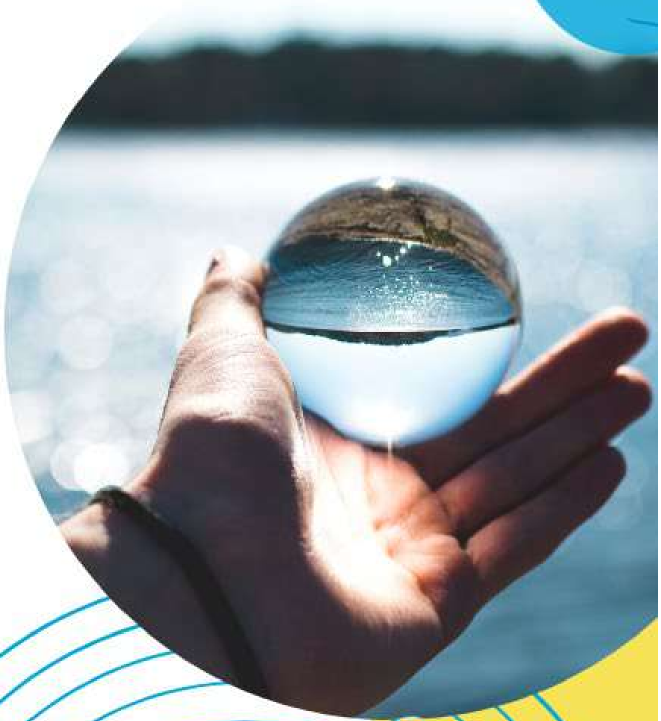
Water... WOW!

10 X STAGE 3 EDUCATION MODULES

- WATER FOR LIFE
- VIRTUAL WATER
- RAINFALL, DROUGHTS, FLOODS
- CATCHING WATER
- WATER FOR LIVING CITIES
- LIVING THINGS IN WATER
- AQUATIC FOOD WEBS & LIFECYCLES
- WATER POLLUTION
- SCIENTIFIC WATER TESTING (FIELD TRIP)
- WATER SOLUTIONS



www.georgesriver.org.au

Georges Riverkeeper Stage 3 Education Modules: Water…WOW!
Overview

Water is essential for life. In Australian cities, it is often taken for granted, but everyone should learn to appreciate water!

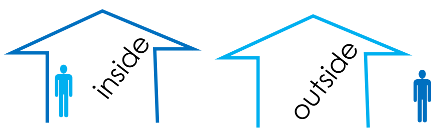
Georges Riverkeeper Stage 3 Education Modules are designed to provide students with theoretical and practical learning about water and waterways. The Modules are designed so that educators can use each in isolation or use them in sequence. Collectively, they cover many important topics, with the material explicitly linked to the NSW primary school syllabus. Some of the information is specific to the Georges River catchment, in southern Sydney, but most of the information is applicable in other regions. Teacher Background at the beginning of each Module provides educators with an overview of useful information for the Module. Symbols at the top of each Teacher Background page provide a quick guide to which syllabus outcomes are covered (i.e. Drama, English, Geography, Maths and/or Science[1]), and whether activities in the module are based inside or outside[2]. Branching is used as a linkage concept[3] that will reappear throughout *Georges Riverkeeper Stage 3 Education Modules*. Each time that branching is mentioned through the Modules, ask students to reflect on how branching networks through which water-based substances flow contribute to carrying materials from one place to another. Repetition of this concept should reinforce the importance of the ability of water to carry substances through branched networks, which is one of the main reasons that water is so important for people. The tables provided for each Module state the syllabus outcomes covered, the learning intentions and sequential learning and teaching activities (with links to resources). The inquiry questions provided within tables can be used to prompt class discussion. It is recommended that, rather than use all suggested activities, educators use those activities that best suit their class. At the end of each Module, 'playground facts' are provided and designed to be presented to students to reinforce key concepts from the module.

The intent is for this to be a living document that is continuously updated and improved. **Please contact Georges Riverkeeper** (contact@georgesriver.org.au) **if you have any suggested improvements for the modules.**

Key for quick guide symbols:

1) Which syllabus?

2) Location for activities in the module?



3) Linkage concept: branching

Contents

Georges Riverkeeper

Water... WOW!

STAGE 3 EDUCATION

Module 1: Water for Life

We need water to live! This module explains why water from our environment is essential to life.

In this module, students will:

- develop an understanding that water is essential to sustain life
- consider the various important uses of water by people
- collect data about personal and family water use
- prioritise daily activities that require water

www.georgesriver.org.au

Module 1: Water for Life

Stage 3 Geography | Stage 3 Maths | inside | linkage concept: branching

Teacher Background

We Need Water to Live (GE3-2: Explains interactions and connections between people, places and environments)

Water from our environment is essential to supporting life as we know it! When astronomers search other planets for signs that they may be able to support life, they do not search for aliens, instead they search for water. Water has been discovered on planets other than Earth (e.g. Mars), although the search for life elsewhere continues.

Here on Earth, we have life owing to the availability of water and water is essential for our own survival. The amount of water in the human body ranges from 50% to 75% of body weight (the average for children is approximately 65%). People feel thirsty when they have lost around 2% to 3% of the water in their body. However, mental performance and physical coordination start becoming impaired even before we become thirsty, after loss of about 1% of water in the body. Water is lost through breathing, perspiration and going to the toilet. To replace the water and avoid dehydration, we should drink at least two litres of water each day (the exact amount for each person depends upon things like age, gender, amount of exercise and weather). Other than making us feel thirsty, common signs of dehydration include dry mouth, flushed skin, headaches, dizziness, constipation, fatigue or muscle cramps.

Water Properties Supporting Life

Branching is used as a linkage concept that will reappear throughout *Georges Riverkeeper Stage 3 Education Modules*, here in the context of blood vessels. Each time that branching is mentioned through the modules, ask students to reflect on how branching networks through which water-based substances flow contribute to carrying materials from one place to another. Repetition of this concept should reinforce the importance of the ability of water to carry substances through branched networks, which is one of the main reasons that water is so important for people.

Blood carries essential nutrients around our bodies through branched networks. So, we can take in food through our mouths and digest food in our stomachs, but from that food our whole body receives nutrients that are transported to where they are needed in blood. If blood did not distribute nutrients across our body, we couldn't function. Branched networks are very important for distribution of nutrients and other materials via blood vessels that pervade our entire body. In each person, there are 100,000 kilometres of blood vessels, which if laid end-to-end could go around the Earth two and a half times! That is a lot of tubing and water is essential for carrying materials through the tubing.

Human blood is almost 80% water. The majority of blood is blood plasma (which is yellow, not red), which carries red blood cells and other essential materials around the body. Blood plasma is 95% water. Water is such a large and important component of blood, because it is very good at carrying materials both in suspension (mainly red blood cells, as well as other materials such as white blood cells) and in solution (e.g. sugars, proteins, electrolytes, hormones), which are essential for keeping people alive and fuelling all of people's activities. Those substance in suspension depend upon water moving to stay in suspension and settle out of suspension if water is kept still, whereas substances in solution stay in solution even when water is still.

As well as carrying useful materials, water is also essential for carrying away wastes. Human urine (i.e. wee) is over 90% water. If we couldn't urinate, our body would build up toxins that would have disastrous consequences. For example, if urea builds up in the body it can interfere with metabolism, the ability to maintain internal balance that supports life and the ability to transport oxygen around our bodies.

Important functions of water in our bodies:

• Water is the primary building block of all the trillions of cells in our body.

• It acts as an insulator, regulating both internal body temperature and external body temperature (through sweating).

• Water is the primary component of saliva, used to aid digestion and swallowing of food.

• Water lubricates our joints.

• Water insulates our brain, spinal cord and organs, acting as a shock absorber.

• Water is used to flush waste and toxins from our body.

• Water is the principal solvent in our body. It carries dissolved minerals, soluble vitamins and certain nutrients to where they are needed.

• Water carries oxygen to cells and carbon dioxide away from cells in our body.

We could not live without water!

Bathing is another essential day-to-day use of water by people. If we neglected to wash our bodies for an extended period, bacteria, dead skin and sweat would build up to produce a potent stench. Skin would become oily or dry and become infected with fungi, yeasts and bacteria. If there were a cut or abrasion to the skin, the built up bacteria would have a high likelihood of causing infection. Dandruff (dead skin) accumulating on the scalp would cause a very itchy head, fungus would start growing between toes, dirt would become lodged under nails and both pimples and rashes would pop up across the body. We use water to wash dishes, cutlery, pots and pans to avoid the stink, decay and associated illness that comes if food scraps are not cleaned away. We use water to wash dirt, sweat and other smelly substances from our clothes. Water carries away our wastes when we flush the toilet.

Water keeps us from becoming dirty and sick!

Water is also an essential component of popular recreational activities such as swimming, fishing, boating, surfing, etc.

We can have lots of fun in water!

Sequence for Module 1: Water for Life	
Syllabus Outcomes	**GE3-2** Explains interactions and connections between people, places and environments. **MA3-2WM** Selects and applies appropriate problem-solving strategies, including the use of digital technologies, in undertaking investigations. **MA3-11MG** Selects and uses the appropriate unit to estimate, measure and calculate volumes and capacities, and converts between units of capacity.
Learning Intentions	For students to: ♦ develop an understanding that water is essential to sustain life ♦ consider the various important uses of water by people ♦ collect data about personal and family water use ♦ list how water is used daily in their lives ♦ prioritise daily activities that require water
Teaching & Learning Activities	Inquiry Question: *How important is water in our daily lives?* ♦ Astronomers constantly search for water on other planets. Why? **View** video https://www.youtube.com/watch?v=gksddX9N26w (more scientific) OR https://www.brainpop.com/science/space/mars/ [from 2:50 onwards] (less scientific) to trigger discussion that water on Mars is an indicator of the planet's potential to support life. ♦ How is water essential for our own survival? The 'Playground fact' (provided below) about the amount of water that different animals drink can be used to reinforce the key message that we need to drink water every day of our lives. There are many ways that humans need water. Use the example of our branching blood vessels carrying water-based blood that carries nutrients around our body. ♦ Water is readily available whenever we turn on the tap. Ask students to brainstorm & list all the ways water is used daily (e.g. drinking, cooking, washing clothes, brushing teeth, showering, watering gardens, etc.). **GE3-2** ♦ How valuable is water? In groups, prioritise activities needing water. What's the most essential water use? If given only 10 litres of water a day for personal use, how would you prioritise the most vital uses from your brainstormed list? What is your justification for allocating water to each use? Is 10 litres of water sufficient to get through your day? **GE3-2, MA3-11MG** ♦ Compare the way students allocated water to the average allocations for different uses shown at https://southeastwater.com.au/CurrentProjects/Programs/Pages/Water-efficiency.aspx?rd=why ♦ How much water do students think they use each day? Create a table with a column for the ways that students use water and the amounts of water (in litres) they think that they need for

	each use, to record student answers. Compare your results to the typical daily water usage per person in Sydney, which is 200 to 300 L and discuss comparisons. **MA3-2WM** 💧 Students discuss or debate - Do we use too much water? **GE3-2**
Resources	> Life on Mars videos: https://www.youtube.com/watch?v=gksddX9N26w https://www.brainpop.com/science/space/mars/ [from 2:50 onwards] > Branching blood vessels image https://ispyphysiology.com/2016/07/20/not-in-the-same-vein/ > Moving blood animation video https://www.youtube.com/watch?v=bXZiUgZpt08 > Household water usage image https://southeastwater.com.au/CurrentProjects/Programs/Pages/Water-efficiency.aspx?rd=why
Feedback	Your feedback is important to us. Please complete this quick online survey: http://bit.ly/ModulesFeedback

Playground fact:

People can survive for about three weeks without food, but only a few days without water. Camels famously can forgo drinking water for extended periods: up to 15 days, then can make up for it by consuming over 40 litres at one drinking session. But, the kangaroo rat from the Californian desert can go even longer without drinking water. It gets its moisture from the seeds that it eats and can survive through a lifetime of up to 5 years without ever drinking any water.

Water... WOW!

STAGE 3 EDUCATION

Module 2: Virtual Water

Water is essential for people not only for direct use, but also to produce our food and most other goods that we use every day.

Virtual water is the amount of water used in the growth and/or production of goods.

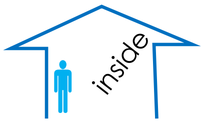
In this module, students will:

- explore how water contributes to the production of food and other goods that we use every day
- calculate how much virtual water is used in the production of a simple meal
- list the areas where water is used to sustain our everyday living
- discover why useable fresh water is a limited resource
- identify ways to conserve water

www.georgesriver.org.au

Module 2: Virtual Water

Stage 3 Geography | Stage 3 Maths | Stage 3 Science



Teacher Background

Water for Farming and Industry (GE3-2: Explains interactions and connections between people, places and environments)

In *Module 1: Water for Life,* students learned that in our households we directly use lots of water from the environment each day! We indirectly use much, much more!

