The story of a river

This activity provides an excellent introduction to the issues relating to water quality and river management. It introduces the inter-connections within a catchment and some of the causes of water pollution by observing the impact of pollution on a simulated catchment. You may wish to do some simple testing - salinity, turbidity or have students make observational recordings, describing what happened and the changes that resulted.

Students can work in pairs to rank the significance of different causes of water pollution based on their own experiences and knowledge of the various causes of water pollution. The class can discuss the impacts and the significance of each. You can then identify what issues may exist in your own catchment.

Key Learning Outcomes

Level 4 Science: Living together
Identify living and non-living things that affect the survival of organisms in an ecosystem.

Level 4 SOSE: Natural and social systems
Describe responses of different elements (including people) to change in natural systems.

Level 5 Science: Living together
Explain the effects of various environmental changes on living things in ecosystems.

Level 5 SOSE: Resources
Compare natural and human environments and describe factors affecting them.

Aims

- to explore the links between lifestyle and water pollution
- to investigate decision making processes

Materials

one clear container such as a punch bowl or small fish tank filled with water (4-5 litre capacity)

16 film canisters (available from most photo labs)

Blackline master 1: Catchment story labels

vinegar	thick muddy water
salty water	baking powder
baking soda	toilet paper
nylon line	vegetable oil
litter	soil
detergent	red food colouring
yellow food colouring	

Note: All these substances are non-toxic.

Advanced preparation

1. There are 16 land uses identified in the activity story. Adapt to suit the size of the group (e.g. each land use could be assigned to two people, some uses could be omitted or more than one allocated per participant to cater for the size of the group. Some land uses could be omitted if they are not relevant to your catchment.
2. Prepare one labelled film canister for each participant. Fill with substances and quantities listed in the table on page 5. Photocopy the 'labels' and cut and tape a label to each canister.

Activity instructions

1. Briefly introduce the concept of Australia being the driest inhabited continent and discuss that water is so precious yet many ecosystems are under threat of pollution. All of us living within water catchments contribute directly or indirectly, significantly or not so significantly to the degradation of our waterways, often without realising the relationships and impacts that humans make.

Procedure

2. Place a clear jar (eg. a punch bowl or small fish tank) containing 4-5 litres of water centrally in the room and explain it represents the 'river'.
3. Distribute the canisters among the group. Remind them not to open them until their 'character' emerges in the story, then they are to empty their canister into the clear bowl of water -'the 'river'.
4. Read the story in a dramatic way, stopping at the end of each section when a character/land use is mentioned. Remind participants to come forward and empty their canister.

   [*Each particular land use is written in* ***bold italic*** *in the story.*]

Note: The title of the river in the story has been left open so that you may include the name, if you wish, of the local river which runs through your catchment.

[Adapted from *Who Polluted the Potomac?*, Anne Ferguson Foundation USA, and *Queensland Waterwatch.*]

The story of a river

The story

This is the story of the travels of a very special river - our river - through its catchment. It begins in the higher parts of the catchment where the rain runs off the slopes and begins its long journey to the sea. In the valley below there is a ***power station*** which generates electricity for the region. It burns large quantities of coal and releases pollutant gases into the atmosphere.

These pollutants combine with moisture in the atmosphere to produce acid rain. Rainfall carries these acids back to the Earth's surface and can pollute the very source of the river. The water gathers momentum as it descends the slopes. The river continues its journey towards the sea through ***farming country*** where, recently, some crops were fertilised. Afterwards they were watered and the run-off into the river has brought with it some of the fertiliser.

The neighbouring farm is a ***piggery***. Some of the manure from the pig pens washes into a drainage pipe which then empties into the river. On the other side of the river are ***grazing lands***. There are very few trees remaining and in some of the lower parts of the pasture, the water table has risen because the trees are not using the water any more. This water brings the salts in the soil up to the surface making the land unusable. It also means that run-off from the land is salty and this threatens the freshwater organisms and animals in the river. A grazing ***herd of cattle*** feed on the vegetation on the banks. When heavy ranis arrive the banks collapse into the river.

The ***coal mine***, which supplies raw mineral for the power station, pumps water out of the river to clean its equipment and flush out some of the waste. This includes various acids which all drain back into the river. Slowly the river starts to wind its way through the outskirts of a major town. Out here there are a number of ***hobby farms***. The houses here are not connected to a sewerage system but have their own septic tanks. Occasionally these tanks overflow and untreated sewage seeps directly into the river.

There are a number of people making use of the river around the bend. Someone is ***fishing*** on the banks. Unfortunately their line gets caught around a rock and is left in the water. Other people are ***water-skiing***. Their boat needs a service and in the meantime its engine is leaking oil directly into the river. Another group of people is enjoying a picnic at a ***park*** overlooking the river. A gust of wind blows some of their rubbish off the table and down into the water.

Further downstream the river is being utilise for ***tourism***. A charter boat is giving some people a scenic tour of the river. Drinks are for sale on board but not everyone uses the bins that are provided.

The river now starts to meander through the suburban part of the town. A new ***subdivision*** is being developed. Many of the trees have been removed and when it rains, the top layer of soil is eroded and contributes to the silting up the river. Most houses in the developed parts of the town have a ***garden***. To keep those nasty bugs away the gardeners use a range of pesticides. At the end of the day the sprinklers are turned on to water the plants. The pesticides wash off into the stormwater drains and enter the river.

