



**BOSTON PUBLIC LIBRARY
MATHEMATICS AND MAPS
TITLE: EXTENDING THE
COORDINATE PLANE TO 4 QUADRANTS**



Essential Question: How can we locate objects on the coordinate plane?

Grade Range: 5 – 8

Time Allocation: 45 – 60 minutes

Overview:

Understanding the coordinate plane and how to locate objects on it is essential to higher level mathematics. By connecting this concept to maps, students have a framework through which to grasp the importance of this foundational idea. The coordinate plane used on representations of the world in the form of a globe or a map use a consistent grid system called latitude and longitude. On the coordinate plane, we label the x-axis and the y-axis. With latitude and longitude, the longitude numbers form the x-axis and the latitude lines form y-axis.

Objectives:

1. Students will describe key vocabulary associated with the coordinate plane.
2. Students will identify locations on the four-quadrant coordinate plane.

Common Core Curriculum Standards

Grade 5 Mathematics – Geometry/Coordinates:

1. Understand that a pair of perpendicular number lines, called axes, defines a coordinate system.
 - a. Their intersection is called the origin, usually arranged to coincide with the 0 on each line.
 - b. A given point in the plane can be located by using an ordered pair of numbers, called its coordinates. The first number indicates how far to travel from the origin in the direction of one axis, the second number indicates how far to travel in the direction of the second axis.
 - c. To avoid ambiguity, conventions dictate that the names of the two axes and the coordinates correspond (e.g., x -axis and x -coordinate, y -axis and y -coordinate).
2. Graph points in the first quadrant of the coordinate plane, and identify the coordinates of graphed points. Where ordered pairs arise in a problem situation, interpret the coordinate values in the context of the situation.

Grade 6 Mathematics - Geometry:



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Graph points and identify coordinates of points on the coordinate plane in all four quadrants. Where ordered pairs arise in a problem situation, interpret the coordinate values in the context of the situation.

Grade 7 Mathematics – Ratios and Proportional Relationships

Plot proportional relationships on a coordinate plane where each axis represents one of the two quantities involved, observe that the graph is a straight line through the origin, and find unit rates from a graph. Explain what a point (x, y) means in terms of the situation, with special attention to the points $(0, 0)$ and $(1, r)$ where r is the unit rate.

Grade 8 Mathematics - Expressions and Equations

Graph proportional relationships and relationships defined by a linear equation; find the slope and interpret the slope in context.

Procedure:

Part 1: Introduction and Vocabulary Review

1. Have students complete the Do Now responding to the following questions about the map “British Empire in 1886.” Note that the map is interesting – our ultimate goal is to focus on the grid system rather than the art around the map.
 - a. What is the content of this map?
 - b. How could we identify locations on this map?
 - c. Why are there repeated numbers on both the x and y-axes?
2. Discuss the Do Now. To identify locations, we will build a coordinate plane on the map. Review the coordinate plane and vocabulary including the origin, x and y-axes, coordinates, coordinate point and quadrants.
3. Using a globe, review how the latitude and longitude system works. Identify the origin of the system, $(0, 0)$ – the meeting of Greenwich, England and the Equator.

Part 2: Extending the Coordinate Plane

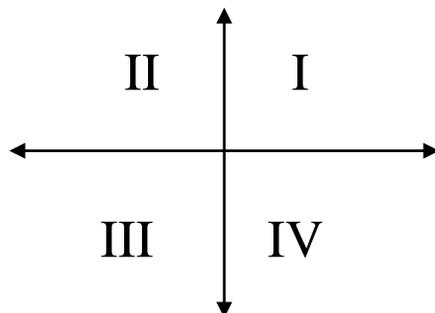
1. Label the longitude lines with multiples of 30 degrees moving in the positive direction. How will we identify locations to the left of 0 on the x-axis? Discuss the extension to the negative numbers and label the negatives on the x-axis.
2. Label the latitude lines with multiples of 30 degrees moving in the negative direction. How will we identify locations below 0 on the y-axis? Discuss the extension to the negative numbers and label the negatives on the y-axis.
3. Since our grid lines go by multiples of 30, discuss how to divide these even further to approximate grid lines by 10 degrees.



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- Label the map with the quadrants – Quadrant I, II, III and IV, starting with I for the quadrant with both positive x and y and moving counterclockwise around the axes as shown below.



- Have students extend the diagram in their notes to include the four quadrants.
- Using the newly labeled map, model how to find the coordinates of the center of North America. Also identify the quadrant. Once students understand the process, have them independently find the coordinates and quadrant the following locations.
 - The center of China
 - The center of Australia
 - The center of South America
- Working in pairs, have students review their answers. Then, have selected pairs share their answers with the class.

