Government of Western Australia
School Curriculum and Standards Authority

PHYSICS

GENERAL COURSE

Year 11 syllabus

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.

Important information

This syllabus is effective from 1 January 2024.

Users of this syllabus are responsible for checking its currency.

Syllabuses are formally reviewed by the School Curriculum and Standards Authority (the Authority) on a cyclical basis, typically every five years.

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Content

Rationale

Physics is a fundamental science that endeavours to unlock the mysteries of the universe and provides the foundation of understanding upon which modern technology is based. It uses a comparatively small number of assumptions, models, laws and theories to explain a wide range of phenomena, from the incredibly small to the incredibly large. Students investigate how the unifying concept of energy explains diverse phenomena and provides a powerful tool for analysing how systems interact. Students learn how an understanding of physics is central to identifying and finding solutions to some of the key issues facing an increasingly globalised society.

The Physics General course involves practical investigations, tasks incorporating logical and analytical thinking and the communication of scientific information and ideas. Studying the Physics General course will enable students to become citizens who are better informed about the world around them, and who have the critical skills to evaluate and make decisions based on scientific evidence about current issues.

Aims

The Physics General course aims to develop students':

- comprehension of the fundamental concepts and principles of physics
- skills of logical thinking and ability to use these skills to solve problems
- appreciation of the significant contribution physics has made to society
- understanding of the ways in which matter and energy interact in physical systems
- understanding of how physics knowledge is used in a wide range of local and global contexts
- investigative skills, including the design and conduct of investigations, the collection and analysis of data, and the interpretation of evidence
- use of the language and conventions of physics to develop skills in communication.

Organisation

This course is organised into a Year 11 syllabus and a Year 12 syllabus. The cognitive complexity of the syllabus content increases from Year 11 to Year 12.

Structure of the syllabus

The Year 11 syllabus is divided into two units, each of one semester duration, which are typically delivered as a pair. The notional time for each unit is 55 class contact hours.

Unit 1 – World of waves

The focus of this unit is waves, sound and light and how they affect us every day of our lives in practical situations.

How waves behave will be observed in contexts, such as music, sound technology, holograms and telecommunications.

Students use science inquiry skills to explore sound and light. Practical activities offer students valuable opportunities to plan investigations, make careful observations, operate equipment in a safe and organised manner, and work collaboratively.

Unit 2 – Hot stuff

This unit focuses on heat as a form of energy and its interaction with matter, and nuclear energy and associated processes. Students explore the nature of heat, temperature, change of state, and how heat is transferred and utilised. Students gain an awareness of fundamental nuclear concepts, including nuclear decay, fission and fusion.

Applications of heating and cooling are investigated, including the efficient use of home heating and insulation, climate control, and temperature regulation in humans. Applications of nuclear technology include medical and industrial uses and power generation.

Students conduct investigations and develop their skills in collecting data safely and accurately. Practical activities offer students valuable opportunities to plan investigations, make careful observations, operate equipment in a safe and organised manner, and work collaboratively.

Each unit includes:

- a unit description – a short description of the focus of the unit
- unit content – the content to be taught and learned.

Organisation of content

Science strand descriptions

The Physics General course has three interrelated strands: Science Inquiry Skills, Science as a Human Endeavour and Science Understanding. The three strands of the Physics General course should be taught in an integrated way. The content descriptions for Science as a Human Endeavour, Science Inquiry Skills and Science Understanding have been written so that this integration is possible in each unit.

Science Inquiry Skills

Science inquiry involves identifying and posing questions; planning, conducting and reflecting on investigations; processing, analysing and interpreting data; and communicating findings. This strand focusses on evaluating claims, investigating ideas, solving problems, reasoning, drawing valid conclusions, and developing evidence-based arguments.

Science investigations are activities in which ideas, predictions or hypotheses are tested, and conclusions are drawn in response to a question or problem. Investigations can involve a range of activities, including experimental testing, field work, locating and using information sources, conducting surveys, and using modelling and simulations. The investigation design will depend on the context and subject of the investigation.

