Government of **Western Australia**
School Curriculum and Standards Authority

INTEGRATED SCIENCE

ATAR COURSE

Year 11 syllabus

IMPORTANT INFORMATION

This syllabus is effective from 1 January 2020.

Users of this syllabus are responsible for checking its currency.

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

Content

Rationale

Science is a dynamic, collaborative human activity that uses distinctive ways of valuing, thinking and working to understand natural phenomena. Science is based on people's aspirations and motivations to follow their curiosity and wonder about the physical, biological and technological world. Scientific knowledge represents the constructions made by people endeavouring to explain their observations of the world around them. Scientific explanations are built in different ways as people pursue intuitive and imaginative ideas, respond in a rational way to hunches, guesses and chance events, challenge attitudes of the time, and generate a range of solutions to problems, building on existing scientific knowledge. As a result of these endeavours, people can use their scientific understandings with confidence in their daily lives. Scientific explanations are open to scrutiny; scientific knowledge may be tentative and is continually refined in the light of new evidence.

The Integrated Science ATAR course encourages students to be questioning, reflective and critical thinkers about scientific issues. The course is based on an integrated view of scientific knowledge that draws on the traditional disciplines of science and new scientific technology to enable students to investigate issues that are interesting and relevant in a modern world. This course provides opportunities for students to consider contemporary scientific developments. This process enables them to make informed judgements and decisions about questions that directly affect their lives and the lives of others.

The course is grounded in the belief that science is, in essence, a practical activity. From this stems the view that conceptual understandings in science derive from a need to find solutions to real problems in the first instance. The inquiring scientist may then take these understandings and apply them in a new context, often quite removed from their original field. This course seeks to reflect this creative element of science as inquiry. It should involve students in research that develops a variety of skills, including the use of appropriate technology, an array of diverse methods of investigation and a sense of the practical application of the domain. It emphasises formulating and testing hypotheses and the critical importance of evidence in forming conclusions. This course enables students to investigate science issues, in the context of the world around them, and encourages student collaboration and cooperation with community members employed in scientific pursuits. It requires them to be creative, intellectually honest, to evaluate arguments with scepticism and to conduct their investigations in ways that are ethical, fair and respectful of others.

The Integrated Science ATAR course is inclusive and aims to be attractive to students with a wide variety of backgrounds, interests and career aspirations. The course will equip students to undertake tertiary study and/or gain employment.

Course outcomes

The Integrated Science ATAR course is designed to facilitate achievement of the following outcomes.

Outcome 1 – Science Inquiry Skills

Students investigate, to answer questions about the natural and technological world, using reflection and analysis to prepare a plan; collect, process and interpret data; communicate conclusions; and evaluate their plan, procedures and findings.

In achieving this outcome, students:

- plan investigations to test ideas about the natural and technological world
- collect and record a variety of information relevant to their investigations
- translate and analyse information to find patterns and draw conclusions to extend their understanding
- reflect on an investigation, evaluate the process and generate further ideas.

Outcome 2 – Science as a Human Endeavour

Students understand that science is a human activity involving the application of scientific knowledge to solve problems and make informed decisions that impact on people and the environment.

In achieving this outcome, students:

- understand the evolving nature of science
- understand that scientific knowledge can be applied to solve problems
- understand that scientific evidence informs decisions that impact on people and the environment.

Outcome 3 – Science Understanding

Students understand relationships within and between living and physical systems by integrating concepts of energy and the structure and nature of matter.

In achieving this outcome, students:

- understand the nature of matter and its relationship to structures in living and physical systems
- understand interactions between components in living and physical systems
- understand interactions between energy and matter.

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 – Driver safety and hearing

Through an integrated, scientific approach, this unit explores two major issues for today's society: safety on the roads, and the effects of listening to loud sounds.

Unit 2 – Biodiversity and conservation

This unit focuses on the effects that human activity has on biodiversity, and methods of conservation.

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 Integrated Science ATAR course has three interrelated strands: Science Inquiry Skills, Science as a Human Endeavour and Science Understanding, which build on students' learning in the Year 7–10 Science curriculum. The three strands of this course should be taught in an integrated way. The content descriptions for Science Inquiry Skills, Science as a Human Endeavour 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 is concerned with 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.

