Looking at the forest through all the trees

Field trip activities for Pine Valley and Onamalutu Scenic Reserve

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1. Field trip activities

Activities in this kit will help your students explore the forest and increase their awareness and knowledge about our native bush by taking a closer look at its trees. Students will be required to use all their senses to measure, survey, photograph, rub, identify and examine, in minute detail, our native forest - they will be looking at the forest through all the trees.

2. Themes

Themes that are developed at these sites:

- Bush regeneration, decomposition and light wells.
- Observation and identification skills.
- History of forestry and early resource utilization.
- Bush exploration.

3. Pine Valley

When you first arrive at Pine Valley, your students will notice the tranquil surrounds, the bush clad mountains, the crystal clear streams, and the sounds of native birds. The mix of trees becomes immediately apparent as trampers pass through plantation forest through to regenerating native beech forest. Originally named for its abundance of white pine or kahikatea, Pine Valley offers the perfect backdrop to help your students hone their identification and observation skills.

4. Onamalutu Scenic Reserve

In 1905 when the area was set aside as a reserve it was considered “the finest clump of forest in the district”. Over the years the river flats in the area had been cleared of bush for timber and farming. The Onamalutu Scenic Reserve stands as an inspiring example of a native kahikatea forest that once covered the Onamalutu Valley and the lower Wairau Plains.

5. Getting there

Off State Highway 6 (16km from Blenheim and just north of the Wairau River Bridge), turn onto Northbank Road.

To Onamalutu

Follow Northbank Road. Follow for approximately 6km, turn right into Onamalutu Road – then 7km along this road.

To Pine Valley

Follow Northbank Road (veer left at junction for Onamalutu) for 22km. Then turn right at Pine Valley sign post.

Past the Pine Valley Outdoor Centre, follow road through farm gates to Pine Valley carpark. Remember to keep gates as you find them.

NOTE: Logging trucks use the surrounding roads - use extreme caution when driving to the sites.

6. Facilities checklist

Pine Valley

- Parking: ample for buses and cars.
- Long drop toilets are available at Mill Flatt.
- Picnic areas and swimming holes.
- Easy walking track.
- Camping available.
- Open space for games.
- Accommodation available at Pine Valley Outdoor Centre.

Onamalutu

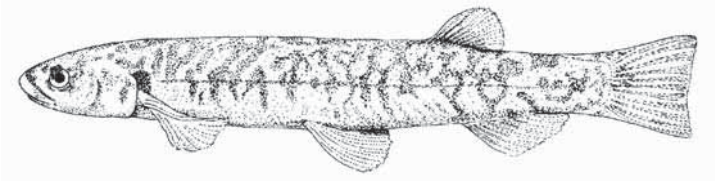
- Parking: ample for buses and cars.
- Flush toilets.
- Picnic areas.
- Easy walking track.
- Camping available.
- Open space for games.

7. Hazards

- Logging trucks use the surrounding roads – use extreme caution when driving to the site.
- Deep flowing river water - all necessary precautions should be taken near the rivers.
- Wasps can be a concern in late summer and early spring.
- Weather can be unpredictable, be prepared for all conditions.

8. Background information

Mt Richmond Forest Park



Pine Valley and Onamalutu Scenic Reserve are both nestled within the Mt Richmond Forest Park. Mt Richmond Forest Park stretches 100km along the rugged backbone of the Mt Richmond Range and includes all five species of beech in New Zealand as well as the common podocarps; rimu, totara, matai, miro and kahikatea. Most of the smaller native forest birds find homes in the area including grey warbler, fantail, bellbird, tomtit, rifleman and silvereye. Tui, weka and kereru are also common. The streams in the area support a large number of freshwater fish including native species as well as the elusive trout.

Geologically the area is very interesting, with the largest active fault in New Zealand, the Alpine Fault, running down the Wairau Valley. The rocks here match exactly those in western Otago, 450km to the south.

The area has an interesting history, particularly of mining (gold and chrome) and timber milling. Argillite, a very hard metamorphosed mudstone used by Mäori to make tools and weapons, is also found in the area.

New Zealand Forests

Before humans arrived, more than 80% of New Zealand was covered in trees. Most of the North Island and nearly all of the South Island – except Central Otago and the Mackenzie Basin – was forested. Throughout the country there were conifer–broadleaf forests. The most common trees within them were kauri, rimu, tötara, kahikatea and mataï. Kauri forests grew in the north of the North Island. Beech forests were found at high altitudes in the North Island's mountain ranges, in Nelson and Marlborough, and on the South Island's west coast. Sometimes areas of forest were burnt out in fires started by volcanic eruptions or lightning, but they grew again.

When Mäori began arriving in New Zealand from 1250–1300 AD, they built dwellings, forts, canoes and other structures from native woods. This level of use had little impact on the forests. Early Mäori, however, also burnt large stands of forest on the North Island's east coast and in Marlborough and Canterbury.

As Europeans arrived in New Zealand from 1840, they needed New Zealand's native hardwoods (kauri, tötara rata and rimu) for export to build ships and settlement in Australia. Soon European settlers in New Zealand needed the wood for houses, fencing and firewood, and soon for railway sleepers. Kahikatea was chosen for housing and roof shingles, mänuka became fuel for cooking and heating.

When organised European settlement started, forest covered around half of New Zealand. Over the next 150 years, intensive logging reduced the remaining forests by about half. By 2005 only 25% of New Zealand native forest remained, mostly in reserves or parks. Beech forest like you find in Pine Valley was the most widespread, followed by conifer–broadleaf forest.

Exotic forest – mainly pine – coveres 7.7% of the land. Pines are natives of North America but find the New Zealand climate very suitable for their growth. Pines, however, produce a thick mat of pine needles which are very acid and not suitable for the growth of many natives. Our canopy trees are too short to compete with pines, so a pine forest provides little food for native wildlife.

9. Tree identification basics

Needles or broad leaves

In the simplest sense, there are two kinds of trees in the world: conifers or cone bearing trees, and flowering plants (trees). Conifers are an ancient group called gymnosperms, which appeared 360 million years ago – long before flowering plants. Both plant groups reproduce by seeds. Flowering trees often have brightly coloured petals, nectar and perfume to attract pollinators such as insects and birds. The conifers, however, are wind-pollinated and have no need of such things.

