



# YEARS 11&12

## AGRICULTURAL SYSTEMS

### TEACHING & LEARNING SUPPLEMENT

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Teaching and Learning Supplement  
**AGRICULTURAL SYSTEMS (ARG315117)**

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## ADVICE TO TEACHERS

This document helps to describe the nature and sequence of teaching and learning necessary for students to demonstrate achievement of course outcomes.

It suggests appropriate learning activities to enable students to develop the knowledge and skills identified in the course outcome statements.

Tasks should provide a variety and the mix of tasks should reflect the fact that different types of tasks suit different knowledge and skills, and different learning styles. Tasks do not have to be lengthy to make a decision about student demonstration of achievement of an outcome.

## COURSE SPECIFIC ADVICE

This *Agricultural Systems* level 3 Teaching and Learning Supplement must be read in conjunction with the *Agricultural Systems* level 3 course document and relevant External Assessment Specifications and Examination Guidelines.

It contains advice to assist teachers delivering the course and can be modified as required. This Teaching and Learning Supplement is designed to support teachers new to or returning to teaching this course

*Agricultural Systems*, level 3 introduces learners to farming systems and operations through an integrated Science, Technologies, Engineering and Mathematics (STEM) inquiry.

In this course learners explore the various systems and sub-systems that support agricultural production and maximise productivity. They learn the theory of food and fibre production, and associated agricultural industries, through a focus on ecosystems, plant and animal productions systems, business and financial management systems and agricultural technologies systems. Learner understanding is demonstrated by researching a case study and by developing an engineering solution to an agricultural problem or situation.

Learners apply their technical and theoretical understandings in a practical and authentic context. Student learning is both theoretical and experiential. Learners undertake an agri-foods case study and design and develop an engineering solution to an agricultural problem or situation.

This document helps to describe the nature and sequence of teaching and learning necessary for learners to demonstrate achievement of course outcomes. It suggests appropriate learning activities to enable learners to develop the knowledge and skills identified in the course outcomes.

## SEQUENCE OF CONTENT

*Agricultural Systems* is divided into six (6) compulsory units of study:

Unit 1: Systems Thinking (10 hours)

Unit 2: Ecosystems (20 hours)

Unit 3: Plant Production Systems (25 hours)

Unit 4: Animal Production Systems (25 hours)

Unit 5: Agricultural Technologies (40 hours)

Unit 6: Agri-Foods Case Study (30 hours)

The recommended time spent on each unit is indicated in brackets. Unit 1 must be delivered first. Units 2-4 can be delivered in any order. Units 5 and 6 are learner-directed activities and can be studied at any time throughout the course.

# TEACHING AND LEARNING

## Unit 1 Systems Thinking

### ***Examples of learning activities***

Learners:

explore systems theory through an Internet search of key concepts and theorists

use graphic communication devices (flowchart, drawing, mind mapping software, infographics) to define and describe various systems

research forms of inquiry and describe the different inquiry cycles for each

use in a simulated scenario or employ through project work a number of problem solving and project planning strategies e.g.

- Political, Economic, Social and Technological (PEST) analysis
- Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis
- Drill Down
- cause and effect diagram
- systems diagrams
- risk analysis and risk management
- cost/benefit analysis
- the planning cycle
- small business project templates
- Gantt charts.

invite a 'systems thinker' (agronomist, engineer, architect, local government planner, spatial technologist, meteorologist, energy distribution worker, computer programmer) to discuss their ways of working with systems

visit an agribusiness and observe systems in practice; develop a graphic organiser (flowchart, drawing, mind mapping software, infographics) the interrelationship between agricultural systems

research relevant careers that require systems thinking skills and capabilities

## Unit 2 Ecosystems

### ***Examples of learning activities***

Learners:

conduct fieldwork at local sites to compare a natural ecosystem, for example forest, native grassland, with a managed ecosystem, for example dairy farm, wheat farm, nursery, vegetable garden, local park, recreation reserve; write a fieldwork report that compares similarities and differences between managed and natural systems

examine a local ecosystem to explain the main principles associated with sustainable management, for example biodiversity, biomass, cycling of matter and efficient use of energy

prepare a table that describes types of degradation, including erosion, mass wasting (for example, landslips), salting, water logging, compaction, soil acidity, water quality issues; include images of each type of degradation

