Lesson 2

Measuring with Different-Size Units (Optional)

Goals

- Generalize (orally and in writing) that it takes more of a smaller unit or fewer of a larger unit to measure the same quantity.
- Given a measurement in one unit, estimate what would be the same amount expressed in a different unit, and explain (orally) the reasoning.

Learning Target

When I know a measurement in one unit, I can decide whether it takes more or less of a different unit to measure the same quantity.

Lesson Narrative

This optional lesson further develops students' understanding of standard units of length, volume, weight, and mass through the tactile experiences of measuring objects. The main idea is that it takes more of a smaller unit and fewer of a larger unit to measure the same quantity.

Students begin by comparing two non-standard units of length. They determine whether it would take more regular paper clips or more jumbo paper clips to measure the length of a piece of paper. Then, students engage in similar exercises involving various standard units. In groups, they rotate through up to five measurement stations, using two units to measure one or more quantities at each station. By reasoning repeatedly, students notice regularity—that a measurement in a smaller unit results in a greater value than the same measurement in a larger unit.

Student Learning Goal

Let's measure things.

Access for Students with Diverse Abilities

- Engagement (Activity 1)

Access for Multilingual Learners

- MLR8: Discussion Supports (Activity 1)

Required Materials

Materials to Gather

- Blank paper: Warm-up, Activity 1
- Paper clips: Warm-up
- Base-ten blocks: Activity 1
- Gallon-sized jug: Activity 1
- Graduated cylinders: Activity 1
- Household items: Activity 1
- Inch cubes: Activity 1
- Internet-enabled device: Activity 1
- Liter-sized bottle: Activity 1
- Metal paper fasteners: Activity 1
- Meter sticks: Activity 1
- Pre-assembled polyhedra: Activity 1
- Quart-sized bottle: Activity 1
- Rulers: Activity 1
- Salt: Activity 1
- Scale: Activity 1
- Straightedges: Activity 1
- Teaspoon: Activity 1
- Tray: Activity 1

Materials to Copy

- Measurement Stations Cutout (1 copy for every 30 students): Activity 1

Lesson Timeline

Warm-up	Activity 1	Lesson Synthesis	Assessment
5 min	30 min	10 min	5 min
			Cool-down

Lesson 2

Measuring with Different-Size Units (Optional)

Required Preparation

Warm-up:

Prepare to display or distribute paper clips in two sizes: regular and jumbo.

Activity 1

Identify where in the classroom each measuring station will be set up. Preparation varies based on whether students will use physical or digital materials.

If using physical materials, prepare each station as follows:

Station 1:
From the first page of the blackline master, print the net for the 2-in by 2-in by 4-in box onto card stock, cut it out, and assemble it.

Provide at least twenty (20) inch cubes, one (1) centimeter cube, and thirty (30) 10-cm rods. The centimeter cube and 10-cm rods can come from a set of base-ten blocks or Cuisenaire rods. However, base-ten blocks are preferable so students can see that one rod is composed of ten centimeter cubes. Wooden inch cubes are available inexpensively at craft stores.

Station 2:
Identify something in the classroom that is about 20 feet long. Prepare a way to communicate the length to be measured without giving away the measurement.

Provide foot-long rulers and at least 2 meter sticks.

Station 3:

Provide 1 gallon-sized jug, 5 quart-sized bottles, 5 liter-sized bottles, and a funnel (if available).

Fill the gallon jug with water.

Station 4:
Prepare a scale that can measure mass and weight in grams, kilograms, ounces, and pounds. (If such a scale is not available, consider using two scales that when used together can give the mass and weight measurement of an object in these four units.)

Prepare 6–8 common household items for students to weigh.

Station 5:
Prepare a 100-ml graduated cylinder, a teaspoon, a straightedge for leveling off the teaspoon, and a small bowl with at least $\frac{1}{2}$ cup of salt. Place everything on a tray for catching spills.

