Turning on the tap

greater WELLINGTON
REGIONAL COUNCIL
Te Pane Matua Taiao

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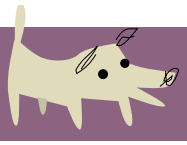

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An introduction to the *'Turning on the Tap'* Teaching Resource

Who can use this resource?

This teaching resource is designed for primary and intermediate teachers of Year 5-8 students. The content is particularly relevant for Wellington, New Zealand.

Overall purpose

'Turning on the tap' is an in-depth, integrated unit of work which comprehensively explores the issues associated with using tap water. Its guided approach allows even inexperienced teachers of environmental education/education for sustainability to teach the concepts of water conservation, water treatment and environmental action. The resource was commissioned by Greater Wellington Regional Council (GW) to encourage students to understand where their tap water comes from and make informed decisions about how they use it.

How to use this resource

This unit of work is an integrated term's work for the curriculum areas of Science, Social Science, Health and Technology. Mathematics and English objectives are also included in many activities. The resource can be taught throughout your timetable and over several subject areas; e.g. section five contains many mathematics objectives and could be delivered during your maths class time.

If you are limited for time you can select activities based on the suggestions on the term plan on page 7. Section three and four are particularly relevant for those visiting the water treatment plants. Ideally the resource should be taught in full for maximum comprehension of the concepts involved.

Structure and content of the resource

The *Turning on the tap* resource is comprised of six sections:

Section One: Water as a resource

This section examines the students' knowledge and experiences with water. Students gain an understanding that water is a precious resource. Differences in water use around the world are also investigated.

Section Two: The water cycle

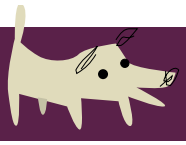
This section includes activities based around the natural water cycle and how water changes state and moves around the environment.

Section Three: How water gets to our taps

This section explores how water is delivered from water collection areas to our taps.

Section Four: Water treatment: Te Marua or Wainuiomata

This section examines the water treatment process inside a water treatment plant. A key part of this section is a visit to one of the Greater Wellington's water treatment plants *(either Te Marua or Wainuiomata)*.



Section Five: How much water are we using?

Students measure how much water is used at school on a daily basis and explore how it is used.

Section Six: Making change

This section provides students with an opportunity to use their new knowledge and understanding to make informed decisions about how they use water. Students identify the priorities for change and organise action for the environment to reduce their use of tap water.

The New Zealand curriculum

Each activity in the resource has a curriculum link to at least one of the learning areas. Major curriculum links are listed in black, minor links are listed underneath in grey.

Suggested success criteria are also given. Teachers can adjust these according to the needs and abilities of their students.

As well as clear links to specific learning areas, the resource also incorporates the values, key competencies and principles from the current New Zealand curriculum. Particular emphasis is placed on the following values: ecological sustainability, innovation, curiosity, inquiry, equity, community and participation. All key competencies are explored in this unit of work.

Timing for activities

Each activity is designed to take approximately 45 minutes, unless otherwise stated.

Level of activities

Although the resource is designed for year 5-8 students, it is aimed primarily at year 6-7 students. Every attempt has been made to cater for a range of abilities and levels within each activity. If using the activities with year 5 or year 8 students, you may need to adapt the learning intentions, success criteria and learning experiences to better suit your students' requirements.

Teaching and learning approach

Education for Sustainability (EfS)/Environmental education

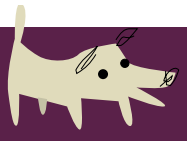
The resource aligns with current thinking and effective pedagogy for Education for Sustainability (EfS). At the time of writing, the Guidelines for Environmental Education in New Zealand Schools (1999) offer a format for environmental education programmes. The concepts, areas and dimensions in the guidelines are incorporated in this unit.

The *'Turning on the Tap'* resource is based on the Framework for Developing Action Competence in Education for Sustainability. This framework describes six aspects that lead to action competence and that develop the key competencies of the New Zealand Curriculum. They are: connectedness, experiences, reflection, knowledge, a vision of a sustainable future and action taking for responsibility.

For details see:
http://efs.tki.org.nz/EfS-in-the-curriculum/Taking-action/Action-competence

Curriculum links – achievement objectives

	L3	L4
Science	***Planet Earth and Beyond*** **Earth Systems** Appreciate that water, air, rocks and soil and life forms make up our planet and recognise these are also Earth's resources **Interacting Systems** Investigate the water cycle and its effect on climate, landforms and life	***Planet Earth and Beyond*** **Earth Systems** Appreciate that water, air, rocks and soil and life forms make up our planet and recognise these are also Earth's resources **Interacting Systems** Investigate the water cycle and its effect on climate, landforms and life
	Nature of Science ***Investigating in science*** Build on prior experiences, working together to share and examine their own and others' knowledge Ask questions, find evidence, explore simple models and carry out appropriate investigations to develop simple explanations ***Participating and contributing*** Use their growing science knowledge when considering issues of concern to them Explore various aspects of an issue and make decisions about possible actions	
Social Sciences	***Social Studies*** Understand how people view and use places differently Understand how people make decisions about access to and use of resources	***Social Studies*** Understand how producers and consumers exercise their rights and meet their responsibilities Understand how people participate individually and collectively in response to community challenges
Mathematics	***Statistics*** **Statistical Investigation** Conduct investigations using the statistical enquiry cycle: gathering, sorting, and displaying multivariate category and whole number data and simple time-series data to answer questions: identifying patterns and trends in context within and between data sets	***Statistics*** **Statistical Investigation** Plan and conduct investigations using the statistical enquiry cycle: gathering, sorting, and displaying multivariate category, measurement and time series data to detect patterns, variations, relationships and trends
	Geometry and Measurement **Measurement** Use linear scales and whole numbers of metric units for length, area, **volume and capacity,** weight (mass), angle, temperature, and time **Shape** - Represent objects with drawings and models	***Geometry and Measurement*** **Measurement** Use appropriate scales, devices and metric units for length, area, **volume and capacity,** weight (mass), angle, temperature, and time



Curriculum links – achievement objectives

	L3	L4
Technology	***Technological Practice*** **Planning for practice** Undertake planning to identify the key stages and resources required to develop an outcome. Revisit planning to include reviews of progress and identify implications for subsequent decision making **Brief development** Describe the nature of an intended outcome, explaining how it addresses the need or opportunity. Describe the key attributes that enable development and evaluation of an outcome	***Technological Practice*** **Planning for practice** Undertake planning that includes reviewing the effectiveness of past actions and resourcing, exploring implications for future actions and accessing of resources and consideration of stakeholder feedback, to enable the development of an outcome **Brief development** Justify the nature of an intended outcome, in relation to the need or opportunity. Describe the key attributes identified in stakeholder feedback, which will inform the development of an outcome and its evaluation
	Nature of Technology **Characteristics of technology** Understand how society and environments impact on and are influenced by technology in historical and contemporary contexts and that technological knowledge is validated by successful function	***Nature of Technology*** **Characteristics of technology** Understand how technological development expands human possibilities and how technology draws on knowledge from a wide range of disciplines
Health	***A: Personal Health and Physical Development*** **A3 Safety management** Identify risks and their causes and describe safe practices to manage these **Healthy communities and Environments:** *People and the environment* Plan and implement a programme to enhance an identified social or physical aspect of their classroom or school environment	***A: Personal Health and Physical Development*** **A3 Safety management** Access and use information to make and action safe choices in a range of contexts
English	***Listening, Reading and Viewing*** **Processes and strategies – Ideas**	***Listening, Reading and Viewing*** **Processes and strategies – Ideas**

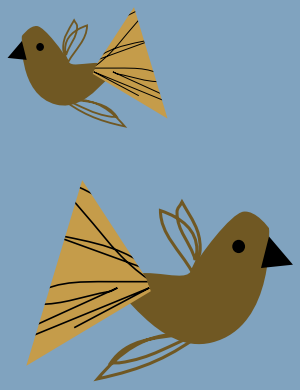
Term Plan for teaching the *'Turning on the tap'* resource

Week	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10 – (or following term)	
Section	**Section One:** Water as a resource	**Section One and Section Two:** The water cycle	**Section Three:** How water gets to our taps		**Section Four:** Water treatment: Te Marua or Wainuiomata		**Section Five:** How much water are we using?		**Section Six:** Making change		
Learning experience	* Water: a precious taonga * Water in pictures * Water in our lives	* Water everywhere * The natural water cycle * Changes in the movement of water	* Our water supply * Water's journey to our taps	* The right water in the right place * No water supply for a day * Keeping our drinking water clean	* Safety at the water treatment plant * What happens at the water treatment plant	* Visiting the water treatment plant: Te Marua/ Wainuiomata * Experiment: Clumping with coagulants	* Household water use in NZ * Using water at school	* Measuring water use: Meter reading * Measuring water use: Water survey	* Our water future? * Which water action? * Planning for action	* Take action	* How did it go?

* highly recommended activity * recommended activity * optional activity

Curriculum areas (major focus ✔)											
Science	✔	✔									
Social Sciences			✔								
Mathematics							✔	✔			
Health				✔							
Technology											
English											

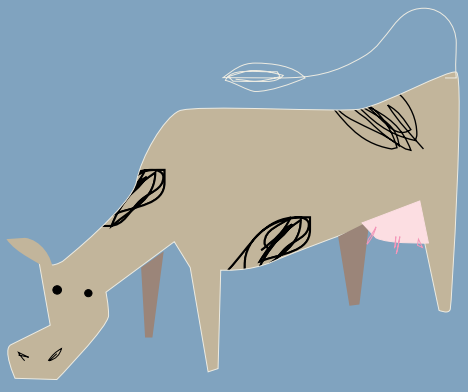
(Other minor curriculum links will also apply)

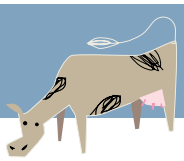


SECTION ONE:

Water as a resource

This section examines the students' knowledge and experiences with water. Students gain an understanding that water is a precious resource. Differences in water use around the world are also investigated.





Section 1: Water as a resource

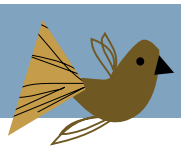
The purpose of this section is to help students to:

- Understand that water is a precious resource (taonga) that we all must look after for the future
- Explore how they interact with water in their daily lives and learn how others use water
- Be motivated to learn about water conservation and the global water situation

Overarching concepts for Section One:

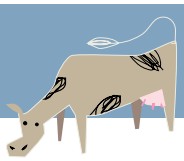
- Fresh water is a limited resource
- Water is important to everyone in lots of different ways
- How we choose to use water has an effect on the world we live in

Section 1: Water as a resource



Learning experiences – Section One

Learning experiences	Learning intentions Students will . . .	Curriculum links (Achievement objectives)	Content
1. Water: a precious taonga	• Understand that fresh water is a precious natural resource	**Science: Level 3 and 4** ***Planet Earth and Beyond:*** *Earth systems* Develop an understanding that water, air, rocks and soil, and life forms make up our planet and recognise that these are also Earth's resources	Slideshow about the importance of water as a taonga (precious treasure)
2. Water in pictures	• Identify the different ways that people view and use water • Recognise that water resources can be found in nature in a variety of forms	**Science: Level 3 and 4** ***Planet Earth and Beyond:*** *Earth systems* Develop an understanding that water, air, rocks and soil, and life forms make up our planet and recognise that these are also Earth's resources **Social Sciences: Level 3** Understand how people view and use places differently	View a set of photos about water use and water in the environment. Discuss and group them according to subject
3. Water in our lives	• Recognise that in different situations, people use and think about water differently • Understand that as water consumers, we all have a responsibility to use water carefully	**Social Sciences: Level 3** Understand how people make decisions about access to and use of resources **Social Sciences: Level 4** Understand how producers and consumers exercise their rights and meet their responsibilities **English: Level 4** ***Listening, Reading and Viewing*** *Processes and strategies* Integrate sources of information, processes, and strategies confidently to identify, form and express ideas	Read a series of case studies about how children from other countries use water and compare to their own water use
4. Water everywhere	• Recognise that there are limited resources of fresh water on earth • Understand that only a small proportion of fresh water on earth is easily available for us to drink	**Science: Level 3 and 4** ***Planet Earth and Beyond:*** *Earth systems* Develop an understanding that water, air, rocks and soil, and life forms make up our planet and recognise that these are also Earth's resources **Science: Level 3 and 4** ***Planet Earth and Beyond:*** *Interacting systems* Investigate the water cycle and its effect on climate, landforms and life	Demonstration of fresh water as a proportion of water on earth



1:1 Water: a precious taonga – teacher notes

Curriculum links

Science: Level 3
Planet Earth and Beyond: *Earth systems:* Appreciate that air, water, rocks, soil and life forms make up our planet and recognise that these are also Earth's resources

Other curriculum links: L 3 and 4
English *Listening, Reading and Viewing*
Processes and strategies

Education for sustainability concepts

Interdependence/ Whanaungatanga: Everything and everyone in our world is connected

Responsibility for Action/ Kaitiakitanga: If we want to use taonga, we must look after that taonga

Background knowledge

Water is a limited resource that we often take for granted here in New Zealand. Even though we have a relatively plentiful supply of water, it is often not used as wisely as it should be. This slideshow aims to express the importance of water in our lives and the value of water to all of us.

Water is a renewable resource. It replenishes with rainfall and is cleansed by the processes it goes through in the water cycle. Competition for the surface water available to us increases as time goes on.

In a Māori world view, the Earth is a living entity. Papatūānuku (the earth mother) is both our ancestor and our provider. People are descended from her through the atua (māori 'gods'). The atua **are** the environment and as descendants of the atua, people **are** part of the environment. Water being part of that environment, we are water and water is us (this is also true in a scientific world view where humans are 70% water).

Tangaroa

Tangaroa is one of the descendants of Papatūānuku (the earth mother) and Ranginui (the sky father). He is one of the atua. Tangaroa is the atua of the sea, rivers, lakes and all life within them. Water is Tangaroa's domain.

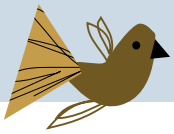
Mauri

As part of this living system, water has its own mauri, energy, or life-force. Some students may have witnessed this energy in a fast flowing river or in the tranquil beauty of a deep pool.

Taonga

A taonga is a heartfelt treasure of immense value. There are times when a taonga can be an item, for example, something handed down through generations (taonga tuku iho), but a taonga can also be an idea or sometimes a person. A taonga is viewed and valued by others in a special way. If we respect and value water, and feel our connection with it as a part of the environment, then we must be responsible to care for it. We need to look after earth's resources in a sustainable way to ensure her gifts remain for future generations. We need to think of water (and earth's other gifts) as taonga.

1:1 Water: a precious taonga – learning experience



Learning experience

- Share the learning intention and success criteria
- Ask the students if they understand what is meant by a 'taonga'. Explain that a taonga is a 'heartfelt treasure of immeasurable value'. Water is very important and has many functions in our environment. Explain that water is seen by Māori as a taonga that must be looked after and respected
- View the slideshow: *'Water: a precious taonga'*. Ask students to record their ideas about the slides as they are displayed during the slideshow. This could be done using a **KWL chart – K** = what you already **know** about water? **W** = what you **want** to know? and **L** = what did you **learn** during the slideshow?
- After discussing the student's own ideas about water, use *BLM 1a: Water: a precious taonga – slideshow notes* to read out the text accompanying each slide. *The numbers are indicative of the slide number the notes belong to.* Allow time for discussion and questions
- After the slideshow, share ideas about why water is a precious taonga/ natural resource. This could be a discussion or students could produce a piece of artwork to reflect their thoughts and feelings

As an extension, students could create their own PowerPoint presentations about water.

Reflection questions

- Why is fresh water important to people?
  We need to drink water to survive
- What do you think it might mean to say that water has 'mauri'?
  (see teacher notes)
- Why should we use fresh water wisely?
  It is necessary to have a continuous supply for our survival

Vocabulary

- taonga
- Tangaroa
- Papatūānuku
- mauri
- immeasurable

Learning intentions

Students will:
Understand that water is a precious natural resource

Success criteria

Students can:
Express their understanding of why water is a precious resource

Resources

Slideshow –
Water: A precious taonga

BLM 1a Water:
a precious taonga –
slideshow notes

BLM 1a: Water: a precious taonga - slideshow notes

1. Title page – Water: a precious resource
2. Water is our lifeblood… the key ingredient for life
3. Without it, we would not survive
4. Earth is covered with water, but a very small amount of this water is fresh, or suitable for drinking
5. Every year, the amount of fresh, clean water gets smaller and the population of the world gets bigger
6. In the future, water will be more of a concern than it is today. It will become even more precious than it is now
7. Water was here before us, before all life. Before there were people, plants or animals, there was water
8. It is thought that water is where the first life began
9. Water has its own energy called 'mauri' or life force. It can be a mighty wall of destruction…
10. Or a gentle, quiet pond of stillness
11. In Te Ao Māori (the world of Māori) water is a sacred taonga to be looked after
12. Water is a taonga, to be valued, used with respect, and handed on in an equally good condition to the next generation
13. Water is the realm of Tangaroa, atua of the seas, lakes and rivers and everything in them. Tangaroa is a child of Ranginui and Papatūānuku, the sky father and the earth mother

14 Wherever there is water, Tangaroa is there; in hot springs, ponds and rolling seas

15. The footsteps of Tangaroa can be seen in the rolling waves, the churning oceans and the ebb and flow of the tides
16. Tangaroa's children are the fish and animals that make their home in the water
17. Papatūānuku, (the earth mother of Tangaroa) forms our land. Her body is the mountains and the earth, her veins and arteries are the waterways and streams
18. The rivers and streams carry the impurities from the land and wash them away out to sea. Streams feed into rivers and rivers flow into the sea

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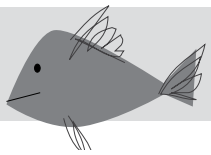

19. Here in New Zealand, we have water all around us. Our islands have many streams and rivers and are surrounded by the ocean
20. Demand for water is high in New Zealand homes and it keeps climbing
21. It seems as if fresh drinking water should be easily available here, but as time goes on it gets more difficult to get new unpolluted water sources
22. Water suitable for drinking, free from disease and impurities, is hard to come by
23. Before being piped to our homes, water from our rivers and catchments is treated and filtered
24. It takes a lot of time, energy and money to collect and treat drinking water. Clean, safe drinking water is not free!
25. People in the Wellington region use about 240 litres, or 2 bathtubs full every day[1]
26. Other countries are not so fortunate. In India, people use about 140L (one bathtub full) per day[2]
27. In parts of Ethiopia, people survive on only about 15L (one bucket) per day[3]
28. Every day in New Zealand, people, households and businesses use huge amounts of water and often water is not used carefully
29. But it is not just us humans who need water. Every living thing depends on water for its survival
30. Without water there would be no plants, animals or food for us
31. When we take water out of the ecosystem it was meant for, it has an impact on the life in that environment
32. We collect our food from the sea and rivers. We want our food baskets to be free from pollution and other problems
33. We all have a responsibility to look after our fresh water, for future generations and for the animals that depend on it for their survival
34. It is up to every one of us to use water wisely. If we waste water or pollute it, then our environment will suffer
35. We must all do our part to protect our lakes, rivers, streams and oceans
36. We must protect the realm of Tangaroa and protect his children

1 Greater Wellington Regional Council Water Supply Annual Report for the year ended 30 June 2010. pg 5
2 http://www.data360.org/dsg.aspx?Data_Set_Group_Id=757#
3 http://www.data360.org/dsg.aspx?Data_Set_Group_Id=757#

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Water: A precious taonga – slideshow outline

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1:2 Water in pictures – teacher notes

Background knowledge

These pictures depict water in the natural environment and people's interaction with water. We all interact with water daily, in a variety of ways. This activity aims to enable students to reflect on their own experiences with water and to share them with others.

Description of the *Water in pictures* photocards

Photo No.	Description	Possible grouping*
1	Snow	1
2	Cow drinking	4
3	Swamp forest	1
4	Waterfall	1
5	Waterskiing	2
6	Drinking fountain	4
7	Mist	1
8	Bottled water	4
9	Water droplet/rain	1
10	Rainwater tank	4
11	Water slide	2
12	Girl in pool	2
13	Cuba Mall bucket fountain	2
14	Kayaks on Hutt River	2
15	Fishing	2
16	Dishwasher	3
17	Washing machine	3
18	Toilet	3
19	Sprinkler watering garden	3
20	Cleaning teeth	3
21	Washing hands	3
22	Bell bird with water trough	5
23	Longfin eel	5
24	Dam	1

*These possible groups are a guide only and are not intended to be the only way to group the photocards. Encourage your students to have their own grouping and to be able to justify their choices.

Photos may be sorted into groups which may include some of the following categories:

1. Water in nature/water as a natural resource
2. Water for recreation
3. Water uses in the home e.g. cleaning, washing
4. Water for drinking
5. Water for plants and animals

Curriculum links

Science: Level 3
Understand how people view and use places differently

Science: Level 3
Planet Earth and Beyond: *Earth systems:* Appreciate that air, water, rocks, soil and life forms make up our planet and recognise that these are also Earth's resources

Other curriculum links: L 3 and 4
English: *Listening, Reading and Viewing Processes and strategies*

Education for sustainability concepts

Responsibility for Action/ Kaitiakitanga: If we want to use taonga, we must look after that taonga

Sustainability/Hauora: The choices we make today affect choices we will be able to make in the future

1:2 Water in pictures – picture cards

1. Snow

2. Cow drinking

3. Swamp forest

4. Waterfall

5. Waterskiing

6. Drinking fountain

7. Mist

8. Bottled water

9. Water droplet/rain

10. Rainwater tank

11. Water slide

12. Girl in pool

13. Bucket fountain

14. Kayaks

15. Fishing

16. Dishwasher

17. Washing machine

18. Toilet

19. Sprinkler in garden

20. Cleaning teeth

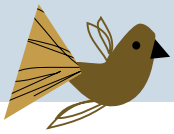
21. Washing hands

22. Bellbird on water trough

23. Longfin eel

24. Dam

1:2 Water in pictures – learning experience



Learning experience

This activity can be done as a whole class or in groups

- Distribute photocards to students. Students without photocards can be the group leaders. Discuss the learning intentions and suggest that the grouping should include both water in nature and the ways that people use water
- Group leaders can invent a title for a category after looking at the photocards. When each group leader has a different category title, each card can be discussed one by one, and grouped (together as a class) into categories
- Students with a photocard can come to the front of the classroom. They can share which category they believe their card belongs to and give reasons. The rest of the class can agree or give alternatives
- Display cards along with category titles
- Discuss how students have seen people/animals use water in the photos. Students can then share their own experiences of water use and compare them to the people depicted in the photo cards
- As a class, use the previous discussions to create some generalised statements about how people use water, acknowledging how water is important to different people in different ways. Record ideas
- Start a list of questions students have about what they have seen in the photos. These questions could lead to an inquiry if you prefer this approach

Alternatively, you could allow small groups to sort cards themselves and assign categories, while the others work on an alternate task.

Reflection questions

- What ideas about water were there in the photos that you had not thought about before?
- What things did other people notice that didn't initially stand out for you? Why do you think this is?
- How do you use water differently to your classmates?

Vocabulary

Start a vocabulary list of interesting words and concepts that come up during the discussion.

Learning intentions

Students will:
Identify the different ways that people view and use water

Recognise that water resources can be found in nature in a variety of forms

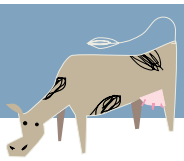
Success criteria

Students can:
Describe and categorise how people are using water in the photos

Describe water resources in nature

Resources

Set of 24 *Water in pictures* photocards



1:3 Water in our lives – teacher notes

Curriculum links

Science: Level 3
Understand how people make decisions about access to and use of resources

Science: Level 4
Understand how producers and consumers exercise their rights and meet their responsibilities

Other curriculum links: L 3 and 4
English *Listening, Reading and Viewing Processes and strategies*

Education for sustainability concepts

Interdependence/ Whanaungatanga: Everything and everyone in our world is connected

Sustainability/Hauora: The choices we make today affect choices we will be able to make in the future

Equity: respect for all life, social justice, intergenerational equity, finite resources

Background knowledge

The global situation

Over the last 300 years, the world's population has increased by seven times, but the amount of water we use has increased 35 times[4]. We use fresh water for more things than ever before. This has meant that fresh water supplies are becoming depleted in many parts of the world.

One in every eight people in the world lack access to clean water[5]. Often there is adequate rainfall or other water sources to provide water for the people of these countries but they lack the infrastructure to get the water to the people.

Water in the Wellington region

In the Wellington area, we are lucky that we usually have a steady supply of water to meet demands, but even we can have water shortages. Our councils are starting to consider building a new dam (2010).

People in the Wellington region use an estimated 240 litres per person per day (L/p/d)[6]. This is a very large amount compared to people in other countries.

Gross vs net water use per person

Figures about our water use can vary according to the source. Our *net* water use (water used at home) is estimated to be about 240 L/p/d but *gross* water use is about 380 L/p/d[7]. Gross water use includes domestic, commercial and industrial water use, fire fighting, pipe maintenance and leakage from pipes. Net figures are based on water use *in homes only*.

Our net water use can only be estimated as homes in the Wellington region are not metered.

4 http://telstar.ote.cmu.edu/environ/m3/s4/cycleHydro.shtml
5 http://water.org/learn-about-the-water-crisis/facts/
6 Greater Wellington Regional Council Water Supply Annual Report for the year ended 30 June 2010. pg 5
7 Greater Wellington Regional Council Water Supply Annual Report for the year ended 30 June 2010. pg 4

Country	Average water used per person per day	Case study synopsis	Reading age (two different methods have been used)
Ethiopia **BLM 1d**	15L /day[8]	Ayana lives in southern Ethiopia. There is no water supply for her family so they source their water from wells and ponds.	8-9 yrs+ or 10-11 yrs*
Israel **BLM 1e**	135L/day[9]	Ori lives in Jerusalem, Israel. He is very careful with water and uses it wisely.	7.5-8.5 yrs+ or 12-13 yrs*
Australia **BLM 1c**	220L/day[10]	Oliver lives in Brisbane, Australia. He and his family have ongoing water restrictions which mean they must be careful with their water.	8.5-9.5 yrs+ or 12-13 yrs*
Samoa **SJ 3:3:99 pg 25**	230L/day[11]	*(Article: School Journal Part 3 number 3, 1999)* Elisapeta lives on Manolo island, Samoa. She has to collect water in buckets for her family.	8.5-9.5 yrs

8 http://www.data360.org/dsg.aspx?Data_Set_Group_Id=757#
9 http://www.okwaterwise.ca/learn-go.html
10 http://www.nwc.gov.au/www/html/236-water-use-in-australia.asp
11 http://www.pacificwater.org/userfiles/file/GEF%20IWRM%20Final%20Docs/SOPAC%20Samoa%20IWRM%20Diagnostic%20Report%2022_10_07.pdf (p28)
\+ Assessing the Difficulty of Reading Materials: The Noun Frequency Method. Warwick B Elley and A.Cedric Croft. 1989 edition.
* **Estimated** reading age based on fry readability formula

1:3 Water in our lives – learning experience

Learning intentions

Students will:

Recognise that in different situations, people use and think about water differently

Understand that as water consumers, we all have a responsibility to use water carefully

Success criteria

Students can:

Compare their water use with people from other countries and give reasons for any differences

Give reasons why we have a responsibility to use water wisely

Resources

BLM 1b Water use in different countries

BLM 1c Water use: Brisbane, Australia

BLM 1d Water use: Southern Ethiopia

BLM 1e Water use: Jerusalem, Israel

School Journal Part 3, number 3, 1999, pg 25 "Don't waste the water!" by Jill Macgregor

Learning experience

This activity is based on the English and Social Sciences curriculum. It could be completed during a reading session.

- Share the learning intentions and success criteria
- View pictures or a slideshow about how children from elsewhere in the world use water

  E.g. Nsomah in Ghana: http://www.wateraid.org/uk/learn_zone/teachers/primary/water_around_the_world/6385.asp
- Explain that students will now read case studies of how other children around the world collect and use water
- Hand out copies of the different case studies *(BLM 1c, 1d and 1e and School Journal 3:3:1999)* to the students
- Ask the students, working in pairs or groups, to read the story they have been given and complete *BLM 1b: Water use in different countries.* Ask them to be prepared to summarise their case study for others
- When they have completed BLM 1b, invite individual students or pairs to join with others who read a different case study. Ask each person/group to summarise the case study they read for the other group and compare their answers for each question
- Discuss their findings as a class

As an extension, students could take on the role of the child in their case study and present a brief role play about water use in that country. Visit http://my.water.org/ or http://watermatters.worldvision.org.nz/ for more extension ideas

Reflection questions

- Of the four situations shown in these case studies, who had to be most careful with water? Why? *Ayana in Ethiopia, because water was the hardest to come by*
- In each case, how much water do you think the family in the story use compared to your family? *Answers will vary*
- Do you think that people in Wellington use a lot of water compared to people in other countries? *Reveal the statistics on water use in each country from teacher notes*

Vocabulary

- waterhole
- responsibility
- consumer
- showerhead
- efficient
- conserve

BLM 1b: Water use in different countries

Questions	Country: Israel/Ethiopia/Australia/Samoa (circle which case study you read)
1. How did people in the case study get the water they used?	
2. How did people in the case study use water in their homes?	
3. Explain how these people use water in the same ways that you do in your home	
4. How do people in the case study save fresh water?	
5. Do people in this country value water? Why/why not?	
6. Do we have a responsibility to use water wisely? Why/why not?	