conduct fieldwork to provide examples of environmental degradation, including erosion, mass wasting (for example, landslips), salting, water logging, compaction, soil acidity, water quality issues

research appropriate techniques for rectifying degraded land and water at a specific site and write a report

show videos which illustrate techniques to rectify degradation problems, for example tree planting, drainage, ground water pumping, deep ripping, liming, track farming, raised bed technology, water management, water quality management and nutrient management

brainstorm techniques to rectify degraded land and water for a specific agricultural or horticultural business

use the Internet to examine climate change impacts and greenhouse gas emissions issues in agriculture and/or horticulture

undertake a media analysis that examines the potential effects of climate change and how agribusinesses are adapting to these effects

use the website Greenhouse in Agriculture to calculate and evaluate the carbon emissions for a particular agricultural or horticultural business

research the concept 'sustainability' and the components of sustainability, including social, economic and environmental factors that influence sustainability of an agricultural and/or a horticultural operation

develop a definition of sustainability through class discussion and debate

use the Internet to research information on the economic, social and environmental aspects of intensive farming practices used in the production of eggs, lamb or pork; prepare a PMI chart to present the information researched

work in small teams to research information about fair trade; use a computer based visualisation program to prepare a concept map of the main issues related to fair trade both in developing countries and within the Australian agricultural and horticultural communities

access the website of Biological Farmers of Australia ([www.bfa.com.au](http://www.bfa.com.au)) or TMOrganics ([www.tmorganics.com](http://www.tmorganics.com)); draw up a PMI chart of information on the value of adopting organic farming methods to the environment, farmer and to consumers

use presentation software to outline the purpose and steps for developing a property management plan for a selected agricultural and/or horticultural business

demonstrate a range of indicators of environmental health, for example soil characteristics (pH, texture, nutrients, organic matter, microorganism), water table depth, ground water salinity, production levels, presence of weeds and vermin, water quality, operator/s' level of awareness of sustainability issues, oxygen levels, pollution

discuss the concept of 'environmental health'

undertake a media analysis by accessing articles or podcasts that describe practices consistent with sustainable resource management, for example tree planting, minimum tillage, laser grading, nutrient management, irrigation management, waste disposal systems, Integrated Pest Management; write a review of a range of these articles/reports

undertake fieldwork using environmental health indicators and relate them to the sustainability of an agricultural or a horticultural business

invite a representative from a local Landcare group to outline their activities and how they develop sustainable catchment management practices

review government policies and regulations on soil and water management in agricultural and/or horticultural businesses and prepare a written essay on the findings

using the Internet, research strategies for sustainable resource management for land and water for an agricultural and/or a horticultural business

work in small teams to research strategies Australian agribusiness companies are using to address environmental issues in food and fibre production such as reducing water consumption, energy use and minimising waste sent to landfill; use visualisation software to prepare a summary of the findings

develop a matrix that identifies organisations that can aid managers in developing strategies for sustainability; describe how these organisations can help manage for sustainability

monitor changes to water quality at a field site and use the analysed data to recommend changes for improvements at the site

**Unit 3**  
**Plant**  
**Production**  
**Systems**

***Examples of learning activities***

Learners:

use anatomical models to describe the main structures associated with plants; draw diagrams of these models indicating the structures associated with nutrition and growth, for example the roots, nodes and axils of plants

conduct fieldwork to local suppliers of plant products for nutrition or reproduction; collect manufacturers' brochures and prepare a matrix that analyses the differing needs of the plants using information provided

present an annotated visual display that identifies the main structures associated with plant reproduction

develop a Digital presentation accompanied by diagrams and notes on one specific plant that explains the processes associated with plant reproduction; develop an overview by taking notes on other presentations

describe the principles of plant genetics through a series of comprehensive exercises using current agricultural and horticultural texts; present the information using an interactive whiteboard (IWB)

invite a guest speaker to discuss the main aspects of plant genetics, including recessive genes, dominant genes, genotype, phenotype, simple characteristics, intermediate inheritance

access dissections using multimedia and real specimens that illustrate the main aspects of plant reproduction, including sexual and asexual reproduction, flower structures, growth cycles – annual, biennial, perennial

use applied exercises to explore the range of biological factors that could influence production efficiency, such as nutrient fixing organisms or disease causing organisms and pests

classify a range of plant varieties into different groups on the basis of the environmental factors that influence production efficiency; justify the decisions made about the groupings

use the BOM website ([www.bom.gov.au](http://www.bom.gov.au)) to identify the implications of temperature (minimum and maximum), rainfall and light intervals on the production of plants

undertake an investigation into the effects of a range of nutrients on hydroponically grown vegetables

use a range of liquid fertilisers to investigate the implications of nutrients on the growth of plants

