Shape of ACT Senior Secondary Curriculum

Agriculture A/T/M

March 2022

Table of Contents

1. PURPOSE

1.1 The *Shape of ACT Senior Secondary Curriculum: Agriculture* will guide the writing of the *Agriculture A/T/M* course.

1.2 This paper has been prepared following consultation with Emeritus Professor Jim Pratley AM FASA of the School of Agriculture, Environment and Veterinary Science at Charles Sturt University.

1.3 The paper should be read in conjunction with The Shape of the ACT Senior Secondary Curriculum located at: *http://www.bsss.act.edu.au/curriculum/bsss_course_development_consultation*

2. INTRODUCTION

2.1 The *Agriculture A/T/M* course will be the basis of planning, teaching, learning and assessment in ACT senior secondary schools.

3. BACKGROUND

3.1 The ACT Board of Senior Secondary Studies has reviewed the *Agriculture A/M* course in the five -year course development cycle of improvement and renewal.

Feedback on the course from implementing schools and the existence of tertiary pathways in Agriculture, Agricultural Science, and related disciplines such as Environmental Science provide reasons to redevelop this course as A/T/M. Innovations in the field nationally and the continued development of local food and fibre enterprises to supply the demand for local products also suggest reasons for expanding the pathways and opportunities for students provided through this course.

3.2 All courses under development are required to meet Board design specifications and to align with Board requirements for the senior secondary curriculum. These specifications align with ACARA course design specifications and provide teachers with flexibility to plan, teach and assess according to the needs and interests of their students.

3.3 The *Agriculture A/T/M* course is to be developed under the Science Framework. Found at: https://www.bsss.act.edu.au/act_senior_secondary_system/curriculum/frameworks

The rationale for this framework describes Science:

The study of Science is the unveiling of the mysteries of the universe in order to make sense of nature in all its wonder and complexity. Through knowledge, observation, questioning, experimentation, discussion, critical analysis and creative thinking in a scientific context, students develop their investigative, analytical and communication skills while cultivating an appreciation of the natural world.

Scientific processes test current understandings and are continually re-evaluated. Students are challenged to examine and reconsider their understanding of scientific concepts, inquiry methods and phenomena. Students apply their knowledge of science to solve problems, make evidence-based decisions and engage in public debate about contemporary issues from a scientific perspective. The study of science explores ways in which scientists work collaboratively and individually in a range of integrated fields to increase understanding of an ever-expanding body of scientific knowledge. They examine strategies proposed to address major scientific challenges now and in the future in local, national, and global contexts.

Studying senior secondary Science provides students with a suite of cognitive and social skills and understandings that are valuable to a wide range of further study pathways and careers. Studying Science will enable students to become citizens who are more knowledgeable about the world around them and who have the critical skills to evaluate issues and make informed decisions. (page 3)

3.4 All courses based on this Framework should develop students':

- sense of wonder and curiosity about nature and an appreciation of how scientific knowledge can be used to address contemporary issues
- understanding of the theories and models used to describe, explain, and make predictions about systems, structures, and properties to provide a reliable basis for action
- understanding that scientific knowledge has developed over time, is used in a variety of contexts; and influences, and is influenced by, historical, social, economic, cultural, and ethical considerations
- understanding that Science is experimental and has developed through independent and collaborative research, and has significant impacts on society and implications for decision making
- ability to design and conduct a variety of field and laboratory investigations involving collection and critical analysis of data, and interpretation of evidence
- ability to critically evaluate scientific concepts, interpretations and claims in order to solve problems and generate informed, considered, and ethical conclusions
- ability to communicate scientific understanding, findings, arguments, and conclusions using appropriate representations, modes, and genres.

3.5 Concepts from the Science Framework (page 3) build on ACARA's F-10 Science curriculum:

Concepts and Knowledge

Courses developed under this Framework provide details of course content through the component units of the course. While this content will differ according to the particular course, all content will be chosen to enable students to work towards the achievement of the common and agreed goals of the Framework.

Overview

Science has three interrelated strands: Science Inquiry Skills, Science as a Human Endeavour, and Science Understanding. In the practice of science, the three strands are closely integrated: the work of scientists reflects the nature and development of science, is built around scientific inquiry, and seeks to respond to and influence society. Students' experiences of school science should mirror this multifaceted view of science. To achieve this, the three strands of the *Australian Curriculum: Science* should be taught in an integrated way. The content descriptions for Science Inquiry Skills, Science as a Human Endeavour and Science Understanding have been written so that this integration is possible in each unit.