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BLM 1b: Example responses




Questions	Israel	Ethiopia	Australia	Samoa
1. How did people in the case study get the water they used?	From their taps. It is piped from Lake Kinneret	From a waterhole, pond or well	From their taps	From a well (vai'eli)
2. How did people in the case study use water in their homes?	*Drinking* *Cooking* *Washing hands:* by pouring water over hands using a cup *Brushing teeth:* using a cup to hold the water *Washing dishes:* using a cloth to wipe the dishes before they wash them	*Drinking* *Cooking* *Washing dishes*	*Drinking* *Cooking* *Washing dishes* *Washing clothes* *Showering* *Flushing the toilet*	Fresh water: *Drinking* *Cooking* Sea water: *Cleaning teeth* *Scaling fish* *Scrubbing vegetables* *Boiling eggs* *Washing dishes*
3. Explain how these people use water in the same ways that you do in your home	Answers will vary, but generally; drinking and cooking	→	Also possibly washing dishes/showering	
4. How do people in the case study save fresh water?	*Showering:* Water efficient shower head. They soap themselves while the water is off They use water in a cup for brushing teeth and washing hands They have tap aerators No baths Water garden with recycled water	*Cleaning themselves:* instead of showering they wipe themselves with a cloth *Brushing teeth:* They used a stick so that it didn't use water (not recommended for NZ students) They mixed water with milk for drinking to make it go further	*Showering:* They had 4 minute showers with a timer Water efficient appliances and shower head Greywater recycling Scraped plates and soaked pots before washing dishes Use the half flush on the toilet Fix leaks	Elisapeta is careful not to spill any water when she collects it They only use fresh water for drinking and cooking. Sea water is used for many things
5. Do people in this country value water? Why/why not?	Water is very precious to people in Israel. They have much less rain than NZ so they are very careful with water	Very little water is used or wasted because it is so hard to get	People in Australia are generally very careful with water because they have frequent droughts and restrictions	Very little water is used or wasted because it is difficult to come by in this part of Samoa
6. Do we have a responsibility to use water wisely? Why/why not?	Yes we do. Because water is a limited, valuable resource. It takes time, energy and money to bring water from water collection areas to our taps so we should use it carefully and thoughtfully			

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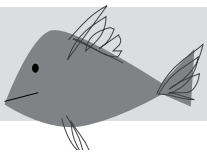
BLM 1c: Water use 1



Brisbane, Australia: Oliver and his family

Getting their water

Oliver lives in Brisbane, Australia. There are taps in several rooms in Oliver's house and water is freely available to him when he needs it. He has water delivered to his house through a network of pipes. The water comes from several dams. It is treated and then pipes deliver the water to people in the city. Water is easy for Oliver to get, but he is very careful with it.

Water conservation

Oliver's family understand that water is not to be taken for granted because in the last few years there have been several droughts in Brisbane and water had to be carefully conserved. Everyone had to stop and think about how they used water. They have made many changes to their lifestyle to save water. After the last drought they bought a water efficient washing machine. They wait until the washing machine is full to do a load of washing so that water is used efficiently.

Saving water at home

The family time their showers with an egg timer. When Oliver gets in the shower he sets the timer for four minutes. When the timer goes off he gets out.

They have a water recycling system which collects the wastewater that is discharged from the laundry, bath, shower, and hand basins. This 'greywater' is treated and then used to flush the toilet and water the garden.

Their toilet has a dual flush system. Oliver uses the half flush button because it uses less water. When they are doing the dishes, the family scrape dirty plates and soak pots instead of rinsing them with water. They wait until the dishwasher is full before turning it on.

Water shortages

When the weather is dry, the water levels in the dams drop and the council informs the public how they can use water and how much they are allowed to use. Water use per person, per day is measured and reported every day in the newspaper.

Because people in Brisbane never know when the next big downpour of rain will come, they are careful with water. By doing small things to save water, they work together and make sure there is enough water for everyone.

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BLM 1d: Water use 2

Southern Ethiopia: Ayana and her family

Water is difficult to come by in parts of Ethiopia for most of the year. In the dry season from October to February, there is very little rainfall. In small villages like the one that Ayana lives in there is no way of storing fresh water or treating it to keep it fresh. Everyone in the community spends many hours a day getting the water they need for their daily lives.

Collecting water

Ayana and her mother start the day early and walk to the waterhole an hour and a half away. They carry the water back home using donkeys. They use the water they collect for washing and cooking. They go to the waterhole again in the afternoon, to collect more water. They must line up for water when they get to the well and people who live nearby get the first priority.

Sometimes Ayana and her mother take so long to get their water that she doesn't make it to school. When she is able to go to school, Ayana finds it difficult to keep up because she is away so much. Other girls in the class are in the same situation.

Most men and boys are responsible for getting water for the animals from ponds. Some boys get to go to school every day.

Using water at home

There are no showers where Ayana lives, so to clean herself she uses some water to wipe her body with a cloth. She brushes her teeth with a special stick. Ayana is very careful with water and doesn't use much.

Ayana likes to add cow's milk to water and drink it. The water that she drinks must be boiled first. She cooks maize every day with her mother. It is difficult to grow any food because there is so little rain. So instead of growing food, they buy corn to eat.

Water shortages

In the dry season, water is even harder to find. There are deep wells, far away, for getting water when the ponds dry up. People bring the water up from the wells and fill troughs and buckets. It takes many people and a lot of effort.

In the rainy season, water falls in ponds closer to their house and life is easier.

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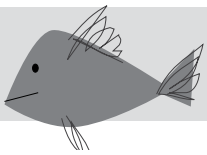
BLM 1e: Water use 3



Jerusalem, Israel: Ori and his family

Ori lives in Jerusalem, Israel. Israel is a dry country, with very little rain and few water resources.

Getting their water

The water in homes in Jerusalem is piped from a great lake in the north called Lake Kinneret. It doesn't often rain in Israel, and there is no rain at all in the hottest months of the year. For this reason, Ori and his community respect and value the water that they are given and are very careful with water.

Using water at home

Ori's family have special attachments on their taps to add air to the water to make it go further. When they wash their dishes they spray each dish with water and then cover them with detergent. They then rinse the detergent off. This saves a lot of water.

Cleaning and bathing

Washing hands is done with a special cup which they use to pour water over their hands instead of using a tap. Using this method, very little water is wasted. Ori brushes his teeth with water from another cup. Ori's family have a small garden which is watered with the water they have recycled from their laundry waste water.

When Ori has a shower, he wets himself with water, and then soaps himself while the water is off. Then he turns the shower on again to rinse off the soap. His shower has a special water efficient showerhead which uses less water than a normal one. Ori never has a bath; in fact there is no bath in his house!

Drinking water

The water which comes from the tap is usually clean, but Ori's family buy bottled water to drink. The house has a water meter which is checked regularly. If the family use more water than they are allowed, they have to pay a lot of money. Everyone in the family does their part to save water.

Water shortages

When there is no rain people start to worry. Crops start to fail and the lake level drops. People start praying for rain. People in Jerusalem seldom waste water. Water is very precious to them.

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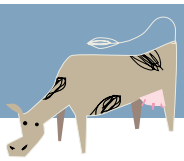


1:4 Water everywhere – teacher notes

Curriculum links

Science: Level 3 and 4 *Planet Earth and Beyond:* *Earth systems:* Develop an understanding that water, air, rocks and soil, and life forms make up our planet and recognise that these are also Earth's resources

Science: Level 3 and 4 *Planet Earth and Beyond:* *Interacting systems:* Investigate the water cycle and its effects on climate, landforms and life

Education for sustainability concepts

Responsibility for action: If we want to use taonga, we must look after taonga

Sustainability/Hauora: The choices we make today affect choices we will be able to make in the future

Background knowledge

Water resources on Earth

Water is everywhere in our world, but only a tiny proportion of this is fresh water, suitable for drinking.

Of all the water on earth, 97% is stored as salt water in the world's oceans. Salt water makes us sick if we drink it. Only 3% of the total water on earth is fresh water. Unfortunately, not all fresh water is easy to access. The fresh water that comes to mind for most of us is surface water, such as lakes, rivers and wetlands. But surface water makes up less than 1% of the fresh water on earth. The majority of fresh water is in places that are very difficult to access, for example, underground (30%), in icecaps and glaciers (68%) and in water vapour (1%).

This fresh, available water is needed not just for humans but for all the plants and animals that live on earth. One in eight people in the world do not have access to fresh water.

Why not use desalination to get fresh water from salt water?

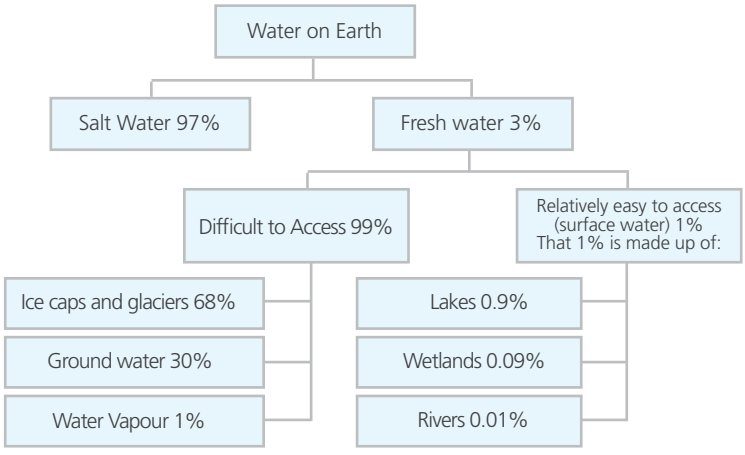
Desalination (removing the salt from sea water for drinking) currently requires huge amounts of energy and is relatively more expensive than other systems. Intakes of water in the ocean often have negative effects on marine life. Desalination plants reduce important marine habitat for all kinds of animals.

The energy required to power a desalination plant also often causes greenhouse gas emissions and air pollution.

Salt is produced as a by-product of desalination and safe disposal of this is also a concern.

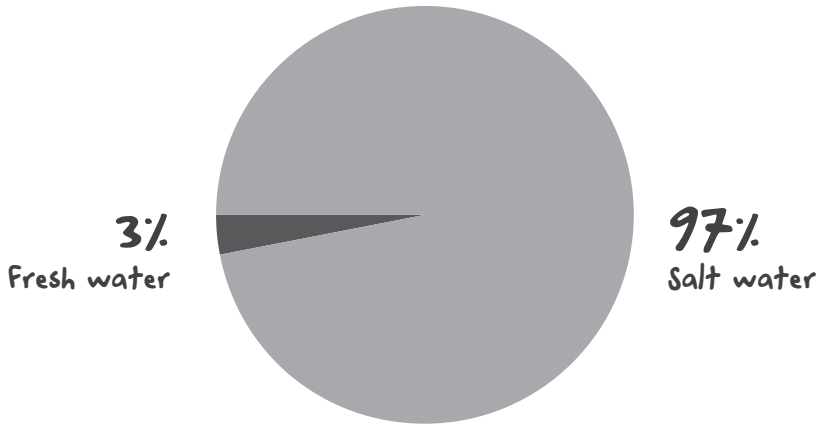
Information for diagram below has been adapted from:
http://ga.water.usgs.gov/edu/earthwherewater.html

For further information see:
NIWA National Institute of Water and Atmospheric Research
http://www.niwa.co.nz/

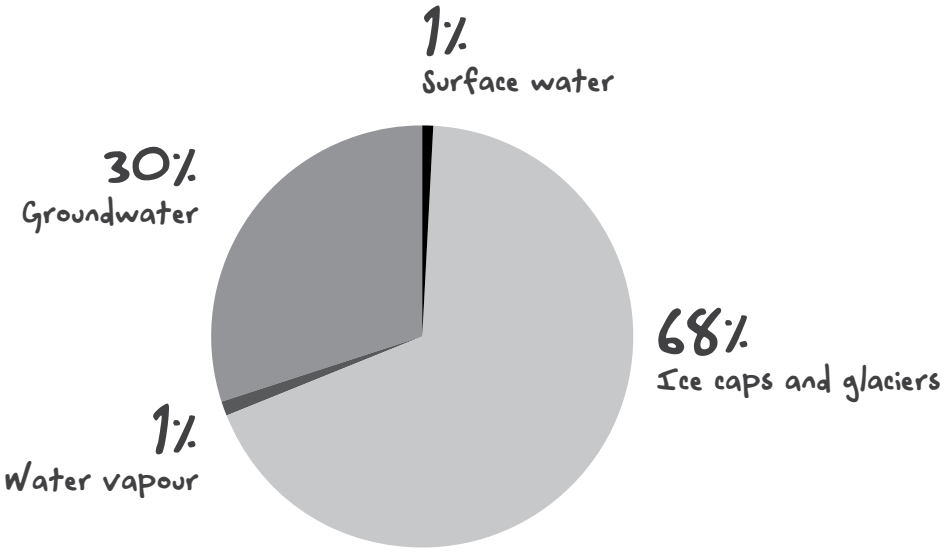


BLM 1f: Water on earth

Proportion of fresh water on earth



The fresh water on earth



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1:4 Water everywhere – learning experience

Learning intentions

Students will:

Recognise that there are limited resources of fresh water on earth

Understand that only a small proportion of fresh water on earth is easily available for us to drink

Success criteria

Students can:

Describe the proportions of the different types of water on Earth

Display the proportions of fresh water that are on earth and describe which are easily available for drinking

Resources

BLM 1f Water on Earth

A bucket or 10L container

A small cup (approx 200mls)

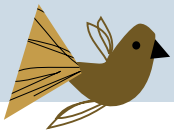
1 teaspoon (5 mL)

Learning experience

- Introduce the learning intentions and success criteria
- Show students a globe of the earth. Ask students how much of the planet is covered by water. Explain that water covers approximately 70-75% of our planet
- Ask students how much fresh water there is compared to salt water on earth. Encourage discussion. Reveal that 97% of the water on earth is salt water and around 3% is fresh water
- Work as a class to make a list of the places on earth where fresh water is found (rivers, lakes, wetlands, snow, ice, glaciers, groundwater)
- Working in small groups, students could order these places from the one that holds the most fresh water to the one that holds the least
- Explain to the students that not all of this fresh water is readily available for drinking. As a class, brainstorm the sources of water that are readily available for drinking (surface water in rivers, lakes and wetlands). Discuss the sources that are not available for drinking, for example, salty water (the sea) or water that is difficult to access (snow, ice, glacier water, underground water). Now carry out the following demonstration to indicate the true proportions of drinkable water:

Demonstration: Water proportions on Earth

	Action	Description
1.	Fill a bucket with water	This is all the water on Earth (including water in the air as rain or mist)
2.	Ask a volunteer to take a small cup of water from the bucket. Add salt to the water in the bucket and stir	The water in the cup represents all the *fresh* water on earth. The water left in the bucket represents the *salt* water that is in the oceans
3.	Ask a student to take a teaspoon of water from the cup	The water left in the cup represents *fresh water* that is difficult to get at (e.g. underground water or water frozen in glaciers/ice caps). The water in the teaspoon represents the remaining *surface* water and other fresh water
4.	Examine the water in the teaspoon	Water left on the teaspoon represents fresh water that is easier to get at – water found in lakes, rivers, streams, or in the ground and underground. But some of this water is still very difficult for us to access – ice and snow, swamps and marshes, water in soil and air



- Explain that the amount of water used in the activity must be multiplied many millions of times to get the actual amounts involved
- Hand out copies of *BLM 1f: Water on Earth* to share in small groups. Discuss the proportions of fresh water in different places on Earth
- Explain that the surface water is the rivers, lakes, wetlands and streams and that this water is the only water that relatively easy for us to access and use
- Ask what this available fresh water is used for? Discuss. Refer to the previous learning experience (1:3 Water in our lives). We use water for making things, growing food, cleaning, washing, and drinking etc. As well as servicing people, this fresh water must also meet the needs of all plants and animals on Earth

As an extension, students could represent the information in BLM 1f: Water on Earth in a different format, for example, as pictograms or bar graphs.

Reflection questions

- Do you think that we have an unlimited supply of fresh water? *Explain that there is a limited amount of fresh water to meet the needs of all life on Earth; plants, animals and humans*

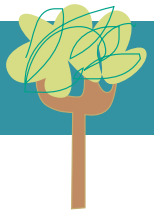
Vocabulary

- proportions
- access/accessible
- inaccessible
- surface water

SECTION TWO:

The water cycle

This section includes activities based around the natural water cycle and how water changes state and moves around the environment.



Section 2: The water cycle

The purpose of this section is to help students to:

- Understand how water changes state (solid – liquid – gas)
- Understand that water moves around the planet in a cycle
- Explore how water moves around a natural catchment compared to an urban catchment

Overarching concepts for Section Two:

- Water naturally moves around the planet in a cycle, changing state as it goes
- Our changes to the natural landscape affect how water moves around a catchment

Section 2: The water cycle

Learning experiences – Section Two

Learning experiences	Learning intentions Students will . . .	Curriculum links (Achievement objectives)	Content
1. The natural water cycle	• Understand that water moves around the planet in a cycle • Investigate water movement in a terrarium and relate this to water movement in the environment	**Science:** **Level 3 and 4** ***Planet Earth and Beyond:*** *Interacting systems* Investigate the water cycle and its effect on climate, landforms and life ***Nature of Science:*** *Investigating in science* Ask questions, find evidence, explore simple models, and carry out appropriate investigations to develop simple explanations	Students set up a terrarium experiment to see the water cycle in action. They observe water changing state from liquid to gas (water vapour) and back again
2. Changes in the movement of water	• Investigate how urban landscapes can alter the pathways of water • Recognise that water behaves differently on permeable and impermeable surfaces	**Science:** **Level 3 and 4** ***Planet Earth and Beyond:*** *Interacting systems* Investigate the water cycle and its effect on climate, landforms and life	Students examine water movement in natural and urban catchments. They investigate how water interacts with both impermeable and permeable surfaces

2:1 The natural water cycle – teacher notes

Curriculum links

Science: Level 3 and 4
Planet Earth and Beyond:
Interacting systems:
Investigate the water cycle and its effect on climate, landforms and life

Nature of Science:
Investigating in science:
Ask questions, find evidence, explore simple models, and carry out appropriate investigations to develop simple explanations

Education for sustainability concepts

Interdependence/ Whanaungatanga:
Everything and everyone in our world is connected

Background knowledge

Water changing state

Water is the only substance on earth that is found naturally as a solid (e.g. ice, snow, hail), liquid (e.g. water, rain) and a gas (e.g. water vapour, steam, fog, mist).

The natural water cycle

Water moves around the planet in a repeating cycle, **changing state** between a liquid, a gas and a solid.

In the water cycle, the sun heats up liquid water on the earth and causes it to become water vapour ***(evaporation)***. The water vapour then rises in the air and, when it hits cold air higher up, it condenses into clouds ***(condensation)***. When the clouds become too heavy, it falls to the earth as rain/hail/snow ***(precipitation)***.

Water movement in the water cycle

When water reaches the earth as precipitation it can:

1. **Evaporate** directly from the ground/ocean/a water body
2. **Run-off** to collect in water systems such as wetlands, lakes, creeks, streams, rivers or estuaries (making its way through these systems to the ocean where, over time, it will evaporate as the sun heats it)
3. **Soak** into the ground

From there follow a number of pathways. It can:

- be taken up by plants and trees, which eventually release it out into the atmosphere as water vapour ***(transpiration)***
- filter through the ground into the groundwater system
- filter down into giant, underground, rock 'sponges' called **aquifers**. Water from aquifers re-enters water systems through springs or seepage into the ocean or by filtering back into waterways

Water can also become solid ice or glaciers or end up in a thermal boiling pool. The options are almost endless!

The cycle continues as water evaporates and then precipitates back to earth.

2:1 The natural water cycle – learning experience

Learning experience

- Share learning intentions and success criteria
- With the students, make a terrarium using listed resources. Explain that you will use the terrarium to show how water changes state and moves in the water cycle. *(Students could construct a terrarium as a homework activity if preferred)*
- Place soil in a vase **or** large jar. Plant several seedlings in soil and water generously so that soil is wet to touch. Place plastic wrap on top of vase/container and secure with a rubber band to prevent any moisture escaping
- Set aside terrarium while you discuss students' predictions. Ask students what they understand by 'the water cycle'. Explain that water moves in a cycle around the earth, changing state as it goes. Ask what students understand by 'changing state' *(see teacher notes – the natural water cycle)*
- Display the poster *'The water cycle'*. Discuss the stages of the water cycle on the poster; evaporation, precipitation, transpiration, condensation. Explain each process. Ask if students can find evidence of any of these stages of the water cycle in the terrarium. *Students should be able to see evaporation as water vapour in or on the side of the container and condensation hanging as water droplets on plastic wrap after about 20 minutes. Precipitation is sometimes visible as water droplets very slowly making their way down the side of the container, or on leaves. After a few hours there should be large water droplets hanging from the plastic wrap and 'precipitation' will be more frequent and easier to observe*
- A few days later, if we take off the plastic wrap and feel the soil would it still be wet? *Yes it would, because water in the terrarium is moving around in a cycle; changing state, but not escaping, as it does on earth*
- Ask students to draw a diagram of the terrarium, labelling the states of water that they can see and where the processes of condensation, evaporation, precipitation and transpiration are occurring. Record observations over several days
- For a simple review of the water cycle and the associated vocabulary see: http://www.epa.gov/ogwdw/kids/flash/flash_watercycle.html
- For an animation about the water cycle, transpiration and run-off see: http://www.youtube.com/watch?v=LBtOZAo2sr4

As an extension, read Connected, Part 2, 2002: An interview with a glass of water. Find words to describe water as a solid, a liquid and a gas in the article.

Learning intentions

Students will:
Understand that water moves around the planet in a cycle

Investigate water movement in a terrarium and relate this to water movement in the environment

Success criteria

Students can:
Explain how water moves in the water cycle

Describe the movement of water in a terrarium and relate this to water movement in the environment

Resources

Clear container, e.g. jar/vase
Plastic wrap
Soil
Spray bottle/watering can
Several small plants
Rubber band
Poster The water cycle

Example of a terrarium

Reflection questions

- Where do the processes of precipitation, evaporation, transpiration and condensation happen outside the terrarium? *(see teacher notes for examples)*

Vocabulary

- state
- terrarium
- condensation
- evaporation
- precipitation
- transpiration

2:2 Changes in the movement of water – teacher notes

Background knowledge

Pathways of water

In a natural catchment covered with trees and vegetation, water will fall onto trees, plants or soil and be absorbed by them. Large amounts of water will seep into the ground in a natural environment *(infiltration)*, and be absorbed by plants. The majority of water in a natural, vegetated catchment passes through the groundwater system.

Impermeable surfaces

Impermeable surfaces will not let water through them. Many surfaces in urban environments are impermeable e.g. concrete, buildings and roads.

Permeable surfaces

Soil, bush and grassed surfaces are permeable, letting water through them so that it can enter groundwater and aquifers.

Run-off

Run-off can be defined as rain that is not absorbed by the ground. Run-off flows overland into our rivers, streams and beaches.

Water movement in poster *'Water movement in natural/urban catchments'*

An equal amount of rain falls in the urban and natural catchment in the poster. The sizes of the arrows are based on proportions of each of the processes. In the urban catchment, there are a lot of impermeable surfaces, so rain is mostly directed into the stormwater system or flows overland as run-off *(red arrows)*.

In the natural catchment, much of the rain is taken up by vegetation and released into the atmosphere by transpiration *(pink arrows)*. The remainder runs off into streams and rivers or filters into aquifers and groundwater *(infiltration – purple arrows)*.

Is more run-off a problem in urban catchments?

Large amounts of run-off can cause flooding and erosion. Less infiltration can cause a depletion of groundwater supplies. Run-off flows down our driveways, footpaths, roads and carparks into drains, taking debris and chemicals into drains, streams and rivers and out to sea.

For more activities relating to the water cycle and water movement in a catchment see: http://www.sciencelearn.org.nz/Contexts/H2O-On-the-Go/

Curriculum links

Science: Level 3 and 4
Planet Earth and Beyond:
Interacting systems:
Investigate the water cycle and its effect on climate, landforms and life

Other curriculum links: L 3 and 4
Science: *Nature of Science:*
Investigating in science

Education for sustainability concepts

Interdependence/ Whanaungatanga:
Everything and everyone in our world is connected

Sustainability/Hauora:
The choices we make today affect the choices we can make in the future

Answers to BLM 2a

1. a) precipitation b) transpiration c) infiltration d) run-off
2. More run-off, less transpiration, less infiltration, less water to groundwater
3. More impermeable surfaces, less trees, less permeable surfaces

2:2 Changes in the movement of water – learning experience

Learning intentions

Students will:
Investigate how urban landscapes can alter the pathways of water

Recognise that water behaves differently on permeable and impermeable surfaces

Success criteria

Students can:
Identify differences in the movement of water in urban catchments compared to natural catchments and give reasons for the differences

Describe how water behaves on impermeable and permeable surfaces

Resources

Poster The water cycle

Poster Water movement in natural/urban catchments

BLM 2a Water movement

Container of water

Learning experience

- Share the learning intentions and success criteria
- Revise the concepts and vocabulary introduced in the previous activity. Discuss the concept of a catchment
- Ask students what would happen to rain if the catchment in the poster *'The water cycle'* was covered with houses and concrete. *(Rain would not soak into the ground)*
- Introduce the word 'impermeable' and discuss the difference between permeable and impermeable surfaces *(see teacher notes)*
- Take a container of water onto a permeable surface (e.g. grass) and an impermeable surface (e.g. courts) in your school grounds. Tip water onto each surface and observe results. Discuss why water behaves differently on these two surfaces
- Ask students to look at the two versions of water movement in a catchment shown on the poster *'Water movement in natural/urban catchments'*/BLM 2a. Explain what run-off and infiltration are *(see teacher notes)*
- In pairs, ask them to describe the differences they see between the two sides of the poster/BLM 2a *(one has lots of permeable surfaces (natural catchment), the other has lots of buildings/impermeable surfaces (urban catchment)*
- Explain that the different arrows show the different pathways water can take when it rains. Encourage the students to notice that there is the same amount of rain falling on both catchments
- Ask 'Where does the largest amount of water go in the natural catchment?' *(pink arrows) transpiration from plants*
- Where are the pink *(transpiration)* arrows in the urban catchment? These arrows are very small; Why is this? *(There are not many trees, therefore not much transpiration)*
- Point out the aquifer in the natural catchment in the poster and explain how the water in a natural catchment filters down into the groundwater or aquifers *(infiltration – see teacher notes)* and then out to sea

- Why do you think the red run-off arrows are so much larger in the urban catchment? *There are a lot more hard (impermeable) surfaces in an urban catchment than a natural catchment. The water can't soak into the ground as much and a lot more of it runs off. To avoid flooding, we use stormwater drains to collect the water and direct it through underground pipes straight into streams and out to the sea*
- Ask the students to complete BLM 2a
- Use the poster *'Water movement in a natural/urban catchment'* as an answer sheet. Discuss their answers *(see teacher notes)*

As an extension, find examples of impermeable surfaces in your school and observe water falling on them and how it is directed into drains

Reflection questions

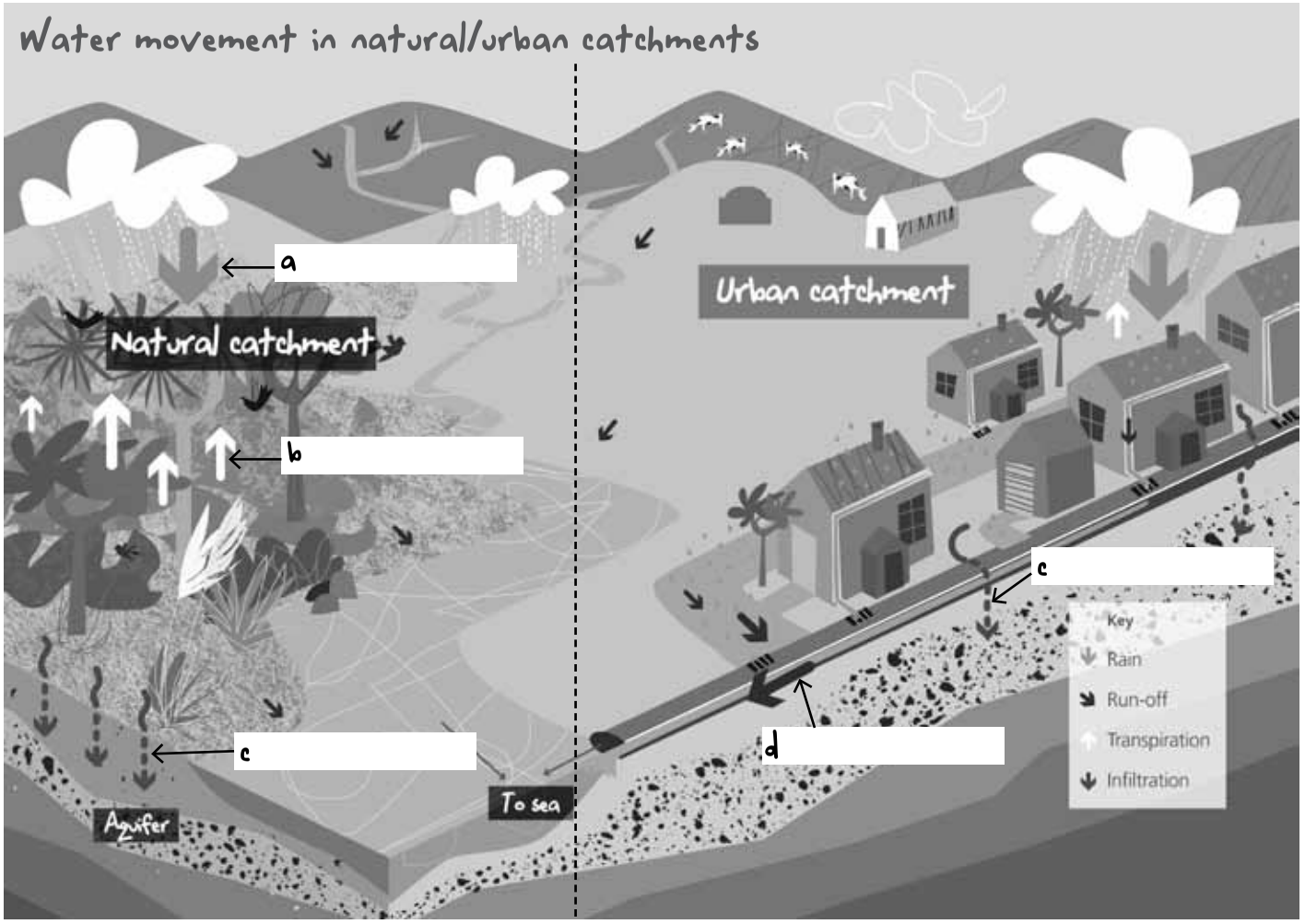
- Why is so much run-off a problem in the urban catchment? *Large amounts of run-off in urban catchments can be a problem because water collects pollutants from* ***impermeable*** *surfaces such as roads and roofs and transfers them directly to streams rather than filtering them out as they pass through the ground. Excess run-off also reduces the flow of water to groundwater*
- How could we minimise problems with run-off in urban landscapes? *Limit the amount of impermeable surfaces and use permeable surfaces wherever possible*

Vocabulary

- catchment (Greater Wellington's *Take Action for Water* educational resource has several activities that explore this concept in detail)
- urban
- run-off
- infiltration
- permeable
- impermeable

BLM 2a: Water movement

1. Place the following words in the appropriate boxes to describe the processes shown:
   run-off, transpiration, infiltration, precipitation (one appears twice)



2. How does water move differently in an urban catchment?

3. What causes these differences?

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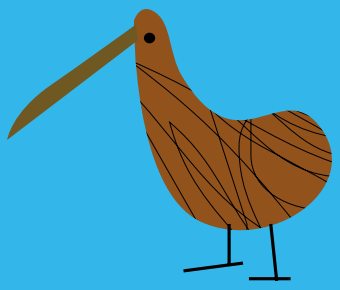
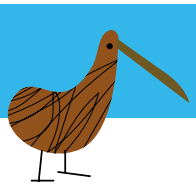


SECTION THREE:

How water gets to our taps

This section explores how water is delivered from water collection areas to our taps.



