



Agriculture

Stage 6

Syllabus

Amended 2013

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1 The Higher School Certificate program of study

The purpose of the Higher School Certificate program of study is to:

- provide a curriculum structure which encourages students to complete secondary education
- foster the intellectual, social and moral development of students, in particular developing their:
 - knowledge, skills, understanding and attitudes in the fields of study they choose
 - capacity to manage their own learning
 - desire to continue learning in formal or informal settings after school
 - capacity to work together with others
 - respect for the cultural diversity of Australian society
- provide a flexible structure within which students can prepare for:
 - further education and training
 - employment
 - full and active participation as citizens
- provide formal assessment and certification of students' achievements
- provide a context within which schools also have the opportunity to foster students' physical and spiritual development.

2 Rationale for Agriculture in the Stage 6 Curriculum

Agriculture provides people with food, fibre, fuel, shelter and the possibility of diverse lifestyles. Agriculture is a composite of rural and urban industries that are structured to produce both raw and value-added materials from plants and animals to meet identified consumer needs.

Agriculture has a unique place in the history of human society. It underpins social structures and provides for basic human needs. It is fundamental to human progress.

Agricultural industries make a significant contribution to Australia's economy through investment, employment of skilled workers, consumption of products from other sectors of the economy and export. Agricultural products contribute significantly to Australia's export income. The total chain, from the farm and the research laboratory to the processing plant, retail outlet and exporter, accounts for a major portion of the nation's Gross Domestic Product. Australia's agricultural industries must undergo significant and continuous change to maintain and possibly enhance this contribution to the Australian economy.

The *Agriculture Stage 6 Syllabus* provides students with opportunities to understand and appreciate these essential aspects of agriculture.

Agriculture's dynamic nature results from the increase in knowledge and the application of technology to the production, processing and marketing of products in complex national and international marketplaces. This complexity has political, social, ethical, economic and environmental implications for Australia. The majority of consumers are isolated from the production and processing of food and fibre. This course provides students with an understanding of the relationships between production, processing and consumption to enable them to participate in debate on the impact of each upon society and the environment.

The *Agriculture Stage 6 Syllabus* has been designed to allow students to develop knowledge and understanding of the interaction between the components of agriculture and the scientific principles that explain the processes that take place when inputs are transformed into outputs. It caters for a diverse range of students and ability levels. It has the facility to challenge students academically as well as providing them with a wide range of practical skills and an awareness of technologies associated with agriculture.

Opportunities are also provided for students to develop awareness of the welfare, ethical and legal issues relating to animal research.

The *Agriculture Stage 6 Syllabus* provides opportunities for multiple pathways to employment and further education. Some students may well be stimulated to move into post-secondary agricultural courses or to seek employment in rural and related industries.

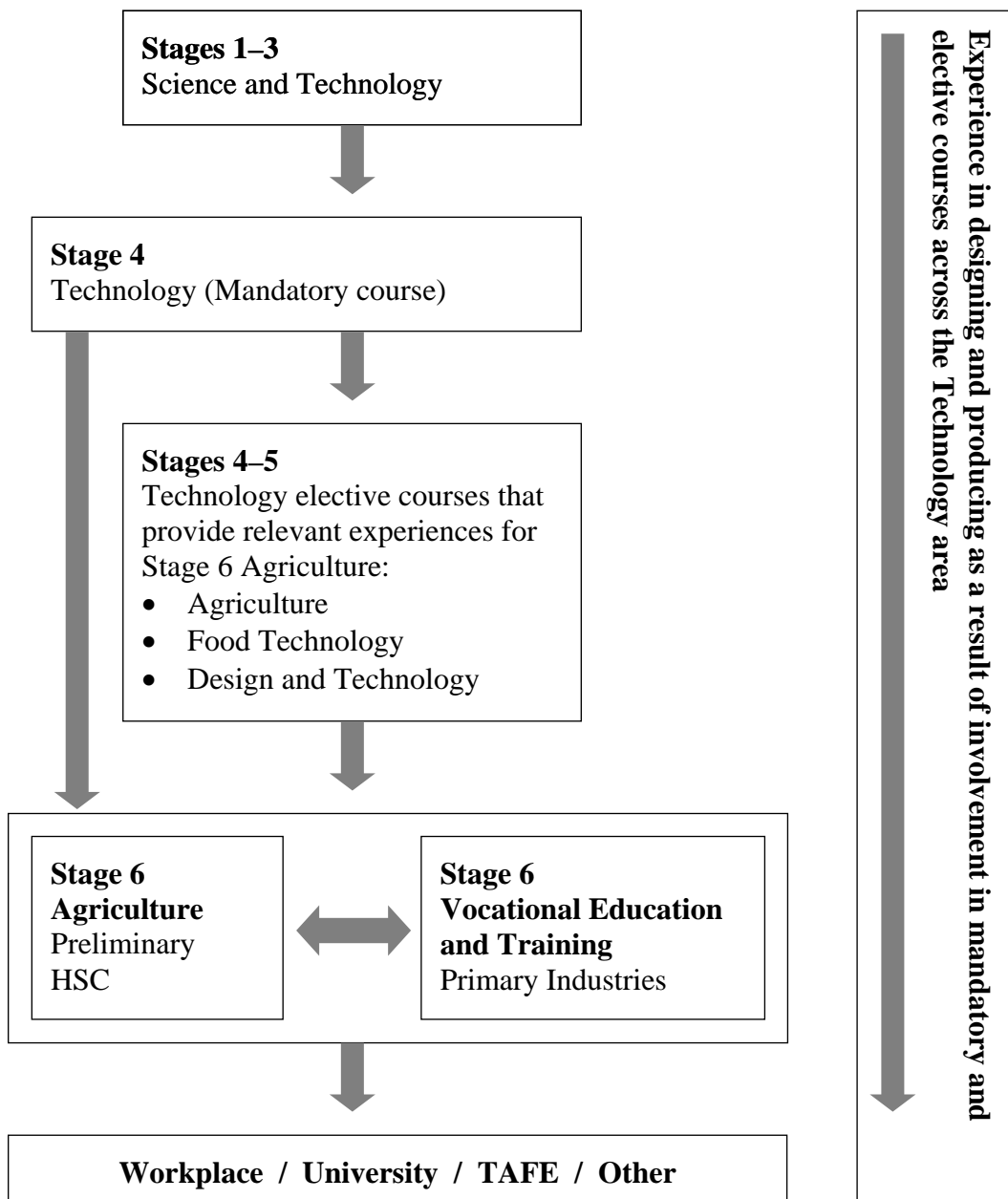
The *Agriculture Stage 6 Syllabus* is designed to increase student understanding and capabilities in a continuum from the farm level through to the international markets in which agricultural commodities are traded. The relevance of the course is enhanced by the inclusion of the study of a farm and agricultural product of particular interest to the student.

