MEET GRAHAM

TEACHING AND LEARNING IDEAS

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TEACHING AND LEARNING IDEAS TO EXTEND THE EXPERIENCE OF 'MEETING GRAHAM'

These teaching ideas are designed to support and extend the experience of 'meeting Graham' and the key road safety messages the installation (Graham) is designed to convey.

'MEETING GRAHAM' AIMS TO IMPART THE FOLLOWING ROAD SAFETY MESSAGES TO STUDENTS:

- ROAD TRAUMA REMAINS AN IMPORTANT PUBLIC HEALTH ISSUE IN VICTORIA AND THE HIDDEN ROAD TOLL OF SERIOUS INJURIES IS NOT IMPROVING YEAR-ON-YEAR.
- THE HUMAN BODY HASN'T EVOLVED TO WITHSTAND THE FORCES INVOLVED IN COMMON CRASH SCENARIOS.
- PEOPLE CAN FEEL OVERLY PROTECTED WHEN THEY'RE USING THE ROAD, AS A DRIVER, PEDESTRIAN, CYCLIST OR MOTORCYCLIST AND CAN FORGET HOW VULNERABLE THEY ARE IN A CRASH.
- TOWARDS ZERO ACKNOWLEDGES THIS VULNERABILITY AND SEEKS TO CREATE A SAFE ROAD SYSTEM WITH SAFER SPEEDS, SAFER VEHICLES, SAFER ROADS AND SAFER ROAD USERS.

AREA	YEARS 3-4	YEARS 5-6	YEARS 7-8	YEARS 9-10
ENGLISH	As a class, students develop a series of questions a TV news reporter might ask Graham in an interview about why he looks the way he does. Then, working in pairs, one student takes on the role of the reporter and the other Graham. (VCELA271)	Write a children's story or rewrite a fairytale to talk about how Graham helps convince others to be safer as pedestrians (e.g. have the gingerbread man wearing bright clothes and safely using pedestrian crossings). Have students read their stories to young children in the school. (VCELT355) • PERSONAL AND SOCIAL CAPABILITY	Using software, create an advertisement to encourage your schoolmates to wear helmets while riding their bicycles, scooters or skateboards. This could be a poster, webpage or video clip. Include Graham in the ad in some way. (VCELY422) • ETHICAL CAPABILITY • PERSONAL AND SOCIAL CAPABILITY	Using the Towards Zero and Safe System websites (https://www.towardszero.vic.gov.au and http://www.tac.vic.gov.au/road-safety/the-safe-system/safe-system-learning-module/safe-system), research the ideas behind the development of Graham (e.g. human vulnerability, people make mistakes) as a means of communicating messages about road safety to the general public. Taking into account audience, consider whether other text types and mediums might be more effective in communicating the message. (VLELY466)
SCIENCE	In small groups, test the forces (kinetic energy) involved at different speeds using toy cars and a ramp (cars placed at different points and the ramp at different angles). Make observations by measuring the distance travelled and present the findings, including conclusions. (VCSSU064) • ETHICAL CAPABILITY • PERSONAL AND SOCIAL CAPABILITY	Describe the adaptations made to Graham's body that allow him to have a greater chance of surviving the forces involved in a crash. Discuss why the human body hasn't developed like Graham has. *(Because the car has evolved faster than we have).* Investigate how long it might take for humans to evolve into something like Graham. Investigate what can be done to protect the human body from the forces involved in a crash. *(For example vehicle features that protect us in a crash, such as seat belts, child restraints and airbags.)* (VCSSU074)	In small groups, investigate kinetic energy and how this relates to vehicles of different masses (e.g. truck versus a car) travelling at different speeds. Discuss the effect of lower speeds on reducing kinetic energy. Use ramps and physics trucks to design an experiment to measure kinetic energy at different speeds. (VCSSU104) • ETHICAL CAPABILITY • PERSONAL AND SOCIAL CAPABILITY	Investigate the different factors involved in how long it takes a vehicle to stop at different speeds. Calculate the stopping distances at different speeds, taking into account braking distance and reaction times of the driver. Discuss what this means for setting speed limits in areas where there are high numbers of people walking and crossing roads, where vehicles may need to stop quickly to avoid a crash. (VCSSU133) • ETHICAL CAPABILITY Investigate how the human body has evolved over time and why it has changed, relating these reasons to the principles of evolution. Document how Graham's body has changed from that of a 'normal' human being and speculate as to why all the changes have occurred and how long it might take for them to occur naturally. (VCSSU120)

