

Points on the Coordinate Plane

Goals

- Generalize the signs of coordinates that represent locations in each quadrant of the coordinate plane.
- Plot a point given its coordinates, or identify the coordinates of a given point on the coordinate plane.
- Recognize that the axes of the coordinate plane can be extended to represent negative numbers.

Learning Targets

- I can describe a coordinate plane that has four quadrants.
- I can plot points with negative coordinates in the coordinate plane.
- I know what negative numbers in coordinates tell us.

Lesson Narrative

In this lesson, students make use of structure when they extend the coordinate axes, expanding the coordinate plane to where positive and negative numbers appear on both the horizontal and vertical axes. The crossing axes create **quadrants**, the four regions of the coordinate plane.

Students begin the lesson by revisiting ordered pairs in order to describe the location of three points in the coordinate plane. They continue to practice identifying the coordinates of points as well as which quadrant a point is located in. Students gain additional experience by choosing, plotting, and writing the coordinates of points in order to hit targets drawn in the coordinate plane.

Student Learning Goal

Let's explore and extend the coordinate plane.

Lesson Timeline

5
min

Warm-up

15
min

Activity 1

15
min

Activity 2

10
min

Lesson Synthesis

Assessment

5
min

Cool-down

Access for Students with Diverse Abilities

- Representation (Activity 1)

Access for Multilingual Learners

- MLR2: Collect and Display (Activity 2)
- MLR8: Discussion Supports (Activity 1)

Student Workbook

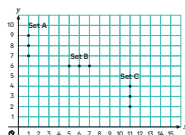
LESSON 11

Points on the Coordinate Plane

Let's explore and extend the coordinate plane.

Warm-up Guess My Line

Choose 1 set of points, and write the coordinates of each of the 3 points in the set. What do you notice about the coordinates?



11

GRADE 6 • UNIT 7 • SECTION C | LESSON 11

Warm-up

Guess My Line

5 min

Activity Narrative

The purpose of this *Warm-up* is for students to review graphing and locating points in the first quadrant of the coordinate plane. Students observe the structure of horizontal and vertical lines when they compare points on the same line and notice which coordinate of the ordered pair changes and why.

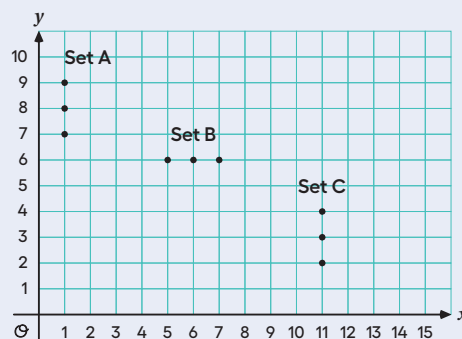
Launch

Give students 2 minutes of quiet work time, and follow with a whole-class discussion.

If necessary, display the ordered pair (x, y) or (horizontal, vertical) to remind students of the order.

Student Task Statement

Choose 1 set of points, and write the coordinates of each of the 3 points in the set. What do you notice about the coordinates?



Set A: $(1, 7)$, $(1, 8)$, and $(1, 9)$

All 3 points have the same x -coordinate.

Set B: $(5, 6)$, $(6, 6)$, and $(7, 6)$

All 3 points have the same y -coordinate.

Set C: $(11, 2)$, $(11, 3)$, and $(11, 4)$

All 3 points have the same x -coordinate.

Activity Synthesis

The key takeaway of this discussion is that points on the same horizontal line share the same y -coordinate and points on the same vertical line share the same x -coordinate. Invite 3 or 4 students to share the coordinates of their 3 points. After each student shares, ask the rest of the class if the given points are on the same horizontal or vertical line and to explain how they know. To help guide the conversation, consider asking some of the following questions:

☞ “What are the coordinates of some other points on the same line?”

“How far is each of the points from one another?”

“How far is each point from the x -axis and the y -axis?”