People who have spent the day at work are now starting to drive home. The ***roads*** are choked with traffic. Oil drips out of many of these cars and sometimes they brake in a hurry leaving traces of rubber on the road. Every time it rains these pollutants are carried into the stormwater drains and straight into the river.

There is still some ***industry*** along the river here. It uses detergents to keep its production equipment clean. But sometimes, the dirty water is hosed out of the factory into the gutter where it disappears into a storm water drain. Once again, however, this water flows straight into the river. If there were phosphates in the detergent then it will cause excess algae growth in the river. When this algae dies and begins to rot, it uses up oxygen which animals in the water rely on. They may suffocate as a result.

Redevelopment is occurring on the opposite bank. Demolishers have discovered a few drums of something mysterious. They won't be able to sell these as scrap. Someone suggests emptying them into the river. Everyone agrees and the waste from the old ***tannery*** is released into the river, to the detriment of all the organisms and animals living in it.

With one final bend the river finally arrives at its mouth and flows into the sea. But look at what flows out with it!

What can we do with our river ? A heavy rainstorm would help. The fresh supply of river water from rain can help flush out many pollutants. Indeed, rivers can be a major way of flushing and cleaning ecosystems. However this only moves the problem to a coastal area where other ecosystems will be affects. We must reduce the amount of pollution that is entering the river.

Catchment story labels

Set 1

Power Station	Herd of Cattle	Farming Country	Piggery
Grazing Land	Coal Mine	Hobby Farms	Fishing
Water Skiing	Park	Tourism	Subdivision
Gardens	Roads	Industry	Tannery

Set 2

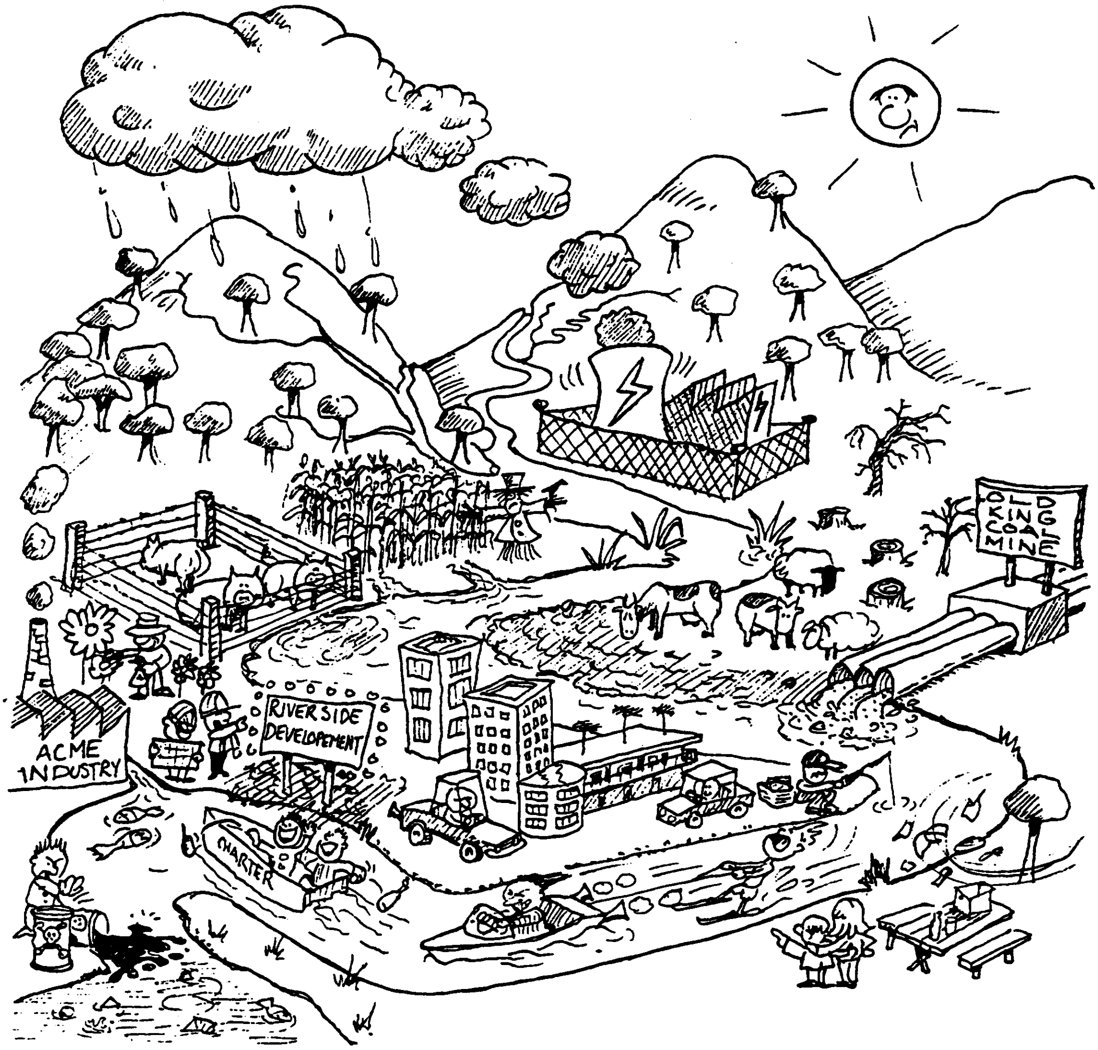
Power Station	Herd of Cattle	Farming Country	Piggery
Grazing Land	Coal Mine	Hobby Farms	Fishing
Water Skiing	Park	Tourism	Subdivision
Gardens	Roads	Industry	Tannery

