4 BRIDGES IN MATHEMATICS

GRADE 4 SUPPLEMENT

Set C5 Geometry: Coordinate Systems

Includes

Skills & Concepts

★ use coordinate systems to specify locations and shapes on a grid with ordered pairs

★ describe paths from one point to another point on a grid

★ multiply 1- and 2-digit numbers by 10 and 100

Bridges in Mathematics Grade 4 Supplement
Set C5 Geometry: Coordinate Systems

Bridges in Mathematics is a standards-based K–5 curriculum that provides a unique blend of concept development and skills practice in the context of problem solving. It incorporates the Number Corner, a collection of daily skill-building activities for students.

The Math Learning Center is a nonprofit organization serving the education community. Our mission is to inspire and enable individuals to discover and develop their mathematical confidence and ability. We offer innovative and standards-based professional development, curriculum, materials, and resources to support learning and teaching. To find out more, visit us at www.mathlearningcenter.org.

Set C5 ★ Activity 1

ACTIVITY

Coordinate Place Four

Overview

Coordinate Place Four is a game in which players take turns placing markers on a grid by identifying ordered pairs. The object of the game is to be the first to place 4 markers in a horizontal, vertical, or diagonal line, while blocking the other player from doing so. A more challenging version of the game involves being first to form a square with 4 markers on the board. The teacher introduces Coordinate Place Four to the whole class, and then students play the game in pairs.
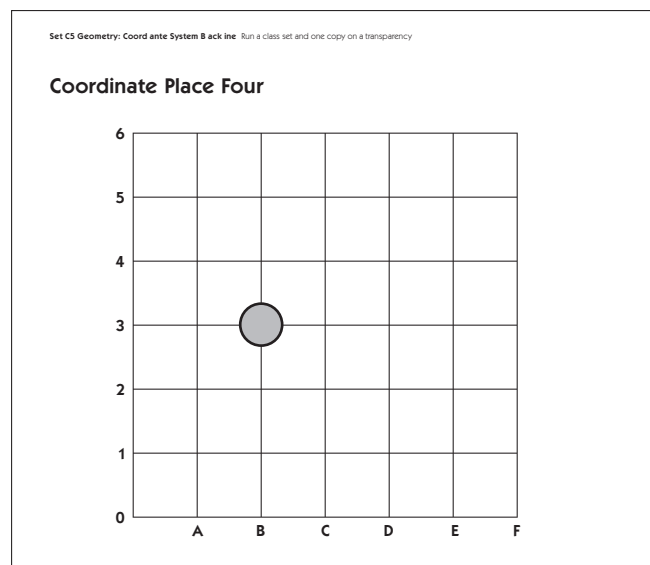
Skills & Concepts

★ use coordinate systems to specify locations and shapes on a grid with ordered pairs

You'll need

★ Coordinate Place Four Game Board (page C5.6, run a class set and 1 copy on a transparency)

★ 12 red and 12 blue game markers

★ overhead pen

★ game markers (each student will need 12 markers in a single color)

★ helper jar containing a popsicle stick for each child with his/her name on it

Instructions for Coordinate Place Four

1. Display the Coordinate Place Four overhead. Give students a few moments to examine the game board quietly. Then explain that you are going to play a new game with the class. The game will help them learn to locate positions on a grid by naming *coordinates*, which are ordered pairs of numbers, or in this case, ordered pairs of letters and numbers. Illustrate the idea of coordinates by placing a game marker at one of the intersections on the grid. Ask students to identify the location of the marker as precisely as possible.

Set C5 Geometry: Coord ante System B ack ine Run a class set and one copy on a transparency

Coordinate Place Four

Activity 1 Coordinate Place Four (cont.)

> **Students** *It's up in the third row.*
> *The marker is over from the beginning of the grid.*
> *It's in the B column.*
> *It's at B, 3.*

2. On the overhead or at the board, write the ordered pair, or *coordinates*, that describes the location of the marker, and explain the notation to the class.

<p style="text-align:center">(B, 3)</p>

> **Teacher** *We can describe the location of the marker very precisely by telling which column and which row it's in. We write the letter of the column first (B), and then the number of the row (3). B and 3 are the coordinates of the marker. Since we write them in order, they are also called an ordered pair.*

3. Move the game marker to several other points on the grid, and ask students to report the ordered pair that gives the location of the marker each time. Then give each student a copy of the game board blackline. Write several ordered pairs on the board, and ask the children to place their finger on each as you go.

<p style="text-align:center">(C, 3)   (B, 6)   (E, 0)   (F, 6)</p>

4. Explain that in the game of Coordinate Place Four, you will take turns with the class to place markers on the grid. The first team to place 4 markers in a horizontal, vertical, or diagonal row wins the game. It is fair to block the other team from getting 4 in a row. Tell the students that you will use the blue markers, and they will use the red. Explain that a team has to record the coordinates they want on one of the lines below the grid before they can place a marker. Then take the first turn.

> **Teacher** *Here are the coordinates I want for my first marker.* (Teacher records B, 2 and places a blue marker there).

Activity 1 Coordinate Place Four (cont.)

 5. Have students pair-share ideas about where the class should place their first red marker. After they have had a minute to talk it over, pull a stick from your helper jar to select a student to take a turn for the class. Ask the rest of the students to remain silent as their classmate records the ordered pair on the overhead and places the marker in the corresponding location.

6. Take turns with the class recording ordered pairs and placing markers. Block the class at the first opportunity, and explain your thinking as you do so.

Set C5 Geometry: Coordinate System Blackline   Run a class set and one copy on a transparency

Coordinate Place Four

Team 1		Team 2	
(B , 2)①	(___ , ___)⑦	(D , 4)①	(___ , ___)⑦
(C , 1)②	(___ , ___)⑧	(D , 5)②	(___ , ___)⑧
(D , 3)③	(___ , ___)⑨	(___ , ___)③	(___ , ___)⑨
(___ , ___)④	(___ , ___)⑩	(___ , ___)④	(___ , ___)⑩
(___ , ___)⑤	(___ , ___)⑪	(___ , ___)⑤	(___ , ___)⑪
(___ , ___)⑥	(___ , ___)⑫	(___ , ___)⑥	(___ , ___)⑫

Teacher *I got a little nervous that you might try to make a vertical row of 4. Can you see why I put my marker on (D, 3)?*

Students *So you can block us.*
Let's block Mrs. Sayles on our next turn.
Oh, I know where to put our next marker! I hope she pulls out my stick next!

