Agriculture in Education Initiative

An Educational Unit for Secondary Schools

Agriculture in Education / Current Unit

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Navigating primary industries in to the 21st Century

Level

9

Curriculum Area

Geography

Print Resource

Year 9 Geography Unit instructions

Resource description

This is a unit developed with a learning sequence about the environmental, economic and technological factors that influence crop yields in Australia and across the world.

The resource is designed with **learning experiences**. This is to provide you, as the teacher with content to cover, but over a time frame that is flexible to your classroom and school set-up.

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Rationale

This resource material aims to help teachers and students in secondary schools investigate and understand more about primary industries in Australia.

The objectives of the educational resources are to:

- Support Primary Industries Education Foundation Australia and its members in expanding awareness about primary industries in Australia by engaging and informing teachers and students about the role and importance of primary industries in the Australian economy, environment and wider community.
- Provide resources, which help build leadership skills amongst teachers and students in communicating about food and fibre production and primary industries in Australia.
- Develop educational resources that can be used across Australia to provide encouragement, information and practical teaching advice that will support efforts to teach about food and fibre production and the primary industries sector.
- Educate school students on ways food and animals are raised and grown.
- Demonstrate to students that everyone can consider careers in primary industries and along the supply chain of food and fibre products.
- Assist school students to spread this message to their families and the broader community.
- Develop engaging learning programs using an inquiry process aligned with the Australian Curriculum.
- Develop in school communities, an integrated primary industries education program that emphasises the relationship between food and fibre industries, individuals, communities, the environment and our economy. These educational resources are an effort to provide practical support to teachers and students learning about food and fibre production and primary industries in schools.

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About the approach

Several key principles underpin the theoretical and practical application to this unit. Students are guided to:

- Search for information using both digital and non-digital means
- Use research techniques and strategies
- Use thinking and analysis techniques
- Present findings to a real audience, and
- Reflect both on the product created and the process undertaken.

Rather than seeing knowledge as something that is taught, the emphasis in this unit is on knowledge and understanding that is learned. The unit involves students in:

- Working from a basis of their prior knowledge and experience
- Seeing a real task or purpose for their learning
- Being directly involved in gathering information firsthand
- Constructing their knowledge in different ways
- Presenting their learning to a real audience
- Reflecting on their learning.

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Curriculum Strands

In this unit, students:

- Explore Environmental Factors that support crop yields
- Investigate contributing environmental factors why a crop is grown where it is
- Examine the role variability across the landscape and its affect on productivity
- Explore some of the digital technologies being developed to increase crop yields
- Introduced to emerging technologies that assist with higher crop yields
- Reflect and evaluate on the environmental, economic and technological factors that influence crop yields

Based on Australian Curriculum, Assessment and Reporting Authority (ACARA) materials downloaded from the Australian Curriculum website in February 2015. ACARA does not endorse any changes that have been made to the Australian Curriculum.

Australian Curriculum content descriptors:

Geography:

The environmental, economic and technological factors that influence crop yields in Australia and across the world ACHGK062

- describing how environmental factors, for example, climate, soil, landform and water, can support higher crop yields and investigating the environmental constraints on agricultural production in Australia, for example, soil moisture, water resources and soils
- investigating how high crop yields (for example from wheat, rice and maize) around the world are related to factors such as irrigation, accessibility, labour supply, landforms and agricultural technologies (for example, high yielding varieties)

Geography Inquiry Skill

Present findings, arguments and explanations in a range of appropriate communication forms, selected for their effectiveness and to suit audience and purpose; using relevant geographical terminology, and digital technologies as appropriate. (ACHGS070)

Interpret and analyse multi-variable data and other geographical information using qualitative and quantitative methods, and digital and spatial technologies as appropriate, to make generalisations and inferences, propose explanations for patterns, trends, relationships and anomalies, and predict outcomes. (ACHGS067)

Cross Curriculum Priorities

Sustainability

OI 7: Actions for a more sustainable future reflect values of care, respect and responsibility, and require us to explore and understand environments.

OI.8: Designing action for sustainability requires an evaluation of past practices, the assessment of scientific and technological developments, and balanced judgments based on projected future economic, social and environmental impacts.

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Using this unit

This unit can be used in a number of ways. It will be of most benefit to teachers who wish to implement the sustained sequence of activities that follow the learning experiences around the content descriptors in Year 9 Geography in the Australian Curriculum.

You may add to or complement the suggested activities with ideas of your own activities or investigations.

The resources have been designed as a hyperlinked unit. This is to provide you with a digital format for your class's use on a website or wiki or provide them on your interactive whiteboard.

We encourage you to explore ways in which the content can be adjusted to the context in which you are working.

Resource sheets are provided for some activities. Most are for photocopying and distribution to students.

The resource sheets are designed to assist teachers to facilitate learning without having to access a range of other resources.

Complementary video resource

This resource has a supporting video that compliments the learning objectives of this topic. The video has been produced with a stand-alone worksheet and activities to complete. This resource can be accessed on the Primezone website http://www.primezone.edu.au.

Resourcing the unit

The resources suggested are on the whole, general rather than specific. Schools and the contexts in which they exist vary widely as does the availability of some resources – particularly in remote areas. There is a strong emphasis in the unit on gathering information and data; research and observations also feature strongly as these methods develop important skills and ensure that the exploration of the topics are grounded in a relevant context.

Some YouTube and online videos in addition to Internet based resources are suggested in the unit. You will need to investigate what is available in your school.

Some research organisations (Cotton Australia, Grains and Research Development Corporation, Rice Growers Association Australia) welcome invitations to come to speak with students. Look for local links in the industry contact list below.

