INITIATE Lesson Plan: *Avoiding an Obstacle in a Smart Car*

Lesson plan at a glance...

Name:	Avoiding an Obstacle in a Smart Car
Course:	Algebra 1 Honors
Grade Level:	8-9
Prerequisites:	*Students should know how to read ordered pairs from a graph, and write slope intercept equations from a graph and/or two points.*
Time: 2 periods	**Preparation: 30 mins** **Instruction:** 2 class periods and homework
Standard(s):	A-REI 10. A-CED 2

In this lesson plan…

Lesson Overview

In this lesson students will determine how a smart car could possibly react if an object is blocking the path of the road. Students will encounter an obstacle while driving their smart car and will have to react to the obstacle. Students will collect the data points at which they turn their cars and use those points to write the equations of the lines to the path they take to have their car safely return to the route. Students can then write a program in Bloxter to have their car travel that exact path on its own.

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:

What are some possible ways a smart car can react to debris in the road?

Materials and Equipment

Smart cars and tablets (or chrome books) for each group
Coordinate Plane with desired path and obstacle drawn for each group
Lesson handout for each student (attached at bottom of lesson plan)
Rulers
Protractors
Assessment sheet for each student (attached at bottom of lesson plan)

Preparation Tasks

	-Copy necessary worksheets and assessment -Be sure cars are charged and ready to go -Make large scale drawings for each group	30 mins

The Lesson

Warm-up Activity: *Class Discussion*	5 mins
Activity 1: *Bypass the Obstacle in Drive Mode*	30 mins

Activity 2: ***Writing Linear Equations***	30 mins
Activity 3: ***Create a Code in Bloxter***	40 mins
Wrap-up Activity: ***Assessment***	20 mins

Warm-up Activity: Class Discussion (5 mins)

Activity Overview: In this activity, students will participate in a classroom discussion about what might happen to a smart car if it detects debris in the road. Students will also view videos.

Activity: Teacher will pose the question, "How might a smart car react to debris in the road?" Students will engage in a classroom discussion about possible reactions of the car. We will come to the conclusion that the smart car will need to go around the debris, then safely return to its original path.
Video one shows a smart car detecting a dog in the road and needing to stop. Obstacle Video 1 Our activity will be similar, however we will deal with a non-moving obstacle. Our obstacle will not move allowing us to just stop, then continue on. This is why we will need to go around the obstacle.
Video two shows a model smart car that is slightly more advanced than ours avoiding obstacles. We will try to mimic a similar scenario. Obstacle Video 2

Activity 1: Bypass the Obstacle in Drive Mode (30 mins)

Activity Overview: In this activity, students will use the smart car in Drive Mode to maneuver around an obstacle.

Activity: Students will be organized into groups and assigned a smart car station. At each station there will be a large paper coordinate plane on which they will drive their car. Plotted on the plane will be the intended path of the car with a starting location and an ending location. Along the path there will be an obstacle. Students will take turns to drive the car along the intended path, veering off the path to avoid the obstacle, then returning to the path. All turns must take place on integer coordinates. After each student in the group has a turn to maneuver the car, the group must choose the best path. As they drive the best path one final time, they will mark the coordinates at which their car turns so they can draw the path on their coordinate plane. All students will record the path of their car on their worksheet.

Teaching Tips:

- *Be sure to allow time for each student to try the drive mode, possibly more than once*

Activity 2: Writing Linear Equations (30 mins)

Activity Overview: In this activity, students will write the equations for all the lines that create the path in which they drove their car to avoid the obstacle.

Activity: Students will use the coordinate points on which they turned their smart cars to write the equations for the lines that make up the path they used to avoid the obstacle. Students should show all work and write the equations in slope-intercept form.

Teaching Tips:

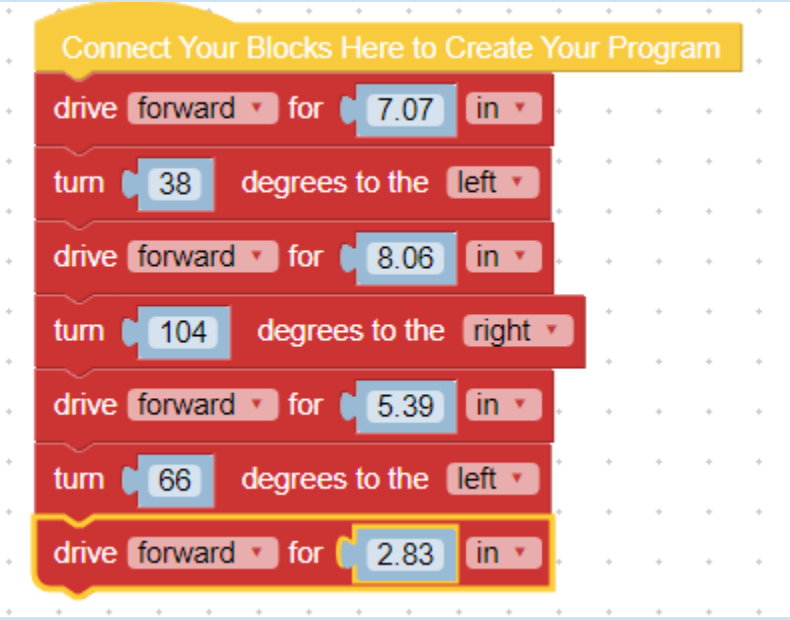
- *Students could finish this activity as homework on the first night*

Activity 3: Create a Code in Bloxter (40 mins)

Activity Overview: In this activity, students will use the Bloxter program to create a program to automatically take their car along the path created in Activity 1.