During 2016-17, the amount of water from the Australian environment consumed for human uses was over 16,500,000,000,000 litres (sixteen and a half trillion litres, which is a lot!). Most was consumed for agriculture (~63%), followed by: industry (~16%); households (~11%); and, water supply, sewerage and drainage (~9%). So, the household use that was the focus of the first module only accounts for about one tenth of our water use: students will learn more about how water is delivered to and from homes in *Module 5: Water for Living Cities*. Agriculture requires almost six times as much water as household uses and includes irrigation of crops and supplying drinking water to livestock. Industrial uses of water include being an ingredient in manufacturing, washing, dilution and cooling.

Water is also vital for transport. Over a billion tonnes of goods are transported on ships into or out of Australia each year.

Virtual Water (ST3-5LW-T: Explains how food and fibre are produced sustainably in managed environments for health and nutrition)

As mentioned above, water is essential for people not only for direct use, but also for agriculture to produce our food and many other products. Virtual water is the amount of water used in producing particular foods or other commodities. The volumes provided are estimates, as precise volumes for each item will depend upon things such as the size of that item, types of machinery used in production and the climate where the item was produced. The water is said to be virtual, because the item does not actually contain the stated volume of water, rather it is the amount of water that was used through the various stages of production. The concept of virtual water is useful when thinking about how everything people use is dependent upon water and the large volumes of water needed to produce different goods.

For example: concrete is a mix of cement, sand and water. Timber (i.e. harvested trees) required water to grow. Paper is also produced from trees and water is used in the pulping of paper. Metal production requires water for washing and cooling. Plastic production requires drilling for oil, which uses a lot of water, with more water used in the production process. Glass production requires furnaces, which are cooled using water.

So, How Much Water is Available to Support Our Activities on Earth

We need lots of water to produce those things that we eat and use every day. Most of the water we use needs to be fresh water, as we can't drink saltwater, can't water crops with saltwater and using saltwater in metal machinery will cause it to seize up through rapid rusting. Students may know that the Earth is covered mainly by water, but they may not realise that only a small amount is fresh and available for most human uses.

Although about 70% of the Earth's surface is water, this resource is one of the main limiting factors for supporting human activities. This is because we are very dependent upon extractable freshwater, but only a tiny percentage of the water on Earth is fresh and available. Most (~97%) of the water on Earth is held in the oceans and is too salty for our needs. Much of the freshwater is either frozen or underground. The remaining amount is the water available to support our needs, and this works out to be about 0.003% of the total water on Earth.

Sequence for Module 2 : Virtual Water	
Syllabus Outcomes	**GE3-2** Explains interactions and connections between people, places and environments. **ST3-5LW-T** Explains how food and fibre are produced sustainably in managed environments for health and nutrition. **MA3-2WM** Selects and applies appropriate problem-solving strategies, including the use of digital technologies, in undertaking investigations. **MA3-11MG** Selects and uses the appropriate unit to estimate, measure and calculate volumes and capacities, and converts between units of capacity.
Learning Intentions	For students to: ♦ explore how water contributes to the production of food and other items that we use every day ♦ calculate how much virtual water is used in the production of a simple meal ♦ list the areas where water is used to sustain our everyday living ♦ explain why water is a limited resource ♦ identify & list ways they can contribute to conserving water
Teaching & Learning Activities	Inquiry Question: *Is there enough water in the world to sustain all the uses by people?* ♦ Introduce the concept of virtual water. What is virtual water? A lot of water is used daily within our homes, but water is also used in the production of food (agriculture) and other products (industry). We refer to this water as virtual because we don't see it. **View** video to discover how food production is placing a strain on our water supplies. **GE3-2, ST3-5LW-T** ♦ Can the amount of virtual water in your lunch be calculated? Using this water footprint list (or do a web search for 'virtual water' for other similar lists) students calculate the water footprint of their lunch. Is the amount of virtual water in their lunch more or less than the two litres of water that they directly consume for drinking each day? How does the amount of virtual water in one meal compare to the 200 - 300 litres of water they directly use in their household each day? Use these questions to prompt student discussions. **MA3-2WM, MA3-11MG** ♦ Introduce the 'Playground fact' that explores the amount of virtual water used for bottled water. Conduct a survey to investigate the number of people who purchase bottled water rather than drink tap water. Conduct a debate on bottled water versus tap water (students can search for information on the web to develop their arguments). ♦ Where else do we use virtual water in our lives? Students attempt to calculate their water usage by using a water footprint calculator. Extension activity: From your footprint calculator results, convert gallons to litres. **MA3-11MG** ♦ After calculating their water footprint, students calculate the average water usage for the

	class. Next, consider that Australia is the driest continent inhabited by humans on Earth, but also has one of the highest rates of water consumption per person (termed our 'water footprint'). ♦ Revisit the inquiry question and discuss just how much water is available in the world. How much of the Earth is covered in water? How much of the Earth's water is fresh and accessible? **View** video Show Me the Water to discover the amount of available freshwater on Earth. **MA3-11MG** ♦ Given that there is a limit on the amount of freshwater, particularly in a dry continent such as Australia, ask students to consider whether they could identify & list ways they can contribute to conserving water.
Resources	> Is water stress causing a global food emergency? http://education.abc.net.au/home#!/media/85250/water-stress-affects-food-production > Virtual water list: https://www.cseindia.org/water-footprint--3880 > Virtual water: http://virtualwater.eu/ > Getting your facts straight about water use http://education.abc.net.au/home#!/media/1239330/getting-your-facts-straight-about-water-use > Water Footprint https://www.cseindia.org/water-footprint--3880 > Calculate your water footprint https://www.watercalculator.org/intro/ > Australia's water footprint https://serc.carleton.edu/integrate/teaching_materials/food_supply/student_materials/1097) > Show me the water! http://education.abc.net.au/home#!/media/1995083/show-me-the-water-
Feedback	Your feedback is important to us. Please complete this quick online survey: http://bit.ly/ModulesFeedback

Playground fact:

It takes five litres of water to produce one litre of bottled water (four litres required for construction of the plastic bottle, plus the one litre of drinking water). The most popular bottled water in Australia costs over $2.50 per litre. Alternatively, for $2.50 you could buy about 250 litres of tap water, which is a bit more than that needed to fill a standard bathtub.

See: https://www.sydneywater.com.au/web/groups/publicwebcontent/documents/document/zgrf/mtyx/~edisp/dd_161652.pdf

Georges Riverkeeper

Water... WOW!

STAGE 3 EDUCATION

Module 3: Rainfall, Droughts & Floods

Fresh water is not evenly distributed across the surface of the Earth, with serious consequences for life and the lifestyles of people.

The amount of available water also changes over time: droughts and floods are severe cases highlighting the uneven distribution of water through time.

In this module, students will:

- create a story about mythical creatures, following the style of a Dreaming Story
- reflect on and suggest improvements to scientific design
- explore the Bureau of Meteorology website to obtain data
- analyse a dataset from the Bureau of Meteorology to answer questions about rainfall

www.georgesriver.org.au

Module 3: Rainfall, Droughts & Floods

Stage 3 English	Stage 3 Geography	Stage 3 Maths

inside

Teacher Background

Fresh Water is Not Evenly Distributed Across the Surface of the Earth (GE3-1 Describes the diverse features and characteristics of places and environments)

In *Module 2: Virtual Water*, students learned that the amount of fresh water on Earth is far less than the total amount of water on Earth, which is mostly salt water in oceans. This module and following modules relate to the distribution of water, particularly accessible fresh water that is so vital to sustaining people's lives. The Aboriginal Dreaming Story of Tiddalik the Frog can be used to remind students that fresh water is not evenly distributed across the surface of the Earth, with serious consequences for life and the lifestyles of people. The amount of available water also changes over time: droughts and floods are severe cases highlighting the uneven distribution of water through time.

Droughts and Floods (GE3-1: Describes the diverse features and characteristics of places and environments, GE3-2: Explains interactions and connections between people, places and environments)

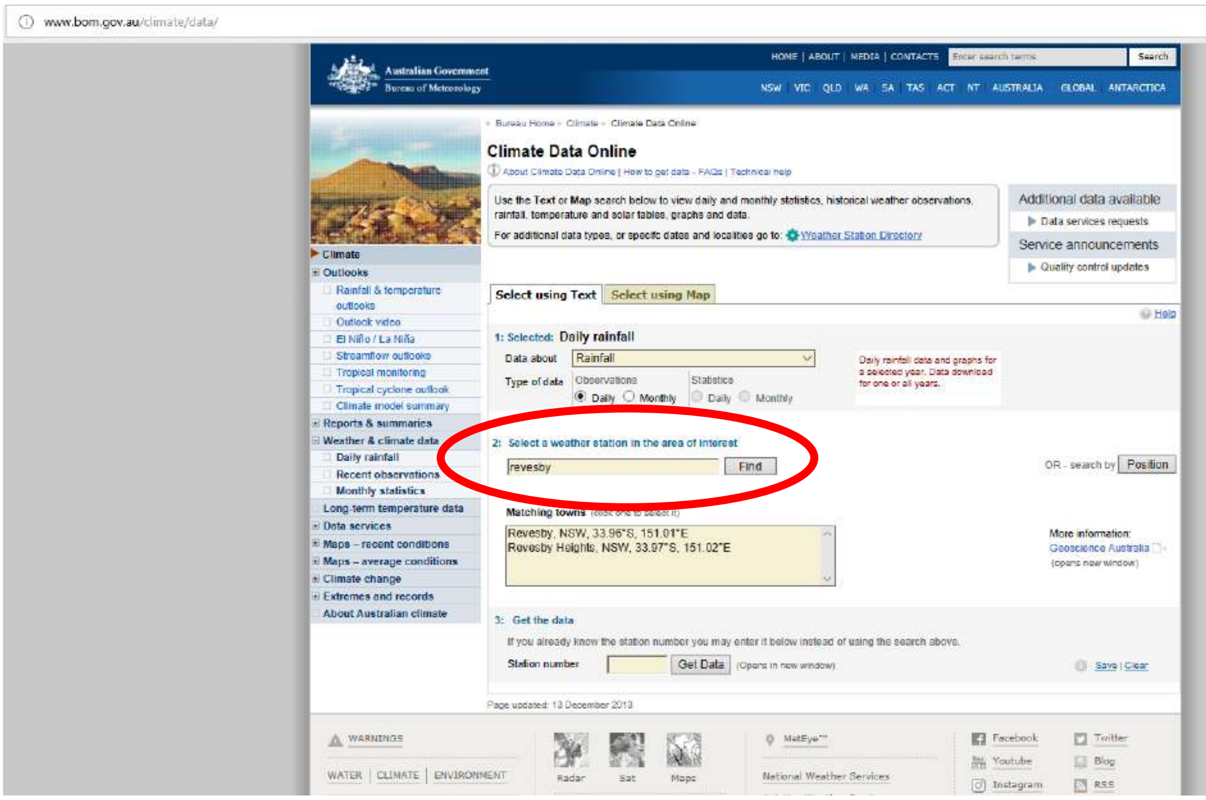
Large parts of Australia are dry for most of the time, but not necessarily classed as being in drought. A drought is defined as occurring when a region has received much lower than average rainfall for that region over the previous three months. 'Much lower' means that, based on rainfall records, there was higher rainfall in the region for 90% of the time prior to the drought. The Bureau of Meteorology measures rainfall and has records since the 1860s. In Australia, there have been decreases in rainfall since 1994, which many scientists attribute to climate change. The most severe drought across Australia on record occurred recently, from 2003 to 2012. New South Wales went back into drought in the middle of 2017. The extended dry conditions led to extreme fires across Australia in the summer of 2019-20.

