Agricultural Production

2021 Subject Outline | Stage 2

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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 2 Agricultural Production.

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 agriculture 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

Stage 2 Agricultural Production is a 20-credit subject.

Stage 2 Agricultural Production focuses on the techniques, procedures, and processes used in agricultural production and on developing an understanding of the relevant agricultural concepts. Students explore aspects of agricultural production that are important in their local area.

The topics in Stage 2 Agricultural Production 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 for Stage 2 Agricultural Production are:

* Topic 1: Animal production
* Topic 2: Plant production
* Topic 3: Resource management
* Topic 4: Agribusiness.

Students study:

* a selection of subtopics from Topic 1 *and/or* Topic 2
* a selection of subtopics from Topic 3 and Topic 4.

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:

|  |  |
| --- | --- |
|  | indicates a possible teaching and learning strategy for science understanding |
|  | indicates a possible science inquiry activity |
|  | indicates a possible focus on science as a human endeavour. |

Science Inquiry Skills



In Stage 2 Agricultural Production, 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 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.

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 conclusions.

| 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 illustrations.   * 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/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 communication in written, oral, and multimodal formats (e.g. presenting a podcast or writing a blog). |

 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 endeavour, with elaborations that are neither comprehensive nor exclusive, in the study of Agricultural Production 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: Animal production

Students extend and integrate their understanding of the key aspects of animal production, including nutrition, reproduction, breeding systems, animal welfare, and disease and pest management. They examine the links between an increasing global population and the demands this places on efficient food production.

Students apply and evaluate practical animal management principles and skills. They investigate the role of technology, and explore how scientists develop and improve technological processes to maximise reproduction and therefore improve production outputs.

Students extend their literacy skills through use of industry-specific terminology and conventions, and their numeracy and critical thinking skills through analysing data to inform decision-making. They examine different perspectives on ethical considerations in animal production, for agricultural animals, communities, and the environment.

Throughout their study of this topic, students maintain a key focus on animal health and welfare.

