> T: Rewrite the number sentence using fractions.
> S: (Write $4 \times \frac{1}{7} = \frac{4}{7}$.)
> T: (Write 7 × 1 seventh.) Say the complete number sentence.
> S: 7 × 1 sevenths = 7 sevenths.
> T: Rewrite the number sentence using fractions.
> S: (Write $7 \times \frac{1}{7} = \frac{7}{7}$.)
> T: Rename 7 sevenths as a whole number.
> S: 1!

Continue with 14 × 1 seventh.

> T: (Write 8 × 1 fourth.) Say the complete number sentence.
> S: 8 × 1 fourth = 8 fourths.

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T: Rewrite the number sentence using fractions.

S: (Write $8 \times \frac{1}{4} = \frac{8}{4}$.)

T: Rename 8 fourths as a whole number.

S: 2!

Repeat the process for 12 × 1 fourth, 4 × 1 fourths, 3 × 1 third, 6 × 1 third, and 24 × 1 third.

Application Problem (8 minutes)

Draw and label a tape diagram to represent each of the following:

1.   Express 1 day as a fraction of 1 week.

2.   Express 1 foot as a fraction of 1 yard.

3.   Express 1 quart as a fraction of 1 gallon.

4.   Express 1 centimeter as a fraction of 1 meter. (Decimal form.)

5.   Express 1 meter as a fraction of 1 kilometer. (Decimal form.)
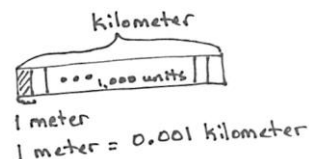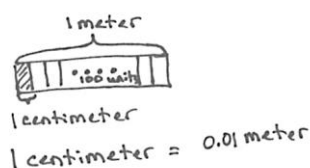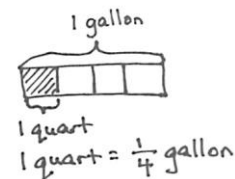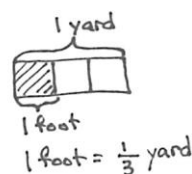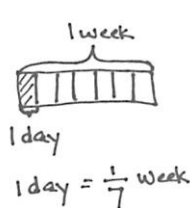
Note: This Application Problem is foundational to the Concept Development wherein students will be multiplying by fractions to convert smaller units to larger units.

Concept Development (30 minutes)

Materials: (S) Personal white board, meter strip (Lesson 13 Template)

Problem 1

14 days = _____ weeks

14 days = 14 × (1 day)

$\qquad$ = $14 \times \left(\frac{1}{7} \text{ week}\right)$

$\qquad$ = $\frac{14}{7}$ weeks

$\qquad$ = 2 weeks

T: (Write 14 days = 14 × (1 day) on the board.)
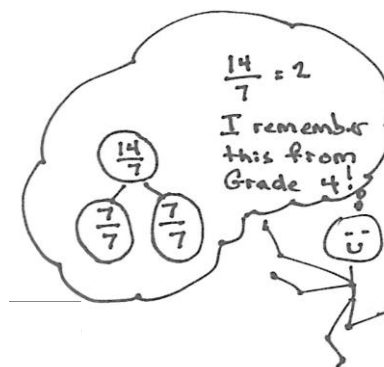
T: What are the two factors?

S: 14 and 1 day.

> **NOTES ON MULTIPLE MEANS OF REPRESENTATION:**
>
> Students benefit from seeing fractions in unit form, as in the Fluency, pictorially, as in the Application Problem, and abstractly, as in the Concept Development. Refer back to the unit form and pictorial to reassure students they can understand and solve fractions.

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T: What fraction of a week is 1 day?

S: $\frac{1}{7}$.

T: So can I rename 1 day as $\frac{1}{7}$ week?

S: Yes.

T: Let's use parentheses to make it clear that this factor, or conversion factor, has the same value. (Write $14 \times (\frac{1}{7}$ week) directly below $21 \times (1$ day) so the equivalence of the two factors is very clear.)

