**The Shape and Space Strand: Outcome SS7.4**

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| **Outcome** | **Indicators** |
| SS7.4 Demonstrate an understanding of the Cartesian plane and ordered pairs with integral coordinates. [C, CN, V]*In support of the K-12 Mathematics goals of Spatial Sense, Number Sense, and Logical Thinking and Mathematical Attitude.* | 1. Label the axes of a four quadrant Cartesian plane and identify the origin.
2. Explain how orientation (the direction in a situation) can influence the labelling of the axes on a Cartesian plane.
3. Identify the location of a point in any quadrant of a Cartesian plane using an ordered pair with integral coordinates.
4. Plot the point corresponding to an ordered pair with integral coordinates on a Cartesian plane with units of 1, 2, 5 or 10 on its axes.
5. Draw shapes and designs, using integral ordered pairs, in a Cartesian plane.
6. Create shapes and designs, and identify the points used to produce the shapes and designs in any quadrant of a Cartesian plane.
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| **Learning Space** [**Top**](#top) |
| In grade six, the students studied the first quadrant of the Cartesian plane and also explored integers as an extension of the whole numbers. In grade seven, they combine these two concepts in their study of the entire Cartesian plane and integral coordinates in ordered pairs on the Cartesian plane. The students also work with different scales on the axes of the Cartesian plane.In this extension of the Cartesian plane students need to be engaged in exploring and looking for patterns and generalizing strategies for reading, writing and plotting ordered pairs as points on a Cartesian Plane. It is also important that students understand that the axes on a Cartesian plane are number lines, and that the negative and positive halves of each number line describe direction of movement from the origin.In outcome P7.2 Demonstrate an understanding of the relationships between linear relations, tables of values, and graphs and draw conclusions and solve problems based on those relationships the students connect their understanding of points on the Cartesian Plane to their understanding of linear relations, Plotting of points can also be compared to the coordinate systems used in maps from Social Studies. Dance and drama movement can be described in terms of coordinate movement from any point on the state and coordinates can also be used to analyze and describe movement in physical education. |

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| **What Students Should…** [**Top**](#top) |
| **Know*** The coordinates of ordered pairs are listed as (horizontal position, vertical position).
 | **Understand*** That the origin is a unique point.
* That the Cartesian plane can be overlaid any picture or diagram and that the placement of the origin can be chosen at the students’ discretion.
* The two axes are perpendicular bisectors that define two dimensions.
* The two axes are two intersecting number lines.
* The coordinates of an ordered pair describe the horizontal and vertical movement from the origin to the point described by the ordered pair.
 | **Be Able to Do*** Read points on a Cartesian Plane and write their ordered pairs.
* Draw a Cartesian plane and label the axes.
* Identify the origin on a Cartesian Plane.
* Plot points on a Cartesian Plane.
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| **Key Questions** [**Top**](#top) |
| * Why is the origin important?
* Why does the order of the coordinates in ordered pairs matter?
* How can you tell which quadrant/corner a given ordered pair will be in?
* How are the axes related to each other?
* What do the axes represent?
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| **Suggestions for Assessment:** [**Top**](#top) |
| **Big Idea:**Properties of the Cartesian plane and using the Cartesian plane.**Suggestions for assessment tasks:**1. Have the students draw a treasure map and then overlay graph paper (on overhead transparencies) over the map. Have them draw a Cartesian plane on the graph paper, having the origin fall on a marked location on their map. Have the students sketch out a route to get from their current location to the treasure that avoids all the traps and danger on the map. On the route, have the students mark all critical points and then write directions (including point coordinates) of how to get from their location to the treasure safely. As a class, create a rubric, checklist, or rating scale (or combination of the three) that will be used to assess their project. Along with points for originality, make sure that the students set a goal of plotting points in all four quadrants of the Cartesian Plane.
2. Provide the students with a set of points that create a design or picture. Purposefully make an error in one at least one of the coordinates, particularly an error related to the sign of the coordinates. Once the students have plotted the design or picture, show them the actual design or picture and ask them to identify and correct the point(s) that contain the error.
