Government of Western Australia
School Curriculum and Standards Authority

SCIENCE IN PRACTICE

Unit GE003 – Wheels in motion

Unit overview

Year 11

Acknowledgement of Country

Kaya. The School Curriculum and Standards Authority (the Authority) acknowledges that our offices are on Whadjuk Noongar boodjar and that we deliver our services on the country of many traditional custodians and language groups throughout Western Australia. The Authority acknowledges the traditional custodians throughout Western Australia and their continuing connection to land, waters and community. We offer our respect to Elders past and present.

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Contents

Unit GE003 – Wheels in Motion

Unit description

Wheels have played a significant role in shaping our lives and transforming human civilisation. They have been instrumental in advancing transportation, industry and various aspects of our daily routines. They have facilitated the movement of people and goods, enabling trade, exploration and cultural exchange across vast distances. It is essential that we have an understanding the science of vehicles and driver behaviour to ensure our safety on the road.

In this unit, students learn how knowledge of how the nervous systems reacts to stimuli and physics can help drivers make informed decisions that can mitigate the risks of driving. Students use a range of practical and research inquiry skills to investigate and conduct experiments on factors affecting reactions and motion. They are encouraged to use information and communication technology to gather and interpret data, and to communicate their findings in a variety of ways.

This unit integrates content from the Physics and Biology science disciplines.

Unit GE003 – Wheels in Motion is a semester long unit equivalent to one course unit. The notional time for the unit is 55 class contact hours.

Unit content

Scientific method

- research a given topic and construct questions for investigation
- determine the appropriate methodology for investigations
- design scientific investigations, including the formulation of investigable questions and/or hypotheses, materials required, selection and/or modification of a procedure to be followed to collect valid and reliable data, and identification of safety and ethical considerations
- use equipment and techniques safely, competently and methodically to collect valid and reliable data, and use equipment with precision, accuracy and consistency
- represent qualitative and quantitative data in meaningful and useful ways, including the construction of appropriately labelled tables, processing of quantitative data using appropriate mathematical relationships and units, and drawing of appropriate graphs
- analyse data to identify and describe trends, patterns and relationships, and recognise errors and limitations in data
- draw conclusions consistent with the evidence and relevant to the question being investigated, identify further evidence that may be required, and recognise limitations of conclusions
- evaluate the investigative procedure, including the relevance, accuracy, validity and reliability of data, and suggest improvements
- communicate information and ideas in a variety of ways using scientific conventions and terminology, including the selection and presentation of data and ideas to convey meaning to selected audiences in written, oral and multimedia formats

Workplace health and safety

- use and apply workplace health and safety documents, including safety data sheets (SDS), and other relevant documents, such as standard operating procedures (SOP), when performing activities
- use appropriate scientific and technological equipment safely to gather data and information
- conduct risk assessments to identify potential hazards and prevent potential incidents and injuries

Scientific literacy

- distinguish between opinion, anecdote and evidence, and scientific and non-scientific ideas
- use reasoning to construct scientific arguments, and to draw and justify conclusions consistent with the evidence and relevant to the question under investigation
- identify examples of where the application of scientific knowledge may have beneficial and/or harmful and/or unintended consequences
- use scientific knowledge to develop and evaluate projected economic, social and environmental impacts and to design action for sustainability

Science understanding

Reaction time and driving

- describe how the nervous system enables us to respond to external changes by transmitting messages along nerves from receptors to the brain where the brain then coordinates a response
- distinguish between voluntary and involuntary responses
- explain how factors such as practice, anticipation, age, fatigue, distractions, eyesight, hearing and drugs can affect reaction time
- state that stopping distance is proportionate to reaction distance and braking distance, and can be calculated using stopping distance = reaction distance + braking distance
- identify factors that affect reaction distance, including the speed of a vehicle and the driver's reaction time, and use the relationship: reaction distance = speed x reaction time to calculate reaction distance
- outline how the braking distance of vehicles is influenced by
  - road and weather conditions
  - condition of brakes and tyres
  - vehicle speed and mass

Motion

- solve simple problems using the equations: $speed = \frac{distance}{t}, v = \frac{s}{t}, a = \frac{v-u}{t}$
- draw and interpret distance-time graphs

- outline how the resistance of an object to a change in its state of motion (inertia) is dependent upon the mass of the object (Newton's First Law of Motion)
- explain, using examples, that a body will remain at rest or in straight line uniform motion unless acted upon by an external, unbalanced force (Newton's First Law of Motion)
- explain, using examples, that the acceleration produced by an unbalanced, external force is directly proportional to the size of the force and inversely proportional to the mass of the object, and can calculated using the formula $F = ma$. (Newton's Second Law of Motion)
- explain, using examples, that for every action (force) there is an equal and opposite reaction (force) (Newton's Third Law of Motion)

Course Outline

The scientific method, workplace health and safety and scientific literacy content will be taught in each unit. The content from these areas aligns with the science understanding content of the unit and are integrated throughout the learning experiences.