It is important that students realise that long-term benefits of agriculture can only accrue if systems can be sustained environmentally, economically and socially. Sustainability is critical if agriculture is to meet the food and fibre needs of society. An understanding of current land use

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must involve a historical perspective that extends to before the arrival of Europeans in 1788. Resolving issues of long-term profitability and sustainability is the challenge for agriculture and is the basis of this course.

3 Continuum of learning for Agriculture Stage 6 students



4 Aim

The *Agriculture Stage 6 Syllabus* is designed to develop students' knowledge and understanding about the production and marketing of both animal and plant products. Students should also develop the associated skills and responsible attitudes that are necessary to manage and market these products in a sustainable manner.

5 Objectives

Students will develop:

- 1 knowledge and understanding of the physical, chemical, biological, social, historical and economic factors that interact in agricultural production systems
- 2 knowledge, understanding and skills required to manage agricultural production systems in a socially and environmentally responsible manner
- 3 knowledge of, and skills in, decision-making and the evaluation of technology and management techniques used in sustainable agricultural production and marketing
- 4 skills in effective research, experimentation and communication
- 5 knowledge and understanding of the impact of innovation, ethics and current issues on Australian agricultural systems.

6 Course structure

The *Agriculture Stage 6 Syllabus* has a Preliminary and HSC course.

It is intended that students engage in and reflect upon practical experience relevant to all aspects of the physical, chemical, biological, economic and social sciences embodied within Agriculture Stage 6. Some of this experience will be in the laboratory, some in small plot work and some on commercial farms or other components of the industry. In all cases, students should use these practical experiences to develop design, practical, management, observation, recording, interpretation and communication skills. Practical experiences may also be used to achieve coverage of the content statements not specifically related to skills. The practical experiences should occupy a minimum of 30 per cent of allocated course time.

6.1 Preliminary course

120 hours indicative time

The Preliminary course incorporates the study of the interactions between the components of agricultural production, marketing and management, while giving consideration to the issues of sustainability of the farming system. This is an 'on-farm', environment-orientated course.

Overview (15%)

- Agricultural systems
- Agricultural history
- Social aspects surrounding agriculture

The farm case study (25%)

- The farm as a unit of production
- Farm management
- Marketing
- Farm technology
- The agricultural workplace

Plant production (30%)

- Plants and their commercial production
- Animals, climate and resource interaction
- Microbes, invertebrates and pests
- Technology
- Experimental design and research

Animal production (30%)

- Animals and their commercial production
- Plants, climate and resource interaction
- Microbes, invertebrates and pests
- Technology
- Experimental design and research

6.2 HSC course

120 hours indicative time

The Higher School Certificate course builds upon the Preliminary course. It examines the complexity and scientific principles of the components of agricultural production and places a greater emphasis on farm management to maximise productivity and environmental sustainability. The farm as a fundamental production unit provides a basis for analysing and addressing social, environmental and economic issues as they relate to sustainability, from both national and international perspectives. This is achieved through the farm product study. Australian agriculture faces many challenges and significant and continuous change is needed to address these challenges. New computer, satellite, robotic and biological technologies are being integrated into management systems. As farmers need to respond to changing economic, social and climatic conditions, the electives focus on innovations, issues and challenges facing Australian agriculture.

Core (80%) (approximately 96 indicative hours)

Plant/Animal production (50%)

- Soil, nutrients and water
- Factors contributing to the degradation of soil and water
- Sustainable resource management
- Plant production systems
- Constraints on plant production
- Managing plant production
- Animal nutrition
- Animal growth and development
- Animal reproduction and genetics
- Animal pests and diseases
- Animal ethics and welfare
- Experimental analysis and research in plant/animal systems

Farm product study (30%)

- The farm as a business
- Decision-making processes and management strategies
- Agricultural technology
- Marketing of a specific farm product

Elective (20%) (approximately 24 indicative hours)

Choose ONE of the following electives to study.

- Agri-food, Fibre and Fuel Technologies
- Climate Challenge
- Farming for the 21st Century

7 Objectives and outcomes

7.1 Table of objectives and outcomes

Objectives	Preliminary course outcomes	HSC course outcomes
<p>Students will develop:</p> <p>1. knowledge and understanding of the physical, chemical, biological, social, historical and economic factors that interact in agricultural production systems</p>	<p>A student:</p> <p>P1.1 describes the complex, dynamic and interactive nature of agricultural production systems</p> <p>P1.2 describes the factors that influence agricultural systems</p>	<p>A student:</p> <p>H1.1 explains the influence of physical, biological, social, historical and economic factors on sustainable agricultural production</p>
<p>2. knowledge, understanding and skills required to manage agricultural production systems in a socially and environmentally responsible manner</p>	<p>P2.1 describes the biological and physical resources and applies the processes that cause changes in plant production systems</p> <p>P2.2 describes the biological and physical resources and applies the processes that cause changes in animal production systems</p> <p>P2.3 describes the farm as a basic unit of production</p>	<p>H2.1 describes the inputs, processes and interactions of plant production systems</p> <p>H2.2 describes the inputs, processes and interactions of animal production systems</p>
<p>3. knowledge of, and skills in, decision-making and the evaluation of technology and management techniques used in sustainable agricultural production and marketing</p>	<p>P3.1 explains the role of decision-making in the management and marketing of agricultural products in response to consumer and market requirements</p>	<p>H3.1 assesses the general business principles and decision-making processes involved in sustainable farm management and marketing of farm products</p> <p>H3.2 critically assesses the marketing of a plant OR animal product</p> <p>H3.3 critically examines the technologies and technological innovations employed in the production and marketing of agricultural products</p>

