Our City

Students will investigate Perth's water sources and understand the impacts of climate change on our water supply. Students will apply their understanding through Tinkercad 3D design application.

Subject area:

Science

Year level:

Year 7

Learning objectives:

- Understand water is an important resource that cycles through the environment.
- Be aware of the impacts of climate change on water sources in Perth.
- Understand the integrated water supply in Perth.

Curriculum links:

Earth and space science	ACSSU116
Earth and space science	ACSSU222
Use and influence of science	ACSHE120
Nature and development of science	ACSHE119

Cross-curriculum priorities: Sustainability

OI.1	The biosphere is a dynamic system providing conditions that sustain life on Earth.
OI.3	Sustainable patterns of living rely on the interdependence of healthy social, economic and ecological systems.
OI.4	World views that recognise the dependence of living things on healthy ecosystems, and value diversity and social justice, are essential for achieving sustainability.
OI.7	Actions for a more sustainable future reflect values of care, respect and responsibility, and require us to explore and understand environments.

General capabilities

Literacy

Critical and creative thinking

Personal and social capability

Information and communication technology (ICT) capability

Ethical understanding

Edible aquifer

Students will gain an understanding of Perth's water supply as they design their own 3D model. This will be further extended as students create an edible aquifer to illustrate how groundwater is extracted and the impacts of pollution on our supply.

Time required:

1 to 2 hours

Resources required:

- **iPad or computer per student**

Preparation:

Ensure student access to:

1. Perth's water supply
2. Anatomy of an aquifer
3. Tinkercad 3D design app
4. SketchUp design app
5. Australian groundwater explorer
6. Activity page 1: Edible aquifer

Steps:

1. Hand out Activity page 1: Edible Aquifer and allow time for students to move through the activities and instructions.
2. Ensure students are familiar with the natural water cycle, review the steps as a class.
3. Connect to Perth's water supply. Students need to input their school or home address to investigate how water is supplied to their area.
4. Create a diagrammatic representation of the Perth integrated water supply in workbooks.
5. View the Anatomy of an aquifer to develop a 3D understanding.
6. Using Tinkercad, SketchUp or any similar free CAD design tool, create a 3D diagram of the Perth urban water cycle.
7. Students then alter this diagram, removing the aquifer and groundwater supply. As students respond to the questions on their activity page, discuss their answers together as a class.
8. Referring to the Australian Groundwater Explorer and Water Corporation's groundwater webpage to answer the questions on the activity page.
9. Working with a partner, students will research and construct an edible aquifer illustrating the underground geology. Working through their science inquiry page, students will choose two challenges to complete in their model and present as an investigation:
    a. How to extract water from the aquifer.
    b. How pollution can infiltrate groundwater.
    c. How this pollutant can can end up in drinking water wells.
    d. How to minimise this happening.
10. Students will complete their investigation questions as they conduct the inquiry.

Underground explorer

Students will explore underground water sources in order to design their own model and illustrate the impact society is having on our water.

Time required:

1 hour

Resources required:

- **iPad or computer per student**
- **Suggested materials: clear container, modelling clay, pebbles, white sand, straw, spray bottle (bore/ well). green felt or grass clippings, cocoa, food colouring, pipette**

Preparation:

Ensure student access to:

- Perth's water supply tool
- Australian groundwater explorer
- Sway electronic report

Steps:

1. Students use the computer-based models from the Australian groundwater explorer to investigate the groundwater in their local area.
2. Using the search function on the Australian groundwater explorer, students then create a written, Powerpoint or interactive Sway electronic report that will inform the reader of:
    a. The thickness and extent of aquifers and aquitards in student's suburb with a virtual cross-section through the aquifers.
    b. The location of groundwater bores and the aquifers they tap into.
    c. Groundwater management areas.
    d. The type of land use on the surface.
3. Students will interpret their research to design a cross-section of their suburb underground. Using the suggested materials, their model will illustrate:
    a. The role of aquifers in our drinking water supply.
    b. The effects of excessive extraction.
    c. The different types of rocks found in aquifers (sandstone, clay, shale, granite, etc.)
    d. Infrastructure design that would promote a more efficient recharging system.
    e. Recharge and discharge areas.
    f. The interaction between groundwater, runoff, streamflow, and subsidence.
4. Suggested materials: clear container, modelling clay, pebbles, white sand, straw, spray bottle (bore/ well). green felt or grass clippings, cocoa, food colouring, pipette.
5. Students present their completed model cross-sections to the class, showing how they have demonstrated the above elements.

