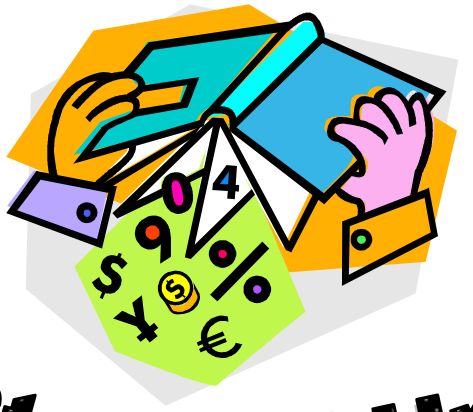
Mathematics:



"A Story of Units"

Parent Handbook

Grade 4
Module 7

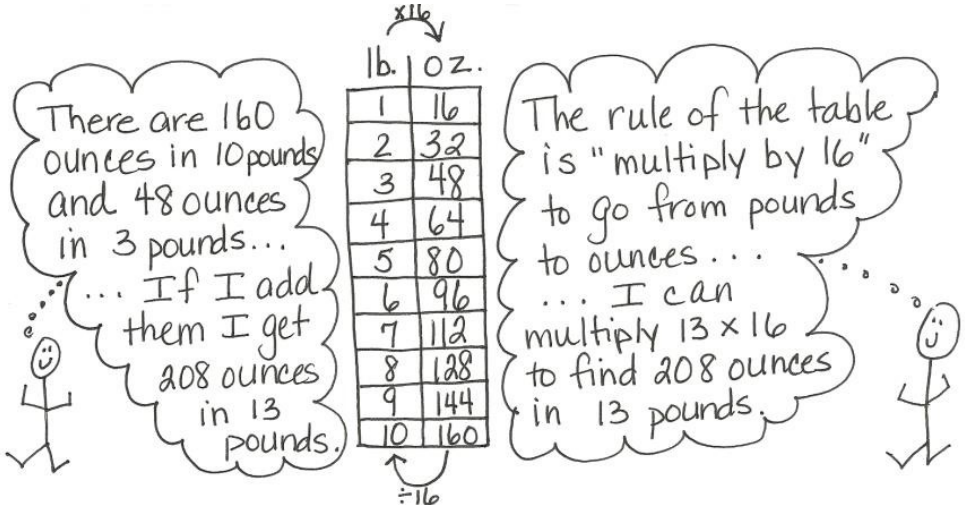
Grade 4 • Module 7

Exploring Measurement with Multiplication

OVERVIEW

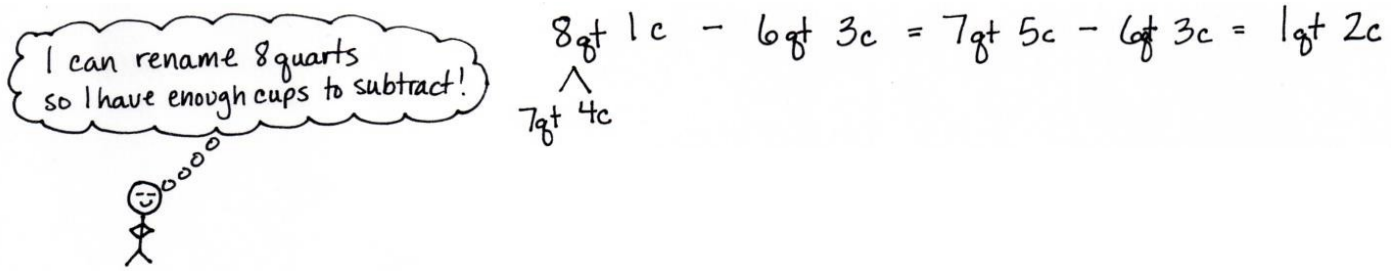
In this module, students build their competencies in measurement as they relate multiplication to the conversion of measurement units. Throughout the module, students will explore multiple strategies for solving measurement problems involving unit conversion.

