Teaching & Learning Activities

1. What is Water and Where Does it Come From?

Aim: To explore the water cycle and investigate our relationship with water.

Explore

Select from these ideas

Brainstorm where water comes from and goes to.

Create a magazine collage of all the different uses for water.

Students draw/illustrate themselves in the water cycle, showing how they use water and where it goes.

Investigate where water comes from and goes to in the school. Create a diagram and see if students can do the same for their water at home.

Activity 1.1 - The Water Cycle

You will need:

- ***Photocopy Master 1*** **- The Water Cycle page 102**
- Large plastic container (e.g. a plastic bottle)
- Half a bucket of soil or potting mix
- 2 or 3 wire coat hangers
- Large clear plastic bag or plastic wrap, pebbles and small rocks
- Plenty of water
- Some small plants, moss, fern, grass seed or bird seed.

Learn

Discuss the water cycles that the students have created focusing on where water comes from.

Use ***Photocopy Master 1*** **- The Water Cycle** to investigate the cycle and explore terms like **transpiration** and **condensation**.

Create a model of the water cycle.

Discuss with the students how our earth looks naturally.

- Is it all flat?
- What happens in the low lying parts?
- Where are the hills?
- How much of the earth is covered in water?
- Where will the pebbles and rocks best go?

Investigate the shapes and types of land shown on **The Water Cycle**.

When they have completed their own water cycles, discuss the different designs and ways that students have gone about creating them. Use ***Photocopy Master 1*** **- The Water Cycle** to decide whether their designs include all the parts of the 'earth' in the water cycle.

Reflect

- How much 'ocean' should there be in your water cycle?
- Why do we need to cover the water cycle in plastic?
- Where do the water droplets on the plastic come from?
- Where does the water form 'oceans' and 'rivers'?
- What important functions does the water cycle have?
- Why are we so reliant on the water cycle? What does it do for us?

The earth is made up of approximately 70% water.

Activity 1.2 - Follow the Water Droplet

You will need:

- ***Photocopy Master 1a* - The Water Cycle page 103**
- ***Photocopy Master 2* - Follow the Water Droplet page 107**

Learn

Using ***Photocopy Master 1a* - The Water Cycle** as an overlay to ***Photocopy Master 1***, explore where in the cycle the school water comes from and goes to.

Follow-up with students.

Explain their home water cycle.

Imagine where the water goes:

Tap	Sink pipes	Septic tank	Ground water infiltration	Ground water flow
Ocean	Evaporation	Condensation	Rain	Rain water tank

Discuss the alternative paths in the water cycle and how many times it might have to cycle before it actually gets to where students can use it.

Rain Ground Aquifer Bore Tap	Rain River Treatment Tap	Rain Tank Tap

Spray some water on the roof and 'listen' and 'watch' where the water goes.

Students could imagine that they are a drop of water and choose a starting point in the water cycle, for example the classroom tap. See ***Photocopy Master 2* - Follow the Water Droplet**.

Students could choose a pathway to mime. Other students guess which pathway is being mimed.

Reflect

- What happens to the water when it falls on the roof? On the paddock? On the driveway or road? On the trees? In the ocean? In the stream?
- What happens to the water when you turn the hose on the garden? Have a shower? Do the washing? Wash your car? Empty the swimming pool?
- What might happen to the water cycle if there were no trees?
- What might happen if there were only roads or paved surfaces?
- What things might make a drop of water flow faster through the cycle? Slower?

Activity 1.3 - Maori Classification of Water

You will need:

- ***Photocopy Master 3* - Nga Momo Wai page 108**

Learn

People have different uses for different kinds of water. For example, the water that we use for washing the clothes is okay to water the garden but is not okay for drinking. In Maori culture, water comes in many different types and therefore has different purposes and is viewed in different ways.

Use ***Photocopy Master 3* - Nga Momo Wai** and carry out Activity 1.2 again, seeing if you can identify the different types of water in your water cycle and where you might find other types of water.

Reflect

- How might Maori people in your community view water in your area?
- What different kinds of water are present in your school?
- How do you feel about this?

Activity 1.4 - Exploring Condensation and Evaporation

You will need (Evaporation and Condensation):

- Cup
- Pot
- Heat source (element, gas ring)
- Cold plate

You will need (Transpiration):

- Flower or small branch with leaves on it
- Plastic bag (sealable)

Learn

Explore different activities such as breathing on a spoon or holding a metal pan above a jug or pot of boiling water, asking students to think about what happens.

Ask students why they think the spoon goes cloudy or the pan gets wet.

What things do they observe and notice?

Discuss situations that students may have already experienced such as seeing their breath on a cold day, condensation on the windows at home, steam rising from pots, condensation on the bathroom mirror.

Carry out the experiment/investigation suggested below. Ask students to set it up, focusing on problem solving skills, questioning and planning an investigation.

Creating evaporation and condensation

Using 2 cups of water, a pot, a heat source and a cold plate or pan create some steam.

'Catch' the steam on the plate, and compare this to creating 'rain', which is called **condensation.**

Leaving the plate above the boiling water will allow it to heat up.

Does the hot plate collect steam? Why is this?

What has happened to the level of the water? Why is this?

Where has the water gone? This process is called **evaporation.**

What makes water evaporate from lakes, puddles, oceans and rivers?

Check your ideas by chalking around the edges of a puddle and checking on it regularly. Where does the water go? What has caused the water in the puddle to heat up?

Ask students to look for other examples of evaporation and condensation around them.

Transpiration

Where else can water 'evaporate' from? e.g. puddles, lakes, oceans etc.

Place a flower, grass or small branch in a plastic bag and close the bag so that it is airtight.

What might happen and why?

Observe the bag over several hours (up to a couple of days).

Discuss observations and explore reasons why this might have happened. *As the plant 'breathes' it releases oxygen. This combines with hydrogen to create water. This water condenses on the sides of the bag creating 'rain'.*

What is the liquid on the side of the bag?

Where did it come from?

Reflect

- Why are plants important in the water cycle?
- What might happen if we didn't have any trees?

Action

Think of other reasons why plants are important to us.

Check your school, how many trees are there?

Could there be more? Could you help more trees to grow in your school? Local area?

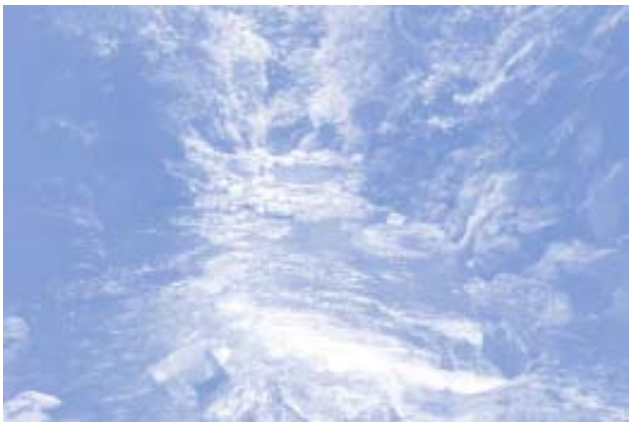
Contact your local Forest and Bird branch, Environment B·O·P or QEII Trust representative. They may have activities planned for your area that students could link with.

2. How Does Water Flow?

Aim: To investigate how water flows in our school and understand how water flows in our catchment.

Explore –

Select from these ideas



Brainstorm how students think water flows.

Play with water – place some on a flat surface, watch to see what happens, where does it 'run' to or where does it 'pool'?

Have a piece of card or a tray. Hold it flat and place some water on it. Tip the card in different directions and watch the water. What direction does liquid water always go in? *Down*

Discuss what causes water to go down? *Gravity*

From the previous activities, when does water go up? *When it is a gas as steam or evaporating.*

Discuss the direction of flowing water and how people use the power of water. For example power stations, water clocks.

See if students can design a water mechanism to make something operate and/or demonstrate the power of water. (It could be a series of pipes at different levels that eventually triggers a switch.)

Activity 2.1 - Where Does Water Flow in the School?

Learn

What happens to water in your playground? Where does it flow from and to?

Ask students to think about what they know about the playground. Where are the wet areas? Where is it really dry? Where are the slopes and hills?

Investigate your playground. Draw a map of the school and mark on the wet and dry areas.

Investigate where the water flows in your school grounds. (Wait for a rainy day and observe what happens.)

What happens to water when it can't soak into the ground?

Where do the puddles form? Which areas dry out the fastest?

Where does the water seem to be moving fast? Slow?
Are there big puddles on high ground or low ground?

Once the water leaves the school grounds where does it go? Check on your water cycle to decide where your water could possibly go.

On your map of the school show how water flows around your school and where it goes. The map might be on an overhead transparency, a wall chart or individual maps.

Discuss how water flows from high ground to low. Discuss how sealed areas will increase the rate of the flow.

Reflect

- Where are the wet places in your school? Dry places?
- How have people changed the ways that water flows around your school?
- As you think about these ideas complete a PNI (Positive, Negative and Interesting) chart about the ways that water flows around your school.

Activity 2.2 - How Does Water Flow Across Different Surfaces?

You will need:

- ***Photocopy Master 7 and 8*** **- Major Catchments pages 112 and 113**

Learn

Students design an investigation of the ways water flows across different surfaces, e.g. does water move faster across vegetated or non-vegetated areas?

