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

AGRICULTURAL SCIENCE AND TECHNOLOGY

ATAR 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.

Content

Rationale

Agriculture for the production of food and fibre is the world's biggest industry and is one of the most exciting as it embraces science and technology in response to the need to supply product to an estimated 50 per cent more people by 2050. Along with the increase in on-farm production needed, there will be an increased need to cater for the off-farm (supply chain) resources.

As the global human population grows, international demand for high quality and safe food and natural fibre products, particularly from Asia, offers a positive outlook for the State's agriculture and food sector. There is already strong demand, in Western Australia, across Australia, and around the world for people skilled in combining scarce resources with innovative methods of production. This demand can only continue to grow.

Western Australia is a world leader in agricultural production and to maintain our reputation for 'clean, green and ethical' products, we need our production systems to remain environmentally and economically sustainable, as well as globally competitive. To achieve this, we will need to develop and adopt technology to meet a variety of challenges: biosecurity; climate variability; competition for natural resources; environmental degradation; animal welfare; skilled labour and food safety.

The Agricultural Science and Technology ATAR course enables students to develop knowledge and skills related to the sustainable use of resources for a wide variety of production systems. Students explore the ways that people manage natural resources, such as plants, animals, soil and water, to meet global societal needs. Students will also explore how new developments in science and technology can increase productivity, efficiency and sustainability whilst responding to evolving domestic and global demands.

Aims

The Agricultural Science and Technology ATAR course aims to develop students':

- knowledge and understanding about the principles, practices and key components underpinning efficient and sustainable food and fibre production systems, including
  - the structure and function of various agricultural production systems,
  - the interdependence of natural systems and agricultural production systems,
  - management strategies, including traditional and modern production techniques
- ability to select and apply skills, and current and emerging technologies to achieve efficient and sustainable food and fibre production
- ability to use investigative processes to address agricultural food and fibre production challenges, including field and laboratory investigations involving collection and analysis of qualitative and quantitative data, and interpretation of evidence
- understanding that agricultural science knowledge is used in a variety of contexts and is influenced by social, economic, environmental, ethical and cultural considerations
- ability to communicate understandings and justify findings and conclusions related to food and fibre production systems.

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.

Each unit includes:

- a unit description – a short description of the focus of the unit
- learning outcomes – a set of statements describing the learning expected as a result of studying the unit
- unit content – the content to be taught and learned.

Progression from the Year 7–10 curriculum

This syllabus continues to develop student understanding and skills from the Years 7–10 Technologies –Food and Fibre context, the Years 7–10 Science curriculum and Years 7-10 Humanities and Social Sciences curriculum.

Organisation of content

This course has Science Inquiry Skills which are developed from the Year 7–10 Science curriculum and nine content areas:

- The development of Australian agricultural practices
- Resource conservation and management in food and fibre production systems
- Growth and development of significant plants for food and natural fibre production
- Genetics and inheritance of traits
- Plant reproduction
- Growth and development of significant animals for food and natural fibre production
- Animal reproduction
- Controlling pests and diseases
- Development and application of technology to support and improve productivity

Science Inquiry Skills

Science inquiry involves identifying and posing questions; 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.

The collection and analysis of data to provide evidence plays a major role in science. This can involve collecting or extracting information and reorganising data in the form of tables, graphs, flow charts, diagrams, text, keys, spreadsheets 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 Agricultural Science and Technology ATAR course, students will continue to develop their science inquiry skills, building on the skills acquired in the Years 7–10 Science curriculum. Each unit provides specific skills to be taught. These specific skills align with the other eight content areas of the unit and it is intended that the Science Inquiry Skills are taught in an integrated way.

Safety

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 Agricultural Science and Technology ATAR course

The Agricultural Science and Technology ATAR course requires students to use the mathematical skills they have developed through the Years 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 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, ≈
- translate information between graphical, numerical and algebraic forms
- distinguish between discrete and continuous data 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.

Representation of the general capabilities

The general capabilities encompass the knowledge, skills, behaviours and dispositions that will assist students to live and work successfully. Teachers may find opportunities to incorporate the capabilities into the teaching and learning program for the Agricultural Science and Technology 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 investigative skills and their understanding of content. Students gather, interpret, synthesise and critically analyse information presented in a wide range of forms. 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, structure evidence-based arguments, and employ appropriate methods to communicate for specific purposes and audiences.

