

The water cycle package



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Guideline for use

About the package

The water cycle package is a new education resource that illustrates key concepts needed to understand the sustainable use of water.

Comprising two posters as well as these guidelines, the package aims to provide Queensland water educators and teachers with resources and information to build learning about:

- ◆ the precious nature of water
- ◆ the natural water cycle
- ◆ water sources
- ◆ water use and reuse in urban and rural locations
- ◆ drinking water and wastewater treatment
- ◆ water sustainability and conservation.

The package has a unique Queensland feel and has been designed to complement the *Water: Learn it for life!** program. While the main target audience is students aged between four and 15, the package can also be used with adult audiences.

These guidelines aim to assist water educators and teachers by offering suggestions and ideas for using the posters to stimulate inquiry. Curriculum links to the *Water: Learn it for life!* resources are included. This is by no means an exhaustive list. The posters can be applied in many different ways and circumstances and the content is applicable across a diverse range of curricula.

Both posters are available free to Queensland councils and schools and can be ordered online at: www.derm.qld.gov.au/waterwise.

* More information about *Water: Learn it for life!* can be found at: www.derm.qld.gov.au/waterwise.

Using the posters

Both posters can be used in a variety of learning contexts. While these guidelines focus on their application in relation to curricula-based programs, they can also be used as part of community education programs. For example, they can be displayed in public spaces such as council foyers, community group buildings, libraries, customer service centres and shopping centres.

The posters are designed to complement each other. *The Water Cycle* poster enables educators to introduce fundamental concepts relating to the natural water cycle. The *Total Water Cycle Management* poster builds on these concepts to create a comprehensive picture of the integrated flow and use of water in contemporary urban and rural environments.

It is important to note that the landscape setting in both posters is the same. The angle from which the learner is observing is, however, slightly higher in the *Total Water Cycle Management* poster. This affects how the hill in the foreground is viewed. Essentially, all differences between the posters are the result of changes that people have made to the natural environment.

The Water Cycle poster lends itself to being used as a precursor to the *Total Water Cycle Management* poster in which the more complex aspects of water supply and management in the contemporary environment are explored.

The Water' Cycle poster

The poster, which depicts the water cycle in the natural environment, aims to educate young people about the different phases of the natural water cycle. The key concepts of precipitation, runoff, infiltration, transpiration, evaporation and condensation are introduced in an engaging and easy to follow manner, featuring Whizzy the waterdrop.

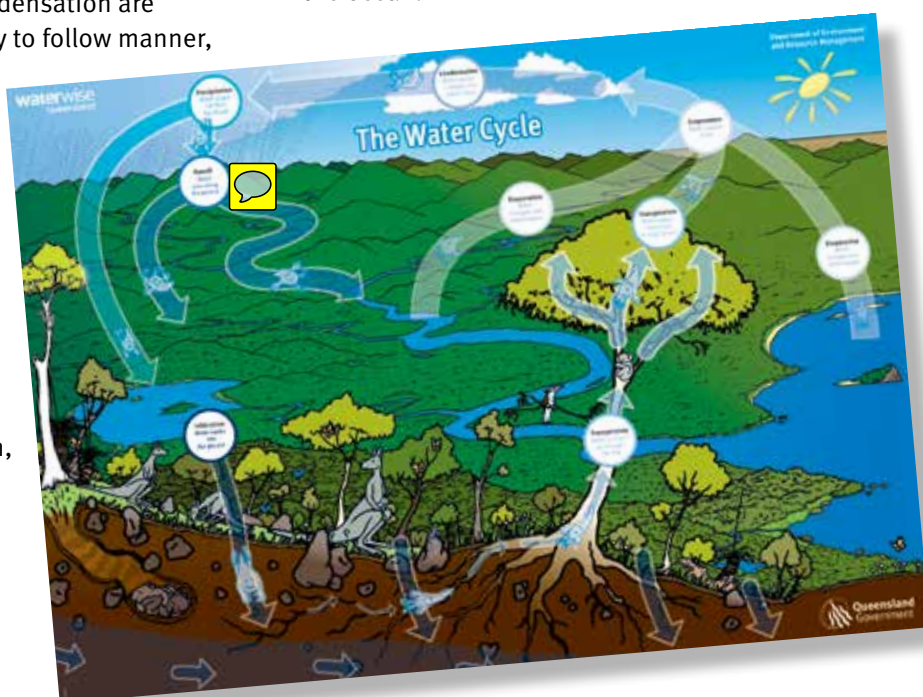
The poster targets children between four and eight years of age, but can also be used with older audiences to explain water cycle concepts and stimulate inquiry about the more complex aspects of water sources and sustainability.