Students can consider the features of scientific testing such as repeat tests, collating data and interpreting data.

Activities might include timing how long it takes for a litre of water to disappear from a particular surface.

Experiment with the pressure nozzle on a hose. Note the difference in water flow depending on the amount of water that goes through the nozzle. Turn the tap on slightly and spray the water onto the grass. Observe what happens to the grass. Turn the tap on some more and change the nozzle to a single stream. Water the grass and watch what happens. *With the high pressure single stream the grass is knocked over and some of the soil displaced, demonstrating the power of water under pressure and on high flow. Compare this with the spray nozzle to a gentle rain where the earth is able to cope with the 'rain' and infiltrate naturally. Water that cannot infiltrate naturally will flow together to the lowest point gradually increasing in volume and velocity. See Activity 2.4 'A Model Catchment' and Activity 4.4 in Section 4 'Muddy Waters' to explore this concept further.*

This activity leads well into Section 3 Activity 3.4 and 3.5 (Stormwater and Car Washing).

Reflect

- What did the investigation show? How does water flow across different surfaces?
- Is there a difference between sealed areas and planted areas?
- What impact do you think water flowing over planted areas, compared to sealed areas, might have on waterways? *Vegetated or grassed areas help to slow the flow of water and will also filter out some sediment and pollutants. Water soaks into grassed areas. Sealed areas allow for all materials and soil to be collected and washed into waterways.*
- How do you think sealed surfaces might increase the risk of flooding? *Sealed surfaces prevent runoff and rain from filtering naturally through the earth. Water running off sealed surfaces will move faster and pick up speed as more water flows, therefore increasing the amount and velocity of the water. This has a cumulative effect by the time the water reaches waterways. Use* ***Photocopy Master 6 and 7*** *to show the waterways in the Bay of Plenty region.*
- Is there anything we can do to help reduce flooding? *Maintaining natural ground covers such as grass, shells or trees will 'break' the flow of the water and allow it to soak into the ground before it reaches waterways.*

Activity 2.3 - Everybody Lives in a Catchment

You will need:

- ***Photocopy Master 7 and 8* - Major Catchments pages 112 and 113**
- Catchment Summary Information pages 27 to 30
- ***Photocopy Master 16* - Legend of the Waimapu River page 123**

Learn

What are the waterways in your area? What is a catchment? *A catchment area or basin is land bounded by natural features such as hills, or mountains from which all runoff water flows to a low point – like water in a bath tub flowing to the plug hole. In the case of a natural catchment area, the low point could be a dam, a location on a river, or the mouth of a river where it enters the ocean.*

See if students can locate local waterways on a map. A topographical map of your area will be helpful.

Discuss where the small streams flow and the large rivers flow. Is there any reason why they flow like this? Consider the topography with water flowing from high to low lying areas.

Go outside and look at the topography of the land, looking at the hills and where students think water might flow to and from. See if you can visit a high point in your catchment to look out over it and see what the land in your catchment looks like.

Using ***Photocopy Master 7 and 8* - Major Catchments**, identify the major waterways in your area. See if you can identify where they start and where they finish.

Add in any smaller waterways that you know of that are not shown on the map.

Use the key to estimate the length of a major river near you. See if you can find out how long the river actually is. Are the two figures similar? Why or why not?

Consider how the land in your catchment is used. List these. (Use Catchment Summary information.)

What can you find out about what people think of the waterways in your area.

Read the legend of the **Waimapu River**. Discuss how the legend tells the story of the formation of the Waimapu River.

See if students can research the history of a local river and how it was formed.

Talk to people who have lived in your area for a long time about the rivers and any changes they might have noticed. Think about all the different groups of people that use the waterways and include them in your consultation e.g. farmers, Regional Council, Maori, local businesses. Collate your information in an interesting way e.g. in a video, tape recording, photo's, interview transcript, an article.

Make a timeline in the shape of your river or catchment, marking any of the significant changes that the people you talk to notice about the river.

Reflect

- Start thinking about why some of these changes might have happened and what the impacts on waterways in your catchment might be.
- What things do you like/dislike about the waterways in your catchment?
- What things would you like to see change?
- How could this happen?

Catchment areas vary in size and make up. Large catchment areas such as those drained by the Wairoa and the Waioeka Rivers are bordered by mountain ranges and include major drainage networks of streams and rivers. Larger catchment areas are made up of hundreds of smaller sub-catchment areas. These may be bordered by low hills and ridges and drained by only a small stream or gully.

Activity 2.4 - A Model Catchment

You will need:

- large plastic sheet (e.g. 2m x 3m)
- materials to build slopes (e.g. bricks, blocks, boxes, sandpit or natural slopes in school grounds), or a sandpit
- watering can or spray nozzle of hose to simulate rainfall.

Learn

This practical activity involves building a model catchment, using a large plastic sheet draped over 'hills' and 'valleys'. A variety of materials could be used to make the hills, (sand, bark, boxes, screwed up newspaper, natural slope of school grounds, etc.). Involve students in the making of a model catchment using the following equipment. Either follow the instructions here or let students create their own 'hilly catchments' based on their observations of their catchment.

Method

1. Use the materials and/or slope outside to create a 'hilly valley'. Your hilly valley needs to include steep and gentle slopes, flat areas and hollows. Or create a catchment shape (as in the diagram) in a sandpit. Consider the shape and form of your own catchment.
2. With the watering can and/or hose nozzle, spray water onto the plastic slope in different areas.
3. Observe how the water flows.
   - » Which way does the water flow?
   - » Does the water flow along the 'hills' or down the 'valleys'?
   - » Where does the water flow?

   From the mountains (high ground) to low areas, valleys, flats and eventually to the sea.
4. Place a leaf at the top of a steep slope within your model catchment and wash the leaf down the slope with 'rain'. Observe.
5. Repeat, placing the leaf at the top of a gentle slope. Observe.
6. Compare the differences between the leaf travelling down the steep slope ('river') and the gentle slope. Compare the differences in water velocity (speed) and width of 'river'.

Reflect

- Where does the water flow from and to?
- When did the 'rivers' start to get large?
- Where does the water always flow?
- Take a photo of your model and blow it up on the photocopier or scan a photo to display in the classroom. Make a class statement about the direction that water flows in your catchment, where different rivers begin and end.
- Keep the model for a future activity if possible.

(This model is used again in Section 4 Activity 4.4 Muddy Waters. You might choose to do these activities at the same time.)

Action

How can you share your information with your community?

Write/draw a report for your school/ local newsletter or newspaper about how water flows in your catchment.

Demonstrate how water flow changes with the topography of the land. Significant changes in the waterways over time might be included.

Introduce your report as a series to be published during the course of the unit. As more information and knowledge is gained about your catchment it can be reported to your local community and used to help raise their awareness.

3. What impact does our water use have?

Aim: To investigate how the use of land and water affects the quality and quantity of our water.

Explore –

Select from these ideas

Brainstorm how we use water. Refer back to the collage made at the start of the unit or make a water use collage.

Have each student find three pictures of water being used e.g. swimming, cleaning a service station forecourt, cows drinking, irrigation, cleaning a car, fishing and power station.

Place the pictures on a large sheet of paper so that everyone can see them.

- Ask students to think about which pictures might be grouped together and for what reason
- Have them group the pictures and give each group a name or category. For example making a living, recreation, drinking, survival, industry, cleaning, natural beauty.

Consider all the different ways that we use and need to use water. Make a list of the categories that are to do with ensuring our survival and ones that make our life easier.

Explore Section 4 Activity 4.5 Property Developer as a starter activity.

Activity 3.1 - Water Use

The following activities examine some of the issues about how our water use affects water quality. Consider whether each use is essential for our survival or something that makes our lives easier. For further information check out the section Water in the Bay of Plenty

		Issue to be explored
Photograph 1 page 142	Drinking water	Drinking water in New Zealand has to be treated. The cost of this can increase depending on the quality of the water prior to treatment. The dirtier the water the greater the cost to treat it.
Photograph 2 page 143	Bottled water	People buy and drink bottled water. This is a consumer choice as we have become more health conscious and want to be sure that what we drink is safe and good for us.
Photograph 3 page 144	Bathroom waste water	It costs to treat wastewater. Although treated water is 'safe' when it is discharged back into a waterway the clarity of the water is often quite different. The additional nutrients that are not filtered out, such as phosphates from detergents, increase the growth of nuisance plants. Running water when it is not required wastes precious resources, e.g. while you brush your teeth.
Photograph 4 page 145	Stormwater	Pollution from litter, oil, dust, animal faeces, chemicals is washed down the stormwater system into waterways.
Photograph 5 page 146	Car washing	Detergents entering waterways add nutrients that promote the growth of nuisance plants, reducing water quality. Washing vehicles on the grass reduces this risk as the soil filters most of the nutrients.
Photograph 6 page 147	Industrial	The Resource Management Act (1991) requires any user of a resource to maintain the quality of the resource. While industries and business use water to help them run their business they have strict conditions to which they must comply. Water that is used on site must be treated before being returned to a waterway.
Photograph 7 page 148	Ground water	Ground water can become contaminated when too much wastewater is irrigated onto the pasture and the bacteria and bugs are carried through to the ground water with the surface water. Other sources of ground water pollution include: leaky underground tanks in particular septic and petrol tanks, offal holes, leaky landfills, spilt oil or chemicals.
Photocopy Master 4 page 109	Cultural views	People use water for many different purposes. People can value water differently. Respecting our waterways is an important part of performing the guardianship or Kaitiakitanga role for Maori.
Photograph 8 page 149	Hydro-electric power generation in the Bay of Plenty	People use electricity every day. We make choices about the amount of electricity that we use in our homes and businesses and this drives the demand for electricity. When the consumer demand for electricity rises, water is used to generate electricity. As electricity is generated, the level of the water in the hydro lake decreases and the level of the water in the river increases. This can create problems as the banks of the river erode, animals living in the water can be left out of water and the look of the river can be affected.
Photograph 9 page 150	Recreation	People use water for a myriad of activities. As much as possible people need to ensure that their activities do not decrease the quality of the water. Boats should be well maintained to prevent accidental oil spills and leaks into waterways. Boats should be cleaned after every use so that weeds are not transferred from one waterway to another.

