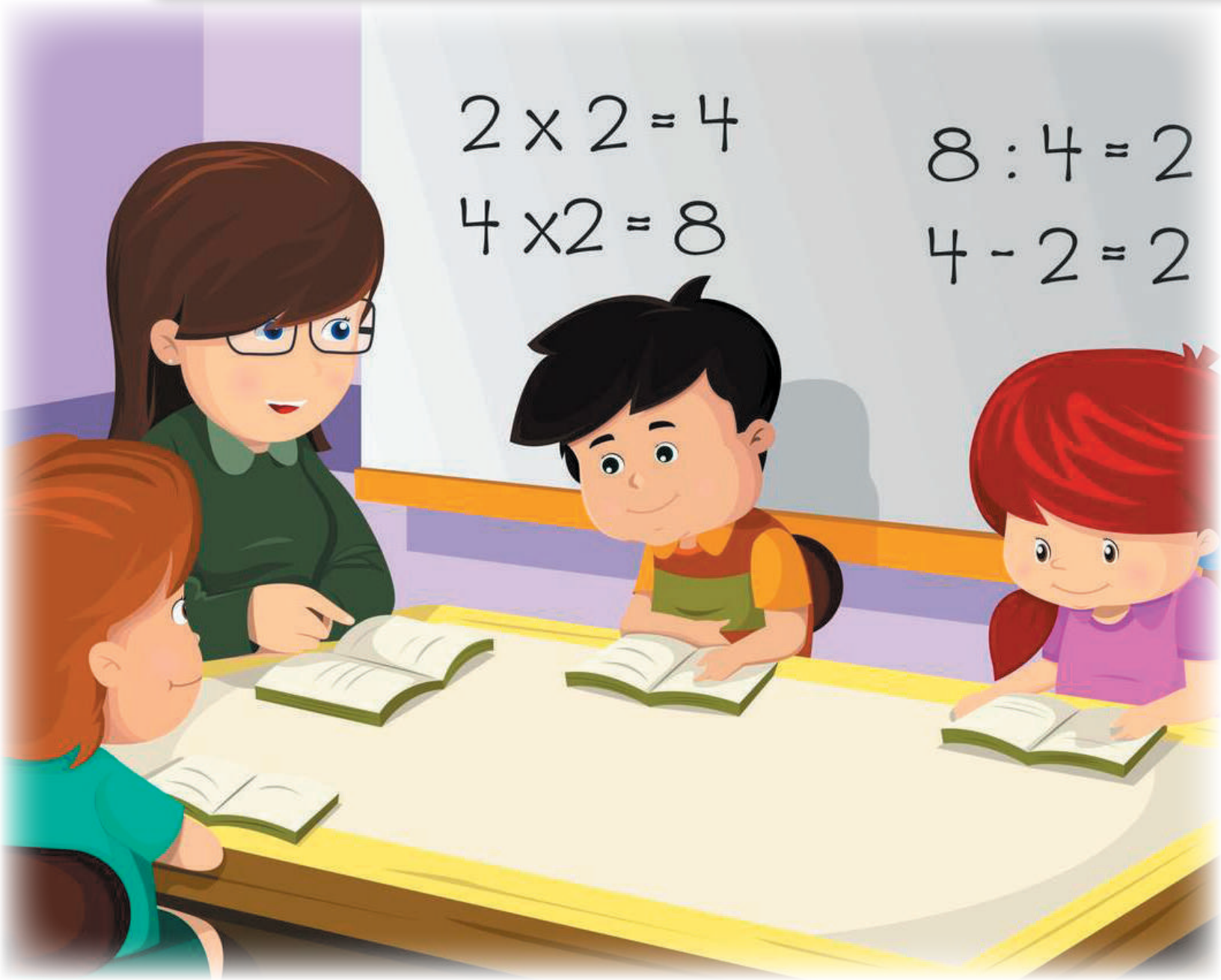
Core Knowledge® MATHEMATICS

Multiplicative Comparison and Measurement

Student Workbook



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ISBN:979-8-88970-914-5

Multiplicative Comparison and Measurement

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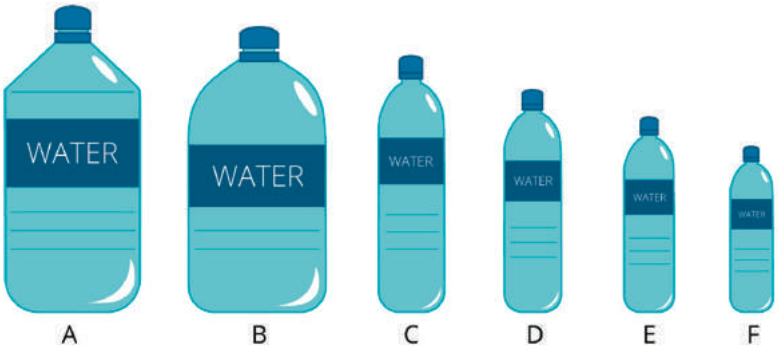


Multiplicative Comparison and Measurement

Student Workbook

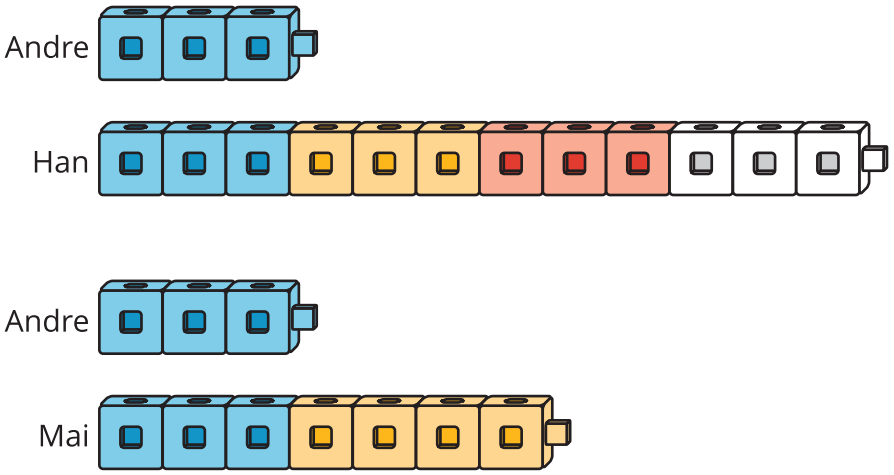
Core Knowledge Mathematics™

Lesson 1: Times as Many

- Let's represent situations that involve "times as many."

Warm-up: Notice and Wonder: Compare Cubes

What do you notice? What do you wonder?



1.1: Twice as Many

Andre has some cubes. Han has twice as many cubes as Andre.

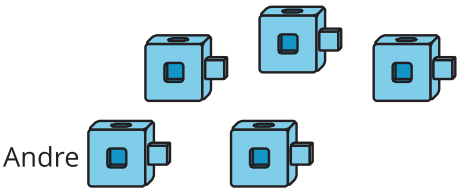
Use cubes, pictures, or other diagrams to show how many cubes Andre could have and how many cubes Han could have.

Be prepared to explain how your representation shows that Han has twice as many cubes.

1.2: Times as Many

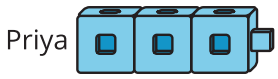
Draw a picture to show the number of cubes the students have in each situation. Be prepared to explain your reasoning.

1. Andre has the following cubes and Han has 4 times as many.



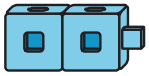
Han

2. Priya has the following cubes and Jada has 6 times as many.



Jada

3. Tyler has the following cubes and Mai has 8 times as many.

Tyler 

Mai

4. What number represents “8 times as many as 2”? Show your reasoning.

1.3: Make n Times as Many

Work with a partner on this activity.