Numeracy

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

Information and communication technology capability

Students apply information and communication technology skills in a contemporary agricultural context. 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 ideas, processes and information. Students assess the impact of ICT on the productivity, efficiency and sustainability of agricultural systems.

Critical and creative thinking

Critical and creative thinking is particularly important in the investigative process. This 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. Students devise innovative solutions to problems, predict possibilities, envisage consequences and speculate on possible outcomes. They also appreciate the role of critical and creative individuals and the central importance of critique and review.

Personal and social capability

Students develop and practise skills of communication, teamwork, decision making, and self-discipline with increasing confidence and sophistication. Students develop skills in both independent and collaborative investigation; they employ self-management skills to plan effectively, follow procedures efficiently, work safely, share research and discuss ideas. Students also recognise the role of their own beliefs and attitudes in their response to issues and applications, consider the perspectives of others, and gauge how these can affect people's lives.

Ethical understanding

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 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

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 the 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 Agricultural Science and Technology 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

Through an investigation of contexts that draw on Aboriginal and Torres Strait Islander histories and cultures, students can investigate the importance of Aboriginal and Torres Strait Islander Peoples' knowledge in developing a richer understanding of the Australian environment. Students 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 can examine the ways in which Aboriginal and Torres Strait Islander 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 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 agriculture, students appreciate that the Asia region plays an important role in such areas as natural resource management, biosecurity and food security.

Sustainability

The Sustainability cross-curriculum priority is explicitly addressed in the Agricultural Science and Technology ATAR course. Agriculture provides authentic contexts for exploring, investigating and understanding the function and interactions of agricultural systems across a range of spatial and temporal scales. By investigating the relationships between agricultural systems and system components, and how systems respond to change, students develop an appreciation for the interconnectedness of the biosphere. Students appreciate that agriculture 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 agricultural science 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

Unit description

In this unit, students learn about the changing approaches to agriculture in Australia over time as well as comparing and contrasting intensive farming systems with extensive farming systems. They learn about resource conservation and management in food and natural fibre production systems, and about plant structures and their role in the growth and development of the plant, and the important role of the growth medium in healthy plant growth. Students also learn about genetics and the inheritance of traits from one generation of organisms to the next, and about a variety of agricultural plant reproduction techniques and their advantages and disadvantages.

Learning outcomes

By the end of this unit, students:

- develop the ability to critically evaluate agricultural science concepts, data interpretation, claims and conclusions, with reference to evidence and practical activities
- develop the ability to communicate and justify findings and conclusions related to food and fibre production systems
- understand the evolution of agriculture in Australia from Indigenous land management practices, to colonial settlement, commercial food and fibre production systems, and towards sustainable practices
- understand that there is a variety of food and fibre productions systems and that the location of a food and fibre production system should be matched to its climatic zone
- understand that production needs to be done in a way that is ecologically/environmentally sustainable and this requires understanding that a production system's ecological footprint needs to be minimised
- understand the concept of the value chain and that decisions made in a food and fibre production system are aimed at producing a marketable product
- recognise key growth stages in plants, and develop an understanding of plant structure, function, nutrition, growth and reproduction
- understand the genetics and inheritance of traits from one generation to the next.

Unit content

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

Science Inquiry Skills

Hypothesis as a science driver

- identify, research and construct questions for investigation; propose hypotheses; and predict possible outcomes

Data processing and analysis

- distinguish between primary and secondary data, and between primary and secondary information sources
- represent data in meaningful and useful ways, including using appropriate graphic representations and correct units and symbols
- organise and process data to identify trends, patterns and relationships
- identify and distinguish between random and systematic errors, and describe their effect on validity and reliability of data
- evaluate how the nature of the procedure and the sample size may influence limitations in data

Interpreting data, drawing conclusions and evaluating scientific claims

- select, synthesise and use evidence to make and justify conclusions
- interpret a range of scientific texts, and evaluate processes, claims and conclusions by considering the quality of available evidence, and use reasoning to construct scientific arguments

Communicating information

- communicate to specific audiences and for specific purposes using appropriate language, nomenclature and formats, including scientific reports