Section 3: How water gets to our taps

The purpose of this section is to help students to:

- Understand how water gets from the water collection area to their taps
- Understand that getting water to taps takes time, energy and money

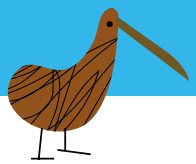
Overarching concepts for Section Three:

- Water is collected from dams, aquifers and groundwater and is distributed through a network of pipes to residents

Section 3: How water gets to our taps

Learning experiences – Section Three

Learning experiences	Learning intentions Students will . . .	Curriculum links (Achievement objectives)	Content
1. Our water supply	• Understand how drinking water is collected for Wellington's water supply • Identify where their drinking water is collected from	**Social Sciences: Level 4** Understand how producers and consumers exercise their rights and meet their responsibilities	Students examine a map describing the water sources in Wellington; the Waiwhetu Aquifer, Hutt Water Collection Area and Wainuiomata/Orongorongo Water Collection Area. They then identify where their water comes from and how it gets to their school
2. Water's journey to our taps	• Understand how drinking water gets from water collection areas to taps • Identify who is responsible for delivering water to residents	**Social Sciences: Level 4** Understand how producers and consumers exercise their rights and meet their responsibilities **Technology: Level 3** ***Nature of Technology:*** *Characteristics of technology* Understand how society and environments impact on and are influenced by technology in historical and contemporary contexts and that technological knowledge is validated by successful function	Students order steps in the process of getting water from the water collection area to our taps
3. The right water in the right place	• Recognise the difference between treated water, untreated water, greywater and wastewater • Describe safe uses for the different types of water	**Social Sciences: Level 3** Understand how people make decisions about access to and use of resources **Health: Level 3** ***Personal Health and Physical Development:*** *Safety management* Identify risks and their causes and describe safe practices to manage these	View examples of treated drinking water, untreated water, greywater and wastewater. Learn about the differences between the types of water and describe appropriate uses for each
4. No water supply for a day	• Understand the possible effects of an earthquake on the water supply network • Plan the use of emergency water supplies during a natural disaster	**Health: Level 3** ***Personal Health and Physical Development:*** *Safety management* Identify risks and their causes and describe safe practices to manage these **Social Sciences: Level 4** Understand how people participate individually and collectively in response to community challenges	Students are led through a scenario involving a fictional earthquake. They investigate the possibility of a disrupted water supply and make plans to prioritise emergency water use



3:1 Our water supply – teacher notes

Curriculum links

Social Sciences: Level 4
Understand how producers and consumers exercise their rights and meet their responsibilities

Other curriculum links: L 3 and 4
Mathematics: *Geometry and Measurement*
Technology: *Nature of technology*

Education for sustainability concepts

Interdependence/ Whanaungatanga: Everything and everyone in our world is connected

Equity: respect for all life, social justice, intergenerational equity, finite resources

Background knowledge

Methods of water collection

There are a variety of different methods used around New Zealand to get water to our taps. Methods include:

1. *Collection from roofs directing rainwater into tanks*
2. *Pump systems in streams to transport water to houses*
3. *Intake pipes to divert water from rivers into water treatment plants and then into a piped network*
4. *Bores and wells to extract water from the ground directly to homes or to a piped network*

The worldwide situation

In New Zealand, most people receive water that is diverted from rivers into a piped network (3). Worldwide, only 5 out of 10 people have some kind of connection to a piped water supply in their homes. Two out of 10 people don't have any access to a treated water supply[12].

Water collection areas in Wellington

We are fortunate that almost all of the people living in the greater Wellington region are connected to a piped water supply to their homes. The Wairarapa and the Kapiti Coast have their own local water supplied by their district councils.

In the four metropolitan cities (Lower Hutt, Porirua, Upper Hutt, and Wellington), the pipe network receives water from three places and distributes it to our taps.

- 40% of this water comes from the Hutt Water Collection Area
- 20% comes from the Wainuiomata/Orongorongo Water Collection Area
- 40% comes from eight wells at Waterloo which pump water from the Waiwhetu Aquifer

Water supply to different suburbs

Usually, water collected in certain areas is supplied to certain suburbs. However, our water supply system is flexible in that water from one area can be supplied to another area if needed. This generally happens when maintenance is being carried out on the pipe network or when a water treatment plant has been shutdown (due to dirty river conditions after heavy rain or for maintenance).

12 World Business Council for Sustainable Development. n.d. Facts and Trends: Water. Geneva: WBCSD. URL: http://www.wbcsd.org/web/projects/water/Water%20Facts%20and%20Trends%20-PPT.pdf Retrieved June 2010.

The Hutt Water Collection Area

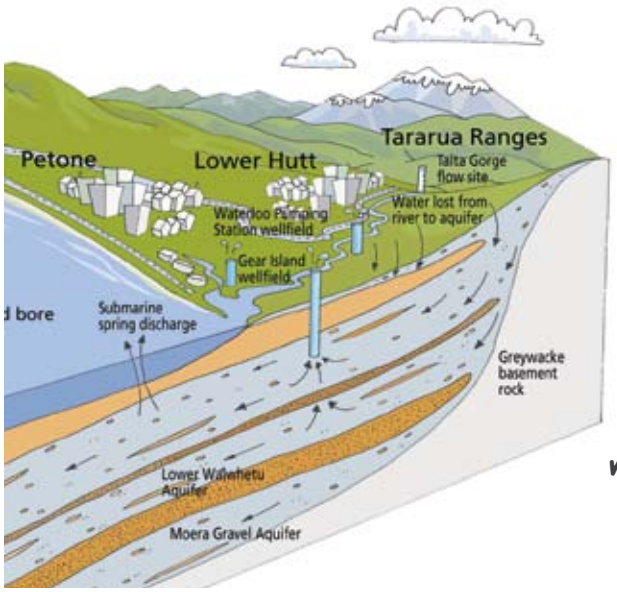
The **Hutt Water Collection Area** is in the hills behind Kaitoke. Water runs off the hills and into streams, collecting naturally in the Hutt River. There is a weir (a small dam) in the river that raises the level of the water. A small proportion of the water from the river is diverted into an intake pipe at the centre of the weir. From the weir, the water is piped to the **Te Marua Water Treatment Plant** and distributed to **Upper Hutt, Manor Park, Stokes Valley, Porirua and the Wellington City western suburbs** *(the area shown in red in the poster 'Greater Wellington's bulk water supply network').* Some of the water from the weir is also stored in the water storage lakes at Te Marua.

The Wainuiomata/Orongorongo Water Collection Area

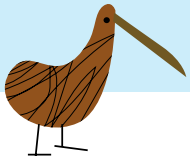
Water from the hills behind Wainuiomata collects naturally in the Wainuiomata and Orongorongo rivers. Weirs raise the level of these and other rivers for the intake pipes, diverting some of the water into the pipe system. The diverted water passes through to the **Wainuiomata Water Treatment Plant** before being distributed to **Wainuiomata** (the area shown in blue)**, the Wellington City Business District** and the **southern and eastern suburbs of Wellington City** *(the area shown in blue and yellow stripes).*

The Waiwhetu Aquifer

The remaining water for Wellington's four metropolitan cities comes from the **Waiwhetu Aquifer,** which is located under **Lower Hutt.** Eight wells pump water from the aquifer to the **Waterloo Treatment Plant**. This water is distributed to **Lower Hutt** (the area shown in yellow), except for Stokes Valley and Manor Park, and is *mixed with water from Wainuiomata* to help supply the **Wellington City Business District** and the **southern and eastern suburbs of Wellington City** *(the area shown in blue and yellow stripes).*



Waiwhetu Aquifer



3:1 Our water supply – learning experience

Learning intentions

Students will:
Understand how drinking water is collected for Wellington's water supply

Identify where their drinking water is collected from

Success criteria

Students can:
Show where their water is collected from and what path it takes on a map of Wellington

Explain how water is collected at the water collection areas

Resources

Poster Greater Wellington's bulk water supply network

BLM 3a The source of our drinking water

Learning experience

- Share learning intentions and success criteria
- Turn on a tap in the classroom. Ask students if they know where the water in the tap comes from. Discuss their ideas
- Explain that water from the tap originally comes from one of three water collection areas; the weir at Kaitoke in the Hutt River, the weirs in the Wainuiomata and Orongorongo rivers or the wells into the Waiwhetu Aquifer. *(This will depend on where your school is located – see teacher notes and the poster)*
- Display the poster *'Greater Wellington's bulk water supply network'* and identify the water collection areas. Explain how water is collected; briefly explain how a weir works and how wells access water from an aquifer *(see teacher notes)*. Explain that this poster only shows the bulk water network. The city council's water supply network takes over at the reservoirs shown and delivers the water the rest of the way to your taps *(see page 50 – 3.2. Water's journey to our taps for more information)*
- Hand out BLM 3a. Draw attention again to the water collection areas, and emphasise the one which provides water to your school. Mention the pipes which carry the water from the water collection area to the suburbs. Ask students to highlight the appropriate water collection area and attempt to trace the path of the pipes from this area to the suburb where your school is. Use the poster as a guide
- Ask if any students are not on town supply and discuss alternatives to town supply

As an extension, students could also trace the pipe network from the water collection areas to their home/Wellington zoo/the airport or other familiar landmarks.

Reflection questions

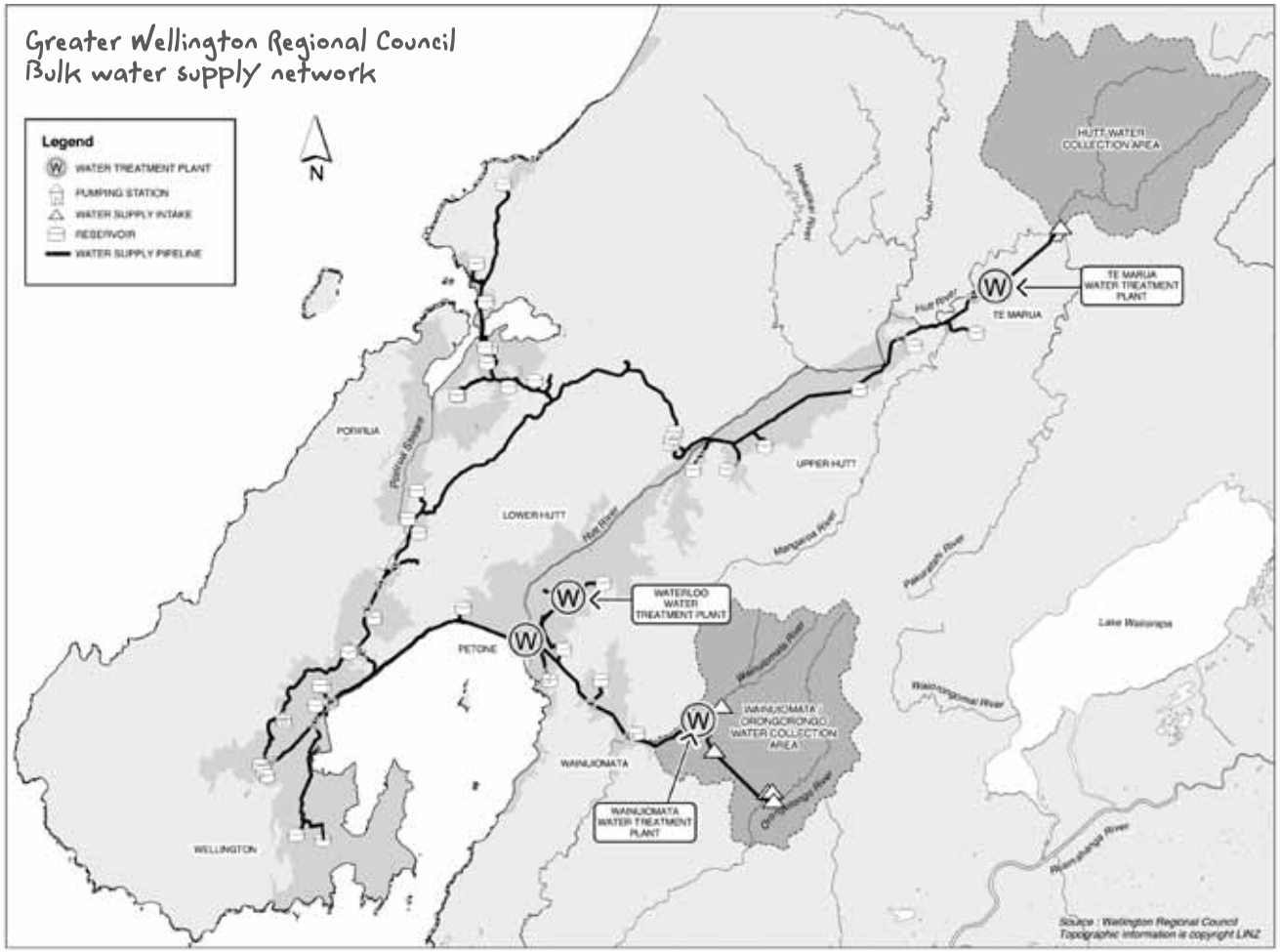
- What is an intake pipe? *An intake pipe is a pipe in the weir which takes water in from the river to be delivered to the water treatment plant*
- What would happen if there was no water available at one of the water collection areas? *Water from another water collection area would be used. The pipe network is designed to be able to deliver water from most water collection areas to most suburbs*

Vocabulary

- water collection area
- Wainuiomata
- Orongorongo
- Waiwhetu
- Kaitoke

BLM 3a: The source of our drinking water

Colour in the water collection area(s) where your drinking water comes from. Trace the path(s) of the main pipes from the water collection area to your school.



How is water collected from this area?

(explain in your own words)

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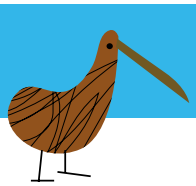


3:2 Water's journey to our taps – teacher notes

Curriculum links

Social Sciences: Level 4
Understand how producers and consumers exercise their rights and meet their responsibilities

Technology: Level 3
Nature of Technology:
Characteristics of Technology:
Understand how society and environments impact on and are influenced by technology in historical and contemporary contexts and that technological knowledge is validated by successful function

Other curriculum links: L 3 and 4
Social Sciences, Science – *Investigating in Science*

Education for sustainability concepts

Interdependence/ Whanaungatanga: Everything and everyone in our world is connected

Sustainability/Hauora: The choices we make today affect the choices we can make in the future

Background knowledge

Water's journey through the pipe network

From a water collection area (e.g. river/aquifer), water takes a complicated journey through a series of pipes before it finally ends up in our homes or workplaces. The combined councils' network (city and regional councils) has a total of 141 reservoirs and tanks, 77 pumping stations, and 2,478 kilometres of pipelines.

The cost of providing water to Wellington

In 2010, it cost $64,000 a day to manage the Greater Wellington (GW) part of that water supply network. This $64,000 a day only gets our water to the 43 reservoirs that GW manages. It actually costs even more to get the water from these reservoirs to our taps because local councils also need to pay for running and maintaining their part of the water supply network.

Water distribution

Most of the water supply network is underground, and we hardly ever see it. If you dug up the area around your house, you would find evidence of the pipe network and in some steep hillside suburbs, you might see some exposed pipes.

Gravity and pumping water

The piped network operates with the help of gravity and pumping stations which boost the flow of water in the pipelines up hills. Gravity assists the flow of water downhill. See http://www.sciencemadesimple.co.uk/page72g.html.

Reservoirs store water on its way to residents, evening out differences in the amount of water being treated and the amount being used. Reservoirs can also be a supply of water when the main supply is disrupted.

Maintenance

A network of meters and gauges monitor the flows and levels in reservoirs and pipes and let suppliers know if any maintenance is needed. Water delivery systems are complex and expensive to maintain.

Water pipes

The photo on page 51 was taken at a home where some construction work was taking place. The two large pipes are the stormwater and wastewater/ sewer pipes. The water supply pipe is the small grey pipe on the far left.

Although you may think that our drinking water is really important and therefore would need a large pipe, this water supply pipe is only 15 mm (or 1.5 cm) in diameter. It connects to a larger water main pipe at the street. Water main pipes in streets are between 100-300 mm in diameter. The bulk water pipes from the water treatment plant are even bigger – the biggest pipes are 1050 mm in diameter.

3:2 Water's journey to our taps – learning experience

Learning experience

- Share the learning intentions and success criteria
- Examine the pipes connected to the taps in the classroom and attempt to trace where they go next. Ask students how the water gets from the water collection area discussed in the previous learning experience to the taps at school or at home. *Encourage further detail than just the pipe network. If you are able to, view local examples of reservoirs, pumping stations and water pipes below ground*
- Explain that water has weight and is heavy. Use an example of a bucket filled with water to illustrate this. Invite students to try to lift the bucket full of water
- Explain that effort and energy is required to move water uphill (against gravity). Water will always try to flow downhill (with gravity). Ask students how the movement of water uphill might be possible. Briefly explain how pumps assist the process *(see teacher notes)*
- Ask students if they know who is responsible for delivering water to residents. *(Greater Wellington Regional Council provides the water and delivers it to reservoirs and the local council e.g Wellington City Council, purchases this water and delivers it to residents from reservoirs to taps).* http://www.wellington.govt.nz/services/watersupply/index.html
- Hand out BLM 3b. Point out the reservoir. Ask students to share their ideas about what a reservoir does *(see teacher notes for description)*
- Ask students to cut out the squares showing the stages of water's journey to our taps on BLM 3b and put them into the correct order. They could also record notes about each stage of the process
- Share answers on BLM 3b: *Answer sheet* and discuss

Reflection questions

- If there was no town supply, how would you get water?
  Answers will vary e.g. collect rainwater, emergency supplies
- How do the councils know if there is a problem with the water supply network? *(see teacher notes)*

Vocabulary

- gravity
- pumping station

Learning intentions

Students will:
Understand how drinking water gets from the water collection area to their taps

Identify who is responsible for delivering water to residents

Success criteria

Students can:
Order the steps in the process of delivering water from the water collection area to tap

Describe who is responsible for delivering their water

Resources

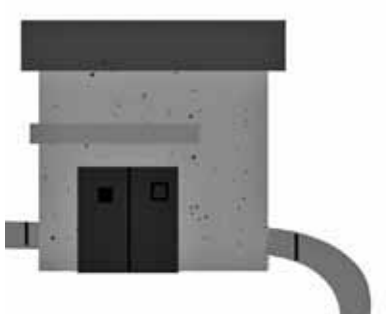
BLM 3b Water's journey from collection area to tap

BLM 3b: Water's journey from water collection area to tap

Cut out the cards below and arrange them in the correct order to show water's journey from the water collection area to the tap.

Explain each step of the journey in your own words.

Pumping station

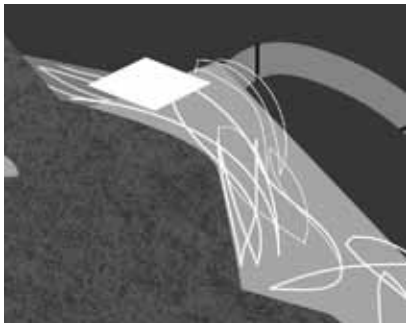


Pipes in your house

Reservoir – (large holding tank)

Tap

Water collection area



Water treatment plant

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BLM 3b: Water's journey from water collection area to tap: Answer sheet

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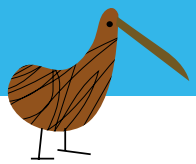

3:3 The right water in the right place – teacher notes

Curriculum links

Social Sciences: Level 3
Understand how people make decisions about access to and use of resources

Health: Level 3
Personal Health and Physical Development:
Safety management:
Identify risks and their causes and describe safe practices to manage these

Other curriculum links: L 3 and 4
Social Sciences, Science – *Investigating in Science*

Education for sustainability concepts

Sustainability/Hauora:
The choices we make today affect the choices we can make in the future

Responsibility for Action/Kaitiakitanga:
If we want to use taonga, we must look after the taonga. Taking action, informed decision-making, citizenship, consumerism, enterprise, resilience and regeneration

Background knowledge

Water quality

Water in the environment will always carry with it varying levels of impurities, such as metals, bacteria or organic matter. Sometimes we can see these impurities (e.g. dirt/grit), but often they are so small that the water could look perfectly clear and still be carrying them.

Water from different sources will contain differing levels of a variety of impurities, depending on the environment it has passed through. Some of these impurities can be harmful to our health.

Greywater

Greywater can be defined as the left-over water from baths, showers, hand basins, and washing machines. It is not free from impurities like treated water. It can be contaminated with waste (e.g. soap, dirt). Greywater can be re-used on gardens or for outdoor use.

Wastewater

Wastewater is water that has been contaminated with human waste and cannot be re-used. Wastewater enters the sewage system and is treated at a sewage treatment plant before being discharged.

Wastewater hazards

Wastewater can contain bacteria, fungi, parasites or viruses that can cause serious infections in humans. It is not to be handled.

Why re-use water?

Often people use treated, drinking-quality water for activities that don't require drinking-quality water, for example, watering the garden or flushing the toilet. In many countries it is common to re-use greywater for these purposes.

To ensure a steady supply of water for future generations and for a larger population we may need to start re-using greywater more in the future. A greywater recycling system cuts down demand for drinking water and reduces the pressure on our water supplies.

Pressure on the water supply

The more water we use, the more 'pressure' we put on the water supply to meet our demands. If everyone used water carefully and used more water efficient appliances (washing machines, dual flush toilets etc) there would not be as much demand for water and the current water supply would be adequate.

3:3 The right water in the right place – learning experience

Learning experience

Before beginning the activity, set up four glasses of water – treated, untreated, greywater, and wastewater (as described in resources on bottom right)*

- Share the learning intentions and success criteria
- Display the four numbered glasses of water. Describe what treated water means and explain that one of the four glasses is treated water (out of the tap)
- Write a definition for treated water and record the definition
- Explain the differences between the other types of water *(untreated, greywater and wastewater)*. Together write definitions of these types of water
- Ask students to guess which types of water are in each numbered glass. Ask them to justify their answers. *Reveal the contents of each glass. Discuss differences in appearance of each type of water*
- As a class, discuss the quality of the treated water that comes out of the tap. Ask students how we use water from the tap. Are there some activities that we use drinking-quality water for which don't need treated water? (e.g. should we use greywater instead of treated water for watering plants?)
- Hand out a copy of BLM 3c. Ask students to record the appearance and appropriate uses of each type of water
- Compare and discuss answers. Discuss appropriate uses of each type of water. Share examples

Reflection questions

- What do we mean by pressure on the water supply? *(see teacher notes)*
- How much less water could we use from the water supply by re-using untreated water or greywater for some activities where we currently use tap water?
- Why can't we re-use wastewater? *(see teacher notes)*
- Why don't we use more rainwater or greywater now?

Vocabulary

- greywater
- wastewater
- untreated
- impurities

Learning intentions

Students will:
Recognise the difference between treated water, untreated water, greywater and wastewater

Describe safe uses for the different types of water

Success criteria

Students can:
Describe the differences between treated water, untreated water, greywater and wastewater

Explain appropriate uses for these different types of water

Resources

BLM 3c: Types of water and their uses

Four clear glasses containing water:

1. Treated water (from the tap/bottled water)

2. Untreated water (from a stream or rainwater tank or other source)

3. Greywater (water that has been used to wash hands or from other washing activity)

4. 'Wastewater'* (a teaspoon of dirt mixed with tap water to simulate wastewater)

****DO NOT use real wastewater***

BLM 3c: Types of water and their uses

Describe the appearance of each type of water and give examples of the types of activities you could use it for in the table below:

Type of water	Description	Appearance	Quality	Possible use
A: Treated water	Water that has been treated and/or filtered and is safe to drink		*Clean, healthy water containing no bacteria, viruses or harmful minerals*	
B: Untreated water 	Fresh water, such as rainwater, collected from a roof or water from a stream or river. Water that has not been treated and could possibly contain bugs or other impurities		*Probably healthy water. Usually safe for drinking*	
C: Greywater 	Greywater is water that is left after washing clothes, dishes, baths or showers. It may contain bugs that make it unsuitable for drinking but can still be used for things like watering gardens. It is not fresh but not seriously polluted		*Probably unhealthy water, not safe to use for drinking*	
D: Wastewater 	Wastewater from toilets, containing human waste, that cannot be used again and must be treated to remove contaminants before it can go back into the water system		*Unhealthy water, definitely not safe to use for drinking, probably contains waste*	

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BLM 3c: Types of water and their uses: Answer sheet

Describe the appearance of each type of water and give examples of the types of activities you could use it for in the table below:

Type of water	Description	Appearance	Quality	Possible use
A: Treated water	Water that has been treated and/or filtered and is safe to drink	Clear, no colour or impurities	*Clean, healthy water containing no bacteria, viruses or harmful minerals*	Drinking, washing the dishes, cooking, showering/bathing, washing hands
B: Untreated water 	Fresh water, such as rainwater, collected from a roof or water from a stream or river. Water that has not been treated and could possibly contain bugs or other impurities	May be clear or slightly coloured. May have impurities	*Probably healthy water. Usually safe for drinking*	Washing clothes, cleaning, filling the pool, drinking (after being boiled)
C: Greywater 	Greywater is water that is left after washing clothes, dishes, baths or showers. It may contain bugs that make it unsuitable for drinking but can still be used for things like watering gardens. It is not fresh but not seriously polluted	May be grey in colour or cloudy. Likely to have some impurities	*Probably unhealthy water, not safe to use for drinking*	Flushing toilets, watering the garden, cleaning the car
D: Wastewater 	Wastewater from toilets, containing human waste, that cannot be used again and must be treated to remove contaminants before it can go back into the water system	Dark or dirty in appearance, will contain impurities	*Unhealthy water, definitely not safe to use for drinking, probably contains waste*	No suitable use. Should be put into sewage system for treatment

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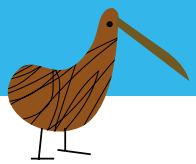


3:4 No water supply for a day – teacher notes

Curriculum links

Health: Level 3
Personal Health and Physical Development:
Safety management: Identify risks and their causes and describe safe practices to manage these

Social Sciences: Level 4
Understand how people participate individually and collectively in response to community challenges

Other curriculum links: L 3 and 4
Social Sciences

Education for sustainability concepts

Interdependence/ Whanaungatanga: Everything and everyone in our world is connected

Sustainability/Hauora: The choices we make today affect the choices we can make in the future

Background knowledge

Water supply issues

We can easily take our water supply for granted. Because the water supply network is so complex and widespread, it is vulnerable to a variety of potential problems. A natural disaster of any kind or a severe weather event can disrupt water services.

How could an earthquake affect our water supply?

An earthquake is usually the result of tectonic plates moving and colliding, causing shaking and movement. The water supply network in Wellington crosses faultlines many times. There may be severe damage to some parts of the network in an earthquake.

Be prepared before a disaster

Being prepared for a disaster like an earthquake is a particular concern in Wellington because of the many faultlines running through the city and surrounds and the vulnerability of these to disruption during an earthquake. After a natural disaster, demand for help from agencies like the Civil Defence will be overwhelming. Therefore, it is up to individual households to prepare for the possibility that they may not have water or food available for several days. In a severe earthquake it may even take several weeks or months to restore water to all homes. It is important that everyone prepares for this possibility. Students should consider how their families would be prepared for a disaster. They should ideally have a family emergency plan and an emergency kit including food and water.

Emergency water supplies

Schools are required to have at least 4 litres of water on hand per person per day when a public supply is not available. Homes should have enough emergency water stored for at least 3 litres of water per person for at least 3 days. This amount is just for drinking. More water should be stored for cooking and personal hygiene. Stored water should be replaced every year.

What should we do during an earthquake?

In an earthquake, it is advised to take no more than a few steps and *drop, cover, and hold*. It is recommended that students shelter underneath a strong table or beside an interior wall.

More information about emergency preparedness is available at:
http://www.whatstheplanstan.govt.nz/earthquake.html

http://www.gw.govt.nz/3-step-emergency-plan/

3:4 No water supply for a day – learning experience

Learning experience

- Share the learning intentions and success criteria
- Explain to students that they are about to hear a fictional scenario about an earthquake. The earthquake has not really happened. It is only a scenario to help them learn about how to prepare for the possibility of a natural disaster
- Read the fictional news report and earthquake scenario on BLM 3d to the students. Clarify the scenario and answer any questions
- Discuss what an earthquake is. What should students do during an earthquake? *See:* http://www.whatstheplanstan.govt.nz/earthquake.html
- Explain to students that they will be responsible for organising how the emergency water supplies are used in their homes. If you have emergency water bottles, display these for effect. *(In a real emergency, students would be picked up from school where possible)*
- Share the other information on BLM 3d. Discuss how much water is required for each activity and share ideas about how they would use the 6 litres a day per person
- Together with the students, decide which water uses would be the highest priority during an emergency situation and which would be the lowest priority
- Reassure students that there has not been an earthquake and that they are safe
- Now that you have explored the possibility that one day there may be a natural disaster, investigate how prepared people are at school and at home for the possibility of such an event
- Ask school staff and the principal whether there are emergency water supplies at the school. Discuss findings
- Ask students if they are prepared for a natural disaster at home. Explain that they should have water and food stored at home in case of emergency and a family plan for emergency situations

As an extension, students could design an emergency survival plan for home or school.

For more information about the Wellington fault, including video footage see: http://juliansrockandiceblog.blogspot.com/2010/05/wellington-fault-with-learnz.html

Learning intentions

Students will:
Understand the possible effects of an earthquake on the water supply network

Plan the use of emergency water supplies during a natural disaster

Success criteria

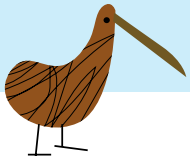
Students can:
Describe how the water supply network may be affected by an earthquake or other natural disaster

Plan how they will use a limited supply of water during an emergency situation

Resources

BLM 3d Earthquake scenario

Emergency water bottles



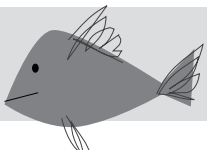
Reflection questions

- How could we clean ourselves if there is very little water? *We would need to clean ourselves with a flannel and a small amount of water*
- How could the water supply be affected during an earthquake? *Shaking and movement of the ground may cause pipes to break*

Vocabulary

- scenario
- fictional
- emergency
- disaster
- disrupted
- damage
- aftershocks

BLM 3d: Earthquake scenario



Fictional news report

At 9:15am this morning, an earthquake occurred on the Wellington faultline, near Upper Hutt. The earthquake measured 7.3 on the Richter scale and could be felt as far away as Taupo. During the earthquake, the ground was shaking for 50 seconds. The earthquake was followed by several aftershocks. More aftershocks are expected in the next few days.

Along the faultline, the ground rose up several metres. The enormous ground movements caused damage to buildings, pipes and cables. There is some damage to many buildings throughout Wellington city and Upper and Lower Hutt. Some buildings have had walls fall down and several roads have been damaged.