In Topic A, students build on the work they did in Module 2 with measurement conversions. Working heavily in customary units, students use two-column conversion tables to practice conversion rates. For example, following a discovery activity where students learn that 16 ounces make 1 pound, students generate a two-column conversion table listing the number of ounces in 1 to 10 pounds. Tables for other measurement units are then generated in a similar fashion. Students then reason about why they do not need to complete the tables beyond 10 of the larger units. They use their multiplication skills from Module 3 to complete the tables and are able to see and explain connections such as (13 × 16) = (10 × 16) + (3 × 16). One student could reason, for example, that "Since the table shows that there are 160 ounces in 10 pounds and 48 ounces in 3 pounds, I can add them together to tell that there are 208 ounces in 13 pounds." Another student might reason, "Since there are 16 ounces in each pound, I can use the rule of the table and multiply 13 pounds by 16 to find that there are 208 ounces in 13 pounds."



As the topic progresses, students solve multiplicative comparison word problems. They are then challenged to create and solve their own word problems and to critique the reasoning of their peers. They share their solution strategies and original problems within small groups, as well as share and critique the problem solving strategies used by their peers. Through the use of guided questions, students discuss not only how the problems were solved, but also the advantages and disadvantages of using each strategy. They further discuss what makes one strategy more efficient than another. By the end of Topic A, students have started to internalize the conversion rates through fluency exercises and continued practice.

Topic B builds upon the conversion work from Topic A to add and subtract mixed units of capacity, length, weight, and time. Working with metric and customary units, students add like units, making comparisons to adding like fractional units, further establishing the importance of deeply understanding the unit. Just as 2 fourths + 3 fourths = 5 fourths, so does 2 quarts + 3 quarts = 5 quarts. 5 fourths can be decomposed into 1 one (4 fourths) 1 fourth, and therefore, 5 quarts can be decomposed into 1 gallon 1 quart. Students realize the same situation occurs in subtraction. Just as 1 – 3/4 must be renamed to 4/4—3/4 so that the units are alike, students must also rename units of measurements to make like units (1 quart – 3 cups = 4 cups – 3 cups). Students go on to add and subtract mixed units of measurements, finding multiple solution strategies, similar to the mixed number work in fractions. With focus on measurement units of capacity, length, weight, and time, students apply this work to solve multi-step word problems.



In Topic C, students reason how to convert larger units of measurements with fractional parts into smaller units by using hands-on measurements. For example, students convert 3 1/4 feet to inches by first finding the number of inches in 1/4 foot. They partition a length of one foot into 4 equal parts and find 1/4 foot equals 3 inches. They then convert 3 feet to 36 inches and add 3 inches to find that 3 1/4 feet = 39 inches. This work is directly analogous to earlier work with fraction equivalence using the tape diagram, area model, and number line in Topics A, B, and D of Module 5. Students partitioned a whole into 4 equal parts, decomposed 1 part into 3 smaller units and found 1 fourth to be equal to 3 twelfths. The foot ruler is partitioned with precisely the same reasoning. Students close the topic by using measurements to solve multi-step word problems that require converting larger units into smaller units.

The End-of-Module Assessment follows Topic C.

Students review their year in Topic D through the practice of skills they have learned throughout the modules and may also review through the creation of a take-home Summer Folder. The cover of a folder may be transformed into the student's own miniature personal board and a collection of activities from the lessons within this Topic are placed inside the folder, which may be practiced throughout the summer. Students practice major skills and concepts learned throughout the year in these final four lessons, including measuring angles and drawing lines, multiplication and division, and addition and subtraction through guided group work, fluency activities, and vocabulary games.

**The sample questions/responses contained in this manual are straight from http://www.engageny.org/. They are provided to give some insight into the kinds of skills expected of students as the lesson is taught.