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Objectives	Preliminary course outcomes	HSC course outcomes
		H3.4 evaluates the management of the processes in agricultural systems
4. skills in effective research, experimentation and communication	P4.1 applies the principles and procedures of experimental design and agricultural research	H4.1 justifies and applies appropriate experimental techniques, technologies, research methods and data presentation and analysis in relation to agricultural problems and situations
5. knowledge and understanding of the impact of innovation, ethics and current issues on Australian agricultural systems	P5.1 investigates the role of associated technologies and technological innovation in producing and marketing agricultural products	H5.1 evaluates the impact of innovation, ethics and current issues on Australian agricultural systems

7.2 Key competencies

Agriculture provides a powerful context within which to develop general competencies considered essential for the acquisition of effective, higher-order thinking skills necessary for further education, work and everyday life.

Key competencies are embedded in the Agriculture syllabus to enhance student learning. The key competencies of ***collecting, analysing and organising information*** and ***communicating ideas and information*** reflect core processes of agricultural inquiry and are explicit in the objectives and outcomes of the syllabus. The other key competencies are developed through the methodologies of the syllabus and through classroom pedagogy. Students work as individuals and as members of groups to conduct agricultural activities and investigations, and through this, the key competencies of ***planning and organising activities*** and ***working with others and in teams*** are developed.

When students plan trials and analyse experimental data, they are developing the key competency ***using mathematical ideas and techniques***. During research investigations, students will need to use appropriate information technologies and so develop the key competency of ***using technology***. Finally, the exploration of current issues and the evaluation of technology and management techniques contributes towards the students' development of the key competency ***solving problems***.

8 Content: Agriculture Stage 6 Preliminary course

8.1 Overview

This component is focused on the interactive nature of agricultural production. The factors that influence agriculture and that are in turn influenced by agriculture are studied. The concepts raised in the overview are integrated throughout the course.

Outcomes

A student:

P1.1 describes the complex, dynamic and interactive nature of agricultural production systems

P1.2 describes the factors that influence agricultural systems

P2.3 describes the farm as a basic unit of production.

Students learn about:	Students learn to:
<p>Agricultural systems</p> <ul style="list-style-type: none"> • the interaction between subsystems on a farm, resources, plants, animals, microbes and management • the climate patterns and soil resources that influence the distribution of agricultural enterprises • the impact of physical, biological, social, historical and economic factors on agricultural systems <p>Agricultural history</p> <ul style="list-style-type: none"> • Aboriginal land practices prior to the arrival of Europeans • changes in the Australian environment that have occurred since the arrival of Europeans 	<ul style="list-style-type: none"> • describe agriculture as a system which is made up of inputs, outputs, boundaries, subsystems, processes, interactions, feedback and monitoring • simulate, construct or represent an appropriate model showing inputs, outputs, boundaries, subsystems, processes and interactions between subsystems on a farm • identify the distribution of the main agricultural regions in NSW and their predominant agricultural enterprises • access information relevant to Australian agriculture from a variety of sources such as journals, newspapers, the internet and field days • outline how physical, biological, social, historical and economic factors have impacted on agricultural systems, using examples • describe how Indigenous Australians managed the land prior to the arrival of Europeans • construct a timeline of significant changes in land use practices since the arrival of Europeans to Australia

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Students learn about:	Students learn to:
Social aspects surrounding agriculture <ul style="list-style-type: none">• the changing role of the family farm in Australian agriculture	<ul style="list-style-type: none">• describe how the traditional family farm has changed• outline some impacts of agriculture on their local community

8.2 Farm case study

This component involves the study of farm production systems by investigating and visiting a selected farm or farms.

Outcomes

A student:

- P1.1 describes the complex, dynamic and interactive nature of agricultural production systems
- P1.2 describes the factors that influence agricultural systems
- P2.3 describes the farm as a basic unit of production
- P3.1 explains the role of decision-making in the management and marketing of agricultural products in response to consumer and market requirements
- P5.1 investigates the role of associated technologies and technological innovation in producing and marketing agricultural products.

Students learn about:	Students learn to:
<p>The farm as a production unit</p> <ul style="list-style-type: none"> • enterprises on a farm • physical and biological resources of a farm <p>Farm management</p> <ul style="list-style-type: none"> • the role of the farm manager • decisions made by the farm manager • the impact of consumers on production • current management practices, with reference to sustainability <p>Marketing</p> <ul style="list-style-type: none"> • ways products from the farm are marketed 	<ul style="list-style-type: none"> • observe, collect and record information on the physical and biological resources of the farm, including soil, climate, vegetation, topography, water and infrastructure • construct a calendar of operations for an enterprise production cycle • describe methods of agricultural record-keeping • identify various measures of performance including gross margins, yield, profitability • identify problems associated with production on the farm • suggest some factors a farmer considers when making farm management decisions • describe the effect of demand and the role of consumer trends on farm production • identify management practices being used to address environmental sustainability • report on planning for future farm improvement • identify marketing strategies • explain reasons for particular marketing strategies for the farm

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Students learn about:	Students learn to:
<p>Farm technology</p> <ul style="list-style-type: none"> • technology used in management and production on the farm <p>The agricultural workplace</p> <ul style="list-style-type: none"> • potential safety hazards in agricultural workplaces • safe work practices employed in agricultural workplaces • legislative requirements 	<ul style="list-style-type: none"> • identify technologies used on the farm • gather data using appropriate instruments to measure resources, including weather and soils • explain ways in which technology is used in farm management and production • recognise and use safe work practices • identify potential safety hazards in agricultural workplaces, assess the risk and suggest strategies to reduce or eliminate the risk, eg safe machinery • outline WHS legislative requirements that impact on the farm

8.3 Plant production

This component focuses on production and management of plants for commercial purposes. Plants in agricultural systems cannot be studied without analysing their interactions with resources (such as soils, climate, farm structures) and microbes/pests that exist in most farm environments.

