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# INITIATE Lesson Plan: *What Effect Does Speed Have on Safety?*

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## Lesson plan at a glance...

**Name:** What Effect Does Speed Have on Safety?

**Course:** Function and Trigonometry

**Grade Level:** 10-12

**Prerequisites:** solving formulas for a given variable, solving equations

**Time:** 105 minutes

**Preparation:** 15 minutes

**Instruction:** 90 minutes

**Standard(s):** HAS.CED.A.2, HAS.CED.A.4, HSF.IF.B.4,  
MP.1, MP.2, MP.3, MP.4

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## Lesson Overview

In this lesson students will research data on safety equipment available for both autonomous vehicles and regular manual vehicles to determine if a significant difference exists. They will further investigate the connection between vehicle speed and driving safety. Comparisons will be made between driving speeds of both types of vehicles and times to complete a route in order to come to a conclusion about vehicle safety/usage.

## Driving Questions

Overarching Driving Question for INITIATE Wide Project:

- How safe are autonomous vehicles?

Lesson Specific Question:

- What, if any, is the relationship between speed and safety?
- With all the added safety features available for vehicles today, are autonomous vehicles really any safer?
- How do driving times compare for autonomous vehicles and regular (manual) vehicles and could that be a deciding factor in safety/usage?

## Materials and Equipment

Internet (computers, Chromebooks, tablets), handouts

## Preparation Tasks

Create handouts, determine groups	<i>Time:</i> 15 minutes
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## The Lesson

<b>Warm-up Activity:</b> Short Survey and Discussion	<i>Time:</i> 10 minutes
<b>Activity 1:</b> Small Group Collection of Data and Discussion	20 minutes
<b>Activity 2:</b> Whole Class Report Out and Discussion	20 minutes
<b>Activity 3:</b> Creating Equations to Model Trip Duration	30 minutes
<b>Wrap-up Activity:</b> Analysis and Reflection	10 minutes

## Warm-up Activity: Short Survey and Discussion (10 minutes)

**Activity Overview:** In this activity, students will be given a short survey about the relationship between speed and accidents. A short discussion will follow based on their opinions.

**Activity:** Students will be given a short survey about their understanding of the relationship between vehicle speed and safety.

### Survey on Vehicle Speed and Safety

Rate each of the following statements based on your current understanding.

(1= strongly disagree, 2= disagree, 3= no opinion, 4= agree, 5= strongly agree)

- 1) Safety options on a motor vehicle should be standard on all vehicles. \_\_\_\_\_
- 2) Adaptive cruise control is basically the same as regular cruise control. \_\_\_\_\_
- 3) As vehicle speed increases, fatality rate also increases. \_\_\_\_\_
- 4) Speed is one of the top 10 causes of accidents. \_\_\_\_\_
- 5) Autonomous vehicles are safer than regular (manual) vehicles. \_\_\_\_\_

A short discussion will take place based on the student responses. It will begin by asking for a show of hands for each numeric choice for question 1. Students will then be asked to volunteer to share why they answered the way they did. After question 1, the instructor will move similarly through each question.

The instructor will then thank the class for their responses and collect their surveys.

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## Activity 1: Small Group Collection of Data and Discussion (20 minutes)

**Activity Overview:** In this activity, students will work as part of a group to search the internet and read articles/watch videos in order to find data that either supports or disproves their assigned statement. They will discuss their findings among their group members.

**Activity:** Students will be divided into 5 groups, with each group being randomly assigned one of the statements from their survey at the beginning of the lesson. There will be a few basic questions on a hand out that should be answered and space left for anything of importance that they find in their searches.

Topic statements and sub questions from handouts:

Group #1: Safety options on a motor vehicle should be standard on all vehicles.

- What safety options are presently available on vehicles?
- What does each of these options do?
- What safety options come standard? For certain models or all?
- What safety options cost extra?
- How might cost influence whether they are purchased or not?

Group #2: Adaptive cruise control is basically the same as regular cruise control.

