

SPIRIT 2.0 Lesson:
Where am I located?

=====Lesson Header=====

Lesson Title: Where am I located?

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1st Author (Writer): Neil Hammond

2nd Author (Editor/Resource Finder): Sara Adams

Algebra Topic: Rectangular Coordinate System

Grade Level: Algebra I – 8th/9th Grade

Cartoon Illustration Idea: A robot that is sitting on a coordinate plane

Outline of Lesson

Content (what is taught):

- Plotting points on a coordinate plane
- Using the coordinate plane to determine quadrants

Context (how it is taught):

- Use robot to drive on the coordinate plane
- Plot 4 or 5 different points with the robot
- Talk about the points in regard to the quadrants and the axes

Activity Description:

In this lesson, there will have be a coordinate grid laid out on a flat surface (table/floor). The students will take turns driving the robot to all of the different points on the plane. They will then discuss where the quadrants are located and what a quadrant is. After this lesson, the group will discuss how to determine what quadrant a point is located in just by seeing the point.

Standards: (At least one standard each for Math, Science, and Technology - use standards provided)

Math

B1, C1, D1

Science

B2

Technology

A3

Materials List:

Classroom Robot
Coordinate Grid
Graph Paper

ASKING Questions (Where am I located?)

Summary: Students are shown a coordinate plane and asked about how to represent the ordered pair on the plane.

Outline

- Have the coordinate plane drawn on the floor/table
- Ask students how to represent certain numbers or ordered pairs on a graph
- Work with different types of numbers (positive, negative, and zero)
- Determine how to plot the ordered pairs

Activity:

Start by asking these questions to see if students understand numbers and ordered pairs.

Questions	Possible Answers
<ul style="list-style-type: none">• How can we represent the number 12 on a graph?	We could use a number line and travel over 12 units.
<ul style="list-style-type: none">• How can we represent a set of two numbers together on a graph?	Since we use a number line going right to left (x-axis) for the first number, we could use a number line going up and down (y-axis) for the second number. This will create the coordinate plane.
<ul style="list-style-type: none">• On a number line which way is positive and which way is negative?• Why do you think we represent numbers in this way?	We represent positive in the right direction and negative in the left direction. It follows the way that we read from left to right.
<ul style="list-style-type: none">• How can we do the same thing with two different number lines?	We can do the same thing for the other axis using up for positive and down for negative. Up because it shows the increase in value.
<ul style="list-style-type: none">• What variables should we use to represent the ordered pair?	We could use any two letters we want but we will like to use 'x' and 'y' so all ordered pairs are represented the same. This also relates to the x and y axis
<ul style="list-style-type: none">• Where do we need to start (zero) when we use the coordinate plane	We should start where the two number lines intersect (the origin)..

Image Idea: Picture of the floor where the coordinate plane is drawn out.

EXPLORING Concepts (Where am I located?)

Summary: Students use a robot to plot points on a coordinate plane.

Outline:

- The students are given a certain point they need to graph
- The students will use the robot to plot the 'x' variable as well as the 'y' variable
- The students will then use the robot to travel a certain distance and be able to tell what ordered pair would be represented when the robot stops moving

Activity:

The students will each be given 4 or 5 points that they need to graph. They will take turns using the robot to plot the points on the coordinate plane that is laid out on the floor or the table. The students need to make sure and always begin at the origin (0, 0) when they start plotting their points. When they are given a point such as (2,4) they need to make sure and plot the '2' first and that number will be along the horizontal axis (right-left). Make sure students understand which way is positive and which way is negative. After they have driven the robot the correct distance for the 'x' variable, then they will travel either up or down to graph the 'y' variable.

Make sure the students are using the robot in the correct way and are actually accomplishing the task at hand. After they have plotted these 4 or 5 points on the floor they will see the points laid out on the coordinate grid. They now need to label which quadrant the point is located in. There are four different quadrants (I, II, III, IV) and they will have to label one of these four quadrants.

Once they have done these two activities, they need to transfer the knowledge and work on seeing a point and recognizing the ordered pair that corresponds with this point. So the students will begin at the origin and they will drive in whatever direction they would like for 5 seconds. After 5 seconds they need to stop the robot and label what the ordered pair is where the robot stopped moving. After they have labeled 4 points, the next student can take a turn plotting points and reading where points are located.

