6. Life in the Lakes Activities

Activity title	Curriculum level	Curriculum link	Environmental education aspect	Page
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6b What Lives in our Lakes?	Any level	Science	About	222
6c Aquatic Treasure Hunt	Any level	Science	In, About	223
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6f Looking at Algae	Any level	Science	About	231
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6i Plants Around The Lakes	L 3–5	Science	In, About	236
6j Lakeside Treasure Hunt	Any level	Science/ Social Studies	In, About	239
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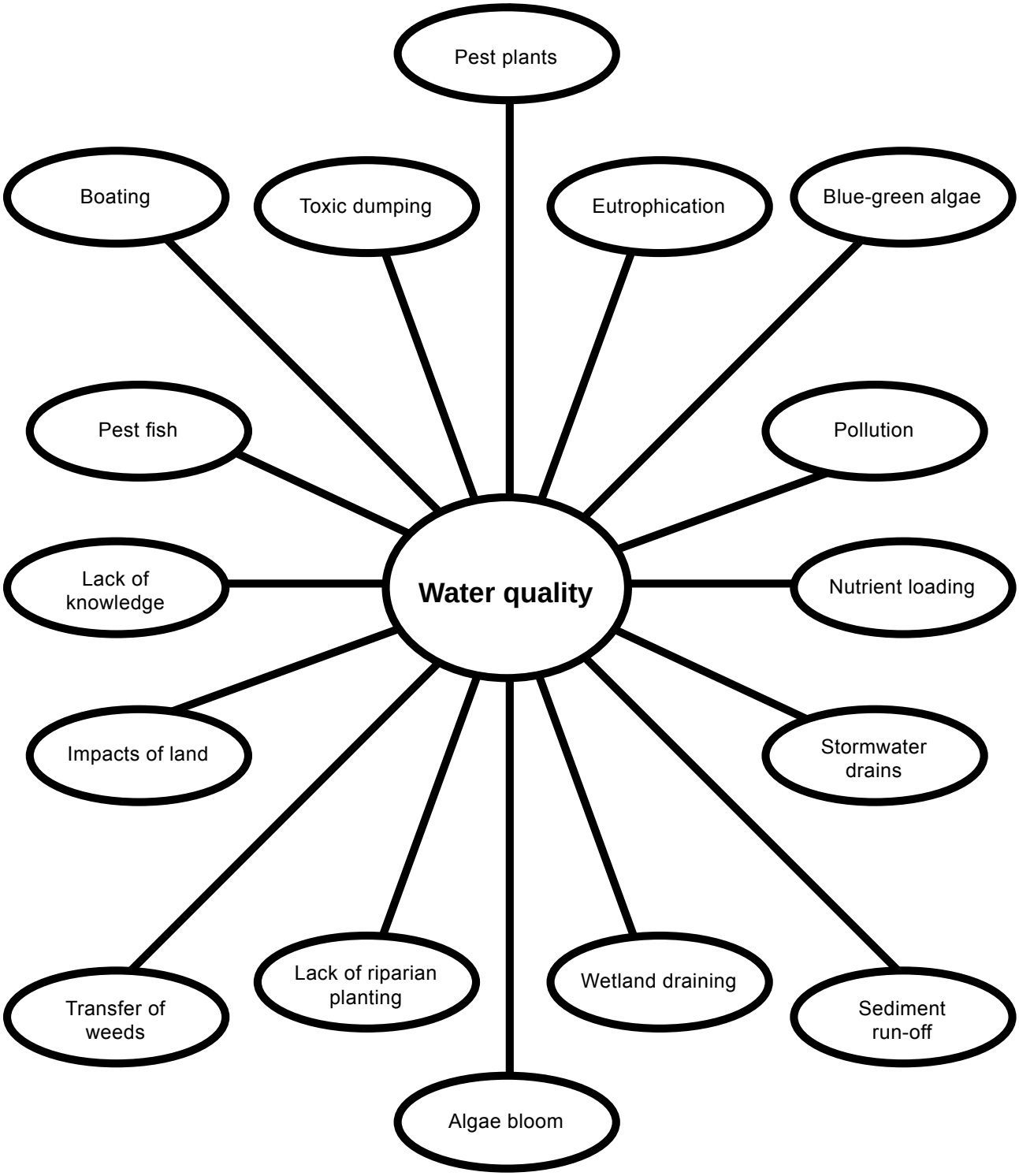
6l Healthy Habitat	Any level	Science/ English	About	245

Relevant resources:

- www.teara.govt.nz
- www.niwascience.co.nz/rc/freshwater/fishatlas/key
- www.niwascience.co.nz/ncabb/aquaticplants/outreach/weedman/
- www.upthecreek.org.nz – interactive stream activity
- http://nwp.rsnz.org/content/Pollution_Detectives/projects_pollutiondetective.htm
- Under water, under threat – video 60 – Department of Conservation Conservancy Office
- NZ's Freshwater Native Fish – video 129 – Department of Conservation Conservancy Office
- Invaders in Paradise - video 144 – Department of Conservation Conservancy Office
- Starters & Strategies, Issue 66, 2005 June, www.teachingonline.org
- Learning Media –
  - The Stream Community - focuses on living things in a variety of natural communities. It contains 23 colour pictures, teachers' notes with a description of each picture, and suggested activities, and a copymaster of a sample stream community food web. ISBN 0 478 05878 0
  - Water – Item 88136 – This picture series has been planned for generating discussion and written work as part of the language programme. Each picture depicts some aspect of water, for example, in the home, at play, and for recreation
- Learning Media – readers – www.learningmedia.co.nz
  - Lake Life, Sharon Holt, ISBN 0790310104 shows support plants, animals, bacteria – and even people. This text examines the importance of lakes and explores some of the potential threats to this precious resource.
  - A Fishy Mystery, Anna MacKenzie, Item No. 30444 A group of children discover some dead fish floating in the local river and they are determined to find out what's killing them. They start by asking their teacher for help, then they conduct some research of their own
- Learning Media – Connected series – www.learningmedia.co.nz
  - Connected 3, 2004 – Item 30054 – Year 4–8, testing the water quality and ecology of local streams. Teachers' notes item 30055
- Royal Society of NZ - Alpha Series – www.rsnz.org/education/alpha
  - Alpha 123 – Freshwater Aquatic Plants
- A History of the Lake – weed infestation of the Rotorua Lakes and the Lakes of the Waikato Hydro-electric scheme, VJ Chapman, NZ Dept of Scientific & Industrial Research, Series 78
- Aquatic Weed Control in the Rotorua Lakes, VA Froude & CJ Richmond, Department of Conservation, January 1990
- Rotorua Lakes Aquatic Weed Update, January 2002 , R Wells, P Chapman, J Clayton, A Taumoepeau, Department of Conservation

Life in the Lakes - Issues

This brainstorm highlights some of the issues relating to Water Quality; you may find others as you work through your selected activities. Many also link to other sections.



Templates 4–10 are useful tools for guiding students from the issues through to action.

Life in the Lakes - Action Ideas

- Separate ponds from the lakes
- Riparian planting with local iwi/community/care group/farmers
- Wetland creation/restoration or enhancement
- Identification of stormwater drains e.g. I only drain rain/fish icon
- Cleaning stormwater grates
- Wash boats on the grass – ensure clear of weeds
- Catch koi carp or any pest fish
- Join a community group perhaps to assist with habitat enhancement
- Design and install stormwater filters
- Apply for funding to use for actions such as the one above
- Approach your local or regional council, Department of Conservation, Fish & Game etc for assistance
- Litter collection
- Pamphlets, brochures, posters etc highlighting an issue
- Signs at boat ramps
- Letter writing/lobbying
- Advertising
- Slogans
- Surveys - advertise results in school foyer, newsletter, local library etc
- Public awareness regarding issues and regulations
- Boat cleaning days
- Radio – advertising/item/reporting or newspaper article
- Stalls
- Organise a community event around an issue

Activity 6a
Understanding Biodiversity

Curriculum links **Science**

Environment Education – about, in

Any level
6
Science

Resources required

- Starters and Strategies 66 June 2006

Method

1 Introduce the idea of variety by giving the students a one-minute challenge to write the names of all the plants, animals and insects they know.

2 Explain that 'diversity' is the name that we give to this variety. Develop the idea that this diversity is what makes life interesting.

3 Introduce students to the concept of variety in nature. Can they imagine a world where there was only one type of tree or bird? i.e. only pine trees and magpies.

4 Can they imagine a world with only buildings and roads and no green spaces in our towns and cities? What would it be like to live in this type of environment?

5 Explain that this variety of life is called biodiversity (short for biological diversity).

6 Challenge students to expand the following examples of biodiversity:

- The difference between animals or plants of the same species e.g. different types of ducks,
- Different species who live in a particular area e.g. birds, fish, insects, plants, fungus could all live in wetland,
- Differences between different environments (ecosystems) e.g. forests, wetlands, lakes etc.

7 Using the school and the local environment as a resource have students identify examples of three different categories of biodiversity i.e., birds, insects, trees, animals – living in the local area.

8 Identify and count the number of different bird species.

9 Identify and name particular environments within a local area (bush, wetland, stream or lake).

10 Reflection:

- What surprised you?
- What did you learn?
- Can you comment on the biodiversity present in the area(s) you visited?

Activity 6b What Lives in our Lakes?

Curriculum links **Science**

Environment Education – about

Any level
6
Science

Resources required

- Waitakere City Council – (Waitakere's Underwater Life) "Focus on Bugs" video – this is included in Environment Bay of Plenty's Water Monitoring Kit.

Method

1 Brainstorm what lives in our local lakes.

2 Using a video as an information source and within your group:

- You will be given three viewings of the video "Waitakere's Underwater Life" (10 minutes each viewing). You will need to make note maps about a specific macro invertebrate.

3 First viewing – this is a general viewing of the video, note just the names of the macro invertebrates shown.

4 Class discussion point: What is a macro invertebrate?

5 Assign each group a macro invertebrate.

6 Second viewing – individuals to note map about their assigned macro invertebrate.

7 Third viewing – using a different coloured pen, add more notes to your note map.

8 Compare/share your notes with other members of group. Add any additional information gathered by other members, to your note map, using a different coloured pen.

9 Reflection:

- What difference might you see if you were to look at the life under a lake's surface? Why might this be?
- How are the organisms related to each other?

Possible next steps

- 6g Who Eats What/Whom?

Activity 6c Aquatic Treasure Hunt

Curriculum links **Science**

Environment Education – in and about

Any level
6
Science

Resources required

- Wairoa resource
- Water Monitoring Kit – available from Environment Bay of Plenty
- Worksheet 1, 2 or 3 as determined by the focus that the children have chosen

Prior learning

- 6b What Lives in our Lakes?

Method

1 Go on a field trip, examining the differences between stream, wetland and lake environments using Waiora (Section 5) as a guide.

