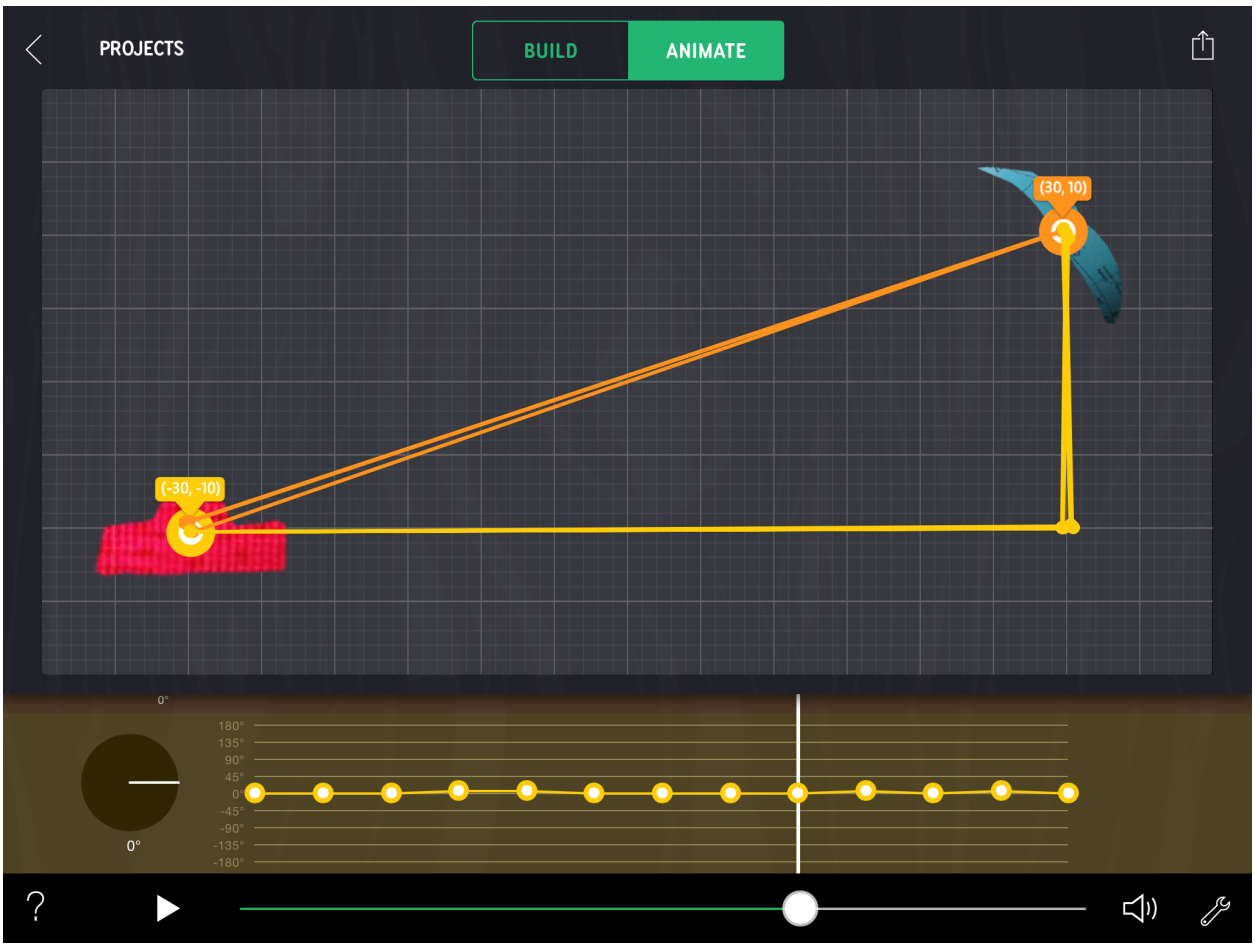
Choreo Graph Activity 6: Traveling Distances

Calculating Distance Using Coordinates in a Coordinate Plane

Overview

Students explore how the distance formula works on coordinate axes and discover how the Pythagorean Theorem relates to the distance formula.



Big Idea

Using the translation and grid tools in the Choreo Graph app, students create a travelling character and calculate the distance between two points in the coordinate plane. To calculate the distance travelled, students use both the distance formula and the Pythagorean theorem.

For more background information, visit this link: Distance and Pythagorean Theorem Information

Learning Objectives

Students will:

- Draw coordinate axes and explore the distance formula.
- Learn about how the Pythagorean Theorem relates to the distance formula.
- Engage in computational thinking as they work with graph controllers and key frames to create, develop, and perfect their animated scenes.