Terminology

New or Recently Introduced Terms

- Customary system of measurement (measurement system commonly used in the United States that includes such units as yards, pounds, and gallons)
- Customary unit (e.g., foot, ounce, quart)
- Cup (c) (customary unit of measure for liquid volume)
- Gallon (gal) (customary unit of measure for liquid volume)
- Metric system of measurement (base ten system of measurement used internationally that includes such units as meters, kilograms, and liters)
- Metric unit (e.g., kilometer, gram, milliliter)
- Ounce (oz) (customary unit of measure for weight)
- Pint (pt) (customary unit of measure for liquid volume)
- Pound (lb) (customary unit of measure for weight)
- Quart (qt) (customary unit of measure for liquid volume)

Familiar Terms and Symbols

- Capacity (the maximum amount that a container can hold)
- Convert (to express a measurement in a different unit)
- Distance (the length of the line segment joining two points)
- Equivalent (the same)
- Foot (ft) (customary unit of measure for length)
- Hour (hr) (unit of measure for time)
- Inch (customary unit of measure for length, 12 inches = 1 foot)
- Interval (time passed or a segment on the number line)
- Gram (g), kilogram (kg) (metric units of measure for mass, not distinguished from weight at this time)
- Length (the measurement of something from end to end)
- Liter (L), milliliter (mL) (metric units of measure for liquid volume)
- Measurement (dimensions, quantity, or capacity as determined by comparison with a standard)
- Meter (m), centimeter (cm), kilometer (km), (metric units of measure for length)
- Minute (min) (unit of measure for time)
- Mixed units (e.g., 3 m 43 cm)
- Second (sec) (unit of measure for time)
- Table (used to represent data)
- Weight (the measurement of how heavy something is)
- Yard (yd) (customary unit of measure for length)

Suggested Tools and Representations

- Analog clock (with second hand)
- Balance scale with mass weights
- Beaker (marked for mL and L)
- Composite figure
- Digital scale (metric and customary units)
- Gallon, quart, pint, and cup containers
- Meter stick, yard stick, 12-inch ruler, centimeter ruler
- Number bond
- Number line
- Protractor
- Stopwatch
- Tape diagram
- Two-column table

Lesson 1

Objective: Create conversion tables for length, weight, and capacity units using measurement tools, and use the tables to solve problems.

Complete the following conversion tables and write the rule under each table.

a.

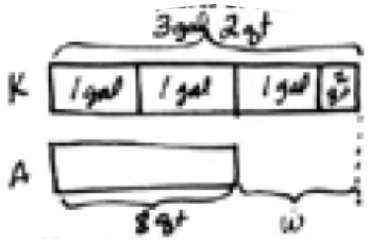
Pounds	Ounces
1	16
3	48
7	112
10	160
17	272

The rule for converting pounds to ounces is: multiply pounds times 16

Lesson 2

Objective: Create conversion tables for length, weight, and capacity units using measurement tools, and use the tables to solve problems.

Kristin has 3 gallons and 2 quarts of water. Alana needs the same amount of water but only has 8 quarts. How many more quarts of water does Alana need?



3gal 2qt = 14qt

14qt - 8qt = 6qt

Alana needs 6 more quarts of water.

Answer true or false for the following statements. If your answer is false, make the statement true by changing the second part of the question.

a. 1 gallon > 4 quarts false — 1 gallon > 3 quarts

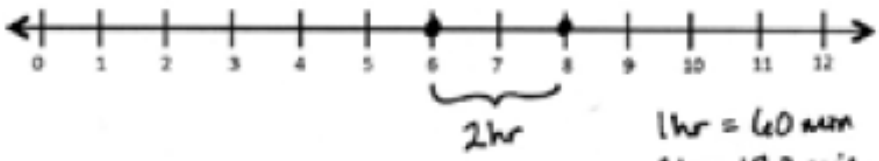
b. 5 liters = 5,000 milliliters true

c. 15 pints < 1 gallon 1 cup false — 15 pints < 2 gallons

Lesson 3

Objective: Create conversion tables for units of time, and use the tables to solve problems.

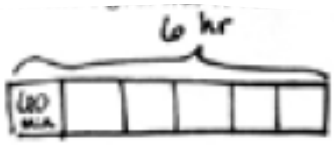
Courtney needs to leave the house by 8:00 a.m. If she wakes up at 6:00 a.m., how many minutes does she have to get ready? Use the number line to show your work.



1 hr = 60 min
2 hr = 120 min

Courtney has 120 minutes to get ready.

