Name: ______________________________

Class: _______________________________

Module 1: Crash Prevention
Lesson 2: Stopping Distance and Crash Avoidance
Laboratory Exercise
Grade 9 - 12

Learning Objective

When you learn to drive you may learn the "3 second rule" that suggests you should leave about three seconds of time between you and the next vehicle. To accomplish this, pick a fixed object like a road sign, and count three seconds between when the car in front of you passes it and when you do.

- Why do you think the "3 second rule" is important?
- If you are traveling at a high rate of speed or if the roads are wet would the 3 second rule change?

We can determine why the 3 second rule is important by using some math.

Procedure

Step 1: Data Collection

Option A: View of highway

If you have view of the highway, calculate the speed of 5 vehicles as they pass a preset starting and ending point. In order to calculate speed, use the following formula: Speed, V= distance /time.

Record your times and velocities below:

Vehicle	**1**	**2**	**3**	**4**	**5**
Time (s)					
Speed (m/s)					

Option B: No view

If you do not have a view of the highway (or want to skip Step 1) use preset speeds.

Vehicle	**1**	**2**	**3**	**4**	**5**
speed (m/s)	15.6	20.1	24.6	29.1	33.5
speed (mph)	35	45	55	65	75

Step 2: Distance traveled during braking (d)
The link is a YouTube video that explains the formula we will be using.
https://www.youtube.com/watch?v=oLPgNkuzw8M

Distance while braking is calculated using the following formula:

$$d = \frac{{v_0}^2}{2\mu g}$$

Where:

$d =$ distance (m)
$v_0 =$ initial speed $\left(\frac{m}{s}\right)$
$\mu =$ coefficient of friction (between tire and asphalt) (no units)
$g = 9.81\frac{m}{s^2}$ (the acceleration due to gravity)

The value of μ on dry asphalt is about 0.95. The value of μ on wet asphalt is about 0.80

So using the formula above, determine the value of *d* for the 5 vehicles you are testing and record your data in the table.

Vehicle	**1**	**2**	**3**	**4**	**5**
Distance during braking					

Step 3: Distance traveled during driver's perception (d_r)
You also have to account for the time it took for the driver to react (**d_r**)

Use the following formula: $d_r = v * t$

Where:

$d_r =$ distance traveled during perception
$v =$ speed (m/s)
$t =$ time to perceive and react to the need to stop, in seconds*

(*The value of t has been determined by experts in the field to be about 1.5 seconds)

So using the formula above, determine the value of d_r.

Vehicle	**1**	**2**	**3**	**4**	**5**
Distance during perception					

Step 4: Total stopping distance (ds)
To determine the total safe stopping distance, you must combine the stopping distance with the distance traveled during perception.

Use the following formula: $d_s = d_r + d$

Where:
$d_s =$ total safe stopping distance
$d_r =$ distance traveled during perception
$d =$ stopping distance

Vehicle	**1**	**2**	**3**	**4**	**5**
Total stopping distance					

Step 5: Graph your results
Plot your data for total stopping distance vs speed using a line graph.

Lab Report
Your lab report should contain the following sections:
1. Introduction and Hypothesis
2. Calculations
3. Results
4. Discussion
5. Conclusions

Questions
Answer these questions in paragraph form within your lab report.

1. What happened to the total stopping distance as speed increased?
2. Considering, the distance it takes to stop a vehicle, why is the "3 second rule" important?
3. How does a vehicle's size (dimensions and/or mass) affect its ability to stop? Is this incorporated into our equations? Why or why not?
4. Imagine 2 cars were following each other had to stop suddenly. How would our formula for total stopping distance be altered if the 2 cars had connected vehicle technology that allowed the 2 cars to communicate with each other, the moment they braked, and to warn the driver of the braking?
5. What effects would in-vehicle technologies have on crash prevention? Explain.
6. How would these technologies affect the "3 second rule"?