The development of Australian agricultural practices

- describe the main attributes and differences in agricultural and land management techniques from Indigenous Australian land management and manipulation techniques to the introduction and then adoption of European farming practises into 'sustainable and technological' Australian farming, including
  - pre-colonisation food and fibre practices employed by Indigenous Australians, such as fire farming, fish traps, tuber propagation, hunter-gatherer
  - traditional European farming techniques, such as those used by the original colonial settlers to survive, to profit-driven agricultural production, such as reliance on tillage, monoculture production, cultivar selection and breeding, and the shift from subsistence to commercial production
  - modern food and fibre production strategies, such as clean, green and ethical, targeting specific market requirements, use of breeding and genetic manipulation, and the use of technology to increase production and to help address a lack of skilled labour
  - the concept of supply and demand, and the domestic and international value chains and how they influence the direction of Australian agriculture

- identify the major climatic zones in Western Australia, including arid, Mediterranean, temperate, subtropical and tropical, and describe attributes that differentiate them regarding agricultural production
- compare and contrast intensive systems, such as horticulture, floriculture, aquaculture, and intensive animal production, and extensive farming systems, such as broadacre cropping, sheep and cattle production, rangeland grazing systems

Resource conservation and management in food and fibre production systems

- recognise that systems are composed of interacting components that should support each other, including inputs, outputs, boundaries and processes
- recognise that plants can obtain their nutrients from soil or soil-less media (for example, aqueous media, peat moss, vermiculite and perlite)
- describe the living and non-living components of soil
- explain the influence of soil texture and structure on availability and holding capacity for water and nutrients
- calculate water availability using the equation field capacity minus wilting point (Readily Available Water – RAW)
- describe nutrient cycling, including carbon, nitrogen and phosphorus, and the water cycle
- explain production practices that have contributed to soil and water degradation issues, such as acidification, salinity, erosion, soil structural decline and eutrophication
- discuss the effect of land degradation on natural resources, biodiversity, soil health and sustainability of agricultural systems
- explain strategies to maintain and/or improve the quality of soil and water resources, such as cultivation practices, crop rotations, drainage methods, maintaining ground cover, and improving soil structure, soil health and ameliorating soil acidity

Growth and development of significant plants for food and natural fibre production

Plant structure and function

- outline the key physical features of plants, including:
  - leaves, including stomata
  - stem, including nodes, vascular system
  - roots, including meristems
  - flowers
  - fruits and seeds
- outline the functions of key plant structures, including:
  - leaves, including photosynthesis, respiration, transpiration
  - stems, including storage of products, direction of growth, components and distribution of vascular bundles
  - roots, including water, and nutrient absorption, including the influence of transpiration on the movement of water and nutrients (soil solution) towards the roots
  - flowers
  - fruits and seeds

- compare monocotyledon and dicotyledon plants based on their morphological features, including flower arrangement, vein structure, vascular bundles, root system and number of cotyledons at germination
- identify agriculturally significant annual, biennial and perennial plants
- outline the key stages of growth for agriculturally significant plants, including germination, emergence, leaf formation, tillering or branching, stem elongation, flowering, seed set and senescence

Genetics and inheritance of traits

- define the key terms used in genetics, including:
  - gametes
  - genes
  - chromosomes
  - allele
  - dominant
  - recessive
  - homozygous
  - heterozygous
  - genotype
  - phenotype
  - autosomal trait
  - sex-linked trait
- explain that the sources of variations in the genotype of offspring arise at the chromosomal level due to a variety of processes, such as mutations and new genetic combinations
- use Punnet squares to determine the potential genotype of offspring as a result of plant and animal reproduction
- discuss the interaction between genotype and environment, and the subsequent impact on phenotype
- evaluate breeding systems, including inbreeding, line breeding, and crossbreeding (hybrid vigour)
- describe the role of a variety of selection criteria, including subjective and objective characteristics, on the breeding programs of production systems

Plant reproduction

- outline the process of cross-pollination and self-pollination (sexual reproduction), including pollination vectors, such as wind, and animal vectors for example insects and birds
- describe common vegetative (asexual) reproduction techniques, such as tubers, stolons, bulbs, rhizomes, layering, grafting, budding and cuttings
- discuss the advantages and disadvantages of asexual reproduction in production systems, such as bananas, viticulture, stone fruits, and citrus
- explain the significant difference in genetic variation between asexual reproduction and sexual reproduction
- describe common sources of natural genetic variation used in plant breeding (wild, natural, seed banks)

Unit 2

Unit description

In this unit, students learn about animal anatomy (structure) and physiology (function), including digestion and reproduction. They learn about the variety of pest and disease causing organisms in food and fibre production systems, the importance of understanding their life cycle in order to control them, the impact of resistance to pesticides and biosecurity measures used to reduce their risk. As well, they learn about the variety of pest management options available through integrated pest management, and about some pests and diseases common to agricultural plants and animals and their control to maintain animal welfare, health and productivity. Students also learn about the application of technology in maintaining and improving productivity in food and fibre production systems.