The poster incorporates images of Queensland wildlife and vegetation, offering another dimension for teachers and educators to explore with students. The setting for the poster has not been designed to represent any area in particular. It is intended that educators working

with the poster set this local context for their audience, perhaps by naming similar features in their area, as well as identifying possible differences.

Notes for use and background information

- The water cycle phases (and associated explanations) are colour coded in different shades of blue to indicate the different phases.
- While the poster focuses on the **processes** of the water cycle, it can also be used to engage students in discussion about the **component elements** such as waterways, surface water and groundwater flows, springs, wetlands and ground and surface water storage.
- It is important to draw attention to, and explain, the **groundwater flow** depicted in the bottom left corner. Emphasise that groundwater is linked to surface water and is not an independent system. Surface water may be flowing (infiltrating) into groundwater across the entire landscape, not just in the section cut away in the foreground. For this reason the infiltration bubble appears further up the page. The interaction with groundwater is a two way process with groundwater supplies also flowing back into the surface water shown—that is, rivers, lake and ocean.
- For older students it is important to explain that while the poster shows processes only occurring in specific areas, they are occurring throughout the entire landscape. **Transpiration** occurs from any vegetation (including any grasslands) and **evaporation** from any surface water. **Runoff** may begin high up in a catchment, and will continue as water flows downhill towards the lowest point. Often the majority of runoff occurs as water enters streams, then rivers and perhaps flows to lakes and eventually the ocean.



- ◆ The Whizzy characters located in the *evaporation* stage of the cycle are slightly lighter in colour, denoting a gaseous rather than liquid state. In reality water cannot be seen at all when it is in its gaseous state, so in fact Whizzy should be invisible. For the purposes of engaging students, Whizzy has been included in the evaporation phase.
- ◆ The poster depicts no human presence. Students should understand that the water cycle still occurs with human presence, but that people have had an impact on the ‘natural’ water cycle shown in this poster. Students may like to predict, observe or investigate what some of these impacts might be.

Curriculum links

The following are suggestions for linking *The Water Cycle* poster with activities contained in the *Water: Learn it for life!* curriculum resource.

Year 1

Mini Inquiry 1 – Why is water unique?

- 1.2.1 Students are introduced to the water cycle through *Whizzy’s Incredible Journeys – Pick-a-Path* book. *The Water Cycle* poster could be introduced at the end of the reading to further explore the water cycle concept.

Mini Inquiry 2 – Where do we find water?

- 2.3 Students explore where they might find water. *The Water Cycle* poster provides additional stimulus for students to reinforce this concept.

Mini Inquiry 3 – Why do we need water?

- 3.1 Students identify ways we need water. Use *The Water Cycle* poster to show how the trees need water and how this process happens.

Years 2 and 3

Unit 1 – Lesson 3: Rain, rain

The Water Cycle poster could be introduced before or after this lesson to explain why it rains and where rain comes from. It also provides a visual aid to assist students to understand that groundwater comes to the surface naturally and flows back into rivers.

Unit 1 – Lesson 4: Go with the flow

The Water Cycle poster provides an excellent resource to conclude this lesson and expand on students’ ideas about where rainwater goes after it falls to the ground.

Unit 1 – Lesson 5: My water story

The Water Cycle poster could act as additional stimuli to assist students to create a storyboard of the water cycle.

Unit 1 – Lesson 8: Informative interviews

In this lesson students explain what they know about water in an interview format. *The Water Cycle* poster can be used as a resource to review the unit.

Unit 2 – Lesson 1: Giving water use the slip

In this lesson students are introduced to the water cycle through *Whizzy’s Incredible Journeys – Pick-a-Path* book. *The Water Cycle* poster could be introduced at the end of the reading to reinforce the concept of the water cycle.

