

KEEPING SAFE AROUND TRUCKS Curriculum resources

3.0. CONNECTING IDEAS

3.1. Taking care and keeping safe around trucks

[Connecting ideas]

[Links to New Zealand Curriculum Learning Area: Mathematics and Statistics]

Read the following facts and information about crashes involving trucks on the road network.

When truck drivers drive the big rigs carrying goods and materials across New Zealand, they have an important professional role in the New Zealand economy. They belong and matter to our community, and they make a difference to the lives of all New Zealanders.

However, the size of the trucks on our roads brings special safety challenges for pedestrians, cyclists, other drivers and their passengers who are sharing the road with them. Because of these challenges, the big truck drivers have tight rules to make sure they stay alert when driving – to protect them from driver fatigue. These regulations set out the total number of kilometres they can drive in a day, the total number of hours they can drive in a day and when they must take breaks from driving.

The following resources show that driver fatigue is an important safety issue for all drivers on the road network: <https://www.nzta.govt.nz/safety/driving-safely/fatigue/>
<https://www.nzta.govt.nz/assets/resources/alternative-fatigue-management-scheme/docs/fatigue-for-supervisors.pdf> <https://www.nzta.govt.nz/commercial-driving/commercial-safety/alternative-fatigue-management-scheme-afms/>
<https://www.nzta.govt.nz/assets/resources/alternative-fatigue-management-scheme/docs/afms-good-practice.pdf>

Even with these safety measures in place, the larger size and mass of trucks makes their involvement in crashes more serious. New Zealand Truck Crash Facts shows trucks are over-represented in serious crashes causing injury or death:

<http://www.transport.govt.nz/research/crashfacts/truckcrashfacts/>

Trucks feature in more crashes than you would expect based on the total distance they travel on the road. The latest truck crash statistics show that deaths from crashes involving trucks range between 15% and 19% of the total road toll. However, the total distance trucks travel is only 6% of the total distance everyone travels on New Zealand roads.

The crash facts also show that we have a high incidence of truck rollover and loss-of-control crashes compared with other countries like the United States of America and Canada. This is in part due to the more challenging road conditions in New Zealand. We have more bridges, more corners and more hills per 100 kilometres of road, and fewer divided highways, than many other developed countries. The Federal Motor Carrier Safety Administration (FMCSA) training video helps explain the causes for truck rollovers and how truck drivers can drive to

avoid them: <https://www.fmcsa.dot.gov/rolloverprevention>

In the majority of crashes on New Zealand roads, the truck drivers are not at fault. (Refer to New Zealand Truck Crash Facts, Figure 3: Truck driver fault in fatal crashes - 2011 to 2015 <http://www.transport.govt.nz/research/crashfacts/truckcrashfacts/> Other drivers cause the majority of truck crash accidents (66%). Truck drivers are responsible for about a third (34%) of the fatal crashes in which they are involved. Other drivers cause accidents by driving in ways that show a lack of understanding of what the driver of a large, heavy vehicle can and cannot do and see on the road.

Tasks

- 1. Identify** the type of vehicle over-represented in serious crashes in New Zealand.
What vehicles are over-represented in serious crashes in New Zealand?
- 2. Draw** a pie chart showing the proportion of truck crashes in which the truck driver was at fault.
- 3. Explain why** we have a higher incidence of truck rollover and loss-of-control crashes compared with other countries like the United States of America and Canada. Suggest measures that might help reduce the incidence of truck rollover and loss of control crashes in New Zealand.
- 4. Make a generalisation** about our next steps for making journeys safer in view of the statistics showing that other drivers sharing the road with truck drivers often cause truck crashes.

NZC Learning Areas Overview

Refer to the resource for Achievement objectives and Learning intentions (L1 to 4)

Health and Physical Education	Personal Health and Physical Development A – A3 Safety management		Healthy Communities and Environments S – D2 Community resources		
Mathematics and Statistics	Geometry and Measurement				
	Measurement	Shape		Position and orientation	
Science	Nature of Science				Physical World
	Understanding about science	Investigating science	Communicating in science	Participating and contributing	Physical inquiry and physics concepts

Social Sciences	Identity, Culture and Organisation	Place and Environment	Continuity and Change	The Economic World
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3.2. Mass matters

[Connecting ideas]

[Links to New Zealand Curriculum Learning Areas: Mathematics and Statistics, Science]

Use your science and mathematics understanding to think about and experiment with the following facts and information.

The over-representation of trucks in serious crashes is in many cases due to the large mass¹ of any truck driving on a New Zealand road.

Trucks are to New Zealand road vehicles what the great whales are to mammals, the hippopotamus is to even-toed ungulates, and the polar bear is to land carnivores. They are all much larger in mass and size than the others in their group. Being much taller, longer and heavier makes a difference when objects change their state of motion, slow down, speed up, change direction or experience a collision impact. Being much taller and longer makes a big difference to what you can and cannot see on the road around you. Being much larger and heavier makes a big difference to the impact when crashes happen.

Trucks are bigger (have a larger mass) than most other vehicles sharing New Zealand roads. The heavier and/or faster the object, the more energy it contains.

The science of larger mass and velocity tells us that in any crash with a lighter vehicle, a cyclist or a pedestrian, it is the road user with the smaller mass who is more likely to experience stopping forces that lead to serious injury or death.

