# Topic Exploration Pack

# Global challenges Part 1

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## Instructions and answers for teachers

These instructions cover the student activity section which can be found on [page 10](#_Student_Activity). This Topic Exploration Pack supports OCR GCSE (9–1) Gateway Science Physics A.

**When distributing the activity section to the learners either as a printed copy or as a Word file you will need to remove the teacher instructions section.**

**Mapping to spec level (Learning outcome)**

P8.1a - recall typical speeds encountered in everyday experience for wind and sound, and for walking, running, cycling and other transportation systems

P8.1b - estimate the magnitudes of everyday accelerations

P8.1c - make calculations using ratios and proportional reasoning to convert units and to compute rates

P8.1d - explain methods of measuring human reaction times and recall typical results

P8.1e - explain the factors which affect the distance required for road transport vehicles to come to rest in emergencies and the implications for safety

P8.1f - estimate how the distances required for road vehicles to stop in an emergency, varies over a range of typical speeds

P8.1g - explain the dangers caused by large decelerations

P8.1h - estimate the forces involved in typical situations on a public road

P8.1i - estimate, for everyday road transport, the speed, accelerations and forces involved in large accelerations

### Introduction

In topic P8.1 global challenges learners take their prior knowledge of forces, accelerations and decelerations and apply it to real life daily situations of vehicles on roads. Learners look at the science of large decelerations, reaction times and road conditions and how this impacts on the safety of the vehicle. Learners should be given freedom to research safety features of a vehicle. This exploration pack will focus on safety and base it on vehicles.

Learners should already be familiar with some concepts from Key Stage 3 such as the basics of describing forces, forces and motion and the basic understanding of SI units. Learners should have built on this further in topics P2 - motion, Newton’s law and forces in action.

Learners may have the following misconceptions or difficulties:

* Learners may confuse the terms distance and displacement. Make it clear that the distance an object travels and its displacement are not the same.
* Learners may confuse the terms speed and velocity. An object's speed and velocity are not the same.
* Learners may confuse acceleration with speed.
* Learners may think a four-wheel drive allows drivers to drive normally in adverse weather conditions.
* Learners may think ABS systems help to reduce stopping distance.

There are many good videos to show which can help learners to grasp a better understanding of each point. The tasks will focus on these.

### Task 1 - Speeds

As a starter activity for P8.1a and b have a list of different everyday experiences on the board as a splat. Show learners the speeds for no more than 30 seconds allowing them to absorb as much information as possible. Provide learners with a list of everyday experiences and the typical speeds of each all muddled up, get learners to match them up.

**Correct answers:**

| Speed of sound |  | 340.29 m/s |
| --- | --- | --- |
| Speed of light |  | 299 792 258 m/s |
| Speed of wind during hurricane |  | 70 m/s |
| Average speed of walking |  | 1.4 m/s |
| Fastest ever-human speed recorded |  | 12.4 m/s |
| Speed of plane |  | 250 m/s |
| Speed of fighter jet |  | 761.2 mph |

**Extension:**

Convert all the units from meters per second to kilometres per hour.

340.29 = 1225.044 km/h

761.2 = 2740.32km/h

299 792 258 = 107 925 212 7.94 km/h

70 = 252 km/h

1.4 = 5.04 km/h

12.4 = 44.64 km/h

250 = 900 km/h

### Task 2 – Base units

This task focuses on converting units and builds on from the extension of task 1. It is again a short activity which could be used as a starter/plenary. There are six base units that learners need to know for the science GCSE. Learners should link the quantity to its corresponding base unit and unit symbol.

**Correct answers:**

| **Quantity** | **Unit** | **Symbol** |
| --- | --- | --- |
| Temperature | Metre | kg |
| Current | Kilogram | A |
| Mass | Second | mol |
| Time | Ampere | s |
| Length | Kelvin | K |
| Amount of substance | Mole | m |

### Task 3 – Reaction time practical

The speed of your reactions plays a large part in everyday life. It can have life changing effects as slower reaction times can have a consequence. None is more so important than when looking at vehicles and breaking. This activity is a practical task which involves learners measuring their own reaction times. There are two phases, first phase measuring reaction time using a single ruler then again with two rulers.

