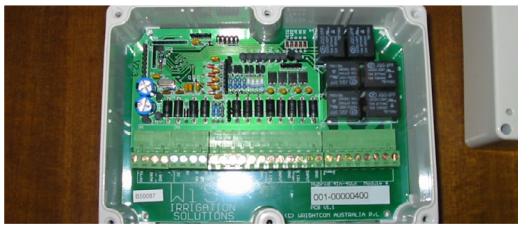
Agriculture in Education:
an educational resource for Year 7- 8 Design and Technologies

Smart Water – Precision Irrigation



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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

This unit also supports elements of the following content descriptions:

Year 7 Science

Some of Earth's resources are renewable, including water that cycles through the environment, but others are non-renewable.	ACSSU116

Year 7 Geography

The nature of water scarcity and ways of overcoming it, including studies drawn from Australia and West Asia and/or North Africa	ACHGK040

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 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 presents and example of sustainable water use and management for agricultural purposes within the Murray-Darling Basin. It investigates an Australian designed and manufactured automated irrigation system that is delivering more efficient water use and productivity increases on a large viticulture exporting operation in northern Victoria. This case study example provides Year 7 STEM teachers with an authentic context for sustainable use and management of water resources. It is supported by the accompanying video - *Smart Water - Precision Irrigation* (*https://youtu.be/tVrTj9jKiRk*)

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 mixed 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 per annum for export. Components of the fully automated irrigation system are demonstrated along with its benefits and efficiencies.

Before commencing this unit, it is important for teachers to liaise with other Year 7 teachers to determine whether students have studied or may be studying the Murray-Darling Basin as part of their investigation of water in Year 7 Science and/or Geography.

To assist teachers in this regard, there are two options provided in Activity 1:

Option 1 - for students who have studied the Murray Darling Basin.
Option 2 - for students who have not studied the Murray Darling Basin.

- Activity 1: The Murray-Darling Basin – Option 1 or 2
- Activity 2: What do we know about irrigation?
- Activity 3: Irrigation and farming
- Activity 4: Irrigation control and automation technologies
- Assessment.

Teacher Background Information

The accompanying video to this unit - *Smart Water - Precision Irrigation* (*https://youtu.be/tVrTj9jKiRk*) focusses on the fully automated watering system at the Andrew Peace farm and winery which is located on 1,600 hectares beside the Murray River in north western Victoria. Using Google maps, encourage students at an appropriate stage in the classroom activities, to locate the operation. It is 41 km NNW from Swan Hill on the Murray Valley HIghway, just south of Piangil. The land is flat and dry. Average annual rainfall is 300mm, mostly falling in winter. Without irrigation, the area is suitable for extensive grazing only.

The Farm

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 hectares. Stone fruit, avocados, apples, almonds, wheat, barley, canola and corn are also grown. These are connected to the subsurface irrigation system.

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

The Winery

Andrew Peace Wines is now one of Australia's largest family owned wineries in Australia, crushing over 30,000 tonnes of grapes and producing two million cases of wine per annum. Most of the wine is exported to the UK and China.

WiSA automated irrigation control system

This Australian made automated irrigation 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.

The fully programmable software system communicates wirelessly.

- It provides accurate data enabling Irrigators to make informed and timely management decisions and to 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 correct 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.

The Murray- Darling Basin River System

The Murray-Darling Basin is Australia's largest river system, covering 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 lives within the Murray-Darling Basin.

The climate varies considerably throughout the Basin, due to its large size. Climates range 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. The climate also varies from time to time - periods of drought, followed by floods. Such events impact on the environment and the people living there:

- Floods increase the water flow into the rivers and dams, replenishing the wetlands and extensive floodplains.
- Floods can 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 - water levels are reduced, native vegetation and animal habitats in the adjacent ecosystems are destroyed, agricultural production declines, jobs are lost and people's livelihoods can be severely affected.

Setting the Scene

As this irrigated winery is located in the Murray-Darling Basin, it is advisable to ensure that students are able to discuss this large irrigated enterprise within the broader context of the importance and health of the Murray Darling Basin river system.

From their Year 7 Geography study of Water in the World, students may already have discussed the sustainable use of water within the Murray-Darling Basin. If so, they would be aware that many communities rely on the river system. There are competing pressures on the water resources and managing these competing priorities is a complex issue.

> *"The Murray-Darling Basin river system supports the production of food, fibre and other products that are vital to Australia's economy and the existence of many rural communities is closely tied to the availability of the water that flows through this system. The health of the river and ecosystems connected to the system are under threat due to environmental changes and human demands on a highly variable system. How do we manage the conflicting needs for water so that it is fairly distributed and the health of the river system is improved and secured for future generations?"* [1]

In view of this, Activity 1 contains two options for teachers:

- Option 1: for students who have studied the Murray Darling Basin; and
- Option 2: for those who haven't.

