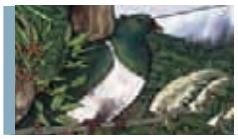
Native Ecosystems

It is important for students to have a sound understanding of how native ecosystems operate before investigating how human activities impact on them.

This first section of *Take Action for Water* introduces students to the water cycle and the catchment concept, before investigating the native animals that live there. Māori perspectives of water are also discussed through the sharing of stories and concepts such as ‘mauri’ and ‘kaitiaki’.



1 The water cycle - Teacher notes

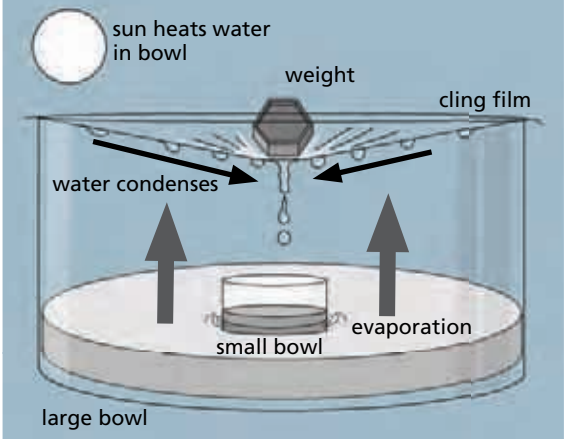
Linking to curriculum

Science - L 3/4 Planet Earth and Beyond: Interacting systems

Investigate the water cycle and its effect on climate, landforms and life.

Explanation for water cycle experiment

The sun will heat the water in the bowl which will cause it to evaporate into water vapour. The water vapour will rise and hit the plastic wrap where it will cool and condense, forming water droplets. The droplets will continue to collect on the plastic wrap until they become too heavy and, with gravity, move to the lowest point of the plastic before falling into the small bowl below.



What is the water cycle?

Water can change states between a liquid (water), a gas (water vapour) and a solid (ice, snow, hail). The water cycle is a true cycle in that there is no beginning or end. The water cycle is driven by the sun. As the sun heats water, it is evaporated into the air as water vapour, where it rises with air currents. The water vapour condenses in the atmosphere's cooler temperatures and creates clouds. As the clouds get heavy, water particles fall out of the sky, due to gravity, as precipitation (water, hail, snow).

Who are Ranginui and Papatūānuku?

In a Māori world view, life began with the separation of Ranginui (sky father) and Papatūānuku (earth mother). From them emerged the various atua (gods).

The water cycle and atua

Aspects of the water cycle are beautifully represented in the story of Ranginui and Papatūānuku. Rain (precipitation) is represented as tears while mist (water vapour) is explained as the sighs of Papatūānuku. The waterways are created by the tears of Ranginui and Papatūānuku.

Water cycle experiment instructions

1. Put some water into the large glass bowl.
2. Place the small bowl in the middle of the large bowl.
3. Cover the top of the large bowl with plastic wrap so there are no gaps. Don't pull the plastic wrap too tightly.
4. Place the stone in the centre of the plastic wrap so it sags in the middle over the small bowl.
5. Place the bowl in the sunlight and leave it for a few hours.

1 The water cycle

Introduction

- Write learning intentions on your board and read through these with students.
- Read the story of Ranginui and Papatūānuku (BLM 1) aloud to the students.

  ? As I am reading the story think about how water is represented.
- After the reading, discuss the following:

  ? What do Ranginui and Papatūānuku represent?

  Ranginui represents the sky and space while Papatūānuku represents the earth.

  ? What do you think this story tells us about water?

  Answers will vary.

Activity instructions

- Set up the water cycle experiment with the class (refer to teacher notes). Explain that the class will look at the experiment again later in the day.

  ? Predict what will happen to the water.

Later in the day

- Look at the water cycle experiment to see what has happened.

  ? How did the water get into the small bowl? Is this what you predicted would happen?

  Refer teacher notes for explanation.
- Using Poster 1, make links between the water movement the students have seen in the experiment and the methods of water moving on the water cycle poster.

  ? How does water form clouds?

  As water heats up it is evaporated from streams, lakes and the sea and rises as water vapour to form clouds.

  ? How does water get from the clouds back down to the stream?

  When the water vapour in clouds cools it turns into liquid water again which falls (due to gravity) onto the ground as rain. This is called precipitation.
- The water cycle is vital for life on earth. Different cultures throughout the world have stories to explain it.

  ? What are the key stages of the water cycle?

  Evaporation, condensation, precipitation.

  ? How does the Māori story of Ranginui and Papatūānuku explain these stages of the water cycle?

  Precipitation is represented by the tears of Ranginui. Evaporation (water vapour) is produced by the sighs of Papatūānuku (mist).

Conclusion

- Hand out BLM 2. Explain to students that their task is to draw an image that represents the water cycle and contains Māori perspectives.

Learning intentions

Students will…

- Understand the water cycle (context - a catchment)

Success criteria

Students can…

- Describe movement of water in the water cycle

Resources

BLM 1: Ranginui and Papatūānuku

BLM 2: The water cycle

Poster 1: Water in the catchment

Water cycle experiment:

Large clear bowl, a small bowl, plastic wrap and a stone, tap water

Vocabulary

evaporation, Papatūānuku , precipitation, rain, Ranginui, sea, streams, transpiration

BLM 1: Ranginui and Papatūānuku

In the beginning there was Te Korekore, the nothingness. All was dark and still. There was no light, no life, but there was potential for life. Slowly the darkness gave way to light and the first parents, Ranginui and Papatūānuku emerged.

Ranginui and Papatūānuku clung to each other in a strong, loving embrace. They created many children, the atua, who lived in the cramped, dimly lit space between them. The children were unhappy living in the dark and decided to separate their parents so they could live in light. They tried to separate their parents several times but their embrace was too strong. Tānemahuta had an idea. He lay down with his back against his mother Papatūānuku and pushed his feet up against his father Ranginui. With great strength he pushed against his parents until finally their embrace was broken.

The separation of Ranginui and Papatūānuku created the universe. Papatūānuku became our earth with its rugged mountains, deep valleys and flat plains. Ranginui became the sky allowing Papatūānuku's body to be enveloped in light, warmth, and air.

Ranginui and Papatūānuku were heartbroken about their separation and often cried as they looked at each other. Their tears covered much of the land and formed the sea. The children were concerned that the crying would flood the earth so they turned Papatūānuku on her side, making it difficult for the grieving parents to look at each other.

The children thrived in the new light filled world. Their mauri, their lifeforce, developed and they brought new life into the world. Tānemahuta, became atua of the forests and created the plants, birds and insects, while Tangaroa became atua of the water and created the fish and other animals that dwell there. Life flourished on Papatūānuku.

However, Tāwhirimatea, who disagreed with the separation of his parents, went to live with his father and became atua of wind and storms. To this day he is still angry with his brothers and shakes the forests of Tānemahuta with fierce storms, breaking branches and crashing trees to the ground. He whips up the seas with gales and casts some of Tangaroa's children on to the shore.

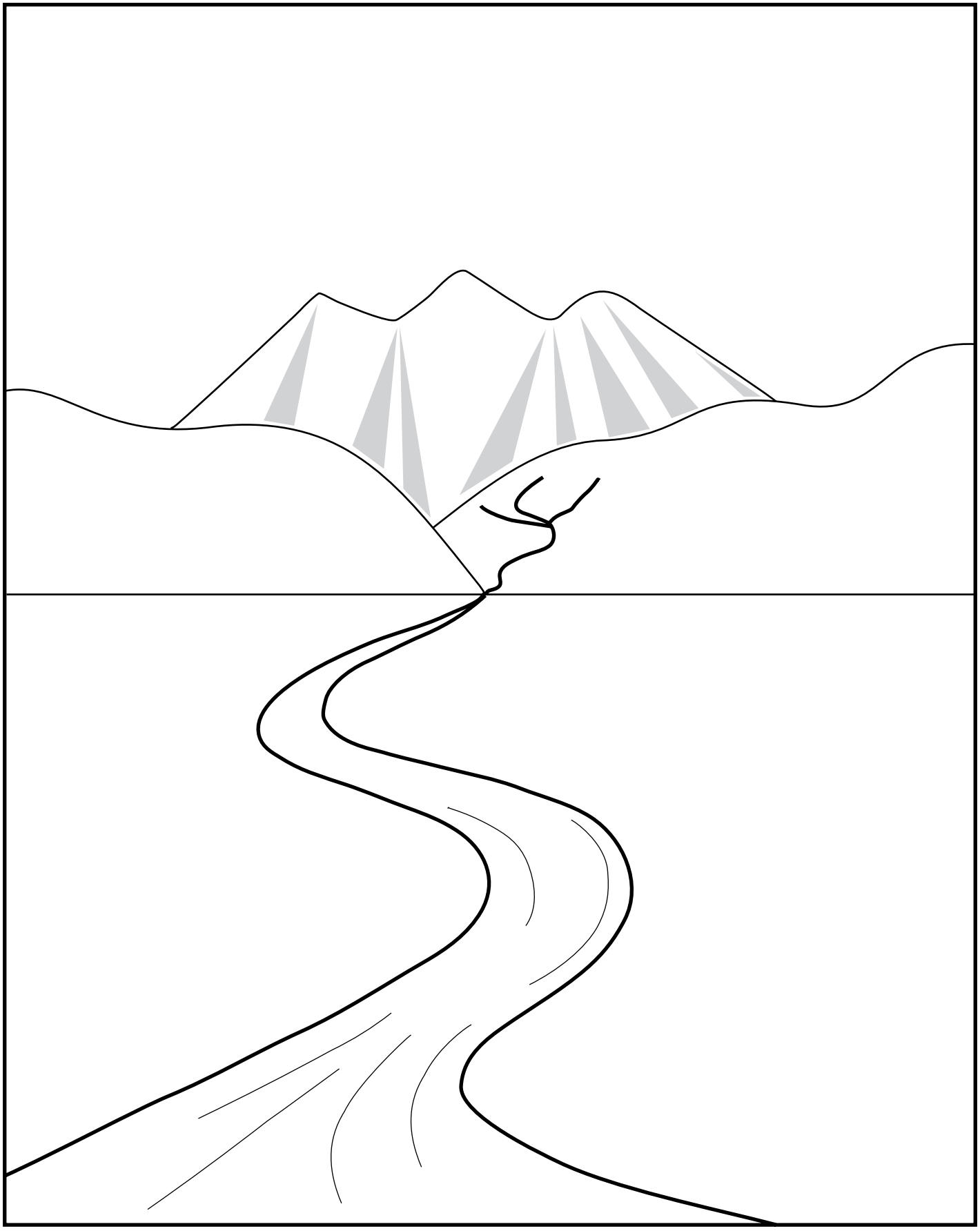
While the agony of the initial separation has eased, Papatūānuku and Ranginui still long for each other and often weep. Papatūānuku's tears bubble up from the earth in the form of fresh water springs and her sighs for Ranginui are seen as the soft mist that lingers over her valleys. Ranginui's tears fall as rain and they merge with the tears of Papatūānuku creating streams and rivers that flow to the sea. Where the mountain peaks seem to touch the sky, the separated parents are closest to each other. Being so close to his beloved, Ranginui sometimes cries and his tears create a veil of mist over the mountain peaks.

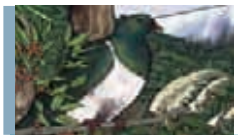
So it was that water was created by the grief of the separated parents. Aotearoa became a land filled with fresh, clean waters that flowed from the rugged mountains to the sea. The streams, rivers and lakes contain their own mauri, their own life giving energy, essential for sustaining life on Papatūānuku.

BLM 2: The water cycle

Draw on the outline below to show how water moves in a catchment.

Illustrate Maori perspectives and the part they play in the water cycle.





2 What is a catchment? - Teacher notes

Linking to curriculum

Science - L 3/4 Planet Earth and Beyond: Interacting systems

Investigate the water cycle and its effect on climate, landforms and life.

What is a catchment?

A catchment is an area of land drained by a river, bordered by hills and ridges. Rain falling onto the hills in a catchment creates the headwaters of a stream. The stream flows downhill due to the force of gravity and merges into other streams. Eventually many streams may feed into a large river which flows out through an estuary to the sea. Water also enters the groundwater system through rivers, streams and directly through the ground when it rains. Groundwater flows under the ground, usually towards the sea.

Questions and answers

BLM 3: The Wellington region's catchments

1. Shade in each catchment on your map in a different colour.
2. What river or stream has the largest catchment area?

   Ruamāhanga River
3. Name the streams and rivers that enter the Tasman Sea.

   Ōtaki River, Waikanae River, Mākara Stream, Porirua Stream
4. Name the streams and rivers that enter Cook Strait.

   Wainuiomata River, Orongorongo River, Ruamāhanga River
5. Name the streams and rivers that enter the Pacific Ocean.

   Whareama River, Pahaoa River
6. What catchment is your school in or closest to?
7. What is the closest mountain significant to iwi to your school?

BLM 4: The Wellington city and surrounds catchment map

1. Shade in each catchment on your map in a different colour.
2. What river or stream has the largest catchment area?

   Hutt River
3. Name the streams (creek is just another name for a stream) that enter the Porirua Harbour.