Industry Contacts

Cotton Australia http://www.cottonaustralia.com.au (http://www.cottonaustralia.com.au)

Meat and Livestock Australia http://mla.com.au (http://mla.com.au)

National Farmers' Federation Farm Facts 2012 at http://www.nff.org.au/farm-facts.html (http://www.nff.org.au/farm-facts.html)

Fisheries Research and Development Corporation, 2013 http://frdc.com.au/ (http://frdc.com.au/)

Australian Pork Limited http://www.australianpork.com.au (http://www.australianpork.com.au)

Forestry

http://www.forestlearning.edu.au/ (http://www.forestlearning.edu.au/)

http://www.agriculture.gov.au/forestry (http://www.agriculture.gov.au/forestry)

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Assessment

The unit provides an opportunity for a range of skills and understandings to be observed.

A guiding assessment rubric has been developed for two learning experiences included in the resource. This is a guide and can be adapted to fit purpose.

The following student learning areas are considered:

- Understandings about the topic.
- Development of skills.
- Use of language in relation to content.
- Ability to use and critically analyse a range of texts.
- Ability to analyse and solve problems.
- Ability to interpret information, perceive its meaning and significance, and use it to complete real-world tasks.
- Ability to work cooperatively with others.
- Approach to learning (independence, confidence, participation and enthusiasm).

Length of Unit

This will of course depend on your particular circumstances but generally; a few weeks to a term are suggested.

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Learning Sequence

Learing Experience	Activities	Summary
Learning Experience1	Students will: ■ 1. Using a Lotus Diagram draw out prior knowledge of what environmental factors support and/or limit higher crop yield. ■ 2. Individual knowledge will contribute to the collective knowledge of the class	Explore Environmental Factors that support crop yields

Learning Experience 2	Students will: ▪ Plan and investigate environmental factors for a chosen crop ▪ Develop a climograph ▪ Research agricultural technologies that lead to increase in yield of crop ▪ Present findings (later lessons)	Investigate contributing environmental factors why a crop is grown where it is
Learning Experience 3	Students will ▪ understand the variability in landscapes and be introduced to the idea of working with that variability in an Agricultural system	Examine the role variability across the landscape and its affect on productivity
Learning Experience 4	Students will ▪ begin to use spatially referenced data using the Australian Soil Resource Information System	Explore some of the digital technologies being developed to increase crop yields
Learning Experience 5	Students will ▪ Land and water resources are increasingly becoming managed based on emerging technologies. Precision Agriculture is one such technology to assist in increasing crop yield	Introduced to emerging technologies that assist with higher crop yields
Learning Experience 6	Students will: ▪ Develop an infographic that will visually represent the information that they have learnt	Reflect and evaluate on the environmental, economic and technological factors that influence crop yields

Learning Experience 1

Environmental Factors that support crop yields

Lesson Overview

The lesson will provide students an opportunity to engage and explore their current knowledge on environmental factors that influence crop yield

Students will

- brainstorm environmental factors that affect crops
- explore and think about how each of these environmental factors individually influence crop yields

Lesson outcomes:

Students will be able to:

- Record environmental factors of crop yield
- Present their findings to the collective group
- Brainstorm the environmental factors which influence crop yield and predict the effects of environmental factors on crop yields.
- Record and review these ideas as a class

Teacher Background information:

The environment affects plants through all stages of growth and development. Environmental factors are defined in environmental science as any factor whether abiotic (non-living) or biotic (living) that influences living things. There are many abiotic and biotic factors that influence plant growth, including water, temperature, climate, light, fire, topography, geology, soil, nutrients, biotic organisms, symbiotic relationships, pH, fire and others. In a healthy plant, all environmental factors contribute to producing a healthy plant. In a crop that is managed, the environmental factors are important to understand and measure to ensure that the yield is a good as it can be, from year to year.

Useful Resources on environmental factors

http://broome.soil.ncsu.edu/ssc051/Lec3.htm (http://broome.soil.ncsu.edu/ssc051/Lec3.htm)

https://biologyplants.wikispaces.com/Factors+affecting+plant+growth+A.M
(https://biologyplants.wikispaces.com/Factors+affecting+plant+growth+A.M)

http://www.ext.colostate.edu/mg/gardennotes/143.html
(http://www.ext.colostate.edu/mg/gardennotes/143.html)

https://ag.arizona.edu/pubs/garden/mg/botany/environmental.html (https://ag.arizona.edu/pubs/garden/mg/botany/environmental.html)

http://oregonstate.edu/dept/eoarc/sites/default/files/publication/328.pdf (http://oregonstate.edu/dept/eoarc/sites/default/files/publication/328.pdf)

Equipment:

Lotus worksheet Resource 1 – enough for each student

Download Resource 1 - Lotus Worksheet (pdf/resource1.pdf)

Download Resource 2 - Lotus Worked answer sheet (pdf/resource2.pdf)

1 enlarged Lotus Diagram to display

Internet access to assist with ideas (if needed)

Lesson steps:

1. Using Resource 1, students will use a Lotus diagram** students to brainstorm ideas on the contributing environmental factors that support crop yields. You may like to ask students to use pencil to fill this in.
2. Guide students to develop ideas on the environmental factors, which may impact on crop yield. For example: To get students thinking terms such as biotic and abiotic – living and non-living, may be discussed to help students get started. A worked answer sheet is provided with Resource 2 (pdf/resource2.pdf)
3. Give students enough time to fill in all 8 boxes around the question. Discuss with students their ideas and then record and display these ideas using lotus diagram for the class to see and refer to in coming lessons.
4. The outer 8 boxes are for students to record further thinking on the environmental factors and how they support and/or limit crop yield. To assist with drawing out answers ask the students to think about the following questions:

- What?
- How?
- When?
- Where?
- Why?