Learning outcomes

By the end of this unit, students:

- develop the ability to critically evaluate agricultural science concepts, data interpretation, claims and conclusions, with reference to evidence and practical activities
- develop the ability to communicate and justify findings and conclusions related to food and fibre production systems
- recognise key growth stages in animals, and develop an understanding of animal structure, function, nutrition, growth and reproduction
- understand that food and fibre production systems need to control pests and diseases for the health of organisms, health of consumers and health of ecosystems
- understand that the development and application of a wide variety of technologies is important for the productivity of food and fibre production systems.

Unit content

This unit builds on the content covered in Unit 1.

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

Science Inquiry Skills

Hypothesis as a science driver

- identify, research and construct questions for investigation; propose hypotheses; and predict possible outcomes

Data processing and analysis

- distinguish between primary and secondary data, and between primary and secondary information sources
- represent data in meaningful and useful ways, including using appropriate graphic representations and correct units and symbols

- organise and process data to identify trends, patterns and relationships
- identify and distinguish between random and systematic errors, and describe their effect on validity and reliability of data
- evaluate how the nature of the procedure and the sample size may influence limitations in data

Interpreting data, drawing conclusions and evaluating scientific claims

- select, synthesise and use evidence to make and justify conclusions
- interpret a range of scientific texts, and evaluate processes, claims and conclusions by considering the quality of available evidence, and use reasoning to construct scientific arguments

Communicating information

- communicate to specific audiences and for specific purposes using appropriate language, nomenclature and formats, including scientific reports

Growth and development of significant animals for food and natural fibre production

Animal digestion and nutrition

- identify and describe the functions of the key structures of monogastric digestive systems in common livestock, such as poultry, pigs, and fish
- explain the processes of gastric digestion
- identify and describe the functions of the key structures of ruminant digestive systems, such as in cattle, sheep and goats
- explain the process of microbial digestion in herbivores
- outline the basic nutritional requirements of production animals, including carbohydrates (including fibre), proteins, fats, vitamins and minerals
- outline a variety of feed sources for production animals, including pastures and mixed ration
- discuss the utilisation of energy within an animal's body, including energy losses
- discuss the relationship between digestibility, palatability and feed intake
- explain the impact of feed intake and feed conversion ratio on productivity
- evaluate feed-on-offer (FOO), and discuss the impact on stocking rates, and dry sheep equivalent (DSE) and potential need for supplementary feeding
- outline the function and use of feed additives
- discuss selection of ingredients in a ration to meet the requirements of a specific production animal
- formulate feed rations for optimal production using the Pearson Square method
- outline the legal requirements of feeding production animals for the purposes of animal health and welfare, and biosecurity, and food safety
- describe the changes in bone, muscle and fat of an animal over the growth curve and relate these to nutritional needs of the animal and consumer preferences

Animal reproduction

Reproduction cycle of selected production animals

- describe the functions of the parts of mammalian and avian reproductive systems
- discuss the oestrus cycles of livestock relative to duration of oestrus, length of oestrus cycle, and timing of seasonal breeding operations
- describe the mammalian reproductive processes, including conception, pregnancy, birth, lactation, weaning
- describe the avian reproductive processes, including fertilisation, egg laying, incubation and hatching

Controlling pests and diseases

Plant health

- identify common pests and diseases, including weeds, invertebrates (e.g. insects, mites, and nematodes), vertebrates (e.g. rabbits) and micro-organisms (e.g. fungi, bacteria and viruses), found in plant production systems and outline their impact on product quality and yield
- describe common signs and symptoms of damage by pests and diseases
- describe techniques to monitor pests and diseases in a plant production system

Animal health

- identify common pests and diseases, including toxic weeds, invertebrates (e.g. insects, mites and helminths), vertebrates (e.g. foxes) and micro-organisms (e.g. fungi, protozoans, bacteria and viruses), found in animal production systems and outline their impact on product quality and yield
- describe common signs, symptoms and impacts of pests and diseases
- describe techniques to monitor pests and diseases in an animal production system
- describe the cause, impact and control options for one example of each of the following:
  - plant-based toxicity, such as gastrolobium species and annual ryegrass toxicity
  - a metabolic disease, such as bloat and milk fever
  - a hereditary disease
- explain vaccination as a method of disease control