#### **Unit 4** **Animal** **Production** **Systems**

#### ***Examples of learning activities***

Learners:

use anatomical models to describe the main structures associated animals; draw diagrams of these models indicating the structures associated with nutrition and growth, for example the digestive systems and skeletal systems in animals

conduct fieldwork to local suppliers of animal products for nutrition or reproduction; collect manufacturers' brochures and prepare a matrix that analyses the differing needs of the plants animals using information provided

work as a member of a team to design and prepare a range of feeds for a specific animal at different stages of growth and development, for example poultry (hatchling, grower, layer) or dairy cattle (newborn calf, weaner heifer, pregnant heifer, early lactation cow, late lactation cow)

present an annotated visual display that identifies the main structures associated with animal reproduction

develop a Digital presentation accompanied by diagrams and notes on one specific animal that explains the processes associated with animal reproduction; develop an overview by taking notes on other presentations

describe the principles of animal genetics through a series of comprehensive exercises using current agricultural texts; present the information using an interactive whiteboard (IWB)

access dissections using multimedia resources that illustrate the main aspects of animal reproduction, including male and female anatomy, egg and sperm development, pregnancy, parturition, lactation, egg incubation, foetal development and hatching

classify a range of animal breeds into different groups on the basis of the environmental factors that influence production efficiency; justify the decisions made about the groupings

use the BOM website ([www.bom.gov.au](http://www.bom.gov.au)) to identify the implications of temperature (minimum and maximum), rainfall and light intervals on the production of animals

research the impacts of seasonality on hormone production and the implications for reproduction in animals

develop a list of desirable characteristics for a particular livestock enterprise and use the list to score and rank five potential breeding males for this enterprise, for example rams, bulls, boars or roosters

#### **Unit 5** **Agricultural** **Technologies**

#### ***Examples of learning activities***

Learners:

conduct fieldwork and describe appropriate techniques currently in practice to modify climate, water, soil and growing media in a business

evaluate the effectiveness of modifying techniques by using video or other visual media to record current techniques to modify climate such as glasshouses, cloud seeding, frost controls, irrigation

visit a commercial agricultural or horticultural business to observe the current practices used to modify climate, soils/growth media and water usage and quality

invite an agronomist or a soil scientist to explain current techniques to modify soil, for example fertilisers, cultivation techniques, gypsum, mulch crops; evaluate the effectiveness of these techniques

produce a series of annotated photographs or a video showing current practices to alter topography, including laser levelling, contouring, terracing and creating raised beds; annotate on an interactive whiteboard (IWB)

research the Keyline sustainable agricultural system developed by PA Yeomans; discuss the appropriateness of this system for a particular agricultural business use a case study to analyse the water management techniques used in a commercial agricultural or horticultural business

use the Internet, multimedia, and library references to research the historical impact of a technology on a commercial business

prepare a matrix that identifies the main pests and diseases associated with plants and/or animals associated with commercial businesses, including metabolic, metazoal and microbial pests and diseases; identify the major causes of the pests and diseases, and evaluate current treatments for the main pests and diseases

conduct demonstrations to illustrate the main plant diseases that affect a commercial business; identify and evaluate the effectiveness of the current treatments for the plant diseases

collect and identify the main plant insect pests that affect a commercial business; identify and evaluate the effectiveness of the current treatments for the insect pests

view a video about the main infectious diseases that affect a commercial business; identify and evaluate the effectiveness of the current treatments for the infectious diseases

conduct experiments to provide pre- and post-treatment data to evaluate the effectiveness of the main control measures for plant and animal pests and diseases

use the Internet and multimedia resources to research the main weed species affecting an agricultural or a horticultural business and evaluate treatments to control weeds

invite a guest speaker such as the weeds officer of the local government authority to explain the role of local authorities in monitoring and controlling weeds

visit a fully commercial business to identify methods of prevention and treatment of weeds; prepare a virtual fieldwork by using a series of photographs taken at the business to describe the methods it uses; evaluate treatments to control weeds in a short report accompanying the virtual fieldwork

