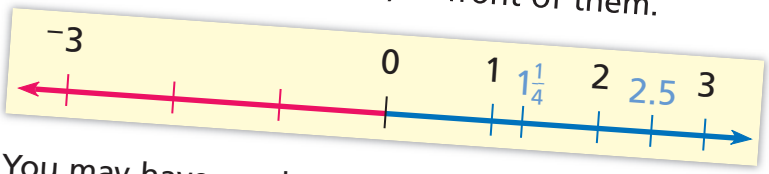
Chapter

12 Extending the Number Line

Dear Student,

The number line is home to many different kinds of numbers. You know how to arrange counting numbers, fractions, and decimals on the number line to show their size. In this chapter, you will be exploring numbers that "live" to the left of 0 on the number line. These numbers are called **negative numbers** and have a minus sign ($^-$) in front of them.



You may have used negative numbers in describing temperature. In places where it gets very cold in the winter, people might say, "It was minus 10 out this morning." Negative 10 is farther below zero than negative 5, so $^-10°$ is colder than $^-5°$.

In Chapter 9, you measured temperatures using the Fahrenheit system. In this chapter, you will work with the metric temperature system, which is called **Celsius.** In Celsius, water freezes at 0 degrees and boils at 100 degrees. Can you think of situations besides temperatures in which something might go below zero?

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

THE WORLD ALMANAC FOR KIDS

Fun with Golf

In golf, the person with the lowest score wins. Each golf course has a number assigned to each hole, called par, which depends on the difficulty of the hole. The sum of the numbers for the whole course is par for the entire course.

The scores to the right show the final results for a local golf tournament. The numbers show the golfers' score above or below par for the course.

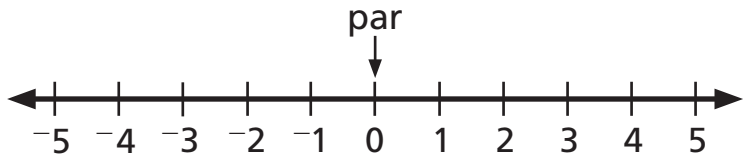
FACT ACTIVITY 1

Use the table of golf scores.

1. Copy the number line on a separate sheet of paper. Write the players' names below their scores.
2. Which players had scores above par?
3. Which player's score is farthest to the left on the number line?
4. Who won the golf tournament?

Results of a Local Golf Tournament

Golfers	Final Score Compared to Par
Ava	$^{+}5$
Brett	$^{-}3$
Corey	$^{+}4$
Dan	$^{-}5$
Eden	$^{+}1$

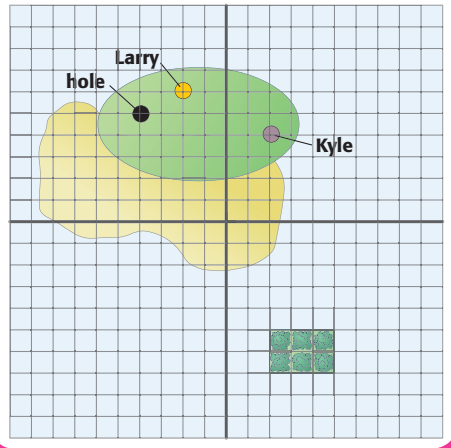


There are either 9 or 18 holes on a golf course. At each hole, golfers try to hit their golf ball as close to the hole on the green as possible, but there are some things that could interfere, such as trees, ponds, and sand traps.

FACT·ACTIVITY 2

Use the grid to answer the questions.

1. Where is the hole located in relation to Kyle's ball?
2. Where is Larry's golf ball located on the coordinate grid?
3. The tree shrubs will be moved for an upcoming tournament. Each corner of the rectangular shrub area will be moved 4 units to the right and 2 units down. What is the new position of the shrub area?



CHAPTER PROJECT

Work with a partner to create your own mini-golf game.