| Science Understanding | Possible contexts |  |
| --- | --- | --- |
| Animal nutrition  Successful animal production requires knowledge of the feeding and nutritional requirements of agricultural animals.   * Identify and explain the role of the organs of digestive systems. * Investigate the components of feed, including carbohydrates, proteins, fats, vitamins, minerals, and water, and their roles in animal nutrition. * Explore the links between nutritional requirements and production status. * Compare feeding systems of different types. * Explore the role of technology in maximising the efficiency of feeding systems. * Apply and evaluate practical animal‑management principles and skills that are relevant to nutrition and feeding. | Compare, via dissection, ruminant and/or monogastric digestive system.  Compare feed rations used for ruminant and monogastric animals.  Investigate growth rates and feed consumption in different animal production systems (e.g. steers, sheep, fish, pigs, and broilers).  Compare the management of lambs in feedlot and paddock situations. |  |
| Develop practical skills such as feed mixing, pasture assessment, feed budgeting, and livestock assessment.  Plan supplementary feed budgets using the Lifetimewool feed budget tables.  Calculate feed rations or recommend changes to pasture or animal management to balance feed supply and demand, using the NSW DPI feed cost calculator at:  <http://www.mla.com.au/Extension-training-and-tools/Tools-calculators/Feed-demand-calculator>  Collect, present, and analyse data on factors affecting feed conversion in an aquaculture system. |  |
| Investigate the role of technology (e.g. weighing systems, feed composition, feed-harvest techniques, feed supplements, feed delivery, and virtual fencing) in delivering improved nutrition to farmed animals. |  |
| Reproduction  The manipulation of animal reproductive cycles and use of reproductive technologies maximise the quality and quantity of animals produced.   * Identify and explain the role of male and female reproductive systems. * Explain the role of reproductive hormones. * Explore the manipulation of reproductive cycles. * Investigate the application of innovative technology in managing reproduction. * Apply and evaluate practical animal management principles and skills that are relevant to reproduction. * Discuss the ethical issues around manipulation of reproduction. | Compare seasonal breeding versus all‑year‑round breeding.  Investigate the findings of research programs such as the Lifetimewool project, or the MLA/AWI initiative, ‘Making More from Sheep’:  <http://www.makingmorefromsheep.com.au/>  Visit a farm to observe and evaluate industry best practice. |  |
| Analyse condition scores at different stages of the reproductive cycle and relate to the Lifetimewool principles:  <http://lifetimewool.com.au/>  Analyse data to compare natural service with artifical insemination.  Develop practical skills associated with manipulating the reproductive cycle, such as sedation, implants, restraining animals, condition scoring, and heat detection. |  |
| Explore how scientists develop and improve technological processes, such as embryo transfer, artificial insemination, sexing semen, oestrus synchronisation, and juvenile in‑vitro embryo transfer, to improve the efficiency of reproductive procedures.  Investigate the effect of ethical issues on the use of reproductive technologies in animal production. |  |
| Breeding systems  Different breeding stock and breeding systems are used for different purposes.   * Investigate methods of selecting breeding stock. * Explore different breeding systems. * Apply and evaluate practical animal management principles and skills that are relevant to managing breeding. | Compare crossbreeding with line breeding.  Compare different systems using terminal sires.  Investigate the Ramselect program — contact Merino Challenge.  Investigate objective and subjective methods for selecting breeding stock.  Apply estimated breeding values (EBVs) in different scenarios such as mock bull sales. |  |
| Analyse EBVs in stud sale books.  Develop practical skills of sire and dam selection and assessing livestock.  Collect and analyse data from stud breeders about their selection programs.  Evaluate the potential outcomes of using different strategies for selecting breeding stock. |  |
| Investigate how, over the last 100 years, more sustainable breeding systems have been developed by matching the genetic makeup of animals to their environment. |  |
| Animal welfare  Animals under human control must be treated humanely.   * Explore the Five Freedoms of animal welfare. * Investigate the balance between efficient production and maintaining welfare standards. * Apply and evaluate practical animal‑management principles and skills that are relevant to maintaining animal welfare. | Research codes of practice.  Watch the Five Freedoms of animal welfare videos at the Australian Lot Feeders Association website. |  |
| Develop practical skills of stress-free handling and restraining for animals for management purposes. |  |
| Investigate the influence of social pressure due to ethical concerns on practices such as mulesing, caged hens, live export, intensive production, and pig housing. |  |
| Disease and pest management  Disease and pests must be controlled in animal production facilities.   * Investigate how the management of a pest or disease is linked to its life cycle. * Investigate and apply the principles of integrated pest management. * Evaluate alternative chemical treatments and methods for managing chemical resistance. * Explain the importance of hygiene in controlling pests and diseases. * Investigate zoonoses and the risks posed to farmers. * Analyse the effectiveness and impact of biosecurity measures. * Explore the innovative use of technology in managing pests and diseases. * Apply and evaluate practical animal‑management principles and skills relevant to diseases and pests. | Investigate the pest management resources such as Liceboss, Wormboss, and Flyboss websites.  Organise a workshop with a guest speaker from Livestock Biosecurity Network (‘like’ on Facebook for resources).  Discuss biosecurity measures relevant to the school farm situation and extrapolate to a commercial situation. |  |
| Conduct a drenching practical in conjunction with faecal egg counts, comparing laboratory results with on‑farm testing.  Visit a farm to observe and evaluate industry best practice.  Visit a commercial farm to observe and evaluate the advantages and disadvantages of the biosecurity measures in use.  Survey farmers, and evaluate and make recommendations about local biosecurity issues, e.g. community coordination of baiting programs, management of an outbreak of disease, awareness of risks posed by zoonoses.  Develop practical skills such as drenching, tailing, vaccinating, hygiene, backlining, and recognition of signs and symptoms of pests and disease.  Prepare guidelines or a flow diagram on the safe handling of pesticides and other chemicals. |  |
| Investigate how scientists and farmers monitor, assess, and evaluate the risk of a biosecurity treatment to prevent an outbreak of disease.  Prepare a presentation that outlines how scientists, e.g. at SARDI, have evaluated economic, social, or environmental impacts of a particular disease or pest in the local community or nationally.  Prepare a procedure that could be enacted at all levels if a disease entered Australia and evaluate the impact of this procedure on the farming and general communities. |  |

Topic 2: Plant production

Students investigate key aspects of plant nutrition, reproduction, production practices, and disease, pest, and weed management. They examine strategies for sustainable production, analysing how these vary according to changes in environmental conditions.