Activity 1

The Coordinate Plane

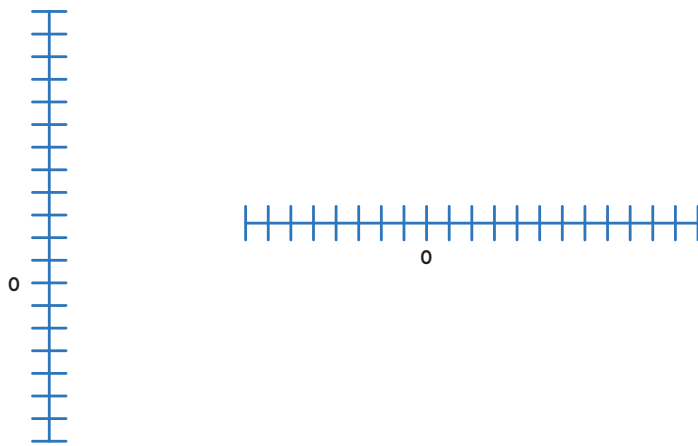
15
min

Activity Narrative

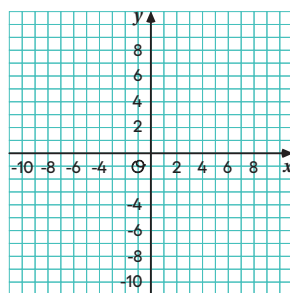
In this activity, students make use of structure as they extend the vertical and horizontal axes to include four regions, called quadrants, just as they extended the number line to include negative numbers. They use ordered pairs to plot and label coordinates and identify their quadrants.

Launch

Display an image of both a vertical and a horizontal number line for all to see:



Explain that just as we extended horizontal and vertical number lines in previous lessons to include negative numbers, we can extend both the number lines of the coordinate plane (the axes) to include negative coordinates. Then display an image of a coordinate plane:



Use the word **quadrant** to describe the four regions of the coordinate plane. It may be helpful to explain that the prefix “quad-” means “4” and give other examples from English and other languages that have a prefix with the same meaning (quadriceps, quadrilateral, *cuatro* [KWA-troh]).

Give students 7–8 minutes of quiet work time, and follow with a whole-class discussion.

Access for Students with Diverse Abilities (Activity 1, Launch)

Representation: Develop Language and Symbols.

Provide students with access to a reference that shows the locations of the x - and y -axes and explains that the first number in a coordinate pair represents the x -coordinate value, while the second number in the coordinate pair represents the y -coordinate value.

Supports accessibility for: Language, Memory

Access for Multilingual Learners (Activity 1, Synthesis)

MLR8: Discussion Supports

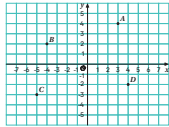
Display sentence frames to support students in producing statements about features of the quadrants that have negative and positive numbers. Examples: "Point _____ is in Quadrant _____ because _____."

Advances: Speaking, Conversing

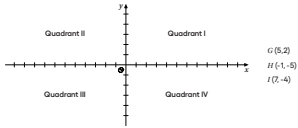
Student Workbook

The Coordinate Plane

- Write the coordinates of each labeled point.



- Plot a point at $(-2, 5)$. Label it E .
- Plot another point at $(3, -4.5)$. Label it F .
- The coordinate plane is divided into four **quadrants**: I, II, III, and IV, as shown here.



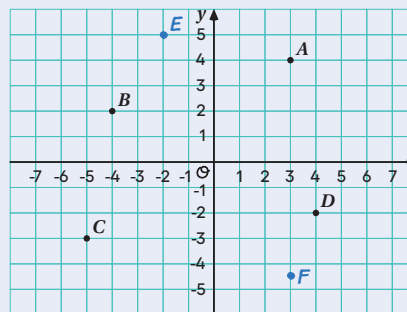
In which quadrant is point G located? Point H ? Point I ?

If a point has a positive y -coordinate, in which quadrants could it be?