- Draw a coordinate grid with 4 quadrants. Show $^{-}5$ to 5 on each axis. Then draw features such as waterfalls, barriers, windmills, and trees.
- Indicate the tee, or starting place, and the hole on your grid. Place a game piece on the tee.
- Prepare 2 sets of cards labeled $^{-}5$ to 5 (including 0) and place them in a bag.
- Pick 2 cards. The first card represents the first number in the ordered pair. The second card represents the second number in the ordered pair. Place your game piece on the coordinates. The player closer to the hole wins.
- Put the cards back in the bag and repeat the game nine times to see who wins the most "holes."

Materials

grid paper

index cards or squares of paper

game pieces (such as pennies and paper clips)

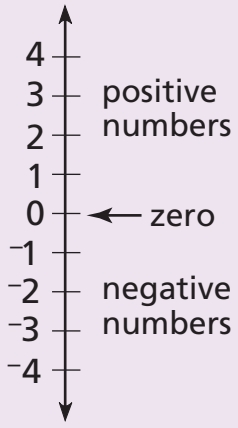
Chapter 12

Lesson 2

REVIEW MODEL
Understanding Negative Numbers

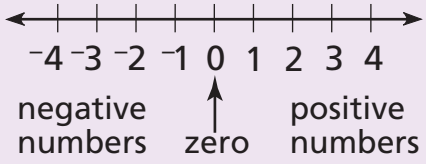
Sometimes in everyday life, you need to use numbers that are less than zero.

On a number line, the **negative numbers** are found on the opposite side of zero from the positive numbers. Negative numbers have a minus sign in front of them. Positive numbers may have a plus sign in front, but usually they are written without a sign.



"I had 2 points in a game. Then I drew a card that said, 'You lose 5 points.'"

"The temperature was 3 degrees. That night it fell by 7 degrees."



To compare numbers, look at their locations on a number line. On a horizontal number line, numbers get greater as you move to the right.

Which is greater, $^{-}3$ or 1? 1 is farther to the right on a horizontal number line. So, $1 > {}^{-}3$.

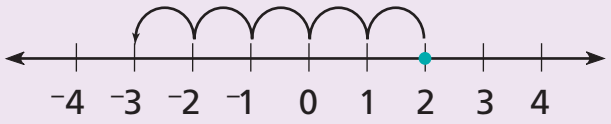
On a vertical number line, numbers get greater as you move up.

Which is greater, $^{-}1$ or $^{-}4$? $^{-}1$ is above $^{-}4$ on a vertical number line. So, $^{-}1 > {}^{-}4$.

You can use a number line to solve problems involving negative numbers.

Problem I had 2 points in a game. Then I drew a card that said, "You lose 5 points." How many points did I have then?

Solution Start with 2 points. Jump 5 points backward. You end with $^{-}3$ points.



Check for Understanding

Tell which number is greater.

1. $^{-}3$ or 0?
2. 2 or $^{-}5$?
3. $^{-}1$ or $^{-}2$?
4. 4 or 0?

5. The temperature was 3° Celsius. That night it fell by 7° Celsius. What was the final temperature?

Chapter 12

Lesson 4

REVIEW MODEL
Finding and Identifying Points on a Grid

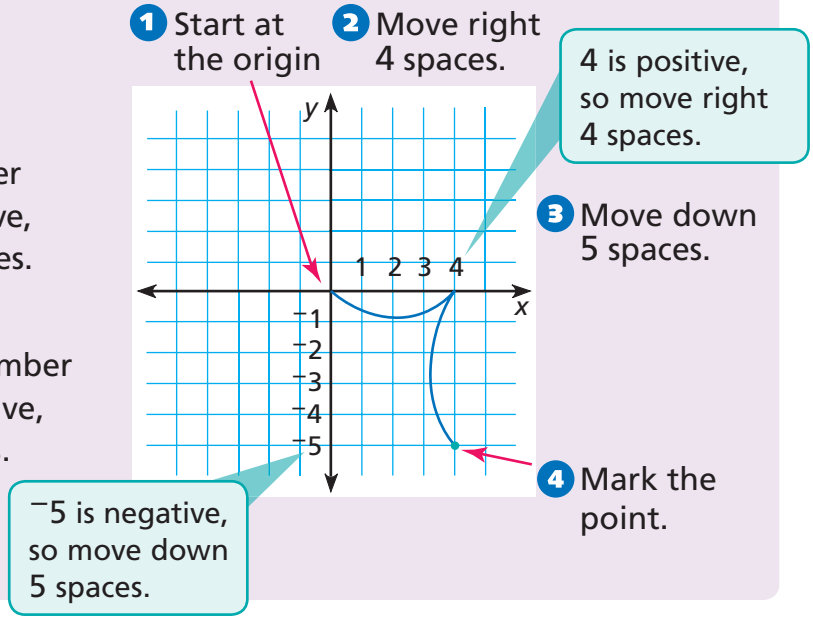
You can find the location of a given point on a grid by counting spaces. Find the point (4,⁻5).

