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
Grade Level:	9th Grade
Prerequisites:	- Solving linear equations & inequalities -Collecting & analyzing data - Utilizing graphing calculators & chromebooks - Geogebra Program site
Time: 2 periods	**Preparation: 30 mins** **Instruction:** 2 class periods and homework
Standard(s):	N.Q.2, N.Q.3, F.IF.4

In this lesson plan…

- Lesson Overview
- Driving Questions
- Materials and Equipment
- Preparation Tasks
- The Lesson
- Learning Objectives and Standards
- Additional Information and Resources

Lesson Overview

In this lesson we are supposed to make the connection between having autonomous vehicles in a student's life and the math content that we are proposing (graphing different kinds of functions: linear functions, quadratic, and exponential). So, students will be exploring the Autonomous vehicles features, parts, cost,..... etc, gathering and analyzing data to understand how easy and safe life will be when Autonomous vehicles are fully functional.

Driving Questions

Overarching Driving Questions for Bowsher Wide Project:

- How safe is autonomous vehicles technology?

Lesson Specific Question:

- What is the definition of safety in autonomous vehicles?
- How many miles do autonomous vehicles have to be driven to demonstrate that they are safer than human driving?
- How safe are the parts of autonomous vehicles? (sensors, software, radars, cameras, ladars, etc.)?

Lesson Specific Links(Safety of Autonomous Vehicles Technology):

- https://youtu.be/JC94Y063x58
- https://youtu.be/HgF7E5q9sU4
- https://www.youtube.com/watch?v=j-_---qMv_Y&t=18s
- https://www.youtube.com/watch?v=Qx4ws86y7gI
- https://www.youtube.com/watch?v=v1VBfaapLp0

Materials and Equipment

- *Overhead projector.*
- *Cardboard.*
- *Smart cars.*
- *Tablets.*
- *Chromebooks.*
- *Internet connection available.*
- *Algebra I textbooks, student's notebooks, pens, pencils, coloring pencils, markers, tape, rulers, pairs of scissors, construction paper.*
- *Measuring tapes*
- *protractors.*
- *List of secure links that students can go to do their research about Autonomous Vehicles and its safety.*

*Preparation Tasks

	Set up the overhead for the problem of the day, chromebooks, and smart cars are ready to run. Also, cardboard and other materials are available and easy to get to by students.	*Time:* ***5 minutes***

*The Lesson

Warm-up Activity: There will be one problem each day for 5 min. This will be posted on the overhead, and students will work on it for 3 min. Then we will discuss it with the whole group. 1. 1st day: the P.O.D will be a question that students have to research to find the answer (using chromebooks and a sheet of paper with some secure links that they can go to). 2. 2nd day: the problem of the day will be my second sub.question that students have to search for and find how many miles autonomous vehicles have to be driven to demonstrate that they are safer than human driving.	*Time:* ***10 min (5 minutes each day).***
Activity 1: Title: Graphing functions using online tools.	***30 min.***
Activity 2: Title: Programing and running smart cars, using the 1st day activity numbers from geogebra.	***30 min.***
Wrap-up Activity: **1st day:** 1. Students will have an Exit ticket with the question: Do you think that Autonomous Vehicles will take over the humans driving vehicles? And how safe they are in your opinion? Provide sufficient evidence from the activities, articles, numbers, etc. that you have worked with. **2nd day:** 1. Group discussion about how safe are Autonomous cars? And if they would like to have it running their lives fully in the next 15 years or so?	***15 min. For the 2 day activities.***

***Warm-up Activity: Title: Problem of the Day {P.O.D}** (10 min: 5 min each day.)

Activity Overview: In this activity,

1. 1st day: the P.O.D will be a question that students have to research to find the answer, using chromebooks and a sheet of paper with some secure links that they can go to.
2. 2nd day: the problem of the day will be my second sub.question that students have to search for and find how many miles do autonomous vehicles have to be driven to demonstrate that they are safer than human driving.

Activity: The problem of the day will be posted on the overhead before the class period starts. So, when students come to class they can start right away and get some extra time added to the 5 min. That routine will be set up in class at the beginning of the year for all classes.

1st day question:

1. What is the definition of safety in autonomous vehicles?

Students have to grab the chromebooks as soon as they get to class and start their research. Then the group will begin

a discussion.

2nd day question:

2. How many miles do autonomous vehicles have to be driven to demonstrate that they are safer than human driving?

***Activity 1: Graphing functions using online tools** (30 minutes)

Activity Overview: In this activity, students will be ***graphing functions using online tools.***

Activity:

- Students will be utilizing the geogebra site on their chromebooks.
- The students will be placed in groups of four, and each group will have three different linear equations to input in the geogebra program.
- They will need to find the point of intersection of the three lines.
- While they are graphing the lines, students will notice that all the lines have different slopes and are in the shape of a triangle.
- Students must find the distance and angle measurements of the triangle.