Science Inquiry Skills

Science inquiry involves identifying and posing questions; planning, conducting, and reflecting on investigations; processing, analysing, and interpreting data; and communicating findings. This strand is concerned with evaluating claims, investigating ideas, solving problems, reasoning, drawing valid conclusions, and developing evidence-based arguments.

Science investigations are activities in which ideas, predictions or hypotheses are tested and conclusions are drawn in response to a question or problem. Investigations can involve a range of activities, including experimental testing, field work, locating and using information sources, conducting surveys, and using modelling and simulations. The investigation design will depend on the context and subject of the investigation.

In science investigations, the collection and analysis of data to provide evidence plays a major role. This can involve collecting or extracting information and reorganising data in the form of tables, graphs, flow charts, diagrams, prose, keys, spreadsheets and databases and previously published information and results. The analysis of data to identify and select evidence, and the communication

of findings, involve the selection, construction and use of specific representations, including mathematical relationships, symbols, and diagrams.

Generic inquiry skills are described below and will be explicitly taught and assessed in each unit. In addition, each unit provides more specific skills to be taught within the generic science inquiry skills; these specific skills align with the Science Understanding and Science as a Human Endeavour content of the unit.

The generic science inquiry skills are:

- identifying, researching, and constructing questions for investigation; proposing hypotheses; and predicting possible outcomes
- designing investigations, including the procedure/s to be followed, the materials required and the type and amount of primary and/or secondary data to be collected; conducting risk assessments; and considering ethical research
- conducting investigations, including using equipment and techniques safely, competently, and methodically for the collection of valid and reliable data
- representing data in meaningful and useful ways; organising and analysing data to identify trends, patterns, and relationships; recognising error, uncertainty, and limitations in data; and selecting, synthesising, and using evidence to construct and justify conclusions
- interpreting scientific and media texts and evaluating processes, claims and conclusions by considering the quality of available evidence; and using reasoning to construct scientific arguments
- selecting, constructing, and using appropriate representations to communicate understanding, solve problems and make predictions
- communicating to specific audiences and for specific purposes using appropriate language, nomenclature, genres, and modes.

Courses developed under this Framework may incorporate an extended scientific investigation.

Science as a Human Endeavour

The use and influence of science are shaped by interactions between science and a wide range of social, economic, ethical, and cultural factors. Scientific knowledge is continually reviewed, and this review process involves a diverse range of scientists working within an increasingly global community of practice and can involve the use of international conventions and activities such as peer review.

Through science, we seek to improve our understanding and explanations of the natural world. The Science as a Human Endeavour strand highlights the development of science as a unique way of knowing and doing and explores the use and influence of science in society.

Science Understanding

The Science Understanding content in each unit develops students' understanding of the key concepts, models and theories that underpin the subject, and of the strengths and limitations of different models and theories for explaining and predicting complex phenomena.

Science understanding is evident when a person selects and integrates appropriate science concepts, models, and theories to explain and predict phenomena, and applies those concepts, models, and theories to new situations. Models in science can include diagrams, physical replicas, mathematical representations, word-based analogies (including laws and principles) and computer simulations.

Science Understanding should be developed through the selection of contexts that have relevance to and are engaging for students.

3.6 All courses of study for the ACT Senior Secondary Certificate should enable students to develop essential capabilities for twenty-first century learners. The Australian Curriculum General Capabilities comprise an integrated and interconnected set of knowledge, skills, behaviours, and dispositions that students develop and use in their learning across the curriculum. While developing all capabilities, in particular, the *Agriculture A/T/M* course will engage with the capabilities of Creative and Critical Thinking, Intercultural Understanding, Ethical Understanding as well as the Cross Curriculum Perspective of sustainability.

The General Capability of Critical and Creative Thinking will be developed by Interdisciplinary Science through their critical examination of theories, inquiry methodologies, data, and arguments.

> *In the Australian Curriculum, students develop capability in critical and creative thinking as they learn to generate and evaluate knowledge, clarify concepts and ideas, seek possibilities, consider alternatives, and solve problems. Critical and creative thinking involves students thinking broadly and deeply using skills, behaviours, and dispositions such as reason, logic, resourcefulness, imagination, and innovation in all learning areas at school and in their lives beyond school.*
> *https://www.australiancurriculum.edu.au/f-10-curriculum/general-capabilities/critical-and-creative-thinking/*

The General Capability of Numeracy will be developed by Interdisciplinary Science through their application of mathematical and logical methodologies to data, and arguments.

