Agriculture

2021 Subject Outline | Stage 1

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Introduction

Subject description

Agriculture is a 10-credit subject or a 20-credit subject at Stage 1. Agricultural Production and Agricultural Systems are 20-credit subjects at Stage 2.

Improved agricultural productivity will be vital in the coming decades to help meet the global challenge of feeding the world’s increasing population. Farmers need the knowledge and skills to manage agricultural production, businesses, and marketing at the local level, while scientists seek to develop new strategies and technologies to help farmers manage our resources for sustainable food and fibre production.

Agriculture encompasses the primary industries and includes enterprises such as livestock (for fibre, meat, milk, and egg production), broadacre cropping, horticulture, viticulture, forestry, and aquaculture. Through the study of agriculture, students develop and apply their knowledge and understanding of concepts from science, technology, economics, and marketing. Work health, safety, and ethical principles underpin all aspects of this subject.

Students consider the changes in agricultural practices over time. They analyse different methods of agricultural production in relation to benefits, risks, and opportunities. They deepen their understanding of sustainable management of the physical and biological environments and of how agriculture impacts on their lives, their communities, and the environment.

Students develop skills in critical thinking that inspire them to explore strategies and possible solutions to address major challenges now and in the future related to the global food supply. They explore and understand agricultural science as a human endeavour, and are encouraged to pursue future pathways, including in agriculture, horticulture, land management, agricultural business practice, natural resource management, veterinary science, food and marine sciences, biosecurity, and quarantine.

Capabilities

The capabilities connect student learning within and across subjects in a range of contexts. They include essential knowledge and skills that enable people to act in effective and successful ways.

The SACE identifies seven capabilities. They are:

* literacy
* numeracy
* information and communication technology (ICT) capability
* critical and creative thinking
* personal and social capability
* ethical understanding
* intercultural understanding.

Literacy

In this subject students extend and apply their literacy capability by, for example:

* interpreting the work of scientists across disciplines, using agricultural knowledge
* critically analysing and evaluating primary and secondary data
* extracting agricultural information presented in a variety of modes
* using a range of communication formats to express ideas logically and fluently, incorporating the terminology and conventions of the study of agriculture
* synthesising evidence-based arguments
* communicating appropriately for specific purposes and audiences.

Numeracy

In this subject students extend and apply their numeracy capability by, for example:

* solving problems using calculations and critical thinking skills
* measuring with appropriate instruments
* recording, collating, representing, and analysing primary data
* accessing and interpreting secondary data
* identifying and interpreting trends and relationships
* calculating and predicting values by manipulating data and using appropriate scientific conventions.

Information and communication technology (ICT) capability

In this subject students extend and apply their ICT capability by, for example:

* locating and accessing information
* collecting, analysing, and representing data electronically
* modelling concepts and relationships
* using technologies to create new ways of thinking about agriculture
* communicating agricultural ideas, practices, processes, and information
* understanding the impact of ICT on the development of agriculture and its application in society
* evaluating the application of ICT to advance understanding and investigations in agriculture.

Critical and creative thinking

In this subject students extend and apply critical and creative thinking by, for example:

* analysing and interpreting problems and solutions from different perspectives
* deconstructing a problem to determine the most appropriate method for investigation
* constructing, reviewing, and revising hypotheses to design investigations
* interpreting and evaluating data and procedures to develop conclusions and make recommendations
* analysing interpretations and claims, for validity, reliability, and usefulness
* devising imaginative solutions and making reasonable predictions
* envisaging consequences and speculating on possible outcomes
* recognising the significance of creative thinking on the development of agricultural knowledge and applications.

Personal and social capability

In this subject students extend and apply their personal and social capability by, for example:

* understanding the importance of agricultural knowledge on health and well-being, personally, in local communities, and globally
* making decisions and taking initiative while working independently and collaboratively
* planning effectively, managing time, following procedures effectively, and working safely
* sharing and discussing ideas about agricultural issues, developments, and innovations while respecting the perspectives of others
* recognising the role of their own beliefs and attitudes in gauging the impact of agriculture on society
* seeking, valuing, and acting on feedback.

Ethical understanding

In this subject students extend and apply their ethical understanding by, for example:

* considering the implications of their investigations on organisms and the environment
* making ethical decisions based on an understanding of agricultural principles and the impact of agricultural activities
* understanding and applying safety and ethical considerations in the treatment of animals
* using data and reporting the outcomes of investigations accurately and fairly
* acknowledging the need to plan for the future and to protect and sustain the biosphere
* recognising the importance of their responsible participation in social, political, economic, and legal decision-making.

Intercultural understanding

In this subject students extend and apply their intercultural understanding by, for example:

* recognising that agricultural science is a global endeavour with significant contributions from diverse cultures
* respecting and engaging with different cultural views and customs and exploring their interaction with agricultural research and practices
* being open-minded and receptive to change in the light of scientific thinking based on new information
* understanding that the progress of agriculture and the nature of agricultural practices influence and are influenced by cultural factors.

Aboriginal and Torres Strait Islander knowledge, cultures, and perspectives

In partnership with Aboriginal and Torres Strait Islander communities, and schools and school sectors, the SACE Board of South Australia supports the development of high-quality learning and assessment design that respects the diverse knowledge, cultures, and perspectives of Indigenous Australians.