As a class go through one worked example.

5. Return to this worksheet at the end of the unit, to reflect on any new knowledge acquired.

**A Lotus diagram allows for a broad subject to be broken into smaller parts. It involves creative thinking and critical analysis. These are the steps to constructing a Lotus diagram:

1. state the topic to be studied
2. brainstorm ideas
3. draw up a table (as illustrated)
4. write the main topic in the centre of the diagram
5. put eight subtopics around the main topic and number them
6. put each of the eight subtopics in the centre of the surrounding boxes
7. put a corresponding idea in each box

Final 'thinking' Questions:

What are abiotic factors? Give 2 examples

What are biotic factors? Give 2 examples

Identify 3 ways soil affects plant growth

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Learning Experience 2:

Lesson Overview

To provide students with an opportunity to explore and investigate contributing environmental factors to why a crop is grown where it is.

Students

- Work individually to identify and explore one crop (wheat, rice, cotton or maize)
- Begin to investigate the contributing environmental factors to why it is grown geographical where it is

(Note: Students can select a cropping area that is not in Australia)

In addition to introductory class further class time will need to be given for investigation

- Investigate current technologies used in increasing crop yield
- Collate information to later present to the class in 3 minute presentation

Lesson outcomes:

Students will

- Plan and conduct an investigation on the contributing environmental factors relevant to a crop
- Identify questions to answer about where and why a crop is grown in an area
- Gather information about rainfall and temperature in the identified crop growing area and create a climograph from latest year and 50year prior to last year.
- Report on current technologies used in increasing crop yield, with a focus on one specific technology

Assessment:

Suggested Assessment: Download Resource 3 - Assessment Rubric (pdf/resource3.pdf)

This learning experience is an opportunity to assess students on their investigation skills. Provided is an assessment rubric (Resource 3 (pdf/resource3.pdf)). Depending on which activity is chosen (presentation, poster, video, report, etc.) you can select wording for the assessment rubric. As a guide here are some online examples for different activities:

Presentation: http://www.readwritethink.org/files/resources/printouts/30700_rubric.pdf (http://www.readwritethink.org/files/resources/printouts/30700_rubric.pdf)

Poster: http://www.rubrics4teachers.com/pdf/GenericPosterRubric.pdf (http://www.rubrics4teachers.com/pdf/GenericPosterRubric.pdf)

Video: https://www2.uwstout.edu/content/profdev/rubrics/videorubric.html (https://www2.uwstout.edu/content/profdev/rubrics/videorubric.html)

Teacher Background information:

There have been many changes in farming methods over the last 200 years and Australian farmers have had to be adaptable as well as resilient and inventive. The challenges of access to fresh water, the legacy of high amounts of fertilisers, massive clearing, over grazing, a tyranny of distance, transport costs and feral animals, have tested Australian farmers to their limits. In response, farming has become more mechanised and reliant on technologies, as well as holistic as it seeks to become more sustainable (Ref 1 https://www.abc.net.au/austory/breaking-new-ground/12697330).

Crops industries provide a significant contribution to the national economy as well as many regional communities. For example, the grains and oilseeds industry (subject to seasonal variation) produces about 35-45 million tonnes of grain per annum from an area of more than 20 million hectares, with an

annual gross value of production (GVP) of around A$9-13 billion. Sugar and cotton are also major contributors with a gross value of production exceeding $1 and $2 billion respectively (Ref 2 (http://www.agriculture.gov.au/ag-farm-food/crops/about-crops)).

Environmental factors (as defined in previous lesson) affect plant growth. These factors have been significant in determining where crops are grown, in particular, rainfall, temperature and soil type. While some of these factors have determined where crops have been grown, over time agriculture innovation has lead to improvements to crop yield and minimising environmental impacts.

REF 1 - https://info.australia.gov.au/about-australia/our-country/our-natural-environment

REF 2 - http://www.agriculture.gov.au/ag-farm-food/crops/about-crops (http://www.agriculture.gov.au/ag-farm-food/crops/about-crops)

Equipment:

Learning Exp 2 - Student worksheet (pdf/Learning Experience 2 – Student worksheet.pdf)

Computer Or Internet enabled device

Internet Access

Learning Experience 2 - student worksheet

Notebook to record research

Print out of 'GIS and Precision Agriculture Information Sheet

https://sugarresearch.com.au/sugar_files/2017/02/IS14015-GIS-and-Precision-Agriculture.pdf

Lesson steps:

1. Introduce the idea of students conducting a geographic investigation. This will be a student driven inquiry. It may be good to review some of the following websites as a guide to student based inquiry research.
   A - http://www.geogspace.net.au/Core%20units/Years%209-10/Inquiry+Skills/y9-10-is-illus1.php
   B - https://www.qcaa.qld.edu.au/downloads/p_10/ac_sa_geog_yr9_inv_production_patterns.pdf (https://www.qcaa.qld.edu.au/downloads/p_10/ac_sa_geog_yr9_inv_production_patterns.pdf)
2. The time allocated for the investigation is to be determined by how much class and home time is feasible in the unit workplan. A suggested timing would be 3 x 60 min classes, and then 4 x 60min for homework.

