Road Smart Teacher Toolkit

Lesson Plan 1 – Crashes and survival: How speed affects severity

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Student Outcomes

In this interactive lesson, students will build and demonstrate their knowledge of the effect of kinetic energy in a crash.

By the end of this lesson, students will be able to:

- Describe what occurs when a moving vehicle hits stationary and moving objects
- Describe the relationship between the speed of a vehicle and the severity of a crash
- Describe the effect of a crash on the human body for different types of road users

Suggested Timing

45 - 55 min

Materials and Preparation

- Devices with internet access for each group of students so they can access the relevant online materials referenced in this lesson plan.
- A computer and projector, and/or digital whiteboard for the teacher to show the opening video.
- Print-outs, for each group, of *Resource 2: Meet Graham Worksheet* from this document (and writing implements to complete them with).

Lesson Overview and Background Information

In this interactive and engaging lesson, students will explore the effects of kinetic energy in a crash. Students first analyse, as a class, a video showing the effect of speed on stopping distance. Students are then introduced to "Graham", an interactive lifelike sculpture created by the TAC and the Monash University Accident Research Centre. Graham is a model of a human body engineered to be able to withstand the forces in a crash.

Graham is designed to show the scale of forces acting on our bodies in a crash, and the *vulnerability* of our bodies (because we are not built to withstand such forces). Students use enquiry-based learning to complete activities that deepen their understanding of the effect of kinetic energy on human bodies and the effects of crashes on different types of road users.

Students end the lesson by reflecting on their own behaviour and making personal commitments for how they can be safer road users.

Evidence Base

Speed is a major factor in road crashes, especially fatal ones. It is particularly a factor for young drivers, for whom over-confidence and inexperience often lead to disastrous results.

Coaching Tip

Cleary explain that *only* if we were built like Graham could we withstand the forces of a crash.

Curriculum Mapping

Science

Content Description

- 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)

Achievement Standard (extract only)

- By the end of year 10 students …give both qualitative and quantitative explanations of the relationships between distance, speed, acceleration, mass and force to predict and explain motion.

Lesson part 2 – Group research activity – “Meet Graham: the great survivor” (35-45 minutes)

1. Play the 2-minute ‘Meet Graham’ video http://www.meetgraham.com.au/ (click on the ‘tell me more’ button to play the video)
2. Describe the intent of the Meet Graham project to the class. More information about this project can be found in the ‘lesson background’ above.
3. Split the class up into groups of between 2 to 4 students, with a maximum of eight groups. (Note that each group will require access to an internet enabled device).
4. Distribute a copy of the *Meet Graham worksheet (Resource* 2) to each group. Assign each group *at least* two body parts from the Body *Parts List* (*Resource 1*). Note that it is okay (in fact, preferable) for multiple groups to be assigned some of the same body parts to generate discussion later.
5. Make sure students understand each question before they begin the activity. Instruct students to navigate to the *Meet Graham* website (www.meetgraham.com.au/view-graham), and explore the ‘View Graham’ section to find the answers to the questions on their worksheet, focusing on their assigned body parts.
6. Give students roughly 15 minutes (they may require additional time if they have more than two body parts) to research the information they need to answer the questions on the worksheet. It may be useful for you to circulate amongst groups while they are researching, to answer questions and assist them in their work.
    a. Roughly halfway through the allocated research time, it may be worthwhile advising students to move onto their next body part, if they are still working on their first part.
7. When students have completed their worksheets (or time has run out), bring the groups back together. Working *body* part by body part, have groups discuss the answers to the questions and what they learned. Focus especially on answers to the third question, which relates to how people could change behaviour, vehicles and utilise safety features to decrease risk.

Part 3 – Conclusion (5 minutes)

1. Ask students to reflect for 60 seconds individually on the most important thing they learned in today’s lesson, and come up with one way they could be a safer road user.
2. Ask students to share their reflections with the class, where appropriate.

Resource 1: Body parts list

There are **eight** body parts that can be allocated to the groups. Each body part should be covered by at least one group, ensuring that all body parts are assigned.

They can be explored at www.meetgraham.com/view-graham.

The body parts are:

- Brain
- Skull
- Face
- Neck
- Rib Cage
- Skin
- Knees
- Legs & Feet

Remember that it is okay (in fact, preferable) that each group is given at least two body parts, *and* that multiple groups are given some of the same parts, to stimulate discussion and comparison later in the activity.

Resource 2: Meet Graham worksheet

Body Part	What is the risk associated with this body part? Why is it particularly vulnerable in a crash?	What changes did the designers of Graham have to make to this body part to make it less vulnerable in a crash?	Imagine - how could you change driver behaviour, vehicle design, or the road environment to make this body part less exposed in real life?