To make sure the students understand these concepts make sure to ask yourself these questions to assess the lesson

- 1) Did the students plot the points in the correct order? (x then y)
- 2) Did the students know the four different quadrants? (I, II, III, IV)
- 3) Did the students read the points in the correct order when they were labeling the points (right-left, then up-down)

Videoclip Idea: Have a video clip of the robot traveling on the 'x' and 'y' axis so they can see how to plot the points.

INSTRUCTING Concepts (Where am I located)

Putting “Rectangular Coordinate System” in *Recognizable* terms: Graphing on a **rectangular coordinate system** is a method of representing pairs of Real numbers on a flat (plane) surface.

Putting “Rectangular Coordinate System” in *Conceptual* terms: Every **Rectangular Coordinate System** has to start somewhere. Chose any plane on the surface and call it the “origin”, or the starting point. Position a Real number line so that the zero is at your chosen point of origin. Then plane another Real number line at right angles to the first one so that its zero is also at the origin. These two lines are the axes. One will be the **horizontal axis**, or **abscissa**, and the other will be the **vertical axis**, or the **ordinate**. Notice how the intersecting Real number lines have subdivided the plane surface into four sections, or **quadrants**

Putting “Rectangular Coordinate System” in *Mathematical* terms: **Ordered Pairs** are necessary to define, or place, any particular point on the grid completely and accurately. An ordered pair is comprised of two real numbers, the first, which represents the position of the point with respect to the abscissa, and the second, which represents the location of the point with respect to the ordinate.

Putting “Rectangular Coordinate System” in *Process* terms: Pinpoint the location of any point (ordered pair) by finding the intersection of the first element of the pair of coordinates with that of the second item in the pair. These ordered pairs can be called **(x,y) pairs**, where the ‘x’ (or first element of the pair) refers to the abscissa location and the ‘y’ (or second element in the pair) refers to the ordinate location.

Putting “Rectangular Coordinate System” in *Applicable* terms: As we drive the robot around the plane surface (or rectangular coordinate system), stop it at irregular (random) time intervals and estimate its position by using ordered pairs of Real numbers. Generate an ordered pair randomly, then drive the robot to the location that is represented by that given ordered pair.

ORGANIZING Learning (Where am I located)

Summary: Students are looking at points on the coordinate plane and trying to determine the quadrant that they are located in.

Outline:

- Plot points on the coordinate plane
- Discuss the four quadrants and which quadrant the point is located within
- Analyze points and determine the quadrant without looking at the coordinate plane

Activity

Students will be given a number of different points they will need to plot on the coordinate plane. They will use the robot to plot the points on the plane. Make sure the students are always starting at the origin when they are plotting the points. After they have plotted the four different points they will need to work on locating the quadrant.

Since there are four different quadrants that the points could be located in (as well as the axes), the students will work with a table and try and come up with a way to determine the quadrant without looking at the coordinate plane.

There are six different types of points that the students can be looking at when they are plotting the points. These different types are as follows: (pos, pos), (pos, neg), (neg, pos), (neg, neg), (0, anything), (anything, 0).

Using the chart located below they will plot two points from each of these categories. They will determine an algorithm for how to look at the points just by the numbers to determine the quadrants requiring a transfer from concrete to abstract reasoning.

After they have collected their data, they will be able to come back with the group and talk about their findings.

Worksheet Idea: A simple chart that has points and what quadrant they are located within.

Point	Quadrant	What do you notice?	Point	Quadrant	What do you notice?
(3, 4)			(2, -5)		
(0, 5)			(-4, -3)		
(6, -3)			(-4, 4)		
(-2, 0)			(4, 5)		
(-1, 7)			(-9, -2)		

Expansion activity: Give clues for an ordered pair and students must use their knowledge to correctly find the point. Can be on the overhead (whole group), or in card form (independently or in partners).

UNDERSTANDING Learning (Where am I located)

Summary: Students will use a robot to plot points on a coordinate plane and will use the robot to tell what the point is where the robot stops moving.

Outline

- Assessment of Pythagorean Formula

Activity

Students will be called to the table one by one and will complete the following tasks.

- 1) They will plot these three points on the coordinate plane
 - a. (1, 5)
 - b. (-2, -6)
 - c. (4, 0)
- 2) After they have finished this activity they will drive the robot wherever they want on the coordinate plane. They can drive in a straight line or a circle or any combination of the two. After they have driven three different times they will tell what the ordered pair is where they have stopped the robot.
 - a. 3 sec
 - b. 5 sec
 - c. 8 sec
- 3) Once they have the 6 points on the graph they will tell what the quadrant is that each of the six points are located within.