AREA	YEARS 3-4	YEARS 5-6	YEARS 7-8	YEARS 9-10
HEALTH AND PHYSICAL EDUCATION	Identify all the road safety features around the school or on the journey to school (e.g. traffic lights, children's crossing, crossing supervisor, bike paths, footpaths). Discuss why they are needed and practise how to use them safely. (VCHPEP091)	Using a range of resources, such as the Towards Zero website (https://www.towardszero.vic.gov.au), develop TV news reports and car advertisements, identify messages about road safety in the media and explore how these relate to health, safety and well-being. (VCHPEP112)	Research the components of a road safety campaign and design a campaign for younger children. The campaign should use Graham and how he highlights the vulnerability of road users. (VCHPEP126) • ETHICAL CAPABILITY • PERSONAL AND SOCIAL CAPABILITY	Identify key road safety messages using the Towards Zero and Safe System websites (https://www.towardszero.vic.gov.au and http://www.tac.vic.gov.au/road-safety/the-safe-system/safe-system-learning-module/safe-system). Identify road safety information young people require and create a visual and multimodal health campaign to promote road safety to young people. (VCHPEP149)
MEDIA ARTS	Using claymation or an augmented reality app, create characters out of different body parts and develop a story about those that could be impacted by a road crash or ones that Graham has that would withstand a road crash. (VCAMAE025)	Using technology, design Graham's family and develop a short animation showing how Graham and his family carry out a range of daily activities, such as having breakfast, cleaning their teeth and walking to school or work. (VCAMAM030)	Consider how the artist Patricia Piccinini interpreted the evidence provided by the biomechanic, David Logan from Monash University Accident Research Centre (MUARC) and surgeon, Christian Kenfield. Consider how effective Graham is in creating awareness of road trauma as an issue and how else the information could have been interpreted. (VCAMAR039)	Explore road safety advertising material via the Transport Accident Commission website: http://www.tac.vic.gov.au. Using Graham or a similar character, develop an advertisement that conveys the message that the human body is vulnerable in road crashes. (VCAMAM042) • ETHICAL CAPABILITY
DANCE	Explore the movements Graham could make and develop these into a dance. Think about how he might make movements such as walking, running, crawling, bending and jumping. Communicate, through facial and body expressions, how Graham might feel about making these movements (e.g. pain, pleasure, hard or easy). (VCADAD026)			

AREA	YEARS 3-4	YEARS 5-6	YEARS 7-8	YEARS 9-10
VISUAL ARTS	Draw the body proportions of Graham. Compare these with the body proportions of a 'normal' adult. Measure and draw the body proportions of your self or friends. Draw one of Graham's children based on what you know about the proportions of a 'normal' child. (VCAVAV026) • PERSONAL AND SOCIAL CAPABILITY	Consider the medium, materials and techniques used in making Graham. How do the choices made by the artist, Patricia Piccinini, enhance the audience's understanding of the artist's intention? What other choices could the artist have made? What choices would you have made in developing Graham? Develop an artwork based on Graham or on your own interpretation of what a human body would have to look like in order to withstand a road crash. (VCAVAE029; VCAVAV030)	Plan and create an artwork around one aspect of human vulnerability and road safety. Demonstrate the use of materials, techniques, processes, visual conventions and technologies to express their ideas and convey meaning about human vulnerability and road safety in the artwork. (VCAVAV039) • PERSONAL AND SOCIAL CAPABILITY	Develop an individual focus for a series of artworks based on human vulnerability and road safety. Consider the different options for making artworks and how these could change the meaning of the artwork. (VCAVAV043)
DESIGN AND TECHNOLOGIES	Design and build toy cars that experiment with how to keep something delicate (e.g. an egg) safe. Make the links between keeping people safe in cars. (VCDSTC024)	Unlike Graham, the human body can't evolve quickly enough to withstand the effect of being in a crash. Design 'enhancements' to people that could be made to help the human body withstand the impact of a crash. This might include metal plates, inserting energy-absorbing material in key places, replacing bones, etc. (VCDSCD039) • PERSONAL AND SOCIAL CAPABILITY	Research and design safer roads and vehicles. Consider the needs of all road users and that of the community generally. (VCDSCD049)	Cars that drive themselves are coming in the near future. Consider the impact of these cars on personal and property safety, sustainability, economics, general society and specific groups. Construct scenarios that illustrate the possible impacts. (VCDSTS055)
CIVICS AND CITIZENSHIP	Identify some road laws that keep people safe. Identify any rules the school has about keeping students safe on the roads. As a class, make rules that you think will help to keep students safe when they travel to and from school. (VCCCL005)	Identify who enforces road laws and the general purpose of road laws. Identify road laws designed to keep children safe and the specific purpose of each (e.g. using child restraints, cycling on the footpath and age restrictions on travelling as a passenger on a motorcycle). (VCCCL013)		

THE SCIENCE BEHIND GRAHAM

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THE LINK BETWEEN SPEED AND CRASHES

The faster you travel, the more difficult it is to avoid a crash and the greater the impact if a crash occurs.