Students investigate the role of technology and biotechnology in plant production, and explore innovative ways in which scientists develop and improve technological processes to enhance the productivity of crops in response to global demand.

Students extend their literacy skills through use of industry-specific terminology and conventions, and their numeracy and critical-thinking skills through analysing data to inform decision-making. They examine a range of economic, social, and environmental impacts of plant production, and consider ethical issues from different perspectives.

| Science Understanding | Possible contexts |  |
| --- | --- | --- |
| Nutrition  A correct balance of nutrients is essential for successful plant production.   * Explore the role of plant structures in nutrient uptake and photosynthesis. * Investigate nutrient requirements of crops. * Analyse the significance of deficiencies and toxicities of macronutrients and micronutrients. * Compare costs and suitability of different fertiliser types. * Explore the role of crop rotations in plant nutrition. * Analyse the benefits and issues of including legumes in crop rotations. * Investigate the role of technology in delivering nutrients to plants. * Apply and evaluate practical plant-management principles and skills that are relevant to crop nutrition. | Compare in-season application of fertiliser with pre-seeding application.  Explore the benefits and issues associated with fertigation. |  |
| Develop practical skills in detecting nutrient deficiencies and toxicities in plants, sampling and testing soil and plant tissue, using boom sprays, calibrating machinery, and handling fertiliser.  Design a practical investigation to assess optimal nutrient requirements for a particular plant species. |  |
| Explore the improvements in nutrient delivery to crops provided by leading-edge technology, e.g. by scientists at CSIRO.  Compare impacts of organic versus inorganic fertilisers on the environment. |  |
| Reproduction  Plant breeding and selection methods depend on the mode of reproduction.   * Investigate the role of plant structures in reproduction. * Compare vegetative and non‑vegetative reproduction processes. * Compare traditional plant breeding methods with innovative plant breeding techniques. * Explore the use of technology to improve plant reproduction. * Apply and evaluate practical plant‑management principles and skills that are relevant to reproduction. | Investigate horticultural examples where plant reproduction has been manipulated to breed improved types. |  |
| Develop practical skills in identifying plant structures and determining plant growth stages.  Compare monocot and dicot characteristics. |  |
| Explore the evidence available for public debate about beneficial and unexpected consequences of genetic modification of crops. |  |
| Production  Plant‑production practices are tailored to suit specific plants and environments.   * Investigate the agronomic decisions required when planning a plant‑production program. * Explore options for effective pasture management. * Investigate fodder conservation practices. * Compare crop‑rotation options and explore the benefits and issues. * Investigate the role of technology in managing plant production. * Apply and evaluate practical plant‑management principles and skills that are relevant to plant production. | Discuss the factors contributing to in-season decision‑making around crop management (e.g. frosted crops, dry spring, late start to season).  Explore the pre-seeding decisions made by broadacre cropping farmers.  Develop production calendars for different cropping scenarios.  Investigate the use of chemicals in industry practices (e.g. Cittight on citrus fruits, hormones in table grapes).  Explore machinery options for different scenarios. |  |
| Investigate the effect of one variable on an aspect of winemaking.  Conduct and evaluate different pruning methods, including industry best practice, and discuss applications in different scenarios.  Organise a farm visit to observe and evaluate industry best practice.  Develop practical skills of monitoring crops, recording crop production data, calculating yield potential, determining crop growth stage, calibrating machinery, operating machinery, and interpreting data collected by precision agriculture systems. |  |
| Explain the effect of different combinations of crop rotations on the soil and evaluate their economic and environmental impacts.  Sustainability of food production in the Asia-Pacific region requires international collaboration:  <http://irri.org/our-work/locations>  <http://www.cgiar.org/our-strategy/cgiar-research-programs/rice-grisp/>  Prepare a presentation about how scientists in various countries are working together to ensure long-term availability of rice to people in the Asia–Pacific region. |  |
| Disease, pest, and weed management  Disease, pest, and weed control is essential for effective plant production.   * Compare the effects of common diseases, pests, and weeds, on crops. * Explore options for control and prevention of diseases, pests, and weeds. * Explain the importance of herbicide diversity in preventing herbicide resistance. * Investigate and evaluate integrated pest and weed management strategies. * Explore the role of technology and innovative practice in managing diseases, pests, and weeds. * Analyse the effectiveness and impact of biosecurity measures. * Compare monocotyledons and dicotyledons and the management of each plant type. * Apply and evaluate practical plant‑management principles and skills that are relevant to disease, pest, and weed control. | Compare chemical and non-chemical management strategies.  Discuss biosecurity measures relevant to the school farm situation and extrapolate to a commercial situation.  Investigate industry resources such as the Weedsmart Innovations website. |  |
| Develop practical skills in identifying weed types, calibrating spray units, applying chemicals safely and effectively, identifying diseases, pests, and weeds, monitoring crops for diseases, pests, and weeds, and reading and interpreting chemical labels.  Record quadrat counts of weed density in crops or pastures in order to suggest appropriate control strategies for that crop or pasture.  Collect and identify weeds in a local area in order to suggest appropriate control strategies for that area.  Design an integrated management plan for an agricultural pest or disease.  Organise a farm visit to observe and evaluate industry best practice.  Visit a commercial farm and investigate the risks and benefits of biosecurity measures on their business. |  |
| Explore the possibilities provided by GPS and precision agricultural practices (e.g. WeedSeeker technology).  Prepare a presentation that outlines how scientists have evaluated economic, social, or environmental impacts of a particular disease or pest in the local community or nationally. |  |

