



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

PLANT PRODUCTION SYSTEMS

ATAR COURSE

Year 11 syllabus

IMPORTANT INFORMATION

This syllabus is effective from 1 January 2017.

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Rationale

The Plant Production Systems ATAR course enables students to develop knowledge and skills related to the sustainable use of resources, and the production and marketing of a range of plants and their products. Students explore ways that people manage natural resources such as plants, animals, soil and water to meet personal and community needs. They evaluate food and fibre production systems, sustainable practices, new technologies, consumer-driven economics, and product marketing.

Plant production systems are a fundamental component of agriculture, which has never been more important than in the twenty-first century. Agricultural output and productivity are expected to continue to increase as the world's population reaches an estimated nine billion by 2050. International demand for high quality and safe food and fibre products, particularly from Asia, predicts a positive outlook for the State's agriculture and food sector, while managing biosecurity risks and minimising the impact of climate variability have become more important in order to remain sustainable and globally competitive. Other challenges include ever-increasing competition for natural resources, environmental degradation and food safety issues.

Australia is well positioned to maintain its reputation for 'clean and green' products, and to be a world leader in agricultural production. There will continue to be a demand for people skilled in combining scarce resources and for innovative methods of production.

Course outcomes

The Plant Production Systems ATAR course is designed to facilitate achievement of the following outcomes.

Outcome 1 – Investigating plant production

Students use investigative processes to address plant production challenges.

In achieving this outcome, students:

- investigate issues, needs and opportunities related to plant production challenges
- generate proposals to address plant production challenges
- collect evidence from own or others' investigations, evaluate solutions and processes, and communicate findings.

Outcome 2 – Plant production principles

Students understand the principles and practices underpinning efficient and sustainable plant production systems.

In achieving this outcome, students:

- understand the structure and function of a range of plants or production systems
- understand the interdependence of the elements of natural systems and plant production systems
- understand management strategies underpinning plant production systems.

Outcome 3 – Plant production practices

Students apply skills and technologies to achieve efficient and sustainable plant production and marketing.

In achieving this outcome, students:

- select and use safely technologies and skills for plant production
- apply skills to manage production in a sustainable manner
- apply economic and management practices to optimise viable plant production.

Outcome 4 – Agriculture, society and environment

Students understand the relationships between agriculture, society and the environment.

In achieving this outcome, students:

- understand the role of agriculture in shaping the environment and its involvement in developing Australian societies
- understand that economic and technological trends, and cultural beliefs and values, affect plant 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.

Unit 1

In this unit, students learn about plant anatomy, growth and development and how these contribute to the production of a marketable product.

Unit 2

In this unit, students learn about the improvement of the immediate plant environment to optimise growth and development through all phases of plant growth.

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

This course has nine content areas:

- Systems ecology
- Plant structure and function
- Plant environment
- Plant health
- Breeding and improvement
- Economics, finance and markets
- Sustainable production
- Investigating plant production
- Produce for purpose

The content should be based around one or more plant production enterprises.

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.

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 Plant Production Systems 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 and 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, including issues relating to reliability and probability, and they interpret and manipulate mathematical relationships to calculate and predict values. In the Plant Production Systems ATAR course, students also use numeracy skills in the form of budgets and marketing decision making.

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 Plant Production Systems 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 Plant Production Systems 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 plant anatomy, growth and development and how these contribute to the production of a marketable product. They learn about plant responses to different growing conditions as well as the impact of pests, including options to minimise negative effects and promote sustainability. Students examine the properties of different soil types and how these affect the plant's ability to access requirements for growth. Students learn about the impacts of plant production on the natural environment, and stewardship of natural and farming resources. They learn about the value of domestic plant production, and marketing options. Students will be involved in an investigation and will learn to identify the elements of valid experimental design.

The content should be based around one or more plant production enterprises.