Unit 2 – Lesson 4: Poster talk

Students evaluate various posters to discover their key features and how they can be used. *The Water Cycle* poster can be used as one example for them to evaluate. There should be an emphasis on the different components and how the poster communicates its messages.

Unit 2 – Lesson 5: Water expert training session

Students explore the various aspects of water through workstation activities, for example, how water travels through plants (workstation 3) and the water cycle (workstation 4). Display *The Water Cycle* poster in a prominent position for reference during these activities.

Years 4 and 5

Unit 1 – Lesson 1: Water, water, everywhere

In this introductory lesson students map their ideas to show their understanding of water in their local area. *The Water Cycle* poster could be shown at the beginning of the lesson for them to recap where water comes from.

Unit 2 – Lesson 1: Making a statement

Students begin this unit by exploring what they already know about water. They are shown 13 water statements and asked whether they are true or false. *The Water Cycle* poster could be used as a visual aid for the class debrief to assist them to clarify their thinking.

Years 6 and 7

Unit 1 – Lesson 6: Catchments and water cycles

In this lesson students explore and outline the processes of the natural water cycle and the water cycle with human impacts. *The Water Cycle* poster can be used as a visual aid to demonstrate the natural water cycle.

Classroom Activities

The following are possible student activities incorporating *The Water Cycle* poster. Activity selection should be based on the age and needs of the group.

Activities are sequenced in order of complexity. Most are posed as short questions but with preparation could be expanded into an in-depth or more detailed exercise.

Each activity may be made appropriate to a higher or lower age range through simple variations such as making them group or individual tasks, or setting them with or without using the poster as a reference.

1. After discussion on *The Water Cycle* poster, play a game using each of the water cycle phases. For example, ask the students whether evaporation goes up or down. If they think evaporation goes up they stand up, if they think evaporation goes down they lie down (a bit like Simon says!). For higher year levels similar questions could be posed in a quiz format.
2. Students count the number of Whizzys in the poster. Why do they think Whizzy appears in different shapes and in different body positions? As a group, discuss some other situations where water is found. Students draw their own version of Whizzy as they think a water drop would appear in one of these other situations.
3. Students identify six things in the poster that need water to survive.
4. A4 or A3 versions of the poster could be laminated and cut into a jigsaw for students to assemble the pieces of the water cycle. (These posters can be downloaded from <www.derm.qld.gov.au/waterwise>.)
5. After rain, take the students outside and explain the water cycle using the soil, trees, sky and clouds. Students create links between what they see and the different parts of *The Water Cycle* poster.
6. Students write a story of the water journey shown in the poster. Reading of *Whizzy's Incredible Journeys – Pick-a-Path* book could occur before or after story writing, depending on the age of the children.
7. Create a cut-out Whizzy which students can move around the poster to re-tell the water cycle story for their local area. Labels and landmarks could be added to make it local. You may like to laminate the poster and use whiteboard markers to draw on the poster itself (it can then be easily wiped off). This activity could also be done with an interactive whiteboard and a Whizzy illustration. Whizzy illustrations are available for download from the *Whizzy's Incredible Journeys* resource page at <www.derm.qld.gov.au/waterwise>.
8. In small groups, students develop a short skit or play that tells the journey of water through the different phases of the water cycle.
9. Pose the following questions and use this to facilitate a class or small group discussion.

These may even lead into a broader homework or research/investigation activity.

- ◆ What differences do you notice between the colours of the grass and plants in different parts of the poster?
 - ◆ What you can see in the poster that has caused this difference?
 - ◆ Do you think these colours would be the same all year round? When might they be different?
 - ◆ What makes grass and other plants green?
10. Include the water cycle phases in the spelling list for higher year levels. Students could also write sentences or a paragraph using these words:
 - ◆ precipitation
 - ◆ runoff
 - ◆ infiltration
 - ◆ transpiration
 - ◆ evaporation
 - ◆ condensation.
 11. Ask students to guess where they think the underground water in the bottom left of the poster is going. Has anyone ever heard of the term aquifer? This may stimulate further study on the Great Artesian Basin (for more information see the section on underground water at <www.derm.qld.gov.au/water>).
 12. Students could brainstorm ideas on what kind of impacts people would have on the setting in *The Water Cycle* poster. This may be extended to an activity where students draw their own poster with a city or town included. If progressing to the *Total Water Cycle Management* poster this activity could be the precursor to its introduction.