Activity: Students will return to their groups and work stations to take necessary measurements. Students will work together to create a Bloxter code that will take their car along the same path they determined in order to avoid the obstacle. After they have written the program they will run it with the car to see if it works. If their program does not work, they can make adjustments to the program and retest it.

Sample Bloxter program following the route from (-6, -6) to (-1, -1) to (0, 7) to (5, 5) to (7, 7)



Teaching Tips:

- *Students may need help measuring with a protractor.*
- *Students will need help determining which angle to measure (which angle the car turns through)*

Wrap-up Activity: Assessment (20 minutes)

Activity Overview: In this activity, students will demonstrate what they know about writing linear equations given two coordinate planes

Activity: Students will individually complete the assessment sheet.

Assessment: Students will complete the assessment worksheet which requires them to choose an alternate route on a map, give directions, and write the equations of all roads traversed.

Learning Objectives and Standards

Learning Objectives	Standards
Plot the turning points of the car on the graph to create a path made of linear functions	A-REI 10. Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line)
Write the slope-intercept form of the linear equations	A-CED 2. Create equations in two variables to represent relationships between quantities; graph the equations on coordinate axes with labels and scales

Additional Information and Resources

Project-based Learning Features

Feature	Where does this occur in the lesson?
Driving Question	In the Warm-up activity students discuss how a smart car would need to react to debris in the road and what the possible reactions could be. The driving question of "How can we make smart cars safer?" will be explored in this context.
Investigation and Problem Solving	In Activity 1 students will work to create an alternate path allowing the smart car to bypass the debris the road. They will need to problem solve to come up with an alternate path. In Activity 3 students will work to create a Bloxter program to have the car take the same path on its own. They will need to determine what measurements are needed and what order to put the steps in to create the program.
Technology Incorporation	In Activity 1 students use smart cars in drive mode to create the path. In Activity 3 students use smart cars and the Bloxter program to create the code for the same path.
Computational Thinking	In all activities students will engage in some of the basics of computational thinking: decomposition and algorithm creation.
Collaboration	In Activity 1 and 3 students must work in groups to accomplish the task.
Assessment	The teacher can do informal assessment throughout the lesson, especially during Activity 2. There is a formal assessment at the end of the lesson.

Computational Thinking Concepts

Concept	Where does this occur in the lesson?
Decomposition	In Activity 1, students have to decompose the task of driving the smart car around the obstacle into smaller tasks, such as having the car turn in a certain direction a few times in effort to return to the path. In Activity 2 students will decompose the action of writing a linear equation from two points into smaller steps: find the slope, find the y-intercept, and then write the equation. In Activity 3 students will again break their path down as they code in Bloxter.
Algorithm Creation	In Activity 1 students will need to create step by step guidelines to have the car avoid the obstacle in drive mode. In Activity 2 students will follow algorithms and use formulas to write equations. In Activity 3 students will create a step by step algorithm in Bloxter to have the car move along the intended path.

Administrative Details

Contact info: Natasha McCree, nmccree@tps.org

Sources: Ohio Content Standards YouTube Bloxter

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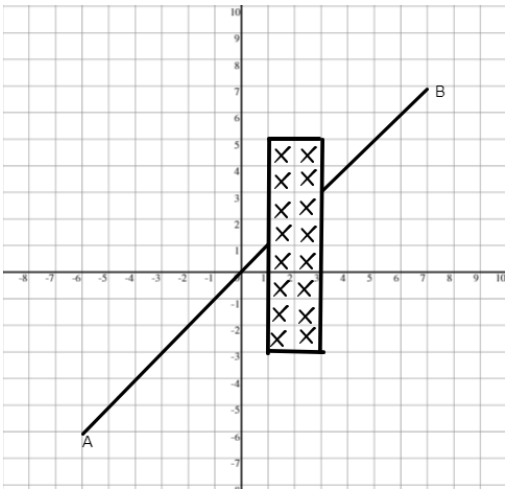
Template adapted from: https://edu.google.com/resources/programs/exploring-computational-thinking/

Avoiding An Obstacle With The Smart Car

Name:_____

Activity 1: Bypass the Obstacle in Drive Mode



You are driving from point A to point B along the road shown. However you detect an obstacle in the road and must maneuver your car around the obstacle. Using the drive mode on the smart car take turns with your group members to come up with a path that will take your car around the obstacle and return to the original intended path. **The trick is you must turn at integer points!**

Once your group has determined a path each member should copy the path on their own worksheet, and the path should also be copied on the large scale group drawing.

Activity 2: Write Linear Equations

You will now write an equation for each line along your path between A and B. For each line record two points on the line and write a slope-intercept form equation. Be sure to show all work!