7. Continue to take turns with the class until one team has placed 4 markers in a row, or until both teams have used all 12 of their markers. If neither team has been able to place 4 in a row by the time all the markers have been used, call it a draw, erase the overhead, and play the game again.

8. When students understand how to play Coordinate Place Four, have them each play the game with a partner. Each pair will need one game board (have them set the second one aside for now), and 24 game markers (12 each in two different colors). Have pairs flip a coin or play Rock, Paper, Scissors to decide which partner will go first. Circulate as children are playing the game to visit with them about their

Activity 1 Coordinate Place Four (cont.)

strategies for winning, and to give assistance as needed. If some pairs finish before others, have them use the other partner's game board to play a second time.

Extensions

• Introduce a more challenging version of Coordinate Place Four during the same instructional period or at some other time. This version is played the same as the original, but the object of the game is to be the first team (or the first player) to place 4 game markers in a square. The completed games below illustrate some of the ways in which squares can be formed on the grid.

Coordinate Place Four

Team 1		Team 2	
(_A_ , _5_)①	(___ , ___)⑦	(_D_ , _3_)①	(___ , ___)⑦
(_E_ , _5_)②	(___ , ___)⑧	(_B_ , _3_)②	(___ , ___)⑧
(_B_ , _3_)③	(___ , ___)⑨	(_B_ , _1_)③	(___ , ___)⑨
(_D_ , _1_)④	(___ , ___)⑩	(_D_ , _4_)④	(___ , ___)⑩
(_E_ , _1_)⑤	(___ , ___)⑪	(_C_ , _4_)⑤	(___ , ___)⑪
(_A_ , _1_)⑥	(___ , ___)⑫	(___ , ___)⑥	(___ , ___)⑫

Coordinate Place Four

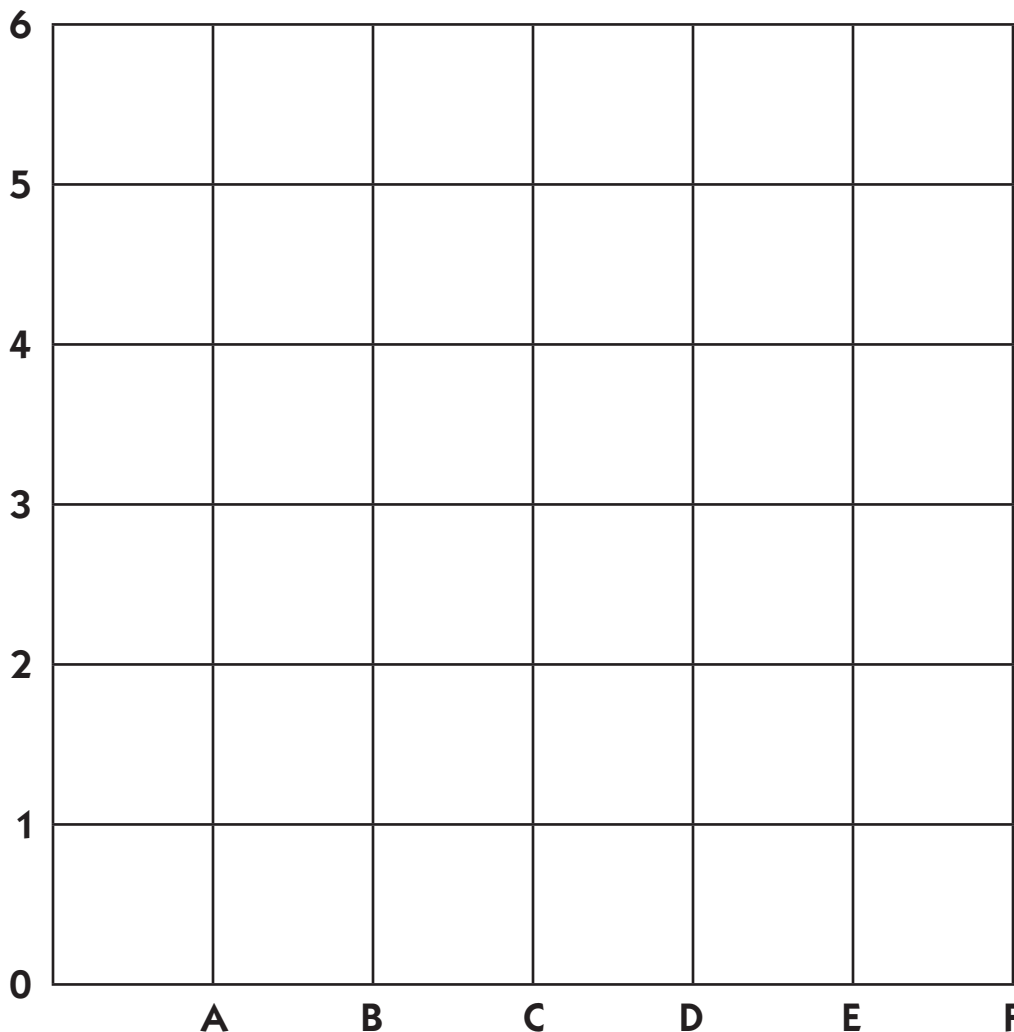| Team 1		Team 2	
(_A_ , _1_)①	(___ , ___)⑦	(_E_ , _5_)①	(___ , ___)⑦
(_C_ , _3_)②	(___ , ___)⑧	(_E_ , _2_)②	(___ , ___)⑧
(_A_ , _3_)③	(___ , ___)⑨	(_C_ , _1_)③	(___ , ___)⑨
(_A_ , _5_)④	(___ , ___)⑩	(_C_ , _5_)④	(___ , ___)⑩
(_B_ , _4_)⑤	(___ , ___)⑪	(_B_ , _5_)⑤	(___ , ___)⑪
(_B_ , _2_)⑥	(___ , ___)⑫	(___ , ___)⑥	(___ , ___)⑫

Coordinate Place Four

Activity 1 Coordinate Place Four (cont.)