The SACE Board encourages teachers to include Aboriginal and Torres Strait Islander knowledge and perspectives in the design, delivery, and assessment of teaching and learning programs by:

* providing opportunities in SACE subjects for students to learn about Aboriginal and Torres Strait Islander histories, cultures, and contemporary experiences
* recognising and respecting the significant contribution of Aboriginal and Torres Strait Islander peoples to Australian society
* drawing students’ attention to the value of Aboriginal and Torres Strait Islander knowledge and perspectives from the past and the present
* promoting the use of culturally appropriate protocols when engaging with and learning from Aboriginal and Torres Strait Islander peoples and communities.

Health and safety

The handling of live animals, pathogens, and a range of chemicals and equipment requires appropriate health, safety, and welfare procedures.

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 2012, in addition to relevant state, territory, or national health and safety guidelines. Information about these procedures is available from the school sectors.

The following safety practices must be observed in all laboratory work:

* Use equipment only under the direction and supervision of a teacher or other qualified person.
* Follow safety procedures when preparing or manipulating apparatus.
* Use appropriate safety gear when preparing or manipulating apparatus.

Any teaching activities that involve the care and use of, or interaction with, animals must comply with the Australian Code of Practice for the Care and Use of Animals for Scientific Purposes, 8th edition, in addition to relevant national, state, or territory guidelines.

Keeping live animals in an educational setting requires permission from the relevant animal ethics committee. Permission to dissect animals must be obtained in writing from these committees.

For Department of Education and Child Development schools, information can be obtained from the DECD Intranet Animal Ethics webpage (<https://myintranet.learnlink.sa.edu.au/educating/extra-curricular-activities/animal-ethics>).

The Non Government Schools Animal Ethics Committee is a collaboration between Catholic Education South Australia and the Association of Independent Schools of South Australia ([www.ais.sa.edu.au/home/general-information/animal-ethics](file:///C:\Users\Ekwomr01\Objective\edrms.saceboard.sa.gov.au-8008-ekwomr01\Objects\www.ais.sa.edu.au\home\general-information\animal-ethics)).

Learning scope and requirements

Learning requirements

The learning requirements summarise the knowledge, skills, and understanding that students are expected to develop and demonstrate through their learning in Stage 1 Agriculture.

In this subject, students are expected to:

1. apply science inquiry skills to deconstruct a problem and design and conduct agricultural investigations, using appropriate procedures and safe, ethical working practices

2. obtain, record, represent, analyse, and interpret the results of agricultural investigations

3. evaluate procedures and results, and analyse evidence to formulate and justify conclusions

4. develop and apply knowledge and understanding of agricultural concepts, skills, and practices in new and familiar contexts

5. explore and understand agricultural science as a human endeavour.

6. communicate knowledge and understanding of agriculture, using appropriate terms, conventions, and representations.

Content

Agriculture is a 10-credit or a 20-credit subject at Stage 1.

The topics in Stage 1 Agriculture provide the framework for developing integrated programs of learning through which students extend their skills, knowledge, and understanding of the three strands of science in the context of agricultural principles and practices.

The three strands of science to be integrated throughout student learning are:

* science inquiry skills
* science as a human endeavour
* science understanding.

The topics in Stage 1 Agriculture are:

* Topic 1: Principles of agriculture
* Topic 2: Enterprise management.

For a 10-credit and a 20-credit subject, students study a selection of concepts from both topics, using appropriate local contexts.

Topics can be studied in their entirety or in part, taking into account student interests and preparation for pathways into future study of agriculture. By exploring selected concepts of each topic, students develop their knowledge, skills, and understanding in context and in greater depth. Note that the topics are not necessarily designed to be of equivalent length — it is anticipated that teachers may allocate more time to one than the other. The concepts selected from each topic can be sequenced to suit individual groups of students.

One or more specific plants and/or animals can be used as the focus for teaching the concepts.

Each 10-credit subject should have a different focus.

A 20-credit subject should have more than one focus.

The following pages describe in more detail:

* science inquiry skills
* science as a human endeavour
* the topics for science understanding.

The descriptions of the science inquiry skills and the topics are structured in two columns: the left-hand column sets out the science inquiry skills or science understanding and the right-hand column sets out possible contexts.

Together with science as a human endeavour, the science inquiry skills and science understanding form the basis of teaching, learning, and assessment in this subject.

The possible contexts are suggestions for potential approaches, and are neither comprehensive nor exclusive. Teachers may select from these and are encouraged to consider other approaches according to local needs and interests.

Within the topic descriptions, the following symbols are used in the possible contexts to show how a strand of science can be integrated:

|  |  |
| --- | --- |
| three cogs symbol | indicates a possible teaching and learning strategy for science understanding |
| question mark symbol | indicates a possible science inquiry activity |
| human body symbol | indicates a possible focus on science as a human endeavour. |

question mark symbol Science Inquiry Skills

In Agriculture, investigation is an integral part of the learning and understanding of concepts, using scientific methods to test ideas and develop new knowledge.

Practical agricultural investigations must involve a range of both individual and collaborative activities during which students extend the science inquiry skills described in the table that follows.

Practical activities may take a range of forms, such as developing or using models and simulations that enable students to develop a better understanding of particular agricultural concepts. The activities include field and laboratory studies during which students develop investigable questions and/or testable hypotheses, and select and use equipment appropriately to collect data. The data may be observations, measurements, or other information obtained during the investigation. Students represent and analyse the data they have collected; evaluate procedures, and describe the limitations of the data and procedures; consider explanations for their observations; and present and justify conclusions appropriate to the initial question or hypothesis.

For a 10-credit subject, it is recommended that a minimum of 8–10 hours of class time involves practical activities.

For a 20-credit subject, it is recommended that a minimum of 16–20 hours of class time involves practical activities.

