MINISTRY OF EDUCATION
Te Tāhuhu o te Mātauranga

Notes for Teachers

Connected 1 2004

Contents and Curriculum Links

Introduction

Connected is a series designed to show mathematics, science, and technology in the context of students' everyday lives. The stories and articles provide starting points for further investigations by individuals, groups, or a whole class. The activities in Connected 1 make science, mathematics, and technology fun for students working at levels 1 and 2 of the New Zealand Curriculum.

General Themes in *Connected 1 2004*

1. Number in Our Everyday World, with a Focus on Multiplication

"Multiplication Monday" is a fictional account of students identifying number in their school environment and having fun with skip-counting/multiplication activities. The teachers' notes focus on ways in which you can build on your students' experience of skip-counting in a manner that goes beyond rote recitation and develops their understanding of number and multiplication.

2. Unit Fractions

"A Bird's Breakfast" develops ideas about fractions, multiplication, and division within the context of birds catching and evenly sharing out segmented worms. The calculations associated with "A Bird's Breakfast" involve the sets model of fractions. In other words, sets of discrete objects are shared. (This is different from the region [or area] model of fractions, in which, for example, a circle is divided into quarters.) With a sets model, the students can use their whole number strategies to solve problems that involve sharing equally. The fractions in these problems are all unit fractions, or they can be reduced to unit fractions. In other words, their numerators (top line digits) are all 1 or can be reduced to it. Dividing an area or a set evenly will always result in unit fractions.

3. Air as Matter and the Force of Moving Air

"All in a Flap" establishes a fictional context for exploring the idea that air is matter, even though it is invisible, and that moving air creates a push.

"Air, Air Everywhere" is an article that explains and expands on the key concepts underlying the previous story and focuses on ways in which humans and other living things use wind. Also, the follow-up activities explore the idea that moving air carries an invisible cargo of living things, such as bacteria and pollen, and non-living things, such as dust, soot, and pollutants.

"A Sprinkle Here, a Sprinkle There" introduces students to scientific thinking and investigative methods within the context of moving air and the things that it carries. The article describes the way in which a 9-year-old girl investigates whether finely ground pepper grains travel further than coarsely ground salt grains when you blow on them with equal force. The article and its follow-up activities introduce the four main processes in an investigation, as outlined in *Science in the New Zealand Curriculum*: focusing and planning; information gathering; processing and interpreting; and reporting.

4. Wind and Sound

"The Winds of Tāwhirimātea" explores whistling sounds produced by moving air, so it links strongly with other content in the collection. It could be used as a lead-in to either a science unit in which the students explore the causes and characteristics of sounds or a music unit in which the students create soundscapes to accompany or represent the narrative. Some of the key ideas and activities for music and science are mutually supporting and could be combined in a cross-curricular unit.

The Number Framework

In the mathematics teachers' notes, reference is made to the Number Framework, which is a key component of the Ministry of Education's numeracy projects. The project materials are available on the NZMaths website in the Numeracy Projects section at **www.nzmaths.co.nz/Numeracy/project_material.htm**

The eight strategy stages of the Number Framework describe the mental processes that students use to estimate answers and solve operational problems. The equally important knowledge stages describe what the students need to know in order to support and broaden their strategies. Brief descriptions of the eight strategy stages follow. For more detail, refer to the project materials in full.

Stage 0: Emergent/Pre-Counting

The students are unable to count visible items.

Stage 1: One-to-one Counting

The students can count a set of up to 10 items, but they cannot join or separate sets.

Stage 2: Counting from One on Materials

The students can join or separate sets by counting everything. They must be able to see the items.

Stage 3: Counting from One by Imaging

The students can image (see in their head) sets of items. They can join or separate sets by counting all the items.

4: Advanced Counting (Counting On)

The students hold one set in their head and count on or back to solve addition or subtraction problems. For example, to solve 6 + 5, the students hold 6 in their head and count on from there: 7, 8, 9, 10, 11.

Stage 5: Early Additive Part–Whole

The students use some basic facts and they understand that numbers can be partitioned and recombined so that they are easier to work with. This is called part-whole thinking. For example, 7 + 8 is the same as 7 + 7 + 1.

Stage 6: Advanced Additive Part–Whole

The students can use a wider range of ways to partition numbers for solving addition and subtraction problems mentally. They are able to use a known multiplication fact to work out an unknown fact. For example, 6 x 6 is the same as 5 x 6 + 6.