Unit content

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

Knowledge and management of plant production systems

Systems ecology

- impact of plant production systems on natural ecosystems, including
 - the effects on soils
 - water quality
 - atmospheric
 - soil pollution
 - loss of biodiversity
- effects of pesticides on the environment

Plant structure and function

- structure and function of stems, roots, leaves, flowers, fruit, seeds
- response of plant growth to limiting factors
 - temperature
 - water
 - gases
 - nutrients
- nutrient requirements throughout plant growth stages

Plant environment

- the environment of the shoot, including gaseous exchange and light absorption
- the environment of the root, including water absorption, macro- and micro-nutrients and oxygen
- function of micronutrients and symptoms of deficiencies
- soil textures and their nutrient and water holding capacity

- comparison of long-term climate records with current weather patterns

Plant health

- impact of pests and diseases on production systems
- life cycles of selected pests and diseases
- assessment of pest and disease risk
- biosecurity measures to reduce risk from pests and diseases
- factors influencing pest and disease control programs

Breeding and improvement

- aims of breeding and selection, including profitability and meeting market requirements
- sources of genetic variation
- selection criteria, including subjective and objective characteristics
- legal requirements of plant production, including plant variety rights (PVR)

Economics, finance and markets

- quantity and value of domestic plant products
- marketing options for plant products
- assessment of resources used in enterprises
- marginal costs and marginal returns and the application of the law of diminishing returns

Sustainable production

- maintaining and improving the quality of soil and water
- stewardship of natural and farming resources, including technologies
- complying with industry codes of practice

Investigating Plant Production

- develop hypotheses to test based on prior information
- design and conduct an investigation, considering aspects of experimental design, including variables and controls
- analyse and interpret data, including calculating means
- present data using appropriate methods
- draw conclusions based on experimental data and validate from other sources

Produce for purpose

- implement a calendar of operations for a selected plant enterprise

Unit 2

Unit description

In this unit students learn about the improvement of the immediate plant environment to optimise growth and development through all phases of plant growth. This includes fertiliser application and soil management techniques. Students learn about the principles of genetics and the effect of interactions between genotype and environment and how this can influence plant breeding. They learn about monitoring and managing pest populations and identify risks to sustainable production. Students learn about the role of quality assurance (QA) programs in plant production systems and how to prepare budgets for an enterprise.

The content should be based around one or more plant production enterprises.

Unit content

This unit builds on the content covered in Unit 1.

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

Knowledge and management of plant production systems

Systems ecology

- benefits to plant production systems of ecosystem components, including
 - clean water
 - plant pollination
 - nutrient cycling
 - pest and disease management
- nutrient cycles, including nitrogen, carbon, phosphorus

Plant structure and function

- sexual reproduction by seeds through self-pollination and cross-pollination
- asexual reproduction by vegetative means
- phases of growth, growth curves, and plant requirements at different stages

Plant environment

- soil pH and its influence on nutrient availability
- interpreting soil and plant test results
- correcting soil acidity and alkalinity
- monitoring soil nutrients
- options for nutrient management, including rotations, artificial fertilisers and biological methods
- maximising the effectiveness of fertilisers through timing and placement
- identifying risks of nutrient pollution

- techniques to manage soil water, soil texture and soil structure, including
 - cultivation
 - drainage
 - weed control
 - surface mulches

Plant health

- monitoring pests and diseases in a production system
- pest and disease management options, including integrated pest management (IPM)
- factors affecting the selection of pesticides, including withholding periods

Breeding and improvement

- genetic terms and concepts, including
 - gamete
 - chromosomes
 - genes
 - alleles
 - dominant
 - recessive
 - genotype
 - phenotype
- predicting outcomes of crosses using punnett squares
- interactions between genotype and environment (GxE)
- breeding systems, including
 - cross breeding
 - backcrossing
 - selfing

Economics, finance and markets

- applying the law of the minimum to plant production
- factors affecting supply and demand
- interpretation of supply and demand information for a product
- preparation of simple budgets for an enterprise and identification of items likely to impact on profit

