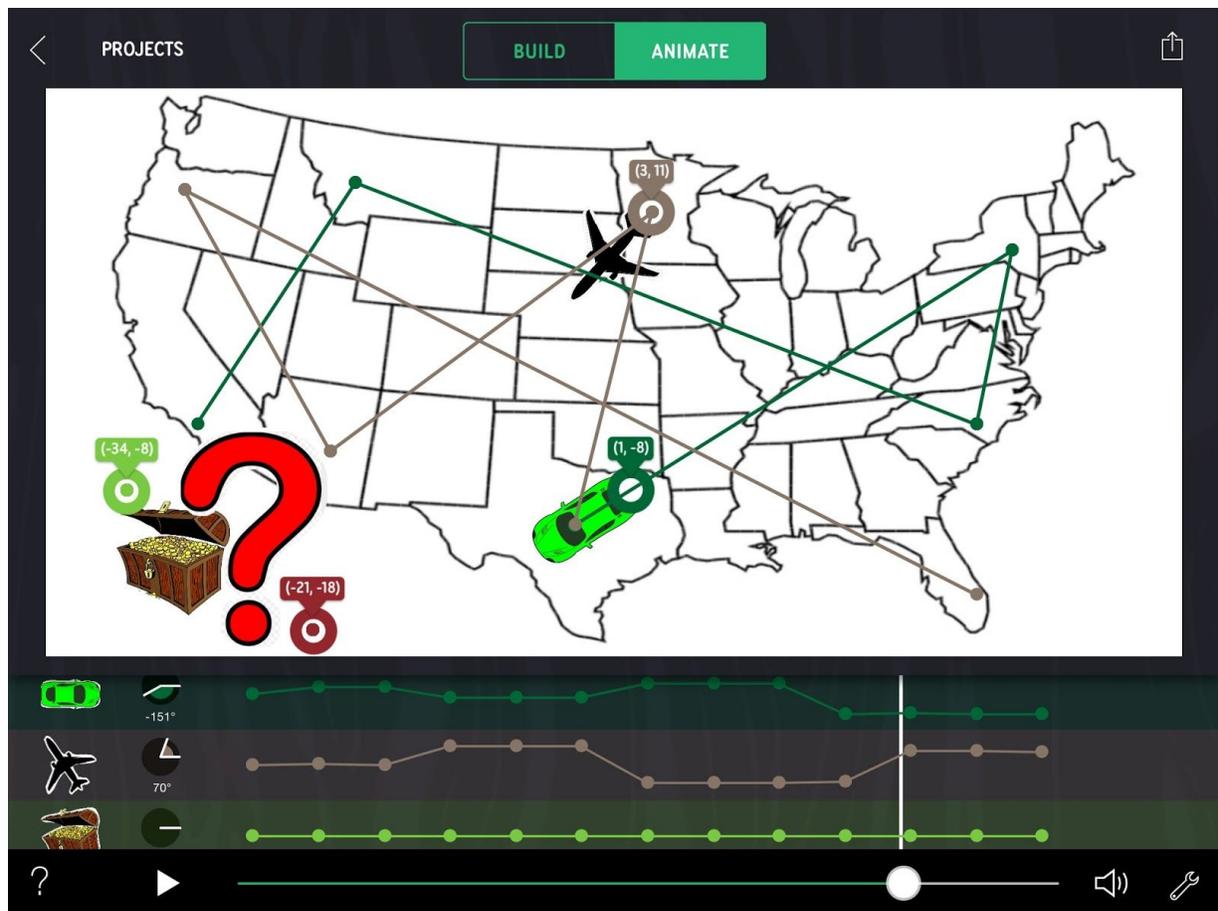


Treasure Map - Lesson 1 - Linear Equations - TD

Lesson Overview

Treasure maps are designed as puzzles--only those who know how to crack the code are able to find the prize. Treasure maps are designed this way on purpose. If they are stolen, they won't be useful unless they are "solved." In this lesson, students will animate their own treasure map. They will use their knowledge of **linear equations** and **graphs of lines** to solve a mathematical puzzle and locate the treasure. Then, they will then be invited to create their own maps for their classmates to solve.

This is a Choreo Graph screenshot of the treasure map activity, students will use their knowledge of linear equations and graphs to locate coordinates for the lost gold.



Intro Info

Treasure maps are known to keep the location of the actual treasure hidden in plain sight. A lack of specific details allows the creator of the map to be the only one in the know.

But what if the creator of the map left behind a few mathematical notes that could be decoded by those who understand linear algebra?



