ROAD TO ZERO

POST-VISIT ACTIVITY: SEE, THINK, REACT

This investigation will explore the *first* part of the stopping distance equation:

Distance travelled while reacting + *Braking distance* = *Stopping distance*

Students will devise and conduct a series of reaction timer tests, and consider which test is the best analogue for a car driver reacting to a braking stimulus. They will also examine the neurological and biomechanical steps involved, and compare their findings to their *Road to Zero* virtual reality (VR) test track data.

Learning context

Science classes

Victorian curriculum learning areas and level

Science	**Level 9–10**
Capabilities	**Level 9–10**

- Critical and Creative Thinking

Victorian curriculum strands and sub-strands

Science	**Science Understanding** ***Physical sciences*** • The description and explanation of the motion of objects involves the interaction of forces and the exchange of energy and can be described and predicted using the laws of physics (VCSSU133) ***Biological sciences*** • An animal's response to a stimulus is coordinated by its central nervous system (brain and spinal cord); neurons transmit electrical impulses and are connected by synapses (VCSSU118) ***Science as a human endeavour*** • The values and needs of contemporary society can influence the focus of scientific research (VCSSU116)
Capabilities	**Critical and Creative Thinking** ***Questions and Possibilities*** • Challenge previously held assumptions and create new links, proposals and artefacts by investigating ideas that provoke shifts in perspectives and cross boundaries to generate ideas and solutions (VCCCTQ045)

Learning intention

Understand the role of reaction time in determining car stopping distances, and the neurological and biomechanical processes involved

Success criteria

- Conduct an experiment exploring the factors affecting reaction time and analyse the results
- Understand the processes involved in a driver reacting to a braking stimulus
- Consider the implications of delayed reaction time to the motion of a vehicle and its ability to stop
- Identify safety implications of investigation findings and suggest solutions

Success criteria

- Students' own data from *Road to Zero* – this was sent via email to each student. Teachers will also have received a full set of class data via their post-visit email.
- OPTIONAL: Student investigation sheet – at the back of this document. Electronic or hardcopy.
- Materials to conduct reaction timer experiment – this is dependent on the students chosen experimental design

Learning activity description

1. Reaction time investigation

This investigation can be guided by using the Student investigation sheet at the back of this document. Alternatively, students can develop the investigation design by themselves.

Students will design an experiment to test their ability to react to a stimulus. The goal is to determine a fair test that best mimics the action of a driver braking in an emergency situation.

Students can research methods to test reaction times and/or use an online or app-based reaction timer, such as https://www.humanbenchmark.com/tests/reactiontime/

Students could also modify the 'ruler-catch' method, found in most Year 10 science textbooks.

It's recommended that students test the reaction times of different parts of their body. Remind them to factor in any movement that needs to occur (e.g. having their finger resting on the trigger (e.g. mouse) will result in a faster reaction time compared to having their hand flat on the table next to the mouse.) Suggested tests are listed below, although students should be encouraged to be creative!

- Hand resting on trigger
- Foot resting on trigger
- Hand moving onto trigger
- Foot moving onto trigger

Students should aim to find an average reaction time for each test type by conducting multiple trials with different test subjects.

2. Analysis

Students should consider the results of their investigation and answer the question:

Of the reaction tests devised, which one most closely models the response of a driver braking?

3. Stimulus and reaction – the reaction pathway

Students could consider all the steps that occur for a driver to react to a braking stimulus, e.g. a ball bouncing across the road. Students should consider what is happening on the road environment, in the car as well as the biological steps required for the driver to move their foot to the brake pedal.

Creating a flow chart, similar to the example right, will help students consider each of the steps.