Land use	Substance	Quantity/Contents
Power Station	vinegar (acid rain)	1/2 canister
Herd of cattle	thick muddy water	1/2 canister
Farming country	baking powder (fertiliser)	1/2 teaspoon
Piggery	thick muddy water	1/2 canister
Grazing land	salty water	1/2 teaspoon salt in full canister of water
Coal Mine	vinegar (acid run-off)	1/2 canister
Hobby farms	yellow water / toilet paper	full canister of water & small piece toilet paper
Fishing	nylon line	tangle of line
Water skiing	vegetable oil	1/2 teaspoon
Park	litter	styrofoam, plastic etc.
Tourism	litter	paper plastic etc
Subdivision	soil	1/2 teaspoon
Gardens	baking soda (pesticide)	1/2 teaspoon
Roads	vinegar (acid run-off)	1/2 canister
Industry	soap water (detergent)	1 drop detergent in full canister of water
Tanner	water/food colour (red), beetroot	5 drop of solution in full canister of water

Student sheet 1

Story of a river

1. How did you feel about the change in the colour and look of the 'river' ?
2. How would you feel about drinking or swimming in this water?
3. Why was the water so different in appearance at the end of the story?
4. Do you think this is like the real situation - is this how pollution might occur in our river?
5. List the ways that pollution in a catchment might affect you personally, how might this accumulated pollution affect the coast / beach / ocean, and in turn you?
6. Were any types of water pollution in the activity illegal? If so, why does this pollution still happen? If not, why aren't laws or penalties to protect waterways more effective?
7. What other kinds of measures could be used to prevent or reduce water pollution?
8. Where could this activity be used to raise people's awareness of water pollution?
9. Write your own story about the catchment in which you live, drawing on the different issues in your area.



Water: who needs it?

Key Learning Outcomes

Level 4 Science: Living together
Identify living and non-living things that affect the survival of organisms in an ecosystem.

Aims

- to develop understanding of the many ways people use water
- to develop understanding of the ways plants and animals rely on water
- to draw conclusions about the quality of water needed for different uses by plants, animals and people

Materials

Student sheet 2: Water Quality Standards

3 containers for each group.

distilled water (approx. 3 litres)

table salt

laboratory scales

small cups (one per student)

Additional resource

Water Quality Standards table, page 45 in *Saltwatch A Resource Book for Schools*. NRE. 1997.

Advanced preparation

1. Prepare the simulated 'water' using distilled water:

container 1	0.10 grams salt per litre distilled water (simulated fresh water)
container 2	1 grams salt per litre (marginal water)
container 3	3 grams salt per litre (brackish water)
container 4	35 grams salt per litre (seawater)

2. Duplicate a copy of Student sheet 2: Water Quality Standards Table for each group.

Activity instructions

1. Divide the class into small groups and provide each group with 3 jugs of the prepared solutions, cups and a copy of Student sheet 2.
2. Explain that one way to measure water quality is to measure how much salt is in it. We can taste salt in water and once it becomes too salty, it is not fit for us to drink and cannot be used by livestock, agriculture or industry. Illustrate this by using examples of different water quality levels requirement in the Water Quality Standards Table on Student sheet 2.
3. Explain that one way salinity levels are measured is with a portable instrument which reads the electroconductivity of the water. It provides reading in 'EC' units. The more salty the water, the higher its EC reading. In the past the most common way salinity was measured was by evaporating a given amount of the solution and weighing the remaining salt. The units were milligrams per litre (mg/L) of solution or TDS (Total Dissolved Salts).
4. Explain the water has a range of natural salts dissolved in it, e.g. sodium, calcium and bicarbonates. These all contribute to the salinity of the water. The amount of these salts in the water varies naturally with the geology of the surrounding area that the surface water and ground water flowed through. For example, an area which was an inland sea in the geological past would naturally have high levels of salt in it.
5. Ask each student to taste water from Container 1. Explain this is water of Excellent quality. It will not taste salty because it has very little salt in it.
6. Repeat step 2 for the remaining containers, in the sequence from Container 2 to 4. They have now tasted water rated from Excellent, Good, Fair, Poor to Very Poor Quality for salt levels. These categories also roughly relate to freshwater (excellent to good), brackish (fair) and seawater levels (poor to very poor).

   [*Explain that the fair to very poor quality water was made by adding table salt to it - a sip of it is not harmful to their health.*]

Water: who needs it?

7. Each group brainstorms to develop a list of ways fresh water (i.e. not sea water) is used by people in Victoria.

   [*E.g. we use water for drinking; other domestic uses such as washing ourselves, washing clothes and dishes, and watering garden. For watering livestock; for growing crops; in industry; and for recreation such as swimming in, fishing in, boating on.*]

8. Group students' examples of uses in headings on the board as shown below.

   [*See example on next page.*]

9. As a class, develop a short list of some of Victoria's aquatic plants and animals.

10. Each group brainstorms to develop a list of ways these animals and plants use fresh water.

    [*E.g. for drinking, growing in, swimming in, catching food in; they need water to live in.*]

11. As a class, use the Water Quality Standards Table to allocate a water quality standard needed for each use by people, plants and animals.

