

9 Measurement

Dear Student,

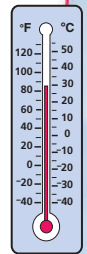
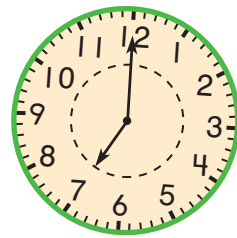
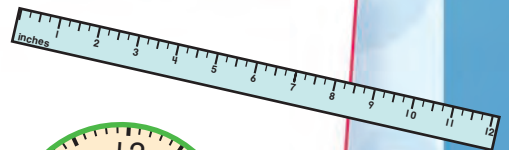
This chapter focuses on measurement. You already know quite a bit about measurement. We can measure how long something takes, how hot something is, or how tall we are. What other types of measurement can you think of?

Why is measurement even important? For one thing, it would be hard to tell someone exactly how tall you are without being right next to them and showing them, unless they had something else, like inches and feet, to compare your height to.

You will study various ways to measure length, weight, and volume. For instance, you will see the relations among inches, centimeters, feet, yards, and miles.

As always, we hope you enjoy this unit of measurement!

Mathematically yours,
The authors of *Think Math!*



Ready for Summer!

What is your favorite season: fall, winter, spring, or summer? For many people, summer is the best time of the year. Many families plan summer activities from taking trips to jumping into a backyard pool.

FACT • ACTIVITY 1

- 1 Noshi's trip will begin on the first day of summer. On June 7th, he begins counting the days until his trip. How many more days until Noshi's trip? How many weeks?
- 2 Noshi's plane departs at 2:30 P.M. He arrives at the airport at 12:45 P.M. How many minutes until the plane takes off?
- 3 If the flight is 160 minutes long, how many hours and minutes is the flight?
- 4 Noshi's return flight from vacation arrives on June 30th at 2:30 P.M. How many days and hours have passed since his plane took off on June 21st?

JUNE

sunday	monday	tuesday	wednesday	thursday	friday	saturday
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21 Summer Begins!
22	23	24	25	26	27	28
29	30					

FACT • ACTIVITY 2

How do you keep cool in hot weather? There are simple things many families do at home. Some set up sprinklers or use hoses and sheets of plastic to make homemade water slides. Some families set up shallow pools to keep cool.

A family looks at the following two plastic inflatable pools.

Family Swimming Pools			
Name	Length	Width	Height
Blue Lagoon	10 feet	6 feet	1 foot, 10 inches
Clear Blue	5 feet	5 feet	$1\frac{1}{2}$ feet

- 1** Katia is 4 feet tall. How many inches taller is she than the top of the Clear Blue pool?
- 2** The Blue Lagoon pool is filled up to 6 inches below its height. What will be the height in inches of the water in the pool?
- 3** Erik's family wants to enclose the Blue Lagoon pool with fencing. If they have 360 inches of fencing, do they have enough to enclose the pool? Explain why or why not.

CHAPTER PROJECT

Some kids sell lemonade on hot summer days. Plan a lemonade stand. Find a recipe that uses lemons. List the ingredients. How many servings does the recipe make? Suppose you are going to make 5 times the number of servings. Determine how much of each ingredient you will need and list the amounts.

- Weigh one lemon. How many ounces does one lemon weigh? How many total ounces and pounds of lemons will you need?
- How much water does your recipe require? Express the total amount of water you will need in cups, pints, and quarts.
- Fix a price and make a price chart for the cost of 1 to 10 cups of your lemonade.

ALMANAC Fact

Even though Florida is surrounded by the ocean, there are more than 1,000,000 swimming pools in the state.

REVIEW MODEL

Adding Different Units

How can you add dimes (D) and nickels (N)?
How can you add feet and inches?

To add amounts written in different units,
change both amounts to the same unit.