If using digital materials, acquire a device that can play a video or run an applet for each station. Open the following links:

Station 1: Cubic Inches and Cubic Centimeters video, available at **ilclass.com/r/15742809**

Station 2: Meters and Feet video, available at **ilclass.com/r/15743789**

Station 3: Quarts and Liters video, available at **ilclass.com/r/15744392**

Station 4: Two options:

Grams, Kilograms, Ounces, and Pounds video available at **ilclass.com/r/15745032**

Digital scale applet, available at **ilclass.com/l/392718**

Station 5: Milliliters and Teaspoons video, available at **ilclass.com/r/15746830**

Even if students are watching the video or using the digital applet in Station 4, consider preparing some real objects labeled with their weight or mass for students to hold.

Warm-up

Width of a Paper

5 min

Activity Narrative

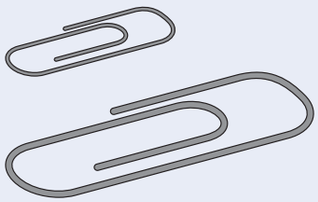
Students begin by thinking about length in terms of non-standard units—a regular paper clip and a jumbo paper clip—and consider how the size of units affects the number of units needed to express a length.

Some students may be able to reason that it takes more of the smaller unit than the larger unit to measure the same length. Encourage them to articulate their reasoning. Others may need to visualize the situation by drawing or by measuring with actual paper clips.

Launch

Hold up a regular paper clip and a jumbo paper clip for the students to see. Give them 1 minute of quiet think time. Afterward, allow students to use the paper clips to measure the paper if they need or wish to do so.

Student Task Statement



This picture shows paper clips in two sizes: regular and jumbo.

Does it take more regular or jumbo paper clips lined up end to end to measure the width of a piece of printer paper? Be prepared to explain how you know.

It takes more regular paper clips, because they are shorter than jumbo paper clips.

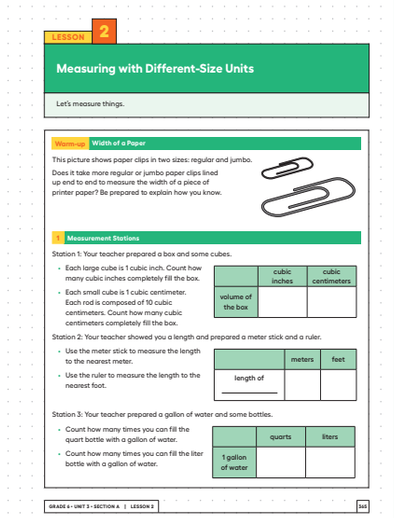
Activity Synthesis

Ask students to share their responses and reasoning. Highlight the fact that it takes more of a smaller unit and fewer of a larger unit to measure the same length.

Building on Student Thinking

Some students may assume that it will take more of the longer clips because they are used to associating the idea of "more" with "larger." Encourage them to use the manipulatives to see that it actually takes fewer of the longer clips to reach across the paper.

Student Workbook



LESSON 2

Measuring with Different-Size Units

Let's measure things.

Warm-up Width of a Paper

This picture shows paper clips in two sizes: regular and jumbo.

Does it take more regular or jumbo paper clips lined up end to end to measure the width of a piece of printer paper? Be prepared to explain how you know.

1 Measurement Stations

Station 1: Your teacher prepared a box and some cubes.

- Each large cube is 1 cubic inch. Count how many cubic inches completely fill the box.
- Each small cube is 1 cubic centimeter. Each rod is composed of 10 cubic centimeters. Count how many cubic centimeters completely fill the box.

	cubic inches	cubic centimeters
volume of the box		

Station 2: Your teacher showed you a length and prepared a meter stick and a ruler.

- Use the meter stick to measure the length to the nearest meter.
- Use the ruler to measure the length to the nearest foot.

	meters	feet
length of _____		

Station 3: Your teacher prepared a gallon of water and some bottles.

