INITIATE Lesson Plan: *Going back home*

Lesson plan at a glance...

Name:	**Going back home**
Course:	**Algebra II**
Grade Level:	**10-12**
Prerequisites:	*Know Trig functions / Use Bloxter*
Time:	**Preparation: 5 min** **Instruction:** 40 min
Standard(s):	CCSS.MATH.CONTENT.8.G.B.7 Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions. G.SRT.7 Define trigonometric ratios, and solve problems involving right triangles. G.SRT.8 Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems G.SRT.11 Understand and apply the Law of Sines and the Law of Cosines to find unknown measurements in right and non - right triangles, e.g., surveying problems, resultant forces.

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, students will use Trig Ratios and the Pythagorean Theorem in order to program their smart car to drive back to its starting point.

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: How can we get our car back Home using the shortest distance?

Materials and Equipment

Chrome Books
Smart Cars
Paper
Calculators

Preparation Tasks

	• Have several areas cleared for the cars to operate. • The students must check whether their chrome books are working, connected to the smart car, and have sufficient battery life. • To check whether the smart car is working, run it using a single command to make the car move forward for 2 seconds.	*Time 5 min*

The Lesson

Warm-up Activity: ***Talk about how smart cars depend on us programming in order to operate efficiently and correctly. This is just a small start in that process. I could use this article if time allows. https://www.theverge.com/2018/6/11/17449076/tesla-autopilot-full-self-driving-elon-musk***	*Time 5 min*
Activity 1: ***Return Home***	25 min
Wrap-up Activity: ***What problems do actual autonomous cars need programing to overcome?***	10 min

Warm-up Activity: (5 min)

Activity Overview: In this activity, students will see limitations to autonomous vehicles.

Activity: ***https://www.theverge.com/2018/6/11/17449076/tesla-autopilot-full-self-driving-elon-musk***
This is an article that is current to what is being done in the real world of bringing fully autonomous cars closer to reality. This article will need to be changed from year to year. The idea is to talk about what issues there are with autonomous cars and how programming is necessary to make cars become more autonomous.

Activity 1: Return Home (25 min)

Activity Overview: In this activity, students will use trig ratios and the Pythagorean Theorem to figure out how to program a car to return to its starting point.

Activity: Students will be asked to figure out on paper the following problem: A car drives due east for 5 miles and then turns and drives due North for 7 miles. If the car wants to drive back to where it started from, what angle does it need to turn and how far does it need to drive? The answer would be 122.7º and 8.6 miles. There will be time to discuss why it isn't 57.3º and what properties they used to come up with that answer.

Students will then be asked to do the same problem but with different numbers to give everyone a chance to do the problem successfully before switching to the programming aspect of this activity.

Students will then be asked to write a program to drive x inches, turn 90º, drive y inches, turn αº, drive z inches and arrive back at the start. They will take turns connecting their chrome books to the car and checking to see if their car does indeed end up where it started from.

If students find this too easy, I will give those students the question: What if the car driving due east for 5 miles then turns 60º instead of 90º like the first time and then drives 7 miles? What will be the angle turn and distance to travel back to the start? The answer should be 155.5º and 10.44 miles.

Students would once again write a program and check to see if the car travels the correct path.

Teaching Tips:

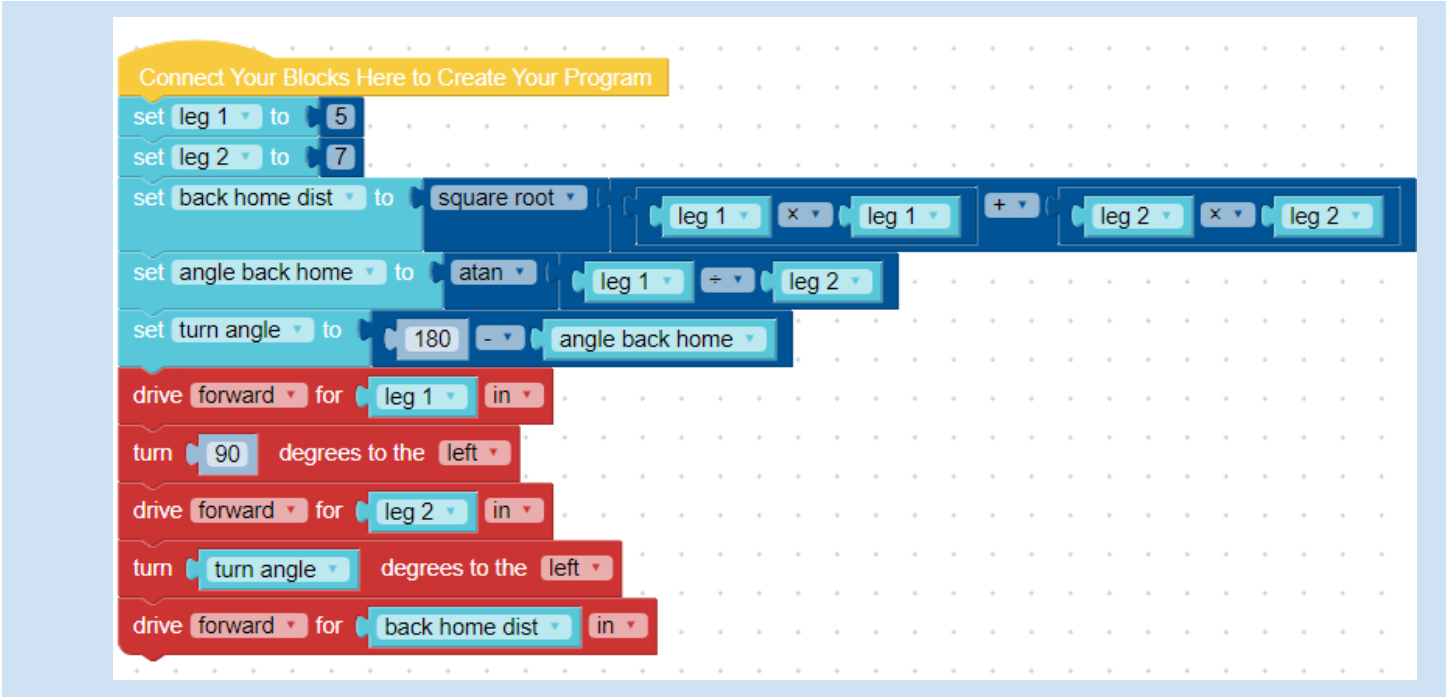
- *Work out the problems ahead of time.*