3. Get the students to investigate: ‘contributing environmental factors affecting crop yield, and changes in technologies that have been used in Australia to increase crop yield’
4. Get the students to think about a crop they would like to investigate. The students can select from the following crops:
    1. Cotton
    2. Wheat
    3. Rice
    4. Maize
    5. Sugar

5. If required, provide students with some guiding questions. Geography is distinguished by the kinds of questions it asks—the “where” and “why there” of a problem.
    1. Where is the crop grown?
    2. Select a major area that the crop is grown. Research rainfall and temperature and draw up a climograph for the crop (Find data at the Beureau of Meteorology http://www.bom.gov.au/climate/data/). Compare the most recent complete year record with record from 10 years ago. Instructions for developing a climograph are listed below.
    3. Has it changed where it occurs spatially over time grown in Australia?
    4. What restricts or limits where the crop is grown?
    5. What developments have been made to overcome some of these restrictions? (Irrigation, soil improvement, drainage, etc.)
    6. How are developments in people’s thinking and technological advances around the world working towards sustainable development of this crop? Agricultural technologies should feature in your answer. Information written in the following two articles may assist students with their answers:

       https://sugarresearch.com.au/growers-and-millers/farming-systems/

       http://www.cottoninfo.com.au/publications/australian-cotton-production-manual

6. Provide an opportunity to student to direct their own investigation, to develop a question they would like to answer. Students use initial research to identify geographically significant questions

to frame an inquiry related to environmental factors and changing technologies affecting crop yield.

7. Get students to collect relevant and unbiased data and information from reliable government and nongovernment sources including photographs, maps, reports, data sources and media reports.
8. After completing their investigations get the students to present findings. The focus of the information presented by students should be on **part f** – the work that is being done to work towards sustainability. The style of presentation is up to you as the teacher, however here are suggested options:
    1. Students prepare a 3-minute presentation outlining their findings. Students use PowerPoint, Prezi (https://prezi.com/) or some other way to graphically display their investigation.
    2. Poster presentation
    3. Create a small video
    4. Write a report
    5. Any other way that suits your classroom dynamics
    6. Students are encouraged to take notes through the presentation as they will be asked to complete a compare and contrast at the end of all presentations.

Note: It will be beneficial to have some information already located to guide students.

Concluding activity for Learning Experience 2:

After students have completed their presentations and developed their climograph, ask the students to reflect on the content of the presentations from other members of the class.

Get the student to select 5 other students work and compare the findings looking at trends, commonalities and differences in the data.

Get the students to review the investigative question above 'conributing environmental factors affecting crop yield, and changes in technologies that have been used in Australia to increase crop yield'.

Discuss as a group.

Cotton

http://www.crdc.com.au/publications/australian-cotton-production-manual

https://cottonaustralia.com.au/education-kit

http://www.agriculture.gov.au/ag-farm-food/crops/cotton

https://www.csiro.au/en/research/plants/crops/cotton/crop-management

Wheat:

http://www.agriculture.gov.au/ag-farm-food/crops/wheat

http://www.grdc.com.au/Resources/GrowNotes

http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0008/516185/Procrop-wheat-growth-and-development.pdf

Rice

https://www.rga.org.au/Public/The_Rice_Industry/

http://www.agriculture.gov.au/ag-farm-food/crops/

Maize

http://www.maizeaustralia.com.au/austoverview.html

https://www.dpi.nsw.gov.au/agriculture/horticulture/vegetables/commodity-growing-guides/sweet-corn

http://www.grdc.com.au/Resources/GrowNotes

Instructions for developing a climograph

A climograph depicts climate data with a column graph to show rainfall and a line graph to show temperature. It makes it easier to see the patterns of average temperature and rainfall over a year.

1. Copy and paste the data, column and row headings for your selected country into an Excel spreadsheet. Do not include in your selection, the column heading or data for the Total column.
2. Next, highlight the data and select the Insert tab. Then, in the Charts group, select Clustered Column.
3. To convert the temperature data to a line graph, click on the temperature columns in the graph. This displays the Chart Tools on the top right-hand side of the screen.

4. Select the Design tab under Chart Tools and click on Change Chart Type. Select Line and click OK. The vertical axis on the left-hand side of your graph measures the amount of rainfall.
5. To add a second vertical axis to measure the temperature, click on the line of plotted temperature data and select the Layout tab. Select Format Selection from the Current Selection group.
6. From the Format Data Series box, select Secondary Axis. To add labels to your graph, click on the Layout tab and select Axis Titles in the Labels group.
7. Enter a primary and secondary vertical axis title. You can also insert a graph title by selecting Chart Title in the Labels group.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Rain	10.6	63.5	136.2	92.9	13.6	24.6	33.5	60.6	18.0	27.1	16.5	167.0
Temp	32.4	30.2	27.6	24.7	22.2	18.8	18.3	18.7	22.9	27.9	31.9	30.3

Final 'thinking' questions:

None provided for this lesson as students are doing their own investigation.