Add: 4 nickels + 3 dimes

One Way

Write the amounts
in dimes.

$$\begin{aligned} 4 \text{ nickels} &= 2 \text{ dimes} \\ 2 \text{ dimes} + 3 \text{ dimes} &= \\ 5 \text{ dimes} \end{aligned}$$

Another Way

Write the amounts
in nickels.

$$\begin{aligned} 3 \text{ dimes} &= 6 \text{ nickels} \\ 4 \text{ nickels} + 6 \text{ nickels} &= \\ 10 \text{ nickels} \end{aligned}$$

Another Way

Write the amounts
in pennies.

$$\begin{aligned} 4 \text{ nickels} &= 20 \text{ pennies} \\ 3 \text{ dimes} &= \underline{30 \text{ pennies}} \\ 20 \text{ pennies} + & \\ 30 \text{ pennies} &= 50 \text{ pennies} \end{aligned}$$

Add: 5 feet + 6 inches

One Way

Write the amounts in feet.

$$\begin{aligned} 6 \text{ inches} &= \frac{1}{2} \text{ foot} \\ 5 \text{ feet} + \frac{1}{2} \text{ foot} &= 5\frac{1}{2} \text{ feet} \end{aligned}$$

Another Way

Write the amounts in inches.

$$\begin{aligned} 1 \text{ foot} &= 12 \text{ inches} \\ 5 \text{ feet} &= 5 \times 12 \text{ inches} = 60 \text{ inches} \\ 60 \text{ inches} + 6 \text{ inches} &= 66 \text{ inches} \end{aligned}$$

✓ Check for Understanding

Add.

1 6 nickels + 3 dimes

2 8 nickels + 4 dimes

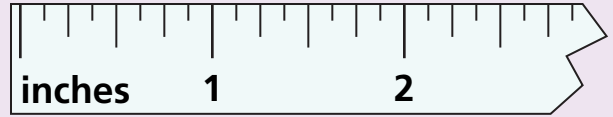
3 3 feet + 6 inches

4 4 feet + 3 inches

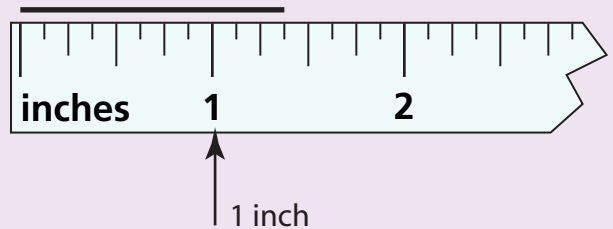
REVIEW MODEL

Reading an Inch Ruler

An inch ruler can be marked in inches, $\frac{1}{2}$ inches, $\frac{1}{4}$ inches, and $\frac{1}{8}$ inches. Some are marked in $\frac{1}{16}$ inches as well. Follow these steps to read a measurement on an inch ruler.

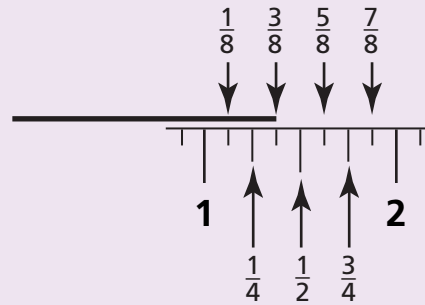


Step 1 Line up the left end of the object you are measuring with zero on the ruler. Count inches, starting at zero. Stop counting at the last inch mark before the end of the line.



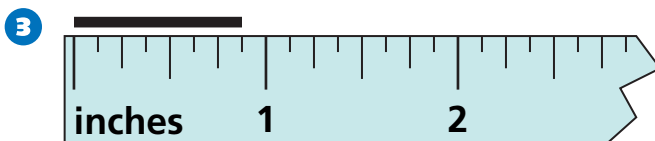
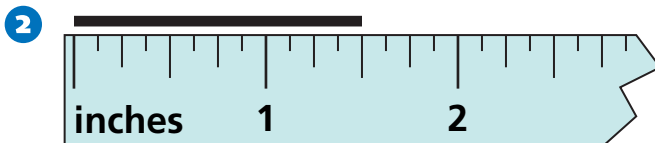
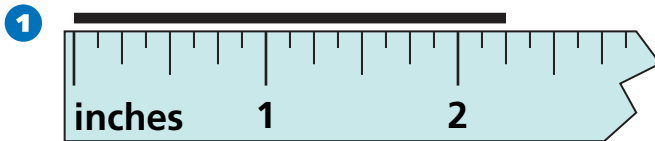
Step 2 Begin at the last inch mark. Identify the ruler mark closest to the right end of the object you are measuring.