Stage 7: Advanced Multiplicative Part–Whole

The students can solve problems mentally by using a range of part–whole strategies to estimate answers and solve problems involving multiplication and division. In such an operation, one or more of the numbers is partitioned and then recombined. For example, 27 x 6 is the same as (20 x 6) + (7 x 6).

Stage 8: Advanced Proportional

By selecting from a repertoire of part–whole strategies, the students can mentally solve problems that involve fractions, decimals, percentages, and ratios.

Multiplication Monday

Possible Achievement Objectives

Mathematics

Number

- Rote count to at least 50 (Exploring number, level 1).
- Recall the basic addition and subtraction facts (Exploring computation and estimation, level 2).
- Mentally perform calculations involving addition and subtraction (Exploring computation and estimation, level 2).
- Demonstrate the ability to use the multiplication facts (Exploring computation and estimation, level 2).

Algebra

- Continue a repeating and sequential pattern (Exploring patterns and relationships, level 1).
- Continue a sequential pattern and describe a rule for this (Exploring patterns and relationships, level 2).

Mathematical Processes

- Use equipment appropriately when exploring mathematical ideas (Problem solving, all levels).
- Use words and symbols to describe and continue patterns (Developing logic and reasoning, levels 1 and 2).
- Record and talk about the results of mathematical exploration (Communicating mathematical ideas, level 1).
- Record, in an organised way, and talk about the results of mathematical exploration (Communicating mathematical ideas, level 2).

Developing the Ideas

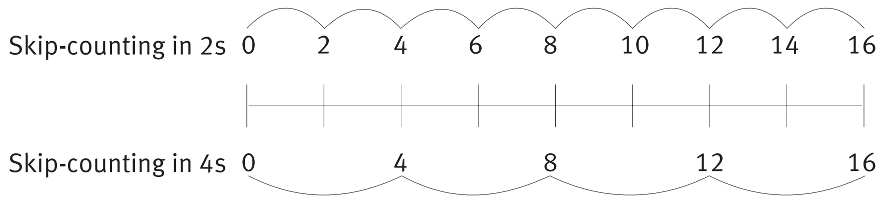
"Multiplication Monday" can help motivate your students to identify and explore numbers in their school environment. They could attempt to identify the sorts of numbers that are described in the story as well as finding other numbers to multiply.

Some students may already be confident at skip-counting in 2s, 5s, and 10s. Even if this is the case, it is still important that they demonstrate an understanding of the relative values represented in each series of numbers. In this way, you can be sure that their understanding goes beyond rote recitation. For example, if the students have built connections between the words and the numerical values in the sequence "5, 10, 15, 20 …", they will understand that 3 lots of 5 are represented by the third number in this series. Similarly, the fifth number in the series would be equal to 5 lots of 5, and so on.

(If the students are completely unfamiliar with skip-counting, you could begin with a few introductory activities from the New Zealand Maths website at **www.nzmaths.co.nz** Click on the Number section from the home page then click on Operating with Number and select Skip-it from the activity grid. This will get you to an activity entitled Skip to Multiply It.)

You could explore other aspects of number if the students analyse more than one skip-counting sequence. For example, 6 appears when you skip-count in 2s or 3s. In the first case, 6 is the third number in the sequence (3 x 2), whereas in the second case, 6 is the second number in the sequence (2 x 3). This provides an opportunity to introduce students to the concept that 2 x 3 yields the same total as 3 x 2. (This is known as the commutative property.)

Multiples of 4, 6, and 7 may be less familiar to the students. When approaching these sequences, encourage the students to use prior knowledge and familiar tools to derive the skip-counting sequences for these numbers. Also, by recording the skip-counting sequence for 2s and 4s on a double number line, the students can explore relationships between the number patterns. Thus 12 can be thought of as 6 lots of 2 or as 3 lots of 4.



Other patterns may become apparent, too. For example, when skip-counting in 4s, all the numbers are even, and the sequence shares every second number with the 2s sequence. Another way of conceiving this relationship is that the 4s sequence is made up of every number in the 2s sequence doubled. The same relationship exists between 3s and 6s. The students could explore other useful patterns. For example, when skip-counting in 3s, the numbers are alternately odd and even.