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| **What to look for:*** See [*Properties of the Cartesian Plane Rubric*](file:///C%3A%5CUsers%5Ckw426%5CAppData%5CLocal%5CTemp%5CProperties%20of%20the%20Cartesian%20Plane%20Rubric.doc)*.*
* See [*Using the Cartesian Plane Rubric.*](file:///C%3A%5CUsers%5Ckw426%5CAppData%5CLocal%5CTemp%5CUsing%20the%20Coordinate%20Plane%20Rubric.doc)
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| **Suggestions for Instruction:** [**Top**](#top) |
| **Big Idea:**Properties of the Cartesian plane and using the Cartesian plane.**Suggestions for instructional activities**1. Begin by giving the students a Cartesian plane with only the first quadrant and ask them how to plot ordered pairs. Have the students discuss their reasoning, and as a class, write a rule or explanation of how to plot an ordered pair in the first quadrant of a Cartesian Plane.
2. Give the students a copy of a Cartesian Plane (four quadrant) with a number of points marked in each quadrant and designated by a capital letter. Also give the students a matching sheet listing the letter names of points and the coordinates of the points. Make most of the points significantly different, but include a couple of pairs of points where the signs on the coordinates are the only difference (e.g., (3, -4) and (-3, -4)). Have the pairs of students work together to try to match the letter names of the points to the quadrants. As they figure out how they think the points match to the ordered pairs, have the students keep a written record of the patterns that they are seeing emerging.
3. Go through the matching activity and have the students discuss and debate the matches of the ordered pairs to the labelled points. As a class, come up with a way to read the coordinates of points on a Cartesian plane.
4. Have the students consider the two axes and ask them what is being used to represent the axes. Discuss whether the direction of the number lines matters (the answer is no – it is only because of convention that we draw them the way that we do). Also discuss why it might be important to give the axes names. Show the students a Cartesian plane that is slightly angled without any labelling on the axes and ask them which they believe is the horizontal axes – it could be either. Discuss the convention of labelling the axes so that the horizontal axis is assigned the earlier letter in the alphabet. For example, if the horizontal axis is called *c*, the vertical axis won’t be called either *a* or *b*.
5. Ask the students if they can identify a unique point on a Cartesian plane. If they don’t point out the point (0,0), and ask them to describe that point in as many ways as possible. Tell the students that this point is called the Origin. Have the students discuss what they think of this name, and also whether they think it matters where the origin is placed.
6. Show the students a page that has only points marked on it (with letter names beside them). Overlay the page with grid paper, placing the origin in about the middle. Have the class determine the coordinates of the points and describe the change between different pairs (e.g., A to B: 3 to the right and 5 down or 3 horizontally and -5 vertically). Next move the overlay so the origin is in a different location and have the students repeat the process. Have the students compare the descriptions of how to change between the pairs of the points and then as a class discuss whether it matters where the origin of a Cartesian plane is placed.
7. Provide the students with a Cartesian plane with the axes labelled, but no points indicated on the plane. Have the students mark the Origin as “O”. Read out and record an ordered pair and ask the students to locate it on their grid. Continue by giving a series of directions (move -3 in the x-direction and +2 in the y-direction, or move 7 horizontally and 0 vertically) and ask the students to record (but not say out loud) the new coordinates of their location on the Cartesian plane. Design the series of directions so that the students end on a particular point (the origin works well) so you can quickly scan their work to see if there are any problems. If there are students who didn’t get to the right endpoint, have an overhead over lay of the path to put over their graph to see where their error(s) was.
8. Have the students go in pairs or in small groups. Each student individually is to plot 4 points on a Cartesian plane and then hide their graph from their other group members. Each player is to get four tokens – coloured chips or pattern block pieces allow the students to distinguish themselves from the other players. Taking turns each student calls out the coordinates for an ordered pair and they record the ordered pair in a chart. If any of the other students in the group have a point plotted on their Cartesian plane whose coordinates have been said, they must give one token to the student who said the coordinates. If the ordered pair said is only one square away from a point they marked on their graph, they must tell the student. Otherwise they can just say “Sorry, nothing there”. Each student must come up with their own strategies for keeping track of hints and ordered pairs guessed. Play continues until all of the marked points have been discovered. The student with the most tokens at that point is the winner. Have the students discuss the strategies they used.
9. Introduce the students to alternate scales for the axes (keep the scales the same on both axes for this grade). Have the students discuss why a different scale would be used. Ask the students to identify where different x or y coordinates would be located on the new axes (e.g., where would you find 1, -3, 14…). Give the students points to plot on the Cartesian plane.
10. Give the students the task of creating a picture or design on a Cartesian Plane with the axes scaled by 2, 5, or 10 and provide instructions for plotting and connecting points to re-create the picture or design on another Cartesian Plane. Have the students exchange their instructions with a partner and have the partner follow the instructions for plotting of the points. Have the students check if they got the same design or picture and if they didn’t have the students analyze the instructions and the plotting to find and correct errors.
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