Lesson 15: Locating Ordered Pairs on the Coordinate Plane

Student Outcomes

- Students extend their understanding of the coordinate plane to include all four quadrants and recognize that the axes (identified as the x-axis and y-axis) of the coordinate plane divide the plane into four regions called quadrants (that are labeled from first to fourth and are denoted by roman numerals).
- Students identify the origin and locate points other than the origin, which lie on an axis.
- Students locate points in the coordinate plane that correspond to given ordered pairs of integers and other rational numbers.

Classwork

Opening Exercise (6 minutes)

Hang posters on the wall, each containing one of the following terms: x-axis, y-axis, x-coordinate, y-coordinate, origin, and coordinate pair. Pair students up, and have them discuss these vocabulary terms and what they remember about the terms from Grade 5. Student pairs then write what they discussed on the posters with the appropriate vocabulary term. Some important aspects for students to remember include the following:

- The x-axis is a horizontal number line; the y-axis is a vertical number line.
- The axes meet forming a 90° angle at the point (0, 0) called the origin.

Example 1 (8 minutes): Extending the Axes Beyond Zero

Students recognize that the axes are number lines and, using straightedges, extend the axes on the coordinate plane to include negative numbers revealing the second, third, and fourth quadrants.

- Describe the x-axis. Considering what we have seen in this module, what types of numbers should it include? Why?
  - The x-axis is a horizontal number line that includes positive and negative numbers. The axis extends in both directions (left and right of zero) because signed numbers represent values or quantities that have opposite directions.

Have student use their prior knowledge to complete Example 1 individually.

Example 1: Extending the Axes Beyond Zero

The point below represents zero on the number line. Draw a number line to the right starting at zero. Then, follow directions as provided by the teacher.

- Use a straightedge to extend the x-axis to the left of zero to represent the real number line horizontally, and complete the number line using the same scale as on the right side of zero.
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- Describe the y-axis. What types of numbers should it include?
  - The y-axis is a vertical number line that includes numbers on both sides of zero (above and below), and so it includes both positive and negative numbers.
- Use a straightedge to draw a vertical number line above zero.

Provide students with time to draw.
- Extend the y-axis below zero to represent the real number line vertically, and complete the number line using the same scale as above zero.

Example 2 (4 minutes): Components of the Coordinate Plane

Students examine how to use the axes and the origin of the coordinate plane to determine other locations in the plane.

Example 2: Components of the Coordinate Plane
All points on the coordinate plane are described with reference to the origin. What is the origin, and what are its coordinates?
The origin is the point where the x- and y-axes intersect. The coordinates of the origin are (0, 0).

- The axes of the coordinate plane intersect at their zero coordinates, which is a point called the origin. The origin is the reference point from which all points in the coordinate plane are described.

To describe locations of points in the coordinate plane, we use ordered pairs of numbers. Order is important, so on the coordinate plane, we use the form (x, y). The first coordinate represents the point’s location from zero on the x-axis, and the second coordinate represents the point’s location from zero on the y-axis.

Exercises 1–3 (8 minutes)

Students locate and label points that lie on the axes of the coordinate plane.

1. Use the coordinate plane below to answer parts (a)–(c).
   a. Graph at least five points on the x-axis, and label their coordinates.
      Points will vary.
   b. What do the coordinates of your points have in common?
      Each point has a y-coordinate of 0.
   c. What must be true about any point that lies on the x-axis?
      Explain.
      If a point lies on the x-axis, its y-coordinate must be 0 because the point is located 0 units above or below the x-axis. The x-axis intersects the y-axis at 0.
2. Use the coordinate plane to answer parts (a)–(c).
   a. Graph at least five points on the y-axis, and label their coordinates.
      *Points will vary.*
   b. What do the coordinates of your points have in common?
      *Each point has an x-coordinate of 0.*
   c. What must be true about any point that lies on the y-axis? Explain.
      *If a point lies on the y-axis, its x-coordinate must be 0 because the point is located 0 units left or right of the y-axis. The y-axis intersects 0 on the x-axis.*

3. If the origin is the only point with 0 for both coordinates, what must be true about the origin?
   *The origin is the only point that is on both the x-axis and the y-axis.*

**Example 3 (6 minutes): Quadrants of the Coordinate Plane**

Students examine the four regions of the coordinate plane cut by the intersecting axes.