In science investigations, the collection and analysis of data to provide evidence play a major role. This can involve collecting or extracting information and reorganising data in the form of tables, graphs, flow charts, diagrams, text, keys, spread sheets and databases.

The analysis of data to identify and select evidence, and the communication of findings, involve the selection, construction and use of specific representations, including mathematical relationships, symbols and diagrams.

Through the Integrated Science ATAR course, students will continue to develop their science inquiry skills, building on the skills acquired in the Year 7–10 Science curriculum. Each unit provides specific skills to be taught. These specific skills align with the Science Understanding and Science as a Human Endeavour content of the unit.

Science as a Human Endeavour

Through science, we seek to improve our understanding and explanations of the natural world. The Science as a Human Endeavour strand highlights the development of science as a unique way of knowing and doing, and explores the use and influence of science in society.

As science involves the construction of explanations based on evidence, the development of science concepts, models and theories is dynamic and involves critique and uncertainty. 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 and can involve the use of international conventions and activities such as peer review.

The use and influence of science are shaped by interactions between science and a wide range of social, economic, ethical and cultural factors. 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 a result, decision making about socio-scientific issues often involves consideration of multiple lines of evidence and a range of stakeholder needs and values. 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. Models in science can include diagrams, physical replicas, mathematical representations, word-based analogies (including laws and principles) and computer simulations. Development of models involves selection of the aspects of the system(s) to be included in the model, and thus models have inherent approximations, assumptions and limitations.

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 8th edition 2013* (www.nhmrc.gov.au/guidelines/publications/ea28).

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 8th edition 2013*.

The *Animal Welfare Act 2002* can be found at www.slp.wa.gov.au. The related animal welfare regulations, along with the licences required for the use and supply of animals, can be downloaded from www.dlg.wa.gov.au.

Information regarding the care and use of animals in Western Australian schools and agricultural colleges can be viewed at www.det.wa.edu.au/curriculumsupport/animalethics/detcms/portal/.

Mathematical skills expected of students studying the Integrated Science ATAR course

The Integrated Science ATAR 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 Year 7–10 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 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.

Students may need to be taught when it is appropriate to join points on a graph and when it is appropriate to use a line of best fit. They may also need to be taught how to construct a straight line that will serve as the line of best fit for a set of data presented graphically.

It is assumed that students will be able to competently:

- 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
- comprehend and use the symbols/notations <, >, Δ, ≈
- translate information between graphical, numerical and algebraic forms
- distinguish between discrete and continuous data and then select appropriate forms, variables and scales for constructing graphs
- construct and interpret frequency tables and diagrams, pie charts and histograms
- describe and compare data sets using mean, median and inter-quartile range

- interpret the slope of a linear graph.

Progression from the Year 7–10 curriculum

This syllabus continues to develop student understanding and skills from across the three strands of the Year 7–10 Science curriculum. In the Science Understanding strand, this course draws on knowledge and understanding from the sub-strand of Biological sciences in Years 7, 8, 9 and 10 and Chemical sciences in Year 10.

In particular, Unit 1 of this 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.

Unit 2 of this course continues to develop the key concepts introduced in the Biological sciences sub-strand, that is, ecosystems consist of communities of interdependent organisms and abiotic components of the environment; matter and energy flow through these systems; especially the impact that human activity has on the delicate balance within ecosystems.

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 Integrated Science ATAR 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 biological and physical systems are structured, interact and change across spatial and temporal 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 concept, 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 Integrated Science ATAR course. 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 Integrated Science ATAR 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 opportunities for students to recognise the importance of Aboriginal and Torres Strait Islander Peoples' knowledge in developing a richer understanding of the Australian environment. Students could develop an appreciation of the unique Australian biota and its interactions, the impacts of Aboriginal and Torres Strait Islander Peoples on their environments, and the ways in which the Australian landscape has changed over tens of thousands of years. They could examine the ways in which Aboriginal and Torres Strait Islander Peoples' knowledge of ecosystems has developed over time, and the spiritual significance of Country/Place.

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 explore the diverse environments of the Asia region and develop an appreciation that interaction between human activity and these environments continues to influence the region, including Australia, and has significance for the rest of the world. By examining developments in science and technology, students could appreciate that the Asia region plays an important role in scientific research and development through collaboration with Australian scientists.