Photograph 1 - Drinking Water

You will need:

- ***Photocopy Masters 9a and 9b*** **- pages 114 and 115**
- ***Photocopy Master 12*** **- Consequence Wheel page 119**

Learn

Where does your drinking water come from at home? At school? *Towns and cities have reticulated water provided by the local council. This water is treated and safe for people to drink. In rural areas there are a number of places people might get their water from: rainwater collected from the roof and stored in tanks; bores or wells (holes in the ground that pump the water up or it might flow up naturally); a stream or river. These people have to check themselves that their water is safe to drink. All of these water sources can be affected by the activities discussed here.*

Some people have water filters in their homes. Why do they have them? *Some people choose to have water filters as their water supply might be from rainwater or some other natural source that they want to ensure will be safe for drinking. Some people do not like the chemicals that are added by water treatment plants, such as fluoride, so they filter them out.*

Why does drinking water have to be treated in New Zealand? *Bacteria such as giardia and cryptosporidium in the water would make people sick if it was not treated.*

Where does harmful bacteria come from? *Animals with access to waterways will defecate in the water or they might die in the water. Stormwater runoff might include animal faeces, remnants from animals squashed on the road and litter. Infiltration from septic tanks and people washing directly in waterways can all lead to harmful bacteria entering our waterways.*

How does the water treatment process work? *Water treatment has three main steps, 1) flocculation where chemicals are added to gather all the impurities together. This then settles to the bottom of a tank and the water is filtered off the top. 2) Filtration is where the water infiltrates through sand and gravel to take out further impurities. 3) Sterilisation is where the germs in the water are killed either by chlorination or special ultra-violet light. The water is now safe to drink. Lime is added to balance the pH that is altered by the chemicals added during flocculation.* ***Photocopy Master 9a and 9b*** *shows the water treatment process. Students could carry out their own filtration experiments, using soil mixed with water and then 'filtering' the mixture through a range of materials such as a sieve, gauze, coffee filter papers etc.*

Websites on the internet also provide good sources of information. Search ***under water treatment****. http://www.wrc.govt.nz/ws/ww/wt.htm is the Wellington Regional Council site and it provides an interactive version of the water treatment process.*

Some water treatment plants do not have to add flocculation agents, as the water supply is reasonably clean. What could be done so that extra chemicals did not have to be added to water supplies? *Protecting our waterways so that harmful substances from stormwater and rural runoff are prevented from entering them. Planting trees on river banks to help prevent erosion.*

Using **Photocopy Master 12** complete a consequence wheel about the treatment of water with the middle statement reading "Water treatment makes water safe to drink". Things that you might consider: the cost of water treatment (in dollars), the cost not to treat water (socially, as people get sick), addition of chemicals such as fluoride, water meters, free water.

Debate the following topic “All water should be metered and people should pay for the water they use”.

Read school journal article (RA 12-14) *Water Supply* 1978 part 4 number 3 about the water treatment process and use **Photocopy Master 9a and 9b** to link the stages in water treatment.

Contact your local district or city council to arrange a visit to your local water treatment plant. Discuss local issues related to the water treatment in your area.

Reflect

- Why do we have to treat our water?
- How do you feel about this? Could things be different?

Photograph 2 - Bottled Water

You will need:

- ***Photocopy Master 12*** **- Consequence Wheel page 119**

Learn

Why do we drink water from bottles? *There has been a significant shift in people's attitudes to drinking water as a health choice. Bottled water is thought to be safer and better for people to drink as it pure and clean, unpolluted and so better for you. It is a consumer choice because we want to be happy and healthy.*

Survey your parents and friends and ask if they bought water in bottles when they were young.

Discuss the changes that have happened that make us willing to buy water in bottles today when in the past it did not happen. *As water sources have become more polluted people want to ensure that drinking water is good quality.*

Where do you think the water in this bottle came from? *The water in this bottle comes from 220 metres underground at the Otakiri Springs, Otakiri, Whakatane.*

Discuss the idea that people are happy to spend money to buy clean bottled water, while water that comes through our taps has to be treated to ensure that it is safe for us to drink. This costs money, people pay for this through their rates.

Discuss whether you think it would be better for people to pay for the water to be kept clean in the first place so that it doesn't have to be treated, or whether people should pay to have water treated. Debate these issues drawing a big tap with all the positive and negative statements written on drops of water coming out of the tap. Statements related to bottled water could be displayed on large bottles, either real or drawn. If students decide that water should be kept clean, discuss action that you can take to help your community keep its water clean. Take a photograph of your display and send it to Environment B·O·P.

Go to the supermarket and survey the places that water is bottled from across New Zealand. See if you can find out where this water goes. Is it sent overseas? Do you think this is good or bad? Use ***Photocopy Master 12*** to complete a consequence wheel on the impacts of water being bottled and sold. The inside statement might say "Otakiri Spring water is bottled and sold all over the world".

Carry out your own investigations into the popularity of bottled water. Survey people and ask if they buy bottled water, when and where. It could be that it is the most convenient way for people to have access to water. Perhaps people would be happy to drink water out of drinking fountains if they were available. Discuss other alternatives.

Some people might prefer the taste of bottled water. Do a blind taste test of bottled water and tap water and see what results you come up with.

What happens to the plastic bottles when people have finished with them? Students could write to the manufacturers and ask if they have bottle recycling.

Reflect

- What have you discovered about people's views on water?
- What sort of water do they like to drink?
- What concerns or issues do they have about drinking water?
- What things can we do to conserve water?

Photograph 3 - Bathroom: Removal of Bacteria

You will need:

- ***Photocopy Master 9a and 9b*** **- pages 114 and 115**
- School journal readings
- ***Photocopy Master 13*** **- Water Use Amounts page 120**

Learn

Where does water in the bathroom go when it goes down the plug hole? *In towns and cities waste water from the house goes into the municipal sewage system. The water is pumped away from the house to the waste water treatment plant. Check with your local district or city council for visiting hours. In rural areas and some older suburbs, waste water goes into a septic tank, which is a big, holding tank in the ground. Anaerobic bacteria help to break the waste down but septic tanks still need to be emptied periodically. This means a truck comes and pumps the contents of the tank out and takes it to the waste water treatment plant. Septic tanks can contribute nutrients and bacteria to ground water supplies.*

Where does the water go in other parts of the house? *All water from the house (kitchen sink, toilet waste, shower, bath and washing machine) goes to either the waste water treatment plant or your septic tank.*

Do we have any other choices for removal of our waste water? *Students could investigate the use of 'graywater' systems that use some waste water in the garden. They could investigate on-site treatment systems where all sewage is re-cycled and used on the property. They could also investigate composting toilets.*

Read *Laying the Drains* School Journal article RA 9.5-10.5 1981 part 3 number 3 about how sewage pipes are laid when a house is built. *Have students create a simple house plan or classroom plan.*

Why does waste water have to be treated? What would happen if dirty water was put straight back into streams or left to run onto the street? *Waste water from homes contains harmful bacteria that need to be treated. If the water was left in the streets, as well as promoting disease, it would eventually make its way into waterways through the stormwater system and natural gravity. Bacteria pollute waterways and make them unsafe for swimming, eating fish or drinking.*

Look at ***Photocopy Master 9a and 9b*** and see if you can work out how waste water is treated. What do you think happens in a settling tank? In a digester? In the disinfection tank? *Water coming into a wastewater treatment plant is first screened at the grit screen traps to take out the very large solids. This material is taken to landfill. In the primary settling tank, the solid material sinks to the bottom and goes into an anaerobic digester where the waste is 'composted'. After the right amount of time and under the right conditions, this waste is transformed into sludge that can eventually be used as clean fill and compost. The water that remains after the settling tank then needs to go through the water treatment process, where it is usually discharged into natural waterways. Searching the internet on waste water treatment provides a wide variety of information.*

Select relevant passages from *The Compost Heap* by June Leonard in School Journal 1986 part 3 number 1, RA 11-13, about how bacteria work. In the case of sewage digesters, the bacteria are anaerobic.

Read *Using Water* School Journal 1979 part 4 number 1, RA 10-12. Discuss any other questions students might have. Send a class fax to your local water treatment plant or contact your local district or city council to arrange a visit there. See the contacts list for details.