2 This could take the direction of an in-depth study on ecosystems and factors affecting the stability of the environment. Also – it is an ideal opportunity for a focused search and detailed account of a lake environment. The focus could be discussion of the differences between habitats and organisms present in the differing environments, i.e. What differences were there? Why might these differences occur?

3 Reflection

- What differences were there?
- Why might these differences occur?

Teacher's notes

- Worksheets 1–3 could be used as a basis for discussion.

Possible next steps

- 6d Microscopic Discoveries
- 6e Pea Soup Lakes
- 6g Who Eats What/Whom?

Activty 6c: Worksheet 1

What Plants Live Here?

Plant name, drawing or description	Where is it living?

Reflection

- What plants were the most common?
- Why do you think that they were living where you found them?

Activty 6c: Worksheet 2

What Animals Live Here?

Animal name, drawing or description	Where is it living?

Reflection

- What animals were the most common?
- Why do you think that they were living where you found them?

Activty 6c: Worksheet 3

1 Name the organisms you have identified living in the freshwater habitat.

2 Give their biological classification name.

3 Name aquatic vegetation that is growing in the water.

4 List what each organism eats/requires for their nutrition.

5 List factors that will affect your organism, i.e. amount of water vegetation, temperature of the water, amount of sunlight, predators etc.

6 Describe how the following factors could change in the lake, i.e. temperature – increased air temperature – summer:

- Increased respiration activity of living organisms.
- Decomposition bacteria activity which is affected by the level of mulch/ dead vegetative material.
- Amount of shading and light around the lake.
- Exposure of the lake to the elements and weather.
- Other factors:
- Dissolved oxygen concentration in the water
- Vegetation level

Activity 6d Microscopic Discoveries

Curriculum links **Science**

Environment Education – about

Any level
6
Science

Resources required

- Light microscope with either a mirror or electric light source
- Microscope slides
- Glass cover slips
- Pipette and tweezers
- Paper towel
- Photographic Guide to the Freshwater Algae of New Zealand (Otago Regional Council) – is a very useful resource for identification purposes

Prior learning

- Use of a microscope - to find out more about how microscopes work and the preparation of wet mounts the following websites will be helpful:
- How to use a microscope properly: http://shs.westport.k12.ct.us/mjvl/biology/microscope/microscope.htm
- Getting to know parts and function of a microscope www.gen.umn.edu/courses/1135/lab/microlab/microlab.html
- www.niwa.govt.nz for pictures or www.teara.govt.nz
- Appropriate procedures for handling specimens e.g. always wash your hands thoroughly with soap after handling specimens

Teacher's notes – using a microscope to look at micro-organisms and sediments

Using a standard light microscope found in most schools wonderful little organisms can be found by looking at 'pond slime' or a drop of 'dirt' from the bottom of any stream, pond or water trough.

The microscope needs to be set up out of direct sunlight with the lowest power objective lens in place.

Method

1 Using a pipette or a pair of tweezers place a small amount of specimen on the microscope slide, ensure that both microscope slide and cover slip are clean. Cover the specimen with a drop of water.

2 Place the cover slip at a 45 degree angle next to the specimen and lower the cover slip to prevent air bubbles from forming.

3 Using the paper towel dab away any excess water around the cover slip.

4 Place the microscope slide on the stage and position it above the view aperture.

5 Lower the low power objective lens to just above the cover slip and while viewing the specimen focus upwards using the course adjustment screw.

6 Adjust the condenser and iris (the amount of light passing through the specimen) until a clear image is obtained.

7 Once organisms are found and greater magnification is needed turn the larger magnifying objective lenses into position.

You might also find microscopic plants (cyanobacteria, algae and phytoplankton).
Refer to http://nwp.rsnz.org, www.niwa.govt.nz or www.teara.govt.nz. The diversity is so great and there are so many different organisms.

8 Reflection

- What did you find out?
- What surprised you?
- What have you learned?

Activity 6e Pea Soup Lakes

Curriculum links **Science**

Environment Education – about

Any level
6
Science

Resources required

- Algal culture
- Commercial fertiliser containing N and P
- Standard laboratory equipment
- Culture water i.e. 2 L hot water from the tap that's been allowed to settle for a day

Prior learning

- 6d Microscopic Discoveries
- To have a look at algae would also be an advantage

Background information

Concern for lakes are algal blooms. Algae are plants naturally present in the lake. When dissolved nutrients such as nitrogen and phosphorus (found in fertilisers and waste products) are added to a lake, algae can grow very quickly. The lake turns greenish, and the situation is called an algae 'bloom'. When the algae die there is a strong odour and bacteria start to decompose the dead algae. Oxygen is used up in this process, which leads to dangerously low concentrations of oxygen in the water. This can kill off fish and other organisms.

Algal blooms can greatly speed 'eutrophication', the natural aging process of a lake. Algal blooms can be controlled by preventing the release of excess nutrients into surface and groundwater. These can be achieved by pollution control regulations and by efficient sewage treatment facilities.

Method

1 Break into groups of four. Each group to have 4 beakers (250 ml). Groups can then plan their own experiment to explore how different amounts of fertiliser will affect algae.

2 Questions to address:

- Measurement of fertiliser
- Labelling
- Control
- Identification and control of variables

Note: One eyedropper of algae culture/beaker will be sufficient. Leave beakers uncovered. Practice good hygiene and have students wash their hands after handling fertiliser or algae. Place all beakers in areas with similar light intensities.