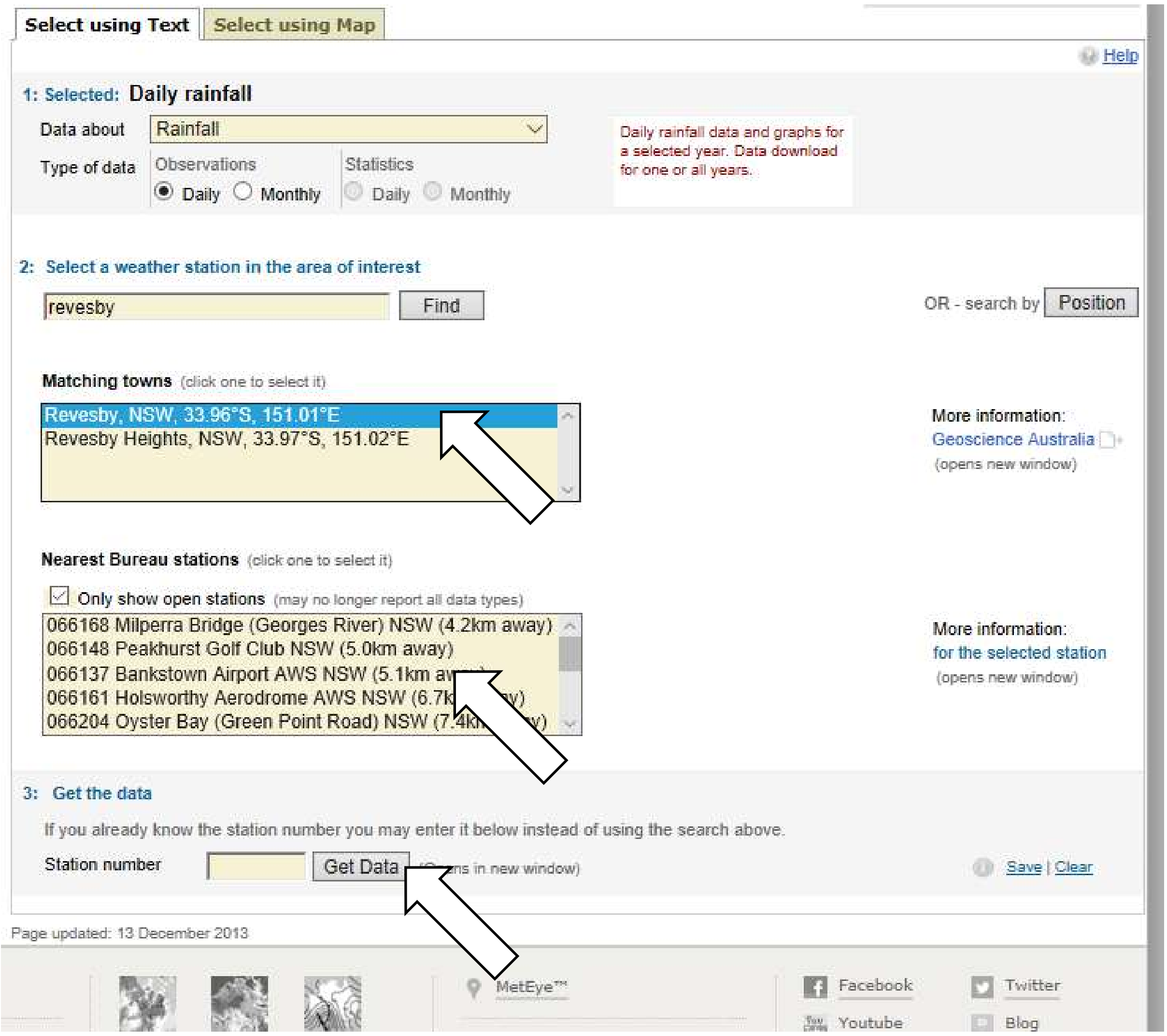
Climate change does not just cause warming and drying, it more generally drives more extreme weather events, including storms and floods. The Georges Riverkeeper factsheet Flooding in The Georges River provides an overview of the history and effects on property of flooding in the Georges River catchment.

Sequence for Module 3 : Rainfall, Droughts & Floods	
Syllabus Outcomes	**GE3-1** Describes the diverse features and characteristics of places and environments. **GE3-2** Explains interactions and connections between people, places and environments. **EN3-2A** Composes, edits and presents well- structured and coherent texts. **EN3-5B** Discusses how language is used to achieve a widening range of purposes for a widening range of audiences and contexts. **MA3-11MG** Selects and uses the appropriate unit to estimate, measure and calculate volumes and capacities, and converts between units of capacity. **MA3-18SP** Uses appropriate methods to collect data and constructs, interprets and evaluates data displays, including dot plots, line graphs and two-way tables.
Learning Intentions	For students to: - create a story about mythical creatures, following the style of a Dreaming Story - reflect on and suggest improvements to scientific design - explore the Bureau of Meteorology website to obtain data - analyse a dataset from the Bureau of Meteorology to answer questions about rainfall
Teaching & Learning Activities	Inquiry Question: *Is it going to rain today?* - **View** the Dreaming Story of Tiddalik the Frog [2:42 duration] to generate discussion that the change in water availability & distribution over time (i.e. droughts) has been occurring in Australia for many, many years and considered important enough for Aboriginals to create a story that was passed from generation to generation over thousands of years. **GE3-1, GE3-2** - In groups, students follow the style of Tiddalik the Frog to create stories about mythical creatures that are responsible for water moving through their urban landscape. After being divided into three groups and through creative story-telling, students explain: i) the transportation of water to taps, ii) the journey of water flushed down toilets and iii) what happens to water that enters the drains on our street. Bring the class together to interweave their whole imagined narrative of water movement through their landscape, into one story. **EN3-2A, EN3-5B** - Ask students: Is it going to rain today? Tomorrow? Next week? How do we make these predictions? Can we access data to help us make better predictions? - Pose inquiry questions to students: Why do we need to measure rainfall? What do we do with rainfall measurements? How is it recorded? How can it be accessed? - Introduce students to the Bureau of Meteorology (BOM) dataset Climate Data Online. Lead students through a method of obtaining rainfall data from Climate Data Online. See below for

	instructions. *Select Using Text* tab > 1. *Selected: Daily rainfall* (*Data about Rainfall* in dropdown box and click on circle for *Type of data, Daily Observations*) 2. *Enter a location* (e.g. choose the suburb where your school is located) and click *Find* > Select *Matching Town* > Select *Nearest Bureau station* > 3. *Get Data*. Daily and monthly rainfall data for the chosen location will be shown > Click on *Plot statistics and this year* at the bottom of the datasets and a monthly rainfall histogram will be created. ♦ Analyse selected data. How much rain has been recorded in the last month? Compare to previous months. What's the average annual rainfall for the selected location? **MA3-11MG, MA3-18SP** ♦ Find newspaper articles about drought across NSW and discuss with students OR discuss Georges Riverkeeper Factsheet: Flooding in the Georges River **GE3-1, GE3-2.** ♦ **Extension**: Rain gauges are great for measuring rain in small areas, but what about large areas? Are they accurate for measuring rain across the globe (see https://eldoradoweather.com/climate/world-maps/world-annual-precip-map.html for average precipitation across the world)? Discuss the limitations. **View** video Measuring rainfall to ascertain a better method used by meteorologists.
Resources	> Tiddalik the Frog https://youtu.be/0y3Ta5xcKV4 > Climate Data Online http://www.bom.gov.au/climate/data/index.shtml > Total annual rainfall across continents https://eldoradoweather.com/climate/world-maps/world-annual-precip-map.html > Measuring Rainfall http://education.abc.net.au/home#!/media/2159478/for-good-measure
Feedback	Your feedback is important to us. Please complete this quick online survey: http://bit.ly/ModulesFeedback

http://www.bom.gov.au/climate/data/

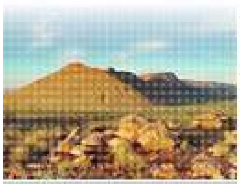



Select using Text
Select using Map
Help
1: Selected: Daily rainfall
Data about
Rainfall
Type of data
Observations
Daily
Monthly
Statistics
Daily
Monthly
Daily rainfall data and graphs for a selected year. Data download for one or all years.
2: Select a weather station in the area of interest
revesby
Find
OR - search by
Position
Matching towns (click one to select it)
Revesby, NSW, 33.96°S, 151.01°E
Revesby Heights, NSW, 33.97°S, 151.02°E
More information:
Geoscience Australia
(opens new window)
Nearest Bureau stations (click one to select it)
Only show open stations (may no longer report all data types)
066168 Milperra Bridge (Georges River) NSW (4.2km away)
066148 Peakhurst Golf Club NSW (5.0km away)
More information:
for the selected station
(opens new window)
3: Get the data
If you already know the station number you may enter it below instead of using the search above.
Station number
Get Data
Save | Clear
Page updated: 13 December 2013
MetEye™
Facebook
Twitter
Youtube
Blog

HOME | ABOUT | MEDIA | CONTACTS Enter search terms Search

Australian Government
Bureau of Meteorology

NSW | VIC | QLD | WA | SA | TAS | ACT | NT | AUSTRALIA | GLOBAL | ANTARCTICA



- ▶ Climate
- ⊞ Seasonal outlooks
- ⊞ Reports & summaries
- ⊞ Weather & climate data
- ⊞ Data services
- ⊞ Maps – recent conditions
- ⊞ Maps – average conditions
- ⊞ Climate change
- ⊞ Extremes of climate
- ☐ About Australian climate

Bureau Home > Climate > Climate Data Online > Daily Rainfall

Daily rainfall

Bankstown Airport AWS

ⓘ About this page

1 year of data | All years of data | PDF

Observations of Daily rainfall are nominally made at 9 am local clock time and record the total for the previous 24 hours. Rainfall includes all forms of precipitation that reach the ground, such as rain, drizzle, hail and snow. About rainfall data

Station: Bankstown Airport AWS	Number: 66137	Opened: 1968	Now: Open	Details
	Lat: 33.92° S	Lon: 150.99° E	Elevation: 7 m	

Show in table...

Key: Units = mm *12.3* = Not quality controlled. ↓ = Part of accumulated total

28.0 Move mouse over rainfall total to view the period of accumulation.

2018	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Graph												
1st	0	0	0	0	0	0	0	0	1.8	0	0	0
2nd	0	0	0	0	0.2	0	0.2	0	1.6	0	0	0
3rd	1.2	0	0	0	0	0	4.0	0	0.4	0.2	6.2	0
4th	1.0	0	0	0	0	0	0.2	0	12.8	3.6	0	0
5th	0	0	0	0	0	0	0.2	0	0.2	50.6	0	1.0
6th	0	0	2.6	0	0	23.6	0.2	0.2	1.0	4.0	0.2	2.4
7th	0	0	5.4	0	0	11.0	0	1.8	4.6	1.8	0	0.2
8th	0	0	0	0	0	0	0	0	67.0	2.0	17.6	0
9th	6.2	0	0	0.2	0	7.2	0	0	1.0	0.2	0	0
10th	3.6	0	1.6	0	0	1.8	0	0	0.2	0.2	0	0
11th	0	0	0	0	0	0	0	0	0	12.0	0	0.2
12th	0	0	0	0	1.0	0.2	0	0	0	15.6	0	0
13th	0	0	0	0	0.2	0.4	0	0	0	4.0	0	2.4
14th	0.2	0	6.8	0	0	0.2	0	0	0	32.8	0	26.6
15th	0	0	0	0	0	0	0	0	0.2	2.0	0.2	7.6
16th	0	0	0	0	0.2	0	0	0	0	3.6	0	24.6
17th	0	0	0	0	0	0	0	0	0	0.6	0	0
18th	0	0	0	0	0	0	0	0	0	26.4	0.4	0
19th	0.4	0	0	0	0	5.0	0	0	0	14.4	0	0
20th	0	0	0	0	0	11.0	0	0	0.4	0	0	8.8
21st	0	0	7.6	0	0	0.6	0	0.2	0	9.0	0	34.2
22nd	0	0	7.2	0		0.4	0	0	0	0	1.6	3.6
23rd	0	0	4.2	0	0	0.2	0	0	0	0	0	0.6
24th	0	0.4	0.2	0	0	0	0	4.4	0	0	0	0.2
25th	0	5.2	1.0	0	0	0	0	0.2	0	0	0	0
26th	0	41.0	4.0	0	0	0	0	0.4	3.0	0	0	0
27th	0	4.6	0	0.4	0	0.2	0	1.6	0.2	0	0	0
28th	0	0	0	5.6	0	2.4	0	0	0	0	12.6	0
29th	0		0	0.4	0	7.0	0.2	0	0	0	32.0	0
30th	0		0	4.4	8.6	0	0	0	0	0	2.0	0
31st	0		0		1.2		0	0		0		0
Highest Daily	6.2	41.0	7.6	5.6	8.6	23.6	4.0	4.4	67.0	50.6	32.0	34.2
Monthly Total	12.6	51.4	40.6	11.0	11.4	71.2	5.0	8.8	94.4	185.0	72.8	114.8

Annual total for 2018 = 679.0 mm | View all monthly data | Plot year of daily data

Summary statistics for all years

Move mouse over highest daily rainfall to view dates.

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	91.9	101.0	100.5	83.0	63.5	80.7	43.1	49.5	43.9	60.9	76.4	68.5
Median	74.6	75.0	78.6	57.5	51.4	55.4	31.2	24.4	34.8	40.0	72.8	56.6
Highest Daily	154.0	176.6	121.6	156.2	132.0	171.0	116.8	243.0	103.0	107.8	95.0	63.8

Plot statistics and this year

Data within the table which are in italics represent observations which have not been fully quality controlled, a process which may take a nu... months to complete. While these data may be correct, you should exercise caution in their use. For observations of daily rainfall which spa...