Total Water Cycle Management poster

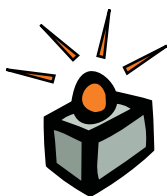
This poster builds on the concepts introduced in *The Water Cycle* poster by illustrating the integrated flow of water within catchments as a result of human presence. This is sometimes referred to as the urban water cycle.

The poster comprehensively depicts the journey of water in contemporary urban and rural environments. It tracks its collection in the catchments, movement through capture and storage, treatment, distribution and use, reuse and return to the natural water cycle. The setting for the poster has not been designed to represent any area in particular. It is intended that educators working with the poster to set this local context for their audience, perhaps by naming similar features in their area, as well as identifying possible differences.



Notes for use and background information

- It is strongly recommended that students are familiar with the setting and concepts introduced in *The Water Cycle* poster before progressing to engage with the *Total Water Cycle Management* poster.
- More information and explanation of the concepts presented in this poster (for example desalination, drinking water treatment processes, and aquifers) can be found in the *Background information for teachers* section of *Water: Learn it for life!*
- A key message for students is that while complicated pipe networks like those depicted flow through almost all towns and cities, they are not visible because they are located underground.
- The house in the foreground cul-de-sac is receiving both drinking water and Class A+ recycled water, via two separate pipe networks. This supply arrangement is known as **dual reticulation**. In the poster, just like in our communities, dual reticulation recycled water pipes are coloured lilac (purple pipe) for easy identification and are sending this recycled water to be used for toilet flushing and outdoor taps. It can also be used as the cold water supply to washing machines. While dual reticulation is being used in some newly developed areas, it is rare in established residential areas because it is costly to install and requires specific piping. Dual reticulation recycled water is likely to be supplied by a local water reclamation plant.
- Purified recycled water** is shown feeding the power station. It is also available for use in other industrial applications and for irrigation.
- South-east Queensland is currently the only part of Queensland which has a purified recycled water pipe connected to a water supply dam as part of an emergency drought response. Water is set to flow through this pipe to supplement the dam supplies if combined water storage levels drop below 40 per cent.
- This poster's landscape is dominated by the **total water cycle management** of the main town/city. It is important to note that the small community shown on the middle left (above the windmill) is sourcing its reticulated water supply from **groundwater** via bores. In communities where aquifer water is available this groundwater can be drawn up and used for reticulated supply. Groundwater is often of a high quality due to lengthy underground filtering processes, and may only require basic chlorination prior to distribution. **Chlorination** helps maintain water quality during distribution in the piping network.
- The disposal of trade and solid waste from the industrial area and wastewater treatment, water reclamation and water purification plants is not shown. Students need to understand that the disposal of this waste occurs, and that it may either be treated to a better quality onsite or carted by trucks to the landfill site.
- In small communities or rural residences away from towns, there is often no centralised wastewater collection and treatment system. In these cases wastewater is usually treated using an anaerobic wastewater treatment system (septic tank) or aerobic wastewater treatment system for each residence.
- A **pumping station** (like the one drawing water from the river below the dam) within the drinking water treatment plant pumps water to the tower. Gravity feed from the tower creates water pressure through the reticulation system and provides a few days of supply in case of any problems with the pumps or with the treatment plant itself. Water towers are becoming less common as they are being replaced by pumps that create the necessary pressure for reticulation.
- There are three pumping locations depicted along the wastewater piping system. These create the pressure needed to send the wastewater to the wastewater treatment plant. When the light on top of a pumping station is flashing it indicates a problem with the pump. If this light is flashing, the local council should be informed.