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Learning Experience 3

Lesson Overview

To provide an overview of the role of variability across the landscape and its affect on productivity

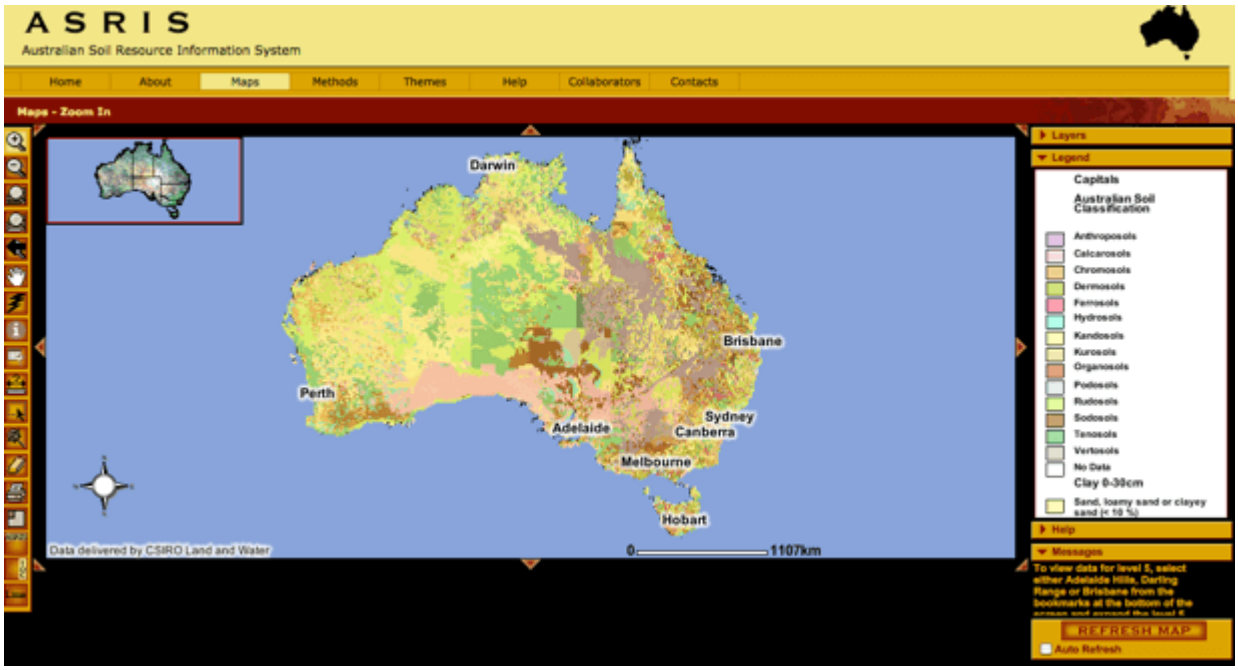
Lesson outcomes:

Students will be able to:

- Identify the difference between spatial and temporal variability
- Relate spatial and temporal variability to production
- Formulate ideas as to how technology can assist in crop production through understanding variability.

Teacher Background information:

The significance of landscape variability is that productivity is also variable. If you look at the Australian landscape as a whole, there are generalisations that you would make according to landform, soil types, soil moisture, nutrients, soil type drainage, and other environmental conditions, like climate.



Source: http://www.asris.csiro.au/# (http://www.asris.csiro.au/#), accessed 10/3/16

Land managers have known about variability for as long as they have been growing crops, however, managing these variations have not always been easy. Without accurate tools to measure and record this variation, managers have been forced to manage their land as though they were uniform (Ref: https://www.csiro.au/en/research/plants/crops/Farming-systems/Precision-agriculture).

Now with technology – we are able to get many different views of the land including a 'birds-eye view' of the landscape, and map more details about the land – and therefore have better decision-making ability.

It is therefore important to understand variability. Variability is explained below.

Variability

Applying the right technique on a farm at the right time by the correct method is something that past farming methodology has not done or been able to do. There is natural variability in the landscape (see picture of Australia), and on farms, variability plays a key role in what is produced there.

There are two types of variability that students can look at to start to get a picture of the complexities of farm management to increase yield. Spatial Variability and Temporal Variability.

Spatial variability

The variation found in soil and crop properties (e.g. soil pH, crop yield) across an area at a given time.

Temporal variability

The variation found in soil and crop properties within a given area at different measurement times.

Spatial variation can be seen in Figure 1(a) where the crop yield from a field averages 2.5 t/ha but comes from two equal size parts of the field yielding 1 t/ha and 4t/ha each. Temporal variability can be seen when comparing Figure 1(a) and 1(b). In the same field, the average crop yield for two successive seasons changes from 2.5 t/ha to 1.5 t/ha.

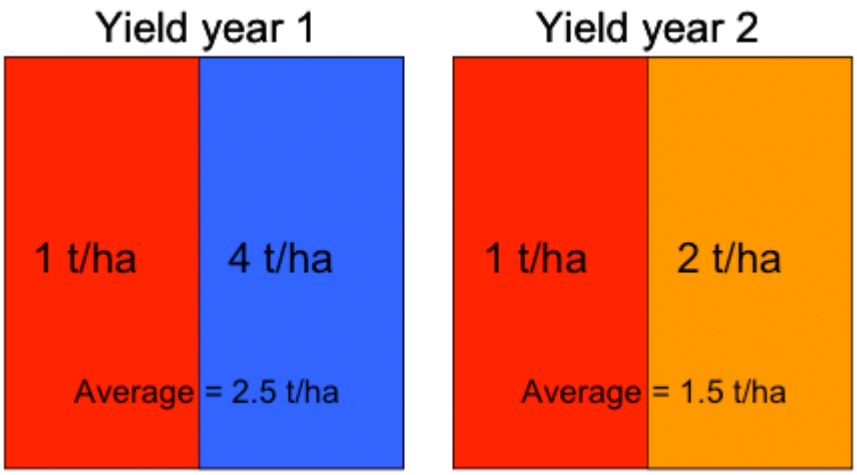


Figure 1: An example of crop yield spatial and temporary variability (a) year 1 average crop yield = 2.5 t/ha; (b) year 2 average crop yield = 1.5 t/ha.