Science as a Human Endeavour

Science concepts, models and theories are reviewed as their predictions and explanations are continually re-assessed through new evidence, often through the application of new technologies. This review process involves a diverse range of scientists working within an increasingly global community of practice.

The application of science may provide great benefits to individuals, the community and the environment, but may also pose risks and have unintended consequences. As an ever-evolving body of knowledge, science frequently informs public debate, but is not always able to provide definitive answers.

Science Understanding

Science understanding is evident when a person selects and integrates appropriate science concepts, models and theories to explain and predict phenomena, and applies those concepts, models and theories to new situations.

The Science Understanding content in each unit develops students' understanding of the key concepts, models and theories that underpin the subject, and of the strengths and limitations of different models and theories for explaining and predicting complex phenomena.

Safety

Science learning experiences may involve the use of potentially hazardous substances and/or hazardous equipment. It is the responsibility of the school to ensure that duty of care is exercised in relation to the health and safety of all students and that school practices meet the requirements of the *Work Health and Safety Act 2011*, in addition to relevant state or territory health and safety guidelines.

Animal ethics

Through a consideration of research ethics as part of Science Inquiry Skills, students will examine their own ethical position, draw on ethical perspectives when designing investigation methods, and ensure that any activities that impact on living organisms comply with the *Australian code of practice for the care and use of animals for scientific purposes* (www.nhmrc.gov.au).

Any teaching activities that involve the care and use of, or interaction with, animals must comply with the *Australian code of practice for the care and use of animals for scientific purposes*, in addition to relevant State guidelines.

Mathematical skills expected of students studying the Physics General course

The Physics General course requires students to use the mathematical skills they have developed through the Year 7–10 Mathematics curriculum, in addition to the numeracy skills they have developed through the Science Inquiry Skills strand of the Science curriculum.

Within the Science Inquiry Skills strand, students are required to gather, represent and analyse numerical data to identify the evidence that forms the basis of their scientific arguments, claims or conclusions. In gathering and recording numerical data, students are required to make measurements using appropriate units to an appropriate degree of accuracy.

It is assumed that students will be able to:

- perform calculations involving addition, subtraction, multiplication and division of quantities
- perform approximate evaluations of numerical expressions
- express fractions as percentages, and percentages as fractions
- calculate percentages
- recognise and use ratios
- transform decimal notation to power of ten notation
- substitute physical quantities into an equation using consistent units so as to calculate one quantity and check the dimensional consistency of such calculations
- solve simple algebraic equations
- comprehend and use the symbols/notations $<$, $>$, Δ, $\approx$
- translate information between graphical and numerical forms
- distinguish between discrete and continuous data and select appropriate forms, variables and scales for constructing graphs.

Progression from the Year 7–10 curriculum

The Physics General course continues to develop student understanding and skills across the three strands of the Year 7–10 Science curriculum. In the Science Understanding strand, the Physics General course may draw on knowledge and understanding from across the four sub-strands of Biological, Physical, Chemical, and Earth and Space Sciences.

In particular, the Physics General course continues to develop the key concepts introduced in the Physical Sciences sub-strand, that is, that forces affect the behaviour of objects, and that energy can be transferred and transformed from one form to another.

Representation of the general capabilities

The general capabilities encompass the knowledge, skills, behaviours and dispositions that will assist students to live and work successfully in the twenty-first century. Teachers may find opportunities to incorporate the capabilities into the teaching and learning program for the Physics General course. The general capabilities are not assessed unless they are identified within the specified unit content.

Literacy

Literacy is important in students' development of Science Inquiry Skills and their understanding of content presented through the Science Understanding and Science as a Human Endeavour strands. Students gather, interpret, synthesise and critically analyse information presented in a wide range of genres, modes and representations, (including text, flow diagrams, symbols, graphs and tables). They evaluate information sources and compare and contrast ideas, information and opinions presented within and between texts. They communicate processes and ideas logically and fluently and structure evidence-based arguments, selecting genres and employing appropriate structures and features to communicate for specific purposes and audiences.