Further Activities

Exploring Calendars

Through emphasising patterns and relationships, you can help students to learn the multiplication facts. For example, you could introduce the first 4 multiples of 7 in the context of a calendar, ending the count at 28. You could go beyond 7 x 4 with an extension activity in which the students use a calculator to skip-count in 7s to find out how many weeks there are in 365 days. There is one day left over, which is why, for example, 1 June was a Friday in 2001, a Saturday in 2002, and a Sunday in 2003. (You could introduce the activity by asking the students to work out why a date usually moves along by one weekday each year.)

Using Calculators for Skip-counting

Including calculators in your programme could allow students to skip-count further than they might otherwise manage. By keying in 2 + = = = = = = …, most calculators will give the skip-counting sequence 2, 4, 6, 8, 10, 12, … (On some calculators, you need to key in + + 2 = = = …) Before the students start such an activity, you could ask simple predictive questions. *How many times will you have to press the "equals" key to get to 20? Do you think you'll see 17 on your way to 20? Why/why not?*

Counting Backwards

Once students are able to count a sequence forwards, they should also learn to count it backwards. Skip-counting backwards is an important skill – a form of repeated subtraction, which is an early division strategy. Just as calculators can be used for skip-counting forwards, they can also be used for skip-counting backwards. For example, the students could key in 200 – 5 = = = = = = … In this way, they will be counting back in 5s. Once again, it would be worthwhile to pose questions that encourage the students to make predictions. *How many times will you have to press "equals" to get from 200 to 150? Continuing back from 150, what number will be on your display after pressing the "equals" key 10 more times?*

Links to the Number Framework

Stage 4: Advanced Counting (the leaves and shoes)

At this level, a student can recite a skip-counting sequence, forwards and backwards, from 0 to 100 for 2s, 5s, and 10s. (The student can also double or halve any number from 1 to 20, which means they can get the first two digits in any of those skip-counting sequences.)

Stage 5: Early Additive (the leaves, shoes, and apple pips)

At this level, a student can recite a skip-counting sequence, forwards and backwards, from 0 to 100 for 2s, 3s, 5s, and 10s. The student also knows how many groupings of 2, if any, are in the whole numbers from 0 to 20. For example, there are 8 groups of 2 in 17. The student also understands how many groupings of 5 there are in numbers up to 50. For example, there are 9 groups of 5 in 47. The student recalls multiplication facts for 2, 5, and 10 as well as the corresponding division facts.

Stage 6: Advanced Additive (the ants and the weeks in a month)

Skip-counting in 6s and 7s, which allows the students to explore the multiplication facts for these numbers, can be viewed as a bridging stage between the Early Additive and Advanced Additive stages. For activities designed to move the students from the Early Additive stage to the Advanced Additive stage, see "Teaching Multiplication and Division" from the Ministry of Education's Numeracy Project materials. These materials are available on the NZMaths website in the Numeracy Projects section at **www.nzmaths.co.nz/Numeracy/project_material.htm** Pages 12 to 17 of these materials include a number of activities in which students derive the multiplication facts for 6 and 7 through a range of part–whole strategies.

Other Number Patterns

Jackson used carrot sticks and corn rings in a logically increasing sequence of numbers consisting of only 1s and 0s. As the text states, this is not related to skip-counting or multiplication, but it does rely on a firm understanding of the number system. You could ask the students to describe how Jackson's pattern works. Then, working in pairs, each student could devise their own two-digit number pattern and write a description of it. They could then swap their pattern descriptions with a partner and try to build one another's patterns according to the written descriptions. For an activity that expands on this exploration of the number system, see Beginning School Mathematics, Cycle 9: 9.1.8 (Grouping on Cigol).

Links to Beginning School Mathematics

The students can gain further experience in counting in 10s to 100, 5s to 50, and 2s to 20 in the following activities from Cycle 10 of Beginning School Mathematics: 10.1.4 (Turn them over and pattern them, page 24), 10.1.43 (Jump for your heart, page 26), and 10.1.44 (In a circle, page 27). They can practise counting in 100s to 900 in the following activities from Cycle 12: 12.1.3 (One hundred at a time, page 21), 12.1.4 (Counting in hundreds, page 22), and 12.1.42 (Join the dots, page 23).