Sustainable production

- identification of risks to sustainable production
- review the sustainability of current management practices
- government legislation relating to a selected enterprise

Investigating plant production

- develop hypotheses to test based on prior information
- design and conduct an investigation, considering aspects of experimental design, including variables and controls
- analyse and interpret data, including calculating means
- present data using appropriate methods
- draw conclusions based on experimental data and validate from other sources

Produce for purpose

- select crops and cultivars to meet market requirements
- manage crops to optimise profitability
- assess quality of product against market specifications
- identify quality assurance programs for selected plant production systems, including their purpose and major features
- identify transport and storage requirements for plant products

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 Plant Production Systems ATAR Year 11 syllabus and the weighting for each assessment type.

Assessment table – Year 11

Type of assessment	Weighting
Investigation An investigation is an activity in which ideas, predictions or hypotheses are tested and conclusions are drawn in response to a question or problem. Tasks include: <ul style="list-style-type: none"> planning investigations, proposing hypotheses and predicting outcomes designing investigations, including the procedures to be followed, discussion of variables, type and amount of data to be collected, risk assessments and consideration of research ethics conducting investigations in a safe, competent and methodical manner to collect valid and reliable data processing, representing and interpreting data, and identifying relationships and limitations in the data communicating findings in an appropriate form, including written, oral, graphic or combinations of these. Appropriate strategies should be used to authenticate student achievement of an investigation that has been completed as a group or outside of allocated class time.	10%
Production project Production projects involve the synthesis of theory and practice of a plant production system. Tasks can involve selecting and applying appropriate production concepts to existing or new situations; managing processes for optimal production and to meet industry standards, and proposing adaptations to improve the management of plant production systems. Tasks can take the form of specific questions based on a selected plant production system, related practical activities, and integration of relevant information from scientific or media sources. It is highly recommended that work completed out of class is authenticated using an in-class assessment task under test conditions.	30%
Test Tests are designed to assess knowledge and the application of concepts relating to plant 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.	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.	40%

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, except Investigation, which must be included at least once. In the assessment outline where a single unit is being studied, each assessment type must be included at least once.

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

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

Grading

Schools report student achievement in terms of the following grades:

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

The teacher prepares a ranked list and assigns the student a grade for the pair of units (or for a unit where only one unit is being studied). The grade is based on the student's overall performance as judged by reference to a set of pre-determined standards. These standards are defined by grade descriptions and annotated work samples. The grade descriptions for the Plant Production Systems 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 detailed concepts about production systems and processes to enterprises, offering clear and accurate explanations.

Uses industry-specific and technical language frequently and accurately.

Comprehensively explains relationships between the social, economic and environmental issues arising from production systems.

Enterprise management skills

Selects and uses appropriate resources and equipment to confidently perform a range of tasks; consistently meeting safety and industry standards.

Completes all aspects of tasks systematically, paying attention to detail.

Consistently applies economic principles to evaluate viability and sustainability.

Applies theoretical concepts consistently when using a selected production system.

Science inquiry skills

Formulates a hypothesis stating the relationship between dependent and independent variables.

Designs investigations to identify and explain how appropriate variables are controlled, describing the experimental method in detail and accurately collecting data.

Organises data logically, and accurately presents it in a range of forms, including appropriate graphs, tables and charts to reveal patterns and relationships.

Provides clear recommendations to improve the validity and reliability of the investigation.

Uses evidence to draw valid conclusions that relate to the hypothesis.

B

Understanding and applying concepts

Applies concepts about production systems and processes to selected enterprises, offering mostly accurate explanations.

Uses industry-specific and technical language frequently.

Describes relationships between social, economic and environmental issues relevant to selected enterprises.

Enterprise management skills

Uses appropriate resources and equipment to complete most aspects of tasks, meeting safety and industry standards.

Uses economic principles to assess viability and to address sustainability.

Applies theoretical concepts when using most aspects of a selected production system.

Science inquiry skills

Formulates a hypothesis that includes the dependent and independent variables.