1. Partner A: Create a set of connecting cubes between 2–6 and show Partner B.

   Partner B: Roll a number cube. Let's call the number rolled n.

2. Partner A: Use the connecting cubes or a diagram to show n times as many as the original set of cubes. Show your reasoning.

   Partner B: Check your partner's work and discuss any disagreements.

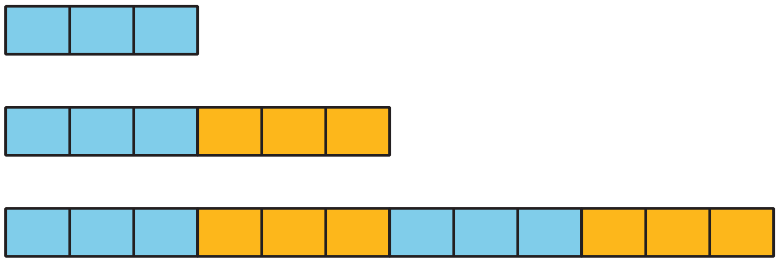
3. Switch roles and repeat.

Lesson 2: Interpret Representations of Multiplicative Comparison

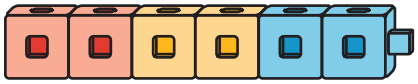
- Let's make sense of representations of problems with "times as many."

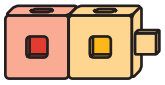
Warm-up: How Many Do You See: Times as Many

How many do you see? How do you see them?



2.1: Represent "Times as Many"

Mai's cubes 

Kiran's cubes 

1. Jada has 4 times as many cubes as Kiran. Draw a diagram to represent the situation.

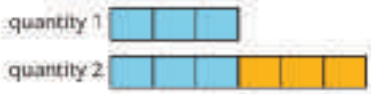
2. Diego has 5 times as many cubes as Kiran. Draw a diagram to represent the situation.

3. Lin has 6 times as many cubes as Kiran. How many cubes does Lin have? Explain or show your reasoning.

2.2: Diagrams to Solve Multiplicative Comparison Problems

Here are four sets of descriptions, diagrams, and equations that compare pairs of quantities.

Match each description to a diagram and an equation that represent the same situation. Be prepared to explain your reasoning.

A Lin has 3 cubes. Jada has 2 times as many.	B Han has 3 cubes. Elena has 3 times as many.
C $2 \times 3 = 6$	D Priya had 5 cubes. Noah had 3 times as many.
E $3 \times 5 = 15$	F $4 \times 4 = 16$
G 	H 
I $3 \times 3 = 9$	J Mai has 4 cubes. Diego has 4 times as many.
K 	L 

Record your matches here:

Set 1: _____, _____, _____

Set 2: _____, _____, _____

Set 3: _____, _____, _____

Set 4: _____, _____, _____

Lesson 3: Solve Multiplicative Comparison Problems

- Let's solve multiplicative comparison problems.

Warm-up: Number Talk: Find the Unknown Factor

Find the value of each unknown mentally.

- $8 \times ? = 16$
- $3 \times ? = 24$
- $? \times 8 = 32$
- $40 \div 8 = ?$

3.1: A Book Drive

This diagram shows the books Lin and Diego donated for the school book drive.

1. Lin donated 16 books. Diego donated 4 books. How many times as many books did Lin donate as Diego did? Explain or show your reasoning. Use the diagram if it is helpful.

2. Priya donated 3 books. Noah donated 21 books. How many times as many books did Noah donate as Priya did?

   Draw a diagram to show your reasoning.

3. Mai made a pile of 27 donated books. Tyler made his own pile of 3 books. How many times as many books did Mai stack as Tyler did?

   Explain or show your reasoning.

3.2: Represent a Missing Amount

1. Clare donated 48 books. Clare donated 6 times as many books as Andre.

    a. Draw a diagram to represent the situation.

    b. How many books did Andre donate? Explain your reasoning.

2. Han says he can figure out the number of books Andre donated using division.

   Tyler says we have to use multiplication because it says “times as many”.

   a. Do you agree with Han or Tyler? Explain your reasoning.

   b. Write an equation to represent Tyler’s thinking.

   c. Write an equation to represent Han’s thinking.

3. Elena donated 9 times as many books as Diego. Elena donated 81 books.

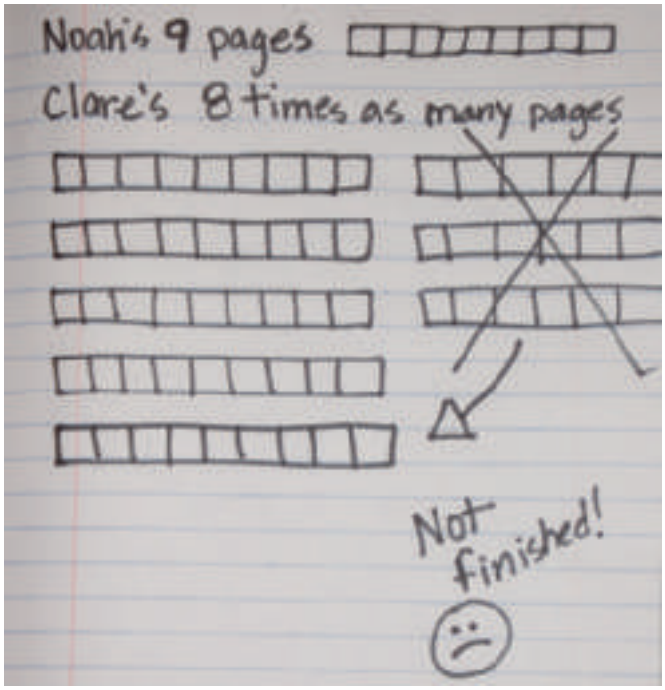
   Use multiplication or division to find the number of books Diego donated.

Lesson 4: Solve Multiplicative Comparison Problems with Large Numbers

- Let's represent and solve multiplicative comparison problems with larger numbers.

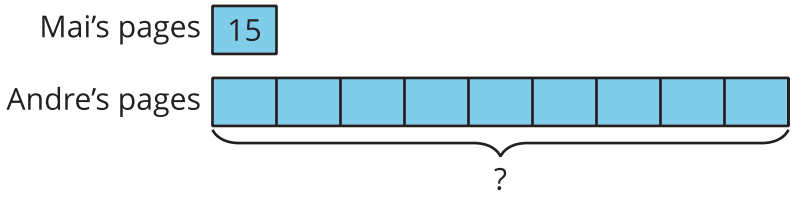
Warm-up: Notice and Wonder: Too Many Times More?

What do you notice? What do you wonder?



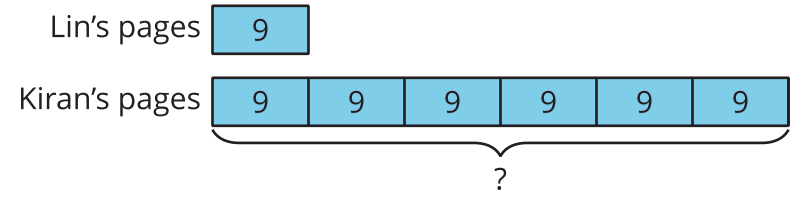
4.1: A New Kind of Diagram

1. Mai and Andre compare the number of pages they read on the first day of the reading competition.



What would be a good estimate for the number of pages Andre read?

