13 The value of water

INQUIRY SEQUENCE

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To access a pre-test with immediate feedback and sample responses to every question in this chapter, select your learnON format at www.jacplus.com.au
13.1 Overview

Numerous videos and interactivities are embedded just where you need them, at the point of learning, in your learnON title at www.jacplus.com.au. They will help you to learn the content and concepts covered in this topic.

We can’t survive without water, but does it mean more than just survival — do we value water in other ways?

13.1.1 Introduction

Water is an important resource used by people. It has great economic, cultural, spiritual and aesthetic value. The health and wellbeing of a community can be greatly impacted by its access to water, and water can be central to the beliefs and practices of indigenous cultures. Access to water is a basic human right. The amount of available fresh water on Earth needs to be shared among an ever-growing global population. It is a resource that must be used carefully so that current and future populations can have adequate supplies.

STARTER QUESTIONS

1. List some of the different ways water is used in our lives.
2. How would your life be different if you didn’t have easy access to water?
3. Do you value water? What are the different ways in which water can have a value to you?
4. Watch the video using the Introduction to water weblink in your Resources tab. List all the ways that water is used by people, animals, plants and the environment. How much of the Earth is covered by water? How much of this water can be used by people?
5. Watch the Value of water photo essay Video eLesson in your Resources tab. Consider some of the different ways that people in your community might value or use water.

FIGURE 1 Traditional methods are used to fish sustainably.
13.2 Water use

LEARNING INTENTION

By the end of this subtopic, you will be able to describe the many ways water is used by people around the world and give examples of agricultural, commercial, industrial and recreational uses.

13.2.1 Global water use

There are three main uses made of water by all people: growing food, producing goods and electricity, and using it in the home. The amount of water consumed for each of these uses differs from one place to another. The problem remains that while the total amount of fresh water is fixed, the amount used on average per person is increasing.

It is interesting to look at water consumption on a global scale. The global average is 1240 cubic metres per person per year but some countries consume more water than others. Examples of countries that consume nearly twice as much as the global average are the United States and Thailand. Some countries that consume the least amount of water per person are Peru, Somalia and China.

FIGURE 1 World water use


<table>
<thead>
<tr>
<th>Main uses of water (in order of use)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture, industry, domestic/municipal</td>
</tr>
<tr>
<td>Agriculture, domestic/municipal, industry</td>
</tr>
<tr>
<td>Industry, domestic/municipal, agriculture</td>
</tr>
<tr>
<td>Industry, agriculture, domestic/municipal</td>
</tr>
<tr>
<td>Domestic/municipal, agriculture, industry</td>
</tr>
<tr>
<td>Domestic/municipal, industry, agriculture</td>
</tr>
</tbody>
</table>

Legend: No data, Difference between first and second uses is 10% or less

13.2.2 How we use water

**FIGURE 2** shows that most of the world’s water is used in agriculture, to grow food for the world’s increasing population. This is especially the case in the drier parts of the world where there is not enough rainfall to grow crops or grass for animals. There is a strong interconnection between the amount of rainfall in a region and the amount of water used in agriculture.

It is interesting to see how this pattern varies among countries. In some countries, the water used in agriculture and industry is greater than the amount of water used in homes for domestic use. In other places, people consume more water for domestic use than for either agriculture or industry.

**FIGURE 3** Regional use of water for different purposes

![Chart showing regional use of water for different purposes]

Source: John Wiley & Sons Australia

13.2.3 Water use in Australia

Agriculture is an important industry in Australia, and it is our thirstiest industry. It produces most of our food requirements and contributes enormously to Australia’s export earnings.

Around 70 per cent of Australia’s fresh water is used as irrigation for farming. Many crops are grown in dry areas where up to half the available water evaporates from the soil surface or seeps too low into the ground for plant roots to absorb. Therefore, more water is applied than is actually needed by plants. In manufacturing industries, most water is used to produce food, beverages and paper.

In many areas in Australia where rainfall is limited or highly seasonal, farmers irrigate their crops with water stored in dams, with groundwater or with water from major rivers. Irrigation is a very important use of water in Australia. Most large-scale farming could not provide food for Australia’s population without using water from rivers, lakes, reservoirs and wells.

There is high demand for irrigation water during summer when river flows are low, and low demand for irrigation water during winter when river flows are high. This reverses the natural pattern of river flow.
13.2 ACTIVITIES

1. Watch the video *Three rivers in Africa* in your Resources tab and look at the information on these rivers in myWorld Atlas. Use the atlas map to trace the flow of the river and upload images to the map showing all the different water uses in the video.

2. Use your atlas to look at patterns in *FIGURE 2* and compare them to a map that shows global wealth.
   a. Identify a country with low wealth and high water use in industry.
   b. Identify two wealthy countries that do not have high water use in industry.
   c. Write a general statement about wealth and water use. Add two exceptions to your general statement.

---

**TABLE 1** Fresh water use in Australia

<table>
<thead>
<tr>
<th>Types of use of fresh water</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>70</td>
</tr>
<tr>
<td>- pasture 35%</td>
<td></td>
</tr>
<tr>
<td>- crops 27%</td>
<td></td>
</tr>
<tr>
<td>- rural and domestic stock 8%</td>
<td></td>
</tr>
<tr>
<td>Urban</td>
<td>12</td>
</tr>
<tr>
<td>Horticulture</td>
<td>10</td>
</tr>
<tr>
<td>Industry</td>
<td>3</td>
</tr>
<tr>
<td>Mining</td>
<td>2</td>
</tr>
<tr>
<td>Services</td>
<td>2</td>
</tr>
<tr>
<td>Hydro-electricity</td>
<td>1</td>
</tr>
</tbody>
</table>

*Source:* John Wiley & Sons Australia

**TABLE 2** Fresh water used to irrigate different crops in Australia

<table>
<thead>
<tr>
<th>Crop type</th>
<th>Water (gigalitres)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Livestock, pasture, grains and other agriculture</td>
<td>8795</td>
<td>56</td>
</tr>
<tr>
<td>Cotton</td>
<td>1841</td>
<td>12</td>
</tr>
<tr>
<td>Rice</td>
<td>1643</td>
<td>11</td>
</tr>
<tr>
<td>Sugar</td>
<td>1236</td>
<td>8</td>
</tr>
<tr>
<td>Fruit</td>
<td>704</td>
<td>5</td>
</tr>
<tr>
<td>Grapes</td>
<td>649</td>
<td>4</td>
</tr>
<tr>
<td>Vegetables</td>
<td>635</td>
<td>4</td>
</tr>
</tbody>
</table>

*Note:* One gigalitre = 1000000000 litres or one thousand million litres or 400 Olympic-size swimming pools

---

**FIGURE 4** The Hunter River in NSW provides water for agricultural irrigation.
13.2 EXERCISE

Check your understanding
1. What is most of the world’s water used for?
2. Which regions of the world use the majority of their water in agriculture?
3. Which countries use water mainly for industrial purposes?
4. How much of Australia’s water is used for agriculture?
5. How many Olympic-size swimming pools are used for irrigating the following in Australia each year:
   a. livestock
   b. cotton
   c. rice
   d. sugar
   e. fruit?
6. Which region uses the highest percentage of its water for industry:
   a. agriculture
   b. domestic use?
7. Why might some farmers need to put more water on their crops than the plants need? Give two reasons why
   crops need to be watered more frequently.
8. Refer to FIGURE 1. Describe the patterns you notice over space of countries with:
   a. very high and high water footprints
   b. very low and low water footprints.

Apply your understanding
9. Explain why some countries might use more water in industry than in agriculture or domestic use.
10. Discuss how water is used in Australia, including which crops use the least and which use the most water.
11. Study FIGURE 2 and decide which of the following statements are true and which are false. Provide evidence
to support your decision.
   a. Australia uses most water for agriculture, then industry, then domestic/municipal.
   b. Countries in North Africa use most water for industry, then domestic/municipal, then agriculture. (Refer to
      the Regions resource in your Resources tab.)
   c. Belarus uses most water for industry, then agriculture, then domestic/municipal.
   d. Colombia uses most water for agriculture, then domestic/municipal, then industry.
   e. Belize uses most water for industry, then agriculture, then domestic/municipal.
   f. Malaysia uses most water for industry, then agriculture, then domestic/municipal.
12. Explain how water can have a social value.

Challenge your understanding
13. Write three summary statements that describe water use in Africa. How do these patterns compare with
   Australia?
14. Suggest what can be done on a global scale to protect water resources.
15. Predict how the water use shown for Australia in FIGURE 2 will change in the next 20 years if Australia’s
   population continues to grow.

To answer questions online and to receive immediate feedback and sample responses for every question, go
to your learnON title at www.jacplus.com.au.
13.3 SkillBuilder: Drawing a line graph

LEARNING INTENTION
By the end of this subtopic, you will be able to represent information using line graphs.

13.3.1 Tell me
What is a line graph?
A line graph displays information as a series of points on a graph that are joined to form a line. A line graph can be drawn by hand or by using a spreadsheet program such as Excel.

13.3.2 Show me
How to complete a line graph
Step 1
Select the data you wish to compare or interpret. Draw a horizontal and vertical axis using a ruler.