INDEPENDENT WORKSHEET

Use Set C5 Independent Worksheet 1 to provide students with more practice using coordinate systems to specify locations on a grid with ordered pairs.

Coordinate Place Four

Team 1		Team 2	
(_____ , _____) ①	(_____ , _____) ⑦	(_____ , _____) ①	(_____ , _____) ⑦
(_____ , _____) ②	(_____ , _____) ⑧	(_____ , _____) ②	(_____ , _____) ⑧
(_____ , _____) ③	(_____ , _____) ⑨	(_____ , _____) ③	(_____ , _____) ⑨
(_____ , _____) ④	(_____ , _____) ⑩	(_____ , _____) ④	(_____ , _____) ⑩
(_____ , _____) ⑤	(_____ , _____) ⑪	(_____ , _____) ⑤	(_____ , _____) ⑪
(_____ , _____) ⑥	(_____ , _____) ⑫	(_____ , _____) ⑥	(_____ , _____) ⑫

Set C5 ★ Activity 2

Dragon's Gold

Overview

Dragon's Gold is a game in which players take turns rolling a die and moving the designated number of spaces on a coordinate grid. There are gold coins of different values placed on some of the coordinate points, and five of the points are marked with stars that allow a player to multiply his or her score for a turn by 10. The object of the game is to get the highest score in 5 turns. The teacher introduces Dragon's Gold to the whole class, and then students play the game in pairs.

Skills & Concepts

★ use coordinate systems to specify locations and shapes on a grid with ordered pairs

★ describe paths from one point to another point on a grid

★ multiply 1- and 2-digit numbers by 10 and 100

You'll need

★ Dragon's Gold (page C5.11, run a class set and 1 copy on a transparency)

★ Dragon's Gold: Blank (page C5.12, optional, run as needed)

★ dice dotted or numbered from 1–6 (1 for each pair of students)

★ red and blue game markers

★ helper jar containing a popsicle stick for each child with his/her name on it

★ Student Math Journals or scratch paper

Instructions for Dragon's Gold

1. Display the Dragon's Gold overhead. Give students a few moments to examine the game board quietly. Then explain that you are going to play a new game with the class. The game will help them practice naming coordinates, and learn to describe paths from one point to another point on a grid.
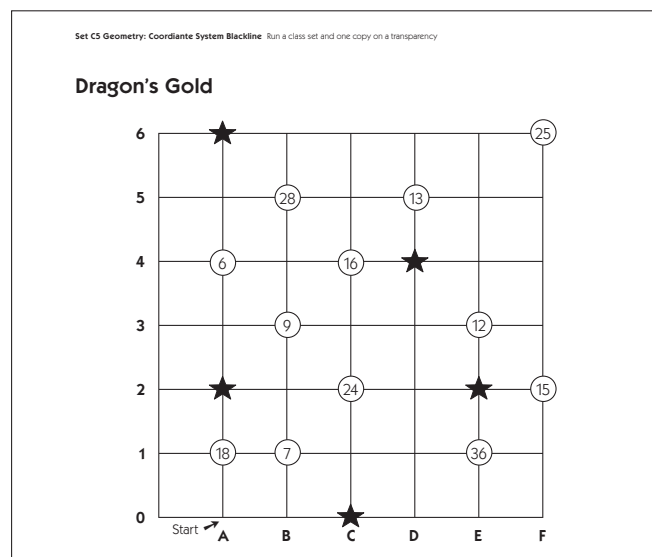
Activity 2 Dragon's Gold (cont.)

2. Explain that in the game of Dragon's Gold, each team places a red or a blue marker on the coordinates (A, 0) to start. Teams take turns rolling a die numbered 1–6 and moving their game marker that many spaces on the grid. Teams have to stay on the grid lines as they move from one point to the next; they can move their marker forward, backward, or sideways, but not diagonally. A team collects the value of any gold pieces they land on along the way. If a team lands on a star during their turn, they get to multiply their total for that turn by 10. If they land on 2 stars during a single turn, they get to multiply their total for that turn by 100.

3. After you have explained the game rules, give students each a copy of the game board. Then ask one of them to roll the die so you can demonstrate the process.

> **Teacher** Let's do a demonstration run together. Jose, will you please roll the die for us? What did we get? 5? Okay, we're going to start on (A, 0). We get to move 5 spaces because we rolled a 5. We have to move along the grid lines, so moving 1 space would mean we could get to (A, 1) and collect a gold piece worth 18 points, or (B, 0) where we couldn't collect anything.

> **Sari** Couldn't we go from (A, 0) up to (B, 1)?

> **Teacher** Nope. Why not?

> **Students** Because you have to stay on the lines.
> You can't go diagonal in this game, only up, down, and sideways.
> But Jose rolled a 5. We get to move 5 spaces, not just 1.

4. Have students pair-share ideas about some of the possible paths they could take, given the number their classmate just rolled. Which path would result in the highest score? Ask them to use their own game boards to plan the best path. After they have had a minute or two to talk, ask a volunteer to share his or her idea with the class by telling you how to move the marker. Trace the suggested path with an overhead pen so everyone can see it.