Learning Objectives:

<p>Linear Equations</p>	<p>Activity: Students will plot coordinates and find 2 linear equations in the form $y = mx + b$. They will then solve the system of equations to find the intersection point.</p> <p>Objective: SWBAT use linear equations to solve real world problem.</p>
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What you need to get started

A set of iPads with the Choreo Graph app

Time Needed

Depending on how much time you want to spend on this project, anywhere from 1 class period (if students are already familiar with Choreo Graph) to 3 class periods.

Collaboration and Group Work

These lessons are designed for students to work individually, in pairs, or in groups. Each student should do all the work on their own sheets, and the iPad should be shared across group members as equally as possible.

We suggest that groups be no larger than four students. Four or more students in a group will require extra attention to make sure that every group member is contributing equally.

Lesson Plan

Introduction

- 1) Discuss and/or review the idea that treasure maps often contain a riddle, and the reason for this.
- 2) As needed: Review plotting coordinates, finding slope, y-intercepts, linear equations, and solving systems of equations - but don't give away the riddle!

To do

- 1) Students will follow the instructions on their sheets.
- 2) The lesson guides students through plotting points in Choreo Graph.
- 3) Below are several screenshots showing the process that students will go through in this lesson.
- 4) If students use Choreo Graph to find the intersection point, their sheet prompts them to show this solution algebraically as well.
- 5) Part 1 is below. Part 2 provides space and guidance for students to design and devise their own stories and math riddles using the grid and coordinates in Choreo Graph. Plan to provide ample time for students to create their own stories, or assign for homework.

Part 1 - Solve the riddle - Find the treasure

You have been hired as a private detective to find treasure that was stolen from an art museum. The museum found the following note with coordinates, but they have no idea what it all means.

“Make the drop at the spot. Choreo Graph points the way.”

CG Keys	Car	Plane
1	(-31, 11)	(-28, -5)
2	(-28, 16)	(-28, -1)
3	(-18, 12)	(-21, -2)
4	(-17, 17)	(-22, 2)
5	(-12, 7)	(-16, -3)
6	(-23, 4)	(-21, -8)
7	(-21, 8)	(-21, -4)
8	(-31, 11)	(-28 -5)
9	(-29, 14)	(-28, -2)
10	(-12, 7)	(-16, -3)
11	(-12, 7)	(-16, -3)

12	$(-12, 7)$	$(-16, -3)$
13	$(-12, 7)$	$(-16, -3)$

6) Circulate the room and check for understanding, help students as needed.

Sharing

- 1) With each lesson, spend some time allowing the students to share their work with the class. In this lesson, students can share difficulties they might be having as well as successes in finding linear equations and the solution to the system of equations.
- 2) You might also invite students to continue noticing ways in which mathematics plays a heavy role in solving codes, encrypted data, etc.

Wrapup

- 1) If necessary, have students label their iPads so they will be able to return to them for the next lessons.

