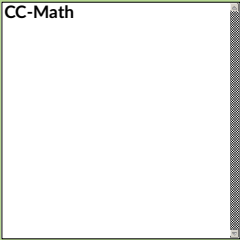# Coordinates and Game Design

(Also available for Pyret)

Students review the importance and need for coordinates in the context of a video game and brainstorm a game of their own.

Prerequisites	None
Relevant Standards CC-Math	*Select one or more standards from the menu on the left (⌘-click on Mac, Ctrl-click elsewhere).*
Lesson Goals	Students will be able to: • Explain the need for *coordinates* in a given situation. • Estimate coordinates in a bounded area.
Student-Facing Lesson Goals	• I can estimate the positions of objects using coordinates. • I can collaborate with a partner to brainstorm a video game. • I can create a sample mock-up (proof of concept) of my video game.
Materials	• Lesson slides template (Google Slides) • Estimating Coordinates worksheet (HTML (Page 4)) • Game Brainstorming organizer (HTML (Page 6)) • Optional: cutouts of the Cat, Dog, and Ruby from the NinjaCat game.
Preparation	• Make sure all materials have been gathered • Decide how students will be grouped in pairs
Supplemental Resources	• Coordinates (Quizizz) • The Awesome Coordinate Plane Activity (Desmos Activity) • Submarine Coordinate Game (Geogebra) • Coordinate Grid Exploration (Geogebra)
Key Points for the Facilitator	• The launch activity should create and reinforce the need for coordinates and to attend to precision. • Continue to use the same "Estimating Coordinates" page so students can track their pattern of estimation over time.

For a textbook-like version of materials similar to these, you may wish to see the prior unit-based version.

Glossary

coordinate :: a number or set of numbers describing an object's location

horizontal axis :: axis on a coordinate plane that runs from left to right

vertical axis :: number line on a coordinate plane that runs from bottom to top, indicating values in that direction

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# Navigating a Grid   20 minutes

Overview

Students are asked to come up with a way of identifying location on a grid, which provides the justification for coordinates.

Launch

Computers use numbers to represent a character's position onscreen, using number lines as rulers to measure the distance from the bottom-left corner of the screen. For our videogame, we will draw the number line so that the screen runs from 0 (on the left) to 1000 (on the right).

We can take the image of the Dog, stick it anywhere on the line, and measure the distance back to the left-hand edge. Anyone else who knows about our number line will be able to duplicate the exact position of the Dog, as long as they know the number.
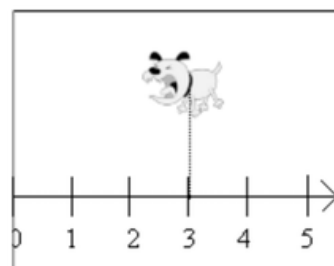
- What is the coordinate of the Dog, if it's on the left-hand edge of the screen?
- What is the coordinate of the Dog, if it's on the right-hand edge of the screen?
- What is the coordinate of the Dog, if it's in the center of the screen?
- What coordinate would place the Dog beyond the left-hand edge of the screen?
- What coordinate would place the Dog beyond the right-hand edge of the screen?

OPTIONAL: Draw a number line on the board, and select a volunteer to leave the room for a moment. Place the printed Dog image somewhere on that line, and have the class quietly choose the number that represents the Dog's location. Remove the Dog and invite the student back into the room. Can they position the Dog at the right place, based on the number chosen by the class?

This number line lets us communicate the position of the Dog using a single number! Unfortunately, it only represents the distance from the left-hand edge of the screen. That means the dog could be at any *height* in the center of the screen, and it would always have the same number to represent its position.

Investigate

By adding a second number line, we can locate a character *anywhere* on the screen in either direction. The first line we drews is called the *x-axis*, which runs from left to right. The second line, which runs up and down, is called the *y-axis*. A 2-dimensional *coordinate* consists of both the x- and y-locations on the axes.

Suppose we wanted to locate NinjaCat's position on the screen. We can find the x-coordinate by dropping a line down from NinjaCat and read the position on the number line. The y-coordinate is found by running a line to the y-axis.

A coordinate pair is always written in the form of (x, y). When we write down these coordinates, we always put the x before the y (just like in the alphabet!). Most of the time, you'll see coordinates written like this: $(200, 50)$ meaning that the x-coordinate is 200 and the y-coordinate is 50.
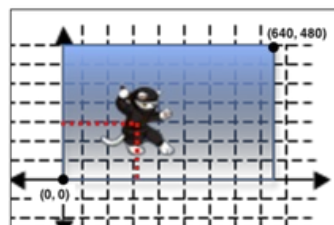
To develop an intuition for coordinates, have students complete Estimating Coordinates (Page 4).

Common Misconceptions

Math-phobic students often fail to realize that *common sense* and *intuition* can be helpful in exercises where the answer is a number! The first two prompts in the "Synthesize" section directly get at this misconception, but you may want to pay special attention to those students while they are working on this workbook page.

Synthesize

- Should any of the characters have x-coordinates that are very similar? How come?
- Should any of the characters have y-coordinates that are very similar? How come?
- How do you think this concept relates to a video game? *Answers vary: we need to know where characters are on the screen, we need a way for players to interact with certain parts of the screen, etc*

Bridging to video games

30 minutes

Overview

Students explore a coordinate activity in which a cartesian point is used to compute the position of a character in a game. From there, they brainstorm a game of their own.

Launch

In pairs, have students explore the Ninja Cat Desmos graph.

> ### Notice and Wonder
>
> As one partner explores the graph, the other student will write down what they Notice on Notice and Wonder (Page 5).
>
> As one partner explores the graph, the other student will write down what they Wonder.

Investigate

- Students complete the Brainstorm Your Own Game worksheet and decide on a Player, Target, Danger, and Background for their game.
- Students will use a Google Draw template (click "Make a copy" when prompted) to create a sample "screenshot" of their game by inserting images via Google Search.

Screenshot should include:

- Labeled estimates of coordinates for each character.
- 2 characters that have the same x-coordinate.
- 2 different characters that have the same y-coordinate.

Synthesize

- When the "Game Over" screen is supposed to be off screen, what coordinates might hide it?
- What would be the coordinate of the dog *before it gets onscreen?*
- Why do we estimate? *Practice number sense, get better at working with numbers*
- What constitutes a good estimate?
- How can we improve our estimation skills? *Practice, get more comfortable with numbers and more comfortable with making guesses*