3 Observe daily for any visual evidence of algal growth. Keep records on the algae growth chart.

4 After about three days growth should become evident as indicated by an increased ‘greenness’ in the beakers and possibly odour. Students can decide how data could be presented e.g. water colour paints/crayons.

5 Reflection:

- Did different groups have similar findings?
- Is there dead algae on the bottom of the beakers? If yes, what will eventually happen to the algae? Would this be good/bad for the animals living in the water? Why?
- Write a concluding paragraph: Why excess of algae can be harmful to our lakes.
- Include any practise you have seen that could contribute to this problem.
- Write any actions you could take to improve the situation.
- How can your algae cultures be disposed of safely at the end of this practical.
- List three possible extension/enrichment practicals/activities you could do.

Possible next steps

- Look at and/or identify algae

Teacher’s notes

- Algal cultures can be grown from any lake water sample kept in a light warm place for a week or two.
- Algal cultures should be poured on the ground around plantings (areas that could use fertiliser). Avoid adding to any surface water and especially not down the drain.
- Enrichment activities – compare different fertilisers, vary the temperature (keeping nutrient concentration constant), visit a lake for evidence of algal blooms or good lake management, test the oxygen concentration of the water, before and after the algal blooms with a water test kit.
- Practises contributing to nutrient input into lakes are – fertilising lawns, fertilising before rainstorms, farmers fertilising pastures, throwing/sweeping organic matter such as leaves or grass cuttings into gutters or into the lake, annual leaf shedding from trees on the lakeshore, waste input from livestock such as cows/sheep, leaking septic tanks, damaged waste removal pipes.
- Positive actions – reducing/eliminating lawn fertiliser, composting organic matter, gutter checks, raking autumn leaves, riparian fencing, regular septic tank checks and problems fixed promptly.

Activity 6f Looking at Algae

Curriculum links **Science**

Environmental Education – about

Any level
6
Science

Resources required

- Three jars of the same size
- Distilled water
- Detergent
- Liquid fertiliser
- Hand lens

Prior learning

- 6d Microscopic Discoveries

Method

1 Focusing questions – What would happen if you:
   - Left a container of water sitting outside for weeks in the shade?
   - Didn't treat your swimming pool with chemicals or clean it all winter?
   - Didn't clean your fish pond or tank for a long time?

2 Prior knowledge
   - Ask students to pair-share the focussing questions. In addition ask; what colour does the water start to turn?
   - What do you start to see on the sides of the container, on the rocks etc?
   - What do you think this 'stuff' that you see is, is it alive, what does it do?

Background information

"The green slime that you often see on stream stones is made up of small plants called algae. It's good to have a thin coating of algae on stream stones because that means that macro invertebrates and other animals are grazing on it and keeping it under control. But it's not so good if the layer of algae is thick or it's growing in long strands. That can mean that too many nutrients are coming into the stream – often in the form of animal dung from nearby farmland" Wonderful Water, Werry, Connected 3 2004.

3 Questions:

- What are nutrients?
- What do you think animal dung has to do with nutrients and algae?
- Why would having algae that is too thick or is growing in long strands, be a problem?
- Experiment: What can pollute the water?

4 What can pollute the water?

a Half fill three jars with distilled water and label them A, B and C.

b Put one tablespoon of detergent in jar A.

c Put one tablespoon of liquid fertiliser in jar B.

d Leave jar C as it is.

e Stir the water in jars A and B. Add 100ml of pond water containing algae to all jars. Each day add a teaspoon of detergent to jar A and a teaspoonful of fertiliser to jar B.

f After one week compare jars.

5 Reflection:

- Which jars shows the greatest growth of algae?
- What effect do you think added fertiliser and detergent might have on the lakes?
- How do you think detergents and fertilisers might get into waterways.
- Where do you think water from inside your house goes when you have finished with it?
- What does “biodegradable” on any detergent bottles mean?

Possible next steps

- Look at a sample under microscope
- Look at and/or identify algae
- 4i Stormwater problem
- 4j Watery Wastes
- 4k Stormwater
- 4l Pollution – What Happens?

Activity 6g Who Eats What/Whom?

Curriculum links

Science

Environment Education – about

Any level
6
Science

Resources required

- Life in the Lakes cards – in file box
- List of scenarios
- A ball of string – is easiest if you have the ball wound onto a stick

Prior learning

- 6b What Lives in our Lakes
- 6j Aquatic Treasure Hunt game

Method

There are several ways you can use these cards:

1 What am I? - in pairs, one student uses a food web card and the other student must guess what type of organism it is by asking questions. The student with the card can only answer in one or two words.

2 Higher level – this time the student can only answer in one or two words and can use “yes” or “no”.

3 Food Webs –

   a Students sit in a circle and take a card off the pack. Give students the time to sit and read their card and discuss with their neighbours what they each have

   b Go round the circle allowing each child to name their card and giver one important fact from the description on it

   c Ask the students which card they think they should start with. The person holding this card is given the reel of string

   d The student states where they believe they are connected to and why. e.g. the fresh water mussel card might like to pass the string to the phytoplankton – because the freshwater mussel depends on this for food through filter feeding (or a similar statement). It doesn’t matter whether the person holding that card already has a reel of string or not they can still receive another one. The connection could be what they eat, where they live or who eats them.

   e The string/s keep being passed on one at a time so all can clearly hear the link and why that link was chosen.

   Keep this up until all students have been connected with at least once.

f Put the following questions to the students:

- Was it easy for you to link up with others – why?
- Was it harder for some people to link than others – what were these cards that were difficult, can you think of any reason why these cards might have been harder?