Numeracy

Numeracy is key to students' ability to apply a wide range of Science Inquiry Skills, including making and recording observations; ordering, representing and analysing data; and interpreting trends and relationships. They employ numeracy skills to interpret complex spatial and graphic representations, and to appreciate the ways in which physical systems are structured, interact and change across spatial scales. They engage in analysis of data, including issues relating to reliability and probability, and they interpret and manipulate mathematical relationships to calculate and predict values.

Information and communication technology capability

Information and communication technology (ICT) capability is a key part of Science Inquiry Skills. Students use a range of strategies to locate, access and evaluate information from multiple digital sources; to collect, analyse and represent data; to model and interpret concepts and relationships; and to communicate and share science ideas, processes and information. Through exploration of Science as a Human Endeavour concepts, students assess the impact of ICT on the development of science and the application of science in society, particularly with regard to collating, storing, managing and analysing large data sets.

Critical and creative thinking

Critical and creative thinking is particularly important in the science inquiry process. Science inquiry requires the ability to construct, review and revise questions and hypotheses about increasingly complex and abstract scenarios and to design related investigation methods. Students interpret and evaluate data; interrogate, select and cross-reference evidence; and analyse processes, interpretations, conclusions and claims for validity and reliability, including reflecting on their own processes and conclusions. Science is a creative endeavour and students devise innovative solutions to problems, predict possibilities, envisage consequences and speculate on possible outcomes as they develop Science Understanding and Science Inquiry Skills. They also appreciate the role of critical and creative individuals and the central importance of critique and review in the development and innovative application of science.

Personal and social capability

Personal and social capability is integral to a wide range of activities in the Physics General course, as students develop and practise skills of communication, teamwork, decision-making, initiative-taking and self-discipline with increasing confidence and sophistication. In particular, students develop skills in both independent and collaborative investigation; they employ self-management skills to plan effectively, follow procedures efficiently and work safely; and they use collaboration skills to conduct investigations, share research and discuss ideas. In considering aspects of Science as a Human Endeavour*,* students also recognise the role of their own beliefs and attitudes in their response to science issues and applications, consider the perspectives of others, and gauge how science can affect people's lives.

Ethical understanding

Ethical understanding is a vital part of science inquiry. Students evaluate the ethics of experimental science, codes of practice, and the use of scientific information and science applications. They explore what integrity means in science, and they understand, critically analyse and apply ethical guidelines in their investigations. They consider the implications of their investigations on others, the environment and living organisms. They use scientific information to evaluate the claims and actions of others and to inform ethical decisions about a range of social, environmental and personal issues and applications of science.

Intercultural understanding

Intercultural understanding is fundamental to understanding aspects of Science as a Human Endeavour, as students appreciate the contributions of diverse cultures to developing science understanding and the challenges of working in culturally diverse collaborations. They develop awareness that raising some debates within culturally diverse groups requires cultural sensitivity, and they demonstrate open-mindedness to the positions of others. Students also develop an understanding that cultural factors affect the ways in which science influences and is influenced by society.

Representation of the cross-curriculum priorities

The cross-curriculum priorities address contemporary issues which students face in a globalised world. Teachers may find opportunities to incorporate the priorities into the teaching and learning program for the Physics General course. The cross-curriculum priorities are not assessed unless they are identified within the specified unit content.

Aboriginal and Torres Strait Islander histories and cultures

Contexts that draw on Aboriginal and Torres Strait Islander histories and cultures provide an opportunity for students to appreciate Aboriginal and Torres Strait Islander Peoples' understanding of physical phenomena, including the motion of objects, and astronomical phenomena, including Aboriginal constellations, their meanings and relationship with creation/Dreaming stories.

Asia and Australia's engagement with Asia

Contexts that draw on Asian scientific research and development and collaborative endeavours in the Asia Pacific region provide an opportunity for students to investigate Asia and Australia's engagement with Asia. Students could examine the important role played by people of the Asia region in such areas as medicine, communication technologies, transportation, sports science and energy security. They could consider collaborative projects between Australian and Asian scientists and the contribution these make to scientific knowledge.