Police have said there is also damage to power lines, stormwater pipes and sewer lines. Some water supply pipes have also been disrupted. Because sewer lines and water pipes have ruptured there is a chance that the water supply might be polluted with waste from the wastewater system.

Major damage has been caused to water supply lines from two of the three water collection areas. These events have interfered with the water supply to most areas of Wellington city, and some areas of Lower Hutt and Porirua.

Residents are asked to not use the water supply until the pipes can be repaired. This may take up to a week. Water will be available from Civil Defence staff very shortly but in the meantime we ask that you use any emergency supplies of water that you have available.

Scenario

Imagine that you have several containers of water stored for emergency situations at home. You have enough for 6 litres of water per person in your family for three days.

1. How would you use water differently in an emergency?

2. What would be a high priority for water use? What would be a low priority?
   List the activities you would use water for and rank them in order of importance. Use the chart below for ideas.

Water use	Amount of water used (litres)	Notes
Flushing toilet	6L full flush	Because sewage pipes may be damaged this should be done only when absolutely necessary
Using taps	10L per minute	
Washing dishes (by hand)	6L	
Drinking water	At least 3L per person per day	
Shower	15L per minute	A bath uses about 90L
Garden hose	15L per minute	
Washing machine	100L per load	
Cooking	About 1.5L per pot	

3. How could you adapt some of the water uses above so that you would use less water?

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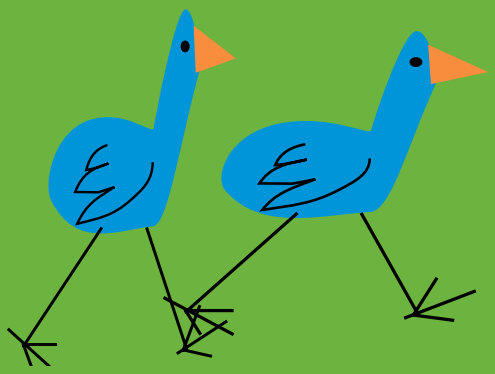


SECTION FOUR:

Water treatment – Te Marua or Wainuiomata

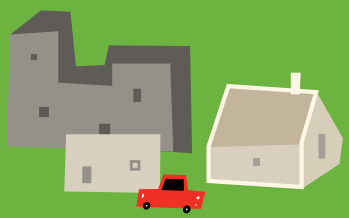
This section examines the water treatment process inside a water treatment plant. A key part of this section is a visit to one of the Greater Wellington's water treatment plants (Te Marua or Wainuiomata)

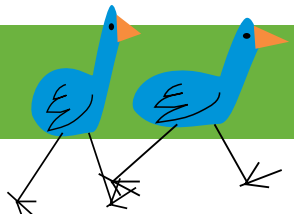
Section Four is divided into two versions: Te Marua and Wainuiomata. You will need to decide on which water treatment plant you wish to visit before proceeding with this section. If you are visiting the Te Marua Water Treatment Plant then you need to use the Te Marua version of this section (pages 65 – 88). If you are visiting the Wainuiomata Water Treatment Plant then you need to use the Wainuiomata version of this section (pages 89 –112).

We recommend booking your tour before you reach this section to ensure that your chosen water treatment plant is able to accommodate your visit.

To organise a date and time to visit the water treatment plant, contact our staff:

ph: (04) 384 5708 or email: info@gw.govt.nz





Section 4: Water treatment

The purpose of this section is to help students to:

- Understand the basic sequence of the water treatment process
- Explore reasons for water treatment

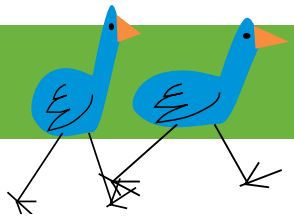
Overarching concepts for Section Four:

- It takes time, energy and resources to treat water and make it suitable for drinking

Section 4: Water treatment – Te Marua

Learning experiences – Section Four

Learning experiences	Learning intentions Students will . . .	Curriculum links (Achievement objectives)	Content
1. Keeping our drinking water clean	• Identify appropriate sources of drinking water	**Health: Level 3 and 4:** ***Personal Health and Physical Development:*** *Safety management* Identify risks and their causes and describe safe practices to manage these	Students identify clean sources of drinking water and explore the Hutt Water Collection Area
2 What happens at the water treatment plant	• Investigate the sequence of events in the water treatment process • Determine the function of water treatment equipment	**Technology: Level 3:** ***Nature of Technology:*** *Characteristics of technological outcomes:* Understand that technological outcomes are recognisable as fit for purpose by the relationship between their physical and functional natures	Students investigate the water treatment process. They place cards describing parts of the treatment process in the correct order on a flow chart
3 Safety at the water treatment plant	• Identify ways to manage hazards at the water treatment plant • Create a safety action plan for their visit	**Health: Level 3 and 4:** ***Personal Health and Physical Development:*** *Safety management* Identify risks and their causes and describe safe practices to manage these	Students discuss ways to manage possible hazards during their visit and collectively create a safety action plan
4. Visiting the Te Marua Water Treatment Plant	• Ask questions to gain further knowledge about the water treatment process	**Science: Level 3 and 4:** ***Nature of Science*** *Investigating in science* – Build on prior experiences, working together to share and examine their own and others' knowledge – Ask questions, find evidence, explore simple models, and carry out appropriate investigations to develop simple explanations	Visit to the water treatment plant to see the water treatment process first hand. By participating and questioning students gain an in-depth understanding of the water treatment process
5. Experiment: Clumping with coagulants	• Observe changes to different types of water when a coagulant is added to it	**Science: Level 3 and 4:** ***Material world:*** *Chemistry and society:* Relate the observed, characteristic chemical and physical properties of a range of different materials to technological uses and natural processes	**This experiment will be conducted by staff at the water treatment plant* Students observe and describe changes to different samples of water when a coagulant is added



4:1 Keeping our drinking water clean – teacher notes

Curriculum links

Health: Level 3 and 4
***Personal Health and Physical Development:* Level 3:**
Safety management:
Identify risks and their causes and describe safe practices to manage these

Level 4:
Safety management:
Access and use information to make and action safe choices in a range of contexts

Other curriculum links: Level 3 and 4
Science: *Nature of Science:*
Investigating in science

Education for sustainability concepts

Responsibility for Action/Kaitiakitanga:
If we want to use taonga, we must look after the taonga. Taking action, informed decision-making, citizenship, consumerism, enterprise,resilience and regeneration

Background knowledge

Collecting the cleanest water

In Wellington, water is collected from rivers where the source is as clean as possible to start with (the Hutt, Orongorongo and Wainuiomata rivers). Providing high-quality drinking water from the water treatment plant is much easier and cheaper if the water to be treated is relatively clean. We remove impurities in the water at a water treatment plant.

Why collect the water at Kaitoke?

Water that is treated at Te Marua Water Treatment Plant comes from Kaitoke. When rain falls in the Tararua Ranges, water that is not absorbed into the ground starts to run downhill towards the sea through the streams of the bush-clad Hutt Water Collection Area. These streams feed into the Hutt River above Kaitoke (just north of Upper Hutt). They run through a large area of native forest, which is an ideal environment for keeping water as clean as possible.

What is an aquifer?

An aquifer is an underground layer of gravels or soil which holds water. Water is usually moving very slowly through an aquifer, being filtered along the way. An aquifer behaves like an underground sponge. Most places on Earth have some form of aquifer underneath them, but because we can't see them, many of us are unaware of their existence.

Water from aquifers

Aquifers naturally filter water while it is underground and typically water that has been underground for more than one year is free from problems. In Wellington, some 40% of our drinking water is from the Waiwhetu Aquifer. Water from the Waiwhetu Aquifer has been underground for more than a year, so the water that comes out of it doesn't need to be treated to be safe to drink.

Kaitoke Weir

A weir is a small dam. It raises the water level in one part of the river to help divert water into an intake chamber. While most of the water flows on down the river, some flows into the intake chamber and through a tunnel in the hillside to the strainer house for screening.

The area above the Kaitoke Weir is called the Hutt Water Collection Area which is managed to reduce the risk of the water becoming polluted. Possible pollutants could include: animal and human waste, soil, rubbish, chemicals, oil and petrol. To manage this risk, grazing stock and vehicles are kept out of the water collection area above the weir, and although people can walk in nearby areas, they are not allowed to camp in those places overnight.

4:1 Keeping our drinking water clean – learning experience

Learning experience

- Share the learning intention and success criteria
- Ask students where they would collect drinking water if there was no town supply available. *Examples include: drinking fountain at Petone, streams high in the catchment, catching rainwater*
- Explain that water in the environment can contain germs/impurities which can make it dangerous to drink. A water treatment plant treats the water and removes impurities from it. Treated water is safe to drink
- Display the poster *'Greater Wellington's water sources'*. Point out the aquifer, rivers and the sea on the diagram. Read out the teacher notes about water from aquifers
- Discuss options for obtaining clean drinking water from the environment pictured on the diagram. Ask students to identify several sources of clean drinking water from the poster. List advantages and disadvantages of taking water from each source: e.g. mountain streams, bush streams, city streams, aquifers etc... Discuss which source would be preferable
- Explain that water is taken for Wellington's water supply from the Hutt Water Collection Area, the Wainuiomata/Orongorongo Water Collection Area and from the Waiwhetu Aquifer. *The Hutt Water Collection Area and the Waiwhetu Aquifer each provide about 40% of Wellington's supply. The remaining 20% of the water supply is taken from the Wainuiomata/ Orongorongo Water Collection Area*
- Brainstorm questions about water treatment. Record questions to ask during the water treatment plant visit. *For more information see: http://www.gw.govt.nz/sources-of-water/*

As an extension, students could research water borne diseases such as giardia. See: *http://www.healthed.govt.nz/uploads/docs/HE213.pdf*

Learning intention

Students will:
Identify appropriate sources of safe drinking water

Success criteria

Students can:
Identify appropriate places to source safe drinking water

Resources

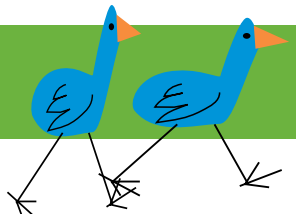
Poster Greater Wellington's water sources

Reflection questions

- What could happen if you drank water containing impurities or germs? *You could become very sick*
- What other methods could we use to treat water from an untreated source before drinking it? *Water purification tablets, boiling (for at least 3 minutes). These methods can kill germs in water such as giardia*

Vocabulary

- impurities
- purification
- giardia



4:2 What happens at the water treatment plant – teacher notes

Curriculum links

Technology: Level 3
Nature of Technology
Characteristics of technological outcomes
Understand that technological outcomes are recognisable as fit for purpose by the relationship between their physical and functional natures

Other curriculum links at Level 4:
Health: *Movement concepts and motor skills: Science and Technology:*
Experience and demonstrate how science, technology and the environment influence the selection and use of equipment in a variety of settings

Education for sustainability concepts

Responsibility for Action/Kaitiakitanga:
If we want to use taonga, we must look after the taonga. Taking action, informed decision-making, citizenship, consumerism, enterprise, resilience and regeneration

Background knowledge

Water treatment – the process

Before the water treatment plant

Water is collected from a natural source. For the Te Marua Water Treatment Plant, water is collected at the Kaitoke Weir.

Screening the water

The water that has been collected must be screened to remove any debris. At the **strainer house**, water passes through rotating **screens** that are finer than a flour sieve *(250 holes per square centimetre)*. Big items, such as, grit, sand, gravel, rocks, sticks and leaves, are flushed back into the river. Small fish can swim into the intake chamber but they usually swim out again and don't travel as far as the strainer house. If they do reach the strainer house they are flushed back into the river. Large fish are prevented from entering the intake chamber by a large grid that you can see when you visit the weir.

Although we have collected the water from the cleanest possible source, there will still be impurities in it that are too small to see or catch in the strainer house screens.

Storing water in Stuart Macaskill Lakes

Sometimes, when there hasn't been much rain, the river's water level gets so low that it would not be good for the ecosystem downstream to take as much water as we need for drinking water treatment. But we always need drinking water. So, when the water levels are high, we take out extra water from the river and store it. We store it in the Stuart Macaskill Lakes. You can see these lakes on your left as you drive up the Rimutaka Hill towards the Wairarapa. The lakes can hold enough water to supply the four cities (Lower Hutt, Porirua, Upper Hutt and Wellington) for 21 days. Having this stored water means that when the water levels in the river are too low to take out all the water we need, we can use water from the lakes as well.

This water can also be used if the river water is too dirty to treat (usually after a storm).

Inside the water treatment plant

Clumping impurities

Because the impurities floating in the water are very small, it's easier to get them out if we can clump them together in groups. In the **reaction tanks**, we add chemicals like Polyaluminium Chloride (PACl) to the water which attract the suspended particles like a magnet and bind them together into larger particles that we can see (called *floc*). The floc is large enough to sink so that we can separate them more easily from the water.

Separating out the floc to remove impurities

The floc sinks to the bottom of the **settling tanks.** Then they are separated off and sent to a **centrifuge**, which spins really fast, removing the excess water, like the spin cycle in a washing machine, returning the clean water to the inlet of the water treatment plant (a great example of recycling) and leaving behind solid sludge waste. The sludge is sent along a **conveyer belt** and down into a **skip bin** to be taken to the landfill at Silverstream. *(Without fail, the student's favourite part of the water treatment plant visit is watching the sludge plop onto the conveyer belt and then off into the skip.)*

Filtering the water

The water that flows out the top of the **settling tank** goes into the next tank through a set of **sand filters**, which act like very fine screens trapping and separating out any last particles that weren't removed in the **settling tanks**.

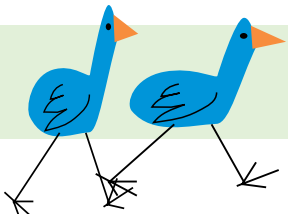
Making sure the water is safe to drink

The clean drinking water is almost ready for our taps. However, it has a long way to go from the water treatment plant, through pipes to local storage **reservoirs** and then through more pipes before it reaches our taps – it might take 2½ days to get from the Te Marua Water Treatment Plant to a reservoir in Wellington city. We add chlorine to the water to kill any bugs that may remain in the water or that might get into the water over the long journey. Fluoride is also added to help keep our teeth strong and healthy.

The water is monitored throughout the treatment process to make sure it meets our country's drinking water standards.

What is a technological outcome?

Technological outcomes are products and systems developed for a specific purpose. A technological outcome is evaluated in terms of its fitness for purpose.



4:2 What happens at the water treatment plant – learning experience

Learning intentions

Students will:
Investigate the sequence of events in the water treatment process

Determine the function of water treatment equipment

Success criteria

Students can:
Order the sequence of events in the water treatment process

Explain the function of water treatment plant equipment

Resources

BLM 4a The water treatment process: Te Marua

BLM 4b Water treatment process cards: Te Marua

Poster Water treatment process – Te Marua

Learning experience

- Share learning intentions and success criteria
- Ask students why we need to treat water before drinking it. *There could be impurities in the water that can make us unwell*
- Explain that we will investigate the equipment used in a water treatment plant and the sequence of events that is undertaken to treat water to drinking-quality standards
- Read aloud the teacher notes on pages 68-69 about the water treatment process. Ask students to listen carefully as they will need some of the information in order to complete the activity
- Hand out BLM 4a and BLM 4b. Discuss any new vocabulary and clarify meaning
- Ask students to cut out cards on BLM 4b. Stick into the correct box under the pictures on BLM 4a. Each card explains a step in the water treatment process
- When students have ordered the cards ask them to compare answers
- Show students the poster *'Water treatment process – Te Marua'*. Revise the steps of the water treatment process with the poster as a guide, while students determine if their cards are in the correct order
- Discuss any equipment featured on the poster and cards. Ask what each piece of equipment's function is. *Treatment plant equipment is written in **bold** on the teacher notes pages*

As an extension, students could create a flowchart to describe the process of water treatment.

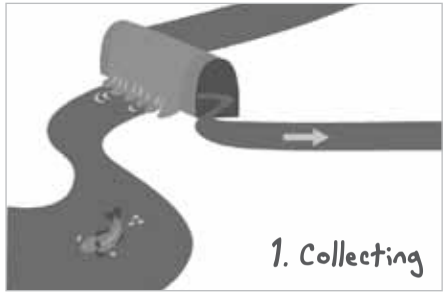
Reflection questions

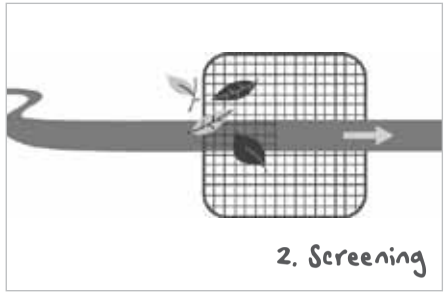
- Why do you think the water has to be as clean as possible before the water treatment process starts? *It takes less effort and resources to treat water to drinking-quality standards if water is relatively clean to start with*
- How do staff make sure that all impurities have been removed? *Water is thoroughly tested along the way before being distributed*
- What might happen if we didn't store water in the Stuart Macaskill Lakes? *We may not have enough water to satisfy all demands for water*

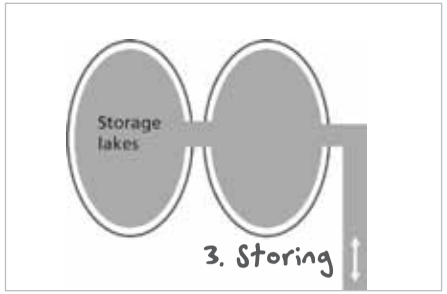
Vocabulary

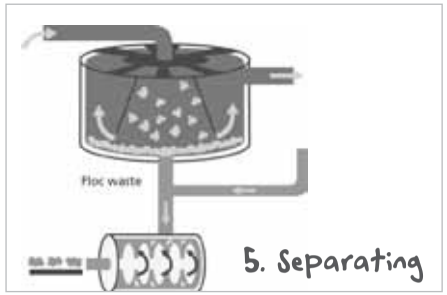
- screening
- filtering
- floc
- chlorine
- fluoride

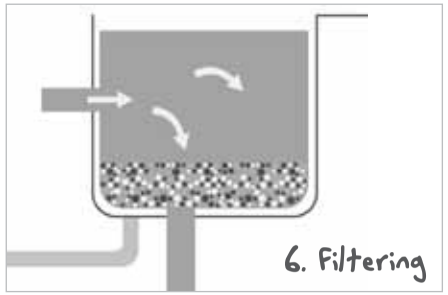
BLM 4a: The water treatment process: Te Marua

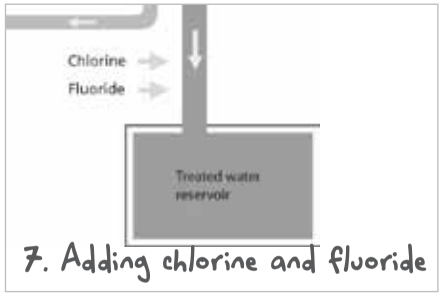












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BLM 4b: Water treatment process cards: Te Marua

Cut out the cards below. Place each card in the appropriate space on BLM 4a to describe the order of the water treatment process.

Water passes through a set of sand filters. These filters act like very fine screens trapping and separating out any last unwanted, small impurities.

Rain falls and collects in streams and rivers in the Hutt Water Collection Area. Some of this water flows into the water supply intake towards the water treatment plant.

The treated water is now ready to be distributed to the community.

The water goes through a fine screen to stop leaves, branches and gravel from getting into the water treatment plant.

We add chemicals to the water and stir it. This helps all the impurities clump together to make 'floc'. Floc is easier to see and to get out.

The floc sink to the bottom of the settling tank. They are separated from the water to make sludge waste. The sludge is carried away to a skip bin.

We add chlorine to the water to kill any bugs that might get into the pipes while the water is on its long journey to our taps. Fluoride is also added to help keep our teeth healthy.

Some untreated water is stored at the Stuart Macaskill Lakes for times when we can't take water from the river.

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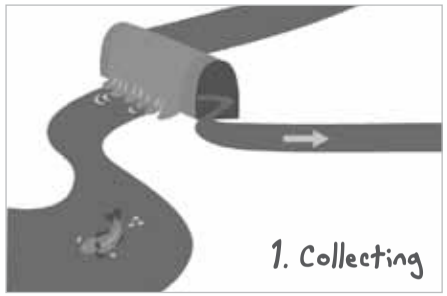
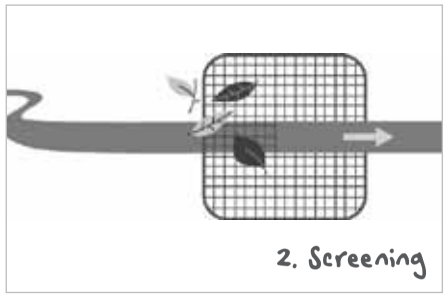
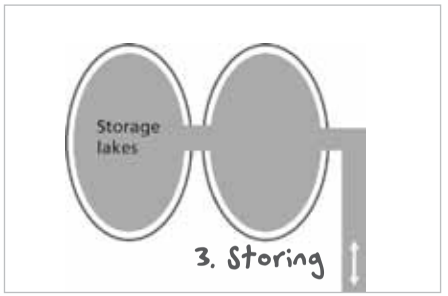
BLM 4b: The water treatment process: Te Marua - Answer sheet



Rain falls and collects in streams and rivers in the Hutt Water Collection Area. Some of this water flows into the water supply intake towards the water treatment plant.



The water goes through a fine screen to stop leaves, branches and gravel from getting into the water treatment plant.



Some untreated water is stored at the Stuart Macaskill Lakes for times when we can't take water from the river.

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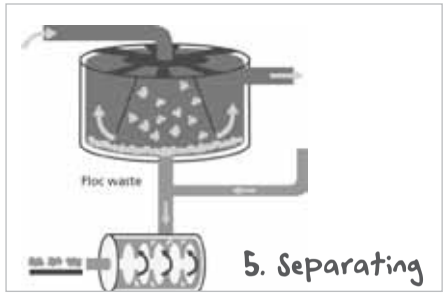
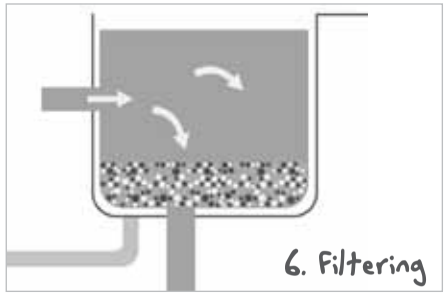


The floc sink to the bottom of the settling tank. They are separated from the water to make sludge waste. The sludge is carried away to a skip bin.



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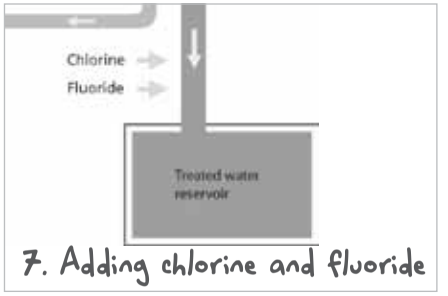

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The treated water is now ready to be distributed to the community.

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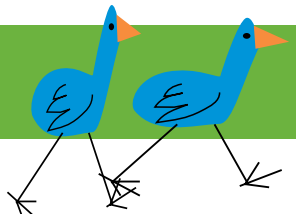


4:3 Safety at the water treatment plant – teacher notes

Curriculum links

Health: Level 3 and 4
Personal Health and physical development:
Level 3: *Safety management:*
Identify risks and their causes and describe safe practices to manage these

Level 4: *Safety management:*
Access and use information to make and action safe choices in a range of contexts

Education for sustainability concepts

Responsibility for Action/Kaitiakitanga:
If we want to use taonga, we must look after the taonga. Taking action, informed decision-making, citizenship, consumerism, enterprise, resilience and regeneration

Background knowledge

Hazards

A hazard is a possible danger. A hazard can be a situation which may lead to an injury or pose a threat to a person.

Why do a safety plan with my students?

This activity is designed to involve students in making a safety plan for the visit to the water treatment plant. If students complete this activity before the visit, they will be more aware of potential hazards at the water treatment plant. They will have more ownership and therefore more buy-in for following a safety plan if they have had a part in creating it.

Will this be the only safety preparation I need to do for the visit?

No. Your school will have its own health and safety plans and regulations for trips. However, completing this activity with your students will make completing your school safety assessments e.g. risk analysis matrices/hazard management plans much easier.

Hazard management process

(Taken from the Dept of Labour website)

1. Identify hazards
2. Assess if significant
3. If yes,
    1. *Eliminate,* if practicable
    2. *Isolate,* if not practicable to eliminate
        – inform people involved
        – monitor to ensure controls are effective
    3. *Minimise,* if hazard can't be isolated
        – inform employees of controls
        – provide, make accessible, and ensure the use of protective clothing and equipment
        – monitor to ensure controls are effective

See http://www.dol.govt.nz/publications/big6/hazard-management-process-img.asp for more information

NB: *Teachers need to complete BLM 4d Visitor information and BLM 4e Group visitor induction on behalf of their students and give to water treatment plant staff on the day of their visit.*

4:3 Safety at the water treatment plant – learning experience

Learning experience

- Share the learning intentions and success criteria
- Ask students if they understand what a hazard is *(see teacher notes)*
- Explain the need for a safety action plan
- Brainstorm what risks/hazards there might be at a water treatment plant. *Read BLM 4d for examples*
- Decide on several ways to prevent the hazards discussed from being a problem during the visit
- Discuss what would happen if there was an emergency situation at the water treatment plant. *It may be necessary to call an ambulance, may need to leave/evacuate*
- Go over health and safety expectations for the day. Discuss the location of your first aid kit and procedures for what students should do if a hazardous situation occurs
- How will students be expected to behave on the day of the visit? How could behaviour affect safety during the visit? E.g. *behaving sensibly and not touching equipment*
- Ask students to complete BLM 4c. Explain that they must think of ways to prevent hazards from occurring and explore how to deal with problems if they do occur. The 'when/where' column applies to when and where the preventative actions should be taken
- Share answers and decide on the best answer for each part of the safety plan. Create a shared safety action plan as a result
- Reassure students that staff at the water treatment plant are trained to deal with hazards and emergency situations at the plant and will give assistance throughout your visit

Learning intentions

Students will:
Identify ways to manage hazards at the water treatment plant

Create a safety plan for their visit

Success criteria

Students can:
Describe ways to prevent hazards from occurring

Contribute to writing a safety action plan

Resources

BLM 4c Safety action plan for plant visit

BLM 4d Visitor information: Te Marua

Reflection questions

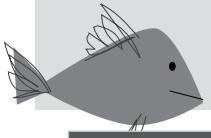
- Is there anything else we could do to keep ourselves safe at the treatment plant? *Answers will vary*
- How could sludge waste be harmful? *See BLM 4d*

Vocabulary

- impurities
- purification

BLM 4c: Safety action plan for water treatment plant visit

Possible risk	Cause of risk	Responsibility	Preventative actions	When/where	Emergency plan
Plant emergency	Various	Plant staff	Regular checks and maintenance	Every day at various locations within plant	Plant staff deal with emergency as required
Contact with dangerous chemicals	Uncontrolled access to restricted areas	Supervising teacher, students, parents/helpers			
Injury from machinery in plant	Uncontrolled access to restricted areas	Supervising teacher, students, parents/helpers			
Electric shock	Uncontrolled access to electrical cabinets	Supervising teacher, students, parents/helpers			
Fall into open water	Climbing over barrier	Supervising teacher, students, parents/helpers			
General fall	Running, not paying attention	Students, supervising teacher, parents/helpers			
Contact with sludge waste	Uncontrolled access to restricted areas	Supervising teacher, students, parents/helpers			
Lost students	Poor supervision, not paying attention	Students, supervising teacher, parents/helpers			
Medical problems resulting from an existing condition such as an allergy	Trigger, such as insect bite Asthma attack	Supervising teacher, parents/helpers, students			
Accident with vehicle in the car park	Poor supervision	Supervising teacher, parents/helpers, students			



BLM 4c: Safety action plan for water treatment plant visit: possible answers

Possible risk	Cause of risk	Responsibility	Preventative actions	When/where	Emergency plan
Contact with dangerous chemicals	Uncontrolled access to restricted areas	Supervising teacher, students, parents/helpers	Instruct students to stay behind all barriers; buddy system, supervision by parents/teachers	Before visit, at start of plant tour	Alert plant staff Apply appropriate first aid
Injury from machinery in plant	Uncontrolled access to restricted areas	Supervising teacher, students, parents/helpers	Instruct students to stay behind all barriers, supervision by parents/teachers	Before visit, at start of plant tour	Alert plant staff Apply appropriate first aid
Electric shock	Uncontrolled access to electrical cabinets	Supervising teacher, students, parents/helpers	Instruct students to stay behind all barriers; buddy system, supervision by parents/teachers	Before visit, at start of plant tour	Call an ambulance (if needed)
Fall into open water	Climbing over barrier	Supervising teacher, students, parents/helpers	Instruct students to stay behind all barriers, supervision by parents/teachers	Before visit, at start of plant tour	Adult to retrieve student Call an ambulance/apply first aid
General fall	Running, not paying attention	Students, supervising teacher, parents/helpers	Instruct students to stay calm and with the group at all times	Before visit, at start of plant tour	Apply appropriate first aid
Contact with sludge waste	Uncontrolled access to restricted areas	Supervising teacher, students, parents/helpers	Instruct students to stay behind all barriers; buddy system; supervision by parents/teachers	Before visit, at start of plant tour	Wash hands immediately
Plant emergency	Various	Plant staff	Internal systems	At start of plant tour	Evacuate to area outside main entrance; roll call
Lost students	Poor supervision, not paying attention	Students, supervising teacher, parents/helpers	Buddy system, supervision; agree on a regrouping area and a time and make sure everyone knows how to get to that area	Before visit, at start of plant tour	Alert plant staff Contact parents Call police to report missing
Medical problems resulting from an existing condition such as an allergy	Trigger, such as insect bite Asthma attack	Supervising teacher, parents/helpers, students	Ensure necessary medication accompanies the student on the visit; make accompanying parents/helpers aware of any health conditions; buddy system	Before visit	Apply appropriate first aid Call an ambulance (if needed) Contact parents Inform plant manager
Accident with vehicle in the car park	Poor supervision	Supervising teacher, parents/helpers, students	Have safe area in carpark to go into and out of bus. Supervise students on way to and from water treatment plant	On the way to or on arrival at plant	Apply appropriate first aid/Call an ambulance (if needed)

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BLM 4d: Visitor Information

Welcome to the Te Marua Water Treatment Plant

The following information is important for your safety

It is a requirement of entry to this facility that you read the following information and note the emergency provisions on BLM 4f. All visitors must sign this sheet to confirm that they have read and understand this information.