Step 1 Start at the **origin**, the place where the horizontal and vertical axes intersect.

Step 2 Look at the first number in the ordered pair. If it is positive, move right that number of spaces. If it is negative, move left.

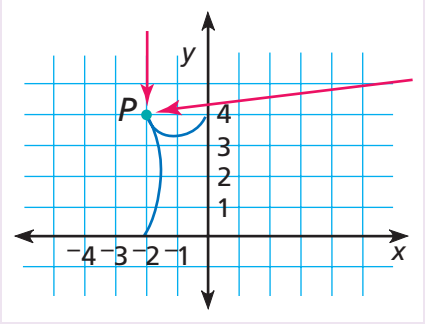
Step 3 Look at the second number in the ordered pair. If it is positive, move up that number of spaces. If it is negative, move down.

Step 4 Mark the point.



To identify a point on a grid, find its distances from the two axes. Identify point *P*.

Step 1 The point is 2 spaces **left** of the vertical axis. The first number is ⁻2. (If the point is **right** of the vertical axis, the first number is positive.)



Point *P* is (⁻2,4).

Step 2 The point is 4 spaces **above** the horizontal axis. The second number is 4. (If the point is **below** the horizontal axis, the second number is negative.)

Check for Understanding

Solve.

1. Where on a grid is the point (⁻2,6)?

2. What point is 3 spaces right of the vertical axis and 7 spaces above the horizontal axis?

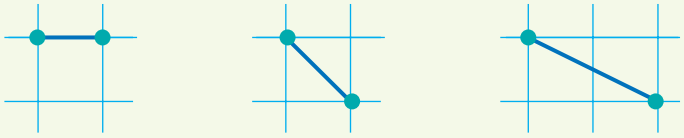
Chapter 12

Lesson 5

EXPLORE
Can You Copy My Picture?

1. On a blank grid page, make a design with points and line segments, following these rules:

   - Points must go on intersections of the grid. 
   - A line segment must begin at one point and end at another.

   - You must use at least 3 points and not more than 8 points in your design.
   - You must use at least 3 line segments and not more than 8 line segments in your design.
   - Label each point with a different letter.

2. Write directions explaining how to copy your design onto a blank grid.

   - Use ordered pairs such as (2,3) to describe where to draw points.
   - Use the letter labels of the points to describe which points to connect.

     $\overline{AB}$

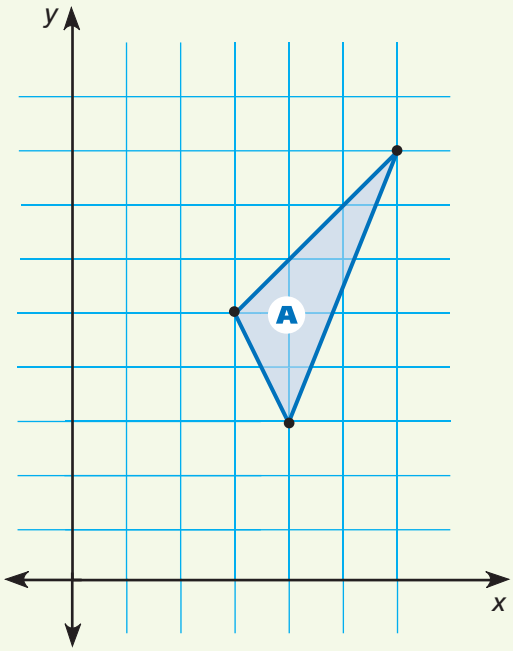
3. Exchange sets of directions with a partner. Follow your partner's directions to draw a design on a blank grid, while your partner follows yours.