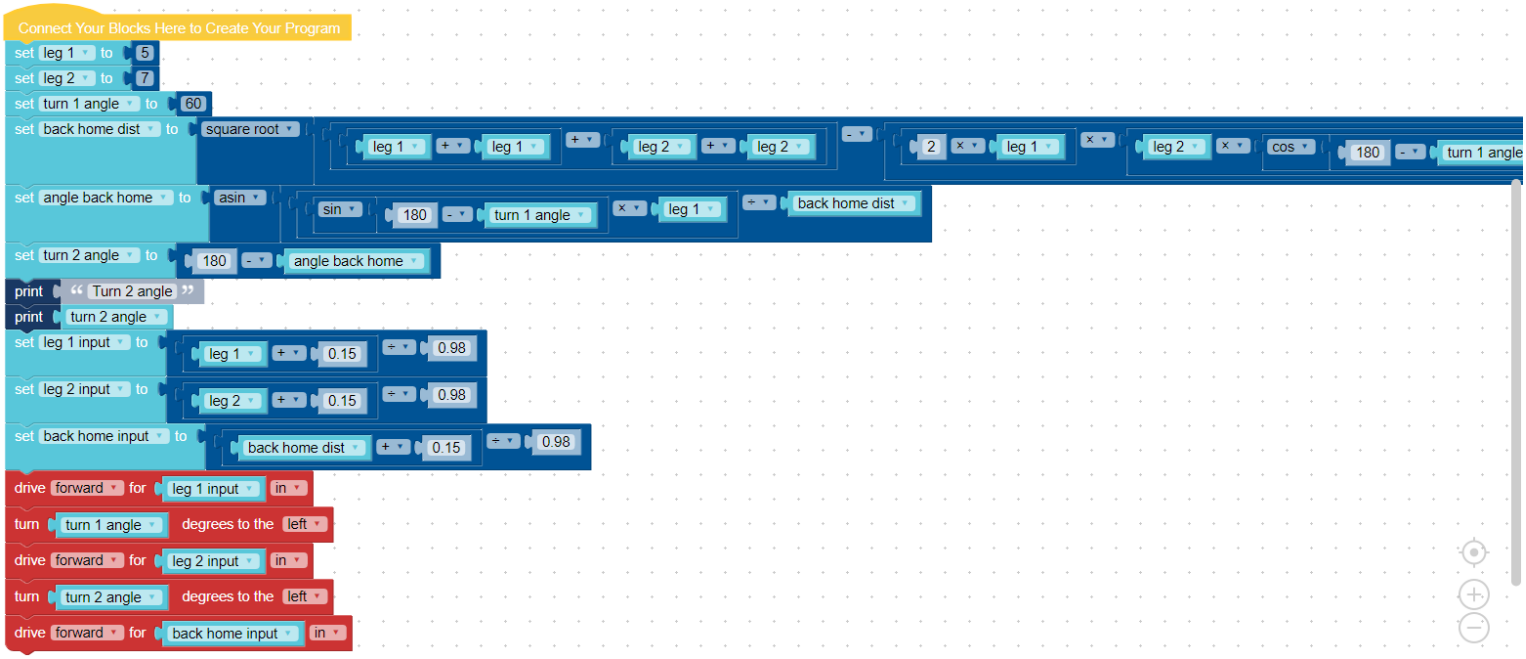
Wrap-up Activity: Analysis and reflection (10 minutes)

Activity Overview: In this activity, students will discuss what math concepts they used to solve the problems and try to write a program that works for any distance and angle turn by defining only 3 variables.

Activity:

1. Talk about how it is easy to program the car when we do all the math ahead of time and then have the car follow the path we find. Can we take it a step farther and have the car do the math for us and trace the path on its own after it calculates the distance to travel and angle to turn. This will require them to break the process down and create their own algorithm.





Assessment: Was the car able to perform the given task?

Learning Objectives and Standards

Learning Objectives	Standards
How to find the missing side of a right triangle.	CCSS.MATH.CONTENT.8.G.B.7 Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions.
How to find the missing angle of a right triangle.	G.SRT.7 Define trigonometric ratios, and solve problems involving right triangles. G.SRT.8 Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems
How to find the missing angle and side of any triangle that we know 2 sides and the included angle.	G.SRT.11 Understand and apply the Law of Sines and the Law of Cosines to find unknown measurements in right and non-right triangles, e.g., surveying problems, resultant forces.

Additional Information and Resources

Project-based Learning Features

Feature	Where does this occur in the lesson?
Driving Question	*At the beginning of this lesson. The question was how to make smart cars more convenient and safer. To make it more convenient, the smart car should be able to navigate by itself. In this lesson plan, the students have learned what mathematical calculations and programing could be done to make a smart car capable of navigating itself.*
Investigation and Problem Solving	*The students are given the basic information needed and then had to come up with a way to solve the problem. Through programming the car, the student could see if they had the correct solution or try to correct what went wrong.*
Technology Incorporation	*The students are using graphing calculators, Chrome books, and Smart Cars.*
Collaborative Opportunities	*The students are paired up in groups with the limited smart cars. The students will work together to find out why their programs don't work if the cars doesn't do what they wanted.*
Assessment Techniques	*Watching the path of the car gives the students immediate assessment on if they did the math correctly.*

Computational Thinking Concepts

Concept	Where does this occur in the lesson?
Decomposition	*By giving the student a general question and letting them come up with a way to solve it, the students are forced to think of what information is missing and how to find them using different math concepts.*
Algorithm Design	*Programing the car requires the student to come up with step by step instructions.*
Abstraction	*The wrap up activity especially has the student write a program that gives a general solution for any distance driven and angle turned.*

Administrative Details

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Sources:

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