# Healthy Water – classroom activity

## Learning Objectives

**Students will:**

- Explain what 'healthy water' might mean
- Describe how **pollutants** might impact on **aquatic** animals' **habitat**
- Use **investigative** science skills to reach conclusions about water samples

## Background Information

'Health' is a concept easily understood by students, so here we transfer this concept to water. Healthy water, for the sake of this exercise, is water that is not significantly polluted or impaired, and can support a robust aquatic ecosystem. As with human health, it is not always possible to tell the health of water just by looking at it. This activity encourages students to use different senses and consider how different 'pollutants' might impact on aquatic creatures.

**ecosystem (n)**

a biological community of interacting organisms and their physical environment.

**From Greek *oikos* "house, dwelling place, habitation" & Late Latin *systema* "organized whole, a whole compounded of parts"**

The simplicity of this activity means it is easily made simpler or more complex for different levels.

| **Vocabulary**<br>**Definitions in Appendix** | |
|---|---|
| **Indicator species** | **Ecosystem** |
| **Aquatic** | **Wai māori** |
| **Habitat** | **Pollutant** |
| **Tannins** | **Sediment** |
| **Waikino** | **Wai ora** |
| **Mauri** | **Waimate** |

## Curriculum Connections

| Level | Science Strand | Objective | Linking in with this resource |
|---|---|---|---|
| 1 + 2 | Nature of Science – investigating in science | Extend their experiences and personal explanations of the natural world through exploration, play, asking questions, and discussing simple models. | Through exploration, see that things aren't always just what you see (in this case, water can contain other things). |
| | Living World – Life processes | Recognise that living things are suited to their particular habitat. | Discuss how each 'pollutant' might change the environment where aquatic creatures live. |
| | Planet Earth & Beyond – Interacting Systems | Describe how natural features are changed and resources affected by natural events and human actions. | Investigate how some of the pollutants might get into waterways. |
| 3 + 4 | Nature of Science – Investigating in Science | Ask questions, find evidence, explore simple models, and carry out appropriate investigations to develop simple explanations. | Investigate samples, and justify reasoning behind decisions. |
| | Living World – Life processes | Explain how living things are suited to their particular habitat and how they respond to environmental changes, both natural and human-induced. | Discuss how 'pollutants' might change the environment of aquatic animals and how they might respond to that change. |
| | Planet Earth & Beyond – Interacting Systems | Investigate the water cycle and its effect on climate, landforms, and life. | How does the water cycle influence movement of pollutants (e.g. rain may move sediment off land)? |
| | Material World – Chemistry & Society | Relate the observed, characteristic chemical and physical properties of a range of different materials to technological uses and natural processes. | Discuss how the erosive power of water might cause sediments to naturally be in waterways. |
| 5 | Nature of Science – Investigating in Science | Show an increasing awareness of the complexity of working scientifically, including recognition of multiple variables.<br><br>Begin to evaluate the suitability of the investigative methods chosen. | Check that students demonstrate understanding of the purpose of a 'control', or reference sample.<br>Decide on how 'replicable' their assessment of samples was. |
| | Material World – Chemistry & Society | Link the properties of different groups of substances to the way they are used in society or occur in nature. | Water as a solvent, in nature and society – investigate uses |
| | Bonus: Social studies | Understand how people's management of resources impacts on environmental and social sustainability. | Consider how accurate the image of '100% Pure' NZ is with regards to waterways. They look clean, are they? |

## Resources

- ☐ Clean sample jars (we use old jam jars)
- ☐ Salt
- ☐ Detergent
- ☐ Dye
- ☐ Cooking oil
- ☐ Sand or mud
- ☐ Teabag
- ☐ River water (or lake water)
- ☐ Clipboards, paper and pencils
- ☐ Filter paper (optional)
- ☐ Magnifying glasses
- ☐ Tea towels for mopping up

## Preparation

- Prepare enough jars of tap or distilled water 'controls' so that each group can have one for comparison
- Prepare 'unknown' jars as follows (you can change this up if it suits you)

| Sample jar | What's in it? |
|---|---|
| 1 | Salt + water |
| 2 | Detergent + water |
| 3 | River or lake water |
| 4 | Oil + water |
| 5 | Tea (teabag removed) |
| 6 | Sand/mud + water |
| 7 | Dye + water |

- Decide whether you wish to use magnifying glasses, filter paper, eye droppers, or any other equipment for students to investigate their samples, consider:
    - Using filter paper is likely to be a long process, perhaps better done as a class – the aim is to see whether there are solid impurities that can be removed from the water
    - Eye droppers (pipettes) can be used to see whether the sample 'beads' or not on a surface
    - Magnifying glasses don't show a lot more, but students enjoy the investigation aspect