Scientists at the University of Adelaide have used crash data to estimate the relative risk of a car becoming involved in a casualty crash (a car crash in which people are killed or hospitalised) for cars travelling at or above 60km/h. They found that the risk doubled for every 5km/h over 60km/h. So, a car travelling at 65km/h was twice as likely to be involved in a casualty crash as one travelling at 60km/h. For a car travelling at 70km/h, the risk increased four times. For speeds below 60km/h the likelihood of a fatal crash is correspondingly reduced.

For pedestrians and other vulnerable road users, such as cyclists and motorcyclists, being hit by a vehicle travelling at anything over 30km/h can mean serious injury or death.

UNDERSTANDING MOMENTUM

It is important to understand why your body keeps moving when a collision occurs. The key is to calculate the momentum of the vehicle.

Momentum is the product of the mass and the velocity of an object (e.g. a vehicle).

- WHICH HAS THE MOST MOMENTUM, A 2,000KG VEHICLE TRAVELLING AT 54KM/H (15M/S) OR A 1,200KG VEHICLE TRAVELLING AT 108KM/H (30M/S)?

e.g. p = mv = 2,000 x 15 = 30,000kgm/s
p = mv = 1,200 x 30 = 36,000kgm/s
Where: p = momentum, m = mass,
v = speed (velocity) in metres per second (m/s)

To convert from km/h to metres per second multiply by 1,000 and divide by 3,600
e.g. 60km per hour = 60 x 1,000 metres per hour
= 60 x 1,000 ÷ 60 metres per minute
= 60 x 1,000 ÷ 60 ÷ 60 metres per second
= 16.7m/s

UNDERSTANDING KINETIC ENERGY

Kinetic energy is the energy possessed by an object because of its motion.

All moving objects have kinetic energy. The amount of kinetic energy depends upon the mass and speed of the object. A moving car has a lot of kinetic energy, especially if it is moving fast and has a lot of mass. Kinetic energy is calculated using the formula:

$KE = ½\ mv^2$

Where: m = mass in kilograms, v = velocity (speed) in metres per second

- DO A RANGE OF KINETIC (MOTION) ENERGY CALCULATIONS BASED ON THE PREVIOUS EXAMPLES OF A 2,000KG VEHICLE TRAVELLING AT 54KM/H (15M/S) OR A 1,200KG VEHICLE TRAVELLING AT 108KM/H (30M/S). WHICH HAS THE GREATEST KINETIC ENERGY?