Vocabulary/Terms

- Distance Formula:

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

- Pythagorean Theorem:
  $a^2+b^2=c^2$

Grades

Middle School, 6-8

Standards Addressed

Common Core State Standards-Math
Geometry
8.G.B.8. Apply the Pythagorean Theorem to find the distance between two points in a coordinate system.

Common Core State Standards-Math
Mathematical practices.
MP2: Reason abstractly and quantitatively.

MP4: Model with mathematics.
Students outline their dance using the angles of rotation and the coordinate notation for the translation.

Classroom Strategies

Single-device implementation
Before class meets, create a character in the app that travels from a starting point to an ending point. For the first example be sure there is vertical as well as horizontal movement. Create a screen shot of the path the character travels with the grid and translation function on. Invite students to calculate the distance travelled using either formula. Play the animation and have the students check if their answers match the real distance travelled. Change the position of the character on screen, and have students work out the distance traveled again. Do they see any differences?

Multiple-device implementation
Working in pairs, have students generate paths for their animated characters to travel and create a story around it. Then ask students to calculate distance travelled using both equations. Use the calculations to compare and contrast.

Tips and Tricks

Getting Started: Have students play with translations where their figure slides from a starting point to an ending point including both vertical and horizontal movement. Have them take note of the coordinates with translation tool toggled on.

Making formulas concrete: The most common mistake made when using the Distance Formula is to accidentally mismatch the *x*-values and *y*-values. Have students repeat counting each set of movements of their animated character. By doing so, they can begin to notice that counting units horizontally is the same as calculating x^2-x^1 in the distance formula (same with y^2-y^1. In the vertical direction).

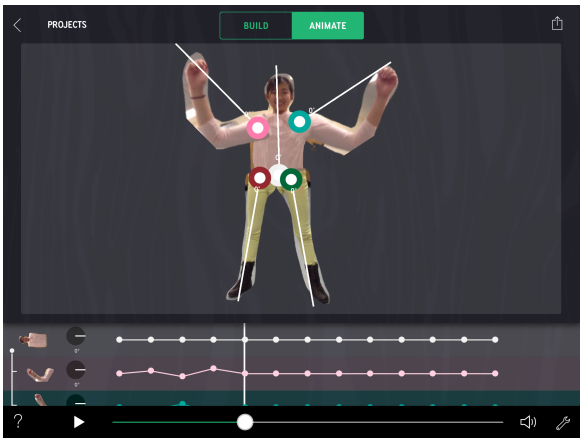
App Features

Begin by entering Make Some Moves. In **Build** mode, students will:

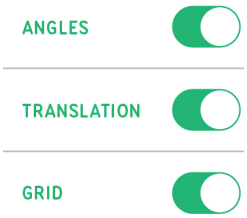
- Take pictures
- Trace and cut out parts of your photo that you want to animate
- Add graphic or musical elements below:

In **Animate** mode, students will use:

Graph Controllers- Choreo Graph uses key frames much like other movie editing software. At each point in the key frame, the student can set how each part of the animation rotates over time. Each node on the line graph below the stage represents the position of that part at a specific time. Stretch the points up and down to set the degrees of rotation. The steeper the line on the graph, the faster the part moves. Students can also set the location of their animated parts by selecting the part they want to move, choosing a node on the line graph or moment in the animation, and then dragging the part to a new position on the stage. They can set the location of parts for the entire animation sequence by repeating this process.



Toggle on math tools to notice:



Degrees each part has rotated

-Path the main parts moved

- Coordinates for location of each part

Expected Activity Time

Part 1: Distance Formula Exploration (20 minutes)
Part 2: Distance Formula and Pythagorean Theorem Exploration (20 minutes)

Materials and Prep

- Traveling Distances Student Sheets
- iPad with Choreo Graph app
- Wifi access for sharing to other iPads and online project space

Introducing the Activity

Create a story problem that involves your animated character traveling across a distance. An example may be that you're character is going across town or to a friend's house. Use Choreo Graph tools to gather data and calculate the distance traveled from point to point.