## Introduction

- Write your learning intentions on the board and read through with students
- Check understanding of words in grey in the learning intention

## Activity Instructions

- Begin with a discussion of what the word 'healthy' means (with regard to people, or other context students think of), leading into these questions:
    - So, what would you expect from 'healthy' water?
    - What senses would you use to decide if water is healthy? Why/why not?
- Split into small groups
- Each group should set up a page with the following:

| Sample | What's in it? | Healthy? Y/N |
|---|---|---|
| 1 | | |
| 2 | | |
| 3 | | |
| 4 | | |
| 5 | | |
| 6 | | |
| 7 | | |

- Provide each group with a sample container of tap water (or distilled water if you have it), this is their 'control'
- Each group then investigates one sample jar to answer the following questions:
    - What do we think is in it?
    - Do we think it is healthy water?
- As groups finish with one jar, have them swap to a different one, until they have investigated all the samples
- When all the groups are finished, discuss as a class.
- You could create a bar graph of what different groups thought each jar was.

| | | Discussion Questions | Guidance |
|---|---|---|---|
| 1 | General | What did you think was in this jar [sample #]? | Answers will vary |
| | | How did you decide this?<br>What senses did you use? | Students should justify their identifications. |
| | | What could you have done to learn more about this sample? | Could be running tests (e.g. filter paper), or using senses that are otherwise not recommended (e.g. taste). |
| 2 | Healthy Water | Did you think this sample was healthy water? (discussion points below) | |
| | | 1 | Salty water can be healthy in some environments, including brackish wetlands. More important than salt, is how much salt, and whether it would naturally be there. You could also discuss features of salt-adapted organisms. |
| | | 2 | Detergent reduces surface tension – this means that some aquatic insects that walk on water, or use surface tension in hunting, may be impacted. Detergents may negatively impact on multiple aspects of fish physiology.<br>Some detergents are high in phosphorous, which is implicated in eutrophication (algal blooms) in aquatic environments. (all impacts dependent on concentration) |
| | | 3 | This may or may not be healthy depending where you got it from, some indicators will include clarity and the number and diversity of living things the waterway supports |
| | | 4 | Depends on the amount of oil. Oil may form a layer on water surface (particularly in still water) preventing oxygen diffusion – suffocating aquatic biota. Animals (including birds) can become 'oiled' similar to petrochemical oils, although the effect is not usually as acute. |
| | | 5 | Many students may insist that this water is unhealthy (or that it's not water, it's tea!). The colour of tea comes from *tannins* leached from leaves, and there are perfectly healthy streams that are the colour of tea. Usually those stemming from wetlands or with significant rotting vegetation. |
| | | 6 | A certain amount of sediment in a waterway is natural, particularly when flow is higher than usual or in stormy conditions. The amount of sediment natural to a waterway will depend on its catchment geology. Here in Central North Island, our streams are usually very clear as there is little fine grained clay in the catchment. Impacts of excess sediment include blocking light for algal growth, damaging fish gills, filling spaces that creatures could live in, and reducing visibility for visual hunters. |
| | | 7 | If using food colouring, this water is not intrinsically unhealthy for humans to drink. Most artificial colours have no adverse effects on animals even in high doses.<br>In high enough concentrations, red and blue food colouring may prevent or limit photosynthesis in aquatic algae, as they would be reflecting the wavelengths needed for photosynthesis to occur. |

| | | | |
|---|---|---|---|
| 3 | Broader context | **Do you think we can always tell if water is healthy just by looking at it? Why? Why not?** | No – there may be things dissolved in the water that affect the health of the ecosystem, such as excess nutrients (cause algal growth and eutrophication), excess salt, or inorganic compounds. |
| | | **If we're talking about a river or a stream, who or what might be impacted if it's not healthy?** | Fish, insects, whio – all of these can be indicator species because they have to survive in the water |

