Lesson 17: Drawing the Coordinate Plane and Points on the Plane

Student Outcomes
- Students draw a coordinate plane on graph paper in two steps: (1) Draw and label the horizontal and vertical axes; (2) Mark the number scale on each axis.
- Given some points as ordered pairs, students make reasonable choices for scales on both axes and locate and label the points on graph paper.

Classwork

Opening Exercise (5 minutes)
Instruct students to draw all necessary components of the coordinate plane on the blank $20 \times 20$ grid provided below, placing the origin at the center of the grid and letting each grid line represent 1 unit. Observe students as they complete the task, using their prior experience with the coordinate plane.
Students and the teacher together discuss the need for every coordinate plane to have the following:

- The \(x\)- and \(y\)-axes drawn using a straightedge,
- The horizontal axis labeled \(x\),
- The vertical axis labeled \(y\),
- Each axis labeled using an appropriate scale as dictated by the problem or set of ordered pairs to be graphed.

Students should erase errors and make any necessary changes before proceeding to Example 1.

**Example 1 (8 minutes): Drawing the Coordinate Plane Using a 1:1 Scale**

- Is the size of the coordinate grid that we discussed in the Opening Exercise sufficient to graph the points given in the set in Example 1?
  - Yes. All \(x\)- and \(y\)-coordinates are between \(-10\) and \(10\), and both axes on the grid range from \(-10\) to \(10\).

**Example 1: Drawing the Coordinate Plane Using a 1:1 Scale**

Locate and label the points \((3, 2), (8, 4), (−3, 8), (−2, −9), (0, 6), (−1, −2), (10, −2)\) on the grid below.

- Can you name a point that could not be located on this grid? Explain.
  - The point \((18, 5)\) could not be located on this grid because 18 is greater than 10 and, therefore, to the right of 10 on the \(x\)-axis. 10 is the greatest number shown on this grid.
- Discuss ways in which the point \((18, 5)\) could be graphed without changing the size of the grid.
  - Changing the number of units that each grid line represents would allow us to fit greater numbers on the axes. Changing the number of units per grid line to 2 units would allow a range of \(-20\) to \(20\) on the \(x\)-axis.
Example 2 (8 minutes): Drawing the Coordinate Plane Using an Increased Number Scale for One Axis

Students increase the number of units represented by each grid line in the coordinate plane in order to graph a given set of ordered pairs.

- Examine the given points. What is the range of values used as \( x \)-coordinates? How many units should we assign per grid line to show this range of values? Explain.
  - The \( x \)-coordinates range from \(-4\) to \(9\), all within the range of \(-10\) to \(10\), so we will assign each grid line to represent \(1\) unit.

- What is the range of values used as \( y \)-coordinates? How many units should we assign per grid line to show this range of values? Explain.
  - The \( y \)-coordinates range from \(-40\) to \(35\). If we let each grid line represent \(5\) units, then the \(y\)-axis will include the range \(-50\) to \(50\).

- Draw and label the coordinate plane, and then locate and label the set of points.

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Example 2: Drawing the Coordinate Plane Using an Increased Number Scale for One Axis

Draw a coordinate plane on the grid below, and then locate and label the following points:

\(\{(−4,20), (−3,35), (1,−35), (6,10), (9,−40)\}\).
Example 3 (8 minutes): Drawing the Coordinate Plane Using a Decreased Number Scale for One Axis

Students divide units among multiple grid lines in the coordinate plane in order to graph a given set of ordered pairs.

- Examine the given points. Will either the $x$- or $y$-coordinates require a change of scale in the plane? Explain.
  - The $x$-coordinates range from $-0.7$ to $0.8$. This means that if each grid line represents one unit, the points would all be very close to the $y$-axis, making it difficult to interpret.
- How could we change the number of units represented per grid line to better show the points in the given set?
  - Divide 1 unit into tenths so that each grid line represents a tenth of a unit, and the $x$-axis then ranges from $-1$ to $1$.
- Draw and label the coordinate plane, and then locate and label the set of points.

Example 3: Drawing the Coordinate Plane Using a Decreased Number Scale for One Axis

Draw a coordinate plane on the grid below, and then locate and label the following points:

$\{(0.1, 4), (0.5, 7), (-0.7, -5), (-0.4, 3), (0.8, 1)\}$. 