   Porirua Stream, Duck Creek, Pāuatahanui Stream, Horokiri Stream
4. Name the streams and rivers that enter Wellington Harbour.

   Kaiwharawhara Stream, Ngauranga Stream, Korokoro Stream, Hutt River, Waiwhetū Stream
5. What catchment is your school in or closest to?
6. What is the closest mountain significant to iwi to your school?

Pēpeha

A pēpeha is a formal introduction that links people to their environment. Students can relate their pēpeha to their tribal rivers and mountains. If students are not affiliated to an iwi they can use the information from the mapping activity (mountains and rivers) and can substitute their school in place of iwi to complete the simplified version of a pēpeha below. Students can build their pēpeha after research with whānau or kaumātua.

Tēnā koutou

Formal greeting to three or more people

Ko (name of your mountain) te maunga

My mountain is (name of your mountain)

Ko (name of your river) te awa

My river is (name of your river)

Ko (name of your tribe) te iwi

My tribe is (name of your tribe)

Ko (your name) ahau

My name is (your name)

Tēnā koutou

Acknowledging the people who have passed on

Tēnā koutou

Acknowledging the people present

Tēnā koutou katoa

Acknowledging the people still to come

2 What is a catchment?

Introduction

- Write learning intentions on your board and read through these with students.

? In 'talking partners', students share their ideas about what they think a catchment is.

Select a small number of partners to share their ideas with the class.

Activity instructions

- Use Poster 1 to explain what a catchment is and how water moves through it.

A catchment is an area of land that 'catches the rain'. The edges or boundaries of a catchment are the hills and ridges around it.

Raindrops fall onto hills in a catchment, then collect together to form tributaries and streams. Water, in streams, continues the journey downhill with the force of gravity. Streams become larger and may eventually feed into a large river. The river flows through an estuary and out to the sea.

Water flowing under the ground is called 'groundwater'. Water enters the groundwater system through rivers, streams and also directly through the ground when it rains.

- Take students outside the classroom to a location in the school grounds where you have a good view of your local catchment.

? What are the boundaries of the school catchment?

Hills and ridges surrounding the flatter land.

? Do you know any names of the local streams, hills and mountains?

Answers will vary.

- Back in the classroom explain that there are many catchments in our region. Hand out the relevant BLM for your area (BLM 3 or 4). The maps show the main catchments in the area. Discuss the map key and the lines on the map. Write the questions for the relevant BLM on the board and ask students to look closely at their maps to complete this activity. Refer to questions and answers on the teacher notes page.

Pēpeha

- Use the pēpeha guide on the teacher notes page to assist students to write their own pēpeha.
- Students can share their completed pēpeha with the class.

Conclusion

- On completion of the BLM activity, discuss and compare answers.

Learning intentions

Students will…

- Learn to identify the physical features of a landform (context - a catchment)

Success criteria

Students can…

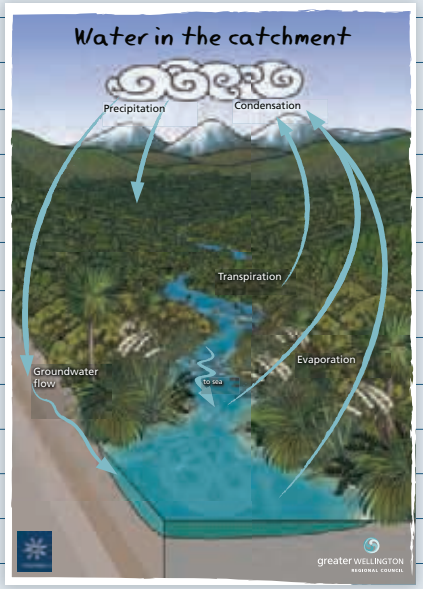
- Identify local catchment boundaries and features

Resources

Poster 1: Water in the catchment

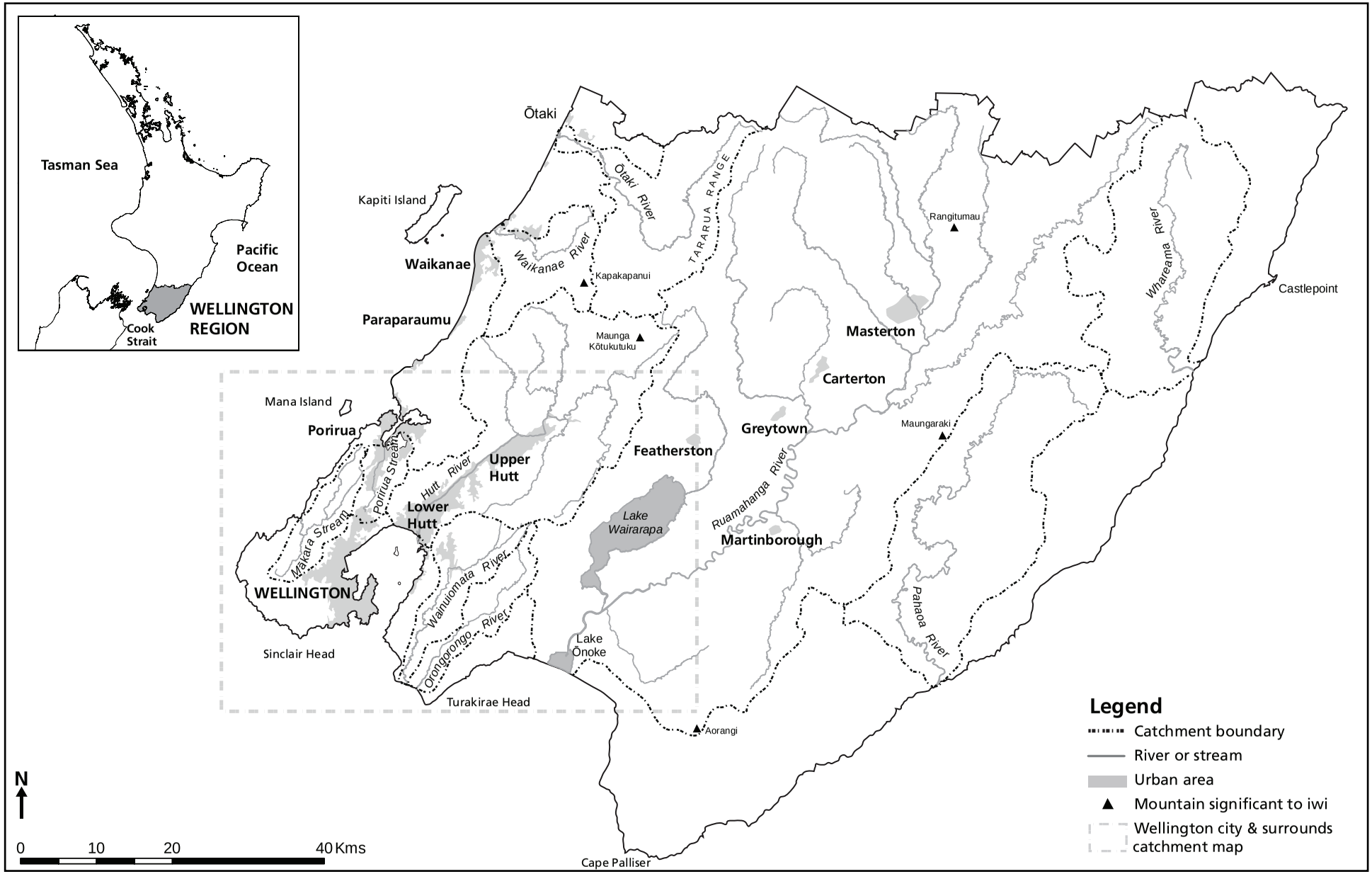
BLM 3: The Wellington region's catchments

BLM 4: Wellington city and surrounds catchment map



Vocabulary

awa (river/stream), boundaries, catchment, estuary, iwi (tribe), maunga (mountain), pēpeha, region, tributary



BLM 3: The Wellington region's catchments

meridian

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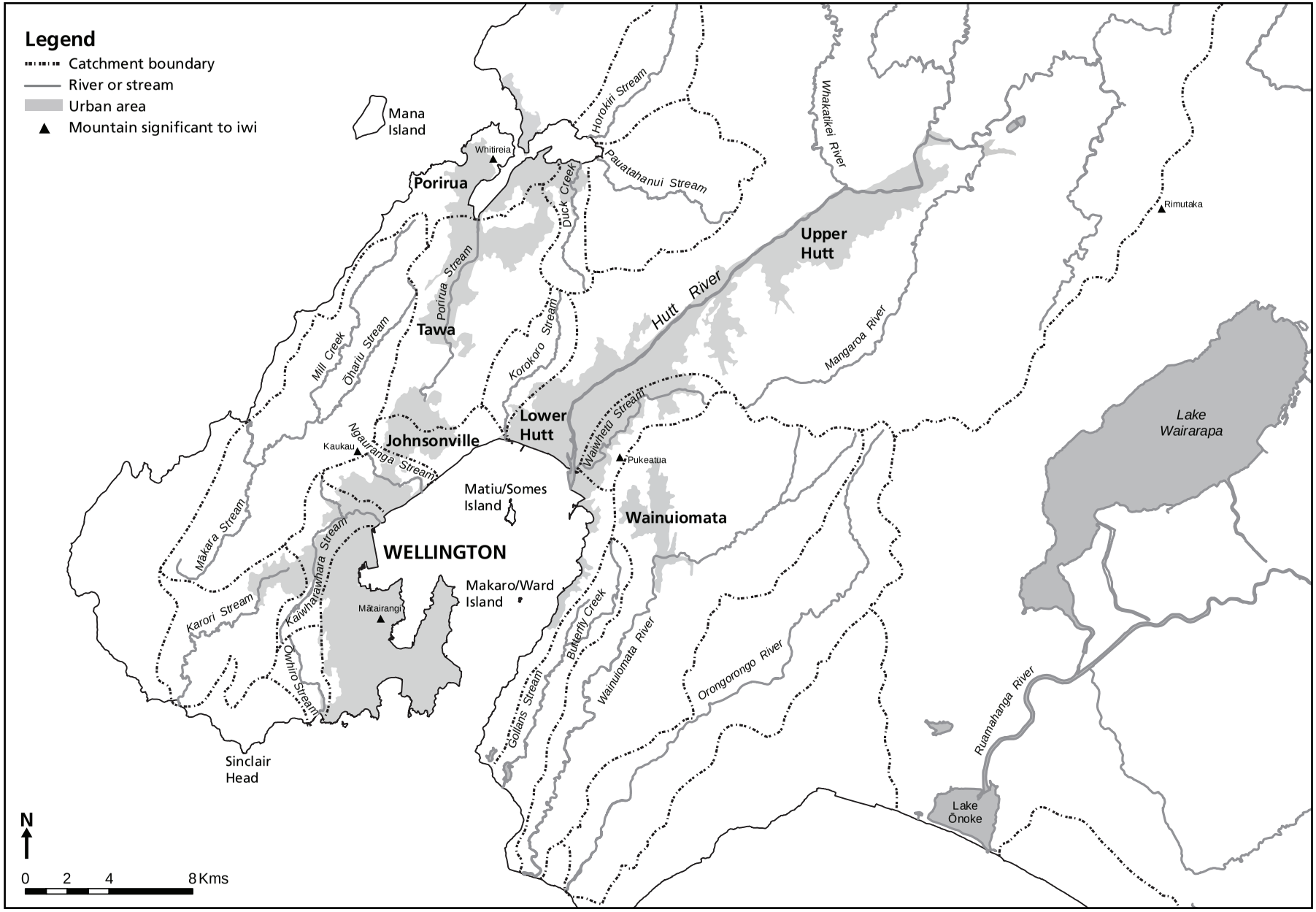
Take Action for Water - Native Ecosystems



BLM 4: Wellington city and surrounds catchment map

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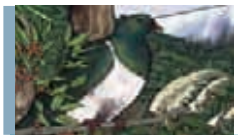
Take Action for Water - Native Ecosystems

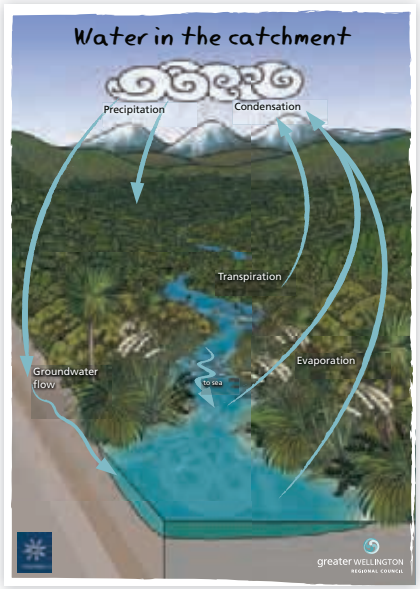


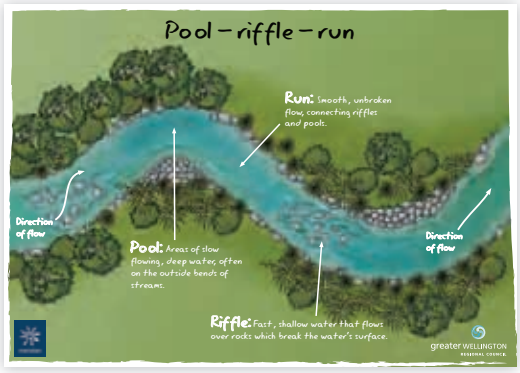
3 Animals in a catchment - Teacher notes

Linking to curriculum

Science - L 3/4 Living World: Ecology

Explain how living things are suited to a particular habitat and how they respond to environmental changes, both natural and human induced.