To Do

Part 1: Distance Formula Exploration (20 minutes)
When objects in Choreo Graph slide around the screen on the coordinate plane, they are moving across a distance. This distance can be found using the coordinates from one point to the next and applying the distance formula:

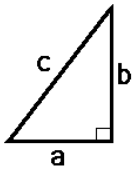
$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

Have students:

- Create a story problem that involves a virtual character traveling across a distance (e.g., going across town or to a friend's house).
- Use the distance formula to calculate the distance traveled from point to point.
- Draw the coordinate axes with a starting point and then plot the next point.
- Count over horizontally and then up or down vertically and note how many units they go in each direction.
- Compare these counts to what you get by using the distance formula. Have students share what they notice.

Part 2: Distance Formula and the Pythagorean Theorem (20 minutes)

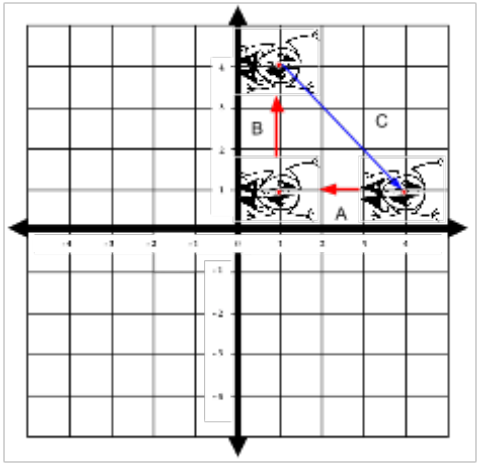
Pythagorean Theorem



$$a^2 + b^2 = c^2$$

In this activity, students use both the distance formula and the Pythagorean Theorem to locate the distance their characters travel from one point to another.
Have students:

- Practice with the sample below, and then have them try to figure out the distance traveled using both formulas.



- Use both horizontal and vertical movement in their animation.
- Find the length of the hypotenuse (c) using both formulas.
- What do they notice using this approach?

- Exchange story animations with a classmate and find their character's distance traveled using both formulas.

Discussion

After students create their paths and calculate distances traveled in different ways, discuss:
:

- How do results from the distance formula compare to the units moved on the grid?
- What if your animated character only moves vertically, but not horizontally? Does the distance formula still work?
- What happens if your object only moves in the horizontal direction, but not vertical? Is there still a distance traveled? What do you notice?

Listen for:

- I noticed that I got the same thing when I drew a triangle between the points and did the Pythagorean theorem.
- When you count squares vertically it is the same as when you calculate y^2-$y^{1.}$
- Counting squares across you get the same thing as when you calculate x^2- x^1 using the distance formula.

Extensions and Inquiring Further

There are many possibilities to extend this activity in creative ways. For example, compare how someone travels a city street versus a bird flying through the air. On city streets that are often in grids, travelers have to take the legs of right triangles to get somewhere, but birds can fly direct distances (hypotenuse). Have students puzzle out what are more effective ways to determine the distance travelled.

Name: _____ Date: _____

Part 1: Distance Formula Exploration

When objects in Choreo Graph slide around the screen on the coordinate plane, they are moving across a distance. This distance can be found using the coordinates from one point to the next. Here is the distance formula:

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

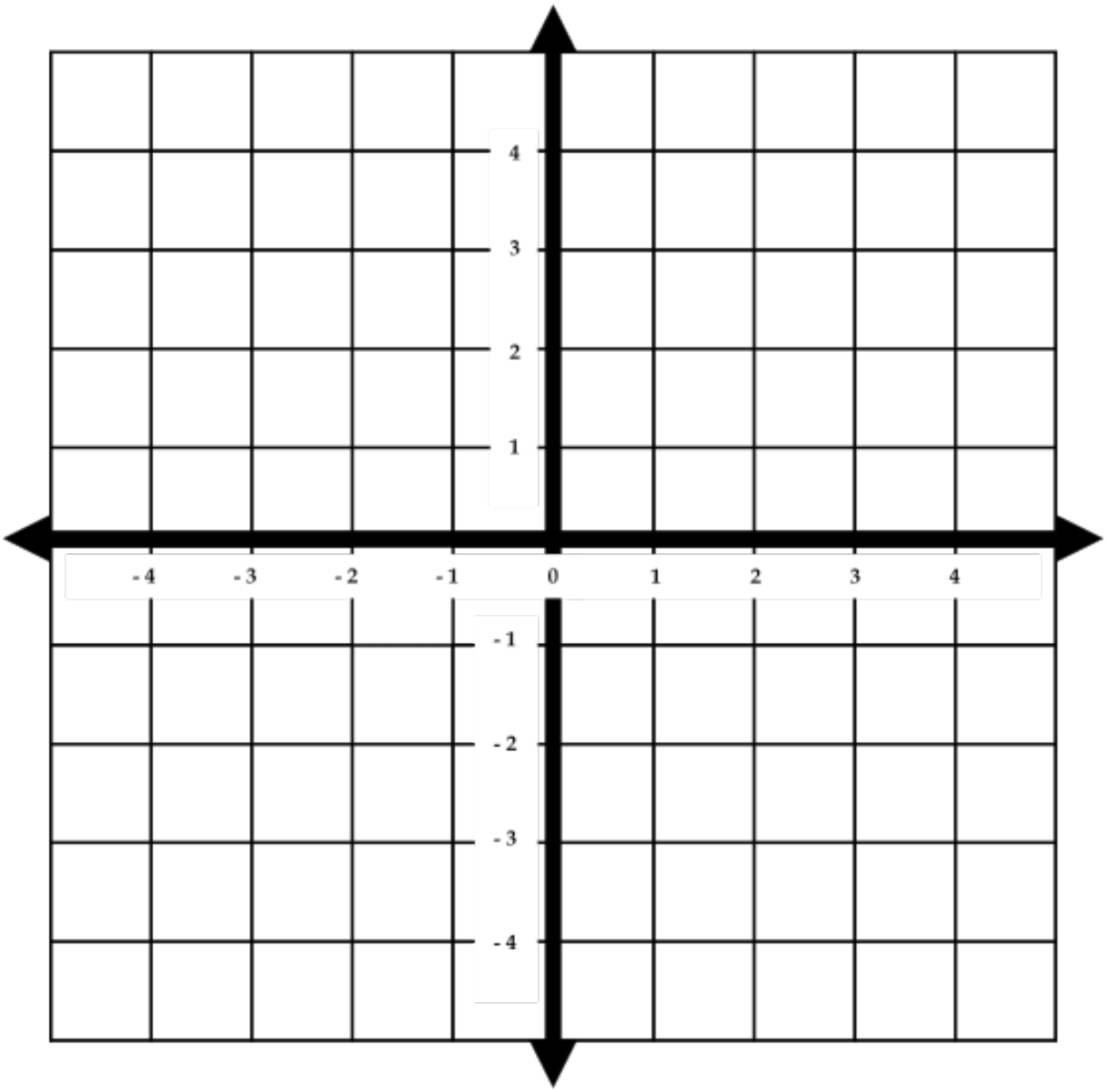
1. Create a story problem that involves your animated character traveling across a distance. An example may be that you're character is going across town or to a friend's house. From point to point, use the distance formula to calculate the distance traveled.

Distance	Point 1 Coordinates	Point 2 Coordinates	$x_2 - x_1$	$y_2 - y_1$	X answer squared	Y answer squared	*X + y*	Square root/ distance
Move 1								
Move 2								
Move 3								

Name: _____ Date: _____

Part 1: Distance Formula Exploration

2. Draw a coordinate axis with your starting point and then plot the next point. When you count over horizontally and then up or down vertically, make note of how many units you travel in each direction, and then compare that to what you did in the distance formula. What do you notice? (Hint you can also use your translation tool for coordinates).



3. On the Choreo Graph stage, count over horizontally and vertically and note how many units the object travels in each direction. Compare that number to the values you get when using the distance formula.

Name: _____ **Date: _____**

Part 1: Distance Formula Exploration
Reflection Questions:

Answer the following questions in complete sentences.

1. What happens if your object only moves vertically, but not horizontally? Does the distance formula still work?

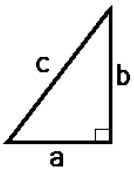
2. What happens if your object only moves in the horizontal direction, but not vertical? Is there still a distance traveled? What do you notice?