> *students become numerate as they develop the knowledge and skills to use mathematics confidently across other learning areas at school and in their lives more broadly. Numeracy encompasses the knowledge, skills, behaviours, and dispositions that students need to use mathematics in a wide range of situations. It involves students recognising and understanding the role of mathematics in the world and having the dispositions and capacities to use mathematical knowledge and skills purposefully*
> *https://www.australiancurriculum.edu.au/f-10-curriculum/general-capabilities/numeracy/*

4. THE CONTEXT OF THE ACT

4.1 Courses of study for the ACT Senior Secondary Certificate:

- provide a variety of pathways, to meet different learning needs and encourage students to complete their secondary education
- enable students to develop the essential capabilities for twenty-first century learners
- empower students as active participants in their own learning
- engage students in contemporary issues relevant to their lives
- foster students' intellectual, social, and ethical development
- nurture students' wellbeing, and physical and spiritual development
- enable effective and respectful participation in a diverse society.

4.2 Each course of study:

- comprises an integrated and interconnected set of knowledge, skills, behaviours, and dispositions that students develop and use in their learning across the curriculum
- is based on a model of learning that integrates intended student outcomes, pedagogy, and assessment
- outlines teaching strategies which are grounded in learning principles and encompass quality teaching
- promotes intellectual quality, establishes a rich learning environment, and generates relevant connections between learning and life experiences

- provides formal assessment and certification of students' achievements.

4.3 In consideration of the ACT context, and in response to contemporary research and literature, an *Agriculture* course should include:

- a student-centred pedagogical approach
- the Science Framework and Achievement Standards
- an interdisciplinary approach to understanding the intersection of various natural and social and economic systems that converge in agriculture
- the educational needs of young people with respect to understanding the scientific, technological, and socio-economic complexity of the production of food and fibre through crops and livestock using sustainable and ethical methods
- skills to assist in decision-making, based on scientific evidence and reasoning in solving problems in agriculture
- knowledge of software, digital systems and innovations in equipment and technology used to quantify, define, and resolve problems in agriculture
- skills in the techniques, equipment, and processes for conducting experimentation and inquiry in *Agriculture*
- awareness of local, national, and global issues, and future trends
- an appreciation of the potential of agriculture in humanitarian development projects
- the experiences of agriculturalists and agricultural practices in different contexts

5. AIMS OF THE AGRICULTURE CURRICULUM

The proposed agriculture curriculum provides an opportunity for students to engage with agriculture as a discipline that is changing, innovative and a producer of knowledge, understanding and skills vital to a sustainable world. Indeed, the University of Melbourne argues that "Agriculture's focus on science and sustainability is how we will adapt to our changing climate, declining environmental health and increasing demand for safe food production to feed our growing populations." (UMelb, 2021) Students who study agriculture will be engaging in a contemporary and important discipline. This is not a training course for farmers; it is a STEM course in solving problems facing society such as how to feed the approximately "811 million people in the world who faced hunger in 2020" (FAO, 2021)

With these problems as a focus, agriculture is a complex discipline that engages with a broad scope of scientific knowledge and methodologies to understand the complex and interrelated systems with which agricultural production engages in producing food and fibre. To understand how to operate sustainably with that web of systems and achieve sustainable agricultural production and outcomes, Sitienei and Morrish (2014) argue that "Agricultural education needs to address elements of emerging agriculture including sustainable production… Inclusion of sustainable agriculture topics in both the high school and college agriculture curriculum can provide solutions to the environmental problems associated with production." (Sitienei, I and Morrish, D.G, 2014, p. 68) It therefore aims to ensure students have knowledge, understanding of, and the skills to investigate, fundamental natural systems such as ecosystems, nutrient cycles, the carbon cycle, climatic systems, water systems, and soil systems.