For the most part, conifers also have needle-shaped leaves and they're evergreens. That means they don't lose all their leaves each year, but instead stay green year-round. Flowering plants are the most recently evolved and most specialised of all the plant groups.

Tree ferns are conspicuous in many New Zealand forests, playing an important role as pioneers where forest has been cleared, particularly on moist south-facing sites. They also establish in canopy gaps opened up by the collapse of old trees. .

One of the easiest ways to explore a forest is to help students develop their observation skills and tree identification skills by taking a close look at leaves

The overall shape of a leaf gives clues to the tree's identity. For example, the silver beech is almost round while the horoeka is long and narrow. Similarly, kawakawa are heart shaped.

While walking through the bush have students stop, look and compair the difference between tree leaves. Have them consider"

Leaf Margins

Examine the edges or margins of leaves some leaves have teeth (serrated) along their margins, some leaves are lobed and some leaf margins are smooth.

Textures

Some leaves are completely hairy, others have hairs on only one side, and others are completely smooth. Leaves may also be thick or thin, rough or smooth.

Simple and compound

Strickly speaking, leaves are either **simple** (not divided into leaflets) or **compound** (made up of a number of individual leaflets). Although simple leaves and leaflets can look alike, leaves can be distinguished by the presence of a leaf bud in the angle between the leaf stalk and the stem; a leaflet never has a bud here.

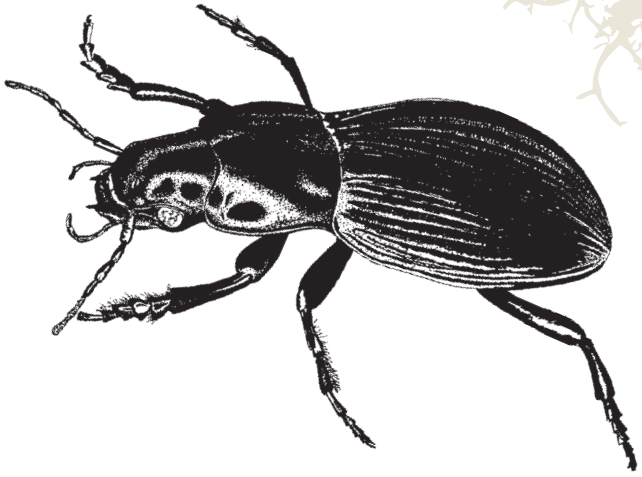
Leaf arrangements

Many trees have **alternate** leaves that are staggered along the twig. Other trees have **opposite** leaves that grow in pairs along the twig and some are **whorled**, where there are 3 or more attached to the stem. Leaflets can be arrange in a **palmate** (hand shaped) or a **pinnate** (feather-like with 2 rows of leaflets) fashon.

Bark basics

Many people can identify trees just by looking at the colour and texture of tree bark. For instance, bark may be shaggy, smooth, or rough; it may have deep furrows or markings. Eucalyptus is an example of a tree easily identified by its brown, paper-like bark that comes off in long strips. However, when using bark to identify a tree, it is best to look at bark growing on the trunk rather than on branches and twigs (because the bark on a branch is thinner and newer, it may look quite different from the trunk). Bark also looks different as a tree gets older.

Nikau is the most southern naturally growing palm tree. Nikau and the vine kiekie give the bush a lush tropical feel. Along with some of the tree ferns, these plants invaded when ancient New Zealand had links with New Caledonia and other tropical land masses.



Activity 1: The fallen log

ln this activity, students will become familiar with some of the organisms living in and on rotten logs. They will gain an understanding of how decomposition takes place and a better appreciation for microhabitats and communities.

Time required

- 40 minutes - 1 hour.
- Additional time as needed for discussion and sharing of findings.

Materials needed

- Log diagram handout.
- Pencils.
- Coloured pencils (optional).

Background information

Throughout their lives, trees collect nutrients from the environment and use them to build new bark, wood, branches, leaves and so on. When a tree dies, its nutrients are recycled back into the environment through decomposition. Decomposers, such as beetles and wetas move into trees and start the process of decomposition even before a tree has died. These creatures may hasten the death of the tree. Wood-eating insects, as well as fungi and bacteria, invade a dead or dying tree, paving the way for other invaders. Here's a look at some common things your students may find on, in and around dead wood.

Things growing on dead wood

Any decaying wood is sure to have fungi, moss, lichens, and other plants growing on it. Wildflower, tree, and other plant seeds that land on a soft, decomposed log may also sprout and grow. Plants and fungi absorb nutrients from the decaying wood, and as they grow, they penetrate the wood and break it apart. Lichens, as they grow, release a weak acid that breaks down the wood. Moss keeps the log moist, making it a suitable place for other plants and animals to live.

Physically, lichens and mosses can be difficult to distinguish. In general, mosses grow in moist dark areas and have small leaf-like structures, in addition to stems. Lichens often appear grey or pale white in appearance, while moss is usually green. Many lichens also create disc shaped fruiting bodies, which cannot be seen on mosses.

Wood munchers

Longhorn beetles and weevil larvae are examples of scavengers that eat or tunnel through wood. Many of those animals also eat other kinds of vegetable matter, such as dead leaves, as do caterpillars and snails. As all of them chew their way through the wood, they help break down the log.

Predators on the prowl

Predator animals, such as centipedes, beetles, and spiders, feed on the scavengers feeding on the decaying log. The predators, and then the scavengers in turn, become meals for birds, lizards, and other animals that tear into a log to find food.

Hideouts and nurseries

Many creatures depend on decaying logs as places to hide from predators or to find shelter from the elements. Some animals may spend the winter inside a rotting log. Some beetles, weevils and other animals lay their eggs in decomposing wood. Various lizards may wait in the relative coolness and dampness of a fallen log during the day and then hunt for food at night. As these animals burrow into the log, they also break it down.

Getting ready

Find a place that has several dead logs, large fallen limbs or decomposing tree stumps that are fairly close together.

Optimally, the logs (or pieces) should be at least 20cm across and should be in different stages of decomposition.

Safety

Check for any hazards at the site, such as deep holes and sharp objects.

Also check to be sure logs won't move in a hazardous way when the students examine them.