Resource 2: Meet Graham worksheet

Body Part	What is the <u>risk</u> associated with this body part? Why is it <u>particularly vulnerable</u> in a crash?	What <u>changes</u> did the designers of Graham have to make to this body part to make it <u>less vulnerable</u> in a crash?	Imagine - how could you <u>change driver behaviour</u>, <u>vehicle design</u>, or the <u>road environment</u> to make this body part less exposed in real life?
• Brain • Skull	• The brain is one of the major organs in the body. It doesn't have much internal support to help cushion it from forces that could damage neural connections and deform the structure of the brain. • The skull protects the brain. Depending on the amount of force the skull can fracture.	• His skull is a lot bigger, with more cerebrospinal fluid and ligaments to brace the brain when a collision occurs. • Graham's skull absorbs more of the impact. The structure of his skull is larger with inbuilt crumple zones to absorb any impact forces. The crumple zones aid in slowing down the momentum of his head as it moves forward on impact and increases his skull's ability to stop the force from continuing through to damage his brain.	Four main behaviours can be applied to all of these body parts: • Vehicle positioning • Speed management • Driver observation • Proper seatbelt use
• Face • Neck	• Injuries to the face are commonly caused by impact with the steering wheel, dashboard, windshield and even shattered glass. These can range from minor scrapes to serious cuts and fractures. • There is not enough strength in the neck to stop the head from jolting forward in a crash. The neck is placed under more pressure than its structure can manage.	• His nose is reduced and his ears are protected by the larger structure of his skull and neck. Fatty tissue has been added around protruding areas like his cheekbones to help further absorb the energy on impact. • Removing the neck has sacrificed his mobility to make his head more resilient to injury in a crash. The ribs, a form of protection, have been extended upwards to reach his skull.	

• Rib Cage • Skin	• Car seatbelts are designed to use the strength of the ribs. The seatbelt rests across your ribs and sternum and across your pelvis. It loads the centre of your chest, spreading the force over the ribcage until the ribs break when the force becomes too great. • Lacerations are lasting reminders for people injured in car crashes. Skin can be stripped down to the flesh, causing nerve damage and pain.	• Stronger ribs to give him better protection. Large barrel-like ribs to withstand greater impacts. Airbag like sacks placed between each of Graham's ribs. The airbags provide an inbuilt added layer of protection for the heart and other vital organs. • Graham has thicker and tougher skin to shield and reduce abrasions and road rash.	
• Knees • Legs & Feet	• The knee is built to bend in one direction, the knee can break if forced into unintended positions. • Injuries to the legs, feet and ankles can cause long-term debilitation because we are so reliant on them for everyday movement.	• His knee joints are fortified with extra tendons that give added flexibility and allow his knees to bend in other ways. • Strong, hoof-like legs with added joints allow him to jump out of the way quickly in a "spring-loaded" fashion. The extra joints in Graham's legs give his lower limbs added flexibility to reduce the impact force placed on the tibia in a crash.	

Resource 3: Safety features explained

Injury Reduction Safety features ***Please note that manufacturers may use different terminology to describe these features***	**Description**
Pedestrian Friendly Bonnet Design	This feature reduces injury to a pedestrian if hit in a crash, whilst maintaining structural integrity.
Seatbelts	For drivers and front-seat passengers, using a lap and shoulder belt reduces the risk of fatal injury by 60 percent in an SUV, van or ute and by 45 percent in a car.
Airbags	Airbags provide a cushion of air that protects a person from striking other parts of the car. They may be located in the steering wheel, in front of the passenger, in the seats, along the top sides of vehicles and near the knees.
Side-Impact Protection System	By having a reinforced energy absorbing honeycomb materials inside the vehicle doors, force is widely distributed across the vehicle. This helps to protect against injury in a side collision.
Head Rests	Attached to the top of a seat, this safety feature reduces whiplash or serious neck and spinal injury.
Crumple Zones	Crumple zones are designed to absorb the energy from the impact of a crash. By absorbing the energy the crumpling prevents the energy traveling through the car.

Crash Avoidance Safety Features ***Please note that manufacturers may use different terminology to describe these features***	**Description**
Lane-Keep Assist	Technology that detects if a car is drifting in its lane or out of the lane. It provides alerts and warnings when this occurs which helps to avoid or mitigate a crash. Some versions will proactively steer the car back into the lane.
Active Cruise Control	Improved cruise control that include warnings or assistance such as automatic braking to adjust the vehicle speed by detecting the distance and speed of the preceding vehicle and maintains an appropriate following distance.
Antilock Brake System (ABS)	Detects panic braking when sudden and forceful movement is applied to the brake pedal. When the system recognises sudden braking, it will add additional pressure to the brake. This allows the wheels on a motor vehicle to maintain tractive contact with the road surface according to driver inputs while braking, preventing the wheels from locking up (ceasing rotation) and avoiding uncontrolled skidding.
Electronic Stability Control (ESC)	ESC is an extension of antilock brake technology that helps drivers maintain control of their vehicles on curves and slippery roads, and hence prevent skidding. ESC becomes active when a driver loses control of their car.
Blind-Spot Warnings	Alarm that alerts the driver if there is something in their blind spot. The warnings administered range across different technologies and can be visual, audible and/or tactile to alert the driver that it is unsafe to change lanes.
Driver Fatigue Monitoring	Technology that provides warnings when it detects a driver falling asleep. This may help avoid or mitigate a crash.
Auto Emergency Braking (AEB)	AEB is a feature that alerts a driver to an imminent crash and helps them use the maximum braking capacity of the vehicle. AEB will independently brake if the situation becomes critical and no human response is made. AEB comes in three categories: 1. low speed system – works on city streets to detect other vehicles in front of the driver’s car to prevent crashes and non-life threatening injuries such as whiplash 2. higher speed system – scans up to 200 metres ahead using long range radar at higher speeds 3. pedestrian system – detects pedestrian movement in relation to the path of the vehicle to determine the risk of collision.