- Count how many times you can fill the quart bottle with a gallon of water.
- Count how many times you can fill the liter bottle with a gallon of water.

	quarts	liters
1 gallon of water		

GRADE 6 • UNIT 3 • SECTION A | LESSON 2

Access for Multilingual Learners (Activity 1, Student Task)

MLR8: Discussion Supports.
As students rotate through stations, encourage them to solidify their own understanding by pressing for details and questioning their peers' explanations. Display sentence frames to support small-group discussion: "I agree (or disagree) because ..." "How do you know ..." "Can you say more about ...?"

Advances: Speaking, Conversing

Access for Students with Diverse Abilities (Activity 1, Student Task)

Engagement: Provide Access by Recruiting Interest.
Use visible timers or audible alerts to help learners anticipate and prepare to transition between activities.

Supports accessibility for: Organization, Attention

Activity 1

Measurement Stations

30 min

Activity Narrative

There is a digital version of this activity.

In this activity, students rotate in groups through five different stations, where they measure one or more quantities using different units. Afterward, students answer questions that prompt them to make sense of the numerical values of the measurements and the sizes of the units.
Here are the quantities being measured and the units used at each station:

- Station 1: Volume of a box, in cubic inches and cubic centimeters
- Station 2: Length, in meters and feet
- Station 3: Volume of water, in gallons, quarts, and liters
- Station 4: Weights and masses of 2–3 objects, in ounces, pounds, grams, and kilograms
- Station 5: Volume of salt, in milliliters and teaspoons

In the digital version of the activity, students watch videos that show measurements being taken. In Station 4, they also have the option to use an applet to explore units of mass and weight. The applet allows students to simulate the use of a digital scale to measure the mass or weight of various objects. Consider using the digital version if the materials needed to physically perform measurements are not readily available or if preparation time is limited. Using digital materials for some stations and physical materials for others is also an option. See *Required Preparation* for more details.

A note about weight and mass:

Students who are able to distinguish between weight and mass might say that they cannot accurately compare the measurements or put the units in order by size. Clarify that we are talking only about the weight of the objects on Earth's surface.

Launch

Tell students that they will further investigate the idea of using different units to measure the same set of items. Introduce the five stations, what students are expected to do at each, the protocol for rotating through them, and the questions to answer at the end.

When introducing Station 4, demonstrate how to change the output unit on the scale(s) used. When introducing Station 5, demonstrate how to use a straightedge to measure a level teaspoon of salt. If students do not use level teaspoons of salt, they will not be able to answer the last set of questions about volume.

Arrange students into 5 groups, and assign a starting station for each group.

Student Task Statement

Station 1: Your teacher prepared a box and some cubes.

- Each large cube is 1 cubic inch. Count how many cubic inches completely fill the box.
- Each small cube is 1 cubic centimeter. Each rod is composed of 10 cubic centimeters. Count how many cubic centimeters completely fill the box.

	cubic inches	cubic centimetres
volume of the box	16	250

Station 2: Your teacher showed you a length and prepared a meter stick and a ruler.

- Use the meter stick to measure the length to the nearest meter.
- Use the ruler to measure the length to the nearest foot.

Answers vary based on the object measured.

	meters	feet
length of the board in the video	5	16

Station 3: Your teacher prepared a gallon of water and some bottles.

- Count how many times you can fill the quart bottle with a gallon of water.
- Count how many times you can fill the liter bottle with a gallon of water.

	quarts	liters
1 gallon of water	4	a little less than 4

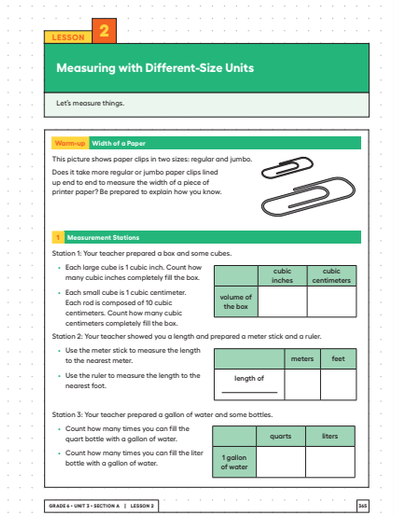
Station 4: Your teacher prepared several objects and one or more scales.