Sustainability

The cross-curriculum priority of Sustainability provides authentic contexts for exploring, investigating and understanding the function and interactions of physical systems. The Physics General course explores a wide range of physical systems that operate at different temporal and spatial scales. By investigating the relationships between systems and system components, and how systems respond to change, students develop an appreciation for the ways in which matter and energy interactions shape the Earth system. In exploring applications of physics knowledge, students appreciate that science provides the basis for decision making in many areas of society and that these decisions can affect or impact on the Earth system. They understand the importance of using physical science knowledge to predict possible effects of human and other activity, and to develop management plans, or alternative technologies, that minimise these effects and provide for a more sustainable future.

Unit 1 – World of waves

Unit description

The focus of this unit is waves, sound and light and how they affect us every day of our lives in practical situations.

How waves behave will be observed in contexts, such as music, sound technology, holograms and telecommunications.

Students use science inquiry skills to explore sound and light. Practical activities offer students valuable opportunities to plan investigations, make careful observations, operate equipment in a safe and organised manner, and work collaboratively.

Unit content

This unit includes the knowledge, understandings and skills described below.

Science Inquiry Skills

- identify, research, construct and refine questions for investigation; propose hypotheses; and predict possible outcomes
- plan, select and use appropriate investigation methods, including preliminary trials, laboratory experimentation, and controlling variables to collect reliable data
- assess risk and address ethical issues associated with these methods
- work collaboratively and individually to conduct investigations, using appropriate measuring devices; safely, competently and methodically for the collection of valid and reliable data
- organise and clearly represent data in tables and appropriate graphs to identify trends, patterns and relationships
- describe sources of experimental error
- use appropriate standard international (SI) units and symbols
- use evidence to make and justify conclusions
- evaluate conclusions by considering the quality of available evidence and make recommendations for improving experimental method

Science as a Human Endeavour

- sound produced by, and tuning of, musical instruments
- noise cancelling technology
- acoustic design
- ultrasound images
- microwave ovens; microwaves in telecommunication

- echolocation to navigate and locate prey
- eyesight in humans and animals; spectacles; colour vision
- holograms
- optic fibres in telecommunications
- stage lighting – coloured filters, shadows
- cameras, projectors (including digital)
- impact of telescopes and microscopes on society; in medicine and astronomy

Science Understanding

Wave motion

- a wave is a means of energy transfer – longitudinal waves (particles vibrate parallel to the direction of movement) and transverse waves (particles vibrate perpendicular to the direction of movement)
- properties of mechanical waves
- waves can be represented graphically and diagrammatically
- wavefronts and rays, wave speed, wavelength, frequency, period, amplitude, phase
- calculate wave speed by applying the formula:

$$v = \frac{s}{t},\ f = \frac{1}{T},\ T = \frac{1}{f},\ v = \lambda f$$

- resonance occurs when an object is vibrated by a source with the same frequency as its natural frequency, producing an increased amplitude of vibration

Sound

- sound is produced by a vibrating source
- volume of sound is related to the amplitude of the wave; pitch of a sound is related to the frequency of the wave
- reflection of sound waves can produce echoes
- waves travelling in the same medium at the same time interfere with each other destructively or constructively. If the waves are of similar frequencies, beats may be produced.
- standing waves can be produced in strings when waves interfere under certain circumstances
- sound waves diffract around openings which are similar in width to the wavelength of the sound
- the function of the ear

Light

- absorption and transmission of light; shadows
- light is the visible part of the electromagnetic spectrum
- all electromagnetic waves travel at the speed of light