GRADE 6 • UNIT 7 • SECTION C | LESSON 11

Student Task Statement

1. Write the coordinates of each labeled point.



- $A(3, 4)$
- $B(-4, 2)$
- $C(-5, -3)$
- $D(4, -2)$

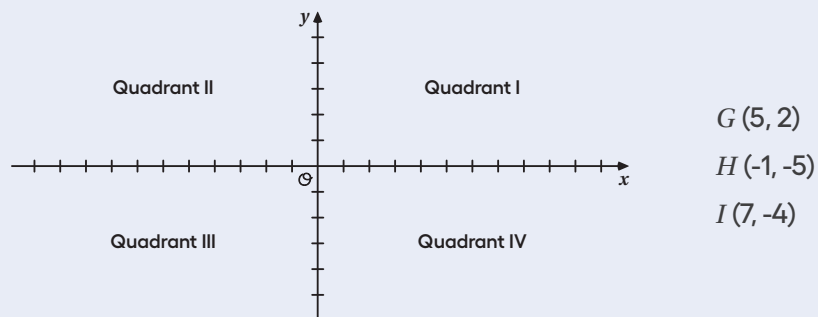
2. Plot a point at $(-2, 5)$. Label it E .

See image.

3. Plot another point at $(3, -4.5)$. Label it F .

See image.

4. The coordinate plane is divided into four **quadrants**: I, II, III, and IV, as shown here.



In which quadrant is point G located? Point H ? Point I ?

Point G is in Quadrant I, H is in Quadrant III, and I is in Quadrant IV.

5. If a point has a positive y -coordinate, in which quadrants could it be?

Quadrant I or Quadrant II

Activity Synthesis

The key idea for students to understand is that by extending the two number lines that form the coordinate axes for the first quadrant, we now have four quadrants. Points in these quadrants can be described by using negative and positive numbers as the x - and y -coordinates. Invite students to share their reasoning about how to identify the quadrants for the points G , H , and I . As time allows, consider asking the following questions:

💬 “If a point has a negative x -coordinate, what quadrants could it be in?”

Quadrants II and III

💬 “If a point has a negative y -coordinate, what quadrants could it be in?”

Quadrants III and IV

💬 “If a point has a positive x -coordinate, what quadrants could it be in?”

Quadrants I and IV

To involve more students in the conversation, consider asking:

💬 “Do you agree or disagree? Why?”

“Who can restate _____’s reasoning in a different way?”

“Does anyone want to add on to _____’s reasoning?”

Activity 2

15
min

Coordinated Archery

Activity Narrative

In this activity, students select points in different regions of the coordinate plane and use ordered pairs to describe them. Students must name specific coordinates in order to hit different parts of an archery target embedded in a coordinate plane. All points within the archery target contain negative coordinates.

Launch



Arrange students in groups of 2. It may be necessary to introduce students to what an archery target looks like and how it is scored. More points are scored the closer to the center the arrow lands. Remind students to label the axes with x and y so that they can accurately describe the coordinates as x -coordinates or y -coordinates.

Give students 5 minutes of quiet work time followed by 2 minutes of partner discussion.

Follow with a whole-class discussion.

Access for Multilingual Learners (Activity 2, Student Task)

MLR2: Collect and Display

Collect the language that students use to describe the location of landing points. Display words and phrases, such as “*x*-coordinate,” “*y*-coordinate,” and “quadrant.” During the *Activity Synthesis*, invite students to suggest ways to update the display:

“What are some other words or phrases that we should include?”


Invite students to borrow language from the display as needed.

Advances: Conversing, Reading

Student Workbook

Coordinated Archery

Here is an image of an archery target on a coordinate grid. The scores for landing an arrow in each of the regions are shown.



- A: 10 points
- B: 8 points
- C: 6 points
- D: 4 points
- E: 2 points

Name the possible coordinates of where one arrow could land to earn each of the following scores:

- 6 points _____
- 10 points _____
- 2 points _____
- no points _____
- 4 points _____
- 8 points _____

GRADE 6 • UNIT 7 • SECTION C | LESSON 11

Student Workbook

Coordinated Archery

Are You Ready for More?

Pretend you are stuck in a coordinate plane. You can only take vertical and horizontal steps that are one unit long.

- How many ways are there to get from the point $(-3, 2)$ to $(-1, -1)$ if you will only step down and to the right?