How could the person in this photograph conserve water? *Only turning the tap on when required, rather than leaving it running while brushing their teeth.*

What happens in a drought when we don't have spare water? See if students know of people who have to be careful with the amount of water that they use, for example people who rely on rainwater. How does our behaviour change in a drought and why does it change? *Investigate with students why we often do things because we have to. Discuss how it could be different. Dry Days for Climbing George is a story in the Ready to Read series that talks about using water from inside the house to water the plants during a drought.*

Ask students to investigate how much water they use in a 24 hour period. Challenge them to limit it to a set amount per day that seems reasonable. Refer to ***Photocopy Master 13*** **- Water Use Amounts** for a guide.

Reflect

- What responsibilities do we have regarding water after we have used it in our houses?
- Are there ways that we can safely re-use water?

Photograph 4 - Stormwater

You will need:

- **Photocopy Master 10 - Stormwater Cartoon page 117**

Learn

What does this photograph show and what is it for? *Stormwater grates allow water from streets to flow into the stormwater system. Some stormwater grates now have fish painted beside them, which signifies that the water flows straight into a natural waterway such as a lake or stream.*

Who or what might be affected by the rubbish on the grate? How would this happen? *Use **Photocopy Master 10** to show how oil and detergents can affect animals and plants that live in the natural waterway. Litter can be mistaken for food by animals and clog their digestive systems. Bacteria from dead animals and faeces can make water unsafe for swimming in and food gathering.*

How could it be different? *Having less paved surfaces means that water will infiltrate naturally rather than having to runoff the hard surfaces. People could take more care with litter and cleaning up animal faeces from the side of the road.*

Photograph 5 - Car Washing

You will need:

***Photocopy Master 11* - Detergent in the Drains page 118**

Learn

What is this person doing? What do you think is in the bucket? *Detergent, car cleaning liquid.*

Where will the water go after they have washed the car? *It will be filtered naturally through the lawn and soil. The water will eventually make its way to a ground water aquifer.*

What would happen if they washed their car on the road or driveway? *The water would probably run into the stormwater drain. The detergents in the water promote the growth of nuisance plants in waterways.*

What effect do detergents have on waterways? *Most detergents contain phosphates, which promote plant growth. When they enter a waterway the phosphates act like a fertiliser and increase plant growth. In time excessive plant growth blocks light from the water and the smaller plants die, decomposing in the water. These plants include algae or 'slime'. As they decompose they remove oxygen from the water. Animals need oxygenated water to survive.*

See if students can design an experiment to show the impact of detergents on plant growth in water ways. You could use water cress as the water plant because it germinates and grows quickly.

Use ***Photocopy Master 11*** to explore how detergents are filtered through ground water. See photograph 7 ground water and carry out the experiential activity about ground water movement in this section.

Reflect

- What do you know about the purpose of a stormwater drain?
- What can you do to lessen the impact on waterways from the stormwater system?

Action

Read *Blue Fish on the Footpath* by Pat Quinn and Westmere School, School Journal Article RA 8.5-9.5, 1992 part 2 number 2.

Explore your community and see if there are ways that you can tell them about the role of stormwater drains and the things that they can do to help prevent environmental pollution.

Contact your local District or City Council and ask how they identify their stormwater drains.

Photograph 6 - Industrial

Learn

How is water being used in this photo? *To clean the outside of the milk tanker.*

How might we benefit from this use of water? *We buy dairy products such as milk, yoghurt and icecream, from the dairy company.*

Where do they get their water from? Who do they have to get permission from to use this water and why do they need permission? *The dairy company will take water from a natural waterway such as a river or ground water aquifer. A consent to use a natural resource is required from Environment B.O.P. For more information on the consent process contact Environment B.O.P.*

How much water do you think they need each day to operate? *This will vary from factory to factory. You could contact a large water user in your area and ask them how much water they use.*

Where does their 'dirty' water go? *All water used on site must be treated before being returned to the environment. Most large businesses also have a stormwater collection system as well. Depending on the nature of the business, this can be discharged straight to waterways, as it is in many towns and cities. Some businesses might have to treat the water first, for example a quarry.*

Reflect

- How is the environment protected from being polluted by business and industry?
- What are the positive things about this? What are the negative things? Could it be different?

Photograph 7 - Ground Water

Learn

Where is the water in this photograph coming from? *A ground water bore has been drilled through the earth until it reached a freshwater aquifer. The water in this picture is from a ground water aquifer. Aquifers can be deep or shallow. Sometimes the water will rise to the surface naturally and other times it will need to be pumped to the surface.*

How could water that is buried under the earth become polluted? Carry out this experiential activity to help students explore ground water movement.

Ground water movement

Select 4 or 5 students to be water molecules. The rest of the class needs to spread out in a rough 5x5 pattern, to act as the earth. When the *water molecules* have moved through the ground they will need to congregate together in an aquifer.

The students acting as the earth should stand with their hands on their hips, with their elbows bent, so that the tip of their elbow touches the person standing next to them.

The water molecules move through the ground, gently brushing past the soil particles.

Repeat the movement of the water but have the water molecules put a small amount of flour or powder on their elbows.

- Some of the powder will be rubbed off onto the earth (soil and rocks), while some will remain on the water molecule.
- Discuss what the powder could represent (bacteria, nitrogen and contaminants) and what effect this could have on ground water purity. Here the earth is filtering contaminants that water from the surface brings down with it.
- Discuss how the soil can filter some sediments and contaminants but some is also carried through to the ground water.

Have some of the students place a sticky label of a known water contaminant such as bacteria, nitrate, arsenic on them. Repeat the activity with the water “moving” through the soil.

- See how many of the contaminants are filtered or rubbed off, how many stay on and are carried into the ground water aquifer. Discuss with the students whether they would be happy to drink the water or not.

Refer back to the Water Cycle and the place of ground water. Decide whether ground water is a ‘safe’ source of water.

Reflect

- How can ground water help us to ‘clean’ water?
- How can ground water become ‘dirty’?
- How important do you think ground water is to us?

Photocopy Master 4 - Cultural

You will need:

- ***Photocopy Master 3*** **- Nga Momo Wai page 108**
- Refer to 'Significance of water to Maori' page 20

Learn

After reading this story discuss the following questions:

In what ways is water described? How does this compare with how you would describe water?

What are the different uses that Maori have for water? *You could also explore uses of geothermal water, soda springs, cleansing rites.*

How does water increase in mana or stature?

How might polluted water affect Maori people? *Refer to Section 1 Activity 1.3 "Maori Classification of Water" discussing the different spiritual status of water.*

How would you feel if one of your ancestors was being harmed?

Discuss with your local Maori community how they view water and the uses they have for it.

Refer to a road map of New Zealand. Find the names of different places and waterways that have 'wai' in them.

Reflect

- Read some poetry about water, rivers or streams. How is water described in those?
- What is your view of water?
- How do you feel about it?

Action

What can you do to ensure that your local waterways retain their *mauri*?

A display in a local shop or area informing people of ways that they can keep our waterways clean.

Identifying sources of pollution through on-going water monitoring. (Contact Environment B·O·P for Stream Sense, a water-monitoring programme for schools).

Run a publicity campaign in your community to inform people what happens to water from stormwater drains.

Help plant the banks of a stream with native plants.

Grow native plants to plant on stream banks.

Encourage local landowners to fence their waterways to prevent stock access.

Be critical of anything we use and buy – do we really need it? What natural habitats and animals were killed in the production of the item bought?

Photograph 8 - Power Generation in the Bay of Plenty

You will need:

- ***Photocopy Master 15*** **- Daily Power Use page 122**

There are a number of hydro-electric power generation schemes in the Bay of Plenty.

These are in the Kaimai area on the Mangapapa River which has two stations and on the Wairoa River which has the Ruahihi power station (all owned by TrustPower).

The Rangitaiki scheme includes the Aniwhenua and Matahina dams (owned by TrustPower) on the Rangitaiki River and another on the Flaxy River.

Learn

Create a picture collage or pictogram of electricity usage.

Have students complete a chart of electricity usage prior to carrying out this activity.

Complete a tally of the number of times that you use electricity from the time that you get home until you go to bed at night.

Make a list at school and then complete the tally marks during the night.
Some starter ideas: turn on a light, use the microwave, watch TV, listen to the radio, use water out of the hot tap, boil the jug, use the computer.

At school discuss the number of times that electricity was used.

Look at ***Photocopy Master 15*** and see if students can work out what part of the line they have contributed to with their electricity use.

Who or what do you think has created the highs and lows in the graph? *Look at* ***Photocopy Master 15*** *average daily power usage in the Bay of Plenty. Why do you think this is? Peaks and troughs in power usage have corresponding peaks in how much water flows over the hydro dam. This affects water levels downstream. Mornings and evenings are the greatest time of demand for domestic electricity.*

Could it be different? How? How could you contribute to levelling out the peaks and troughs?

An alternative is to read the school electricity meter and find out how much power the school consumes. Find out what this costs the school. Investigate ways that electricity usage can be reduced in the school.

Carry out the practical activity and imagine that you are an animal living on the river banks. What happens to you when the water rises and falls? How do you feel about the soil that gets washed into the river from the banks during low water periods, making the water look cloudy and dirty? Now imagine that you are at home and that your electricity for the day has been rationed. How will use your ration of electricity? What alternatives can you use to electricity? What effect will the alternatives have on the environment?