e.g. $E = ½\ mv^2$

$E = ½ * 2000 * 15 = 225kJ$

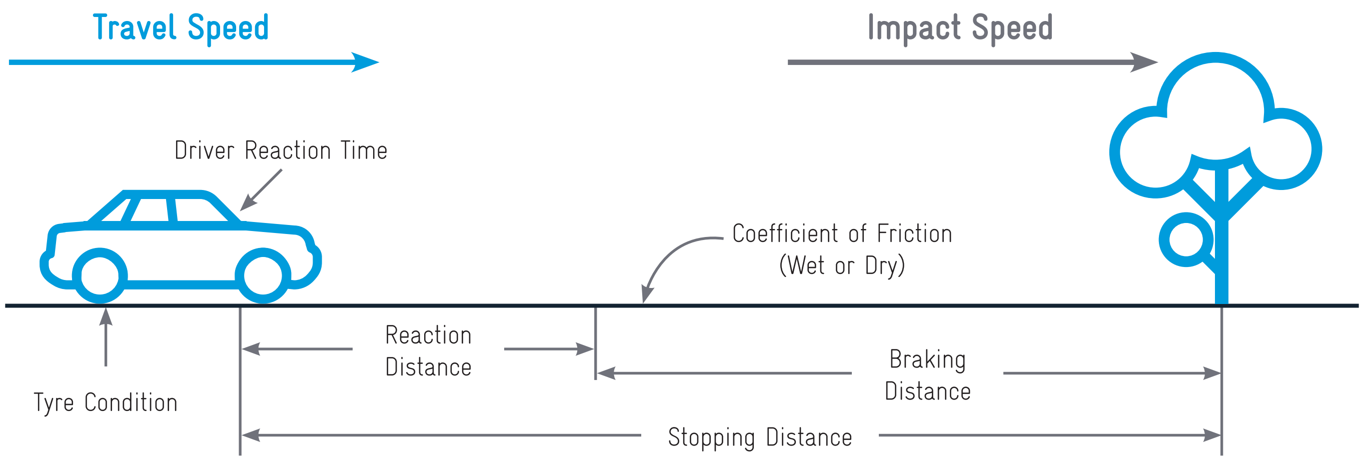
$E = ½ * 1200 * 30 = 540kJ$

- CALCULATE THE KINETIC ENERGY OF A VEHICLE OF MASS 1,500KG GOING AT 60KM/H, 65KM/H, 70KM/H, 75KM/H AND 80KM/H. USING A SPREADSHEET WILL MAKE THIS EASIER.

When a vehicle is involved in a crash, the kinetic energy must be absorbed or dissipated. Typically this energy is dissipated through reducing speed by engaging the brakes, but in a crash this must be absorbed through vehicle crumple zones, energy-absorbing flexible road barriers and air-bags. If the human body absorbs a large amount of this energy it can result in serious injury or death.

- VIEW SOME CRASH TEST VIDEOS OF FRONTAL AND SIDE-ON COLLISIONS OF A RANGE OF VEHICLES TO BETTER UNDERSTAND MOMENTUM AND THE FORCES INVOLVED IN A CRASH. YOU CAN FIND A COLLECTION OF CRASH TEST VIDEOS HERE: HTTP://WWW.YOUTUBE.COM/USER/ANCAPCRASHTESTS

THE SCIENCE OF STOPPING DISTANCES



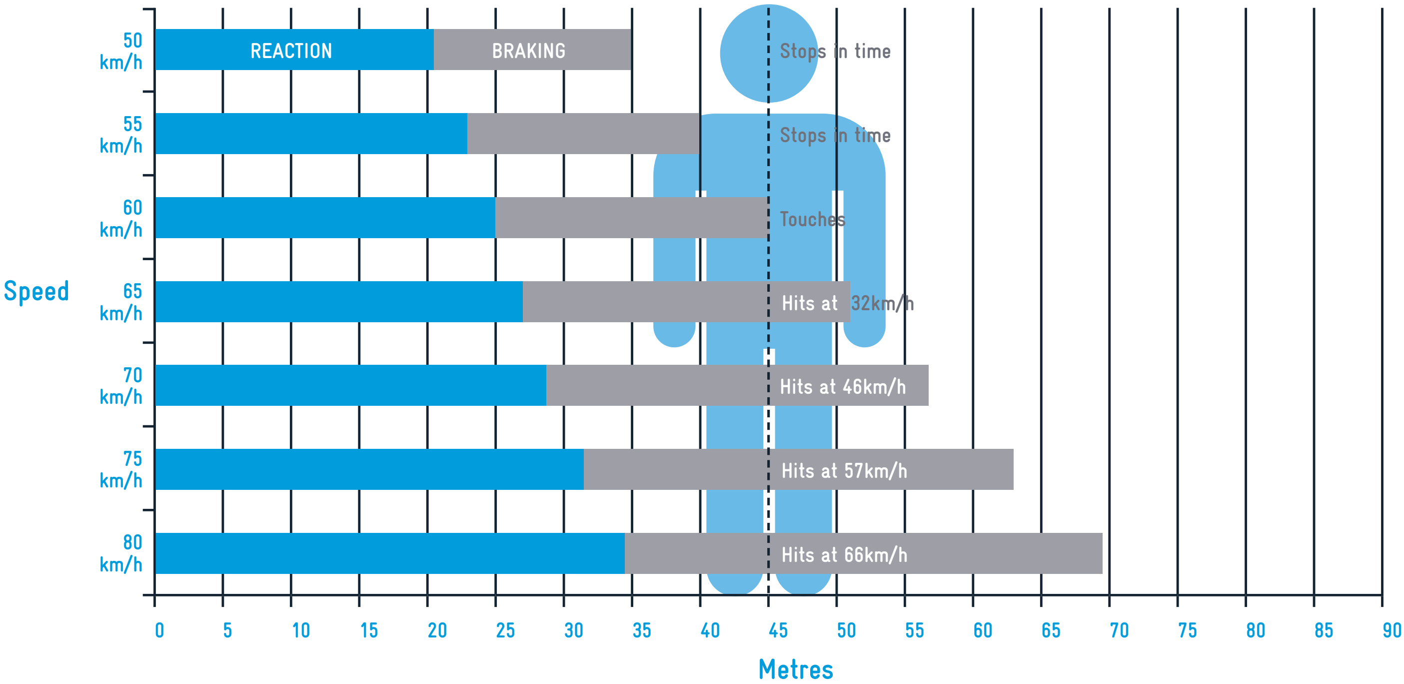
Stopping distance is calculated by adding the reaction time distance (metres per second) to the braking distance. The average reaction time of a driver to brake in an emergency is about 1 second. The braking distance is calculated using the formula:

$$\frac{v^2}{2\mu g}$$

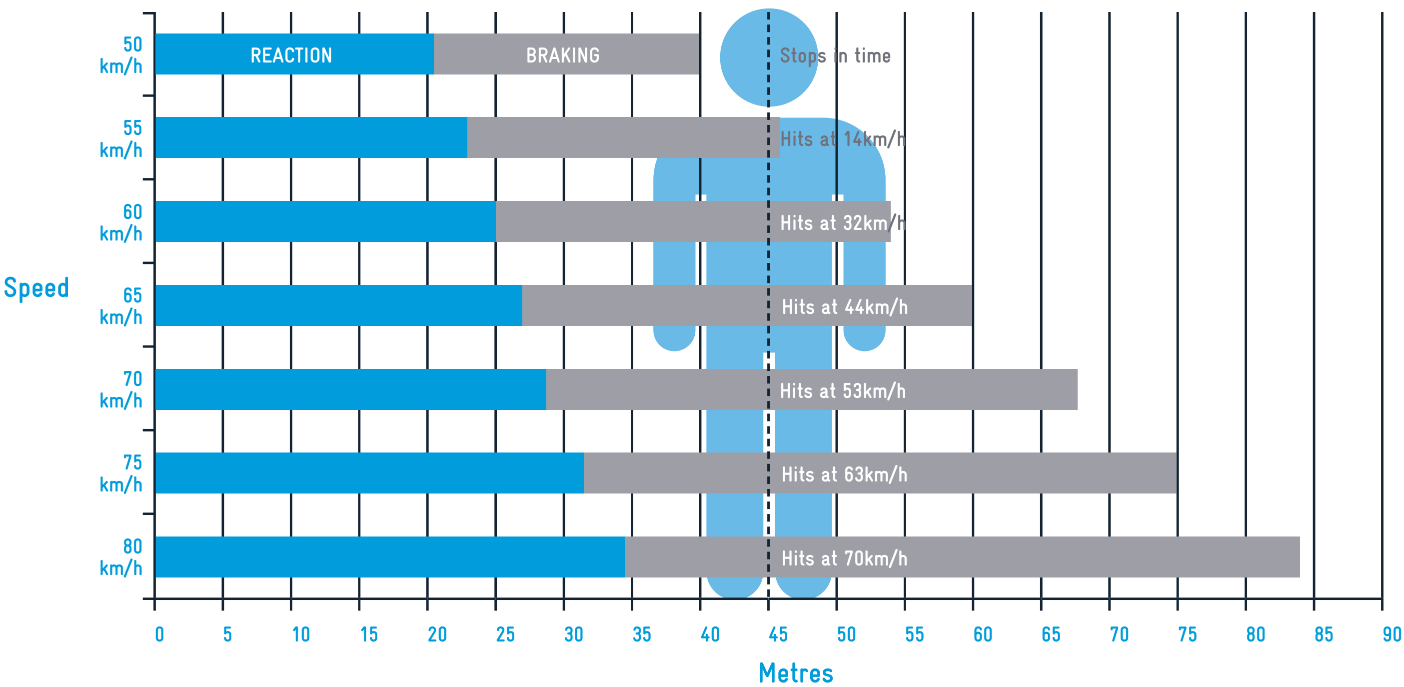
Where: d= stopping distance
v = speed (velocity) in m/s
g = 9.8 (gravitational constant)
μ = friction coefficient

This friction coefficient is a value between 0.8 for new tyres and good road to 0.4 for poor tyres and poor road. It can even be lower for black ice, snow, hail or heavy rain. Use 0.6 for an average car.

STOPPING DISTANCES IN DRY CONDITIONS



STOPPING DISTANCES IN WET CONDITIONS



BIOLOGY – HOW GRAHAM'S BODY PROTECTS HIM IN A CRASH

SKULL

One of the most significant parts of the body for injury is the head. Head injuries can be debilitating, if not fatal, and can result in lifelong impairment.