4. Did you copy your partner's design accurately?

Chapter 12

Lesson 6

EXPLORE
Changing a Figure's Coordinates



1. What happens to Figure A when you change the coordinates of all of its points according to the rules in these tables?

A	B	C	D
(x,y)	$(x + 3,y)$	$(x,y - 2)$	$(x + 6,y + 4)$
(3,5)	(6,5)		
(4,3)			(10,7)
(6,8)		(6,6)	

2. Use a copy of the Figure Changing Rules Page to complete the tables and draw Figures B, C, and D.

Chapter 12

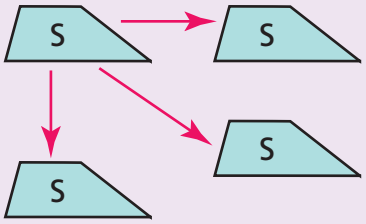
Lesson 6

REVIEW MODEL
Translating and Reflecting Figures

You can move a figure using a *translation* or a *reflection.*

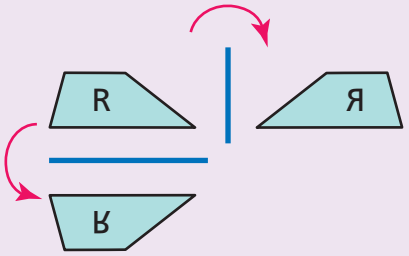
A translation is also called a "slide." A translation is a movement of a figure along a straight line.

The diagram shows three translations of Figure S. Notice that the figure does not twist, turn over, or change in size. It moves rigidly, as though it were a caboose moving along a train track.



A reflection is also called a "flip." A reflection is a movement of a figure by flipping it over a line.

The diagram shows two reflections of Figure R. Notice that the figure does not change in size during the reflection. It does, however, flip over so that you can see its back side.

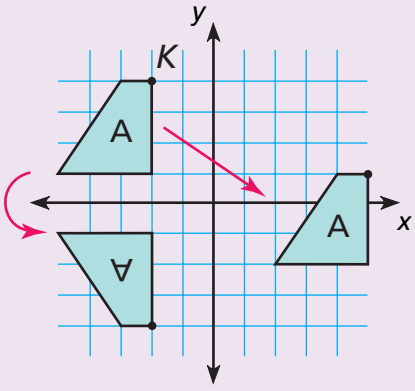


Figures and points can be translated and reflected on a grid.

The diagram shows a translation of Figure A and a reflection of Figure A over the horizontal axis.

Point *K* is one corner of Figure A. It is located at $(^{-}2,4)$.

When Figure A is translated, point *K* is translated to (5,1). When Figure A is reflected over the horizontal axis, point *K* is reflected to $(^{-}2,^{-}4)$.



Check for Understanding

Tell whether the letter has been translated or reflected.

1. G G

2. N И

3. The point $(^{-}5,1)$ is one corner of Shape A above. Give the coordinates of the point after Shape A is translated and reflected as shown.

Chapter 12

Lesson 7

EXPLORE
Graphing Number Sentences

There are many pairs of numbers that you could pick for x and y to make this number sentence true: $y = x + 4$.

Here are some examples:

(x,y)
(1,5)
(2,6)
(3,7)

Each of these pairs of numbers are coordinates of points.

1. Find at least 3 more pairs of numbers that fit $y = x + 4$.

   Record them in the first table on the Graphing on a Coordinate Grid Activity Master.

   Then draw the point for each pair of coordinates on the grid.

2. Find 5 pairs of numbers that make this sentence true: $y = x + 3$.

   Record them in the second table and draw the points on the grid.

