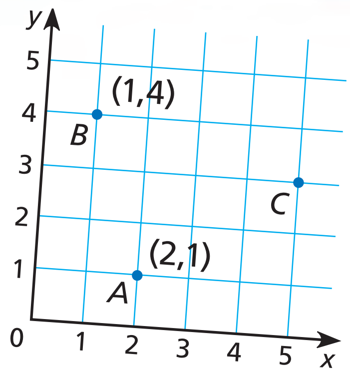
Chapter

15 Graphing

Dear Student,

In this chapter you will be using graphs to solve problems that involve measurement. To graph, you will be using points' coordinates, similar to the way you did in Chapter 6. For example, what are the coordinates of Point *C*?



Suppose the horizontal axis of this graph was labeled "seconds" and the vertical axis was labeled "feet," and I told you that Sam walks 4 feet per second. Which point shows how far Sam walked after 1 second? In this chapter you will see how you can extend a graph to figure out, for example, how far Sam has gone after ten, one hundred, or even one thousand seconds.

Now it is time to start because you need to finish one lesson per math class and class has already begun!

Mathematically yours,
The authors of ***Think Math!***

THE WORLD ALMANAC FOR KIDS

Indy 500: Vroom!

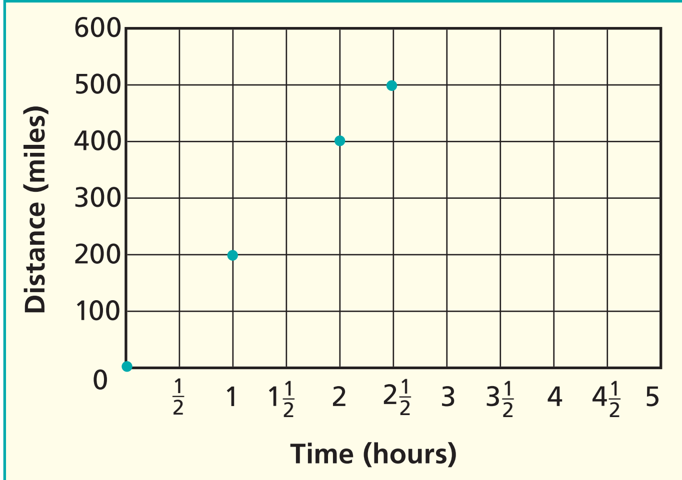
The Indianapolis Motor Speedway was built in 1909 as a testing facility for the automobile industry. In 1911, track owners made the race 500 miles. This race is known today as the Indy 500.

FACT·ACTIVITY 1

The graph shows the time it takes one driver to complete a 500 mile race. If you look at the time and the distance, you can determine that the average speed of Driver A is 200 mph.

1. How many miles has Driver A driven in the first hour?
2. How much time does it take to drive 400 miles? 500 miles?
3. Copy the graph on grid paper. Connect the points. What is the distance Driver A traveled after $\frac{1}{2}$ hour? after $1\frac{1}{2}$ hours?
4. The table shows the time and distance driven by Driver B. Include Driver B's data on the graph you made for Problem 3.