HOME | ABOUT | MEDIA | CONTACTS

Australian Government
Bureau of Meteorology

NSW VIC QLD WA SA TAS ACT NT AUSTRALIA GLOBAL ANTARCTICA

Bureau Home > Climate > Climate Data Online > Daily Rainfall > Graph

2018 rainfall

Bankstown Airport AWS

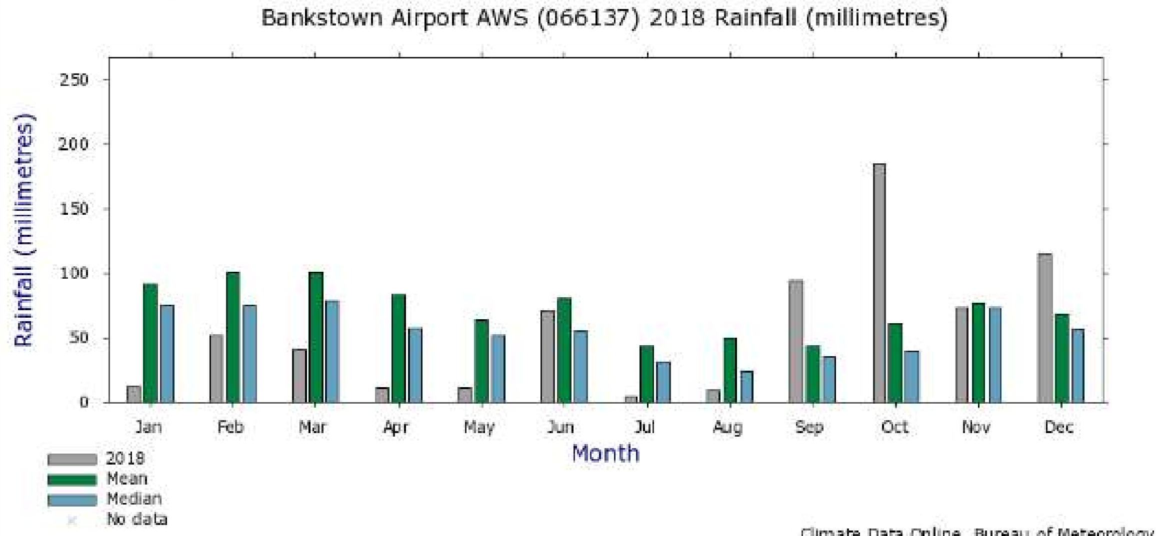
About this page

1 year of data | All years of data | PDF

Observations of Daily rainfall are nominally made at 9 am local clock time and record the total for the previous 24 hours. Rainfall includes all forms of precipitation that reach the ground, such as rain, drizzle, hail and snow. About rainfall data

Station: Bankstown Airport AWS	Number: 66137	Opened: 1968	Now: Open
	Lat: 33.92° S	Lon: 150.99° E	Elevation: 7 m

Climate
- Seasonal outlooks
- Reports & summaries
- Weather & climate data
- Data services
- Maps – recent conditions
- Maps – average conditions
- Climate change
- Extremes of climate
- About Australian climate



Note: Data may not have completed quality control

Climate Data Online, Bureau of Meteorology
Copyright Commonwealth of Australia, 2019

Product Code: IDCJAC0009

Page created: Thu 06 Jun 2019 13:06:36 PM EST

WARNINGS MetEye™ Facebook Twitter Youtube Blog

Georges Riverkeeper

Water... WOW!

STAGE 3 EDUCATION

Module 4: Catching Water

Water is the only substance on Earth that naturally occurs as a solid, liquid and gas. The availability of water on the surface of the Earth in a particular location changes over time by moving through the water cycle.

In this module, students will:

- learn about the source of rainfall
- explore the natural water cycle
- conduct an experiment investigating evaporation
- reflect on and suggest improvements to scientific investigations
- design and make a rain gauge
- dramatise or digitally explain the Water Cycle

www.georgesriver.org.au

Module 4: Catching Water

Stage 3 Drama | Stage 3 Geography | Stage 3 Maths | Stage 3 Science | inside | outside | linkage concept: branching

Teacher Background

The Water Cycle (GE3-1: Describes the diverse features and characteristics of places and environments)

In *Module 3: Rainfall, Droughts & Floods*, students learned about the uneven distribution of water across the surface of Earth and through time, owing to the variability of rainfall. More broadly, the availability of water on the surface of the Earth in a particular location changes over time by moving through the water cycle. Water is the only substance on Earth that naturally occurs as a solid, liquid and gas. Depending on the temperature and atmospheric pressure, water changes between those three forms. The water coming out of taps and in our streams, rivers and oceans is liquid. As the sun shines on liquid water it provides energy for evaporation, so that water becomes a gas that enters the atmosphere as water vapour. There is more evaporation as it gets hotter (students may have experienced this with drying quicker after a swim on a hot summer day than on a cooler day). We usually can't see water vapour, but it is measurable as humidity. As water vapour rises, it cools and changes back to tiny liquid water droplets that merge to form clouds. As droplets merge they collectively become increasingly heavy until they ultimately fall from clouds under the force of gravity. In Australia, most water falls as rain (liquid), but in colder regions it can fall as snow (solid), and we occasionally have solid hail falling from the sky. This water can flow across land and back into streams, rivers and oceans. As we experience it, this is the water cycle!

The other part of the water cycle, which is less visible because it happens underground, is infiltration of water through the ground. As water travels through soil it is well filtered. It can be taken up by plant roots and travel through the plant and into the atmosphere, as evapotranspiration. Alternatively, it can become groundwater (which is just water that is under the ground), which later can be discharged back into streams, rivers or oceans via springs.

Why Most Water on Earth is Salty (GE3-1: Describes the diverse features and characteristics of places and environments, ST3-1WS-S: Plans and conducts scientific investigations to answer testable questions, and collects and summarises data to communicate conclusions)

Through the water cycle, water is cleansed by filtration and distillation, so that fresh water can be reused to sustain life over and over again. Some filtration occurs when water travels over land, within flowing waterways (i.e. streams and rivers) or through the ground. Some substances can be trapped and removed from water by soils, vegetation or other surfaces, whilst animals also contribute to filtration via collecting food. But, water can also pick up other substances as it flows over them. Distillation occurs when water evaporates: gaseous water cannot carry the same substances that can be dissolved or float in liquid water. This is why most water on the Earth is salty…

In *Module 1: Water for Life*, it was mentioned that water is very good at picking up substances that dissolve or float, and that most of the water on Earth occurs in salty oceans. Those two facts are related, via the water cycle. The reason that the water in the oceans is salty is that streams and rivers, and oceans themselves, pick up salts that occur in rocks as they move across land. So, streams and rivers are constantly transporting small concentrations of salt into oceans. When water contributed by rivers evaporates from an ocean, it does not take the salt with it. The salt is left behind in the ocean. Rather than getting increasingly salty over time, ocean salinity has reached equilibrium at about 35 parts per thousand. This is because as new salts arrive, others are taken up by organisms living in oceans or settle out from being dissolved to form new minerals.

How are Branching River and Stream Networks Formed? (GE3-1: Describes the diverse features and characteristics of places and environments, GE3-4: Acquires, processes and communicates geographical information using geographical tools for inquiry)

Branching is used as a linkage concept that will reappear throughout *Georges Riverkeeper Stage 3 Education Modules*, here in the context of river and stream networks. Each time that branching is mentioned through the modules, ask students to reflect on how branching networks through which water-based substances flow contribute to carrying materials from one place to another. Repetition of this concept should reinforce the importance of the ability of water to carry substances through networks, which is one of the main reasons that water is so important for people.

Recall the branched blood vessel networks through which water-based blood flows through that were mentioned in previous modules. Water also flows through branched networks in rivers and streams. The channels of those networks are formed through erosion owing to liquid water being pushed down slopes by gravity. When rain falls, some will infiltrate into soils, but some flows across land. It will always flow down slopes, following the path of least resistance, but is able to push through unconsolidated soils. Over time, larger and larger channels will be eroded by moving water, with bigger channels where more water flows. Thus, a branched network is formed. On upper hillslopes, where the volume of water flowing across land is relatively low, the channels are small. Downslope, these small channels meet each other, bringing in larger volumes of water that form larger channels. All of the streams and rivers that flow into the same waterbody are part of the same catchment. The Georges River catchment covers 960 km^2, within the boundaries shown on the map below (page 23).

Sequence for Module 4: Catching Water	
Syllabus Outcomes	**GE3-1** Describes the diverse features and characteristics of places and environments. **GE3-2** Explains interactions and connections between people, places and environments. **ST3-1WS-S** Plans and conducts scientific investigations to answer testable questions, and collects and summarises data to communicate conclusions. **MA3-11MG** Selects and uses the appropriate unit to estimate, measure and calculate volumes and capacities, and converts between units of capacity. **DRAS3.3** Devises, acts and rehearses drama for performance to an audience.
Learning Intentions	For students to: ♦ describe where fresh water comes from ♦ explain the water cycle using the correct terminology for each stage ♦ conduct an experiment investigating evaporation ♦ reflect on and suggest improvements to scientific investigations ♦ design and make a rain gauge ♦ dramatise or digitally explain the Water Cycle
Teaching & Learning Activities	<u>Inquiry Question</u>: *Where does fresh water come from and where does it go?* ♦ Students asked to think about and describe the source of water? Where does water from taps come from? Where does water in rivers and lakes come from? **View** video The Anatomy of a Raindrop [to 0:50] for an introduction to the water cycle.**GE3-1, GE3-2** ♦ Use the first 'Playground fact' to remind students that water is constantly being recycled, via the water cycle. The water on the Earth today is the same as that present millions of years ago. ♦ Place a beaker or glass with 100 mL of water outdoors in the sun for 4 hours, after marking the initial height of the water. Make a hypothesis. What might happen after 4 hours? Observe changes. What has happened to some of the water in the beaker? Where has it gone? Discuss evaporation. **View** diagram to explore what happens to water vapour. https://easyscienceforkids.com/all-about-the-water-cycle/ **ST3-1WS-S** ♦ Invite students to dramatise or digitally explain the Water Cycle. **DRAS3.3** ♦ Introduce that rain is measured in millimetres. **View** video How to Measure Rainfall. Students design and make a device that captures and measures rainfall. Evaluate the precision of the device as a measurement for collecting rainfall. **MA3-11MG** ♦ Students to review their rain gauge design once it rains. Does it need any modifications? Allow

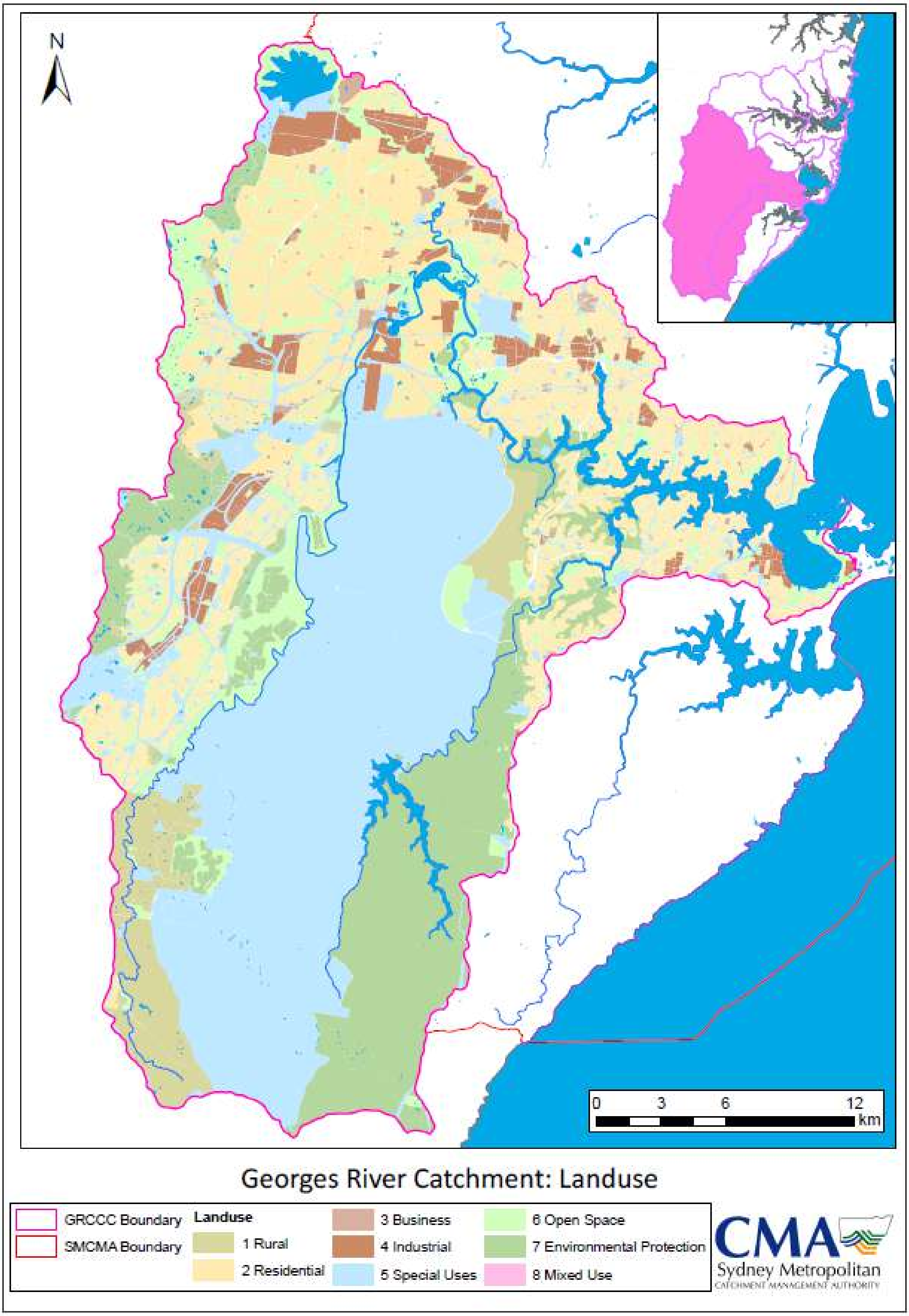
	students to improve their rain gauge if needed. ♦ Extension Activity: This extension activity involves students undertaking a scientific experiment to compare the filtration capacity of different soils (e.g. gravel, sand, potting mixture) and/or the amounts of salt in water from different sources (e.g. tap water, seawater). The activity demonstrates filtration of water when passing through soils and that dissolved substances (e.g. salt) are left behind when water evaporates. Develop a hypothesis about whether water from different sources will leave behind different amounts of salt when they evaporate. Briefly, tap water or water collected from Botany Bay (500 mL) should be poured into shallow baking trays with dark colouring, allowed to evaporate over two days and the amount of salt left behind observed. Are there differences in the amount of salt left behind from different water sources? The same water should be poured through gravel, sand or potting mixture placed in pots with holes in the bottom, with the shallow trays used to capture the water. The water should be allowed to evaporate and the amount of salt left behind observed. If it is difficult to source different types of water, 'pollutants' could also be added to the water (e.g. dirt, oil, food colouring) to compare the filtration capacities of gravel vs sand vs potting mixture. Black or brown jelly beans with the outer covering pierced with a fork work well as pseudo-poo (showing that the solid part can be filtered when water passes through the soil, but the dissolved colouring is not, as dissolved pollutants like excess nutrients would not be filtered). This website contains more information for an experiment involving allowing water from different sources to evaporate and observing how much salt is left behind, but the activity can be modified to suit available resources: https://scientistinresidence.ca/pdf/earth-science/Water%20PDF/SRP_Water_Lesson%202%20WF.pdf This activity leads nicely into the urban water cycle information, because soils are being replaced with hard surfaces that have none of the filtration capacity of soils.**ST3-1WS-S** ♦ Use the second 'Playground fact' to reinforce that the substances that water can carry change as it moves through the water cycle, e.g. salt is left behind when water evaporates, so salty water is converted to fresh water.
Resources	> Anatomy of a raindrop http://education.abc.net.au/home#!/media/1575211/anatomy-of-a-raindrop > Water cycle diagram https://easyscienceforkids.com/all-about-the-water-cycle/ > Evaporation experiments https://scientistinresidence.ca/pdf/earth-science/Water%20PDF/SRP_Water_Lesson%202%20WF.pdf
Feedback	Your feedback is important to us. Please complete this quick online survey: http://bit.ly/ModulesFeedback