Designs investigations to identify and control appropriate variables, describing the experimental method and adequately collecting data.

Presents data in a range of forms, including appropriate graphs, tables and charts to reveal patterns and relationships.

Suggests ways to improve the validity and reliability of the investigation.

Uses evidence to draw conclusions that relate to the hypothesis.

C	<p>Understanding and applying concepts</p> <p>Describes key aspects of production systems, processes and the links to selected enterprises, providing partially accurate statements.</p> <p>Generally uses basic industry-specific and technical language.</p> <p>Identifies key social, economic and environmental issues relevant to a selected enterprise.</p>
	<p>Enterprise management skills</p> <p>Uses appropriate resources and equipment to perform a range of directed tasks and, with support, meet safety and industry standards.</p> <p>Identifies the economic principles required to assess viability, but uses them only occasionally and/or with errors.</p> <p>Applies theoretical concepts when using several aspects of a selected production system.</p>
	<p>Science inquiry skills</p> <p>Identifies dependent, independent and controlled variables.</p> <p>Makes a prediction as a hypothesis.</p> <p>Briefly outlines the experimental method and collects data.</p> <p>Follows set experimental procedures to collect data.</p> <p>Presents data using basic tables and appropriate graphs, identifying general trends in data.</p> <p>Makes general suggestions for improving the investigation.</p> <p>Draws simple conclusions that may not be linked back to the hypothesis.</p>
D	<p>Understanding and applying concepts</p> <p>Describes elements of production systems and processes, but with limited linking to selected enterprises.</p> <p>Provides brief, inaccurate and/or largely incomplete responses.</p> <p>Uses everyday language with minimal industry-specific and technical language.</p> <p>Identifies sustainable practices but without elaboration.</p>
	<p>Enterprise management skills</p> <p>Uses resources and equipment to carry out tasks, mostly collaboratively and with extensive reinforcement.</p> <p>Displays limited application of safety and industry standards.</p> <p>Poor linking exists between theoretical concepts and practical application.</p>
	<p>Science inquiry skills</p> <p>Incompletely/inaccurately identifies the dependent, independent and controlled variables.</p> <p>Describes method with insufficient detail.</p> <p>With guidance, follows set experimental procedures to collect data.</p> <p>Presents data that is unclear and insufficient.</p> <p>Includes anomalous results in the data without identifying them as anomalous.</p> <p>Overlooks trends in data.</p> <p>Offers simple conclusions that are not supported by the data or are not related to the hypothesis.</p>
E	<p>Does not meet the requirements of a D grade and/or has completed insufficient assessment tasks to be assigned a higher grade.</p>

Appendix 2 – Glossary

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

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.
Natural systems	Comprise ecological and physiological systems that exist without human intervention.
Plant production systems	Are those based on natural systems that have been managed, manipulated, adapted and refined to meet human needs for food, fibre, shelter and lifestyle.
Skills	Include handling plants, harvesting plant products, applying plant health remedies, testing and plant improvement methods.
Social systems	Are those that have evolved to manage human interaction with each other and the built and natural environments.
Sustainability	Can be considered as meeting the needs of current and future generations through integration of environmental protection, social advancement and economic prosperity.
Systems	Can include plant production and marketing systems, management systems, value-adding systems, service and maintenance systems, biotic systems and abiotic systems.
Technologies	Including genetic engineering, new plant production techniques, specialised equipment and machinery, global positioning systems, and information and communication technology (ICT).



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PLANT PRODUCTION SYSTEMS

ATAR COURSE

Year 12 syllabus

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Rationale

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Plant production systems are a fundamental component of agriculture, which has never been more important than in the twenty-first century. Agricultural output and productivity are expected to continue to increase as the world's population reaches an estimated nine billion by 2050. International demand for high quality and safe food and fibre products, particularly from Asia, predicts a positive outlook for the State's agriculture and food sector, while managing biosecurity risks and minimising the impact of climate variability have become more important in order to remain sustainable and globally competitive. Other challenges include ever-increasing competition for natural resources, environmental degradation and food safety issues.