- ◆ Traditionally rain that falls on hard surfaces in towns/cities becomes stormwater and flows to the nearest waterway via stormwater systems. The use of rainwater tanks reduces stormwater runoff. Increasingly, this runoff may be regarded as undesirable because it carries pollutants (such as oil, chemicals and rubbish) into waterways.
- ◆ Additionally, stormwater can potentially be captured, treated and used as an alternative water source in a process known as **stormwater harvesting**. Alternatively, it can contribute to natural river flows needed to ‘flush’ the system. In Queensland a number of options for stormwater harvesting are being investigated. In the *Total Water Cycle Management* poster, stormwater harvesting is shown in the residential area above the heading *Stormwater management*. Initially stormwater from the residential area flows into a bioretention basin where it is treated through natural filtration processes. It is then harvested and directed into an underground storage tank for later reuse—for example, irrigation of local parks.
- ◆ Constructed wetlands are sometimes created to improve the quality of stormwater that flows to waterways. When directed through wetlands, the effects of sedimentation and settling, exposure to ultraviolet light from the sun and filtration by reeds and other plant life all contribute to improved stormwater quality. In the *Total Water Cycle Management* poster a constructed wetland is shown treating stormwater at the bottom left corner of the commercial area.
- ◆ Sources upstream/upriver from the reservoir and dam may also form part of the water supply for the larger town/city below. Sources could include urban stormwater and treated effluent discharges. This practice occurs throughout Queensland, Australia and the world.
- ◆ Reading and interpreting the pipe legend fulfils both **SOSE and maths Essential Learnings**.

Curriculum links

The following are suggestions for linking the *Total Water Cycle Management* poster with activities contained in the *Water: Learn it for life!* curriculum resource.

Years 4 and 5

Unit 1 – Lesson 2: Going on a water wander

In this lesson students embark on a field trip to learn about water issues and infrastructure in their local area. Prior to the field trip the *Total Water Cycle Management* poster provides an excellent visual aid to show the range of infrastructure required for towns to have water supply.

Unit 1 – Lesson 4: Catchment catch-up

In this lesson students build up a picture of how water works in their local catchment. Use the *Total Water Cycle Management* poster to explain how the urban water cycle works and explore the impacts that human activity has on water quality.

Unit 2 – Lesson 2: Reading the meter

In this lesson students learn how to locate and read a water meter and investigate the amount of water used. The *Total Water Cycle Management* poster shows water meters attached to each of the houses in the foreground cul-de-sac (small black circles marked WM).



Unit 2 – Lesson 3: Water tickets please!

In this lesson students monitor and provide feedback on their water usage and of essential and non-essential uses of water. The main house in the cul-de-sac could be used to stimulate discussion on this issue.

Unit 2 – Lesson 4: The resource race

Students explore the problems encountered when people compete for a limited resource. Refer to the *Total Water Cycle Management* poster to depict the extent that water is needed and used within our communities.

Unit 2 – Lesson 6: Drip detectives and Lesson 9: Teaching my family to audit

Refer to the *Total Water Cycle Management* poster to identify water saving strategies in residential areas.

Years 6 and 7

Unit 1 – Lesson 2: Saving water in the home

In this lesson students brainstorm ways to save water in and around the home and conduct a home water audit to gauge their family’s water usage. Introduce the *Total Water Cycle Management* poster and identify how water is being used and saved.

Unit 1 – Lessons 3 and 4: Water journeys through our town – Parts 1 and 2

Students investigate sources and destinations of water moving through their local catchment and distinguish between groundwater and surface water. They also investigate the main features of water supply and distribution in their local area. Use the *Total Water Cycle Management* poster to demonstrate how water flows through the community, where water comes from, how it is used, stored, where it goes when it leaves your home etc. Point out the desalination, wastewater treatment, water reclamation and water purification plants and explain these processes. Also highlight that water can be reused as greywater in the garden and stormwater runoff can be harvested for irrigation use.

Unit 1 – Lesson 6: Catchments and water cycles

In this lesson students explore and outline the processes of the natural water cycle and the water cycle with human impacts. *The Water Cycle* poster can be used to demonstrate the natural water cycle. Ask them to identify human impacts on the water cycle. Refer to the *Total Water Cycle Management* poster as a visual aid to facilitate this discussion.

Unit 2 – Lesson 4: Water in my catchment

Students focus on the catchment that supplies their water. The impacts of various local land uses on drinking water supplies are also identified. Their task is to create a class catchment map and record features and land uses for their local catchment. The *Total Water Cycle Management* poster could be used to identify elements which need to be included. For example, start and end points of the waterways, dams and drinking water treatment plants that fall into their area, stormwater outflows, urban areas, local sites and landmarks, natural features such as billabongs and mountains etc.

