Overview and Connection to Culminating Project

During Learning Task 3, teams determine the location for the systems, equipment, and activities they have selected to include in their playground. In order to do that, they will learn about plotting points on a coordinate plane and plot points on their floor plan to show where to drill post holes. They can use this visual of the playground floor plan in their final presentation in order to highlight how they maximized the use of their space while maintaining a safe distance between systems, features, and activities within their playground.

Learning Objectives

Students will be able to

- Identify and plot points in all four quadrants of a coordinate plane.
- Use the coordinate plane to draw polygons and apply their understanding to solve real-world problems.
- Communicate a location using academic language.
- Articulate strategies used to calculate area.

Driving Questions

- How can you use the dimensions of your playground and your equipment, activities, and systems to make the best possible arrangement within your playground?
- How can you use the coordinate plane to determine the length or width of a location or item?

Assessment

Check for Understanding • Draw Polygons on the Coordinate Plane

Timeline

- Lesson 1 What Is a Coordinate Plane?
- Lesson 2 Where Should We Drill?
- Lesson 3 How Can We Improve Our Playground?

Check for Understanding • Draw Polygons on the Coordinate Plane (see Handouts and Assessments)

Language Support Strategies

Highlight the academic vocabulary used in this task. Briefly preview the terms orally and have students repeat them aloud and share what they know (definition or real-life connections).

Academic Vocabulary

- coordinate plane (or grid)
- distance
- negative number
- ordered pair
- origin
- plot
- point
- polygon
- quadrant
- vertex
- x-axis, x-coordinate, x-value
- y-axis, y-coordinate, y-value

Materials, Supplies, and Technology

- Video: How to Set Posts in Concrete (without mixing)
- Blank copies of the playground floor plans (see Handouts and Assessments)
- Blank copy of a coordinate plane for display
- Copies of Check for Understanding Draw Polygons on the Coordinate Plane (see Handouts and Assessments)

Language of Instruction

- anchor, anchored
- back to back
- location
- post
- reverse roles

LESSON 1

WHAT IS A COORDINATE PLANE?

WARM-UP

Where Is the Playground Structure?

- Explain that playground equipment needs to be anchored into the ground in order to be safe. A common way to anchor structures in the ground is to set posts into holes that are filled with concrete. Show the video <u>How to Set Posts in Concrete (without mixing)</u>, which shows this process.
- Give students a blank template of the playground floor plan their team chose in Learning Task 1. Divide each team into partners. Have the partners sit back to back so they cannot see each other or each other's floor plans. Student 1 will decide where to put one of the playground structures they chose in Learning Task 1 on the playground floor plan. Student 1 should explain to Student 2 (without showing the floor plan) exactly where to draw the structure on their own floor plan. Then, reverse roles and repeat the process.
 - Both you and a team member will each have a blank copy of the playground floor plan that your team chose.
 - Sit back to back with your partner.
 - Draw a playground structure on your playground floor plan. Without showing your partner the floor plan, explain to your partner exactly where to draw the structure on their own floor plan.
 - Then, reverse roles and repeat the process.

STUDENT EDITION



NOTE

Expect students to find it difficult to communicate locations in this way. After letting students experience the activity in a productive struggle, move to the project activity and introduce the coordinate plane.

LESSON 1 • WHAT IS A COORDINATE PLANE?

PROJECT ACTIVITY

About Descartes

• Read the following to students, or ask a student to read it.

René Descartes was a French mathematician who lived in the 1600s. When he was a child, he was often sick, so the teachers at his boarding school let him stay in bed until noon. He continued staying in bed until noon for almost all his life. While in bed, Descartes thought about math and philosophy.

One day, Descartes noticed a fly crawling around on the ceiling. He watched the fly for a long time. He wanted to know how to tell someone else where the fly was. Finally he realized that he could describe the position of the fly by its distance from the walls of the room. When he got out of bed, Descartes wrote down what he had discovered. Then he tried describing the positions of points the same way he described the position of the fly. Descartes had invented the coordinate plane! In fact, the coordinate plane is sometimes called the Cartesian plane in his honor.

(Source: mathforum.org/cgraph/history/fly.html)

STUDENT EDITION

Place Equipment on a Coordinate Plane

- Display a coordinate plane. Show some examples of how to locate "flies" or points.
- Show some examples of how to plot points. Remind students that in an **ordered pair**, the first number tells you the position of the point on the *x*-axis, and the second tells you the position on the *y*-axis.

Example



LESSON 1 • WHAT IS A COORDINATE PLANE?

• Next, have students use the coordinate plane in their Student Edition to repeat the activity from today's warm-up activity using their coordinate plane instead of their floor plan.



Math Curricular Connection Suggestions

Mathsnacks: Game Over Gopher (coordinate plane game)

Engage NY: Negative Numbers

Khan Academy: Intro to negative numbers

Khan Academy: Coordinate plane

LESSON 2

WHERE SHOULD WE DRILL?

WARM-UP

Plot Points on a Coordinate Plane

• Have students work on the warm-up activity in their Student Edition.