The line is $1\frac{3}{8}$ inches long.



✓ Check for Understanding

Find the length of the line.



EXPLORE

Measuring with a Broken Ruler

The fifth grade borrowed all of our rulers except a broken one. Use the broken ruler to check the lengths of these lines.

1 inches

2 inches

3 inches

Now use a broken ruler to find the lengths of these lines.

4

5

6

7

8

REVIEW MODEL

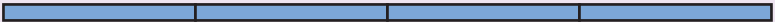
Converting Inches and Feet

You can convert between measurements in inches and measurements in feet.

Remember: 1 foot = 12 inches.

Convert 4 feet to inches.

Step 1 Think: each 1 foot in the measurement is equal to 12 inches.

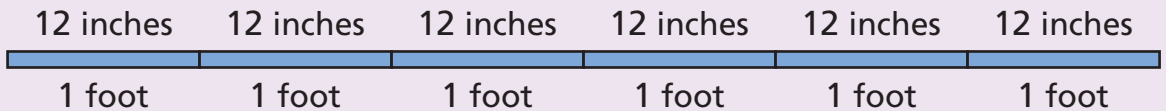
1 foot	1 foot	1 foot	1 foot
			
12 inches	12 inches	12 inches	12 inches

This is four groups of 12.
I'll multiply 4 by 12.

Step 2 Multiply. $4 \times 12 = 48$
So, 4 feet = 48 inches.

Convert 72 inches to feet.

Step 1 Think: a group of 12 inches in the measurement is a foot.



How many groups of 12 inches are in 72 inches?
I'll divide 72 by 12.

Step 2 Divide. $72 \div 12 = 6$
So, 72 inches = 6 feet.

Check for Understanding

Convert.

- 1 7 feet to inches
- 2 36 inches to feet
- 3 5 feet to inches
- 4 96 inches to feet

EXPLORE**Measuring Length
with Cuisenaire® Rods**

- 1 Use the fact that the white rod is 1 centimeter long to find the width of your hand, not including your thumb.
- 2 How wide is your hand with your thumb?
- 3 How long is your hand from wrist to fingertip?
- 4 How long is your shortest finger?

-
- 5 Using one hand as a ruler, estimate the distance from your elbow to your wrist on your opposite arm.
 - 6 Using your hand as a ruler, estimate the length of your foot.

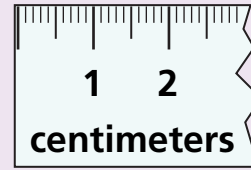
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- 7 Using your hand as a ruler, estimate the width of the back of your chair.
 - 8 Use a centimeter ruler to measure the back of your chair more precisely.



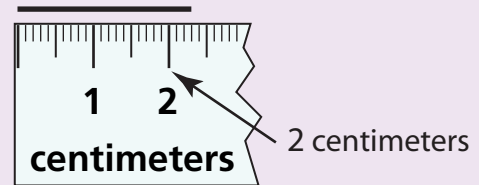
REVIEW MODEL

Reading a Centimeter Ruler

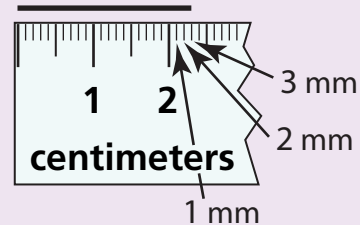
A centimeter ruler is marked in centimeters and millimeters. Follow these steps to read a measurement on a centimeter ruler. Remember: 1 centimeter = 10 millimeters.



Step 1 Line up the left end of the object you are measuring with zero on the ruler. Count centimeters, starting at zero. Stop counting at the last centimeter mark before the end of the line.



Step 2 Begin at the last centimeter mark. Each small mark on the ruler represents 1 millimeter (mm). Identify the millimeter mark at the right end of the object you are measuring.