Irrespective of which option is used, introduce the activities by having students familiarise themselves with the location and extent of the Murray-Darling Basin river system.

Teachers are advised to obtain a copy of the **Murray-Darling Basin wall map poster** for students to refer to at this stage and also to have on display throughout the unit.

The poster can be ordered at -
http://www.mdba.gov.au/publications/products/murray-darling-basin-map-poster-2013

Both options focus on student discussion.

The resource below is a useful reference for teachers choosing option 2 for their students.
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

[1] 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

discuss

Student Activity 1: The Murray-Darling Basin - Option 1

Water is an important learning focus in Science, Geography and Technologies in Year 7. This activity encourages you to reflect on what you know about of Australia's most important river system - the Murray-Darling Basin.

The fully automated irrigation system that you investigate in this unit, is located within the Murray-Darling Basin. You will discover how an Australian produced technological innovation is not only reducing water use, but also increasing the output from a large family owned farming operation located on the banks of the Murray River.

Share what you already know about water use and the Murray Darling Basin with the rest of your class.

1. With the help of the Murray-Darling Basin poster or a wall map of Australia, describe the location and extent of this river system.

2. Which states does it flow through?

3. Is your school located in the Murray Darling Basin? What is the name of the nearest large river and how far away is it from you school?

4. Suggest the approximate percentage of Australia that the Basin covers.

5. Name some of the rivers that form part of The Murray-Darling Basin.

6. Nominate a city, town or holiday destination within the Murray Darling Basin that you have visited. Share what you liked about it. Select another destination - one you don't know anything about. Find out three things about it. Share these.

7. Your teacher may choose to divide the class into three groups to suggest how floods and droughts within the Murray-Darling Basin impact on:

   a. agricultural production,

   b. cities and towns; and

   c. the extensive flood plains and wetlands.

8. The Murray-Darling Basin is often referred to as the food bowl of Australia. Recall some of the major agricultural activities carried out within the Basin.

   - 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.

task

Student Activity 1: The Murray-Darling Basin - Option 2

Water is an important learning focus in Year 7 Technologies, Science and Geography.

This activity introduces you to Australia's most important river system - the Murray-Darling.

The fully automated irrigation system that you will investigate in this unit, is located within the Murray-Darling Basin. Many communities rely on this river system for many different uses.

The Murray-Darling Basin covers almost 14 per cent of the Australian continent. It is Australia's largest river system. Using a map of the Basin, suggest answers to the following:

1. How do we decide the boundaries of a river basin? Think about where streams and rivers start and finish.
2. Name the states that lie within the Murray Darling Basin.
3. Do you live in the Murray-Darling Basin? What is the nearest river?
4. Have you visited somewhere in the Murray Darling Basin? If so, where was it? Describe something you remember about it.

Because of its size, the climate varies from one place to another. It also varies from year to year. Floods and droughts impact on the environment and the people.

- Floods increase water flow and replenish the wetlands and extensive floodplains.
- Floods can damage crops, destroy livestock, damage houses, buildings, property, roads and bridges. People can drown driving through flood waters.
- Droughts reduce the water flow into the rivers and creeks, wetlands dry out and native vegetation and animal habitats suffer.
- Lack of rain reduces agricultural production with livestock and crop losses.
- People can lose their jobs and livelihoods as result of droughts.

5. How do people "control" rivers? Name some major structures that have been built on some rivers within the Murray-Darling Basin. Suggest reasons why this was done.

The Murray-Darling Basin is often called the food bowl of Australia. From your knowledge:

6. What type of agricultural activities are carried out within the Basin?
7. Suggest reasons why farming and environmental issues have to be addressed.

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

8. Compile a list of consequences of human activities in the Murray-Darling Basin.
9. What is the Murray-Darling Basin Plan and why has it been developed?
10. What are environmental flows and why are they needed?

Activity 2: What do you know about irrigation?

Teacher Background Information

New technologies developed in Australia enable farmers to manage water use more efficiently while also increasing their productivity. As the world demand for food grows, Australia's ability to increase our food and fibre production depends on our ability to use our water supplies sustainably and to maintain the health of our river systems.

Irrigation - Definition

"Irrigation is 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 two important examples. 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.

Setting the Scene

Students will need copies of Student Activity sheets 2-5 and the Assessment task.

1. Display this key question in a prominent position in the classroom - How can we maintain the health of Australia's largest river system? Encourage students to suggest answers to this as they work through the remaining activities in this unit.

[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

discuss

Student Activity 2: What do you know about Irrigation?