The following activities from Cycle 12 involve using a number line to count in 2s and 5s: 12.1.5 (Frog jumps, page 25), 12.1.44 (How many at a time?, page 27), and 12.1.84 (How did I count?, page 28).

The students can gain further experience in identifying and creating number patterns in the following activity from Cycle 11: 11.3.14 (Pattern mania, page 134).

Links to Figure It Out

The following Figure It Out activities explore multiplication and division. Most of the problems at level 2 can be solved with the use of skip-counting and/or number lines. Some of those at levels 2–3 could be solved in the same way, but others will challenge the students to extend their range of strategies for multiplication and division.

Number: *Book One*, Level 2, pages 12–15 and 19

Number: *Book Two*, Level 2, pages 16–19

Number, Levels 2–3, page 13

Basic Facts, Levels 2–3, pages 10, 14, 20, and 22

A Bird's Breakfast

Possible Achievement Objectives

Mathematics

Number

- Model and explain addition calculations with a sum of up to 20 (Exploring computation and estimation, level 1).
- Using up to 20 objects, model and explain subtraction calculations (Exploring computation and estimation, level 1).
- Write and solve story problems which involve halves, quarters, thirds, and fifths (Exploring number, level 2).
- Write and solve story problems which involve whole numbers, using addition, subtraction, multiplication, or division (Exploring computation and estimation, level 2).
- Demonstrate the ability to use the multiplication facts (Exploring computation and estimation, level 2).

Algebra

- Continue a sequential pattern and describe a rule for this (Exploring patterns and relationships, level 2).

Mathematical Processes

- Devise and use problem-solving strategies to explore situations mathematically (Problem solving, all levels).
- Use equipment appropriately when exploring mathematical ideas (Problem solving, all levels).
- Classify objects (Developing logic and reasoning, levels 1 and 2).
- Record, in an organised way, and talk about the results of mathematical exploration (Communicating mathematical ideas, level 2).

Developing the Ideas

The questions included in "A Bird's Breakfast" are designed to establish links between division, multiplication, and fraction work. For example, an initial connection between division and fractions will be made when the students discover that evenly sharing 18 worm segments between 2 birds results in 2 halves of the total – 9 segments each.

Note that the calculations embedded in "A Bird's Breakfast" involve the sets model of fractions. In other words, sets of discrete objects are shared. This is different from the region (or area) model of fractions, in which, for example, a circle is divided into quarters. With a sets model, the students can use their whole–number strategies to solve problems that involve sharing equally. Note also that the fractions in these problems are all unit fractions, or they can be reduced to unit fractions. In other words, their numerators (top line digits) are all 1 or can be reduced to it. Dividing an area or a set evenly will always result in a unit fraction.

To give the students an initial reference point, you could have them construct a large chart showing different ways of talking about fractions. For example, the following descriptions are all ways of saying the same thing:

three twelfths of twelve = 3
$\frac{3}{12}$ of twelve = 3
one quarter of twelve = 3
$\frac{1}{4}$ of 12 = 3
twelve divided by 4 = 3
$12 \div 4 = 3$
$\frac{12}{4} = 3$

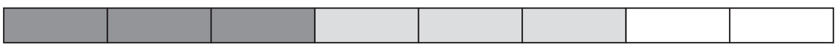
You could also discuss other key concepts with the students at an early stage. For example, the names for fractions are generally the same as the ordinal number names, for example, thirds, fifths, and sixths. However, the terms whole, half, and quarter do not conform to this rule, and the students will need to construct meaning for these fraction names through a variety of informal experiences. Furthermore, a quarter can also be referred to as a "fourth". Because this is more consistent with other fraction names, it may be helpful to use this term initially.

The students' knowledge of doubles, halves, and skip-counting sequences will support their ability to find various fractions of a collection of items. Their addition and subtraction knowledge and strategies will also support their early multiplicative thinking.

In the first two sections of "A Bird's Breakfast", the idea of sharing fairly is highlighted. Coloured cubes would be the ideal equipment for modelling the various segmented worms and sharing out the segments equally. In order to encourage the students to think about the sub-groups of segments in various situations, they could construct model worms with groups of coloured cubes. For example, the answer to question 6 will become apparent if the students construct the following models. (At a glance, it is obvious that worms B and C cannot be divided evenly between 3 birds.)

A.

B.



C.