Playground fact:

Most of the water on Earth today is the same water that occurred during the time of the dinosaurs and has just been travelling continuously through the water cycle over millions of years. So, the water that you drink today could have been the same water that a dinosaur drank 100 million years ago!

Playground fact:

It is estimated that if it were possible to take all of the salt out of the ocean and spread it evenly across land, the salt would form a continuous layer more than 160 metres deep!


N
0 3 6 12
km
Georges River Catchment: Landuse
GRCCC Boundary
SMCMA Boundary
Landuse
1 Rural
2 Residential
3 Business
4 Industrial
5 Special Uses
6 Open Space
7 Environmental Protection
8 Mixed Use
CMA
Sydney Metropolitan
CATCHMENT MANAGEMENT AUTHORITY

Georges Riverkeeper

Water... WOW!

STAGE 3 EDUCATION

Module 5: Water for Living Cities

People interfere with the natural water cycle in various ways. In urban areas, the water cycle is altered by: the capture and distribution of fresh water through pipes for people to use; the piping of household wastewater to sewage treatment plants; and, directing stormwater from hard urban surfaces into drainage systems.

In this module, students will:

- consider how humans alter the water cycle
- determine where water flows when it rains in their schoolyard
- create a drainage map of their school

www.georgesriver.org.au

Module 5: Water for Living Cities

Stage 3 Geography | Stage 3 Science | inside | outside | linkage concept: branching

Teacher Background

The Urban Water Cycle (GE3-2: Explains interactions and connections between people, places and environments, GE3-3: Compares and contrasts influences on the management of places and environments, ST3-1WS-S: Plans and conducts scientific investigations to answer testable questions, and collects and summarises data to communicate conclusions)

In *Module 4: Catching Water*, students learned about how water moves through the natural water cycle, including being filtered as it passes through soils. The urban water cycle is very different from the natural water cycle. In urban landscapes, water is redirected for human uses and receives less natural filtration, but this is countered by passing water through treatment plants in the supply and wastewater chain.

People interfere with the natural water cycle in various ways. In urban areas, the water cycle is altered by: the capture and distribution of fresh water through pipes for people to use; the piping of household wastewater to sewage treatment plants; and, directing stormwater from hard urban surfaces into drainage systems.

Water Distribution Networks

Branching is used as a linkage concept that will reappear throughout *Georges Riverkeeper Stage 3 Education Modules*, here in the context of urban water distribution networks. Each time that branching is mentioned through the modules, ask students to reflect on how branching networks through which water-based substances flow contribute to carrying materials from one place to another. Repetition of this concept should reinforce the importance of the ability of water to carry substances through branched networks, which is one of the main reasons that water is so important for people.

Recall the natural branched networks of blood vessels within our body and streams across catchments through which water flows through, which were mentioned in previous modules. Water also flows through human-made branched networks for distribution across urban areas.

Household Water Supply

Large dams are built to halt the flow of rivers and catch the water that supplies our cities. In the Georges River catchment, there are dams on the Woronora River and at Prospect Reservoir. The water supply network functions quite differently than the natural watercycle, with water travelling large distances through pipes than have no capacity for filtration. Because of the lack of filtration whilst traveling from place to place, water is purified before redistribution through pipes and to people's taps.

Sydney Water supplies over 1.5 billion litres of drinking water to homes and businesses each day. About 80% of it comes from Warragamba Dam, located on the Nepean River near the Blue Mountains. Water is treated at one of nine water filtration plants, or the Kurnell desalination plant, and supplied through a network of 22,822 kilometres of pipes, 247 reservoirs and 151 pumping stations.

Wastewater Network

The wastewater network also involves lots of pipes. These pipes take dirty water from the sinks, drains and toilets in our homes to wastewater treatment plants. At those plants, the water is cleansed using processes of filtration and biological uptake that mimic those occurring in the natural water cycle, before being released to the environment. Sydney Water's wastewater network consists of 16 wastewater treatment plants, 14 water recycling plants, 686 wastewater pumping stations and 45,863 kilometres of pipes. Most of the wastewater in the network flows downslope, powered by gravity, to wastewater treatment plants.

Stormwater Network

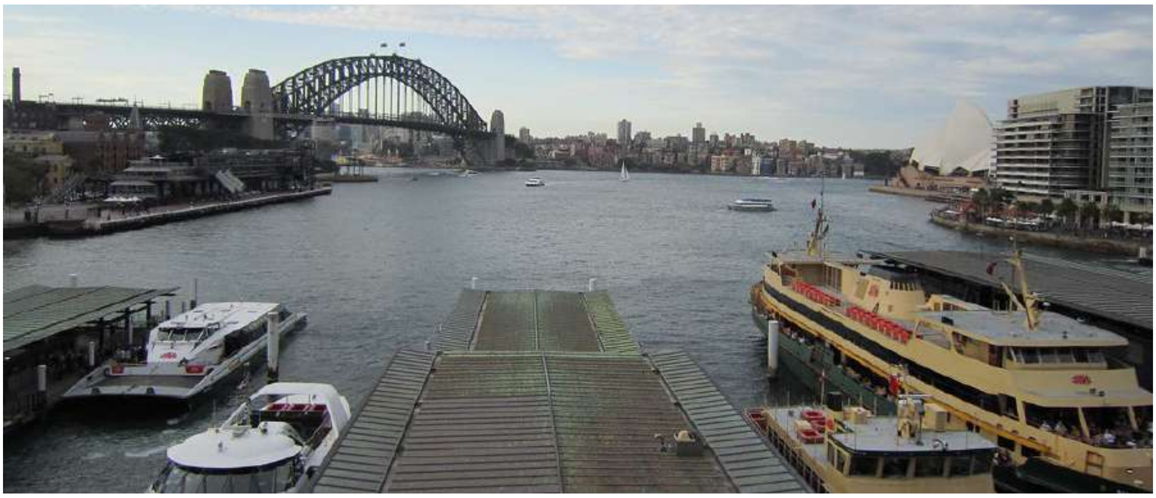
Urban areas have many hard surfaces such as roofs, roads and footpaths, which prevent rain from soaking into the ground. Stormwater is the water that flows across such hard surfaces after rain. Additionally, there are many more potential pollutants in urban areas than in forests. For example, stormwater pollution can include oils, detergents and tyre residue that runs off roads; fertilisers, pesticides and lawn clippings that run off lawns and gardens; sediment that runs of poorly maintained construction sites; and, any other pollutants that are thoughtlessly disposed of down outdoor drains. Stormwater flowing down drains does not travel to wastewater treatment plants, it flows to natural waterways untreated.

Sequence for Module 5: Water for Living Cities	
Syllabus Outcomes	**GE3-1** Describes the diverse features and characteristics of places and environments. **GE3-2** Explains interactions and connections between people, places and environments. **GE3-3** Compares and contrasts influences on the management of places and environments. **GE3-4** Acquires, processes and communicates geographical information using geographical tools for inquiry. **ST3-1WS-S** Plans and conducts scientific investigations to answer testable questions, and collects and summarises data to communicate conclusions.
Learning Intentions	For students to: ♦ determine where water flows when it rains in their schoolyard ♦ create a drainage map of their school ♦ explore and map where water goes on school premises when it rains
Teaching & Learning Activities	Inquiry Question: *How do we change the natural environment?* ♦ Revisit the imagined stories that students created following the Tiddalik the Frog story about water distribution in Module 3 and the Inquiry Question: Where does water come from and where does it go? Ask students about their ideas about where does water in our home really come from and where does it really go to. Use the 'Playground fact' to remind students that humans have always relied upon a source of fresh water for their survival, although we have become increasingly detached from where our water is sourced over time. ♦ Schoolyard drainage mapping (see page 29 for an example) - Using Google Maps, print a map of your school. Mark NORTH on the map. Take a tour of the school yard and map out all the drains, marking their location with a star on the map. Extension: Can you add a scale bar to your map to show distance? **GE3-1, GE3-4** ♦ Activity: mapping drainage around the school - When it rains at school, where does water go? Which drains collect water? Form a hypotheses stating where water will flow when it rains. Pour water from a watering can at various locations across the school to determine in which direction water will drain away from the schoolyard. Draw arrows on your map showing drainage directions across hard surfaces or crosses for locations where you tested and the water infiltrated into the soil, rather than flowed towards drains. Add a legend to show drains, direction of water flow across hard surfaces and where water infiltrates the ground. **GE3-3, GE3-4** ♦ Discuss how the natural environment within the school yard has been changed over time. Compare how many drains occur around hard surfaces (e.g. asphalted areas), compared to how many occur around open surfaces (e.g. grassed areas). **GE3-2, GE3-3**

	💧 Using your aerial image of the school, estimate the percentage of the school covered by hard surfaces (e.g. roofs, paths, carparks, asphalt, hardened playgrounds). How do hard surfaces affect where rain goes? If there were no hard surfaces at all, where would rainfall go? **GE3-2, GE3-3, GE3-4** 💧 What about rubbish when it rains? Drop some confetti on the ground in various locations and observe and map where it goes when water is poured from a watering can. Map where it will go. (Much will go down the drain). How does rubbish and hard surfaces affect our waterways when it rains? **GE3-3, ST3-1WS-S**
Feedback	Your feedback is important to us. Please complete this quick online survey: http://bit.ly/ModulesFeedback

Playground fact:

Sydney city is located where it is today because the Tank Stream, which flowed into the harbour under what is now Circular Quay, provided fresh water to early British settlers. Unfortunately, it took less than 40 years for those settlers to pollute the stream so badly that it became undrinkable, being used instead as a sewer that was later directed through stone tunnels as the city grew above it. Until the late 1800s, sewage continued to be discharged untreated into Sydney Harbour.
See https://www.sustainabilitymatters.net.au/content/wastewater/article/history-of-wastewater-treatment-in-sydney-311574744 for more history of Sydney's wastewater treatment.




Drains
Direction of water flow indicated by arrows
Water infiltrates ground
N
10 metres

Georges Riverkeeper

Water... WOW!