> **Max** We think you can get the highest score if you move the marker up 3 spaces and over to the right 2 spaces.
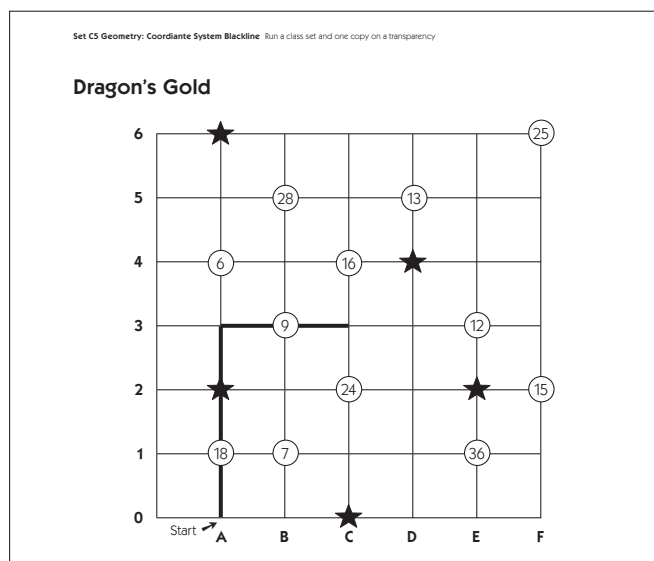
Activity 2 Dragon's Gold (cont.)

> **Students** *Wow! If you go Max's way, you land on a star.*
> *So we'd have 18 + 9 is 27, and then we'd get to multiply 27 by 10. That's 270 points, just for one turn!*
> *We have a different idea that gets more points.*
> *So do we! Can we show?*
> *If you go over to the right 4 and up 1, you can get 360 point because it's 36 × 10.*
> *There's an even better way. If you go up 2 and over to the right 3, you land on 18 and a star and 24. That's 42 × 10 which is 420 points!*
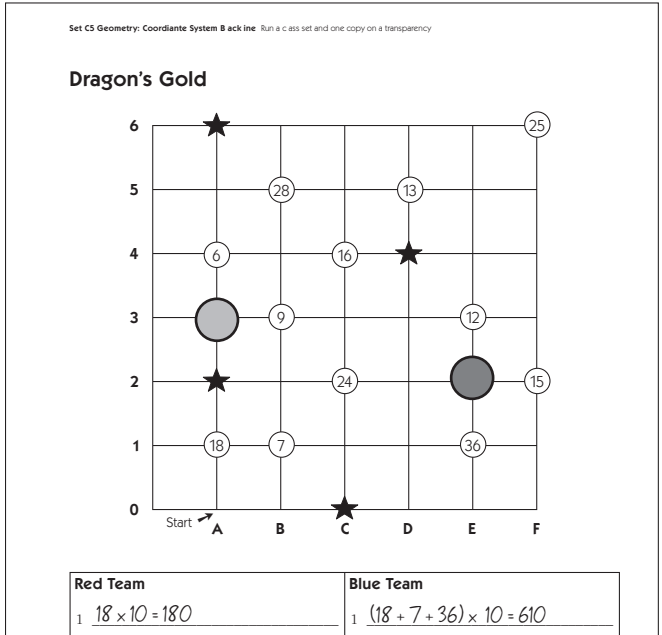
5. After students have had a chance to discuss some of their ideas, erase the overhead. Place a red and a blue game marker near the start point at coordinates (A, 0). Take your turn first so students have the benefit of seeing the game in action once more before it is their turn. Roll the die, decide on the best path, and record it on the board so the students can see it.

> **Teacher** *I am going to play as the red team today, and you will all work together as the blue team. Here I go. I rolled a 3. Let me think for a minute. Okay, here's the path I am planning to take. I think I can get the most points this way. Put your thumbs up if you agree.*

Mrs. Nolan's Paths

Start at (A, 0). Move up 3 spaces.

6. Move your marker according to the plan you just recorded. Work with input from the class to record an equation for your turn on the overhead. Then have a volunteer roll the die for the class. Ask students to work in pairs to determine the path that will yield the highest score for their team. Let them know that it is okay if they land on the same coordinates as you. When they have had a minute or two to work, pull a stick from your helper jar to choose a student to share his or her plan with the class. Record the proposed path on the board so everyone can see it, and then have the student move the marker accordingly. Work with input from the class to record an equation for their first move.

Set C5 Geometry: Coordiante System B ack ine   Run a c ass set and one copy on a transparency

Dragon's Gold

Red Team	Blue Team
1 $18 \times 10 = 180$	1 $(18 + 7 + 36) \times 10 = 610$

Kids' Paths

Start at (A, 0). Move up 1 space, to the right 4 spaces, and up 1 space.

Activity 2 Dragon's Gold (cont.)

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Note *It is okay to choose a path that does not yield the highest possible score. As students become familiar with the game, they will get more adept at finding the most productive paths.*

....

7. When it is your turn again, explain that you have to start from the point you landed on the last time around. Roll the die, plan your route, record your proposed path on the board, and move your marker accordingly. Then work with input from the students to record an equation for your second turn.

8. Continue to take turns with the students until both teams have had 5 turns. Ask students to add the totals for both teams and determine the winner. When you have completed the game, have students each play Dragon's Gold with a partner. Each pair will need one game board (have them set the second one aside for now), 1 blue and 1 red game marker, a die numbered or dotted 1–6, and their math journals or scratch paper. Let students know that they will need to record their proposed path for each turn in their journal or on a piece of scratch paper and show it to their partner before they make their move. Have pairs flip a coin or play Rock, Paper, Scissors to decide which partner will go first. Circulate as they are playing the game to observe, and to give assistance as needed. If some pairs finish before others, have them use the other partner's game board to play the game a second time.