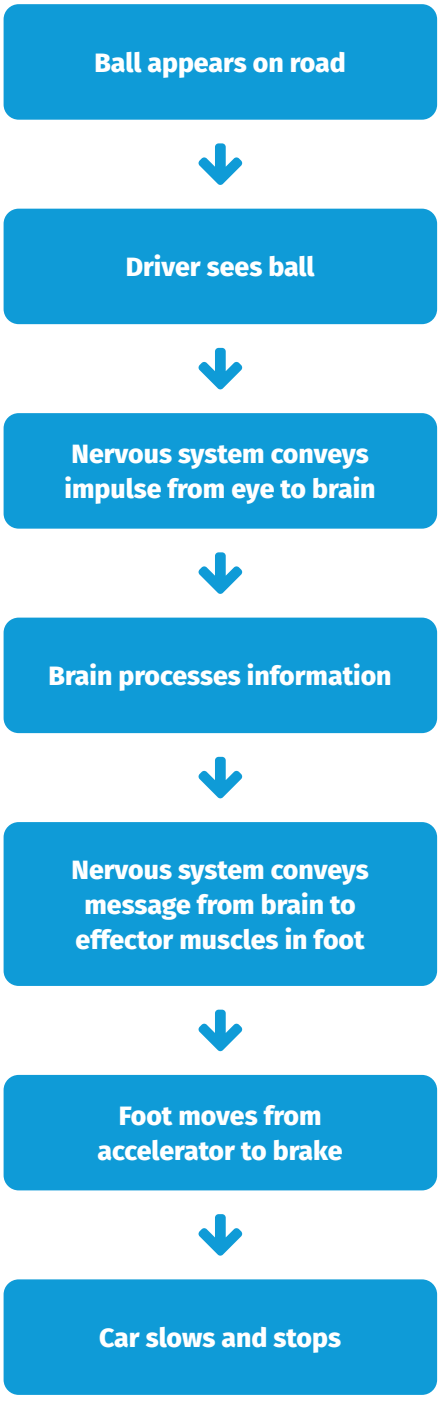
4. Share and brainstorm

To extend the investigation further, students could consider other factors that could potentially affect a driver's ability to react. This could include:

- Being tired
- Age
- Distractions
- Mental or physical impairments

Students focus on one of these factors, and could devise modified or new reaction time tests, or conduct a research project to investigate its role in driver safety.

Flow chart example



Student worksheet

Name:

STUDENT INVESTIGATION SHEET:
SEE, THINK, REACT:
REACTION TIME INVESTIGATION

Aim:

To test reaction time using various methods using different parts of the body, and determine which method most closely models the response of a driver undertaking emergency braking?

Introduction:

How quickly can you react? Some of you may think you have an answer to this – you may have used an online reaction timer, where you knew the signal to press a button was about to appear. But what if you weren't ready for it? And what if, instead of having to press a button with your finger, you had to push a pedal with your foot? What if you were operating complicated heavy machinery, then suddenly had to react? This is the reality every single time a car is driven.

In this experiment, you will design different models for testing your reaction time. Is there a difference in reaction time between your hand and foot? What about if your hand or foot is next to the reaction timer, rather than on top of it, as is the case when a driver's foot moves from the accelerator to the brake?

Hypothesis:

Method:

Results:

Record the reaction times (RT) for your different models or test types in the table below. Remember to perform each test multiple times, and calculate an average reaction time.

Test type	RT 1 (s)	RT 2 (s)	RT 3 (s)	RT 4 (s)	Avg (s)

Q1 Which of the models you tested had the **fastest** average reaction time? Why do you think this was the case? Consider the nervous systems reaction-response pathway in your answer.

Q2 Which of the models you tested had the **slowest** average reaction time? Why do you think this was the case? Consider the nervous systems reaction-response pathway in your answer.

Conclusion

Of the reation tests devised, which one most closely models the response of a driver braking? Use your results to justify your answer.

Student worksheet

Name:

STUDENT INVESTIGATION SHEET:
SEE, THINK, REACT:
ROAD TO ZERO DATA COMPARISON

Compare the average reaction times from your investigation to the results from your *Road to Zero* VR stopping distance experiment. These were emailed to you after your visit.

Q1 Which test type explored today best modelled the response in the VR environment (finger on controller button)?

Q2 Was there a difference in reaction time between the *Road to Zero* results and the test that your group identified as most closely modelling a driver reaction?

Q3 Do you think that pushing the VR controller button during your *Road to Zero* experiment was a good way of modelling a driver in an emergency braking situation? How could it be changed to make it more realistic?

Research shows that the average time it takes for a driver to react to a hazard by braking is about 1.2 seconds – longer for drivers who are tired, distracted or impaired by alcohol/drugs.

Q4 Could you come up with a maths equation to make your Road to Zero reaction time results more realistic (e.g. add 1 second? Double the reaction time?)