T: What's 14 times $\frac{1}{7}$ week?

S: 14 sevenths week.

T: Let's use a number bond to express 14 sevenths as 2 groups of 7 sevenths. (Draw the number bond pictured to the top right.)

T: How many weeks is $\frac{14}{7}$ weeks?

S: 2 weeks.

T: Did we convert from a larger to smaller unit or smaller to larger unit?

S: Smaller to larger unit.

T: Yes. A day is a smaller unit than a week.

T: On your personal white board, take a moment to convert 24 feet to yards and 24 quarts to gallons using the same process.

24 feet = _____ yards	24 quarts = _____ gallons
24 feet = 24 × (1 foot)	24 quarts = 24 × (1 quart)
$\quad = 24 \times \left(\frac{1}{3} \text{ yard}\right)$	$\quad = 24 \times \left(\frac{1}{4} \text{ gallon}\right)$
$\quad = \frac{24}{3}$ yards	$\quad = \frac{24}{4}$ gallons
$\quad = 8$ yards	$\quad = 6$ gallons

NOTES ON MULTIPLE MEANS OF ACTION AND EXPRESSION:

Students may benefit from first confirming the conversions using foot rulers (concrete) and then returning to patterns on a T-Chart or list as was used in Grade 4.

12 × (1 inch) = 1 foot.

24 × (1 inch) = 2 feet.

36 × (1 inch) = 3 feet.

Rewrite the chart as fraction multiplication:

$12 \times \frac{1}{12}$ foot = 1 foot.

$24 \times \frac{1}{12}$ foot = 2 feet.

$36 \times \frac{1}{12}$ foot = 3 feet.

This may help solidify the concept of 1 inch being a fraction of a foot and support seeing the simplicity of the fraction multiplication.

COMMON CORE

Lesson 14:   Use fraction and decimal multiplication to express equivalent measurements.

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Problem 2

195 cm = _____ m

195 cm = 195 × (1 cm)

$\qquad$ = 195 × (0.01 m)

$\qquad$ = 1.95 m

T: (Write 195 cm.) Let's use the same process to convert smaller metric units (point to the centimeters) to larger metric units using decimal numbers. What metric units are larger than centimeters?

S: Meters. → Kilometers.

T: Let's convert 195 centimeters to meters.

T: Just as we have been doing, let's rename 195 centimeters as a multiplication expression with one factor naming the unit. Talk to your partner.

S: Last time, we made the unit a factor, so that means we have 195 groups of 1 centimeter. → One factor is 195, and the other factor is 1 centimeter. → 195 × 1 cm.

T: (Write 195 cm = 195 × (1 cm).) Using the parentheses really helps me see the conversion factor. (Point to 1 cm.)

T: Let's rename the conversion factor as meters. One centimeter is equal to what fraction of a meter?

S: 1 hundredth meter → 1 one hundredth meter.

T: Tell me how to write 1 hundredth in decimal notation.

S: Zero point zero 1.

T: (Write 195 cm = 195 × 0.01 m.) What is 195 times 0.01 meter?

S: 1.95 meters.

T: Is that the correct conversion? Does 195 cm equal 1.95 meters? (Hold up a meter stick and model the equivalence at the concrete level to verify.)

Repeat the process with the following possible sequence: convert 4,500 grams to kilograms; convert 578 milliliters to liters.

4,500 grams = _____ kilograms	578 milliliters = _____ liters
4,500 grams = 4,500 × (1 gram)	578 milliliters = 578 × (1 milliliter)
$\qquad$ = 4,500 × (0.001 kilogram)	$\qquad$ = 578 × (0.001 liter)
$\qquad$ = 4.5 kilograms	$\qquad$ = 0.578 liter

Problem 3

A container holds 16 cups of juice. Convert the capacity to pints. (2 cups = 1 pint.)

A truck weighs 1,675,280 grams. Convert the weight to kilograms.