Extensions

- Allow children to use calculators to determine their totals for each turn. This may be especially useful for students who don't already know how to multiply by 10 and 100. After inputting the first few combinations, they may set the calculator aside, confident that 13×10 is 130, 27×10 is 270, and so on.
- Consider running additional copies of the game board and adding Dragon's Gold to your Work Places.
- Run copies of the Blank game board (page C5.12) and let students enter their own values on the coins before they play the game again.
- Give students 1″ graph paper, and let them design and play their own coordinate grid games.
- If you have a computer in your classroom with Internet access, some of your students may enjoy two of the applets found on the Utah State National Library of Virtual Manipulatives web site: *Ladybug Leaf* and *Ladybug Mazes*. The web site is free to all, and can be accessed at http://nlvm.usu.edu. Follow the links to the Grades 3–5 geometry section, where you'll find a variety of applets including *Ladybug Leaf* and *Ladybug Mazes*. Both of these activities involve programming a ladybug around the screen to either hide behind a leaf (easier) or move through a maze (more challenging). Both provide good practice at describing paths from one point to another point. Instructions are included with each applet on the web site, along with suggestions for parents and teachers. Another applet students may enjoy is *Turtle Geometry*, also found on the National Library of Virtual Manipulatives web site.
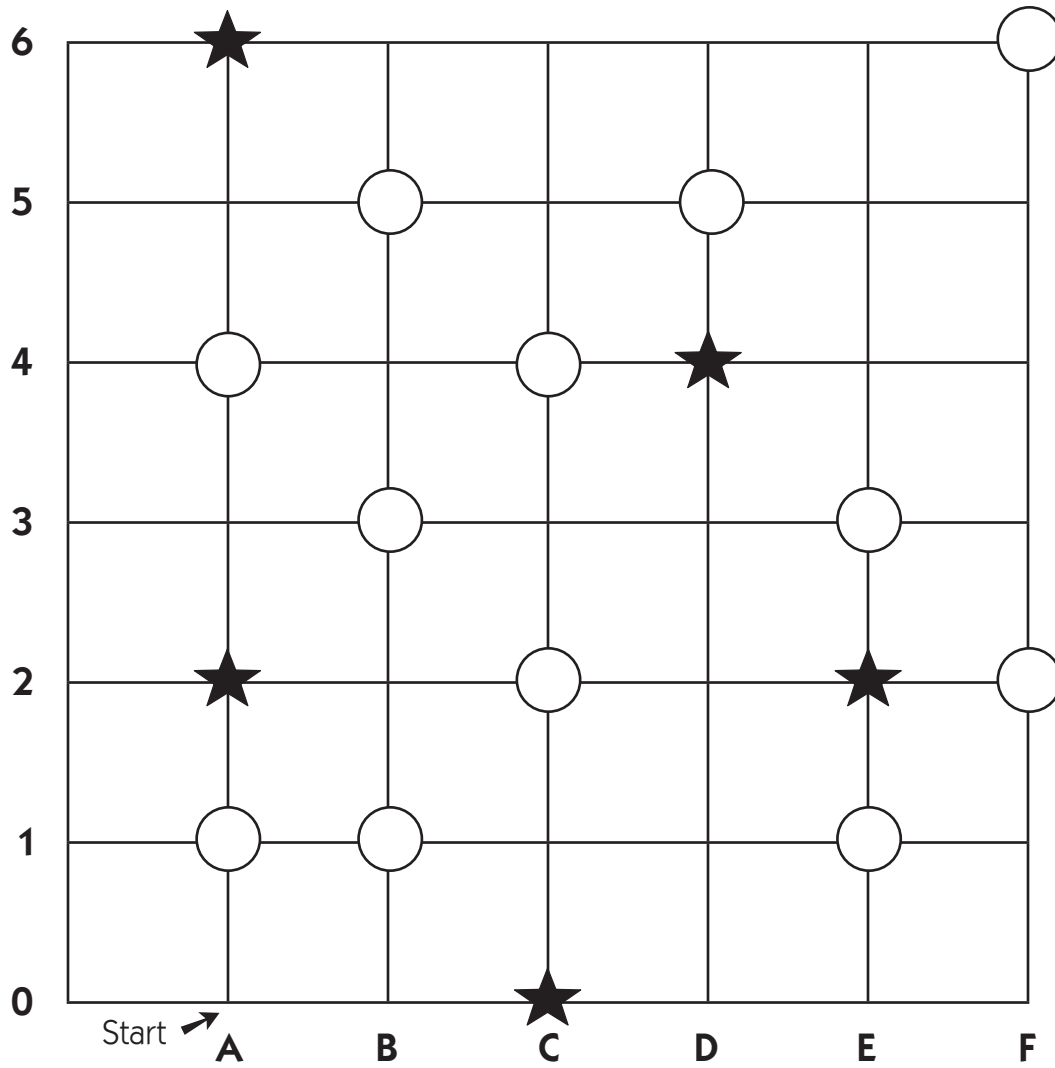
INDEPENDENT WORKSHEET

Use Set C5 Independent Worksheets 2–4 to provide students with more practice using coordinate systems to specify locations and shapes on a grid with ordered pairs, and describing paths from one point to another on a grid.