2. The diagram shows the pages Lin and Kiran read on one day of the reading competition.



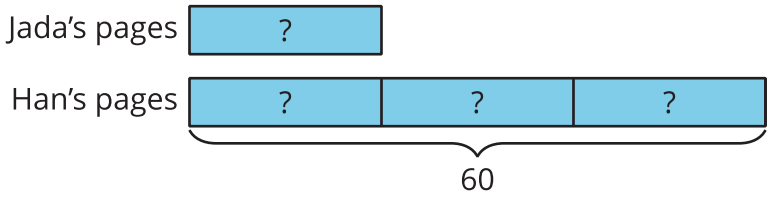
a. Complete the statement and explain how you know.

Kiran read _____ times as many pages as Lin.

b. Write a multiplication equation that compares the pages read by Lin and Kiran.

c. How many total pages did Kiran read?

3. Jada read some pages. Han read 60 pages altogether.

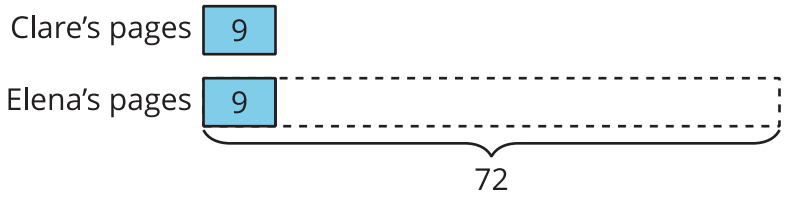


a. How many times as many pages did Han read? Explain how you know.

b. Write a multiplication equation to compare the pages read by Han and Jada. Use a symbol to represent the unknown.

c. How many pages did Jada read? Explain how you know.

4. Elena read 72 pages. Clare read 9 pages.



a. How is this diagram different from the earlier diagrams?

b. Write a multiplication equation to compare the pages read by Elena and Clare. Use a symbol to represent the unknown.

c. How many times as many pages does Elena read as Clare?

4.2: Who Read More?

For each situation:

- Write an equation to represent the situation. Use a symbol to represent the unknown.
- Draw a diagram to show the comparison.
- Answer the question about the situation.

1. Diego read 8 times as many books as Lin read. Lin read 7 books.

    a. Equation:

    b. Diagram:

    c. How many books did Diego read?

2. Tyler has some books. Clare has 72 books, which is 12 times as many books as Tyler has.

    a. Equation:

    b. Diagram:

    c. How many books does Tyler have?

3. Noah read 13 books. Elena read 130 books.

a. Equation:

b. Diagram:

c. Complete the statement:

_____ read _____ times as many books as _____ read.

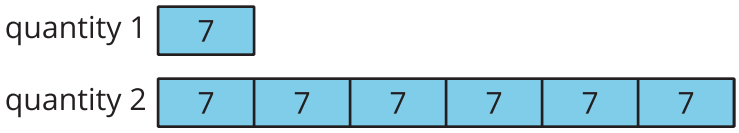
Lesson 5: One- and Two-step Comparison Problems

- Let's solve multiplicative comparison word problems.

Warm-up: Which One Doesn't Belong: Something's Missing

Which one doesn't belong?

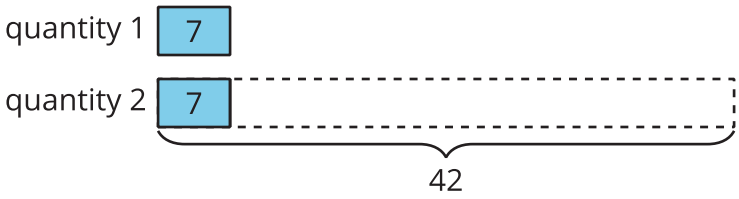
A.



B.

$$6 \times 7 = 42$$

C.



D.

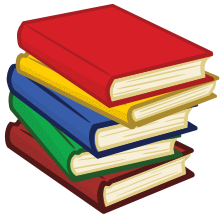
42 is 6 times as many as _____.

5.1: The Book Fair

For this year's book fair, a school ordered 16 science books and 6 times as many picture books.

Last year, the school ordered 4 times as many picture books and 4 times as many science books than they did this year.

1. How many picture books were ordered this year?



2. How many picture books were ordered last year?

3. How many more science experiment books were ordered last year than this year?

5.2: More Book Fair Purchases

1. At the book fair, they collected $13 Tuesday morning and 8 times as much as that in the afternoon. How much money did they collect at the book fair on Tuesday?

2. On Thursday, Mai purchased a biography for $16 and a comic book for $3. That day, the book fair's amount of total sales was 9 times as much money as Mai spent.

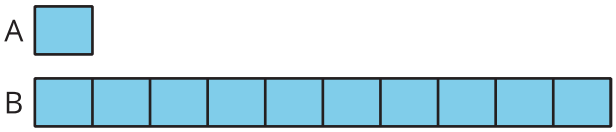
   What was the amount of total sales for the book fair on Thursday?

Lesson 6: Ten Times as Many

- Let’s represent “10 times as many.”

6.1: Ten Times as Many

Here is a diagram that represents two quantities, A and B.



1. What are some possible values of A and B?

2. Select the equations that could be represented by the diagram.

   A. $15 \times 10 = 150$

   B. $16 \times 100 = 1{,}600$

   C. $30 \div 3 = 10$

   D. $5{,}000 \div 5 = 1{,}000$

   E. $80 \times 10 = 800$

   F. $12{,}000 \div 10 = 1{,}200$

3. For the equations that can't be represented by the diagram:

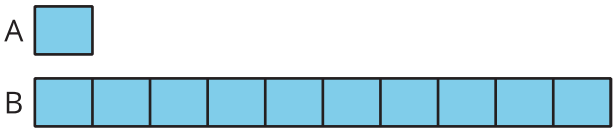
   a. Explain why the diagram does not represent these equations.

   b. How would you change the equations so the diagram could represent them?

   c. Compare your equations with your partner's. Make at least two observations about the equations you and your partner wrote.

6.2: What Remains the Same?

1. Use the diagram to complete the table.



value of A	value of B
14	
	1,000
160	
	850
1,000	
	2,070
	3,900

2. Select some values from your table to explain or show:

   a. How you found the value of B when the value of A is known.

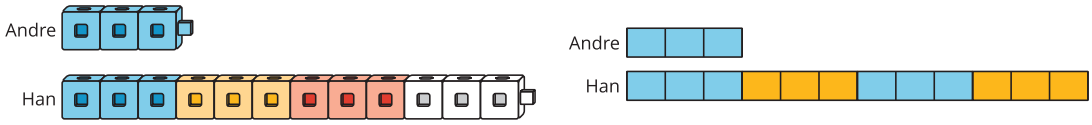
   b. How you found the value of A when the value of B is known.

Section Summary

Section Summary
In this section, we learned to use multiplication and the phrase "_____ times as many" or "_____ times as much" for comparing two quantities.

At first, we used cubes and drawings to represent the quantities. For example: Andre has 3 cubes and Han has 12. We compared the number of cubes by:

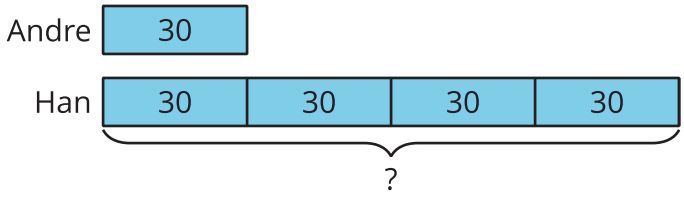
- saying "Han has 4 times as many cubes as Andre"
- drawing diagrams that shows 3 pieces for Andre and 4 times as many pieces for Han



- writing an equation such as $4 \times 3 = 12$

As the numbers got larger, drawing every unit of each quantity became less convenient, so we used simpler diagrams with numbers to represent the size of the quantities.