Tānemahuta and Tangaroa

Tānemahuta and Tangaroa are the children of Ranginui and Papatūānuku. Tānemahuta is the atua of the forest. He created the plants and animals that inhabit the forest (including humans). Tangaroa is the atua of the sea and waterways. He created the fish and aquatic animals that inhabit the water. Some insects, including the mayfly, choose to live with Tane and Tangaroa at different times of their lives.

In a Māori world view, all things in the natural world (eg. streams, rivers, mountains, plants and animals) have their own mauri (life force).

Habitats and animals

A habitat (which is Latin for 'it inhabits') is a natural environment which provides an animal or group of animals with all the things they need to live. Native animals have evolved over time to suit their habitat. Each animal in the catchment has a preferred habitat where it spends most of its time.

The habitats in a native forest catchment can be divided into stream and forest habitats.

There are three main types of habitat in a stream; pools, riffles and runs. A pool is an area of slow flowing, deep water which is often on the outside bend of a stream. A riffle is an area of fast, shallow water which flows over stones that break the surface of the water. A run is a smooth, unbroken flow of water that connects pools and riffles. Most animals in the stream are suited to a combination of these habitat types, living either in pools and runs, or riffles and runs.

There are two main habitat types in a forest; the forest floor and the trees. The forest floor is the ground between the trees that is usually covered with leaf litter. The trees of the forest provide valuable habitat for a variety of animals.

Answers to BLM 6

Forest floor	Forest trees	Pool-run	Riffle-run
Native land snail	Tūī	Water snail	Mayfly nymph
Stinking ground beetle	Wētā	Worm	Cased caddisfly larva
Centipede	Kererū	Longfin eel	Redfin bully
Earthworm	Morepork	Banded kōkopu	
Blue duck	Mayfly adult	Dragonfly nymph	
	Orbweb spider	Kōura	
	Caddisfly adult	Inanga	
	Dragonfly adult		
	Forest gecko		

3 Animals in a catchment

Introduction

- Write learning intentions on your board and read through these with students.

  In 'talking partners', students share their ideas about what they think a catchment is.

  Select a small number of partners to share their ideas with the class.

Activity instructions

- Read the story of Tānemahuta and Tangaroa (BLM 5) aloud to the students.

  How does this story explain where animals live?

  Animals generally live in the realm of the atua that created them.

  What is the Māori name for the life force in all living things?

  Mauri.

- Refering to Poster 1, explain that there are different types of habitat (environments where different animals are found) in the catchment.

  What habitats are there in a catchment? Where would you find living things?

  Forest floor, trees, stream.

- Using Poster 2, explain to students that not all areas of a stream are the same. Discuss with students the definitions of pool, riffle and run. Explain that most animals in the stream are suited to a combination of habitat types, living either in pools and runs, or riffles and runs.
- Hand out BLM 6. Working in pairs students cut out the four main habitat headings (forest trees, forest floor, pool-run, riffle-run). Students then cut out and read the animal cards one by one and place them under the habitat heading they are most suited to.
- Students discuss and compare answers.

Conclusion

- Show students Poster 3. Explain that the poster demonstrates the preferred habitats of animals in the catchment. Answers can then be compared with Poster 3 which shows where most of the animals live.
- The animal cards can then be glued onto paper to be kept as a record of students' learning. These will be required again for Activity 4: Report Writing.

Learning intentions

Students will…

- Learn about animal habitats (context - a catchment)

Success criteria

Students can…

- Identify animal habitats in a forest covered catchment

Resources

Poster 1: Water in the catchment

Poster 2: Pool, riffle, run

Poster 3: Animals in the catchment

BLM 5: Tānemahuta and Tangaroa

BLM 6: Animal cards

Vocabulary

animals, banks, flow, forest, habitat, mauri, overhanging, pool, riffle, run, sediment, stream bed

BLM 5: Tānemahuta and Tangaroa

After the separation of Ranginui and Papatūānuku their children became kaitiaki of the world. As guardians, their role was to protect and conserve their particular domain. Tānemahuta became kaitiaki of te ngahere (forests), Tangaroa kaitiaki of wai (water).

Tānemahuta clothed his mother with a lush, green cloak. Aotearoa became a land covered by forests, te ngahere o Tāne (the forests of Tāne). From the ground hugging ferns to the forest giants dripping with vines, te ngahere was alive and flourishing. Creatures of all shapes and sizes filled the forest. Centipedes scurried amongst leaf litter, wētā lived in trees and butterflies flittered around the clearings. Songs of the birds combined to create a dawn symphony. Tūī chattered, kākā squawked and kōkako sung its haunting song.

Meanwhile,Tangaroa filled the waters, both fresh and salty, with an abundance of life. Kōura (crayfish) and kākahi (mussel) lived in flowing fresh waters while mako (shark) and tarakihi chose to live in the salty sea. But Tangaroa also made remarkable fish that could travel between these two worlds. Tuna (eel), born in the salty sea, was guided by the currents of Tangaroa to the land of Aotearoa. Here tuna moved into the fresh water where she lived for many years. Eventually Tangaroa called her back to the sea to lay her eggs, and tuna obeyed.

Some animals wanted to spend their lives with both Tānemahuta and Tangaroa. Mayfly began life with Tangaroa in the stream, and then emerged to grow wings and fly among te ngahere o Tane. Mudfish lived in wetlands of Tangaroa but when the water dried up, he hid under the damp logs of Tānemahuta or burrowed into the earth.

But not all descendants of Tangaroa wanted to live with him. When Tāwhirimatea lashed the land and sea with storms, Tangaroa's reptilian grandchildren, decided that they would be safer with Tānemahuta. They abandoned their grandfather and entered te ngahere o Tane. Skink slithered under logs, tuatara burrowed underground and gecko hid in tree holes. To this day they live in the forest, but still look similar to their relatives the fish, with scaly skin and a fish-like wriggle.

Tangaroa was angry with Tānemahuta for sheltering the rebellious reptiles, and waged war on his brother. Tāne decided to make peace, so he plucked off his eyebrows and gave them as a present to Tangaroa. Tangaroa did not want this gift and cast them upon the shore. There they sprouted and grew into the golden coloured pīngao that now lives on the sand dunes, marking the boundary between the domains of Tānemahuta and Tangaroa.

And so there was an abundance of life on both land and in the water, and Aotearoa was filled with plants, birds, insects, reptiles and fish. All these living things possessed their own mauri - the energy to live, to have young, and to fulfil their life's purpose. In early Aotearoa the mauri was strong and the plants and the animals flourished. Everything was in balance and life was good.

BLM 6: Animal cards

Habitats

Forest trees	Forest floor	Pool-run	Riffle-run

Tūī

I live in the forest and around its edges. I build my nest in the branches of trees.

Longfin eel

I live under logs and overhanging banks in the pools of the stream.

Kererū

I build a messy nest in tall trees and fly and swoop around the forest.

Morepork

I live in the forest and build my nest in the treetops or in holes in tree trunks.

Banded kōkopu

I live under large rocks, pieces of wood and overhanging banks in the pools of the stream.

Forest gecko

I climb up trees and shrubs at night and hide in tree trunks during the day.

Blue duck

I live along the edges of fast flowing streams and on the forest floor.

Redfin bully

I live in between rocks in the riffles and runs of the stream.

Inanga

I live in the runs and pools of the stream.

Tree wētā

I live in holes in the branches of trees. I have no wings and my antennae are very long.

Kōura

I live in the slow flowing water in the pools and runs of the stream.

Dragonfly adult

I live in bush areas around water. I rest on branches of trees.

Cased caddisfly larva

I live under and on rocks in the riffles of the stream.

Worm

I live in the soft sediment found in the pools of the stream.

Cased caddisfly adult

I live around the edges of the stream. I rest on the branches of trees.

Native land snail

I live in damp places on the forest floor and sometimes climb onto plants.

Dragonfly nymph

I tunnel into the soft earth of stream banks. I am usually found in the pools of the stream.

Mayfly adult

I live around the edges of the stream. I rest on the branches of trees.

Mayfly nymph

I live under rocks in the riffles of the stream.

Water snail

I live on the rocks in the pools, runs and slow flowing areas of the stream.

Stinking ground beetle

I live on the forest floor under old logs and in the undergrowth.

Earthworm

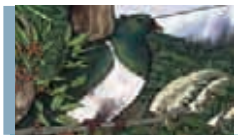
I can sense light but have no eyes. I live in the soil of the forest floor.

Orbweb spider

I live in my web on tree branches, waiting for insects to fly into my trap.

Centipede

I crawl along the forest floor and hide under stones and logs.



4 Report writing - Teacher notes

Linking to curriculum

English - L3/4 Speaking, Writing and Presenting

Processes and Strategies

Integrate sources of information, processes and strategies confidently to identify, form and express ideas.

Ideas

Select, form, and communicate ideas on a range of topics.

Structure

Organise texts using a range of appropriate structures.

Science - L 3/4 Living World: Ecology

Explain how living things are suited to their particular habitat and how they respond to environmental changes, both natural and human induced.

Living World: Life Processes

Recognise that there are life processes (breathing, feeding and moving) common to all living things and these occur in different ways.

Why write a report?

This report writing activity allows teachers to integrate written language objectives into the unit. It provides an ongoing reflection tool for students, while the completed report is also useful for assessment.

This activity enables students to become experts on a particular animal species (eg. banded kōkopu, longfin eel, mayfly or cased caddisfly). The process of collecting and collating information for their report will allow students to closely focus on one particular animal, learning about its life processes, how it is suited to its habitat and how human induced environmental changes have affected it.

The report will be prepared in stages. At the end of the activities listed below students will require some time to make relevant notes about their learning. Once all the activities are completed, students will be ready to use their collated notes and acquired knowledge to write a comprehensive report. More able students can be directed to additional books and websites to further investigate their chosen animal.

Completing the planning sheet

Information to help students complete BLM 7 can be found in the following activities:

Activity 3:	Animals in the catchment (previous activity)
	(Description of animal, where does it live?)
Activity 6:	Role of plants and algae
	(Where does it live?, feeding)
Activity 7:	Breathing in the stream
	(Breathing)
Activity 8:	What do animals eat?
	(Feeding)
Activity 9:	The freshwater highway
	(Life cycle, draw the life cycle)
Activity 11:	Deforestation
	(Human activity, kaitiaki)
Activity 13:	Pollution
	(Human activity, kaitiaki)
Activity 14:	Stream habitat destruction
	(Human activity, kaitiaki)

After completing BLM 7 and their learning in Activity 14, students can use BLM 8 to draft their reports before they publish their work.

4 Report writing

Introduction

- Explain to students that during the course of the unit they will become an expert on one of the following animals: banded kōkopu, longfin eel, cased caddisfly or mayfly. Ideally the same number of students will study each animal.
- Students review the information on the animal cards and Poster 3 (both from the previous activity) and think about the animal they are most interested in.

  ? Which stream animal are you going to become an expert in?
- Read through the learning intentions for this activity with students and explain that to demonstrate their expert knowledge they will be writing a report about their animal.

Activity instructions

- Hand out BLM 7 to the students.

  ? What do you already know about your chosen animal?

  Students refer back to BLM 6 and make notes on their planning sheet in the relevant sections.

  (Description of animals, where does it live?)

Explain to students that they will add information to this planning sheet after each activity. Store this BLM somewhere safe for easy access.

Conclusion

Split the class into small groups containing experts on the various animals. Students can share with the rest of the group the information they have already collected about their animal.

Learning intentions

Students will…

- Learn to communicate their knowledge and understanding in a report structure (context - aquatic animals)

Success criteria

Students can…

- Record relevant information about their chosen stream animal
- Complete a report about their animal, structuring their ideas into paragraphs

Resources

Poster 3: Animals in the catchment

BLM 6: Animal cards from previous lesson

BLM 7: Writing planning sheet

BLM 8: Writing draft

Useful reference books:

Andrew Crowe - *Which New Zealand Insect*

R.M. McDowall - *New Zealand freshwater fishes*

BLM 7: Writing planning sheet

Select one animal that you wish to become an expert on during this study (banded kōkopu, cased caddisfly, longfin eel or mayfly). As you learn new information about your selected animal add it to the planning sheet below.

My chosen animal is ...

Where does it live?

Describe your animal.
What does it look like?

Describe the movement of the animal at different stages of its life cycle.

Draw the life cycle.

What does your animal eat?
How does it eat?

What are the effects of **human activity** on the mauri of the stream and the animals? (eg. deforestation, pollution and stream habitat destruction).

How does your animal breathe?

As **kaitiaki** how can you help this animal?

BLM 8: Writing draft

Title .....

Introduction

.....

.....

.....

.....

.....

The animal

Description and features

.....

.....

.....

.....

