LawCentral Schools

Resources for Alberta Classrooms

The Physics of Distracted Driving Legislation

Activity Overview

Students will write a data-based evaluation that supports or criticizes the current distracted driving legislation. The inquiry will also address ways to improve the legislation to better address teen drivers. To support their evaluation, students will perform an experiment that uses kinematic equations to make calculations about stopping time and distances.

Curriculum Connections

This activity is designed for Physics 20 and Science 20 in Alberta and has the following learning outcomes:

- To apply kinematic equations and to convert units in real world applications
- To reflect on the role of science and technology in society
- To develop skills in science (nature of science)

** Although this activity was created for Alberta students it can be easily adapted to other provinces.*

Time Required

Approximately 80 minutes

Materials Required

- Alberta Distracted Driving Legislation Fact Sheet
- Student handout
- 1 Ruler (30cm) per group

Lesson Format

- Brainstorming
- Inquiry Lab Activity
- Exploration Questions
- Discussion

Pre-requisite Knowledge

- How to convert units, km/h into m/s
- Knowledge of Kinematic Equations such as:
  - $a = \Delta v / \Delta t$
  - $\Delta d = ½ (v_i + v_f) \Delta t$
  - $V_f^2 = v_i^2 + 2a\Delta d$
  - $d = v_i t + ½ at$
- An understanding of the concept of acceleration due to gravity

For the Teacher

Instructions

This activity is a cross curricular approach that applies physics to everyday lives of students. Students will complete a scientific inquiry, answer reflections questions, and complete an evaluation of distracted driving legislation. Many students will have recently received their driver's license and should have a lot to say about the topic!

1. Start the lesson with a class discussion about the distracted driving law. Brainstorm student ideas and write these ideas on the board. This is an important step in order to identify any misconceptions about the law that students might have.

2. Distribute the student worksheet and the *Distracted Driving Fact Sheet* published by the Government of Alberta

3. Instruct students to read the material

4. Place students in small groups where they will begin the inquiry lab activity

5. Students will complete measuring reaction times and then begin answering the reflection questions

6. If time permits, facilitate a class debate on the necessity of the distracted driving legislation from a Physics perspective. Students can refer to the last question on their worksheet

Guidance

When planning their experiment some students may struggle with a method to simulate distracted driving. Here are some suggestions:

- Typing a text message on a mobile phone (if school rules allow phones)
- Answering math questions verbally
- Answering math questions using paper and a pen
- Drawing a picture

Possible Adaptations

- If time is a concern you can provide students with reaction times and eliminate the experimental design component. This activity makes a great review of Kinematic Equations.
- Students can also measure reaction time using an online measuring program suchs as:
  http://faculty.washington.edu/chudler/java/redgreen.html
- This lesson can be continued by having students conduct online research into the topic. Students could analyse published research to help support their critique of the distracted driving legislation.

Assessment

Assessment criteria is found in the student handout materials.

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Answer Key for Reflection Questions

1. Distance = Velocity x Difference in Reaction Time

   Difference in Reaction Time =
   Distracted Driving Reaction Time – Control Driving Reaction Time

2. $V_f^2 = v_i^2 + 2a\Delta d$

   $(0m/s)^2 = (28m/s)^2 + 2a(66m)$

   $a = -5.9\ m/s$

   * The initial velocity was determined by converting 100km/h into 28m/s

3. Total Distance Braking = $\Delta d_{\text{before brakes applied}} + \Delta d_{\text{after brakes applied}}$

   $\Delta d_{\text{before brakes}}$ = reaction time (s) x 14m/s

   $V_f^2 = v_i^2 + 2a\ \Delta d_{\text{after brakes applied}}$

   $(0m/s)^2 = (14m/s)^2 + 2(-5.9m/s)\Delta d$

   $\Delta d_{\text{after brakes applied}} = 16.6m$

4. Some possible answers are…
   - Driving is more complex than pinching fingers
   - Even though we were driving distracted we were expecting the ruler to drop
   - In real life there can be multiple distractions
   - Some people are really good at sending text messages, maybe that changes the results

For the Students

Inquiry Question

Based on scientific evidence from experiments you have conducted, is the current distracted driving law fair and justified? What is most important addition or deletion you would make to better target teenage drivers?