If Andre has 30 cubes and Han has 4 times as many, we can represent the comparison with a diagram like this:



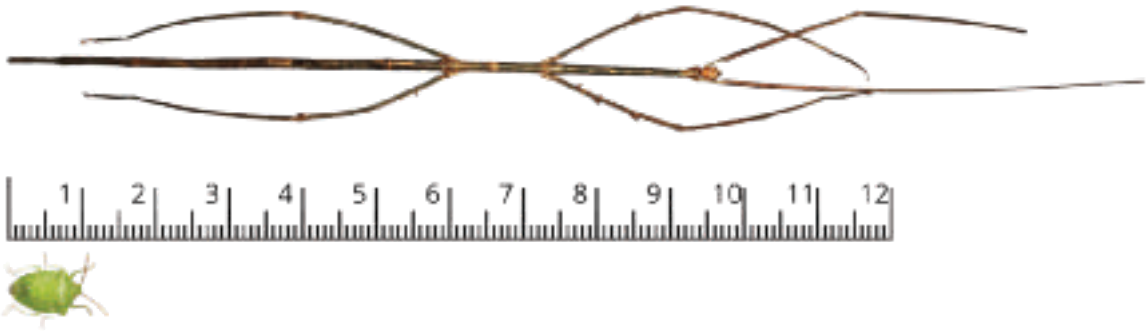
We ended by comparing quantities in which one quantity is ten times as much as another. We also recalled some patterns in the numbers when we multiplied a number by 10.

Lesson 7: Meters and Centimeters

- Let's explore lengths in meters and centimeters.

Warm-up: Notice and Wonder: Big Bug, Little Bug

What do you notice? What do you wonder?



7.1: How Long is One Meter?

1. Use the centimeter paper to build a strip that is 100 centimeters long. You will need scissors and tape.

   If you do it precisely, your paper strip will be 1 meter long.

2. List 5 items in the classroom that you think are about 1 meter long.

   Then, use your paper strip to check how close your prediction is to 1 meter.

3. Decide whether each of the following is more than 1 meter, less than 1 meter, or about 1 meter.

   a. The stick insect in the warm-up activity

   b. The step you make when walking

   c. The step you make when running

   d. Your arm span

   Be prepared to explain how you know.

7.2: In and Around the School

Priya took some measurements in meters and recorded them in the table, but she made some errors when converting them to centimeters. She also left out one measurement.

	measurement in meters	measurement in centimeter
a. height of door	2	200
b. height of hallway	3	30
c. width of hallway	5	500
d. length of gym	18	180
e. length of hallway	27	2,700
f. length of playground	50	

1. Find and correct Priya's conversion errors. Be prepared to explain how you know.

2. Fill in the length of the playground in centimeters. Write an equation to represent your thinking.

Lesson 8: Meters and Kilometers

- Let's explore measurements in meters and kilometers.

Warm-up: Number Talk: Times Hundreds and Thousands

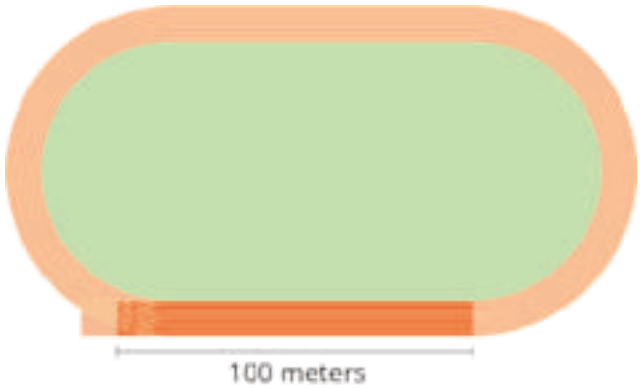
Find the value of each expression mentally.

- 3×100
- 40×100
- 43×100
- $43 \times 1{,}000$

8.1: How Long is One Kilometer?

There are 1,000 meters in 1 kilometer.

1. The darkly shaded section of the track is the length of a 100-meter race. How many 100-meter races does it take to travel 1 kilometer?



2. Your teacher will give you images of something with a length or height measured in meters.

   About how many of the items given to you are needed to make 1 kilometer? Explain or show how you know.

3. Work with your group to write a number in the blank so that each statement is true.

   a. One kilometer is the length of (about, exactly) _____ soccer fields.

   b. One kilometer is the length of (about, exactly) _____ Statues of Liberty.

   c. One kilometer is the length of (about, exactly) _____ Olympic-size swimming pools.

   d. One kilometer is the length of (about, exactly) _____ basketball courts.

4. Estimate where you might end up if you travel 1 kilometer from your school's front door.

8.2: Meters and Kilometers

1. Complete the table with the missing lengths in meters or kilometers.

kilometers (km)	meters (m)
$\frac{1}{2}$	
1	1,000
5	
	6,000
$8\frac{1}{2}$	
10	
	12,000
27	

2. Andre says 100 meters is longer than 10 kilometers. Do you agree or disagree? Explain or show your reasoning.

3. Which is greater? Be prepared to explain how you know.

   a. 2,000 meters or 3 kilometers

   b. 500 meters or 1 kilometer

   c. 14 kilometers or 14,000 meters

   d. 8 kilometers or 80,000 meters

Lesson 9: Grams and Kilograms, Liters and Milliliters

- Let's explore measurements in grams, kilograms, liters and milliliters.

Warm-up: Which One Doesn't Belong: Meter, Meter on the Page

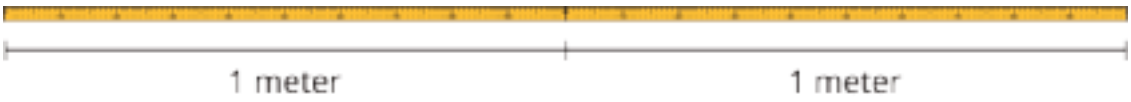
Which one doesn't belong?

A. 2 m

B. 2,000 meters

C. 200 centimeters

D.



9.1: A Whole Lot of Paper Clips

One paper clip weighs 1 gram.

1. How many grams are the paper clips in each image?

a.

b.

c.

2. The paper clips in this image weigh 1 kilogram.

What is the relationship between kilograms and grams?

3. Complete the table with the missing amounts in grams.

kilograms (kg)	grams (g)
2	
7	
15	
$\frac{1}{2}$	
$9\frac{1}{2}$	

4. Which weighs more? Be prepared to explain how you know.

a. 8 kilograms or 8 boxes with 100 paper clips in each box

b. 1,250 paper clips or 1 kilogram

c. 500 grams or 2 boxes of 250 paper clips in each box

d. $\frac{1}{2}$ kilogram or 500 paper clips

9.2: Liters and Milliliters

1. a. Estimate: How many times do we fill the 100-milliliter glass to get 1 liter of liquid? (Assume that each time the liquid is filled to the 100-milliliter line.)

   b. Write a sentence to describe the relationship between milliliters and liters.

   _____

   _____

2. How many times do we need to fill each of these containers to get 1 liter?

   a. A 1-milliliter medicine dropper

   b. A 250-milliliter measuring cup

   c. A 20-milliliter cup

3. Complete the table with the missing amounts in liters or milliliters.

liters (L)	milliliters (mL)
1	
4	
7	
16	
	500
	20,000

Lesson 10: Multi-step Measurement Problems

- Let's solve multi-step measurement problems.