- How many links did you make?
- What does this show us about the environment?

g At this stage get one person to tug their string, all who feel the tug then have to tug on their strings – gently. Questions:

- Who felt the tug – why –then discuss the meaning of interconnectedness and ecosystems (a specific type of area e.g. in and around the lake)
- What does this tell us about the relationships between the lake and the creatures and plants living there, biodiversity (the range of plants, insects, animals etc living in that ecosystem – you need the biodiversity for all to survive) and interdependence (how the trees need the rain to survive and the lake needs trees to remain clear and cool so that the creatures living in the stream have a suitable habitat with plenty of oxygen and food) – how all living things within an ecosystem are dependent on one another and how important it can be to that ecosystem if one thing changes

h You can take g) to the scenario stage instead of just tugging on the strings. Some scenarios you might use would be:

- The introduction of a pest plant (see red bordered pest cards)
- Introduction of intensive farming practices and heavy use of fertilisers
- Riparian plantings alongside the lake edge.

4 Reflection:

- What does this activity tell us about the relationships between the different organisms in our lake?
- What can we learn about New Zealand's biodiversity from this activity?
- What places in your own school/local community are at risk for reasons similar to those in this game, or others? Do these areas support ecosystems and areas of biodiversity?
- How does it feel to know that our lakes are dying? Are our lakes dying?
- What can we do about this?

This is a chance for you and your students to plan an action to help either in the restoration or protection of an area by the lake or a local stream site.

Possible next steps

- Food pyramids – Energy Pyramid, Kiwi Outdoors, Hillary Commission, 1995, pages 60–61

Activity 6h Habitat Hunt

Curriculum links **Science**

Environment Education – about

Any level
6
Science

Method

Rotorua is a beautiful and unique district.

1 Think of places where you know native plants and animals live.

2 Briefly

- describe these areas to you partner
- list the important features to keep the living things alive
- give five reasons why you should care and protect these places
- give five ways you could make this happen

3 Join with another pair to complete your group and share your ideas that you have listed.

4 Go outside and evaluate the range of life in a particular habitat (at school or in your local area). Look at the features organisms found have that make them suited to that environment.

5 Reflection:

- Using your ideas to write three strong and positive statements, explain what you have learned.

Activity 6i Plants Around the Lakes

Curriculum links **Science**

Environment Education – about

Any level
6
Science

Prior learning

- 6c Aquatic Treasure Hunt

Method

Plants around water play an important part in the overall health of a stream/lake.

Using suitable resources:

- Dictionary
- Library books
  - Trees, Shrubs (Dewey Classification Number 582)
  - Macrophytes, Periphytons (Dewey Classification Number – 574)
- Website
  - www.niwa.cri.nz
  - www.waterlink.org.nz
  - www.rsnz.nwp.govt.nz
  - www.ew.govt.nz

1 Give a brief description of 'plant'

_____

2 List different types of plant you would find around the lake/stream

_____

_____

3 List the main difference between the plants in no 2

_____

4 List the advantages and disadvantages of growing vegetation around a waterway/feature.

Advantages:

Disadvantages:

5 Give a meaning for

Native

Exotic

Now explain these in terms of the vegetation

6 List

Three native species

Three exotic species

7 List the advantages and disadvantages of growing natives to exotics

Advantages

Disadvantages

8 Give a meaning for

Macrophytes _____

Habitat _____

Biodiversity _____

Ecosystem _____

Organism _____

Sustainability _____

9 Write a paragraph using at least three of the above words about the value of having native plants around lake/streams.

_____

_____

_____

_____

_____

_____

_____

_____

10 Choose an environmental pest plant that can be found along lake and stream edges.

For each describe:

- why it is considered a pest
- what landowners and users can do to help contain the plant
- what effect it can have on the waterway
- what positive action you can do
- what positive action the community can do.

Possible next steps

- 6j Lakeside Treasure Hunt

Activity 6j Lakeside Treasure Hunt

Curriculum links

Science

Environment Education – about

Any level
6
Science

Resources required

- Reference books
- Charts about lakeside plants and insects

Prior learning

- 6f Looking at Algae
- 6g Who Eats What/Whom?
- 6h Habitat Hunt
- 6i Plants Around The Lakes

Method

Search around on the lakeshore and along the lake bush line and find four native plants (trees, ferns, shrubs) and four invertebrates.

1 List/draw your plants and four invertebrates.

2 For one of your plants:

- Accurately draw a leaf (or group of leaves). It is to be a life size drawing (you may trace around the leaf). You may include seeds, cones or flowers.
- Give the common and scientific names.
- State where you found it (on the sand/grass, ? metres from the water line).
- Find out a few pieces of information about it (uses, medicine, timber, clothing).
- And write three or four sentences.
- Do a bark rubbing.
- Describe the trunk – it is rough, smooth, what colour, is it straight, crooked, is it just one trunk or does it split?

3 For one of your invertebrate:

- Do a quick sketch of your invertebrate.
- Name your invertebrate.
- Describe its habitat – what it lives on, its nutrition, enemies etc.

4 Design a food chain that includes at least one of your invertebrates and native plant.

- Can you design a food web?

5 Now repeat the above from a separate part of the lake shore or a different lake and compare your set of results.

- Is the vegetation different/same – how is it different?
- Are the invertebrates the same?
- How do the habitats differ? How does this affect the range of insects found in that area.
- Are your food chains/webs affected by these differences?

6 Reflection

- Class discussion to evaluate the environments, and determine which is the ‘best’ and why?

