Year 7-8

Design & Technologies

Agriculture in Education:
an educational resource for Year 7- 8 Design and Technologies

Smart Water – Precision Irrigation

Funded by the Australian Government, Department of Education under the Agriculture in Education Program Phase 2.

AGRIFOOD SKILLS AUSTRALIA

Smart Water – Precision Irrigation

Year 7- 8 Design and Technologies

Content Description	
Analyse how food and fibre are produced when designing managed environments and how these can become more sustainable	*ACTDEK032*
Independently develop criteria for success to evaluate design ideas, processes and solutions and their sustainability	*ACTDEP038*

Source: Australian Curriculum v8.1
http://www.australiancurriculum.edu.au/technologies/design-and-technologies/curriculum/f-10?layout=1

learn

Learning Outcomes

Students will gain a greater understanding of:

- The importance of the Murray-Darling Basin to Australia's food and fibre production and exports;
- The complex issues surrounding water use and health of the Murray-Darling river system;
- The reliance of Australian agriculture on irrigation;
- The main sources of water for irrigation in Australia;
- The locational advantages of the the Andrew Peace farm and winery for irrigation;
- The components of a fully automated watering system and their purpose;
- The efficiencies generated from a fully automated irrigation system; and;
- The contribution of these technologies to improved agricultural productivity and addressing competing priorities for water use in the Murray Darling Basin.

Description

This unit enables students to deepen their understanding of the complexities of water management within the Murray-Darling Basin Basin by investigating an Australian designed and manufactured automated irrigation system that is delivering water use efficiencies and productivity increases to a large viticulture exporting operation in northern Victoria. The unit is supported by the accompanying video - *Smart Water - Precision Irrigation*.

The video overviews a family operated business that, has developed from a small vineyard on the banks of the Murray River in north west Victoria, into to a fully irrigated 1,600 hectare farming and wine producing enterprise. Summer and winter crops, fruit and almonds are grown in addition to the grapes and the on-site winery currently produces two million cases of wine pa for export. Components of the irrigation system at Andrew Peace Wines are demonstrated along with its benefits and efficiencies. The video – *Environment Industry – Water Monitoring Technologies*, explains the components of the WiSA irrigation system in greater detail.

The unit provides a useful case study example for Year 7 Geography and Science.

Activity 1: The Murray-Darling Basin – Option 1 or 2

Activity 2: What do we know about irrigation?

Activity 3: Irrigation and f andarming

Activity 4: Components of the watering system

Activity 4: Irrigation control and automation technologies

Assessment.

discuss

Teacher Background Information

The accompanying video to this unit - *Smart Water - Precision Irrigation* focusses on the fully automated watering system at Andrew Peace Wines.

Andrew Peace farm and winery is located on 1,600 hectares beside the Murray River in north western Victoria. The land is very flat and dry. Average annual rainfall is 300mm, mostly falling in winter. Without irrigation, the area is suitable for extensive grazing only. Over the past 35 years, the family has purchased adjacent farms and the entire property is now licensed for irrigation.

The vineyards occupy close on 270 ha and the winery produces two million cases of wine pa for export. Stone fruit, avocados, apples and almonds are grown. Wheat, barley, canola and corn, are now also connected to the subsurface irrigation system.

Further information on the farm can be accessed at http://www.apwines.com/the-farm

The Winery

The rich soils along the bank of the Murray River are suitable for grape growing. From a grape intake from of just 1,711 tonnes in 1996, Andrew Peace Wines is now one of Australia's largest family owned wineries in Australia crushing over 30,000 tonnes per year.

The two biggest customers are the UK and China – teachers may be interested to view the modified Andrew Peace websites for these potential customers.

WiSA automated irrigation control system

This Australian made and owned system has applications across a range of industries and purposes - horticulture, viticulture, pastoral farming, parks and gardens, hydroponics, turf, golf courses, forestry, waste water, mining and municipal activities. It enables farmers to improve the operation and efficiency of their irrigation systems and improve productivity. Specifically, the fully programmable software system communicates wirelessly and:

- Provides accurate data enabling Irrigators to make informed and timely management decisions and reduce water use;
- Is a reliable real time system for plant, weather, environmental and soil moisture information to help prevent frost damage, heat stress and disease;
- Improves plant health, quality, yield and appearance by maintaining optimal soil conditions and ensuring the right amount of water and nutrients are applied at the right time;
- Monitors and controls irrigation and environmental sensors;
- Is easy to use and can be controlled from a computer, smart phone or Tablet;
- Modular design provides flexibility to add to and modify the system over time.