Unit 2 – Lesson 6: Filtering groundwater and Lesson 7: Making water drinkable – Water treatment

In these lessons students explore the stages that occur in a water treatment plant and identify a number of ways to make water drinkable. Using the *Total Water Cycle Management* poster, point out what happens to groundwater, drinking water treatment plants, the processes for purification of recycled water, where the water comes from and where it ends up after purification.

Classroom Activities

The following student activities are designed for use with the *Total Water Cycle Management* poster. Activity selection should be based on the age and needs of the student group. Activities are sequenced in order of complexity.

(Note: Many of the activities listed in the Classroom Activities section for *The Water Cycle* poster can also be applied to the *Total Water Cycle Management* poster.)

1. Undertake a ‘spot the difference’ activity. Students identify the changes between the two water cycle posters. It is suggested that this focuses on the changes to the landscape. At a higher level, students may explain what they think has caused each of the changes from *The Water Cycle* poster.
2. For each of the water types listed in the pipe legend, students use the poster to name all the locations that this water comes from and/or goes to. This may include other locations not shown on the poster, and these could be highlighted or circled in the list.
3. Students identify all the water saving ideas in the poster. For example, the use of swimming pool covers, rainwater tanks or greywater and the delivery of recycled water via tankers to the building site for the purposes of dust suppression. (Note: *The Bucket loads of savings!* poster is another useful resource for this activity. This poster can be ordered online from: <www.derm.qld.gov.au/waterwise>.)
4. Students explore all the different uses of water in and outside the foreground cul-de-sac main house, and the source for each of these. This list could be summarised in a table showing possible uses for drinking water, water from the environment and recycled water. This could be extended into a class activity/game where students name the most appropriate water source for a range of different water uses.
5. Using words from both posters, students pick a word out of a hat and explain what that word means using the poster and/or Whizzy.
6. Point out where the water meters are for each house in the foreground cul-de-sac (small black circles marked WM). Ask students as a homework exercise, to identify their home water meter and take a reading each day to see how much water their home is using. They could monitor it over a week and calculate daily usage. They could then divide that by how many family members live in the house to get an average daily use per person. For younger students you could do this as a class activity using one of the school’s water meters.
7. Segment the poster as a jigsaw and get groups of students to research different sections. A jigsaw learning strategy could be used if you want students to assimilate a lot of information about the total water cycle relatively quickly. Create groups with the same number of students as the number of poster jigsaw pieces. These are the ‘home’ groups. Number the poster jigsaw pieces and then number

off each student in each group. The students from different groups with the same number are assigned to work together in 'expert' groups to analyse the corresponding poster jigsaw piece. They collate the information for that poster piece and then report back to their 'home' group.

8. Students write additional pick-a-path journeys for Whizzy that extend from the journeys in *Whizzy's Incredible Journeys – Pick-a-Path book*. For example Whizzy could journey to a wastewater treatment plant.
9. Overlay a grid on the poster to teach students the use of grid references (this can easily be drawn on if the poster is laminated). Students practice finding what is located at various grid references, and writing grid references for locations on the poster. This would be useful for pinpointing specific elements within the water distribution process. Higher level students may also add contour lines to the poster using non-permanent marker.

10. Students write a story of the water journey in the poster (or one section of the journey). This story could form the basis for a tour guide role-play scenario, for example, students take the rest of the class on a guided virtual tour of all the places that water in one type of pipe may possibly visit.
11. Ask students what is different about the piping network for the community located below the label *Bore water treatment and supply*. Undertake an investigation into septic tanks; where they are used and how they work. For older students this may extend to cover aerobic wastewater treatment systems, and may include the advantages and disadvantages of this system over septic tanks, and even a centralised system for wastewater collection and treatment. Students research where water comes from in their area and identify what features from the poster are in their local area. This could be used as the basis for groups of students developing their own *Total Water Cycle Management* poster that reflects their local area.



More information

Visit the Department of Environment and Resource Management website <www.derm.qld.gov.au/waterwise>.

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