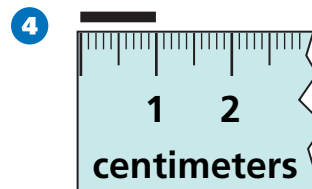
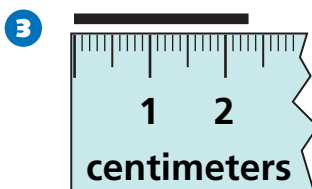
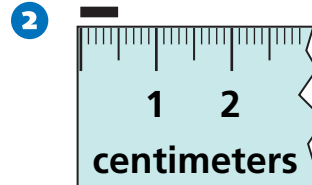
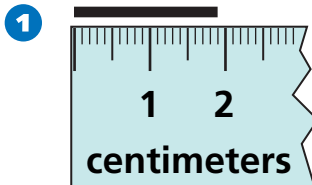


Step 3 Write the measurement as a decimal number. Write the number of centimeters to the left of the decimal point and the number of millimeters to the right.

The line is 2.3 centimeters long.

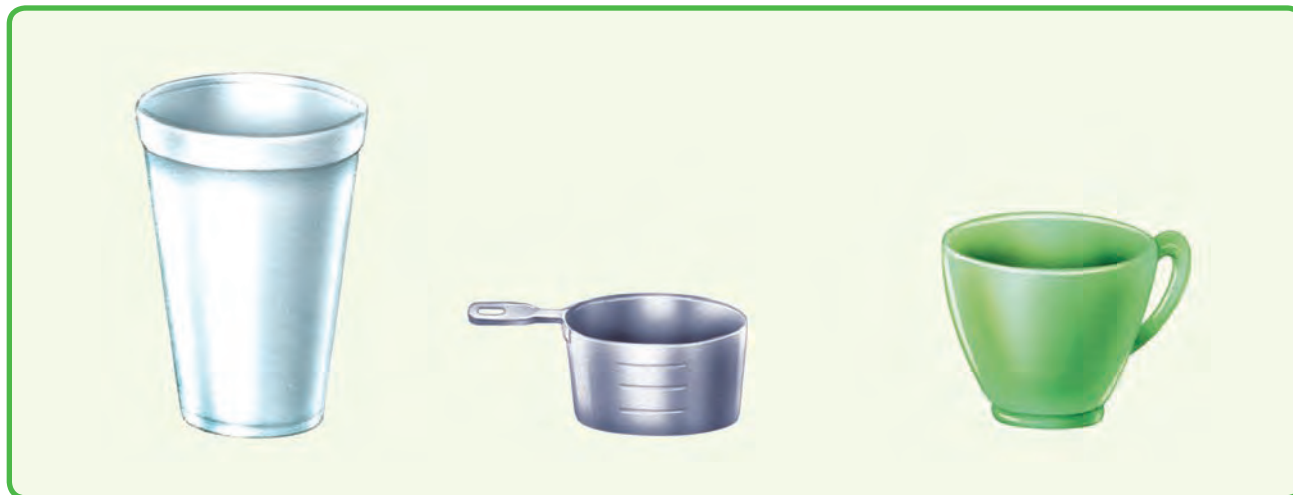
✓ Check for Understanding

Find the length of the line.



What is a Cup?

Use a drinking cup or a cup from home to answer these questions.



- 1 Can your own cup hold more or less than a measuring cup?
How do you know?