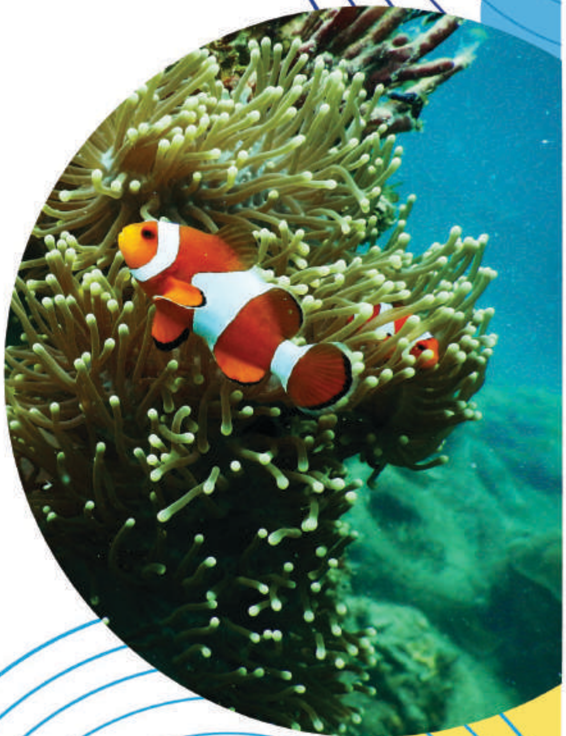
STAGE 3 EDUCATION

Module 6: Living Things in Water

All plants and animals are adapted to survive in specific environments, which excludes them from living in other environments in which they are not adapted to live.

In this module, students will:

- identify animals that live in waterways
- consider the meaning of 'adaptation'
- explore examples of animal and plant adaptations
- classify aquatic animals according to their physical traits



www.georgesriver.org.au

Module 6: Living Things in Water

Stage 3 Science

inside

linkage concept: branching

Teacher Background

Adaptations of Plants and Animals Living in Water (ST3-4LW-S: Examines how the environment affects the growth, survival and adaptation of living things)

In *Module 4: Catching Water* and *Module 5: Water for Living Cities*, students learned about the natural water cycle and how it is altered by humans changing their environments from forested to hardened urban landscapes. This has implications for all plants and animals. All plants and animals are adapted to survive in specific environments, which excludes them from living in other environments in which they are not adapted to live. Plants and animals need to be adapted to the conditions and resources in their environment. Conditions are things that affect survival, but are not consumed, like temperature and the salinity of water. An adaptive trait to enable an animal to cope with low temperature could include a thick layer of fat or fur. Resources are things that affect survival and are 'consumed' (that is, there is a limit to how much resource is available, so if you are not as good as others in the environment at accessing the resource, you will miss out!). Resources include nutrients for plants, food for animals and space for both plants and animals. An adaptive trait enabling predators to capture limited prey resources could include being faster than the prey and others trying to capture the prey.

An example showing how adaptations are suited for a particular environment is the adaptation of camels to survive in the dry conditions and with the limited resources (particularly, low water availability) prevailing in deserts. The traits of camels include the ability to forego drinking water for a couple of weeks (recall the 'Playground fact' from *Module 1: Water for Life*) whilst travelling through the desert, nostrils that can close and long eyelashes to keep desert sands out of the nose and ears during a sandstorm, etc. But, those traits are not useful for surviving in a rainforest, on a coral reef or in a city.

There are a few key differences in the conditions affecting survival on land and in water, with corresponding differences in traits, e.g.

- Water is denser and therefore harder to move through than air. Many animals that live in water have streamlined bodies to minimise the resistance pushing against them as they are moving through water.

- All animals need to maintain internal body warmth to function, but heat is taken away from the body more by water than air. Many of the animals that live in water near the cold poles have a thick layer of fat to insulate their bodies.

- Not much food travels through the air, but lots of food is suspended in water and travels around on water currents. There are few animals that create traps or have feeding structures designed to filter food flowing through air (spiders building webs is the exception), but lots of animals filter food from water, including sponges, barnacles, corals, oysters, some ducks, many fish, jelly blubbers, krill, baleen whales and flamingos.

- All plants and animals require oxygen for metabolism, but there is less oxygen in water than in air. Some animals overcome this by coming to the surface and breathing air, whereas fish have gills (see below).

Animals Adaptation: Fish Gills

Breathing requires extracting oxygen from the surrounding environment and disposing of carbon dioxide from the body. We do this by drawing air into our lungs, but most fish breathe underwater using gills. The challenge when breathing underwater is that it contains only about one twentieth the amount of oxygen that occurs in air. Fish pull water through their mouths and are constantly actively pumping it over their gills, which have lots of exposed surface area to facilitate the extraction of the relatively small amount of oxygen in water. The high surface area of gills is a crucial adaptation allowing fish to breathe in water.

Plant Adaptation: Mangrove Pneumatophores (ST3-4LW-S: Examines how the environment affects the growth, survival and adaptation of living things)

Branching is used as a linkage concept that will reappear throughout *Georges Riverkeeper Stage 3 Education Modules*, here in the context of the root networks of plants such as mangroves. Each time that branching is mentioned through the modules, ask students to reflect on how branching networks through which water-based substances flow contribute to carrying materials from one place to another. Repetition of this concept should reinforce the importance of the ability of water to carry substances through networks, which is one of the main reasons that water is so important for people.

Recall the branched networks of blood vessels within our body, streams across catchments and urban distribution infrastructure through which water flows through, which were mentioned in previous modules. Water also flows through branched roots of trees.

By using root ‘snorkels’, mangroves cope with low oxygen in saturated soils in a different way than fish cope with low oxygen in water. The branching roots (pneumatophores) bring oxygen back to the whole plant so that it can survive in saturated soils. Branching roots also carry water from the ground up through the trunk and to all branches, so that all of the tree has adequate water and nutrients that are carried in water.

Sequence for Module 6: Living Things in Water	
Syllabus Outcomes	**ST2-4LW-S** Compares features and characteristics of living things and non-living things. **ST3-4LW-S** Examines how the environment affects the growth, survival and adaptation of living things.
Learning Intentions	For students to: ♦ identify animals that live in waterways ♦ explain the meaning of 'adaptation' ♦ give examples of animal adaptations ♦ explain how gills help fish breathe ♦ write an informative text on mangrove adaptations ♦ explain the role of pneumatophores ♦ classify aquatic animals according to their physical traits
Teaching & Learning Activities	Inquiry Question: *How do the structural features of living things support survival?* ♦ Students brainstorm and list animals that live in a waterway. From this list, print or draw these animals for a classification activity later in the module (alternatively, use the images provided within this module, page 35). ♦ Introduce the term *adaptation*. What does this mean? Provide students with an example of an animal adaptation. For example: An ibis has long legs for wading and a long, curved beak for probing in mud searching for food. Its head and top of neck are bare of feathers allowing its head to be lightweight after probing for food in the water. Feathers on its head would become heavy when wet. **ST2-4LW-S** ♦ View: How do fish gills function? Write an explanation to show understanding of how gills help a fish to breathe. **ST3-4LW-S** ♦ Why are mangrove trees special? Mangroves have unique adaptations that allow them to survive. View this 7 minute video explaining survival and adaptation of mangroves. From the information presented in the video, write an informative text explaining the importance of mangrove adaptations. Mangrove don't have gills, so how do they breathe when their roots are in water? Explain the role of pneumatophores. **ST3-4LW-S** Inquiry Question: *How can we group living things?* ♦ Use the 'Playground fact' to encourage students to think about the advantages of particular traits for animals living in water: consider why do some very different animals living in the same

	environment have similar traits? ♦ All animals have adapted features that help them survive in their environment. Using the images of (25) aquatic animals, ask students to classify these animals according to their physical traits. **ST2-4LW-S** - Using the (25) animals provided, cut the sheet up into individual animals - Distribute the animals across the class, so that each student has one animal - Divide the class into two groups. Ask each group to think about the physical traits of their animals (the second table provided within this module has some suggestions of obvious traits for each animal) and how their animals could be divided into different groups based on similarities/differences in traits. - Students could divide their animals into two groups, based on traits (e.g. one group of animals may have webbed feet or fins, the other without webbed feet or fins), then the other group of students could look at the animals within the two groups and be asked whether they know the trait that was used for classification into each group OR students could be challenged to keep dividing their animals into groups until they can't go any further, writing the traits used for each division on the back of their animal cards as they move through the exercise. - Think of why the traits that you have identified are useful for animals living in water. Ask each student to describe one trait of their animal that is adapted for life in water.
Resources	> How do fish breath? https://www.youtube.com/watch?v=zj5v3n6NIm8 > How do mangrove trees live in mud and sea water? http://education.abc.net.au/home#!/media/85976/how-do-mangrove-trees-survive- > 25 aquatic animals for classification (page 35) + accompanying table with traits (page 36)
Feedback	Your feedback is important to us. Please complete this quick online survey: http://bit.ly/ModulesFeedback

Playground fact:

Animals with very different ancestors and evolutionary histories have ended up with similar physical traits that work well in particular environments. For example, in open water streamlined bodies with large, flat appendages for propulsion work well and animals with this body shape include fish, reptiles (e.g. turtles), mammals (e.g. seals, dolphins and whales) and birds (e.g. penguins). The evolution of similar traits in different animals is called convergent evolution.

Platypus - *mammal* - *bones* - *fur* - *webbed feet* - *rounded bill*	**Turtle** - *reptile* - *bones* - *scales* - *hard shell* - *flippers*	**Shark** - *fish* - *bones* - *gills* - *fins* - *big teeth*	**Duck** - *bird* - *bones* - *feathers* - *wings* - *webbed feet*	**Frog** - *amphibian* - *bones* - *webbed feet* - *slimy* - *four limbs*
Marlin - *fish* - *bones* - *scales* - *big fin* - *long nose spike*	**Crab** - *no bones* - *hard shell* - *six legs* - *nippers*	**Anemone** - *no bones* - *soft body* - *attached to rock* - *tentacles*	**Eel** - *fish* - *bones* - *slimy* - *long body* - *long fin*	**Penguin** - *bird* - *bones* - *webbed feet* - *flightless wings* - *streamlined*
Pelican - *bird* - *bones* - *feathers* - *big beak* - *webbed feet*	**Seasnail** - *no bones* - *hard shell* - *soft body* - *no limbs*	**Dugong** - *mammal* - *bones* - *flippers* - *streamlined* - *whiskers*	**Dragonfly** - *insect* - *no bones* - *wings* - *big eyes* - *six legs*	**Sealion** - *mammal* - *bones* - *fur* - *big teeth* - *flippers*
Stingray - *fish* - *bones* - *flat body* - *long tail*	**Jelly blubber** - *no bones* - *soft body* - *tentacles*	**Seahorse** - *fish* - *bones* - *small fins* - *long nose* - *curled tail*	**Seastar** - *no bones* - *no eyes* - *no fins* - *no teeth* - *five arms*	**Bream** - *fish* - *bones* - *scales* - *gills* - *fins*
Lobster - *no bones* - *hard body* - *long feelers* - *long tail*	**Octopus** - *no bones* - *soft body* - *eight arms* - *large eyes*	**Tadpole** - *bones* - *streamlined* - *long tail* - *slimy*	**Dolphin** - *mammal* - *bones* - *blow hole* - *fins* - *streamlined*	**Crocodile** - *reptile* - *bones* - *four legs* - *big teeth* - *long tail*

Georges Riverkeeper

Water... WOW!

STAGE 3 EDUCATION

Module 7: Aquatic Food Webs & Life Cycles

To live and grow, all life on Earth needs energy and nutrients, this is why plants and animals have adapted to capture those resources.

There are many food chains in watery environments or ecosystems, and together these create complex food webs.

In this module, students will:

- compare the life cycles of aquatic animals
- create a food web to show how environments and living things are interdependent

www.georgesriver.org.au

Module 7: Aquatic Food Webs & Life Cycles

Stage 3 Science

inside

Teacher Background

Food Webs in Watery Environments (ST3-4LW-S: Examines how the environment affects the growth, survival and adaptation of living things)

In Module 6: Living Things in Water, students learned about how some plants and animals are adapted to living in water. To live and grow, all life on Earth needs energy and nutrients, so plants and animals must be adapted to capture those resources. Plants are called producers because they can create their own energy if they have access to sunlight, nutrients and water. Conversely, consumers cannot create their own energy, they get energy by eating other life forms. Consumers can be herbivores that eat plants, carnivores that eat animals, omnivores that eat both plants and animals (e.g. people are omnivores) or detritivores that eat dead plants or animals. The pathway of energy and nutrients flowing from producers to herbivores to carnivores through to top predators is called a food chain. There are many food chains within each aquatic ecosystem and together these create complex food webs. All the plants and animals living in an aquatic ecosystem are interconnected and dependent upon each other through the food web.