Plot these points on the coordinate plane below.

Point A	(2, 5)	Point <i>E</i>	(7, 5)
Point B	(2, 1)	Point F	(7, 1)
Point C	(-6, -3)	Point G	(1, -3)
Point D	(-6, 4)	Point <i>H</i>	(1, 4)



- How far away is point A from point B?
 4 units
- How far away is point C from point D?
 7 units
- How far away is point *E* from point *F*?
 4 units
- How far away is point *G* from point *H*?
 7 units
- 5. How far away is point *A* from point *E*? 5 units
- How far away is point *B* from point *F*?
 5 units
- How far away is point C from point G?
 7 units
- How far away is point *D* from point *H*?
 7 units

Are there any patterns or shortcuts you noticed that can help you determine distances between points? If the distance is horizontal, you work with the x-values of the order pair, which are different. If the distance is vertical, you work with the y-values of the order pair, which are different. If the points are in the same quadrant, you subtract those values. If the points are in different quadrants, you take the absolute value and add the values.

STUDENT EDITION



LESSON 2 • WHERE SHOULD WE DRILL?

PROJECT ACTIVITY

Decide Where to Drill

- Have students draw the *x* and *y*-axis on their playground floor plan using a vertex of their reflecting pool as the origin (0, 0). Tell them to label and number each axis.
- Have students decide where on the floor plan/coordinate plane to place their playground equipment from their Playground Information Table in Learning Task 1. Then have them determine the coordinates and mark their floor plan/coordinate grid according to the instructions in the Student Edition.



• Draw the *x*- and *y*-axis on your playground floor plan using a vertex of your reflecting pool as the origin (0, 0).

Answer will vary.

- Label and number each axis.
- Decide where on the floor plan/coordinate plane to place the playground equipment you chose in the Playground Information Table from Learning Task 1. Your playground equipment should be spread out among all four quadrants of your floor plan.
- Remember, playground equipment needs to be anchored into the ground in order to be safe. You need to drill holes in each corner or vertex of the use zone for each piece of playground equipment. Use the table below to tell the local construction company exactly where they should drill holes to anchor your playground equipment. Remember to label all dimensions and units of measurement!
- Then draw the drill holes on your floor plan/coordinate plane.

Name of Playground Equipment	Dimensions for Use Zone	Area of Use Zone	Coordinates for Holes

STUDENT EDITION

NOTE

The playground floor plan dimensions are given in yards, but students recorded the dimensions and area of their use zones in feet and square feet on their Playground Information Table. Check with each team to make sure they have correctly converted feet to yards and that they know how to deal with fractional or decimal yards on the coordinate grid. Example: A use zone has a length of 13 feet, which is equal to 4 and

 $\frac{1}{3}$ yards. How do you place the coordinate to show a length of 4 $\frac{1}{3}$ yards?

LESSON 2 • WHERE SHOULD WE DRILL?

Math Curricular Connection Suggestions

Mathsnacks: Game Over Gopher (coordinate plane game) Engage NY: Negative Numbers Khan Academy: Intro to negative numbers

Khan Academy: Coordinate plane

LESSON 3

HOW CAN WE IMPROVE OUR PLAYGROUND?

WARM-UP

Coordinate Plane

• Have students work on the warm-up activity in their Student Edition.

Daniela has created a map of her backyard on the coordinate plane so that each unit length is 1 yard. She wants to design a right triangular garden that has an area of 8 square yards. If she plots one vertex of the base of the plant bed at (3, 8) and one vertex at (7, 8) on her coordinate plane, where could she plots the last vertex?



To make the garden a right triangular garden, Daniela could place the vertex any place that has an x-coordinate of 3 or an x-coordinate of 7.

To make it 8 square yards, the point would need to be (3, 4) or (7, 4).

STUDENT EDITION

• Have students discuss their thinking in solving the warm-up problem.

LESSON 3 • HOW CAN WE IMPROVE OUR PLAYGROUND?

PROJECT ACTIVITY

Decide Where to Drill

• Give students time to continue working on the "Decide Where to Drill" activity or any other unfinished activities. If a team can demonstrate they are finished (every team member can thoroughly explain what was done), then have them work on one of the extensions or curricular connections from this unit.

Math Curricular Connection Suggestions

Mathsnacks: Game Over Gopher (coordinate plane game) Engage NY: Negative Numbers Khan Academy: Intro to negative numbers Khan Academy: Coordinate plane

CHECK FOR UNDERSTANDING

Draw Polygons on the Coordinate Plane

Distribute the Learning Task 3 assessment: Check for Understanding • Draw Polygons on the Coordinate Plane.

A sixth grade class needs to build a safety fence around their playground. They use ordered pairs to show where to put the corners of their fence. There will be corners at (-3, 1), (3, 1), (-1, -5), and (1, -5).

- 1. What kind of figure will the fence make? *The figure is a square.*
- If each square on their coordinate grid represents 1 square foot on the playground, how much area will there be inside of the fence?
 Each side of the square is 6 feet long, so the area is 36 square feet.

HANDOUTS AND ASSESSMENTS