- Select 2–3 different objects to put on the scale(s).
- Record the weights in grams, kilograms, ounces, and pounds.

Answers vary based on the objects weighed. The objects in the video have the following measurements:

object	grams	kilograms	ounces	pounds
Pen	18	0.018	0.65	0.04
Bottle of oil	971	0.971	34.25	2.14
Bag of rice	1,376	1.376	48.55	3.035
Clothespin	4	0.004	0.15	0.01

Student Workbook


LESSON 2

Measuring with Different-Size Units

Let's measure things.

Warm-up Width of a Paper

This picture shows paper clips in two sizes: regular and jumbo. Does it take more regular or jumbo paper clips lined up end to end to measure the width of a piece of printer paper? Be prepared to explain how you know.

1 Measurement Stations

Station 1: Your teacher prepared a box and some cubes.

- Each large cube is 1 cubic inch. Count how many cubic inches completely fill the box.
- Each small cube is 1 cubic centimeter. Each rod is composed of 10 cubic centimeters. Count how many cubic centimeters completely fill the box.

	cubic inches	cubic centimeters
volume of the box		

Station 2: Your teacher showed you a length and prepared a meter stick and a ruler.

- Use the meter stick to measure the length to the nearest meter.
- Use the ruler to measure the length to the nearest foot.

	meters	feet
length of _____		

Station 3: Your teacher prepared a gallon of water and some bottles.

- Count how many times you can fill the quart bottle with a gallon of water.
- Count how many times you can fill the liter bottle with a gallon of water.

	quarts	liters
1 gallon of water		

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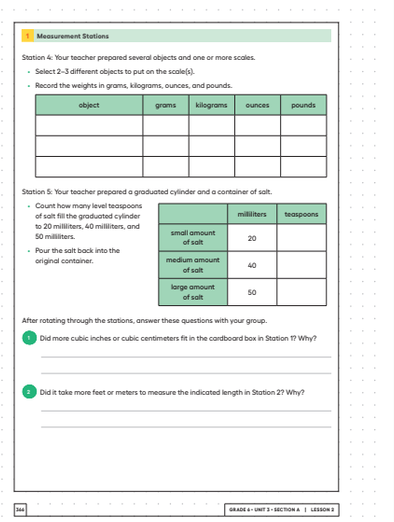
Student Workbook


1 Measurement Stations

Station 4: Your teacher prepared several objects and one or more scales.

- Select 2–3 different objects to put on the scale(s).
- Record the weights in grams, kilograms, ounces, and pounds.

object	grams	kilograms	ounces	pounds

Station 5: Your teacher prepared a graduated cylinder and a container of salt.

- Count how many level teaspoons of salt fill the graduated cylinder to 20 milliliters, 40 milliliters, and 50 milliliters.
- Pour the salt back into the original container.

	milliliters	teaspoons
small amount of salt	20	
medium amount of salt	40	
large amount of salt	50	

After rotating through the stations, answer these questions with your group.

1. Did more cubic inches or cubic centimeters fit in the cardboard box in Station 1? Why?

2. Did it take more feet or meters to measure the indicated length in Station 2? Why?

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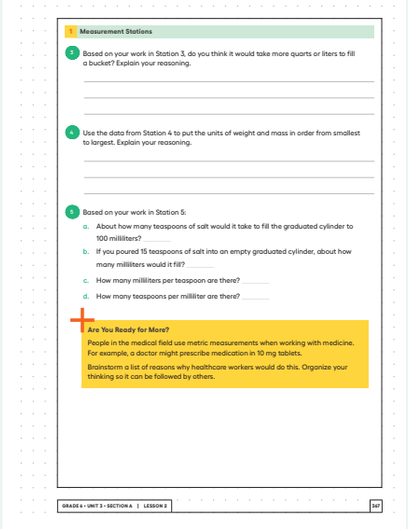
Student Workbook



1 Measurement Stations

3 Based on your work in Station 3, do you think it would take more quarts or liters to fill a bucket? Explain your reasoning.