Weeks	Teaching point
1–2	**The nervous system** • describe how the nervous system enables us to respond to external changes by transmitting messages along nerves from receptors to the brain where the brain then coordinates a response **Voluntary and involuntary responses** • distinguish between voluntary and involuntary responses • use equipment and techniques safely, competently and methodically to collect valid and reliable data, and use equipment with precision, accuracy and consistency • represent qualitative and quantitative data in meaningful and useful ways, including the construction of appropriately labelled tables, processing of quantitative data using appropriate mathematical relationships and units, and drawing of appropriate graphs • analyse data to identify and describe trends, patterns and relationships, and recognise errors and limitations in data • draw conclusions consistent with the evidence and relevant to the question being investigated, identify further evidence that may be required, and recognise limitations of conclusions • use and apply workplace health and safety documents, including safety data sheets (SDS), and other relevant documents, such as standard operating procedures (SOP), when performing activities • use appropriate scientific and technological equipment safely to gather data and information • conduct risk assessments to identify potential hazards and prevent potential incidents and injuries
3–4	**Reaction time** • describe how the nervous system enables us to respond to external changes by transmitting messages along nerves from receptors to the brain where the brain then coordinates a response • distinguish between voluntary and involuntary responses • explain how factors such as practice, anticipation, age, fatigue, distractions, eyesight, hearing and drugs can affect reaction time • research a given topic and construct questions for investigation • determine the appropriate methodology for investigations • design scientific investigations, including the formulation of investigable questions and/or hypotheses, materials required, selection and/or modification of a procedure to be followed to collect valid and reliable data, and identification of safety and ethical considerations • represent qualitative and quantitative data in meaningful and useful ways, including the construction of appropriately labelled tables; processing of quantitative data using appropriate mathematical relationships and units; drawing of appropriate graphs • analyse data to identify and describe trends, patterns and relationships, and recognise errors and limitations in data

Weeks	Teaching point
	• draw conclusions consistent with the evidence and relevant to the question being investigated, identify further evidence that may be required, and recognise limitations of conclusions • use and apply workplace health and safety documents, including safety data sheets (SDS), and other relevant documents, such as standard operating procedures (SOP), when performing activities • use appropriate scientific and technological equipment safely to gather data and information • conduct risk assessments to identify potential hazards and prevent potential incidents and injuries • distinguish between opinion, anecdote and evidence, and scientific and non-scientific ideas • use reasoning to construct scientific arguments, and to draw and justify conclusions consistent with the evidence and relevant to the question under investigation • identify examples of where the application of scientific knowledge may have beneficial and/or harmful and/or unintended consequences • use scientific knowledge to develop and evaluate projected economic, social and environmental impacts and to design action for sustainability **Commence Assessment task 1 – Investigation (40%)**
5–6	**Reaction time investigation** **Continue Assessment task 1 – Investigation** • use equipment and techniques safely, competently and methodically to collect valid and reliable data, and use equipment with precision, accuracy and consistency • represent qualitative and quantitative data in meaningful and useful ways, including the construction of appropriately labelled tables; processing of quantitative data using appropriate mathematical relationships and units; drawing of appropriate graphs **Stopping distance** • state that stopping distance is proportionate to reaction distance and braking distance, and can be calculated using stopping distance = reaction distance + braking distance • identify factors that affect reaction distance, including the speed of a vehicle and the driver's reaction time, and use the relationship: reaction distance = speed x reaction time to calculate reaction distance • outline how the braking distance of vehicles is influenced by ▪ road and weather conditions ▪ condition of brakes and tyres ▪ vehicle speed and mass • analyse data to identify and describe trends, patterns and relationships, and recognise errors and limitations in data • draw conclusions consistent with the evidence and relevant to the question being investigated, identify further evidence that may be required, and recognise limitations of conclusions • communicate information and ideas in a variety of ways using scientific conventions and terminology, including the selection and presentation of data and ideas to convey meaning to selected audiences in written, oral and multimedia formats • use appropriate scientific and technological equipment safely to gather data and information