Australia is well positioned to maintain its reputation for 'clean and green' products, and to be a world leader in agricultural production. There will continue to be a demand for people skilled in combining scarce resources and for innovative methods of production.

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- collect evidence from own or others' investigations, evaluate solutions and processes, and communicate findings.

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In achieving this outcome, students:

- understand the structure and function of a range of plants or production systems
- understand the interdependence of the elements of natural systems and plant production systems
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Outcome 3 – Plant production practices

Students apply skills and technologies to achieve efficient and sustainable plant production and marketing.

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- select and use safely technologies and skills for plant production
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Outcome 4 – Agriculture, society and environment

Students understand the relationships between agriculture, society and the environment.

In achieving this outcome, students:

- understand the role of agriculture in shaping the environment and its involvement in developing Australian societies
- understand that economic and technological trends, and cultural beliefs and values, affect plant 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 12 syllabus is divided into two units which are delivered as a pair. The notional time for the pair of units is 110 class contact hours.

Unit 3

In this unit, students learn about the importance of sustainable management practices, and the balance of short-term financial needs with long-term maintenance and improvement of resources.

Unit 4

In this unit, students identify issues for Australia in maintaining global competitiveness, and examine market protection strategies.

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

This course has nine content areas:

- Systems ecology
- Plant structure and function
- Plant environment
- Plant health
- Breeding and improvement
- Economics, finance and markets
- Sustainable production
- Investigating plant production
- Produce for purpose

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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, including issues relating to reliability and probability, and they interpret and manipulate mathematical relationships to calculate and predict values. In the Plant Production Systems ATAR course, students also use numeracy skills in the form of budgets and marketing decision making.

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 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 Plant Production Systems 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 Plant Production Systems 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 3

Unit description

In this unit, students learn about the importance of sustainable management practices, and the balance of short-term financial needs with long-term maintenance and improvement of resources. Students identify major markets and advantages of Australian produce, and the role of quality assurance. They consider factors involved in fertiliser selection, and use production records in decision making. Students evaluate experimental data and scientific method, as well as proposing areas for future investigation.

Unit content

An understanding of the Year 11 content is assumed knowledge for students in Year 12. It is recommended that students studying Unit 3 and Unit 4 have completed Unit 1 and Unit 2.

The content should be based around one or more plant production enterprises. This unit includes the knowledge, understandings and skills described below. This is the examinable content.

Knowledge and management of plant production systems

Systems ecology

- comparison of natural, agricultural and urban ecosystems, including the energy flow and recycling of matter

Plant structure and function

- utilisation of the net products of photosynthesis
- transpiration and its controls
- absorption and translocation of nutrients
- plant hormones and their role in plant physiology, including gibberellins, ethylene, cytokinins and auxins

Plant environment

- determining the availability of water in growing media and soil water management
- production records used in nutrition management
- decision making involved in fertiliser selection, including soil and crop type, stage of growth, cost, availability, and application method

Plant health

- the relationship between modes of action of pesticides to their effectiveness, and to resistance risk
- the development of pesticide resistance
- avoiding and managing pesticide resistance

Breeding and improvement

- sources of genetic diversity, including seed banks
- breeding technologies, including genetically modified organisms (GMO)
- steps in breeding new plant varieties

Economics, finance and markets

- comparative advantage of Australian producers in the international market
- importance of the global economy to Australian plant production, including major markets and competitors
- use budgets and gross margins to compare profitability of management decisions
- use market information to plan production and marketing
- use financial records to guide decision making

Sustainable production

- intergenerational equity as ensuring that the wellbeing of future generations (social, economic and environmental factors) are not compromised by the activities of the current generation
- duty of care in the workplace
- planning for sustainability: balancing short-term needs with long-term improvement of resources