Dragon's Gold
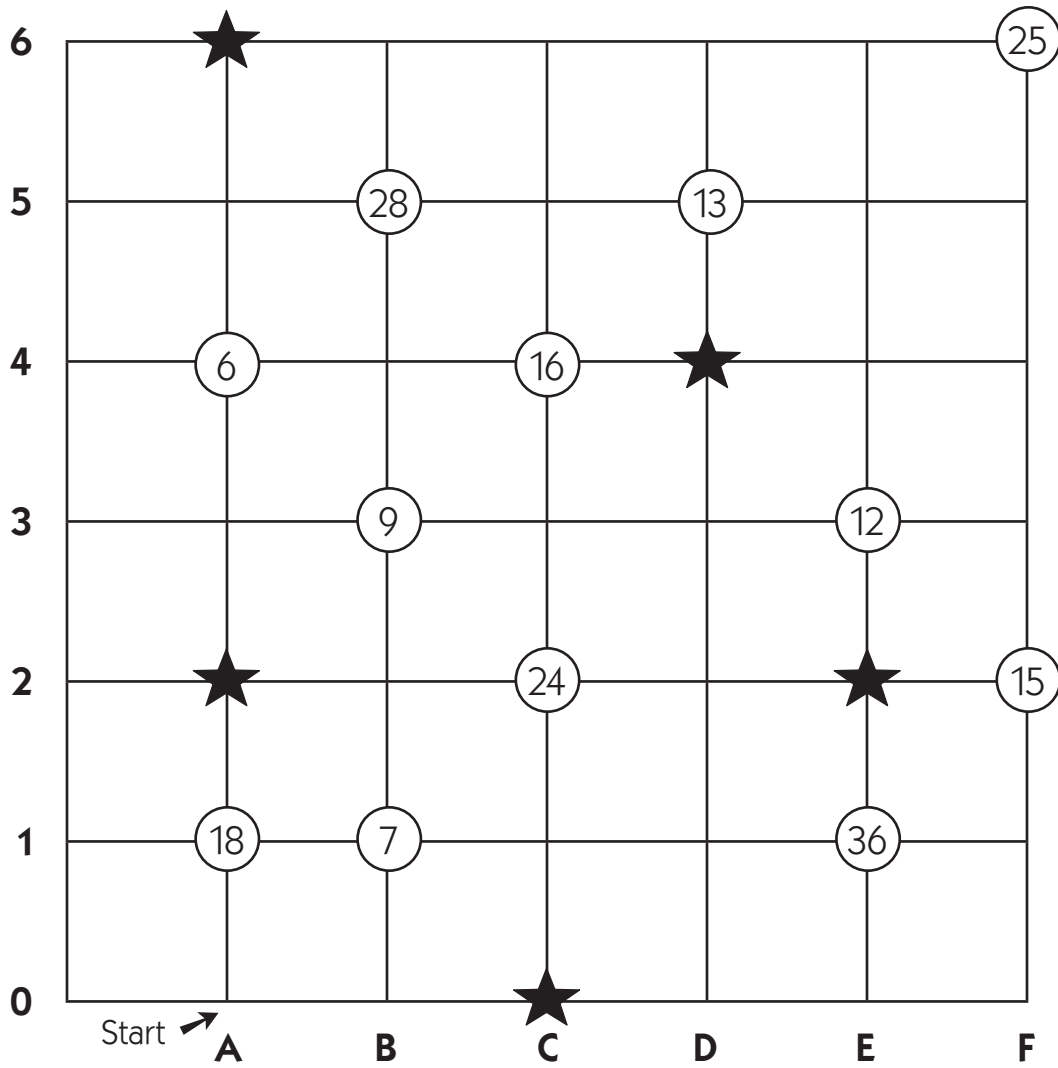
Red Team	Blue Team
1 _____	1 _____
2 _____	2 _____
3 _____	3 _____
4 _____	4 _____
5 _____	5 _____
Total Score _____	Total Score _____

Dragon's Gold Blank

Red Team	Blue Team
1 _____	1 _____
2 _____	2 _____
3 _____	3 _____
4 _____	4 _____
5 _____	5 _____
Total Score _____	Total Score _____

NAME _____   DATE _____

Set C5 ★ Independent Worksheet 1

INDEPENDENT WORKSHEET

Coordinate Dot-to-Dots

1 On each of the grids below, draw and number a dot at each of the ordered pairs on the list. Connect the dots in order to make a picture. The first dot is drawn for you.