Evenly space and then label the years along the horizontal axis. Look carefully at your range of data and work out appropriate increments for the vertical axis, then evenly space and label this information on the axis. Start at zero where the axes join. Label the $x$ and $y$ axes.

Step 2
Plot the statistics. Draw a dot at the point where the position on the horizontal axis meets the relevant position on the vertical axis. Once you have plotted all the statistics, join the dots. This can be done freehand or using a ruler. Add a title and a source to the graph.

13.3.3 Let me do it
Go to learnON at www.jacplus.com.au. to access the following additional resources to help you build this skill:

- a longer explanation of this skill and its application in Geography (Tell me)
- a video showing the step-by-step process of this skill (Show me)
- an activity and interactivity for you to practise this skill (Let me do it)
- self-marking questions to help you understand and use this skill.

**FIGURE 1** Water use in Greater Sydney


* estimated
^ not corrected for weather

**TABLE**

<table>
<thead>
<tr>
<th>Year</th>
<th>Population (million)</th>
<th>Water demand (GL/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1991</td>
<td>3.5</td>
<td>1.5</td>
</tr>
<tr>
<td>1992</td>
<td>3.6</td>
<td>1.6</td>
</tr>
<tr>
<td>1993</td>
<td>3.7</td>
<td>1.7</td>
</tr>
<tr>
<td>1994</td>
<td>3.8</td>
<td>1.8</td>
</tr>
<tr>
<td>1995</td>
<td>3.9</td>
<td>1.9</td>
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<tr>
<td>1996</td>
<td>4.0</td>
<td>2.0</td>
</tr>
<tr>
<td>1997</td>
<td>4.1</td>
<td>2.1</td>
</tr>
<tr>
<td>1998</td>
<td>4.2</td>
<td>2.2</td>
</tr>
<tr>
<td>1999</td>
<td>4.3</td>
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<tr>
<td>2002</td>
<td>4.6</td>
<td>2.6</td>
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<tr>
<td>2003</td>
<td>4.7</td>
<td>2.7</td>
</tr>
<tr>
<td>2004</td>
<td>4.8</td>
<td>2.8</td>
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<tr>
<td>2005</td>
<td>4.9</td>
<td>2.9</td>
</tr>
<tr>
<td>2006</td>
<td>5.0</td>
<td>3.0</td>
</tr>
<tr>
<td>2007</td>
<td>5.1</td>
<td>3.1</td>
</tr>
<tr>
<td>2008</td>
<td>5.2</td>
<td>3.2</td>
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<tr>
<td>2009</td>
<td>5.3</td>
<td>3.3</td>
</tr>
<tr>
<td>2010</td>
<td>5.4</td>
<td>3.4</td>
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<tr>
<td>2011</td>
<td>5.5</td>
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<td>2012</td>
<td>5.6</td>
<td>3.6</td>
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<tr>
<td>2013</td>
<td>5.7</td>
<td>3.7</td>
</tr>
<tr>
<td>2014</td>
<td>5.8</td>
<td>3.8</td>
</tr>
<tr>
<td>2015</td>
<td>5.9</td>
<td>3.9</td>
</tr>
<tr>
<td>2016</td>
<td>6.0</td>
<td>4.0</td>
</tr>
<tr>
<td>2017</td>
<td>6.1</td>
<td>4.1</td>
</tr>
<tr>
<td>2018</td>
<td>6.2</td>
<td>4.2</td>
</tr>
<tr>
<td>2019</td>
<td>6.3</td>
<td>4.3</td>
</tr>
</tbody>
</table>

**Resources**

| eWorkbook | SkillBuilder: Drawing a line graph (ewbk-9398) |
| Video eLesson | SkillBuilder: Drawing a line graph (eles-1635) |
| Interactivity | SkillBuilder: Drawing a line graph (int-3131) |
13.4 The value of clean water

LEARNING INTENTION
By the end of this subtopic, you will be able to explain how water quality may affect perceptions of the value of water, and explain some of the ways that water quality is measured.

13.4.1 Water quality

Value refers to how important something is or what it is considered to be worth. The value people place on water will vary according to their standard of living, income, culture, location and the way they use water. In this way the value of water is subjective. This means that people have different opinions or perspectives. People who live in cities in developed countries with easy access to piped water may not value water as much as farmers in rural areas in the same country. Those living in developing countries with no or limited access to water are likely to feel that water has a much higher value.

The value of water and the way that it can be used is determined by the quality of the water. Water that is not polluted is better for humans to drink and use, and it is also thought of as more beautiful (valuable aesthetically).

Different pollutants — faeces (human and animal), food wastes, pesticides, chemicals and heavy metals — can come from industrial wastewater, domestic sewage, cars, gardens, farmland, mining sites and roads, and flow into waterways.

Some countries, cities and local areas are better than others at providing services and enforcing laws to prevent pollutants from entering water. Some of the worst polluted rivers and lakes in the world include rivers and aquifers in China (such as the Songhua River and the Yellow River), the Citarum River in Indonesia (FIGURE 2), the Yamuna and Ganges rivers in India, the Buriganga River in Bangladesh and the Marilao River in the Philippines. These water sources provide drinking water to millions of people, so levels of pollution can have a significant negative impact on the health and wellbeing of many people.

FIGURE 1 The different values of water

ECONOMIC
- Agriculture industry
- Income creation
- Ability to produce goods

SPiritual
- Religious beliefs
- Spiritual beliefs
- Ceremonies

CULTURAL/AESTHETIC
- Traditional practices
- Admiring nature’s beauty
- Inspiring creativity and art

SOCIAL
- Lifestyle
- Recreational activities

aquifer a body of permeable rock below the Earth’s surface which contains water, known as groundwater. Water can move along an aquifer.

FIGURE 2 (a) and (b) The Citarum River, Bandung, Indonesia, is one of the most polluted rivers in the world, but local people still rely on it for fishing.
13.4.2 Measuring water quality

Investigating the physical properties of a river or creek at various points along its length is one way to measure water quality and any evidence of human impact. Does the quality of the water change between upstream and downstream sites? Are there human factors that can account for these changes? Differences may be more obvious if the waterway passes through a built-up area or a farm.

Temperature

Aquatic plants and animals have a particular temperature range in which they can survive. High water temperatures can result in reduced oxygen available for plants and animals. Comparing temperature readings with biodiversity counts provides data to help investigate this relationship.

pH

A pH value is used to measure the acidity or alkalinity of water on a scale of 1 to 10. Drinking water should have a pH reading of around 6. A reading either side of this may indicate that water is polluted. You can test pH by taking a sample of water from different parts of a waterway and using pH paper or chemical reagents.

Turbidity

Water that lets little sunlight through is said to be turbid. Turbidity is the amount of suspended sediment in water — sediments such as clay, silt, industrial waste or sewage. A Secchi disc (see FIGURE 3) is used to measure turbidity.

Salinity

Salinity measures the amount of salt in the water. It is measured with an electrical conductivity meter, or EC meter.

FIGURE 3 A Secchi disc is used to measure turbidity.

FOCUS ON FIELDWORK

Investigating waterways

Some schools are located close to a waterway, even if it is a highly modified one like a concrete drain. Do you know what the water in that source is like? There are many simple tests that you can conduct on water to measure how clean it is.

Learn how to measure the quality of the water in a waterway near you with the Physical properties of water fieldwork activity in your Resources tab.

Resources

- **eWorkbook**  The value of clean water (ewbk-9402)
- **Video eLesson**  The value of clean water — Key concepts (eles-5108)
- **Interactivity**  The value of clean water — Interactivities (int-8535)
- **Fieldwork**  Physical properties of water (fdw-0018)
13.4 ACTIVITIES

1. As a class, discuss whether people always see natural, clean water sources as being more valuable and beautiful than waterways that have been changed by people.
   a. Are there examples of waterways that are not clean or natural that people still appreciate as beautiful?
   b. Investigate the importance of the Ganges River to the Hindu religion, and pilgrimages involving ceremonial bathing in the river. Does the cleanliness of water affect its spiritual value? How might people who see the river as sacred feel when they see it being polluted?

2. Work in groups or pairs to investigate one of the polluted rivers mentioned in the text. Show where it is located on a map. What does it look like? What has caused the pollution? Is anything being done to improve conditions? What strategies would you suggest for improving the water quality?

13.4 EXERCISE

Check your understanding

1. List three common pollutants found in waterways.
2. What is an aquifer?
3. What is the purpose of a Secchi disc?
4. Describe one way in which a river might become polluted.
5. Demonstrate why the value of water is subjective, using three examples.
6. Outline what each of the following measures can reveal about the quality of water:
   a. temperature
   b. pH
   c. turbidity
   d. salinity.

Apply your understanding

7. Explain why someone living on a farm during a drought might value water differently to someone living in Sydney or another major city in Australia.
8. Do you value water? Support your answer with at least two reasons.
9. Explain why pollutants released onto the ground can find their way into aquifers.
10. If you wanted to test a water source to see if it is polluted, what tools would you use and what would you use them for?
11. Examine the image of the Citarum River in Indonesia (FIGURE 2). Compare this with a river you have visited in Australia.
12. Should governments enforce laws to prevent pollutants from entering waterways? Provide three reasons to justify your answer.