## Possible Extension Activities

- How is freshwater classified in Te Ao Māori? Download this page for a guide. Can you classify the water around your school?
- What do the Māori names of your local streams/rivers mean? Do they reflect the observed 'health' of these water bodies?
- Ask a local kaumātua how they would know if a stream was healthy – do they use the same kind of indicators you did? Why, or why not?
- Have students investigate what tools scientists use to determine the health of waterways
    - Are there any you can try?
    - How would you keep the results comparable, between different people? Different waterways?
- Investigate the *DairyNZ* campaign 'The Vision is Clear'
    - List advantages of the campaign – to the public, to the environment, and to *DairyNZ*
    - Research what land-uses have the biggest negative impacts on New Zealand waterways
    - Develop an argument defending or attacking the validity of the *DairyNZ* campaign for healthy waterways
    - Opinion article 'The public relations war over freshwater as re-started' by *Stuff* reporter Charlie Mitchell may give more food for thought
- Research the chemical structure of detergents and use this to explain some of the impacts that detergents may have in aquatic environments.
    - Find out whether there are rules around the amount of phosphates allowed in New Zealand detergents
    - Investigate other human and natural sources of phosphates in our waterways
    - Consider how individuals could reduce their impacts
- Is your local waterway naturally silty or clear? What land-uses might be contributing sediment?
    - Students could use Google maps or talk to Council to estimate the extent of different land use types in the catchment.
- For further resources to support freshwater learning, see: https://www.taupofortomorrow.co.nz/resources-for-the-classroom

## Additional curriculum connections – extension activities

| Level | Strand | Objective | Linking in with this resource |
|---|---|---|---|
| 3 + 4 | Nature of Science | Appreciate that science is a way of explaining the world and that science knowledge changes over time. | When and why did laws around phostphates in detergents change? |
| | Geometry and Measurement | Use side or edge lengths to find the perimeters and areas of rectangles, parallelograms, and triangles and the volumes of cuboids. | Use spatial data to estimate extent of land-use types. |
| 5 | Nature of Science | Show an increasing awareness of the complexity of working scientifically, including recognition of multiple variables. | Investigating methods for determining health of waterways. |
| | | Begin to evaluate the suitability of the investigative methods chosen. | Which methods of water quality testing are most robust? Replicable? |
| | | Develop an understanding of socio-scientific issues by gathering relevant scientific information in order to draw evidence-based conclusions and to take action where appropriate. | Gather information on how different land-uses affect water, and use to guide investigation of 'The Vision is Clear'. |
| | Social Studies | Understand how people's management of resources impacts on environmental and social sustainability. | Land-use impacts on waterways. |
| 6 | Nature of Science | Develop an understanding of socio-scientific issues by gathering relevant scientific information in order to draw evidence-based conclusions and to take action where appropriate. | Gather information on how different land-uses affect water, and use to guide investigation of 'The Vision is Clear'. |
| | Geography | Understand how people interact with natural and cultural environments and that this interaction has consequences. | What are the consequences of human land-use on waterways? |
| | Economics | Understand how the different sectors of the New Zealand economy are interdependent. | Consider the competing but interdependent nature of Tourism and Dairy industries in New Zealand. |

## Appendix: Vocabulary

These definitions from various websites, you may wish to find your own sources.

| | Word Kupu | Definition |
|---|---|---|
| Science language | **Aquatic** | Relating to water.<br>(of a plant or animal) growing or living in or near water.<br>An aquatic plant or animal, especially one suitable for a pond or aquarium. |
| | **Ecosystem** | An ecosystem or biome describes a single environment and every living (biotic) organism and non-living (abiotic) factor that is contained within it or characterizes it. An ecosystem embodies every aspect of a single habitat, including all interactions between its different elements. |
| | **Habitat** | Place where an organism or a biological population normally (or is adapted to) live(s), reside(s) or occur(s) |
| | **Indicator species** | A species which is a good indicator of the living conditions in a particular habitat. |
| | **Pollutant** | An undesired contaminant that results in pollution. |
| | **Sediment** | The matter that settles to the bottom of a liquid.<br>Material deposited by water, wind, or glaciers. |
| | **Tannin** | Bitter-tasting, complex aromatic compounds found in the vacuoles of certain plant cells, for example in bark. When vegetation breaks down tannins may leak into waterways creating a yellow/tea-like colour. |
| Kupu Māori | **Waikino** | Harmful waters. The mauri of the water has been altered through pollution or corruption and has the potential to do harm to humans. |
| | **Wai māori** | Freshwater, mineral water. Ordinary water which runs free or unrestrained and it has no sacred associations. |
| | **Waimate** | Dead water. This class of water has lost its mauri and is dead. It is dangerous to humans because it can cause illness or misfortune. Geographically it refers to sluggish water, stagnant or back water. Some tribes refer to it as waikawa. |
| | **Waiora** | This is water in its purest form. It is used in rituals to purify and sanctify and has the power to give life, sustain wellbeing and counteract evil. Waiora also means health. |