T: Introduce students to the process, setting up the measurement as an equivalent expression with the unit as a factor.

16 cups = _____ pints

16 cups = 16 × (1 cup)

$= 16 \times \left(\frac{1}{2} \text{ pint}\right) = \frac{16}{2}$ pints

$= 8$ pints

1,675,280 grams = _____ kilograms

1,675,280 grams = 1,675,280 × (1 gram)

$= 1,675,280 \times (0.001 \text{ kilogram})$

$= 1,675.28 \text{ kilograms}$

Problem Set (10 minutes)

Students should do their personal best to complete the Problem Set within the allotted 10 minutes. For some classes, it may be appropriate to modify the assignment by specifying which problems they work on first. Some problems do not specify a method for solving. Students should solve these problems using the RDW approach used for Application Problems.

Student Debrief (10 minutes)

Lesson Objective: Use fraction and decimal multiplication to express equivalent measurements.

The Student Debrief is intended to invite reflection and active processing of the total lesson experience.

Invite students to review their solutions for the Problem Set. They should check work by comparing answers with a partner before going over answers as a class. Look for misconceptions or misunderstandings that can be addressed in the Debrief. Guide students in a conversation to debrief the Problem Set and process the lesson.

You may choose to use any combination of the questions below to lead the discussion.

- In each problem, what are the smaller units? What are the conversion factors in each problem?

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- 24 feet is 8 yards, while 24 quarts is 6 gallons. Why did we end up with more yards than gallons when both conversions started with 24 units?

- When our conversion factor is a fraction, we are converting to larger units. When our conversion factor is a whole number, we are converting to smaller units. Explain this using examples from your Problem Set and memory.

- Whether we are converting small units to large units or large units to small units, we are multiplying. Explain why this is true.

Exit Ticket (3 minutes)

After the Student Debrief, instruct students to complete the Exit Ticket. A review of their work will help you assess the students' understanding of the concepts that were presented in the lesson today and plan more effectively for future lessons. You may read the questions aloud to the students.

2. After solving, write a statement to express each conversion. The first one is done for you.

a. The screen measures 24 inches. Convert 24 inches to feet.

$24 \text{ inches} = 24 \times (1 \text{ inch})$

$= 24 \times (\frac{1}{12} \text{ feet})$

$= \frac{24}{12} \text{ feet}$

$= 2 \text{ feet}$

The screen measures 24 inches or 2 feet.

b. A jug of syrup holds 12 cups. Convert 12 cups to pints.

$12 \text{ cups} = 12 \times (1 \text{ cup})$

$= 12 \times (\frac{1}{2} \text{ pint})$

$= \frac{12}{2} \text{ pints}$

$= 6 \text{ pints}$

12 cups is equal to 6 pints.

c. The length of the diving board is 378 centimeters. What is its length in meters?

$378 \text{ cm} = 378 \times (1 \text{ cm})$

$= 378 \times (0.01 \text{ m})$

$= 3.78 \text{ m}$

The diving board's length is 3.78 meters.

d. The capacity of a container is 1,478 milliliters. Convert this to liters.

$1,478 \text{ mL} = 1,478 \times (1 \text{ mL})$

$= 1,478 \times (0.001 \text{ L})$

$= 1.478 \text{ L}$

1,478 milliliters is equal to 1.478 liters.

e. A truck weighs 3,900,000 grams. Convert the truck's weight to kilograms.

$3,900,000 \text{ g} = 3,900,000 \times (1 \text{ g})$

$= 3,900,000 \times (0.001 \text{ kg})$

$= 3,900 \text{ kg}$

The truck's weight is 3,900 kilograms.

f. The distance was 264,040 meters. Convert the distance to kilometers.

$264,040 \text{ m} = 264,040 \times (1 \text{ m})$

$= 264,040 \times (0.001 \text{ km})$

$= 264.04 \text{ km}$

The distance was 264.04 kilometers.