    [*Excellent, Good, Fair, Poor or Very Poor. Some may need to be guesses.*]

12. Draw conclusions.
    - People, plants and animals use water of a range of qualities.
    - Many uses require Excellent to Good quality water.
    - Fewer uses can be made of Poor and Very Poor quality water.
    - Fewer aquatic plants and animals can survive in Poor and Very Poor water quality.
    - For health reasons, human consumption (drinking) and contact (swimming) need Excellent or Good quality water.

Extension

Conduct salinity readings of your water samples with the EC or TDS Meter supplied in the Waterwatch equipment kit.

Alternative activity

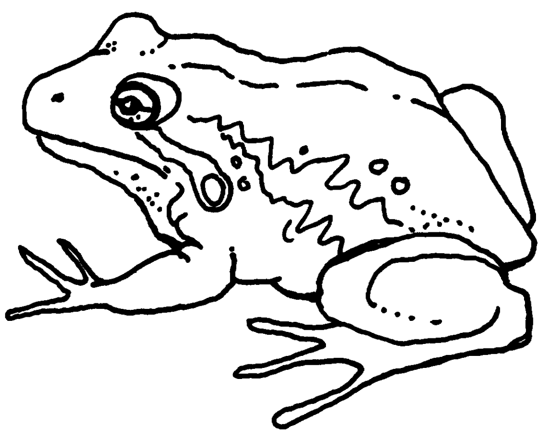
Students bring in water samples from home or local watercourses and conduct the activity without the tasting component.

e.g. People

Drinking	Domestic Uses	For Livestock	Growing Crops	Industry	Recreation Swimming	Recreation Fishing, Boating
Excellent to Good	Excellent to Poor	Excellent to Very Poor	Excellent to Medium	Excellent to Very Poor	Excellent to Good	Excellent to Very Poor

e.g. Animals

Platypus	Frog	Fish	Reeds	Algae
Excellent to Good	Excellent to Good	Excellent to Good	Excellent to Good	Excellent to Poor



Water quality standards

One way to measure water quality is to measure the salinity level in the water. Salinity levels can be measured with a portable instrument which reads the electroconductivity of the water. It provides reading in 'EC' units. The more salty the water, the higher its EC reading. Salinity can also be measured by evaporating a given amount of the water and weighing the remaining salt. The units are milligrams per litre (mg/L) of solution or TDS (Total Dissolved Salts).

Conversions
From EC to mg/L multiply by 0.6
From mg/L to EC divide by 0.6

Water Quality Standards Table

Rating	EC	mg/L
Excellent	0–799 EC	0–479 mg/L
Good	800–1,699 EC	480–1019 mg/L
Fair	1,700–2,499 EC	1020–1,499 mg/L
Poor	2,500–9,999 EC	1,500–5,999 mg/L
Very Poor	Over 10,000 EC	over 6,000 mg/L

1. Use the Water Quality Standards table above to complete the Salinity Tolerance Table below.

Salinity Tolerance Table

Upper salinity limits for some water uses		Water quality required
Domestic	1667 EC	e.g. Excellent (preferred) to Good
Industry		
Rayon	167 EC	
Paper	250 EC	
Petroleum	583 EC	
Carbonated beverages	1417 EC	
Irrigation		
Tobacco	83 EC	
Citrus, legumes, garden plants	1,667 EC	
Vines, grass, cabbages	2,500 EC	
Lucerne, cotton	4,167 EC	
Livestock		
Poultry	5,833 EC	
Pigs	7,500 EC	
Horses	10,833 EC	
Milking cows and ewes	11,667 EC	
Beef cattle	18,333	
Dry sheep	25,000 EC	

(Source: Groundwater Victoria, Department of Industry, Technology and Resources, Melbourne. 1987)

2. Conclusions
Write a sentence or two to summarise your conclusions about the water quality needs of plants, animals and people. (e.g. Is the same water quality needed for every

Introducing water quality

Conduct as a demonstration or organise students to conduct this experiment in small groups.

Other experiments in this publication can be used to measure specific changes. This initial experiment or demonstration provides a visual introduction to pollutants and water quality.

> ### Key Learning Outcomes
> **Level 4 Science: Living together**
> Identify living and non-living things that affect the survival of organisms in an ecosystem.

Aims

- to highlight that we rely on good quality water coming from our taps
- to introduce the connection between our drinking water and the rivers in our catchment
- to illustrate that water quality can be affected by inputs
- to illustrate that water may be polluted even though it looks clear

Materials

Per group:

2 glass jugs or clear containers

1 glass or container per ingredient

tap and creek (or river) water

texta and masking tape to label jugs and glasses

teaspoon(s)

ingredients to represent pollutants (e.g. soil, fertiliser, salt, cooking oil, laundry powder, ammonia, rubber bands, vinegar)

Student sheet 2: Introducing water quality

If required, Blackline master 8: Water supply distribution system.

If demonstrating, use larger containers and quantities of pollutants so as to be more visible to the class.

Advanced preparation

1. Collect about half a litre of creek water per group from a local waterway.
2. Collect a large jug (about 2 litres) of water from a tap in the school.
3. Duplicate the required copies of Student sheet 2: Introducing water quality.
4. If required, make an overhead of Blackline master 8: Water supply distribution system, or draw a simplified version on the board.

Activity instructions

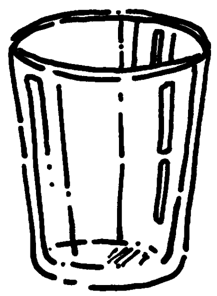
1. Place both jugs of water in clear view of all the students and explain what is in each. Ask which they would rather drink?