**Example 3: Quadrants of the Coordinate Plane**

- The x- and y-axes divide the coordinate plane into regions called quadrants. Why are the regions called quadrants?
  - *The axes cut the plane into four regions. The prefix “quad” means four.*
- Which of the four regions did you work with most in Grade 5, and why was it the only region you used?
  - *The region on the top right of the coordinate plane. We only used this region because we had not learned about negative numbers yet.*
- The four quadrants are numbered one through four using roman numerals. The upper-right quadrant is Quadrant I, and the remaining quadrants are numbered moving counterclockwise from Quadrant I: Quadrant II, Quadrant III, and Quadrant IV. What was the first axis that we extended in Example 1, and what did it reveal?
  - *We extended the x-axis to the left beyond zero, and it revealed another region of the coordinate plane.*

**Scaffolding:**
- Remind students that the prefix *quad* means four, and cite some other examples where the prefix is used.
- Some students may not have knowledge of roman numerals. Create a table in which students can compare the standard symbols 1–8 and the roman numerals I–VIII.
This top left region is called Quadrant II. Label Quadrant II in your student materials. These regions only make up half of the coordinate plane. Where does the remaining half of the coordinate plane come from? Explain.

- We need to extend the $y$-axis down below zero to show its negative values. This reveals two other regions on the plane, one to the left of the $y$-axis and one to the right of the $y$-axis.

The quadrants of the coordinate plane are in a counterclockwise direction starting with Quadrant I. Label the remaining quadrants in your student materials.

**Exercises 4–6 (5 minutes)**

Students locate and label points that lie on the coordinate plane and indicate in which of the four quadrants the points lie.

<table>
<thead>
<tr>
<th>Exercises 4–6</th>
<th></th>
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<tbody>
<tr>
<td>4. Locate and label each point described by the ordered pairs below. Indicate which of the quadrants the points lie in.</td>
<td></td>
</tr>
<tr>
<td>a. $(7, 2)$</td>
<td>Quadrant I</td>
</tr>
<tr>
<td>b. $(3, -4)$</td>
<td>Quadrant IV</td>
</tr>
<tr>
<td>c. $(1, -5)$</td>
<td>Quadrant IV</td>
</tr>
<tr>
<td>d. $(-3, 8)$</td>
<td>Quadrant II</td>
</tr>
<tr>
<td>e. $(-2, -1)$</td>
<td>Quadrant III</td>
</tr>
</tbody>
</table>

| 5. Write the coordinates of at least one other point in each of the four quadrants. |  |
| a. Quadrant I | Answers will vary, but both numbers must be positive. |
| b. Quadrant II | Answers will vary, but the $x$-coordinate must be negative, and the $y$-coordinate must be positive. |
| c. Quadrant III | Answers will vary, but both numbers must be negative. |
| d. Quadrant IV | Answers will vary, but the $x$-coordinate must be positive, and the $y$-coordinate must be negative. |
6. Do you see any similarities in the points within each quadrant? Explain your reasoning.

The ordered pairs describing the points in Quadrant I contain both positive values. The ordered pairs describing the points in Quadrant III contain both negative values. The first coordinates of the ordered pairs describing the points in Quadrant II are negative values, but their second coordinates are positive values. The first coordinates of the ordered pairs describing the points in Quadrant IV are positive values, but their second coordinates are negative values.

Closing (4 minutes)

- If a point lies on an axis, what must be true about its coordinates? Specifically, what is true for a point that lies on the x-axis? The y-axis?
  - The y-coordinate is always 0 if a point lies on the x-axis. The x-coordinate is always 0 if a point lies on the y-axis.

- What do you know about the location of a point on the coordinate plane if:
- Both coordinates are positive?
  - If both coordinates are positive, the point must be located in Quadrant I.

- Only one coordinate is positive?
  - If only one coordinate is positive, the point is either in Quadrant II or Quadrant IV. If only the first coordinate is positive, then the point is in Quadrant IV. If only the second coordinate is positive, then the point is in Quadrant II.

- Both coordinates are negative?
  - If both coordinates are negative, the point is located in Quadrant III.

- One coordinate is zero?
  - If one coordinate is zero, then the point is located on the x-axis or the y-axis.

- Both coordinates are zero?
  - If both coordinates are zero, then the point represents the origin.

Lesson Summary

- The x-axis and y-axis of the coordinate plane are number lines that intersect at zero on each number line.
- The axes partition the coordinate plane into four quadrants.
- Points in the coordinate plane lie either on an axis or in one of the four quadrants.

