Georges Riverkeeper

Water... WOW!

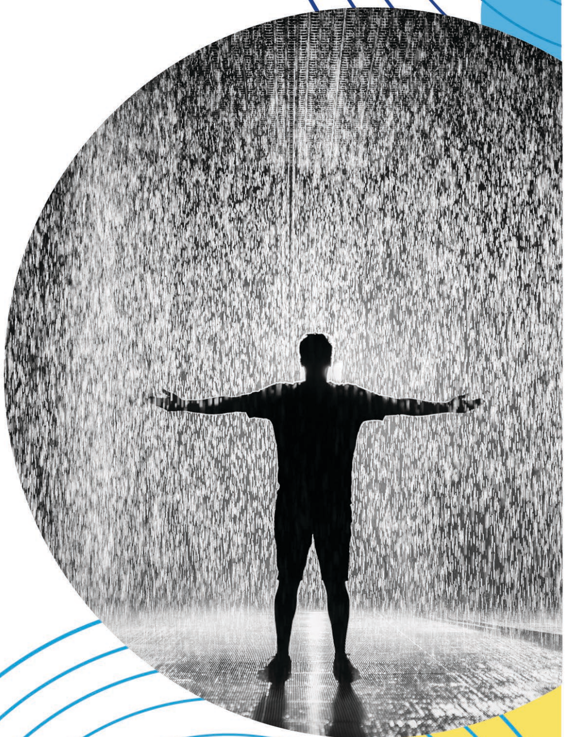
STAGE 3 EDUCATION

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



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	Inquiry Question: *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

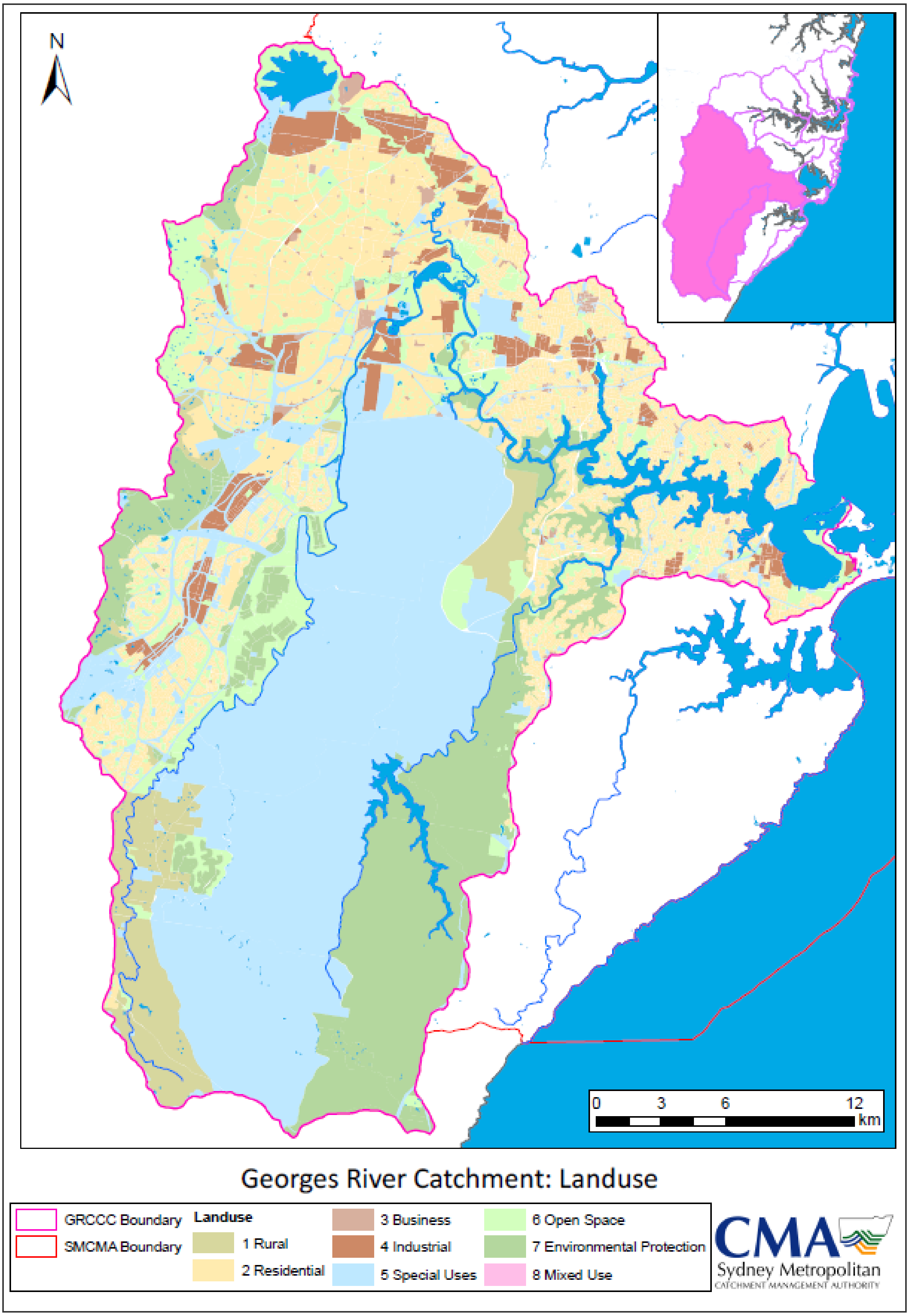
	students to improve their rain gauge if needed. ♦ Extension Activity: This extension activity involves students undertaking a scientific experiment to compare the filtration capacity of different soils (e.g. gravel, sand, potting mixture) and/or the amounts of salt in water from different sources (e.g. 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!



Georges River Catchment: Landuse

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.

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PO Box 205

Hurstville BC NSW 1481

Australia

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