Investigating plant production

- develop hypotheses to test, based on prior information
- design and conduct an investigation considering aspects of experimental design, including variables, controls, randomisation and replication
- analyse and interpret data, including use of standard deviation and standard error
- present data using appropriate methods
- draw conclusions based on experimental data and validate from other sources
- evaluate experimental design, including possible bias and experimental error, and propose areas for future investigation

Produce for purpose

- identify variations in product quality and quantity and causes, including variety, weather, nutrition, handling and transport
- effect of product variation on financial return
- evaluate on-farm practices to meet quality assurance criteria

Unit 4

Unit description

In this unit, students identify issues for Australia in maintaining global competitiveness, and examine market protection strategies. Students investigate the implications of climate change on plant production systems, and the breeding of new cultivars. Students learn about manipulating plant processes and managing pests to optimise production in a sustainable manner. They consider and propose solutions to address suboptimal production. They consider the advantages and disadvantages of new technologies, and their related ethical and economic issues. They assess and manage risks involved in plant production and use financial analysis to guide decision making. They consider the importance of conservation and restoration of natural and agricultural ecosystems, and propose short-term and long-term enterprise goals.

Unit content

This unit builds on the content covered in Unit 3. The content should be based around one or more plant production enterprises.

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

Knowledge and management of plant production systems

Systems ecology

- conservation of biodiversity and natural ecosystems
- climate change and possible impacts on production systems

Plant structure and function

- manipulating plant processes by managing plant growing conditions
- the use of plant hormones in manipulating end products
- use of synthetic hormones in weed control

Plant environment

- designing a plant nutrition program
- management of plant nutrition and soil water throughout the growing season
- nutrient application to reduce environmental impacts

Plant health

- economic principles of pest and disease control, including thresholds and economic injury levels of pests
- management strategies for pest and disease outbreak on a local, national and international level
- comparing the effectiveness of different pest control methods

Breeding and improvement

- developing cultivars for specific environments and markets
- impact of breeding technologies and related ethical issues

Economics, finance and markets

- maintaining Australian global competitiveness
- protection strategies for Australian markets, including quarantine and tariffs
- altering production systems in response to consumer trends

Sustainable production

- establishing short-term and long-term enterprise goals
- optimising production through new technologies
- managing the conflicting demands of social, environmental and economic factors, also known as the 'triple bottom line'
- responding to the impacts of climate change on production systems
- assessment and management of risk, including probabilities, consequences, avoidance and mitigation

Investigating plant production

- develop hypotheses to test, based on prior information
- design and conduct an investigation considering aspects of experimental design, including variables, controls, randomisation and replication
- analyse and interpret data, including use of standard deviation and standard error
- present data using appropriate methods
- draw conclusions based on experimental data and validate from other sources
- evaluate experimental design, including possible bias and experimental error, and propose areas for future investigation

Produce for purpose

- propose adaptations to production systems to improve efficiency or to meet changed circumstances
- evaluate new technologies to optimise production

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 Plant Production Systems ATAR Year 12 syllabus and the weighting for each assessment type.

Assessment table – Year 12

Type of assessment	Weighting
Investigation An investigation is an activity in which ideas, predictions or hypotheses are tested and conclusions are drawn in response to a question or problem. Tasks include: <ul style="list-style-type: none"> planning investigations, proposing hypotheses and predicting outcomes designing investigations, including the procedures to be followed, discussion of variables, type and amount of data to be collected, risk assessments and consideration of research ethics conducting investigations in a safe, competent and methodical manner to collect valid and reliable data processing, representing and interpreting data, and identifying relationships and limitations in the data communicating findings in an appropriate form, including written, oral, graphic or combinations of these. Appropriate strategies should be used to authenticate student achievement of an investigation that has been completed as a group or outside of allocated class time.	10%
Production project Production projects involve the synthesis of theory and practice of a plant production system. Tasks can involve selecting and applying appropriate production concepts to existing or new situations, managing processes for optimal production and to meet industry standards, and proposing adaptations to improve the management of plant production systems. Tasks can take the form of specific questions based on a selected plant production system, related practical activities, and integration of relevant information from scientific or media sources. It is highly recommended that work completed out of class is authenticated using an in-class assessment task under test conditions.	20%
Test Tests are designed to assess knowledge and the application of concepts relating to plant 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.	20%
Examination Typically conducted at the end of each semester and/or unit and reflecting the examination design brief for this syllabus.	50%

Teachers are required to 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).