Challenge your understanding

13. Based on your own water use, do you think your habits reflect the importance of water in the world?
14. If water quality in a river decreases to the point at which it is dangerous for people to come into contact with it, is that waterway still valuable?
15. Predict whether the way people in your community value water will change in the next 50 years, providing at least two reasons for your opinion.

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au.
13.5 SkillBuilder: Annotating a photograph

LEARNING INTENTION
By the end of this subtopic, you will be able to identify and annotate important geographical information in a photograph.

13.5.1 Tell me
Why annotate photographs?
Photographs are used to show aspects of a place, but often people will notice different elements in the same photograph depending on their interest and knowledge. Annotations are added to photographs to draw the reader’s attention to what can be seen and concluded from the details.

13.5.2 Show me
How to annotate a photograph

Step 1
Examine the photograph carefully for key information — use SPICESS to remind you what might be important.

Step 2
Identify the source, place and date of the photograph. The photograph in FIGURE 1 is tagged 17 March 2012. The author is Mattinbgn, and the location is Campaspe River near Axedale. Provide the source underneath as this enables the reader to understand its author and the time of year.

Step 3
Add labels to the image, focusing on the key aspects you wish the viewer to notice. This might include natural or human features. It is often much easier to add labels if you took the photograph and made field notes while you were there. For example, you could have determined if the river was flowing and in which direction. Labels can be placed outside the photograph with fine lines connecting them to the feature.

13.5.3 Let me do it
Go to learnON to access the following additional resources to help you build this skill:
- a longer explanation of this skill and its application in Geography (Tell me)
- a video showing the step-by-step process of this skill (Show me)
- an activity and interactivity for you to practise this skill (Let me do it)
- self-marking questions to help you understand and use this skill.

Resources
- eWorkbook: SkillBuilder: Annotating a photograph (ewbk-9406)
- Video eLesson: SkillBuilder: Annotating a photograph (eles-1633)
- Interactivity: SkillBuilder: Annotating a photograph (int-3129)
13.6 The economic value of water

LEARNING INTENTION
By the end of this subtopic, you will be able to explain why water has economic value, and demonstrate its value with examples from the rice farming and aquaculture industries in Asia.

13.6.1 Economic value

The economic value of water must include all the different ways that we use water to produce a good or service. This includes drinking water, water used for irrigation, water used for industry and in recreation, and power generation. It can also relate to the importance of water as a breeding ground and nursery for fish stocks. In Australia and many other countries, the basic economic value of water is recognised in the charges we pay to access piped water. Water plays a significant role in the production of food through the agricultural industry. It can contribute to domestic food security and the reduction of poverty.

13.6.2 Rice farming in Asia

In Asia, rice forms the staple food for the majority of the population. The world’s top five rice producers in 2018–2019 were all found in Asia — China, India, Indonesia, Bangladesh and Vietnam. Rice cultivation is best suited to areas with a tropical climate, with warm temperatures and high amounts of rainfall. Rice production requires a high amount of water availability. Rice is an important form of foreign income in Thailand, India and Vietnam.

13.6.3 Aquaculture in Asia

Aquaculture, also known as aqua farming, involves breeding and harvesting plants and fish in water environments. It can include farms in both salt water and fresh water. The aqua farms are set up in ponds, in cages and on rafts and long lines (for shellfish).

Overfishing, destructive fishing practices and pollution have taken a toll on fish populations in the wild. As wild fish populations have plunged, fish catches by traditional means have declined, and aquaculture is a way of addressing this shortage. Aquaculture contributes to world fish supplies and food security in Asia.

Aquaculture is heavily concentrated in Asia, in areas where there are tropical climates, vast coastlines and large inland water bodies. These features can make many Asian countries suitable for aquaculture industries.
Aquaculture is an important source of foreign income and an important factor in encouraging economic development. Aquaculture can support local communities by generating employment and income, and provides a means to significantly improve standards of living. Traditional aquaculture operations tend to be small-scale and farmer owned and managed, providing autonomy to the owner. Aquaculture can often complement other farming practices such as rice farming, and a rice–fish culture has developed in some regions of China and India. Aquaculture provides opportunities for participation by both the men and women of the community. Much of the daily management and often the sale of the products is carried out by women.

Despite the economic benefits of aquaculture, it has a number of environmental drawbacks. These include natural habitat destruction, release of chemical and organic effluent, and the depletion of wild fish stocks.

**13.6 ACTIVITY**
Research the environmental impacts of aquaculture such as natural habitat destruction, release of chemical and organic effluent, and the depletion of wild fish stocks. Share your findings with your class.

**13.6 EXERCISE**

**Learning pathways**

<table>
<thead>
<tr>
<th>LEVEL 1</th>
<th>LEVEL 2</th>
<th>LEVEL 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>2, 3, 4, 10, 14</td>
<td>1, 6, 8, 9, 15</td>
<td>5, 7, 11, 12, 13</td>
</tr>
</tbody>
</table>

**Check your understanding**

1. Define the term *economic resource*.
2. What does it mean for something to have economic value?
3. What is the staple food of many Asian countries?
4. List the top five rice-producing countries in the world.
5. In what kind of climate does rice grow well?
6. Define the term *aquaculture*.
7. What does it mean to ‘overfish’ an area of the ocean?

**Apply your understanding**

8. What aspects of the climate in tropical areas makes it good for rice growing?
9. Do parts of Australia have a suitable climate for aquaculture? Give reasons for your decision.
13.7 The value of water to health

LEARNING INTENTION

By the end of this subtopic, you will be able to explain the value of clean water to human health, and evaluate strategies to improve access to clean water around the world.

13.7.1 The impact of dirty water on health

Water has great value in improving the health and living standards of people around the world.

Nearly 780 million people in the world have no access to clean water, and 2.4 billion people have no safe way of disposing of human waste. Lack of toilets means many people defecate in open spaces or near the same rivers from which they drink. It is estimated that 90 per cent of sewage in poor countries ends up flowing straight into rivers and creeks.

This is an unacceptable situation. Dirty water and lack of proper hygiene kill 3.4 million people around the world every year, most of them children younger than five. People who are sick are often unable to work properly, to look after their families or to attend school, adding to the poverty cycle they may already be in. The diseases that can be passed on to people as a result of contaminated water include diarrhoeal diseases such as cholera, typhoid and dysentery. Malaria, a disease transmitted by mosquitoes that breed in still water, kills about a million people every year.

13.7.2 COVID-19

Access to water, hand washing facilities and hygiene services are vital in reducing the spread of COVID-19 and other viruses. Communities with limited access to water, facilities and services are likely to be disproportionately impacted by these viruses. These includes the homeless, rural communities, people living in informal settlements, migrants and refugees. As well, women, the very young, very old and people with disabilities are often disproportionately impacted by rapidly spreading disease.
13.7.3 Reducing water-borne diseases

People use different methods to treat the water they have collected. They can let it stand and settle, strain it through a cloth, filter it, add bleach or chlorine, or boil it. Some people do not treat their water at all.

When there is barely enough water to drink or to cook with, it is difficult for people to set aside water for washing hands and cleaning clothes. However, hygiene and sanitation are very important for health.

A number of aid groups, such as WaterAid, Water.org, CARE and A Glimmer of Hope, work on projects to improve sanitation and access to clean water. Washing hands, building cheap and effective toilets, and teaching the community about good hygiene all help to reduce disease.

13.7.4 Sustainable Development Goals

In 2015, the United Nations agreed on 17 Sustainable Development Goals to achieve a better and more sustainable world for all. Goal 6 of the Sustainable Development Goals was ‘Ensure access to water and sanitation for all’, and in 2016 the United Nations General Assembly adopted the ‘International Decade for Action – Water for Sustainable Development’ (2018–2028). As FIGURE 2 shows, some improvements have already been made.

![FIGURE 2 People with access to water services, 2000 and 2017](image)


WDI (SH,STA.SMSS.ZS; SH,STA.BASS.ZS).
CASE STUDY

Community-led total sanitation (CLTS), Nigeria

WaterAid went to a village called Olorioko in the state of Ekiti to see if they could improve sanitation. When they arrived, there were very high rates of illness and death due to water-related diseases. The people in the village used the bush near their houses as their toilet.

CLTS leaders developed a relationship with the villagers and taught them how faeces can enter their food and make them sick. Once they understood this, the people wanted to change their practices so this would no longer happen. Action plans were drawn up and eventually the villagers created clean water points, built simple but effective toilets, and were given lessons in sanitation.

The health of the entire village has improved and they are also increasing their wealth. The CLTS project, which started in Bangladesh some years ago, has been a success and is spreading throughout Nigeria.

Use the Health is wealth weblink in your Resources tab to learn about a community-led sanitation project around the world.

13.7 ACTIVITIES

1. Work in groups of three or four. Use the information about the importance of safe water and sanitation to create a video promoting understanding of this issue in your school.
   a. Make particular reference to North and sub-Saharan Africa, and find out what is being done by aid organisations to improve the situation in these regions.
   b. Plan a video presentation that is interesting and catchy and will help people understand the action needed to improve access to clean water and sanitation.