Science inquiry skills are fundamental to students investigating the social, ethical, and environmental impacts and influences of the development of scientific understanding and the applications, possibilities, and limitations of science. These skills enable students to critically consider the evidence they obtain so that they can present and justify a conclusion.

| Science Inquiry Skills | Possible contexts |
| --- | --- |
| Scientific methods enable systematic investigation to obtain measurable evidence.   * Deconstruct a problem to determine and justify the most appropriate method for investigation. * Design investigations, including: * a proposal, hypothesis, or inquiry question * types of variables * dependent * independent * factors held constant (how and why they are controlled) * factors that may not be able to be controlled (and why not) * materials required * the method to be followed * the type and amount of data to be collected * identification of ethical and safety considerations. | Develop inquiry skills by, for example:   * designing investigations that require investigable questions and imaginative solutions (with or without implementation) * critiquing proposed investigations * using the conclusion of one investigation to propose subsequent experiments * changing an independent variable in a given procedure and adapting the method * researching, developing, and trialling a method * improving an existing procedure * identifying options for measuring the dependent variable * researching hazards related to the use and disposal of chemical and/or biological materials * developing safety audits * identifying relevant ethical and/or legal considerations in different contexts. |
| Obtaining meaningful data depends on conducting investigations using appropriate procedures and safe, ethical working practices.   * Conduct investigations, including: * selection and safe use of appropriate materials, apparatus, and equipment * collection of appropriate primary and/or secondary data (numerical, visual, descriptive) * individual and collaborative work. | Develop inquiry skills by, for example:   * identifying equipment, materials, or instruments fit for purpose * practising techniques and safe use of apparatus or equipment * comparing resolution of different measuring tools * distinguishing between, and using, primary and secondary data. |
| Results of investigations are represented in a well-organised way to allow them to be interpreted.   * Represent results of investigations in appropriate ways, including: * use of appropriate SI units, symbols * construction of appropriately labelled tables * drawing of graphs, including lines or curves of best fit as appropriate * use of significant figures. | Develop inquiry skills by, for example:   * practising constructing tables to tabulate data, including column and row labels with units * identifying the appropriate representations to graph different data sets * selecting appropriate axes and scales to graph data, e.g. see:   <http://www.contentextra.com/lifesciences/unit3/unit3home.aspx>   * clarifying understanding of significant figures using, for example:   <http://www.math-aids.com/Significant_Figures/>   * comparing data from different sources to describe as quantitative or qualitative. |
| Scientific information can be presented using different types of symbols and representations.   * Select, use, and interpret appropriate representations, including: * mathematical relationships, such as ratios * diagrams * equations   to explain concepts, solve problems, and make predictions. | Develop inquiry skills by, for example:   * drawing and labelling diagrams * recording images * writing and using formulae and chemical equations * constructing flow diagrams. |
| Analysis of the results of investigations allows them to be interpreted in a meaningful way.   * Analyse data, including: * identification and discussion of trends, patterns, and relationships * interpolation or extrapolation where appropriate. | Develop inquiry skills by, for example:   * analysing data sets to identify trends and patterns * determining relationships between independent and dependent variables * using graphs from different sources (e.g. CSIRO or the Australian Bureau of Statistics (ABS)), to predict values other than plotted points * calculating mean values and rates of reaction, where appropriate. |
| Critical evaluation of procedures and data can determine the meaningfulness of the results.   * Identify sources of uncertainty, including: * random and systematic errors * uncontrolled factors. * Evaluate reliability, accuracy, and validity of results, by discussing factors including: * sample size * precision * resolution of equipment * random error * systematic error * factors that cannot be controlled. | Develop inquiry skills by, for example:   * discussing how the repeating of an investigation with different materials/equipment may detect a systematic error * using an example of an investigation report to develop report-writing skills.   Useful website:  <http://www.biologyjunction.com/sample%20ap%20lab%20reports.htm> |
| Conclusions can be formulated that relate to the hypothesis or inquiry question.   * Select and use evidence and scientific understanding to make and justify conclusions. * Recognise the limitations of conclusions. * Recognise that the results of some investigations may not lead to definitive conclusions. | Develop inquiry skills by, for example:   * evaluating procedures and data sets provided by the teacher to determine and hence comment on the limitations of possible conclusions * using data sets to discuss the limitations of the data in relation to the range of possible conclusions that could be made. |
| Effective scientific communication is clear and concise.   * Communicate to specific audiences and for specific purposes using: * appropriate language * terminology * conventions. | Develop inquiry skills by, for example:   * reviewing scientific articles or presentations to recognise conventions * developing skills in referencing and/or footnoting * distinguishing between reference lists and bibliographies * practising scientific communication in written, oral, and multimodal formats (e.g. presenting a podcast or writing a blog). |

human body symbol Science as a Human Endeavour

The science as a human endeavour strand highlights the development of science as a way of knowing and doing, and explores the purpose, use, and influence of science in society.

By exploring agricultural science as a human endeavour, students develop and apply their understanding of the complex ways in which science interacts with society, and investigate the dynamic nature of agricultural science. They explore how agricultural scientists develop new understanding and insights, and produce innovative solutions to everyday and complex problems and challenges in local, national, and global contexts. In this way, students are encouraged to think scientifically and make connections between the work of others and their own learning. This enables them to explore their own solutions to current and future problems and challenges.

Students understand that the development of science concepts, models, and theories is a dynamic process that involves analysis of evidence and sometimes produces ambiguity and uncertainty. They consider how and why science concepts, models, and theories are continually reviewed and reassessed as new evidence is obtained and as emerging technologies enable new avenues of investigation. They understand that scientific advancement involves a diverse range of individual scientists and teams of scientists working within an increasingly global community of practice.