Warm-up: Notice and Wonder: Distances Traveled

What do you notice? What do you wonder?

animal	distance traveled in a day
three-toed sloth	30 meters
snail	2,500 centimeters
dromedary	40 kilometers
giant tortoise	500 meters

10.1: Long Hikes, Short Hikes

Here are estimates of the farthest distances that some animals would move in one day.

animal	distance traveled in a day
three-toed sloth	30 meters
snail	2,500 centimeters
dromedary	40 kilometers
giant tortoise	500 meters

1. Put the animals and their travel distances in order, from the shortest to the longest. Explain or show your reasoning.

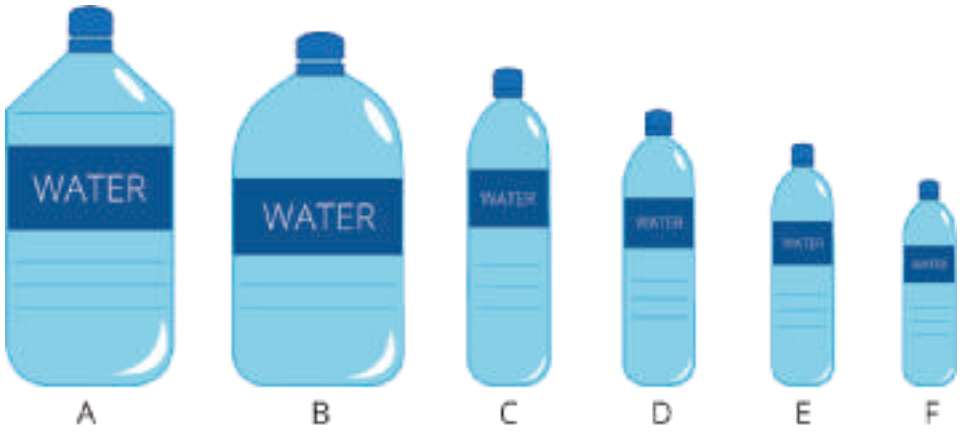
2. Do you agree with each statement? Explain your reasoning.

    a. A giant tortoise can move 2 times as far as a snail can move in a day.

    b. A dromedary can move 80 times as far as a giant tortoise can move in a day.

10.2: Big Bottles, Little Bottles

Here are six water bottle sizes and four clues about the amount of water they each hold.



- One bottle holds 350 mL.
- A bottle in size B holds 5 times as much water as the bottle that holds 1 L.
- The largest bottle holds 20 times the amount of water in the smallest bottle.
- One bottle holds 1,500 mL, which is 3 times as much water as a bottle in size E.

Use the clues to find out the amount of water, in mL, that each bottle size holds. Be prepared to explain or show your reasoning.

A: _____ mL

B: _____ mL

C: _____ mL

D: _____ mL

E: _____ mL

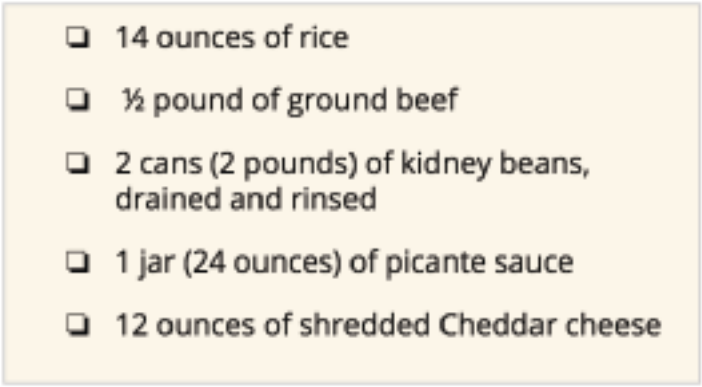
F: _____ mL

Lesson 11: Pounds and Ounces

- Let’s explore measurements in pounds and ounces.

Warm-up: Notice and Wonder: A Recipe

What do you notice? What do you wonder?



11.1: Pounds and Ounces

Your teacher will show images of some packaged food items.

1. Use the information on the images to find out how pounds (lbs) and ounces (oz) are related.

   a. Write a sentence to describe the relationship between the two units.

   _____

   _____

   b. Use two pieces of information to show that your conclusion is right.

2. Complete this table with amounts in ounces.

pounds (lb)	ounces (oz)
1	
2	
3	
4	
5	
8	
10	

11.2: Party Prep

1. A family is cooking for a party and needs to buy some ingredients for a main dish:
    - 5 pounds of rice
    - $\frac{1}{2}$ pound of almonds
    - 2 pounds 8 ounces of pinto beans

    How many ounces of each ingredient does the family need to buy? Show your reasoning.

2. To make the dessert, they need 6 pounds of flour. If they already have 40 ounces of flour in the pantry, how many more ounces of flour do they need to buy?

Lesson 12: Hours, Minutes, and Seconds

- Let’s explore time in hours, minutes, and seconds.

Warm-up: What Do You Know about 1 Hour?

What do you know about 1 hour?

12.1: Mai's School Day

The table shows how Mai spends the time she is awake on a school day.

activity	hours	minutes
morning routine	1	
getting to school	$\frac{1}{2}$	
time at school	8	
getting home from school	$\frac{3}{4}$	
homework and reading	$1\frac{1}{2}$	
playing and family time	2	
bedtime routine	$\frac{1}{4}$	

1. Complete the table to show how many minutes Mai spends on each activity. Be prepared to explain or show your reasoning.

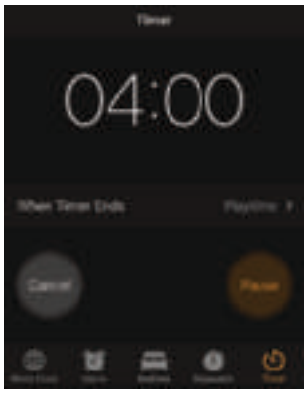
2. How many hours does Mai spend at school? How many minutes is that? Explain or show how you know.

3. How many minutes does Mai sleep on a school night? Explain or show your reasoning.

12.2: Precious Minutes and Seconds

Diego set a timer to make sure that things are not done for too long or too short an amount of time.

activity	minutes	seconds
brushing teeth	2	
showering	3	
heating a cup of milk in the microwave	$\frac{1}{2}$	
break during homework time	5	
quick workout	10	
daily reading	30	



1. Complete the table with the number of seconds for each activity. Be prepared to explain your reasoning.

2. Diego noticed that on a television channel, commercial breaks are often between $1\frac{1}{2}$ and $2\frac{1}{2}$ minutes long each. How long are they in seconds? Explain or show your reasoning.

3. Diego's workout starts with 4 minutes of warm-up and stretching, followed by 100 seconds of jumping jacks.

   If he works out for 10 minutes exactly, how many more seconds are left in his workout?

Lesson 13: Multi-step Measurement Problems with Fractions

- Let's solve multi-step measurement problems.

Warm-up: True or False: Some Number Times a Fraction

Decide whether each statement is true or false. Be prepared to explain your reasoning.