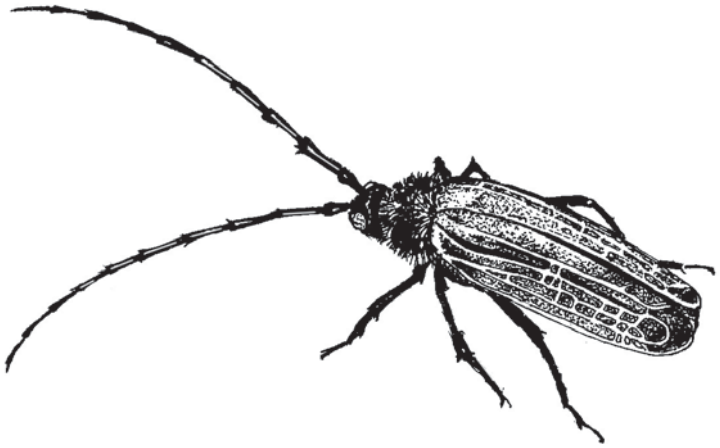
Doing the activity

1. Begin by asking the students why forests aren't piled high with fallen trees, branches, and leaves. What happens to trees after they die?
2. Divide the group into teams of three or four, and explain that the teams will each examine a rotting log. Team members will need to keep track for each different kind of plant or animal they see and where it was found.
3. Take students to the study area and have each team choose a log/area to study.
4. SAFETY! Establish safety rules; be sure to include specific boundaries and expectations.
5. Explain that students should examine their log, disturbing it and the things living there as little as possible. They should note any plants and animals they find, and if they can't identify something, they should make a sketch of it. Encourage them to look for evidence of animal activities such as insect holes, spider webs, animal dens, animal tracks, piles of sawdust, or patterns in the wood under the bark.
6. Have students complete the "log survey" and create a diagram of the log, labelling what they found
7. When they've finished examining their logs, have students examine areas around the log. They might look in leaf litter, under rocks, around the bases of trees and so on. Record similarities and differences between these areas and the log, noting which of the plants and animals they found around their log also live in these areas.
8. Have them present their findings to the rest of the group.
9. Note the light well created by the fallen log

10. Fallen logs are sometimes called “nursery trees” can you tell why? *(You will often find young seedlings on the fallen log because of the rich nutrients provided by the decomposing log.)*

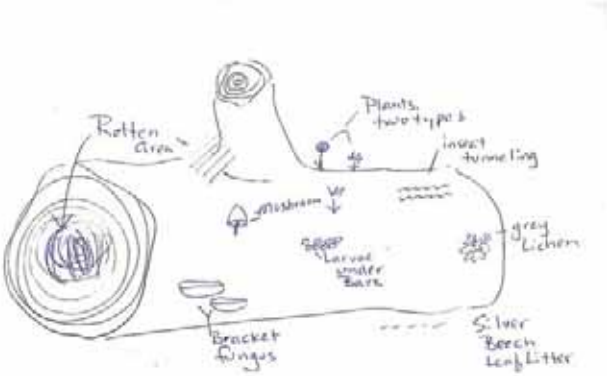
Points to ponder: group discussion

- What similarities and differences were there between each of the logs? What might explain the differences?
- Which animals and plants were found both on the log and in nearby areas, such as in leaf litter? What do those areas and the log have in common?
- How do the animals you found in the log interact with it? *(The log provides habitat, including shelter, food, a place to raise young, and space to live.)*
- Why is it important that the logs like the one you studied decompose? *(Decomposition recycles the nutrients stored in the log.)*
- How does the forest ecosystem benefit from a fallen log i.e., wouldn’t it have been better to take the dead log away - maybe make a picnic table? *(The log provides a habitat for plants and animals that are, in turn, food for other creatures. As animals and plants break down the log, its stored nutrients become available for other plants and animals.)*



Rotting log survey

1. Take a close look at a fallen log. What is happening?
2. Draw any plants and animals you find on your log.
3. Look for evidence of animal activities such as insect holes, spider webs, animal dens, animal tracks, piles of sawdust, or patterns in the wood under the bark.
4. Examine areas around the log - check the leaf litter and under rocks. Record similarities and differences. Draw which of the plants and animals that they found around their log also live in these areas.



Sample log survey

Draw your fallen log below:

Activity 2: Pine Valley scavenger hunt

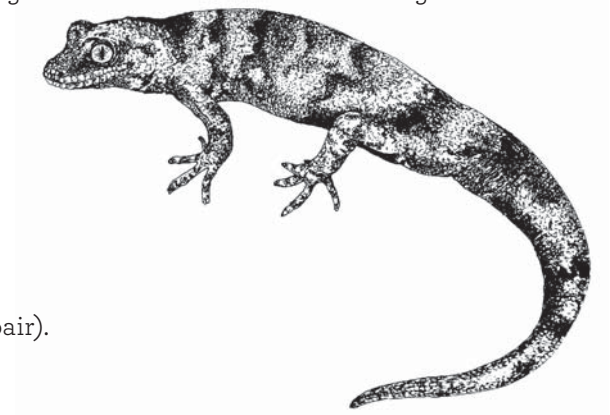
NAME: _____

Can you find:

- ○ A tree with five leaves on each branch. Can you name it? _____
- ○ A fantail.
- ○ A tree that looks like it is wearing a dress. Can you name it? _____
- ○ A plant you can see through. Can you name it? _____
- ○○○○ Four different kinds of mosses, ferns or lichens.
- ○ A tree with leaves as long as your forearm. Can you name it? _____
- ○ Algae and fungi mixed together.
- ○ A tree with hairs.
- ○ A bush with teeth?
- ○○○ Three different insects.
- Five things man-made (describe them):
  1. _____
  2. _____
  3. _____
  4. _____
  5. _____
- ○ Something red (describe it): _____
- ○ A young seedling and its likely parent.
- ○ A fungus.
- ○ Pollution: _____
- ○ Evidence insects have been eating. What did you see? _____
  _____
- ○ Something very cool (describe it) _____
  _____
- ○ Something introduced to the forest that shouldn't be there (describe it): _____
  _____

Activity 3: Getting in touch with plants

There are lots of different clues to help you identify trees and plants. Check their size, their colour, the shape of their leaves, and the texture and colour of their bark. In this activity, however, students will be using their sense of touch instead of sight to tell the difference between trees.



Time required

- Approx 30 minutes.