![Coordinate Plane](image)
Example 4 (8 minutes): Drawing the Coordinate Plane Using a Different Number Scale for Both Axes

Students appropriately scale the axes in the coordinate plane in order to graph a given set of ordered pairs. Note that the provided grid is $16 \times 16$ with fewer grid lines than the previous examples.

Example 4: Drawing the Coordinate Plane Using a Different Number Scale for Both Axes

Determine a scale for the $x$-axis that will allow all $x$-coordinates to be shown on your grid.

The grid is 16 units wide, and the $x$-coordinates range from $-14$ to $14$. If I let each grid line represent 2 units, then the $x$-axis will range from $-16$ to $16$.

Determine a scale for the $y$-axis that will allow all $y$-coordinates to be shown on your grid.

The grid is 16 units high, and the $y$-coordinates range from $-4$ to $3.5$. I could let each grid line represent one unit, but if I let each grid line represent $\frac{1}{2}$ of a unit, the points will be easier to graph.

Draw and label the coordinate plane, and then locate and label the set of points.

\{(-14, 2), (-4, -0.5), (6, -3.5), (14, 2.5), (0, 3.5), (-8, -4)\}

- How was this example different from the first three examples in this lesson?
  - The given set of points caused me to change the scales on both axes, and the given grid had fewer grid lines.

- Did these differences affect your decision making as you created the coordinate plane? Explain.
  - Shrinking the scale of the $x$-axis allowed me to show a larger range of numbers, but fewer grid lines limited that range.
Closing (4 minutes)

- Why is it important to label the axes when setting up a coordinate plane?
  - It is important to label the axes when setting up a coordinate plane so that the person viewing the graph knows which axis represents which coordinate and what scale is being used. If a person does not know the scale being used, she will likely misinterpret the graph.

- Why shouldn’t you draw and label the entire coordinate grid before looking at the points to be graphed?
  - Looking at the range of values in a given set of points allows you to determine an appropriate scale. If you set a scale before observing the given values, you will likely have to change the scale on your axes.

Lesson Summary

- The axes of the coordinate plane must be drawn using a straightedge and labeled x (horizontal axis) and y (vertical axis).
- Before assigning a scale to the axes, it is important to assess the range of values found in a set of points as well as the number of grid lines available. This allows you to determine an appropriate scale so all points can be represented on the coordinate plane that you construct.

Exit Ticket (4 minutes)
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Exit Ticket

Determine an appropriate scale for the set of points given below. Draw and label the coordinate plane, and then locate and label the set of points.

\{ (10, 0.2), (-25, 0.8), (0, -0.4), (20, 1), (-5, -0.8) \}
Exit Ticket Sample Solutions

Determine an appropriate scale for the set of points given below. Draw and label the coordinate plane, and then locate and label the set of points.

\{ (10, 0.2), (25, 0.8), (0, -0.4), (20, 1), (5, -0.8) \}

The x-coordinates range from -25 to 20. The grid is 10 units wide. If I let each grid line represent 5 units, then the x-axis will range from -25 to 25.

The y-coordinates range from -0.8 to 1. The grid is 10 units high. If I let each grid line represent two-tenths of a unit, then the y-axis will range from -1 to 1.

Problem Set Sample Solutions

1. Label the coordinate plane, and then locate and label the set of points below.

\{ (0.3, 0.9), (-0.1, 0.7), (-0.5, -0.1), (-0.9, 0.3), (0, -0.4) \}
2. Label the coordinate plane, and then locate and label the set of points below.

\{(90, 9), (-110, -11), (40, 4), (-60, -6), (-80, -8)\}

![Graph of the coordinate plane with labeled points (90, 9), (-110, -11), (40, 4), (-60, -6), (-80, -8).]

Extension:

3. Describe the pattern you see in the coordinates in Problem 2 and the pattern you see in the points. Are these patterns consistent for other points too?

The \(x\)-coordinate for each of the given points is 10 times its \(y\)-coordinate. When I graphed the points, they appear to make a straight line. I checked other ordered pairs with the same pattern, such as \((-100, -10), (20, 2)\), and even \((0, 0)\), and it appears that these points are also on that line.