4 Use the data from Station 4 to put the units of weight and mass in order from smallest to largest. Explain your reasoning.

5 Based on your work in Station 5:

a. About how many teaspoons of salt would it take to fill the graduated cylinder to 100 milliliters? _____

b. If you poured 15 teaspoons of salt into an empty graduated cylinder, about how many milliliters would it fill? _____

c. How many milliliters per teaspoon are there? _____

d. How many teaspoons per milliliter are there? _____

Are You Ready for More?

People in the medical field use metric measurements when working with medicine. For example, a doctor might prescribe medication in 10 mg tablets.

Brainstorm a list of reasons why healthcare workers would do this. Organize your thinking so it can be followed by others.

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The objects in the applet have the following measurements:

object	grams	kilograms	ounces	pounds
Pencil	9	0.009	0.31747	0.019842
Cellphone	155	0.155	5.4675	0.34172
Potatoes	4,536	4.536	160	10
Milk jug	3,901	3.901	137.6	8.6002
Microwave	18,144	18.144	640	40
Socks	65.204	0.0652	2.3	0.14375
Pillow	1,360.8	1.3608	48	3

Station 5: Your teacher prepared a graduated cylinder and a container of salt.

- Count how many level teaspoons of salt fill the graduated cylinder to 20 milliliters, 40 milliliters, and 50 milliliters.
- Pour the salt back into the original container.

	milliliters	teaspoons
small amount of salt	20	4
medium amount of salt	40	8
large amount of salt	50	10

After rotating through the stations, answer these questions with your group.

1. Did more cubic inches or cubic centimeters fit in the cardboard box in Station 1? Why?

   More cubic centimeters fit in the box because they are smaller.

2. Did it take more feet or meters to measure the indicated length in Station 2? Why?

   It took more feet because feet are smaller than meters.

3. Based on your work in Station 3, do you think it would take more quarts or liters to fill a bucket? Explain your reasoning.

   It would take more quarts to fill a bucket.

   Sample reasoning:

   - A liter is bigger than a quart because one gallon of water filled fewer liter bottles. It would take fewer liters to fill a bucket as well.
   - One gallon filled more quart bottles than liter bottles, so one bucket would fill more quart bottles as well.

4. Use the data from Station 4 to put the units of weight and mass in order from smallest to largest. Explain your reasoning.

From least to greatest, the units are gram, ounce, pound, and kilogram. Sample reasoning: Each object's weight was the largest number of grams, fewer ounces, even fewer pounds, and the smallest number of kilograms.

5. Based on your work in Station 5:

a. About how many teaspoons of salt would it take to fill the graduated cylinder to 100 milliliters?

About 20 teaspoons for 100 milliliters of salt.

b. If you poured 15 teaspoons of salt into an empty graduated cylinder, about how many milliliters would it fill?

About 75 milliliters for 15 teaspoons of salt

c. How many milliliters per teaspoon are there?

About 5 milliliters per teaspoon

d. How many teaspoons per milliliter are there?

About $\frac{1}{5}$ teaspoons per milliliter

Are You Ready for More?

People in the medical field use metric measurements when working with medicine. For example, a doctor might prescribe medication in 10 mg tablets.

Brainstorm a list of reasons why healthcare workers would do this. Organize your thinking so it can be followed by others.

Sample responses:

- Unit conversions are simpler.
- Calculations are often simpler.

Activity Synthesis

Though much of the discussion will take place within groups, spend a few minutes ensuring that everyone understands the answers to the five questions. To conclude the activity, invite students to share anything that surprised them from the measuring work.

Building on Student Thinking

At Station 1, students may count the number of base-10 centimeter rods rather than the number of centimeter cubes. Remind them that the question prompts for the number of cubes.