The mass and velocity (speed in a certain direction) of a moving truck affect:

- truck braking
- truck cornering
- impact (damage) in a crash.

Braking	Cornering	Impact
When the velocity is the same for two vehicles: the heavier vehicle goes further before stopping.	When the velocity is the same in two vehicles: the heavier vehicle has a greater overturning (side) force as it enters the corner.	When the velocity is the same in two vehicles: the heavier vehicle experiences the greater damage (to the vehicle and

¹ Mass is a measure of how much matter (stuff) is in an object. It is measured in kilograms (kg).

		its driver) on the point of impact.
When mass is the same for two vehicles: the faster vehicle goes further before stopping.	When mass is the same for two vehicles: the faster vehicle has a greater overturning (side) force as it enters the corner.	When mass is the same for two vehicles: the faster vehicle experiences greater damage (to the vehicle and the driver) at the point of impact.
If you double the truck's velocity: it will take at least four times the distance to stop.	If you double the truck's velocity: there will be at least four times more overturning force on the truck.	If you double the truck's velocity : there will be at least four times more impact (energy release) in a collision with another object, vehicle or pedestrian.

Refer: The Official New Zealand Road Code for Heavy Vehicles

<https://www.nzta.govt.nz/resources/roadcode/heavy-vehicle-road-code/information-for-heavy-vehicle-drivers/stability/>

Videos

Stopping distance:

Volvo Trucks – Emergency braking at its best!: <https://youtu.be/ridS396W2BY>

Braking:

Mercedes-Benz Actros Safety Truck – Active Brake Assist 2: <https://youtu.be/jSQSueFrzI>

Mercedes Truck Brake Test: <https://youtu.be/Ap9BXQqKi6U>

Rollover:

Volvo Truck Rollover Test 2: <https://youtu.be/rww9oFNoNi8>

Blind spots:

Truck Driver's Blind-spot and Cycling: <https://youtu.be/IV-rhiGRFTE>

Safety Truck Video – Keep out of Truck Blind Spots: <https://youtu.be/dLIPki7CZ04>

Jack-knife:

Volvo Trucks – Increased safety on slippery roads with Volvo Trucks' Stretch Brake: https://youtu.be/MNwJ7Acs_3Y

Crash tests:

Volvo FH 2012 – Crash Test (By Geo93): https://youtu.be/m0HG6_xnoY0

Tasks

1. Define mass, distance, speed, velocity and their units.

2. Use model vehicles (toy trucks, trolleys, and marbles of different mass), meter rulers and deformable material to investigate the reliability and validity of the claims in the information box above. For example:

- Compare and contrast the stopping distance** of two vehicles with different mass but similar velocity (speed in a specified direction).
 - **How are the stopping distances similar? How are they different?**
- Compare and contrast the damage done** by (the impact of) two vehicles with different mass but similar velocity (speed in a specified direction).
 - **How is the impact similar? How is it different?**

3. Select an experiment and/or mathematical investigation from the suggestions below to determine:

- the total extent of the blind spots (areas) around different truck and truck trailer units
- the path of a truck and trailer unit through a left- or right-hand turn
- how the mass or velocity of a model truck/marble changes its stopping distance, its ability to corner or its impact when it collides with a fixed object.

4. Investigate and make models to show how and why a High Productivity Motor Vehicle (HPMV) can exceed a mass of 44,000kg and or the maximum length dimensions allowed for standard vehicles, but meet the higher individual axle and axle group limits and be no wider or higher than a standard vehicle. Use your models to explain how HPMV's on the road network change the ways we should think about keeping safe around trucks. For example use models to show why longer vehicles require more road space for turning. <https://www.nzta.govt.nz/vehicles/vehicle-types/vehicle-classes-and-standards/vehicle-dimensions-and-mass/high-productivity-motor-vehicles/>

5. Explain how and why New Zealand Transport Agency engineers set maximum allowable weights for trucks and HPMV's using the road network. Explore how and why the gross weight of a truck is determined by its axle loadings. Why can different axle types and tyre types carry heavier loads? Identify the different ways truck designers arrange axles to maximise the load a truck can carry. Make a 2 to 3 minute mockumentary using models to demonstrate these. In your video explain why the gross weight of a truck using the road network matters to road engineers and road users.

<https://www.nzta.govt.nz/assets/Commercial-Driving/docs/proforma-vehicles-report.pdf>
<https://www.nzta.govt.nz/vehicles/licensing-rego/road-user-charges/ruc-rates-and-transaction-fees/>

6. Share your new learning about how children can keep safe around trucks using one of the following products.

Advertisement, animation, art work, baking, board game, brochure, cake decoration, cartoon, carving, chart, comic book, computer game, cupcakes, dance, shop window display, drama, drawing, documentary, flyer, graph, game, haiku, “how to” guide, illustrated story, infographic, jingle, kete (traditional Māori baskets), letter, logo, mask, map, mime, montage, musical performance, mural, photo essay, pamphlet, performance, pick a path, postcards, poster, poem, puppet show, radio show, rap, recipe, role play, rubric, scrapbook, sculpture, slideshow, song, speech, t-shirt, television commercial, trading cards, video, whakataukī, web page.

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Reflection on Connecting Ideas Sessions

What do you know you don't know about keeping safe around trucks?

What have you learnt that is new to you about keeping safe around trucks?

What do you wonder about keeping safe around trucks?

Use the student responses to make decisions about follow-up work.