Please Note: This sheet must be left at the plant upon departure.

Hazards - The main hazards on site are:

- **Corrosive and toxic chemicals**
- **Open water surfaces**
- **Rotating machinery**
- **Sludge waste**

Corrosive and toxic chemicals

The following chemicals are stored and used on this site. The storage location of these chemicals is identified on the site plan (BLM 4f).

Chemical	Hazard	Health Effects
Chlorine Gas	Poisonous and Highly Corrosive	Asphyxiation/Pulmonary Oedema
Carbon Dioxide Gas	Displaces Oxygen	Asphyxiation
Caustic Soda	Highly Corrosive	Severe Burns
Fluoride	Toxic	Poisoning
Aluminium Sulphate	Mildly Corrosive	Minor Burns
Hydrated Lime	Mildly Corrosive	Minor Burns

Open water surfaces

Hand rails and barriers are installed around all open water surfaces. Please ***do not lean on or climb over any railing or barrier*** that is provided for your protection.

Rotating machinery

Please be aware that the Treatment Plant is fully automated and therefore machinery could start at any time. All exposed rotating parts have been fitted with guards to prevent accidental contact. ***Keep clear of any working machinery and equipment.***

Sludge Waste

Most contaminants, including Viruses, Giardia and Cryptosporidium, are removed from the raw water and concentrated in the sludge waste. ***Do not handle this waste.*** Wash your hands if accidental contact occurs.

In the event of an emergency make your way quickly to the evacuation area shown on map (BLM 4f)

I have read and understood the above information and agree to act in a responsible manner during my visit, and in accordance with the advice contained in this induction handout.

Name: _____ Organisation: _____

Signature: _____ Date: _____

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4:4 Visiting the Te Marua Water Treatment Plant – teacher notes

Background knowledge

Organisation for the visit

Before your visit, make sure you and your students are well prepared for the day. Visit the location to familiarise yourself with the area.

To organise a date and time to visit the water treatment plant, contact our staff; ph: (04) 384 5708 or email: info@gw.govt.nz

A suggested itinerary is included – see *Visit schedule: Te Marua Water Treatment Plant* on pages 82 and 83. You may choose to only visit the water treatment plant.

Visiting Kaitoke Weir and/or the Strainer House before the water treatment plant

On the way to the water treatment plant, you may wish to take the bus to the Waterworks Road end of Kaitoke Regional Park to visit the Kaitoke Weir and the Strainer House. You can walk to the weir from the Pakuratahi Forks carpark in the Kaitoke Regional Park . The weir is a 15 minute walk from the carpark, on a sealed road. The walk to the Strainer House is a one hour return trip. See the map on page 81.

Water is collected for the Te Marua Water Treatment Plant from the Kaitoke Weir. Going to the weir is well worth the effort, as students will get to see where the water starts the treatment process. This will enhance understanding of the treatment process and how it relates to the surrounding environment.

If you decide to visit the Kaitoke Weir, we recommend that you contact the Kaitoke Regional Park Ranger on 04 526 7322 to check that the weir walk is open.

What can I do, as a teacher, to maximise learning during our visit?

Preparing students well for the visit will encourage excitement about it. Having some prior knowledge of the water treatment process will increase student interest and understanding. Students should have some prepared questions to ask staff. You may want to also give individual students responsibility for aspects of the visit. This will also encourage full attention and engagement.

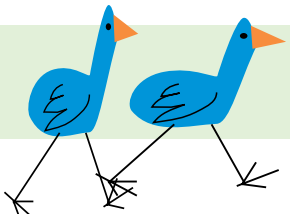
Curriculum links

Science: Level 3 and 4
Nature of Science:
Investigating in science:
Build on prior experiences, working together to share and examine their own and other's knowledge

Ask questions, find evidence, explore simple models, and carry out appropriate investigations to develop simple explanations

Education for sustainability concepts

Responsibility for Action/Kaitiakitanga:
If we want to use taonga, we must look after the taonga. Taking action, informed decision-making, citizenship, consumerism, enterprise, resilience and regeneration



What to take:

Students:

- Sensible walking shoes
- A warm jacket
- Sunblock and a hat
- **BLM 4g** Coagulant experiment notes, *1 copy between 2*
- Digital cameras (if possible)
- Prepared questions for the staff at the water treatment plant *(ideally email these prior to the visit)*
- Pen and something firm to press on
- Food and drink

Teachers:

- **BLM 4d** Visitor information *(completed) to give to guide*
- **BLM 4e** Group visitor induction *(completed) to give to guide*
- **BLM 4f** Map of Te Marua Water Treatment Plant
- A list of students and adults present at visit *to give to the guide*
- Health and safety documentation
- First aid kit

Stuart Macaskill lakes lookout

Visiting the Stuart Macaskill lakes lookout is optional. The lookout is located just outside the gates of the Te Marua Water Treatment Plant. It consists of picnic tables and seats built out of water supply infrastructure along with information about the lakes. It is also a handy location for your class to have a morning tea or lunch break.

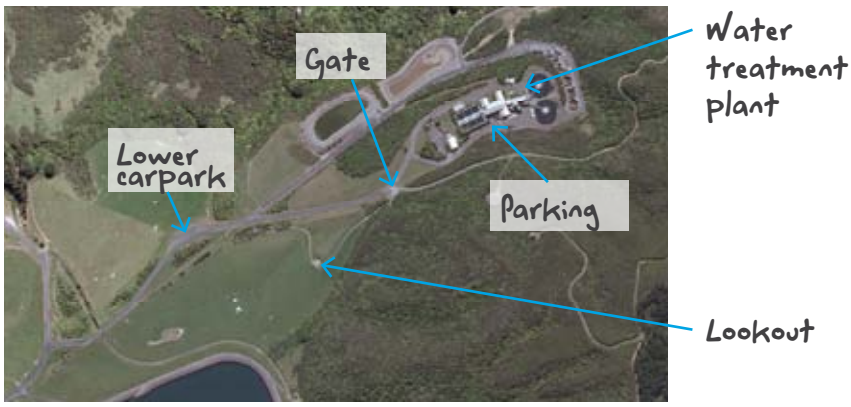
There will be no guide with you at the lakes lookout.

Below is a suggested learning sequence to take students through while at the lookout point. Adapt according to your student's prior knowledge and interests.

Suggested learning experience while at lookout:

1. Walk to the lookout from either the lower carpark (about 5-10 minutes walk), or from the water treatment plant carpark (5 minutes walk).
2. Read 'Why did we build them?' sign aloud to students. Allow questions and answer as best you can. Ask students to remember questions you can't answer to ask staff at the end of the visit.
3. Explain that the viewport pipes above the signs at the lookout are pieces taken from the Te Marua to Wellington water pipeline. These pieces were taken out when shut-off valves were inserted into the pipeline.
4. Read the earthquake interpretation sign aloud. Explain the purpose of the Stuart Macaskill lakes. If time, estimate with students where the Wellington fault lies and line students up on it. Explain that the fault goes through Wellington city, through this area and on to the Bay of Plenty.
5. If there is more time, also discuss the location of the water pipeline *(see map on earthquake sign).* Discuss this location in relation to the faultline.
6. You can either walk back down to the bus or walk up to the water treatment plant. The bus can meet you at the water treatment plant entrance at the end of your tour.

Map of Stuart Macaskill Lookout



4:4 Visiting the Te Marua Water Treatment Plant – learning experience

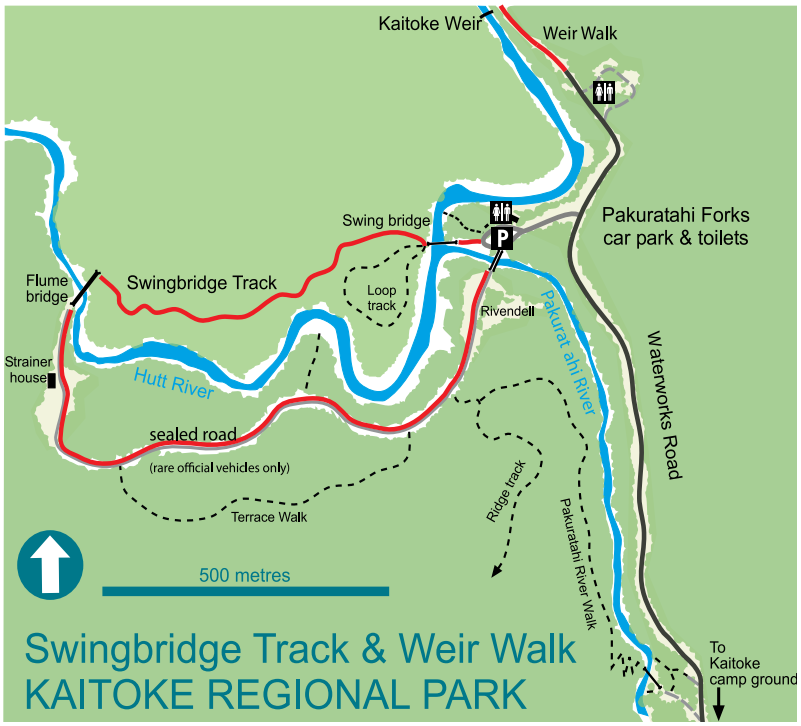
Learning experience

The visit schedule on pages 82 and 83 summarises the visit to the Te Marua Water Treatment Plant. It outlines the responsibilities of the water treatment plant staff, teachers and students. **Please read it carefully before your scheduled visit.**

Prior to your visit, ensure that you have sent a notice home to parents, detailing what students need to bring *('what to take' – teacher notes).* Also discuss your expectations of students before the visit.

On the way to the water treatment plant, you may want to also visit the Kaitoke Weir and the Strainer House. This is a worthwhile add-on to a trip. The weir is where the water starts the treatment process and the Strainer House is where leaves, branches and gravel are removed from the water *(see teacher notes).*

The maximum group size is 30 students and the minimum age allowed is 7 years. The ratio of adults to students should be at least 1:6 for children aged between 7-9 years and 1:12 for children aged between 10-15 years.



Learning intentions

Students will:
Ask questions to gain further knowledge about the water treatment process

Success criteria

Students can:
Ask appropriate questions to plant staff about water treatment

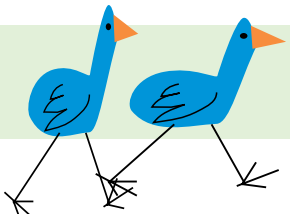
Resources

BLM 4d Visitor information: Te Marua

BLM 4e Group visitor induction

BLM 4f Map of Te Marua Water Treatment Plant

BLM 4g Coagulent experiment (for students to complete during experiment)



Visit schedule: Kaitoke Weir and Strainer House *(unguided, optional)*

Timeframes	Where	What happens at each point:		
		What do the guides do?	What do the students do?	What does the teacher do?
Before the water treatment plant				
Kaitoke Weir *(Optional)* *15 minutes*	Kaitoke Regional Park	No guides	Examine weir, ask questions	Point out areas of interest including the weir and water collection area. Ask questions, initiate discussion
Strainer House *(Optional)* *One hour for Strainer house walk*	Kaitoke Regional Park	No guides	Examine Strainer House, ask questions	Point out areas of interest. Ask questions, initiate discussion

Visit schedule: Te Marua Water Treatment Plant *(guided)*

Activity and Timeframes	Where	What happens at each point:		
		What does the guide do?	What do the students do?	What does the teacher do?
At the water treatment plant				
Meet the guide *10 mins*	Front door	– Introduce themselves and lead group through to teaching room – Explain what their job involves – Give health and safety talk	Listen	Supervise students
Introduction *5 mins*	Teaching room	– Ask students what they already know about why we need to treat water – Show pictures of giardia and cryptosporidium bugs	Listen, answer questions	Encourage students
Viewing the water treatment process diagram *15 mins*	Teaching room	– Ask students what they already know about the water treatment process – Add information about each step to extend students' knowledge and understanding. Encourage critical thinking – Allow opportunities for several questions	Share their knowledge	Circulate and help students

Activity and Timeframes	Where	What happens at each point:		
		What does the guide do?	What do the students do?	What does the teacher do?
At the water treatment plant				
Experiment: Coagulation *10 mins*	Teaching room	Set up and discuss coagulant experiment (learning experience 4.5)	Listen, watch and be involved when invited to. Answer questions. Record predictions on BLM 4g	Supervise students
Explore the water treatment plant *30 mins*	Different locations around plant *(guided)*	Take the students around the water treatment plant, showing them the filters, pipe gallery and the sludge	Learn about each stage of the water treatment process	Supervise students
Experiment review *10 mins*	Teaching room	Guide the students as they see what has happened in the experiments	Investigate what has happened with the experiment. Record the results on BLM 4g	Supervise and support students
Pose questions based on research *10 mins*	Teaching room	Answer the students' questions or suggest an expert who the students could contact later to find answers	Ask questions based on their inquiry so far	Support and assist students
Total visit time *(Treatment plant only)*	1 ½ hours			
Total visit time *(Including the Stuart Macaskill Lakes lookout and treatment plant -**without** Kaitoke Weir or Strainer House)*	2 hours			
Total visit time *(Including the Stuart Mackaskill Lakes lookout, treatment plant and Kaitoke Weir)*	2 hours and 45 minutes			
Total visit time *(Including the Stuart Mackaskill Lakes lookout, treatment plant, Kaitoke Weir **and** Strainer House)*	3 hours 45 minutes			

BLM 4e: Group Visitor Induction

Understanding of Responsibility: Visiting Groups

As part of our health and safety programme, we require that all visitors to Greater Wellington Regional Council (GWRC) water treatment plants sign in upon arrival and out upon departure. Signing in is an acknowledgement that visitors have been made aware of our Visitor Induction details before entering the plant.

To speed the arrival and departure process for visiting groups, we ask that the teacher or group leader sign in on the day, on behalf of the whole group. This will signify acceptance of responsibility for ensuring that all members of the group have had the GWRC induction information explained to them. The teacher or adult who has prime responsibility for the visiting group must also sign the following declaration on the day of the visit.

Declaration

*I have read and understood the Visitor Induction information on BLM 4d for **Te Marua Water Treatment Plant**, and have conveyed this information to the group members who will be present for our visit. I agree to take responsibility for the members of my group acting in a responsible manner during our visit, in accordance with the advice contained in the induction handout.*

Name: _____

Group/School: _____

Date: _____

Total number of visitors: Children: _____ Adults: _____

Signature: _____

** Please bring with you, attached to this form, a list of the names of all children and adults who are included in your group, ensuring that it is accurate on the day of the visit. This will help us to account for your group members quickly in the unlikely event of an emergency occurring while you are on site.*

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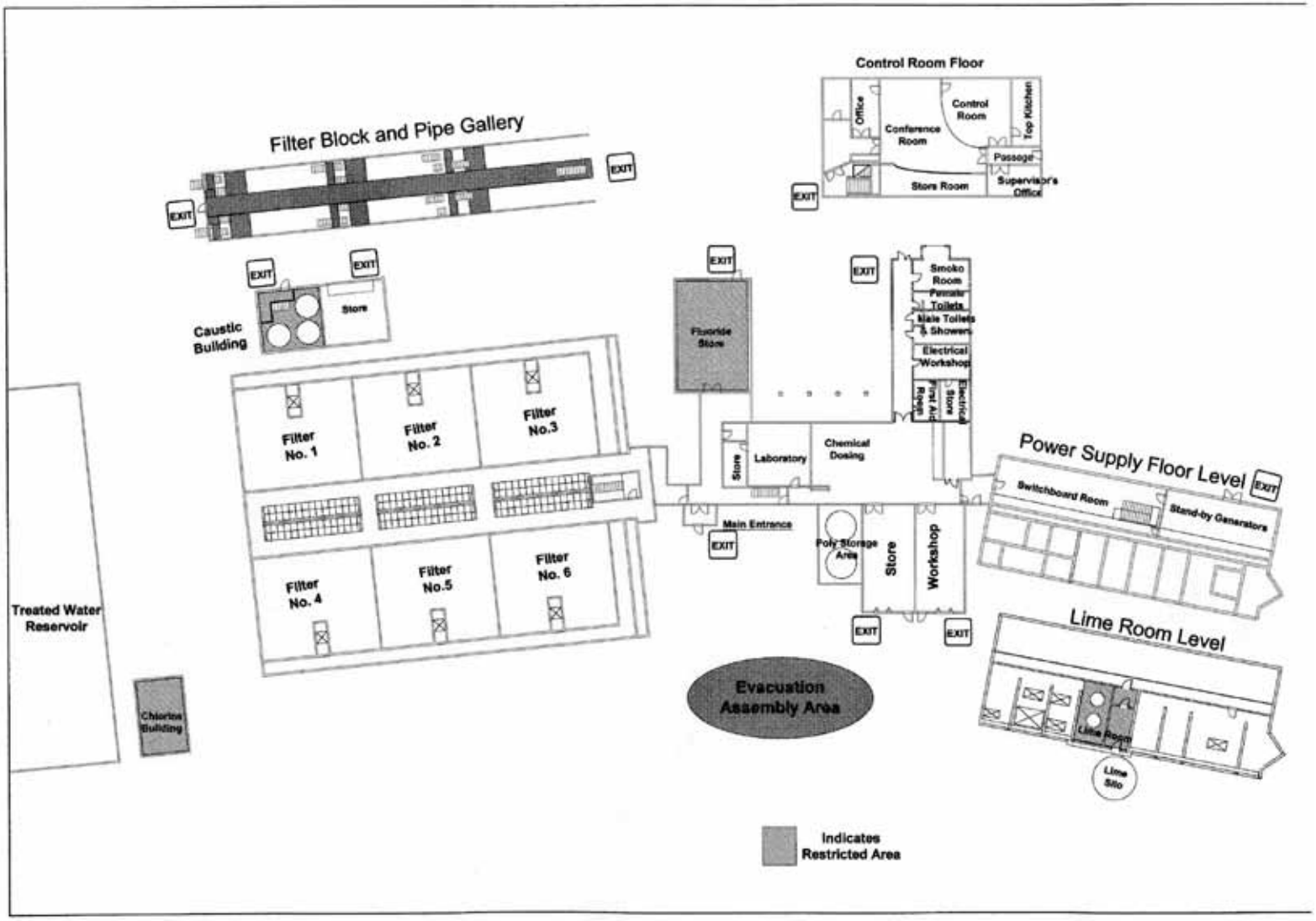
BLM 4f: Map of Te Marua Water Treatment Plant



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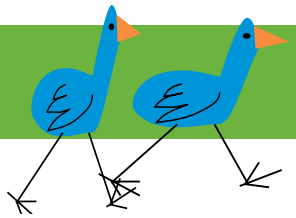

4:5 Experiment: Clumping with coagulants – teacher notes

Curriculum links

Science: Level 3 and 4
Material World:
Chemistry and society:
Relate the observed, characteristic chemical and physical properties of a range of different materials to technological uses and natural processes

Other curriculum links: Level 3 and 4
Science: Investigating in science

Education for sustainability concepts

Responsibility for Action/Kaitiakitanga:
If we want to use taonga, we must look after the taonga. Taking action, informed decision-making, citizenship, consumerism, enterprise, resilience and regeneration

Background knowledge

What is a coagulant?

A coagulant is a type of chemical – such as polyaluminium chloride (PACl). It helps small impurities to 'clump' together. Coagulant is added in the rapid mix tank in the water treatment plant. The coagulant attracts particles of solids to it and causes them to bind together. Mixing it quickly makes the clumping process work faster.

Why are coagulants used in water treatment?

Coagulants are used to remove impurities from water. They help solid and dissolved impurities clump together and they can then be more easily removed from the water.

What is floc?

Floc is a collection of solid particles suspended in water. When the small impurities from water clump together, they make 'floc'. Floc is formed when a coagulant is added to water.

How is the floc removed?

In the settling tanks, the water separates out. The floc is large enough so that it sinks to the bottom of the tanks. The floc at the bottom of the tank is then scraped off and sent to the sludge handling plant.

What is a 'control'?

A control in an experiment is an unchanged, normal specimen. For this experiment, it would be dirty water without the coagulant added. The control is a 'normal' model to compare the other specimens with.

Any valid experiment must have a control.

Safety with coagulants

Contact with the coagulant should be avoided. Those handling the chemicals may need to wear safety equipment.

4:5 Experiment: Clumping with coagulants – learning experience

Learning experience

Staff at the water treatment plant will perform this experiment while the students observe.

- Staff will ask students what they think a 'coagulant' is.

  Staff will work with student's ideas to reach an acceptable definition. Staff will then explain what a coagulant does and give associated safety information for the experiment (see teacher notes)
- An experiment will be set up at the front of the room with jars of water
- The experiment will consist of up to six jars of water, each a different type
- Staff will put different types of water into each jar. Students will be involved where possible. The contents of each jar will be labelled
- What do students think will happen when a coagulant is added to water in the jars with dirt in them? *Make predictions on BLM 4g*
- Staff will then add a small dose of the coagulant (PACl) to each of the jars, except one, which will be the 'control'
- Discuss what a control is and why we need one *(see teacher notes)*
- The machine will then stir the jars. Students observe what is happening
- After mixing, leave jars to settle for at least 20 minutes. The students will leave the experiment in place while they are taken on a tour of the plant
- When the students return, they will observe and compare the physical changes of the water in each jar. *Some will have formed 'floc' (see teacher notes)*
- Discuss, with the help of staff, what happened to the water inside each jar after coagulant was added to it. *Discuss reasons for different reactions*

Learning intentions

Students will:
Observe changes to different types of water when a coagulant is added to it

Success criteria

Students can:
Explain what happens when a coagulant is added to different types of water

Resources

BLM 4g Coagulant experiment notes

Reflection questions

- Why would coagulant be used for treating water? *To clump impurities together so that they can be removed more easily*
- What is floc? *See teacher notes*
- Why did some jars not form any floc when coagulant was added? *There were few impurities in these jars*

Vocabulary

- coagulant
- PACl (polyalumium chloride)
- particles
- prediction
- observation

BLM 4g: Coagulant experiment

What is a coagulant?

Contents of jar	Prediction When coagulant is added…	Observation When coagulant was added…

Explain your observations:

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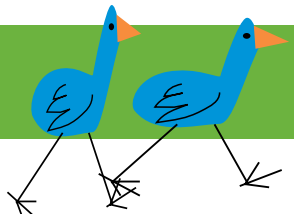
Section 4: Water treatment – Wainuiomata

Learning experiences – Section Four

Learning experiences	Learning intentions Students will . . .	Curriculum links (Achievement objectives)	Content
1. Keeping our drinking water clean	• Identify appropriate sources of drinking water	**Health: Level 3 and 4:** ***Personal Health and Physical Development:*** *Safety management* Identify risks and their causes and describe safe practices to manage these	Students identify clean sources of drinking water and explore the Wainuiomata/Orongorongo Water Collection Area
2. What happens at the water treatment plant	• Investigate the sequence of events in the water treatment process • Determine the function of water treatment equipment	**Technology: Level 3:** ***Nature of Technology:*** *Characteristics of technological outcomes:* Understand that technological outcomes are recognisable as fit for purpose by the relationship between their physical and functional natures	Students investigate the water treatment process. They place cards describing parts of the water treatment process in the correct order on a flow diagram
3. Safety at the water treatment plant	• Identify ways to manage hazards at the water treatment plant • Create a safety action plan for their visit	**Health: Level 3 and 4:** ***Personal Health and Physical Development:*** *Safety management* Identify risks and their causes and describe safe practices to manage these	Students discuss ways to manage possible hazards during their visit and collectively create a safety action plan
4. Visiting the Wainuiomata Water Treatment Plant	• Ask questions to gain further knowledge about the water treatment process	**Science: Level 3 and 4:** ***Nature of Science*** *Investigating in science* – Build on prior experiences, working together to share and examine their own and others' knowledge – Ask questions, find evidence, explore simple models, and carry out appropriate investigations to develop simple explanations	Visit the water treatment plant to see the water treatment process first hand. By participating and questioning students gain an in-depth understanding of the water treatment process
5. Experiment: Clumping with coagulants	• Observe changes to different types of water when a coagulant is added to it	**Science: Level 3 and 4:** ***Material world:*** *Chemistry and society:* Relate the observed, characteristic chemical and physical properties of a range of different materials to technological uses and natural processes	**This experiment will be conducted by staff at the water treatment plant* Students observe and describe changes to different samples of water when a coagulant is added



4:1 Keeping our drinking water clean – teacher notes

Curriculum links

Health: Level 3 and 4
***Personal Health and Physical Development:* Level 3**
Safety management:
Identify risks and their causes and describe safe practices to manage these

Level 4
Safety management:
Access and use information to make and action safe choices in a range of contexts

Other curriculum links: Level 3 and 4
Science: *Nature of Science:*
Investigating in science

Education for sustainability concepts

Responsibility for Action/Kaitiakitanga:
If we want to use taonga, we must look after the taonga. Taking action, informed decision-making, citizenship, consumerism, enterprise, resilience and regeneration

Background knowledge

Collecting the cleanest water

In Wellington, water is collected from rivers where the source is as clean as possible to start with (the Hutt, Orongorongo and Wainuiomata rivers). Providing high-quality drinking water from the water treatment plant is much easier and cheaper if the water to be treated is relatively clean. We remove impurities in the water at a water treatment plant.

Why collect the water from the Wainuiomata/ Orongorongo Water Collection Area?

Water that is treated at Wainuiomata Water Treatment Plant comes from the Wainuiomata and Orongorongo catchments. When rain falls in the Rimutaka Ranges, water that is not absorbed into the ground starts to run downhill towards the sea through the streams of the Wainuiomata/Orongorongo Water Collection Area. The streams run through a large area of native forest, which is an ideal environment for keeping water as clean as possible.

What is an aquifer?

An aquifer is an underground layer of gravels or soil which holds water. Water is usually moving very slowly through an aquifer, being filtered along the way. An aquifer behaves like an underground sponge. Most places on Earth have some form of aquifer underneath them, but because we can't see them, many of us are unaware of their existence.

Water from aquifers

Aquifers naturally filter water while it is underground and typically water that has been underground for more than one year is free from problems. In Wellington, some 40% of our drinking water is from the Waiwhetu Aquifer. Water from the Waiwhetu Aquifer has been underground for more than a year, so the water that comes out of it doesn't need to be treated to be safe to drink.

Weirs for collecting water

A weir is a small dam. It raises the water level in one part of the river to help divert water into an intake chamber. While most of the water flows on down the river, some flows into the intake chamber and on to the water treatment plant for treating. The area around our weirs is managed to reduce the risk of the water becoming polluted. Possible pollutants could include: animal and human waste, soil, rubbish, chemicals, oil and petrol. To manage this risk, grazing stock and vehicles are kept out of the water collection area above the weir, and although people can walk in nearby areas, they are not allowed to camp in those places overnight.

4:1 Keeping our drinking water clean – learning experience

Learning experience

- Share the learning intention and success criteria
- Ask students where they would collect drinking water if there was no town supply available. *Examples include: drinking fountain at Petone, streams high in the catchment, catching rainwater*
- Explain that water can contain germs/impurities which can make it dangerous to drink. A water treatment plant treats the water and removes impurities from it. Treated water is safe to drink
- Display the poster *'Greater Wellington's water sources'*. Point out aquifers, rivers and the sea on the diagram. Read out teacher notes about water from aquifers
- Discuss options for obtaining clean drinking water from the environment pictured on the diagram. Ask students to identify several sources of clean drinking water from the poster. List advantages and disadvantages of taking water from each source: e.g. mountain streams, bush streams, city streams, aquifers etc... Discuss which source would be preferable
- Explain that water is taken for Wellington's water supply from the Hutt Water Collection Area, the Wainuiomata/Orongorongo Water Collection Area and from the Waiwhetu Aquifer. *The Hutt Water Collection Area and the Waiwhetu Aquifer each provide about 40% of Wellington's supply. The remaining 20% of the water supply is taken from the Wainuiomata/ Orongorongo Water Collection Area*
- Locate the Orongorongo and Wainuiomata rivers on a map. Ask students why this area would have been chosen for a water collection area? (see teacher notes). *For more information about Wellington's water supply see: http://www.gw.govt.nz/sources-of-water/*
- Brainstorm questions about water treatment. Record questions to ask during the water treatment plant visit

As an extension, students could research water borne diseases. See: http://www.healthed.govt.nz/uploads/docs/HE213.pdf

Learning intentions

Students will:
Identify appropriate safe sources of drinking water

Success criteria

Students can:
Identify appropriate places to source safe drinking water

Resources

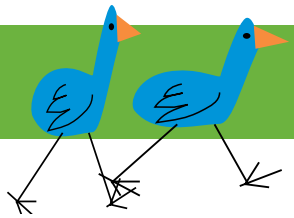
Poster Greater Wellington's water sources

Reflection questions

- What could happen if you drank water containing impurities or germs? *You could become very sick*
- What other methods could we use to treat water from an untreated source before drinking it? *Water purification tablets, boiling (for at least 3 minutes). These methods can kill germs in water such as giardia*

Vocabulary

- impurities
- purification
- giardia



4:2 What happens at the water treatment plant – teacher notes

Curriculum links

Technology:
Level 3 and 4
Nature of Technology:
Characteristics of technological outcomes:
Understand that technological outcomes are recognisable as fit for purpose by the relationship between their physical and functional natures

Other curriculum links at Level 4:
Health: *Movement concepts and motor skills: Science and Technology:*
Experience and demonstrate how science, technology and the environment influence the selection and use of equipment in a variety of settings

Education for sustainability concepts

Responsibility for Action/Kaitiakitanga:
If we want to use taonga, we must look after the taonga. Taking action, informed decision-making, citizenship, consumerism, enterprise, resilience and regeneration

Background knowledge

Water treatment – the process

Before the water treatment plant

Water is collected from a natural source. For the Wainuiomata Water Treatment Plant, water is collected at **weirs** on the largest accessible rivers in the Wainuiomata/Orongorongo Water Collection Area.

Screening the water

The water that has been collected must be screened to remove any debris. At the **weir,** water passes through **bar screens** which have holes that are 15-20 mm wide. Big items, such as, grit, sand, gravel, rocks, sticks and leaves, are flushed back into the river. Small fish can swim into the intake chamber but they usually swim out again. Large fish are prevented from entering the intake chamber by a large grid.

Although we have collected the water from the cleanest possible source, there will still be impurities in it that are too small to see or catch in the bar screens.

Inside the water treatment plant

Clumping impurities

Because the impurities floating in the water are very small, it's easier to get them out if we can **clump** them together in bigger groups. In the reaction tanks, we add chemicals like Polyaluminium Chloride (PACl) to the water which attract the suspended particles like a magnet and bind them together into larger particles that we can see (called **floc**).