a (A, 5) ①
(A, 1) ②
(E, 1) ③
(E, 2) ④
(D, 2) ⑤
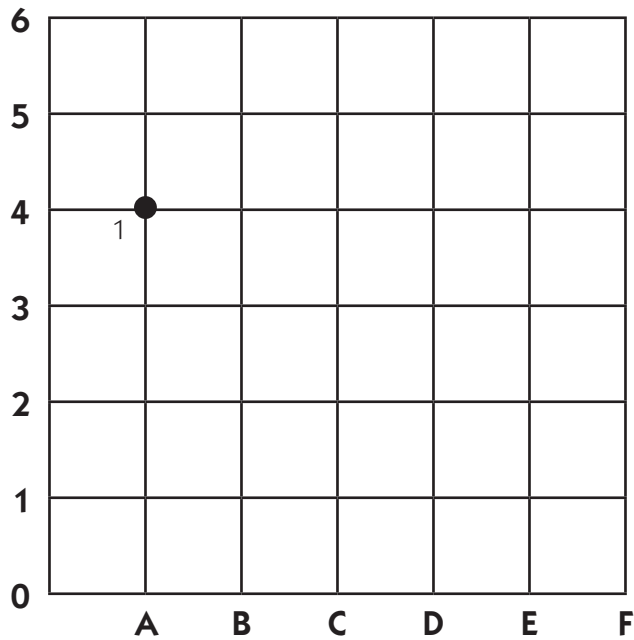(D, 3) ⑥
(C, 3) ⑦
(C, 4) ⑧
(B, 4) ⑨
(B, 5) ⑩
(A, 5) ⑪
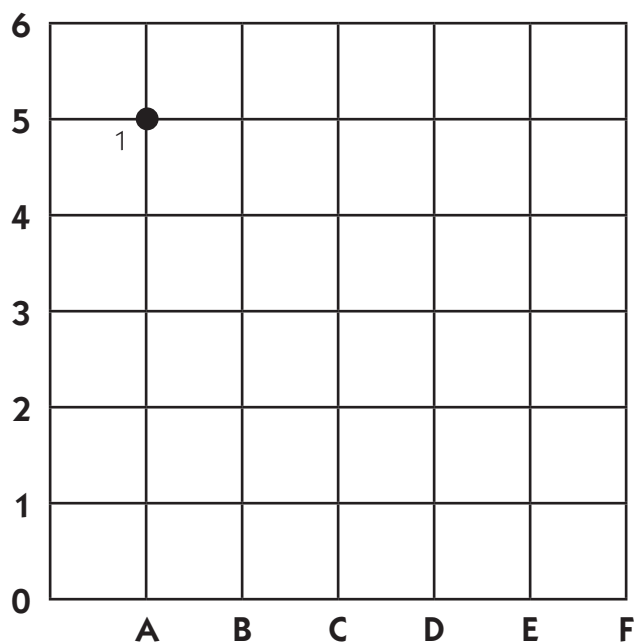
b (A, 2) ①
(B, 1) ②
(C, 1) ③
(D, 2) ④
(C ,2) ⑤
(C, 5) ⑥
(D, 3) ⑦
(B, 3) ⑧
(C, 5) ⑨
(C, 2) ⑩
(A, 2) ⑪
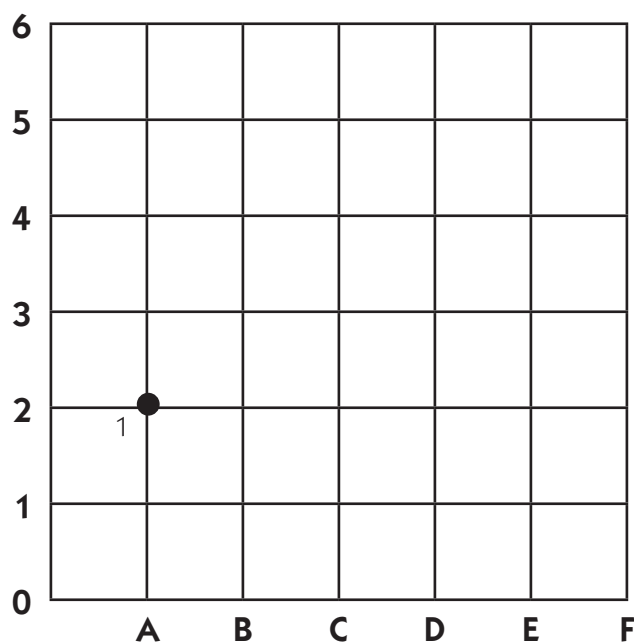
Independent Woksheet 1 Coordinate Dot-to-Dots (cont.)
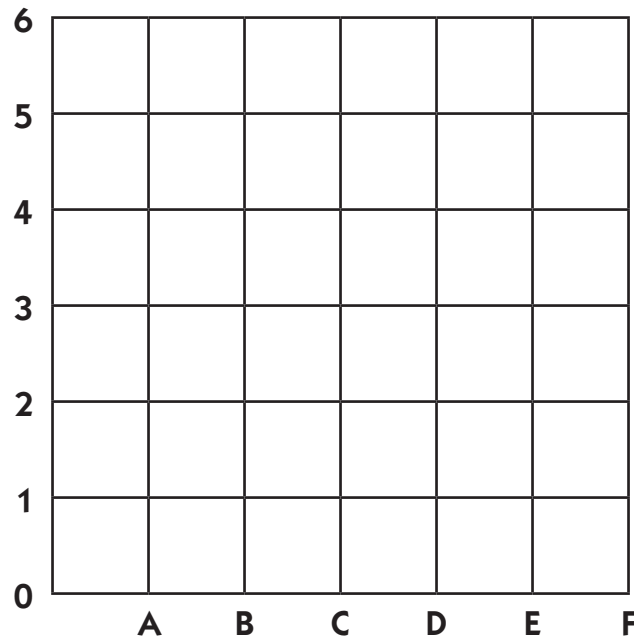
C (A, 4) ①
(D, 5) ②
(A, 3) ③
(C, 4) ④
(C, 1) ⑤
(B, 5) ⑥
(E, 3) ⑦
(A, 4) ⑧
(E ,4) ⑨

2 Make up your own dot-to-dot picture on the grid below. Use at least 12 dots for your picture. List the coordinates for your picture in order.

Coordinates:

(___ , ___) ①
(___ , ___) ②
(___ , ___) ③
(___ , ___) ④
(___ , ___) ⑤
(___ , ___) ⑥
(___ , ___) ⑦
(___ , ___) ⑧
(___ , ___) ⑨
(___ , ___) ⑩
(___ , ___) ⑪
(___ , ___) ⑫
(___ , ___) ⑬
(___ , ___) ⑭
(___ , ___) ⑮
(___ , ___) ⑯
(___ , ___) ⑰

NAME _____ DATE _____

Set C5 ★ Independent Worksheet 2

INDEPENDENT WORKSHEET

Robot Programs

1 Robbie built a robot to run on this grid. It can only move on the grid lines up, down, and sideways. He wrote a program to get the robot to make a square on the grid. Does Robbie's program work? Follow the steps by drawing on the grid to find out.

- Start at coordinates (A, 2) and go up 3 spaces.
- Turn and go right 3 spaces.
- Turn and go down 3 spaces.
- Turn and go left 3 spaces.

Does the program work to make a square?
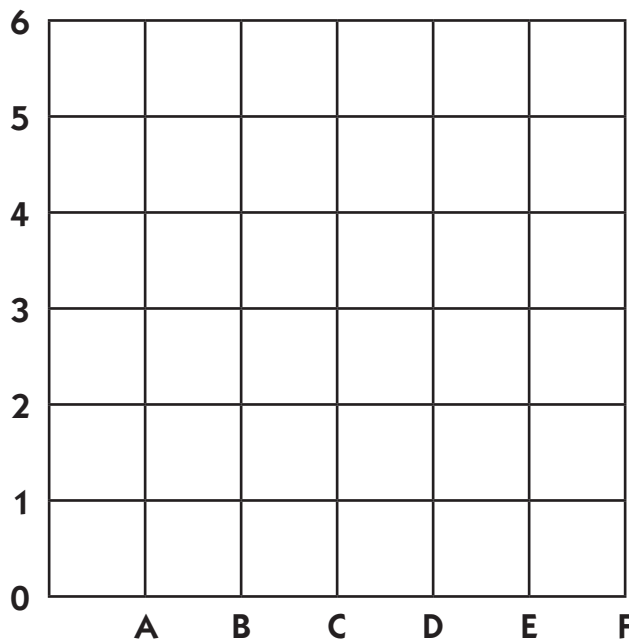
2 Robbie wrote another program. Follow the steps by drawing on the grid to find out what shape the robot will make.

- Start at coordinate (E, 0) and go up 6 spaces.
- Turn and go left 4 spaces.
- Turn and go down 6 spaces.
- Turn and go right 4 spaces.

