INITIATE Lesson Plan: *Finding Slopes*

Lesson plan at a glance...

Name: Finding Slopes

Course: Algebra 1

Grade Level: 9th

Prerequisites: Understanding of ordered pairs and how to plot them on a graph.
Be able to measure using centimeters.

Preparation: Determine the students who will be in each group. Make sure the smart cars and tablets are prepared for each group (borrow additional cars/tablets from other teachers if necessary).
Make sure each group has the table sheet to track their results as well as a measuring tape.

Instruction:
Time: 2 class periods

Standard(s): F.LE.1.b, S.ID.7

In this lesson plan…

Lesson Overview

In this lesson students will create their own data plots for three-four different lines based on operating the car for different times at different speeds. They will develop an understanding for the concept of slope and the relationship between the value of the slope and the steepness of the resulting line.

Driving Questions

Overarching Driving Questions for Bowsher Wide Project:

- How can we make smart cars safer and more convenient?
- How can we protect them from cyberattacks?

Lesson Specific Question:

- Based on the speed of the smart car, what is the safe driving distance between cars?

Materials and Equipment

- Smart Cars
- Tablets
- Data tables
- Pencils
- Measuring tapes
- Graph paper
- Rulers
- Colored pencils
- Worksheets (see below)

Preparation Tasks

	Connect the smart cars with the tablets	3 minutes

The Lesson

Warm-up Activity: Introduction of the lesson plan	5 minutes
Activity 1: Driving your Smart Car	40 minutes
Activity 2: Plotting your points and determining slopes	30 minutes
Activity 3: Converting your speed	10 minutes
Wrap-up Activity: Why is this important?	7 minutes

Warm-up Activity: Introduction of the lesson (5 minutes, day 1)

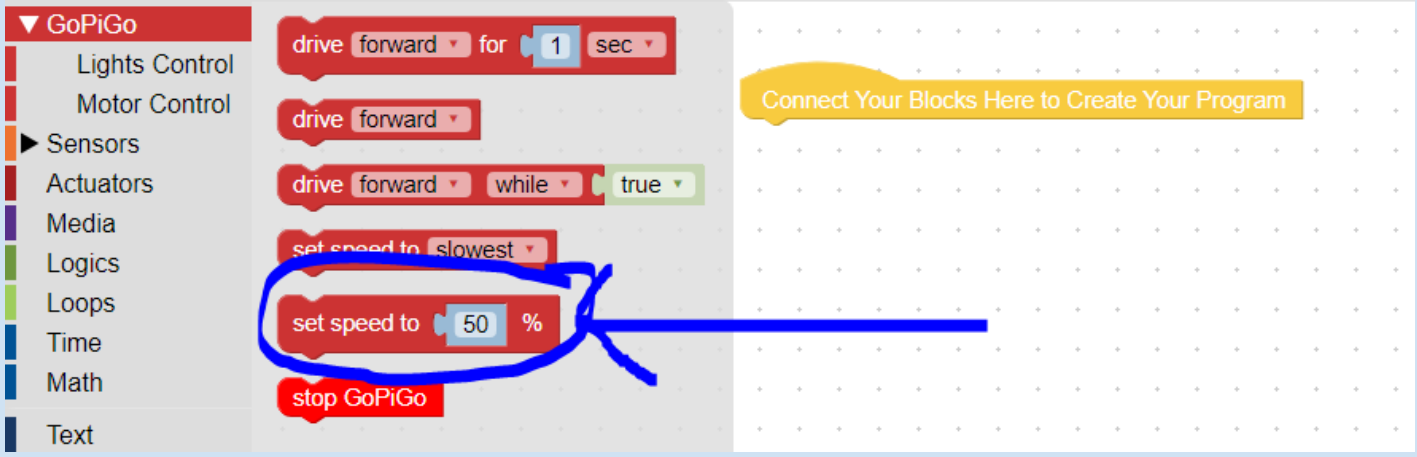
Activity Overview: In this activity, students will be introduced to the ideas of using the smart cars to gather data points that we will graph later and then use to determine the relationships between slopes.