.....

.....

Where does it live?

.....

.....

.....

.....

.....

.....

.....

Life processes

Drawing of life cycle

Describe the movement of the animal at different stages of its life cycle

.....

.....

.....

.....

.....

.....

.....

Breathing

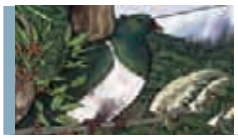
Feeding

Human activity

How has human activity affected the mauri of the stream and your animal?

What can you do as kaitiaki to help your animal?

Conclusion



5 Aquatic insects and their life cycles - Teacher notes

Linking to curriculum

Science - L 3/4 Living World: Evolution

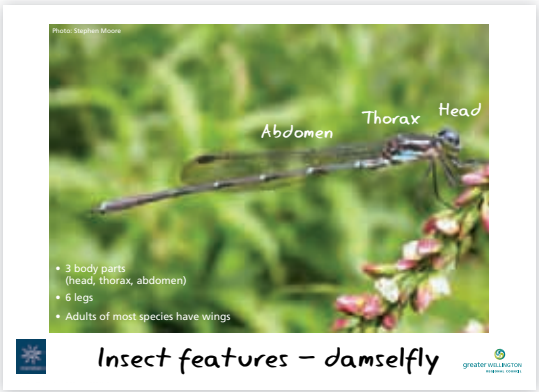
Begin to group plants, animals, and other living things into science - based classifications.

Living World: Life processes

Recognise that there are life processes (**growing**) common to all living things and these occur in different ways.

Answers to BLM 10

1. 3 body parts (head, thorax, abdomen), 6 legs and most adult insects have wings.
2. Insects with a complete metamorphosis have a pupa stage whereas insects with an incomplete metamorphosis don't.
3. a. Caddisfly pupa
   b. Dragonfly nymph
   c. Caddisfly larva
   d. Adult caddisfly or adult dragonfly
   e. Adult caddisfly or adult dragonfly
   f. Caddisfly eggs
   g. Dragonfly eggs



What are aquatic insects?

Insects have three body parts (head, thorax and abdomen), hence their name which means 'in sections'. They have six legs attached to a thorax. Adults of most species of insect have wings.

Insects that are found in our streams are usually juveniles. They spend most of their lives in the water before emerging to become adults. As adults they have wings and live on land. The most important role of an adult insect is to mate and lay eggs.

Not all insects grow and change in the same way. Some change completely from young to adults, whereas others change only partially. The dragonfly has an incomplete metamorphosis (egg - nymph - adult). Adult dragonflies lay eggs and the young, called nymphs, look like smaller versions of the adult. As they grow they shed their skin and eventually become adults. Mayflies, stoneflies, damselflies and waterboatmen all undergo an incomplete metamorphosis. Terrestrial insects like grasshoppers, wētā and stick insects also have this type of life cycle.

Caddisflies, on the other hand, undergo a complete metamorphosis (egg - larva - pupa - adult). Adult caddisflies lay eggs and the grub-like young, called larva (plural - larvae), look quite different to their parents. Eventually they make a cocoon (pupa) and start to change, emerging later as winged adults. Aquatic insects which have a complete metamorphosis include beetles, dobsonflies and mosquitos. Terrestrial insects like butterflies, beetles, fleas, flies, moths, bees, wasps and ants also share this type of life cycle.

Aquatic insects as indicators of stream health

One of the main learning activities of the *Take Action for Water* explore day is to look for aquatic insects, therefore it is important for students to have an understanding of these animals before the day.

The aquatic insects you find living in a stream can help to indicate the health of the stream. Some aquatic insects cannot tolerate any pollution whereas others can survive in polluted waters. For example, mayflies are only found in healthy, clean water whereas worms and snails can live in quite polluted streams.

5 Aquatic insects and their life cycles

Introduction

- Write learning intentions on your board and read through these with students.
- Insects have features that distinguish them from other animals.

  As a class brainstorm the main features of an insect.

  They have three body parts consisting of a head, thorax and abdomen with six legs attached to the thorax. In most species the adults have wings.
- Show Photocard 1. Compare the insect features on the photocard with the class brainstorm.
- Insects like the damselfly (pictured in Photocard 1) are called aquatic insects because they spend part of their life cycle in the water. Their bodies change at the different stages of the life cycle so that they can breathe and move in different habitats.
- Some insects, including the damselfly, choose to spend their lives with different atua at different times of their lives.

  How do you think the damselfly might spend time with both Tangaroa and Tānemahuta during its life?

  As young they live with Tangaroa in the water, as adults with wings they fly along the forest edge of Tānemahuta.

Activity instructions

- Explain to students that all animals need to grow. Humans are born as babies and slowly grow into adults. We spend most of our lives as adults and as adults are able to have babies. This is a human life cycle.
- Aquatic insects grow and change in different ways. Hand out BLM 9 and BLM 10. Discuss the two examples of life cycles; incomplete and complete metamorphosis. Working in pairs, students read BLM 9 and use this information to answer the questions about insect life cycles on BLM 10.
- Students discuss answers and glue BLMs into their books as a record of their learning.

Conclusion

- The concept of insect life cycles can be reinforced by teaching the students Pūrerehua by Hirini Melbourne. This song portrays the life cycle (complete metamorphosis) of the native red admiral butterfly. Refer to the notes in *He Waiata mā te Katoa/Songs for Everyone* on pages 14–16.

Learning intentions

Students will…

- Learn to identify the main features of an insect (context - aquatic insects)
- Learn about different life cycles (context - aquatic insects)

Success criteria

Students can…

- Identify the main features of an insect
- Identify different stages within insect life cycles

Resources

Photocard 1: Insect features - damselfly

BLM 9: Insect life cycles

BLM 10: Understanding insect life cycles

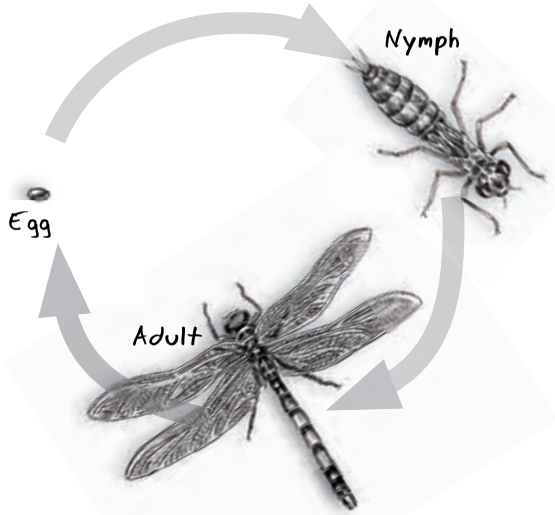
He Waiata mā te Katoa/Songs for Everyone by Hirini Melbourne (Learning Media 2004)

Vocabulary

adult, aquatic, cocoons, complete (full) metamorphosis, egg, incomplete (partial) metamorphosis, insect, larva, life cycle, moult, nymph, pupa

BLM 9: Insect life cycles

Incomplete metamorphosis: The dragonfly



Incomplete metamorphosis has **3 stages**:

1. **Egg** - Adult females lay eggs in the muddy edges of small streams.
2. **Nymph** - The eggs hatch into nymphs that may live for years in the stream. They live in tunnels which they make in the mud of the stream bed.
3. **Adult** - When nymphs are ready to turn into adults they will climb out of the water and rest on plants. They moult for the last time and their wings emerge. Adults live on the plants and land along the stream edge for a few weeks before they die.

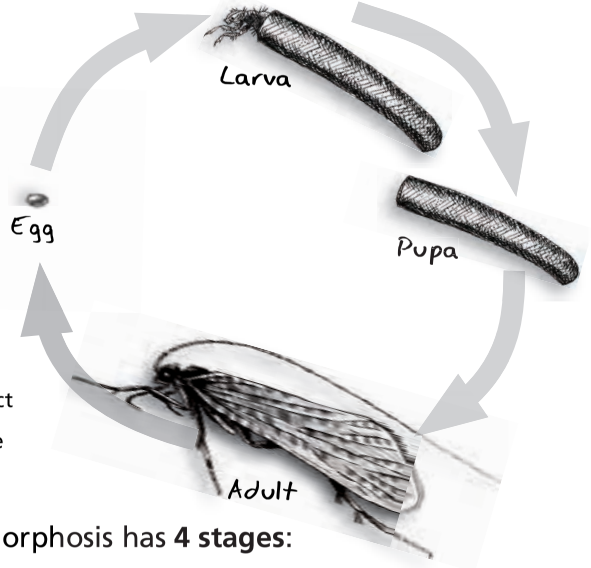
Aquatic insects with incomplete metamorphosis:

Damselflies, dragonflies, mayflies, stoneflies, water boatmen

Some other insects with incomplete metamorphosis:

Bugs, grasshoppers, stick insects, wētā

Complete metamorphosis: The cased caddisfly



Larva = one young insect

Larvae = more than one young insect

Complete metamorphosis has **4 stages**:

1. **Egg** - An adult female lays her eggs on the water's surface which then sink to the stream bed.
2. **Larva** - Eggs hatch into larvae which look like caterpillars. They make cases out of silk and live under stones in the riffles of the stream for about a year.
3. **Pupa** - Larvae attach their cases to large rocks in the water. They make changes to their cases so that they become cocoons.
4. **Adult** - The adults emerge from their cocoons and swim to the surface. Adults live on the plants and land along the stream edge for a few weeks before they die.

Aquatic insects with complete metamorphosis:

Diving beetles, dobsonflies, caddisflies, mosquitos

Some other insects with complete metamorphosis:

Ants, bees, butterflies, fleas, flies, lacewigs, moths, wasps

BLM 10: Understanding insect life cycles

Refer to BLM 9 and Photocard 1 to help you answer the questions below.

1. What are the main features of an insect?

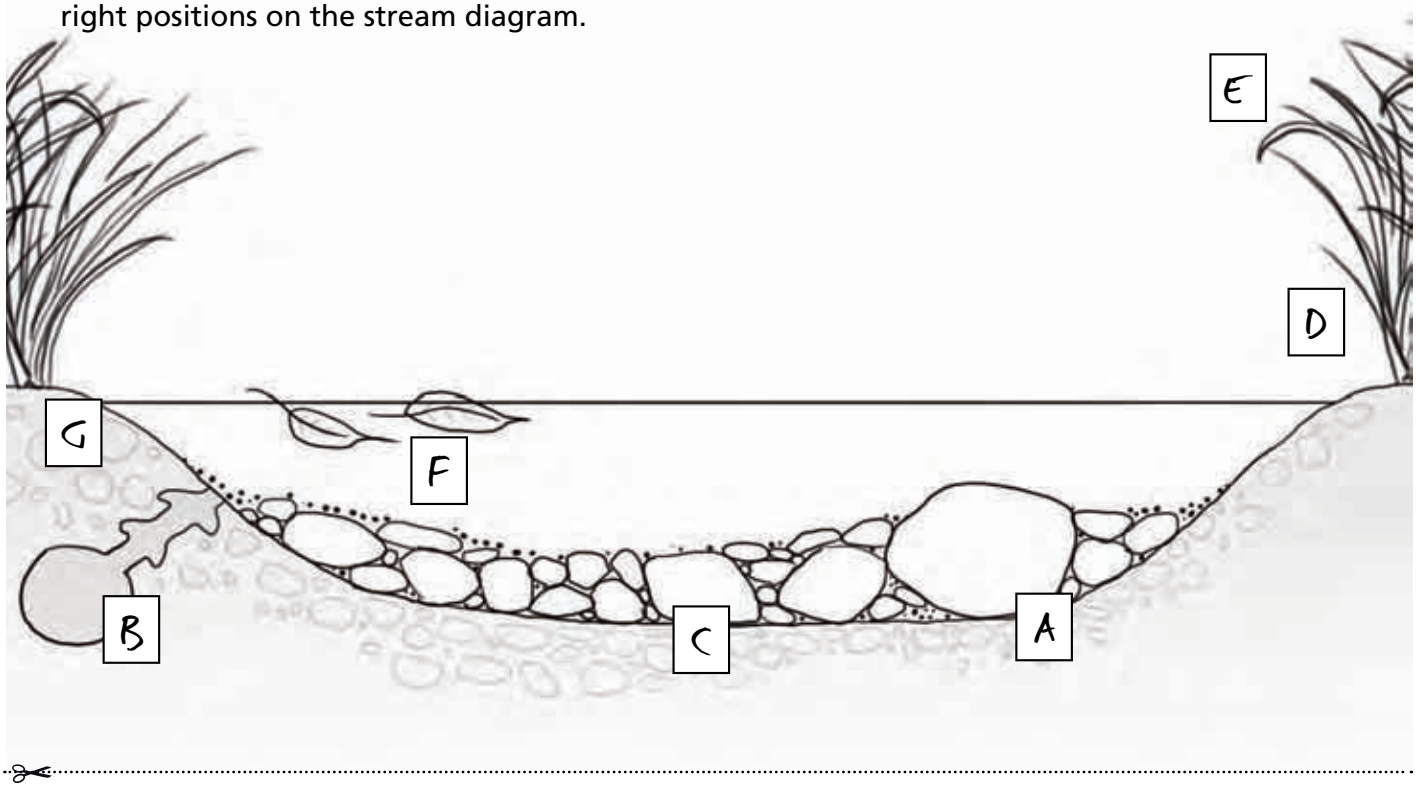
- .....
- .....