DRIVER A'S TIME AND DISTANCE IN A RACE



DRIVER B'S TIME AND DISTANCE IN A RACE

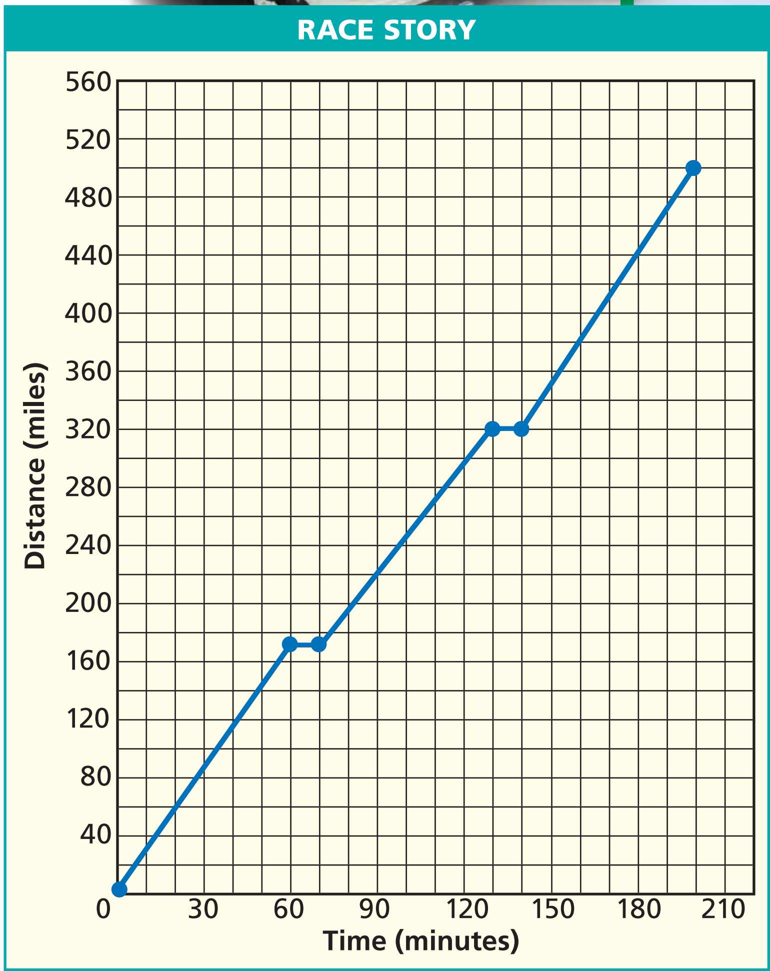
Time (hours)	Distance (miles)
0	0
1	125
2	250
3	375
4	500

FACT · ACTIVITY 2

The drivers in a race do not drive at a constant speed. In a long race like the Indy 500, drivers usually stop for 1 to 3 "pit stops" for refueling, repairs, and tire changes.

Use the Race Story graph for 1–4.

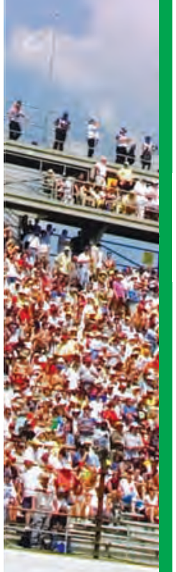
1. How long does it take the driver to finish the race?
2. The driver went ■ miles in the first 60 minutes, so his speed was ■ miles per hour.
3. When did the driver make pit stops? How can you tell from the graph?
4. Between the first and second pit stops, the driver drove ■ miles in ■ minutes. Did he drive faster or slower than he did in the first part of the race? Explain.

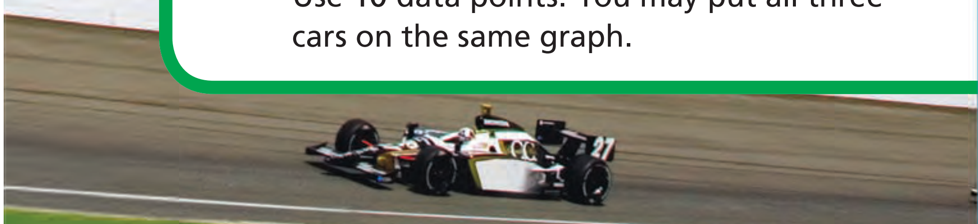


CHAPTER PROJECT

Research three different kinds of cars. Find each car's gas mileage for highway and city driving, and its fuel tank capacity. The gas mileage is the average number of miles the vehicle travels on a gallon of gas. The higher the gas mileage, the less you will spend on gas.

- Compare the gas mileage of the cars you chose. Draw a graph to display the results! Use 10 data points. You may put all three cars on the same graph.





ALMANAC Fact

The winner of the 2006 Indy 500 race reached a speed of 221 miles per hour. After crossing the finish line, the winner drove the car down Victory Lane and drank a glass of milk!

Chapter 15
Lesson 2

REVIEW MODEL
Making a Straight-Line Graph

You can complete an input-output table and make a graph to show how some measurement units are related.

In 1 pint there are 2 cups.