In the assessment outline for the pair of units, each assessment type must be included at least twice, except Investigation, which must be included at least once.

The set of assessment tasks must provide a representative sampling of the content for Unit 3 and Unit 4.

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

Grading

Schools report student achievement in terms of the following grades:

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

The teacher prepares a ranked list and assigns the student a grade for the pair of units. 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 Plant Production Systems ATAR Year 12 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.

ATAR course examination

All students enrolled in the Plant Production Systems ATAR Year 12 course are required to sit the ATAR course examination. The examination is based on a representative sampling of the content for Unit 3 and Unit 4. Details of the ATAR course examination are prescribed in the examination design brief on the following page.

Refer to the WACE Manual for further information.

Examination design brief – Year 12

Time allowed

Reading time before commencing work: ten minutes

Working time for paper: three hours

Permissible items

Standard items: pens (blue/black preferred), pencils (including coloured), sharpener, correction fluid/tape, eraser, ruler, highlighters

Special items: non-programmable calculators approved for use in the ATAR course examinations

SECTION	SUPPORTING INFORMATION
Section One Multiple-choice 20% of the total examination 20 questions Suggested working time: 30 minutes	Questions can require the candidate to refer to the stimulus material which can include: text, diagrams, tables and/or graphs.
Section Two Short answer 50% of the total examination 5–8 questions Suggested working time: 90 minutes	Each question is divided into parts. Questions can require the candidate to refer to the stimulus material that can include: text, diagrams, graphs, tables, photographs and/or scenarios.
Section Three Extended answer 30% of the total examination Two questions: one compulsory question and one question from a choice of two Suggested working time: 60 minutes	The compulsory question focuses on the practical application of knowledge, skills and understandings directly related to a plant production enterprise studied by the candidate. The other question requires the candidate to interpret and integrate information. Stimulus material can include: text, diagrams, graphs, tables, photographs and/or scenarios.

Appendix 1 – Grade descriptions Year 12

A

Understanding and applying concepts

Comprehensively explains management practices of production systems with clear links to production.

Comprehensively explains marketing principles of production systems.

Examines and evaluates the impact of innovation and ethics on production systems to present logical, well-developed arguments.

Analyses the effects of social, economic and environmental issues on production to provide relevant and detailed suggestions to develop sustainable production systems.

Science Inquiry Skills

Formulates a hypothesis that states the relationship between dependent and independent variables.

Designs investigations to identify dependent and independent variables, and control appropriate variables.

Describes the experimental method in detail and accurately collects data.

Organises data logically and accurately processes data.

Presents data in a range of forms, including graphs, tables and charts to reveal patterns and relationships.

Comprehensively explains trends using data, including numerical data when appropriate, as evidence to draw conclusions that relate to the hypothesis.

Evaluates the experimental method and provides specific relevant suggestions to improve the validity and reliability of the data collected.

Communicates detailed and relevant information and concepts logically and coherently, using correct terminology and appropriate conventions.

Enterprise management skills

Selects and uses appropriate resources and equipment to plan and consistently manage a broad range of tasks in an efficient, confident and safe manner, adhering to industry standards.

Applies a wide range of economic principles and tools to plan and manage for optimal production.

Applies sustainable production practices to a wide range of operations.

Completes all tasks systematically and concisely, and validates work with significant evidence.

B

Understanding and applying concepts

Explains management practices of selected production systems linking them to production.
 Explains marketing principles of selected production systems.
 Explains the impact of innovation and ethics on production systems.
 Analyses the effects of social, economic and environmental issues on production to provide relevant suggestions to develop sustainable production systems.