- the frequency of light determines its colour
- the appearance of coloured objects in terms of their absorption, reflection or transmission of light
- state and apply the laws of reflection
- the angle of incidence and the angle of reflection are measured in relation to the normal
- the formation of images in plane mirrors
- real images can be projected on to a screen
- virtual images cannot be projected onto a screen
- the formation of images in mirrors (converging and diverging)
- ray diagrams can be drawn to determine image formation mirrors
- measure object distance and image distance and determine magnification by applying the formula:
  magnification $= \frac{d_i}{d_o} = \frac{h_i}{h_o}$
- parabolic reflectors can be used to focus or produce parallel rays
- the speed of a wave varies with the medium, and this causes refraction (change in direction) in terms of a change in the speed of wave as it crosses an interface
- substances with high refractive index/optical density slow light down causing it to bend towards the normal; Snell's law can be verified in practical activities
- the change in direction of light rays is measured by constructing normal rays and measuring the angles of incidence and refraction
- the critical angle for a medium can be observed in practical activities
- images produced by converging and diverging lenses
- ray diagrams can be drawn to determine image formation lenses
- use the terms 'optical centre', 'principal focus', 'principal axis', 'focal length', object distance and image distance as they apply to thin spherical lenses
- measure object distance and image distance and determine magnification
- simple applications of the polarisation of light
- the structure and function of the eye

Unit 2 – Hot stuff

Unit description

This unit focuses on heat as a form of energy and its interaction with matter and nuclear energy and associated processes. Students explore the nature of heat, temperature, change of state, and how heat is transferred and utilised. Students gain an awareness of fundamental nuclear concepts, including nuclear decay, fission and fusion.

Applications of heating and cooling are investigated, including the efficient use of home heating and insulation, climate control, and temperature regulation in humans. Applications of nuclear technology include medical and industrial uses and power generation.

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- organise and clearly represent data in tables and appropriate graphs to identify trends, patterns and relationships
- describe sources of experimental error
- use appropriate standard international (SI) units and symbols
- use evidence to make and justify conclusions
- evaluate conclusions by considering the quality of available evidence and make recommendations for improving experimental method
- communicate scientific ideas and information using appropriate scientific language, conventions and representations

Science as a Human Endeavour

Heat

- the principles of heat storage and transfer apply to the operation of common devices, for example, protective clothing, car radiators
- buildings can incorporate design features which make more efficient use of energy for heating, cooling and lighting (climate control systems), solar hot water systems, insulation
- ground source heat pumps (GSHP) or geoexchange can be used to regulate temperatures in buildings
- differences between evaporative and refrigerative air conditioners/cooling systems
- temperature regulation in humans can involve shivering, sweating and extremes of temperature (hypothermia and hyperthermia)
- the role of heat transfer processes in global warming

Nuclear radiation

- medical uses of radioisotopes
- industrial uses of radioisotopes, smoke alarms
- nuclear weapons
- the role of the Open Pool Australian Lightwater (OPAL) reactor at Lucas Heights

Science Understanding

Heat

- heat as a form of energy
- heat energy flows from one object to another because of a difference in temperature
- internal energy of a substance equals the sum of the kinetic energy and the potential energy of its particles
- heat, internal energy and temperature
- the kinetic theory of matter describe matter as a collection of moving particles. This theory can be used to explain the behaviour of substances as they are heated or cooled. As a substance heats up, its particles move faster (gain kinetic energy)
- different types of thermometers
- thermometers are calibrated using fixed points
- absolute zero
- effects of heat: thermal expansion and contraction
- differential expansion of metals – different metals expand at different rates when heated and this property is applied in devices, such as thermostats

- different substances need different amounts of heat energy to raise their temperature. The heat capacity of a substance is the amount of heat needed to raise the temperature of 1 kilogram of the substance by 1 degree Celsius; apply the equation $Q = mc\Delta T$
- changes of state (melting, boiling, freezing, condensing, sublimation) involve changes in potential energy of the particles
- substances remain at the same temperature while they are undergoing a change of state
- latent heat is the heat involved in change of state and does not involve change in temperature; apply the equation $Q = mL$
- changes of state can be represented in graphs called heating/cooling curves
- the cooling effect of evaporation
- vapour pressure affects the rate of evaporation
- boiling point and freezing point and the factors which affect them: pressure, solute concentration
- heat transfer processes: conduction, convection and radiation and their applications
- thermal insulation properties of materials, including ratings and classification
- the relationship between pressure and volume of a gas when the temperature is constant
- the relationship between temperature and volume of a gas when the pressure is constant
- the relationship between pressure and temperature of a gas when the volume is constant
- transformation to heat energy must be taken into account when considering the conservation of energy of a system