This can be taken further and learners can take caffeine to see if that affects their reaction time. This can then be linked to drivers being intoxicated, drugged and tired as well as other factors which will affect their thinking distance. This is a good opportunity for class discussion.

**Useful links:**

A video which shows reaction in a vehicle:

<https://www.youtube.com/watch?v=AY8JiSWOxdo>

Reaction time practical method:

<http://www.nuffieldfoundation.org/practical-biology/measuring-reaction-time-human-nerve-controlled-reaction>

### Task 4 – Stopping distance

To introduce P8.1e andf show learners the following video clip which looks at stopping distances at different speeds. Get learners in pairs to think of two other factors that might affect the stopping distance. Write it on a post it note and stick it on the board. As a class go over each factor and see which ones come up more often. Begin to distinguish between breaking and thinking distance.

<https://www.youtube.com/watch?v=OG2WCDvX-M8>

Alternatively get learners to read the following text and underline using two different colours:

Colour 1 – Underline anything that affects his thinking distance

Colour 2 – Underline anything that affects his breaking distance

‘On a cold icy morning in December, Mick woke up rushing, as he was late for work. He had been at a party all night where he was dancing and drinking. He was still suffering from the after effects of the alcohol. This caused him to wake up very tired and in a rush. As he got into his car he sped off down the road double the normal speed limit oblivious to the icy and wet roads. He turned to turn the radio on and before he knew it he was heading for a head on collision with the vehicle in front. It was too late.’

### Task 5 - Safety

This task focuses on P8.1g and enables learners to explore the safety aspects of a vehicle. It can be used as a homework task but would be recommended as an in-class activity. Learners could be given the task as a role e.g. trainee health and safety inspectors for a car company etc. The task involves learners researching the different safety aspects of a vehicle which protects its occupants and prevent accidents.

Good places to start for information:

<http://www.bbc.co.uk/schools/gcsebitesize/science/add_ocr_gateway/forces/crumplezonesrev3.shtml>

<http://www.rd.com/advice/9-car-safety-features-to-look-out-for/>

<https://www.youtube.com/watch?v=KV2cXxpHa58>

<http://www.iihs.org/iihs/ratings/crash-avoidance-features>

**Task 5a: Preventing Accidents**

Complete this diagram to show how each aspect of the vehicle prevents an accident.

**Traction control:**

Prevents the car from skidding when accelerating, so driver can escape from dangerous situation quickly.

**Electric windows:**

Easier to open/close windows.

Less distraction for the driver.



**Task 5b: Protecting a passenger**

**Paddle shift controls:**

Allows driver to keep both hands on wheel when changing gears or radio.

**Anti-lock braking system (ABS):**

Prevent tyres from skidding, which means vehicle stops more quickly and driver remains in control.

Complete this diagram to show how each aspect of the vehicle prevents an accident.

**Collapsible steering columns:**

So driver is not injured when he/she hits the steering wheel.

**Safety cage:**

A cage, which strengthens the cabin section of the car to prevent the vehicle from collapsing when vehicle turns upside down.

**Seatbelt:**

Holds passengers in place.



**Airbags:**

Provides a cushioning effect to absorb the energy, instead of hitting the dashboard.

**Crumple zone:**

Car bonnet crumples absorbing energy allowing passengers to slow down more gently.

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# Topic Exploration Pack

## Learner Activity

### Task 1 - Speeds

Match the following everyday experiences with its correct speed.

| Speed of sound |  | 250 m/s  |
| --- | --- | --- |
| Speed of light |  | 70 m/s |
| Speed of wind during hurricane |  | 761.2 mph |
| Average speed of walking |  | 12.4 m/s |
| Fastest ever-human speed recorded |  | 1.4 m/s  |
| Speed of plane |  | 299 792 258 m/s |
| Speed of fighter jet |  | 340.29 m/s |

**Extension**

Convert all the units from meters per second to kilometres per hour.