Separating out the floc to remove impurities

Millions of tiny bubbles of air are pumped into the water. The bubbles join onto the floc, floating them to the surface where they form a 'floc blanket'. The blanket of floc then floats to the one end of the tank where it is tipped over the edge of the tank and into the wastewater system by a tilting tray. The waste is sent to a **centrifuge**, which spins really fast, removing the excess water like the spin cycle in a washing machine, returning the clean water to the inlet to the water treatment plant (a great example of recycling) and leaving behind solid sludge.

The sludge is sent along a **conveyer belt** and down into a skip to be taken to the landfill at Wainuiomata. *(Without fail, the student's favourite part of the water treatment plant visit is watching the sludge plop onto the conveyer belt and then off into the skip.)*

Filtering the water

The water that is left under the floc blanket flows through a **sand filter** at the bottom of the tank. This acts like a very fine screen, trapping and separating out any last particles that didn't float to the top.

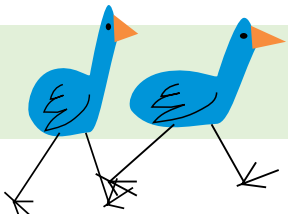
Making sure the water is safe to drink

The clean drinking water is almost ready for our taps. The water has a long way to go from the water treatment plant, through pipes to local storage reservoirs and then through more pipes before it reaches our taps – it might take 2 days to get from the Wainuiomata Water Treatment Plant to a **reservoir** in Wellington city. Before the water goes to the treated water reservoir we add chlorine to kill any bugs that may remain in the water or that might enter the water over the long journey. About 5 million litres can be stored in the treated water reservoir at Wainuiomata at a time. Fluoride is also added before it reaches our taps, to help keep our teeth strong and healthy.

The water is monitored throughout the treatment process to make sure it meets our country's drinking water standards.

What is a technological outcome?

Technological outcomes are products and systems developed for a specific purpose. A technological outcome is evaluated in terms of its fitness for purpose.



4:2 What happens at the water treatment plant – learning experience

Learning intentions

Students will:
Investigate the sequence of events in the water treatment process

Determine the function of water treatment equipment

Success criteria

Students can:
Order the sequence of events in the water treatment process

Explain the function of water treatment plant equipment

Resources

BLM 4h The water treatment process: Wainuiomata

BLM 4i Water treatment process cards: Wainuiomata

Poster Water treatment process – Wainuiomata

Learning experience

- Share learning intentions and success criteria
- Ask students why we need to treat water before drinking it. *There could be impurities in the water that can make us unwell*
- Explain that we will investigate the equipment used in a water treatment plant and the sequence of events that is undertaken to treat water to drinking standards
- Read aloud the teacher notes on pages 92-93 about the water treatment process. Ask students to listen carefully as they will need some of the information in order to complete the activity
- Hand out BLM 4h and BLM 4i. Discuss any new vocabulary and clarify meaning
- Ask students to cut out cards on BLM 4i. Stick into the correct box under picture on BLM 4h. Each card explains a step in the water treatment process
- When students have ordered the cards ask them to compare answers
- Show students the poster *'Water treatment process – Wainuiomata'*. Revise the steps of the water treatment process with the poster as a guide, while students determine if their cards are in the correct order
- Discuss any equipment featured on the poster and cards. Ask what each piece of equipment's function is. *Treatment plant equipment is in **bold** on teacher notes pages*

As an extension, students could create a flowchart to describe the process of water treatment.

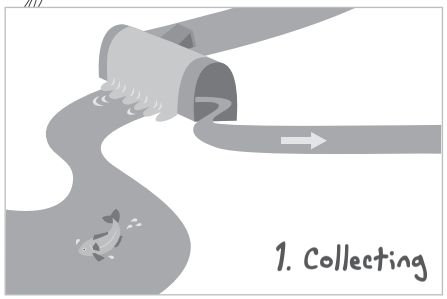
Reflection questions

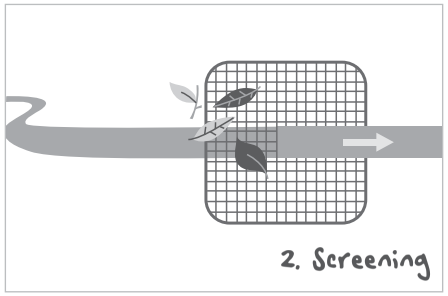
- Why do you think the water has to be as clean as possible before the water treatment process starts? *It takes less effort and resources to treat water to drinking-quality standards if water is relatively clean to start with*
- How do staff make sure that all impurities have been removed? *Water is thoroughly tested along the way before being distributed*

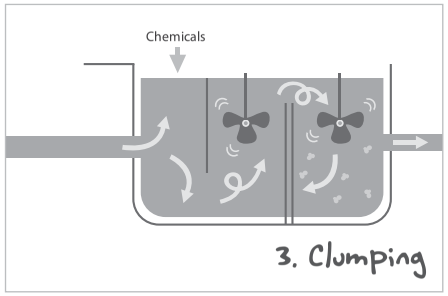
Vocabulary

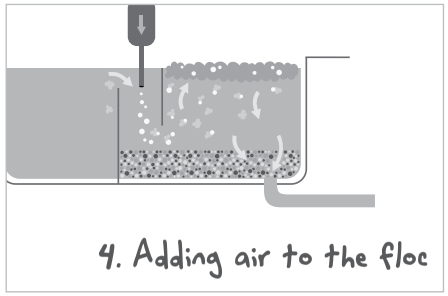
- filtering
- floc
- chlorine
- fluoride

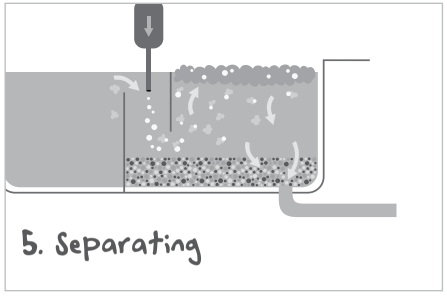
BLM 4h: The water treatment process: Wainuiomata

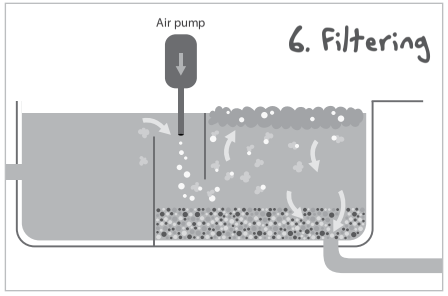


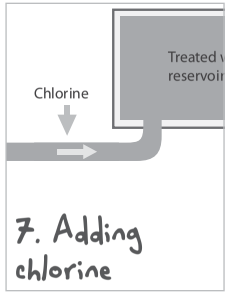


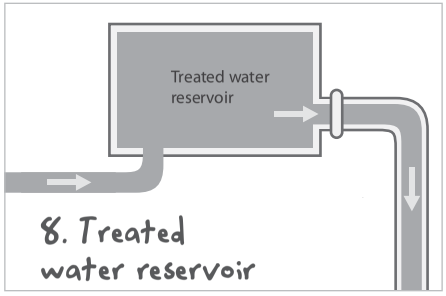


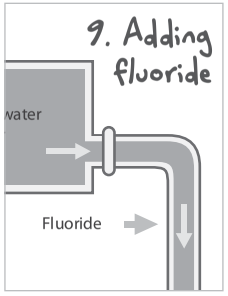












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BLM 4i: Water treatment process cards: Wainuiomata

Cut out the cards below. Place each card in the appropriate space on BLM 4h to describe the order of the water treatment process.

Rain falls and collects in streams and rivers in the Wainuiomata/Orongorongo Water Collection Area. Some of this water flows into the water supply intakes to the water treatment plant.

Millions of bubbles of air are also added. These stick to the floc, making them rise to the surface in a layer which looks like a blanket.

We add chemicals to the water and stir it. This helps all the impurities clump together to make 'floc'. Floc is easier to see and to get out.

Fluoride is later added to help keep our teeth healthy.

The water goes through a fine screen to stop leaves, branches and gravel from getting into the water treatment plant.

The floc is then tipped off the surface of the tank with a tilting tray. The floc is separated from the water to make sludge waste. The sludge is carried away to a skip bin.

The treated water is almost ready to be distributed to the community.

Chlorine is added to the water to kill any bugs that might be in the water.

The remaining water passes through a set of sand filters. These filters act like very fine screens trapping and separating out any last unwanted, small impurities.

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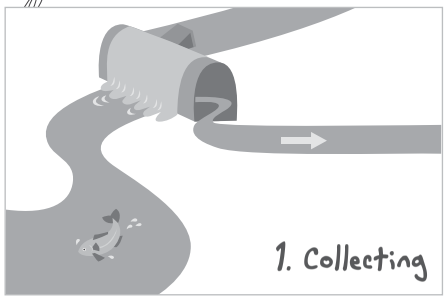
BLM 4i: The water treatment process: Wainuiomata – Answer sheet



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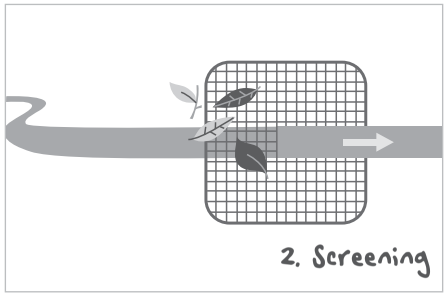
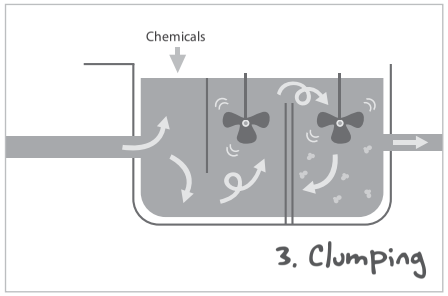


The water goes through a fine screen to stop leaves, branches and gravel from getting into the water treatment plant.



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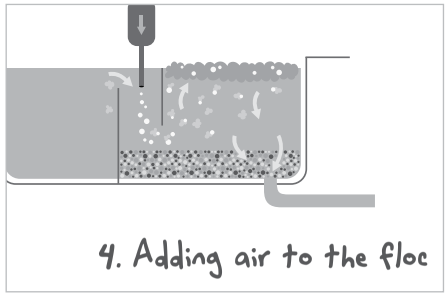
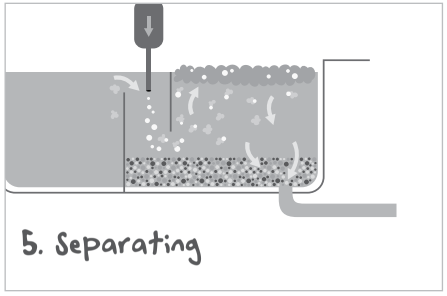


Millions of bubbles of air are also added. These stick to the floc, making them rise to the surface in a layer which looks like a blanket.



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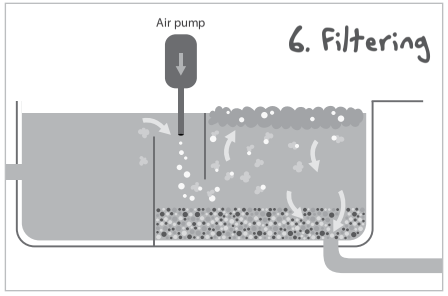

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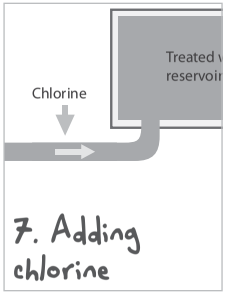

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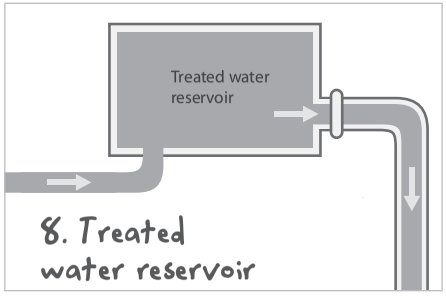

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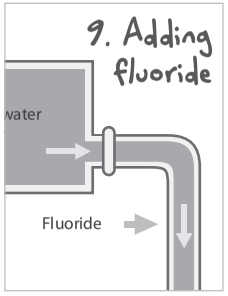

Fluoride is later added to help keep our teeth healthy.

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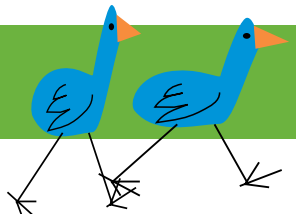

4:3 Safety at the water treatment plant – teacher notes

Curriculum links

Health: Level 3 and 4
***Personal Health and Physical Development:* Level 3**
Safety management: Identify risks and their causes and describe safe practices to manage these

Level 4
Safety management: Access and use information to make and action safe choices in a range of contexts

Education for sustainability concepts

Responsibility for Action/Kaitiakitanga: If we want to use taonga, we must look after the taonga. Taking action, informed decision-making, citizenship, consumerism, enterprise, resilience and regeneration

Background knowledge

Hazards

A hazard is a possible danger. A hazard can be a situation which may lead to an injury or pose a threat to a person.

Why do a safety plan *with* my students?

This activity is designed to involve students in making a safety plan for the visit to the water treatment plant. If students complete this activity before the visit, they will be more aware of potential hazards at the water treatment plant. They will have more ownership and therefore more buy-in for following a safety plan if they have had a part in creating it.

Will this be the only safety preparation I need to do for the visit?

No. Your school will have its own health and safety plans and regulations for trips. However, completing this activity with your students will make completing your school safety assessments e.g. risk analysis matrices/hazard management plans much easier.

Hazard management process

(Taken from the Dept of Labour website)

1. Identify hazards
2. Assess if significant
3. If yes,
    1. *Eliminate,* if practicable
    2. *Isolate,* if not practicable to eliminate
        - inform people involved
        - monitor to ensure controls are effective
    3. *Minimise,* if hazard can't be isolated
        - inform employees of controls
        - provide, make accessible, and ensure the use of protective clothing and equipment
        - monitor to ensure controls are effective

See http://www.dol.govt.nz/publications/big6/hazard-management-process-img.asp for more information

NB: *Teachers need to complete BLM 4k: Visitor Information and BLM 4l: Group visitor induction on behalf of their students and give to water treatment plant staff on the day of their visit.*

4:3 Safety at the water treatment plant – learning experience

Learning experience

- Share learning intentions and success criteria
- Ask students if they understand what a hazard is *(see teacher notes)*
- Explain the need for a safety action plan
- Brainstorm what risks/hazards there might be at a water treatment plant. *Read BLM 4k for examples*
- Decide on several ways to prevent the hazards discussed from being a problem during the visit
- Discuss what would happen if there was an emergency situation at the water treatment plant. *It may be necessary to call an ambulance, may need to leave/evacuate*
- Go over health and safety expectations for the day. Discuss the location of your first aid kit and procedures for what students should do if a hazardous situation occurs
- How will students be expected to behave on the day of the visit? How could behaviour affect safety during the visit? *E.g. behaving sensibly and not touching equipment*
- Ask students to complete BLM 4j. Explain that they must think of ways to prevent hazards from occurring and explore how to deal with problems if they do occur. The 'when/where' column applies to when and where the preventative actions should be taken
- Share answers and decide on the best answer for each part of the safety plan. Create a shared safety action plan as a result
- Reassure students that staff at the water treatment plant are trained to deal with hazards and emergency situations at the plant and will give assistance throughout your visit

Learning intentions

Students will:
Identify ways to manage hazards at the water treatment plant

Create a safety plan for their visit

Success criteria

Students can:
Describe ways to prevent hazards from occurring

Contribute to writing a safety action plan

Resources

BLM 4j Safety action plan for plant visit

BLM 4k Visitor information: Wainuiomata

Reflection questions

- Is there anything else we could do to keep ourselves safe at the treatment plant? *Answers will vary*
- How could sludge waste be harmful? *See BLM 4k*

Vocabulary

- impurities
- purification

BLM 4j: Safety action plan for water treatment plant visit

Possible risk	Cause of risk	Responsibility	Preventative actions	When/where	Emergency plan
Plant emergency	Various	Plant staff	Regular checks and maintenance	Every day at various locations within plant	Plant staff deal with emergency as required
Contact with dangerous chemicals	Uncontrolled access to restricted areas	Supervising teacher, students, parents/helpers			
Injury from machinery in plant	Uncontrolled access to restricted areas	Supervising teacher, students, parents/helpers			
Electric shock	Uncontrolled access to electrical cabinets	Supervising teacher, students, parents/helpers			
Fall into open water	Climbing over barrier	Supervising teacher, students, parents/helpers			
General fall	Running, not paying attention	Students, supervising teacher, parents/helpers			
Contact with sludge waste	Uncontrolled access to restricted areas	Supervising teacher, students, parents/helpers			
Lost students	Poor supervision, not paying attention	Students, supervising teacher, parents/helpers			
Medical problems resulting from an existing condition such as an allergy	Trigger, such as insect bite Asthma attack	Supervising teacher, parents/helpers, students			
Accident with vehicle in the car park	Poor supervision	Supervising teacher, parents/helpers, students			

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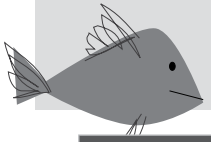

BLM 4j: Safety action plan for water treatment plant visit: possible answers

Possible risk	Cause of risk	Responsibility	Preventative actions	When/where	Emergency plan
Contact with dangerous chemicals	Uncontrolled access to restricted areas	Supervising teacher, students, parents/helpers	Instruct students to stay behind all barriers; buddy system, supervision by parents/teachers	Before visit, at start of plant tour	Alert plant staff Apply appropriate first aid
Injury from machinery in plant	Uncontrolled access to restricted areas	Supervising teacher, students, parents/helpers	Instruct students to stay behind all barriers, supervision by parents/teachers	Before visit, at start of plant tour	Alert plant staff Apply appropriate first aid
Electric shock	Uncontrolled access to electrical cabinets	Supervising teacher, students, parents/helpers	Instruct students to stay behind all barriers; buddy system, supervision by parents/teachers	Before visit, at start of plant tour	Call an ambulance (if needed)
Fall into open water	Climbing over barrier	Supervising teacher, students, parents/helpers	Instruct students to stay behind all barriers, supervision by parents/teachers	Before visit, at start of plant tour	Adult to retrieve student Call an ambulance/apply first aid
General fall	Running, not paying attention	Students, supervising teacher, parents/helpers	Instruct students to stay calm and with the group at all times	Before visit, at start of plant tour	Apply appropriate first aid
Contact with sludge waste	Uncontrolled access to restricted areas	Supervising teacher, students, parents/helpers	Instruct students to stay behind all barriers; buddy system; supervision by parents/teachers	Before visit, at start of plant tour	Wash hands immediately
Plant emergency	Various	Plant staff	Internal systems	At start of plant tour	Evacuate to area outside main entrance; roll call
Lost students	Poor supervision, not paying attention	Students, supervising teacher, parents/helpers	Buddy system, supervision; agree on a regrouping area and a time and make sure everyone knows how to get to that area	Before visit, at start of plant tour	Alert plant staff Contact parents Call police to report missing
Medical problems resulting from an existing condition such as an allergy	Trigger, such as insect bite Asthma attack	Supervising teacher, parents/helpers, students	Ensure necessary medication accompanies the student on the visit; make accompanying parents/helpers aware of any health conditions; buddy system	Before visit	Apply appropriate first aid Call an ambulance (if needed) Contact parents Inform plant manager
Accident with vehicle in the car park	Poor supervision	Supervising teacher, parents/helpers, students	Have safe area in carpark to go into and out of bus. Supervise students on way to and from water treatment plant	On the way to or on arrival at plant	Apply appropriate first aid/Call an ambulance (if needed)

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BLM 4k: Visitor Information: Wainuiomata

Welcome to the Wainuiomata Water Treatment Plant

The following information is important for your safety

It is a requirement of entry to this facility that you read the following information and note the emergency provisions on BLM 4m. All visitors must sign this sheet to confirm that they have read and understand this information.

Please Note: This sheet must be left at the plant upon departure.

Hazards - The main hazards on site are:

- **Corrosive and toxic chemicals**
- **Open water surfaces**
- **Rotating machinery**
- **Sludge waste**

Corrosive and toxic chemicals

The following chemicals are stored and used on this site. The storage location of these chemicals is identified on the site plan BLM 4m.

Chemical	Hazard	Health Effects
Chlorine Gas	Poisonous and Highly Corrosive	Asphyxiation/Pulmonary Oedema
Carbon Dioxide Gas	Displaces Oxygen	Asphyxiation
Fluoride	Toxic	Poisoning
Aluminium Sulphate	Mildly Corrosive	Minor Burns
Hydrated Lime	Mildly Corrosive	Minor Burns

Open water surfaces

Hand rails and barriers are installed around all open water surfaces. Please ***do not lean on or climb over any railing or barrier*** that is provided for your protection.

Rotating machinery

Please be aware that the Treatment Plant is fully automated and therefore machinery could start at any time. All exposed rotating parts have been fitted with guards to prevent accidental contact. ***Keep clear of any working machinery and equipment.***

Sludge Waste

Most contaminants, including Viruses, Giardia and Cryptosporidium, are removed from the raw water and concentrated in the sludge waste. ***Do not handle this waste.*** Wash your hands if accidental contact occurs.

In the event of an emergency make your way quickly to the evacuation area shown on map (BLM 4m)

I have read and understood the above information and agree to act in a responsible manner during my visit, and in accordance with the advice contained in this induction handout.

Name: _____ Organisation: _____

Signature: _____ Date: _____

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4:4 Visiting the Wainuiomata Water Treatment Plant – teacher notes

Background knowledge

Organisation for the visit

Before your visit, make sure you and your students are well prepared for the day. Visit the location to familiarise yourself with the area.

To organise a date and time to visit the water treatment plant, contact our staff; ph: (04) 384 5708 or email: info@gw.govt.nz

A suggested itinerary is included – see *Visit schedule: Wainuiomata Water Treatment Plant* on pages 105 and106. You may choose to only visit the water treatment plant.

What can I do, as a teacher, to maximise learning during our visit?

Preparing students well for the visit will encourage excitement about it. Having some prior knowledge of the water treatment process will increase student interest and understanding. Students should have some prepared questions to ask staff. You may want to also give individual students responsibility for aspects of the visit. This will also encourage full attention and engagement.

Wainuiomata Lower Dam

Visiting the Wainuiomata Lower Dam is optional. The dam is located just before the Wainuiomata Water Treatment Plant *(on the right as you drive in).*

It is a large, decommissioned dam which is no longer part of the water supply infrastructure. The dam was finished in 1884 and is one of the oldest dams in New Zealand.

The dam is approximately a two minute drive from the water treatment plant. There are no guides available at the dam. Further health and safety documentation and checks may be necessary by the teacher before visiting the dam. The large grassy area behind the dam is ideal for a morning tea or lunch break.

Wainuiomata hydro-electric generator

A hydro-electric generator has been constructed near the Wainuiomata Water Treatment Plant. It is a five minute walk from the water treatment plant. It has an information panel about the generator and offers the opportunity for your students to look through the door of the plant at the equipment. The hydro-electric generator uses water collected at the Orongorongo Weir to generate electricity.

If you wish to visit the hydro-electric generator please indicate this when booking your tour.

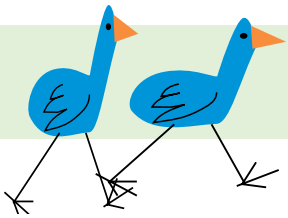
Curriculum links

Science: Level 3 and 4
Nature of Science:
Investigating in science:
Build on prior experiences, working together to share and examine their own and other's knowledge

Ask questions, find evidence, explore simple models, and carry out appropriate investigations to develop simple explanations

Education for sustainability concepts

Responsibility for Action/Kaitiakitanga:
If we want to use taonga, we must look after the taonga. Taking action, informed decision-making, citizenship, consumerism, enterprise, resilience and regeneration



4:4 Visiting the Wainuiomata Water Treatment Plant – learning experience

Learning intentions

Students will:
Ask questions to gain further knowledge about the water treatment process

Success criteria

Students can:
Ask appropriate questions to plant staff about water treatment

Resources

BLM 4k Visitor information:Wainuiomata

BLM 4l
Group visitor induction

BLM 4m Map of Wainuiomata Water Treatment Plant

BLM 4n Coagulent experiment for students to complete during experiment)

Learning experience

The visit schedule pages 105 and 106 summarises the visit to the Wainuiomata Water Treatment Plant. It outlines the responsibilities of the water treatment plant staff, teachers and students. **Please read it carefully before your scheduled visit.**

Prior to your visit, ensure that you have sent a notice home to parents detailing what students need to bring *('what to take' – teacher notes)*. Also discuss your expectations of students before the visit.

After the tour of the water treatment plant, you may want to also visit the Wainuiomata Lower Dam or the Wainuiomata hydro-electric generator. The Wainuiomata Lower Dam is unguided, and both are a worthwhile add-on to a trip *(see teacher notes)*.

The maximum group size is 30 students and the minimum age allowed is 7 years. The ratio of adults to students should be at least 1:6 for children aged between 7-9 years and 1:12 for children aged between 10-15 years.

What to take:

Students:

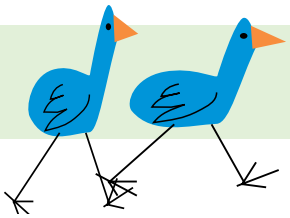
- Sensible walking shoes
- A warm jacket
- Sunblock and a hat
- **BLM 4n** Coagulant experiment notes, *1 copy between 2*
- Digital cameras (if possible)
- Prepared questions for the staff at the water treatment plant *(ideally email these prior to the visit)*
- Pen and something firm to press on
- Food and drink

Teachers:

- **BLM 4k** Visitor information (completed) *to give to guide*
- **BLM 4l** Group visitor induction (completed) *to give to guide*
- **BLM 4m** Map of Te Marua Water Treatment Plant
- A list of students and adults present at visit to give to the guide
- Health and safety documentation
- First aid kit

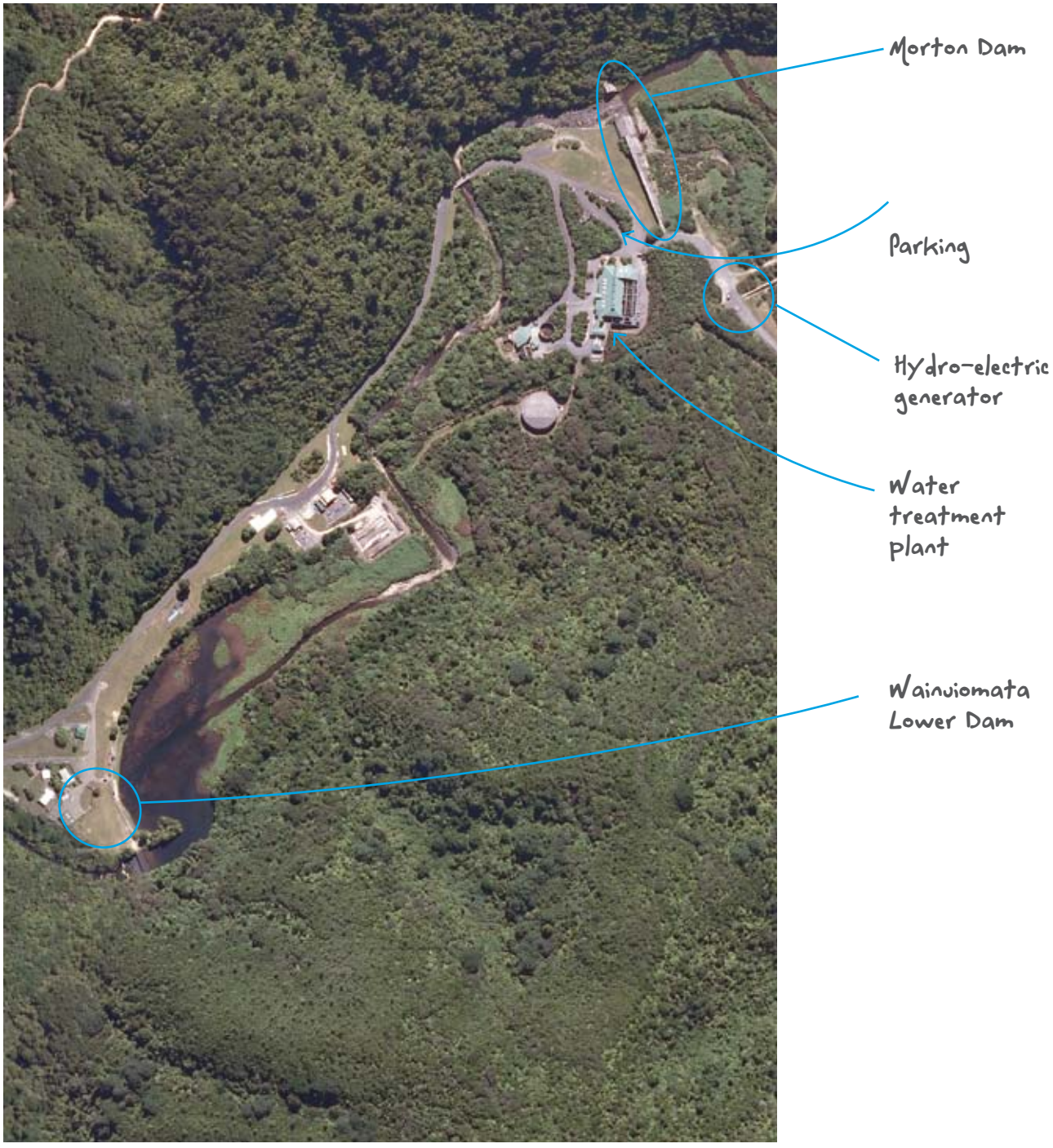
Visit schedule: Wainuiomata Water Treatment Plant

Activity and timeframes	Where	What happens at each point:		
		What do the guides do?	What do the students do?	What does the teacher do?
Meet the guides *10 mins*	Front door	• Introduce themselves and lead group through to teaching room • Explain what their jobs involve • Give health and safety talk	Listen	Supervise students
Introduction *5 mins*	Teaching room	• Ask students what they already know about why we need to treat water • Show pictures of giardia and cryptosporidium bugs	Listen, answer questions	Encourage students
Viewing the water treatment process diagram *15 mins*	Teaching room	• Ask students what they already know about the water treatment process • Add information about each step to extend students' knowledge and understanding. Encourage critical thinking • Allow opportunities for several questions	Share their knowledge	Circulate and help students
Experiment: Coagulation *10 mins*	Teaching room	Set up and discuss coagulant experiment (learning experience 4.5)	Listen, watch and be involved when invited to. Answer questions Record predictions on BLM 4n	Supervise students
Explore the water treatment plant *30 mins*	Different locations around plant *(guided)*	Take the students around the water treatment plant, showing them the filters, pipe gallery and the sludge	Learn about each stage of the water treatment process	Supervise and support students



Activity and timeframes	Where	What happens at each point:		
		What do the guides do?	What do the students do?	What does the teacher do?
Experiment review *10 mins*	Teaching room	Guide the students as they see what has happened in the experiments	Investigate what has happened with the experiment. Record the results on BLM 4n	Supervise and support students
Pose questions based on research *10 mins*	Teaching room	Answer the students' questions or suggest an expert who the students could contact later to find answers	Ask questions based on their inquiry so far	Supervise and support students
Total visit time *(Treatment plant only)*	1 ½ hours			
Total visit time *including Wainuiomata Lower Dam and/or hydro-electric generator)*	Approximately 2 hours			

Map of Wainuiomata Water Treatment Plant



BLM 4l: Group Visitor Induction

Understanding of Responsibility: Visiting Groups

As part of our health and safety programme, we require that all visitors to Greater Wellington Regional Council (GWRC) water treatment plants sign in upon arrival and out upon departure. Signing in is an acknowledgement that visitors have been made aware of our Visitor Induction details before entering the plant.