In a car crash, your body is dealing with much greater energy levels. The skull absorbs a lot of force on impact simply by fracturing. Essentially this stops the force from carrying through to the brain in much the same way a helmet works. A helmet is designed, on purpose, to break. And the force required to break a helmet stops the force continuing through to injure the skull and brain.

Graham's skull has been engineered to absorb more of the crash impact earlier, much like a helmet. The structure of his skull is larger, more helmet-like in design, 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.

BRAIN

The brain is one of the most vulnerable parts of our body.

It sits delicately surrounded by cerebrospinal fluid, which acts as an inbuilt safety mechanism to protect the brain from day-to-day knocks and jolts. The brain itself has very little internal structure that helps to cushion it.

In a car crash, we are dealing with forces much greater than the physical knocks our brains are designed to take. Impact forces cause the brain to hit the walls of the skull, causing hundreds of neural connections to break and the whole structure of the brain to be damaged.

Although we can't strengthen the brain, we can offer it more support. Graham's brain is the same as yours, but his skull is a lot bigger with more cerebrospinal fluid and ligaments to brace the brain when a collision occurs. His head offers greater overall safety, effectively protecting the brain and reducing the damage caused on internal impact with the skull wall.

FACE

Our faces are a delicate mix of bone, muscle and cartilage. In a crash, 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.

Many people injured in car accidents receive fractures to their nose, damaging not only the bone but disrupting sinuses and the delicate parts behind the cheekbone.

To combat this, Graham has a rather flat face. 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.

NECK

As a car stops suddenly many parts of the body will continue to move due to the transfer of energy. Our head is one of these.

We do not have enough strength in our necks to stop the head jolting forward in a crash. Our head recoils forward and suddenly stops and then suddenly moves backwards causing an extreme extension of both the neck and spine. The forward motion causes a hyperflexion injury and the backwards motion a hyperextension injury. Simply put, our neck is placed under more pressure than its structure can manage.

The added danger is the spinal cord running through the neck. If it is to bend and stretch too much it will break, causing serious injuries like paraplegia or quadriplegia.

Graham's design addresses this problem by simply having no neck at all. 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, fortifying his torso with a brace-like structure that protects his head from injury when there is a sudden movement.

RIBCAGE

In a crash, our bodies must manage the kinetic energy that is produced by a crash. Currently, our bodies are subjected to much higher impact forces than we were designed to withstand, so we have very little ability to manage the energy in a crash, which results in injury. However, some body parts are better at managing energy than others, like the ribs. The ribs are one of the most effective protective measures for our organs. Think of them as the first line of defence in a collision impact.

Vehicle seat belts are designed to use the strength of the ribs to help us withstand the forces of a crash. That's why the three-point seat belt rests across your ribs and sternum and across your pelvis. It loads the centre of your chest, spreading the force over the ribcage, however the ribs will break when the force becomes too great.

Ideally, we want to stop gradually, rather than suddenly in a car accident. So while the ribs guard against impact, airbags in a car protect against the forward momentum. They inflate to stop us hitting the steering wheel and dashboard and slow our speed gradually.

Graham has been designed with stronger ribs to give him better protection in a crash. His chest is large and barrel-like to withstand greater impacts. However, his torso is more airbag-like than armour-like. Sacks, that do a similar job to that of an airbag, have been placed between each of Graham's ribs. On impact these airbags absorb the force and reduce his forward momentum. The airbags provide an inbuilt added layer of protection for the heart and other vital organs.

SKIN

A pedestrian impact is mostly blunt force trauma. However, if our bodies are pitched to the road or if broken glass is involved, then cuts and abrasions can occur. Skin is vulnerable to the road, with bitumen potentially wearing through clothing. This is even more important for motorcyclists and cyclists, who only have minimal protection between them and the road.

Typically, skin injuries aren't life-threatening, but lacerations are lasting reminders for people injured in car accidents. Skin can be stripped down to the flesh, causing nerve damage and pain.

Graham has thicker and tougher skin to shield and reduce abrasions and road rash. This is even more apparent around the arms, elbows and hands – areas that are often instinctively outstretched when attempting to break a fall.

KNEES

When a pedestrian is hit by a car it's usually when they're stepping out from a kerb. On impact, the immediate problem is that our knees are only built to bend in one direction, so they will almost always break first. Depending on the force of the impact, the tendons can also pull, twist and hyperextend well beyond their intended radius.