Weeks	Teaching point
	• conduct risk assessments to identify potential hazards and prevent potential incidents and injuries • distinguish between opinion, anecdote and evidence, and scientific and non-scientific ideas • use reasoning to construct scientific arguments, and to draw and justify conclusions consistent with the evidence and relevant to the question under investigation • identify examples of where the application of scientific knowledge may have beneficial and/or harmful and/or unintended consequences • use scientific knowledge to develop and evaluate projected economic, social and environmental impacts and to design action for sustainability **Assessment task 2 – Supervised written assessment (20%)**
7–8	**Motion** • solve simple problems using the equations: $speed = \frac{distance}{t}, v = \frac{s}{t}, a = \frac{v-u}{t}$ • use equipment and techniques safely, competently and methodically to collect valid and reliable data, and use equipment with precision, accuracy and consistency • represent qualitative and quantitative data in meaningful and useful ways, including the construction of appropriately labelled tables; processing of quantitative data using appropriate mathematical relationships and units; drawing of appropriate graphs • analyse data to identify and describe trends, patterns and relationships, and recognise errors and limitations in data • draw conclusions consistent with the evidence and relevant to the question being investigated, identify further evidence that may be required, and recognise limitations of conclusions • communicate information and ideas in a variety of ways using scientific conventions and terminology, including the selection and presentation of data and ideas to convey meaning to selected audiences in written, oral and multimedia formats • use appropriate scientific and technological equipment safely to gather data and information • conduct risk assessments to identify potential hazards and prevent potential incidents and injuries **Continue Assessment task 1 – Investigation**
9–10	**Reaction time investigation** **Continue Assessment task 1 – Investigation** • describe how the nervous system enables us to respond to external changes by transmitting messages along nerves from receptors to the brain where the brain then coordinates a response • distinguish between voluntary and involuntary responses • explain how factors such as practice, anticipation, age, fatigue, distractions, eyesight, hearing and drugs can affect reaction time • research a given topic and construct questions for investigation • determine the appropriate methodology for investigations • design scientific investigations, including the formulation of investigable questions and/or hypotheses, materials required, selection and/or modification of a procedure to be followed to collect valid and reliable data, and identification of safety and ethical considerations

Weeks	Teaching point
	• use equipment and techniques safely, competently and methodically to collect valid and reliable data, and use equipment with precision, accuracy and consistency • represent qualitative and quantitative data in meaningful and useful ways, including the construction of appropriately labelled tables, processing of quantitative data using appropriate mathematical relationships and units, and drawing of appropriate graphs • analyse data to identify and describe trends, patterns and relationships, recognise errors and limitations in data • draw conclusions consistent with the evidence and relevant to the question being investigated, identify further evidence that may be required, and recognise limitations of conclusions • evaluate the investigative procedure, including the relevance, accuracy, validity and reliability of data, and suggest improvements • communicate information and ideas in a variety of ways using scientific conventions and terminology, including the selection and presentation of data and ideas to convey meaning to selected audiences in written, oral and multimedia formats • use and apply workplace health and safety documents, including safety data sheets (SDS), and other relevant documents, such as standard operating procedures (SOP), when performing activities • use appropriate scientific and technological equipment safely to gather data and information • conduct risk assessments to identify potential hazards and prevent potential incidents and injuries • distinguish between opinion, anecdote and evidence, and scientific and non-scientific ideas • use reasoning to construct scientific arguments, and to draw and justify conclusions consistent with the evidence and relevant to the question under investigation • identify examples of where the application of scientific knowledge may have beneficial and/or harmful and/or unintended consequences • use scientific knowledge to develop and evaluate projected economic, social and environmental impacts and to design action for sustainability **Complete Assessment task 1 – Investigation (40%)**
11	**Motion graphs** • solve simple problems using the equations: $speed = \frac{distance}{t}, v = \frac{s}{t}, a = \frac{v-u}{t}$ • draw and interpret distance-time graphs • use equipment and techniques safely, competently and methodically to collect valid and reliable data, and use equipment with precision, accuracy and consistency • represent qualitative and quantitative data in meaningful and useful ways, including the construction of appropriately labelled tables, processing of quantitative data using appropriate mathematical relationships and units, and drawing of appropriate graphs • analyse data to identify and describe trends, patterns and relationships, and recognise errors and limitations in data • draw conclusions consistent with the evidence and relevant to the question being investigated, identify further evidence that may be required, and recognise limitations of conclusions