Water treatment process

Students will gain an appreciation for the process involved in supplying climate-resilient water to Perth as they design a 3D computer model.

Time required:

1 hour

Resources required:

- **iPad or computer per student**
- **Activity page 2: Water treatment processes**

Preparation:

Ensure students have access to the following websites:

1. Desalination
2. Groundwater
3. Rainfall and dams
4. Tinkercad 3D design app
5. SketchUp design app

Steps:

1. Students are to review the Perth water supply tool, identifying how water sources have changed over time.
2. Students choose one of Perth's water sources – groundwater, desalination, dams or groundwater replenishment. Research their responses to these two questions in their science journal:
    a. How does this water source assist in securing a climate resilient water supply for the future?
    b. How did this source become part of Perth's integrated water supply system? Provide information on the history of the water source in Perth.
3. Students choose a water source and outline the steps required to treat this source to drinking water standards. Students may refer to Water Corporation website and also illustrations provided in Activity page 2: Water treatment processes.
4. Logging into Tinkercad 3D design app or SketchUp design app, ensure students are familiar with the program by going through a tutorial. Students will then create their own 3D diagram to illustrate the processes required to treat their chosen source.
5. Students will sit in groups according to their water source and present their model to their peers. Compare how they illustrated the diagrams and describe what is happening at each step of the process.

Edible aquifer

Living on the world's driest inhabited continent, we need to understand how we can live more sustainably. As we continue to feel the impacts of climate change in WA including increases in average annual temperatures, more extreme weather events and significant changes to rainfall, it's never been more important to save our precious resource – water.

Instructions:

1. Explore Perth's water supply tool, input your school or home address to investigate how water is supplied to your area.
2. Create a diagrammatic representation of the Perth integrated water supply in your student workbook.
3. View the Anatomy of an aquifer to develop a 3D understanding.
4. Using Tinkercad, SketchUp or any similar free CAD design tool, create your own 3D diagram of Perth's urban water cycle.
5. Alter this 3D diagram, removing the aquifer and groundwater supply. Explain in detail how this would impact the local water supply.
6. List all NATURAL factors that influence our water supply.