Sustainability

The Sustainability cross-curriculum priority is explicitly addressed in the Integrated Science ATAR course. This course provides authentic contexts for exploring, investigating and understanding the function and interactions of biotic and abiotic systems across a range of spatial and temporal scales. By investigating the relationships between biological systems and system components, and how systems respond to change, students develop an appreciation for the interconnectedness of the environmental, social and economic factors associated within the biosphere. Students appreciate that integrated science provides the basis for decision making in many areas of society and that these decisions can impact the Earth system. They understand the importance of using science to predict possible effects of human activities, and to develop management plans or alternative technologies that minimise these effects and provide for a more sustainable future.

Unit 1 – Driver safety and hearing

Unit description

Young people are growing up in a world of rapid change. Expanding technologies, new social structures and shifting community values are complex, interrelated factors that affect the way individuals live their lives. The transition to adulthood can bring up issues of independence and self-identity. For adolescence, nothing symbolises independence more than obtaining their drivers licence, and of expressing self-identity through the music they listen to. Students investigate the issues of inexperience, distractions, drugs and alcohol and the effects they have on drivers; and of vehicle safety. Students also explore the properties of sound and how listening to music and noise can affect the physiology of hearing.

Through the investigation of appropriate contexts, students explore how international collaboration, evidence from multiple disciplines, and the use of ICT and other technologies, have contributed to developing understanding of vehicle safety design, and technology for helping the hearing impaired. They investigate how scientific knowledge is used to offer valid explanations and reliable predictions, and the ways in which scientific knowledge interacts with economic and ethical factors.

Students use science inquiry skills to explore the relationship between acoustic properties of materials and the effect they have on sound distribution in a room. Students consider the effect of age and noise levels on the function of hearing. They develop skills in constructing and using models to describe and interpret data about the function of the cochlea in determining pitch and loudness.

Unit content

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

Science Inquiry Skills

- identify, research and construct questions for investigation; propose hypotheses and predict possible outcomes
- design investigations, including the procedure(s) to be followed, the materials required, and the type and amount of primary and/or secondary data to be collected; conduct risk assessments; and consider research ethics, including animal ethics
- conduct investigations, including factors affecting reaction time, safety features of cars, effect of ageing on hearing, and acoustic properties of materials, safely, competently and methodically for the collection of valid and reliable data
- represent data in meaningful and useful ways; organise and analyse data to identify trends, patterns and relationships; qualitatively describe sources of measurement error, and uncertainty and limitations in data; and select, synthesise and use evidence to make and justify conclusions
- interpret a range of scientific and media texts, and evaluate processes, claims and conclusions by considering the quality of available evidence; and use reasoning to construct scientific arguments
- select, construct and use appropriate representations, including labelled diagrams and models, to communicate conceptual understanding, solve problems and make predictions

- select, use and interpret appropriate mathematical representations to solve problems and make predictions, including linear and non-linear graphs and algebraic relationships representing physical systems:
  - reaction distance = speed x reaction time
  - stopping distance = reaction distance + braking distance
  - equations of motion: $v_{av} = \frac{s}{t}$ $a = \frac{v-u}{t}$ $s = ut + \frac{1}{2}at^2$ $F = ma$
  - change in momentum: $\Delta\rho = m(v - u) = F\Delta t$
  - velocity of a wave: $v = f\lambda$
- communicate to specific audiences, and for specific purposes, using appropriate language, nomenclature, genres and modes, including scientific reports

Science as a Human Endeavour

- scientific knowledge and improved technology have contributed to enhancement of safety features in vehicles to protect both occupants and pedestrians
- increased understanding of the influence of drugs and alcohol on driving ability has led to improved methods of detection of drivers under the influence
- analysis and interpretation of accident statistics can be used to identify major trends to support the development of legislation regarding speed zones, blood alcohol limits and vehicle safety
- scientific knowledge is used to develop educational campaigns to reduce the over-representation of young drivers involved in road accidents
- hearing aids and cochlear implants are devices developed from an improved understanding of the mechanisms of hearing; these devices have improved lifestyles of people suffering from hearing impairment
- developments in technology and physiological testing of hearing have enabled early diagnosis of loss, and the implementation of strategies for protection
- proliferation in the use of personal music devices has resulted in increased incidence of noise-induced hearing loss through prolonged exposure to loud music