Materials needed

- Blindfolds (one for each pair).

Doing the activity

1. Hone your skills - ask each child to find one rock small enough to hide in his fist. Sit everyone in a circle and ask the children to both look at and feel their rocks. Then ask the children to pass their rocks to you.

   First, they will identify their rock by sight. You should pass the rocks, one at a time, around the circle. When a child thinks he has found his rock, the child sets that rock on the ground in front of him. The child continues to pass the other rocks around the circle. Make this game less obvious to the final players by including two or three extra rocks.

   After everyone has identified his rock, take the rocks back. Now have the participants close their eyes. Play the game as before, this time relying on the sense of touch to claim a rock. Emphasize the importance of not looking at the stone. If the children have the co-ordination, have them hold the rock behind them as they feel it and then pass it around.

2. Now try testing your new skills on trees. Divide students into pairs. Give each pair a blindfold. Explain that partners will take turns wearing the blindfold and examining a bush using only the sense of touch.

3. SAFETY TALK:

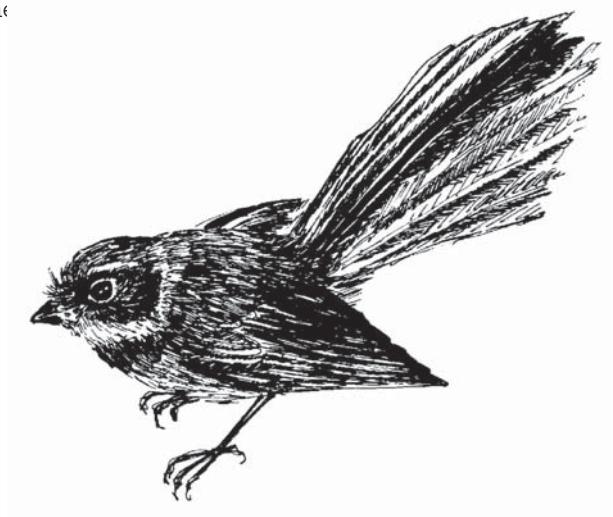
   - Beech trees with scale insects/mould **are off limits** (black sooty mould covering the tree trunk) could cause harm to native scale insect and also very popular with wasps!
   - Point out any potential hazards students should avoid.
   - Clearly define the boundaries for conducting the activity.
   - Keep away from beech trees with wasps.
   - Remind the “sighted” partners that they have to carefully lead their blindfolded partners to a tree.

   The safest way to have the blindfolded person take the “sighted” partner’s arm and walk about a half step behind him or her. The “sighted” partner should walk slowly and describe anything that needs to be avoided.

4. Have the “sighted” partner guide the blindfold partner to a bush. When they reach the tree, the “sighted” partner should place the blindfolded partner’s hand on the leaves of the bush and along the branch.
5. Are the leaves smoothe, furry, big, small, waxey, do the leave the branch in pairs or do the alternate down the branch or are they in clusters at the end of the stem? After a few minutes the “sighted” partner should lead the blindfolded partner back to where they began, but take an indirect route.
6. Once back, remove the blindfold and let them try to find the tree with their eyes open.
7. Have the students switch roles and repeat.
8. When everyone is finished, bring the students together and have them describe the different trees they examined.
    - How did they feel about being blindfolded?
    - What did they notice about their leaves?
    - Were they able to identify their bush?
    - What was it that helped them to identify their individual tree?

Activity 4: Leaf interview

One of the best and simplest ways to identify New Zealand native trees is by looking at their leaves. In this activity students will develop the observation skills by comparing different leaves to help them identify some



Time required

- 45 minutes.

Materials needed

- Key to native trees page.
- Leaf interview page.
- Leaf identification flip chart ot book.
- Pencils/crayons.
- Coloured pencils (optional).

Getting ready

During the walk, have students collect 3-5 different kinds of leaves. Encourage them to only pick leaves from off the ground.

Safety

Establish clear rules of behaviour for students, including respect for plants and other living things.

Doing the activity

Have students form pairs or small groups. Ask them to examine their leaves and sort them into groups according to any criteria that they determine

Have students share some of the ways they sorted the leaves.

Ask:

- What are differences between the leaves?
- What do the leaves have in common?
- Do any leaves have teeth?
- Do any have hairs? Where?
- What do the leaves feel like?
- Who found the biggest leaf? The smallest leaf? The most narrow?
- Have any leaves been eaten by insects? How can they tell?
- Can they trace the veins on their leaves with their fingers?
- What kind of tree did their leaves come from?

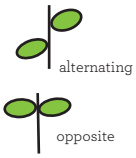
Next have each pair/group go to a living tree or bush to conduct a leaf interview. Note: They will need to be able to examine the leaves as they sit on the branch. After they have completed the leafe interview present it to their classmates. Depending on time availability, each pair/group can do one or more leaf interviews and presentations.

Leaf interview

Draw your leaf:

What is the shape of the leaf? *Broad or narrow? Hand shaped? Is the tip round or pointed?*

What are the leaf margins? What does it look like around the edges *-toothed or smooth, fine or course teeth?*



What is the leaf arrangement. How are the leaves spaced on the twig - *opposite (growing in pairs along the twig) alternating (leaves staggered along the twig) Clustered - leaves in clusters of three or more.*

What is the texture of the leaf? Smooth? Hairs? Rough? Prickly? Stiff? Soft? Waxy? Thick or thin?

Has anything eaten the leaf? What could it have been?