Giuliana's goal was to run a marathon in under 6 hours. What was her goal in minutes?



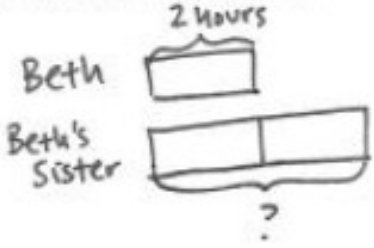
1 hr = 60 min
6 hr = 360 min

Giuliana's goal was to run a marathon in under 360 minutes.

Lesson 4

Objective: Solve multiplicative comparison word problems using measurement conversion tables.

Beth is allowed 2 hours of TV time each week. Her sister is allowed 2 times as much. How many minutes of TV can Beth's sister watch?



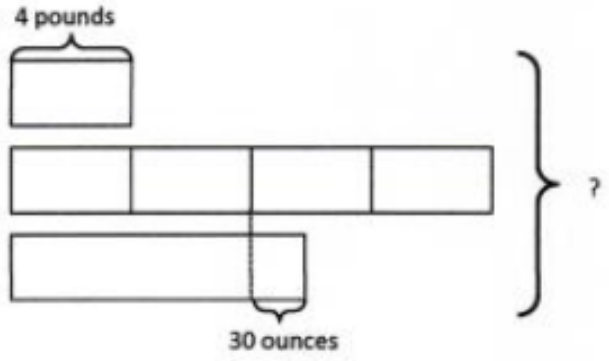
2 x 60 minutes = 120 minutes
2 x 120 minutes = 240 minutes

Beth's sister is allowed to watch 240 minutes of TV each week.

Lesson 5

Objective: Share and critique peer strategies.

Create a problem of your own using the diagram below to guide you, and solve for the unknown.



4 lb × 7 = 28 lb

28 lb + 30 oz = 29 lb 14 oz

1 lb 14 oz

I have 3 dogs. Blade weighs 4 pounds. Buddy weighs four times as much as Blade weighs. Ruby weighs 30 ounces more than twice that of Blade's weight. How much do my three dogs weigh *altogether?*

Lesson 6

Objective: Solve problems involving mixed units of capacity.

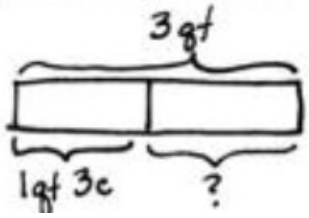
e. 16 qt 2 c + 4 c = 17 qt 2 c

1 qt

f. 6 gal 5 pt + 3 gal 3 pt = 10 gal 0 pt

8 pt = 1 gal

The capacity of a pitcher is 3 quarts. Right now, it contains 1 quart 3 cups of liquid. How much more liquid can the pitcher hold?



3 qt − 1 qt 3 c = 1 qt 1 c

2 qt 4 c

The pitcher can hold 1 quart 1 cup more liquid.

Lesson 7

Objective: Solve problems involving mixed units of length.

Find the following sums and differences. Show your work.

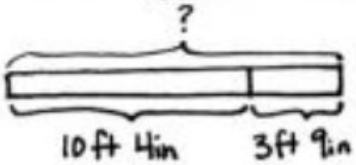
a. 5 yd 2 ft + 2 ft = 6 yd 1 ft

1 yd 1 ft 1 ft

b. 7 yd 2 ft + 2 yd 2 ft = 10 yd 1 ft

1 yd 1 ft 1 ft

In gym class, Jared climbed 10 feet 4 inches up a rope. Then, he continued to climb up another 3 feet 9 inches. How high did Jared climb?



3 ft 9 in $\xrightarrow{+10\text{ ft}}$ 13 ft 9 in $\xrightarrow{+3\text{ in}}$ 14 ft $\xrightarrow{+1\text{ in}}$ 14 ft 1 in

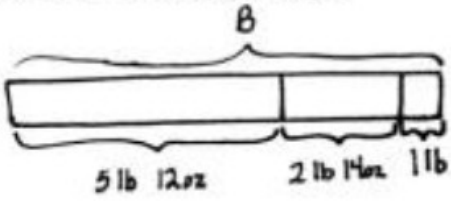
Jared climbed 14 feet 1 inch high.