Integrated pest management

- discuss the importance of understanding pest life cycles in managing and controlling pests and diseases
- outline how resistance to pesticides impacts on pest control
- outline biosecurity measures, such as quarantine, border control and on-farm biosecurity programs (quality assurance programs)
- explain how biosecurity measures reduce risks from pests and diseases

- describe and evaluate a variety of pest management options, including:
  - chemical control
  - biological control
  - physical and mechanical control
  - cultural control
  - genetic control

Development and application of technology to support and improve productivity

- identify and explain how a variety of existing and emerging technologies could be used in food and fibre production systems to
  - improve quality of products
  - improve efficiency of production
  - improve natural resource management and environmental footprint
  - address consumer trends

Assessment

Assessment is an integral part of teaching and learning that at the senior secondary years:

- provides evidence of student achievement
- identifies opportunities for further learning
- connects to the standards described for the course
- contributes to the recognition of student achievement.

Assessment for learning (formative) and assessment of learning (summative) enable teachers to gather evidence to support students and make judgements about student achievement. These are not necessarily discrete approaches and may be used individually or together, and formally or informally.

Formative assessment involves a range of informal and formal assessment procedures used by teachers during the learning process in order to improve student achievement and to guide teaching and learning activities. It often involves qualitative feedback (rather than scores) for both students and teachers, which focuses on the details of specific knowledge and skills that are being learnt.

Summative assessment involves assessment procedures that aim to determine students' learning at a particular time, for example when reporting against the standards, after completion of a unit/s. These assessments should be limited in number and made clear to students through the assessment outline.

Appropriate assessment of student work in this course is underpinned by reference to the set of pre-determined course standards. These standards describe the level of achievement required to achieve each grade, from A to E. Teachers use these standards to determine how well a student has demonstrated their learning.

Where relevant, higher order cognitive skills (e.g. application, analysis, evaluation and synthesis) and the general capabilities should be included in the assessment of student achievement in this course. All assessment should be consistent with the requirements identified in the course assessment table.

Assessment should not generate workload and/or stress that, under fair and reasonable circumstances, would unduly diminish the performance of students.

School-based assessment

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

School-based assessment involves teachers gathering, describing and quantifying information about student achievement.

Teachers design school-based assessment tasks to meet the needs of students. As outlined in the *WACE Manual*, school-based assessment of student achievement in this course must be based on the Principles of Assessment:

- Assessment is an integral part of teaching and learning
- Assessment should be educative
- Assessment should be fair
- Assessment should be designed to meet its specific purpose/s
- Assessment should lead to informative reporting
- Assessment should lead to school-wide evaluation processes
- Assessment should provide significant data for improvement of teaching practices.

The table below provides details of the assessment types and their weighting for the Agricultural Science and Technology ATAR Year 11 syllabus.

Summative assessments in this course must:

- be limited in number to no more than eight tasks
- allow for the assessment of each assessment type at least once over the year/pair of units
- have a minimum value of 5 per cent of the total school assessment mark
- provide a representative sampling of the syllabus content.

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

Assessment table – Year 11

Type of assessment	Weighting
Science inquiry Science inquiry involves identifying and posing questions; processing, representing and interpreting data, and identifying relationships and limitations in the data; and communicating findings. Science inquiry tasks are activities which can include analysis and interpretation of scientific, industry, and media texts, and surveys, and evaluating processes, claims and conclusions by considering the quality of available evidence, and using reasoning to construct scientific arguments; and environmental and field work, field trips. Tasks may use qualitative and/or quantitative analysis of primary and/or second-hand data.	15%
Project Projects involve the integration of science and technology into a food or fibre production system. Students develop a general understanding of a food or fibre production system. From this understanding, students analyse and synthesise information from different sources to explain relevant scientific and/or technological concepts that improve product quality, efficiency of production, sustainability, and respond to consumer trends. Projects can involve selecting appropriate production concepts that could be applied to existing or new situations, and analysing and evaluating possible management processes to achieve optimal production and to meet industry standards, and proposing adaptations to improve the performance of food and fibre production systems. Project tasks can take the form of research reports, in-class responses, oral and/or multimedia presentations.	20%
Test Tests are designed to assess knowledge and the application of concepts relating to food and fibre production systems. Questions can involve comprehension, evaluation and application of information, and problem solving. Tests typically consist of multiple-choice questions, as well as questions requiring short and extended answers.	25%
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.	40%

Teachers must use the assessment table to develop an assessment outline for the pair of units.