Aquatic Life Cycles (ST3-4LW-S: Examines how the environment affects the growth, survival and adaptation of living things)

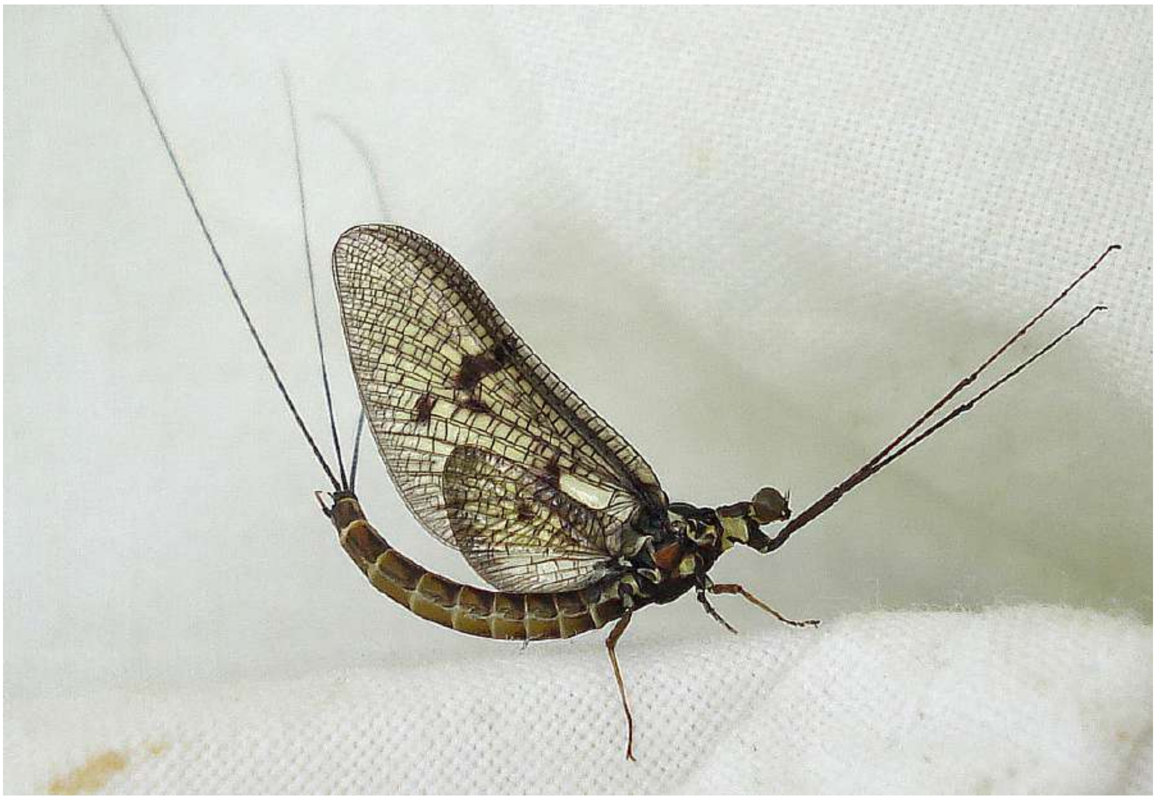
In some cases, there are extreme changes in the traits of animals as they pass through different life stages. Students probably know about the life cycle of frogs → eggs → tadpoles → frogs. They may not know that there are many insects that lay their eggs in water, live in water as juveniles and then emerge from water as flying adults. These include mosquitoes, stoneflies, mayflies, caddisflies and dragonflies.

Sequence for Module 7: Aquatic Food Webs & Life Cycles	
Syllabus Outcomes	**ST3-4LW-S** Examines how the environment affects the growth, survival and adaptation of living things.
Learning Intentions	For students to: ♦ revise that living things have life cycles ♦ compare the life cycles of two aquatic animals ♦ investigate the lifecycle of an aquatic macroinvertebrate, such as a dragonfly ♦ create a food web to show how environments and living things are interdependent
Teaching & Learning Activities	Inquiry Question: *What are the similarities and differences between the life cycles of aquatic living things?* ♦ Students to investigate life cycles of aquatic animals, including insects that lays its eggs in water such as mosquitoes and dragonflies. Have students search for information about life cycles of different aquatic animals (e.g. frogs, dragonflies, mayflies, eels, corals), draw and label the stages of the life cycle. How does the life cycle differ between different aquatic animals? **ST3-4LW-S** ♦ Use the 'Playground fact' to reinforce that some animals that live in water during essential developmental stages can metamorphose and dramatically change their body shape and lifestyle. Dragonfly emergence is another example of a transition from the aquatic to terrestrial stage of the life cycle involving metamorphosis. ♦ Discuss the essential resources animals need for survival (food, water, shelter). Brainstorm what food certain animals eat. Using string and the animal cards from the previous module, create a food web for understanding the interconnectedness of all living things. There are many different types of ecosystem and food webs, such as this stream food web. ♦ What is an ecosystem? Why are ecosystems important? Review 7 minute video from Module 6 explaining survival and adaptation of mangroves. List the animals dependent on the mangrove wetland for survival. Use the activities in this link to consider what it means to be a healthy ecosystem? **ST3-4LW-S** ♦ Compare the way that different aquatic animals capture food: dragonfly stalking, humpback whale using bubble nets and porcelain crab filter feeding.
Resources	> Dragonfly emergence https://www.youtube.com/watch?v=CyIF7eX6qmo > String food web exercise https://scientistinresidence.ca/pdf/life-

	science/Aquatic%20Ecosystems/SRP_Aquatic%20Ecosystems_Lesson%205%20WF.pdf > Stream food web https://www.researchgate.net/figure/A-generalised-diagram-showing-reciprocal-flows-of-invertebrate-prey-and-inputs-of-plant_fig1_227642618 > How do mangrove trees live in mud and sea water? http://education.abc.net.au/home#!/media/85976/how-do-mangrove-trees-survive- > What it means to be a healthy ecosystem https://stemlyndalesc.weebly.com/what-does-it-mean-to-be-a-healthy-ecosystem.html > Dragonfly hunting https://www.youtube.com/watch?v=W557aSVdW_g > Humpback whale bubble net https://www.youtube.com/watch?v=Q8iDcLTD9wQ > Porcelain crab feeding https://www.youtube.com/watch?v=-4atIpzhzJM
Feedback	Your feedback is important to us. Please complete this quick online survey: http://bit.ly/ModulesFeedback

Playground fact:

Mayflies live most of their lives in water, where they walk or swim, only having the capacity to fly as short-lived adults. Some species have immature stages that grow in unpolluted streams for up to several years. They climb out of the water and transform into adults only to reproduce. Adults do not feed and the digestive system is filled with air, so their energy stocks only allow a short burst of activity. The shortest lifespan of any adult mayfly species is only five minutes!



Georges Riverkeeper

Water... WOW!

STAGE 3 EDUCATION

Module 8: Water Pollution

Most of the pollutants going into waterways now come from stormwater. Anything that goes down an outdoor drain is destined to end up in the local waterway. These pollutants effect the environment and humans.

In this module, students will:

- investigate the types and causes of urban stormwater pollution
- learn how human activities can result in water pollution
- predict what pollutes water bodies
- identify and dramatise ways to stop water pollution

www.georgesriver.org.au

Module 8: Water Pollution

Stage 3 Drama | Stage 3 Geography | Stage 3 Science

inside

linkage concept: branching

Teacher Background

Sources of water pollutants (GE3-2 explains interactions and connections between people, places and environments)

Branching is used as a linkage concept that will reappear throughout *Georges Riverkeeper Stage 3 Education Modules*, here in the context of pollution entering river and stream networks. Each time that branching is mentioned through the modules, ask students to reflect on how branching networks through which water-based substances flow contribute to carrying materials from one place to another. Repetition of this concept should reinforce the importance of the ability of water to carry substances through networks, which is one of the main reasons that water is so important for people.

Recall the branched networks of blood vessels within our body, streams across catchments, urban distribution infrastructure and tree roots through which water flows through, which were mentioned in previous modules. Because water flows through networks, it can carry useful substances from one place to another, but it also does the same with pollutants.

In *Module 6: Living Things in Water* and *Module 7: Aquatic Food Webs & Life Cycles*, students learned that plants and animals are adapted to particular environments. Given that adaptations evolve over many generations, it is not possible to instantly adjust to enable survival if there are large changes in an environment, such as occurs when forest is converted to an urban landscape. As explained in *Module 5: Water for Living Cities*, this alters the water cycle and dramatically increases the pollutant loads in waterways.

There is a common misconception that most water pollution comes from industrial discharges. There was far more untreated industrial pollution entering waterways prior to the 1970s than there is today, with the idea that 'the solution to pollution is dilution'. However, it became increasingly evident that waterways were being overwhelmed by industrial pollutants. Regulations were introduced to reduce the amount of industrial pollutants entering waterways. There are still some legacies from earlier practice of discharging untreated industrial pollutants directly into waterways, e.g. heavy metals bind to sediments and have accumulated in river beds.

Most of the pollutants going into waterways now come from stormwater. Over 90% of the pollutants entering the Georges River come in stormwater. Remember that water is very good at transporting materials that float and in solution. Also recall the branching networks of streams which converge and form larger rivers: so streams are able to collect pollutants from a broad area across which the branching network spreads. In urban areas, stormwater runs across hard surfaces that have minimal filtration capacity. Stormwater picks up oils, detergents and tyre residue that runs off roads; fertilisers, pesticides and lawn clippings that run off lawns and gardens; sediment that runs of poorly maintained construction sites; and, any other pollutants that are thoughtlessly disposed of down outdoor drains. Water flowing through stormwater systems made from concrete (including stormwater channels and underground pipes) picks up more pollutants that dissolve from concrete. The drain is for rain! Anything other than rain that goes down outdoor drains is a pollutant.

Unlike the water flushed down our toilets or going down indoor sinks into the sewage system, water that enters the stormwater system is not treated before being discharged to waterways. So, anything that goes down an outdoor drain is destined to end up in the local waterway. Water in sewage systems travels to treatment plants for purification prior to discharge. But, sometimes there are leaks in the pipes of sewage systems that introduce pollutants into waterways. For more information about pollution in the Georges River see the factsheet.

Effects of Pollution (ST3-4LW-S Examines how the environment affects the growth, survival and adaptation of living things, GE3-2 explains interactions and connections between people, places and environments, GE3-3 compares and contrasts influences on the management of places and environments.)

As mentioned above, there are many different types of pollutants that enter waterways. These pollutants have many different effects, including damaging natural environments and also reducing opportunities for human uses. The Georges River can be used as a case study to show how effects vary across a river. In the upper river, the river flows through natural forest and supports highly diverse communities of native plants and animals. The water is clean, safe for swimming and even for drinking with minimal additional treatment (e.g. the Woronora Dam captures water for household use). However, there is much urban development around the streams that enter the middle of the river. Those streams receive much stormwater. Weeds thrive with the nutrients supplied in stormwater, but there are few native animals that can survive in such polluted water. It is not safe to swim in the polluted water and it is certainly not safe to drink it. Given the high concentrations of pollutants that may be accumulated in the bodies of fish, there are warnings that fish captured from the middle reaches of the river should not be eaten (see below). At the bottom of the river, tides do a reasonable job of flushing out pollutants in water (reflected in improved grades for water quality on Report Cards). It is possible to swim and eat fish captured towards the bottom of the river, but many native species struggle to cope with water pollution and other pressures from human developments impacting the lower river and Botany Bay. For example, Captain Cook first named the bay 'Stingray Bay' owing to frequent stingray sightings, but stingrays are now a rare sighting. Botany Bay was known as a highly productive estuary for fishing in the 1880s, but commercial fishing ended in 2002 and native fish are not as abundant as they were historically. Also, Georges River once supported one of the most highly productive oyster cultivation industries in NSW, but that industry was decimated by pollution and disease.

Sequence for Module 8: Water Pollution	
Syllabus Outcomes	**ST3-4LW-S** Examines how the environment affects the growth, survival and adaptation of living things. **GE3-2** Explains interactions and connections between people, places and environments. **GE3-3** Compares and contrasts influences on the management of places and environments. **DRAS3.3** Devises, acts and rehearses drama for performance to an audience.
Learning Intentions	For students to: ♦ define 'stormwater' ♦ investigate the types and causes of urban stormwater pollution ♦ how human activities can result in water pollution ♦ predict what pollutes water bodies ♦ identify & dramatise ways to stop water pollution
Teaching & Learning Activities	Inquiry Question: *How does stormwater affect our environment?* ♦ Students define the term 'stormwater'. **GE3-2, GE3-3** ♦ Students investigate the types and causes of urban stormwater pollution. Where do stormwater pollutants originate from? What are the various sources of stormwater pollutants? (e.g. fuel and oil on roads, litter, sediment from building sites, garden clippings & leaves, dog droppings, fertilisers & detergents). How is stormwater pollution harmful? How can we prevent it? This hands-on water pollution activity may be undertaken by the teacher for students to predict what pollutes water bodies and to identify ways to stop water pollution. **GE3-2, GE3-3** ♦ Once pollutants enter our waterways, what happens next? How does pollution affect aquatic animals and their food source? Students watch the video Toxic Silt in Sydney Harbour (2:58) and discuss the impacts of contaminants in our oceans. How do toxins in the food chain affect us? (It is suggested that teachers provide a copy of the video transcript to students to tackle unfamiliar terms and unpack the content).**GE3-2, GE3-3, ST3-4LW-S** ♦ Use the 'Playground fact' to reinforce that plastic pollution entering our waterways is a major issue that requires a solution. ♦ Students plan and present a dramatisation that effectively highlights how pollution can enter our waterways, as well as promoting ways to prevent water pollution. **DRAS3.3**
Resources	> Water pollution activity https://www.watercorporation.com.au/home/education/teaching-resources/find-a-lesson-plan/lesson-plan/water-pollution > Toxic silt in Sydney Harbour http://education.abc.net.au/home#!/media/30105/

Feedback	Your feedback is important to us. Please complete this quick online survey: http://bit.ly/ModulesFeedback

Playground fact:

Over 300 million tonnes of plastic is produced every year, about 100 million tonnes of which ends up in the environment and does not decompose. The litter we produce is the equivalent of dumping a full garbage truck of plastics into the ocean every minute of the year. By 2050 the weight of plastic in the ocean is predicted to be more than the weight of fish in the ocean.