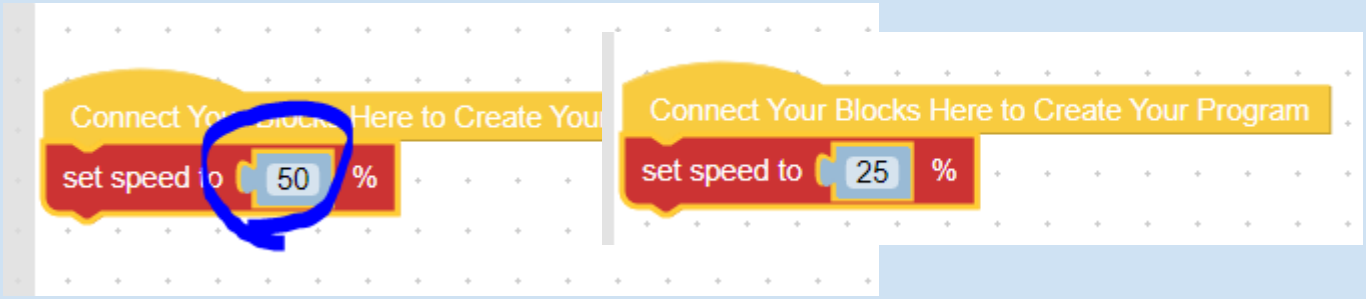
Activity: Lesson Explanation (5 Minutes)
Explain to the students that they will be working in small groups to complete four different tables with their smart cars and tablets. We will practice writing the code that will be necessary to run each trial. We will also talk about how to complete the table.
Students will be placed in a group and will determine who will do each job for each table (coder, distance measurer, data tracker, observer) so that all of the students will have the opportunity to do each task.

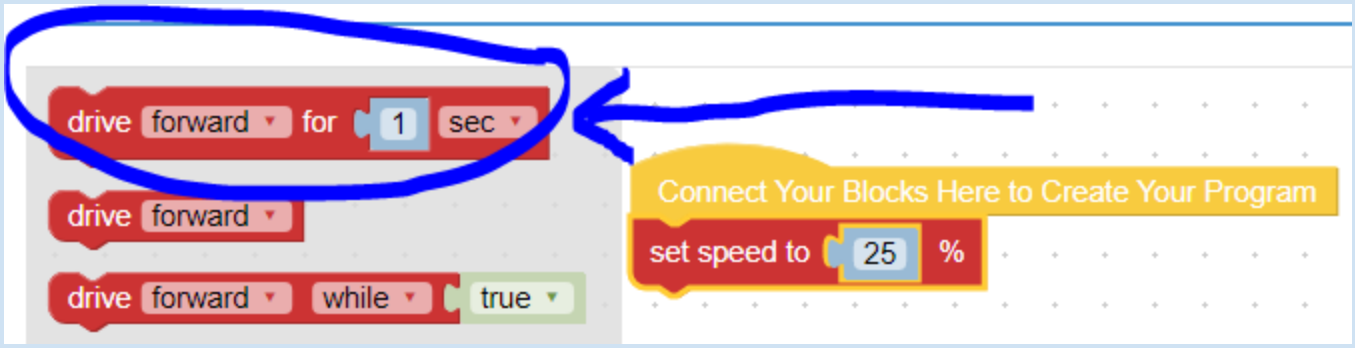
Activity 1: Driving your smart car (45 minutes, day 1)

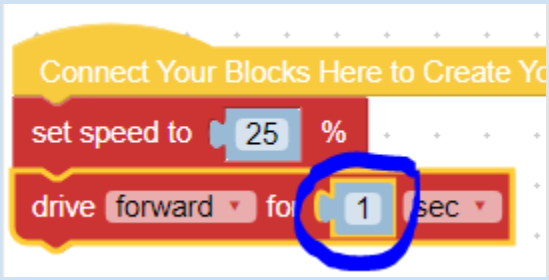
Activity Overview: In this activity, students will run the smart at different speeds for different times (in seconds) and measure the resulting distance that the car traveled and place the result in their table.

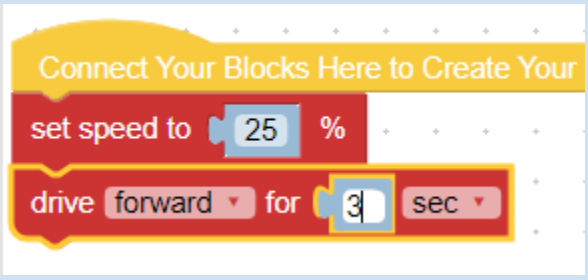
Activity: Coding Setup (5 minutes)
Once students are in their groups, I will show them the coding setup for the first table they are going to complete. For this table the car will be traveling at a speed rate of 25% for 3 seconds. We will then discuss how to change the time from 3 seconds to 4 seconds, 5 seconds and 6 seconds to complete their table.