Exit Ticket (4 minutes)
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Exit Ticket

1. Label the second quadrant on the coordinate plane, and then answer the following questions:
   a. Write the coordinates of one point that lies in the second quadrant of the coordinate plane.
   b. What must be true about the coordinates of any point that lies in the second quadrant?

2. Label the third quadrant on the coordinate plane, and then answer the following questions:
   a. Write the coordinates of one point that lies in the third quadrant of the coordinate plane.
   b. What must be true about the coordinates of any point that lies in the third quadrant?

3. An ordered pair has coordinates that have the same sign. In which quadrant(s) could the point lie? Explain.

4. Another ordered pair has coordinates that are opposites. In which quadrant(s) could the point lie? Explain.
Exit Ticket Sample Solutions

1. Label the second quadrant on the coordinate plane, and then answer the following questions:
   a. Write the coordinates of one point that lies in the second quadrant of the coordinate plane.
      
      *Answers will vary.*
   b. What must be true about the coordinates of any point that lies in the second quadrant?
      
      *The x-coordinate must be a negative value, and the y-coordinate must be a positive value.*

2. Label the third quadrant on the coordinate plane, and then answer the following questions:
   a. Write the coordinates of one point that lies in the third quadrant of the coordinate plane.
      
      *Answers will vary.*
   b. What must be true about the coordinates of any point that lies in the third quadrant?
      
      *The x- and y-coordinates of any point in the third quadrant must both be negative values.*

3. An ordered pair has coordinates that have the same sign. In which quadrant(s) could the point lie? Explain.
   
   *The point would have to be located either in Quadrant I where both coordinates are positive values or in Quadrant III where both coordinates are negative values.*

4. Another ordered pair has coordinates that are opposites. In which quadrant(s) could the point lie? Explain.
   
   *The point would have to be located in either Quadrant II or Quadrant IV because those are the two quadrants where the coordinates have opposite signs. The point could also be located at the origin (0, 0) since zero is its own opposite.*

Problem Set Sample Solutions

1. Name the quadrant in which each of the points lies. If the point does not lie in a quadrant, specify which axis the point lies on.
   a. (−2, 5)  
      *Quadrant II*
   b. (8, −4)  
      *Quadrant IV*
   c. (−1, −8)  
      *Quadrant III*
   d. (9, 2, 7)  
      *Quadrant I*
   e. (0, −4)  
      *None; the point is not in a quadrant because it lies on the y-axis.*
2. Jackie claims that points with the same \(x\) and \(y\)-coordinates must lie in Quadrant I or Quadrant III. Do you agree or disagree? Explain your answer.

Disagree; most points with the same \(x\)- and \(y\)-coordinates lie in Quadrant I or Quadrant III, but the origin \((0, 0)\) is on the \(x\)- and \(y\)-axes, not in any quadrant.

3. Locate and label each set of points on the coordinate plane. Describe similarities of the ordered pairs in each set, and describe the points on the plane.

   a. \[\{(−2, 5), (−2, 2), (−2, 7), (−2, −3), (−2, −0.8)\}\]
      The ordered pairs all have \(x\)-coordinates of \(−2\), and the points lie along a vertical line above and below \(−2\) on the \(x\)-axis.

   b. \[\{(−9, 9), (−4, 4), (−2, 2), (1, −1), (3, −3), (0, 0)\}\]
      The ordered pairs each have opposite values for their \(x\)- and \(y\)-coordinates. The points in the plane line up diagonally through Quadrant II, the origin, and Quadrant IV.

   c. \[\{(−7, −8), (5, −8), (0, −8), (10, −8), (−3, −8)\}\]
      The ordered pairs all have \(y\)-coordinates of \(−8\), and the points lie along a horizontal line to the left and right of \(−8\) on the \(y\)-axis.

4. Locate and label at least five points on the coordinate plane that have an \(x\)-coordinate of 6.

   a. What is true of the \(y\)-coordinates below the \(x\)-axis?
      The \(y\)-coordinates are all negative values.

   b. What is true of the \(y\)-coordinates above the \(x\)-axis?
      The \(y\)-coordinates are all positive values.

   c. What must be true of the \(y\)-coordinates on the \(x\)-axis?
      The \(y\)-coordinates on the \(x\)-axis must be 0.