Nuclear radiation

- structure of the atom, isotopes
- decay of unstable isotopes, production of alpha, beta, gamma radiation
- half-life, radiometric dating
- effect of radiation on humans, radiation dose, safety precautions
- production of electricity using nuclear reactors
- fission and fusion reactions

School-based assessment

The *Western Australian Certificate of Education (WACE) Manual* contains essential information on principles, policies and procedures for school-based assessment that needs to be read in conjunction with this syllabus.

Teachers design school-based assessment tasks to meet the needs of students. The table below provides details of the assessment types for the Physics General Year 11 syllabus and the weighting for each assessment type.

Assessment table – Year 11

Type of assessment	Weighting
Science Inquiry **Experiment** Practical tasks are designed to develop or assess a range of laboratory related skills and conceptual understanding of physical principles, and skills associated with representing data; organising and analysing data to identify trends and relationships; recognising error, uncertainty and limitations in data; and selecting, synthesising and using evidence to construct and justify conclusions. Tasks can take the form of practical skills tasks, laboratory reports, and short in-class tests to validate the knowledge gained. **Investigation** Activities in which ideas, predictions or hypotheses are tested and conclusions are drawn in response to a question or problem. Investigations can involve experimental testing, field work, locating and using information sources, conducting surveys, and using modelling and simulations. Assessment tasks can take the form of an experimental design brief, a formal investigation report, or exercises requiring qualitative and/or quantitative analysis of second-hand data. Appropriate strategies should be used to authenticate student achievement on an out-of-class assessment task.	40%
Extended response Tasks can take the form of: individual research assignments involving interpretation of a range of scientific and media texts; case studies; answers to specific questions based on individual research; interpretation and analysis of information in scientific and media texts; oral or multimedia presentations. Appropriate strategies should be used to authenticate student achievement that has been completed as a part of a group or as an out-of-class task.	30%
Test Tasks can involve comprehension and interpretation exercises; analysis and evaluation of qualitative and quantitative information; application of scientific principles to explain situations; use of reasoning to construct scientific arguments and problem solving.	30%

Teachers are required to use the assessment table to develop an assessment outline for the pair of units (or for a single unit where only one is being studied).

The assessment outline must:

- include a set of assessment tasks
- include a general description of each task
- indicate the unit content to be assessed
- indicate a weighting for each task and each assessment type
- include the approximate timing of each task (for example, the week the task is conducted, or the issue and submission dates for an extended task).

In the assessment outline for the pair of units, each assessment type must be included at least once over the year/pair of units. In the assessment outline where a single unit is being studied, each assessment type must be included at least once.

The set of assessment tasks must provide a representative sampling of the content for Unit 1 and Unit 2.

Assessment tasks not administered under test/controlled conditions require appropriate validation/authentication processes.

Grading

Schools report student achievement in terms of the following grades:

Grade	Interpretation
A	Excellent achievement
B	High achievement
C	Satisfactory achievement
D	Limited achievement
E	Very low achievement

The teacher prepares a ranked list and assigns the student a grade for the pair of units (or for a unit where only one unit is being studied). The grade is based on the student's overall performance as judged by reference to a set of pre-determined standards. These standards are defined by grade descriptions and annotated work samples. The grade descriptions for the Physics General Year 11 syllabus are provided in Appendix 1. They can also be accessed, together with annotated work samples, through the Guide to Grades link on the course page of the Authority website at www.scsa.wa.edu.au.

