Teacher Guide
Year 7-8

Design and Technologies
Geography

Sustainable Food and Fibre Production

Supporting students to learn about Australian agriculture's role in sustainability

Lesson 5
Winning with Water

This resource has been developed by:

Primary Industries Education Foundation Australia | primezone Food and fibre classroom educational resources.

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Contents

Learning Areas & Australian Curriculum Content

Design and Technologies

Analyse how food and fibre are produced in managed environments and how these can become sustainable **(AC9TDE8K04)**

Geography

The location and distribution of water resources in Australia, their implications, and strategies to manage the sustainability of water **(AC9HG7K02)**

Collect, organise and represent data and information from primary research methods, including fieldwork and secondary research materials, using geospatial technologies and digital tools as appropriate **(AC9HG7S02)**

Interpret and analyse geographical data and information to identify similarities and differences, explain patterns and trends and infer relationships **(AC9HG7S03)**

This lesson is written with the assumption that students have assumed knowledge of the above outcomes. The lesson is intended to provide a case study to support the above outcomes.

Lesson Objective

Students will expand their understanding of water scarcity and management, and gain a deeper understanding of strategies to manage water sustainability. They will examine water sustainability through case studies, highlighting contemporary irrigation techniques and water management strategies. Additionally, students will develop their skills by interpreting and analysing geographical data in the form of a climate graph.

Lesson Overview

- **Activity 5.1** - Irrigation Techniques (15 mins)
- **Activity 5.2** - Fieldwork Experiment on Infiltration (40 mins)
- **Activity 5.3** - Geographical Skills (25 mins)

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Resources and Equipment

Activity 5.1 - Irrigation Techniques

1. **Worksheet 5.1a - Irrigation Techniques**
2. Straws (different lengths and diameters) or pipe cleaners
3. Playdough (various colours)
4. Paper towels for cleanup

Activity 5.2 - Fieldwork Experiment on Infiltration

1. Digital devices
2. How to Make an Infiltration Ring From a Can (3:09)
3. How to Measure Infiltration Rate (1:29)
4. **Worksheet 5.2a - Fieldwork Experiment on Infiltration**
5. Pre-made infiltration rings or equipment to make them: tin can, can opener, marker.
6. Pieces of timber
7. Rubber mallets
8. Stopwatches
9. Filled water bottles

Activity 5.3 - Geographical Skills

1. **Worksheet 5.3a - Climate Graph of Griffith, NSW**
2. Digital devices/workbooks

Additional Resources

- Climate Graphs Explained (and how to make one) (6:43)
- NSW - Daily Weather Observations
- Updated Area of Operation 2021

Lesson Guide

Activity 5.1 - Irrigation Techniques

Students will engage their creativity by modelling different irrigation techniques using straws and playdough to show their understanding of the principles and effectiveness of various water management strategies.

a) Divide students into small, collaborative groups, distributing the modelling materials to each group.

b) Discuss the importance of water management and irrigation in agriculture. Introduce the different types of irrigation techniques by distributing a printed copy of **Worksheet 5.1a - Irrigation Techniques** to students or displaying a version in a central area.

c) Explain that students will be competing in a race to model these techniques using straws and play dough.

d) Select one of the irrigation techniques in the table randomly and allocate students three minutes to create their model within their collaboration groups. Select a winner after each round based on the quality and understanding of relevant features of the model. If the class requires a demonstration first, present the following example:

Drip Irrigation:

- Students roll out thin strips of playdough to represent rows of crops.
- Demonstrate how to insert straws/pipe cleaners into the playdough to mimic drip irrigation lines.
- Discuss the advantages and disadvantages of drip irrigation. **Answers page 6**

e) As a class, continue, by working through each irrigation technique as above.

f) After completing the modelling activity, conduct a class discussion and answer the reflection questions or allow students to answer the questions. **Answers page 6**

Activity 5.2 - Fieldwork Experiment on Infiltration

Students will conduct a fieldwork experiment on water infiltration to develop their knowledge of irrigation practices in agriculture. They will collaborate in groups to conduct fieldwork and record results.

a) Prior to the lesson, determine three suitable fieldwork locations within the school environment with differing soil types. One site may include a sandpit or a long jump pit if available. If the school does not have any sites that contain sand, consider providing students with a sample of sand.