This course also provides an opportunity for students to understand agricultural science in its socio-economic context as a discipline and industry that seeks to meet the demands of consumers and markets. Students in *Agriculture* will study how to communicate findings clearly and persuasively and understand resistance to innovations in practice and sustainability. Indeed, Ross Kingwell et al

argue that farms will need to address "Periods of climate volatility and any underlying spatial shifts in climate patterns affect production risk, and ultimately the financial risk of farming and business expansion; and, social attitudes and expectations, within and outside of farm communities, invariably affect the nature and outcomes of farm practices and the social attractiveness of farming". (Kingwell, R. et al, 2019, p. 33) They highlight the many pressures on meeting demand and operating in a complex economic climate, pressures that may lead to agricultural practices that are contrary to scientific best practice, such as overgrazing or soil degrading tilling systems. Students in this discipline examine such problems and search for solutions. Agricultural science might engage with the process of value adding in the agricultural sector, for example, by "adding attributes to a product" or by enabling innovations such as "adopting organic, chemical-free, or low-emissions farming systems" (NALAC, 2020, p. 89) Such complex scientific investigations are prompted often by the socio-economic pressures.

The course will support teachers in engaging a diverse range of students and thus provide pathways and knowledge to new groups of people. Wangberg advocates studying the context and diverse experiences of agriculturalists to make "visible the experiences of women and minorities in agriculture." (Wangberg, JK, 2006, p. 24) They argue that this will encourage minorities and women to undertake studies in which they see people like themselves and thereby engage agricultural studies in broader socio-economic contexts. Indeed, the Australian Government has noted "the importance of women as cultural and business leaders in Australian AgriFood. Women spearhead many entrepreneurial initiatives in regional Australia Equally so in the Australian context…[to] help supplement the traditional image of AgriFood… with that of a young woman in a factory managing a team creating, on the farm itself, mixed cut salads for sale to consumers"(NALAC, 2020, p. XXII) With a similar intention to expand the base from which a workforce is drawn, Scott Graham argues that if the agricultural workforce is to grow, students from urban areas with little experience of agriculture must be enticed into studies in agriculture by drawing attention to the many lucrative and meaningful careers to found in the sector. (Graham, S. 2021, p. 12)

Agriculture aims to engage students in investigating contemporary case studies to develop current and relevant skills and knowledge. For example, in the face of rapid environmental change, Agriculture is potentially the provider of solutions to the many challenges that follow from variable climate. This course aims to make students aware of the science that may contribute to combating warming and climate change and provide relevant foundational STEM knowledge, skills and understanding so that they may contribute to that ongoing project of remediation. As the Australian National Agricultural Labour Advisory Committee noted in 2020, "The nature of agricultural employment is being revolutionised by technological innovation and it is critical that education and training pathways keep up with new farming practices to maintain the competitiveness of Australian AgriFood and realise imminent growth opportunities" (NALAC, 2020, p. 107). As such, Agriculture courses must continually evolve to equip students with the scientific skills, knowledge and understandings required for work and further study in this discipline. The flexibility and problem focus of this course allows teachers to redesign programs of learning to keep units contemporary, relevant, and challenging.

Agriculture aims to provide students access to meaningful and satisfying careers in a vital and growing economic sector. Charles Sturt University School of Agriculture notes the future focused and contemporary nature of the science of agriculture. They describe their subject as "one of the most rapidly changing fields of study in the 21st century." They further note the significance of that rapidly changing context for a graduate of agriculture in arguing that "there is high demand for skilled professionals to develop ethical and sustainable food production systems, to support the world's growing populations" (CSU, 2021). In keeping with this vital and dynamic sector's future focus, the Australian Commonwealth Your Careers and Job Outlook websites cite "strong" demand for Agricultural Scientists and further 6.1% growth in demand for Agricultural Scientists over the next five years (Joboutlook.gov.au, 2021; yourcareer.gov.au, 2021; Labour Market Information Portal, 2020). This course provides a first step towards a rewarding and interesting career in a diverse and multifaceted sector.

6. STRUCTURE OF THE AGRICULTURE CURRICULUM

The *Agriculture* course has been reformulated to reflect new development in the discipline of agriculture as a STEM subject and to support the inclusion of a T pathway in the course.

RATRIONALE

Agriculture A/T/M engages students in investigating the complex relationships between consumer and market demands and the systems which underpin agricultural production. Students develop the scientific and technological skills to engage with the study of contemporary agriculture.

Students develop knowledge and understanding about complex biological, chemical, and physical systems and their interactions that underpin agriculture. They develop the scientific skills to investigate key systems in particular and localised case studies. They develop the technological skills to acquire and process data that inform understanding and solving problems in meeting market demands.