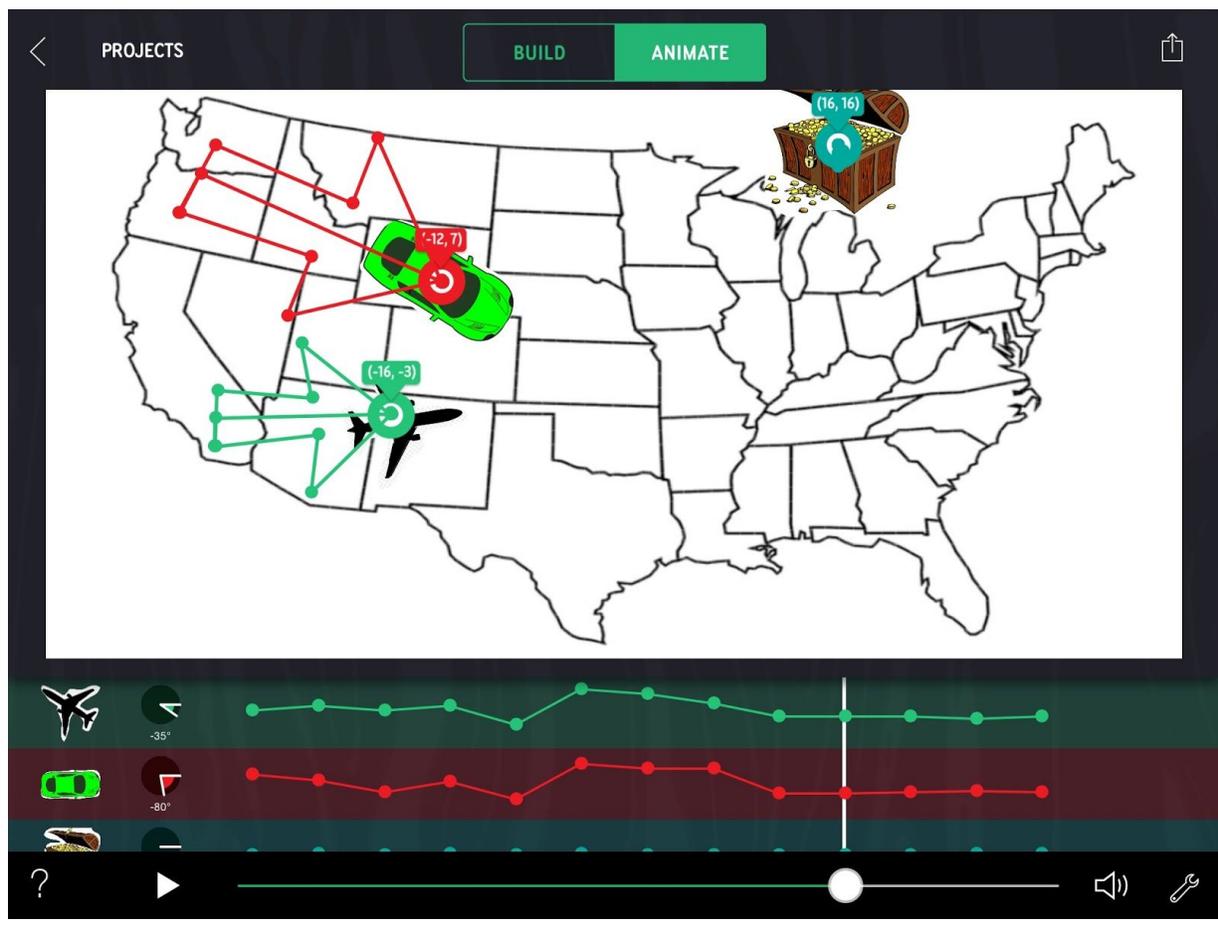
Pictured here are the images used to create the sample treasure map. Students are invited to find or draw their own, or, you can provide images for them.



Sample Choreo Graph screenshot showing the map and traced items, ready to start animating.



Screenshot shows the map with all the coordinates plugged in. Arrows point toward an intersection point that the students need to find.



Algebra solution to find the treasure. First find slopes, y-intercepts, and the equations of the two lines for the car and plane. Then solve the system of equations to find the intersection point.

Plane: $(-28, -2) \rightarrow (-16, -3)$

Car: $(-29, 14) \rightarrow (-12, 7)$

Plane: Slope $\frac{-2 - (-3)}{-28 - (-16)} = \frac{1}{-12}$

$$-3 = -\frac{1}{12}(-16) + b$$

$$-3 = \frac{4}{3} + b$$

$$b = -\frac{9}{3} - \frac{4}{3}$$

Plane $y = -\frac{1}{12}x - \frac{13}{3}$

Car: Slope: $\frac{14-7}{-29-(-12)} = \frac{7}{-17}$

$$7 = -\frac{7}{17}(-12) + b$$

$$7 = \frac{84}{17} + b$$

$$\frac{35}{17} = b$$

CAR

$$y = -\frac{7}{17}x + \frac{35}{17}$$

$$-\frac{1}{12}x - \frac{13}{3} = -\frac{7}{17}x + \frac{35}{17}$$

$$-\frac{17}{204}x + \frac{84}{204}x = \frac{105}{51} + \frac{221}{51}$$

$$\frac{67}{204}x = \frac{326}{51}$$

$$3417x = 64,504$$

$$\boxed{x = 19.5}$$

$$y = -\frac{1}{12}(19.5) - \frac{13}{3}$$
$$= -1.6 - \frac{13}{3}$$

$$\boxed{y \approx -5.9 \approx -6}$$

If students find the intersection point using Choreo Graph, they will still be prompted to find the equations of the lines, and then the solution to the system. That solution is also provided in this document.

The screenshot displays the Choreo Graph application interface. At the top, there are navigation buttons for "PROJECTS", "BUILD", and "ANIMATE". The main area shows a map of the United States with a red line and a green line. The red line has a point labeled $(20, -7)$ and the green line has a point labeled $(28, -2)$. A treasure chest icon is located at the top right with the coordinates $(16, 15)$. Below the map is a control panel with a graph showing the red and green lines, a timeline, and various icons for navigation and settings.