3. Using the third table, do the same for this sentence: $y = x + 1$.

4. What do you notice about the three sets of points you graphed?

Chapter 12

Lesson 8

REVIEW MODEL

Problem Solving Strategy

Draw a Picture

The streets of Hilldale run north and south. They are numbered consecutively, beginning with 1st Street. The avenues run east and west. They are numbered consecutively, beginning with 1st Avenue. Anton lives at the corner of 2nd Street and 4th Avenue. Tony's Grocery is located at 7th Street and 2nd Avenue. Best Grocery is located at 5th Street and 7th Avenue. Anton wants to ride his bike from his house to the closest grocery store. Which store should he ride to?

Strategy: Draw a Picture

Read to Understand

What do you know from reading the problem?

the street and avenue layout of Hilldale, and the locations of Anton's house and two grocery stores

What do you need to find?

the store closest to Anton's house

Plan

What strategy can you use to solve the problem?

You can *draw a picture*—a map—of Hilldale. Then you can measure the distances from Anton's house to the two stores.

Solve

How can you solve the problem?

From the given information, I can draw a map of the town, and place dots at Anton's house and the two stores. Then I can find the shortest distance from Anton's house to each store. I must remember that Anton can ride his bike only on streets and avenues, without taking shortcuts. My map shows that the shortest distance to Best Grocery, 6 blocks, is 1 block shorter than the shortest distance to Tony's Grocery. So, Best Grocery is closest.

MAP OF HILLDALE

Check

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

Problem Solving Practice

Use the strategy *draw a picture* to solve.

1. Melissa's garden is a square 24 feet on a side. She placed a fence post at every corner and every 6 feet along the sides. How many fence posts did she use?

2. Aaron parked his car in the underground garage in the Seaview Building. Over the next hour he took the elevator up to the ground floor, up another 6 stories, down 4 stories, up 9 stories, down 5 stories, and down 10 stories to his car. On which floor was he parked?

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. A brick weighs 6 pounds plus half of its total weight. How much does the brick weigh?

4. A baseball team has five pitchers and two catchers. How many different pitcher-catcher combinations are possible?

5. Tomas's house number is a multiple of his age, which is 26. The house number consists of three consecutive digits. What is the number?

6. There are six more girls than boys in the fourth grade. If there are 100 students total, how many boys are there?

7. There are four houses in a row on Digby Street. Marcus lives west of Gregory. Della lives east of Gregory. Taylor lives between Gregory and Della. Who lives farthest west?

8. Val bought three sweaters. The sales tax on her purchase was $4. The total cost, including tax, was $91. If the sweaters were all the same price, what was the cost of each?

9. There are 11 blue guppies and 8 yellow guppies in a fish bowl. They begin jumping one at a time into a second bowl. How many must jump before you can be sure that there are two of the same color in the second bowl?

10. A square rug has an area of 64 square feet. A snail crawled around the outside of the rug at a rate of 2 feet per hour. How long did it take the snail to complete the journey?

Chapter 12 Vocabulary

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

1. The symbol that means subtraction is the ___?___ sign.
2. A(n) ___?___ sign in front of a number means the opposite of that number.
3. A number to the right of zero on the number line is called a(n) ___?___.
4. A pair of numbers used to locate a point on a coordinate plane is a(n) ___?___.
5. The ___?___ of a coordinate plane is where the two axes meet.
6. A straight path that extends in both directions is a(n) ___?___.
7. A(n) ___?___ is the very last point on one side of a line segment.
8. A(n) ___?___ is a part of a line that includes two endpoints and all the points between them.
9. A grid with a horizontal axis and a vertical axis is a(n) ___?___.

Word List A

- axes
- axis
- coordinate
- coordinate plane
- coordinates
- endpoint
- function
- grid
- line
- line segment
- minus
- negative
- negative number
- ordered pair
- origin
- positive number

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

10. A house number is to an address as a coordinate is to a(n) ___?___.
11. A bead is to a necklace as a(n) ___?___ is to a line.