Action

Complete an action plan on how to reduce electricity and water usage in the school. Present it to the Board of Trustees. Ask permission to action it throughout the school.

Practical Activity - Simulating Water Levels

You will need:

- 2 x 1.5 litre plastic drink bottles
- A length of plastic tubing or hose (approximately 30cm)
- Blu tack
- Craft knife
- Water

Ask students if they can think of a way to show how water moves in a hydro-electricity generating lake. To generate electricity, water is fed through the dam to turn the turbines. In times of high electricity demand, more water will be let through the dam in order to generate more electricity. Consequently, the level of the water in the river downstream of the lake will increase.

A simple demonstration could be set up using two or three plastic bottles such as 1.5 litre lemonade bottles. Make a hole in the side of the bottom third of the bottle large enough to insert a piece of plastic tubing.

Fill the first bottle up with water and insert the other end of the plastic tube into another bottle.

Take the cap off the bottle and let the water run down into the second bottle.

This is to simulate water moving from a hydro lake into a power station and then onto the river. Students can see that the water level goes down in one and up in the other.

Use blu tack to seal the holes.

Discuss which parts of the simulation relate to power generation, for example bottle 1 is the lake, the tubing is the power station and bottle 2 the river.

Reflect

- Who drives the demand for electricity?
- What impact does this have on the environment?

Action

What can you do to save water by saving electricity?

Carry out a survey of all the electricity that is used in your classroom. Are there times when electrical appliances are left on in your classroom when they could be turned off?

Carry out the same survey at home and see where you can make savings by turning things off that are not in use. Check out your power demand levels at home at night. Is it necessary to have the television, stereo and radio all going at once? Talk to the adults at home about how you could be more energy efficient and make some savings on the power bill at the same time.

Photograph 9 - Recreation

Learn

How do people like to use water for recreation? See how many things you can list in 1 minute.

Check on the water cycle to see what happens to water each time it is used for recreational purposes. Where does the water go? Is it cleaner or dirtier after it has been used?

What actions can we take to make sure that when we use water it is kept as clean as possible?

Make a list of these actions and put them in a place where you can check them to make sure that water is preserved and conserved.

How might people be affected by water pollution? *Increased bacteria levels and decreased water clarity make water unsafe for swimming. Polluted waters will not support animal life for fishing, bird watching and generally pleasant views.*

Reflect

- What have you found out about the recreational use of waterways in your area?
- What are your favourite recreational activities with water? Does your activity pollute water?
- What are the important things to do to ensure that when we have fun with water it does not become polluted?

4. What impact does our use of the land have on water quality?

Aim: To understand how water and land use impacts on other living things

You will need:

- Photographs 10 to 17 - pages 151 to 158
- Effects of land use on stream and catchment health - table pages 24-26
- ***Photocopy Masters 5 and 6*** **- Land Use Classes pages 110 and 111**

Explore

Select from these ideas

Use photographs as visual resources.

Brainstorm the things that we do on the land. For example, play, build houses, farm, grow plants, make roads etc.

Watch a short clip of a video with the sound turned down (any video will do). Have students focus on how the land is being used.

Create a land use picture collage. Group the uses.

Look through a selection of books already in the classroom. Collate the land uses that are shown in those books.

Make a pre-list of the land uses that students think will have a negative impact on waterways. Check this after you have completed the activities in this section.

For a detailed explanation of each photograph and the issue highlighted, refer to the environmental information section at the front of this unit where the following issues are explained:

- Removal of natural land cover
- Dairy shed effluent
- Stock access to waterways
- Erosion
- Continuous cropping
- Sealed surfaces
- Road works and sub-divisions
- Other issues

Activity 4.1 - Discussion Cube

Learn

You will need:

- Photographs 10 - 17
- ***Photocopy Masters 10 and 11*** **- pages 117 and 118**
- Discussion Cube (a covered box)

Follow the water drop – refer back to Section 1, Activity 1.2 Follow the Water Droplet page 47. This time, however, consider the **land uses** that the drop goes through and what happens to the water drop when it comes into contact with certain places and surfaces. The aim is to examine what impact different land uses have on water quality.

If a large mural of the water cycle has not already been constructed, it would be useful here. Students need to clearly trace the pathway of water as it flows over, around or through the particular land use that is depicted in the photograph. For example in photograph 10, water flowing over land that has recently been irrigated too heavily with effluent is likely to pick up some bacteria and carry that either to a stream or through the earth to a ground water aquifer.

Use an old box to make a cube. Attach one picture to each side of the box to make a discussion cube. Let students 'roll' the cube to select a photograph to discuss.

Split the students into groups of four with each member of the group selecting a "Puzzle" "Predict" "Wonder" or "Clarify" card to think about and discuss the photograph. As students each explore their card remaining students in the group can attempt to answer the questions that are posed.

Set time limits for each person to fulfil their role, and change roles within the groups for each photograph.

As a class, each group can take turns at reporting what their group discussed for each photograph.

Puzzle Look carefully at the picture. Ask a question about something that you don't understand, or that needs further explanation, e.g. what is happening...? Tell me about...? What does...mean?	**Wonder** Look carefully at the picture. Ask a question about what is happening in the picture and how that activity might affect a nearby stream or ground water source, e.g. I wonder why... I wonder if... I wonder who... I wonder how... I wonder when... I wonder what...
Predict Look carefully at the picture. Predict what might happen to the water quality in a nearby waterway as a result of this activity, e.g. I think that... I predict that...	**Clarify** Look carefully at the picture. Explain to your group what is happening in the picture and what impact you think this activity might have on water quality.

Activity 4.2 - PNI (Positive, Negative, Interesting)

Learn

Have each group select one photograph and summarise what they think is happening in a PNI (Positive, Negative and Interesting) chart. Students will need to consider all the factors, such as quality of the water before, during and after the activity, where the water goes, and who or what might be affected by the changing water quality e.g. dairy shed effluent.

Reflect

- What did you learn about what we do on the land and how that impacts on water? Were you surprised?
- Which activities do you think have the biggest impact on water? The least impact?

Positive	Negative	Interesting
· Waste water is not put straight back into a stream. · Using natural nutrients to fertilise the ground. · Recycling water and nutrients. · No smelly pond. · Saving money on fertiliser.	· Land owner might forget to shift the irrigator. · Expensive to irrigate the effluent. · Some of the bacteria might runoff into streams especially during winter. · During wet weather the ground might get waterlogged.	· In time the land may become too saturated, where will the effluent go then?

Activity 4.3 - Inquiry and Action Learning Process

Have students select a photograph to investigate the issue shown. Use the inquiry process outlined at the beginning of this unit on pages 40 and 41.

Help students to source different types of information such as interviewing people, the internet, library, writing letters/faxes, site visits. This approach could constitute a unit of its own.

Activity 4.4 - Muddy Waters

You will need:

This activity requires a plastic model catchment so that water can be collected at the bottom. Or use the model constructed in Chapter 2, Activity 2.4 A Model Catchment page 56.

- soil and sand
- 2 x squares of turf (e.g. 30 cm x 30 cm)
- 4 x sample jars

Learn

Method

With the watering can and/or hose nozzle, spray some water onto the catchment model and collect a sample at the bottom.

Sprinkle a layer of sand over the "hills" at the top of the catchment (the wet plastic should hold the sand in place). Spray some water onto the catchment model and collect a sample at the bottom. (You may need to dig a collecting pit to sit your sample jar in at the point where your "river" flows into the "sea" - off the piece of plastic).

What happens to the sand?

Place turf (grass side up) at the top of the catchment. Spray some water onto the turf and collect a sample at the bottom.

Repeat step 3 with soil side of turf up. Collect a sample at the bottom (plastic needs to be cleared of debris between each step).

Leave the collected samples undisturbed for 5 minutes, then compare them.

Key Questions

What differences are there between the four samples? *The first sample should be clear. The second should have sand settled at the bottom with clear water on top. The third and fourth samples will both be murky but hopefully you will see that the third is less so.*

What has created these differences? How does this relate to rain falling on the land? What happens if the rain lands on bare earth? On plants?

The sand is an example of how sedimentation or silt can build up in waterways when it is washed off the land. Why do you think sediment or silt build up might be a problem in waterways? *The first sample is your control. The sand sample is an example of sedimentation. The last two samples hopefully will show the effects of vegetation versus bare soil (i.e. vegetation helps to hold the soil in place). Sediment reduces water clarity and can make rivers more prone to flooding. Sediment can also smother stream life.*

If a farmer had just sprayed chemicals or fertiliser onto his pasture at the top of the hill and then it rained heavily, what would happen to the chemical or fertiliser? *Run-off into nearest waterway. Students could also think of other chemicals people put onto land that could affect waterways, such as weed killer.*

What would be the effect of this downstream? *The fertiliser can cause excessive algal/weed growth. Eventually the numbers of plants block their own sunlight and they die. Bacteria break down the dead plants using oxygen from the waterway. This leaves less oxygen available for animal life in the waterway.*

Make a list of land uses in your catchment and see if there are any other situations that you can simulate in this model. For example, add a sponge to represent a wetland at the bottom of the catchment, how does this change the water quality? The water flow? Sprinkle dye onto the sponge to show the effect of fertiliser and use another colour to reflect runoff or bacteria from effluent.