- $16 \times \frac{1}{4} = 4$

- $8 \times \frac{3}{4} = 12$

- $32 \times \frac{2}{8} = 8$

- $60 \times \frac{1}{12} = 10$

13.1: Info Gap: Noah's School Day (Part 1)




Problem Card

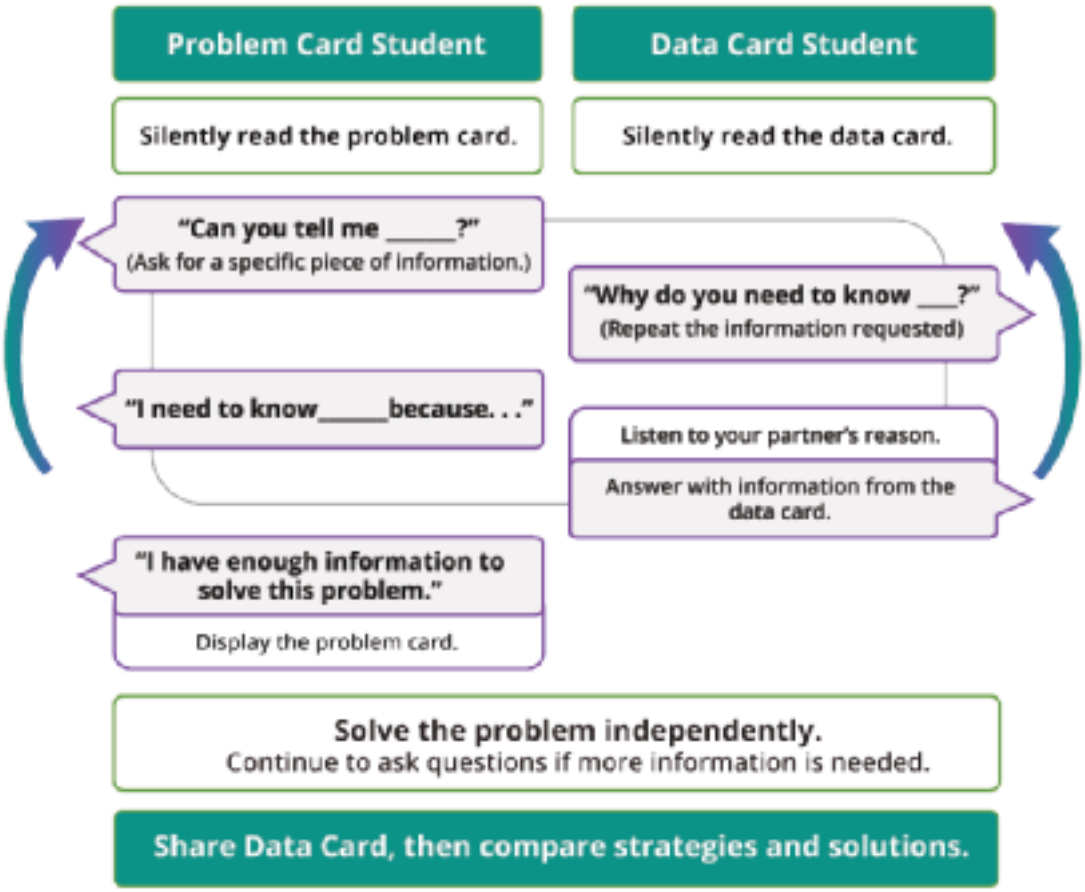
On a school day, Noah usually spends 40 minutes on his morning routine and 75 minutes on his sports practice.

Which one takes more time:

1. Noah's morning routine or his bedtime routine?
2. Noah's sports practice or his homework and reading time?

13.2: Info Gap: Noah's School Day (Part 2)

Your teacher will give you either a problem card or a data card. Do not show or read your card to your partner.



Pause here so your teacher can review your work.

Ask your teacher for a new set of cards and repeat the activity, trading roles with your partner.

13.3: Shopping List

Here are six ingredients that a shopper bought and some clues about each quantity.

The items are listed in order of weight, from least to greatest.

ingredient	pounds	ounces
rice noodles		
shrimp		
tapioca flour		
tofu		
carrots		
brown rice		

- The heaviest item weighs 4 times the weight of tofu.
- One ingredient weighs $\frac{1}{2}$ pound.
- The item that weighs 10 pounds is 10 times the weight of shrimp.
- The carrots are 3 times as heavy as the shrimp.
- The carrots are 2 times as heavy as the tapioca flour.
- Brown rice weighs 20 times as much as the weight of noodles.

Use the clues to find out the weight of each ingredient in both pounds and ounces.

Section Summary

Section Summary
In this section, we learned about various units for measuring length, distance, weight, capacity, and time. We saw how different units that measure the same property are related.

Here are the relationships that we saw:

- One meter (m) is 100 times as long as 1 centimeter (cm).
- One kilometer (km) is 1,000 times as long as 1 meter (m).
- One kilogram (kg) is 1,000 times as heavy as 1 gram (g).
- One liter (L) is 1,000 times as much as 1 milliliter (mL).
- One pound (lb) is 16 times as heavy as 1 ounce (oz).
- One hour is 60 times as long as 1 minute.
- One minute is 60 times as long as 1 second.

When given a measurement in one unit, we can find the value in another unit by reasoning and writing equations. For example, to express 5 kilograms in grams, we can write $5 \times 1{,}000 = 5{,}000$. To express 4 pounds in ounces, we can write $4 \times 16 = 64$.

Throughout the section, we used these relationships to convert measurements from one unit to another, to compare and order measurements, and to solve problems in different situations.

Lesson 14: Weight and Capacity Measurements

- Let's solve problems about weight and capacity.

Warm-up: Number Talk: Lots of Thousands

Find the value of each expression mentally.

- $1{,}200 + 900$

- $12{,}500 + 9{,}000$

- $13{,}000 + 9{,}900$

- $130{,}000 + 99{,}000$

14.1: Milk and Mango Lassi

1. Here are three true statements about this jug of milk.

   - This jug contains 1 gallon of milk.
   - This jug contains 4 quarts of milk.
   - This jug contains 16 cups of milk.

   Complete each statement so that it is true:

   a. One gallon is _____ times as much as 1 quart.

   b. One gallon is _____ times as much as 1 cup.

   c. One quart is _____ times as much as 1 cup.

2. For a potluck party, Priya and three other relatives are bringing mango lassi.

guest	amount of lassi
Priya	10 cups
Uncle	3 quarts
Cousin	8 cups
Grandma	2 gallons

   a. Who prepared the most mango lassi? Explain or show your reasoning.

   b. How many cups of lassi did all the guests bring?

   c. Complete this sentence: Priya's grandma made _____ times as much lassi as Priya's cousin. Show how you know.

14.2: Clay for Art Class

At a craft store, clay is sold in packs of different sizes: 1 pound, 24 ounces, 3 pounds, and 5 pounds.

An art teacher needs 120 ounces of clay for her class.

1. Would she have enough clay if she bought each of the following combinations? Explain or show your reasoning.

	1-pound pack	24-ounce pack	3-pound pack	5-pound pack
Combo A	1		1	
Combo B	1	1	1	1
Combo C		1	2	

2. Decide if each statement is true or false. Be prepared to explain or show your reasoning.

    a. A 3-pound pack weighs 2 times as much as a 24-ounce pack.

    b. If we combine a 1-pound pack, a 3-pound pack, and a 5-pound pack, we'd have 6 times as much clay as what's in a 24-ounce pack.

Lesson 15: Length Measurements

- Let's solve problems about distances and lengths.

Warm-up: Which One Doesn't Belong: Measurements

Which one doesn't belong?

A. 3 feet

B. (3×1) yards

C. (2×18) inches

D. $\left(\frac{1}{3} + \frac{1}{3} + \frac{1}{3}\right)$ yard

15.1: Frisbee Throws

Six students were throwing frisbees on field day. Here is some information about each person's first throw.

student	distance
Han	17 yards
Lin	$51\frac{1}{2}$ feet
Clare	$21\frac{1}{3}$ feet
Andre	22 yards 2 feet
Elena	
Tyler	

- Elena's frisbee went 3 times as far as Clare's did.
- Andre's frisbee went 4 times as far as Tyler's did.