Students explore how scientific progress and discoveries are influenced and shaped by a wide range of social, economic, ethical, and cultural factors. They investigate ways in which the application of science may provide great benefits to individuals, the community, and the environment, but may also pose risks and have unexpected outcomes. They understand how decision-making about socio-scientific issues often involves consideration of multiple lines of evidence and a range of needs and values. As critical thinkers, they appreciate science as an ever-evolving body of knowledge that frequently informs public debate, but is not always able to provide definitive answers.

The key concepts of science as a human endeavour underpin the contexts, approaches, and activities in this subject, and must be integrated into all teaching and learning programs.

The key concepts of science as a human endeavor, with elaborations that are neither comprehensive nor exclusive, in the study of Agriculture are:

Communication and Collaboration

* Agricultural science is a global enterprise that relies on clear communication, international conventions, and review and verification of results.
* Collaboration between scientists, governments, and other agencies is often required in scientific research and enterprise.

Development

* Development of complex scientific models and/or theories often requires a wide range of evidence from many sources and across disciplines.
* New technologies improve the efficiency of scientific procedures and data collection and analysis. This can reveal new evidence that may modify or replace models, theories, and processes.

Influence

* Advances in scientific understanding in one field can influence and be influenced by other areas of science, technology, engineering, and mathematics.
* The acceptance and use of scientific knowledge can be influenced by social, economic, cultural, and ethical considerations.

Application and Limitation

* Scientific knowledge, understanding, and inquiry can enable scientists to develop solutions, make discoveries, design action for sustainability, evaluate economic, social, cultural, and environmental impacts, offer valid explanations, and make reliable predictions.
* The use of scientific knowledge may have beneficial or unexpected consequences; this requires monitoring, assessment and evaluation of risk, and provides opportunities for innovation.
* Science informs public debate and is in turn influenced by public debate; at times, there may be complex, unanticipated variables or insufficient data that may limit possible conclusions.

Topic 1: Principles of agriculture

Students explore the scientific principles of plant and animal production, and investigate the structures and functions of agricultural plants and animals, to extend their understanding and application of the requirements for plant and animal growth.

Students analyse innovative research in farming methods and the role of technology in developing more efficient production processes. They develop their social capability and ethical and intercultural understanding by examining local and global concerns about the sustainability of future supplies of food and other plant and animal materials.

Students extend their literacy skills through use of industry-specific terminology and conventions, and their numeracy skills through the analysis of data in practical activities.

| Science Understanding | Possible contexts |  |
| --- | --- | --- |
| Anatomy and physiology  Management of plant and animal production requires knowledge of anatomical and physiological information.   * Use examples to explain the structure and function of organs and organ systems relevant to the production of agricultural plants and/or animals. * Recognise different stages of plant and/or animal growth in the production process. * Identify anatomical and physiological differences between monogastric and ruminant animals that affect the food requirements of agricultural animals. * Describe the differences between monocotyledonous and dicotyledonous plants that relate to the use of plants in agricultural production. | Investigate the role of specific organs/structures/functions in the following contexts:   * animal reproduction * genetics and breeding systems * plant propagation and reproduction.   Relevant organs for agricultural animals include those of the reproductive and digestive systems.  Relevant structures and functions of plants include: leaves, stems, roots, and flowers, and photosynthesis, respiration, translocation, and reproduction. | three cogs symbol |
| Dissect a digestive system, exploring the links between structure and function.  Collect and analyse farrowing data.  Visit a commercial trial site to explore how trial-design principles have been incorporated.  In groups, design, conduct, and evaluate a pot-based plant trial that incorporates rigorous trial-design principles. | question mark symbol |
| Investigate the economic benefits for farmers of using new breeding technologies for livestock.  Research the use of genetic modification of specific traits to improve crop performance and increase sustainability. | human body symbol |
| Plant and animal health  Aspects of plant and animal health are managed by farmers to increase agricultural production.   * Explain the importance of appropriate nutrition for animal health. * Describe the conditions required for optimal plant growth. * Describe the signs and symptoms of disease and pests in plant and/or animal enterprises. * Explore the impact of weeds in cropping enterprises. * Identify and examine the key features of agricultural invertebrate pests. | Specific aspects of the animal or plant production that could be used as contexts include animal or crop nutrition, or biosecurity measures.  Plan feed rations to match animal‑production status.  Explain the role of feed components.  Investigate macronutrients and micronutrients.  Identify and examine agriculturally significant invertebrates such as parasitic worms and insects.  Plan integrated management plans for pests, diseases, and weeds. | three cogs symbol |
| * Describe the principles and strategies of biosecurity measures used in the production of agricultural plants and/or animals. * Describe the Five Freedoms of animal welfare. | Examine appropriate chemical treatments for a range of pests.  Explore disease-outbreak scenarios.  Explore codes of conduct to identify how industry bodies manage animal-welfare concerns. | three cogs sybmol |
| Collect photographic evidence of weed or pest presence in a crop and determine the potential yield impact and management options.  Analyse samples of different cattle feed rations, identifying the sources of each nutrient, assessing acidosis risk, and estimating metabolisable energy and crude protein.  Conduct investigations of growing conditions for animals or plants, such as:   * chicken feed trials * sheep feed systems * pasture comparisons * fertiliser regimes * cropping trials. | question mark symbol |
| Investigate the contribution of scientific research to the management of zoonoses and make recommendations for a community program to eradicate a particular disease in the local context.  Conduct an audit of livestock enterprises at school to evaluate the effectiveness of animal-welfare practices. | human body symbol |
| Agricultural production skills  Development of specific practical skills is an integral part of agricultural production:   * Develop practical production skills. * Explore alternative techniques. * Use mathematical calculations required for agricultural production. * Use appropriate industry-specific terminology. | Conduct crop inspections with an agronomist across a season to develop skills in identifying crop stages, nutrient deficiencies and toxicities, and disease or pest impacts.  Visit farms that use different techniques for flystrike control, canopy management, tillage, or other practices.  Visit a commercial agricultural business and investigate the work health and safety strategies employed. Compare these strategies with those of other similar businesses. | three cogs symbol |
| Develop practical skills in areas such as:   * flystrike prevention * piggery hygiene * treatment of minor animal-health problems * monitoring sheep for health issues * recognising signs and symptoms of ill-health in plants and animals * monitoring crops for pests and diseases * weed identification * testing water quality * operating agricultural machinery * preparing feed for livestock * assessing rams * condition scoring of sheep * cattle mustering and handling * calibrating spray units * interpreting chemical labels * safe storage of chemicals * safe use of chemicals * risk assessment * maintaining and repairing water systems * recording water consumption in irrigation systems * calculating yields and averages * converting units of measurement. | question mark symbol |
| Innovation and technology  Scientific research and technological advances influence plant and animal production processes:   * Explore the role of technology in improving commercial agricultural production. * Explore examples of improvements to agricultural production resulting from innovative agricultural research. | Examples of contexts include:   * GPS and auto-steer technology * reproductive technology * technology for processing and value-adding * monitoring water quality and use * weed identification * monitoring livestock health with smart collars * virtual fencing scenarios * exploration of the application of drones (UAVs, unmanned aerial vehicles).   Interview an agricultural scientist to identify pathways into this field, research trends, current projects, use of technology, and opportunities that are available. | three cogs symbol |
| Investigate how new technologies improve production processes by visiting commercial agricultural businesses or research facilities.  Collect and analyse data from soil‑moisture probes in a broadacre or horticultural setting with a view to making agronomic recommendations.  Conduct a workshop with an industry group supporting the use of crop technology. | question mark symbol |
| Discuss the benefits and issues associated with an innovative use of technology in agriculture, e.g. in precision agriculture.  Investigate how advances in engineering have affected agricultural production. | human body symbol |