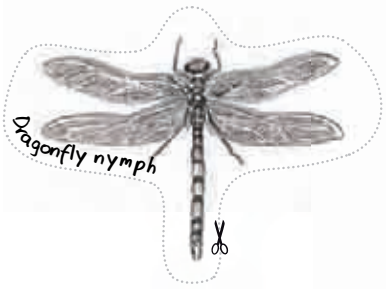
2. What is the difference between an **incomplete metamorphosis** and a **complete metamorphosis**?

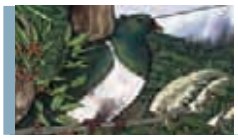
.....

.....

3. Cut out the stages of the dragonfly and cased caddisfly life cycles below and place them in the right positions on the stream diagram.







6 The role of plants and algae in a catchment - Teacher notes

Linking to curriculum

Science - L 3/4 Living World: Ecology

Explain how living things are suited to a particular habitat and how they respond to environmental changes, both natural and human induced.

Answers to BLM 11

1. Leaves of plants and algae **produce oxygen** (through photosynthesis) for animals to breathe.
2. Branches and leaves provide **shade** for animals on the land.
3. Leaves and leaf litter provide **food / shelter** for forest floor animals.
4. Trees and plants provide **shelter** for kererū, bats and other animals.
5. Overhanging branches and leaves **shade** the stream, keeping it cool.
6. Roots of trees provide **stability and strength** for stream banks.
7. Fruit and nectar from plants provide **food** for tūī and other animals.
8. Dead leaves in the water provide **food** for cased caddisfly larvae.
9. Plants, branches and logs provide **shelter** for fish.
10. Short algae provides **food** for mayfly nymphs, caddisfly larvae and snails.

Why are plants and algae important for animals?

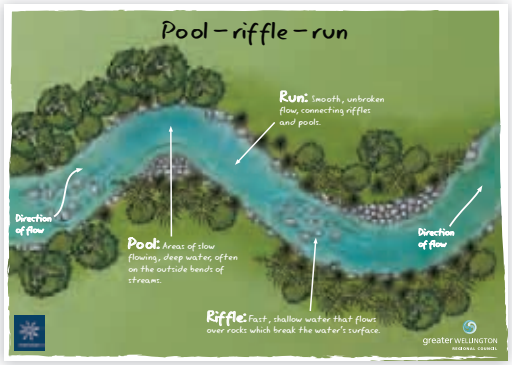
Plants and algae are essential for animal life.

- Plants and algae release oxygen into the environment. Oxygen is essential for the survival of all animals on land and in the water. The process whereby plants and algae create oxygen is called photosynthesis.

  The process of photosynthesis:

  carbon dioxide + water + light energy produces carbohydrates (including sugar) + *oxygen*

  Most of the oxygen produced by plants (on the land) remains in the atmosphere. Oxygen filters into still water slowly, but this process is sped up in the riffles of streams as the turbulent water allows oxygen to be mixed into the water at a faster rate. Algae and aquatic plants in streams release oxygen directly into the water.
- Plants and algae provide food for animals. Through photosynthesis, plants make their own food which allows them to grow. Some animals feed directly on the different parts of plants and trees (eg. leaves, nectar, fruit, wood). Leaves that fall into the stream and algae, found on rocks in the stream, provide food for some aquatic insects.
- Trees provide shade, creating a cool habitat for the animals that live near them. They also shelter animals from weather and danger. A wide range of invertebrates (animals without a backbone) live on trees or in dead leaves and logs on the forest floor. Plants and logs also provide shade for animals living in the water. Many of our native aquatic insects and fish can only live in cool water.
- The roots of trees play an important role holding together and strengthening stream banks and land throughout the catchment. This prevents erosion. Soil that is not held in place by plants, can be eroded more easily by water and wind and ultimately end up in waterways.



6 The role of plants and algae in a catchment

Introduction

- Read through today's learning intentions with your students.
- In a Māori world view Tānemahuta clothed Papatūānuku with plants and trees. Te ngahere (forest) once covered most of Aotearoa.

  ? Why do animals need plants to survive?

  Do not share answers at this stage as this question will be re-visited at the end of the session.

Activity instructions

- Hand out BLM 11 to students. Discuss the picture of the stream in a native forest catchment. The BLM shows some of the ways trees enable animals to live on land and in the stream.
- Read the completed example sentence on the BLM about photosynthesis to the students.

  ? Why do plants photosynthesize?

  Photosynthesis is a process where the plant turns carbon dioxide, water and light into food for the plant (sugar) so it can grow and reproduce. The process also produces oxygen.
- Explain to students that they must use the pictures on BLM 11 to get clues to help complete the sentences. The numbers in the picture link to the sentences.
- Show Poster 2 and discuss the following question with the class.

  ? Where in a stream does oxygen from the air get mixed into the water?

  In the riffles. The turbulent water allows more oxygen to be mixed into the water.
- Explain to students that they must use the pictures on BLM 11 to get clues to help complete the sentences. The numbers in the picture link to the sentences.
- On completion of the activity discuss students' answers and mark together. Students should alter incorrect answers as they are discussed to ensure they have a complete, correct record.

Conclusion

- Revisit the question from the beginning of today's session. Have students changed their opinions?

  ? Why do animals need plants to survive?

  Plants provide animals with oxygen, shelter, food and shade. They also help to keep the water clear by preventing erosion. Clean, clear water is essential for many stream animals.

Report writing

Complete the "where does it live" and "feeding" sections of BLM 7.

Learning intentions

Students will…

- Learn how plants are essential for animal life (context - a catchment)

Success criteria

Students can…

- Identify the different ways that plants enable animals to live

Resources

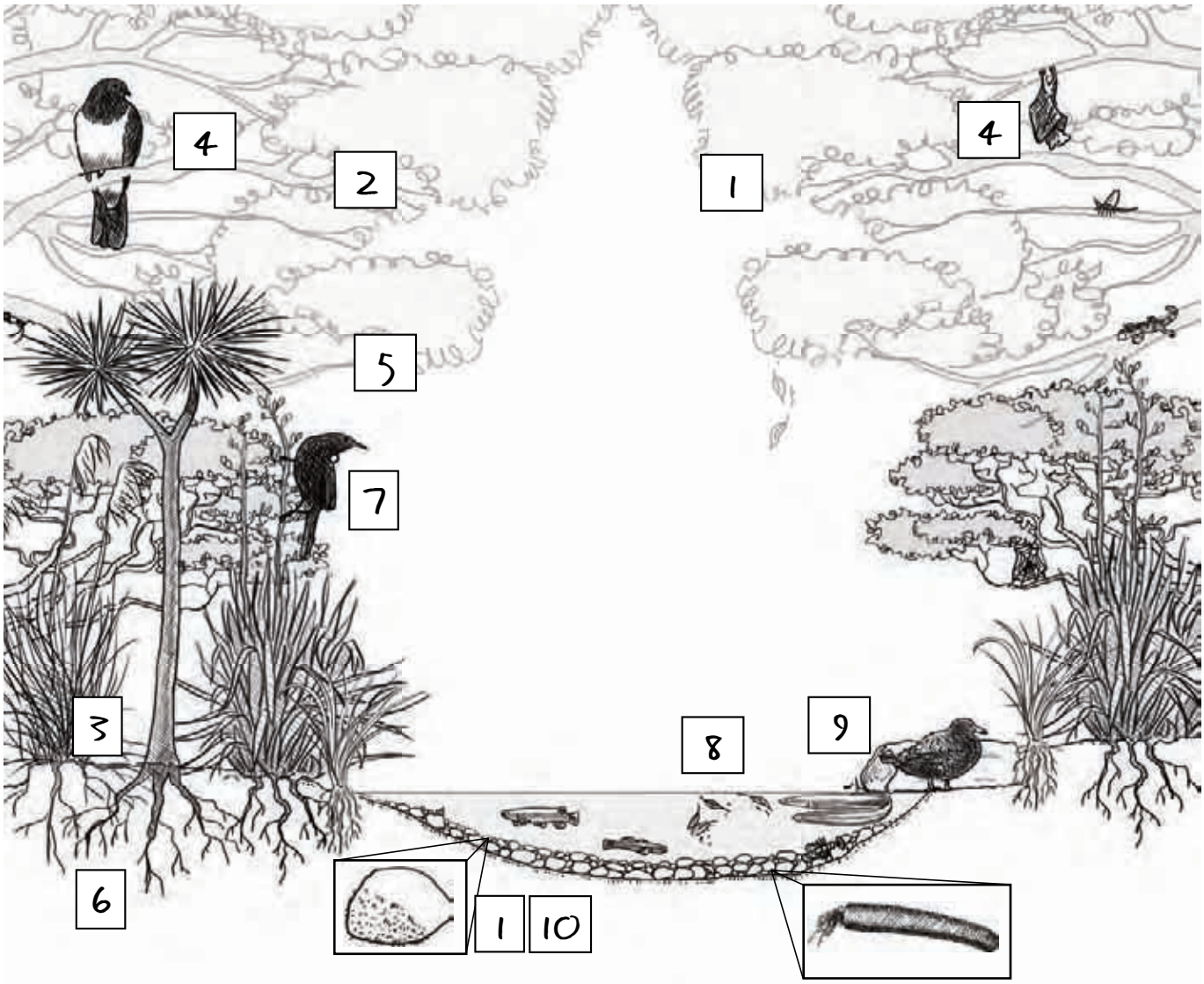
BLM 11: The role of plants and algae in the catchment

Poster 2: Pool, riffle, run

Vocabulary

algae, branches, carbon dioxide, nectar, ngahere (forest), oxygen, photosynthesis, plants, shelter, stability, stream banks

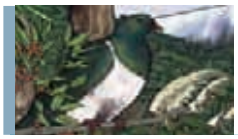
BLM 11: The role of plants and algae in the catchment



Complete the following sentences with the most appropriate word from below:

1. Leaves of plants and algae **produce oxygen** (through photosynthesis) for animals to breathe.
2. Branches and leaves provide ..... for animals on the land.
3. Leaves and leaf litter provide ..... for forest floor animals.
4. Trees and plants provide ..... for kererū, bats and other animals.
5. Overhanging branches and leaves ..... the stream, keeping it cool.
6. Roots of trees provide ..... for stream banks.
7. Fruit and nectar from plants provides ..... for tūī and other animals.
8. Dead leaves in the water provide ..... for cased caddisfly larvae.
9. Plants, branches and logs provide ..... for fish.
10. Short algae provides ..... for mayfly nymphs, caddisfly larvae and snails.

shade	food	shelter	stability and strength	produce oxygen



7 Breathing in the stream - Teacher notes

Linking to curriculum

Science - L 3/4 Living World: Life processes

Recognise that there are life processes (**breathing**) common to all living things and these occur in different ways.

Answers to BLM 12

1. Banded kōkopu, longfin eel
2. Mayfly nymph, cased caddisfly larva, stonefly nymph, dobsonfly larva
3. Dragonfly nymph
4. Mosquito larva
5. Diving beetle adult, water boatman nymph and adult

How do you breathe in a stream?

When humans inhale (breathe in) we take in air. The oxygen from the air is absorbed into the body. When we exhale (breathe out) the waste gas, carbon dioxide, is released into the air. All animals need to take in oxygen and release carbon dioxide to survive. Carbon dioxide is then used by plants to photosynthesize.

This activity investigates how fish and aquatic insects get their oxygen. Fish use gills to breathe. They take water in through their mouths and it is pumped over their gills where oxygen is absorbed before being pumped out of the body.

Most insects breathe through holes in the sides of their bodies called spiracles. Spiracles are openings to a series of tubes inside the insect's body which allow oxygen to be transported to the main organs. Aquatic insects have made adaptations to this system so they can spend part of their life underwater.

- Some juvenile aquatic insects have adapted to living totally underwater and do not need to come to the surface for air. They have gills that take oxygen from the water. Mayflies, cased caddisflies, dragonflies, stoneflies and dobsonflies all breathe in this way. As adults they live on the land. They lose their gills and breathe through spiracles.
- Some juvenile aquatic insects, such as mosquitos, breathe at the surface of the water. Mosquitos have a siphon that breaks the surface of the water so they can get oxygen from the air. As adults they live on the land and breathe through spiracles.
- Some aquatic insects, such as diving beetles and water boatmen, spend their whole life (as juveniles and adults) going in and out of the water. They need to regularly come to the surface to breathe through spiracles and to collect air to take underwater with them. They breathe underwater by carrying bubbles of air from the surface and when this runs out they must go back to the surface. Diving beetles carry bubbles of air under their wing covers while water boatmen carry air in hairs under their bodies.

7 Breathing in the stream

Introduction

- Read through the learning intention for today's activity with students.
- Explain to students that all living animals need to breathe (get oxygen from their environment) to survive. Ask students to take a deep breath and then let it out.

  ? What gas do we take into our body that is essential for life?

  Oxygen.

  ? What gas do we need to release from our bodies when we breathe out?

  Carbon dioxide.