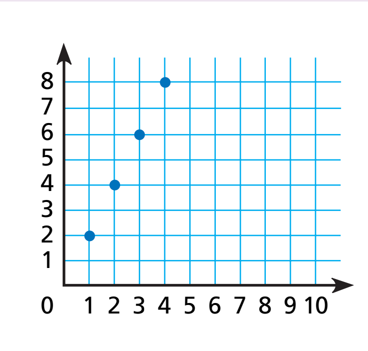
Complete the input-output table to show how pints and cups are related.

input →	Pints	1	4	2	3
output →	Cups	2	8	4	6

Follow these steps to make a graph.

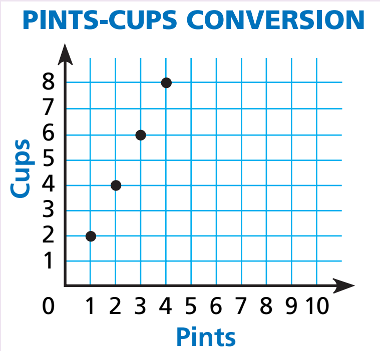
Step 1

For each pair of numbers in the table, use the input as the first coordinate of a point, and use the output as the second.



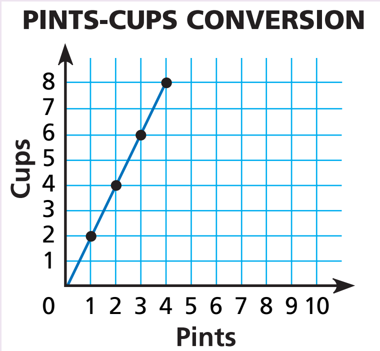
Step 2

Write labels on the graph's axes to tell what each coordinate stands for. Write a title for the graph.



Step 3

Connect the points, and see if they make a line. The coordinates of each point on this line show the same capacity in pints and in cups.



Check for Understanding

Copy and complete each table. Then use Activity Master 154: Conversion Graph I to make a graph for each table. (Note: You will need to change the labels on the graph on the activity master for each problem.)

1. In 1 quart there are 4 cups.

Quarts	1	4	■	5
Cups	4	■	8	■

2. In 1 yard there are 3 feet.

Yards	1	6	■	4
Feet	■	■	0	■

Chapter 15

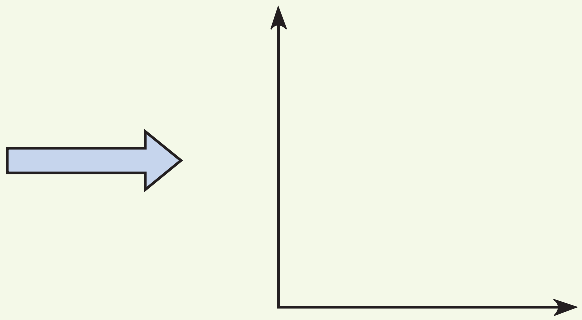
Lesson 3

EXPLORE
Fitting the Graph on the Page

Beth is writing an article for the school newspaper. She wants to include a graph showing how to convert inches to feet.

Use Activity Master 157: Conversion Graph III to make a graph with inches on one axis and feet on the other. Your graph must include at least 6 grid points.

Inches	?
Feet	1



1. Make a table showing the conversions from inches to feet.

2. Make a graph of the points in the table.

REVIEW MODEL
Choosing an Appropriate Scale

When you make a graph, you need to choose a reasonable scale for the axes.

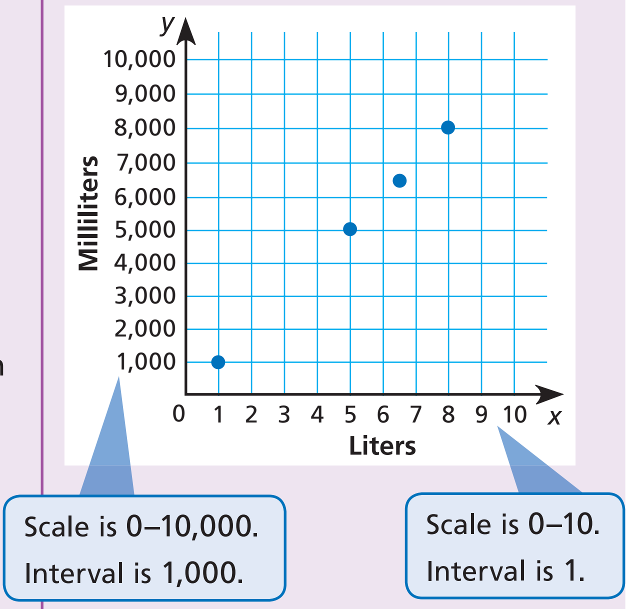
- **The scale is the set of numbers that are placed at equal distances along the axes. Sometimes the two axes are labeled with the same scale, and sometimes different scales are used. You should choose a scale that allows you to show all the numbers in the data you are graphing.**
- **The interval is the difference between one number and the next on the scale.**