To speed the arrival and departure process for visiting groups, we ask that the teacher or group leader sign in on the day, on behalf of the whole group. This will signify acceptance of responsibility for ensuring that all members of the group have had the GWRC induction information explained to them.

The teacher or adult who has prime responsibility for the visiting group must also sign the following declaration on the day of the visit.

Declaration

*I have read and understood the Visitor information on BLM 4k for **Wainuiomata Water Treatment Plant**, and have conveyed this information to the group members who will be present for our visit. I agree to take responsibility for the members of my group acting in a responsible manner during our visit, in accordance with the advice contained in the induction handout.*

Name: _____

Group/School: _____

Date: _____

Total number of visitors: Children: _____ Adults: _____

Signature: _____

* Please bring with you, attached to this form, a list of the names of all children and adults who are included in your group, ensuring that it is accurate on the day of the visit. This will help us to account for your group members quickly in the unlikely event of an emergency occurring while you are on site.

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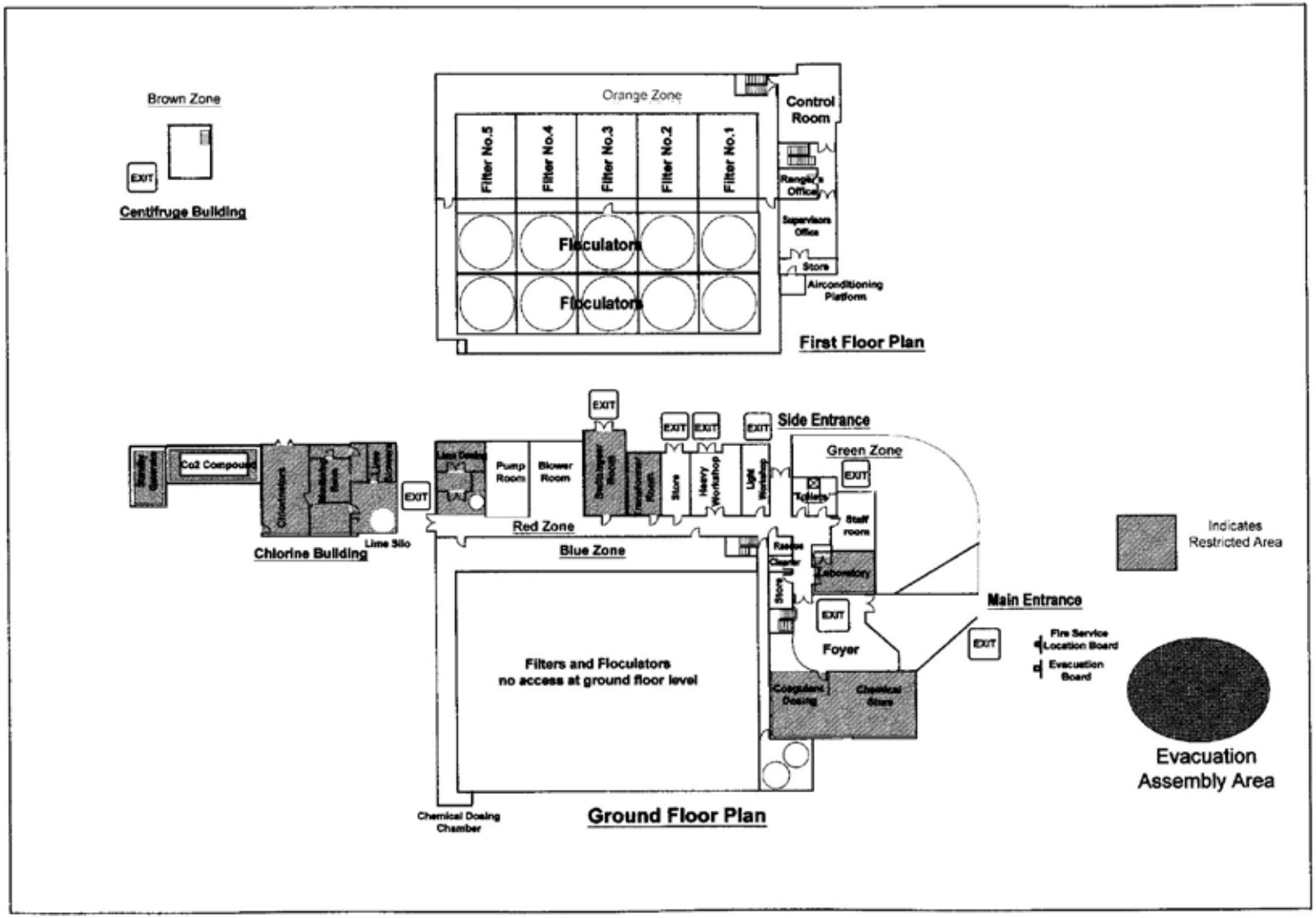
BLM 4m: Map of Wainuiomata Water Treatment Plant



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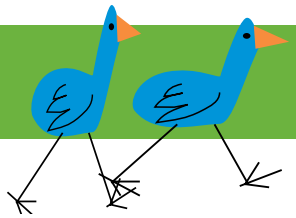


4:5 Experiment: Clumping with coagulants – teacher notes

Curriculum links

Science: Level 3 and 4
Material World:
Chemistry and society:
Relate the observed, characteristic chemical and physical properties of a range of different materials to technological uses and natural processes

Other curriculum links: Level 3 and 4
Science: Investigating in science

Education for sustainability concepts

Responsibility for Action/Kaitiakitanga:
If we want to use taonga, we must look after the taonga. Taking action, informed decision-making, citizenship, consumerism, enterprise, resilience and regeneration.

Background knowledge

What is a coagulant?

A coagulant is a type of chemical – such as polyaluminium chloride (PACl). It helps small impurities to 'clump' together. Coagulant is added in the rapid mix tank in the water treatment plant. The coagulant attracts particles of solids to it and causes them to bind together. Mixing it quickly makes the clumping process work faster.

Why are coagulants used in water treatment?

Coagulants are used to remove impurities from water. They help solid and dissolved impurities clump together and they can then be more easily removed from the water.

What is floc?

Floc is a collection of solid particles suspended in water. When the small impurities from water clump together, they make 'floc'. Floc is formed when a coagulant is added to water.

How is the floc removed?

Millions of tiny bubbles of air are pumped into the water. The bubbles join on to the floc and helps the floc float to the surface, forming a floc blanket. The floc blanket is pushed to one end of the tank where it is tipped over the edge by a tilting tray. The floc is sent to the sludge handling plant.

What is a 'control'?

A control in an experiment is an unchanged, normal specimen. For this experiment, it would be dirty water without the coagulant added. The control is a 'normal' model to compare the other specimens with. Any valid experiment must have a control to compare against.

Safety with coagulants

Contact with the coagulant should be avoided. Those handling the chemicals may need to wear safety equipment.

4:5 Experiment: Clumping with coagulants – learning experience

Learning experience

Staff at the water treatment plant will perform this experiment while the students observe.

- Staff will ask students what they think a 'coagulant' is.
  Staff will work with student's ideas to reach an acceptable definition. Staff will then explain what a coagulant does and give associated safety information for the experiment (see teacher notes)
- An experiment will be set up at the front of the room with jars of water
- The experiment will consist of up to six jars of water, each a different type
- Staff will put different types of water into each jar. Students will be involved where possible. The contents of each jar will be labelled
- What do students think will happen when a coagulant is added to the water in the jars with dirt in them? *Make predictions on BLM 4n*
- Staff will then add a small dose of the coagulant (PACl) to each of the jars, except one, which will be the 'control'
- Discuss what a control is and why we need one *(see teacher notes)*
- The machine will then stir the jars. Students observe
- After mixing, leave jars to settle for at least 20 minutes. *The students will leave the experiment in place while they are taken on a tour of the plant*
- When the students return, they will observe and compare the physical changes of the water in each jar. They can then complete the observation column on BLM 4n. *Some jars will have formed 'floc' (see teacher notes)*
- Discuss, with the help of staff, what happened to the water inside each jar after coagulant was added to it. *Discuss reasons for different reactions*

Learning intentions

Students will:
Observe changes to different types of water when a coagulant is added to it

Success criteria

Students can:
Explain what happens when a coagulant is added to different types of water

Resources

BLM 4n Coagulant experiment notes

Reflection questions

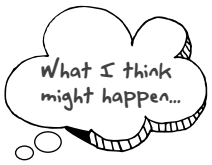
- Why would coagulant be used for treating water? *To clump impurities together so that they can be removed more easily*
- What is floc? *(see teacher notes)*
- Why did some jars not form any floc when coagulant was added?
  There were few impurities in these jars

Vocabulary

- coagulant
- PACl (polyalumium chloride)
- particles
- prediction
- observation

BLM 4n: Coagulant experiment

What is a coagulant?



Contents of jar	Prediction When coagulant is added…	Observation When coagulant is added…

Explain your observations:

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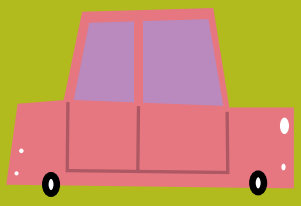


SECTION FIVE:

How much water are we using?

Students measure how much water is used at school on a daily basis and explore how it is used.

Section 5: How much water are we using?

The purpose of this section is to help students to:

- Understand how much water they use every day
- Measure water use in their school
- Use graphs and data to obtain information about water use

Overarching concepts for Section Five:

- Water is used in many different ways at school and at home
- We can all use less water by using it more efficiently

Section 5: How much water are we using?

Learning experiences – Section Five

Learning experiences	Learning intentions Students will . . .	Curriculum links (Achievement objectives)	Content
1. Household water use in New Zealand	• Compare water use in New Zealand with water use in other countries • Examine patterns or trends about household water use	**Mathematics: Level 3 and 4** ***Statistics:*** *Statistical investigation* – Identifying patterns and trends in context, within and between data sets; – Communicating findings, using data displays	Students compare household water use in New Zealand to use in other countries
2. Using water at school	• Investigate the water outlets/uses in their school environment • Represent water outlets with symbols on a map	**Science: Level 3 and 4** ***Nature of Science:*** *Investigating in Science* Ask questions, find evidence, explore simple models and carry out appropriate investigations to develop simple explanations **Mathematics: Level 3** ***Geometry and Measurement:*** *Shape* Represent objects with drawings and models	Students record where the water outlets are located in their school
3. Measuring water use: Water meter	• Investigate how much water is used at school using the water meter on their school's water supply pipe	**Mathematics: Level 3 and 4** **Statistics:** *Statistical investigation* – Conduct investigations using the statistical enquiry cycle: gathering, sorting, and displaying multivariate category and whole number data and simple time-series data to answer questions – Identifying patterns and trends in context, within and between data sets	Students learn how to read a water meter and examine the results of the readings to find an average amount of water used per school day
4. Measuring water use: Water survey	• Investigate how much water they use at school in a day	**Mathematics: Level 3 and 4** ***Statistics:*** *Statistical investigation* – Conduct investigations using the statistical enquiry cycle: gathering, sorting, and displaying multivariate category and whole number data and simple time-series data to answer questions	Students record their daily water use on tally chart. Results are then combined to find how water is used during a school day
5. Our water future	• Reflect on how much water is used at school • Recognise that their water use will have an effect on the future environment and community	**Science: Level 3 and 4** ***Nature of Science:*** *Participating and contributing* Use their growing science knowledge when considering issues of concern to them Explore various aspects of an issue and make decisions about possible actions	Students reflect on how much water is used at school each day. They examine how their water use could influence future water issues

5:1 Household water use in New Zealand – teacher notes

Curriculum links

Mathematics: Level 3 and 4
Statistics: *Statistical investigation:*
Conduct investigations using the statistical enquiry cycle; gathering, sorting and displaying multivariate category and whole number data and simple time-series data to answer questions: identifying patterns and trends in context, within and between data sets

Other curriculum links: Level 3 and 4
Social Sciences, Science: *Nature of Science:*
Investigating in Science

Education for sustainability concepts

Equity: respect for all life, social justice, intergenerational equity, finite resources.

Responsibility for Action/ Kaitiakitanga: If we want to use taonga, we must look after the taonga.

Background knowledge

Most people in New Zealand rely on a town supply for their water. It takes time, effort, money and resources to deliver water to households.

Water withdrawal

Almost 110,000 km³ of rain falls over planet earth each year. This is equal to about 1800 times the volume of Lake Taupo. About 2/3 of this amount evaporates or is transpired through plants and other organisms. The remaining 1/3 of water provides surface water and groundwater[13]. Some of this surface water is withdrawn for human use (water withdrawal). We use this water for our industries, agriculture and for domestic use.

New Zealand's household water use

New Zealand's domestic (household) water use is high in proportion to our industrial and agricultural use when compared to other countries. Our household water use makes up approximately 22% of our country's total water use, compared to an average of 10% worldwide. However, in our cities, domestic water use is a much higher percentage. In the Wellington region, domestic water use is approximately 60% of the four cities total water use.

Do New Zealanders use a lot of water?

Yes, we use a relatively large amount of water when compared to people in most other countries. The volume of water that the four cities in the Wellington region currently use in a week would fill the Westpac stadium. The United Nations says that people need a minimum of 50 litres per person per day to survive – however some countries use far less than this[14].

People who live in Porirua, Lower Hutt, Upper Hutt and Wellington are estimated to currently use about 240 litres per person per day (L/p/d) in their homes alone[15]. Having enough water for everyone in New Zealand in the future will rely on more water efficient appliances and water conservation and fair distribution between households, industry, agriculture and the environment.

13 http://www.fao.org/nr/water/aquastat/water_use/index.stm
14 http://www.newint.org/issue354/facts.htm
15 Greater Wellington Regional Council Water Supply Annual Report for the year ended 30 June 2010. pg 5

Gross vs net water use per person

Figures about our water use can vary according to the source. Our *net* water use (water used at home) is estimated to be about 240 L/p/d but *gross* water use is about 380 L/p/d [16]. Gross water use includes domestic, commercial and industrial water use, fire fighting, pipe maintenance and leakage from pipes. Net figures are based on water use *in homes only.*

Our net water use can only be estimated as homes in the Wellington region are not metered.

Summer vs winter water use

Our water use increases over summer, with watering gardens, filling swimming pools and greater demand for water to drink and wash with. Unfortunately, water is less plentiful in summer as there is less rainfall. In winter there is more rain but demand is lower. Water providers must plan for seasonal variations in water availability and use.

Answers to BLM 5b

1. United Kingdom.
2. High, reasons will vary but could include; we are not very careful with using water in our homes, we use a lot of water in the garden and bathroom compared to other countries.
3. 234L in winter.
   251L in summer.
4. In the bathroom – probably for showers and baths.
5. 'Unaccounted for' means other uses which don't fit into another category. This includes leaks in water pipes.
6. People need to water their gardens, fill pools and wash more often in summer.
7. Answers will vary, e.g. Take shorter showers, less baths, flush toilet only when necessary etc…

16 Greater Wellington Regional Council Water Supply Annual Report for the year ended 30 June 2010. pg 4

5:1 Household water use in New Zealand – learning experience

Learning intentions

Students will:

Compare water use in New Zealand with water use in other countries

Examine patterns or trends about household water use

Success criteria

Students can:

Answer questions about household water use in New Zealand from information in graphs

Describe patterns of water use in our homes

Resources

BLM 5a Water use in New Zealand

BLM 5b Water use in NZ worksheet

Learning experience

- Share the learning intentions and success criteria
- Explain that we will examine how an average New Zealander uses water at home and what proportion of New Zealand's total water is used in homes
- Revisit the concept of one litre of water. Show students examples of different quantities of water (e.g. a standard bucket = around 10 litres)
- Ask how much water (in litres) students think we use every day in our homes? Share ideas. *Clarify what is meant by litres per person per day. Revise the statistics in section one, learning experience 3*
- Hand out BLM 5a and 5b. Ask students to examine Graph 1 on BLM 5a. Compare proportions of water used for farming/agriculture between countries. Discuss reasons for differences *(e.g. some countries are developing or industrialised)*. Explain the meaning of terms used in the graphs
- Ask students what percentage of New Zealand's water use is used for households in NZ? *(approximately 22%)*
- Ask students to answer the questions on BLM 5b
- Discuss answers and reflect on findings

As an extension, create other graphs of this data or investigate other data about water use e.g. http://www.gw.govt.nz/water-use-3/

Reflection questions

- How do you think your own water use changes between summer and winter? *Answers will vary*
- Is water available in summer in as large amounts as it is in winter? *No, less rainfall means there is less water available in summer*

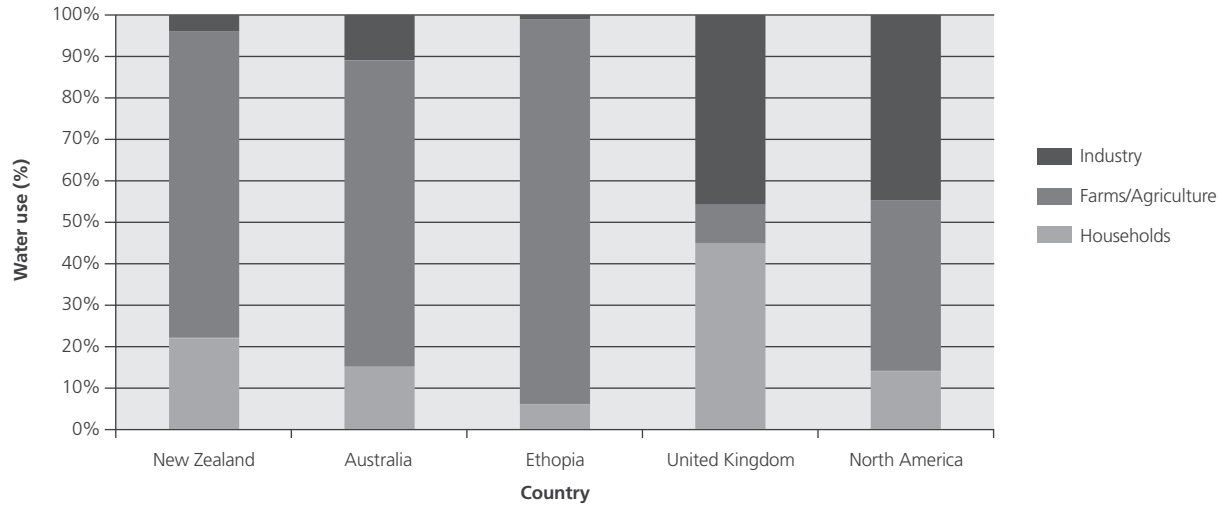
Vocabulary

- households
- proportion
- agriculture
- industry/industrial

BLM 5a: Water use in New Zealand

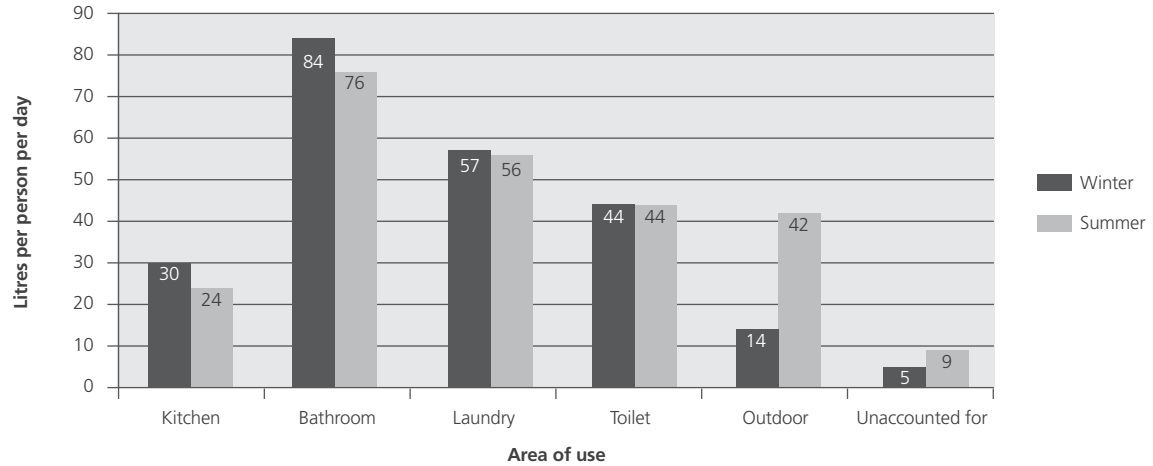
Graph 1:
World water use in households, farms and industry

(data sourced from http://www.fao.org/nr/water/aquastat/main/index.stm)



Graph 2:
Estimated household water use in Wellington

(data adapted from BRANZ EC1356)



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BLM 5b: Water use in New Zealand worksheet

Answer the following questions using BLM 5a:

1. Which country has the highest proportion of household water use?

2. Is New Zealand's household water use high or low compared with other countries? Why do you think this is?

3. How much water do Wellington residents use at home on an average day?

In winter:

In summer:

4. What is most of the water in Wellington homes used for?

5. What do you think 'unaccounted for' means? Why do we need this option?

6. Why is 'outdoor' water use so much greater in summer?

7. When you look at graph two, what obvious ideas come to mind about reducing your water use?

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5:2 Using water at school – teacher notes

Background knowledge

Water is used by all schools and households in New Zealand. We all play a part in using the large amount of water that our country uses.

Map of the school

Prior to the activity, photocopy a school map for each group. To allow enough room to record all water outlets ***enlarge the map to an A3 size.***

Water outlets in schools

Water outlets are objects or appliances which we obtain water from. Sometimes these are known as fixtures. Examples of water outlets include; taps, drinking fountains, water tanks, toilets, urinals and watering equipment. Students will become more aware of the uses of water in their school through this activity.

Water collection

In some schools there will also be areas of water collection e.g. rainwater tanks or greywater recycling. Include these on your map as well and explain how they work. You could use a different colour to indicate that these objects save or re-use water instead of using it up.

Timing and organisation

This activity involves students investigating water outlets around the school. Make sure that your survey is conducted at a quiet time of the day when other classes are not using water outlets. If possible involve the caretaker, other school staff or parents in the investigations.

Disruption of other classes

Try to be considerate of other classes. To avoid students interrupting teachers, you could give students information about taps located inside or near classrooms. Discuss how students could get the information they need with the minimum disturbance to other classrooms.

Groups for surveying

Ensure that there are both female and male members of each group so that they can accurately survey all toilets and bathrooms.

Curriculum links

Science: Level 3 and 4
Nature of Science:
Investigating in science:
Ask questions, find evidence, explore simple models, and carry out appropriate investigations to develop simple explanations

Mathematics: Level 3
Geometry and Measurement: *Shape:*
Represent objects with drawings and models

Other curriculum links:
Level 4 **Mathematics,**
Geometry and measurement
Position and orientation

Education for sustainability concepts

Sustainability/Hauora:
The choices we make today affect choices we will be able to make in the future

Responsibility for Action/Kaitiakitanga:
If we want to use taonga, we must look after the taonga

5:2 Using water at school – learning experience

Learning intentions

Students will:
Investigate the water outlets/uses in their school environment

Represent water outlets with symbols on a map

Success criteria

Students can:
Identify water outlets in their school environment

Label water outlets on a school map using symbols

Resources

Map of the school (A3)

Pens/pencils

Books/clipboard

Learning experience

- Share the learning intentions and success criteria
- Revisit the graph of household water use around the world. Explain that you will be investigating where water is used in their school every day
- Provide students with a map of the school. Discuss the water outlets/uses at the school. These may be taps, water tanks, drinking fountains, toilets etc…
- Explain that students are to draw symbols on the map for each type of water outlet/use. Discuss and decide on appropriate symbols for each outlet, making sure that each symbol is distinctive and easy to draw
- Divide students into several groups. Assign each group of students to an area of the school to investigate. *You may need to organise adult supervision at certain locations e.g. bathrooms adjacent to classrooms. Remind students to be quiet and considerate of other classes*
- When students have labelled the water outlets in the area of the school they investigated, they can come together to share results. Each student or pair should end up with a map detailing all water outlets in the school
- After labelling maps, construct a table describing the outlets found. For example:

Type of water outlet	People who use it	Total number	What this water is used for
Classroom taps	Students and staff		Washing hands, washing art equipment, filling up containers etc…
Toilets			
Drinking fountains			
Etc…			

- What other water uses/outlets are at home which are not used at school? *For example: washing machines, baths etc…*

As an extension, students could find places in the school where there are leaks or where water is not being used efficiently.

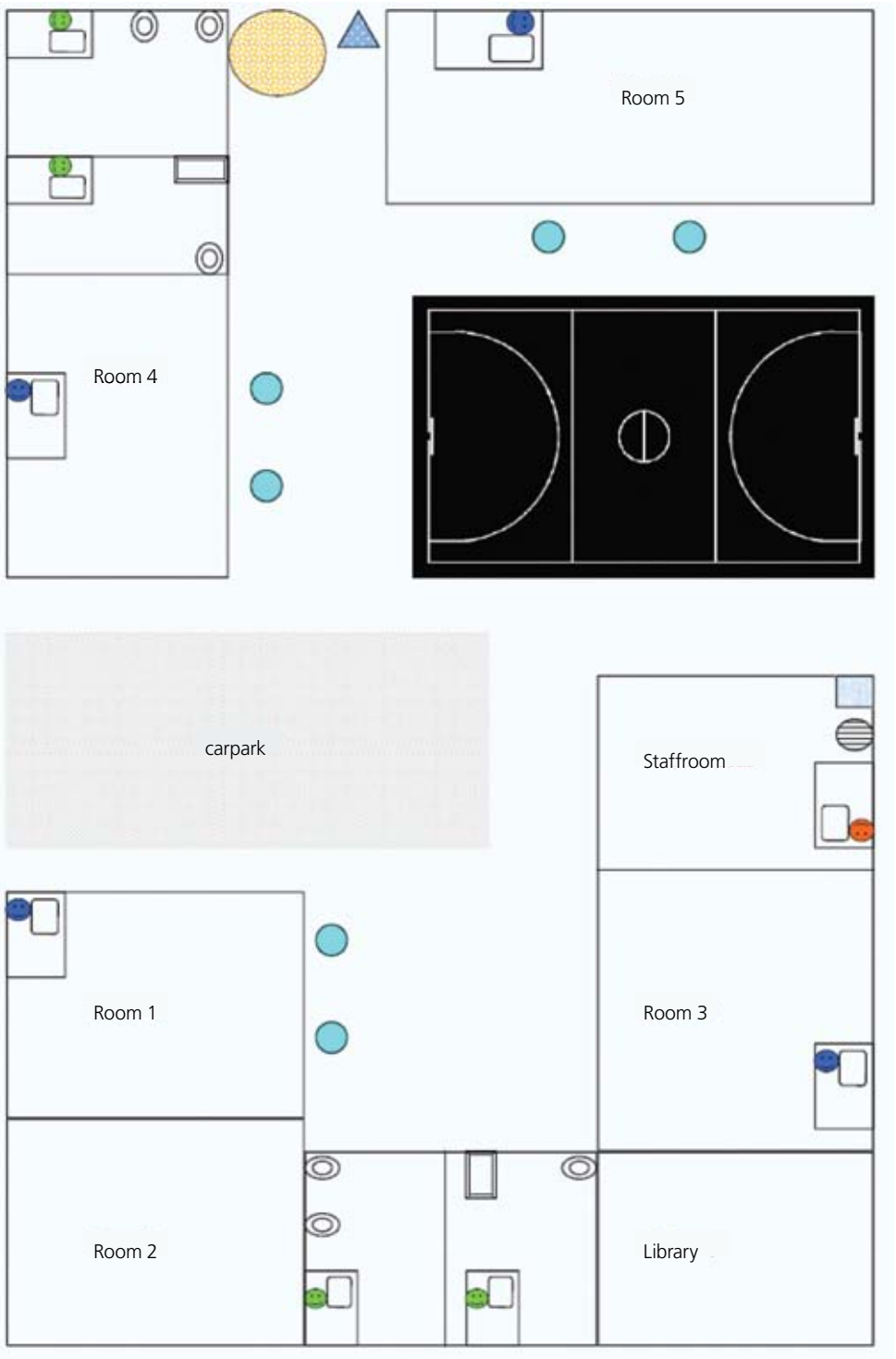
Reflection questions

- What are your thoughts about how we use water at school? *Answers will vary*
- Could any of these water outlets/activities re-use greywater instead of using drinking-quality water? *Yes – toilets, hoses, urinals etc…*

Vocabulary

- outlet
- symbol

Example of labelled school map:



Key

- Classroom taps
- Bathroom taps
- Urinals
- Toilets
- Drinking fountains
- Staffroom taps
- Water cooler
- Hot water zip
- Rainwater tank
- Hose

5:3 Measuring water use: Water meter – teacher notes

Curriculum links

Mathematics: Level 3 and 4
Statistics:
Statistical investigation:
- Conduct investigations using the statistical enquiry cycle: gathering, sorting, and displaying multivariate category and whole number data and simple time-series data to answer questions

- Identifying patterns and trends in context, within and between data sets

Other curriculum links at Level 3 and 4:
Mathematics – *Geometry and measurement:* measurement.
Social Sciences, Science – *Nature of Science:* Investigating in Science

Education for sustainability concepts

Responsibility for action: If we want to use taonga, we must look after that taonga

Sustainability/Hauora: The choices we make today affect choices we will be able to make in the future

Background knowledge

School water use

A school's water use will differ depending on which water fixtures you have and your school roll. For example, a school with a swimming pool uses far more water than one without a pool and the more students at your school, the more water you will use.

The water meter

A water meter is a device which measures the volume of total water used by a property. It measures water directly and accurately.

What is a cubic metre?

A cubic metre is a volume of water 1 metre x 1 metre x 1 metre. This volume is equal to 1000 litres (L). Large volumes of water are measured in cubic metres (m^3). Water meters measure water in cubic metres (black digits) and litres (red digits).

What does a water meter look like?

Your school water meter will be in the ground, shielded by a metal or plastic cover which is able to be lifted off in order to read it. Meters are usually located somewhere near the front boundary of the school.