Did you know that legislation is another word for the written law?

Tasks

You have been hired by the province of Alberta to form a science advisory committee. The government wants your input on the distracted driving law. You must complete the following tasks:

Task 1: Scientific Inquiry

Design an experiment to compare how various different activities affect a driver's ability to stop in an emergency.

Task 2: Reflection Questions

Answer reflection questions about your experiment.

Task 3: Evaluation of the Law

Analyse your results and write a scientific evaluation that supports or criticizes the distracted driving legislation. Suggest improvements that specifically target teenage drivers.

Distracted Driving Law for Beginners

After reading through the *Distracted Driving Fact Sheet* you might still have some questions about what it includes. For example the term "personal grooming" could mean different things to different people. Does *personal grooming* include taking out a contact lens that is bothering you? Does it include scratching an itch?

Laws are not always crystal clear. The written law could not possibly include and anticipate every possible situation. Laws are written so that there is some built-in flexibility. What happens in the real world is that police officers (at the scene) and judges (in court) have discretion in interpreting the law. You might not be able to talk your way out of a fine by arguing that "it doesn't specifically say I can't do that."

The distracted driving law can be changed later as new issues arise. There is a section that states that prohibited uses can be added *by regulation* at a later date. Therefore, one must keep in mind that hands-free devices could be banned in the future.

How You Will Be Assessed

Task 1: Scientific Inquiry (total 4 points)

	4 Points Excellent	3 Points Proficient	2 Points Adequate	1 Point Limited *	Insufficient/ Blank *
Experimental Design – including Hypothesis, Materials, and Procedure	Design shows student has **strong** understanding of the scientific process and conducted a thoughtful and **well controlled** experiment	Design shows student has **good** understanding of the scientific process and conduced experiment that **controlled obvious variables**	Design shows student has a **basic** understanding of the scientific process but **did not control obvious variables**	Design shows students has a **poor** understanding of the scientific process. Design includes **no attempt to control obvious variables**	**Insufficient evidence** of student performance

Task 2: Reflection Questions (total 12 points)

3 Point Questions

- Proper use of measurement – 1 point
- Work shown (partial points may be given) – 1 point
- Correct answer – 1 point

2 Point Questions

- Evidence supporting the chosen argument – 1 point for each piece of evidence (2x)

Task 3: Evaluation of the Law (total 8 points)

	4 Points Excellent	3 Points Proficient	2 Points Adequate	1 Point Limited *	Insufficient/ Blank *
Assess the appropriateness, risks and benefits of distracted driving legislation from a variety of perspectives	Provides **comprehensive** information about the strengths and weaknesses of the distracted driving legislation	Provides **thorough** information about the strengths and weaknesses of the distracted driving legislation	Provides **basic** information about the strengths and weaknesses of the distracted driving legislation	Provides **superficial** information about the strengths and weaknesses of the distracted driving legislation	**Insufficient evidence** of student performance
Make clear and logical arguments to defend a given position on an issue, based on findings	Develops a position and uses evidence in a **compelling** manner to support position	Develops a position and uses evidence in a **credible** manner to support position.	Develops a position and uses evidence in a **simplistic** manner to support position.	Develops a position and uses evidence in an **inconclusive** manner that does little to support position	**Insufficient evidence** of student performance

Task 1: Scientific Inquiry

Problem

How is a driver's reaction time influenced by performing various activities while driving?