To be assigned a grade, a student must have had the opportunity to complete the education program, including the assessment program (unless the school accepts that there are exceptional and justifiable circumstances).

Refer to the *WACE Manual* for further information about the use of a ranked list in the process of assigning grades.

Appendix 1 – Grade descriptions Year 11

A	**Understanding and applying concepts** Applies models and principles to explain systems and processes. Presents clear and logical arguments which are supported by evidence. Selects scientific information to support a point of view. Explains concepts using appropriate scientific language and clearly labelled diagrams. Presents work in a planned and organised format. Selects and manipulates equations to solve simple calculations for a variety of situations.
	Science inquiry skills Formulates a testable hypothesis that states the relationship between dependent and independent variables. Plans an investigation to collect appropriate data. Identifies controlled variables and provides specific detail on how they will be controlled, e.g. balls will be dropped from 80 cm height. Organises data logically and presents it in a range of forms, including appropriate graphs and tables and identifies patterns and relationships. Accurately calculates averages. Analyses experimental data to describe trends and explains these using relevant scientific concepts. Uses evidence to make and justify conclusions that relate to the hypothesis. Evaluates experimental method and makes specific relevant suggestions to improve the validity and reliability of an investigation. Communicates information and concepts logically, using scientific language, conventions and representations.

B	**Understanding and applying concepts** Applies models and principles to describe and partially explain systems and processes. Presents arguments or statements which are not well-supported by evidence. Selects some scientific information to support a point of view. Explains concepts without detail, using some scientific language and labelled diagrams. Selects and manipulates equations to solve simple calculations.
	Science inquiry skills With guidance, formulates a testable hypothesis that includes dependent and independent variables, in a context that has been provided. With guidance, plans an investigation to collect appropriate data. Identifies some controlled variables without detail, e.g. balls will be dropped from the same height. Presents data in a range of forms, including appropriate graphs and tables, and identifies patterns and relationships. Describes trends and briefly explains these using relevant scientific concepts. Uses evidence to make conclusions that relate to the hypothesis. Evaluates experimental method and makes general relevant suggestions to improve the validity and reliability of an investigation. Communicates information and concepts logically, generally using scientific language and representations. Makes some errors in the use of conventions.

C	**Understanding and applying concepts** Describes some systems and processes in a general way. Presents statements of ideas, with some development of an argument. Selects some scientific information to support a point of view but includes irrelevant or incorrect information. Describes concepts using simple diagrams and everyday language. Develops responses which are often incomplete. Calculations are often incomplete and contain some errors.
	Science inquiry skills With guidance, predicts a general outcome for an investigation. With guidance, plans an investigation to collect appropriate data. Inconsistently identifies some controlled variables. Presents data using basic tables and graphs with some errors or omissions. Describes trends in the data and draws simple conclusions that may not be linked back to the hypothesis. Describes difficulties experienced in conducting the investigation and makes general relevant suggestions to improve the validity and reliability of an investigation. Communicates information and concepts, without detail, using occasional scientific language and conventions. Develops representations which lack detail.
D	**Understanding and applying concepts** Recognises systems and processes. Develops explanations which are incomplete or contain errors. Presents statements of ideas, but with limited development of an argument. Selects inappropriate scientific information to support a point of view. Describes situations using everyday language; includes irrelevant or incorrect information. Includes diagrams which are often incomplete. Simple calculations of physical quantities are often incomplete or incorrect.
	Science inquiry skills With guidance, identifies the dependent variable without linking it to the independent variable. With guidance, follows a provided experimental procedure to collect data. Confuses variables. Presents data that is unclear, insufficient and lacks appropriate processing. Identifies trends in the data incorrectly or overlooks trends. Offers simple conclusions that are not supported by the data or are not related to the hypothesis. Identifies difficulties experienced in conducting the investigation which affected its validity and reliability. Communicates information using everyday language with frequent errors in the use of conventions. Develops responses which are often incomplete or irrelevant.
E	Does not meet the requirements of a D grade and/or has completed insufficient assessment tasks to be assigned a higher grade.