Students develop the concept of the dynamic and interactive nature of plant enterprises by designing and developing models of plant enterprises where the interactions between their components are highlighted. Learning about the components and interaction of plant enterprises will be enhanced by developing practical skills in growing and monitoring plants or crops.

Outcomes

A student:

- P2.1 describes the biological and physical resources and applies the processes that cause changes in plant production systems
- P3.1 explains the role of decision-making in management and marketing of agricultural products in response to consumer and market requirements
- P4.1 applies the principles and procedures of experimental design and agricultural research
- P5.1 investigates the role of associated technologies and technological innovation in producing and marketing agricultural products.

Students learn about:	Students learn to:
<p>Plants and their commercial production</p> <ul style="list-style-type: none"> • basic morphology and function of leaves, stems, roots, flowers, seeds and fruits • regionally significant plants • consumer and market requirements for commercial plant products • propagation techniques <p>Animals, climate and resource interaction</p> <ul style="list-style-type: none"> • effects of soil texture, structure, pH and fertility on plant production • inorganic and organic fertilisers 	<ul style="list-style-type: none"> • describe the functions of leaves, stems, roots, flowers, seeds and fruits • distinguish between the external and internal anatomy of monocotyledons and dicotyledons • identify a range of regionally significant plants • recognise the features of plant products that are important to consumers • propagate plants by sexual and asexual methods • grow and monitor a crop/pasture from planting through to harvest • measure and describe the features of soil including colour, texture, structure, pH, organic matter, parent material and water-holding capacity • identify macro and micro nutrients important for plant growth

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Students learn about:	Students learn to:
<ul style="list-style-type: none"> • cultivation and grazing practices • management for sustainable production • effective rainfall and the concept of the growing season Microbes, invertebrates and pests • the nature and impact on plant production systems of microbes, invertebrates and pests Technology • use of technologies in producing and marketing plant products Experimental design and research • elements of experimental design • collection and simple analysis of data • recent research findings that contribute to plant production systems 	<ul style="list-style-type: none"> • select fertiliser(s) appropriate to the soil and the requirements of the crop/pasture • select appropriate tillage implements and/or techniques to establish a crop or pasture • outline various grazing practices • recognise sustainable management practices including crop rotation, green manuring, minimum tillage and mulching • collect and use meteorological data such as temperature, rainfall and evaporation • outline one important disease and one pest for a selected crop/pasture • outline the role of beneficial organisms in plant production systems • evaluate methods that can be used to control and prevent plant pests and diseases • research and describe a current technology in plant production or marketing • recognise elements of experimental design including control, randomisation, replication and standardisation of conditions • conduct a simple plant trial using appropriate methodology • calculate mean and standard deviation using trial data • use a range of sources to gather information about a specific agricultural problem or situation in plant production systems

8.4 Animal production

This component is focused on the production and management of animals for commercial purposes. Animals in agricultural systems cannot be studied without analysing their interactions with plants, climate, resources and microbes/pests that exist in most farm environments.

Students study the concept of the dynamic and interactive nature of animal enterprises by developing models of animal enterprises whereby the interactions between components are highlighted. Learning about the components and interactions of animal enterprises will be enhanced by developing practical skills in growing and monitoring animals.

All practical activities involving animals must comply with the Animal Research Act 1985 (NSW) and the *Australian code of practice for the care and use of animals for scientific purposes* as described in the current edition of *Animals in Schools: Animal Welfare Guidelines for Teachers*, produced on behalf of the Schools Animal Care and Ethics Committee by the NSW Department of Education and Training. This advice applies to all schools of the NSW Department of Education and Training, Catholic Education Commission and to those participating schools of the Association of Independent Schools of NSW. The guidelines are available at www.schools.nsw.edu.au/animalsinschools.

Outcomes

A student:

- P2.2 describes the biological and physical resources and applies the processes that cause changes in animal production systems
- P3.1 explains the role of decision-making in management and marketing of agricultural products in response to consumer and market requirements
- P4.1 applies the principles and procedures of experimental design and agricultural research
- P5.1 investigates the role of associated technologies and technological innovation in producing and marketing agricultural products.

Students learn about:	Students learn to:
<p>Animals and their commercial production</p> <ul style="list-style-type: none"> • regionally significant animals • basic anatomy and physiology of monogastric and ruminant digestive systems • basic nutritional requirements • basic anatomy and physiology of reproductive systems in mammals and poultry 	<ul style="list-style-type: none"> • identify a range of regionally significant farm animals • identify the parts of monogastric and ruminant digestive systems • describe the functions of the parts of monogastric and ruminant digestive systems • outline the nutritional requirements of animals including carbohydrates, protein, fat, vitamins, minerals and water • identify the parts of mammalian and avian reproductive systems • describe the functions of the parts of mammalian and avian reproductive systems