Topic 2: Enterprise management

Students investigate ways in which efficient management of agricultural enterprises is vital to communities. They explore key aspects of production, marketing, business strategies, and environmental management issues. Students examine different types of production systems and the associated ethical, health, and safety issues.

Students develop skills in planning, implementing, and analysing outcomes in a small agricultural enterprise. They develop their social capability and ethical understanding by examining different perspectives on the use and sustainability of natural resources, and on the management of agricultural enterprises.

| Science Understanding | Possible contexts |  |
| --- | --- | --- |
| Plant and animal production  Efficient production in an agricultural enterprise requires knowledge of alternative practices and systems.   * Investigate the purposes of different enterprises. * Investigate different types of intensive and extensive production systems. * Analyse the advantages and disadvantages of using different production systems in various settings. * Evaluate the use of different varieties or breeds within a production system. * Determine the inputs required and constraints encountered when managing agricultural enterprises. * Compare the management techniques required in enterprises raising different types of livestock. * Compare the management of monocotyledonous and dicotyledonous crops. * Discuss benefits and issues associated with management skills. * Investigate ethical issues associated with commercial farming practices. * Identify work health and safety issues relevant to agriculture. | Explore contexts such as:   * use of chemicals * feedlotting * growing citrus fruit, e.g. in the South Australian Riverland * growing wheat on Eyre Peninsula * cattle breeding * growing horticultural crops organically * biodynamic dairy farming * fertiliser calculations * feed ration formulation * feed budgeting * tillage comparisons * breed comparisons * comparison of stud and commercial production * quality assurance (QA) systems.   Brainstorm constraints affecting different agricultural enterprises and discuss ways to manage them.  Explore horticulture, aquaculture, floriculture, viticulture, apiculture.  Use industry experts, such as stock agents or experienced farmers, to explore low-stress handling techniques for livestock.  Investigate training and education opportunities for commercial farmers within South Australia, interstate, and/or internationally.  Visit a livestock stud and explore how the business has developed and managed its goals and strategies.  Develop a guidebook with strategies for handling agricultural animals for a particular purpose, such as preparing cattle for showing, including work health and safety, and animal-welfare aspects. | three cogs symbol |
|  | Investigate different enterprise mixes on commercial properties, using a case‑study format.  Plan a cropping program for a paddock, exploring the purposes, advantages, and disadvantages of relevant crop types.  Calculate yields and averages.  Convert units of measurement.  Determine water consumption in irrigation systems.  Evaluate sources of information for farmers that are produced by industry bodies, e.g. journals, websites, consultants, Facebook pages, fact sheets, and information seminars. | question mark symbol |
| Investigate the development of different production systems.  Discuss the effect of ethical considerations on animal management and handling during marketing. | human body symbol |
| Marketing methods  The marketing methods used for agricultural commodities should maximise the return on the investment.   * Investigate different types of marketing options for agricultural commodities. * Compare the use of different marketing options in various settings. * Explore benefits and issues associated with different marketing options. | Compare different sale options, such as on‑hooks sale, on farm sales, saleyard, contracts, and direct to end-user.  Use a scenario approach to investigate how farmers can manage financial risk through different marketing strategies.  Investigate value-adding opportunities such as food tourism.  Investigate a farmer cooperative to identify the reasons for its development, how it is managed, and the benefits and challenges to members.  Conduct a field trip to a local saleyard to explore delivery, documentation requirements, and purchase methods.  Discuss the advantages and disadvantages of farmers’ markets. | three cogs symbol |
| Survey farmers to collect data about commonly used marketing strategies and their benefits and challenges. | question mark symbol |
| Explore new technologies for marketing livestock.  Investigate the impact of direct online marketing.  Investigate possible domestic and international markets for products that satisfy diverse and specific cultural requirements. | human body symbol |
| Business planning  Business plans for agricultural enterprises must consider factors that influence productivity.   * Explore factors that affect profit and loss in agricultural businesses. * Explore the influence of key weather and climate factors on the management of farm enterprises. * Investigate different tools that farmers use for business planning and record keeping. * Explore options for assessing business performance. * Investigate how business planning and risk management contribute to economic sustainability. | Examples of factors include human resources, seasonal conditions, interest rates, commodity and input prices, and global markets.  Aspects of business planning include:   * cash-flow budgeting * producing gross margins * recording income and expenditure * profit and loss investigations * planning for profit * estimating yields and production * monitoring and analysing market fluctuations * drought-proofing strategies * planning crop rotations * planning production calendars * exploring farm ownership options  (e.g. freehold, leasing, share-farming, partnership, family company, foreign ownership, farmer co-operative) * using industry benchmarks * assessing production data. | three cogs symbol |