Hypothesis

If a driver is _____ **then** the amount of time to brake will _____ because _____

_____

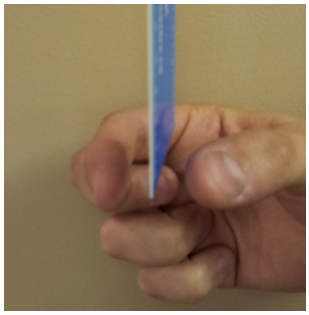
_____

Materials

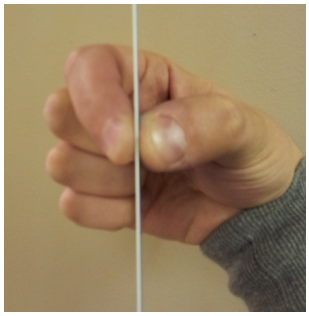
List of materials used:

Tip: Measuring Reaction Time

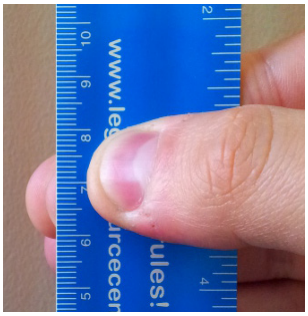
1. Hold a ruler above your partner's index finger and thumb.



2. When the ruler is dropped your partner will pinch the ruler to stop it from falling.



3. Use the distance the ruler fell, known acceleration due to gravity, and initial velocity to determine the time it took to stop the ruler (reaction time).



Procedure

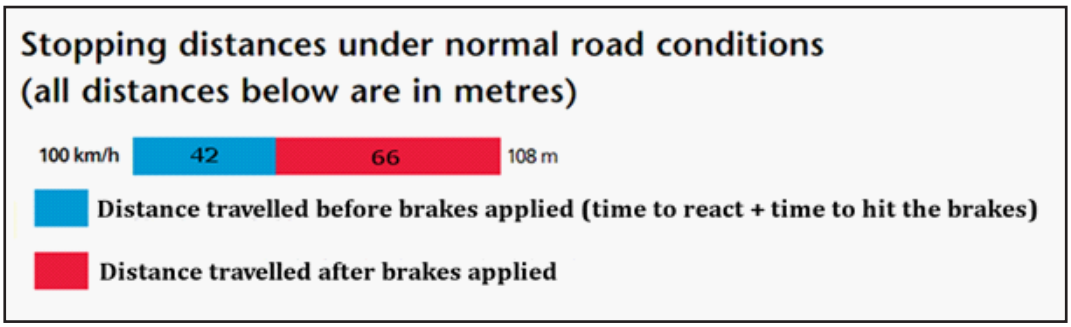
Write the procedure for your experiment here. Read the Alberta Distracted Driver's Legislation and identify activities that can be simulated in an experiment. Remember to control external variables. Your procedure should test what you want to test, and nothing else.

Observation

Record your experimental data here:

Task 2: Reflection Questions

1. Your are driving 100 km/h on the highway and a deer runs in front of you. Using your results from your experiment, calculate the extra distance in metres required to come to a complete stop when driving distracted hands on. (3 points)



2. Use the diagram above to answer the questions. Once the brakes are applied what is the vehicles rate of acceleration in m/s? (3 points)

3. For this question use your reaction time results from the experiment and your calculated rate of acceleration when braking from question 2.

If you were driving at 50 km/h and a child 25 m away stepped in front of your car. Would you be able to brake in time to not hit the child?

a. How far would you travel before stopping?

i. While distracted (hands on) (3 points)

ii. While distracted (hands free) (3 points)

iii. Without a distraction (3 points)

4. Do you think your experiment to measure reaction time is a fair comparison to what it would be like to drive. Why or why not? (2 points)

Evaluation of the Law

You will write a scientific evaluation to the Alberta Government about Distracted Driving Legislation from the perspective of a scientific advisory committee. You will list its strengths, weaknesses, and recommend amendments (changes) that should be made to the law.

Tip: the best communicators say the most with the fewest words!

For full points it is important to provide evidence from your research to support your arguments. It is also important to remember the limitations of your simulation.

The following format for the report might be helpful. It is important to note that your strengths, weaknesses, and recommendations sections may be longer or shorter than indicated below.

Title

Strengths

_____

_____

Weaknesses

_____

_____

Recommendations

_____

_____