Group 1	Group 2	Group 3	Group 4
2x+y=3	y=x-1	y=x-1	y=-x+5
x-y=6	y=4-2x	x+y=0	y=2
-2x+y=5	y=-x-5	x=0	x=10

*I will be around checking all the groups to see if they need help or need me to answer questions about the program, equations, etc.

Teaching Tips:

- *Solve each equation into slope-intercept form (if needed)*
- *Enter the three equations(one by one) into the geogebra program, graph the 3 functions,* ***find the points of intersection, find the distances between the vertices of the triangle,*** *and* ***find the measures of the angles of the triangles and its supplements.***
- *Make sure to gather data and organize the numbers in a table (in a notebook/file) to use the second day.*

Activity 2: Programing and running smart cars, using the 1st day activity numbers from geogebra (30 minutes)

Activity Overview: In this activity, students will be **programming and running smart cars, using the 1st day activity data from geogebra.**

Activity:

- Students are going to join their groups from the previous day.
- Each group will have a smart car and tablet.
- Students will be programming a route for the smart car to go from points A, B, and C of the triangles they graphed the previous day (using the distances between the vertices and the angle measurements of the triangle-> Gopigo program

- Program your smart car with Bloxter programming in such a way that you will provide the data (distances between the vertices and angle measures) of the source and destination (from point A->C and back to A); and your car will turn to the specific angle and move between any two vertices.
    - Assume the unit of distance is 1 Inch.
    - Take the coordinates for source and destination and angle measures from Activity 1 that was done the previous day.
- After each group completed the design of their route between the 3 vertices of the triangle, students must run their smart cars and show that the car can follow their program smoothly (from point A->C and back to A).
- I will be around checking all the groups to see if they need help or need me to answer questions about the program, equations, etc.

Teaching Tips:

- *Gather your data from the previous activity*
- *Connect your smart car to the tablet with the Bloxter programming software*
- *Start designing your route between the vertices of the triangle you designed by graphing all the linear equations (utilizing the distances and angle measures you found the previous day)*

Wrap-up Activity: Analysis and reflection (15 minutes)

Activity Overview: In this activity, students will analyze their collected by using the data as evidence for their reflection on autonomous cars technology and safety.

Activity:

1. 1st day: Students will have an Exit ticket with the question: Do you think that Autonomous Vehicles will take over the humans driving vehicles? And how safe they are in your opinion? Provide sufficient evidence from the activities, articles, numbers, etc. that you have worked with.

2. 2nd day: Group discussion about how safe are Autonomous cars? And if they would like to have it running their lives fully in the next 15 years or so?

Assessment:

- **Exit ticket the first day by answering this question: Do you think that Autonomous Vehicles will take over the humans driving vehicles? And how safe they are in your opinion? Provide sufficient evidence from the activities, articles, numbers, etc. that you have worked with.**
- **After the second day activity is completed, each group completed the design of their route between the 3 vertices of the triangle, students must run their smart cars and show that the car can follow their program smoothly (from point A->C and back to A).**

Learning Objectives and Standards

Learning Objectives	Standards
1. Students to know the definition of safety in autonomous vehicles.	***- N.Q.2*** Define appropriate quantities for the purpose of descriptive modeling.★
2. Students to find How many miles autonomous vehicles have to be driven to demonstrate that they are safer than human driving.	***- N.Q.3*** Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.★
3. Students to gather data about how safe are the parts of autonomous vehicles? (sensors, software, radars, cameras, ladars, etc.).	- F.IF.4 For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include the following: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity. ★(A2, M3)

Additional Information and Resources

Project-based Learning Features

Feature	Where does this occur in the lesson?
Driving Question	*Students will be using their smart cars to mimic the actual AV and demonstrate its safety features including the distance and color sensor.*
Investigation & Problem Solving	Students will watch the video and take detailed notes of what they have observed.
Making Sense of Data & Technology Incorporation	Students will use the previous findings from geogebra to program the car.
Collaborative Opportunities	Students will work in groups taking different roles to program the smart cars.
Computational Thinking	Students will do the following in order as : Decomposition : break the problems into smaller problems Abstraction : they will get rid of unnecessary parts in order to the given problem. Pattern recognition: students will look for similarities as the do the entire lesson plan. Algorithm design: students will program their smart cars using the geogebra findings.
Assessment Techniques	Students will be asked to give feedback of the actual smart car. Pre-assessment (exit ticket) vs post assessment for students.

Computational Thinking Concepts

Concept	Where does this occur in the lesson?
Decomposition	*Students will break the problems into smaller problems.*
Pattern Recognition	Students will find similarities among the activities.
Abstraction	Students will eliminate the unneeded parts and focus on the parts that matters.
Algorithm Design	Students will program the smart cars using the angles which they have found on geogebra.

Administrative Details

Contact info:

- **ftaihakhalood@gmail.com**
- **kftaiha@tps.org**
- **Phone # (419-2777656).**

Sources:

- **INITIATE Program presentations, articles, videos, tour (NOVAY company), Tatra presentation.**
- **ODE Website .**
- **Algebra 1 textbook.**
- **Google classroom resources.**
- **Teacher's collaboration during summer program.**

Date Written: June 27, 2019

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