2. In developed countries that generally have good access to clean water and sanitation, are there individual communities that struggle to access clean water? Investigate this question and report back to your class on what you discovered. In your investigation, consider the reasons why clean water scarcity might occur in developed nations (both natural processes such as drought, and human processes such as pollution), and how these might impact on the availability of water in the future.
13.7 EXERCISE

Learning pathways

LEVEL 1
1, 7, 8, 9, 13

LEVEL 2
2, 3, 4, 11, 14

LEVEL 3
5, 6, 10, 12, 15

Check your understanding
1. How many people in the world do not have access to clean water?
2. Where is Nigeria located within Africa?
3. What does CLTS stand for?
4. Identify one way (other than by drinking or cooking with dirty water) that not having access to clean water is dangerous to human health.
5. Outline the differences between safely managed, basic and unimproved sanitation.
6. What percentage of people around the world are estimated to be using sanitation facilities that are not safely managed?
7. What does SDG stand for?

Apply your understanding
8. Explain why so much human waste ends up in rivers in some countries.
9. Why are clean rivers important for human health?
10. Explain why many people living in poverty who fall sick also suffer economically.
11. Explain what a water-borne disease is, and give two examples of this kind of disease.
12. Which do you think is more important for human health: access to water or good sanitation? Or are they both equally important? Explain your view.

Challenge your understanding
13. Predict what might happen to people’s health in North and sub-Saharan Africa if access to water and sanitation is not improved.
14. Suggest one change that could help a community improve their sanitation from limited to basic.
15. Access to clean water is an important tool in fighting viruses such as COVID-19. Africa has far fewer people with access to clean water than North America, but as of January 2021, the average number of new confirmed cases in North America was significantly higher than across Africa. Suggest reasons why this might have been the case.

To answer questions online and to receive immediate feedback and sample responses for every question, go to your learnON title at www.jacplus.com.au.
LEARNING INTENTION
By the end of this subtopic, you will be able to describe some of the ways that Aboriginal Peoples find, use and manage water resources, and outline how Culture and water resource management are interconnected.

13.8.1 The importance of water management
Water is vital for the survival of human beings. Aboriginal Peoples’ knowledge of the land and how to survive in it has been passed from generation to generation through Dreaming Stories. Understanding water sources plays an important role in Culture as well as in daily life and survival.

Evidence from the passing down of Culture through stories, song, dance and art, from physical changes made to the land and artefacts, and from historical records left by early European settlers and explorers shows that Aboriginal Peoples managed their water very carefully. They channelled and filtered water, covering it to keep it clean and to stop it from evaporating. They also created wells and tunnel reservoirs, and managed and cultivated stocks of food sources in lakes, rivers and oceans.
On 30 March 2008, the Victorian government returned the heritage-listed Lake Condah in Victoria to the Gunditjmara traditional owners. Lake Condah is considered one of Australia’s earliest and largest aquaculture ventures. The Gunditjmara Peoples are preserving their culture by engaging in tourism, water restoration and sustainability projects. One example is the plan to restore the ancient stone aquaculture system at the lake for eel farming.

In western New South Wales, the Ngemba Peoples have a similarly sophisticated aquaculture system on the Barwon River at Brewarrina. This is commonly known as the Brewarrina Fish Traps.

The Ngemba Peoples used this system to manage and maintain a source of fresh water and further a plentiful and sustainable supply of food resources. They maintain its cultural and spiritual importance by carefully caring for Country.

13.8.2 Finding water

Aboriginal Peoples sourced water to live on Country through many different methods depending on where they lived, the seasons and the environment. These methods included collecting surface water from creeks, rivers and waterholes; accessing underground water supplies such as soaks and springs; and obtaining it directly from plants, including tree roots.

An understanding of the seasons also helps manage the water resources and provides a key to knowing where water is likely to be found. During the dry seasons and periods of drought, mound springs are incredibly important. These springs are linked by songlines and stories, and are often connected to rain-making rituals.

The rainbow serpent is a key symbol of creation for Aboriginal Peoples, but its journey from underground to the surface also represents groundwater rising to the top via springs. The creation of water sources and where to find them was often told in stories or through artwork. Use the How the water got to the plains weblink in your Resources tab to hear one story that describes how billabongs appeared in the dry inland plains, told by Butchulla Elder Olga Miller.
The importance of the seasons to water management is clear in the Miriwoong seasonal calendar, which maps the changing seasons of Miriwoong Country in northern Western Australia. Use the Miriwoong seasonal calendar weblink in your Resources tab to view this calendar and learn more about the Miriwoong Language and Culture.

### 13.8.3 Groundwater

Particularly in Australia’s desert regions, groundwater was vital for Aboriginal Peoples. There are many groundwater sources throughout Australia. One of these sources is soaks: groundwater that comes to the surface, often near rivers and dry creek beds, and which can be identified by certain types of vegetation. Another source is mound springs: mounds of built-up minerals and sediments brought up by water discharging from an aquifer.

**Mound springs of the Oodnadatta Track**

The Oodnadatta Track is located in the north-east of South Australia. The track follows the edge of the Great Artesian Basin and the south-western edge of Kati Thanda–Lake Eyre and, along its route, groundwater makes its way to the surface in several locations.

The Oodnadatta Track crosses the traditional lands of three Aboriginal Peoples. In the south, between Lake Torrens and Kati Thanda–Lake Eyre, is the Country of the Kuyani Peoples; most of the west of Kati Thanda–Lake Eyre is the Country of the Arabana Peoples; and to the north is the Country of the Arrernte Peoples.

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**FIGURE 4** The Oodnadatta Track and Great Artesian Basin

**FIGURE 5** The Oodnadatta Track passes close to the Old Ghan, the Great Northern Railway

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The Ancestors established the springs as water sources and as sites for important ceremonies and events. Knowledge of these water sources and the cultural practices associated with them have been passed down through the generations. Mound springs were particularly important for Aboriginal Peoples. They could rely upon springs as reliable sources of water in a very harsh, dry environment.

Old campsites provide archaeological evidence that people remained at such places for varying time periods. However, because the plant and animal life around these regions is quite sparse during some seasons, people also moved away from the springs when rainfall was plentiful in other parts of their Country.

As the springs were spread over hundreds of kilometres, they were also part of an important network of trading and communication routes across Australia. As Aboriginal Peoples moved around the region, they traded goods and shared information with other groups. This interconnection between Peoples allowed for a valuable trade in resources such as ochre, stone and wooden tools, bailer shells, and pituri (a spindly shrub used during ceremonies and to spike waterholes to catch animals for food).

Some of this knowledge of Country was passed on to Europeans as they explored the area. John McDouall Stuart, the first European to cross Australia’s interior from south to north, followed parts of the Oodnadatta Track in 1862. The overland telegraph was also constructed along its pathway as was the Great Northern Railway, which made the land of the Northern Territory accessible for expanding European colonisation.

**FIGURE 6 A cross-section of a typical mound spring**

CASE STUDIES

Dreaming Stories that discuss the creation and location of water

1. **Thutirla Pula (Two Boys Dreaming)**

   This is one of the most important stories of the Wangkangurru and other peoples of Central Australia. Thutirla Pula is how the spirits of the Dreaming first crossed the desert called Munga-Thirri (land of sandhills). One of the most important songlines is the story of the Two Boys Dreaming.

   The story tells of two boys crossing the Simpson Desert, through Queensland and back to just north of Witjira (Dalhousie) in the Finke River area. The songline contains information on every waterhole or soak that was known in the Simpson Desert. Following this songline meant you could cross the Simpson Desert using available groundwater along the way, taking 600 kilometres off the usual journey south of the Simpson Desert to Kati Thanda–Lake Eyre, then back north along the Diamantina River.
2. **Bidalinha (or the Bubbler)**

The Kuyani ancestor Kakakutanha followed the trail of the rainbow serpent Kanmari to Bidalinha (the Bubbler) where he killed it. He then threw away the snake’s head, which is represented by Hamilton Hill, and cooked the body in a *dirga* (oven), which is now Blanche Cup.

Kakakutanha’s wife, angry at missing out on the best meat from the snake, cursed her husband, and he went on to meet a gruesome death at Kudna-ngampa (Curdimurka). The bubbling water represents the movements of the dying serpent.

### FIGURE 7 Groundwater springs along the Oodnadatta Track

Source: Spatial Vision

3. **Thinti-Thintinha Spring (Fred Springs)**

The *thunti-thuntinha* (willy wagtail) danced his circular dance to create this spring and the surrounding soils, which are easily airborne in windy conditions. The moral to the story is that, while it is easy to catch the skilful *thunti-thuntinha*, you must never do so because of the terrible dust storms that may follow.

4. **Camp of the Mankarra-kari (Kewson Hill: The Seven Sisters)**

The Seven Sisters came down here to dig for *yalkapakanha* (bush onions). As they peeled the onions, they tossed the skins to one side, creating the dark-coloured extinct mound spring on the south-west side of the track. The peeled bulbs created the light-coloured *yalka-parlumarna* hill to the north-east, which is also an extinct mound spring.