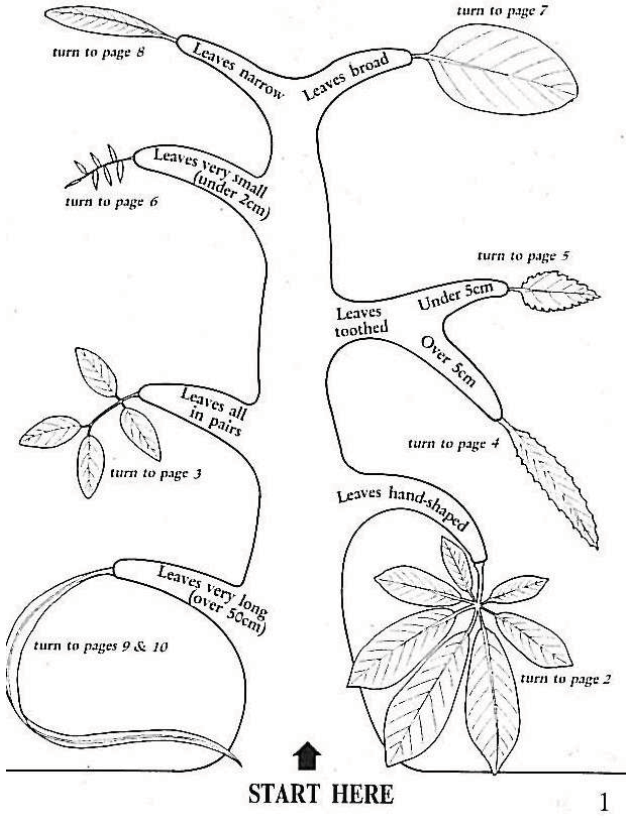
What is the size of the leaf? What is the approximate length and width (in cm)?

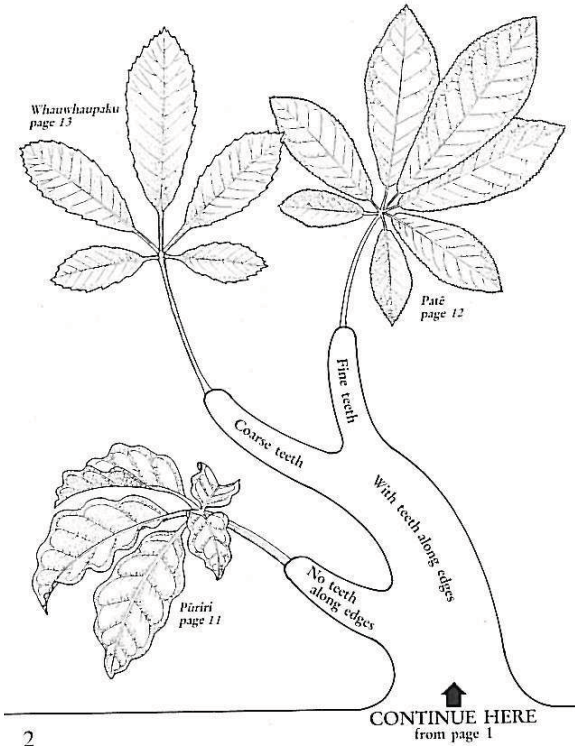
Length_____ Width _____

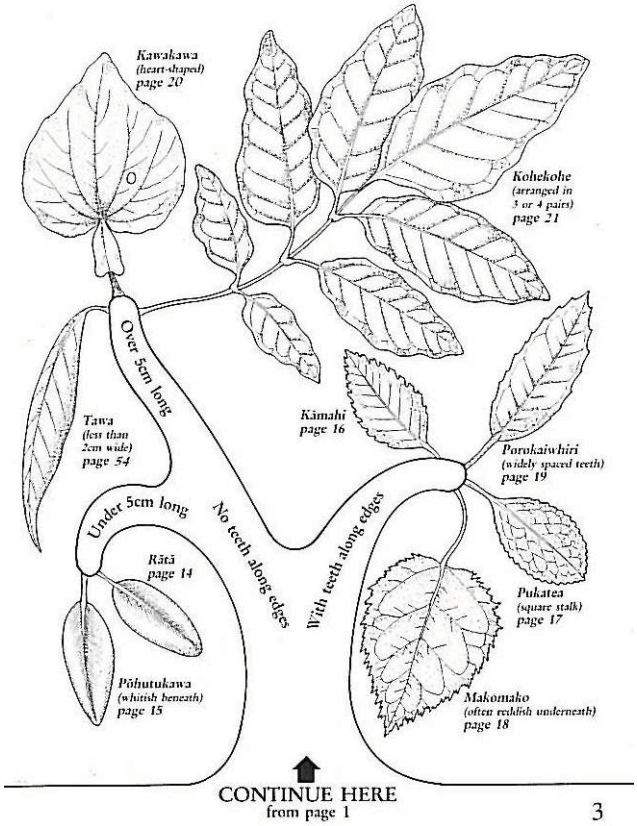
What is the colour of the leaf on both sides? White underneath? Dull? Shiny? Green? Yellow?

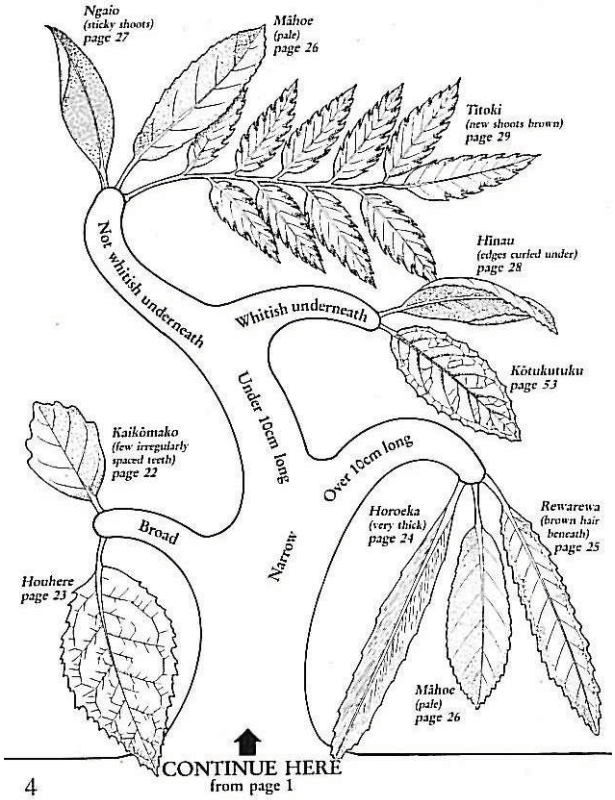
Identify your leaf using the tree key or ID book