| For a small enterprise, record key enterprise and production data, and then evaluate the strengths and weaknesses of the enterprise.  Conduct an enterprise investigation into meat rabbits. Develop a plan, including financial estimates and management strategies, carry out the project, then analyse the production and economic data collected.  Select a commodity and use an industry resource such as the Stock Journal to monitor and analyse price fluctuations across a season. | question mark symbol |
| Explore how different software options for agribusinesses (e.g. finances, production, stud data management, yield mapping, paddock records, and climate records) can improve the efficiency of the agribusiness. | human body symbol |
| Environmental management  Responsible use of resources is important for protection of the local environment and determines the sustainability of agricultural enterprises.   * Describe the physical, chemical, and biological properties of soil, air, and water, and how they relate to agriculture. * Investigate the key environmental management issues for commercial agricultural businesses. * Explore management strategies for conservation of environmental resources. * Discuss the responsible use of chemicals in agricultural settings. | Examples of contexts include:   * soil-erosion management * soil-modification strategies * irrigation options * water-quality monitoring * waste-management planning * remnant-vegetation assessment * revegetation strategies * climate-change studies * biodiversity protection * chemical-application programs.   Investigate the contribution of a lobby group or community group in resolving an environmental issue. | three cogs symbol |
| Record and analyse key data from an area of remnant vegetation on a commercial farm and make recommendations for sustainable management of this resource for different purposes, such as ecotourism or stock feed.  Develop a plan for sustainable waste and water management for feedlotting cattle.  Research climate-change forecasts that are relevant to agriculture. Explore the short-term and long-term impacts on different agricultural industries.  Investigate short-term and long-term effects of use of agricultural chemicals on soil quality. | question mark symbol |
| Research an environmental issue affecting the local district and evaluate the risks and benefits associated with various management scenarios.  The use of water resources for irrigation can lead to unforeseen environmental issues. Use scientific research to discuss the cause of one of these issues in a local area, and suggest possible solutions.  Investigate how scientific research enables farmers to evaluate environmental impacts on their enterprises and to plan for the future. | human body symbol |

Assessment scope and requirements

Assessment at Stage 1 is school based.

Evidence of learning

The following assessment types enable students to demonstrate their learning in Stage 1 Agriculture.

* Assessment Type 1: Agricultural Reports
* Assessment Type 2: Applications.

For a 10-credit subject, students provide evidence of their learning through four assessments. Each assessment type should have a weighting of at least 20%.

Students complete:

* at least one practical report
* one report with a focus on science as a human endeavour
* at least one applications task.

For a 20-credit subject, students provide evidence of their learning through eight assessments. Each assessment type should have a weighting of at least 20%.

Students complete:

* at least two practical reports
* two reports with a focus on science as a human endeavour
* at least two applications tasks.

For both the 10-credit and 20-credit subjects, at least one assessment should involve collaborative work.

Assessment design criteria

The assessment design criteria are based on the learning requirements and are used by teachers to:

* clarify for the student what they need to learn
* design opportunities for the student to provide evidence of their learning at the highest level of achievement.

The assessment design criteria are the specific features that:

* students should demonstrate in their learning
* teachers look for as evidence that students have met the learning requirements.

For this subject, the assessment design criteria are:

* investigation, analysis, and evaluation
* knowledge and application.

The specific features of these criteria are described below.

The set of assessments, as a whole, must give students opportunities to demonstrate each of the specific features by the completion of study of the subject.

Investigation, Analysis, and Evaluation

The specific features are as follows:

IAE1 Deconstruction of a problem and design of an agricultural investigation.

IAE2 Obtaining, recording, and representation of data, using appropriate conventions and formats.

IAE3 Analysis and interpretation of data and other evidence to formulate and justify conclusions.

IAE4 Evaluation of procedures and their effect on data.

Knowledge and Application

The specific features are as follows:

KA1 Demonstration of knowledge and understanding of agricultural concepts and practices.

KA2 Application of agricultural concepts, skills, and practices in new and familiar contexts.

KA3 Exploration and understanding of the interaction between agricultural science and society.

KA4 Communication of knowledge and understanding of agriculture, using appropriate terms, conventions, and representations.