Word List B

- axis
- function
- grid
- line segment
- ordered pair

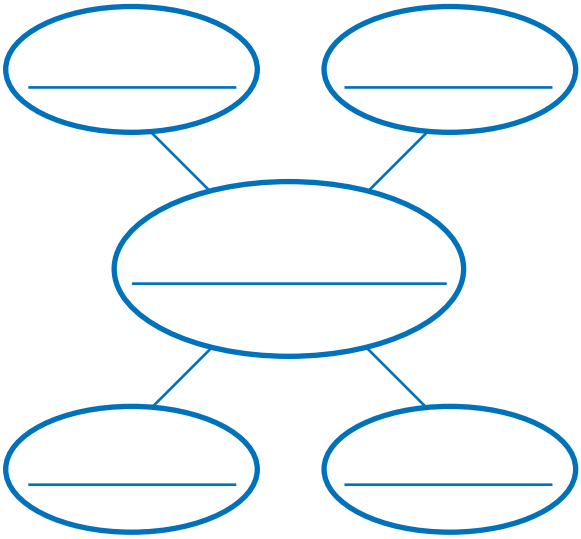
Talk Math

Discuss with a partner what you have learned about graphing numbers. Use the vocabulary terms *negative number, positive number,* and *origin.*

12. How do you label the axes on a coordinate plane?
13. How do you plot an ordered pair on a coordinate plane?

Concept Map

14 **Create a concept map for *Coordinate Plane.* Use what you have learned about the parts of a coordinate plane.**



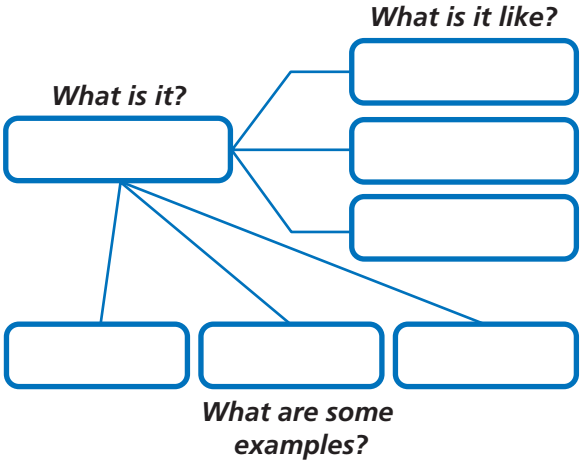
Word Definition Map

15 **Create a word definition map for the term *negative number.***

A What is it?

B What is it like?

C What are some examples?



FUNCTION The word *function* can describe a job: Sam's *function* is as a team coach. The word *function* can also describe a purpose: The *function* of a dam is to hold back water. *Function* can also describe an event: A PTA open house is a school *function.*

In math, a *function* is a special kind of relationship, in which an output's value depends on an input.

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GAME

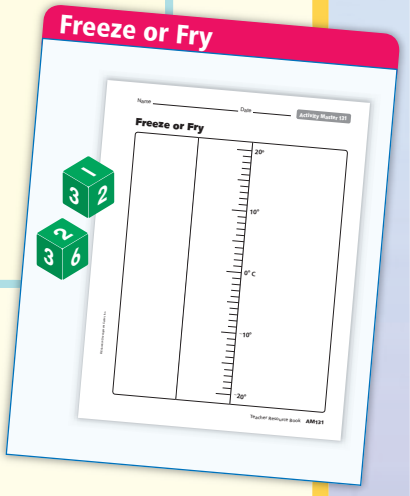
Freeze or Fry

Game Purpose

To practice adding and subtracting Celsius temperatures

Materials

- Activity Master 131: *Freeze or Fry* game board
- Paper bag
- Number cubes (2 of one color, 2 of another color)
- Small objects to use as game tokens (1 for each player)



How To Play The Game

1. This is a game for two players. You will need the game board, paper bag, and two sets of number cubes. Each player needs one token.

2. Put the four number cubes in the paper bag. Choose which color will mean a temperature increase and which will mean a temperature decrease.