### FIGURE 8 The Old Bubbler on the Oodnadatta Track, where the Dreamtime serpent died
13.8 ACTIVITIES

1. Use Google Earth and enter the search terms Oodnadatta or William Creek to locate the Oodnadatta Track. Describe the landscape you see. Why is finding groundwater so important in this environment?

2. Use an atlas or Google Earth to map the Two Boys Dreaming story from the case study and describe how following the story would have saved a lot of time travelling across the desert.

3. Look at the Mirriwoong seasonal calendar in your Resources tab to answer the following questions.
   a. Which Australian region does this calendar represent?
   b. How are the seasons divided? How does this compare with a European calendar?
   c. How are seasons and water linked in this calendar?

4. Use Google Earth to locate the Wabma Kadarbu Mound Springs Conservation Park. Place a pin on this location. Now zoom in and out to help you complete the following tasks.
   a. Where is this park located within South Australia? Where is this place in relation to where you live? Use distance and direction in your answer.
   b. What is the name of the nearest road?
   c. Describe the surrounding area.
   d. Why would these springs be so important to Aboriginal Peoples and European explorers?
   e. Do some research to find out why these springs are protected today.
   f. Use Google Maps to annotate this area with your findings. Include photos that you find using the internet.

13.8 EXERCISE

Learning pathways

LEVEL 1
1, 3, 7, 10, 14

LEVEL 2
2, 4, 8, 11, 13

LEVEL 3
5, 6, 9, 12, 15

Check your understanding

1. Define the following terms in your own words:
   a. soak
   b. mound spring
   c. groundwater
   d. waterhole.

2. Outline one reason why songlines and Dreaming stories helped Aboriginal Peoples survive in Australia's desert environments.

3. Describe one way that Aboriginal Peoples managed water sources to ensure their food sources were protected.

4. What does evidence show about traditional Aboriginal Peoples managing water supplies?

5. Outline why Dreaming Stories were important to Aboriginal Peoples living on Country in the Oodnadatta region.

6. Explain why water sources were important to the interconnection between Aboriginal Peoples.
The cultural and spiritual value of water

LEARNING INTENTION

By the end of this subtopic, you will be able to outline why water has cultural value for many First Nations peoples, and provide specific examples of its cultural value for Aboriginal Peoples in Australia.

13.9.1 Water in culture and religion

Water features in the cultures of most peoples around the world. Many famous artworks include water; for example, the famous woodblock print by Japanese artist Katsushika Hokusai shown in FIGURE 1. Water also plays an important role in religious traditions around the world. Water is used in practices such as ritual washing or cleansing, and many religious traditions include a belief in water gods or deities, or include stories about floods.

13.9.2 First Nations peoples’ connections to water

For many First Nations peoples, water has a strong spiritual importance that connects their cultures to the natural world. Water is central to both maintaining life and the cultural practices of many peoples around the world. Water is integral to some sacred landscapes in Aboriginal cultures and for the peoples of the Torres Strait Islands, giving these places significant spiritual value.

The Indigenous Peoples’ Water Declaration demonstrates this cultural importance of water. The declaration came from a meeting in 2008 in north-east Arnhem Land, Northern Territory, where First Nations peoples from around the world met to discuss water management issues in their communities.
13.9.3 The cultural value of water for Aboriginal Peoples

Water has significant cultural value for Australian Aboriginal Peoples in both historical and contemporary contexts. Waterways including rivers, oceans, lakes, lagoons, waterholes and underground water sources are directly linked to Dreaming stories and Creation stories. Explanations of how the world and its landscapes came to be are derived from these stories which are locational and may vary depending on the area.

Water as a common factor of identity usually relates to either of the two distinct water areas: Freshwater Peoples and Saltwater Peoples. Depending on geographical location, cultural practices that incorporate water may vary. For example, Saltwater Peoples will have specific stories and practices that relate to marine life in the ocean, such as whales and sharks. Ceremony, dance, art, hunting practices and totem systems will vary when caring for water sources.

Water has enabled Aboriginal Peoples to sustain societies in one of the driest countries on Earth. Knowledge embedded in Country and maintained through songlines that interconnect the Freshwater Peoples and Saltwater Peoples have also ensured cultural interconnection through water.

Water in art

It is highly common, particularly for Desert Peoples, to represent water in paintings of Dreaming stories. This is possibly due to water being scarce in their areas and is a vital way to ensure that knowledge and lore for particular stories are protected, cared for and maintained. The representations of water differ due to different symbols and art styles used across Australia.

13.9.4 Ongoing connections to water

Water continues to be of spiritual and cultural importance for the many Aboriginal Peoples and Torres Strait Islander Peoples across Australia. Due to water being a core aspect of Country (and intrinsically linked to heritage, identity and a sense of belonging) contemporary Aboriginal Peoples and Torres Strait Islander Peoples are still connected with the significant waters within their Country. These connections also help to ensure that ancient beliefs and stories are maintained.
CASE STUDY

Gamay Botany Bay Rangers

In New South Wales, an Aboriginal organisation called the Gamay Botany Bay Rangers is providing care for the waterways of Botany Bay and its surrounding areas. Using Aboriginal cultural knowledge and understanding they are ensuring conservation of Country. In particular, Botany Bay is protected and cared for through educational and cultural strategies.

Key to the delivery of their programs and initiatives is that Aboriginal Peoples are at the forefront, leading and providing awareness for everyone who accesses Botany Bay and its surrounding areas.

13.9 ACTIVITIES

1. Research a community in Asia and explain the cultural and spiritual significance of water for that community.
2. Using the case study and the Gamay Botany Bay Rangers and Caring for Country weblinks, assess the ways in which the Gamay Botany Bay Rangers care for water. As a class, list the reasons why it is important for Aboriginal Peoples to be involved in the conservation and management of their local water resources.
3. Use the Water Dreaming weblink in your Resources tab to hear an interview with artist Malcolm Maloney Jagamara about water imagery in his art. Research and locate one Aboriginal artwork that tells the story of water and write a short paragraph explaining its meaning and symbolism.
4. Identify any waterways in your local area and region.
   a. Construct a map of these identified waterways.
   b. Research your local area and identify the traditional owners of the land in your area. Identify their significant waters and how they are protected and cared for.
13.9 EXERCISE

Learning pathways

LEVEL 1
1, 4, 9, 10, 15

LEVEL 2
2, 3, 7, 8, 13

LEVEL 3
5, 6, 11, 12, 14

Check your understanding
1. List three reasons why water is important for Aboriginal Peoples.
2. How is water linked to Aboriginal Culture?
3. Describe the connection between water and landscapes.
4. Name the two distinct water areas that Aboriginal Peoples identify with.
5. Identify similarities that First Nations peoples from different places may have in relation to water sources.
6. Describe what it means for a place to have spiritual significance.

Apply your understanding
7. Explain the relationship between water and Dreaming stories.
8. How does the work of groups such as Gamay Botany Bay Rangers benefit all Australians’ access to water?
9. Explain and give two examples of the cultural value of waterways for Aboriginal Peoples.
10. Provide two reasons why cultural practices related to water will vary depending on location.
11. Explain how Aboriginal law is connected with water.
12. How is Aboriginal art used to tell the story of water?

Challenge your understanding
13. Propose a strategy that includes Aboriginal Peoples and peoples not from an Aboriginal background working together to conserve and protect their water sources.
15. Suggest one way that you could learn more about the cultural and spiritual importance of water to the Aboriginal Peoples of your area.

To answer questions online and to receive immediate feedback and sample responses for every question, go to your learnON title at www.jacplus.com.au.
13.10 The aesthetic and social value of water

LEARNING INTENTION

By the end of this subtopic, you will be able to explain some of the ways in which water has aesthetic and social value.

13.10.1 Aesthetic value

Water can have an aesthetic value. Aesthetics is about the nature and appreciation of beauty, and can be used to describe the way people respond to the environment. It includes the way people interact with a place through their senses and the emotions they experience.

Water contributes to the visual quality of an environment. Houses and units near rivers, lakes and the ocean tend to be much more expensive than properties some distance from the water. In part, this takes into consideration the aesthetic value of a water view. People enjoy being able to watch the waves breaking, or to watch sailboats on a lake from their homes.

Together with vegetation, water is one of the most important features of an environment in providing emotional and psychological benefits to people. Water is required for basic human survival, and environments that contain a large amount of water make people feel safe and nurtured. Being close to water and appreciating its beauty can help people feel relaxed and calm.

FIGURE 1 Water can help people feel calm and relaxed.

<table>
<thead>
<tr>
<th>Water with high aesthetic value</th>
<th>Water with low aesthetic value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pristine</td>
<td>Polluted</td>
</tr>
<tr>
<td>Little odour</td>
<td>Smelly</td>
</tr>
<tr>
<td>Clear</td>
<td>Murky</td>
</tr>
<tr>
<td>Blue or slightly green colour</td>
<td>Dark green to brown colour</td>
</tr>
<tr>
<td>Free from floating debris,</td>
<td>Floating debris, scum and oil</td>
</tr>
<tr>
<td>scum and oil</td>
<td></td>
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</tbody>
</table>

aesthetics (aesthetic qualities) the beautiful or attractive features of something

psychological benefits positive effects on emotional or mental wellbeing
CASE STUDY

The aesthetic value of the Great Barrier Reef

When people visit the Great Barrier Reef they feel a sense of beauty, naturalness and remoteness. The amazing contrasting colours of the water, from deep, dark blues to iridescent aqua, contribute to the natural beauty of the reef. The bright white sand, the green islands and the unusual shapes of the reefs and cays create beautiful mosaic patterns in the water.