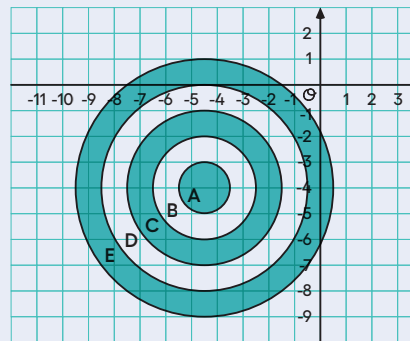
- How many ways are there to get from the point $(-1, -2)$ to $(4, 0)$ if you can only step up and to the right?

- Make up some more problems like this and see what patterns you notice.

GRADE 6 • UNIT 7 • SECTION C | LESSON 11

Student Task Statement

Here is an image of an archery target on a coordinate grid. The scores for landing an arrow in each of the regions are shown.



- A: 10 points
- B: 8 points
- C: 6 points
- D: 4 points
- E: 2 points

Name the possible coordinates of where one arrow could land to earn each of the following scores:

Sample responses:

- 6 points $(-2, -4)$
- 10 points $(-4.5, -4)$
- 2 points $(0, -3)$
- no points $(-10, -10)$
- 4 points $(-2, -2)$
- 8 points $(-3, -4)$

Are You Ready for More?

Pretend you are stuck in a coordinate plane. You can only take vertical and horizontal steps that are one unit long.

- How many ways are there to get from the point $(-3, 2)$ to $(-1, -1)$ if you will only step down and to the right?

10 paths

- How many ways are there to get from the point $(-1, -2)$ to $(4, 0)$ if you can only step up and to the right?

21 paths

- Make up some more problems like this and see what patterns you notice.

Answers vary

This problem is mostly an exercise in careful counting, although some students may realize that, for example, the first problem amounts to counting how many ways there are to arrange two steps to the right and three steps down. For some, this may be an easier representation of the problem.

Activity Synthesis

The purpose of this discussion is to allow students to describe points in the plane that involve negative coordinates. Display the archery target from the *Task Statement* for all to see. Ask students to share their responses for coordinates in the various regions of the target and record them for all to see. Record the points exactly as students describe them, and encourage students to be precise. If not mentioned by students, ask whether it's possible to use coordinates to describe the exact center of the target. If necessary, suggest using decimals or fractions as coordinates.

Lesson Synthesis

The purpose of this discussion is to summarize the main ideas of the lesson. Display a blank coordinate plane, and label it as students discuss the following questions:

“What are the names of the quadrants, and where are they in the coordinate plane?”

The quadrants are called I, II, III, and IV. They go in counterclockwise order from top right to top left to bottom left to bottom right.

“What quadrant is the point $(-4, 5)$ in? How do you know?”

That point is in Quadrant II. The x -value is negative, so the point is left of the y -axis, and the y -value is positive, so the point is above the x -axis.

“What quadrant is the point $(5, -4)$ in? How do you know?”

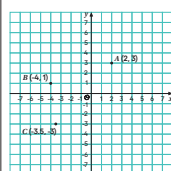
That point is in Quadrant IV. The x -value is positive, so the point is right of the y -axis, and the y -value is negative, so the point is below the x -axis.

If time allows, ask students to use the targets to make up their own challenges for the class. Invite other students to pick points that meet the requirements of the challenge. For example, one challenge could be to hit a point that is exactly between two regions. Another might be to hit the target in the bullseye three times on a horizontal line.

Student Workbook

Lesson Summary

Just as the number line can be extended to the left to include negative numbers, the x - and y -axis of a coordinate plane can also be extended to include negative values.



The ordered pair (x, y) can have negative x - and y -values. For $B(-4, 1)$, the x -value of -4 tells us that the point is 4 units to the left of the y -axis. The y -value of 1 tells us that the point is 1 unit above the x -axis.

The same reasoning applies to the points A and C . The x - and y -coordinates for point A are positive, so A is to the right of the y -axis and above the x -axis. The x - and y -coordinates for point C are negative, so C is to the left of the y -axis and below the x -axis.