Topic 3: Resource management

Students explore ways in which innovative management decisions for sustainable agricultural production are developed in response to competing demands on natural resources and the effects of climate change. They investigate options for sustainable land management, and exploring industry best practice in irrigation methods.

Students investigate the effective use of various types of technology to monitor soil and water quality, waste emissions, and climate data. They consider consequences of the use of resources in agriculture, examine the effect of agricultural practices on biodiversity, and explore strategies for managing waste effectively.

Students analyse approaches to the use of resources to effectively balance the competing social, economic, political, and environmental demands of agricultural production.

| Science Understanding | Possible contexts |  |
| --- | --- | --- |
| Soils  Soil properties determine the management strategies used to produce high-quality soil.   * Investigate the influence of physical, biological, and chemical factors on soil management. * Describe how soil profiles are used as a tool in soil management. * Compare conventional, minimum, and no-till systems. * Describe the causes of problems encountered with soils, and options for remediation. * Investigate options for sustainable land management. * Apply and evaluate practical soil‑management principles and skills that are relevant to managing soils. | Explore the management options for dealing with erosion, flood damage, salinity, non-wetting soils, sodicity, acid soils, and waterlogging.  Conduct a soil‑management workshop with a guest speaker from South Australian No-Till Farmers Association (SANTFA).  Visit a farm to investigate tillage machinery and soil management techniques.  Explore the short-term and long-term consequences of poor soil management. |  |
| Investigate soil properties by testing samples for structure, texture, porosity, water‑holding capacity, free lime, and pH.  Investigate the modification of soil properties at a farm site using gypsum, lime, or organic matter.  Analyse soil profiles to determine production options and management strategies.  Develop practical skills in assessing soil health and the impact of management practices, such as irrigation scheduling, crop selection, and tillage systems. |  |
| Explore how scientists design action plans for soil remediation after catastrophic events, such as bushfires and floods, by collecting data for many factors relating to the affected soil.  Investigate Indigenous resource-management practices. |  |
| Water  The quality and use of water resources are continually monitored in farming communities.   * Investigate water‑conservation methods. * Explore the role of technology in monitoring water use and quality. * Analyse and interpret water‑quality data. * Explore industry best practice in irrigation methods. * Investigate how irrigation scheduling can improve production. * Explore issues related to leaching and salinity. * Apply and evaluate practical management principles and skills to maintain water systems and natural waterways. | Discuss how to use data from soil‑moisture probes to inform decisions around irrigation scheduling, and in-season fertiliser and chemical applications.  Discuss the social, environmental, and economic issues around water prices or water allocations for local farming communities. |  |
| Conduct water‑quality testing and investigate the link to aquatic animal health and productivity in aquaculture systems.  Develop practical skills in collecting and analysing water‑quality data, planning irrigation schedules, and monitoring soil water levels. |  |
| Discuss the social and economic factors that reduce acceptance of water restrictions by people in farming communities. |  |
| Waste management  Innovative management methods for waste materials from farming processes have economic and environmental benefits.   * Explore methods of sustainably managing waste materials. * Investigate the economic and environmental benefits of new technologies and innovative practices in waste management. * Apply and evaluate practical management principles and skills for managing waste materials. | Discuss different forms of waste produced by farming systems and methods for disposal.  Discuss value-adding opportunities provided by waste management. |  |
| Conduct an industry visit (e.g. to a dairy, feedlot, or intensive sheds) to investigate and evaluate management of manure and water. |  |
| Investigate current research into methane reduction in feedlot cattle using dietary changes or strategies that alter rumen microbial populations.  Investigate the requirements and organisation of sustainable water‑management systems in intensive farm systems. |  |
| Biodiversity  A larger number of plant species provides more diversity in available genes and a potentially greater variety of crops.   * Evaluate the issues associated with monocultural production systems. * Explore the effect of agricultural practices on biodiversity. | Develop practical skills in identifying native grasses and revegetation of damaged areas. |  |
| Collect, present, and analyse data on the impact of an agricultural practice on the biodiversity of an area. |  |
| Discuss the long-term consequences of clearing land for farming on biodiversity and the sustainability of a farming business.  Investigate the impact of the change from monocultural production to diverse production. |  |
| Climate  Agricultural practices vary according to climatic factors.   * Explore how production choices can be matched to weather patterns and climate zones. * Analyse the role of technology in monitoring and predicting climate and weather data. * Investigate the potential impact of climate change on existing agricultural practices. | Analyse the options available and benefits provided by long-range forecasting and farm-based weather stations.  Discuss variety selection to suit specific climates and growing seasons. |  |
| Develop practical skills in collecting and analysing weather data. |  |
| Discuss the impact of climate‑change scenarios on farming businesses and make recommendations to support sustainability. |  |