Activity 6K Streaming Water

Curriculum links **Science**

Social Studies

Environment Education – about

Any level
6
Science/
Social Studies

This activity is based on one developed by Environment Waikato and modified by Faye Wilson-Hill, Lynette Brown, Mary Loveless and Leyette Callister.

Resources required

- Reflection questions

Prior learning

- Enough prior knowledge to play role effectively is required
- 6g Who Eats What/Whom?
- 6h Habitat Hunt
- 6l Healthy Habitat

Teacher's notes

This activity is the same as 4q S.O.S, except 6k uses drama as the tool, whereas 4k uses drawing.

Method

In this activity students take on different roles related to a stream and the impacts that change it.

1 Give members of the class various roles - trees, freshwater invertebrates, snails, fish (kokopu, inanga, bullies, trout), aquatic plants, landowners (three or four), developer.

2 Mark a stream on the ground. Place trees along the riverbank and then let the animals get in and swim around. This is a nice stream, fresh clean water and the animals are happy. Beautiful water, lots of oxygen, and food.

3 Landowners are happy as they have a nice place to live and visit, take children for picnics etc.

Reflection questions 1

- What do you (the animals) like about the stream?
- What do you dislike?
- Landowners – what do you value about this place.

4 It starts to rain, however the soil will not wash into the stream as the trees prevent soil erosion. Now spread the soil (brown paper cut-outs) along the edges of the stream behind the trees.

5 Mr or Ms Developer has just brought a large portion of the land that adjoins the stream. They have applied for and been granted resource consent to develop the land for urban housing at high density. To meet the demands for housing the developer has to chop down the trees. (Get someone to pretend to chop down the trees and remove the trees from the stream edge)

6 Unfortunately without the shade of the lovely trees the water heats up. (add black sheets of paper to the stream to represent an increase in temperature)

Reflection questions 2

- What has changed?
- What will happen to the water quality? Why?
- What animals will be removed from the stream ecosystem?

7 As the water heats up the stonefly is not longer able to cope and dies off.

8 Now it rains – very heavy rain.

9 Have available soil (brown paper, cones, cardboard cut outs etc) and place these in the stream.

Reflection questions 3

- What has changed?
- What will happen to the water quality? Why?
- What animals will be removed from the stream ecosystem?

10 Now that the trees have gone the soil starts to fall into the stream building up sediment around the rocks, filling in the habitat of the mayfly and caddis fly.

11 There are no trees overhead and no food or nutrients for the stream. The food chain breaks down and the koura is left without food.

12 However, the developer is happy, he has sold most of the sections and people have build houses. They wash their cars on their newly paved driveways and the stormwater takes the soap suds away (to the stream). Litter dropped by kids flies into the stream, the local teenagers throw their cigarette butts and beer cans into the stream.

Reflection questions 4

- What has changed?
- What will happen to the water quality? Why?
- What animals will be removed from the stream ecosystem?
- Is this now a desirable place to live?

13 Reflection

- What is the stream like now compared to the beginning?
- What has happened to the look of the stream?
- What has happened to the animals that live in the stream?
- What happened to the water quality?

Take each of the roles and explore how they felt during the decline of the stream.

Ask the developer what has happened? How do they feel? Are there any other options that could have been taken? What are they?

Discuss the food chain, who eats who and which of the pollutants affected which of the animals?

Do we have a responsibility to “care for the environment”?

Reflections

Reflection questions 1

- What do you (the animals) like about the stream?
- What do you dislike?
- Landowners - what do you value about this place?

Reflection questions 2

- What has changed?
- What will happen to the water quality? Why?
- What animals will be removed from the stream ecosystem?

Reflection questions 3

- What has changed?
- What will happen to the water quality? Why?
- What animals will be removed from the stream ecosystem?

Reflection questions 4

- What has changed?
- What will happen to the water quality? Why?
- What animals will be removed from the stream ecosystem?
- Is this now a desirable place to live?

Final Reflection

- What is the stream like now compared to the beginning?
- What has happened to the look of the stream?
- What has happened to the animals that live in the stream?
- What happened to the water quality?

Activity 61 Healthy Habitat

Curriculum links **Science**

Social Studies

English

Environmental Education - about

Any level

6

Science/
Social Studies

This resource is based on 'A Beautiful Stream' from Greater Wellington Regional Council's Take Action resource.

Resources required

- Clear plastic container filled with water,
- Largish rocks (only need a couple), forest/bush scene (coloured picture laminated, largish branch that will fit into the water container).
- In small containers: plastic/rubber insects, snails, birds (especially kotare/kingfisher), frogs and various fish shapes – if you can't find plastic versions you can photocopy pictures and laminate, larvae (polystyrene balls or those long squiggly shaped polystyrene).
- Enough small containers (e.g. film canisters or ziplock bags for some items) for each of the following: leaves, twigs, rotting tree, rope nests, paper, rotting vegetables, soil, gravel, sheep wool, sheep/cow poo (mud), sheep/cow urine (yellow food colouring), fertiliser (green food colouring), herbicides (blue food colouring), poison (red food colouring), dead possum (fur), rubble, toilet paper and waste, oil, paint, detergent, old plastic bags, toxic chemicals (tumeric powder), blue-green algae (small pumice dyed blue-green colour with food colouring), green algae (small pumice dyed green with food colouring), mosses and plants (sphagnum moss dyed green).
- Have a picture of the sun stuck onto a stick.

Method

1 Collect all the materials and place them in the containers with labels indicating contents of each one. Have enough containers for one per child or pair of children.