FIGURE 3 The beauty of living creatures, and vegetation above and below the waters surrounding Fitzroy Island, on the Great Barrier Reef in Queensland.
13.10.2 Social value

Water has a social value as it helps people undertake activities that maintain a healthy lifestyle. People are able to undertake many activities such as swimming, kayaking, sailing, and a range of other water sports and social interactions.

FOCUS ON FIELDWORK

Perceptions of water’s value

There are many factors that contribute to the way we value water. Conducting your own survey of a local waterway, or examining images or footage of waterways, can help you collect qualitative data about the value of a waterway from your perspective.

Qualitative data is subjective (based on opinion). This means that it cannot easily be calculated or measured, but there are ways to record your views and attitudes to a place. For example, you might create a rating system or use descriptions based on your senses (what you saw, heard, smelled, felt and, perhaps, tasted during your visit).

Examine your own perceptions of a waterway using the Perceptions of water’s value fieldwork activity in your Resources tab.

Resources

- eWorkbook: The aesthetic and social value of water (ewb-k-9426)
- Video eLesson: The aesthetic and social value of water — Key concepts (eles-5113)
- Interactivity: The aesthetic and social value of water — Interactivities (int-8540)
- Fieldwork: Perceptions of water’s value (fdw-0019)

13.10 ACTIVITY

As a class or in small groups, brainstorm the kinds of water environments you have visited.
- What makes them beautiful?
- Are they also useful to humans or used by us in other ways?
- Are they protected because of their beauty? Or are there other reasons?
### 13.10 EXERCISE

#### Learning pathways

<table>
<thead>
<tr>
<th>LEVEL 1</th>
<th>LEVEL 2</th>
<th>LEVEL 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>2, 3, 8, 9, 14</td>
<td>1, 5, 6, 11, 13</td>
<td>4, 7, 10, 12, 15</td>
</tr>
</tbody>
</table>

#### Check your understanding

1. In your own words, define the term **aesthetics**.
2. List three features of a beach that has high aesthetic value.
3. List three features of a river that gives it social value.
4. Give one example of how water adds to the aesthetics of an inland environment.
5. Environments with lots of water generally make people feel ________________.
6. Identify two psychological benefits of being near or watching the ocean.
7. Apart from water, what other natural feature provides important emotional and psychological benefits to people?

#### Apply your understanding

8. Would you expect a home in a coastal town to be more expensive than the same kind of home in a remote inland town of the same size with the same facilities? Give reasons for your decision.
9. Explain why it would be important to have clean water in an area where there are swimming activities.
10. Discuss the following statement: Water has many psychological and aesthetic benefits but does not have any social value.
11. Coral bleaching is a process from which coral loses its beautiful colours. How would this change the aesthetic value of the Great Barrier Reef?
12. Explain the social value of water. Use one specific example to demonstrate your explanation.

#### Challenge your understanding

13. Suggest whether people might still want to visit Fitzroy Island for its aesthetic value if it wasn’t close to the Great Barrier Reef.
14. Rubbish on beaches decreases the area’s aesthetic value, and yet some people still leave rubbish on beaches. Propose one strategy to stop people littering beaches.
15. Should places be protected if they are considered beautiful? Suggest why deciding which places should be protected solely for their beauty might be complicated.

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au.
13.11 Virtual water

LEARNING INTENTION
By the end of this subtopic, you will be able to define the term virtual water and explain the value of water to food production.

13.11.1 Virtual water

The water we consume is not just what we use in cooking, drinking, washing, flushing or in the garden. Water is used to manufacture everything we use, including mobile phones, toys, cars and newspapers. This virtual water needs to be accounted for in our water footprint.

Virtual water is also known as embedded water, embodied water or hidden water. It includes all the water used to produce goods and services. Food production uses more water than any other type of production.

Hidden in a cup of coffee are 140 litres of water used to grow, produce, package and ship the coffee beans. That is roughly the same amount of water used by an average person per day in Australia for drinking and household needs. There is a lot of water hidden in a hamburger too: 2400 litres. This includes the water needed to grow the feed for the cattle over a number of years, to grow wheat for the bread roll, to grow all the other ingredients in the hamburger, and to process all the food.

Virtual water varies from food to food. For example, it takes about 3400 litres of water to grow 1 kilogram of rice, whereas it takes 200 litres to grow 1 kilogram of cabbage. Regions that are water stressed and that export food and other products (such as Australia and some countries in Africa and Asia) are effectively exporting their precious water in these goods.

A country that imports rice, rather than growing it locally, therefore saves 3400 litres of water for every kilogram it imports. Some countries (such as Japan) have very little land on which to grow food; other countries have very few cubic metres of renewable water per person. Singapore, for example, has only about 130 cubic metres per person. Both types of countries survive by virtual water imports: they import food rather than attempt to grow and produce all their food themselves. This means that small, wealthy countries can import food that needs a lot of water to produce, and export products that need little water to produce. This makes water available for domestic purposes such as drinking and cooking.

The major exporters of virtual water are found in North and South America (the United States, Canada, Brazil and Argentina), South Asia (India, Pakistan, Indonesia, Thailand) and Australia. The major virtual water importers are North Africa and the Middle East, Mexico, Europe, Japan and South Korea.

FIGURE 1 Virtual water is the water used to produce our goods and services, such as the water used to irrigate food crops.
13.11.2 Water footprint

The water footprint of an individual or country is the total volume of fresh water that is used to produce the goods and services consumed by the individual or country. It includes the use of:

- blue water (rivers, lakes, aquifers)
- green water (rainfall used for crop growth)
- grey water (water polluted after agricultural, industrial and household use).

Not all goods consumed in one particular country are produced in that country — some foods and products are imported. Therefore the water footprint consists of two parts: use of domestic water resources and use of water outside the borders of the country.

In the United States, the average water footprint per person per year is 2480 cubic metres, which is enough to fill an Olympic-size swimming pool. In China, the average water footprint per person is 1071 cubic metres per year. The figure for Australia is 1393 cubic metres per person per year. Japan, with a footprint of 1200 cubic metres per person per year, has about 65 per cent of its total water footprint outside its borders, meaning a lot of its water is imported in the form of consumer goods and food. On the other hand, only about 7 per cent of the Chinese water footprint falls outside China.

The Middle East and Northern Africa rely heavily on imports for agricultural products. This means that many items, such as food, are bought from other countries. As a result the region also imports large amounts of virtual water.

![Average water footprints](image_url)

**Source:** World Water Exchange (2016)
<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
<th>Global average water (litres)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apple or pear</td>
<td>1 kg</td>
<td>700</td>
</tr>
<tr>
<td>Barley</td>
<td>1 kg</td>
<td>1300</td>
</tr>
<tr>
<td>Banana</td>
<td>1 kg</td>
<td>860</td>
</tr>
<tr>
<td>Beef</td>
<td>1 kg</td>
<td>15500</td>
</tr>
<tr>
<td>Beer (from barley)</td>
<td>250 mL</td>
<td>75</td>
</tr>
<tr>
<td>Bread (from wheat)</td>
<td>1 kg</td>
<td>1300</td>
</tr>
<tr>
<td>Cabbage</td>
<td>1 kg</td>
<td>200</td>
</tr>
<tr>
<td>Cheese</td>
<td>1 kg</td>
<td>5000</td>
</tr>
<tr>
<td>Chicken</td>
<td>1 kg</td>
<td>3900</td>
</tr>
<tr>
<td>Chocolate</td>
<td>1 kg</td>
<td>24000</td>
</tr>
<tr>
<td>Coconut</td>
<td>1 kg</td>
<td>2500</td>
</tr>
<tr>
<td>Coffee (roasted)</td>
<td>1 kg</td>
<td>21000</td>
</tr>
<tr>
<td>Cotton shirt</td>
<td>1</td>
<td>2700</td>
</tr>
<tr>
<td>Cucumber or pumpkin</td>
<td>1 kg</td>
<td>240</td>
</tr>
<tr>
<td>Dates</td>
<td>1 kg</td>
<td>3000</td>
</tr>
<tr>
<td>Eggs</td>
<td>1</td>
<td>200</td>
</tr>
<tr>
<td>Goat meat</td>
<td>1 kg</td>
<td>4000</td>
</tr>
<tr>
<td>Hamburger</td>
<td>1</td>
<td>2400</td>
</tr>
<tr>
<td>Lamb</td>
<td>1 kg</td>
<td>6100</td>
</tr>
<tr>
<td>Leather</td>
<td>1 kg</td>
<td>16600</td>
</tr>
<tr>
<td>Lettuce</td>
<td>1 kg</td>
<td>130</td>
</tr>
<tr>
<td>Maize</td>
<td>1 kg</td>
<td>900</td>
</tr>
<tr>
<td>Mango</td>
<td>1 kg</td>
<td>1600</td>
</tr>
<tr>
<td>Millet</td>
<td>1 kg</td>
<td>5000</td>
</tr>
<tr>
<td>Milk</td>
<td>250 mL</td>
<td>250</td>
</tr>
<tr>
<td>Olives</td>
<td>1 kg</td>
<td>4400</td>
</tr>
<tr>
<td>Orange</td>
<td>1</td>
<td>50</td>
</tr>
<tr>
<td>Paper</td>
<td>A4 sheet</td>
<td>10</td>
</tr>
<tr>
<td>Peach or nectarine</td>
<td>1 kg</td>
<td>1200</td>
</tr>
<tr>
<td>Peanuts (in shell)</td>
<td>1 kg</td>
<td>3100</td>
</tr>
<tr>
<td>Pork</td>
<td>1 kg</td>
<td>4800</td>
</tr>
<tr>
<td>Potato</td>
<td>1 kg</td>
<td>4800</td>
</tr>
<tr>
<td>Rice</td>
<td>1 kg</td>
<td>3400</td>
</tr>
<tr>
<td>Soya beans</td>
<td>1 kg</td>
<td>1800</td>
</tr>
<tr>
<td>Sugar (sugar cane)</td>
<td>1 kg</td>
<td>1500</td>
</tr>
<tr>
<td>Tea</td>
<td>250 mL</td>
<td>30</td>
</tr>
<tr>
<td>Tomato</td>
<td>1 kg</td>
<td>180</td>
</tr>
<tr>
<td>Wheat</td>
<td>1 kg</td>
<td>1300</td>
</tr>
<tr>
<td>Wine</td>
<td>125 mL</td>
<td>120</td>
</tr>
</tbody>
</table>