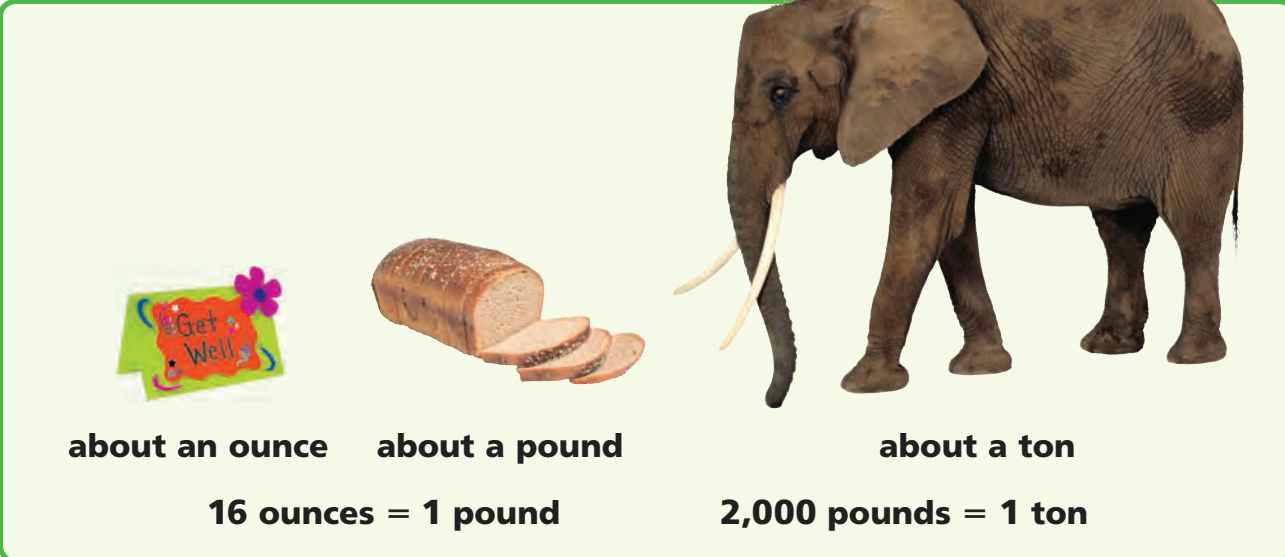
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- 2 Now pick up a handful of rice, beans, or whatever your teacher supplies. Estimate how many of your handfuls make a standard cup and then measure to check your estimate.

-
- 3 Now use a standard measuring cup to find out how much your cup will hold.

EXPLORE

Weight

You can measure weight in ounces, pounds, or tons.



about an ounce about a pound about a ton

$16 \text{ ounces} = 1 \text{ pound}$ $2,000 \text{ pounds} = 1 \text{ ton}$

1 How many ounces are in a ton?

2 Think about the following questions carefully.

- A** Which is heavier, 1 cup of feathers or 1 cup of marbles?
- B** Which is heavier, 1 pound of feathers or 1 pound of marbles?

3 Compare the weights of different objects and decide which is heavier. Things you might want to compare include:

- a pint of corn flakes and a pint of corn kernels
- a cup of oil and a cup of water
- a quart of sand and a quart of rice
- a cup of dried pasta and a cup of cooked pasta

How do you know which item is heavier?

REVIEW MODEL

Problem Solving Strategy

Look for a Pattern

A *fathom* is a unit of length used to measure the depths of bodies of water. Five fathoms is 30 feet, 6 fathoms is 36 feet, and 7 fathoms is 42 feet. At its deepest point, Lake Erie is 35 fathoms deep. How deep is the deepest point in Lake Erie in feet?

Strategy: Act It Out

Read to Understand

What do you know from reading the problem?

5 fathoms = 30 feet, 6 fathoms = 36 feet, 7 fathoms = 42 feet;
Lake Erie is 35 fathoms deep.

What do you need to find out?

Lake Erie's depth in feet

Plan

How can you solve this problem?

You can *look for a pattern* in the given depths and use it to find the length of a fathom.

Solve

What is the pattern in the given depths?

From the given information, I can see that each additional fathom is 6 feet more than the last. So, 1 fathom = 6 feet. I can find the depth of Lake Erie by multiplying its depth in fathoms by 6 feet: $35 \times 6 = 210$. So, Lake Erie is 210 feet deep at its deepest point.

5 fathoms = 30 feet
6 fathoms = 36 feet
7 fathoms = 42 feet

Check

Look back at the problem. Did you answer the questions that were asked? Does the answer make sense?

Yes. To check if the answer makes sense, I could make a table showing fathom depths up to 35 fathoms.

Problem Solving Practice

Use the strategy *look for a pattern* to solve.

- 1 A *furlong* is a unit of measure. 1 mile = 8 furlongs, 2 miles = 16 furlongs, and 3 miles = 24 furlongs. It is 72 furlongs from South City to Meadville. How many miles is it between the towns?
- 2 Greg scored 72 on his first quiz, 76 on his second quiz, and 80 on his third quiz. His scores continued to increase in the same pattern. On which quiz did he score 100?