While these two concepts of variability are at the heart of PA, it is the amount of variation and the pattern of the variation that is important for decision-making.

In reality spatial variability is a little more complicated and not easily put into boxes as indicated in Figure 1. For management purposes it would make things easier if an area was more uniform like Figure 2a, however the reality is probably better explained as in Figure 2b

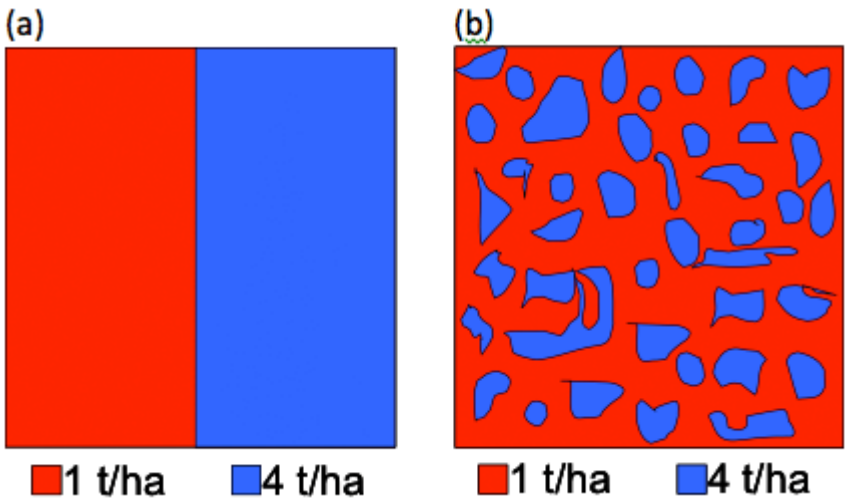


Figure 2. An example of differences in the pattern of spatial variability. The average yield (2.5 t/ha) and the amount of variation (50% = 1/t/ha; 50% = 4 t/ha) is the same in both (a) and (b).

Reference (http://sydney.edu.au/agriculture/pal/publications_references/educational_resources.shtml): Module G: Yield Variability and Site-specific Crop Management, by Brett Whelan and James Taylor

Equipment:

Provide students background information

Background information (pdf/background-info.pdf)

Notebooks

Internet

Video display options

Lesson steps:

1. Provide students information on spatial and temporal variability from teacher background information.
2. Show the following short videos on soils to help provide some content

Soils Support Agriculture (https://www.youtube.com/watch?v=GGV2jlg_P4M)

Soils Clean and Capture Water (https://www.youtube.com/watch?v=ZwQeTJEeedk)

3. For each of the following environmental factors below, describe how spatial and temporal variability are important to crop yield by completing the table provided in Resource 4. (pdf/resource4.pdf)
    1. Soil
    2. Water
    3. Nutrients

Download Resource 4 (pdf/resource4.pdf)

Download Resource 5 (pdf/resource5.pdf)

4. Resource 5 (pdf/resource5.pdf) provides some suggested answers

Final 'thinking' Questions:

Give one example of spatial variability in a crop of wheat

Give one example of temporal variability in a crop of wheat

Think and record one-way land managers are changing how they are managing their land with regard to variability?

Learning Experience 4:

Lesson Overview

To provide students with an opportunity explore some of the digital technologies being developed to increase crop yields

Lesson outcomes:

Students will be able to:

- View online mapping resources
- Review map content and understand the difference between Information Layers

Teacher Background information:

Land and water resources are increasingly becoming managed based on emerging technologies, such as GIS mapping, Precision Agriculture and new crop breed varieties.

In this lesson we will look at soil and land resource information developed and updated by CSIRO. http://www.asris.csiro.au/index.html# (http://www.asris.csiro.au/index.html) ASRIS provides online access to the best publicly available information on soil and land resources in a consistent format across Australia.

Students are increasingly going to need skills around how to create maps, and identify map layers and how to interpret maps created digitally. While these are highly technical skills required by students, by starting to explore some of these resources they will gain a greater understanding of the potential value of these skills.

Equipment:

Computer Or Internet enabled device

Internet Access

Lesson steps:

1. First get students to watch the PIEFA video on 'the environmental economic and technological factors that influence crop yield' https://www.youtube.com/watch?v=_D7stAkpj-4&feature=em-upload_owner
2. In this lesson we will look at soil and land resource information developed and updated by CSIRO. http://www.asris.csiro.au/index.html# (http://www.asris.csiro.au/index.html) ASRIS provides online access to the best publicly available information on soil and land resources in a consistent format across Australia.
3. Get students to go to the ‘getting started’ page
4. Give the students an opportunity to explore the map tools, by going to the tab at the top called ‘Maps’

5. View the video ‘1. Navigation in ASRIS’
6. Allow the students to explore the maps. This gives students the opportunity to explore different ‘layers’ of maps. In particular get students to view layers using the
    1. National Soils Grid
    2. Landcover

- Climate

1. Use the legend to identify the different information

NOTE:

- This program does not cover all areas of Australia. Using the bookmarks selection tab located at the bottom of the page, you can select areas including: Adelaide Hills (SA), Darling Downs (WA) and Brisbane (QLD)
- Selecting the Australia view students will be able to explore the following layers: National Soils Grid, Landcover, Landscape and Terrain, Climate (and students can view both Temperature and Precipitation)

2. View the video on ‘2. viewing soil maps’ and video on ‘3. contextual information’ to help with interpretation.

Additional Exercise:

There are now projects and peoples farm businesses that are heavily using these technologies to help with management decisions on their properties

Universities are also heavily invested in the research around how to produce more sustainably both environmentally and economically. At UNE they are using a university property at Kirby to assist with their teaching, so more students are emerging with knowledge of PA and its use as a management and decision making tool

1. Go to the UNE Smart Farm website: une.edu.au/research/research-centres-institutes/smart-farm (http://www.une.edu.au/research/research-centres-institutes/smart-farm)
2. Watch introductory video to the UNE Smart Farm.
3. Get students to look at: http://www.une.edu.au/research/research-centres-institutes/smart-farm/smart-farm-data (http://www.une.edu.au/research/research-centres-institutes/smart-farm/smart-farm-data)
4. Open Access Data, students click on CSIRO Sensornets
5. Each of the symbols is a monitoring site.

