ROAD TO ZERO

# ROAD TO ZERO ONLINE SCIENCE RESOURCES

## (WITH FOCUS ON THE PHYSICAL SCIENCES)

## Introduction to the resource

### About Road to Zero

The Road to Zero Education Complex at Melbourne Museum takes students on an engaging and immersive learning experience in which they explore the science of road safety. Road to Zero programs address the Science and Health and Physical Education curriculum for Year 9, 10 and VCAL students. Compelling large screen projections, interactive touch screens and virtual reality experiences reveal the scientific principles of motion, forces, energy and the significance of speed and reaction time on stopping distance and impact. Find out more about the programs offered (including the pop up exhibition that travels to rural secondary schools) by visiting **roadtozero.vic.gov.au**.

### About the interactive on line resources

To support teachers and students in the current environment, the TAC has translated two science-focused interactives in the Road to Zero Experience Space into online experiences that students can access remotely – from their tablets or desktops. **Read more** about the two interactives – *Crash Forces Elevator Experience and Speed, Physics and Crashes*.

Six learning activities (including an extension activity) have been developed to complement the digital resources. The activities invite students to explore the physics of road crashes and the relationship between speed and impact to the human body.

If you are an early-career science teacher or new to teaching physics, you may want to consult these resources for information about ways to teach the physics concepts:

Loughran, J., Berry, A., & Mulhall, P. (2012). *Understanding and Developing Science Teachers' Pedagogical Content Knowledge* (2nd ed.). Sense Publishers.

Hewitt, P. G. (2014). *Conceptual Physics* (12th ed.). Pearson Education Limited.

## Curriculum links

The activities have been designed to be used at levels 9–10 of the Victorian Curriculum. The table below shows the content descriptions these activities address.

| Science Understanding: Physical sciences |
|---|
| Newton's laws of motion can be used to quantitatively analyse the relationship between force, mass and acceleration of objects (VC2S10U17) |
| **Science as a Human Endeavour: Nature and development of science** |
| Scientific knowledge is contestable and is validated and refined over time through expanding scientific methods, replication, publication, peer review and consensus (VC2S10H01) |
| **Science Inquiry** |
| **Questioning and predicting:** investigable questions, reasoned predictions and hypotheses can be used in guiding investigations to test and develop explanatory models and relationships (VC2S10I01) |
| **Planning and conducting:** equipment can be selected and used to generate and record data sets that show precision, including consideration of sample size and using digital tools as appropriate (VC2S10I03) |
| **Processing, modelling and analysing:** data and information can be organised, processed and summarised by selecting and constructing representations including tables, graphs, descriptive statistics, models, symbols, formulas and mathematical relationships (VC2S10I04); and |
| information and processed data can be analysed and compared to identify and explain qualitative and quantitative patterns, trends, relationships and anomalies (VC2S10I05) |
| **Evaluating:** the validity and reproducibility of investigation methods and the validity of conclusions and claims can be evaluated, including by identifying assumptions, conflicting evidence, biases that may influence observations and conclusions, sources of error and areas of uncertainty (VC2S10I06); and |
| arguments based on a variety of evidence can be constructed to support conclusions or evaluate claims, including consideration of any ethical issues and cultural protocols associated with accessing, using or citing secondary data or information (VC2S10I07) |
| **Communicating:** communicating and justifying scientific ideas, findings and arguments for diverse audiences involves the selection of appropriate presentation formats, content, scientific vocabulary, conventions, models and other representations, and may include the use of digital tools (VC2S10I08) |

## Suggestion for using this resource

The activities could be used over a sequence of lessons, to introduce students to the concepts of mass, weight, speed, velocity, distance, displacement, acceleration, force, motion, collision and Newton's laws. For students who may already be familiar with these terms and concepts, the activities could be used to assess their understanding.

## Description of the online resources and activities

| Name | Key resource/s | Description of learning activities |
|---|---|---|
| **Crash Forces Elevator** | **Road to Zero on line resource – 360 degree elevator ride**<br>http://roadtozero.museum.vic.gov.au/experiences/crash-forces | **Activity 1: Ready to take a ride?**<br>**Level of difficulty: simple-moderate**<br>This introductory activity – where students take a 360-degree elevator ride – invites students to make inferences about the effect of speed on road crash outcomes. The experience equates falling from different heights in an elevator to the effect of speed on impact during a road crash. The activities focus on force, motion and impact to the human body, and students are asked to predict what will happen when the elevator cables snap.<br>**Suggestions for modification**<br>Depending on students' literacy and numeracy skills, you may wish to explore terms such as speed, km/h and gravitational potential energy. For more able students, teachers might find the video **Would you weigh less in an elevator?** helpful to tease out students' understanding of the relationship between gravity, potential energy and weight. |

| Name | Key resource/s | Description of learning activities |
|---|---|---|
| **Speed, Physics and Crashes** | **Road to Zero on line resource**<br>http://roadtozero.museum.vic.gov.au/experiences/speed-and-physics | **Activity 2: Exploring head-on crashes**<br>**Level of difficulty: simple**<br>This activity explores the impact of head-on crashes at different speeds on the human body. Before watching the videos, students make predictions about the impact of head-on crashes at different speeds on both vehicles and drivers. They then watch the videos to evaluate their predictions.<br>**Suggestions for modification**<br>In the videos, both cars were travelling at speed. Students seeking extension could explore the likely impacts if the driver was in a moving car and the passenger was in a stationary car. |
| | | **Activity 3: Exploring side-on crashes and Newton's Laws of Motion**<br>**Level of difficulty: moderate**<br>This activity challenges students to apply Newton's Laws of Motion to understand the force at play when a car has a side on collision with a tree.<br>**Suggestions for modification**<br>Students with additional learning needs could watch the videos and respond to questions 1–4 and 6. Students seeking extension could attempt question 5 and 7. |
| | **Road to Zero on line resource**<br>http://roadtozero.museum.vic.gov.au/experiences/speed-and-physics<br><br>**TAC Searchable Road Trauma Statistics**<br>https://www.tac.vic.gov.au/road-safety/statistics/online-crash-database | **Activity 4: Exploring pedestrian crashes**<br>**Level of difficulty: moderate**<br>This activity encourages students to make connections between their learning, their local area and personal endeavors to become responsible road users.<br>**Suggestions for modification**<br>Students with additional learning needs could watch the videos, answer the first question on their own, and complete the data analysis task in mixed ability groups. We recommend teachers show students how to use the TAC searchable database.<br>Students seeking extension could collect information and data about impacts to body systems in crashes at different speeds. |
| **Road safety awareness** | **Quiz**<br>http://roadtozero.museum.vic.gov.au/experiences/speed-and-physics/#/quiz/0<br><br>**Speed Fact Sheet**<br>https://www.grsproadsafety.org/wp-content/uploads/Speed-Fact-sheet_Last-version_April-14th.pdf | **Activity 5: Sharing your road safety awareness**<br>**Level of difficulty: simple-moderate**<br>This activity invites students to demonstrate what they have learnt by preparing a piece of advice for Victorian road users. Students can also take a multi choice quiz.<br>**Suggestions for modification**<br>Students with additional learning needs could complete the activities in mixed ability groups. Students seeking extension could devise their own quiz questions and answers and test the class, using an app like socrative. They could also provide feedback to their peers on their responses. |
| **Extension activity** | | **Extension activity: Designing an experiment**<br>Students design an experiment (using toy cars if at home) to explore a factor (other than speed) that affects the impact on the driver during a head-on crash. The purpose of the activity is to invite students to design an experiment – not to develop their experimental report writing skills. |