1. Complete the table with Elena and Tyler's distances. Explain or show your reasoning.

2. Who are the top 3 throwers for that round?

   Find out by listing the students and their distances in feet and in order, from longest to shortest.

rank	student	distance (feet)
1		
2		
3		
4		
5		
6		

15.2: Stone Towers

While on an outing, a group of friends had a stone-stacking contest to see who could build the tallest stone tower.

- Andre's stone tower is 3 times as tall as Diego's, but Diego didn't build the shortest tower.
- The tallest tower is 4 feet and 2 inches tall and belongs to Tyler.
- One person built a tower that is 39 inches tall.
- Tyler's tower is 5 times as tall as the shortest tower.

1. How tall is each person's stone tower? Be prepared to explain or show your reasoning.

person	tower height (inches)
Andre	
Tyler	
Clare	
Diego	

2. Elena came along and built a tower that is 5 times as tall as Diego's tower. Is Elena's tower more than 6 feet? Show your reasoning.

Lesson 16: Compare Perimeters of Rectangles

- Let's solve problems about rectangles of different sizes.

Warm-up: Number Talk: Two and Four Times a Fraction

Find the value of each expression mentally.

- $2 \times \frac{3}{2}$
- $4 \times \frac{3}{4}$
- $4 \times \frac{9}{4}$
- $\left(2 \times \frac{3}{4}\right) + \left(2 \times \frac{9}{4}\right)$

16.1: Pipe-cleaner Perimeters

How many different rectangles can be made using the entire length of one 12-inch pipe cleaner?

1. Record as many pairs of side lengths as you can think of. Be prepared to explain your reasoning.

length (inches)	width (inches)

2. Which pair represent the side lengths of a square?

16.2: Perimeter Predictions

1. Your teacher will assign a pair of side lengths to you. Use a pipe cleaner to build a rectangle with those side lengths.

   What is the perimeter of your rectangle?

2. Two 12-inch pipe cleaners are joined (with no overlaps) to make a longer stick and then used to build a square.

   a. What is the side length of this square? What is its perimeter?

   b. How do the side length and perimeter of this square compare to those of the first square?

3. Several pipe cleaners are joined (with no overlaps) to build a square with a perimeter of 60 inches.

   a. How many pipe cleaners are used? Explain or show how you know.

   b. What is the side length of the square?

   c. How do the side length and perimeter compare to those of the first square?

16.3: Gridded Rectangles

1. Draw the following rectangles on centimeter grid paper. Label each rectangle. Record the side lengths and the perimeter of each.
    - Rectangle A has a perimeter of 16 centimeters.
    - Rectangle B has side lengths that are 3 times the side lengths of rectangle A.
    - Rectangle C has side lengths that are $\frac{1}{2}$ of the side lengths of B.

rectangle	length (cm)	width (cm)	perimeter (cm)
A			16
B			
C			

2. Rectangle D has a perimeter of 96 centimeters.

    The perimeter of D is:

    - _____ times the perimeter of A
    - _____ times the perimeter of B
    - _____ times the perimeter of C

Lesson 17: More Perimeter Problems

- Let's solve problems about the perimeter of various shapes.

Warm-up: True or False: Fractions and Whole Numbers

Decide if each statement is true or false. Be prepared to explain your reasoning.

- $\frac{8}{12} + \frac{3}{12} + \frac{9}{12} + \frac{4}{12} = 2$

- $\frac{20}{4} + \frac{10}{4} + \frac{6}{4} = 8$

- $2 = \frac{59}{100} + \frac{41}{100} + \frac{89}{100} + \frac{11}{100}$

- $2 = \frac{3}{8} + \frac{3}{8} + \frac{12}{8}$

17.1: Along the Walls in Tiny Steps

A rectangular room has a perimeter of 39 feet and a length of $10\frac{1}{2}$ feet.

1. What is the width of the room in feet? Explain or show your reasoning.

2. An ant walked along two walls of the room, always in a straight line. It started in one corner and ended up in a corner opposite of where it started. How many inches did it travel? Explain or show your reasoning.

17.2: Missing Measurements

Your teacher has posted six quadrilaterals around the room. Each one has a missing side length or a missing perimeter.

1. Choose two diagrams—one with a missing length and another with a missing perimeter. Make sure that all six shapes will be visited by at least one person in your group.

   Find the missing values. Show your reasoning and remember to include the units.

2. Discuss your responses with your group until everyone agrees on the missing measurements for all six figures.

3. Answer one of the following questions. Explain or show your reasoning.

   a. The perimeter of B is how many times the perimeter of D?

   b. The perimeter of one figure is 1,000 times that of another figure. Which are the two figures?

   c. The perimeter of F is how many times the perimeter of B?

Section Summary

Section Summary
In this section, we solved problems and puzzles by converting units of measurement—gallons, quarts, cups, pounds, ounces, yards, feet, and inches—and by comparing measurements in different units. We saw that the problems could be solved in different ways.

For example, if Priya threw a frisbee 16 yards and this is 4 times as far as the distance Jada threw in feet, how far did Jada throw the frisbee?

- One way to solve this problem is by finding $16 \div 4$ to find Jada's throw distance in yards ($16 \div 4 = 4$) and then multiplying the result to convert the yards to feet ($4 \times 3 = 12$, so 4 yards is 12 feet).
- Another way is to first convert the 16 yards to feet ($16 \times 3 = 48$, so 16 yards is 48 feet) and then divide the result by 4 to find Jada's throw distance ($48 \div 4 = 12$).

In the last two lessons, we solved multiplication and comparison problems that involve the perimeter of rectangles and some other quadrilaterals.

Lesson 18: Two Truths and a Lie

- Let's compare facts about animals.

Warm-up: Notice and Wonder: Animal Facts

What do you notice? What do you wonder?

30 feet

130 inches

3 feet

18.1: Two Truths and a Lie

Your teacher will give you a fact sheet about some animals or ask you to perform some research.

1. Choose two animals that you would like to compare.
2. Use the information from your teacher or your research to write two true comparison statements and one false comparison statement about these animals.
    a. Write one statement on the front side of an index card.
    b. On the back side of the card, write whether the statement is true or false.

18.2: Gallery Walk: Two Truths and a Lie

1. Read at least 5 statements that are not yours and decide if they are true.
    - Find at least one statement that is false. Write down the statement here. Be prepared to explain or show how you know.

    - If a statement you read is unclear, use a sticky note to leave a comment or question for the writer.

2. Collect your cards and any notes that your classmates might have left for you.
    - Think about how to make revisions to make your statements stronger and clearer.
    - Record your revised statements here.

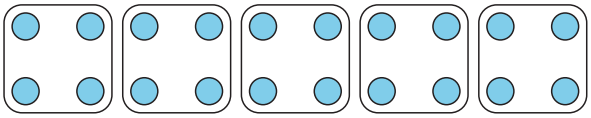
Section A: Practice Problems

1. **Pre-unit**

   Write a multiplication expression represented by each diagram.

   a.

   b.



2. **Pre-unit**

   Each bottle contains 2 liters of water. How many liters of water are there in 6 bottles?