Activity 1: The Murray-Darling Basin - Option 1

This unit provides Year 7 students with a deeper understanding of how water for agricultural production within the Murray-Darling Basin is being managed. Before commencing this unit, it is important for teachers to know whether students have investigated the Murray-Darling Basin in Science and or Geography. Ideally, this unit should be taught in conjunction with and to complement, students water studies in Year 7 Science and Geography.

Teachers are advised to become familiar with the following comprehensive resource:

The Murray-Darling Basin - Balancing the priorities of agriculture and the environment
http://www.environment.gov.au/water/education/publications/murray-darling-basin-balancing-priorities-agriculture-and-environment-teacher-guide

They may also choose to obtain the wall map poster which can be ordered as follows
http://www.mdba.gov.au/publications/products/murray-darling-basin-map-poster-2013

If students have already investigated the Murray-Darling Basin in Science and Geography, select Option 1 below to determine student's existing appreciation of the nature, complexity and competing priorities for water use and management in the Basin.

If students haven't studied the Murray-Darling Basin, Option 2 is suggested.

The case study is a 1,600 ha viticulture and mixed farming operation in the Murray-Darling Basin located on the banks of the Murray River 41 km from Swan Hill.

Option1:

1. Ask students to recall the location and size of the Murray-Darling Basin.
2. What percentage of Australia does the Basin cover? Which states lie within it?
3. How does the climate vary? Comment on the effects of rainfall variations - floods and droughts, on agricultural production, settlements and the extensive Basin flood plains.
4. Ask students to locate Swan Hill and Mildura - either from the above wall map, if one is available, an atlas, or preferably on Google Earth.
5. Have students locate Andrew Peace Wines. From Swan Hill, head NNW along the Murray Valley highway till just south of Piangil and the Malley Highway junction. The farm and wine making facilities are visible on Google Earth on the left.
6. Ask students to observe and comment on the land use adjacent to the river and the relationship between water availability and land use.
7. The Murray-Darling Basin is often referred to as the food bowl of Australia. Ask students to recall the major agricultural activities the Basin supports.

Ask students to write their own thoughts on the following.

- The human impacts on the river system since European settlement.
- The importance of the Basin from a farming and environmental perspective.
- Why water management is such a difficult and complex issue.

Use these as the basis of further discussion.

Activity 1: The Murray-Darling Basin - Option 2

This unit of work complements your studies on water in Science and Geography.

Introduction

The Murray-Darling Basin covers almost 14 per cent of the Australian continent. It is Australia's largest river system. People are often amazed to learn that it covers four states - southern Queensland, much of New South Wales, over half of Victoria and the south-east of South Australia. About 10% of Australia's population live within the Murray-Darling Basin.

Owing to its large size, the climate varies throughout - ranging from sub-tropical in Queensland, temperate in the east, cool to cold in the mountainous areas, through to hot and semi-arid to arid on the plains further west. Not only does the climate vary from place to place within the Basin, it also varies from time to time - periods of drought, followed by floods. Such events impact on the environment and the people living there with varying consequences:

- Floods increase the water flow into the rivers and dams, and replenish the wetlands and extensive floodplains.
- Floods often cause severe damage to crops and livestock and destroy houses, buildings, property and infrastructure such as roads and bridges.
- Droughts place a strain on water availability, reduce water levels, native vegetation and animal habitats are destroyed, agricultural production declines, jobs are lost and people's livelihoods can be severely affected.

The Basin produces a significant amount of Australia's food for domestic consumption and also for export sale overseas. Many towns and settlements are located within the region - mostly close to the numerous rivers that make up the Basin. Indigenous people lived there for thousands of years, obtaining their livelihood from the rivers and surrounding wetlands.

Over the years since European settlement, increasing demands have been imposed on the system. Large dams were built on many of the rivers and farming expanded wherever water could be made available through irrigation. We now know that this use was unsustainable and the environment of the Murray-Darling Basin has suffered.

It is important that the health of Australia's largest river system is maintained. This is crucial to the communities that live within the Murray-Darling Basin and to the economy of Australia.

The priority now is to balance the competing demands of people and the environment and to ensure the sustainability of the system itself and the production systems within it.

task

Activity 1: The Murray-Darling Basin - option 2

The statements and questions below will assist your investigation into new technologies being developed in Australia enabling greater efficiencies in water use and management and farm productivity. As the worldwide demand for food continues to grow, the sustainable use of water underpins the ability of Australia's agricultural industries to increase the amount of food and fibre produced for both local and overseas markets.

The case study is based on a 1,600 ha viticulture and mixed farming operation in the Murray-Darling Basin, located on the banks of the Murray River 41 km from Swan Hill.

1. How are the boundaries of a river basin determined? Think of where streams and rivers start and finish.

2. Do you live in the Murray-Darling Basin? Have you visited the region? If so, share where this was and describe what the area was like?