Problem Solving Strategies

- ✓ Act It Out
- ✓ Draw a Picture
- ✓ Guess and Check
- ✓ **Look for a Pattern**
- ✓ Make a Graph
- ✓ Make a Model
- ✓ Make an Organized List
- ✓ Make a Table
- ✓ Solve a Simpler Problem
- ✓ Use Logical Reasoning
- ✓ Work Backward
- ✓ Write an Equation

Mixed Strategy Practice

Use any strategy to solve. Explain.

- 3 Sheila had a rectangular photo with a perimeter of 30 inches. The photo was 3 inches longer than it was wide. What was the area of the photo?
- 4 Penny bought 2 sweaters each priced at \$29 and 3 shirts each priced at \$9. She paid for her purchase with a \$100 bill. How much change did she receive?
- 5 Pedro's age is a multiple of 14. His older brother was 20 when their younger cousin was born. His brother is now 50. How old is Pedro?
- 6 Three apples cost \$1.29. Julia bought 5 apples. How much did they cost?
- 7 Sue is in front of Todd. Becky is behind Andy but ahead of Sue. From front to back, what is the order in which the four are standing?
- 8 Teresa started to read a 284-page book. For the first 5 days, she read 28 pages each day. How many pages did Teresa have left to read?
- 9 What number is missing from the table?
- 10 Ted listened to 86 songs in 4 hours. About how long would it take him to listen to 130 songs?

Number of fathoms	1	2	3	4
Number of feet	6	12	■	24

Choose the best vocabulary term from Word List A for each sentence.

- 1 A(n) ___?___ is the unit used for measuring temperature.
- 2 You can measure ___?___ in ounces, pounds, or tons.
- 3 The measurement of an object from end to end is its ___?___.
- 4 The ___?___ is a customary unit for measuring capacity equal to 16 cups.
- 5 One ___?___ is exactly 3 feet long.
- 6 A fish tank holding 240 gallons of water weighs about 1 ___?___.
- 7 One ___?___ in the metric system is about the same as 1 quart in the customary system.
- 8 One hundredth of a meter is 1 ___?___.
- 9 A(n) ___?___ is one twelfth of a foot.
- 10 Four cups are the same as 1 ___?___.

Complete each analogy. Use the best term from Word List B.

- 11 Foot is to length as ___?___ is to weight.
- 12 Cup is to pint as half-gallon is to ___?___.

Word List A

centimeter
cup
degree
foot
gallon
inch
length
liter
milliliter
pint
pound
quart
ton
unit
weight
yard

Word List B

gallon
inch
liter
pound
quart
yard

Talk Math

Discuss with a partner what you have learned about measurement. Use the vocabulary terms *cup*, *gallon*, *pint*, and *quart*.

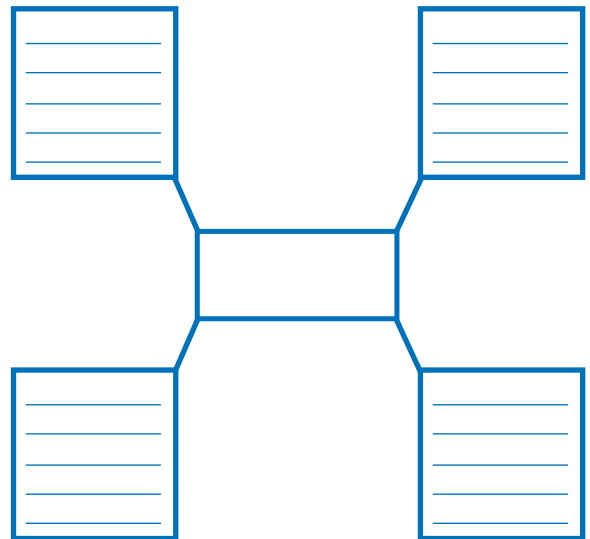
- 13 How can you find the number of cups in a gallon?
- 14 Suppose you know the number of gallons you have. How can you find how many cups you have?