Lesson 8

Objective: Solve problems involving mixed units of weight.

Use the information in the chart about Jodi's school supplies to answer the following questions:

a. On Mondays, Jodi packs only her laptop and supply case into her backpack. How much does her full backpack weigh?



6 lb 12 oz + 2 lb 14 oz = 8 lb 26 oz

16 10

= 9 lb 10 oz

Her full backpack weighs 9 Poonds 10 ounces on Mondays

Lesson 9

Objective: Solve problems involving mixed units of time.

Find the following sums or differences. Show your work.

a. 3 hr 45 min + 25 min = 4 hr 10 min

15+10

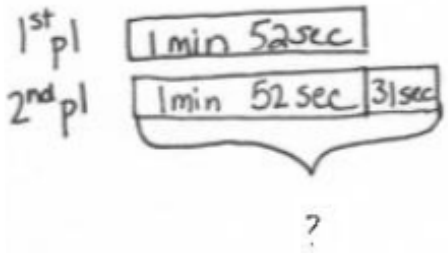
3hr + 60min + 10min

b. 2 hr 45 min + 6 hr 25 min = 9 hr 10 min

15min + 10min

2hr 60min + 6hr 10min

At the Cup Stacking Competition, the first place finishing time was 1 minute 52 seconds. That was 31 seconds faster than the second place finisher. What was the second place time?



1 min 52 sec + 31 sec

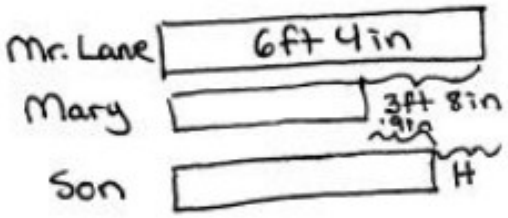
8+23 = 2min 23sec

The second place time was 2min 23sec.

Lesson 10

Objective: Solve multi-step measurement word problems.

Mr. Lane is 6 feet 4 inches tall. His daughter, Mary, is 3 feet 8 inches shorter than her father. His son is 9 inches taller than Mary. How many inches taller is Mr. Lane than his son?



H = 3 ft 8 in − 9 in

2ft 12in

= 2ft 20in − 9in

= 2ft 11in

= 24in + 11in

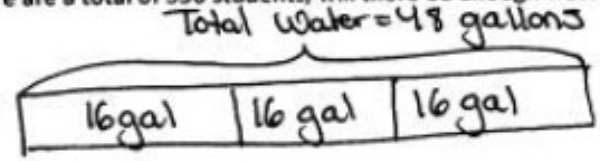
= 35in

Mr. Lane is 35 inches taller than his son.

Lesson 11

Objective: Solve multi-step measurement word problems.

Grades 3, 4, and 5 have their annual field day together. Each grade level is given 16 gallons of water. If there are a total of 350 students, will there be enough water for each student to have 2 cups?



1 gallon = 16 cups

48 gallons = 48 x 16 cups

= 768 cups (we have.)

$$\begin{array}{r} 48 \\ \times\ 16 \\ \hline 288 \\ +\ 480 \\ \hline 768 \end{array}$$

350 x 2 cups = 700 cups (we need.)

There is enough water for each student to have 2 cups.

Lesson 12

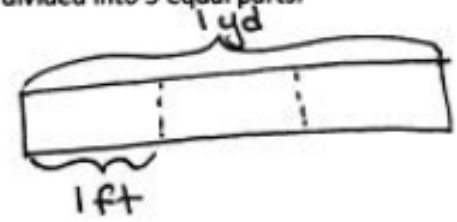
Objective: Use measurement tools to convert mixed number measurements to smaller units.

Draw a tape diagram to show 1 yard divided into 3 equal parts.

