



LESSON PLAN

Lesson 6: Forces and passive safety

UNIT TITLE: Safer by Design - Investigating Forces, Motion and Road Safety



LEVEL

Years 9-10



LESSON NUMBER

6 of 9



LESSON LENGTH

60 minutes



VICTORIAN CURRICULUM 2.0 CONTENT DESCRIPTIONS

- **Science as a Human Endeavour:** advances in technologies have enabled advances in science, while science has contributed to developments in technologies and engineering. (VC2S10H02).
- **Physical sciences:** Newton's laws of motion can be used to quantitatively analyse the relationship between force, mass and acceleration of objects. (VC2S10U17).



VICTORIAN CURRICULUM 2.0 ACHIEVEMENT STANDARDS

- **Science:** Students examine the relationship between science, engineering and technologies. (Level 9 & 10).
- **Physical sciences:** Students use Newton's laws to describe and predict the motion of objects in a system. (Level 9 & 10).

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KEY VOCABULARY

- **active safety** – vehicle features that help prevent a crash from occurring (e.g. automatic emergency braking, lane-keeping assist)
- **passive safety** – vehicle features that protect people if a crash occurs (e.g. seatbelts, airbags, crumple zones)
- **force** – a push or pull that can change the motion of an object (measured in newtons, N)
- **inertia** – the tendency of objects with mass to resist changes in their state of motion
- **acceleration** – the rate of change of velocity; how quickly an object speeds up, slows down, or changes direction (measured in m s^{-2})
- **time** – the measured duration between two events (measured in seconds, s)
- **work** – the transfer of energy that occurs when a force moves an object over a distance (measured in joules, J)
- **energy** – the capacity to do work; energy can be stored, transferred, and transformed but not created or destroyed (measured in joules, J)
- **structure** – the physical arrangement and design of parts in an object; in vehicles, some structures are engineered to absorb energy in a crash
- **seatbelt** – a safety strap that holds occupants in their seat during a crash, spreading the stopping force across the body to reduce injury
- **airbag** – an inflatable cushion that deploys rapidly in a crash to cushion the head and chest and reduce the force of impact on occupants



MATERIALS REQUIRED FOR THE LESSON

Student

- Active and Passive Safety Worksheet (Key Resource 4)
- Physics of passive safety systems (Resource 6.1)

Teacher

- Supporting Slide Deck – as needed, display on screen or use a document camera or write on whiteboard
- Teacher Workbook – as needed for reference, including for display on screen or with a document camera
- ANCAP Video on Vehicle Structure – [on Vimeo](#) or [embedded in the ANCAP website](#)
- ANCAP Video on Seatbelts – [on Vimeo](#) or [embedded in the ANCAP website](#)
- ANCAP Video on Airbags – [on Vimeo](#) or [embedded in the ANCAP website](#)



LEARNING OBJECTIVE

- We will understand how passive safety features improve vehicle safety.

SUCCESS CRITERIA

- I can explain safety features using work and energy.
- I can explain safety features using inertia, forces and acceleration.
- I can elaborate on how specific safety features improve safety.



TEACHING CONSIDERATIONS

- Further resources: The following may be useful to supplement the material in this lesson:
 - [ANCAP website on vehicle safety](#)
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Structure of lesson:

1

INTRODUCTION



TIMING: 10 mins

Activate prior knowledge

- **Ask** students to access their copy of the Active and Passive Safety Worksheet (Key Resource 4).
- **Explain** that we want to understand both the benefits of safety features and the scientific explanation for how they work. **Show** students the worksheet extract on slide 36 in the Supporting Slide Deck. **Model** the explanation of how anti-lock braking systems improve safety using a think aloud.
- **Instruct** students to use their notes from the previous lesson to add an explanation in the space provided for one of the active safety features from the previous lesson.
- **Check for understanding** by sampling student responses using a suitable mode of response. Use questioning to support students to elaborate on their thinking and make connections.

Introduce learning objective

- **Show** the learning objective.
 - **Explain** how students can achieve this through the success criteria.
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PHYSICS OF PASSIVE SAFETY SYSTEMS



TIMING: 30 mins

Explanation and modelling

- **Distribute** the Physics of passive safety systems worksheet (Resource 6.1) to students (or if using the Workbook, direct students to page 48). **Explain** to students that we will work through this worksheet to explore the key physics ideas behind common passive safety features. Emphasise that the focus here is not on making calculations, but of understanding how changes in one quantity effect another.
- **Ask** students to look at Part 1 of the worksheet. **Elaborate** on the key ideas of work and energy from the worksheet using a think aloud.

Guided and independent practice

- **Prompt** students to fill in the sentence frames and make additional notes in the space provided.
- **Show** the ANCAP video on the role of vehicle structure in safety via the [Vimeo link](#) or directly from the [ANCAP website](#). **Prompt** students to add additional relevant information from the video to their notes.
- **Check for understanding** by sampling all student responses using mini whiteboards or another suitable mode of response. **Respond** by prompting students to make connections and extend their thinking. Address any errors and misconceptions.

Explanation and modelling

- **Ask** students to look at Part 2 of the worksheet. **Elaborate** on the key idea of inertia from the worksheet using a think aloud.

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Guided and independent practice

- **Prompt** students to fill in the sentence frames and make additional notes in the space provided.
- **Show** the ANCAP video on seatbelts via the [Vimeo link](#) or directly from the [ANCAP website](#). **Prompt** students to add additional relevant information from the video to their notes.
- **Check for understanding** by sampling all student responses using mini whiteboards or another suitable mode of response. **Respond** by prompting students to make connections and extend their thinking. Address any errors and misconceptions.

Explanation and modelling

- **Ask** students to look at Part 3 of the worksheet. **Elaborate** on the key ideas of net force and acceleration from the worksheet using a think aloud.

Guided and independent practice

- **Prompt** students to fill in the sentence frames and make additional notes in the space provided.
 - **Show** the ANCAP video on airbags via the [Vimeo link](#) or directly from the [ANCAP website](#). **Prompt** students to add additional relevant information from the video to their notes.
 - **Check for understanding** by sampling all student responses using mini whiteboards or another suitable mode of response. **Respond** by prompting students to make connections and extend their thinking. Address any errors and misconceptions.
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SAFETY SYSTEMS



TIMING: 15 mins

Explanation and modelling

- **Ask** students to access their copy of the Active and Passive Safety Worksheet (Key Resource 4). Explain that we will now focus on the passive safety features on the right-hand side.
- **Model** the explanation of how seatbelts improve safety using a think aloud. Emphasise the connection to inertia.

Guided and independent practice

- **Instruct** students to use their notes from this lesson to add an explanation in the space provided for airbags and crumple zones.
 - **Check for understanding** by sampling all student responses using mini whiteboards or another suitable mode of response. **Respond** by prompting students to make connections and extend their thinking. Address any errors and misconceptions.
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CONCLUSION



TIMING: 5 mins

Reflection on learning

- **Show** the learning objectives and success criteria.
 - **Instruct** students to complete the following sentences. Use slide 37 in the Supporting Slide Deck.
 - Increasing the time it takes for a collision to occur will ____(*decrease*)____ the force involved.
 - How do restraints such as seatbelts and airbags relate to inertia?
 - What effect do crumple zones have on the energy involved in a collision? What is the role of work in this?
 - **Check for understanding** by sampling student responses using mini whiteboards or choral response. **Respond** to address any errors, misunderstandings or misconceptions.
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