Science Inquiry Skills

Formulates a hypothesis that states the relationship between dependent and independent variables.
 Designs investigations to identify dependent and independent variables, and control appropriate variables.
 Describes the experimental method and accurately collects data.
 Organises data logically and usually processes data accurately.
 Presents data in a range of forms, including graphs, tables and charts to reveal patterns and relationships.
 Explains trends using some numerical data, where appropriate, and uses evidence to draw conclusions that relate to the hypothesis.
 Evaluates the experimental method and provides relevant suggestions to improve the validity and reliability of the data collected.
 Communicates information and concepts logically, using correct terminology and appropriate conventions.

Enterprise management skills

Selects and uses resources and equipment to manage a range of tasks safely and effectively, meeting industry standards.
 Uses a range of economic principles and tools to plan and manage for optimal production.
 Applies sustainable production practices in a selected enterprise.
 Completes all task aspects thoroughly, using evidence to validate work.

C

Understanding and applying concepts

Describes key management practices of selected production systems with some linking of them to production.

Describes marketing principles of selected production systems.

Describes the impact of innovation and ethics on production systems.

Identifies key social, economic and environmental issues relevant to a selected production system to give some simple suggestions to develop sustainable production systems.

Science Inquiry Skills

Provides a statement that links dependent and independent variables without stating their relationship.

Designs investigations to identify and control some variables, briefly outlines the experimental method and collects data. Follows set experimental procedures to collect data.

Organises and processes data with some errors or omissions.

Presents data using basic tables and appropriate graphs, identifying general trends in data.

Describes trends in the data and draws simple conclusions that may not be linked back to the hypothesis.

Provides general suggestions to improve the investigation.

Communicates information and concepts, without detail, using some correct terminology and appropriate conventions.

Enterprise management skills

Uses resources and equipment to perform tasks in an inconsistent manner where safety and effectiveness are not always maintained.

Uses elements of economic principles and tools to optimise production.

Considers sustainable production practices in a selected production system.

Completes essential task requirements, using basic evidence to support work.

D

Understanding and applying concepts

Provides limited descriptions of management practices of selected production systems with limited linking of them to production.

Provides limited descriptions of marketing principles of selected production systems.

Provides limited descriptions of the impact of innovation and ethics on production systems.

Makes little reference to social, economic and environmental issues relevant to a selected production system.

Science Inquiry Skills

Provides a statement that identifies one or more relevant variables without making links between them.

Identifies a limited number of controlled variables.

Describes method with limited detail. With guidance, follows set experimental procedures to collect data.

Presents data that is unclear, insufficient and lacks appropriate processing.

Identifies trends in the data incorrectly or overlooks trends. Includes anomalous results in the data without identifying them as anomalous.

Offers simple conclusions that are not supported by the data or are not related to the hypothesis.

Provides trivial or irrelevant suggestions for improving the investigation.

Communicates information using everyday language with frequent errors in the use of conventions.

Enterprise management skills

Selects inappropriate equipment and resources for tasks, with infrequent adherence to industry and safety standards.

Displays ineffective and inconsistent application of theoretical concepts.

Completes a few task requirements.

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.

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.
Natural systems	Comprise ecological and physiological systems that exist without human intervention.
Plant production systems	Are those based on natural systems that have been managed, manipulated, adapted and refined to meet human needs for food, fibre, shelter and lifestyle.
Skills	Include handling plants, harvesting plant products, applying plant health remedies, testing and plant improvement methods.
Social systems	Are those that have evolved to manage human interaction with each other and the built and natural environments.
Sustainability	Can be considered as meeting the needs of current and future generations through integration of environmental protection, social advancement and economic prosperity.
Systems	Can include plant production and marketing systems, management systems, value-adding systems, service and maintenance systems, biotic systems and abiotic systems.
Technologies	Including genetic engineering, new plant production techniques, specialised equipment and machinery, global positioning systems, and information and communication technology (ICT).