Science Understanding

The driver

- reacting to driving conditions requires the proper functioning of the nervous system: the brain, spinal cord, nerves and receptors, including eyes and ears
- during driver reaction, nerve impulses travel in defined pathways and require neurotransmitters to transfer impulses across synapses between neurons
- a driver's reaction time impacts on driving ability and is affected by:
  - anticipation
  - fatigue
  - age
  - eyesight and hearing
  - environmental distractions

  - drugs, including alcohol, cannabis, methylamphetamine, ecstasy, codeine, dexamphetamine and benzodiazepine

- blood alcohol concentration is affected by:
  - amount of alcohol consumed, including alcohol percentage
  - rate of consumption of standard drinks
  - food consumption
  - body size and body fat, including differences in men and women
  - liver function

The motor vehicle

- stopping distance is proportionate to reaction distance and braking distance, and can be calculated using: stopping distance = reaction distance + braking distance
- reaction distance is affected by the speed of a vehicle and the driver's reaction time, and can be calculated by applying the relationship: reaction distance = speed x reaction time
- braking distance of vehicles is influenced by:
  - road and weather conditions
  - condition of brakes, including anti-lock braking systems
  - condition of tyres
  - vehicle speed
  - vehicle mass
- braking distances of a vehicle can be calculated by determining its mass, speed, force and deceleration using the following mathematical equations: $v_{av} = \frac{s}{t}$ $a = \frac{v-u}{t}$ $s = ut + \frac{1}{2}at^2$ $F = ma$
- Newton's Laws of Motion assist in the explanation of the resultant motion of occupants during collisions
- the relationship of speed and mass on the change in momentum $\Delta\rho = m(v - u) = F\Delta t$ and the implications of the change on unrestrained people and objects in vehicles involved in collisions
- vehicle safety devices and features – airbags, seatbelts, crumple zones, anti-lock braking systems and electronic stability control – use the application of Newton's laws and conservation of momentum in their design

Sound production and transfer

- sound production and transfer require a source of vibration in a medium; the intensity is measured in decibels
- sound waves are longitudinal waves, composed of areas of compression and rarefaction, which transfer energy as a disturbance of particles in a medium, and are detected as a sound
- the wave model can be used to demonstrate general properties of a wave
  - displacement, amplitude and period
  - compression and rarefaction
  - the relation of velocity, frequency and wavelength can be represented in the following mathematical expression: $v = f\lambda$

- behaviour of sound waves, including reflection, refraction, diffraction and interference, assist in understanding echoes and can be applied in the design of spaces for reducing or enhancing sound level and quality
- different materials have different acoustic properties that can be used to produce specific audio effects

Hearing

- sound is transferred by physical means through the ear before being detected by receptors in the cochlea and the information sent to the brain
- the ability to detect the frequency (pitch), amplitude (loudness) and direction of sound by the ears varies between individuals and with age
- hearing loss can be due to either conductive deafness or nerve deafness
- hearing loss caused by excessive loudness in the workplace, or from recreational activities, can be prevented or reduced by monitoring audio levels and listening times, and using ear protection to reduce exposure to damaging levels of sound
- hearing aids and cochlear implants use different mechanisms to assist hearing

Unit 2 – Biodiversity and conservation

Unit description

Biodiversity refers to the variety of life that surrounds us, including all of Earth's plants, animals, their habitats and the ecological processes. Increased scientific understanding of biodiversity has brought to the forefront its importance to our existence. There is a large dependency on biological resources to meet our needs to maintain life. The need for developing areas for our use through clearing land impacts negatively on biodiversity and ecological processes and needs to be monitored carefully. The richer the diversity of life, the greater the opportunity for new medical discoveries, economic development and adaptive responses to climate change. Hence, the need for conservation of flora and fauna to maintain biodiversity is of high importance and is relevant to everyone.

Students will engage with identifying real-world problems for investigation, making systematic observations and drawing conclusions, including identifying inconsistencies in data. They will also learn to perform calculations for specific understandings. Major trends in use of our ecosystems and the associated issues and challenges that arise from these, sustainability, and environmental impact, will be examined.