Refer to the information at the beginning of this unit on land use and impact on quality and quantity of water.

Reflect

- How do plants help stop erosion?
- What happens to soil without plants on it?
- Can soil be renewed?
- What else can end up in waterways besides sediment?

Activity 4.5 - Property Developer

You will need:

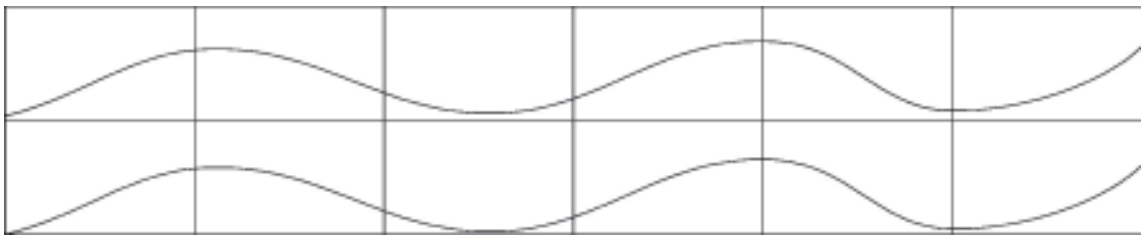
- Large sheets of paper A2 (approximately 12)
- crayons
- film canisters of vinegar
- muddy water
- baking powder
- salt
- yellow dye and toilet paper
- nylon line
- vegetable oil
- small pieces of plastic
- soil
- detergent
- red dye
- plenty of time to complete the activity

Learn

This experiential learning activity invites participants to consider their values related to a known waterway or imagined waterway with high water quality.

Set the scene by telling the students that they are going to own a prime piece of riverside real estate and they are able to develop it any way that they want. You hope that they are going to develop their piece of land into wonderful industries. They might choose a fun park, a gold mine, a farm… anything they want.

Each group lays its piece of paper on the ground so that a rectangle is formed with the sheets of paper, e.g.



Draw a river through the middle of the large rectangle so that each piece of paper has a 'riverside section'.

Discuss how beautiful the river is, how clean the water is and how much people love the river. The Maori people like to gather kai for their hui, everyone gets their drinking water from it, the local tourism operator does boat tours to the source of the pure water, children swim in the water.

Let the groups take away their 'sections' and draw in their planned development. Give 5-10 minutes to complete this.

Bring the whole river back together again and share with the rest of the class what each group has created.

What impacts do their 'dream' activities have on the beautiful river? Give them 5 minutes in their groups to think of the pollutants that might enter the river.

Have the students explain their impact. Select an example of that impact from the canisters to 'put' into the waterway to demonstrate the impact. Tip this into the fish bowl or jar of clear water that represents the river. As they do this, ask them to explain where the impact has come from and what it is doing to the river.

After each addition, ask students to look at the "River" (fish bowl). Can they see an effect of their impact on the waterway?
Would they like to drink the water? Would they swim in the water? Would they eat kai from the river? Why or why not?

Ask the next group down the River how they feel about taking water that the person before you has dirtied. Discuss these feelings.

When each group has added their impact, ask the whole class how they feel about the River.

Reflect on the values that they discussed about this place prior to the development.

Explore what has happened.

What has changed and would we be able to uphold those values in this place if changes occurred?

Is there anything that they would change and could change about their development?

Students discuss alternative ways to use their property. Conclude by asking students to consider the future for their waterway. What would they like to see happen and why?

Is there any action that we can take to ensure this future for the waterway?

Reflect

- What impact did our choices have on the river?
- What impact did our choices have on other people, plants and animals that lived in the River?
- What did we choose to change?
- What did we feel like we had to change because others didn't like it? What wouldn't we have changed if we didn't have to? Why not?
- What are our responsibilities when 'using' water?

Activity 4.6 - Shifting Sands

In this activity students take on the different roles related to a stream. It helps students to understand the impact of soil erosion on waterways and how that can be changed when trees are planted. This activity is good to link with Section 5 How Clean is Our Local Stream? as students start investigating activities in the environment.

Learn

Split the class into three groups. One will be the animals living in the stream – fish, mayflies, stoneflies, snails, koura etc. Another will be the eroding soil and the third trees.

Mark a stream on the ground and let the animals get in and swim around.

Ask the animals how it is in the stream? What do they like? What do they dislike?

Now ask the soil group to spread around the edges of the stream.

Say that as it begins to rain, some of the soil is washed into the stream and some of it is knocked off in erosion. The soil all ends up in the stream.

Ask the animals how they like it now? What has changed? How is it different? What would they like to change?

Take the soil out of the water and have the trees set themselves out, some along the stream banks, some a little further back. Tell them to stand like trees with their roots and branches spread out.

This time when it rains the soil is 'caught' by the trees and does not enter the stream.

Ask the animals how they like it this time? What is different? What do you like? What do you dislike? What would you change?

Discuss what has happened.

Reflect

- What role do you think trees have with streams?
- How do they stop erosion?
- How do they protect the water quality?
- What does this mean for our role as Kaitiakitanga?

Action

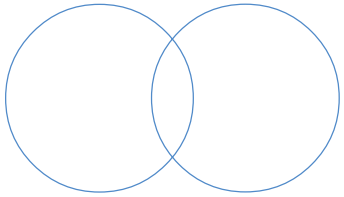
Trees for Survival is a programme that encourages schools to grow trees to plant on erodable land. Working in partnership with a sponsor, a growing unit is purchased for the school to grow trees. Students help to plant the trees and become involved in positive action *for* the environment.

Activity 4.7 Debating the Issues

Learn

Using the information at the beginning of this unit Major Catchments of the Bay of Plenty region page 27, consider what the issues for water quality in your area are. How is water used in your area? What are the dominant land uses? Begin building a local catchment picture of some of the things you might expect to find in your area.

Use venn diagrams to investigate water quality issues.



For example, the topic could be "People should wash their cars on the grass". The two outer parts of the circles would be the *agree* and *disagree* statements, the intersection for the *maybe* comments, or *Usually, Definitely Not* and *Sometimes*.

Other statements that you could investigate – "Removing trees from stream edges is bad", "People should be able to do what ever they like with streams on their property", "Water is a non-renewable resource". Ask students to think of their own statements.

When water becomes polluted, who is affected? Use a T chart to investigate all the possible outcomes of water pollution or lack of conservation e.g. see over page.

A gardener leaves the hose on all night by mistake

Social	Economic	Environmental	Physical
Should water be free or should it be user pays in private homes? (A lot of schools and homes are already on water meters)	More water has to be treated, costing rate payers more.	More water is used than needed.	Ground becomes saturated.

Other suggestions:

- Washing your car on the side of the road.
- Fertiliser truck crashes into a river, emptying all the fertiliser into the river.
- An irrigator breaks down and the dairy shed effluent runs into the nearby stream.
- An orchardist sprays chemicals onto the trees and some of it drifts into the river.
- A herd of cows crosses a stream everyday to be milked. As the cows walk through they poo in the stream and their hooves create lots of sediment.

- A manufacturer uses water from the river to cool the machinery. The company's computer gets a virus and the water going back into the stream is too hot. The hot water kills all the animals and plants.
- A painter cleans the brushes and containers and then tips the water onto the street.
- A service station hoses the forecourt into the stormwater system twice a day, every day.
- Cows have access to a stream, eroding the banks as they drink from it.

Reflect

- What were the issues discussed for your area?
- What parts of the environment do water quality issues affect? Social? Economic? Environmental? Physical?

Place opposing thoughts relating to the issue on either side of the T.

e.g. issue: Water pollution - affects....

Activity 4.8 - Twenty Questions

Learn

Have students write 20 questions about water pollution and the answers to their questions. (Adjust the number to suit your needs.)

Swap questions and answers with a partner.

Use the questions in a class quiz, playing noughts and crosses with the correct answers.

Split the class into teams of 4 or 5. Each group in turn selects a numbered question to answer. If they get it right they score a point, if not the question goes back into the pool and the next group can ask for that card. (This helps to keep everyone involved and listening). If they ask for a question that has already gone they forfeit a turn.

Use the questions to play a game of "Around the World". Students stand quietly and if they know the answer to a question they may take a step forward around the room. Their goal is to get back to their desk. A control measure for noise could be a step back.

Reflect

- Can you name one source of water pollution?
- Where does that source of pollution come from?
- What effect does it have on the water?
- How could it be prevented?
- How do you use water at home? In the garden? On the farm?
- What changes might you make?

5. How clean is our local stream?

Aim: To find out how clean our local stream is by monitoring the water quality.

Explore-

Select from these ideas

How clean is the water? What does clean mean? Some sources of pollution are easily seen, such as rubbish dumping, while others are less visible, such as bacteria.

In the previous activities some of the 'pollutants' we added didn't seem to change the water at all, but we knew that the pollutant had been added. How do we know if a waterway is polluted?

Think of a local waterway.

How do we know that the water is clean or dirty?

What could we look at to check on the quality?

What would we do if we found that the water quality is good? Bad?