- What is adaptive cruise control?
- How does it compare to regular cruise control?
- Does either of these options come standard on most vehicles? If so, in what year did this take effect?
- What are some of the benefits of adaptive cruise control?

Group #3: As vehicle speed increases, fatality rate also increases.

- What data is available to either support or deny this statement?
- Is there any mathematics out there that addresses this correlation?
- What effect has lowering the speed limit on expressways had on fatality rate, if any?
- Is there ever a time when fatality rate decreases as speed increases?
- Is there any data out there that addresses autonomous cars and fatality rates?

Group #4: Speed is one of the top 10 causes of accidents.

- What are the top 10 causes of accidents?
- What are the percentages for each cause?
- Does age have any relationship to each cause?
- Are there any safety devices for vehicles that might lower speed's rating in causes of accidents?

Group #5: Autonomous vehicles are safer than regular (manual) vehicles.

- What safety devices are on autonomous vehicles that compare to regular (manual) vehicles?
- Are there any extra safety devices on autonomous vehicles? If so, what are they and what is their purpose?
- What might be considered a "risk" to safety when talking about autonomous vehicles?
- What data is available that compares autonomous vehicle safety to regular (manual) vehicle safety?
- What testing has been done or is currently going on to help answer this question?

Using Chrome books/computers, students will collect data that pertains to their statement. They will look for reported percentages, proportions, or any other data that might help them and their fellow classmates make informed decisions. The instructor will circulate throughout the classroom to help answer questions and to help facilitate their learning. The instructor might say:

"That's very interesting. Could you please elaborate?"

"When you read/hear data like that, how does that make you feel?"

"Does what you are reading/hearing make sense? Why/why not?"

"Do you think that will change in the future? Why/why not?"

The instructor will also keep track of time in order to make sure enough time is given for each group to share information amongst themselves. When approximately 15 minutes has passed, the instructor will say, "Time for discussion."

#### Teaching Tips:

- *If you want to have smaller groups, you could divide the class into 10 groups with two groups assigned to each statement.*
- *On a previous day, you could have a short discussion on how to conduct a proper internet search. This may save your students time when looking independently for data.*

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## Activity 2: Whole Class Report Out and Discussion (20 minutes)

**Activity Overview:** In this activity, students will present the data that they found pertaining to their statement. They will discuss any new questions that they may have generated and the answers they found for these new questions. The other class members will be able to question them about their presentation. Any new questions generated will be recorded to be answered at a later date.

**Activity:** Students will present the data that they found on their topic statement. They will use the questions on their handout to help guide their presentation, adding any other information that they found that could further clarify student understanding of the topic. Once each presentation is completed, a question/answer session will follow. Any questions that can't be answered at this time will be recorded, so that they could possibly be answered at a later date. The instructor could also say, "You bring up a valuable point (question), I would like you or someone from the group to do some further research on this and report back to the class."

#### Teaching Tips:

- Remember to record any important questions that were not answered and make time to later visit them. These questions should be visited within a few days to demonstrate that the questions were important.

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### Activity 3: Creating Equations to Model Trip Duration (30 minutes)

**Activity Overview:** In this activity, students will work in groups of 2-3 to derive a formula that can be used to help determine the amount of time necessary to complete a fixed route. Using this derived formula, they will create equations to model real-life situations. They will create tables for these equations and compare the values that are generated. Comparisons will be made to determine if any differences in time exist, and if they do exist, to decide if those differences could be a deciding factor in safety/usage.

**Activity:** Working in small groups of 2-3 students, students will solve the distance formula ( $d=rt$ ) for  $t$ .

They will use this derived formula to create equations to determine the time needed to complete a route, and create tables of values for the following real-life situations: 1) both an autonomous vehicle and regular (manual) vehicle traveling along a fixed route for 20 miles at constant [normal] speeds of 10mph, 15mph, 20mph, 25mph, and 30mph, 2) a regular (manual) vehicle traveling over this same route at constant [faster] speeds of 35mph, 40mph, 45mph, 50mph and 55 mph, and 3) a regular (manual) vehicle traveling over a variable rate route of 35mph for the first 5 miles, 45mph for the next 10 miles, and 25mph for the last 5 miles.