Your caretaker will be aware of the location of the water meter. You may need assistance to lift off the lid. There may be a cover on the meter numbers or debris which needs to be cleared off to see the reading.

The meter may look similar to the example below.

When should we read the meter?

You will need to read the meter at the same time every day to record your results. This will ensure consistency.

We suggest that you read the meter first thing in the morning and last thing before students go home.

The water bill

Look at previous school water bills to obtain more data about your water use. A water bill displays the actual amount of the water used at your school during a certain time period. Readings to calculate the amount owing are taken from your school water meter, therefore past water bills will give you reliable information about the history of water use in your school.

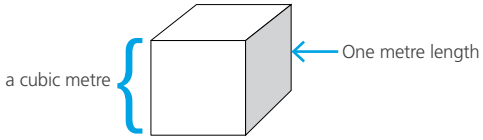
Water meter

5:3 Measuring water use: Water meter – learning experience

Learning experience

This activity should be completed in short intervals over several days.

- Share the learning intention and success criteria
- Explain that you are going to read the school water meter to find out exactly how much water is used per day at the school
- Introduce the idea of a cubic metre of water. To show what a cubic metre looks like, use a metre ruler, newspaper and tape to construct lengths of rolled newspaper one metre long. Tape them together into a square or use more to make a cube. Explain that a cubic metre is 1m x 1 m x 1m *(see teacher notes).* One cubic metre is equal to 1000L



- Discuss when the water meter should be read to determine total water use in a school day. Agree on a procedure for obtaining the meter readings
- Visit the water meter and complete BLM 5c. Explain the units of measurement of water and relate these to everyday examples
- Continue reading the meter over the next several days to get an average daily use. Compare this to the students' prior estimates
- After reading the meter over several days take all of the results to find an average amount of water used per day
- *As an extension, examine several school water bills and compare to your other results. Graphs of the results may allow more comparison.*

Reflection questions

- What surprised you about the meter reading results?
- Was there a difference between the afternoon reading on day one and the morning reading on day two? If so, give reasons for the difference. *The difference will be the amount of water used after students leave school and at night. This will include water used in school cleaning and any leaks in school water pipes or taps*

Vocabulary

- meter
- measurement
- reading
- estimate

Learning intentions

Students will:
Investigate how much water is used at school using a water meter

Success criteria

Students can:
Gather water use data from the school water meter

Find the average amount of water used per day at school

Resources

Metre rulers

Newspaper

Tape

BLM 5c Reading the school water meter

Clipboard

Pen/ pencil

BLM 5c: Reading the school water meter

How to read the meter

3	7	4	6	2	8	5

- The black-on-white digits show the number of **cubic metres** of water used since the meter was installed, in this case 3746 cubic metres
- The three white-on-red digits show litres, in this case 285 litres (therefore the total reading is equal to 3,746,285 litres)
- A fourth white-on-red digit to the far right would show tenths of litres (that is, amounts of 100 millilitres)

Use the empty grids below to record your school's meter readings first thing in the morning and then again in the afternoon just before you leave school.

Meter readings

Day 1:

Morning reading

Afternoon reading

Total water used by our school on day 1: (Afternoon reading – morning reading) = _____

Day 2:

Morning reading

Afternoon reading

Total water used by our school on day 2: (Afternoon reading – morning reading) = _____

Average water use per day = _____

(Average water use per day = (total water use day 1 + total water use day 2) ÷ 2)

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5:4 Measuring water use: Water survey – teacher notes

Background knowledge

Measuring water use

Water is measured in cubic metres (m^3), litres (L), or millilitres (mL). 1000mL equals one litre and 1000L = one cubic metre. Water is used extensively every day in schools, by both staff and students. It is important to include staff use in your survey as well as students use.

Accuracy of results

The table included is based on average water use for each outlet. Amounts have also been rounded for ease of calculation for the activity. Appliances can vary hugely depending on age and technology, for example, a dishwasher can use between 10 and 40 litres of water per cycle.

If you wish to measure water use more accurately, you can investigate your water outlets and appliances to get more exact figures for how much water they use. This could be done by measuring the actual amounts of water used or looking in associated manuals or records.

Urinals and toilets

Toilets and urinals will make up a large proportion of the students' water use at school. Water use of toilets and urinals also varies, depending on age and condition.

Automatic flushing of urinals can waste a large amount of water; they are programmed to flush after a certain amount of time. Urinals use between 3.8L (new) and 19L (20+ years old) per flush. Urinals which flush after each use are more water efficient than those which flush automatically. Half flush toilets use about 3L if they are new. Older toilets can use 11-13L for a full flush.

Leaks or wastage?

Dripping taps or leaking appliances waste a lot of water but are often fairly quick, cheap and easy to fix. You may want to teach students how to change a washer in a tap or discuss how you would manage finding a leak as part of the activity.

Swimming pools

Pools can use a very different amount from one day to the next. To find a rough estimate of water used by a pool per day, multiply the capacity (width x length x depth) by the number of times you fill the pool each year and then divide by 365 (days).

Curriculum links

Mathematics: Level 3 and 4
Statistics:
Statistical investigation: Conduct investigations using the statistical enquiry cycle: gathering, sorting, and displaying multivariate category and whole number data and simple time-series data to answer questions

Other curriculum links at Level 3 and 4:
Mathematics – *Geometry and measurement:* measurement, **Social Sciences, Science –** *Nature of Science:* Investigating in Science

Education for sustainability concepts

Responsibility for Action/Kaitiakitanga: If we want to use taonga, we must look after the taonga

Sustainability/Hauora: The choices we make today affect choices we will be able to make in the future

5:4 Measuring water use: Water survey – learning experience

Learning intentions

Students will:
Investigate how much water they use at school in an average day

Success criteria

Students can:
Gather data about their water use for the day

Identify how they contribute to water use during a school day

Resources

Tally chart

BLM 5d School daily water use

Learning experience

If possible, the day before this activity, get students to use a tally chart similar to the one below to record how many times they use each water outlet in a day. Each time they use a water outlet they should record it on the chart.

- Share the learning intention and success criteria
- Explain that the tally chart records how many times they use each water outlet each day. They will use it to work out how much water they use each day at school
- Revisit the maps of the school the students created with water outlets on them. Examine all of the water outlets on the map. Ask students to estimate how much water they think would be used at the school each day considering all of these outlets
- After the students have completed the tally charts for one day, combine results together to get the average number of times each water outlet is used. Use these averages to complete BLM 5d
- Adjust the use of BLM 5d according to your students' abilities. Those who are struggling may only complete the student use section
- Using BLM 5d, find how much water is used at your school each day
- *As an extension, survey water wastage in your school by measuring how efficient your appliances are and if there are any leaks. See http://www.thameswater.co.uk/wiseuptowater/pdfs/water-use-survey.pdf for ideas.*
- For homework, ask students to complete a home survey

My tally chart of daily water use

	Tally of number of times used	Total times used
Drinking		
Drinking fountains		
Drink bottles		
Toilet		
Half flush		
Full flush		
Urinals		
Hygiene		
Washing hands		
Taps in classroom		
Other		

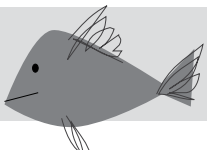
Reflection questions

- What surprised you about your survey results? *Answers will vary*
- How do you personally contribute to using water at school?

Vocabulary

- survey
- efficient
- average

BLM 5d: School daily water use



Water use	Water used (L) (averages only)		No. of times used a day (average)		Total water used (per person)
Student use					
Drinking					
Drinking fountains	0.5L (500ml)	x		=	
Drink bottles	0.5L (500ml)				
Toilet					
Half flush	3L	x		=	
Full flush	6L				
Urinals	10L per flush				
Hygiene and cleaning					
Washing hands	1L	x		=	
Taps in classroom	10L per minute				
				Total water use per student	
				x number of students =	
				Total water use: students	
Staff use					
Staffroom					
Staffroom taps	10L per minute	x		=	
Drinking water	2L per person				
Hot water: kettle	2L per jug				
Dishes: in sink	6L				
Dishwasher	30L				
Staff toilets	6L				
				Total water use: staff	
Other					
		x		=	
				Total water used at school per day (total water use: students + total water use: staff + other)	

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5:5 Our water future – teacher notes

Curriculum links

Science: Level 3 and 4
Nature of Science:
Participating and contributing: Use their growing science knowledge when considering issues of concern to them

Explore various aspects of an issue and make decisions about possible actions

Education for sustainability concepts

Equity: respect for all life, social justice, intergenerational equity, finite resources

Sustainability/Hauora: The choices we make today affect choices we will be able to make in the future

Responsibility for Action/Kaitiakitanga: If we want to use taonga, we must look after the taonga. Taking action, informed decision-making, citizenship, consumerism, enterprise, resilience and regeneration

Background knowledge

The future of Wellington's water supply

Wellington's current water supply is sometimes stretched, especially in summer, when demand for water increases and there is less rainfall. A major, new water source will probably be needed in the next few years unless water use per person can be reduced as the population grows.

This activity encourages critical thinking to examine how students' actions and behaviours can influence the future environment.

Will conserving water really make a difference?

Yes. If we reduce our water use by 15% then a new water source may not be necessary until about 2040.

Conserving water will also reduce our energy and resource use and decrease our waste. Every litre of tap water produced and distributed uses resources and energy.

What is wrong with creating new water sources?

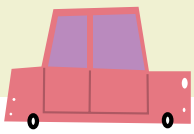
When we interrupt natural water sources to create a new dam, lake or weir, the natural pathways of water are changed forever. Animal habitat is lost and water movement within that catchment is irreversibly altered. This may have serious consequences for land and water around the affected area. The effects vary depending on the type of structure being built and how it is built. The clean water we need for drinking water is often found in the most pristine environments. One potential site for a new dam is the Whakatikei River in the Akatarawa Forest.

Won't we always need more water as the population grows?

We will eventually need more water as the population grows and demand increases. But, water conservation and informed action can make a large difference to when new sources will be needed. If we can delay a new water source the local environment will benefit.

In recent years, Sydney residents have reduced their water use despite population growth and the city is now using the same amount of water as it did in the early 1970s. http://www.sydneywater.com.au/annualreport/performance/water_efficiency.html

5:5 Our water future – learning experience



Learning experience

- Share the learning intentions and success criteria
- Reflect on learning so far during this unit. Resources from section one could be used as a prompt for discussion
- Revisit the results from learning experiences 5.3 and 5.4 and discuss findings. Recap how water is used by students during a school day and how much is used
- Work out the average amount of water used per person per day from meter readings and audit results. Record this amount used on *BLM 5e*. Is the amount per person per day more or less than what the students expected? What is most of this water used for?
- Ask students if they think that reducing water use at school could have an effect on the environment. *Explain that how we use water now and in the near future will affect our future water sources and supplies in the long term. Explain that everyone in the community plays a part in protecting our water resources (see teacher notes and part 2 BLM 5e)*
- How could the total water use of the school be reduced? What are they doing already to conserve water? *Record ideas on BLM 5e*
- Discuss the different futures described in BLM 5e and the possible consequences of our actions. Ask students to add their ideas about reducing school water use to the column on the right of the table
- Share ideas and answers. Discuss the current situation at school and whether students would like anything to change to improve the situation. Are there any underlying issues?
- *As an extension, visualise a desirable water future for your community. This could take the form of an illustration, story, or map.*

Learning intentions

Students will:
Reflect on how much water is used at school

Recognise that their water use will have an effect on the future environment and water supply

Success criteria

Students can:
Describe how much water is used per person per day at school

Explain how water use at school has an effect on the future water supply

Resources

BLM 5e Water use: now and in the future

Reflection questions

- How will we change our behaviour?
  Answers will vary
- Which future from BLM 5e would you want to happen?
  Water future 3 is most desirable

Vocabulary

- conservation
- long-term
- community

Answers for BLM 5e

Part One: *Answers will vary*

Part Two: *example response:*

Water future 3 Water use decreases

Water conservation by everyone.

Less water used and wasted. More water re-use, rainwater collection and water efficient equipment used. Less water is needed.

Another water source WOULD NOT be needed in the near future.

Harsher water restrictions WOULD NOT be necessary.

BLM 5e: Water use: now and in the future

Part 1: Water Use: What is happening now?

How many litres per person per day do we use at school? *(See BLM 5c, 5d)*	Can we reduce our water use? **Y/N**
litres per person per day	*If yes, how could we reduce the amount of drinking-quality water that we use?*
What are we already doing to save water?	

Part 2: Water Use: What will happen in the future?

Complete the chart for water future three

	Water future 1 *Water use increases*	Water future 2 *No change to water use*	Water future 3 *Water use decreases*
Water conservation	No water conservation	Some water saving	
Using water at school	Water use increases. More water is wasted. No water re-use or rainwater collection.	Water use stays the same. Some water re-use or rainwater collection	
If every school and home did the same…			
Water sources/collection to supply water	Another dam/lake/other source WOULD BE needed soon	Another dam/lake/other source WOULD BE needed in the near future	
Water restrictions	Harsher water restrictions WOULD BE necessary	Harsher water restrictions MAY BE necessary	

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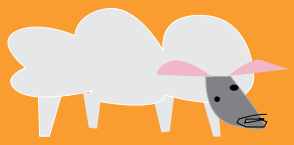
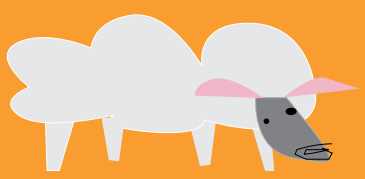
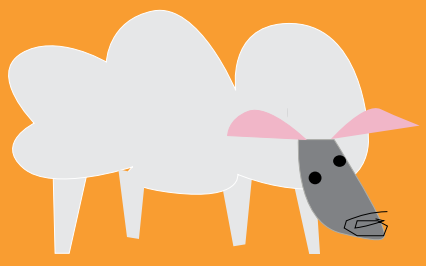
SECTION SIX:

Making change

This section provides students with an opportunity to use their new knowledge and understanding to make informed decisions about how they use water. Students identify the priorities for change and organise action for the environment to reduce their use of tap water.







Section 6: Making change

The purpose of this section is to help students to:

- Understand how they can conserve treated water
- Recognise how their actions contribute to a sustainable future

Overarching concepts for Section Six:

- Everyone can use water more efficiently and help protect our natural environment
- We need to make informed choices about how we use our tap water

Section 6: Making change

Learning experiences – Section Six

	Learning experiences	Learning intentions Students will . . .	Curriculum links (Achievement objectives)	Content
Before taking action	1. Which water action?	• Target an issue about water use in their school • Decide on an environmental action to reduce their water use and address the issue	**Science: Level 3 and 4** ***Nature of Science:*** *Participating and contributing* Use their growing science knowledge when considering issues of concern to them Explore various aspects of an issue and make decisions about possible actions	Students examine possible actions to reduce their water use. They make an informed decision about how they could use water more efficiently and decide on an appropriate action
	2. Planning for action	• Organise, plan and implement an action project to reduce their water use	**Health: Level 3** ***Healthy communities and Environments:*** *People and the environment* Plan and implement a programme to enhance an identified social or physical aspect of their classroom or school environment	The action is planned. The students and teacher plan when, where and how the action will take place. Responsibilities are assigned and action is organised
Taking action	Take action for the environment		**Health: Level 3** ***Healthy communities and Environments:*** *People and the environment* Plan and implement a programme to enhance an identified social or physical aspect of their classroom or school environment	
After taking action	3. How did it go?	• Reflect on their action project and evaluate how it went	**Technology: Level 3 and 4** ***Technological Practice:*** *Brief Development* Justify the nature of an intended outcome, explaining how it addresses the need or opportunity. Describe the key attributes that enable development and evaluation	Students critically reflect on their action and describe how they will maintain their project. Students can reassess water use and monitor change, which may lead to further action

6:1 Which water action? – teacher notes

Curriculum links

Science: Level 3 and 4
Nature of Science:
Participating and contributing:
Use their growing science knowledge when considering issues of concern to them

Explore various aspects of an issue and make decisions about possible actions

Other curriculum links at Level 3 and 4: **Technology;**
Technological practice: Brief development, Planning for practice

Education for sustainability concepts

Interdependence/ Whanaungatanga:
Everything and everyone in our world is connected

Sustainability/Hauora: The choices we make today affect choices we will be able to make in the future

Background knowledge

What is taking action for the environment?

Taking action is making an informed decision to carry out a task that will contribute to a sustainable future. The information students have learned throughout this unit should allow them to make informed decisions about which water action is appropriate for them and will contribute to a sustainable water future. Examples of water actions are listed on BLM 6a.

Planning for action

When planning to take action you will need to consider what students will learn as a result of the action, how they can be involved and how manageable and achievable it is. Action should be a result of the learning and investigation during the water unit. An action should ideally target either an issue which came up during your investigations or a long standing water issue in your school. Following the processes in this section will help to successfully plan for action.

Why can't the teacher choose the action?

The aim of environmental action is that the students are motivated to take action for their own reasons. Their environmental action will mirror their experiences and will be right for them. Innovative thinking should be encouraged. Well managed, student centred actions can have a lasting, profound influence on students' lives.

What is action competence?

Action competence is the ability of students to take action on issues that concern them. It is learning about environmental issues so that students can plan and take action on those issues. http://efs.tki.org.nz/EfS-in-the-curriculum/Taking-action/Action-competence

Why is taking action important?

Taking action is an essential part of environmental education. The action component is crucial, and will often lead towards the resolution of an issue or problem. You may choose to carry your action over to the next term or to enlist help from the community or another class in order to make it happen.

What are guiding questions?

Guiding questions keep your action relevant to your learning and goals. They define the requirements for action and ensure that your action is going to target the issues you have investigated during your unit.

6:1 Which water action? – learning experience

Learning experience

(This activity may take several sessions to complete)

- Share the learning intentions and success criteria
- Revisit the desired water future from Section Five, Learning Experience Five. Discuss how school water use could affect the future environment
- Encourage students to set a water saving goal as a starting point. Have water bills and audit information available. Agree on a realistic, obtainable goal which addresses a water issue. Your goal may be to achieve a 10% reduction in water use in a year or it may be to increase the amount of water recycling or rainwater harvesting in your school
- Discuss any issues about school water use (from your audit or other investigations) and the underlying problems behind these. Which issue is the most concerning? What is the cause of this issue?
- Ask students to brainstorm ideas about water actions which would help achieve the goal for their school and solve the issue
- Show any relevant presentations and information listed on BLM 6a to students. After viewing examples, discuss possible actions to address your school issue
- Decide on your top three potential actions. Record them on BLM 6b. Use your goal to establish some other guiding questions *(see teacher notes)*. Complete the decision making grid together as a class (the decision making grid will help make choosing an action more straightforward)
- When you have decided on an action, complete BLM 6c either in groups or as a class. The questions on BLM 6c will encourage students to make sure that the action chosen is appropriate for the issue involved and the goal they have established. The action should be guided by the teacher so that it is manageable and achievable

Reflection questions

- How will this action help you reach your goal?
  Answers will vary
- Can you achieve this action with the time and resources you have available?
- How does this action contribute to a sustainable future?

Vocabulary

- goal
- issue
- significantly

Learning intentions

Students will:
Target an issue about water use in their school

Decide on an environmental action to reduce their water use and address the issue

Success criteria

Students can:
Identify an issue about water use in the school to target

Identify an environmental action that will reduce their water use and address the issue

Resources

BLM 6a Examples of water actions

BLM 6b Decision making grid (enlarge to A3)

BLM 6c Our chosen action

BLM 6a: Examples of water actions

		Issue	Potential solution	Description of solution	Examples
			LC = low cost **MC** = medium cost **HC** = high cost		*Unless other website stated these can be found at* http://kdc.nsw.edu.au/showcase.html#built
Water conservation	Changes to water use	A lack of awareness about the need to conserve water at school and in the community	Education campaign at school about water conservation **LC**	An awareness campaign motivating students and the community to use drinking water wisely; assembly presentations/ posters/concerts/ newsletter items etc…	2008 KDC Sydney water challenge
			Make a movie to tell people how they can conserve water **LC**	Students could design and make a movie about water conservation at their school	Erskineville_Wollemi_Year3.pdf
		Students consistently forget to conserve water at certain locations at the school	Mural about water conservation **LC**	Students design a mural about water conservation for areas where water is being wasted	Erskineville Year 3 Boronia
			Signs to remind students to conserve water **MC**	Students design and produce signs to remind students to conserve water at key locations	Narellan Vale 4H
		Water is not being used wisely in homes	Produce a brochure/ movie/show/song about water conservation at home **LC**	Research and design a targeted brochure to show examples of water conservation devices and actions for homes	http://www.sustainability.govt.nz/goal/reduce-water-usage http://www.sawater.com.au/sawater/captainplop/cp_flash_spread/index.html
	Emergency water	No water stored at home or at school in case of an emergency	Set up emergency supplies of water for school/home **LC**	Research and plan an emergency supply of water for school/home. Encourage others to do the same by sharing your experiences	http://www.wellington.govt.nz/services/watersupply/emergency/emergency.html

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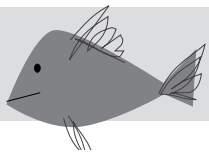

		Issue	Potential solution	Description of solution	Examples
Water wastage	Inefficient water use	Hoses or inefficient sprinklers are used to water the garden and use a large proportion of our water	Replace old watering system with a more water effcient watering system **HC**	Investigate the alternatives for your garden irrigation and obtain funding to replace it	http://www.gw.govt.nz/assets/Be-the-Difference/Water-conservation/WGNDOCS-767001-v1-HowtoChoosetherightirrigationequipmentforyourgardenleaflet-Webversion.pdf
		Drinking-quality water is being used to water the garden/flush toilets	Install a rainwater tank or greywater recycling system **HC**	Design a system to collect rainwater in a water tank to flush toilets or use greywater recycling to flush toilets/ water the garden	http://www.theoutlookforsomeday.net/films/2010/054/ Malabar 3N http://www.watersmart.co.nz/garden-irrigation-wellington
		Taps are inefficient and waste water	Investigate and install water saving devices for taps **MC**	Install tap aerators/flow restrictors for taps to reduce flow	Narellan Vale 3-4 S
		Toilets are inefficient (no dual flush)	Install dual flush, water efficient toilets **HC**	Students investigate alternatives to their current toilets and urinals	
			Install water saving device in toilet **LC**	Place 2L plastic bottle in each cistern to save water with each flush if dual flush too expensive	http://www.youtube.com/watch?v=hWbVuVcATqk&feature=related
		Urinals are wasting water – old inefficient system	Install automated or waterless urinals **HC**	Students investigate alternatives to their urinals	http://www.waterless.co.nz/testimonials.htm
		Water from drinking fountains is wasted	Install more water efficient drinking fountains/modify drinking fountains **HC - LC**	Students research and make changes to their water fountains to make them more water efficient	Heathcote PS
			Recycle water from fountain which would otherwise be wasted **MC**	Students design a system for recycling wastewater from drinking fountains onto gardens	Bradbury PS
	Leaks	Leaks from taps or pipes	Investigate and describe steps to fix a leak **LC**	Research how to fix any leaks from taps or pipes in your school and then design a method to fix them	http://www.pcc.govt.nz/A-Z-Services/Water-Use-and-Wastage

Don't be limited by these ideas – be creative with your action

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BLM 6b: Decision making grid

Possible action			
Guiding questions			
Would this action reduce our water use significantly?			
Do we have the resources we need or can we get them easily?			
Will we learn about something new as a result of this action?			
Will the action involve our community?			
Total score (Scoring out of 3: 3 = definitely 2 = maybe 1 = probably not)			

Example of a decision making grid

Possible action	Rainwater tank	Install aerated taps in our classrooms	Produce a movie about water conservation
Guiding questions			
Would this action reduce our water use significantly?	3	3	2
Can we achieve this action within the time we have?	1	3	1
Do we have the resources we need or can we get them easily?	1	1	1
Would we be excited about doing this action?	2	1	3
Will we learn about something new as a result of this action?	3	2	2
Will the action involve our community?	3	1	3
Will this action contribute to our school goal?	3	3	3
Total score	**16**	**14**	**15**

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BLM 6c: Our chosen action

Our school's water goal is...

How will this action help us reach our goal?

Our water action will be:

How much water will we save?

This action will help save water by:

We chose this action because...

What issue does this action help to solve?

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6:2 Planning for action – teacher notes

Curriculum links

Health: Level 3
Healthy communities and Environments:
People and the environment:
Plan and implement a programme to enhance an identified social or physical aspect of their classroom or school environment

Other curriculum links:
Level 3 and 4: **Technology;**
Technological practice: Brief development, Planning for practice

Education for sustainability concepts

Interdependence/ Whanaungatanga:
Everything and everyone in our world is connected

Sustainability/Hauora:
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Responsibility for Action/Kaitiakitanga:
If we want to use taonga, we must look after the taonga. Taking action, informed decision-making, citizenship, consumerism, enterprise, resilience and regeneration

Background knowledge

How can the teacher help to enable students to complete the action?

Thinking ahead of students and removing potential obstacles will help the action to progress. This may include discussing the action project in advance with the principal, BOT or local businesses.

Environmental action ideally involves people outside your school. There will be many people who will be able to help you – in councils, among parents and families, in not-for-profit groups, businesses and other agencies.

Generally people are keen to help schools and are generous with their time. Initiatives which bring communities together are valuable in many ways and will enrich your school.

Should we complete more than one action?

This will depend on how much experience you and the students have with environmental action. The fewer projects you have, the higher the chance of success and the more likely the project is to create lasting change.

How do I find time to carry out this action?

You may find that you need to carry the action over into the following term or ask for some extra resources in order to achieve your action. Support from other staff and the principal is vital to the success and longevity of an action project.

Obtaining funding for action projects

Funding for water action projects is available from several different sources. You may also be able to fundraise or negotiate with local businesses to achieve your goals.

Examples of funding available are:

Where there's water community environmental grant
http://www.waternz.org.nz/wherethereswater.html
(In May each year)

WWF Environmental education fund
http://www.wwf.org.nz/what_we_do/education/funding_for_schools/
(April and September each year)

Other funding

There are other funding opportunities available from councils, businesses and the Ministry for the Environment.

For other funding opportunities see: http://www.fis.org.nz/ *(NZ funding information service (FIS) website)*

6:2 Planning for action – learning experience

Learning experience

(This activity can be completed as a class or in groups)

- Share the learning intention and success criteria
- Discuss the action chosen in the previous activity. Ensure that the action is both achievable and realistic
- Consider the resources required to complete the action. Brainstorm ideas and record
- Ask students if they have ideas about who could assist with the project. They may have relatives or contacts who could lend a hand. Also consider businesses, councils and other outside agencies
- Name people who will need to be consulted before starting the action and discuss this process
- Complete BLM 6d individually or together as a class
- After completion, prioritise steps and assign responsibilities. Record these and agree on an appropriate timeframe
- Agree on a collective plan of action
- Constructing a timeline or a list of steps may help to keep you on track and organised
- **Begin your action!**

Reflection questions

- What are the potential consequences of your action?
  Answers will vary

Vocabulary

- resources
- completed
- responsible/responsibilities
- consequences

Learning intentions

Students will:
Organise, plan and implement an action project to reduce their water use

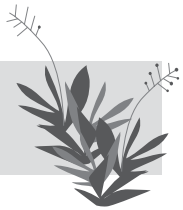
Success criteria

Students can:
Complete an action plan for their project and implement the plan

Resources

BLM 6d School water action plan

BLM 6d: School water action plan



When will it be completed?

What is the cost? Where will the money come from?

Where will this action happen?

What resources and information do we need?

Who will we need to talk to about this action?

Action

How will we let people know about our action?

What needs to be done?	*Who* is responsible?
1.	1.
2.	2.
3.	3.
4.	4.
5.	5.

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6:3 How did it go? – teacher notes

Background knowledge

Why reflect and evaluate?

Reflective thought and critical evaluation allows students to think objectively and to stand back from their project and look at it from a different perspective. Reflection allows knowledge to be assimilated and adapted and encourages deep, critical thinking.

How will reflecting and evaluating help our action?

Reflecting will enable students to take more responsibility for the action and to think about improvements which could be made. Reflecting on action will increase their understanding of the action process and increase the likelihood of successful future environmental action. Reflecting on learning will also have implications on your teaching.

Planning for reflection

Ask questions during your action taking which prompt reflective thought. Questions which encourage students to examine their thoughts and feelings will allow more effective reflection and evaluation.

Share your experiences with the school and community

Inform others in your school of what your environmental action was and why you did it. Present a play at assembly, write a blog or web page or an article for the newsletter.

This may inspire other classes to be involved or participate in their own action for the environment.

Allowing time for celebration

Ensure that you celebrate your action with your students and applaud their successes. If others have been involved in your action, acknowledge their efforts as well.

Keep positive

Keep positive about the project and its successes. Students often really enjoy participating in action for the environment. Keep up momentum by frequently revisiting your action and maintaining it. If there have been mistakes, learn from them and look forward to your next project.

Curriculum links

Technology:
Level 3 and 4
Technological practice:
Brief development
Justify the nature of an intended outcome, explaining how it addresses the need or opportunity. Describe the key attributes that enable development and evaluation of an outcome

Education for sustainability concepts

Sustainability/Hauora:
The choices we make today affect choices we will be able to make in the future

Responsibility for Action/Kaitiakitanga:
If we want to use taonga, we must look after the taonga. Taking action, informed decision-making, citizenship, consumerism, enterprise, resilience and regeneration

6:3 How did it go? – learning experience

Learning intentions

Students will:
Reflect on their action project and evaluate how it went

Success criteria

Students can:
Complete an evaluation of their action project

Resources

BLM 6d School water action plan *(completed)*

Learning experience

- Share the learning intention and success criteria
- Explain to students what evaluation means and why it is important *(see teacher notes)*
- Discuss how the process of taking action went. Ask students what difference the action has made
- Was the action plan carried out as decribed on BLM 6d? What changes were needed?
- Complete a bus stop activity or PMI chart using the following questions:
  1. Did you achieve what you set out to achieve?
  2. Did you enjoy the action project? *Explain*
  3. Did it solve the problem/ issue? *Why/Why not?*
  4. What did you learn from this action? What else would you like to learn?
  5. Is the community involved? How could we encourage them to be involved?
  6. Does your action require any maintenance? If so, what sort of maintenance is needed? Who is responsible and when will it be done?
  7. If you did this action project again, what would you do differently? *Why?*
  8. Will this action have an effect on the future environment?
  9. How did you personally contribute to this action?
  10. What would you like to see happen next?
- After completion, discuss the responses. Plan any maintenance needed
- Ask students if they have any ideas about what the next steps are for the project. Refine ideas and share them with other interested people
- *As an extension, re-survey your water use or water meter readings and compare to previous results. Has there been an improvement? Inform the school about the difference you have made.*

Vocabulary

- achieve
- evaluation
- maintenance

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