design and conduct a quiz that tests students' knowledge of weeds, pests and diseases of plants and animals

design a biosecurity plan for the integrated management of pests, diseases and weeds for a specific agricultural or horticultural business

use the Internet and multimedia resources to research methods of keeping financial and production records associated with a business that may assist in maintaining or improving outputs

invite a guest speaker to demonstrate decision-making software currently used in agribusinesses; evaluate the advantages of these compared to current manual systems



view a demonstration of agricultural systems modelling software; analyse its usefulness in planning modifications to physical and biological aspects of the business

prepare a report that describes current technologies used in a specific agricultural or horticultural operation

prepare a Venn diagram to demonstrate the similarities and differences between current and new technologies available for a specific agricultural or horticultural business

research the potential drivers for the adoption of new and emerging technologies in a specific agricultural or horticultural business

undertake a case study of an existing property and assess current and potential new technologies for the business

conduct a site visit to a commercial agricultural and/or horticultural business; investigate the innovative technologies utilised at the site; prepare a written report that examines the impact of the new technology, now and into the near future

use recent publications and the Internet to research and analyse new or emerging technologies that relate to a specific agricultural and/or horticultural business

visit a research facility, or access their website, to investigate an emerging technology that may be adopted in the near future; assess the opportunities for increased sustainable operations for a specific agricultural or horticultural business should the new technology be adopted

present a Digital presentation that selects and justifies appropriate technologies for a specific agricultural and/or horticultural business; evaluate the likely impact of new and emerging technologies on the operation

evaluate the likely impact of new and emerging technologies on a specific fully commercial business, through research and class discussion

undertake a PMI (plus, minus, interesting) analysis of a range of new and emerging technologies; consider the social, economic and environmental impacts on a particular agricultural or horticultural business

research the Bureau of Meteorology website ([www.bom.gov.au](http://www.bom.gov.au)) and evaluate how weather forecasts have been improved; prepare a report that identifies the impact this has had on commercial agricultural and/or horticultural businesses

attend an agricultural or a horticultural field day; interview business representatives on the features of the new technologies available for a range of production activities for a specific agribusiness

select a tool, a piece of equipment, or software that features a recent technological development; use information brochures or the manufacturer's website to identify the economic, social or environmental advantages of using this tool/equipment/ software in an agricultural or a horticultural business

use a number of problem solving and project planning strategies to support the development of an engineering solution to an agricultural problem or situation e.g.

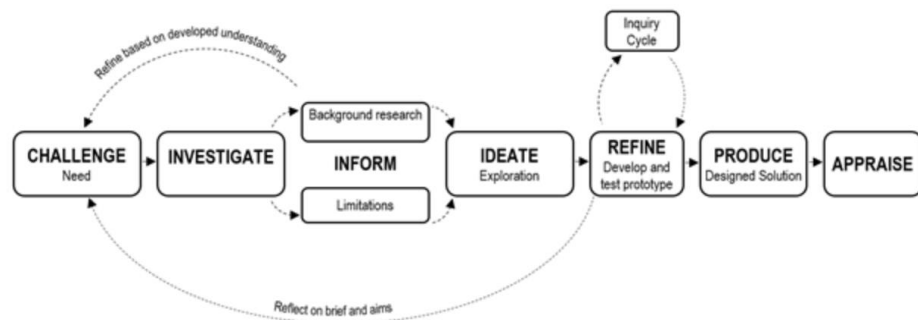
- Political, Economic, Social and Technological (PEST) analysis
- Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis
- Drill Down
- cause and effect diagram
- systems diagrams
- risk analysis and risk management
- cost/benefit analysis

- the planning cycle
- small business project templates
- Gantt charts.