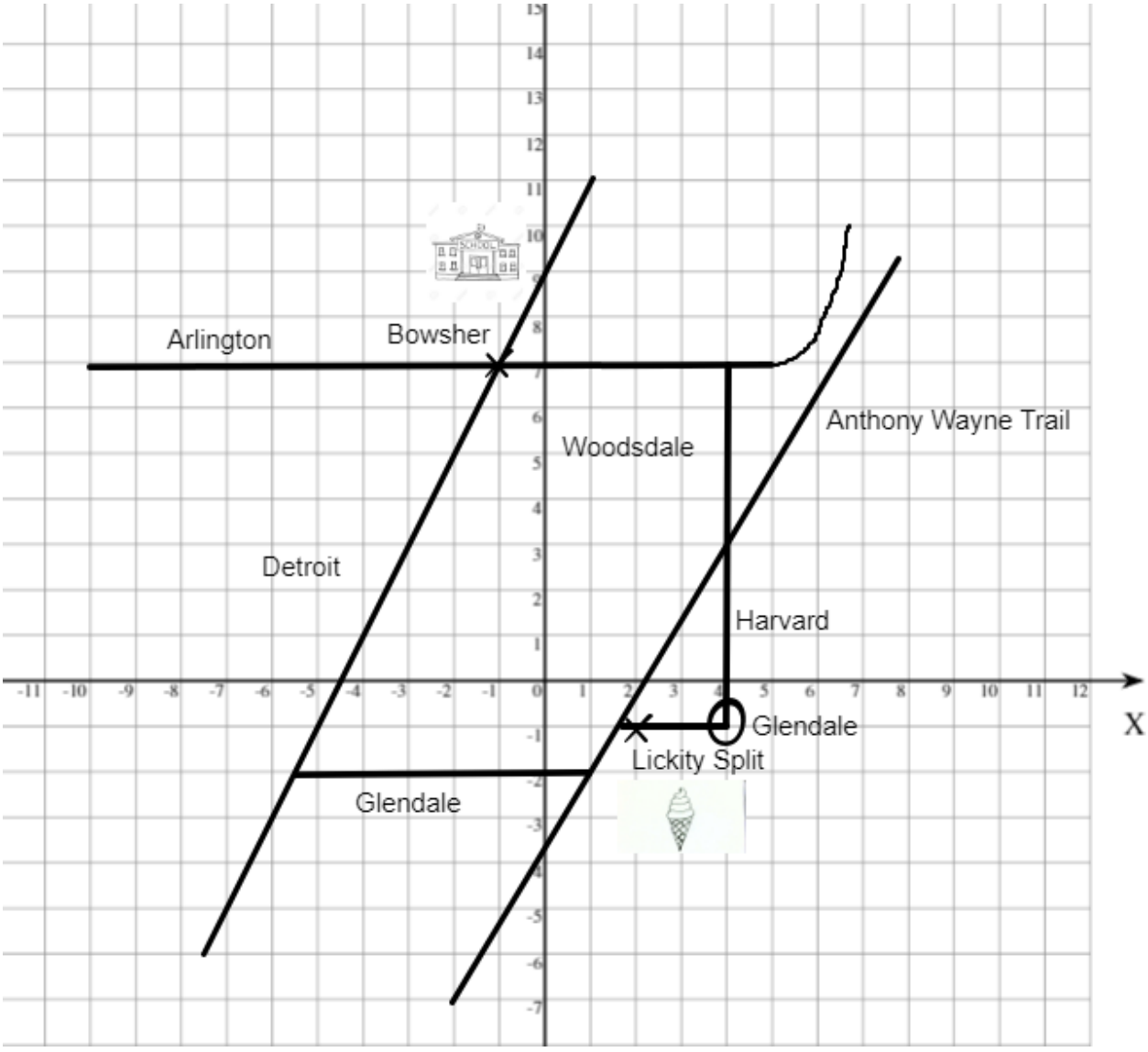
Line 1	Line 2
Points: (-6, -6) and (,) Equation:_____	Points: (,) and (,) Equation:_____
Line 3	**Line 4**
Points: (,) and (,) Equation:_____	Points: (,) and (,) Equation:_____

Line 5 (if needed)	Line 6 (if needed)
Points: (,) and (,)	Points: (,) and (,)
Equation:_____	Equation:_____

Activity 3: Create a Code in Bloxter

You will now try to write a code in Bloxter that can be used to take your smart car along the exact same path you created in Activity 1. (hint: you will need to take some precise measurements on your group's large scale drawing) Record your program below. After your program is written, you will test your program on the large grid. Make corrections to your program as needed.

Avoiding An Obstacle In A Smart Car – Assessment



After school you decide to go to Lickity Split for some ice cream. Your original plan was to drive down Arlington, turn right on Woodsdale, stay straight across the Anthony Wayne Trail onto Harvard, then turn right onto Glendale. However, there is an accident at the intersection of Harvard and Glendale so you must choose a new route. Give step by step directions to take your car from Bowsher to Lickity Split. Then find the equations of the lines for all roads you traverse.