3. Locate Swan Hill and Mildura - either from a wall map, if one is available in your classroom, an atlas, or preferably on Google Earth.

4. Next, locate Andrew Peace Wines. From Swan Hill, head NNW along the Murray Valley highway till just south of Piangil and the Malley Highway junction. The farm and wine making facilities are visible on Google Earth on the left.

5. What can you notice about the land use adjacent to the river and the relationship between water availability and land use?

6. The Murray-Darling Basin is often called the food bowl of Australia. From your existing knowledge, what are some of the agricultural activities carried out within it?

7. The company that developed and installed the 'smart watering' system at Andrew Peace Wines is based in Swan Hill. Why do you think it is located there?

8. Suggest reasons why farming and and environmental issues have to be addressed?

Watch the video *A Brief History of Water use in the Murray Darling Basi*n
https://www.youtube.com/watch?v=Jbi3e4Ogx1c

Discuss and record the issues raised – use these questions below as a guide.

1. Compile a list of consequences of human activities in the Murray-Darling Basin.

2. What is the Murray-Darling Basin Plan and why has it been developed?

3. What are environmental flows and why are they needed?

4. How has this video helped you understand some of the water management issues?

Share your observations with the rest of the class.

task

Activity 2: What do we know about irrigation?

As a class suggest various types of watering/irrigation systems you are familiar with and identify the type places where you have seen them in operation.

- What type of situation are they being used in?
- Are they automated or manual?

Working in groups, suggest one situation/ purpose where an automated watering/irrigation system would be useful. It could be an agricultural activity, sporting field, a recreational park, botanical gardens. For your chosen situation/purpose, decide:

- The source of water - a city/town water supply, or a river, tank.
- Where your system would be located, Think about the climate.
- Might there be times of the year when it wasn't needed?
- How the water would get from the source to the desired location.
- What you would want it to do.
- What might 'the system' look like – what would be the various parts?
- How often would you want the water to be applied.
- Whether you would need it to 'turn itself off" if it was raining.
- Would someone need to monitor and check it from time to time?
- What else might you want the system to do.
- Decide the three most important reasons for installing your irrigation system
- Think about what problems or disadvantages your system might have.

Report back your findings to the class.

- Make a class list of the common features that were identified as useful.
- Record the reasons groups gave for wanting to install an automated irrigation system.
- Vote by a show of hands to decide the three most important reasons.
- Share any negative impacts your irrigation system might also have.
- Conduct a similar show of hands vote.
- Record the three benefits of an irrigation system that scored the highest number of votes and the three most identified negative impacts.

You can use these for comparison and reflection as you work through the next activity.

task

Activity 3: Irrigation and Farming

Read and discuss the following

"Irrigation is the the controlled application of water for agricultural purposes through manmade systems to supply water requirements not satisfied by rainfall. Crop irrigation is vital throughout the world in order to provide the world's ever-growing populations with enough food". USGS[1] *http://water.usgs.gov/edu/irquicklook.html*

Agricultural production in Australia helps provide food and clothing for a nation of 23 million people and around 65% of its agricultural production is exported to international markets[2]. Achieving this level of production in the driest inhabited continent on Earth is a challenge.

Sources of water for irrigation in Australia

Surface water, drawn from rivers, lakes, weirs and dams, is the main source of irrigation water. The Murray-Darling system in eastern Australia and the Ord River in the Kimberleys of Western Australia are the most important. Other significant river/dam systems are on the Burdekin River in Queensland, south-west of WA and in the Gippsland district of Victoria.

Ground water from the Great Artesian Basin is another large source of water. This provides water for livestock and crops over much of north-eastern Australia via springs and bores. The amount and source of irrigation water for agriculture per state/territory can be accessed from the Australian Bureau of Statistics *http://www.abs.gov.au/ausstats/abs@.nsf/mf/4618.0*

Watch the video – *Smart Water - Precision Irrigation*

Discuss these and any other questions you might have from the video

1. What are the characteristic features of the land and the adjacent river;
2. What is grown and produced on the property?
3. Why is irrigation necessary and what are the various uses of water on site?
4. Andrew Peace mentioned a measure of the productivity of the farm. What was it?
5. Where is the water sourced from and what steps are undertaken to secure it?
6. Water is applied by four different methods. What are these?
7. Identify and list as many benefits of the fully automated system as you can.
8. Write down the three main components of the WiSA irrigation system
9. What skills do you think people working for WiSA would require?

1 The USGS is a Federal science agency in the U.S. Department of the Interior. It provides impartial information on the health of our ecosystems and the environment.