3. Put your tokens at 0° Celsius. Decide who will go first.

4. Without looking, take two number cubes from the bag. Toss them.
   - The colors of the cubes show whether the temperature increases or decreases. The numbers tossed show how many degrees to increase or decrease.
   - Combine the result of the toss to find how many degrees, and in which direction, to move your token.

   Example: Blue means increase. Green means decrease.

   Blue 4 means to increase 4°. Green 1 means to decrease 1°.

   So, move your token up a total of 3°.

5. Put the cubes back in the bag for the next player's turn. Play until one player's token goes above the highest temperature or below the lowest temperature on the thermometer.

GAME

Coordinate Hide-and-Seek

Game Purpose
To practice using ordered pairs to name and locate points

Materials
- Activity Master 134: *Blank Grid*
- Small objects to use as game tokens (1 for each player)
- Manila folder

How To Play The Game

1. This is a game for two players. Each player needs one blank grid and one game token. Sit opposite each other. Stand the manila folder between your grids.

2. Secretly place the token on your grid. The token must be placed at an intersection of two grid lines.

3. Take turns guessing the location of the other player's token.
   - You may ask only one question on each turn.
   - The question must have a *yes* or *no* answer.

   These are examples of questions you may ask:
   - Is it at (3,4)?
   - Is it to the left of (3,4)?
   - Is the first coordinate positive?
   - Is the second coordinate 3?

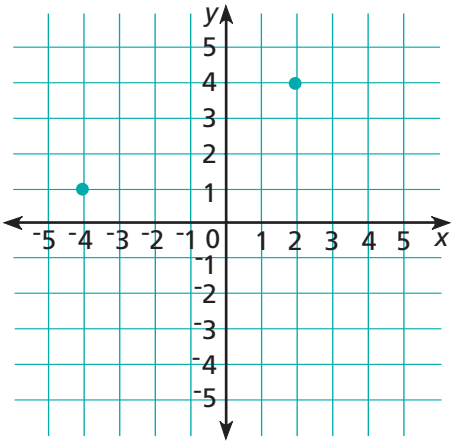
   Record your responses. You can use counters (in a different color from yours) to track the responses on your grid. Or you can mark the responses directly on your grid.

4. The first player to locate the other player's token is the winner. Play as many games as time allows.

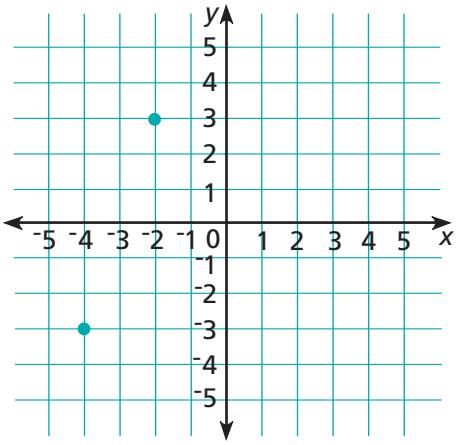
CHALLENGE

Find the missing point or points on each grid. Then write the ordered pair for each point in the figure. Hint: You may want to use a blank grid to draw the figures. There may be more than one answer.

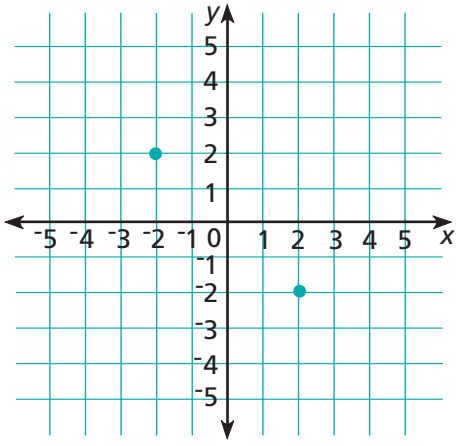
1 Two more points are needed to make a rectangle.



2 One more point is needed to make a right triangle.



3 Two more points are needed to make a square.



4 Two more points are needed to make a trapezoid.