2 Set up the clear plastic container with water in it – it needs to be fairly large.

3 Read the story "Healthy Habitat" (or get student/s to read). As each 'item' is mentioned the student that has that particular item comes and puts their item into the water. Discuss the reflection questions in the story.

4 Reflection

- After the story reflect/discuss the ideas at the end of the story.

Teacher's notes

- Getting students to brainstorm and write down or draw what it was about the lake and its streams that they valued at this first reflection stage; will provide a visual reminder when you come to the final reflection stage. You can use these to consider what is missing from the ecosystem now and discuss whether these should or can be restored and if so how? An extension of this can be to have a large sheet of paper easily accessible with the lake and its streams drawn on it. Rather than writing or drawing their ideas on 'post its' the students write or draw them onto the large picture of the stream.
- Unlike the stagnant water in our plastic container a real stream would carry the pollution down to the next river, lake or sea. This is a good discussion point.
- Most of the habitat degradation, pollution and loss of fish species is the result of a combination of many small issues rather than one big one.
- Human impacts of a wide variety are the main causes of the degradation our streams, rivers and lakes along with their ecosystems. Where negative impacts have in the past had the major impact, positive human actions can and are having beneficial impacts on these same environments and ecosystems.
- This activity works well being acted out as well, you can use a scrap of light-coloured material with the 'issue' written on it for each student to wear or hold. This allows students that are 'toxic' type 'issues' to touch the fish or plants as they flow down the stream into the lake, giving them another insight into story.

Glossary

- Habitat: A plant or creature's home or territory.
- Ecosystem: A community of living things, together with their environment.

A Healthy Habitat

Many years ago there was a beautiful lake not far from here. This lake was a perfect place for all sorts of plants and creatures. The streams feeding it flowed down from the hills through the forests tumbling over rocks and pebbles. Their waters were nice and cool as the trees provided shade along their banks. This lake was a large lake; it had deep, cold parts as well as lots of trees around the edge of it. In this place of clean, cool water lived lots of green algae and mosses and plants, snails, larvae, worms, fresh-water shrimps along with many other small creatures. This was lovely healthy habitat - lots of oxygen and food. Fish of all sorts lived here as well. Inanga (whitebait), kokopu, koara, tuna (eels), porohe (common smelt), and bullies were some of the fish living in this wonderful lake. There may even have been upokororo (grayling). Sometimes birds such as kotare (kingfisher) fed on the fish. The water of our beautiful healthy habitat was sparkly clear, cool and clean. High in the hills it starts to rain, but that's good as the trees and plants of the forest will soak up the water and use it to help them grow, and only some of this water will slowly find its way into the streams and flow on down to our lake.

Imagine this place of clean, clear water, with all sorts of wonderful plants and creatures living in and around it. On a nice sunny day would you like to have swum there? Would you like to have found a nice spot to sit and have a picnic beside it? Would you have eaten the fish that were caught in this lake? What else about this place would you value? What is it about this ecosystem that is so good for the plants and creatures living in it like? What would you change?

Occasionally leaves and bits of grass fell off the trees and plants into the lake and the streams that fed it. But this was good as it provided food for the insects that lived in the water. They ate the dead leaves and kept the water clean. Sometimes old twigs and even bits of rotting tree would fall into the lake and streams. But the insects (macro invertebrates) would eat these too, or if the log was very large some would use it as a home.

One day a small group of people came to live by this lake. The people were Māori. They lived happily by the lovely lake. The birds and macro invertebrates were happy too. The Māori caught eel/tuna from the using rope net/hinaki. If the hinaki broke, bits of rope were left in the stream, the macro invertebrates would eat this as the ropes were made of flax (harakeke), and they liked to eat harakeke. The people were very careful to look after the lake and its streams and all that lived in and around it. The lake was very special to them; it was regarded as a taonga or treasure.

Let's stop and picture our lake and its ecosystem now. Would you still like to have a swim there? Would you like to have found a nice spot to sit and have a picnic beside it? Would you have eaten the fish that were caught here? What else about this place would you value? Would you change anything at this stage?

After many years, more people came to this lovely spot. This time they were settlers from Europe, and they began to build a town nearby. This town was much larger than the Māori village and soon rubbish began to build up. Some of this rubbish like paper and rotting vegetables blew or fell into the lake. As the town grew the settlers needed more wood for their houses and food. They started to clear the bush (take the bush scene away) around the lake and then also the streams to make way for farms. As they cleared the bush, the land was turned over and disturbed. This time when it rained there were no trees left to anchor the soil or to slow the rain from rushing down into the streams taking the loose soil and dirt with it. All the extra soil and sediment in the streams started to build up around the rocks filling in the habitat of the mayfly and caddis fly. Some even got washed on down into our lake. There are no longer any trees overhead and no food or nutrients for the now not-so-healthy ecosystem. The food chain breaks down and there is no food for the koura. Because the trees no longer shaded the streams, the water heated up and some of our creatures died off - the stonefly would be one, the grayling died off to such an extent that it is now extinct. This water flowed on down into our lake and warmed up the water in the lake. Because all the trees had been cut down around the lake for houses and farms even the deep cold parts of the lake were not enough to keep the temperature of the water cool. This affected all the plants and creatures of the lake as well.

The farmers raised sheep and cows as well as growing vegetables and fruit. Sometimes the sheep wool and sheep and cow poo as well as their urine would get into the stream because the streams were not fenced off and the animals could walk in them. The farmers also put fertilisers on their soil so that more food would grow for all the new people of the town. Sometimes they sprayed herbicides from an aeroplane to kill off the gorse that was growing on the hills. All of this would flow down with the water of the streams feeding our poor lake.