Unit content

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

Science Inquiry Skills

- identify, research and construct questions for investigation; propose hypotheses; and predict possible outcomes
- design investigations, including the procedure(s) to be followed, the materials required, and the type and amount of primary and/or secondary data to be collected; conduct risk assessments; and consider research ethics, including animal ethics
- conduct investigations, including soil sampling and analysis, water testing and ecological surveying, safely, competently and methodically for the collection of valid and reliable data
- represent data in meaningful and useful ways; organise and analyse data to identify trends, patterns and relationships; qualitatively describe sources of measurement error, and uncertainty and limitations in data; and select, synthesise and use evidence to make and justify conclusions
- interpret a range of scientific and media texts, and evaluate processes, claims and conclusions by considering the quality of available evidence; and use reasoning to construct scientific arguments
- select, construct and use appropriate representations, including labelled diagrams and models, to communicate conceptual understanding, solve problems and make predictions
- select, use and interpret appropriate mathematical representations, including linear and non-linear graphs, to solve problems and make predictions
- communicate to specific audiences, and for specific purposes, using appropriate language, nomenclature, genres and modes, including scientific reports

Science as a Human Endeavour

- environmental impact statements are required for all high impact developments to understand the possible changes to biodiversity in the affected area and how negative impacts can be reduced, repaired or avoided
- the interrelationship between the ecosystem services and human needs, including food, shelter, security, health and social activities
- sustainable management of overexploited terrestrial and marine resources is attempting to stop decline of biodiversity
- scientists use data from a variety of sources to offer valid explanations, make predictions, and evaluate actions and impacts of human activity on biodiversity and the implementation of conservation strategies

Science understanding

Key threats to biodiversity

- biodiversity includes the diversity of genetics, species and ecosystems; biodiversity changes naturally over time and varies due to differences in location
- human population growth is the main driver of the pressures on biodiversity, with increased demand on resources to meet requirements for survival
- biodiversity is threatened through deterioration of habitat quality by:
  - clearing of land for agriculture, industry and urbanisation
  - fragmentation of native ecosystems
  - extraction of natural resources
  - altered fire regimes
- the decline in reproduction and survival of plant and animal species is affected by:
  - invasive species and pathogens
  - pressures from stock animals
  - pollution by chemical and/or solid waste
  - changed hydrology caused by over-extraction, nutrient loading and changes to local climate

Monitoring biodiversity

- models of ecosystem interactions, including food webs, and successional models, can be used to predict the impact of change
- ecological monitoring, including satellite imagery and photography, needs to occur in areas undisturbed and disturbed by human activity so that the effects on communities can be compared
- monitoring of ecosystems provides information on the number and distribution of species; data for analysing ecosystems are derived from surveying techniques, including:
  - capture – recapture
  - quadrat surveys
  - line transects
  - radio and video tracking
  - scats and tracks
- recognising patterns and trends in ecosystem changes relies on interpretation of data and the reliability of the surveying techniques used

- soil and water quality is monitored by sampling and analysing pH, salt and nitrate levels, as well as the amount of solid wastes

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 Integrated Science ATAR Year 11 syllabus and the weighting for each assessment type.

Assessment table – Year 11

Type of assessment	Weighting
Science inquiry Science inquiry involves identifying and posing questions; planning, conducting and reflecting on investigations; processing, analysing and interpreting data; and communicating findings. Students evaluate claims, investigate ideas, solve problems, reason, draw valid conclusions, and/or develop evidence-based arguments. Students must complete at least one investigation in each unit, including a fieldwork or environmental investigation in Unit 2. **Practical** Practical work can involve a range of activities, such as practical tests; modelling and simulations; qualitative and/or quantitative analysis of second-hand data; and/or brief summaries of practical activities. **Investigation** Investigations are more extensive activities which can include experimental testing; conducting surveys; and/or comprehensive scientific reports.	35%
Extended response Tasks requiring an extended response can involve selecting and integrating appropriate science concepts, models and theories to explain and predict phenomena, and applying those concepts, models and theories to new situations; interpreting scientific and/or media texts and evaluating processes, claims and conclusions by considering the quality of available evidence; and using reasoning to construct scientific arguments. Assessment can take the form of answers to specific questions based on individual research; exercises requiring analysis; and interpretation and evaluation of information in scientific journals, media texts and/or advertising.	10%
Test Tests typically consist of multiple-choice questions and questions requiring short and extended answers. Tests should be designed so that students can apply their understanding and skills in Integrated Science to analyse, interpret, solve problems and construct scientific arguments.	20%
Examination Typically conducted at the end of each semester and/or unit. In preparation for Unit 3 and Unit 4, the examination should reflect the examination design brief included in the ATAR Year 12 syllabus for this course.	35%

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 twice.