Infiltration rings may be pre-prepared for student use, or they may be made during the practical task. See How to Make an Infiltration Ring From a Can (3:09)

b) Introduce the fieldwork experiment and as a class, view the explanatory video How to Measure Infiltration Rate (1:29).

c) Distribute a copy of **Worksheet 5.2a - Fieldwork Experiment on Infiltration** to each student and read through the information on page one.

d) Allocate students into fieldwork groups and provide each group with pre-prepared infiltration rings or the equipment to make them, a piece of timber, a rubber mallet, a stopwatch, and a filled water bottle.

e) Adhering to your school's WHS policy in regard to onsite risk assessments, accompany students to each fieldwork site (numbered sites 1-3), and follow the method on the worksheet to complete two trials at each site. Students record their findings from each trial on the worksheet and calculate the average time taken for infiltration at each site.

f) Conduct a class discussion of student results and the irrigation techniques they would use based on the time taken for water to infiltrate the soil at each site.

g) Students complete answers to the discussion questions on the worksheet.

Activity 5.3 - Geographical Skills

Students will interpret and analyse geographical data and information in the form of a climate graph to explain patterns and trends within a case study location. They will interpret the key features of a climate graph and discover how to use this data to infer relationships.

a) Remind students of the key features of climate graphs, such as:

- Temperature is represented with a line graph in red and drawn by hand using a curved line
- Rainfall is represented with a bar graph in blue (bar=blue=rainfall).

If students need further knowledge or revision on climate graphs, the video Climate Graphs Explained (and how to make one) (6:43) may be useful.

b) Distribute a copy of **Worksheet 5.3a - Climate Graph of Griffith, NSW** to each student.

c) Students interpret and analyse the climate graph by observing the key features. They then answer the questions on the worksheet, linking the data to the case study location.

d) As a class, discuss the answers. **Answers page 6**

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Answers

Activity 5.1 - Irrigation Techniques

Worksheet 5.1a - Irrigation Techniques

1. Flood irrigation involves flooding the entire field with water, which may result in water wastage due to evaporation and runoff. In contrast, drip irrigation delivers water directly to the roots of plants through small holes/emitters, minimising water loss.
2. A pivot irrigation system consists of large, wheeled structures with sprinklers that rotate around a central pivot point. This design allows water to be spread over a large area in a circular pattern. As the pivot moves, the sprinklers distribute water evenly across the field, covering the area with minimal water wastage.
3. Drip irrigation works well in arid or semi-arid climates where water scarcity is a significant concern. It addresses the challenges posed by water scarcity by delivering water directly to the roots of plants via holes/emitters, minimising evaporation and runoff. Drip irrigation helps to conserve water, making it ideal for regions with water scarcity.
4. Central irrigation systems provide water distribution to multiple fields from a central source, ensuring efficient water usage and maximising crop yields. Unlike flood irrigation, which may lead to water wastage and uneven distribution, and drip irrigation, which may require more complex maintenance, central irrigation may provide the farmer with more control over water use.
5. Flood irrigation typically has lower initial costs but higher long-term expenses due to potential water wastage and possible soil erosion. Drip irrigation involves higher initial investment for equipment and installation but is more cost-effective through water efficiency. Pivot irrigation requires substantial upfront investment but can be cost-effective for large-scale operations over time, especially in areas with limited water resources.
6. Modern technologies such as sensors, automated control systems, and precision irrigation tools enhance the efficiency and precision of irrigation practices. These technologies monitor soil moisture levels, weather conditions, and crop water requirements in real time, allowing farmers to adjust irrigation times and use water more efficiently.
7. Student answers will vary. Suggested answer: Drip irrigation is often considered more sustainable than flood or pivot irrigation due to its efficient water usage, reduced environmental impact, and potential for long-term savings. By minimising water wastage and soil erosion, drip irrigation supports agricultural sustainability while addressing the challenges of water scarcity and climate change.

Activity 5.2 - Fieldwork Experiment on Infiltration

Worksheet 5.2a - Fieldwork Experiment on Infiltration

Student answers will vary based on the fieldwork locations chosen.

Activity 5.3 - Geographical Skills

Worksheet 5.3a - Climate Graph of Griffith

1. Line graph, which is drawn free-hand in red.
2. degrees Celsius (°C).
3. Bar graph, drawn in blue with a ruler.
4. Millimetres (mm).
5. Yes, slightly lower for April.
6. January.
7. February and June.
8. Total sum of all months: 349 mm.

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Student Activities
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Irrigation Techniques

Read the information below to learn about common irrigation techniques used in agriculture.