Name: _____ Date: _____

Part 2: Distance Formula and Pythagorean Theorem

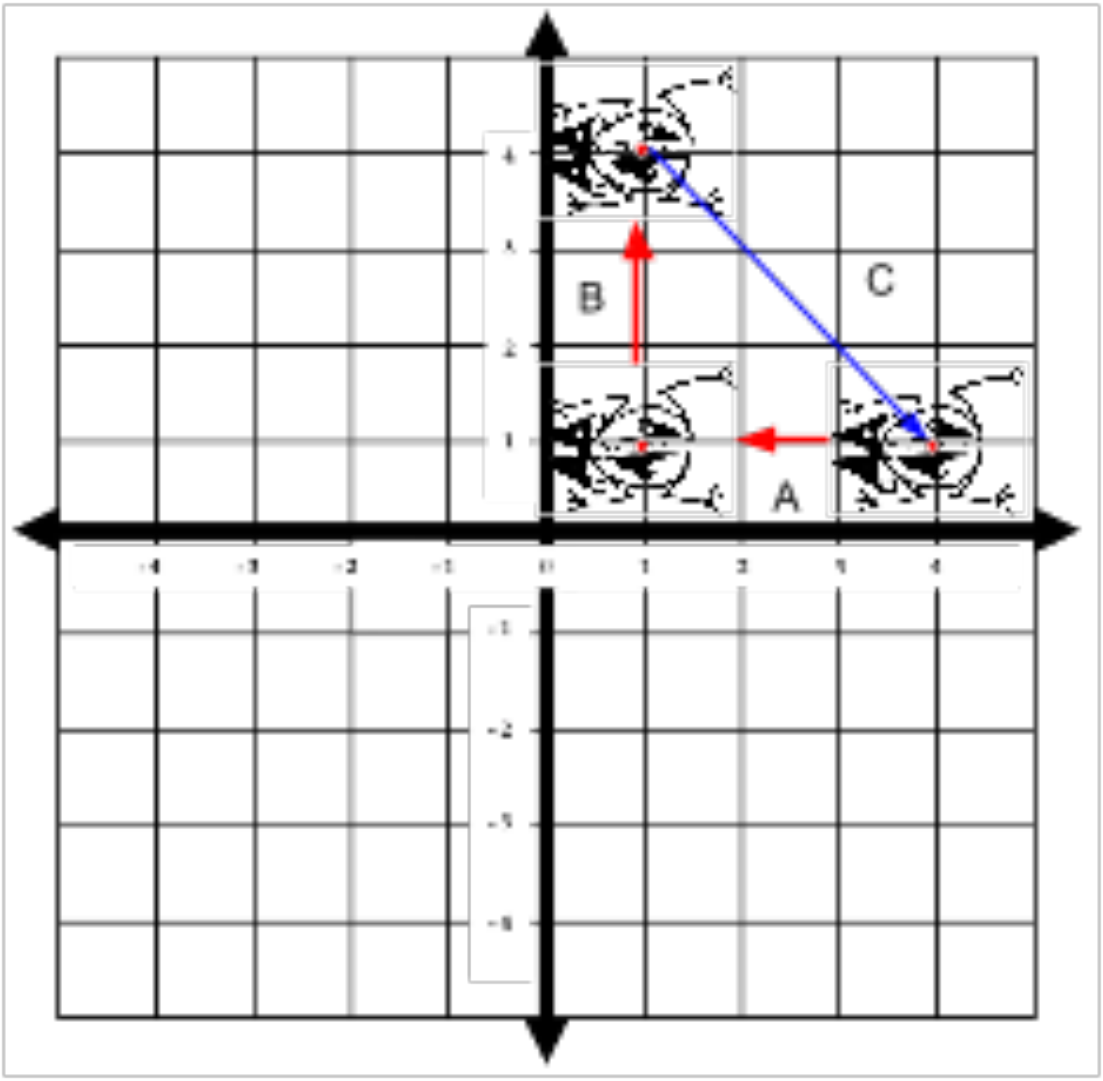
$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

Pythagorean Theorem



$a^2 + b^2 = c^2$

In this activity, you are going to use both the distance formula and the Pythagorean Theorem to locate the distance your animated character travels. Practice with the sample below.



Name: _____ Date: _____

Part 2: Distance Formula and Pythagorean Theorem

After you have practiced with the sample, try to locate the distance for your own animated character by:

1. Creating two movements that form a right angle.

2. Challenging yourself to find the length of the hypotenuse (c) using both formulas.

3. Swapping your animations with a classmate and asking them to try to find the distance travelled using both formulas.

Name: _____ Date: _____

Part 2: Distance Formula and Pythagorean Theorem

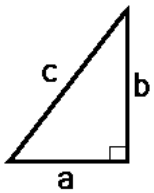
Data Sheet

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

Find the distance of the hypotenuse (c) using the distance formula and the Pythagorean Theorem.

point 1 coordinates	point 2 coordinates	$x_2 - x_1$	$y_2 - y_1$	x answer squared	y anwer squared	x + y	square root/ distance

Pythagorean Theorem



$a^2 + b^2 = c^2$

a^2	b^2	c^2	$\sqrt{x}$

Name: _____ Date: _____

Part 2: Distance Formula and Pythagorean Theorem Reflection Questions:

1. After calculating distances using each formula, how do the distances compare to each other?

2. Which formula was most efficient to use?