   [*Taste, appearance and health are important for drinking quality water. Both jugs may have clear water but tap water is treated therefore we know it is high quality water that is safe to drink. Creek water may not be as clear; it may even have some more obvious pollutants in it.*]

2. Explain that our tap water has come from a river somewhere, usually one in the catchment. Water is collected from a river, carried in underground pipes to our schools, homes and workplaces. So river water becomes our drinking water.

   [*Explain the term 'catchment' if needed. If desired, use the overhead of Blackline master 8: Water supply distribution system to illustrate water is piped from a river (dam) to a house.*]

   [*For Aborigines, drinking water usually came directly from a river and was good quality. Early settlers also obtained their water directly from rivers and creeks but waterways became polluted as the population increased. Today it is generally not considered safe to drink water directly from most waterways. As part of this unit students will investigate why water has become polluted since European settlement.*]



Introducing water quality

3. If undertaking as student experiments, organise the class into small groups and distribute materials. Different groups could conduct the experiment with different pollutants to allow for more types of pollutants to be simulated.
4. If a demonstration, pour a glass of tap water for every pollutant' ingredient you will demonstrate.
5. Add 1 teaspoon of one of the ingredients to the 1st glass of tap water and label it. As you add the ingredient, discuss what it represents.

   (*E.g. soil, fertiliser, salt can represent pollutants from farms and gardens*

   laundry powder and ammonia can represent household pollutants

   oil, vinegar, plastic bag, rubber bands can represent industrial pollutants

   rubber bands might be rubber tyres, oil might be motor oil washed down stormwater drains, food colouring might represent chemicals that a factory dumps illegally into a waterway, vinegar might represent acid mine drainage from a strip mine).

3. Discuss ideas from students as to how and where each pollutant in step 5 might get into a real-life river.
4. Can they see any differences in the water after the ingredient has been added?

   [*E.g. the water may become cloudy.*]

   Introduce the term 'pollutant' and discuss how this pollutant may affect water quality.

   [*Increase or decrease water quality? All these ingredients will* decrease *water quality.*]

5. Repeat this for each other ingredient sample you have to simulate different types of pollutants which can enter a river.
6. Write up a class list of which pollutants dissolved or disappeared when added to the water, so that you could not *see* a difference in the water. It still looks clear but it is polluted.

   (*E.g. ammonia.*)

7. Put the jars on a sunny window sill and record observations on a daily or every-other-day basis.
8. Summarize observations after 5 days.

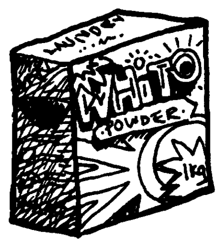
   [*Some items will 'disappear', dissolve or break down, some will not. The water may change colour in some cases.*]

9. Summarize conclusions.

   [E.g. We prefer to drink clear rather than cloudy water. A range of pollutants can get into water. Not all pollutants are visible in water.]

Note

The water in some rivers looks brown because it is coloured by naturally occurring tannins. This water is not necessarily unhealthy but people want to drink clear water. Some Water Authorities have therefore installed expensive equipment to remove this colouring from their reticulated water supplies.



[Adapted from *Nonpoint Source Pollution Prevention. Grades 3-5*. Air and Waste Management Association. USA. 1993.]

Introducing water quality

Materials

Per group:

- 1 clear container per ingredient you will be testing
- creek or river water
- texta and masking tape teaspoon(s)
- ingredients (choose from soil, fertiliser, salt, cooking oil, laundry powder, ammonia, rubber bands, food colouring, vinegar.)

Activity instructions

1. Pour the creek or river water into your container and label your 'mini-pond' with your names and the date.
2. Add 1 teaspoon of one of the ingredients to your 'mini-pond' and add a label to it to record the ingredient added.
3. Can you see any differences in the water after the ingredient has been added? Do you think this ingredient will affect water quality?
4. Repeat this for another ingredient if you have time.
5. Put the uncovered 'mini-ponds' on a sunny window sill.
6. Record your observations for your 'mini-pond' and four others. In the first column write down what each 'mini-pond' contains.

Observations

'Pollutant'	Day 1	Day 2	Day 3	Day 4	Day 5
Your 'mini-pond' contains ____________					
'mini-pond 2' contains ____________					
'mini-pond 3' contains ____________					
'mini-pond 4' contains ____________					
'mini-pond 5' contains ____________					

Introducing water quality

7. Describe what happened over the 5 days when soil was added to the water. (How did the water look when you first added the soil? What happened to the soil over time?)

____

____

____

8. Describe what happened over the 5 days when oil was added to the water.

____

____

____

9. Describe what happened over the 5 days when ammonia was added to the water.

____

____

____

10. After listening to the results from all the teams, list which ingredients dissolved or disappeared when added to the water (i.e. you could not see a difference in the water).

Dissolved or disappeared in the water	No difference in the water
______________________	______________
______________________	______________
______________________	______________

11. List all the 'ingredients' that polluted the water in the 'mini-ponds'.

Pollutants

____

____

____

12. In the space below, write the name of one of the pollutants the ingredients in the 'mini- ponds' represented and draw or explain how and where this pollutant might get into a real-life lake or river.

____

____

____

Measuring water quality

Key Learning Outcomes

Level 4 Science: Living together
Identify living and non-living things that affect the survival of organisms in an ecosystem.