**Hint:** multiply number by 18 then divide by 5.

### Task 2 – Base units

Task 2 involves six base units that you need to know for the science GCSE.

Link the quantity to its base unit and the unit symbol.

| **Quantity** |  | **Unit** |  | **Symbol** |
| --- | --- | --- | --- | --- |
| Temperature |  | Metre |  | kg |
| Current |  | Kilogram |  | A |
| Mass |  | Second |  | mol |
| Time |  | Ampere |  | s |
| Length |  | Kelvin |  | K |
| Amount of substance |  | Mole |  | m |

### Task 3 – Reaction time practical

Task 3 is a practical task which involves you measuring your own reaction times. There are two phases, first phase measuring reaction time using a single ruler then the second phase with two rulers.

**Phase 1- 1 ruler**

* Have your partner with their hand over the edge of the table.
* Hold the ruler so the 0 cm end is just at your partner’s index finger.
* Tell your partner to grab the ruler as fast as possible once it has been released. No sounds or gestures should be made as you are releasing the ruler. Record the centimeter mark your partner grabs it.
* Repeat the experiment two more times. Then switch places with your partner and redo it.

| **Name** | **Length of ruler before grabbing it (cm)** | **Average length(cm)** |
| --- | --- | --- |
| **Attempt 1** | **Attempt 2** | **Attempt 3** |
|  |  |  |  |  |
|  |  |  |  |  |

Who has the best reaction time?

What factors do you think might affect your reaction time?

**Phase 2- 2 rulers**

* Have your partner with both their hands over the edge of the table.
* This time hold two rulers so the 0 cm end is just at your partner’s index finger for both hands.
* Tell your partner you will only be releasing one of the two rulers and they must pick the correct one. They must grab the ruler as fast as possible once it has been released. No sounds or gestures should be made as you are releasing the ruler.
* Tell them not to squeeze both hands only one.
* Record the centimeter mark your partner grabs it.
* When you are ready randomly decide one ruler to drop. It does not matter which one.
* Repeat the experiment two more times. Then switch places with your partner and redo it.

If your partner picks the wrong hand for any attempt it will be classed as 100 cm.

| **Name** | **Length of ruler before grabbing it (cm)** | **Average length(cm)** |
| --- | --- | --- |
| **Attempt 1** | **Attempt 2** | **Attempt 3** |
|  |  |  |  |  |
|  |  |  |  |  |

### Task 4 - Stopping distance

Watch the following video clip which looks at stopping distances at different speeds. In pairs, think of two other factors that might affect the stopping distance. Write it on a post it note and stick it on the board. As a class go over each factor and see which ones come up more often. Begin to distinguish between breaking and thinking distance.

<https://www.youtube.com/watch?v=OG2WCDvX-M8>

Read the following text and underline using two different colours.

Colour 1 – Underline anything that affects his thinking distance

Colour 2 – Underline anything that affects his breaking distance

‘On a cold icy morning in December, Mick woke up rushing, as he was late for work. He had been at a party all night where he was dancing and drinking. He was still suffering from the after effects of the alcohol. This caused him to wake up very tired and in a rush. As he got into his car he sped off down the road double the normal speed limit oblivious to the icy and wet roads. He turned to turn the radio on and before he knew it he was heading for a head on collision with the vehicle in front. It was too late.’

### Task 5 – Safety

Task 5 allows you to explore the safety aspects of a vehicle. The task involves researching different safety aspects of a vehicle which protects its occupants and prevent accidents. Use the internet and books to help you complete the relevant spaces below.

**Task 5a: Preventing Accidents**

Complete this diagram to show how each aspect of the vehicle prevents an accident.

**Electric windows:**

**Traction control:**

**Paddle shift controls:**

**Anti-lock braking system (ABS):**

**Task 5b: Protecting a passenger**

Complete this diagram to show how each aspect of the vehicle prevents an accident.

**Crumple zone:**

**Airbags:**

**Seatbelt:**

**Safety cage:**

**Collapsible steering columns:**