Analysis Chart

- 15 Create an analysis chart for the terms *inch*, *foot*, *yard*, and *centimeter*. Use what you know and what you have learned about measures of length.

Word Web

- 16 Create a word web using the term *pound*.



What's in a Word?



YARD A *yard* is not always a unit of measurement. Someone's house might have a front *yard*. This type of *yard* comes from the Old English word *geard*, which means "an enclosed space."

In mathematics, the word *yard* comes from the Old English word *gierd*, which means "twig." Originally, a *yard* measured about 5 meters. Later, the *yard* became a standard length of 3 feet. This is the measure we use today.



Technology

Multimedia Math Glossary

www.harcourtschool.com/thinkmath

GAME

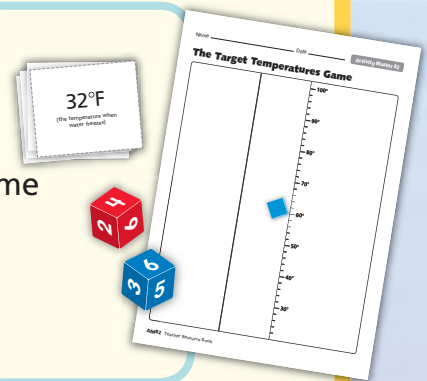
Target Temperatures

Game Purpose

To practice adding and subtracting temperatures

Materials

- Activity Master 82: The Target Temperatures Game
- Activity Master 83: Target Temperature
- 1 small game piece, such as centimeter cube
- 2 number cubes (labeled 1–6)



How To Play The Game

- 1** This game is for 2 players.
 - Mix up the Target Temperature cards. Place them face down in a pile.
 - Put the game piece at 60°F on the game board.
- 2** Turn the top card face up. This is the target temperature. Your goal is to land on this temperature.
- 3** Partners take turns.
 - Roll the two number cubes.
 - Use either the sum or difference of the numbers you rolled. Move the game piece that many degrees in either direction—warmer or colder.
- 4** If you land on the target temperature, keep the card. Turn the next card of the deck face up. This is the new target temperature. Keep playing.
- 5** The game ends when all of the Target Temperature cards have been collected.
- 6** The player with the most cards at the end of the game wins.

GAME

Build-a-Foot

Game Purpose

To practice using Cuisenaire® Rods to find lengths in centimeters
To relate centimeters to inches

Materials

- Activity Master 86: Spinner
- Inch ruler
- Paper clip and pencil
- Cuisenaire® Rods



How To Play The Game

- 1** Play this game with a partner. Each player will build a train of Cuisenaire® Rods. The goal is to estimate when the length of your train is close to 1 foot. If you can estimate the length to within 1 centimeter, you win.
- 2** First, make a spinner using Activity Master 77: Spinner. Put the point of a pencil through one end of the paper clip. Put the tip of the pencil on the center of the spinner. Then you can spin the paper clip around the pencil.
- 3** Take turns spinning the spinner. Collect the Cuisenaire® Rod shown by your spin.
- 4** Make a train of rods by placing them end-to-end.
- 5** When you think your train is 1 foot long, use the ruler to check.
 - If your train is more than 1 centimeter shorter or longer than a foot, you must remove the rod added to the train. If your train is longer than a foot, remove pieces until it is less than a foot long.
 - If your train is within 1 centimeter of a foot, you win!

CHALLENGE

Have you ever wondered how to measure distances around a curve?

All you need is a piece of string that is about 12 inches long and a ruler. Use these materials to measure the distance of the five trips on this map of Washington, D.C.

The map shows a highway called the Beltway that circles Washington, D.C. On the map, the Beltway is Interstate 495.

For each trip, place the string on the map where you get on the Beltway. Follow the road with the string to where you get off. Then use the scale on the map to estimate the distance you would travel on the Beltway in miles.



- 1 From McLean, VA, to Annandale, VA
- 2 From Greenbelt, MD, to Capitol Heights, MD
- 3 South from College Park, MD, to Springfield, VA
- 4 South from Landover, MD, to Tysons Corner, VA
- 5 North from Andrews Air Force Base, MD, to Silver Spring, MD