The people weren't satisfied with the fish of the lake, they were not big enough and so they introduced fish from other countries like the brown trout and the rainbow trout. These fish not only ate the food of the native fish but also ate some of them.

Many possums had started to live in the area and were eating the fruit and causing harm to the trees. Poison was used to kill them off, but sometimes a dying possum would fall into the water and the poison would leak into it. Blue-green algae started to flourish and some habitats became smothered as well as the water being further polluted by the toxins released from the blue-green algae. Oxygen levels became depleted, killing off more invertebrates and fish eggs.

Depressed yet? We haven't even mentioned petrol, toxic chemicals, detergents or plastics. We all know that these also found their way into our stream.

Let's stop and picture our lake and its ecosystem now. Would you still like to have a swim there? Would you like to have found a nice spot to sit and have a picnic beside it? Would you eat the fish caught here? Is there anything about this place you would value? What is the habitat like now?

Reflection

- What do you think is still living in our lake ecosystem now?
- What do you think the likely future is for this lake and its streams?
- Do you think that a restoration programme is advisable?
- Look at the picture you created earlier (if you did). What is missing from the picture now? Would you be able to restore the lake, its streams and their ecosystem?
- Would you restore the fauna and flora of the lake?
- What would happen if you only restored the lake and its edges?
- Would this be enough, where else would you need to restore it?
- If so how would you go about it, what would the steps be?
- What do you think the picture would look like after you had restored the lake and its streams – would it look like it did originally?
- How long do you think it would take for the lake to regain its health?
- What impact would our changes have made on the stream and on the lake below?
- What impact would our choices have made on the people living in the area – consider social, economic and environmental impacts.
- What impact would our choices have on the plants and animals that live in and around the area?

This could be adapted in several ways e.g.

- Discuss the nutrient levels in the lake and the increase of the cyanobacteria.
- Shorten rest of activity to get to that get students to research Rule 11 and its implications.

Background Information - Blue-Green Algae

Other than in exceptional circumstances, cyanobacteria tend not to bloom over winter, bloom formation doesn't happen until lake water temperatures increase. As you may be aware, cyanobacteria also respond to increased nutrient levels. So intense and frequent blue-green algae blooms are symptomatic of more serious problems in the lake (eutrophication) and it is the effects of nutrient enrichment rather than blue-green algae blooms per se that adversely impact lake ecosystems.

Typically what happens in lakes such as Rotoiti is that the hypolimnion (the deepest layer) becomes thermally stratified during summer. Because the thermocline effectively isolates the hypolimnion from surface waters, deeper water progressively deoxygenated as summer progresses. This provides ideal conditions for the lakebed sediments to give up their nutrients. When waters finally mix in autumn, a large pulse of nutrients in the water column drives further bloom formation.

It is this oxygen-depleted water that is probably the most limiting on lake organisms, particularly as anoxic layer pushes further towards the surface. This anoxic water effectively narrows the niche of species such as trout and lake koaro and koura, i.e. oxygen loving species are pushed further towards surface waters. There is presently much concern that koura are diminishing in the lakes because of these effects.

One would normally expect macrophytes to respond favourably to an increased nutrient regime, and this is where cyanobacteria start to exert an effect. With bloom development, turbidity increases, and the extent of light penetration reduces such that deeper occurring weed beds and micro-algae (diatoms) are starved of light and perish.

So in this respect the light reducing effects of blue-green blooms is a two edged sword, as it has by default a limiting (albeit indirect) effect on adventive weed species (weeds that have been introduced into a new locale or environment and are not yet fully established e.g. Lagarosiphon, hornwort and Egeria). Because in lakes such as Rotoiti and Rotorua adventive pest weed species have largely displaced native macrophytes, a collapse of adventive weed beds is likely also to impact on refuge requiring organisms (e.g. bullies, koaro etc). We expect that as improvements in water clarity are made, growth of adventive aquatic pest weed species will also increase.

Knowledge on the direct impacts of the blooms themselves on other organisms is slightly more nebulous - there is still much uncertainty regarding the effects of cyanotoxins on humans let alone other organisms.

What gives cyanobacteria a selective advantage over other forms of micro algae is that many species are toxic and so are less heavily browsed by the next trophic level (zooplankton). Cyanobacteria release a range of toxins (called cyanotoxins) that are broadly grouped under: hepatotoxins (those affecting the liver) and neurotoxins (effecting nervous function). Microcystin is one such hepatotoxin and at very high levels may be sufficient to kill a human. We have had high microcystin levels (4800µg/L) in Lake Rotorua (i.e. almost 5000x higher than WHO standards for drinking water). However, a 10 kg child would need to ingest 10 L of water before any health impairment was evident. Even at 25,000µg/L (some of the highest levels recorded) a child would still need to drink 2 L (in a one-off event). However, there are likely to be greater impacts from chronic exposure, i.e. ongoing exposure to low levels of microcystin has shown to lead to carcinogenic effects in mice. In humans the recommended maximum exposure to microcystin on an ongoing basis is just 0.1 ml (i.e. people should not even be brushing their teeth with water out of our worst affected lakes). It is possible that the same insidious effects are also impacting aquatic fauna to an extent. I am not aware of any work being done presently on the actual effects of cyano-toxins on the health of aquatic organisms, but some work is being done in Rotoiti to assess where cyanotoxins are stored in fish and koura and at what levels so that we can determine the impacts of cyanotoxins on humans (through consumption of fish).