School assessment

Assessment Type 1: Agricultural Reports

For a 10-credit subject, students undertake at least two agricultural reports. Students may undertake more than two agricultural reports within the maximum number of assessments allowed. At least one report has a practical focus, and one has a focus on science as a human endeavour in an agricultural context.

For a 20-credit subject, students undertake at least four agricultural reports. Students may undertake more than four agricultural reports within the maximum number of assessments allowed. At least two reports have a practical focus and two have a focus on science as a human endeavour in an agricultural context.

Students investigate aspects of agriculture through practical discovery and data analysis, and/or by selecting, analysing, and interpreting information.

Practical Reports

As students design and safely carry out agricultural investigations, they demonstrate their science inquiry skills by:

* deconstructing a problem to determine the most appropriate method for the investigation
* formulating investigable questions and hypotheses
* selecting and using appropriate equipment, apparatus, and techniques
* identifying variables
* collecting, representing, analysing, and interpreting data
* evaluating procedures and considering their impact on results
* drawing conclusions and/or making recommendations
* communicating knowledge and understanding of agriculture.

Practical investigations can be conducted individually or collaboratively. For each investigation, students present an individual report.

One practical investigation should enable students to investigate a question or hypothesis for which the outcome is uncertain.

One practical investigation should enable students to individually deconstruct a problem to design their own method and justify their plan of action.

Evidence of deconstruction (where applicable) should outline the deconstruction process, the method designed as most appropriate, and a justification of the plan of action, to a maximum of 4 sides of an A4 page. This evidence must be attached to the practical report.

Suggested formats for this evidence include flow charts, concept maps, tables, or notes.

In order to manage the implementation of an investigation efficiently, students could individually design investigations and then conduct one of these as a group, or design hypothetical investigations at the end of a practical activity.

A practical report must include:

* introduction with relevant agricultural concepts, and either a hypothesis and variables, or an investigable question
* materials/apparatus
* the method that was implemented
* identification and management of safety and/or ethical risks
* results, including table(s) and/or graph(s)
* analysis of results, including identifying trends and linking results to concepts
* evaluation of procedures and their effect on data, and identifying sources of uncertainty
* conclusion and/or recommendations, with justification.

The report should be a maximum of 1000 words if written, or a maximum of 6 minutes for an oral presentation, or the equivalent in multimodal form.

Only the following sections of the report are included in the word count:

* introduction
* analysis of results
* evaluation of procedures
* conclusion and/or recommendations, with justification.

Suggested formats for presentation of a practical investigation report include:

* a written report
* an oral presentation
* a multimodal product.

Science as a Human Endeavour Report

Students explore and investigate a contemporary example of how agricultural science interacts with society. This may focus on one or more of the key concepts of science as a human endeavour described on pages 11 and 12 and may draw on a context suggested in the topics or relate to a new context.

Student could consider, for example, how:

* humans seek to improve their understanding and explanation of natural resources
* working scientifically is a way of obtaining knowledge that allows for testing scientific claims
* scientific theory can change in the light of new evidence
* technological advances change ways of working scientifically
* links between advances in agricultural science impact and influence society
* society influences agricultural science research
* emerging agriculture-related careers and pathways involve science.

Students access information from different sources, select relevant information, analyse their findings, and explain the connection to science as a human endeavour.

Possible starting points for the investigation could include, for example:

* the announcement of a discovery in the field of agricultural science
* an article from an agricultural publication (e.g. Stock Journal)
* a TED talk based on an agricultural development
* an expert’s point of view on a controversial innovation
* public concern about an agricultural issue that has environmental, social, economic, or political implications.

Based on their investigation, students prepare a scientific communication, which must include the use of scientific terminology.

The communication should be a maximum of 1000 words if written, or a maximum of 6 minutes for an oral presentation, or the equivalent in multimodal form.

For this assessment type, students provide evidence of their learning in relation to the following assessment design criteria:

* investigation, analysis, and evaluation
* knowledge and application.

Assessment Type 2: Applications

For a 10-credit subject, students undertake at least one applications task. Students may undertake more than one applications task within the maximum number of assessments allowed, but at least one should be under the direct supervision of the teacher. The supervised setting (e.g. classroom, laboratory, or field) should be appropriate to the task.

For a 20-credit subject, students undertake at least two applications tasks. Students may undertake more than two applications tasks within the maximum number of assessments allowed, but at least one should be under the direct supervision of the teacher. The supervised setting (e.g. classroom, laboratory, or field) should be appropriate to the task.

Applications tasks allow students to provide evidence of their learning in tasks that may:

* be applied, analytical, and/or interpretative
* pose problems in new and familiar contexts
* involve individual or collaborative assessments, depending on task design.

An applications task may involve, for example:

* deconstructing and analysing a problem
* creating possible solutions
* considering different scenarios in which to apply knowledge and understanding
* graphing, tabulating, and/or analysing data
* evaluating procedures and identifying their limitations
* formulating and justifying conclusions
* representing information diagrammatically or graphically
* using agricultural terms, conventions, and notations.

As a set, the applications tasks should be designed to enable students to apply their science inquiry skills, demonstrate knowledge and understanding of key agricultural concepts and practices, and explain connections with science as a human endeavour in an agricultural context. Problems and scenarios should be set in a relevant context, which may be practical, social, or environmental.

Applications tasks may include, for example:

* modelling or representing concepts
* developing simulations
* an oral presentation
* a practical skills assessment
* a graphical skills exercise
* a multimodal product
* a data-interpretation exercise
* an extended response and/or short-answer questions
* a written assignment
* participation in a debate
* a structured interview
* an excursion report
* a response to agricultural science in the media.