Topic 4: Agribusiness

Students extend their understanding of the ways in which the profitability of farming businesses depends on many factors, some of which are unpredictable. They examine some of these factors and investigate strategies for maximising returns from agricultural enterprises.

Students investigate different legal requirements, work health and safety standards, and cultural influences and practices that impact on different markets, locally, nationally, and internationally.

Students evaluate the possible outcomes of market strategies and devise imaginative solutions that allow for changes in technology and market forces.

| Science Understanding | Possible contexts |  |
| --- | --- | --- |
| Enterprise management  Knowledge of the requirements of a farm business improves production outcomes and economic viability.   * Explore the relationship between the inputs and outputs of farm businesses. * Analyse the external factors that affect farm businesses. * Investigate the importance of, and techniques for, risk management in farming businesses. | Investigate the legal requirements, e.g. brand registrations and PIC numbers for livestock systems.  Use models to investigate the effects of different levels of fertiliser on yield.  Investigate the requirements of industry QA systems, e.g. CropCare, AusMeat, Woolworths QA, Hazard Analysis and Critical Control Points (HACCP), CattleCare, FlockCare, LPA, APIQ.  Use scenarios to investigate the impact of changing conditions on farm businesses, e.g. climate change, succession, enterprise mix, technology update, infrastructure improvements. |  |
| Conduct a case study analysing a particular aspect of a farm business and make recommendations to improve sustainability. |  |
| Explore farm ownership options (e.g. leasing, share farming, sole trader, partnership, company, foreign ownership) and discuss the impact on individuals, a community, and the economy.  Evaluate the benefits and costs to farm businesses of participating in quality assurance (QA) systems. |  |
| Enterprise analysis  Assessing individual enterprises for financial and production performance allows farm managers to develop a successful business.   * Explore different methods of assessing farm finances. * Analyse production data to determine profitability and future planning. | Investigate different ways of managing and assessing farm finances (e.g. gross margins and cash-flow budgets).  Explore how farmers use benchmarks such as yield, quality, daily growth rates, and feed conversion ratios to assess enterprise performance. |  |
| Collect production data (e.g. crop yields, or milk quality and quantity) and assess for trends over time or season.  Develop practical skills in collecting and analysing production data. |  |
| Investigate how technology can enhance the collection of enterprise data to improve production outcomes. |  |
| Farm systems  Various factors determine the type of farm system used.   * Compare different farm systems. * Analyse the benefits and issues with intensive and extensive production systems. * Explore the appropriate applications for different farming systems. | Investigate alternative farming options, such as organic, conventional, biodynamic, and permaculture. |  |
| Obtain information from an intensive or extensive enterprise as the basis for an investigation exploring advantages and disadvantages of different farm systems. |  |
| Survey consumers about their understanding of different farming systems and how this influences their purchasing patterns. |  |
| Marketing  Successful marketing of agricultural commodities requires familiarity with the requirements of different markets and the factors that influence them.   * Compare local, national, regional, and global markets. * Investigate market specifications for different enterprises in local and export markets. * Explore the benefits and issues of value-adding processes. * Compare different selling methods. * Investigate the legal requirements of agricultural production for local and export markets. | Conduct a grain-marketing exercise, looking at different scenarios.  Discuss preparation for sale of livestock and products such as wool to maximise returns.  Investigate the documentation required for sale of agricultural commodities (e.g. livestock and commodity vendor declarations, animal health statements).  Investigate different selling methods (e.g. saleyard, on-farm, contracts, on hooks, direct to end-user).  Explore legal requirements of food production (e.g. food labelling, regulations, food safety, ear tags). |  |