Example

Choose an appropriate scale for the data in the table.

Liters	1	5	8	$6\frac{1}{2}$
Milliliters	1,000	5,000	8,000	6,500

- The greatest number in the row for liters is 8. So for the *x*-axis, a scale of 0–10 with an interval of 1 is good.
- The greatest number in the row for milliliters is 8,000. So, for the *y*-axis, a scale of 0–10,000 with an interval of 1,000 is good.



Check for Understanding

Copy and complete each table. For each table, choose an appropriate scale for the data and use Activity Master 157: Conversion Graph III to make a graph.

1.

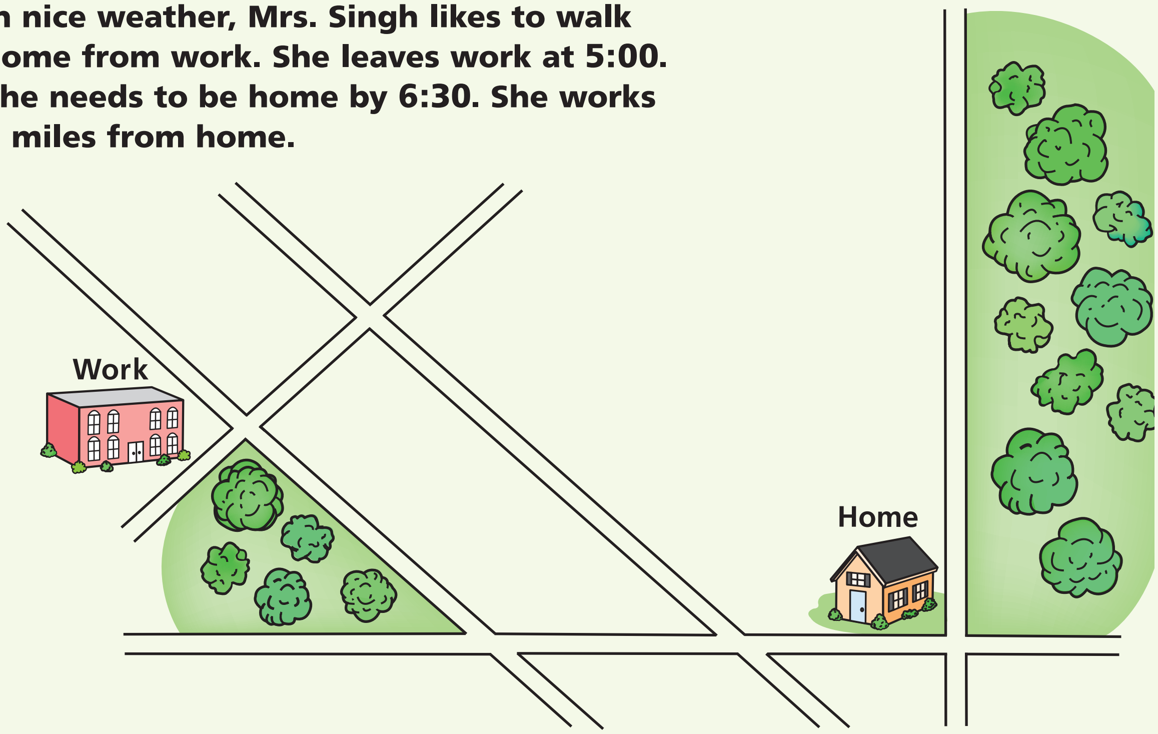
Meters	3	6	1	2	0
Millimeters	■	■	1,000	■	■

2.