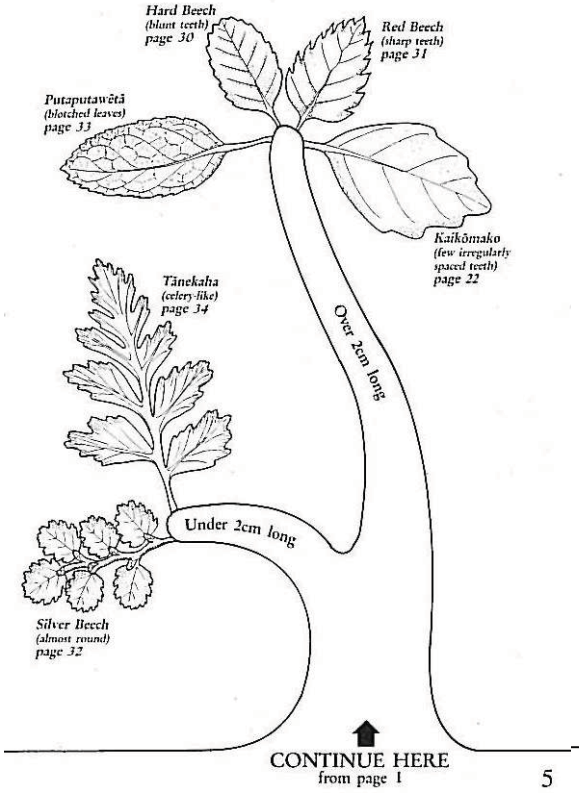
Key to New Zealand native trees

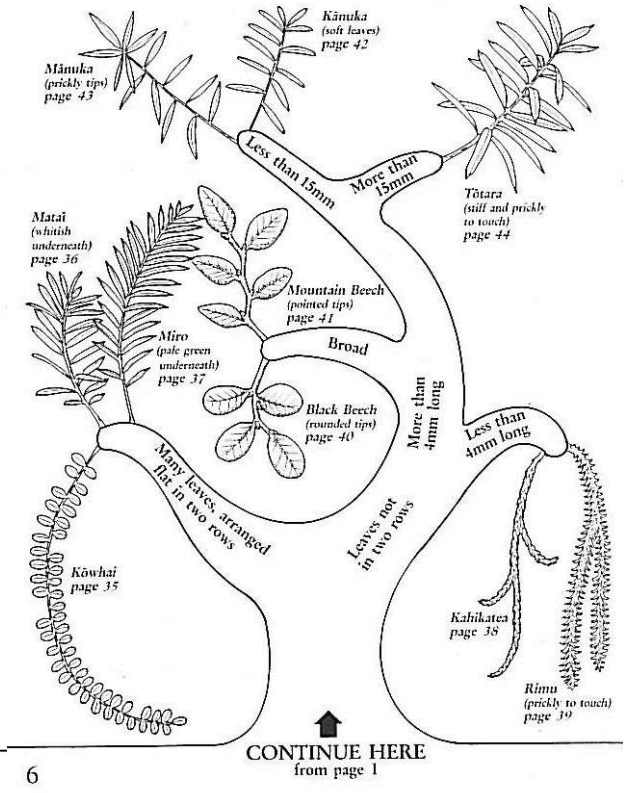


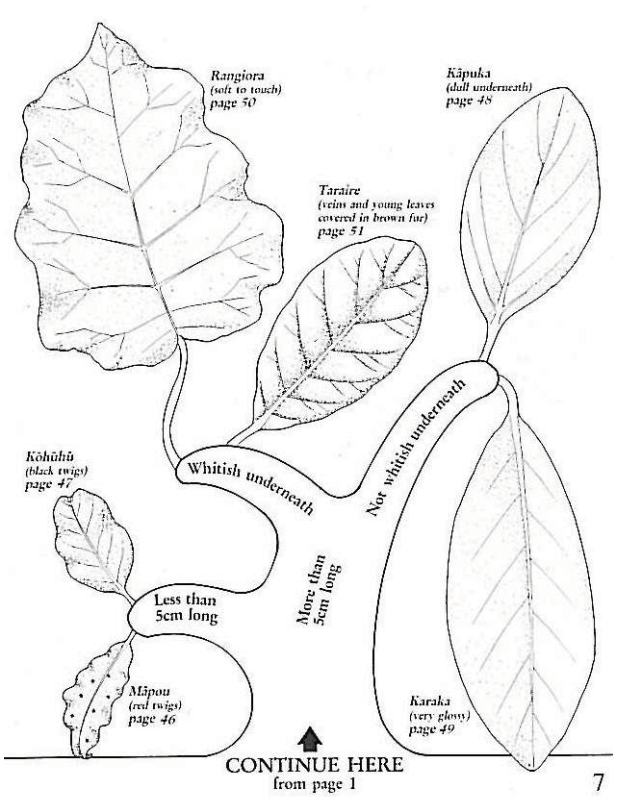


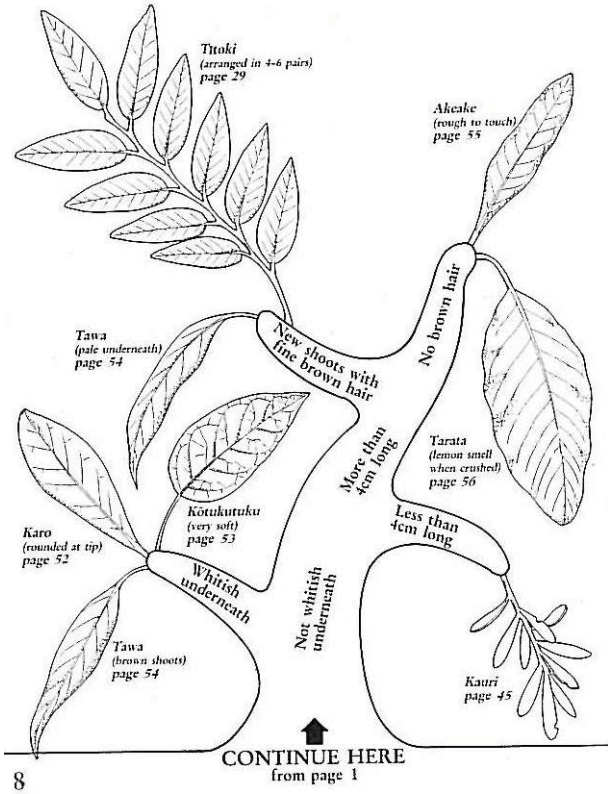












Activity 5: Leaf rubbing ID book

Use leaf rubbings to create your own tree identification book.

(Note: this activity can be done on its own or is a good extension to Activity 4 – Leaf interviews).