2 Australian Agricultural Exports – Australian Government Department of Foreign Affairs and Trade http://dfat.gov.au/trade/topics/pages/agriculture.aspx

task

Activity 4: Irrigation control and automation technologies

Background Information

How water is lost: All plants, whether irrigated or rain fed, transpire water from their leaves to reduce temperature when exposed to the sun. If crops are irrigated, a lot of water that is taken from a river or a dam can be lost through seepage, evaporation and transpiration, before it actually gets to the farm. As much as 85% of water can be lost when open earth channels are used to supply water. On the other hand, as little as 5% can be lost when new fully piped systems are installed and managed appropriately.

Smart watering system

Farmers today are aware of the need to increase food production using cost efficient, ethical and sustainable production techniques. As many parts of Australia rely on irrigation to supplement inadequate and unreliable rainfall, irrigation is one of the key factors enabling Australian farmers to increase their food production for both local and overseas markets.

Watch the video below. It explains the role of each of the component parts of the WiSA smart watering system installed on Andrew Peace's property. It will help you understand how the automated irrigation system works and the benefits of accurate and reliable real time plant, weather, environmental and soil moisture information.

Video: *Environment Industry - Water Monitoring Technologies*

1. Describe what the system does and what it can measure.

2. Draw up a table with headings as below and list key components their use.

Component	Use	Comments

3. Under comments, suggest the value of each of these capabilities.

4. What are the benefits to farmers of satellite controlled irrigation?

5. Explain how the system delivers:
   a) sustainability and cost efficiencies;
   b) precise measurement and monitoring; and
   c) labour and time savings.

6. What is the added advantage of the system's flexibility?

7. Fertigation is a common practice of farmers, horticulturalists and landscapers. Find a definition and explain the role of irrigation in this process. Acknowledge your source.

8. Find definitions for any terms, such as an actuator, that you are not familiar with.

assess

Assessment - an irrigated landscape solution

Working in small teams, identify a garden site in your school that is inadequately watered. Your task is to design a sustainable watering system for the site. You will be required to present your proposal to your school council for approval.

Your proposal will be judged on its ability to deliver a sustainable irrigation solution.

Your proposal needs to contain:

- A description of the system;
- What it does;
- A plan view of the layout and workings;
- The component parts and their role;
- The benefits it will deliver;
- How your design ideas and system will meet the identified success criteria.

Step 1:

- Brainstorm and decide key objectives for your proposed irrigation system.
- Identify your criteria for success.
- Decide necessary tasks and responsibilities and how you will divide these up between team members.
- What risks might there be in your proposal and how will you deal with them?

Step 2:

- Think about the water source - is it secure?
- Consider sustainability aspects - which features can deliver these.
- Sourcing and installing the components. When to do this.
- How it will be operated. How practical is your solution?
- Construct a draft plan showing the component parts and how they are linked.
- Decide how you will describe and demonstrate your proposed irrigation system and the efficiencies it will deliver.
- Modify and adjust your plan if necessary.

Step 3:

- Finalise your plan.
- Present your plan.

web

Online Teacher Support Resources

1. Andrew Peace wines
   http://www.apwines.com/

2. A Secure water supply – Target 100.
   TLF ID M015287
   http://www.target100.com.au/Hungry-for-Info/Education/National-Curriculum-Study-Guides

3. Cracked Soils – ABC Catalyst
   http://www.abc.net.au/catalyst/stories/2402408.htm

4. Inland waters - CSIRO
   http://www.csiro.au/en/Research/Environment/Biodiversity/Biodiversity-book/Chapter-10

5. The Murray- Darling Basin – Balancing the priorities of agriculture and the environment – Teacher Guide
   http://www.environment.gov.au/water/education/publications/murray-darling-basin-balancing-priorities-agriculture-and-environment-teacher-guide

6. The Murray Darling Basin – Teacher Guide and Lesson Plans
   http://www.mdba.gov.au/education/teachers

7. Water Resources in a Changing Climate: Western Victoria
   http://www.mla.com.au/files/c3335e5a-7a7d-4ee0-927a-9d66008a9067/vic-water-resources-.pdf

8. Water our Most Precious Resource - target 100
   http://www.target100.com.au/Hungry-for-Info/Education/National-Curriculum-Study-Guides

9. WiSA Global Pty Ltd
   http://www.irrigatewisa.com.au/about

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Centre Pivot Andrew Peace Wines, Pty.Ltd, for AgriFood Skills Australia


TriSCAN probe, WiSA Global Pty.Ltd, for AgriFood Skills Australia


New plantings AP Wines, WiSA Global Pty.Ltd, for AgriFood Skills Australia


Hybrid Board, WiSA Global Pty.Ltd, for AgriFood Skills Australia