Years	2	5	1	6	0
Months	■	■	12	■	■

EXPLORE
Getting Home on Time

In nice weather, Mrs. Singh likes to walk home from work. She leaves work at 5:00. She needs to be home by 6:30. She works 6 miles from home.



1. If it takes her 30 minutes to walk 1 mile, how long will it take her to get home? Will she be home in time?

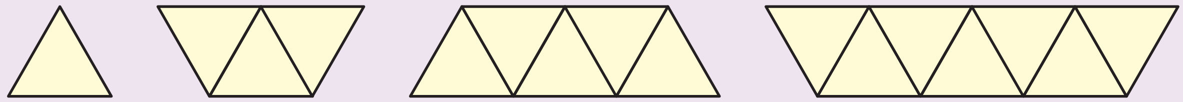
2. If she can walk fast and jog a bit so that she covers 5 miles in 1 hour, how long will it take her to get home? Will she be home in time?

3. What is the slowest speed at which she could walk and still make it home by 6:30?

Chapter 15
Lesson 7

REVIEW MODEL
Problem Solving Strategy
Make a Table

Look at the sequence of triangles. Copy and complete the table. Then find the number of triangles in Picture *n*.



Picture Number	1	2	3	4	*n*
Number of Triangles	1	3	5	7	$2n-1$

Strategy: Make a Table

Read to Understand

What do you know from reading the problem?

I know that each successive picture has more triangles than the picture before it.

What do you need to find out?

the number of triangles in Picture *n* in this sequence

Plan

How can you solve this problem?

You can make a table and look for a pattern in the number of triangles.

Solve

How can you use a table to solve the problem?

You can look for patterns in the way the number of triangles increases in each successive picture in this sequence.

What pattern do you notice?

There are two more triangles in each successive picture. There is only 1 triangle in the first picture. For all the other pictures, the number of triangles is 2 times the Picture Number in the sequence, less 1 triangle.

So, the *n*th picture will have $2n - 1$ triangles.

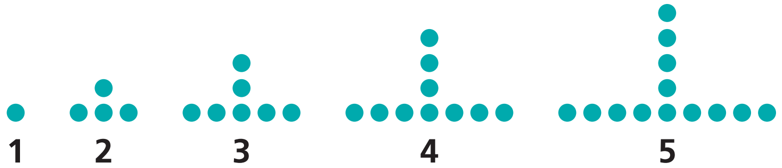
Check

Look back at the problem. Did you answer the question that was asked?

Problem Solving Practice

Use the strategy *make a table* to solve.

1. Based on the sequence below, how many circles are in Picture n?



2. Below is a list of students in the chorus and the grade they are in.

Miranda	4	Shawn	5	Amanda	5	Ryan	4	Adele	3
Lindsey	5	Faith	4	Kevin	5	Jody	5	Sabrina	5
Jarrell	3	Ellen	4	Eva	5	Sarah	5	John	4
Heather	5	Kendall	5	Jordan	5	Ashley	4	Lauren	5

What fraction of the students are in fifth grade?

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

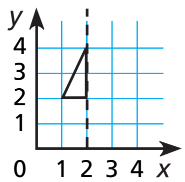
Use any strategy to solve. Explain.

3. Shelby bought $\frac{3}{4}$ yard fabric. She used $\frac{1}{6}$ yard of the fabric for a collar. How much fabric is left?

4. There are 186 people going on a field trip on buses. Each bus can seat 38 people. How many buses will be needed for the field trip?

5. On Friday, Rashad received a check. He deposited \$75.50 into his savings account. Before he deposited the money, he used \$12.75 from the check to buy a gift and he deposited \$15.00 into his checking account. He kept \$20.00 in cash. How much was Rashad's check?

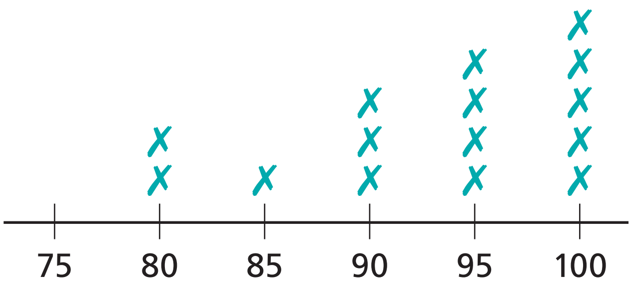
6. Caitlin drew this triangle. She then reflected it over the vertical dashed line and translated it down 2 spaces. What are the new vertices of the triangle?