Georges Riverkeeper

Water... WOW!

STAGE 3 EDUCATION

Module 9: Scientific Water Testing (Field Trip or Game)

It is infeasible to measure all of the pollutants that may exist in a waterway. Instead, scientists monitor 'indicators' such as water bugs to measure the condition of waterways.

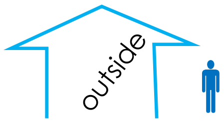
In this module, students will:

- understand the meaning of tolerant and sensitive water bugs
- observe water bugs from their local waterway
- identify water bugs using a Waterbug Identification Guide, as an indicator of the quality of the water from which the bugs were collected

www.georgesriver.org.au

Module 9: Scientific Water Testing (Field Trip)

Stage 3 Geography | Stage 3 Maths | Stage 3 Science



Teacher Background

Measuring Water Pollution (GE3-2 explains interactions and connections between people, places and environments.)

In *Module 8: Water Pollution*, students learned about the sources and effects of water pollution. It is possible to measure water pollution directly using probes or collecting samples for analyses in scientific laboratories. But, there are many pollutants that have many different effects. Also, many of the worst pollutants do not stink or make water dirty; they are largely invisible, although they can have serious consequences for natural environments and human health. It is infeasible to measure all of the pollutants that may exist in a waterway. Instead, scientists monitor 'indicators', which provide an indication of the suitability of waterways for different uses, the relative condition of the waterway and the likelihood of the presence of a suite of other unmeasured pollutants.

Sometimes the choice of pollutant that is measured may be determined by the intended use of a waterway, with different levels of purity required for different uses. Drinking water needs to be extremely clean, the water we swim in should be very clean, whereas if the water is being used to water sportsfields, it doesn't need to be as clean. For example, at swimming bathes the main health concern is a nearby sewage spill, which can be assessed by measuring bacterial concentrations.

Another reason for using indicators is that some pollutants of water have lingering effects even after the pollutant itself has been washed away and is no longer detectable. For example, if a large amount of old pesticide was thoughtlessly poured down a drain, it would wipe out most of the animals in the local waterway and the effects could be seen even after the pesticide itself had been washed further downstream. Often it is more practical to measure the effects of a pollutant, rather than trying to capture the pollutant itself.

Using Waterbugs to Measure Condition of Waterways (ST3-4LW-S Examines how the environment affects the growth, survival and adaptation of living things. GE3-3 compares and contrasts influences on the management of places and environments.)

In *Module 6: Living Things in Water*, students learned about adaptations of animals to living in water. They have adapted to living under certain environmental conditions. But, if those environmental conditions change, particularly if they change rapidly, the animal may not be adapted to the new conditions. Animals can be sensitive to changes in water quality, the amount and speed of water flow, and the habitat available in waterways. These are all altered by the introduction of stormwater to waterways near urban areas. So, we can sample water bugs as an indicator of how much waterways have been altered. Those waterways that flow through forest usually have lots of different native waterbugs that can survive within the undisturbed environment. Conversely, there are only a few waterbugs that can survive in highly disturbed waterways. If only fly larvae, snails and leeches survive in a waterway, it tells us that the waterway is very unhealthy. This is an easier way to measure the condition of the waterway than trying to measure all potential pollutants, because there are a multitude of pollutants in some waterways.

Sequence for Module 9: Scientific Water Testing	
Syllabus Outcomes	**ST3-1WS-S** Plans and conducts scientific investigations to answer testable questions, and collects and summarises data to communicate conclusions. **ST3-4LW-S** Examines how the environment affects the growth, survival and adaptation of living things. **GE3-3** Compares and contrasts influences on the management of places and environments. **MA3-17MG** Locates and describes position on maps using a grid-reference system.
Learning Intentions	For students to: ♦ locate their local waterway using Google Maps ♦ understand the meaning of tolerant and sensitive bugs ♦ observe freshwater macroinvertebrates from their local waterway ♦ identify freshwater macroinvertebrates using a Waterbug Identification Guide ♦ sketch and label a waterbug ♦ determine the quality of the water through observation and identification of waterbugs
Teaching & Learning Activities	Inquiry Question: *How can we test the quality of our local waterway?* ♦ What is the quality of our local waterway? Introduce students to the Waterbug Guide. Observe the pictures of waterbugs in the guide. What differing features do they have? Explain to students that certain waterbugs are sensitive or tolerant to pollution. If the water is polluted, sensitive bugs are the first to die. Tolerant bugs, on the other hand, are more resilient to the effects of pollution. What are some waterbugs on the identification guide that are known to students? **ST3-4LW-S** ♦ Using Google maps, locate the nearest local waterway. Watch the Waterbug Blitz instructional video and if possible, undertake a waterbug survey at the local waterway. Alternatively, contact Georges Riverkeeper or the Georges River Environmental Education Centre for advice about school excursions involving scientific monitoring along the Georges River. **MA3-17MG**, **ST3-1WS-S.** It is also possible to Download the Junior Waterwatch Teacher's Guide and Field Manual for many great waterway monitoring suggestions. ♦ Through identification of the waterbugs, students are challenged to determine the quality of their local waterway.**ST3-1WS-S** ♦ Students partake in a scientific sketch of one of the waterbugs identified from the water sample. Label adaptations beneficial for life in water, thinking back to Module 6. **ST3-4LW-S** ♦ For those unable to venture out to a local waterway, an alternative is the Catchment Detox game: Managing Australia's waterways is a huge challenge with climate change, increased

	demand for water and environmental problems putting our rivers under stress. This game & audio looks at catchment management. **GE3-3**
Resources	> Streamwatch Waterbug Guide https://media.australianmuseum.net.au/media/dd/Uploads/Documents/26879/Steamwatch%20Aquatic%20Macro%20Invertebrate%20Guide.914cd59.pdf > Waterbug Blitz instructional videos: https://www.waterbugblitz.org.au/Resources > Waterwatch manuals https://www.nswwaterwatch.org.au/resources/waterwatch-manuals > Catchment Detox http://www.abc.net.au/science/catchmentdetox/files/home.htm
Feedback	Your feedback is important to us. Please complete this quick online survey: http://bit.ly/ModulesFeedback

Contact list:

- Georges River Environmental Education Centre (https://georgesriv-e.schools.nsw.gov.au/, email: georgesriv-e.school@det.nsw.edu.au)
- Georges Riverkeeper (http://www.georgesriver.org.au/, email: contact@georgesriver.org.au)

Georges Riverkeeper

Water... WOW!

STAGE 3 EDUCATION

Module 10: Water Solutions

This module is largely open-ended and provides the opportunity to let students use their imaginations to come up with creative solutions to solve water problems, following the solution fluency process.

In this module, students will:

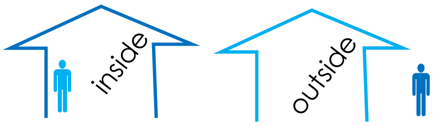
- review the benefits of water
- identify the problems associated with urban waterways
- work through the 6Ds of Solution Fluency to define a problem, plan and devise a solution and deliver their suggested solution

www.georgesriver.org.au

Module 10: Water Solutions

Stage 3 Geography

Stage 3 Science



Teacher Background

This module is largely open-ended and provides the opportunity to let students use their imaginations to come up with creative solutions to solve water problems, following the solution fluency process:

The 6Ds of Solution Fluency

• DEFINE: What is the problem that we face? (defining the problem or challenge)

• DISCOVER: What's causing the problem, and why do we need to solve it? (investigate and research the background of the problem)

• DREAM: What does the ideal solution look like? (consider the problem and develop a solution to it)

• DESIGN: How will we create our solution? (plan the initial framework for the solution)

• DELIVER: What will the production process look like? (the actual development stage of the task)

• DEBRIEF: Did the solution suit the purpose and the audience? (reflection on learning process and relevance of content, processes, skills or techniques)

Water Sensitive Urban Design

See the Pollution Prevention factsheet for an overview of present strategies for prevention of water pollution in the Georges River. At the end, it offers some simple tips for reducing pollution. But, it also alludes to higher level pollution prevention, including Water Sensitive Urban Design. There is also a factsheet providing an overview of Water Sensitive Urban Design. There is far more detailed information available about opportunities for a water sensitive greater Sydney, with a focus on benefits for people. Water sensitive designs, such as urban wetlands, can also provide habitats that support complex communities of native animals and plants.

There are also useful videos about things like raingardens, gross pollutant traps, and suggested activities in worksheets to use science and technology to solve Australia's water problems. But, this module is mainly designed to encourage students to apply their water knowledge and learnings for the other modules to consider what they regard to be a major water problem and then work through a solution.

Sequence for Module 10: Water Solutions	
Syllabus Outcomes	**ST3-1WS-S** Plans and conducts scientific investigations to answer testable questions, and collects and summarises data to communicate conclusions. **ST3-2DP-T** Plans and uses materials, tools and equipment to develop solutions for a need or opportunity. **ST3-3DP-T** Defines problems, and designs, modifies and follows algorithms to develop solutions. **GE3-2** Explains interactions and connections between people, places and environments. **GE3-3** Compares and contrasts influences on the management of places and environments.
Learning Intentions	For students to: ♦ to review the benefits of water in our community ♦ identify the problems associated with waterways and the urban water cycle ♦ work through the 6Ds of Solution Fluency to define a problem, plan and devise a solution and deliver their suggested solution ♦ present their solution to an audience
Teaching & Learning Activities	Inquiry Question: *Can we design a solution to an identified problem?* ♦ From reviewing the modules students list the problems associated with water. These may include shortage of water, water overuse or pollution. ♦ Using the 6Ds of Solution Fluency (*Define*, *Discover*, *Dream*, *Design*, *Deliver*, and *Debrief*: do a web search for more information and find that which best suits your class) students undertake a planning and designing process to find a solution to their identified problem. ♦ View the video Poop and Paddle: An Eco-Friendly Floating Toilet to stimulate the thinking process of designing a solution to a problem.
Resources	> Opportunities for a water sensitive greater Sydney https://watersensitivecities.org.au/wp-content/uploads/2016/06/47952-SW-GREATER-SYDNEY-DOCUMENT-JANUARY-2016-WEB-1.pdf > Raingardens https://www.youtube.com/watch?v=4pz8vHuGEHs > Gross pollutant traps https://www.youtube.com/watch?v=m9b05au0eAs > Using science and technology to solve Australia's water problems http://www.awa.asn.au/documents/Science2_Using_science_and_technology_to_solve_Australias_water_problems.pdf > Poop and paddle https://www.youtube.com/watch?v=sjvN2vt3kbg&feature=youtu.be
Feedback	Your feedback is important to us. Please complete this quick online survey: http://bit.ly/ModulesFeedback. We hope that teachers and students found the modules to be useful for learning about water and waterways.

Biographies of authors

Dr David Reid

David is a scientist who studies waterways for his work at Georges Riverkeeper in southern Sydney. He grew up near Lake Macquarie and the beaches south of Newcastle, where he spent much time swimming, surfing, exploring the life in water and generally enjoying being close to water. After finishing school, he went to university and his studies eventually led to completion of a PhD on waterbugs and food webs in farmland streams. Gaining those qualifications has allowed him to do research and monitoring work in waterways around the world, including those in New South Wales, Victoria, South Australia, New Zealand and New York City (see https://www.researchgate.net/profile/David_Reid15). He still enjoys having fun in water too!

Antonina Fieni

Antonina loves rivers. She is often seen paddling up rivers and creeks looking for Eastern water dragons or sacred kingfishers. When not paddling, Antonina is teaching environmental science and geography at the Georges River Environmental Education Centre and at the Field Study Centre at Sydney Olympic Park. Her qualifications include a Bachelor of Education and a Graduate Diploma in Environment.

Acknowledgements

Georges Riverkeeper was established in 1979 and is a waterway management organisation located in southern Sydney that is dependent upon funding from member councils. Thank you for funding and other support to Bayside Council, Campbelltown City Council, City of Canterbury Bankstown, Fairfield City Council, Georges River Council, Liverpool City Council, Sutherland Shire Council and Wollondilly Shire Council. Any opinions expressed in these modules are those of the authors, not Georges Riverkeeper or member councils.

Thank you to Beth Salt and Nathan Varley for reviewing the modules and providing suggestions for improvements prior to their release. Thank you to Georges River Environmental Education Centre and local schools for helping with development of the modules, using the modules and providing feedback to improve the modules.

Thank you Creative Commons (https://creativecommons.org/), from which most images were sourced.

January 2020

Authorised and published by Georges Riverkeeper

PO Box 205

Hurstville BC NSW 1481

Australia

This document is available at www.georgesriver.org.au

Georges Riverkeeper

Georges Riverkeeper is an alliance of Councils with collective responsibility for the Georges River and its catchment.

www.georgesriver.org.au