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Students learn about:	Students learn to:
<ul style="list-style-type: none"> • factors affecting growth and development • legal requirements, safe handling and management techniques for the care and welfare of animals • consumer and market requirements for a commercial animal product <p>Plants, climate and resource interaction</p> <ul style="list-style-type: none"> • management for sustainable production <p>Microbes, invertebrates and pests</p> <ul style="list-style-type: none"> • the nature and impact on animal production systems of microbes, invertebrates and pests <p>Technology</p> <ul style="list-style-type: none"> • the use of technologies in producing and marketing animal products within animal welfare guidelines <p>Experimental design and research</p> <ul style="list-style-type: none"> • elements of experimental design • the collection and simple analysis of data 	<ul style="list-style-type: none"> • describe the factors affecting growth and development • manage and monitor the growth and development of a farm animal • select and perform appropriate safe handling and management techniques for the care and welfare of farm animals • monitor the physical aspects of the environment of a selected farm animal • recognise the features of animal products that are important to consumers • recognise sustainable management practices including stocking rates, grazing management, effluent management and native vegetation protection • describe an important disease and pest for a selected farm animal • evaluate methods that can be used to control and prevent animal pests and diseases • outline the role of beneficial organisms in animal production systems • research and describe a current technology in animal production or marketing • recognise elements of experimental design including control, randomisation, replication and standardisation of conditions • conduct a simple animal trial using appropriate methodology within animal welfare guidelines • calculate mean and standard deviation using trial data

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Students learn about:	Students learn to:
<ul style="list-style-type: none">• recent research findings that contribute to animal production systems	<ul style="list-style-type: none">• use a range of sources to gather information about a specific agricultural problem or situation in animal production systems

9 Content: Agriculture Stage 6 HSC course

9.1 Plant/Animal production

Animal production is dependent on plants, which in turn are dependent on the soil and water. Farmers aim to manage the physical and biological processes in soils, plants and animals to produce agricultural products in a sustainable manner. Students examine the ways in which farmers manage and manipulate these processes and systems to maximise outputs.

All practical activities involving animals must comply with the Animal Research Act 1985 (NSW) and the *Australian code of practice for the care and use of animals for scientific purposes* as described in the current edition of *Animals in Schools: Animal Welfare Guidelines for Teachers*, produced on behalf of the Schools Animal Care and Ethics Committee by the NSW Department of Education and Training. This advice applies to all schools of the NSW Department of Education and Training, Catholic Education Commission and to those participating schools of the Association of Independent Schools of NSW. The guidelines are available at www.schools.nsw.edu.au/animalsinschools.

Outcomes

A student:

- H1.1 explains the influence of the physical, biological, social, historical and economic factors on sustainable agricultural production
- H2.1 describes the inputs, processes and interactions of plant production systems
- H2.2 describes the inputs, processes and interactions of animal production systems
- H4.1 justifies and applies appropriate experimental techniques, technologies, research by methods and data presentation and analysis in relation to agricultural problems and situations.

Students learn about:	Students learn to:
<p>Soil, nutrients and water</p> <ul style="list-style-type: none"> • chemical and physical characteristics of soil • the role of soil nutrient cycles in Australian agricultural systems including the nitrogen cycle and the carbon cycle • the role of microbes and invertebrates in the decomposition of organic matter 	<ul style="list-style-type: none"> • describe chemical characteristics of a soil including soil pH, ion exchange capacity, soil carbon and nutrient status • describe physical characteristics of a soil including soil structure, texture, porosity and bulk density • perform a first-hand investigation to analyse and report on the physical and chemical characteristics of a soil • illustrate the nitrogen cycle and the carbon cycle • research using secondary sources the importance of microbes and invertebrates in decomposition and nutrient cycling

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Students learn about:	Students learn to:
<ul style="list-style-type: none"> • sources of water on a farm and water management in a farm system <p>Factors contributing to the degradation of soil and water</p> <ul style="list-style-type: none"> • the historical development of Australian land use practices, from Aboriginal practices to the present day • farming practices that have contributed to soil degradation such as salination, acidification, soil structure decline, loss of soil organic matter and erosion and the effects of these on soil and water • practices that have contributed to changes in water quality and availability <p>Sustainable resource management</p> <ul style="list-style-type: none"> • sustainable techniques to maintain and/or improve soil fertility including alternative strategies to the application of inorganic fertilisers • the role of individual farmers, the broader community and government in reducing the harmful environmental effects of agriculture and in conserving water, protecting waterways and managing water quality • tension between sustainability and short-term profitability in farming systems 	<ul style="list-style-type: none"> • investigate using secondary sources the various sources of water and appropriate management of water use on farms • describe the influence of legislation and government regulations including licensing on the availability and use of water for agricultural purposes • describe the impacts of historical land use practices in the development of Australian agricultural systems • investigate using secondary sources the practices that have led to one important soil degradation problem, the outcomes of these practices on the land/water system and current recommended procedures to alleviate the problem • describe farming/agricultural practices that have affected water quality and quantity including fertiliser usage, the effects of stock, effluent management, chemicals, grassed waterways, riparian zones, dam construction and irrigation methods • describe techniques used to manage soil fertility including conservation tillage systems, maintenance of soil organic matter (or carbon), crop rotations, organic fertilisers, inorganic fertilisers and pasture ley phase • research using secondary sources programs such as Catchment Management and Landcare that involve community and government groups working together to conserve and protect soils, water, waterways and water catchments • assess the factors involved in long-term sustainability of agricultural systems including Australian land classification/capability and whole-farm planning • identify tensions between sustainability and short-term profitability in farming systems