Activity instructions

- Streams and rivers are the realm of Tangaroa, where fish (ika) and aquatic animals live. All creatures in the realm of Tangaroa need oxygen to survive. This activity looks at the fish and aquatic insects that live in our streams and the different ways they breathe.
- Show students Photocard 2. Discuss the mayfly nymph's gills and how they breathe. The mayfly nymph's gills are able to take oxygen from the water, this is one of the ways in which aquatic insects breathe. This activity will examine other ways that aquatic insects breathe.
- Hand out BLM 12 and read through the chart with students. Students will cut off the animal section. They will then cut out individual animals and place each picture under the appropriate method of breathing. This can be completed individually or in pairs.
- On completion of the activity discuss students' answers and compare with model answers.

  Ensure that all students have the correct answers and allow them to adjust their answers accordingly.

  Students can then glue pictures to the BLM.

Conclusion

- **Aquatic breathing game** - This is a fun way to ensure students understand the different methods of breathing. As a class agree on actions for how banded kōkopu, mayfly, dragonfly, mosquito and diving beetles get their oxygen. Once everyone has practised the action you can play the game. Get the class to stand in a circle. When you call the name of an animal students perform the correct action. This can be played as an elimination game or use it as an energiser throughout the day.

Report Writing

Students complete the "breathing" section of BLM 7.

Learning intentions

Students will…

- Learn how some animals breathe (context - aquatic animals)

Success criteria

Students can…

- Identify the different ways aquatic animals breathe

Resources

BLM 12: How do aquatic animals breathe?

Photocard 2: Breathing: mayfly nymph

Vocabulary

aquatic, breathe, gills, ika (fish), rectum, siphon, spiracles, surface

BLM 12: How do aquatic animals breathe?

Cut along the dotted lines around each stream animal. By reading the clues below and looking at the pictures of the animals decide how each animal breathes. Place the cut out animal under the correct breathing description.

How do I breathe?

I get oxygen from the water

1. I swallow water and pump it over my **gills**. My gills take oxygen from the water before it is pumped out of my body.

2. I have **gills** that are attached to the outside of my body. I take oxygen out of the water as it flows over my gills.

3. I have **gills** inside my rectum. I suck water into my rectum to get oxygen from the water. I can also fire the water out of my rectum like a rocket booster.

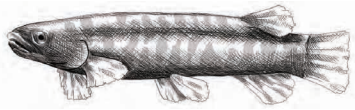
I get oxygen from the air

4. I have a **siphon** (tube) that I push up to the surface of the water so I can get oxygen from the air.

5. I can **carry bubbles** of air from the surface in hairs under my body or under my wing covers. When it runs out I return to the surface.

Mayfly nymph

Banded kōkopu



Stonefly nymph

Water boatman

Mosquito larva

Dobsonfly larva

Cased caddisfly larva

Longfin eel

Diving beetle adult

Dragonfly nymph

8 What do animals eat? - Teacher notes

Linking to curriculum

Science - L 3/4 Living World: Ecology

Explain how living things are suited to their particular habitat and how they respond to environmental changes, both natural and human induced.

Science - L 3/4 Living World: Life processes

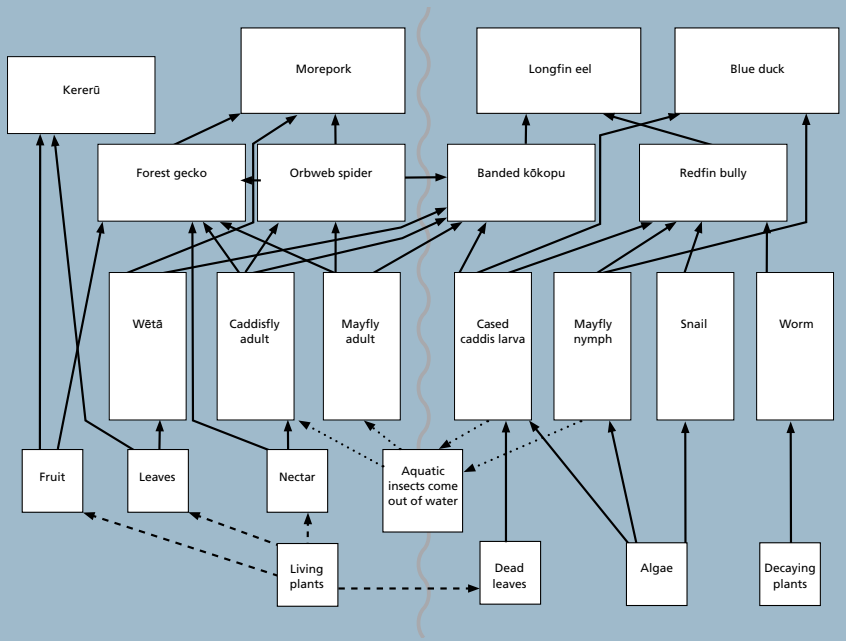
Recognise that there are life processes (feeding) common to all living things and these occur in different ways.

All animals need to feed so that they have energy to live, grow, move and reproduce. This food web activity illustrates the interactions and the flow of energy between a group of organisms (plants and animals) that live in a stream. When drawing a food web it is important that the arrow shows the direction of the flow of energy. If an eel eats a banded kōkopu this is shown as: banded kōkopu ⟶ longfin eel. This is because the energy embodied in the banded kōkopu is used by the eel.

Within a catchment animals eat different types of food. Many animals eat plant material (cased caddisfly larvae, mayfly nymphs, snails, worms, wētā, kererū), while some animals eat other animals (longfin eels, banded kōkopu, redfin bullies, blue ducks, moreporks, orbweb spiders) and some eat a mixture of animals and plant material (geckos).

Although animals may eat the same food, they have quite different body parts to help deal with this food. Cased caddisfly larvae, mayfly nymphs and snails all eat algae as part of their diet. Cased caddisflies use strong mouthparts, mayflies use brushes on their mouthparts and snails use their rough tongues to gather algae from the rocks. This activity helps students to understand that animals feed in different ways.

Answers to BLM 14



Answers to BLM 15

1a	Longfin eel	1b	Smell, special senses, sharp teeth that point backwards
2a	Mayfly nymph	2b	Brushes on mouthparts to sweep food into mouth
3a	Cased caddisfly larva	3b	Strong mouthparts for scraping and chewing
4a	Worm	4b	Escalator like gut
5a	Banded kōkopu	5b	Special senses to detect animals falling in water
6a	Redfin bully	6b	Large eyes
7a	Blue duck	7b	Forward facing eyes, bill
8a	Snail	8b	Rough tongue to scrape algae

8 What do animals eat?

Introduction

- Read through the learning intentions for this activity with your students.
- Explain that in any catchment animals interact (have contact) with other living things. Some animals eat plants and some eat other animals. Other animals eat both plants and animals.
- Explain to students that humans are part of a food web and eat both plants and animals. Use the diagram below as a starter for a discussion around human food webs. Grasses create their own food through photosynthesis. Cows eat grass and then humans eat cows (steak). Wheat (weet-bix) is a grass that humans eat. Explain that when making a food web the arrow shows the direction that the energy moves.

Activity instructions

- Explain to students that they will now investigate a food web in a catchment.
- Hand out BLM 13 and BLM 14 and explain the key on BLM 14. Students cut out the cards and read the information about the diet of animals on the cards to get clues as to where to place the cards in the food web.
- On completion of the activity discuss students' answers and compare with model answers.

  Ensure that all students have the correct answers and allow them to adjust their webs accordingly.

  ? What are the connections between the land and water food webs?

  Leaves from plants fall into streams and are eaten by caddisfly larvae.

  Caddisflies and mayflies leave the water and live on land as adults.

  Banded kōkopu eat wētā, spiders, mayfly and caddisfly adults that fall in the water.
- Hand out BLM 15. Students can use their completed food web for support as they match up the feeding descriptions to the correct animals.

Conclusion

- Discuss answers for the BLM 15.

  ? How are cased caddisfly larvae, mayfly nymphs and snails similar?

  They all eat algae.

  Do they all feed in the same way?

  No. Caddisflies use strong mouthparts, mayflies use brushes and snails use rough tongues.

Report Writing

Complete the "feeding" section of BLM 7.

Learning intentions

Students will…

- Learn that food webs show interactions between plants and animals
  (context - forest stream ecosystem)
- Learn that animals have special features for feeding
  context - aquatic animals)

Success criteria

Students can…

- Complete a food web for a forest stream ecosystem
- Match features for feeding with the correct aquatic animal

Resources

BLM 13: Animal food web cards

BLM 14: Food web

BLM 15: Feeding in the stream

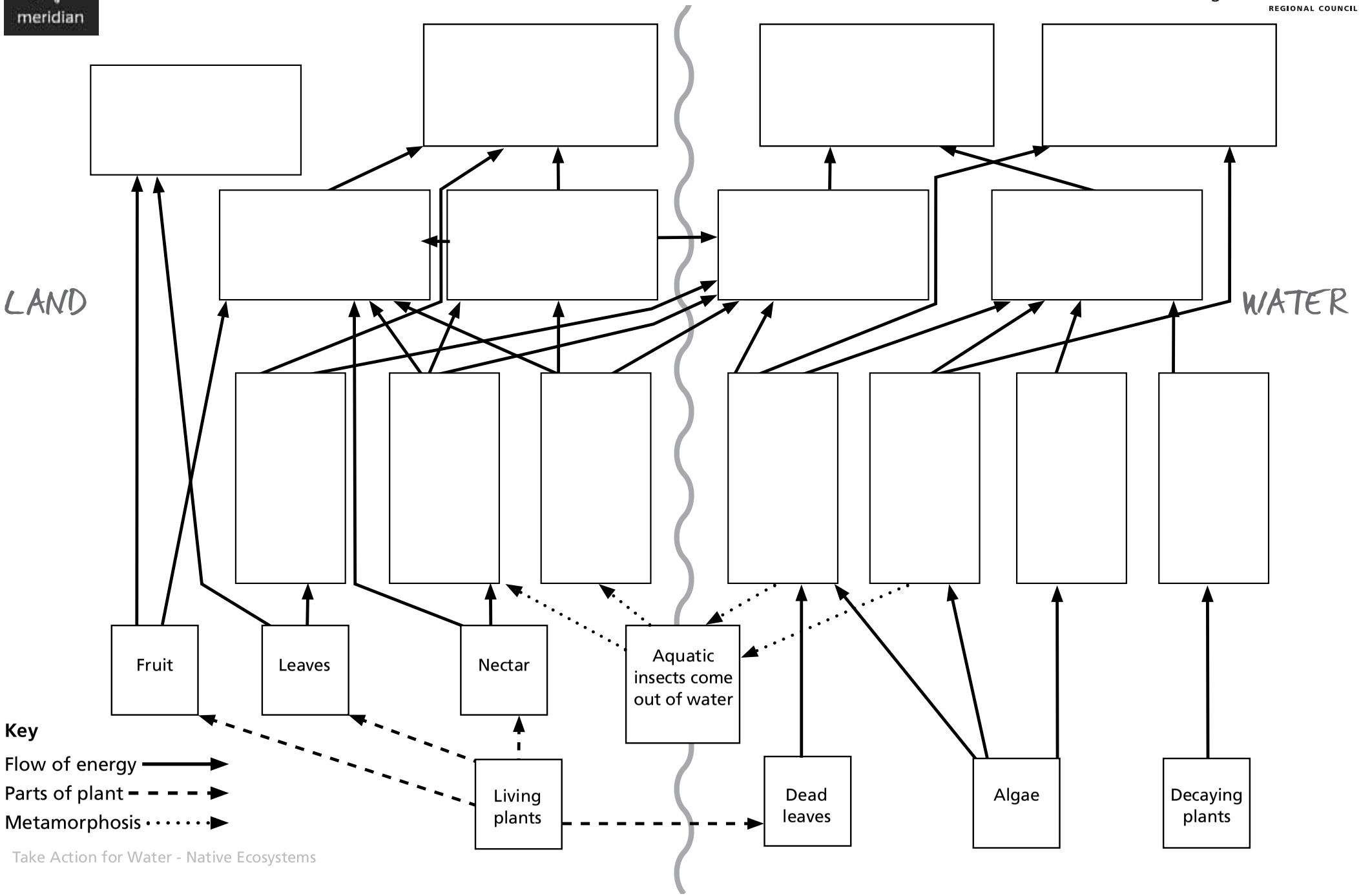
Vocabulary

decaying, energy, escalator, food web, interact

BLM 13: Animal food web cards

 **Tree Wētā** I eat leaves. I am eaten by birds and banded kōkopu when I fall into the stream.	 **Caddisfly adult** I eat nectar from plants. I am eaten by banded kōkopu, spiders and geckos.	 **Kererū** I eat fruit, berries and leaves from trees.
 **Morepork** I eat spiders, geckos, wētā and other insects.	 **Forest gecko** I eat mayfly and caddisfly adults, spiders, fruit and nectar.	 **Orbweb spider** I use my web to catch flying insects like mayfly and caddisfly. I am eaten by banded kōkopu.
 **Blue duck** I eat mayfly and caddisfly larvae.	 **Mayfly adult** I have no mouthparts and don't eat while I'm an adult. I am eaten by spiders, geckos and fish.	 **Water snail** I eat algae that grows on rocks in the stream.
 **Longfin eel** I eat fish such as banded kōkopu and bullies.	 **Cased caddisfly larva** I eat algae that grows on the rocks and dead leaves that fall into the stream.	 **Banded kōkopu** I eat insects and spiders that fall into the stream. I also eat caddisfly larvae.
 **Worm** I eat decaying plants and other material.	 **Redfin bully** I eat mayfly nymphs, caddisfly larvae, snails and worms.	 **Mayfly nymph** I eat spiders, geckos and fish and other material that grows on the rocks in the stream.

