Lesson 19: Drawing on the coordinate grid

Goals
- Generate a list of ordered pairs to create an image on the coordinate grid, and explain (orally) the reasoning.

Learning Targets
- I can use ordered pairs to draw a picture.

Lesson Narrative

In this optional culminating lesson, students use graphing technology to plot ordered pairs and create images. Using graphing technology for this lesson is highly recommended over doing it with pencil and paper. In the first activity, students recreate a given image to help familiarise them with how the graphing technology works. The second activity, where students design their own image, could be lengthened or shortened as needed by instructing students to create an image with more or less detail. Using graphing technology gives students an opportunity to attend to precision because the program graphs exactly what they enter and will not guess at what they might have meant if they input a point incorrectly.

Addressing
- Draw polygons on the coordinate grid given coordinates for the vertices; use coordinates to find the length of a side joining points with the same first coordinate or the same second coordinate. Apply these techniques in the context of solving real-world and mathematical problems.

- Solve real-world and mathematical problems by graphing points in all four quadrants of the coordinate grid. Include use of coordinates and absolute value to find distances between points with the same first coordinate or the same second coordinate.

Instructional Routines
- Group Presentations

- Discussion Supports

Required Materials
Graphing technology
Examples of graphing technology are: a handheld graphing calculator, a computer with a graphing calculator application installed, and an internet-enabled device with access to a site like desmos.com/calculator or geogebra.org/graphing. For students using the digital materials, a separate graphing calculator tool isn't necessary; interactive applets are embedded throughout, and a graphing calculator tool is accessible on the student digital toolkit page.

Graph paper

Acquire devices that can run Desmos (recommended) or other graphing technology. It is ideal if each student has their own device. It is highly recommended to use graphing technology for this lesson. If graphing technology is not available, using graph paper is a possibility or consider skipping this lesson.

Student Learning Goals
- Let's draw on the coordinate grid.

19.1 Cat Pictures

Optional: 15 minutes (there is a digital version of this activity)

This activity introduces students to using graphing technology to plot ordered pairs and create images.

Launch

Demonstrate how to use the technology available in the classroom to plot coordinate pairs. If using Desmos in a web browser, consider using these instructions:

- On a blank graph, add a new table by clicking on the "+" icon in the upper left and select "table" from the drop-down menu.

- Enter pairs of x- and y-values in the table. Corresponding points should appear on the graph.

- Click on the wheel icon on the upper right corner of left sidebar. The circle next to the y label in the table will turn into a solid circle.

- Click on the circle next to y and turn on the "Lines" option in the drop-down menu. Consecutive points on the graph will now be connected by line segments.

Provide access to graphing technology. Give students 10–12 minutes of quiet work time followed by a whole-class discussion.

Engagement: Internalise Self-Regulation. Provide a project checklist that chunks the various steps of the project into a set of manageable tasks. Consider providing students with a starting point and ordered pairs for select key details such as tips of the ears.
*Supports accessibility for: Organisation; Attention*

Anticipated Misconceptions

Some students may struggle with getting the graphing technology to do what they want. Consider having a peer show them how to use it or help them identify their mistakes.

Students who are doing the activity on paper may not realise that they should continue listing ordered pairs when they get to the part about adding more details. Encourage them to list the ordered pairs as appropriate.