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Students learn about:	Students learn to:
<p>Plant production systems</p> <ul style="list-style-type: none"> • process of growth and development in plants • processes of respiration, photosynthesis, net assimilation rate, water and nutrient uptake on the effects of plant growth • beneficial relationships between microbes and plants including the fixing of atmospheric nitrogen in legumes • the role of plant hormones on plant growth and development • pasture production systems <p>Constraints on plant production</p> <ul style="list-style-type: none"> • constraints imposed by environmental factors • competition in plant communities • complex interaction involving problem organisms (pathogenic microbe or invertebrate), the host and the environment in plant disease 	<ul style="list-style-type: none"> • outline the phases of growth of one agricultural monocotyledon and dicotyledon used in agriculture • describe the effect on plant growth of the processes of respiration, photosynthesis, net assimilation rate, water and nutrient uptake • perform a first-hand investigation to determine the effect of light on plant growth • identify root nodules on a legume and outline their significance in the management of soil fertility • outline the effects of plant hormones including auxins, gibberellins, cytokinins, ethylene and abscisic acid • explain how plant hormones may be used to manage plant production • identify native and introduced pasture species and describe their role in pasture production systems • explain the significance of a diverse pasture mix • describe how light, temperature, available moisture, oxygen/carbon dioxide ratios, wind and biotic factors affect plant growth, development and production • describe sources of competition in plant communities • investigate how farmers manage plant competition through plant density and weed control strategies • perform a first-hand investigation to determine the effects of planting density on plant growth and/or yield • investigate using secondary sources the complex interaction between the problem organism, the host and the environment for one plant disease

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Students learn about:	Students learn to:
<p>Managing plant production</p> <ul style="list-style-type: none"> • managing the constraints on plant growth and development to maximise production • the interaction of genotype, environment and management • responsible and strategic use of chemicals • integrated pest management (IPM) <p>Animal nutrition</p> <ul style="list-style-type: none"> • ruminant and monogastric digestion • beneficial relationships between microbes and animals including the role of microbes in animal digestion • the fate of energy in animal nutrition • managing the nutritional requirements of monogastrics and ruminants in terms of their digestive physiology 	<ul style="list-style-type: none"> • explain how farmers can manage plant production systems to overcome environmental constraints • outline plant breeding systems and their genetic basis including selective breeding, hybridisation and genetic engineering • explain how plant breeding is used to develop new plant varieties to improve product quality, yield and environmental adaptation • interpret an agricultural pesticide label and relate it to safe practice and correct usage • define integrated pest management (IPM) • outline IPM's ability to reduce the problems of pesticides and chemical resistance in target organisms • research using secondary sources an integrated pest management program for a plant production system • evaluate an IPM program, naming the target organism and the plant host • compare the similarities and differences in the physiology of ruminant and monogastric digestion • describe the relationship between the ruminant and rumen microbes • construct a diagram to illustrate the energy losses associated with digestion and metabolism in animals • design and explain a ration to meet the nutritional requirements of a selected animal for a particular stage of production • use nutritional data to determine the suitability of animal feeds in terms of energy and protein requirements for particular production stages for one monogastric and one ruminant

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Students learn about:	Students learn to:
<p>Animal growth and development</p> <ul style="list-style-type: none"> • changes in the proportion of muscle, fat and bone during the life of an animal • management practices to optimise growth and development <p>Animal reproduction and genetics</p> <ul style="list-style-type: none"> • the role of hormones in the regulation of animal reproduction and behaviour • factors that limit the fertility of farm animals • reproductive techniques • breeding systems and their genetic basis to improve quality and production of animals <p>Animal pests and diseases</p> <ul style="list-style-type: none"> • animal disease • integrated pest management (IPM) 	<ul style="list-style-type: none"> • compare the proportions of bone, muscle and fat at various stages of development in an animal and relate these to consumer needs • evaluate management techniques available to farmers to manipulate growth and development including use of hormone growth promotants (HGPs), feed additives and genetics • describe how hormones regulate reproduction and behaviour in animals including testosterone, oestrogen, progesterone, prostaglandin, follicle stimulating hormone and luteinising hormone • explain the interaction between hormones in an animal's oestrus cycle • identify the factors that limit fertility of farm animals including genetics, environment, pests and diseases, management and nutrition • evaluate management techniques available to farmers to manipulate reproduction in farm animals including artificial insemination, multiple ovulation, flushing, embryo transfer and oestrus synchronisation • discuss the use of breeding systems in animal production systems including crossbreeding and line breeding • outline the role of objective measurement and heritability on the breeding programs of farms, using at least one specific industry program as an example • investigate the complex interaction between the problem organism, the host and the environment for one animal disease • research using secondary sources an IPM program for an animal production system • evaluate an IPM program, naming the target organism and the animal host

9.2 Farm product study

Farms are a part of a broader sector in which products are marketed and processed. Students examine marketing and processing of a product in terms of its quality and quantity and undertake a specific farm product study.

Outcomes

A student:

- H3.1 assesses the general business principles and decision-making processes involved in sustainable farm management and marketing of farm products
- H3.2 critically assesses the marketing of a plant OR animal product
- H3.3 critically examines the technologies and technological innovations employed in the production and marketing of agricultural products
- H3.4 evaluates the management of the processes in agricultural systems.

Students learn about:	Students learn to:
<p>The farm as a business</p> <ul style="list-style-type: none"> • the place of the farm in the wider agribusiness sector <p>Decision-making processes and management strategies</p> <ul style="list-style-type: none"> • factors of quality and quantity that influence decision making • the impact of financial pressures on farmers <p>Agricultural technology</p> <ul style="list-style-type: none"> • the impact scientific research and associated technology has had on agricultural production and marketing <p>Marketing</p> <ul style="list-style-type: none"> • marketing strategies 	<ul style="list-style-type: none"> • outline the importance of farms in the wider agribusiness sector of the Australian economy • describe a wide variety of farm business structures from the family farm to the corporate enterprise • assess farm production systems based on measurements of quality and quantity • outline the financial pressures that may impact on farmers including the irregular nature of income, high expenditure on inputs, the dynamic nature of markets and interest rates and risk management • use techniques to analyse the financial situation of a farm enterprise including calculating gross margin and return to capital • outline the importance of ongoing research related to agricultural industries • describe recent technologies and their impact on agricultural production and/or marketing • discuss strategies available to farmers to market farm products including vertical integration, contract selling, direct marketing, cooperatives and marketing boards