Level 5 Science: Living together
Explain the effects of various environmental changes on living things in ecosystems

Aims

- to identify which tests are used to measure water quality
- to allow students to become familiar with the water testing equipment before conducting the tests at their field monitoring site

Materials

cardboard

Student sheet 4: Measuring water quality

Blackline master 2: Measuring water quality

Waterwatch monitoring equipment kit

Waterwatch Monitoring Results Book OR

A Community Water Quality Monitoring Manual for Victoria (Record sheets are on pages 5-10 of Habitat Survey section, pages 22 - 23 of Biological Surveys section, page 26, Physical and Chemical Tests section).

Advanced preparation

1. Duplicate required numbers of Student sheet 4 and Blackline master 4.
2. Cut out a set of the measuring water quality cards for each group of students, and mix them thoroughly.
3. Bring the Waterwatch test kit and copies of the *Waterwatch Monitoring Results Book* (or copies of the record sheets from *A Community Water Quality Monitoring Manual for Victoria.)*

Alternatively, create your own student sheet as a Match with lines activity.

Delete the cards/details for any water quality tests you are not doing with your class as part of your Waterwatch monitoring.

Activity instructions

1. Briefly review that many human or wildlife uses of water require excellent or good quality water. And even though it may look clear, water may be polluted.
2. Water can become polluted if it has too much **sediment** [soil], **salt** or **nutrients** [*e.g. from fertiliser, detergent, laundry powder*] or not enough **oxygen** in it.

   [*Unjumbled words for Student sheet 3 Questions 4 - 8.*]

   Items that don't decompose are more obvious pollutants [plastic, rubber, oil]. Some pollutants such as 'toxins' cannot be seen [*some industrial and domestic products*]
3. Explain that the class is going to monitor the water quality at (*name of your site*) as part of the Australia-wide Waterwatch monitoring program. Having good quality of water is important and we can all do our part.
4. Explain that water quality scientists use a range of tests to measure water quality so before the class can begin, the students will need to become familiar with these special tests, the equipment and some new words. [Hold up the test kit and a copy of the *Waterwatch Monitoring Results Book*, if you have one] Students will be introduced to these tests and words today but over the next several weeks will have time to get even more familiar with them - TODAY IS JUST AN INTRODUCTION.
5. Hand out Student sheet 1 and card sets.
6. Explain the following words that water quality scientists need to know, writing the key words on the board for students to be become familiar with spelling and pronunciation.
7. Water quality scientists measure:

   (A) some physical features of the water (flow, temperature, turbidity)

   (B) some chemical features of the water (pH, phosphorus and nitrogen levels, dissolved oxygen levels, conductivity)

   (C) they sample and record: the types and abundance of aquatic macro-invertebrates

   (D) they record:

   streamside habitat (the condition and type of streamside vegetation)

   Students record their answers to Q. 1 A - D.
8. Explain that to accurately measure water quality we need some special equipment. Show students the water testing equipment in the Waterwatch kit, naming each piece as you hold it up.

   [*E.g. pH meter.*]

Measuring water quality

9. Assign groups and distribute card sets. Students work in teams to match the right water quality tests with what they measure. They then match each water quality test to the correct piece of equipment used to make this test. Note that one set of cards represent a test that is of no value for measuring water quality.

   [*Water depth does not affect water quality*].

10. Once all the groups have made their choice of tests and matched them to the equipment, ask a student from each group to:
    - name one of the water quality tests they chose
    - explain what it measures

      [*E.g. temperature*] and
    - explain how this factor affects aquatic life

      [*E.g. it affects the living conditions of plants and animals in the water*].

    For Level 5, students should provide more detailed answers.

11. Repeat this till you cover all the tests for water quality.
12. Students complete Student sheet 3.
13. Summarise why these factors are important for water quality.

    [*E.g.*
    - if salinity and turbidity levels are too high, we can't drink the water.
    - *Plants and animals can't survive if salinity, turbidity, dissolved oxygen, and temperature conditions aren't right for them*].

    For Level 5, summarize this in more detail.

Correct match for cards in Blackline master 4: Measuring water quality

Test	What it measures	How to measure it
Turbidity	Clarity of the water (level of suspended particles in the water)	A Turbidity Tube
Water temperature	The temperature of the water	A temperature meter or probe
Water flow	The volume and speed of the water flow	Measure a length along the streambank; time how long an object takes to float over this set distance, then calculate the flow rate
pH	Acidity or alkalinity level of the water	A pH meter
Conductivity	Salinity level of the water	TD Scan 4 probe or meter
Dissolved oxygen	Oxygen concentration in the water	Chemical tests to measure the water's colour change than read oxygen levels from a graph
Phosphorus	Nutrient level in the water	Phosphorus chemical test kit
Water depth	Depth of the water	A metre ruler
Stream habitat	State of the vegetation; bank erosion; diversity of water habitats	Stream Habitat Record Sheet
Macro-invertebrates	Presence of water quality sensitive species	Dip nets, plastic trays and Macro-invertebrate Record Sheet

Student sheet 4

Measuring water quality

Water quality can sometimes be judged by looking at it. But for accurate testing and monitoring we need to measure water quality with special equipment and always take measurements in the same way.

Imagine you are water quality scientists. You need to know what to test in the water and what equipment to use to measure it.