6. Students can graph (using the graph tab) different variables (for example air temperature) over a time period

Another similar website to ASRIS is the Soil and Landscape Grid of Australia.
http://www.clw.csiro.au/aclep/soilandlandscapegrid/index.html

In a similar way to ASRIS, this website allows a user to view maps and layers. While this program is has been set up for researchers to use to review Australia's Soil and landscape attributes, through using programs such as Google Earth students can start to discover more applications of the technology.

Reference:

ASRIS (2011). ASRIS – Australian Soil Resource Information System. http://www.asris.csiro.au/ Accessed 3rd November 2015

Final 'thinking' questions:

1. Select the National Soils Grids Layer, and click on the Australian Soil Classification layer. Zoom in to your area, and record what the predominant soil type is for your area.
2. Explain one reason why soil classification is important to what is grown in an area.

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Learning Experience 5:

Lesson Overview

Introduce students to emerging technologies that assist with higher crop yields.

Lesson outcomes:

Students will be able to:

- Define how precision agriculture is important to crop management
- Identify different tools used in precision agriculture
- Identify both the hardware and software important to gathering information for input

Teacher Background information:

Land and water resources are increasingly becoming managed based on emerging technologies.

Precision Agriculture (PA) can be defined as the development and application of tools and practises to monitor and manage spatially-variable agricultural landscapes (UNE, 2015). PA has been slowly picking up pace and usefulness due to the rapid design, development and implementation of PA tools that are leading to increasing in production, which in turn lead to financial benefits for farmers.

PA is about farm management that involves identifying and managing on-farm variability. It has also been defined as 'doing the right thing, in the right place, in the right way, at the right time.' GRDC Factsheet Precision Agriculture

Agricultural pioneers and innovators have always been looking for ways to increase yield and reduce on farm costs since agricultural began. It is with advancements in technology (like Global Positioning System (GPS)) that have enabled today's produces and researchers to look at management of crops in a much more 'precise' way.

What are some Precision Agriculture Tools?

These are some of the technologies that are helping to transform the way that farmers farm:

- GPS – essential for knowing exact location, and use in auto-steer technology
- GIS – software that uses data collected to assist in creating spatially referenced maps
- Sensory Systems – developed to detect differences in a range parameters such as greenness of vegetation, water, soil moisture etc., and these feedback data to be recorded
- Robotics – unmanned field quads, unmanned drones
- Software – GIS, QGIS

The use of these technologies combined with qualified people (like agronomists) that can understand, analyse, and assist in decision-making, are working at getting land managers more productivity out of their land. GRDC produced a Precision Agriculture Factsheet https://grdc.com.au/__data/assets/pdf_file/0034/205999/precision-agriculture.pdf.pdf, which provides further supportive information on this topic.

Around Australia and the world, gathering data (in particular) site-specific data is becoming very important. Site-specific information feeds into tools such as Geographic Information Systems (GIS). GIS is an essential tool in Precision Agriculture. It is important because it is through locational information gathered by GPS devices that give spatially referenced information that helps create maps and inform decision-making.

Equipment:

Computer Or Internet enabled device

Internet

Print out for each student ‘What is Precision Agriculture’ Information sheet: https://sugarresearch.com.au/sugar_files/2017/02/IS14013-What-is-Precision-Agriculture.pdf

Lesson steps:

1. Define Precision Agriculture from Teacher Background information above for the students
2. Watch with students the **video** (https://www.youtube.com/watch?v=tEj__Vo1WxQ) on Precision Agriculture and using Resource 6 (pdf/resource6.pdf) answer the following question:
3. What are 3 benefits mentioned by using PA technology? Fill in Resource 6 (pdf/resource6.pdf) Step 3

Download Resource 6 (pdf/resource6.pdf)

Download Resource 7 (pdf/resource7.pdf)

Discuss with students the following information on data collection. These days land mangers are gathering as much information and data as possible. Variability is key to why information and data is collected. Many land managers today are no longer treating their productive areas as a uniform block due to variability in the landscape. Monitoring specific site and developing sensors (soil probes, ‘greeness index’) are a big part of how farmers are gathering information to be able to make better decisions on their farm. Look at the following Precision Agriculture website (http://psstl.esri.com/apps/ag/storytelling_AgFive/) with students.