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.

Appropriate strategies should be used to authenticate student achievement for tasks that have been completed out of class or as part of a group.

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 Integrated Science ATAR 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 scientific concepts to accurately explain and link complex processes in detail. Applies models to explain processes in detail, using supporting examples and diagrams where appropriate. Accurately applies scientific knowledge to unfamiliar contexts or examples. Analyses issues and presents well-developed arguments which are supported by evidence. Accurately interprets data and diagrams. Describes complex relationships between data and concepts using appropriate terminology and conventions. Performs multistep calculations accurately, showing all workings, and using correct units.
	Science inquiry skills Formulates a testable hypothesis that clearly states the relationship between dependent and independent variables. Designs investigations to identify and control appropriate variables; describes the experimental method in detail and accurately collects data. Processes data accurately and provides relevant suggestions to improve the validity and reliability of the investigation. Organises data logically and correctly, and presents it in a range of forms, including graphs, tables and charts to reveal patterns and relationships. Comprehensively explains trends using numerical data and uses evidence to draw conclusions that relate to the hypothesis. Communicates detailed information and concepts logically and coherently, using appropriate scientific language and conventions.

B	**Understanding and applying concepts** Applies scientific concepts to accurately explain and link simple, and some complex, processes. Applies models to explain processes, using supporting examples and diagrams where appropriate. Applies scientific knowledge to unfamiliar contexts or examples, sometimes lacking detail. Presents well-developed arguments which are supported by evidence. Interprets most data and diagrams correctly. Describes relationships between data and concepts using appropriate terminology and conventions. Performs multistep calculations with only minor inaccuracies.
	Science inquiry skills Formulates a testable hypothesis that states the relationship between dependent and independent variables. Designs investigations to identify and control appropriate variables, describes the experimental method and accurately collects data. Processes data and suggests ways to improve the validity and reliability of the investigation. Presents data in a range of forms, including graphs, tables and charts to reveal patterns and relationships. Explains trends and uses evidence to draw conclusions that relate to the hypothesis. Communicates information and concepts logically, using appropriate scientific language and conventions.

C	**Understanding and applying concepts** Applies scientific concepts to describe simple systems and processes. Applies models to explain some processes using supporting examples and diagrams where appropriate. Applies scientific knowledge to some unfamiliar contexts or examples. Presents arguments or statements supported by some evidence. Develops responses which lack detail and may include irrelevant and inaccurate information. Interprets some data and diagrams correctly. Describes simple relationships between data and concepts using appropriate terminology and conventions. Solves some multistep calculations.
	Science inquiry skills Formulates a testable hypothesis that links dependent and independent variables. Designs investigations to identify and control some variables, briefly outlines the experimental method and collects data. Processes data and makes general suggestions for improving the investigation. Presents data using basic tables and graphs. Describes trends in the data and draws simple conclusions that may not be linked back to the hypothesis. Communicates information and concepts, without detail, using some appropriate scientific language and conventions.

D	**Understanding and applying concepts** Incorrectly applies scientific concepts to describe systems and processes. Inconsistently applies models and includes some irrelevant or incorrect information. Inconsistently applies scientific knowledge to unfamiliar contexts. Presents statements of ideas with limited development of an argument. Makes little use of evidence. Includes several inaccuracies in the interpretation of data and diagrams. Incorrectly describes the relationships between data and concepts and uses inappropriate terminology. Solves calculations with errors and omissions. Does not use appropriate conventions for working out.
	Science inquiry skills Identifies one or more relevant variables without making links between them. Identifies a limited number of controlled variables. Does not distinguish between the dependent, independent and controlled variables. Describes a method which lacks detail. Presents data that is unclear, insufficient and lacks appropriate processing. Presents data in an appropriate format. Incorrectly Identifies trends in data or overlooks trends. Offers simple conclusions that are not supported by the data or are not related to the hypothesis. Communicates information using everyday language with frequent errors in the use of conventions.