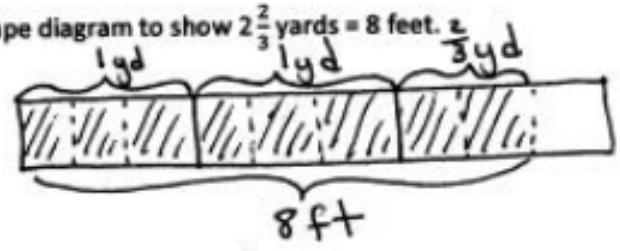
a. $\frac{1}{3}$ yd = 1 ft

b. $\frac{2}{3}$ yd = 2 ft

c. $\frac{3}{3}$ yd = 3 ft

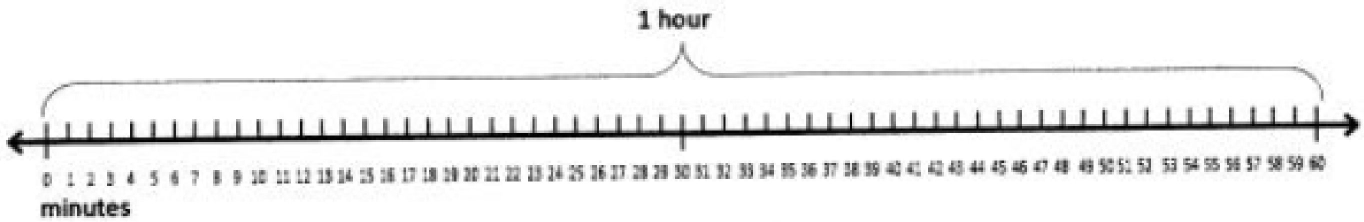


Draw a tape diagram to show $2\frac{2}{3}$ yards = 8 feet.



Lesson 13

Objective: Use measurement tools to convert mixed number measurements to smaller units.



a. $\frac{1}{60}$ hour = ___1___ minute

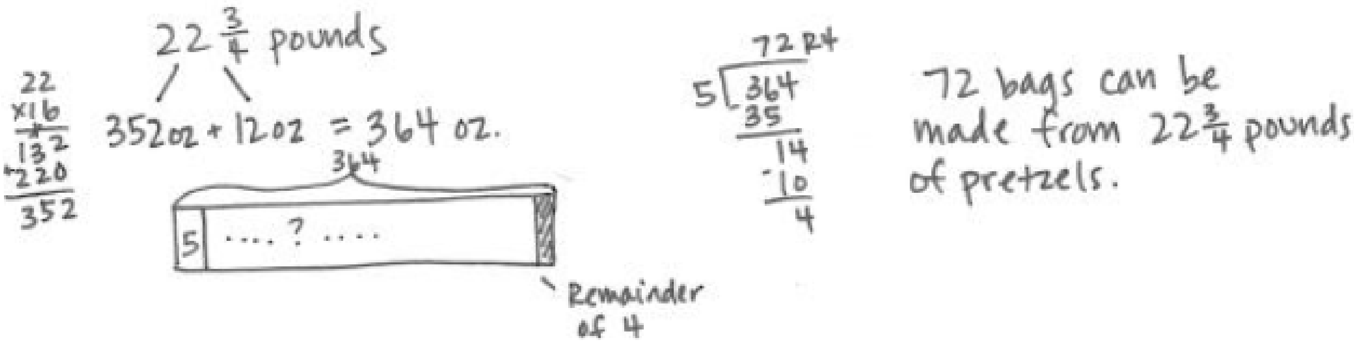
b. $\frac{30}{60}$ hour = $\frac{1}{2}$ hour = ___30___ minutes

c. $\frac{15}{60}$ hour = $\frac{1}{4}$ hour = ___15___ minutes

Lesson 14

Objective: Solve multi-step word problems involving converting mixed number measurements to a single unit.

5 ounces of pretzels are put into each bag. How many bags can be made from $22\frac{3}{4}$ pounds of pretzels?



Post-Module Review Work:

Lessons 15-16

Objective: Create and determine the area of composite figures.

Lesson 17

Objective: Practice and solidify Grade 4 fluency.

Lesson 18

Objective: Practice and solidify Grade 4 vocabulary.