What do we think our local stream/river water quality will be like? **How will we find out?** Take student responses and record them as a brainstorm or a graffiti chart. Save it to compare with the next activities. Use the students ideas to create the basis of your stream visit activities. Using the journal article Testing the North River 1996 part 2 number 3, gives students ideas about how they can **find out** about how clean their local stream is.

Learn

Environmental Education *in* the Environment.

These activities are designed to give an overall picture of water quality. Although single activities will give you an indication, it is the accumulation of the results of **all** the activities and the investigations that have occurred throughout this unit that will give you a more accurate picture of the water quality of a stream.

Activity 5.1 - Pre-Field Trip Discussions

5.1.1. The Physical Factors

You will need:

- ***Photocopy Masters 18 - 25*** **- pages 125 - 135**

Learn

Clarity - *Photocopy Master 18* - Clarity page 125

Gather water samples from different places around the school in clear glass jars. Try to get a variety of sources e.g. from the tap, a puddle, the swimming pool.

Discuss the differences in quality and why these differences might occur.

Discuss the clarity tube and its purpose (refer to ***Photocopy Master 18*** for instructions).

Have students think about what things might alter the clarity of a waterway. *Erosion, stock in a stream, fertiliser runoff increases plant and algae growth, stormwater runoff, discharges from industry.*

pH - *Photocopy Master 19* - pH page 126

Sometimes pollutants enter waterways and they cannot be seen immediately. Measuring the pH (acidity or alkalinity) of the water can be one way of detecting differences. Discuss what pH is and discuss examples, e.g. citrus fruit is acidic around about 3 or 4, bottled water is around 7, neutral. Fertiliser has a pH of around 6.

Discuss what might cause differences in pH. *Acid spilling into a waterway such as an accidental spill of trade waste. Acidic water can kill fish living in a waterway and make the water very toxic. Alkaline readings can be caused by excessive lime fertiliser or detergents in the water. This can cause too much plant growth in the waterway and block it or use up valuable oxygen in the water.*

Look again at the water samples and decide what sort of pH you would expect them to have. Follow the instructions in ***Photocopy Master 19*** and test 2 water samples. Discuss the results.

Temperature - *Photocopy Master 20* - Temperature page 127

Discuss why the temperature of a stream would matter and who it would matter to. *Macroinvertebrates like cold fast running water with plenty of oxygen in it. Still water tends to have less oxygen and heats up faster. Macroinvertebrates are at the beginning of the food chain for other aquatic life.*

Discuss things that people can do to either make a stream cooler or warmer. *Damming a river will make the downstream flow slower and potentially increase the temperature. Using water to cool machinery and returning the water slightly warmer. Planting trees will provide more shade, cooling water down.*

Guess the temperature of different water sources around the school. Practice reading a thermometer and taking the temperature of water, Photocopy Master 20.

5.1.2. Water Flow

You will need:

- ***Photocopy Masters 21a and 21b*** **- pages 128 - 130**
- ***Photocopy Master 14*** **- Otara River page 121**

Find out if the water from a local river or stream is used by people and what it is used for. Discuss what a cubic metre is. Do some conversions of cubic metres to litres (1 cubic metre = 1000 litres). Comparisons: a milk tanker with truck and trailer carry 25 000 cubic metres, the Olympic swimming pool built for Sydney has a capacity of 2000 cubic metres (50m x 20m x 2m deep), a standard hot water cylinder in a home holds 180 litres of water.

Discuss who and what is affected by a change in the flow of a river. *Regional Councils measure the flow of a river to determine if there is sufficient water for people who want to 'take' water and also to understand how flows change in floods.*

Look at ***Photocopy Masters 21a and 21b***, the field sheet for the flow activities, and practice relevant skills such as measuring the depth of water and converting the measurement to metres. Put 'mock' figures into the calculation and discuss the results and how to convert the figures.

There are two sections to this to get a measure of cubic metres per second of water flow. Part 1 is the **velocity** of the water and Part 2 is the **area** of the stream.

The stream velocity

1. Add together all the orange float times. Divide it by the number of repetitions, i.e. find the average time.
2. Divide this time by the distance that the orange travelled (hopefully 10 metres).
   Velocity = Time/Distance
   = metres/second
   (Using 10 metres makes the maths easy!)

The stream area

1. Add together all the depth measurements (make sure that these are in metres. If the depth has been recorded in centimetres convert to metres, e.g. 41cm = 0.41m). Divide them by the number of measurements made to give you an average depth in METRES.
2. Multiply the average depth by the width of the stream to get square metres (m^2).
   Area = stream width x average depth (take 10 depth measurements across the stream and average)
   = _____ m x _____ m
   = _____ m^2

The overall flow of the stream

1. Multiply the velocity (from part 1, Photocopy Master 21a) with the area (from part 2, Photocopy Master 21b).
2. Your answer is cubic metres per second. To convert to litres multiply this by 1000.
   Flow of stream
   = Velocity x Area
   = _____ m/s x _____ m^2
   = _____ m^3/s (to convert to litres x 1000)

- Have students practice using these equations and discuss what information they will be finding out from doing this activity.

5.1.3. The Biological Factors – The Animals

You will need:

- ***Photocopy Masters 23 - 25* - pages 132 - 135**

Discuss what sorts of animals students might expect to find in a stream. *Fish, eels, insects, snails, worms, midge, sandfly and mosquito larvae, back swimmers, water boatmen, fresh water koura, mussels, leeches, macroinvertebrates – larvae and nymphs of adults such as mayflies, dragonflies, damselflies, stoneflies, dobsonfly larvae.* The Stream Community picture pack is a valuable resource from Learning Media that will assist with this.

Investigate the lifecycle of some of these animals and the places that they like to live.

Refer to ***Photocopy Master 23* - Bug identification chart**. The numbers on the chart refer to the animals Pollution Tolerance Index or PTI. The smaller the number, the more tolerant the animal is of pollution. Animals such as the mayflies and stonefly nymphs score a 4 and are not tolerant to pollution.

Talk about the part that they play in the overall food chain, as they are only living out part of their lifecycle in the water. For example, stream insects (and other aquatic invertebrates) feed from materials within the stream:

- algae growing on rocks is munched by grazers **e.g. snails,**
- fragments of organic matter are netted by filterers **e.g**. **sandfly larva**
- leaves and twigs that become trapped in the stream are eaten by browsers and shredders **e.g**. **mayfly**
- Predators prowl trying to capitalise on the hard work of the grazers, filterers, shredders and browsers (i.e. eat them!) **e.g. the glamorous toebiter.**

The Stream Community has a food web card that is helpful for this.

Play a game of Who am I? Students ask yes and no questions to another student to try and identify an animal, e.g. I have a PTI of 4, I like cold running water, I live part of my life in the water, the adult part out of the water. Who am I?

Discuss how students will find and identify these animals by discussing field sheet **Photocopy Master 23**.

5.1.4. Habitat Assessment – Bug Food and Stick Races

Discuss the environments that we like to live in and the habitats that help us to thrive. Ask the students to consider what kind of habitat they think stream animals need to thrive. *Cool, clear running water with a variety of places to live. The bottom of the stream needs to have rocks for the water to bubble over and become aerated, and sides of the stream should be planted with trees to provide shade, food and filtered light.*

Look at the photographs of streams included in this unit and gather your own photos. Decide which ones students think would be a 'good' habitat for animals.

Design a water craft that will determine the stream rating as a suitable habitat for animals. Be prepared to test them at the stream. Remember to make them biodegradable in case they get away.

Go over ***Photocopy Master 24*** **- Bug Food and Stick Races** and discuss the things students will need to be looking for in this activity.

For a more precise assessment use **Photocopy Master 25**, Habitat Assessment sheet. Each of the factors on the master are scored and then an overall rating of habitats for the stream is reached.

Reflect

- Are students aware of the procedures required to carry out the stream activities?
- Do they have an expectation of what they might find and what this will tell them about the water quality in that stream?

Activity 5.2 - The Field Trip: Education *in* the Environment

Choosing a suitable site for water activities is essential for an enjoyable day. Important factors to consider are that streams are safe for students to enter, that they have places for the different activities, and that they are known to at least one member of the group.

A pre-visit to the site is strongly recommended so that a Risk Analysis can be carried out. Check your school policy for acceptable adult-student ratios around water and follow this policy. Students should be involved in planning risk management procedure for the day.

Each activity requires adult supervision and should have been thoroughly explained and discussed with students before visiting the stream. Students should have a good understanding of what the activity measures, why they are doing it and how the activity is carried out.

Two parts to a field trip can be completed in one day. Students can also investigate how a local water user such as a water or waste water treatment plant (as discussed in section 3) uses water. Contact your District or City Council to arrange a visit.