Based on previous discussions, students will make comparisons between their tables: a) autonomous vehicle and regular (manual) vehicle traveling over the same route and using the same [normal] speeds, b) autonomous vehicle traveling at normal speeds and regular (manual) vehicle traveling at faster speeds, and c) autonomous vehicle traveling at normal speeds and regular (manual) vehicles traveling at variable rates. Based on time alone, they will determine for which routes time isn't a consideration when deciding on whether to use an autonomous vehicle or regular (manual) vehicle. Based on time alone, they will also determine for which routes time is a consideration when deciding on whether to use an autonomous vehicle or regular (manual) vehicle. Finally, based on time and speed/safety data they have collected from prior activities, students will then determine which routes would be better for autonomous vehicles and which routes would be better for regular (manual) vehicles.

#### Teaching Tips:

- A short review lesson on solving for a given variable might be helpful.

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

**Activity Overview:** In this activity, students will retake the survey they initially took in the beginning of the lesson. For any statement that they changed their answer, they will explain their reasoning.

**Activity:** Students will be given back their original survey. They will be asked to retake the survey, putting their answers next to the original ones and circling them.

Students will then turn their surveys over and explain any differences between their original answers and circled answers. They will be asked to cite any information they learned from the lesson that might have influenced their decisions.

**Assessment:** Based on participation and summative assessments (questioning, moving throughout the classroom and listening to discussions, answers on survey, answers on equation handout).

## Learning Objectives and Standards

Learning Objectives	Standards
<ul style="list-style-type: none"> <li>To answer the question about the relationship between vehicle speed and safety</li> </ul>	HSA.CED.A.2 Create equations in two or more variables to represent relationships between quantities HAS.CED.A.4 Arrange formulas to highlight a quantity of interest, using the same reasoning as solving equations
<ul style="list-style-type: none"> <li>To compare the driving times between autonomous vehicles and regular (manual) vehicles</li> </ul>	HSF.IF.B.4 For a function that models a relationship between two quantities, interpret key features of tables in terms of the quantities
<ul style="list-style-type: none"> <li>To determine if autonomous vehicles are actually any safer than our current modes of transportation</li> </ul>	MP.1 Make sense of problems and persevere in solving them MP.2 Reason abstractly and quantitatively MP.3 Construct viable arguments and critique the reasoning of others MP.4 Model with mathematics

## Additional Information and Resources

### Project-based Learning Features

Feature	Where does this occur in the lesson?
<b>Making Sense of Data</b>	In activity 1, students are making sense of data when they read articles that pertain to their statement and come to conclusions based on that data.
<b>Driving Question</b>	In activity 1, students are using a driving question in order to gather information that will help to answer the broader question the relationship between vehicle speed and safety.
<b>Computational Thinking</b>	In activity 3, students are deriving formulas and creating equations. They are then applying them to real-life situations.
<b>Collaborative Opportunities</b>	In the warm-up, students are sharing their opinions and discussing their rationale behind them. In activity 1, students are working in small groups to gather information. In activity 2, students are discussing their findings with the class. In activity 3, students are working in small groups to create equations to model real-life situations and applying those equations to real-life situations in order to make comparisons.

### Computational Thinking Concepts

Concept	Where does this occur in the lesson?
<b>Decomposition</b>	In activity 1, students are breaking down information when they are divided into groups to research different aspects of the effect of speed.
<b>Pattern Recognition</b>	In activity 2, students are comparing their findings to findings of other students and making connections. In activity 3, students are using the equations they created and recognizing patterns as they apply these equations.
<b>Algorithm Design</b>	In activity 3, students are creating equations to model real-life situations.

## Administrative Details

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**Sources:** <http://education.ohio.gov>

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