What shape will the robot make on the grid when it follows this program?

Set C5 Geometry: Coordinate Systems Blackline Run a class set.
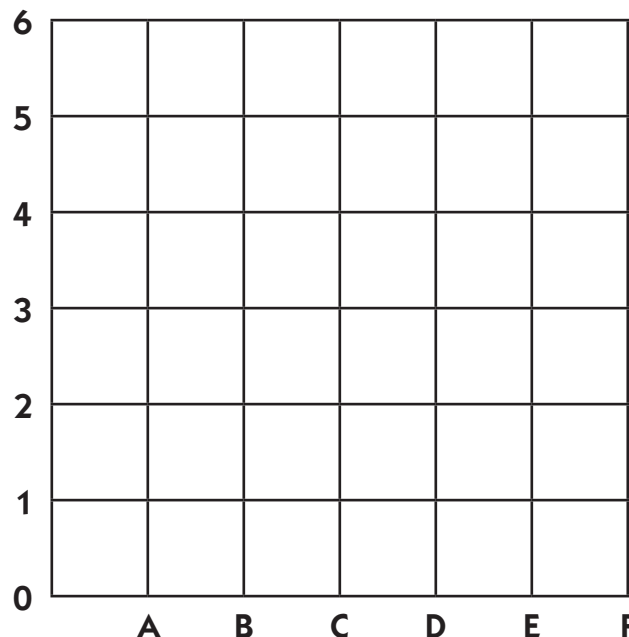
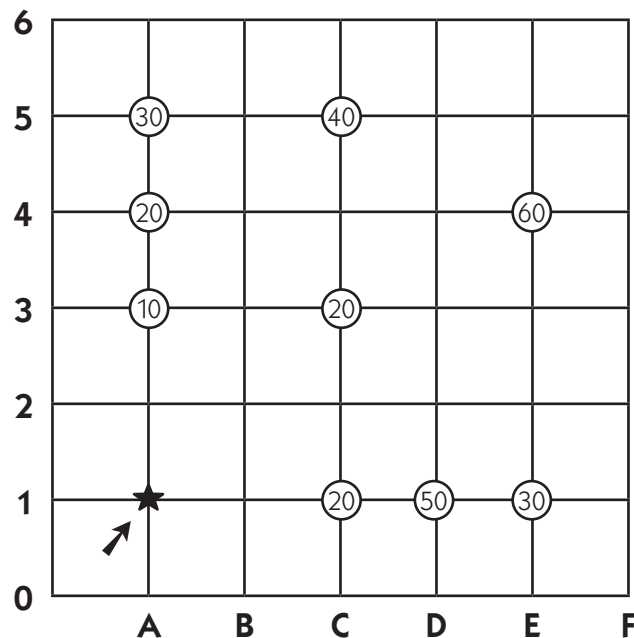**NAME** _____   **DATE** _____

Set C5 ★ Independent Worksheet 3

Pirate James & His Robot

Pirate James programmed a robot to collect gold pieces for him. The numbers on the grid show how many gold pieces are at each location. The robot started at (A,1). It made just 3 turns and traveled 14 spaces before returning to its starting point with exactly 170 gold pieces. The robot only traveled on the horizontal and vertical grid lines. At which 3 points on the grid did the robot make its turns?

Hint *If the robot starts at (A, 1) and makes only 3 turns before it comes back to where it started, what shape is its path?*

The robot turned at coordinates (___, ___), (___, ___) and (___, ___).

Set C5 ★ Independent Worksheet 4

INDEPENDENT WORKSHEET

Rosa's Robot

Pirate Rosa built a robot to go out and collect treasure for her. She needs to program the robot so it knows where to go on the map.

The robot can collect no more than 45 gold coins before it has to come back, and it can only travel along the grid lines. It can travel only 30 spaces before it runs out of fuel.

Help Pirate Rosa program the robot to collect as much treasure as it can carry and return to the starting point before it runs out of fuel. Draw on the map at right, and keep track of the robot's moves on the table below.

Start
(A, 0)
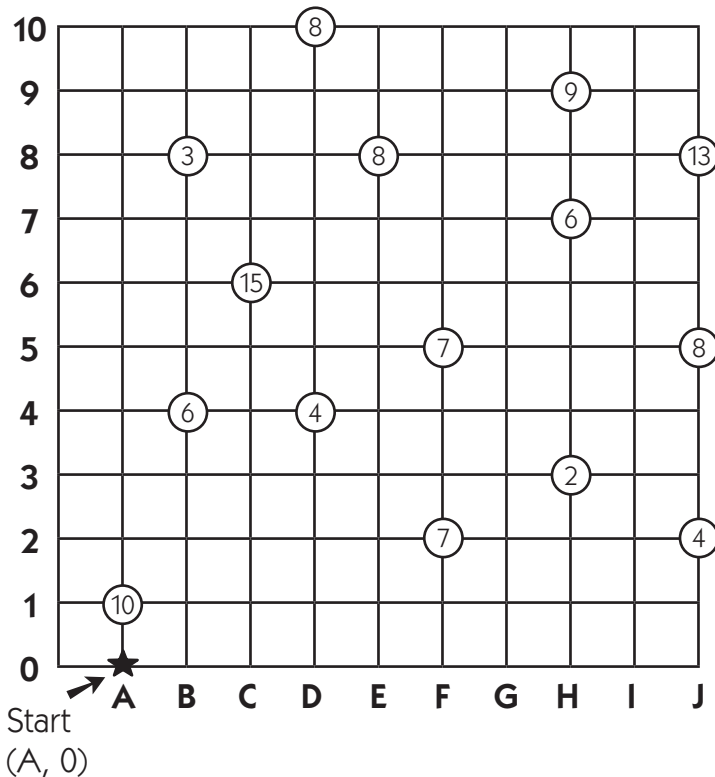
Destination Coordinates	Spaces Moved	Running Total of Spaces Moved	Coins Collected	Running Total of Coins Collected