BLM 14: Food web



BLM 15: Feeding in the stream

Read the text below and use your completed food web to help you match up the feeding descriptions to the correct animals. Summarise the main features that each animal uses to find and eat food.

Feeding description	Animal	What are the main features for finding food and eating food?
I have a good sense of smell and special senses along my body that help me to find food. I have a large mouth and fine sharp teeth that point backwards allowing me to catch fish.	1a	1b
I have brushes on my mouthparts that help me to sweep algae and other food from the surface of rocks into my mouth.	2a	2b
I have strong mouthparts that are good for scraping algae off rocks and chewing leaves. I prefer soft leaves that have bacteria and fungi growing on them.	3a	3b
My body shape allows me to move through the soil on the stream bed easily. My gut is like a long escalator that moves a lot of food through my body.	4a	4b
I have special sensors along the side of my body that help me know when insects and spiders fall into the water.	5a	5b
I have large eyes that help me search for insects, worms and snails on the stream bed. I eat them one by one as I find them.	6a	6b
I have forward facing eyes that help me find my food under water. I use my bill to scrape aquatic insects off the rocks.	7a	7b
I have a rough tongue that I drag across rocks to scrape algae off the surface and into my mouth. I move slowly over the rocks but I can always hide in my shell.	8a	8b

Mayfly nymph	Longfin eel	Redfin bully	Snail
Worm	Banded kōkopu	Cased caddisfly larva	Blue duck

9 The freshwater highway - Teacher notes

Linking to curriculum

English - L3/4 Listening, Reading, and Viewing: Ideas

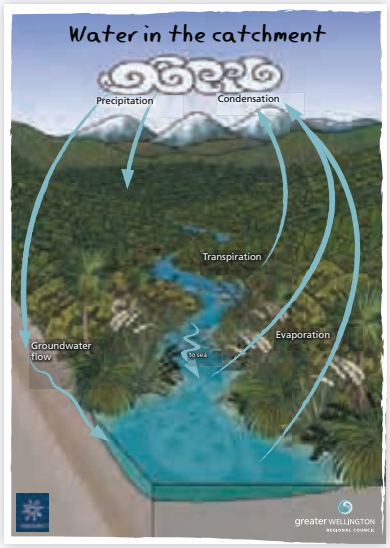
Show an increasing understanding of ideas within, across, and beyond texts

Science - L 3/4 Living World: Ecology

Explain how living things are suited to their particular habitat and how they respond to environmental changes, both natural and human induced.

Living World: Life processes

Recognise that there are life processes (**life cycle**) common to all living things and these occur in different ways.



Freshwater fish and aquatic insects

Some of our freshwater fish and aquatic insects need to move up and down our waterways at different stages in their life cycles. This activity investigates when and why these migrations occur for the aquatic animals below.

- **Longfin eel** adults lay their eggs at sea in the Tongan Trench in the Pacific Ocean. The young eels drift in ocean currents until they reach the New Zealand coast where most of them swim upstream into the upper catchment. Most feeding and growth takes place in fresh water. As adults they migrate downstream and out to sea where they reproduce. Adults live for up to eighty years, they breed once and then die.
- **Banded kōkopu** adults lay their eggs in leaf litter at the stream edge. After the eggs hatch the young fish are washed out to sea where they live for a short time. The young kōkopu (one of the whitebait species) then migrate back to fresh water. Most feeding and growth takes place in fresh water. Adults can breed every year and can live for more than nine years.
- **Mayfly** adults lay their eggs in the riffles of streams, the eggs sinking to the stream bed. Once the eggs hatch, the nymphs emerge and live in the riffles. Sometimes the nymphs drift downstream to find better habitat and sometimes they are washed downstream by floods. The nymphs grow and moult. Eventually they leave the water and turn into adults. Adults fly upstream to lay their eggs (which compensates for the downward drift of the nymphs). Mayflies live for about a year, most of this time is spent living in the stream as a nymph. Adults live for a day or two, breed once and then die.
- **Cased caddisfly** adults lay their eggs in the riffles of streams, the eggs sinking to the stream bed. Once the eggs hatch, the larvae emerge and live in the riffles. Sometimes the larvae drift downstream to find better habitat and sometimes they are washed downstream by floods. The larvae then pupate inside their cases and emerge as adults. Adults fly upstream to lay their eggs (which compensates for the downward drift of the larvae). Cased caddisflies live for about a year, most of this time is spent living in the stream as a larva. Adults live for several days, breed once and then die.

Answers to BLM 20

Animal	Why does it need to move up or down the stream?	Where does it live during the different parts of its life cycle?	Where does it live most of its life?
Longfin eel	The elvers swim upstream to find suitable habitat. The adults swim downstream to the sea, where they lay their eggs.	Egg - sea Larva - sea Glass eel - sea Elver - rivers Adult - rivers and streams	Pool
Banded kōkopu	The young drift downstream to go to sea. The whitebait swim upstream to find suitable habitat.	Egg - forest leaf litter Larva - sea Whitebait - stream Adult - stream	Pool
Mayfly	The young drift downstream to find better habitat. Adults fly upstream to lay eggs.	Egg - stream Nymph - stream Sub adult - stream side Adult - stream side	Riffle
Cased caddisfly	The young drift downstream to find better habitat. Adults fly upstream to lay eggs.	Egg - stream Larva - stream Pupa - stream Adult - stream side	Riffle

9 The freshwater highway

Introduction

- Read through today's learning intentions with students.
- Show Poster 1 and discuss how streams feed into rivers, which eventually flow through estuaries and into the sea. The streams and rivers of Tangaroa and the forests of Tānemahuta, along the edge of the stream, are like highways that aquatic animals use. They are essential for life. This activity looks at the different ways aquatic animals make use of this highway.

Activity instructions

- This reading activity can be done in a number of ways depending on the time available and the reading level of the class. The following lesson plan is based on completing the activity in one session (using a jigsaw approach) with each reading group reading one text.
- Split the class into four reading groups and give each group the relevant BLM text (BLM 16, 17, 18 or 19) for their reading ability and BLM 20. (Refer to resource list for reading ages)
- Each reading group reads and discusses the text before completing the questions on BLM 20.
- On completion of the activity, students are put into groups of four, containing an expert from each reading group. The students exchange information about how their animal moves in the catchment at different stages of its life cycle. Students will need to listen carefully and make notes about their chosen animal for their reports.

Conclusion

- On completion of the activity discuss the importance of the freshwater highway.

? Which animals need access to the sea? Why?

Longfin eel and banded kōkopu both need to live in the sea for part of their life cycle.

? Why is forest cover important for migration?

Protects adult insects from drying out and dying.

Report Writing

- After jigsaw sharing students complete the "life cycle" and "movement section" of BLM 7.

Learning intentions

Students will…

- Learn that living things are suited to different habitats at different stages of their life cycle (context - aquatic animals)

Success criteria

Students can…

- Explain why some New Zealand aquatic animals move around the catchment at different stages of their life cycle

Resources

Poster 1: Water in the catchment

BLM 16: Banded kōkopu

Reading age 9 - 10

BLM 17: Longfin eels

Reading age 10 - 12

BLM 18: Mayflies

Reading age 11 - 13

BLM 19: Cased caddisflies

Reading age 11 - 13

BLM 20: Freshwater highway

Vocabulary

breed, current, downstream, freshwater, highway, migrate, sub-adult, survival, upstream, whitebait

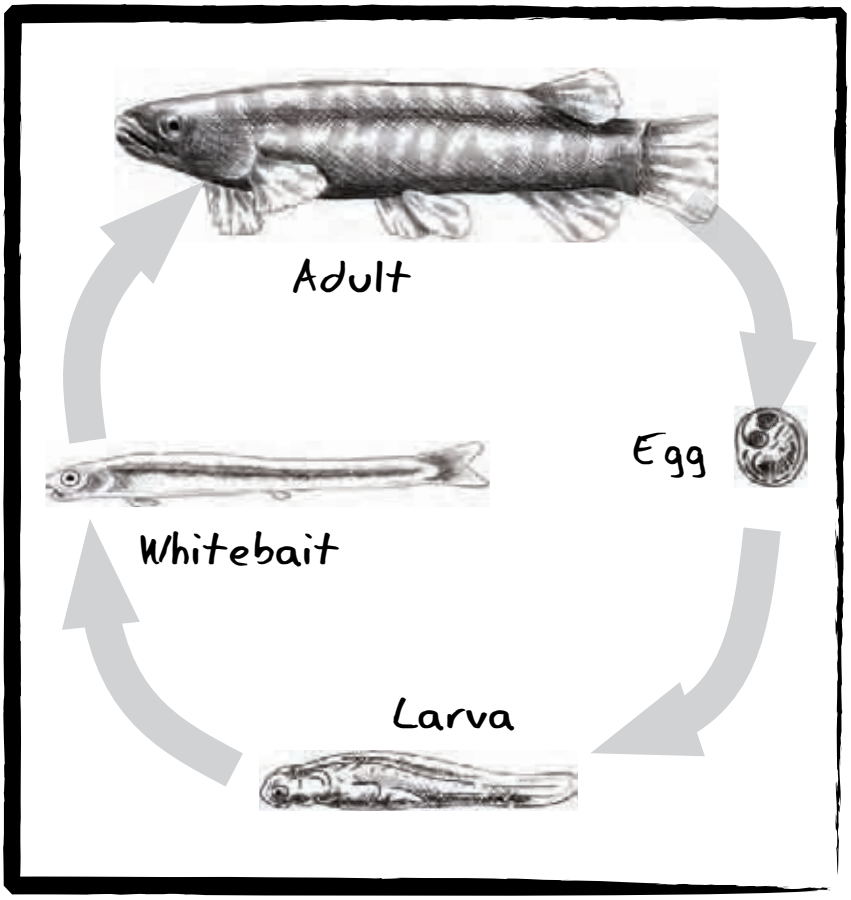
BLM 16: Banded kōkopu

Freshwater highway

Our streams and rivers are like a freshwater highway. Native fish and aquatic insects migrate (move) up and down this highway at different stages in their life cycles. Read the information below to learn how banded kōkopu use this highway.

Living in the stream

Adult banded kōkopu live in the pools of small forest-covered streams. They like to live under banks, rocks or logs.



Travelling down the highway

In autumn the water level of the stream is high. When the stream floods the adult kōkopu swim onto the forest floor beside the stream. There they lay thousands of small eggs. The eggs lie waiting on the forest floor. When the forest floor is flooded again the eggs hatch into larvae (young fish).

The larvae are then washed down the stream to the river and out into the sea. While at sea the young fish feed and grow.

Larva = one young fish
Larvae = more than one young fish


Photo: Alton Perrie

Travelling up the highway

In mid spring, after about four months at sea, the young fish return to the estuaries as part of the whitebait run. They swim up the river and into smaller streams and swamp forests where they will grow into adults.

Banded kōkopu are good climbers and can even climb up waterfalls. This means they can swim to streams high up in the catchment.

Adult banded kōkopu

Banded kōkopu become adults when they are two or three years old. Adults can breed every year and can live for more than nine years. They grow to about twenty centimetres long.

BLM 17: Longfin eels

Fresh water highway

Our streams and rivers are like a freshwater highway. Native fish and aquatic insects migrate (move) up and down this highway at different stages in their life cycles. Read the information below to learn how longfin eels use this highway.

Living in the stream

Adult longfin eels are often found in the pools of rivers and small forest covered streams. They live there for many years.

Travelling down the highway

In autumn the adult eels, that are ready to breed, swim down the stream to the river and out through the estuary into the sea. Scientists think that the eels swim to the Tongan trench which is between Tonga and New Caledonia. Here the adults breed, lay millions of eggs and then die.