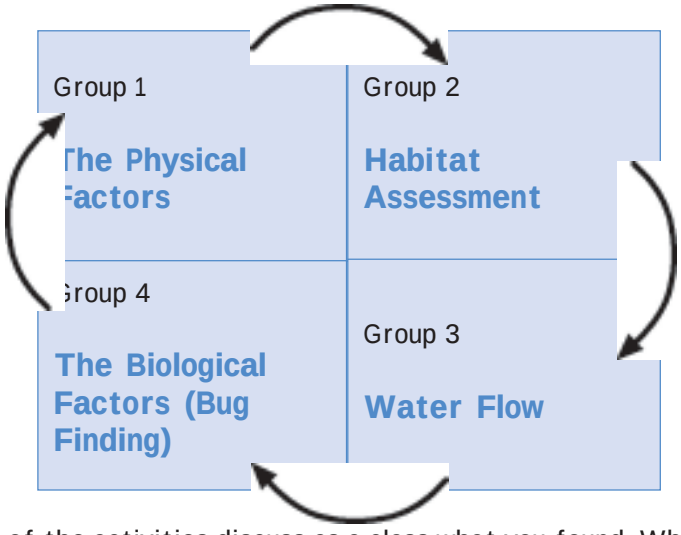
The success of the water activities is reliant on good adult supervisors who have been well briefed on the expectations of them for the day. Sending home a copy of the activity that they will be supervising several days before the trip allows time for any issues to be sorted out.

Learn

Discuss with students what they expect to find, see and investigate.

Focus on the stream and the things that they can see that will contribute to good water quality and poor water quality.

A 'round robin' type arrangement of the water quality activities ensures that students get maximum hands-on experiences. Select suitable sites for each of the activities. For example:



Reflect

- At the conclusion of the activities discuss as a class what you found. What 'picture' is emerging about the stream?

Please ensure all equipment is returned clean and complete. Please report any damage, loss or difficulties on return of the equipment.

Make sure you take only pictures and leave only footprints.

6. Your Own Catchment "Picture"

Aim: To bring together the students' ideas about water in their area and consider what actions they might take to protect, conserve or enhance that water.

Explore-

Select from these ideas

Use graffiti sheets to gather information from your stream or water use site visit.

Place large sheets of paper around the room with headings for each of the activities from the stream or questions that you want to investigate. Include personal viewpoint statements as well as factual information. You could also gather information on group skills asking students to comment on how well they worked as a group.

Have the students move quietly around the room placing comments and responses on the charts under the headings.

If they agree with a response already written by another student, they can tick that comment.

Each sheet can then be summarised by a group and presented back to the class.

Activity 6.1 - Business Card Summary

Learn

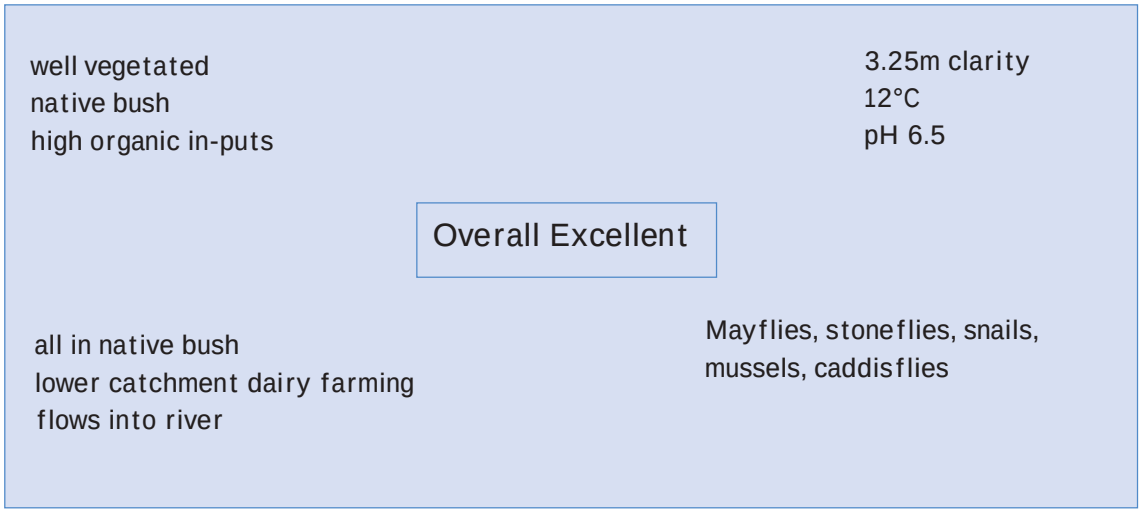
Using half an A4 sheet of paper or card, have students write a business card summary of the information they gathered at the stream.

In the middle of the card is the name of the stream. Students can then select from the following pieces of information:

- flow
- clarity,
- pH
- temperature
- number of bugs
- habitat assessment
- catchment information
- land uses surrounding the stream
- possible sources of pollution
- future action

Students could devise an overall rating for their stream.

This could also be done pictorially.



Activity 6.2 - Trircles

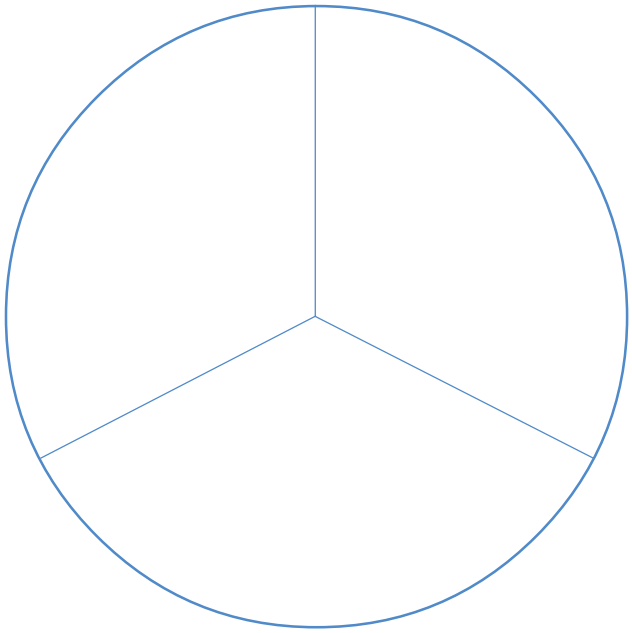
Trircles are circles divided into thirds. They help students to structure information.

The overall heading will be waterways in the students' area, inside the circle could be: questions, answers, conclusions, problems, possible solutions, possible outcomes,

Past, present, future.

Done on big sheets, this information is easily shared.

e.g.



Activity 6.3 - Jigsaw

You will need:

- ***Photocopy Master 26*** **- Jigsaw page 136**

Make a jigsaw of the catchment you have been studying. On the centre square put the name of the catchment. On the outside squares students answer questions about the catchment. The back of the template might have a visual that can be reformed when all the questions have been answered.

Sample questions:

- Name 5 different land uses in the area.
- Name 1 tributary of the major river.
- List 3 sources of pollution in the catchment.
- Name one pollutant and the consequences it has.
- Describe one action that can be taken to improve water quality.
- Draw an animal that has a PTI of 4
- Draw a clarity tube showing low clarity.
- Name something that will improve stream habitat.
- List 10 different uses for water.
- List 5 water conservation measures.

Students can then compare answers and complete each others 'jigsaws'.

Activity 6.4 - Situation Sets

Have students imagine that they are an invertebrate living in the stream. Have them act out or write a letter to the other participant, or draw a cartoon for the following situations telling them what impact their actions have had on them.

What do you do when:

- A person washes their car on the side of the road and the detergent comes down the stormwater pipe on top of you.
- A farmer lets the cows walk through the stream and they poo on you.
- A family empty their pool with all the chlorine in it into the stormwater drain and you and all your friends get sick drinking the chlorinated water.
- A property developer cuts down the trees beside your stream to show off the view, but now you don't have any food and it gets really hot during the day with the sun beating down.
- An orchardist sprays the trees and some of the spray drifts into the stream making you feel very unwell.
- An electricity company decides they want to dam your river to generate electricity. It means that your stream will be flooded into a lake. Where will you live?

Consider the situation with your own waterways. Can you talk to, write to, visit anyone to discuss the impact of their actions on the water quality in your area?

Activity 6.5 - Media Release

A major environmental catastrophe has happened in your local area (Select one!)

- A fertiliser truck has crashed into your stream.
- A tanker with acid wash leaked overnight and the acid has gone down the stormwater system into the river.
- A truck driver fills the truck with petrol instead of diesel by mistake. The driver empties the petrol down the stormwater drain.
- During a flood the stormwater pipes get overloaded and mix with the sewage pipes. Raw sewage ends up in the river.
- The council drops poison baits for possums into the water source for a local town by accident. The water supply is polluted and no one can drink the water.
- Read the paper or check Environment B·O·P's website www.envbop.govt.nz for local news releases of other environmental issues.

You are the reporter for the local television channel and you have to get this report on for the 6 o'clock news. You need to find out all the facts of the situation plus you have to interview people to ensure that different view points are covered: the council; the perpetrator; a local bystander; a witness; a person who uses the water such as a farmer for stock water; local iwi gathering kai; local whitebaiters; people fishing; water skiing; rowing; regional council water monitoring staff; fire brigade etc.

Produce your report and play it live.

Reflect

- What is the state of water in your area?
- Are you happy with this?
- What things can you start doing in your school to make a difference?
- Don't work alone! Talk to other groups in the community who also might be interested in helping you, such as local iwi, Care groups, junior naturalists, cubs, Scouts, Girl Guides, Kiwi Conservation Club, environmental club at your school.
- Share your findings with others.
- Celebrate the clean water in your community and broadcast the ways in which it can stay that way.

Homai te waiora ki au
Give me the life-giving water

We hope that you and your students have enjoyed this unit of work and feel empowered to make a difference so that clean, healthy water will be available for many generations to come.