They understand the challenges of producing and disseminating reliable scientific knowledge in a heavily contested space. They appreciate and address the challenges of applying contemporary research findings and recommendations in a context characterised by tradition, economic pressures, and policy conflict.

This course prepares students for further work and study in a growing economic sector in which well-paid and meaningful employment is available. It also develops general scientific capacity for further work and study in other areas of science and social science.

UNITS

The units have been drafted for discussion as follows:

Sustainable Agriculture

Students investigate the interconnected systems that underpin agriculture locally, nationally, and globally. They inquire into how agricultural production depends on and affects the ecosystems in which it operates. Students apply rigorous data collection, data analysis and experimental methods to quantify and understand systems. Students critically analyse how technological solutions can be used effectively to improve production and sustainability. They examine how agricultural practices can be varied to achieve reductions in carbon emissions and environmental pollution and increases in biodiversity while sustaining food and fibre production.

Farming in Context

Students examine agriculture regionally. They investigate the nature of the local ecologies, climate and geology that determine outcomes for primary producers. They evaluate agricultural processes to reflect on their efficacy and sustainability. Students investigate the challenges and opportunities facing agriculture in their region due to climate change, environmental challenges, and government policy changes.

Meeting Market Demand

Students analyse agriculture from the perspective of plate to paddock. They examine the demands of consumer markets and regulatory regimes and work backward to investigate how agricultural enterprises can meet those requirements. In working backward, they apply rigorous scientific processes to understand the intersecting systems and parameters of problems, evaluate possible solutions and determine the best choices.

Contemporary Agriculture
Students investigate the challenges and opportunities facing contemporary farmers globally. They inquire into a range of technological, biological, and engineering solutions to challenges in the local context. They critically analyse proposed solutions to challenges and problems in agriculture, including global hunger and rural poverty worldwide. Students develop the scientific and technological skills to quantify and understand problems and propose solutions in agriculture.
Independent Study
An Independent Study unit has an important place in senior secondary courses. It is a valuable pedagogical approach that empowers students to make decisions about their own learning. An Independent Study unit can be proposed by an individual student for their own independent study and negotiated with their teacher. The program of learning for an Independent Study unit must meet the unit goals and content descriptions as they appear in the course. Students must have studied at least **THREE** standard 1.0 units from this course. An Independent Study unit requires the principal's written approval. Independent Study units are only available to individual students in Year 12. Principal approval is also required for a student in Year 12 to enroll concurrently in an Independent Study Unit and the third 1.0 unit in a course of study.

7. CONSIDERATIONS

7.1 Incorporating a futures orientation

Agriculture is both a highly local and a global industry and its products are traded and shipped around the world. The threats and challenges are also highly localised and global, and students of *Agriculture* will learn about and how to address challenges on a local and global scale. In this ever-changing environment, Agriculture has become a vital area of study as the demand for food continues to grow, despite the global trends that make such production vulnerable. As such in engaging with the central problems of change and future planning, studies of Agriculture address the following aim of the ACT Education Directorate:

> *The imperative to create a futures-oriented curriculum is a major opportunity to lead improved teaching and learning. A futures orientation will include consideration that society will be increasingly complex, with Australians interacting in a global environment needing to know how to learn, adapt, create, communicate, and interpret and use information critically.*
> *(The Future of Education and Skills Education 2030, 2018)*

7.2 Agriculture curriculum

The *Agriculture* curriculum has an important place in the ACT senior secondary curriculum and the Australian and global economy. It challenges students to think about, respond to and create solutions to contemporary problems in food and fibre production. Students actively engage in problem solving processes to create solutions that contribute positively to preferred personal, social, ethical, economic, environmental, legal, sustainable, and technological futures.

7.3 Equity and opportunity

Agriculture A/T/M is inclusive of students' needs and interests. It provides flexibility and choice for teachers and students. The factors that influence these choices include school and community contexts, local community learning opportunities, contemporary and local issues, and available learning resources.

7.4 Connections to other learning areas

The *Agriculture* course builds on knowledge, skills and understanding from students' previous studies of Australian Curriculum courses. Students learn about fundamental natural systems, ecosystems and agriculture in the Science and HASS- Geography learning areas from 7 -10. As a STEM subject, *Agriculture* complements studies in any Science subject.