Learning Targets

- I can describe a coordinate plane that has four quadrants.
- I can plot points with negative coordinates in the coordinate plane.
- I know what negative numbers in coordinates tell us.

10

GRADE 6 • UNIT 7 • SECTION C | LESSON 11

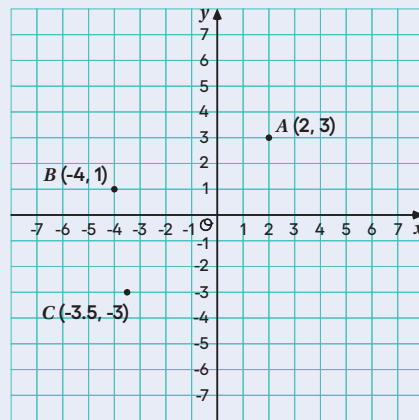
Responding To Student Thinking

More Chances

Students will have more opportunities to understand the mathematical ideas addressed here. There is no need to slow down or add additional work to the next lessons.

Lesson Summary

Just as the number line can be extended to the left to include negative numbers, the x - and y -axis of a coordinate plane can also be extended to include negative values.



The ordered pair (x, y) can have negative x - and y -values. For $B(-4, 1)$, the x -value of -4 tells us that the point is 4 units to the left of the y -axis. The y -value of 1 tells us that the point is 1 unit above the x -axis.

The same reasoning applies to the points A and C . The x - and y -coordinates for point A are positive, so A is to the right of the y -axis and above the x -axis. The x - and y -coordinates for point C are negative, so C is to the left of the y -axis and below the x -axis.

Cool-down

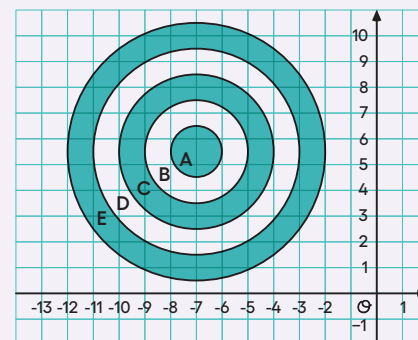
Target Practice

5 min

Student Task Statement

Here are the scores for landing an arrow in the different regions of the archery target.

- A: 10 points
- B: 8 points
- C: 6 points
- D: 4 points
- E: 2 points



- Andre shot three arrows and they landed at $(-5, 4)$, $(-8, 7)$ and $(1, 6)$. What is his total score? Explain or show your reasoning.

14 points

Sample reasoning: $(-5, 4)$ is 6 points, $(-8, 7)$ is 8 points, and $(1, 6)$ is 0 points.

- Jada shot an arrow and scored 10 points. She shot a second arrow that landed directly below the first one but scored only 2 points. Name two coordinates that could be the landing points of her two arrows.

Sample responses:

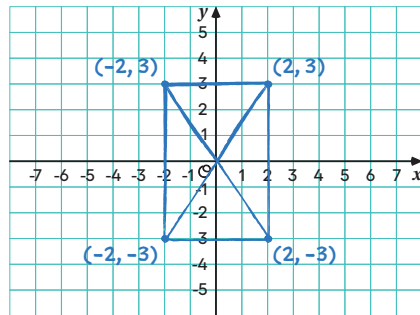
- $(-7, 5)$ and $(-7, 1)$
- $(-6.5, 5.5)$ and $(-6.5, 1.1)$

Practice Problems

6 Problems

Problem 1

- a. Graph these points in the coordinate plane: $(-2, 3)$, $(2, 3)$, $(-2, -3)$, $(2, -3)$.



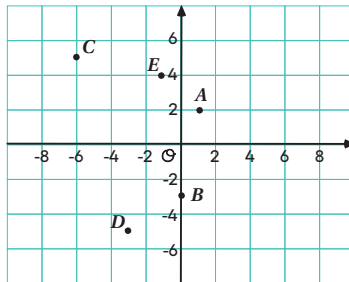
- b. Connect all of the points to each other. Describe the figure.