So if the bones themselves can't bend, you need joints that can. Graham's knees have movement in all directions. His knee joints are fortified with extra tendons that give added flexibility and allow his knees to bend in other ways. This means that when a crash happens, his knees have a greater chance of retaining their structure and are less likely to be injured.

LEGS

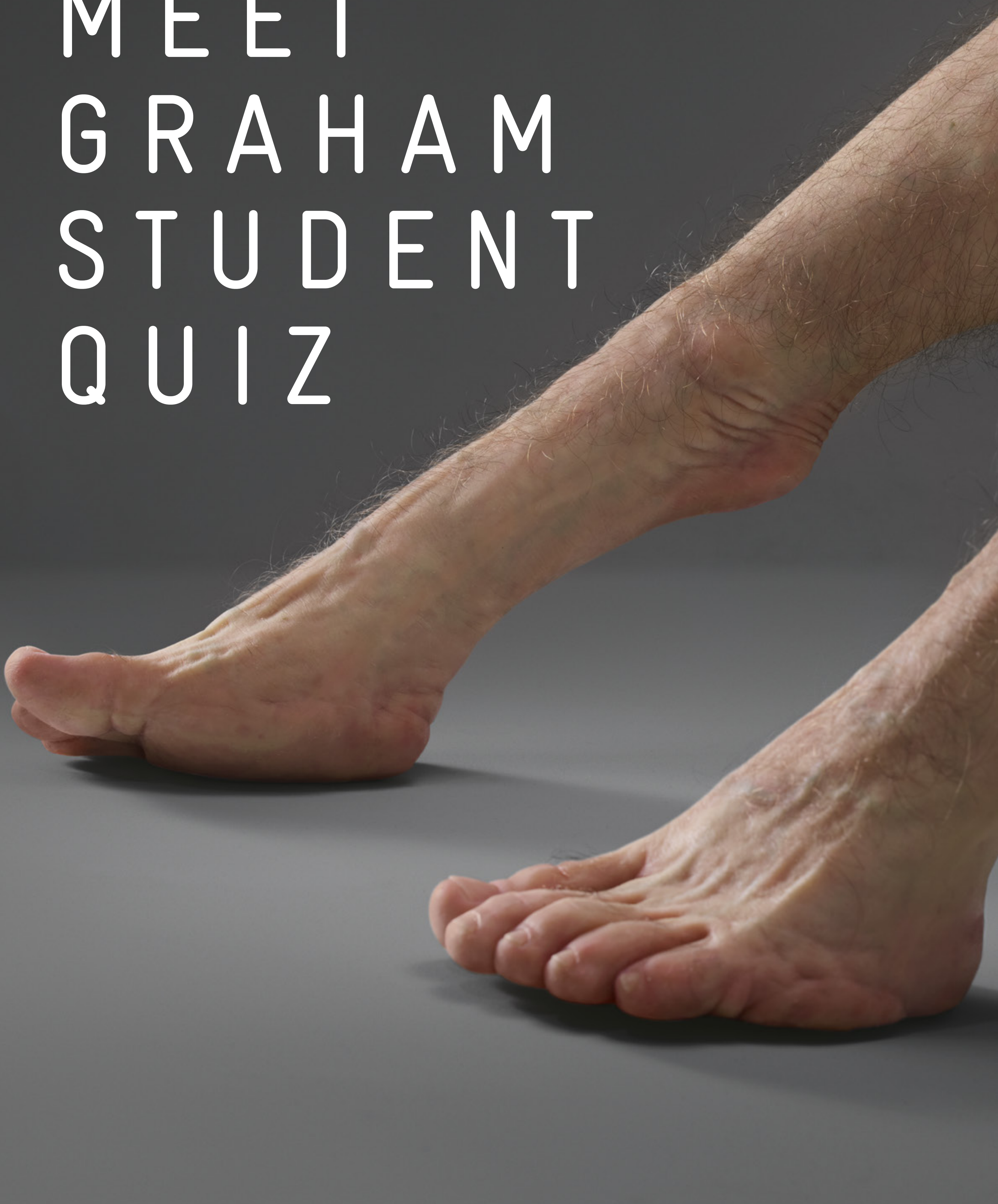
For pedestrian crashes, there are now so many variables that affect injury severity – the size of the vehicle, height, speed and angle of impact. And there are many situations where legs are badly damaged. In fact, injuries to the legs, feet and ankles can cause long-term debilitation because we are so reliant on them for everyday movement. The shin is the least protected bone, in the body with only a thin layer of skin covering it.