Time required

- 20 minutes.

Materials needed

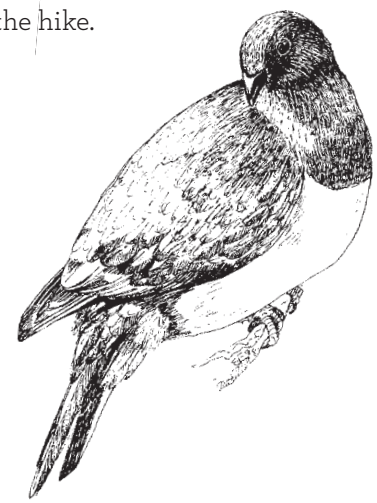
- White paper (copy paper works great).
- Hard/smooth surface to write on (laminated paper works great).
- Dark coloured crayons.
- Tree identification book/flip guide.

Doing the activity

1. During the hike collect leaves (there are plenty on the ground, no need to pick them off trees), identify which tree the leaf came from.
2. Find a comfortable spot for the group to sit and work.
3. Put a leaf upside down smooth surface, then cover with a plain piece of paper.
4. While holding the paper and leaf in place, use the side of a crayon to rub across the leaf. A dark crayon will produce a clearer print of the leaf.
5. Make sure that you color over the entire leaf. Rubbing firmly all over the leaf will show the veins and the outline of the leaf
6. When finished, have them flip the leaf over and do a rubbing of the other side of the leaf.
7. After the craft is complete, have the kids label the leaves back at school. You can punch holes in their pages and use yarn to make them a leaf identification album.

Activity 6: Human camera

Another observation activity that helps students take a moment to focus on specific areas of the forest and create a memento to take away from the hike.



Time required

- 20 minutes.

Materials

- Blank paper.
- Colour pencils/crayons.

Getting ready

Have students work in pairs -- one is the 'camera' (eyes closed) and the other the 'photographer'.

Safety

Point out any potential hazards students should avoid.

Clearly define the boundaries for conducting the activity.

Remind the 'photographer' that they have to carefully lead their 'camera' partners around.

The safest way is to have the 'camera' take the 'photographers' arm and walk about a half step behind him or her. The 'photographer' should walk slowly and describe anything that needs to be avoided.

Doing the activity

1. The 'camera' uses his hands to make a frame (hold hands up, palms facing away, thumbs together – makes a U shaped box).
2. The 'photographer' has 5-10 minutes to take the 'camera' to approximately three sites to set up the 'shots' and positioning the 'frame'.
3. When the frame and shot is set the 'photographer' squeezes the shoulders of the 'camera'. The 'camera' opens its eyes for 10-15 seconds, then shuts them to take a 'shot'.
4. Each of these 'shots' must be remembered as the pairs then swap roles.
5. Discuss the experience with the group:
    - Do you think using the frame helps focus the eyes on a specific area instead of trying to take everything in at once?
    - Did you notice more detail in with in the frame than when you were just walking along?
6. On completion each 'camera' develops their favourite 'photo' by drawing a picture to represent it.

Activity 7: How big is that tree?

Students will consider forestry practices in New Zealand and learn ways to measure how tall a tree is without having to climb up a giant ladder to measure its height.

Time required

- 20 minutes or more, depending on how many of the measuring techniques you have the students try.

Materials

- Ruler, pencil or stick for each pair of students.
- Paper and pencil for writing notes.
- Measuring tape (optional).

Doing the activity

1. Discuss the history of forestry in New Zealand.

   How much of New Zealand was covered by native forest when Māori arrived? *(80%)*

   How much of New Zealand is covered by native forest today? *(25%)*

   What happened to the native forests? *(Wood used for building houses, ships masts, cleared for pasture lands.)*

   How many houses can one tree make?

   (The old native hardwoods such as matai and totara that were cut down in the 1800s were 1500 to 2000 years old and one tree would supply the timber needed for 2-3 houses.

   Today pine trees are harvested when the reach 25-30 years old and it takes about 30–40 trees to build one house.)

2. Discuss the fact that all throughout the Richmond Range was extensively logged and the exotic forests surrounding the area are still being harvested today.

   In Pine Valley, Mill Flat got its name because there was a pine mill (near where the swing bridge is now).

   Onamalutu was set aside as a reserve when the farmer who owned it realised that it was the last remaining piece of kahikitia forest left in the entire valley.

3. Foresters have always done "timber cruises" to determine the approximate timber yield of a stand of trees, they calculate the volume of lumber in a given area, examine the health of the forest and survey the species found there. Many experienced foresters can gauge the amount of timber a tree would produce just by looking at it.

   To determine the amount of lumber any particular three will provide, you have to determine its height and circumference. Foresters can measure a tree using an Abney hand level, a hypsometer, a transit, a clinometer, a relascope, a laser or other instrument designed for that purpose.

   There are, however, several simpler ways that still provide a fairly accurate information.

   Select a one or two trees for students to measure.

Explain they will become foresters for the day and use several techniques to measure the height of the a tree.

Discuss ideas on how to measure the tree that don't involve really long ladders or climbing climb to the top and risking falling out of it.

Break the group into teams of 2 or 3 and select one or two of the methods below to trial. If time allows they can try each of the methods decribed below.

Option 1 - A distant view

1. Stand far enough from the tree so you can view the whole tree, top to bottom, without moving your head. For the most accurate measurement, stand so that you are on a piece of ground that is about level with the ground at the tree's base. Your view of the tree should be as unobstructed as possible.
2. Have a friend stand near the base of the tree.
3. Hold a pencil or a small, straight stick (or ruler) in one hand and stretch your arm out so that the pencil is at arm's length in front of you (between you and the tree).
4. Close one eye and adjust the pencil up or down so that you can sight the very top of the tree at the top of the pencil. This is easiest if you turn the pencil so that the sharpened point is pointing straight up. The tip of the pencil should just cover the top of the tree in your line of sight as you look at the tree "through" the pencil.
5. Move your thumb up or down the pencil so that the tip of your thumbnail is aligned with the tree's base. While holding the pencil in position so that the tip is aligned with the tree's top (as in step 4), move your thumb to the point on the pencil that covers the point (again, as you look "through" the pencil with one eye) where the tree meets the ground.
6. Rotate your arm so that the pencil is horizontal (parallel to the ground). Keep your arm held straight out, and make sure your thumbnail is still aligned with the tree's base.
7. Have your friend move away from the tree (in the same direction you are pointing the pencil) until you can sight his or her feet "through" the point of your pencil. That is, your friend's feet should be aligned with the pencil's tip. Since, depending on the height of the tree, you may need to be some distance away from your friend, consider using hand signals (with the hand that is not holding the pencil) to tell him or her to go farther, come closer, or move to the left or right.
8. Measure the distance between your friend and the tree. Have your friend remain in the place or mark the spot with a stick or rock. Then use a measuring tape to measure the straight-line distance between that spot and the base of the tree. The distance between your friend and the tree is the height of the tree. If you don't have a measuring tape you can pace out the distance, although this will not be as accurate (for kids two steps equal about one metre).