Source: John Wiley & Sons Australia
13.11 ACTIVITY

1. Study TABLE 1. Choose three meat, five grain, two dairy, two non-food, four fruit, four vegetable and two processed products from the list. Create a bar graph to show how much water is used to produce a vegetarian diet and a meat-based diet. Which diet uses more water?
2. Use the Just add water weblink in the Resources tab to listen to an audio program about the water footprint in food production.
   a. What makes them beautiful?
   b. Are they also useful to humans or used by us in other ways?
   c. Are they protected because of their beauty? Or are there other reasons?
3. Conduct a debate on the following statement: That people should eat less meat in order to consume less water.

13.11 EXERCISE

Learning pathways

<table>
<thead>
<tr>
<th>LEVEL 1</th>
<th>LEVEL 2</th>
<th>LEVEL 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>2, 3, 5, 9, 14</td>
<td>1, 7, 8, 10, 13</td>
<td>4, 6, 11, 12, 15</td>
</tr>
</tbody>
</table>

Check your understanding

1. Define the terms virtual water and water footprint in your own words.
2. Refer to FIGURE 2. Describe the patterns you notice between countries with (i) very high and high water footprints and (ii) very low and low water footprints.
3. Describe the difference between virtual water and a water footprint.
4. Describe how the scale of footprints is different for countries with (i) very high and high water footprints and (ii) very low and low water footprints.
5. Outline the differences between blue, green and grey water.
6. Approximately how many litres of water is used to make:
   a. a hamburger
   b. a cup of tea
   c. a sheet of A4 paper
   d. an egg?
7. Write three summary statements that describe the water footprints of two regions.

Apply your understanding

8. Explain the difference between virtual water and a water footprint.
9. Explain how water is embedded (or hidden) in a cup of coffee.
10. Create a bar graph to show how much water is used to produce a vegetarian diet and a meat-based diet.
11. How do water footprints connect places that are far from each other?
12. ‘In a dry country such as Australia, it makes more sense to import food and resources that require a lot of water to produce.’ Drawing on your understanding of virtual water, provide an argument for and an argument against this viewpoint. Ensure that your arguments are supported with evidence and are logical.

Challenge your understanding

13. Should people eat less meat in order to consume less water? Give reasons, based on data, for your opinion.
14. Predict whether the proportion of Australia’s water footprint outside its borders will increase or decrease in the future. Give reasons for your view.
15. Propose one way that more grey water could be used to reduce Australia’s green and blue water footprints.

To answer questions online and to receive immediate feedback and sample responses for every question, go to your learnON title at www.jacplus.com.au.
13.12 Investigating topographic maps: The value of water in Noosa

LEARNING INTENTION

By the end of this subtopic, you will be able to describe perceptions of the social, cultural and economic value of water at Noosa.

13.12.1 Noosa’s beaches and river

Noosa is about 140 kilometres north of Brisbane, Queensland, between the mouth of the Noosa River and the headland of Noosa National Park. Noosa demonstrates how water can have value in different ways.

Noosa is a popular tourist destination and, as such, the water at nearby beaches and in local rivers and lakes contributes economic value to the area. Hotels with water views will charge tourists higher prices than those without water views. Similarly, Noosa’s water has an aesthetic value — it is visually appealing and is part of the attraction of Noosa. People enjoy looking out to the ocean or over the river. The aesthetic and social value of water helps visitors relax and unwind, and the many water-based activities in Noosa such as cruises, canoeing and kite-surfing contribute to the culture of place.

FIGURE 1 Visitors enjoy the spectacular views from Noosa National Park.

FIGURE 2 An oblique aerial photograph of Noosa

FIGURE 3 Many activities for holiday makers at Noosa are water-based.
Source: Data based on QSpatial, State of Queensland (Department of Natural Resources, Mines and Energy, Department of Environment and Science), http://qldspatial.information.qld.gov.au/catalogue/
13.12 EXERCISE

Learning pathways

- **LEVEL 1**
  1, 2, 8

- **LEVEL 2**
  3, 4, 5, 7

- **LEVEL 3**
  6, 9, 10

Check your understanding

Examine **FIGURE 4**.

1. State the scale of the map in one sentence.
2. State the contour interval of the map.
3. State the feature at the following area references:
   a. AR0376
   b. AR0470
   c. AR0583.
4. State the distance from the breakwater at AR0781 to the causeway at AR0380.
5. State the altitude of:
   a. the spot height at AR1081
   b. the sewage treatment works at AR0878
   c. the caravan park at AR0780.
6. List different ways in which people use the water around Noosa. What evidence is there on the map for these uses?

Apply your understanding

7. Explain why you think the settlements around Noosa have developed in their current locations. Support your answer with observations from **FIGURE 4**.
8. Explain why the settlements located in AR1079 and AR0880 are separated.
9. Throughout this chapter we have examined the economic, aesthetic, cultural and spiritual value of water. How do you think the settlement patterns around Noosa have been influenced by:
   a. the economic value of water
   b. the aesthetic value of water
   c. the cultural and spiritual value of water?

Challenge your understanding

10. Predict how increased tourism and development around Noosa may have an impact on the value of water in the region in the future. In your answer, refer to the economic, aesthetic and cultural/spiritual value of water.

To answer questions online and to receive immediate feedback and sample responses for every question, go to your learnON title at www.jacplus.com.au.
13.13 Thinking Big research project: The Great Artesian Basin

Scenario

It’s the year 2100, and Australia is relying more and more on groundwater for its water supply. The federal government wants to supply Victoria and Western Australia with groundwater from the Great Artesian Basin (GAB), but the Queensland, New South Wales, South Australian and Northern Territory governments are against this proposal as they think the water will be depleted if it is not used sustainably.

FIGURE 1 Your task is to research groundwater use in the Great Artesian Basin.

Task

Your team of engineers has been commissioned by the Queensland, New South Wales, South Australian and Northern Territory governments to present a poster display to the federal Minister for Water. You need to convince her that using the GAB to supply water to distant states is not a solution to the water crisis.

Go to your Resources tab to access the resources you need to complete this research project.

Resources

ProjectsPLUS Thinking Big research project: The Great Artesian Basin (pro-0233)
13.14 Review

13.14.1 Key knowledge summary

13.2 Water use
- The global average water use is 1240 cubic metres per person per year.
- Most of the world’s water is used for agriculture to grow food for the world’s population.
- Around 70 per cent of Australia’s fresh water is used as irrigation for farming.
- Rainfall in Australia is limited and highly seasonal in some areas.

13.4 The value of clean water
- Water has economic, cultural, spiritual and social value.
- The use of water in agriculture, income creation and to produce goods means that water has economic value.
- Water can have a spiritual value because it can be used in religious and spiritual beliefs and ceremonies.
- Water can have cultural and social value because it is used in recreational activities, traditional practices and lifestyle choices.

13.6 The economic value of water
- Water is used in a variety of ways to produce goods and services, including drinking water, irrigation, industry, recreation and power generation.
- The world’s top five rice producers are found in Asia. Rice requires a high amount of water availability.
- Aquaculture involves breeding and harvesting plants and fish in water environments such as ponds, cages, rafts or long lines. It can support local communities, improve standards of living and generate employment and income.

13.7 The value of water to health
- Nearly 780 million people in the world have no access to clean water and 2.4 billion people have no safe way of disposing of human waste.
- Dirty water and lack of hygiene kill 3.4 million people around the world every year.

13.8 The value of water for Aboriginal Peoples
- Before European colonisation, Aboriginal Peoples managed Australia’s water resources very carefully because of its importance to maintaining life (through food and drink) and Culture.
- Knowledge of where to find water is passed down from generation to generation; for example, through Dreaming stories.
- Groundwater and mound springs are very important water sources in dry environments.