Part 3: Placing Maps on the Four-Quadrant Coordinate Plane

- Pass out the map of Massachusetts, Connecticut and Rhode Island. Using the world map as a reference, in which quadrant is this map located? Students should recognize that it is in Quadrant II, so x-axis values should be negative and y-axis values positive. Have students add negative numbers to their x-axis.
- Have students choose three points on the map and label with coordinates. Working in pairs, have students state the coordinates and have their partner label the point. Each person should confirm the accuracy of their partner's work.
- Pass out the map of Africa. Using the world map as a reference, in which quadrant is this map located? Students should recognize that it is in both Quadrants I and Quadrant IV, so the x-axis is positive and the y-axis goes into the negative.
- Have students choose three points on the map, with at least two in Southern Africa, and label with coordinates. Working in pairs, have students state the coordinates and have



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their partner label the point. Each person should confirm the accuracy of their partner's work.

Part 4: Extension – Degrees and Minutes

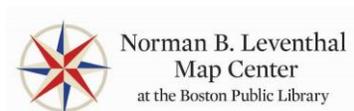
1. Map units are measured in degrees, but parts of degrees are measured in minutes. There are 60 minutes in one degree. So, even though the value between 71° and 72° can be written as 71.5° , it can also be written as $71^\circ, 30'$ where the "" is the symbol for minutes.
2. Review the map of Massachusetts and the numbers on the x and y-axis.
 - a. Thinking about where this map is in relation to the world, in what quadrant is this map? Adjust the signs of the values on the axes accordingly.
 - b. Why are the lines between 4 and 5 degrees labeled with multiples of 15?
3. Using this map, have students choose three locations and write the coordinate point that represents each location. Then, they should work with a partner to quiz each other and check the accuracy of their work.

Part 5: Practice and Evaluation

Students should complete the practice part of the assignment to practice identifying coordinates on the coordinate plane. Collect these assignments and review both the notes section of the assignment and the responses.

Materials:

- Maps:
 - Map of the British Empire 1886
 - A National Highways Map of Massachusetts (<http://maps.bpl.org/id/12686>)
 - Map of Africa (<http://maps.bpl.org/id/m0612013>)
- Rulers



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Extending the Coordinate Plane

Name _____

Date _____

Part 1: Introduction and Vocabulary Review

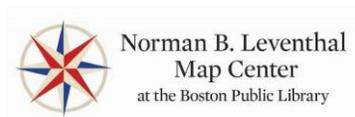
1. Review the map of the British Empire in 1886.

a. What is the content of this map? _____

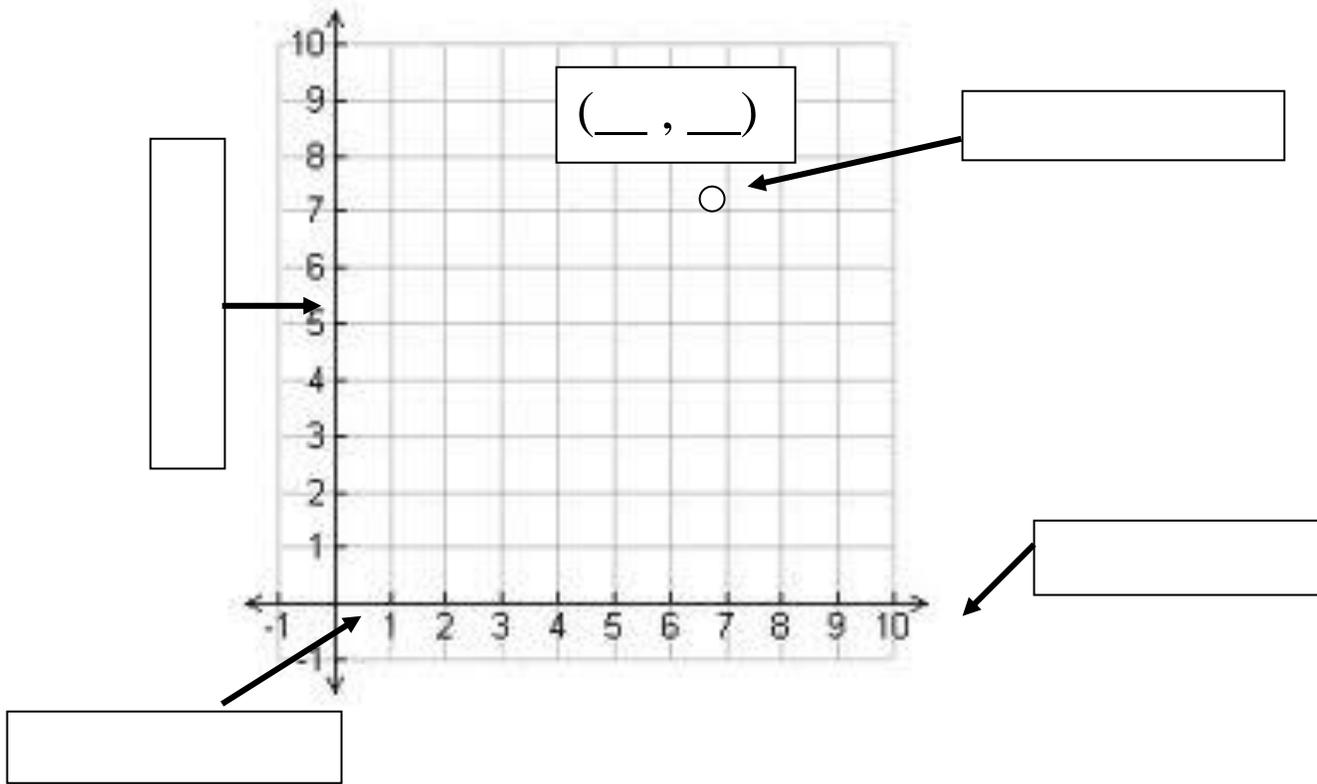
a. How could we identify locations on this map? _____