COMMON CORE　| Lesson 14:　Use decimal multiplication to express equivalent measurements.
| Date:　6/15/14

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Lesson 14:　Use fraction and decimal multiplication to express equivalent measurements.

Date:　10/27/14

engage^ny　**2.D.20**

Name _____   Date _____

1. Solve. The first one is done for you.

a. Convert days to weeks.	b. Convert quarts to gallons.
28 days = 28 × (1 day) $= 28 × \left(\frac{1}{7} \text{ week}\right)$ $= \frac{28}{7}$ week = 4 weeks	20 quarts = _____ × (1 quart) $= $ _____ $× \left(\frac{1}{4} \text{ gallon}\right)$ = _____ gallons = _____ gallons
c. Convert centimeters to meters. 920 cm = _____ × (_____ cm) = _____ × (_____ m) = _____ m	d. Convert meters to kilometers. 1,578 m = _____ × (_____ m) = _____ × (0.001 km) = _____ km
e. Convert grams to kilograms. 6,080 g =	f. Convert milliliters to liters. 509 mL =

COMMON CORE

Lesson 14:   Use fraction and decimal multiplication to express equivalent measurements.
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2. After solving, write a statement to express each conversion. The first one is done for you.

a. The screen measures 24 inches. Convert 24 inches to feet.	b. A jug of syrup holds 12 cups. Convert 12 cups to pints.
$24 \text{ inches} = 24 \times (1 \text{ inch})$ $= 24 \times \left(\frac{1}{12} \text{ feet}\right)$ $= \frac{24}{12} \text{ feet}$ $= 2 \text{ feet}$ The screen measures 24 inches or 2 feet.	
c. The length of the diving board is 378 centimeters. What is its length in meters?	d. The capacity of a container is 1,478 milliliters. Convert this to liters.
e. A truck weighs 3,900,000 grams. Convert the truck's weight to kilograms.	f. The distance was 264,040 meters. Convert the distance to kilometers.

COMMON CORE

Lesson 14:   Use fraction and decimal multiplication to express equivalent measurements.
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Name _____   Date _____

1. Convert days to weeks by completing the number sentences.

   35 days = _____ × (_____ day)

           = _____ × (_____ week)

           =

           =

2. Convert grams to kilograms by completing the number sentences.

   4,567 grams = _____ × _____

              = _____ × _____

              =

              =

Name _____   Date _____

1. Solve. The first one is done for you.

a. Convert days to weeks. 42 days = 42 × (1 day) $= 42 \times \left(\frac{1}{7} \text{ week}\right)$ $= \frac{42}{7}$ week = 6 weeks	b. Convert quarts to gallons. 36 quarts = _____ × (1 quart) $= \underline{\hspace{2cm}} \times \left(\frac{1}{4} \text{ gallon}\right)$ = _____ gallons = _____ gallons
c. Convert centimeters to meters. 760 cm = _____ × (_____ cm) = _____ × (_____ m) = _____ m	d. Convert meters to kilometers. 2,485 m = _____ × (_____ m) = _____ × (0.001 km) = _____ km
e. Convert grams to kilograms. 3,090 g =	f. Convert milliliters to liters. 205 mL =

2. After solving, write a statement to express each conversion. The first one is done for you.

a. The screen measures 36 inches. Convert 36 inches to feet.	b. A jug of juice holds 8 cups. Convert 8 cups to pints.
36 inches = 36 × (1 inch) $= 36 \times \left(\frac{1}{12} \text{ feet} \right)$ $= \frac{36}{12} \text{ feet}$ = 3 feet The screen measures 36 inches or 3 feet.	
c. The length of the flower garden is 529 centimeters. What is its length in meters?	d. The capacity of a container is 2,060 milliliters. Convert this to liters.
e. A hippopotamus weighs 1,560,000 grams. Convert the hippopotamus' weight to kilograms.	f. The distance was 372,060 meters. Convert the distance to kilometers.

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Lesson 14:   Use fraction and decimal multiplication to express equivalent measurements.

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