For 7–8, use the graph.

7. What is the median score? What is the range?

8. Jody scored better than the mean score, but less than the mode. What was her score?



SCORES ON MS. BAKER'S MATH TEST

Chapter 15 Vocabulary

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

1. How one quantity changes in comparison to the change of another quantity is called __?__.
2. The incline of a graphed line with respect to the axes is its __?__.
3. The difference between one number and the next on the scale of a graph is a(n) __?__.
4. A common rate that compares distance over time is __?__.
5. The numbers placed at fixed distances on the axes of a graph form the __?__.
6. The distance an object travels divided by the time it takes to travel the distance is the __?__.
7. The operation or operations needed to convert one unit to another related unit is called a(n) __?__.
8. A diagram that shows the relationship between two measures is called a(n) __?__.
9. Changing kilograms to pounds is called __?__.

Word List A

- conversion graph
- conversion rule
- converting measurements
- coordinate grid
- interval
- miles per hour
- rate
- scale
- slope
- speed
- steepness

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

10. Latitude and longitude are to a map as horizontal and vertical lines are to a __?__.
11. Inches is to length as miles per hour is to __?__.

Word List B

- coordinate grid
- interval
- scale
- slope
- speed

Talk Math

Discuss with a partner what you have learned about tables and graphs of measurement relationships. Use the vocabulary terms *conversion rule* and *rate*.

12. How can you tell whether the graph of three or more points will lie along a straight line?
13. Suppose you know how much the temperature has changed in degrees Fahrenheit. How can you find out how much it changed in degrees Celsius?

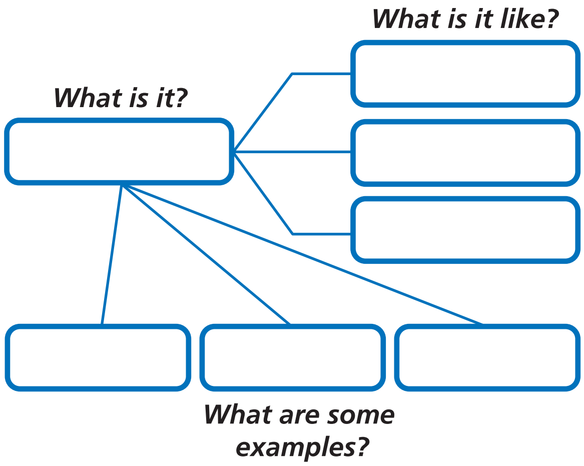
Word Definition Map

14 Create a word definition map for the term *coordinate grid.*

A What is it?

B What is it like?

C What are some examples?



Degrees of Meaning Grid

15 Create a degrees of meaning grid using the terms *conversion rule* and *rate.* Use what you know and what you have learned about comparing units.

General	Less General	Specific	More Specific

What's in a Word?

SCALE In math, *scale* refers to the numbers set at fixed distances that label a graph. In music, a *scale* is a group of tones that go up or down in pitch with each tone relating to the others in a specific way. In daily life, a *scale* is a machine that measures the weight of something. A climber *scales* a cliff.

Scale has to do with intervals. A graph *scale* has intervals depending on what it measures. The tones in a musical *scale* are set at definite intervals. A weight *scale* has intervals in pounds or grams. A climber moves hands and feet at intervals in order to go forward.