3. **Pre-unit**

   Find the value of each product. Explain or show your reasoning.

   a. $5 \times \frac{1}{8}$

   b. $5 \times \frac{3}{8}$

   c. $4 \times \frac{7}{12}$

4. **Pre-unit**

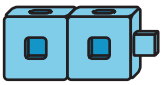
Find the value of each expression.

a. $\frac{2}{5} + \frac{4}{5}$

b. $1\frac{5}{8} - \frac{4}{8}$

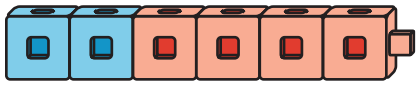
c. $2\frac{1}{6} + 1\frac{5}{6}$

5. Here are some connecting cubes.

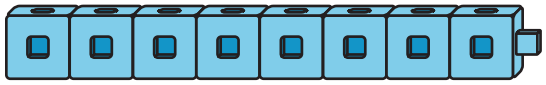


Select **all** pictures that show 4 times as many connecting cubes.

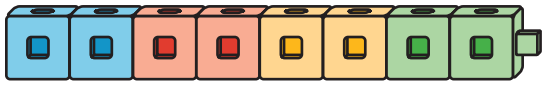
A.



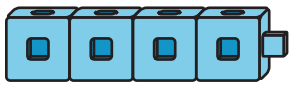
B.



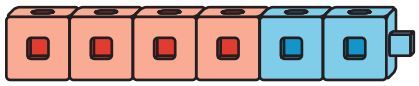
C.



D.



E.



(From Unit 5, Lesson 1.)

6. Han read 4 books during the summer. Priya read 3 times as many books as Han.

    a. Draw a diagram that represents the situation.

    b. Write an equation that represents the situation.

(From Unit 5, Lesson 2.)

7. Mai exercised 3 times as many hours as Tyler last week. Mai exercised for 15 hours.

    a. Write an equation to represent the situation.

    b. How many hours did Tyler exercise last week?

(From Unit 5, Lesson 3.)

8. Diego has 8 songs on his playlist. Mai has 3 times as many songs as Diego.

   a. Write an equation that represents the situation.

   b. Draw a diagram that represents the situation.

   c. Explain how the diagram and equation are related.

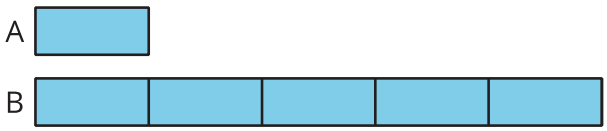
   d. How many songs are on Mai's playlist?

(From Unit 5, Lesson 4.)

9. Lin scored 6 points in her basketball game on Saturday. She scored 3 times as many points in her basketball game on Sunday. How many points did Lin score altogether in the two games? Explain or show your reasoning.

(From Unit 5, Lesson 5.)

10. a. If diagram A represents 15, what does diagram B represent? Explain your reasoning.

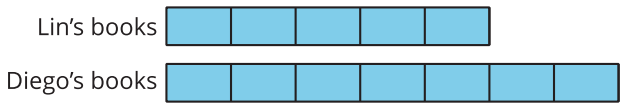


b. If diagram B represents 100, what does diagram A represent? Explain your reasoning.

(From Unit 5, Lesson 6.)

11. **Exploration**

The diagram represents the books that Diego and Lin brought to the book fair.



For each question, explain or show your reasoning.

a. If Lin brought 10 books, how many books did Diego bring?

b. If Diego brought 21 books to the fair, how many books did Lin bring?

c. If Lin and Diego brought 60 books altogether, how many did they each bring?

12. **Exploration**

Write a comparison story problem.

Trade problems with a partner.

a. Draw a diagram and write an equation to represent the situation.

b. Solve the story problem.

Section B: Practice Problems

1. Select **all** measurements that are greater than 1 meter.

   A. the width of a paper clip

   B. the length of your math workbook

   C. the width of the classroom

   D. the height of the door in the classroom

   E. the length of a finger

(From Unit 5, Lesson 7.)

2. a. The Burj Khalifa is a skyscraper in Dubai. It is 828 meters tall. Is that more or less than 1 kilometer? Explain your reasoning.

   b. An airplane flies 9,500 meters above the ground. Is that more or less than 1 kilometer? Explain your reasoning.

(From Unit 5, Lesson 8.)

3. a. A bottle of water holds 250 milliliters.

   - How many of those bottles does it take to make 1 liter?

   - How many liters of water does the bottle hold?

b. Jada's backpack weighs 3.5 kg. How many grams is Jada's backpack? Explain or show your reasoning.

(From Unit 5, Lesson 9.)

4. A tuna fish can swim 200 kilometers in a day.

   a. The camel travels 40 kilometers in a day. How many times farther does the tuna fish travel than the camel?

   b. The giant tortoise travels 500 meters in a day. How many kilometers is that?

   c. How many times as far as the giant tortoise does the tuna fish travel?

(From Unit 5, Lesson 10.)

5. The average weight of a newborn baby is 7 pounds and 8 ounces. How many ounces is that?

(From Unit 5, Lesson 11.)

6. Diego said it took him 1,800 seconds to get home from school yesterday. Lin thinks he is exaggerating.

    a. It took Diego $\frac{1}{2}$ hour to get home from school yesterday. How many minutes is that? Explain your reasoning.

    b. How many seconds is that? Explain or show your reasoning.

    c. Was Diego's statement correct or is he exaggerating?

(From Unit 5, Lesson 12.)

7. Han makes sparkling juice by mixing 1.5 liters of juice and 500 milliliters of sparkling water.

    a. How many milliliters of sparkling juice did Han make?

    b. How many times more juice did Han use than sparkling water?

(From Unit 5, Lesson 13.)

8. **Exploration**

Jada is trying to decide which option will take less time to make a trip. Here are the details.

Option 1 (Fly)

- 30 minutes to get to the airport
- $1\frac{1}{2}$ hours waiting at the airport
- 45 minute flight
- $1\frac{1}{4}$ hours to get to destination

Option 2 (Drive)

- $3\frac{3}{4}$ hour drive
- $\frac{1}{2}$ hour stop for lunch

Which option takes less total time? Explain your reasoning.

9. **Exploration**

There are different hikes leaving from the same location. Here are the distances:

Trail A: 800 m Trail B: 2.5 km Trail C: 1,300 m Trail D: 3 km

a. Andre hiked a total of more than 3 km but less than 4 km. Which trails might Andre have taken?

b. Jada hiked more than 2 km but less than 3 km. Which trails might Jada have taken?

Section C: Practice Problems

1. a. Jada's class drank 2 gallons of milk at lunch. How many cups is that?

   b. The third graders at Jada's school drank 3 times as much milk as Jada's class. How many quarts is that?

(From Unit 5, Lesson 14.)

2. Diego saw a snake that is 9 inches long at the pet store. The world's longest snake, a python, is 10 yards long. How many times longer is the python than the snake Diego saw? Explain or show your reasoning.

(From Unit 5, Lesson 15.)

3. a. Andre drew a rectangle that is 5 centimeters long and 6 centimeters wide. What is the perimeter of Andre's rectangle?

   b. Jada drew a rectangle whose side lengths are 4 times as long as those of Andre's rectangle. What is the perimeter of Jada's rectangle?

(From Unit 5, Lesson 16.)

4. a. A rectangle has perimeter 19 cm. One side is 4 cm. How long is the other side of the rectangle?

   b. A square has perimeter 19 cm. How long is each side of the square? Explain or show your reasoning.

(From Unit 5, Lesson 18.)

5. **Exploration**

   A furlong is 220 yards. It is a unit usually used to measure the distance of horse races. A mile is 5,280 feet. Mai read that a furlong is $\frac{1}{8}$ mile. Is this true? Explain or show your reasoning.

6. **Exploration**

   Many of the length measurements that we use today have interesting histories. Choose one of them, such as a foot, a yard, or a marathon and investigate its origin.

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