In this activity you will be finding out about irrigation. When we water a plant growing in a pot or water the garden, we are irrigating it. But how can we define irrigation? A suggestion. Methods used to apply water to enable plants to grow. Record this definition, or your own.

As a class, suggest answers to these questions:

- Why do we irrigate? When do we irrigate?
- Suggest examples of watering/irrigation systems that you have seen.
- Are they automated or done by hand – (manual)?

task

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;
- What you would be irrigating;
- How you would get water from a source to your location;
- What your 'irrigation system' might look like – what its various parts would be;
- How often you would want the water to be applied;
- Whether you would need it to 'turn itself off" if it was raining;
- Whether someone would need to monitor and check it from time to time;
- What else you might want your the system to do;
- The three most important reasons for installing your irrigation system; and
- Any problems or disadvantages it could have.

Explain your group's irrigation system to the class. After hearing them all:

- Recall and write up a class list of the reasons given for installing an automated irrigation system;
- Vote by a show of hands, to choose the three most important reasons. Record these;
- Recall and write up a class list of problems or negatives suggested; and
- Vote again by a show of hands, to choose the three most commonly provided problems. Record these.

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

discuss

Student Activity 3: Irrigation and Farming

This activity enables you to investigate a 1,600 ha viticulture and mixed farming operation within the Murray-Darling Basin that is watered by a fully automated irrigation system. It is situated on the banks of the Murray River in Victoria, 41 km from Swan Hill.

1. As a class, locate Swan Hill and Mildura either from a wall map, an atlas, but preferably using Google Earth.

2. Locate Andrew Peace Wines. It is on the Murray Valley Highway. Head north west from Swan Hill along the highway towards Mildura. The farm and wine making facilities are visible on Google Earth near Piangil just south of the T intersection with the Mallee Valley Highway.

3. Suggest how the land near to the river is being used and how the landuse abruptly changes as you move further away from the river. What might be the reason for this?

4. The company that developed and installed the 'smart watering' system at Andrew Peace Wines is based in Swan Hill. Why might the company be located there?

Watch the video – *Smart Water - Precision Irrigation* (*https://youtu.be/tVrTj9jKiRk*)

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

1. Does the land look like you thought it did when using Google Earth? What is similar and what is different?

2. Would vines be able to grow here without irrigation? Justify your answer.

3. The owner of this family operation, Andrew Peace, mentioned some measures of the productivity of the farm. What were they? How has he been able to achieve these?

4. Where is the water sourced from and what steps are undertaken to secure the supply required each year?

5. Soil moisture monitors and sensors are components of the irrigation system? Explain their purpose and benefits.

6. Andrew mentions that he uses two types of drip tape for the vines. Suggest why he uses both types and the benefits each provides.

7. James mentions labour saving units. Explain what he means by this.

8. On the WISA website, *http://www.irrigatewisa.com.au/industries/viticulture* promotional materials state that the WISA irrigation management system provides users greater control, increased flexibility and greater accuracy. Give examples of how each one of these three features would benefit a farming enterprise like Andrew Peace Wines.

9. Explain why Anthony, the farm manager, is so supportive of the irrigation system.

10. What skills do you think people working for WiSA would require?

task

Student 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. With irrigation, a lot of water taken from a river or a dam can be lost before it actually gets to where it is needed. This can happen through seepage and evaporation, as well as transpiration. Up to 85% of water can be lost when irrigation water is supplied through open earth channels. Compare this with as little as 5%, 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 that you were introduced to in Activity 3. 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* (*https://vimeo.com/161446326*)

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

2. Draw up a table with headings as below. List the 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;
   c) labour and time savings; and
   d) flexibility.

6. 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.

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

assess

Assessment - a sustainable irrigation 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 are to assume your team will be presenting 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.
- The proposed cost of your irrigation system.

Step 1:

- Decide the decide key objectives for your proposed irrigation system. What do you want it to do?
- Identify some success criteria. These are what you can measure that proves your irrigation system works according to your design.
- Decide necessary tasks and responsibilities and how you will divide these up between team members.
- Identify possible risks and how your group will deal with these.

Step 2:

- Identify your water source.
- Determine the features that will make your system a sustainable one.
- Decide where and when you will obtain and install the components.
- Decide where it will be operated from.
- 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:

- Present your plan to the School Council. This “council” could consist of other members of the class, with your teacher as the Chair of the Council.

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

Produced by

AGRIFOOD SKILLS AUSTRALIA

AgriFood Skills Australia

General inquiries:
Phone: 02 6163 7200
Fax: 02 6162 0610
Email: reception@agrifoodskills.net.au
Web: www.agrifoodskills.net.au

Location
Level 3, 10-12 Brisbane Avenue
Barton
ACT 2600

Postal address
PO Box 5450
Kingston
ACT 2604

Developed by

Dianne Stuart

Cover images


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