7.5 Role of digital technologies

Students and teachers integrate a growing range of online information, tools, and applications. These include digitised online materials such as books, newspapers, journals, and images, as well as other online resources including databases, reference works and indexes to library holdings. Furthermore, use of new technological developments such as the use of augmented reality and virtual reality will also be considered.

7.6 Clarity of curriculum

The curriculum is substantial and flexible. It is sufficiently rich and descriptive to guide teachers with limited experience but avoid excessive prescription that would hamper experienced teachers from exercising their skills. The curriculum document is expressed clearly in terms that are accessible to a new teacher, while allowing all teachers to enhance it with their interests and expertise.

7.7 Breadth and depth of study

Content descriptions specify the knowledge, understanding and skills that students are expected to learn and that teachers are expected to teach. Teachers are required to develop a program of learning that allows students to demonstrate all the content descriptions.

A program of learning is what a college provides to implement the course for a subject meeting students' needs and interests. It is at the discretion of the teacher to emphasise some content descriptions over others. The teacher may teach additional (not listed) content if it meets the specific unit goals providing that it does not duplicate content in other units.

7.8 The nature of the learner

The courses address the needs of diverse learners through (T), (A) and (M) categories of study.

7.9 General capabilities

Agriculture A/T/M develops critical and creative thinking when students explore problems, develop innovative ideas, generate solutions, and evaluate and refine their ideas. They develop personal and social capability, while working collaboratively and developing a range of self-management skills. Students develop ethical understanding as they identify and investigate the nature of ethical concepts, values, and principles. They reflect on ethical principles of food choices considering animal welfare, sustainability, and resource use. Students develop intercultural understanding as they engage with diverse cultures in ways that recognise commonalties and differences.

7.10 Cross curriculum perspectives

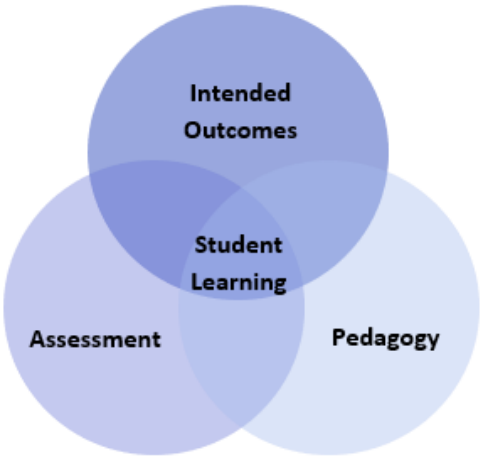
Aboriginal and Torres Strait Islander histories and cultures, Asia and Australia's engagement with Asia, and Sustainability perspectives are represented in the course in ways that are appropriate.

8. PEDAGOGY AND ASSESSMENT

The underpinning beliefs and learning principles for the development of ACT Board of Senior Secondary School curriculum as are follows:

8.1 Underpinning beliefs

- All students are able to learn
- Learning is a partnership between students and teachers
- Teachers are responsible for advancing student learning.



8.2 Learning Principles

1. Learning builds on existing knowledge, understandings, and skills.

   (Prior knowledge)
2. When learning is organised around major concepts, principles, and significant real-world issues, and within and across disciplines, it helps students make connections and build knowledge structures.

   (Deep knowledge and connectedness)
3. Learning is facilitated when students actively monitor their own learning and consciously develop ways of organising and applying knowledge within and across contexts.

   (Metacognition)
4. Learners' sense of self and motivation to learn affects learning.

   (Self-concept)
5. Learning needs to take place in a context of high expectations.

   (High expectations)
6. Learners learn in different ways and at different rates.

   (Individual differences)
7. Different cultural environments, including the use of language, shape learners' understandings and the way they learn.

   (Socio-cultural effects)
8. Learning is a social and collaborative function as well as an individual one.

   (Collaborative learning)
9. Learning is strengthened when learning outcomes and criteria for judging learning are made explicit and when students receive frequent feedback on their progress.

   (Explicit expectations and feedback).

9. CONCLUSION

Agriculture A/T/M is to be developed under the Science Framework. The course provides students with a suite of cognitive and social skills and understandings that are valuable to a range of further study and career pathways. In learning to solve complex problems in Science, they develop a deep understanding of the complex array of systems converging in agricultural projects. Studying *Agriculture* will enable students to become citizens who are more knowledgeable about the world around them and who have the critical skills to evaluate issues and make informed decisions. This course will support students in pursuing a range of meaningful careers in Agriculture.

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