1. Review with the students the webpage tab that observes **soil tests**. Ask the students how does the farmer check for temporal variability? What design is used to test soil samples? Why is it important to check nutrient levels?
2. Review with the students the webpage tab that observes **yield**. What are two reasons for monitoring yield?
3. Review with the students the webpage tab that observes **Management Zones**. How can understanding management zones assist with increasing productivity?
4. Review with the students the webpage tab that observes **Recommendation**. In particular the last sentence in the description ‘By applying only the amount needed at any given location, the grower not only applies the right amount to maximize crop health, but also decreases costs’. This brings up new terminology ‘variable rate application’. **Variable Rate Application** refers to the application of a material, such that the rate of application is based on the precise location, or qualities of the area that the material is being applied to (Ref (http://pubs.ext.vt.edu/442/442-505/442-505_PDF.pdf))
5. PA does rely on certain information components to help land managers with decision-making and is cyclical. Get students to read the following document produced on ‘what is Precision

Agriculture'
https://sugarresearch.com.au/sugar_files/2017/02/IS14013-What-is-Precision-Agriculture.pdf

6. Ask students to complete Resource 6 (pdf/resource6.pdf) Step 4, and represent the Precision Agriculture cyclical information graphically
7. Label the diagram
8. Get students to record at each part of the cycle what information would be collected, recorded or acted upon.

5. Get the students individually to select one of the above technologies and research a particular use of that technology used by land managers to assist in management.
6. Record from their research. Fill in Resource 6 (pdf/resource6.pdf) Step 6
    1. What technology
    2. How is it used
    3. What role does it have on a farm
    4. How has this lead to benefits (land manager or to the property?)

Suggested answers located in Resource 7 (pdf/resource7.pdf)

Final 'thinking' Questions:

1. In your own words describe 3 ways Precision Agriculture would benefit a land manager growing a crop of Rice?
2. How does GPS assist with GIS?
3. Why is GIS essential to Precision Agriculture?

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Learning Experience 6: It's a wrap

Lesson Overview

Reflect and evaluate on the environmental, economic and technological factors that influence crop yields.

Lesson outcomes:

Students will

- review information gathered and visually represent it in an infographic
- provide a summary of information accumulated over the previous 5 learning experiences

Assessment

Suggested Assessment:

Download Resource 8 (pdf/resource8.pdf)

This learning experience is an opportunity to assess students on their investigation skills. Provided is an infographic assessment rubric (Resource 8 (pdf/resource8.pdf)).

Teacher Background information:

Information graphics or infographics are graphic visual representations of information, data, or knowledge intended to present information quickly and clearly. Infographics have evolved in recent years to be for mass communication as they can easily communicate large amounts of information.

Infographics can be created by hand using tools such as graph paper, pencils, markers and other stationary. However computer software is now widely available in being able to produce infographics. A simple search of 'infographics' in Google (http://www.google.com.au) will provide you with some possibilities

Equipment:

Computer Or Internet enabled device

Internet

Print or show example of sample infographics

Lesson steps:

1. Create an infographic (canva.com/create/infographics (http://www.canva.com/create/infographics))
2. Graphically represent the interaction between environmental, economical and technological factors that influence crop yields
   Represented in the answer should be how:

   Environmental Factors, Good practice, new technologies, sustainable management and reduction of costs lead to higher crop yields, which have economic benefits

   Final 'wrap':

3. Get students to review the first activity that they completed using the lotus diagram. At the time they were asked to complete the squares with their prior knowledge. Ask them to review their answers and add any newly acquired knowledge. Ask the students to complete their review in a different colour.

- How do 21st century technologies and practices influence crop yield? How do 21st century technologies and practices influence environmental impacts?

Resources:

References:

Learning Experience 1

http://oregonstate.edu/dept/eoarc/sites/default/files/publication/328.pdf (http://oregonstate.edu/dept/eoarc/sites/default/files/publication/328.pdf)

http://broome.soil.ncsu.edu/ssc051/Lec3.htm (http://broome.soil.ncsu.edu/ssc051/Lec3.htm)

https://biologyplants.wikispaces.com/Factors+affecting+plant+growth+A.M (https://biologyplants.wikispaces.com/Factors+affecting+plant+growth+A.M)

http://www.ext.colostate.edu/mg/gardennotes/143.html (http://www.ext.colostate.edu/mg/gardennotes/143.html)

https://ag.arizona.edu/pubs/garden/mg/botany/environmental.html (https://ag.arizona.edu/pubs/garden/mg/botany/environmental.html)

Learning Experience 2

http://www.australia.gov.au/about-australia/australian-story/austn-farming-and-agriculture (http://www.australia.gov.au/about-australia/australian-story/austn-farming-and-agriculture)

http://www.agriculture.gov.au/ag-farm-food/crops/about-crops (http://www.agriculture.gov.au/ag-farm-food/crops/about-crops)

Learning Experience 3

http://www.csiro.au/en/Research/AF/Areas/Sustainable-farming/Precision-agriculture (http://www.csiro.au/en/Research/AF/Areas/Sustainable-farming/Precision-agriculture)

Module G: Yield Variability and Site-specific Crop Management, by Brett Whelan and James Taylor (http://sydney.edu.au/agriculture/pal/publications_references/educational_resources.shtml (http://sydney.edu.au/agriculture/pal/publications_references/educational_resources.shtml))

Learning Experience 4

ASRIS (2011). ASRIS – Australian Soil Resource Information System. http://www.asris.csiro.au/ (http://www.asris.csiro.au/) Accessed 3rd November 2015

Learning Experience 5

http://www.grdc.com.au/uploads/documents/GRDC_PA_FS_6pp.pdf (http://www.grdc.com.au/uploads/documents/GRDC_PA_FS_6pp.pdf)

http://pubs.ext.vt.edu/442/442-505/442-505_PDF.pdf (http://pubs.ext.vt.edu/442/442-505/442-505_PDF.pdf)

Assessment Rubric- http://www.jou.ufl.edu/fspa/wp-content/uploads/2014/04/Print-Rubrics.pdf (http://www.jou.ufl.edu/fspa/wp-content/uploads/2014/04/Print-Rubrics.pdf)

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