Trial Runs (40 minutes)
Once of the groups have their initial code create for their smart, they will run their first trial. The student in charge of measuring the distance will measure the distance the car went in centimeters and the recorder will place the information in the table. Then they will change their code for 4 seconds, then 5 seconds, and 6 seconds, running the car each time and recording the distance.

The student groups will repeat this process until they have completed all four of the tables, recording data for 10%, 25%, 50% and 70% speed for the car.

Teaching Tips:

- *Establish a plan to ensure that all students are involved with each aspect of the lesson.*

Activity 2: Plotting Points and Determining Slopes (30 minutes, day 2)

Activity Overview: In this activity, students will graph their data points, creating different lines, and will then discover the relationship between slope and the steepness of a line.

Activity:
Today in their groups, students will be plotting their data points on a graph. They will use a different color to represent each speed of the car so they can easily distinguish between the lines. Students will need to determine an appropriate scale for their graph to best include all of their given data points.

Once students have finished graphing all of their lines, they will then discuss as a group, the answers to the worksheet* which will help them realize the relationship between slopes and steepness of lines.

Teaching Tips:

- *Have extra graph paper, rulers, and colored pencils easily available for students.*

Activity 3: Converting Your Speed (10 minutes, day 2)

Activity Overview: In this activity, students will convert the centimeters per second speed of their smart car into miles per hour.

Activity:
As a class, we will discuss how this pattern that we recognized is the slope of the line and as a result was the speed of their car in centimeters per second. We will then make a plan for how to convert this measurement into miles per hour using conversion factors. We will do one together as a whole class, and the students in their groups can then determine the other speeds.

Teaching Tips:

- *Depending on how well the students can do conversions, more problems may need to be done as an entire class. This can also be assigned as homework.*

Wrap-up Activity: Why is this Important? (5-7 minutes, day 2)

Activity Overview: In this activity, students will watch a video in which they will learn about safe driving distances.

Activity:
Why does it matter that the faster a car is traveling, the steeper the line it creates? What does this imply in their real world?
Watch video: https://www.youtube.com/watch?v=jwgmOR8C7ak

After the video have a class discussion that will then have students realize that as cars travel at faster speeds, more time will be required for braking.

Assessment: We will discuss the slope formula $m = \frac{y2-y1}{x2-x1}$ and students will be given an exit ticket which will have a graph of a line and they will have to use the line and the formula to find the slope.

Learning Objectives and Standards

Learning Objectives	Standards
Students will be able to determine the different slopes for each of the four tables and recognize that these slopes are different because the speed of the smart car was different for each table.	F.LE.1.b Distinguish between situations that can be modeled with linear functions… b. Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.
Students will understand that the slope represents the speed of the smart car.	S.ID.7 Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.

Additional Information and Resources

Project-based Learning Features

Feature	Where does this occur in the lesson?
Driving Question	At the beginning of the lesson students will be presented with their task of driving their smart car at different speeds for different lengths of time and then measuring the resulting distance. They will be reminded that they should be thinking about why is this important to know when thinking about how we make smart cars safer. During activity 3 and the wrap-up, we will discuss why having an understanding of the speed of a smart car will help us make the car safer by understanding the ideas behind safe stopping/driving distances.
Making Sense of the data	In activity 2 students will begin the process of interpreting the data they have collected by first graphing each table. Afterwards they will answer questions that will get them thinking about the patterns that they are seeing in each of the different tables. This will lead to them having an understanding between the relationship of the slope value and how fast the smart car was traveling.
Technology Incorporation	In activity 1 students will be working with the smart cars and tablets to complete their tables for the distances traveled based on each given time.
Collaborative Opportunities	In activities 1 and 2, students will be working in groups and will be able help each other graph their points correctly, and answer the follow-up questions.
Assessment Techniques	In activity 3 and the wrap-up we will ensure that all students are recognizing that the faster the car traveled, the larger the slope of the line and therefore the steeper the line. Students will also be given a question in which they have to determine the slope of the line from a graph after we have explicitly discussed the slope formula.