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GAME

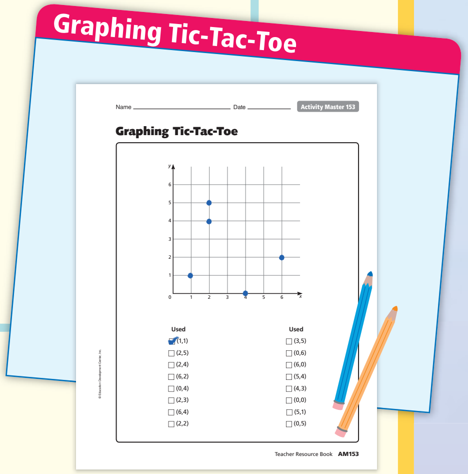
Graphing Tic-Tac-Toe

Game Purpose

To recognize when points on a coordinate grid lie along a straight line

Materials

- Activity Master 153: *Graphing Tic-Tac-Toe*
- Color pencils
- Straightedge



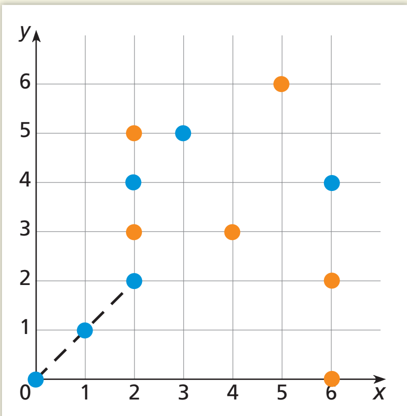
How To Play The Game

1. This is a game for 2 players. You will both use the same *Graphing Tic-Tac-Toe* game and straightedge. You will each need a different color pencil. The object of the game is to mark 3 points that lie along a straight line. Remember, there might be more than one way to make a straight line using given points.

2. Decide who will go first, and then take turns.
   - Choose an ordered pair from the list. Mark the point with those coordinates in your color on the grid.
   - Put a check mark in the box to show that the ordered pair has been used. Once an ordered pair has been used, it may not be used again.

3. The first player to mark 3 points that lie along a straight line wins. Be sure to check the points with the straightedge if you are unsure whether a straight line has been made.

   Example: Jai went first. He is using orange. Kari is using blue. After 6 turns each, Kari wins.



GAME

The Great Race

Game Purpose

To practice plotting points to show time and the related distance traveled

Materials

- Activity Masters 160–162: *The Great Race* Game Board, Time Cards, and Distance Cards
- Color pencils • Scissors • Straightedge

How To Play The Game

1. This is game for 2 players. Use the same game board. Start at (0,0). The goal is to cross the finish line in less time. It does not matter how many turns you take. Choose your color pencil.

2. Cut out all the cards. Mix them together. Place them face down in a stack. Decide who will go first. Then take turns. Start by taking 4 cards in turn. Be sure to have 4 cards in your hand at all times.

3. Choose one of your cards. Place it face up on the table.
   - If the card is a Time card, the other player must play a Distance card.
   - If the card is a Distance card, the other player must play a Time card.
   - If the other player does not have the right type of card, he or she must discard and take a new card until the right type of card can be played.

4. The cards show your time and distance for this part of the trip. On your first turn, start at (0,0). Calculate the time and distance. Mark the point on the grid. Draw a line segment between the two points. On the rest of your turns, start at your last point.

5. If you run out of cards, re-mix the discard stack. Both players must cross the finish line. But whoever took less time wins.

CHALLENGE

Lots of Conversions

Copy and complete each conversion table. Draw a graph on grid paper to show each conversion. Then use the table and graph to answer the questions. You might need to extend the table or the graph to answer some of the questions.

1. Convert kilograms to pounds. 1 kilogram is about 2.2 pounds.

Kilograms	1	2	3	4	5
Pounds	2.2	■	■	■	■

A About how many pounds are equivalent to 1.5 kilograms?
B About how many kilograms are equivalent to 7 pounds?
C About how many kilograms are equivalent to 0.5 pound?
D About how many kilograms are equivalent to 10 pounds?

2. Convert gallons to liters. 1 gallon is about 3.8 liters.

Gallons	1	2	3	4	5
Liters	3.8	■	■	■	■

A About how many liters are equivalent to 2.5 gallons?
B About how many gallons are equivalent to 10 liters?
C About how many gallons are equivalent to 4.5 liters?
D About how many gallons are equivalent to 25 liters?

3. Convert kilometers to miles. 1 kilometer is about 0.6 mile.

Kilometers	1	2	3	4	5
Miles	0.6	■	■	■	■

A About how many miles are equivalent to 3.4 kilometers?
B About how many kilometers are equivalent to 4 miles?
C About how many kilometers are equivalent to 1.5 miles?
D About how many kilometers are equivalent to 9 miles?