Graham has an inbuilt defence to help avoid these situations altogether. Strong, hoof-like legs with added joints allow him to jump out of the way quickly in a "spring-loaded" fashion.

Second to this, as a driver or passenger, injuries to the feet and legs from the floor pans can occur. The extra joints in Graham's legs give his lower limbs added flexibility to reduce the impact force placed on the tibia in an accident.

TOWARDS ZERO TAC

THE MEET GRAHAM STUDENT QUIZ



MEET GRAHAM

TOWARDS ZERO TAC

QUIZ FOR STUDENTS

1. HOW DOES GRAHAM'S HEAD PROTECT HIS BRAIN?

- ☐ a. His head is a lot bigger than ours.
- ☐ b. His head has more cerebrospinal fluid than ours.
- ☐ c. His head has ligaments to brace it in a collision.
- ☐ d. All of the above.

2. HOW HAS GRAHAM'S SKULL BEEN ENGINEERED TO PROTECT HIS BRAIN?

- ☐ a. His skull is much thicker and stronger than ours.
- ☐ b. His skull has lots of padding around it.
- ☐ c. His skull has been designed like a helmet, with inbuilt crumple zones to absorb the impact.
- ☐ d. His skull is similar to ours, just thicker.

3. HOW HAS GRAHAM'S FACE BEEN DESIGNED TO REDUCE INJURY IN A CRASH?

- ☐ a. He has a rather flat face and lots of fatty tissue to absorb the impact of a crash.
- ☐ b. The skin on his face is very thick, to prevent cuts and scrapes.
- ☐ c. His facial bones are much stronger, to protect him from the impact of a crash.
- ☐ d. He has a small face and little ears.

4. WHAT HAS HAPPENED TO GRAHAM'S NECK AND WHY?

- ☐ a. His neck is shorter than ours, with stronger muscles to hold it still in a crash.
- ☐ b. His neck is protected by a lot of fat, to absorb the impact in a crash.
- ☐ c. His neck is more flexible than ours, so that it can bend more easily to cope with sudden movements in a crash.
- ☐ d. He doesn't have a neck, because our necks don't have the strength to manage the sudden movements of our heads that happen in a crash.

5. WHAT IS DIFFERENT ABOUT GRAHAM'S RIBCAGE?

- ☐ a. His ribs are stronger than ours.
- ☐ b. His chest is large and like a barrel.
- ☐ c. He has sacks like airbags between each rib.
- ☐ d. All of the above.

6. HOW HAS GRAHAM'S SKIN BEEN DESIGNED TO PROTECT HIM FROM CUTS AND ABRASIONS?

- ☐ a. It has more padding than ours.
- ☐ b. It heals more quickly than ours.
- ☐ c. It is thicker and tougher than ours.
- ☐ d. It stretches more easily than ours.

7. WHAT ARE GRAHAM'S KNEES LIKE?

- ☐ a. They are very stiff, with limited movement, so they don't bend easily in a crash.
- ☐ b. They can move in all directions, so they are less likely to be injured in a crash.
- ☐ c. They are stronger than ours.
- ☐ d. He doesn't have knees, because these are often injured in a crash.

8. HOW HAVE GRAHAM'S LEGS BEEN DESIGNED TO AVOID POSSIBLE CRASH SITUATIONS AS A PEDESTRIAN?

- ☐ a. He can run very fast so he can get away from dangerous situations.
- ☐ b. He has strong, hoof-like legs with added joints to allow him to jump out of the way quickly.
- ☐ c. They are very flexible so he can turn away quickly from possible crash situations.
- ☐ d. None of the above.

ANSWERS TO THE MEET GRAHAM' STUDENT QUIZ

1. How does Graham's head protect his brain? d. All of the above. **2. How has Graham's skull been engineered to protect his brain?** c. His skull has been designed like a helmet, with inbuilt crumple zones to absorb the impact. **3. How has Graham's face been designed to reduce injury in a crash?** a. He has a rather flat face and lots of fatty tissue to absorb the impact in a crash. **4. What has happened to Graham's neck and why?** d. He doesn't have a neck, because our necks don't have the strength to manage the sudden movements of our heads that happen in a crash. **5. What is different about Graham's ribcage?** d. All of the above **6. How has Graham's skin been designed to protect him from cuts and abrasions?** c. It is thicker and tougher than ours. **7. What are Graham's knees like?** b. They can move in all directions, so they are less likely to be injured in a crash. **8. How have Graham's legs' been designed to avoid possible crash situations as a pedestrian?** b. He has strong hoof-like legs with added joints to allow him to jump out of the way quickly.