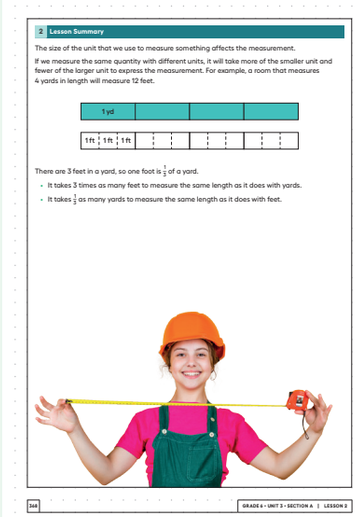
At Station 2, students may need reminders about measuring objects at the zero marking on the ruler and about keeping the ruler going straight, both of which will affect the answer. Show them that they can measure along the edge of the object to make sure that the ruler is not veering off in one direction or another.

At Station 4, students may be unclear about how to change the output unit on the scale for each object. Consider showing the class ahead of time. Students who are able to distinguish between weight and mass might say that they cannot accurately compare their measurements. Clarify that we are talking only about the weight of the objects on Earth's surface.

At Station 5, some students may consistently use under-filled or rounded teaspoons of salt, so their data will not reveal the 5:1 ratio of milliliters to teaspoons. Repeat the demonstration of how to measure a level teaspoon for them.

Students may answer 3 milliliters for the question about 15 teaspoons because they divided by 5 instead of multiplying by 5. Encourage them to pay attention to which unit is bigger, and ask what that tells them about which numerical value should be larger.

Student Workbook


2 Lesson Summary

The size of the unit that we use to measure something affects the measurement.

If we measure the same quantity with different units, it will take more of the smaller unit and fewer of the larger unit to express the measurement. For example, a room that measures 4 yards in length will measure 12 feet.

1 yd

1 ft 1 ft 1 ft

There are 3 feet in a yard, so one foot is $\frac{1}{3}$ of a yard.

- It takes 3 times as many feet to measure the same length as it does with yards.
- It takes $\frac{1}{3}$ as many yards to measure the same length as it does with feet.

Lesson Synthesis

Display the physical tools or objects that could be used to measure a particular attribute, for instance, a gallon jug and a quart bottle, or a yardstick and a foot-long ruler. To reinforce the key idea of the lesson, ask questions such as:

- *"What do quarts and gallons measure?"*

  Volume of a liquid

- *"Which is bigger: 1 quart or 1 gallon?"*

  1 gallon

- *"If we measure the volume of water in a fish tank in gallons and quarts, would it take more quarts or more gallons? How do you know?"*

  More quarts, since 1 quart is smaller than 1 gallon

- *"Would it take more quarts or more liters to measure the volume of the water in the tank?"*

  More quarts, since 1 liter is a little bit greater than 1 quart

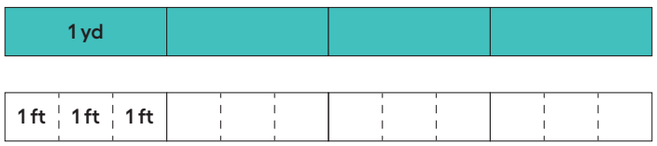
- *"Suppose we measure the volume of water in the fish tank with another unit and it takes more of that unit than quarts. What could that unit be?"*

  cups, milliliters, tablespoons

Lesson Summary

The size of the unit that we use to measure something affects the measurement.

If we measure the same quantity with different units, it will take more of the smaller unit and fewer of the larger unit to express the measurement. For example, a room that measures 4 yards in length will measure 12 feet.



There are 3 feet in a yard, so one foot is $\frac{1}{3}$ of a yard.

- It takes 3 times as many feet to measure the same length as it does with yards.
- It takes $\frac{1}{3}$ as many yards to measure the same length as it does with feet.

Cool-down

Which Measurement is Which?