Computational Thinking Concepts

Concept	Where does this occur in the lesson?
Decomposition	In activities 1 and 2, students will be breaking down the entire problem by first completing the table, and then drawing the respective graphs for each table and then answering leveled questions that will lead them to be able to make predictions.
Pattern Recognition	In activity 2, students will be asked to recognize if there are any patterns in each table, and then use these patterns to make predictions about other possible values.
Algorithm Design	In activity 3, students will be converting the speed of the smart car from centimeters per seconds into miles per hour. For this, they will need to think about the process required for completing this process. In activity 2, students will be developing the process for finding slopes.

Administrative Details

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Sources: Bloxter , Ohio Content Standards

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Template adapted from: https://edu.google.com/resources/programs/exploring-computational-thinking/

Name: _____ Date: _____ Period: _____

Tables for Each Trial

For each table, set your car to travel at the given speed. Run the car 4 times for each speed, 1 time for 3 seconds, again for 4 seconds, 5 seconds, and 6 seconds. After each time the car travels, measure the distance the car went in centimeters and record this value in your table.

Table 1: 10% speed

Time (seconds)	3	4	5	6
Distance (cm)				

Coder: _____ Measuring: _____
Recorder: _____ Car Starter: _____

Table 2: 25% speed

Time (seconds)	3	4	5	6
Distance (cm)				

Coder: _____ Measuring: _____
Recorder: _____ Car Starter: _____

Table 3: 50% speed

Time (seconds)	3	4	5	6
Distance (cm)				

Coder: _____ Measuring: _____
Recorder: _____ Car Starter: _____

Table 4: 70% speed

Time (seconds)	3	4	5	6
Distance (cm)				

Coder: _____ Measuring: _____
Recorder: _____ Car Starter: _____

Name: _____ **Date:** _____ **Period:** _____

Smart Cars and Graphs of Lines

In your group, discuss and respond to each question below based on your tables and graphs.

1. What do you notice about all of the graphs?

2. Is there a pattern displayed in any of your tables? Which ones? What is that pattern?

3. Why are the patterns different for each table?

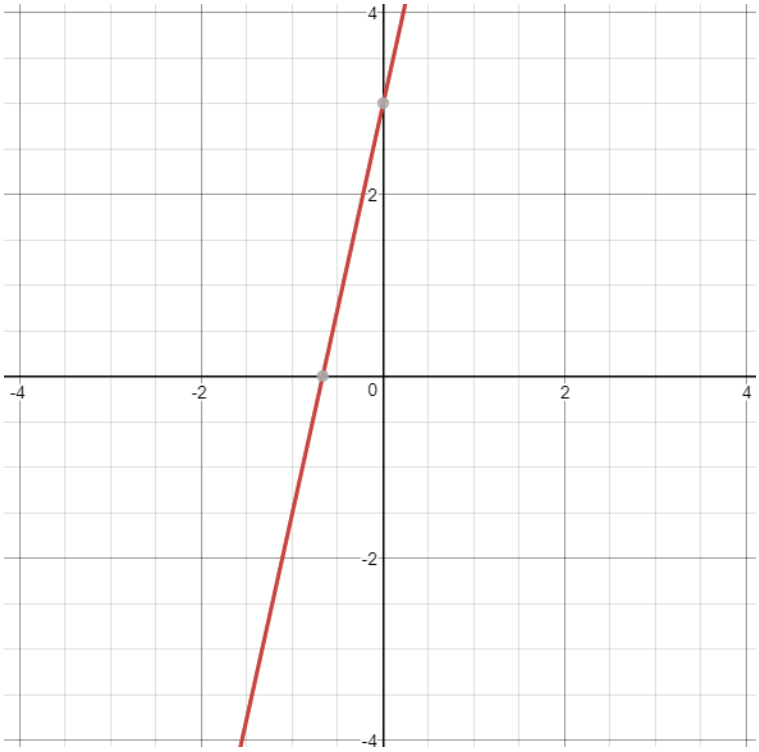
4. For Table 1, based on the pattern you discovered, can you predict how far the smart car would have went if it had traveled for 15 seconds?

5. For Table 3, based on the pattern you discovered, can you predict how far the smart car would travel after 12 seconds?

6. This pattern is called the slope. What relationship is visible between the slope for each table and the corresponding line?

Name: _____ Date: _____ Period: ____

Find the slope for each graph.

1. 

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