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Students learn about:	Students learn to:
<p>Marketing a specific farm product</p> <ul style="list-style-type: none"> • the marketing chain for a product • government influence on production and marketing • quantity and quality criteria for a product • the importance of product specification in the marketing of a product • problems that may occur in meeting market specifications of a product and methods used to meet requirements • processing raw agricultural commodities • the nature and potential for value adding to a product • the role of advertising and promotion in the marketing of a product • supply of and demand for a product 	<ul style="list-style-type: none"> • determine the marketing chain for the product • explain various marketing options for the product • outline government influence on the production and marketing of the product such as legislation, regulations, codes of practice, low cost loans, tax incentives • assess the quantity and quality of the product • analyse market specifications for the product • evaluate the management strategies used to assess and meet market specifications • schedule the timing of operations in a production cycle to meet market specifications • analyse marketing information such as a sales report for the product • construct a flow chart of steps involved in processing the raw agricultural commodity into its various forms • evaluate ways in which the product can be value added • outline strategies for advertising and promotion of the product • assess a current advertising or promotional campaign for the product • describe factors affecting the supply of and demand for the product • interpret supply and demand information for a product

9.3 Electives

Choose ONE of the following electives to study.

Elective 1 – Agri-food, Fibre and Fuel Technologies

This elective examines the role of biotechnology in the production of food, fibre and fuel in agricultural systems. It deals with the terminology and process of biotechnology at the gene level with an examination of the problems and benefits of genetic engineering and gene technology.

Issues including the following will be examined:

- food safety and labelling
- biosecurity
- ethical issues surrounding the use of genetically modified organisms
- environmental and social issues related to land use for food or biofuel production.

This elective also explores the ways agriculture is able to improve productivity using biotechnology and assist in the creation of an environmentally sustainable future for agricultural production.

Outcomes

A student:

H3.4 evaluates the management of the processes in agricultural systems

H4.1 justifies and applies appropriate experimental techniques, technologies, research by methods and data presentation and analysis in relation to agricultural problems and situations

H5.1 evaluates the impact of innovation, ethics and current issues on Australian agricultural systems.

Students learn about:	Students learn to:
<p>Innovation, ethics and current issues</p> <ul style="list-style-type: none"> • the term ‘biotechnology’, a term used to cover the use of living things in industry, technology, medicine or agriculture • ethical concerns and controversy surrounding the use of biotechnology in agricultural production 	<ul style="list-style-type: none"> • define DNA, gene, genetically modified organism (GMO), gene markers, genetic engineering and protein synthesis • describe the implications of biotechnology in the agri-foods, fibre and fuel industries • outline the importance of food safety and labelling of GMOs • discuss the issues relating to food production using GMOs • examine regulations that surround development and use of GMOs and biotechnology

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Students learn about:	Students learn to:
<ul style="list-style-type: none"> • current areas of development in biotechnology <p>Managing processes in agricultural systems</p> <ul style="list-style-type: none"> • the benefits and problems of biotechnology and genetic engineering in agricultural industries • a wide range of potential applications of gene technology and biotechnology in agriculture <ul style="list-style-type: none"> • biofuel production <p>Research methodology and presentation of research</p> <ul style="list-style-type: none"> • research into technological developments 	<ul style="list-style-type: none"> • explain the role of biosecurity • evaluate biofuel production with respect to world food demands and sustainable and efficient use of carbon • describe current developments in biotechnology including biofuels, biopesticides, rumen modification, gene markers, vaccine production, embryo and sperm testing and embryo splitting • discuss a current biotechnology development • analyse the conflict between increased production and ethical concerns in biotechnology innovation • investigate uses of biotechnology in agriculture such as genetic modification of crops to incorporate resistance to pests and diseases, herbicide tolerance, slowing the ripening of fruit or altering the timing and duration of flower production • describe ways biofuel is produced from grain, sugar, vegetable oils, algae and green waste/straw • identify and describe industries or activities that consume biofuel products • analyse a research study of the development and/or implementation of ONE agricultural biotechnology in terms of: <ul style="list-style-type: none"> – design of the study – methodology of the study – collection of data for the study – presentation of data – analysis of the data – conclusions and recommendations • explain the need for research in the development of agricultural technologies

Elective 2 – Climate Challenge

Australia has one of the more variable climates of the world’s major agricultural production areas. This presents challenges and opportunities for agricultural production. Recent research indicates that atmospheric changes could cause even more variation of climate in the future. This elective examines the variability of climate and some possible causes, the way farmers can manage their farms and adaptation strategies to mitigate risk and maximise profitability and sustainability.

Outcomes

A student:

H3.4 evaluates the management of the processes in agricultural systems

H4.1 justifies and applies appropriate experimental techniques, technologies, research by methods and data presentation and analysis in relation to agricultural problems and situations

H5.1 evaluates the impact of innovation, ethics and current issues on Australian agricultural systems.

Students learn about:	Students learn to:
<p>Innovation, ethics and current issues</p> <ul style="list-style-type: none"> • Australia’s variable climate 	<ul style="list-style-type: none"> • examine using secondary sources the climates of the local area and of a contrasting region in Australia • calculate mean and standard deviation of rainfall and maximum and minimum temperature over the past 30 years for the local area and for a contrasting region in Australia • analyse data to determine the frequency of wet, normal and dry years, hot, normal and cool years for the local area and for a contrasting region in Australia • explain the implications of climate variability for agricultural production • compare the variability of climate in different geographical regions in Australia • extrapolate from climate variability data to determine the effects of climate change on production • investigate research evidence in relation to long-term climate variation such as ice cores and tree growth rings