5 min

Student Task Statement

1. A dog weighs 38 when measured in one unit and 84 when measured in a different unit. Which measurement is in pounds, and which is in kilograms? Explain your reasoning.

   38 is in kilograms 84 is in pounds

   Sample reasoning: A kilogram is heavier than a pound, so we need fewer kilograms to measure the same weight.

2. A bird weighs 6 when measured in one unit and 170 when measured in a different unit. Which measurement is in ounces, and which is in grams?

   6 is in ounces 170 is in grams

3. A kiddie pool holds 180 or 680 units of water, depending on which unit is used to measure. Which measurement is in gallons, and which is in liters?

   180 is in gallons 680 is in liters

4. A storage container that holds 29 or 1,024 units, depending on which unit is used to measure. Which measurement is in cubic feet, and which is in cubic meters?

   29 is in cubic meters 1024 is in cubic feet

Responding To Student Thinking

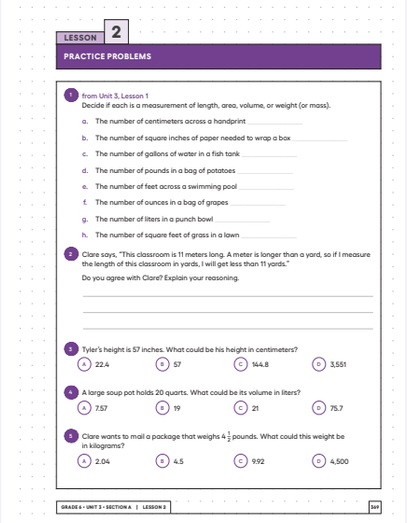
More Chances
Students will have more opportunities to understand the mathematical ideas addressed here. There is no need to slow down or add additional work to the next lessons.

Lesson 2

Practice Problems

7 Problems

Student Workbook



LESSON 2

PRACTICE PROBLEMS

1. from Unit 3, Lesson 1
Decide if each is a measurement of length, area, volume, or weight (or mass).
   a. The number of centimeters across a handprint _____
   b. The number of square inches of paper needed to wrap a box _____
   c. The number of gallons of water in a fish tank _____
   d. The number of pounds in a bag of potatoes _____
   e. The number of feet across a swimming pool _____
   f. The number of ounces in a bag of grapes _____
   g. The number of liters in a punch bowl _____
   h. The number of square feet of grass in a lawn _____

2. Clare says, "This classroom is 11 meters long. A meter is longer than a yard, so if I measure the length of this classroom in yards, I will get less than 11 yards."
Do you agree with Clare? Explain your reasoning.

3. Tyler's height is 57 inches. What could be his height in centimeters?
(A) 22.4 (B) 57 (C) 144.8 (D) 3,551

4. A large soup pot holds 20 quarts. What could be its volume in liters?
(A) 7.57 (B) 19 (C) 21 (D) 75.7

5. Clare wants to mail a package that weighs $4\frac{1}{2}$ pounds. What could this weight be in kilograms?
(A) 2.04 (B) 4.5 (C) 9.92 (D) 4,500

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Problem 1

from Unit 3, Lesson 1

Decide if each is a measurement of length, area, volume, or weight (or mass).

a. The number of centimeters across a handprint

Length

b. The number of square inches of paper needed to wrap a box

Area

c. The number of gallons of water in a fish tank

Volume

d. The number of pounds in a bag of potatoes

Weight (or mass)

e. The number of feet across a swimming pool

Length

f. The number of ounces in a bag of grapes

Weight (or mass)

g. The number of liters in a punch bowl

Volume

h. The number of square feet of grass in a lawn

Area

Problem 2

Clare says, "This classroom is 11 meters long. A meter is longer than a yard, so if I measure the length of this classroom in yards, I will get less than 11 yards."

Do you agree with Clare? Explain your reasoning.

Clare is incorrect.

Sample reasoning: Yards are shorter than meters, so more yards than meters are needed to measure the same length.

Problem 3

Tyler's height is 57 inches. What could be his height in centimeters?