Option 2 - Fixed angle method

1. Fold a square piece of paper in half so that it forms a triangle. The triangle will have one right (90 degree) angle and two 45 degree angles.
2. Hold the triangle near one eye so that the right angle is away from you, facing you, and one side is horizontal (parallel to the ground, assuming the ground is level).
3. Move back from the tree until you can sight the top of the tree at the top tip of the triangle. Close one eye to sight the tree's top. You want to find the point where your line of sight follows the hypotenuse of the triangle to the very top of the tree.

4. Mark this spot and measure the distance from it to the base of the tree. This distance, plus your height (because you used the angle of elevation from eye level, not from the ground) is also the height of the tree. This works because the angle of elevation using your triangle is 45 degrees, and the tangent of 45 degrees = 1. If you don't have a measuring tape you can pace out the distance, although this will not be as accurate (for kids two steps equal about one metre).

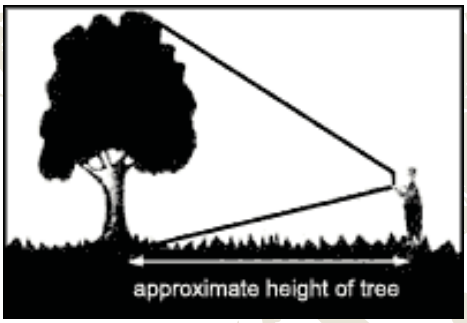
Option 3 – Proportion of height

1. One student stand at the base of tree.
2. Another student should stand in front of this student, holding a ruler vertically at arm's length and walk backwards, keeping arm stiff, until the bottom and top of the ruler line up with the top and bottom of the tree.
3. The student with the ruler should record where the top of their partner's head appears on the ruler (for example, at 10cm) _____. Divide the length of the ruler by this figure (for example, 30cm ÷ 10cm = 3cm _____.
4. Measure your partner's actual height and multiply it by the previous result. For example, if the student's height was 180cm, then the height of the tree would be 180cm x 3cm = 540cm _____. Convert to metres/cm(s)/100 _____.

Or with a pencil:

5. Choose one partner, measure his/her height in metres and record it here: _____.
6. Have this partner stand at the base of the tree. Standing in front of him/her, hold your pencil straight out in front of you and move slowly away from the tree until the top of the pencil is at the top of your partner's head, and the bottom of the pencil is at the bottom of your partner's feet.
7. Next, estimate how many pencil lengths it would take to reach the top of the tree. You can do this by flipping the pencil from end to end, up the tree.
8. Multiply this number by the height of your partner. For example, if your partner is 1.8 metres tall and the tree is 4 pencil lengths high, the height of the tree is 1.8 metres x 4 = 7.2 metres.

Option 4 – Stick method



1. Hold the stick at its base vertically.
2. Make certain that the length of the stick above your hand equals the distance from your hand to your eye.
3. Move away from the tree while sighting the trunk base above your hand.
4. Stop when the top of the stick is level with the top of the tree. You should be looking over your hand at the base of the tree and, moving only your eyes, looking over the top of your stick at the top of your tree.
5. Mark the spot you are standing in with the stick and measure how far you are from the tree and that measurement, in metres, is the tree's height. If you don't have a measuring tape you can pace out the distance, although this will not be as accurate (for kids two steps equal about one metre).

Extension activity:

Find a quiet spot along the trail and have the students find a spot to sit.

Read the following excerpt:

In 1911 travel writer W. H. Koebel described the New Zealand bushman: *"Clad in blue 'dungaree' trousers and coarse grey shirt, with clasp-knife in his belt, he plies his long-handled, keen-bladed axe with lithe, supple movements ... He is of spare rather than of heavy build, but every muscle in his frame is of iron blended with elasticity. His arms and bearded face are tanned to dark mahogany, and his eye glows with the steady, keen light that only those who live their lives with nature possess."*

Others described as close-knit teams of bushmen often lived in remote camps, working up to 12 hours a day, six days a week, with their day off on Sunday left to sharpening tools and doing laundry. Alcohol was usually forbidden at the camps, but the men relaxed by smoking pipes, playing cards and holding men-only 'buck dances'.

The all-important cook was up at 4am to prepare a huge breakfast of porridge and meat stew. The men had jam sandwiches for lunch, but expected a dinner of soup, meat and vegetables, and pudding. The cook announced meals by blowing on a bullock horn, which also raised the alarm if there was an accident. Injured men could face slow death or a painful trip to reach medical help.

Most bush camps were all-male, but sometimes the wife and children of the boss lived there too, the woman cooking for the men.

Some timber was milled near the logging site. Logs were jacked into position on a platform over a pit. They were then cut up by two men using a crosscut saw, one standing on top of the log and one beneath.

Pit-sawing could not keep up with the demand for timber, and from the 1840s, water-powered sawmills were built. After 1865 steam-powered mills appeared. LIKE FOUND IN MILL FLATT ???

Sawmilling was skilled work. Sawyers had to judge how to cut a log to get the correct size and grade of timber. Like logging, milling was risky. Early machinery lacked safety guards, and there were some gruesome accidents. From the 1890s sawmill and timber workers' unions helped improve conditions of work.

(Nancy Swarbrick. 'Logging native forests - Logging and sawmilling, 1840–1920', Te Ara - the Encyclopedia of New Zealand, updated 2-Mar-09)

Activity

Have students discuss or write in their journal their thoughts about what it would have been like to live in one of these timber camps in the 1840s -1920s.