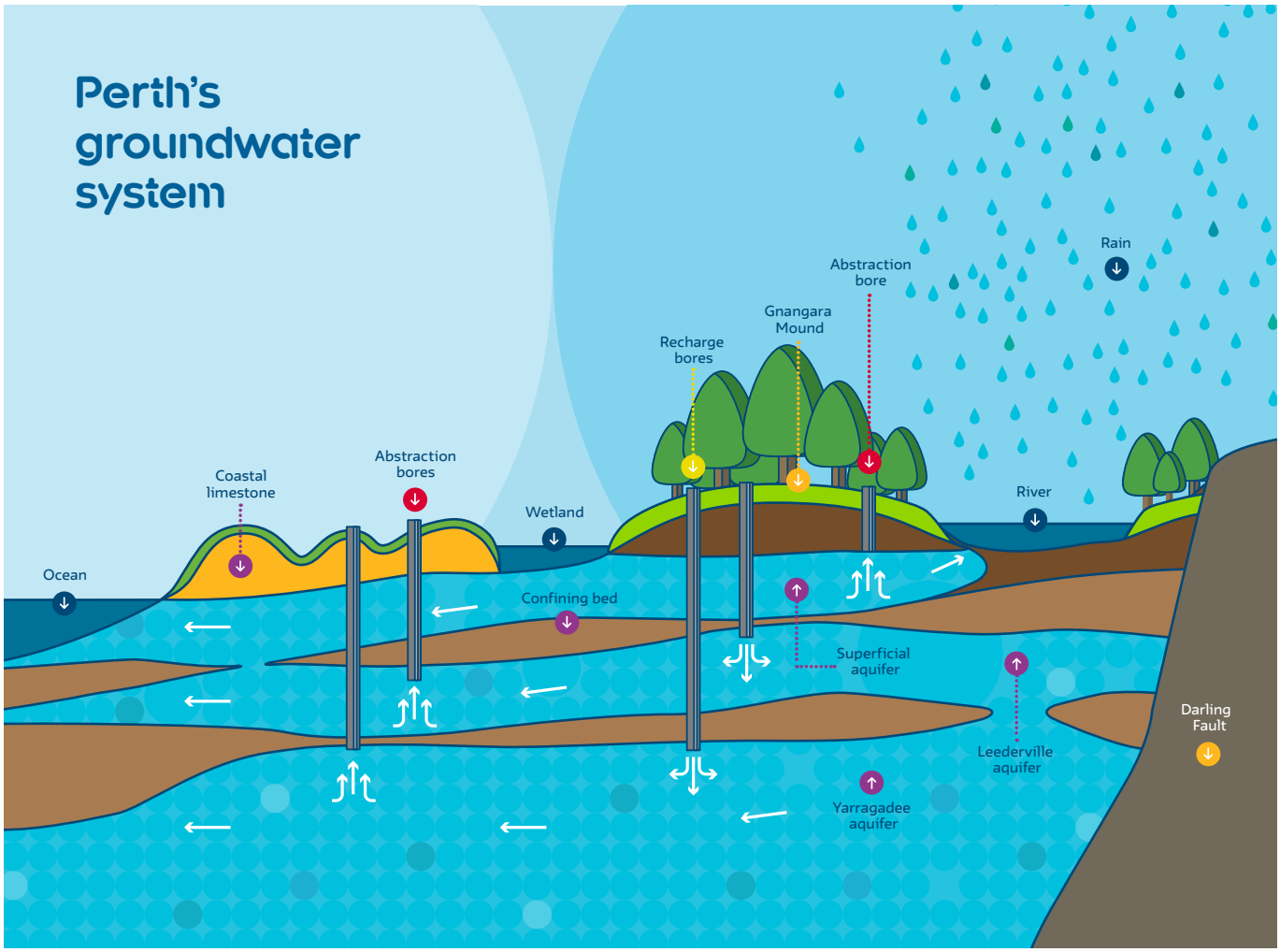
7. The department uses computer-based models to better understand groundwater flow systems. They are the most sophisticated tools available for simulating aquifer behaviour, and for predicting the effects of groundwater use. They can tell us the volume of water flowing into an aquifer and where that water is coming from. Use the computer- based models at Australian groundwater explorer to investigate the groundwater in your local area. Referring to the Australian groundwater explorer and Water Corporation's groundwater webpage, answer the following questions:

   a. Is Perth's groundwater a renewable or non-renewable resource? Why?

Activity page 1: Edible aquifer

b. How do our actions affect groundwater?

c. What is the difference between an aquifer, the water table and groundwater?



Activity page 1: Edible aquifer

Scientific Inquiry

Work with a partner to research and construct an edible aquifer. The model should be made using edible ingredients and replicate the following elements:

- aquifer
- confined aquifer
- saturated zone
- unconfined aquifer
- unsaturated zone
- water table
- debris to illustrate pollution and natural matter

The challenge is to demonstrate one or all of the following in your model:

- how to extract water from the aquifer
- how pollution can infiltrate ground water
- how this can end up in drinking water wells
- how to minimise this happening

Note: You may use minimal non-edible materials as instruments for the demonstrations.

Equipment:

- .....
- .....
- .....
- .....