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Students learn about:	Students learn to:
<p>Research methodology and presentation of research</p> <ul style="list-style-type: none"> • research into climate variability 	<ul style="list-style-type: none"> – improved irrigation practices – timing of planting – soil moisture conservation – extended fallows – retaining residues – moisture monitoring – crop density – financial analysis such as gross margins <p>and/or</p> <p>Animal production</p> <ul style="list-style-type: none"> – grazing strategies – stocking rates – shelter or shade areas – fodder conservation – new varieties/breeds – enterprise changes – financial analysis such as gross margins <ul style="list-style-type: none"> • analyse a research study of climate variability or management strategies related to climate variability in terms of: <ul style="list-style-type: none"> – design of the study – methodology of the study – collection of data for the study – presentation of data – analysis of the data – conclusions and recommendations • explain the need for research in climate variability or management strategies for climate variability

Elective 3 – Farming for the 21st Century

While Australian agriculture is composed of many traditional agricultural industries, new or alternative production methods are emerging as a result of technological research and development. The continued success of Australian agriculture in the global economy will rely on continued innovation at all levels within the industry. The aim of this elective is to introduce students to the range of developing technologies and for students to appreciate their impact on agriculture. It is also an opportunity for students to gain a further understanding of a new technology.

It is important that the technologies studied are recent technologies, that is, they have been developed or implemented within approximately the past 10 years.

Outcomes

A student:

H3.4 evaluates the management of the processes in agricultural systems

H4.1 justifies and applies appropriate experimental techniques, technologies, research by methods and data presentation and analysis in relation to agricultural problems and situations

H5.1 evaluates the impact of innovation, ethics and current issues on Australian agricultural systems.

Students learn about:	Students learn to:
<p>Innovation, ethics and current issues</p> <ul style="list-style-type: none"> • issues relating to research and development • developments in agricultural technologies • marketing of technology developments 	<ul style="list-style-type: none"> • discuss issues related to the research and development of technologies including funding sources, patents, plant breeders' rights, animal welfare, legislation and contracts • evaluate a range of new technological developments that may assist agricultural industries including: <ul style="list-style-type: none"> – satellite technologies, eg global imaging and global positioning systems – computer technologies, eg climate/weather forecasting, laser technologies and computer record keeping systems – biotechnologies, eg genetically modified organisms – electronic identification systems, eg NLIS – robotics, eg milking, shearing and machinery • evaluate methods that companies may use to market new technological developments

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Students learn about:	Students learn to:
<p>Managing processes in agricultural systems</p> <ul style="list-style-type: none"> • reasons for adopting technologies • adopting a technological development <p>Research methodology and presentation of research</p> <ul style="list-style-type: none"> • research into technological developments • the need for research 	<ul style="list-style-type: none"> • explain the reasons for adopting technologies in agriculture • For ONE recent technological development: <ul style="list-style-type: none"> – explain the reasons for the development of the technology – outline the historical development of the technology – describe in detail the technological development – evaluate the impact of the technological development in terms of: economic, environmental, social, legal and managerial factors • analyse a research study of the development and/or implementation of ONE recent agricultural technology in terms of: <ul style="list-style-type: none"> – design of the study – methodology of the study – collection of data for the study – presentation of data – analysis of the data – conclusions and recommendations • explain the need for research in the development of agricultural technologies

10 Course requirements

For the Preliminary course:

- 120 indicative hours are required to complete the course
- practical experiences should occupy a minimum of 30% of course time.

For the HSC course:

- the Preliminary course is a prerequisite
- 120 indicative hours are required to complete the course
- practical experiences should occupy a minimum of 30% of course time.

11 Post-school opportunities

The study of Agriculture Stage 6 provides students with knowledge, understanding and skills that form a valuable foundation for a range of courses at university and other tertiary institutions.

In addition, the study of Agriculture Stage 6 assists students to prepare for employment and full and active participation as citizens. In particular, there are opportunities for students to gain recognition in vocational education and training. Teachers and students should be aware of these opportunities.

11.1 Recognition of student achievement in Vocational Education and Training (VET)

Wherever appropriate, the skills and knowledge acquired by students in their study of HSC courses should be recognised by industry and training organisations. Recognition of student achievement means that students who have satisfactorily completed HSC courses will not be required to repeat their learning in courses in TAFE NSW or other Registered Training Organisations (RTOs).

RTOs such as TAFE NSW provide industry training and issue qualifications within the Australian Qualifications Framework.

The degree of recognition available to students in each subject is based on the similarity of outcomes between HSC courses and industry training packages endorsed within the Australian Qualifications Framework (AQF). Training packages are documents that link an industry's competency standards to AQF qualifications. More information about industry training packages can be found on the National Training Information Service (NTIS) website (www.ntis.gov.au).

Recognition by TAFE NSW

TAFE NSW conducts courses in a wide range of industry areas, as outlined each year in the *TAFE NSW Handbook*. Under current arrangements, the recognition available to students of Agriculture in relevant courses conducted by TAFE is described in the *HSC/TAFE Credit Transfer Guide*. This guide is produced by the Board of Studies and TAFE NSW and is distributed annually to all schools and colleges. Teachers should refer to this guide and be aware of the recognition available to their students through the study of Agriculture Stage 6. This information can be found on the TAFE NSW website (www.tafensw.edu.au/mchoice).

Recognition by other Registered Training Organisations

Students may also negotiate recognition into a training package qualification with another Registered Training Organisation. Each student will need to provide the RTO with evidence of satisfactory achievement in Agriculture Stage 6 so that the degree of recognition available can be determined.

12 Assessment and reporting

Advice on appropriate assessment practice in relation to the Agriculture syllabus is contained in *Assessment and Reporting in Agriculture Stage 6*. This document provides general advice on assessment in Stage 6 as well as the specific requirements for the Preliminary and HSC courses. The document contains:

- suggested components and weightings for the internal assessment of the Preliminary course
- mandatory components and weightings for the internal assessment of the HSC course
- the HSC examination specifications, which describe the format of the external HSC examination.

The document and other resources and advice related to assessment in Stage 6 Agriculture are available on the Board's website at www.boardofstudies.nsw.edu.au/syllabus_hsc