b. Why are there repeated numbers on both the x and y-axes?

2. The Coordinate Plane – Review



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Part 2: Extending the Coordinate Plane

Draw a coordinate plane on the world map of the British Empire, locating the origin at the intersection of the Equator and Greenwich, England. Label the gridlines with multiples of 30, making sure that x-axis lines left of the origin and y-axis lines below the origin are negative. Also label the map with the quadrants.

- Using the newly labeled map of the British Empire, identify the coordinates of the following locations. Also identify the quadrant of each location.

Location	Coordinates of the Center	Quadrant
North America		
China		
Australia		
South America		

- Choose two other countries on the map. Add them to the table above and indicate both the coordinates of the center and the quadrant.

Part 3: Placing Maps on the Four-Quadrant Coordinate Plane

1. Review the map of Massachusetts, Connecticut and Rhode Island.
 - a. Using the world map as a reference, in which quadrant is this map located? Adjust the signs of the numbers accordingly. _____
 - b. Choose three points on the map and label with their coordinates. List them below.

Location	Coordinates	Quadrant

- c. Working with a partner, state the coordinates of a location and have your partner label it and state the quadrant. Switch back and forth until you each have 6 points labeled on your maps.
2. Review the map of Africa.
 - a. Using the world map as a reference, in which quadrant is this map located? Adjust the signs of the numbers accordingly. _____

- b. Choose three points on the map and label with their coordinates. At least two of your points should be in Southern Africa. List them below.

Location	Coordinates	Quadrant

- c. Working with a partner, state the coordinates of a location and have your partner label it and state the quadrant. Switch back and forth until you each have 6 points labeled on your maps.

Part 4: Extension – Degrees and Minutes

Map units are measured in degrees, but parts of degrees are measured in minutes. There are 60 minutes in one degree. So, even though the value between 71° and 72° can be written as 71.5°, it can also be written as 71°, 30' where the "" is the symbol for minutes.

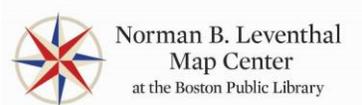
1. Review the map of Massachusetts and the numbers on the x and y-axis.
 - a. Thinking about where this map is in relation to the world, in what quadrant is this map? Adjust the signs of the values on the axes accordingly.

- b. Why are the lines between 4 and 5 degrees labeled with multiples of 15?

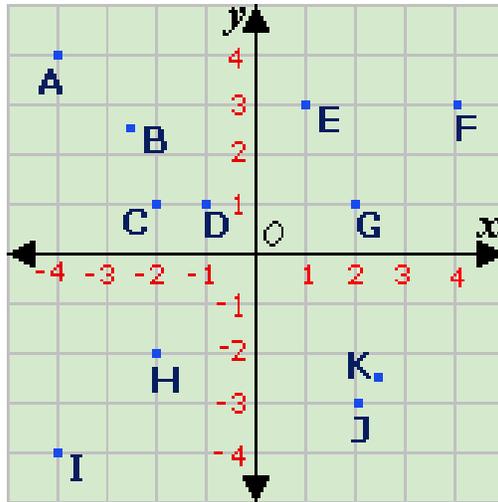
4. Using this map, have students choose three locations and write the coordinate point that represents each location using degrees and minutes. Then, they should work with a partner to quiz each other and check the accuracy of their work.

Location	Coordinates (In Degrees and Minutes)	Quadrant

Part 5: Practice and Evaluation



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1. Complete the table for the points above.

Name	Coordinates	Quadrant
A		
B		
C		
D		
E		
F		
G		
H		
I		

2. Plot the following points. Label them with the appropriate letter on the graph. Check them off when you are done.

- ___ J (-3, -2) ___ N $\left(-2\frac{1}{2}, 4\right)$
 ___ K (1, -4) ___ P $\left(4\frac{1}{2}, -3\right)$
 ___ L (-3, 0)
 ___ M (4, 1)