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	• communicate information and ideas in a variety of ways using scientific conventions and terminology, including the selection and presentation of data and ideas to convey meaning to selected audiences in written, oral and multimedia formats • use and apply workplace health and safety documents, including safety data sheets (SDS), and other relevant documents, such as standard operating procedures (SOP), when performing activities • use appropriate scientific and technological equipment safely to gather data and information • conduct risk assessments to identify potential hazards and prevent potential incidents and injuries **Assessment task 3– Practical assessment (10%)**
12–13	**Newton's Laws of Motion** • outline how the resistance of an object to a change in its state of motion (inertia) and is dependent upon the mass of the object (Newton's First Law of Motion) • explain, using examples, that a body will remain at rest or in straight line uniform motion unless acted upon by an external, unbalanced force (Newton's First Law of Motion) • explain, using examples, that the acceleration produced by an unbalanced, external force is directly proportional to the size of the force and inversely proportional to the mass of the object, and can calculated using the formula $F = ma$. (Newton's Second Law of Motion) • explain, using examples, that for every action (force) there is an equal and opposite reaction (force) (Newton's Third Law of Motion) • use equipment and techniques safely, competently and methodically to collect valid and reliable data, and use equipment with precision, accuracy and consistency • represent qualitative and quantitative data in meaningful and useful ways, including the construction of appropriately labelled tables, processing of quantitative data using appropriate mathematical relationships and units, and drawing of appropriate graphs • analyse data to identify and describe trends, patterns and relationships, and recognise errors and limitations in data • draw conclusions consistent with the evidence and relevant to the question being investigated, identify further evidence that may be required, and recognise limitations of conclusions • use and apply workplace health and safety documents, including safety data sheets (SDS), and other relevant documents, such as standard operating procedures (SOP), when performing activities • use appropriate scientific and technological equipment safely to gather data and information • conduct risk assessments to identify potential hazards and prevent potential
14–15	**Defying the laws of physics** • outline how the resistance of an object to a change in its state of motion (inertia) is dependent upon the mass of the object (Newton's First Law of Motion) • explain, using examples, that a body will remain at rest or in straight line uniform motion unless acted upon by an external, unbalanced force (Newton's First Law of Motion) • explain, using examples, that the acceleration produced by an unbalanced, external force is directly proportional to the size of the force and inversely proportional to the

Weeks	Teaching point
	mass of the object, and can calculated using the formula *F = ma*. (Newton's Second Law of Motion) • explain, using examples, that for every action (force) there is an equal and opposite reaction (force) (Newton's Third Law of Motion) • communicate information and ideas in a variety of ways using scientific conventions and terminology, including the selection and presentation of data and ideas to convey meaning to selected audiences in written, oral and multimedia formats • distinguish between opinion, anecdote and evidence, and scientific and non-scientific ideas • use reasoning to construct scientific arguments, and to draw and justify conclusions consistent with the evidence and relevant to the question under investigation • identify examples of where the application of scientific knowledge may have beneficial and/or harmful and/or unintended consequences • use scientific knowledge to develop and evaluate projected economic, social and environmental impacts and to design action for sustainability **Assessment task 4 – Project (30%)**

Assessment Outline

Assessment type	Assessment type weighting	Assessment task weighting	When	Assessment task
Investigation	40%	40%	Weeks 4–10	**Assessment task 1 – Reaction time** Students work in groups to plan and conduct the investigation and summarise their findings in a live or virtual poster presentation. Each student will prepare a written report to communicate their findings. Planning, working safety and group contributions will be monitored via student logbooks, responses to reflection questions, peer and self-assessments and teacher observations. Time: 13 hours
Project	30%	30%	Weeks 14–15	**Assessment task 4 – Movie stunts** Students will work individually to analyse and synthesise information from at least two different sources to illustrate a claim by explaining the relevant scientific concepts and describing the impact and/or influence on the society. Students will use their research to produce either an infographic or science magazine article. Time: 8 hours
Practical assessment	10%	10%	Week 11	**Assessment task 3 – Car races** Students will work in groups to demonstrate their ability to perform accurate tests to safely collect meaningful data and individually to process and analyse the collected data. Time: 50 minutes
Supervised written assessment	20%	20%	Week 6	**Assessment task 2 – Reaction time and driving** Students will work individually to answer short and extended answer questions on the identified syllabus content. Time: 50 minutes
Total	**100%**	**100%**		