See image

Sample response: The figure is a rectangle with line segments connecting the opposite corners.

Problem 2

Write the coordinates of each point.



- $A(1, 0)$
- $B(0, -3)$
- $C(-6, 5)$
- $D(-3, -5)$
- $E(-1, 4)$

Problem 3

The points $(-3.5, 4)$, $(0, 4)$, and $(6.2, 4)$ are all on the same horizontal line. Write the coordinates of 2 additional points that are on the same horizontal line.

Sample response: $(3, 4)$ and $(-1, 4)$

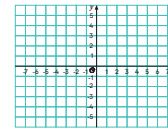
Any point that has a y-coordinate of 4 is on the line.

Student Workbook

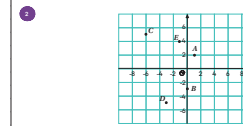
LESSON 11

PRACTICE PROBLEMS

- 1 a. Graph these points in the coordinate plane: $(-2, 3)$, $(2, 3)$, $(-2, -3)$, $(2, -3)$.



- b. Connect all of the points to each other. Describe the figure.



Write the coordinates of each point.

GRADE 4 • UNIT 7 • SECTION C | LESSON 11

11

Student Workbook

11 Practice Problems

- 1 The points $(3.5, 4)$, $(0, 4)$, and $(6.2, 4)$ are all on the same horizontal line. Write the coordinates of 2 additional points that are on the same horizontal line.

- 2 From Unit 7, Lesson 2
One night, it is 24°C warmer in Tucson than it was in Minneapolis. If the temperatures in Tucson and Minneapolis are opposites, what is the temperature in Tucson?

- ☐ A -24°C
☐ B -12°C
☐ C 12°C
☐ D 24°C

- 3 From Unit 2, Lesson 9
Lin ran 29 meters in 10 seconds. She ran at a constant speed.

- a. How far did Lin run every second? _____
- b. At this rate, how far can she run in 1 minute? _____

GRADE 4 • UNIT 7 • SECTION C | LESSON 11

12

Problem 4

from Unit 7, Lesson 2

One night, it is 24°C warmer in Tucson than it was in Minneapolis. If the temperatures in Tucson and Minneapolis are opposites, what is the temperature in Tucson?

- A. -24°C
- B. -12°C
- C. 12°C
- D. 24°C

Problem 5

from Unit 2, Lesson 9

Lin ran 29 meters in 10 seconds. She ran at a constant speed.

- a. How far did Lin run every second?

2.9 meters every second, because $29 \div 10 = 2.9$

- b. At this rate, how far can she run in 1 minute?

174 meters, because $(2.9) \cdot 60 = 174$

Problem 6

from Unit 6, Lesson 16

Noah is helping his band sell boxes of stickers to fund a field trip. Each box contains 20 pages of stickers and sells for \$30.

a. Complete the table for values of m .

boxes sold (b)	money collected in dollars (m)
1	30
2	60
3	90
4	120
5	150
6	180
7	210
8	240

b. Write an equation for the amount of money, m , that will be collected if b boxes of chocolate bars are sold. Which is the independent variable and which is the dependent variable in your equation?

- $m = 30b$
- b is independent, m is dependent.

c. Write an equation for the number of boxes, b , that were sold if m dollars were collected. Which is the independent variable and which is the dependent variable in your equation?

- $b = \frac{m}{30}$
- m is independent, b is dependent

Student Workbook

11

Practice Problems

from Unit 6, Lesson 16

Noah is helping his band sell boxes of stickers to fund a field trip. Each box contains 20 pages of stickers and sells for \$30.

a. Complete the table for values of m .

boxes sold (b)	money collected in dollars (m)
1	
2	
3	
4	
5	
6	
7	
8	

b. Write an equation for the amount of money, m , that will be collected if b boxes of chocolate bars are sold. Which is the independent variable and which is the dependent variable in your equation?

c. Write an equation for the number of boxes, b , that were sold if m dollars were collected. Which is the independent variable and which is the dependent variable in your equation?

GRADE 4 • UNIT 7 • SECTION C | LESSON 11

15