E	Does not meet the requirements of a D grade and/or has completed insufficient assessment tasks to be assigned a higher grade.

Appendix 2 – Glossary

This glossary is provided to enable a common understanding of the key terms in this syllabus.

Accuracy	The extent to which a measurement result represents the quantity it purports to measure; an accurate measurement result includes an estimate of the true value and an estimate of the uncertainty.
Animal ethics	Consideration of respectful, fair and just treatment of animals. The use of animals in science involves consideration of replacement (substitution of insentient materials for conscious living animals), reduction (using only the minimum number of animals to satisfy research statistical requirements) and refinement (decrease in the incidence or severity of 'inhumane' procedures applied to those animals that still have to be used).
Data	The plural of datum; the measurement of an attribute, for example, the volume of gas or the type of rubber. This does not necessarily mean a single measurement: it may be the result of averaging several repeated measurements. Data may be quantitative or qualitative and be from primary or secondary sources.
Evidence	In science, evidence is data that is considered reliable and valid and which can be used to support a particular idea, conclusion or decision. Evidence gives weight or value to data by considering its credibility, acceptance, bias, status, appropriateness and reasonableness.
Field work	Observational research undertaken in the normal environment of the subject of the study.
Genre	The categories into which texts are grouped; genre distinguishes texts on the basis of their subject matter, form and structure (for example, scientific reports, field guides, explanations, procedures, biographies, media articles, persuasive texts, narratives).
Hypothesis	A scientific statement based on the available information that can be tested by experimentation. When appropriate, the statement expresses an expected relationship between the independent and dependent variables for observed phenomena.
Investigation	A scientific process of answering a question, exploring an idea or solving a problem, that requires activities, such as planning a course of action, collecting data, interpreting data, reaching a conclusion and communicating these activities. Investigations can include observation, research, field work, laboratory experimentation and manipulation of simulations.
Law	A statement describing invariable relationships between phenomena in specified conditions, frequently expressed mathematically.
Measurement error	The difference between the measurement result and a currently accepted or standard value of a quantity.
Media texts	Spoken, print, graphic or electronic communications with a public audience. Media texts can be found in newspapers, magazines and on television, film, radio, computer software and the internet.
Mode	The various processes of communication – listening, speaking, reading/viewing and writing/creating.
Model	A representation that describes, simplifies, clarifies or provides an explanation of the workings, structure or relationships within an object, system or idea.
Primary data	Data collected directly by a person or group.
Primary source	Report of data created by the person or persons directly involved in observations of one or more events, experiments, investigations or projects.

Reliable data	Data that has been judged to have a high level of reliability; reliability is the degree to which an assessment instrument or protocol consistently and repeatedly measures an attribute, achieving similar results for the same population.
Reliability	The degree to which an assessment instrument or protocol consistently and repeatedly measures an attribute, achieving similar results for the same population.
Representation	A verbal, visual, physical or mathematical demonstration of understanding of a science concept or concepts. A concept can be represented in a range of ways and using multiple modes.
Research	To locate, gather, record, attribute and analyse information in order to develop understanding.
Research ethics	Norms of conduct that determine ethical research behaviour; research ethics are governed by principles, such as honesty, objectivity, integrity, openness and respect for intellectual property and include consideration of animal ethics.
Risk assessment (in the school/agricultural college context)	Evaluations performed to identify, assess and control hazards in a systematic way that is consistent, relevant and applicable to all school activities. Requirements for risk assessments related to particular activities will be determined by jurisdictions, schools or teachers as appropriate.
Secondary data	Data collected by a person or group other than the person or group using the data.
Secondary source	Information that has been compiled from records of primary sources by a person or persons not directly involved in the primary event.
Simulation	A representation of a process, event or system which imitates a real or idealised situation.
System	A group of interacting objects, materials or processes that form an integrated whole. Systems can be open or closed.
Theory	A set of concepts, claims and/or laws that can be used to explain and predict a wide range of related observed or observable phenomena. Theories are typically founded on clearly identified assumptions, are testable, produce reproducible results and have explanatory power.
Uncertainty	Range of values for a measurement result, taking account of the likely values that could be attributed to the measurement result, given the measurement equipment, procedure and environment.
Validity	The extent to which tests measure what was intended; the extent to which data, inferences and actions produced from tests and other processes are accurate.