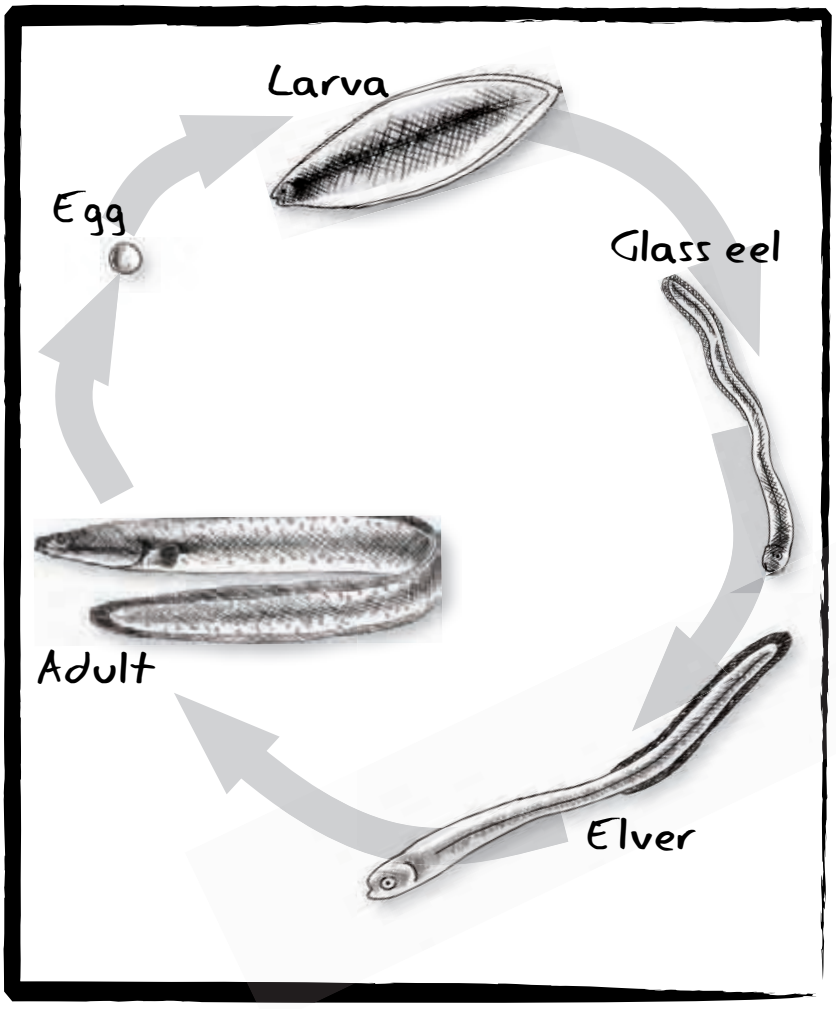
Living at sea

The eggs hatch into leaf shaped larvae that drift in the ocean currents. They feed on plankton, which are small plants and animals that float in the sea. The larvae take about a year and a half to return to New Zealand waters where they change into small see-through eels called glass eels.

Larva = one young eel

Larvae = two or more young eels

Photo: Alton Perrie



Travelling up the highway

In spring the eels enter the estuaries and rivers. At this stage they change again into small dark coloured eels called elvers. Small eels live in the riffles in rivers but once they are about 30cm long they can move in to the pools of small streams and rivers.

Longfin eels are fantastic climbers and can even climb up steep waterfalls. This means they can swim to streams high up in the catchment.

Adult longfin eel

Adult longfin eels can become very large and live for a very long time. Females may reach two metres in length, weigh up to twenty five kilograms and live for eighty years. An adult longfin eel breeds once and then dies.

BLM 18: Mayflies

Freshwater highway

Our streams and rivers are like a freshwater highway. Native fish and aquatic insects migrate (move) up and down this highway at different stages in their life cycles. Read the information below to learn how mayflies use this highway.

Living in the stream

The young mayflies, called nymphs, need a lot of oxygen. They live in the riffles where fast flowing water moving over the rocks mixes oxygen into the water. Mayflies take oxygen from the water through their gills. They have flat bodies and are able to cling onto rocks in the fast flowing water.

Photo: Stephen Moore

Travelling down the highway

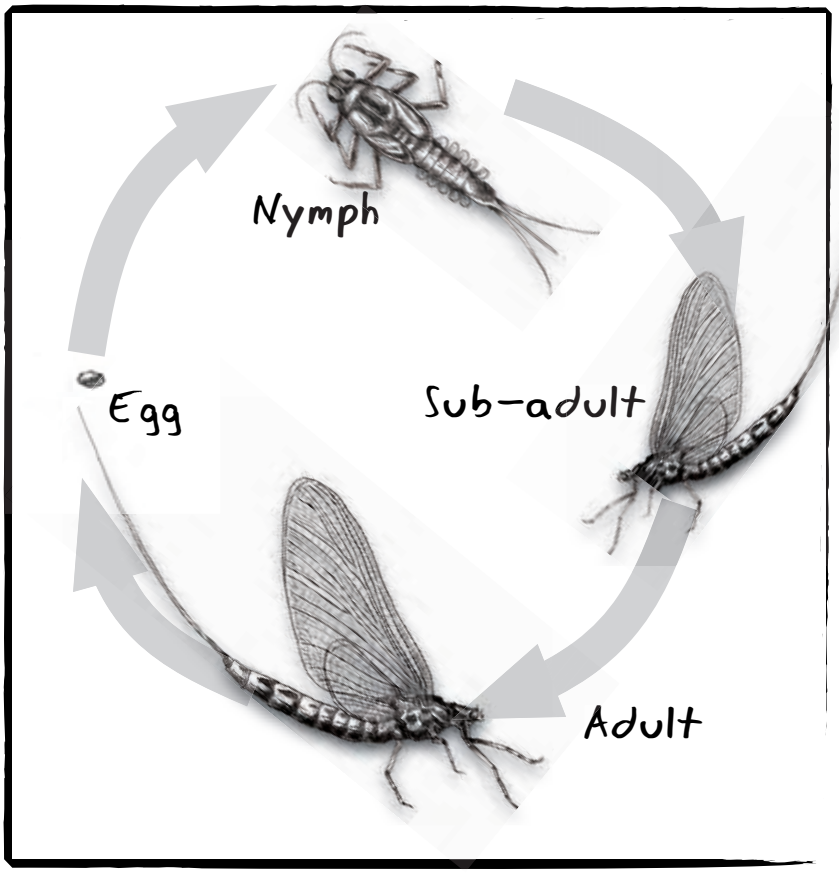
If the habitat changes and is no longer suitable, mayfly nymphs can move away to find better habitat. They do this by letting go of the rocks and drifting in the current. Mayflies usually drift at night and each night they can move many metres downstream until they find suitable habitat. During floods mayflies can drift a long way downstream.

Adult mayflies

Adult mayflies only have a few days to live and must mate and lay their eggs before they die. They do not feed as they have no mouthparts.

Mayfly life cycle

The mayfly has an incomplete metamorphosis. However, unlike other insects with an incomplete metamorphosis, it has four stages of growth. The nymph hatches from its egg. It grows and moults, shedding its skin many times. Eventually it crawls from the water, moults, and a winged insect called a sub- adult emerges. After resting for a day it will moult for the final time and become an adult.



Travelling up the highway

Adult mayflies are weak fliers but they have large sail like wings which allow them to catch the wind and sail through the air. They sail upstream to find a good site to lay their eggs because the nymphs will drift downstream during their lifetime. The adults usually fly over streams and into the forest which protects them from temperatures that are too hot or too cold, and from drying winds that can kill them.

BLM 19: Cased caddisflies

Freshwater highway

Our streams and rivers are like a freshwater highway. Native fish and aquatic insects migrate (move) up and down this highway at different stages in their life cycles. Read the information below to learn how cased caddisflies use this highway.

Living in the stream

The young cased caddisflies, called larvae, need a lot of oxygen. They live in the riffles, where fast flowing water moving over rocks mixes oxygen into the water. Caddisflies take oxygen from the water through their gills. They make cases from silk to live in which they tow around with them.


Photo: Stephen Moore

Travelling down the highway

If the habitat changes and is no longer suitable the cased caddisfly larvae can move away to find better habitat. They do this by letting go of the rocks and drifting in the current. They can drift many metres down stream each night. If they don't want to be washed downstream during floods they can crawl deep into the stream bed where they will be safe until the flood passes.

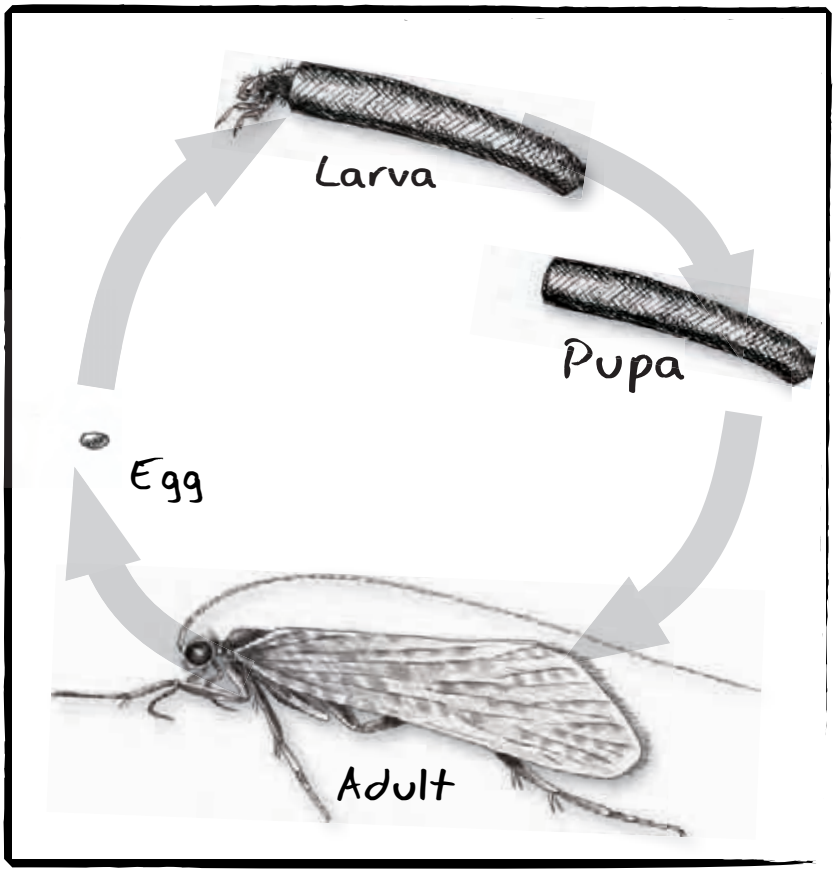
Adult caddisflies

Adult caddisflies live from several days to several weeks. They must mate and lay their eggs before they die. Adults feed on the nectar of flowers.

Larva = one young cased caddisfly
Larvae = two or more young cased caddisflies

Cased caddisfly life cycle

The cased caddisfly has a complete metamorphosis. The larvae hatch from eggs. They continue to grow until it is time to change into adults. Then they attach their cases to large stones to make their cocoons. Eventually the adult caddisflies wriggle out of their cocoons and swim to the surface. They crawl onto a stone or plant and are ready for adult life.



Travelling up the highway

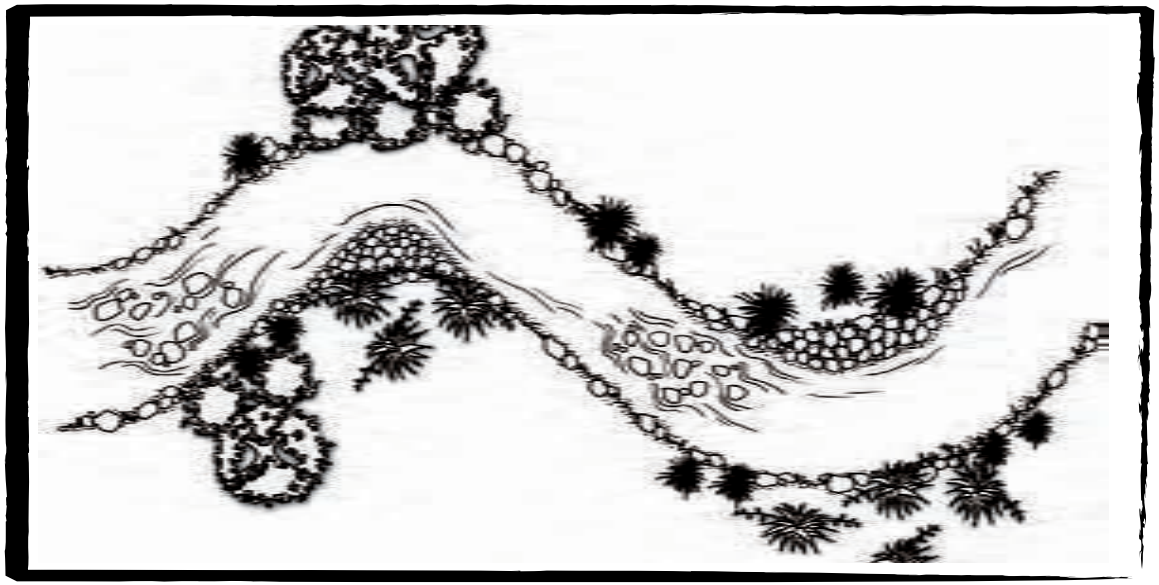
Adult caddisflies are usually strong fliers who can fly up to several kilometres. They fly upstream to find a good site to lay their eggs because the larvae will drift downstream during their lifetime. The adults usually fly over streams and into the forest. The forest protects them from temperatures that are too hot or too cold, and from drying winds that can kill them. The forest also provides them with food.

BLM 20: The freshwater highway

1. Read the text about your animal and complete the information boxes below.

Animal	Where does it live during the different parts of its life cycle? (eg. egg, larva, adult)
Why does it need to move up or down the stream?	

2. Label on the stream diagram below where the animal spends most of its life.



3. On the map of a catchment below show the movement of your aquatic animal at different stages of its life cycle.