Student Task Statement

Use graphing technology to recreate this image. If graphing technology is not available, list the ordered pairs that make up this image. Then compare your list with a partner.
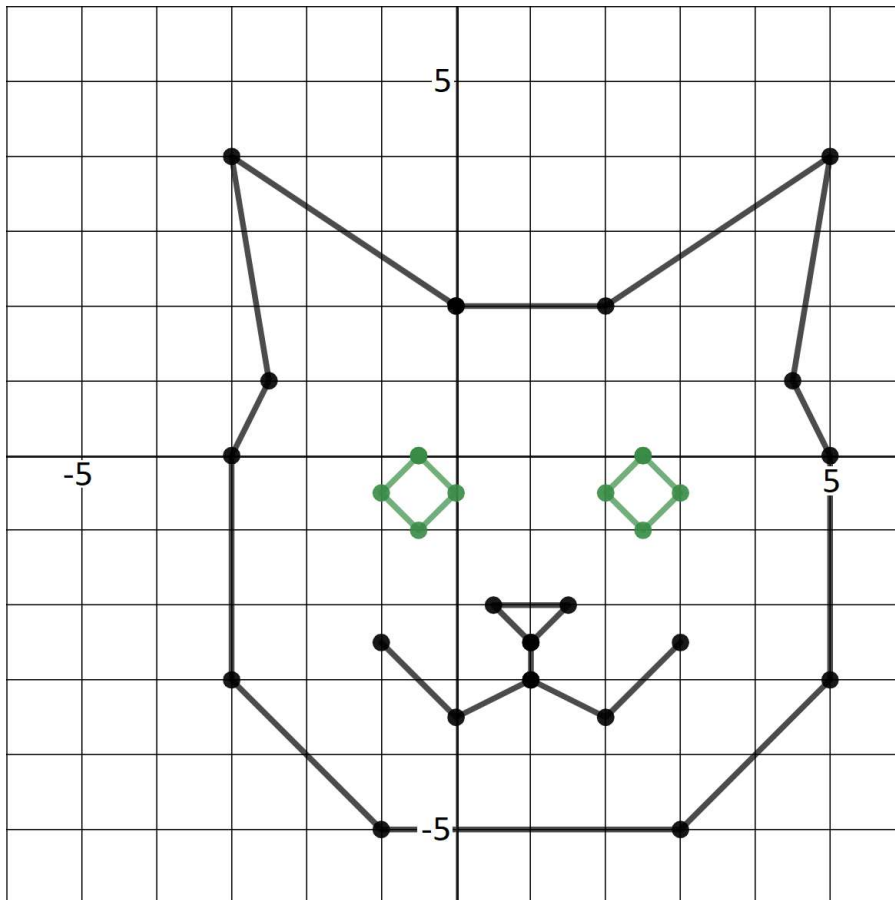
If you have time, consider adding more details to your image such as whiskers, the inside of the ears, a bow, or a body.

Student Response

For the outline of the head:

x	y
0	2
2	2
5	4

4.5	1
5	0
5	-3
3	-5
-1	-5
-3	-3
-3	0
-2.5	1
-3	4
0	2

For the left eye:

x	y
-1	-0.5
-0.5	0
0	-0.5
-0.5	-1
-1	-0.5

For the right eye:

x	y
2	-0.5
2.5	0
3	-0.5
2.5	-1
2	-0.5

For the nose and mouth:

x	y
-1	-2.5
0	-3.5
1	-3
1	-2.5
0.5	-2
1.5	-2

1	-2.5
1	-3
2	-3.5
3	-2.5

Are You Ready for More?

If you are using graphing technology, add these statements to the list of things being graphed:

$x > 6$
$y > 5$
$x < -4$
$y < -6$

Describe the result. Why do you think that happened?

Student Response

Answers vary. Sample response: There is a frame around the cat's face and everything outside it is shaded. This happened because these are the places where it is true that $x > 6$ or $y > 5$ or $x < -4$ or $y < -6$.

Activity Synthesis

Briefly invite students to share what challenges they experienced while graphing the image and how they overcame them. If not brought up by students, highlight the fact that the image's line of symmetry was not on the axis and ask them to share how this affected the coordinates.

19.2 Design Your Own Image

Optional: 30 minutes (there is a digital version of this activity)

In this activity, students use graphing technology to create an image of their own design. While determining the ordered pairs needed to make their image, they have opportunities to think about distances on the coordinate grid, signs in ordered pairs, reflections across an axis, and distance from zero. Students make use of structure as they adjust their ordered pairs until the image looks just the way they want it.

Instructional Routines
- Group Presentations

- Discussion Supports

Launch

If needed, review how to use the graphing technology to make sure every student feels capable of plotting points and connecting them.

Student Task Statement

Use graphing technology to create an image of your own design. You could draw a different animal, a vehicle, a building, or something else. Make sure your image includes at least 4 points in each quadrant of the coordinate grid.

If graphing technology is not available, create your image on graph paper, and then list the ordered pairs that make up your image. Trade lists with a partner but do not show them your image. Graph your partner's ordered pairs and see if your images match.

Student Response

Answers vary.

Activity Synthesis

Invite students to share what they thought about while they were figuring out the ordered pairs for their image. Consider doing a gallery walk so students can see each other's designs.

Speaking: Discussion Supports. Encourage and support opportunities for peer interactions. Prior to the whole-class discussion, invite students to share their image and their process with a partner. Display sentence frames to support student conversation such as: "First, I ____ because . . .", "I noticed ____ so I . . .", "How did you . . .?", "A different step I used was ____ because . . ."
Design Principle(s): Support sense-making; Optimise output