Irrigation Technique	Description	Advantages	Disadvantages
Flood Irrigation 	Flood irrigation involves flooding the entire field with water and allowing it to soak into the soil.	• Simple and inexpensive. • Suitable for a wide range of crops and soil types. • Can help to distribute nutrients in the soil.	• Water usage may be inefficient as water can evaporate or run off fields. • Uneven distribution of water, leading to waterlogging in some areas and dry spots in others. • Increased risk of soil erosion and nutrient runoff into waterways.
Drip Irrigation 	Drip irrigation sends water directly to the base of plants through a network of hoses or tubes with small holes/ emitters for the water to "drip" out of.	• Highly efficient water usage, minimises water loss through evaporation and runoff. • Precise water delivery to plant roots promotes healthier growth and higher yields. • Can be automated and controlled to deliver water at optimal times, reducing labour requirements.	• Initial installation costs can be high due to the infrastructure/equipment required. • Requires regular maintenance to prevent clogging of holes/ emitters to ensure even water distribution. • Vulnerable to damage from pests, rodents, and physical disturbances.
Pivot Irrigation 	Pivot irrigation involves large wheeled structures with sprinklers that rotate around a central pivot point, watering crops in a circular pattern.	• Efficient water usage with minimal evaporation. • Suitable for large-scale agriculture, covering large areas with less equipment and labour requirements. • Can adapt to irregularly shaped fields and hilly terrain.	• High initial investment for equipment and infrastructure. • Limited flexibility in crop selection and field layout due to the circular pattern of irrigation. • Energy-intensive operation, especially if powered by fossil fuels.
Central Irrigation 	Central irrigation systems distribute water from a central source through channels or pipes to multiple fields.	• Efficient water distribution, providing even coverage to all fields. • Can be customised to suit different crop types and field sizes. • Allows for the use of automation technology for precise water management.	• Requires significant infrastructure investment for construction and maintenance. • Vulnerable to leaks and pipe failures, leading to water loss and potential damage to crops. • Dependent on a single water source, which may be subject to availability and government constraints.

After modelling the irrigation techniques in the table above, record your responses to the reflection questions in the spaces below.

1. What are the differences between flood irrigation and drip irrigation?

2. How does the design of a pivot irrigation system allow water to be spread over a large area?

3. In what type of climate would drip irrigation work well?
   How does it address the challenges posed by water scarcity?

4. What are the advantages of central irrigation compared to other methods such as flood or drip irrigation?

5. Consider the economic factors (cost) involved in selecting an irrigation method for a farming operation. How might the initial investment and long-term maintenance costs differ between flood, drip, and pivot irrigation systems?

6. How do modern technologies enhance the efficiency and precision of irrigation practices?

7. Which method do you think is more sustainable? Explain your answer.

Fieldwork Experiment on Infiltration

When considering irrigation for farming in Australia, the type and depth of soil must be taken into account. The composition of the soil affects water drainage and retention capabilities. For example, sandy soils drain quickly but retain less moisture, requiring more frequent irrigation, whereas clay soils retain water for longer periods but may have poor drainage, increasing the risk of waterlogging. The depth of the soil is also crucial. Shallow soils have less capacity to hold moisture, limiting root growth and affecting crop yields. Understanding the soil type helps select the appropriate irrigation method to optimise water use efficiency and reduce costs.

Crop type is another vital consideration, as different crops have varying water needs to achieve optimal yields. For example, crops like rice require flooded irrigation, while others like wheat and barley need moderate irrigation. The season also impacts irrigation requirements, with summer often demanding more water due to higher evaporation rates. The availability of water sources, such as rivers, aquifers, or dams is critical, especially in regions where water is scarce. Cost factors, including installation, maintenance, and water pricing, must also be weighed against the expected yield benefits. Farmers must comply with legal requirements regarding water usage rights and environmental regulations which can affect the amount and timing of irrigation.

Infiltration is the movement of water into a soil profile. The rate at which infiltration occurs is controlled by the properties of the soil, the level of soil saturation when rainfall or irrigation starts, and by the ways in which humans have modified the landscape. Infiltration rates control runoff rates and soil erosion, which are important as these processes influence the quality and quantity of our water resources. An infiltration ring or ring infiltrometer is used to measure infiltration.

Infiltration Fieldwork Experiment

Method:

1. Prepare an infiltration ring using a tin can with the two ends and label removed. On the outside, mark a line around the can 2 cm from the 'bottom'. On the inside, mark a line 5 cm from the 'top'.
2. Place the can on the soil surface of a sample site 1.
3. Use a piece of wood and a mallet to gently tap the can into the ground up to the marked 2 cm line.
4. Pour water into the can up to the top.
5. Start the stopwatch immediately and time how long it takes for the water level to drop from the top to the 5 cm mark inside the can.
6. Record the time taken in seconds for the water level to drop to the 5 cm mark in the results table under trial 1.
7. Repeat steps 2-7 at the same sample site but at least 50 cm away from the first trial and record the time taken in the table under trial 2.
8. Calculate an average for the two trials at this site.
9. Repeat steps 2-8 for sites 2 and 3.