1. Water quality scientists use a range of tests to measure water quality.

They measure:

(A) the physical features of the water:

___ ___ ___ W

T ___ ___ ___ ___ ___ ___ ___ ___ ___ ___

T ___ ___ ___ ___ ___ ___ ___ ___

(B) the chemical features of the water:

p ___

P ___ ___ ___ ___ ___ ___ ___ ___ ___

D ___ ___ ___ ___ ___ ___ ___ ___   O ___ ___ ___ ___ ___

C ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___

They sample and record:

(C) the aquatic macro-invertebrates / microvertebrates [Circle the correct word]

They record:

(D) streamside habitat / housing [Circle the correct word]

2. Match the cards.

Select the right tests for measuring water quality.

Match each water quality test with what it measures.

Measuring water quality

3. List the different kinds of tests we can use to measure water quality.

Test	What it measures

4. Circle the correct words (there may be more than one) **in each sentence.**

i) Water is polluted if we can see this on it. [oil, froth, waterboat]

ii) Even though it looks clear, water could be polluted by high levels of [sunlight, nutrients, salt].

iii) High levels of [sediment, oxygen, sunlight] in water reduces its quality.

5. Unjumble these letters.

River water becomes polluted if there is too much of the following things in it:

i) aslt ___ ___ ___ ___

ii) mistedin ___ ___ ___ ___ ___ ___ ___ ___

iii) sitrunnet ___ ___ ___ ___ ___ ___ ___ ___ ___

iv) Water becomes polluted if there is not enough of the following in it:

goyenx ___ ___ ___ ___ ___ ___ ___

Measuring water quality

Test	What it measures	How to measure it
Turbidity	Salinity level of the water	A pH meter
Water temperature	Acidity or alkalinity level of the water	TD Scan 4 probe or meter
Water flow	Oxygen concentration in the water	A temperature meter or probe
pH	The temperature of the water	Chemical tests to measure the water's colour change than read oxygen levels from a graph
Conductivity	Clarity of the water (level of suspended particles in the water)	Phosphorus chemical test kit
Dissolved oxygen	The volume and speed of the water flow	A Turbidity Tube

Measuring water quality

Phosphorus	Presence of water quality sensitive species	Measure a length along the streambank; time how long an object takes to float over this set distance, then calculate the flow rate
Water depth	State of the vegetation; bank erosion; diversity of water habitats	Dip nets, plastic trays and Macro-invertebrate Record Sheet
Stream habitat	Depth of the water	A metre ruler
Macro-invertebrates	Nutrient level in the water	Stream Habitat Record

Teacher sheet 5

Interpreting sample data

Key Learning Outcomes

Level 4 Science: Living together
Identify living and non-living things that affect the survival of organisms in an ecosystem.

Level 5 Science: Living together
Explain the effects of various environmental changes on living things in ecosystems

Maths

Aims

- to graph water quality readings to assist interpretation of results
- to analyse water quality readings
- to draw conclusions from the water quality readings

Materials

Student sheet 5: Interpreting sample data.

Advanced preparation

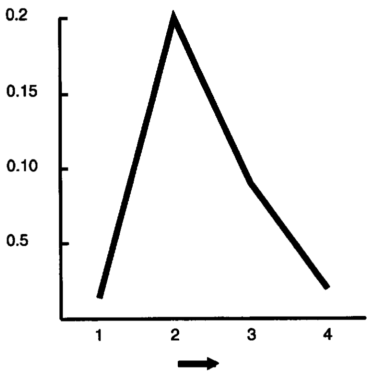
1. Duplicate Student sheet 5.
2. Overhead or mural of river and landuse (if required).

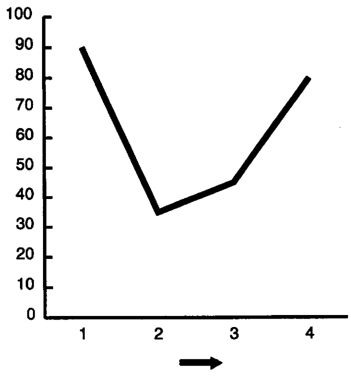
Activity instructions

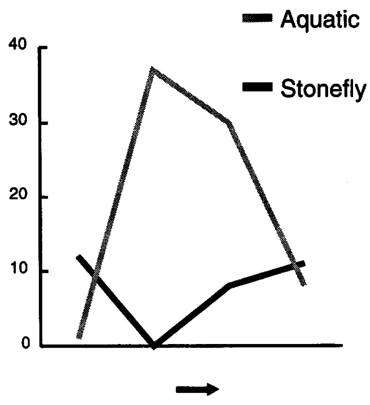
1. Students draw a full page version of the river to show land uses along its length. Or create a mural or overhead for class use.
2. Students complete the graphing activity and interpret what these imaginary results mean.
3. Review the answers as a class to summarise how the readings for each chemical test changes along the river, and discuss reasons why the readings may alter along the river's course.

   [*Site 1 is in a forested area. Site 2 is just after a town where some septic tanks leak untreated sewerage into the river. Site 3 and 4 are in well managed farmland with little erosion and where very little fertiliser runs off into the river.*]
4. As a class, discuss what impacts the lower water quality downstream of the town might have on:
   - people's use of the river near the town
   - plant and animals life in the river

Note
The Waterwatch program encourages data to be shared by schools. Just like this example river data, schools can share data collected at different sites along a river.