A. 22.4

B. 57

C. 144.8

D. 3,551

Problem 4

A large soup pot holds 20 quarts. What could be its volume in liters?

A. 7.57

B. 19

C. 21

D. 75.7

Problem 5

Clare wants to mail a package that weighs $4\frac{1}{2}$ pounds. What could this weight be in kilograms?

A. 2.04

B. 4.5

C. 9.92

D. 4,500

Problem 6

from Unit 2, Lesson 13

Noah bought 15 baseball cards for $9.00. Each baseball card costs the same amount. For each question, explain your reasoning.

a. At this rate, how much will 30 baseball cards cost?

$18.00

Sample reasoning: 30 is twice as much as 15, and 18 is twice as much as 9.

b. At this rate, how much will 12 baseball cards cost?

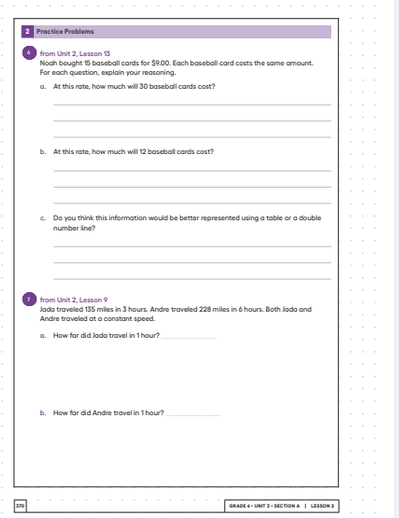
$7.20

Sample reasoning: Each baseball card costs 60 cents, and 0.6 times 12 is 7.2.

c. Do you think this information would be better represented using a table or a double number line?

Sample response: A table would be more convenient, because the rows of the table can be listed in any order, and only several pairs of values need to be included.

Student Workbook



2 Practice Problems

4 from Unit 2, Lesson 13
Noah bought 15 baseball cards for $9.00. Each baseball card costs the same amount. For each question, explain your reasoning.

a. At this rate, how much will 30 baseball cards cost?

b. At this rate, how much will 12 baseball cards cost?

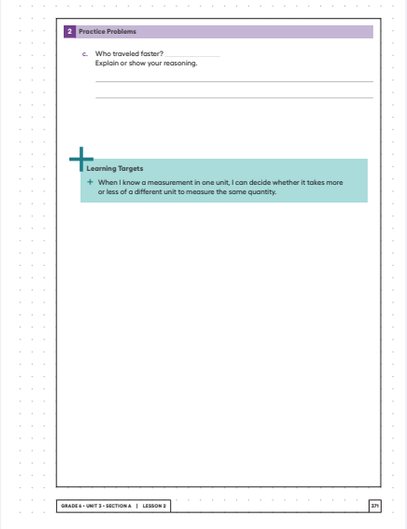
c. Do you think this information would be better represented using a table or a double number line?

7 from Unit 2, Lesson 9
Jada traveled 135 miles in 3 hours. Andre traveled 228 miles in 6 hours. Both Jada and Andre traveled at a constant speed.

a. How far did Jada travel in 1 hour? _____

b. How far did Andre travel in 1 hour? _____

Student Workbook


2 Practice Problems

c. Who traveled faster? _____
Explain or show your reasoning.

Learning Targets

+ When I know a measurement in one unit, I can decide whether it takes more or less of a different unit to measure the same quantity.

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Problem 7

from Unit 2, Lesson 9

Jada traveled 135 miles in 3 hours. Andre traveled 228 miles in 6 hours. Both Jada and Andre traveled at a constant speed.

a. How far did Jada travel in 1 hour?

Jada traveled 45 miles per hour because 135 ÷ 3 = 45.

b. How far did Andre travel in 1 hour?

Andre traveled 38 miles per hour because 228 ÷ 6 = 38.

c. Who traveled faster? Explain or show your reasoning.

Jada traveled faster. Sample reasoning: She covered a greater distance in the same amount of time.