Procedure to make edible aquifer:

1. .....
2. .....
3. .....
4. .....
5. .....
6. .....
7. .....
8. .....
9. .....
10. .....

Activity page 1: Edible aquifer

1. What challenge are you choosing to demonstrate in your model?

2. State the variables for the experiment:

Independent variable What will I change?	Dependent variable What will I measure?	Controlled variables What will I keep the same?

3. Make a prediction about the results of your demonstration and explain your reasoning:

4. Draw a labelled diagram of the equipment set up:

Activity page 1: Edible aquifer

5. Write the method you used to conduct your demonstration:

6. Design a table for recordering investigation results. Label all relevant columns:

7. Scientific knowledge has changed our understanding of the world. How could your aquifer model be used to improve or influence positive human activity in the future?

Water treatment processes

The information provided will assist you to design your own treatment processes and create 3D illustrations of each step involved with supplying water.

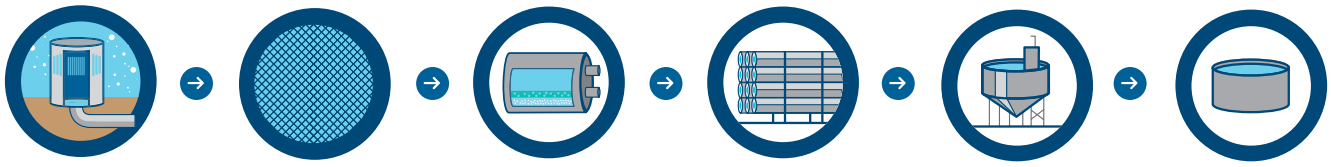
Desalination

Seawater desalination is the removal of salt and impurities from seawater to produce fresh water. In 2019-20 water produced by our 2 desalination plants made up 43% of Perth's water supply.

Treatment

- **Screening:** During this process, large objects are removed from seawater that have entered the plant.
- **Dual media filter**: This process helps to remove any solid materials remaining in the water following the screening process.
- **Reverse osmosis**: This step places water under pressure as it passes through tubes containing tightly wound membranes with microscopic pores. Water molecules are forced through the membrane, leaving dissolved materials behind.
- **Diffuser:** Salt that was removed from the water during the reverse osmosis step is then mixed with some of the purified water and dispersed back out into the ocean.
- **Mineralisation:** In the mineralisation tank, lime is added to correct the pH, chlorine is added to disinfect the water, and fluoride is added to help prevent tooth decay.
- **Storage tank:** The water is then pumped into a storage tank, before being added to the water supply.

Desalination



Activity page 2: Water treatment processes

Groundwater

Groundwater comes from rain that trickles down into our aquifers. It gives us the lakes, wetlands, bushland and urban trees that make our city green.

Treatment

Aeration: the is the process of removing any trapped gasses and adding oxygen by spraying the water into the air.

- **Clarification:** Sediment in the water removed through a process of settling out the solids
- **Filtration:** Layers of activated charcoal and sand remove any remaining solids
- **Mineralisation:** the final process adds chlorine to disinfect the water and fluoride to protect against tooth decay.

Groundwater

Groundwater replenishment

Wastewater is 99.9% water and mostly comes from kitchen sinks, showers and washing machines. Once treated, it can be recycled for reuse or returned to the natural water cycle.

Treatment

- **Ultrafiltration:** This step separates out all the molecules from the water that are larger than 0.1 of a micron, which is equivalent to 1/300th of a human hair.
- **Reverse Osmosis**: Then the water is placed under pressure as it passes through tubes containing tightly wound membranes with microscopic pores, 100 times smaller than ultrafiltration. Water molecules are forced through the membrane, leaving dissolved materials behind.
- **Ultraviolet disinfection**: The water is subjected to ultraviolet light as a final disinfection step to destroy any trace levels of micro-organisms that may remain.
- **Injection recharge bore:** Clean water is recharged into the aquifers and stored in the ground until it is extracted some time later

Groundwater Replenishment