Infiltration Fieldwork Experiment

Results:

	Time taken for water to reach 5 cm mark inside infiltration ring (seconds)		
	Trial 1	Trial 2	Average
Site 1			
Site 2			
Site 3			

Discussion:

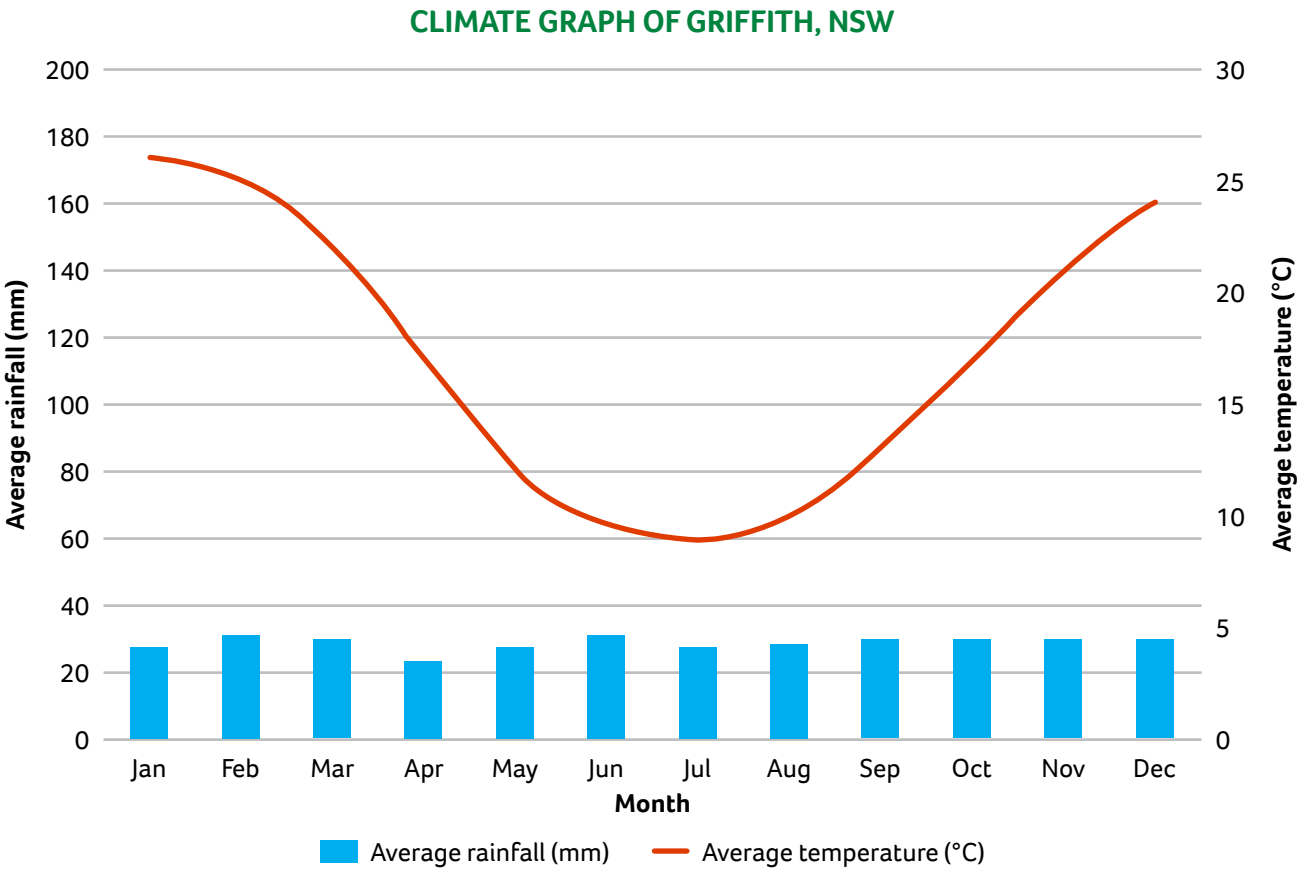
1. Outline your results from Trial 1 and Trial 2. How does the speed of water infiltration differ across each site? What might this tell us about the type of soil at each site?

2. Which irrigation technique would you suggest using for your school environment if it were an operational farm? Explain your choice.

Climate Graph of Griffith, NSW

Refer to the climate graph of Griffith below to answer the following questions.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average rainfall (mm)	28	31	30	24	28	31	28	29	30	30	30	30
Average temperature (°C)	26	25	22	17	12	10	9	10	13	17	21	24



1. How is temperature shown on a climate graph?

2. What unit of measurement is used for measuring temperature on the climate graph?

3. How is precipitation shown on a climate graph?

4. What unit of measurement is used to show precipitation?

5. Is there an even distribution of precipitation throughout the year?

6. Which month had the hottest temperature?

7. Which months had the highest rainfall?

8. Calculate the total annual precipitation.