For this assessment type, students provide evidence of their learning in relation to the following assessment design criteria:

* investigation, analysis, and evaluation
* knowledge and application.

Performance standards

The performance standards describe five levels of achievement, A to E.

Each level of achievement describes the knowledge, skills and understanding that teachers refer to in deciding how well students have demonstrated their learning on the basis of the evidence provided.

During the teaching and learning program the teacher gives students feedback on their learning, with reference to the performance standards.

At the student’s completion of study of a subject, the teacher makes a decision about the quality of the student’s learning by:

* referring to the performance standards
* taking into account the weighting of each assessment type
* assigning a subject grade between A and E.

Performance Standards for Stage 1 Agriculture

| - | Investigation, Analysis and Evaluation | Knowledge and Application |
| --- | --- | --- |
| A | Critically deconstructs a problem and designs a logical, coherent, and detailed agricultural investigation.  Obtains, records, and represents data, using appropriate conventions and formats accurately and highly effectively.  Systematically analyses and interprets data and evidence to formulate logical conclusions with detailed justification.  Critically and logically evaluates procedures and their effect on data. | Demonstrates deep and broad knowledge and understanding of a range of agricultural concepts and practices.  Applies agricultural concepts, skills, and practices highly effectively in new and familiar contexts.  Critically explores and understands in depth the interaction between agricultural science and society.  Communicates knowledge and understanding of agriculture coherently, with highly effective use of appropriate terms, conventions, and representations. |
| B | Logically deconstructs a problem and designs a well-considered and clear agricultural investigation.  Obtains, records, and represents data, using appropriate conventions and formats mostly accurately and effectively.  Logically analyses and interprets data and evidence to formulate suitable conclusions with reasonable justification.  Logically evaluates procedures and their effect on data. | Demonstrates some depth and breadth of knowledge and understanding of a range of agricultural concepts and practices.  Applies agricultural concepts, skills, and practices mostly effectively in new and familiar contexts.  Logically explores and understands in some depth the interaction between agricultural science and society.  Communicates knowledge and understanding of agriculture mostly coherently, with effective use of appropriate terms, conventions, and representations. |
| C | Deconstructs a problem and designs a considered and generally clear agricultural investigation.  Obtains, records, and represents data, using generally appropriate conventions and formats, with some errors but generally accurately and effectively.  Undertakes some analysis and interpretation of data and evidence to formulate generally appropriate conclusions with some justification.  Evaluates procedures and some of their effect on data. | Demonstrates knowledge and understanding of a general range of agricultural concepts and practices.  Applies agricultural concepts, skills, and practices generally effectively in new or familiar contexts.  Explores and understands aspects of the interaction between agricultural science and society.  Communicates knowledge and understanding of agriculture generally effectively, using some appropriate terms, conventions, and representations. |
| D | Prepares a basic deconstruction of a problem and an outline of an agricultural investigation.  Obtains, records, and represents data, using conventions and formats inconsistently with occasional accuracy and effectiveness.  Describes data and undertakes some basic interpretation to formulate a basic conclusion.  Attempts to evaluate procedures or suggest an effect on data. | Demonstrates some basic knowledge and partial understanding of agricultural concepts and practices.  Applies basic agricultural concepts, skills, and practices in familiar contexts.  Partially explores and recognises aspects of the interaction between agricultural science and society.  Communicates basic information about agriculture, using some appropriate terms, conventions, and/or representations. |
| E | Attempts a simple deconstruction of a problem and a procedure for an agricultural investigation.  Attempts to record and represent some data with limited accuracy or effectiveness.  Attempts to describe results and/or interpret data to formulate a basic conclusion.  Acknowledges that procedures affect data. | Demonstrates some limited recognition and awareness of agricultural concepts and practices.  Attempts to apply one or more basic agricultural concepts, skills, and/or practices in familiar contexts.  Attempts to explore and identify an aspect of the interaction between agricultural science and society.  Attempts to communicate information about agriculture. |

Assessment integrity

The SACE Assuring Assessment Integrity Policy outlines the principles and processes that teachers and assessors follow to assure the integrity of student assessments. This policy is available on the SACE website ([www.sace.sa.edu.au](file:///C:\Users\Ekwomr01\Objective\edrms.saceboard.sa.gov.au-8008-ekwomr01\Objects\www.sace.sa.edu.au)) as part of the SACE Policy Framework.

The SACE Board uses a range of quality assurance processes so that the grades awarded for student achievement in the school assessment are applied consistently and fairly against the performance standards for a subject, and are comparable across all schools.

Information and guidelines on quality assurance in assessment at Stage 1 are available on the SACE website ([www.sace.sa.edu.au](file:///C:\Users\Ekwomr01\Objective\edrms.saceboard.sa.gov.au-8008-ekwomr01\Objects\www.sace.sa.edu.au)).

Support materials

Subject-specific advice

Online support materials are provided for each subject and updated regularly on the SACE website ([www.sace.sa.edu.au](file:///C:\Users\Ekwomr01\Objective\edrms.saceboard.sa.gov.au-8008-ekwomr01\Objects\www.sace.sa.edu.au)). Examples of support materials are sample learning and assessment plans, annotated assessment tasks, annotated student responses, and recommended resource materials.

Advice on ethical study and research

Advice for students and teachers on ethical study and research practices is available in the guidelines on the ethical conduct of research in the SACE on the SACE website ([www.sace.sa.edu.au](file:///C:\Users\Ekwomr01\Objective\edrms.saceboard.sa.gov.au-8008-ekwomr01\Objects\www.sace.sa.edu.au)).