## Engineering Systems

- Types of Engineering - <https://www.teachengineering.org/kl2engineering/types-of-engineering>

## Engineering Design Cycle



(diagram based on Design Thinking : a non-linear process, Teo Yu Siang, 2016)

- Engineering Design Process - <https://www.teachengineering.org/kl2engineering/designprocess>
- What is Engineering? - <https://youtu.be/H9VDkvgGmVo>

## Unit 6 Agri-Foods Case Study

### Examples of learning activities

Learners:

compare potential local, national and international markets for the small business and use a nested circle diagram to represent findings

examine case studies of commercial businesses and discuss strategies for marketing the business product

undertake research for an opportunity to value-add to an agricultural or a horticultural business product

prepare a Gantt chart to show the activities, their order and time allocations required to establish the small business

brainstorm examples of ongoing evaluation and decision making that takes place as students undertake production activities in the small business, for example producing vegetables, grapes or meat chickens, and deciding when the products are ready for harvest or market

discuss key factors involved in setting up a business, including the components of a business plan such as budgets and cash flow estimates, production operations and timeline, marketing and financial strategies

design a written business plan and include production, marketing, risk management and financial strategies

use appropriate software to develop a budget and cash flow estimates for the small business; analyse the financial risks and implement strategies to reduce these risks

use a fieldwork case study to show the steps in the preparation and design of a business plan for the business; include a budget and cash flow statement as well as production, financial and marketing strategies

use the Internet to research and analyse alternative production technologies appropriate to the small business project

conduct a web search of a range of state and national codes of practice; examine these codes of practice to investigate health and safety issues relevant to the small business project

set up a class blog to develop and share strategies for minimising waste in the small business projects

use an environmental management system such as DairySAT to assist in planning for environmental risks in the small business

access the Department of Primary Industry website and do a PMI chart on how an environmental management system can be used to reduce environmental risks in the small business

prepare a list of recommendations of quality standards to be used in the small business and suggest how these can be monitored to ensure a quality product

undertake research on the role of HACCP in the dairy or broiler industry; prepare a list of key points and apply these to the small business

view a video or vodcast on food processing and identify areas where hygienic and safe food practices are critical in the primary production of particular foods; prepare a mindmap or knowledge map of the key information applicable to the small business

identify, list and safely use appropriate production processes, tools and equipment while conducting the small business; evaluate their effectiveness and efficiency; make modifications as appropriate; document all decisions and stages of the production operations for the small business

write an interim report that describes the progress of the small business project, including reference to production outputs, cash flow, meeting timeline targets and whether quality standards are met

## SUPPORTING STUDENT RESPONSES AND ELABORATIONS

A successful and engaging agricultural education program (Food and Fibre Production) requires a balance between classroom-based academic learning and hands-on experiential learning.

The National Association of Agricultural Educators (USA) states that the successful integration of these components will result in ‘... a strong program that produces well rounded individuals who are prepared to be leaders in agriculture, business, and industry.’

Experiential learning is any learning that supports students in applying their knowledge and conceptual understanding to real-world problems or situations where the instructor directs and facilitates learning.

By engaging in formal, guided, authentic, real-world experiences, individuals:

- deepen their knowledge through repeatedly acting and then reflecting on this action,
- develop skills through practice and reflection,
- support the construction of new understandings when placed in novel situations, and
- extend their learning as they bring their learning back to the classroom.

Specifically:

- **Experiential learning teaches students the competencies they need for real-world success.**
- Although we can simulate the real world in the classroom and laboratory, authentic experiential learning creates an invaluable opportunity to prepare students for a profession or career.
- **Experiential learning motivates students.** When students are engaged in learning experiences that they see the relevance of; they have increased motivation to learn.
- **Experiential learning creates self-directed learners.** Through experiential learning, students are confronted with unfamiliar situations and tasks in a real-world context. To complete these tasks, students need to figure out what they know, what they do not know, and how to learn it.

*As described by the University of Texas – Faculty Innovation Centre*

## WORK REQUIREMENTS

The work requirements outlined in the course document should form the minimum assessment tasks for each of the units. Teachers will need to acknowledge these requirements when designing their scope and sequence however, additional assessment (particularly of a formative nature) may be included to support and enhance the learning program. The learning activities, described in the preceding section, may support, facilitate and enrich learners' understandings in preparation for completion of the following work requirements.

Some formal teaching that describes the conventions for preparing various text forms (e.g. experimental design report, field trip report, business plan) may be required.

## RESOURCES

Brown, L., Hindmarsh R. & McGregor R. 2015 *Dynamic Agriculture Years 11-12*, Cengage Learning Australia, 3<sup>rd</sup> Edition

Brown, L., Hindmarsh R. & McGregor R. 2014 *Dynamic Agriculture Years 7-10*, Cengage Learning Australia, 4<sup>th</sup> Edition



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State of Tasmania (Department of Education) 2016. Updated March 2019.