| Conduct a livestock marketing investigation (e.g. live assessment of sheep, relating results to market specifications, and marketing options).  Develop practical skills in completing legislated documentation. |  |
| Explore how famers can identify and exploit niche marketing opportunities to improve sustainability. Discuss the associated risks.  Debate the validity of the principle of the ‘food miles’ campaign for global markets in terms of emissions of carbon dioxide:  <http://www.sbs.com.au/shows/foodinvestigators/listings/detail/i/1/article/2941/Food-Miles> |  |
| Work health and safety  Best practice in work health and safety is crucial in reducing farming workplace accidents, injuries, and liability.   * Investigate the required training, processes and documentation required for agricultural work health and safety systems. * Access and use safety information from a variety of sources. * Explore the appropriate use and maintenance of personal protective equipment (PPE) for agricultural production. * Analyse strategies for reducing workplace injuries. * Investigate safe and effective machinery maintenance and operation. | Complete a risk assessment for a practical task using documents such as codes of practice, standard operating procedures (SOPs), safety data sheets (SDSs), and regulations. |  |
| Develop practical skills that incorporate work health and safety principles for all practical activities, especially manual handling, use of PPE, interpreting SOPs and risk assessments, reading and interpreting chemical labels, and the safe storage and handling of chemicals. |  |
| Investigate how new data‑collection systems have revealed information about work health and safety incidents on farms that has led to improved safety of farm processes. |  |

Assessment scope and requirements

All Stage 2 subjects have a school assessment component and an external assessment component.

Evidence of learning

The following assessment types enable students to demonstrate their learning in Stage 2 Agricultural Production:

School assessment (70%)

* Assessment Type 1: Agricultural Reports (30%)
* Assessment Type 2: Applications (40%)

External assessment (30%)

* Assessment Type 3: Production Investigation (30%).

Students provide evidence of their learning through seven assessments, including the external assessment component. Students complete:

* three agricultural reports:
* two with a practical focus, including one with individual student design
* one with a focus on science as a human endeavour
* three applications tasks
* one production investigation.

At least one agricultural report or applications task 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
* teachers and assessors to design opportunities for the student to provide evidence of their learning at the highest possible level of achievement.

The assessment design criteria consist of specific features that:

* students should demonstrate in their learning
* teachers and assessors 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 (30%)

Students complete three agricultural reports. Two reports have a practical focus, and one report has 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 making recommendations
* communicating knowledge and understanding of agriculture.

As a set, practical investigations should enable students to:

* work both individually or collaboratively
* investigate a question or hypothesis for which the outcome is uncertain
* investigate a question or hypothesis linked to one of the topics in Stage 2 Agricultural Production
* individually deconstruct a problem to design their own method and justify their plan of action.

For each investigation, students present an individual report.

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 report on a practical investigation 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 1500 words if written, or a maximum of 10 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 the report include:

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

Science as a Human Endeavour Report

Students 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.

Students select and explore a recent discovery, innovation, issue, or advance linked to one of the topics in Stage 2 Agricultural Production. They analyse and synthesise information from different sources to explain the science relevant to the focus of their investigation, show its connections to science as a human endeavour in an agricultural context, and develop a conclusion.