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).

Reporting

Schools report student achievement, underpinned by a set of pre-determined standards, using the following grades:

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

The grade descriptions for the Agricultural Science and Technology ATAR Year 11 syllabus are provided in Appendix 1. They are used to support the allocation of a grade. They can also be accessed, together with annotated work samples, 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.

The grade is determined by reference to the standard, not allocated on the basis of a pre-determined range of marks (cut-offs).

Appendix 1 – Grade descriptions Year 11*

A	Explains, in detail, the relationships between structure and function in biological systems important in agricultural plants and animals used in food and fibre production.
	Explains, in detail, the principles and factors that underpin sustainability in agricultural production systems.
	Uses industry-specific and technical language frequently in the correct context.
	Communicates detailed information and concepts logically and coherently, using correct terminology and appropriate conventions.
	Sources valid and reliable data, organises it logically, and accurately presents it in a variety of forms, including appropriate graphs, tables and charts to reveal trends, patterns and relationships.
	Comprehensively explains trends, patterns and/or relationships and uses evidence to draw valid conclusions.

B	Describes the relationships between structure and function in biological systems important in agricultural plants and animals used in food and fibre production.
	Briefly explains the principles and factors that underpin sustainability in agricultural production systems.
	Uses industry-specific and technical language accurately.
	Communicates information and concepts logically, using correct terminology and appropriate conventions.
	Sources valid and reliable data, and presents it in a variety of forms, including appropriate graphs, tables and charts to reveal trends, patterns and relationships.
	Briefly explains trends, patterns and/or relationships and uses evidence to draw conclusions.

C	Outlines structure and function in biological systems important in agricultural plants and animals used in food and fibre production.
	Outlines the principles and factors that underpin sustainability in agricultural production systems.
	Uses industry-specific and technical language.
	Communicates information and concepts, with minimal detail, using some correct terminology and appropriate conventions.
	Sources data and presents it using basic tables and appropriate graphs.
	Outlines general trends, patterns and/or relationships in the data and draws simple conclusions.

D	Identifies structures and some of their functions in biological systems important in agricultural plants and animals.
	Identifies some of the principles and factors that underpin sustainability in agricultural production systems.
	Uses everyday language with minimal industry-specific and technical language.
	Communicates information using everyday language with frequent errors in the use of conventions.
	Sources data that may be invalid and/or unreliable, and may present it using incorrect and/or incomplete formats.
	Identifies trends, patterns and/or relationships in the data incorrectly or overlooks them. Offers simple conclusions that are not supported by the data.

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

***** These grade descriptions will be reviewed at the end of the second year of implementation of this syllabus.

Appendix 2 – Glossary

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

Data
The plural of datum; the measurement of an attribute; for example, the mass of an animal or the number of worm eggs in a sample. 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.

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.

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.

Random error
Uncontrollable effects of the measurement equipment, procedure and environment on a measurement result; the magnitude of random error for a measurement result can be estimated by finding the spread of values around the average of independent, repeated measurements of the quantity.

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.

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.

Signs
In the context of plant and animal pests and diseases, signs are the evidence of the damaging factor (pest or disease). Examples of signs include egg masses laid on the underside of a leaf as a sign of an insect pest, insect frass, egg masses in animal manure, and fungal spores.

Sustainability
Can be considered as meeting the needs of current and future generations through integration of environmental protection, social advancement and economic prosperity.

Symptoms
Symptoms are changes in plant or animal growth or appearance in response to biotic or abiotic factors. Examples of symptoms include dieback, flagging, wilting, and chlorosis in plants, and skin lesions, hair loss and weight loss in animals.

Systematic error
The contribution to the uncertainty in a measurement result that is identifiable and quantifiable; for example, imperfect calibration of measurement instruments.

Systems
Can include food and fibre production systems, management systems, value-adding systems, service and maintenance systems, biotic systems and abiotic systems.

Technologies
Include artificial breeding techniques, electronic identification systems, genetic engineering, specialised equipment used in food and fibre production, and information and communication technology (ICT).

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.