Interpreting the data

Site 1 appears to have Excellent quality water because the readings show:

- high number of sensitive Stonefly nymphs
- a Phosphate reading in the Excellent/Good range
- a Dissolved oxygen reading in the Excellent/Good range

Site 2 appears to have Very Poor quality water because the readings show:

- a high number of very tolerant aquatic worms and no sensitive Stonefly nymphs
- a Phosphate reading in the Degraded range
- a Dissolved oxygen reading in the Degraded range

Students are not likely to draw all these conclusions at this early stage in the unit of study, but here are some possible reasons for the downstream improvement in water quality. Water quality improves at Sites 3 and 4 as a new creek has joined the river upstream from Site 4, bringing in clean water, and landuse around Sites 3 and 4 reduce erosion and runoff into the river. The river has lots of ripples in the section between Sites 2 and 3, allowing it to pick up oxygen.

Interpreting sample data

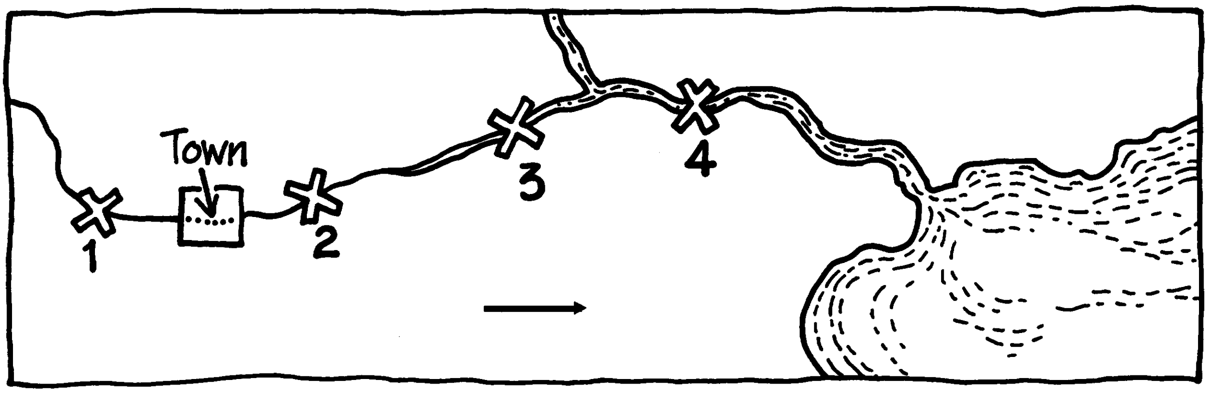
Activity instructions

Scientists have measured water quality at 4 sites along a river. Their water quality readings for the river are recorded in the table below.

Water quality records table

Test results		SITE 1	SITE 2	SITE 3	SITE 4
Phosphates	(mg/L)	0.015	0.2	0.09	0.02
Dissolved oxygen	(%)	90	35	45	80
Stonefly nymphs	(number)	12	0	8	11
Aquatic worms	(number)	1	37	30	8

Adapted from 'Catchment Wise'. Dept. Conservation and Land Management, 1994.



1. *The upper catchment of this river has native forest. The lower catchment has well managed farmland (cattle) with little erosion as stock are fenced from the river at most sites. The river bank is well vegetated along most of its length, except around the town. Part of the town is sewered but some areas still have septic systems which leak.*

   Draw a full page version of the river. Draw in the land uses (vegetated river banks, native forest, town, farmland).

2. Read the Water quality records table above. Does the Phosphorus level in the river increase or decrease after it has flown past the town?

   ____

   Suggest some reasons why. ______________________________

   ____

   ____

Interpreting sample data

Circle whether True or False.

4. The Phosphate reading is lower at Site 1 than at Site 2. True False
5. The Phosphate reading is highest at Site 1. True False
6. The Dissolved Oxygen reading is higher at Site 1 than at Site 4. True False
7. The Dissolved Oxygen reading is higher at Site 4 than at Site 2. True False
8. Water quality scientists have developed rating guidelines for each chemical test so that you can judge the quality (Excellent to Very Poor) of your water sample.

Use the table below to check the quality of the water in the river. Write this onto the map of the river on the first page, using a different colour pencil for each water quality measure (e.g. red for all Phosphate, brown for Dissolved Oxygen.)

Water Quality Rating Guidelines for Chemical Tests for Victoria

Test	Excellent	Good	Fair	Poor	Very Poor
Conductivity (µs)					
mountain	less than 30	less than 90	less than 150	less than 225	more than 222
valley	less than 80	less than 240	less than 500	less than 750	more than 750
plain	less than 100	less than 250	less than 500	less than 750	more than 750
Turbidity (NTU)					
mountain	less than 5.0	less than 7.5	less than 10.0	less than 12.5	more than 12.5
valley	less than 10.0	less than 12.5	less than 15.0	less than 22.5	more than 22.5
plain	less than 15.0	less than 17.5	less than 20.0	less than 30.0	more than 30.0
pH (units)	6.0–7.0	5.5–6. or less than 8.0	8.0–8.5	5.0–5.5 or 8.5–9.0	lower than 5.0 higher than 9.0
Reactive Phosphate (mg/L)	less than 0.008	less than 0.025	less than 0.050	less than 0.1	more than 0.1
Total Phosphate (mg/L)	less than 0.010	less than 0.025	less than 0.050	less than 0.1	more than 0.1
Dissolved Oxygen (%)	80–110	between 70–80 or 110–130	between 50–70 or 130–150	between 40–50 or 150–160	less than 40 more than 160

Macro-invertebrates

Very sensitive to water quality - Lives in excellent quality water.	stonefly nymphs
Very tolerant of water quality - Lives in a range of conditions, including poor quality water	aquatic worms

9. Conclusions

Write a paragraph to describe the river's water quality. What might be some reasons for the water quality differences at the different sites.