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

* the announcement of a discovery in the field of agricultural science
* an expert’s point of view on a controversial innovation
* a TED talk based on an agricultural science development
* an article from an agricultural publication (e.g. Stock Journal)
* public concern about an agricultural issue that has environmental, social, economic, or political implications
* changes in government funding for agriculture-related purposes, e.g. for scientific research into biotechnology, soil conservation, hormone use in food production, biosecurity, water management, the greenhouse effect, pest and disease control, monitoring changes in global temperature, animal and plant
* innovative directions in research.

Based on their investigation, students prepare a report that must include use of appropriate terminology and:

* an introduction to identify the focus of the investigation and the key concept(s) of science as a human endeavour that it links to
* relevant agricultural science concepts or background
* an explanation of how the focus of the investigation illustrates the interaction between agricultural science and society, including a discussion of the potential impact of the focus of the investigation, e.g. further development, effect on quality of life, environmental implications, economic impact, intrinsic interest
* a conclusion
* citations and referencing.

The report should be a maximum of 1500 words if written, or a maximum of 10 minutes for an oral presentation, or the equivalent in multimodal form.

This report could take the form of, for example:

* an article
* a letter to the editor
* a written or oral report.

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 (40%)

Students undertake three applications tasks, with at least one under the direct supervision of the teacher. The supervised setting should be appropriate to the task. Each supervised task should be a maximum of 90 minutes of class time, excluding reading time.

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, 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. Problems and scenarios should be set in a relevant context, which may be practical, social, or environmental.

Applications tasks may include:

* developing simulations
* a practical skills assessment
* an oral presentation
* modelling or representing concepts
* a graphical skills exercise
* a multimodal product
* an extended response and/or short-answer questions
* 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.

External assessment

Assessment Type 3: Production Investigation (30%)

Students individually undertake one production investigation. In negotiation with the teacher they develop and conduct their own individual practical investigation based on a primary production enterprise in agriculture. The management of the timeline for the production needs to be considered in the planning, as estimated yields may be necessary rather than actual yields.

Students design a production plan. One draft of the plan should be submitted for teacher feedback and approval. Students may modify their plan in response to teacher feedback before they undertake their investigation.

Students collect both primary data and secondary data, and analyse and evaluate their findings. Students may need to collect data in different time frames and support each other in collection of primary data for the purpose of ensuring safe and ethical work practices, depending on contexts and/or resources.

Students submit their modified production plan with their production report for assessment.

Production Plan

The production plan should include:

An introduction that:

* identifies the purpose of the investigation
* describes the background research and significance of the aspect of agricultural production being investigated
* identifies the specific production goals.

The procedure to be undertaken, including:

* a list of resources required, such as equipment, chemicals, and facilities, and some justification of the chosen types and quantities of resources
* management strategies such as a calendar of activities
* projected gross margin
* marketing considerations, such as risk management, quality assurance requirements, and a justified strategy for selling the product
* safety considerations, such as risk assessments, and personal protective equipment (PPE) and standard operating procedures (SOPs) required
* environmental and animal welfare considerations.

Production Report

The production report should include:

* tables, graphs, and photographs for production records (such as weights, volumes, counts, health status)
* actual and/or projected financial records (such as income and costs, profit and loss)
* analysis of the records in relation to the production and financial goals
* evaluation of procedures and results to identify limitations of, and improvements to, the investigation
* a conclusion for the investigation and how the findings relate to current industry practice
* expression of ideas, using appropriate agricultural terminology and referencing.

The combined word count for the production plan and the production report should be a maximum of 2000 words, if written, or the equivalent in multimodal form.

The following specific features of the assessment design criteria for this subject are assessed in the production investigation:

* investigation, analysis, and evaluation — IAE1, IAE2, IAE3, and IAE4
* knowledge and application — KA1 and KA4.

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 and assessors 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 each school assessment type, the teacher makes a decision about the quality of the student’s learning by:

* referring to the performance standards
* assigning a grade between A and E for the assessment type.

The student’s school assessment and external assessment are combined for a final result, which is reported as a grade between A and E.

Performance Standards for Stage 2 Agricultural Production

| - | 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 both the school assessment and the external 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 2 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)).