13.9 The cultural and spiritual value of water
- Water is very important to the cultures of many First Nations peoples around the world.
- Aboriginal Peoples’ sense of identity and belonging is tied to their connection to the water of their Country.
- Symbols of water used in Aboriginal Cultures’ art differ between different Peoples.
- Water still connects Aboriginal Peoples to their Country today, and so local Aboriginal Peoples are often asked to help conserve special places using Cultural knowledge.
13.10 The aesthetic and social value of water

- Water contributes to the visual quality of the environment, and improves the value of property and people’s enjoyment.
- Water provides emotional and psychological benefits to people.
- Water has a social value as it helps people undertake activities to maintain a healthy lifestyle and social interactions.

13.11 Virtual water

- Virtual water is embedded water and includes all the water used to produce goods and services.
- Food production uses more water than any other type of production.
- The water footprint of a country is the total volume of fresh water that is used to produce the goods and services consumed by that country and includes blue water and green water.

13.14.2 Key terms

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>aesthetics</td>
<td>(aesthetic qualities) the beautiful or attractive features of something</td>
</tr>
<tr>
<td>aquifer</td>
<td>a body of permeable rock below the Earth’s surface which contains water, known as groundwater. Water can move along an aquifer.</td>
</tr>
<tr>
<td>Dreaming</td>
<td>in Aboriginal cultures, the time when the Earth took on its present form, and cycles of life and nature began; also known as the Dreamtime. Dreaming stories pass on important knowledge laws and beliefs.</td>
</tr>
<tr>
<td>economic</td>
<td>a system made up of producing, buying and selling goods and services</td>
</tr>
<tr>
<td>industry</td>
<td>the production of goods and services</td>
</tr>
<tr>
<td>iridescent</td>
<td>bright and colourful</td>
</tr>
<tr>
<td>mound spring</td>
<td>mound formation with water at its centre, which is formed by minerals and sediments brought up by water from artesian basins</td>
</tr>
<tr>
<td>psychological benefits</td>
<td>positive effects on emotional or mental wellbeing</td>
</tr>
<tr>
<td>soak</td>
<td>place where groundwater moves up to the surface</td>
</tr>
<tr>
<td>songline</td>
<td>directly linked to Dreamings and Creation Stories, which depict the paths travelled by ancient creator spirits. They incorporate knowledge, spirituality and beliefs, which are embedded in Country and demonstrate the interconnectedness between the spiritual, physical and living worlds.</td>
</tr>
<tr>
<td>turbidity</td>
<td>the amount of sediment suspended in water</td>
</tr>
<tr>
<td>virtual water</td>
<td>all the water used to produce goods and services. Food production uses more water than any other production.</td>
</tr>
<tr>
<td>water footprint</td>
<td>the total volume of fresh water that is used to produce the goods and services consumed by an individual or country</td>
</tr>
</tbody>
</table>

13.14.3 Reflection

Complete the following to reflect on your learning.

Revisit the inquiry question posed in the Overview:

**We can’t survive without water, but does it mean more than just survival — do we value water in other ways?**

1. Now that you have completed this topic, what is your view on the question? Discuss with a partner. Has your learning in this topic changed your view? If so, how?
2. Write a paragraph in response to the inquiry question outlining your views.
<table>
<thead>
<tr>
<th>Subtopic</th>
<th>Success criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>13.2</td>
<td>I can describe the ways water is used by people, and give examples of agricultural, commercial, industrial and recreational uses.</td>
</tr>
<tr>
<td>13.3</td>
<td>I can represent information using line graphs.</td>
</tr>
<tr>
<td>13.4</td>
<td>I can explain how water quality may affect perceptions of the value of water. I can explain some of the ways that water quality is measured.</td>
</tr>
<tr>
<td>13.5</td>
<td>I can identify and annotate important geographical information in a photograph.</td>
</tr>
<tr>
<td>13.6</td>
<td>I can explain why water has economic value. I can demonstrate the economic value of water with examples from the rice farming and aquaculture industries in Asia.</td>
</tr>
<tr>
<td>13.7</td>
<td>I can explain the value of clean water for people’s health. I can evaluate strategies to improve access to clean water around the world.</td>
</tr>
<tr>
<td>13.8</td>
<td>I can describe some of the ways that Aboriginal Peoples find, use and manage water resources. I can outline how Aboriginal Culture and water resource management are interconnected.</td>
</tr>
<tr>
<td>13.9</td>
<td>I can outline why water has cultural value for many First Nations peoples. I can provide specific examples of water’s cultural value for Aboriginal Peoples in Australia.</td>
</tr>
<tr>
<td>13.10</td>
<td>I can analyse and describe the aesthetic and social value of water.</td>
</tr>
<tr>
<td>13.11</td>
<td>I can define the term virtual water. I can explain the value of water to food production.</td>
</tr>
<tr>
<td>13.12</td>
<td>I can describe perceptions of the social, cultural and economic value of water at Noosa.</td>
</tr>
</tbody>
</table>

**Resources**
- **eWorkbook**
  - Chapter 13 Student learning matrix (ewbk-8484)
  - Chapter 13 Reflection (ewbk-8485)
  - Chapter 13 Extended writing task (ewbk-8486)
- **Interactivity**
  - Chapter 13 Crossword (int-8542)
Below is a full list of rich resources available online for this topic. These resources are designed to bring ideas to life, to promote deep and lasting learning and to support the different learning needs of each individual.

### eWorkbook
- **13.1** Chapter 13 eWorkbook (ewbk-7993)
- **13.2** Water use (ewbk-9394)
- **13.3** SkillBuilder: Drawing a line graph (ewbk-9398)
- **13.4** The value of clean water (ewbk-9402)
- **13.5** SkillBuilder: Annotating a photograph (ewbk-9406)
- **13.6** The economic value of water (ewbk-9410)
- **13.7** The value of water to health (ewbk-9414)
- **13.8** The value of water for Aboriginal Peoples (ewbk-9418)
- **13.9** The cultural and spiritual value of water (ewbk-9422)
- **13.10** The aesthetic and social value of water (ewbk-9426)
- **13.11** Virtual water (ewbk-9430)
- **13.12** Investigating topographic maps: The value of water in Noosa (ewbk-9434)
- **13.13** Chapter 13 Student learning matrix (ewbk-8484)
- **13.14** Chapter 13 Reflection (ewbk-8485)
- **13.15** Chapter 13 Extended writing task (ewbk-8486)

### Video eLesson
- **13.1** The value of water — Water: a vital resource (eles-1615)
- **13.2** Water use — Key concepts (eles-5107)
- **13.3** SkillBuilder: Drawing a line graph (eles-1635)
- **13.4** The value of clean water — Key concepts (eles-5108)
- **13.5** SkillBuilder: Annotating a photograph (eles-1333)
- **13.6** The economic value of water — Key concepts (eles-5109)
- **13.7** The value of water to health — Key concepts (eles-5110)
- **13.8** The value of water for Aboriginal Peoples — Key concepts (eles-5111)
- **13.9** The cultural and spiritual value of water — Key concepts (eles-5112)
- **13.10** The aesthetic and social value of water — Key concepts (eles-5113)
- **13.11** Virtual water — Key concepts (eles-5114)
- **13.12** Investigating topographic maps: The value of water in Noosa — Key concepts (eles-5115)

### Sample responses
- **13.1** Chapter 13 Sample responses (sar-0146)

### Interactivity
- **13.2** Water use — Interactivity (int-7780)
- **13.3** SkillBuilder: Drawing a line graph — Interactivity (int-3131)
- **13.4** The value of clean water — Interactivities (int-8535)
- **13.5** SkillBuilder: Annotating a photograph — Interactivities (int-3129)
- **13.6** The economic value of water — Interactivities (int-8536)
- **13.7** The value of water to health — Interactivities (int-8537)
- **13.8** The value of water for Aboriginal Peoples — Interactivities (int-8538)
- **13.9** Oodnadatta Track (int-3079)
- **13.10** The aesthetic and social value of water — Interactivities (int-8539)
- **13.11** Unreal (int-3080)
- **13.12** Investigating topographic maps: The value of water in Noosa — Interactivity (int-8541)
- **13.14** Chapter 13 Crossword (int-8542)

### Digital document
- **13.2** Regions (doc-17950)
- **13.12** Topographic map of Noosa (doc-36257)

### Fieldwork
- **13.4** Physical properties of water (fdw-0018)
- **13.10** Perceptions of water’s value (fdw-0019)

### ProjectsPLUS
- **13.13** Thinking Big research project: The Great Artesian Basin (pro-0233)

### Google Earth
- **13.4** Oodnadatta (gogl-0128)
- **13.5** William Creek (gogl-0129)
- **13.6** Wabma Kadarbu Mound Springs (gogl-0130)
- **13.11** Our water footprint

### myWorld Atlas
- **13.2** Three rivers in Africa (mwa-4541)
- **13.7** How is water used in Australia? (mwa-4537)
- **13.11** World health (mwa-4430)
- **13.11** Our water footprint (mwa-4540)