A similar strategy could be used for question 3, in which the students explore an 18-segment worm to discover all the ways to divide it without leaving any remainders. In other words, the students are asked to find all the whole number factors for 18.

To answer question 7, the students could skip-count in fours once they have identified the relationship of "plus 4 segments" between one worm and the next. A table might help to highlight this relationship.

Worm	1	2	3	4	5	6
Number of segments	8	12	16	20	24	28

Questions 8, 9, and 10 could lead into a discussion about the order of unit fractions and the inverse relationship between the size of the fraction and the value of the denominator. In other words, as the denominator of the fraction gets bigger, the actual number of items gets smaller. For example, with fractions of 20 items:

$\frac{1}{2} = 10$

$\frac{1}{4} = 5$

$\frac{1}{5} = 4$

$\frac{1}{10} = 2$

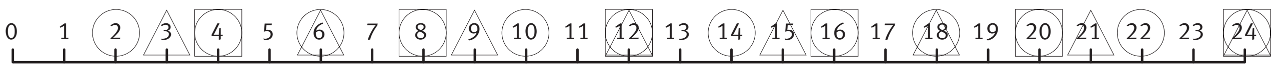
(In a region or area model, the proportion of the whole decreases as the denominator increases.)

In question 11, the students are asked to reconstruct the whole worm from one quarter. Using the knowledge that there are four quarters in a whole, they could skip-count in 4s or rely on their knowledge of the multiplication facts for 4. Students whose knowledge is less advanced might use a strategy of doubling then doubling again: "I know that double 5 is 10, and double 10 is 20, so the whole worm must be 20 segments long."

With question 12, you could begin by encouraging the students to consider what they already know about the numbers 20, 28, 12, and 32. They may realise immediately that these worms can be shared evenly between 4 chicks and that because all the numbers are even, they can all be halved (shared between 2 chicks) with no remainders. This might provide an opportunity to pose an interesting question. *Can a worm with an even number of segments be divided evenly only among an even number of birds?*

Further Activities

The students could investigate the skip-counting sequences for numbers up to 10 and identify the numbers that occur in more than one sequence. They could record these on a number line. For example, they might count in 2s, 3s, and 4s to 30 and look for numbers that occur in all three.



Links to the Number Framework

Stage 3: Counting from 1 by Imaging, to Stage 4: Advanced Counting

At this stage, students are able to divide a region or set into two or more equal parts by using materials or by imaging the materials for simple problems, for example, in questions 1, 3–6, and 8–10.

Stage 5: Early Additive

At this stage, students are able to find a fraction of a number mentally by using their knowledge of addition facts. For example, in question 3, the students need to work out $\frac{1}{3}$ of 18 and $\frac{1}{6}$ of 18.

$\frac{1}{3}$ of 18 is 6 because $6 + 6 + 6 = 18$

$\frac{1}{6}$ of 18 is 3 because $3 + 3 + 3 + 3 + 3 + 3 = 18$

Stage 6: Advanced Additive

At this stage, students are able to use known multiplication and division facts to estimate answers and solve problems involving fractions and proportions. For example, in question 12 D, $\frac{1}{4}$ of 32 is a whole number (8), so there could be 8 or 4 chicks in the nest, and each would get an even share of the 32-segment worm. In order to work this out, known multiplication facts could be used in the following way.

4 x 4 = 16
16 x 2 = 32
so (4 x 4) x 2 = 32
or 4 x 8 = 32

The activity sequence "Hungry Birds" on page 11 of *Book 7: Teaching Fractions, Decimals, and Percentages* is aimed at students who are making the transition from Stage 4, Advanced Counting, to Stage 5, Early Additive. (These materials are also available in the NZMaths website's Numeracy Projects section **www.nzmaths.co.nz/Numeracy/project_material.htm**) Some parts of the sequence could be used as an introduction to the simpler problems in "A Bird's Breakfast". For example, there is an activity using cubes to evenly divide a 15-segment worm between 3 birds. This activity could act as a model for using the same cube-based strategy to solve question 6 of "A Bird's Breakfast", a more challenging activity. Some of the later sections of "Hungry Birds" could be used as extension activities for "A Bird's Breakfast".

Links to Beginning School Mathematics

The students can gain further experience in dividing a set of objects into 2, 3, 4, and 5 equivalent sets in the following activities from Beginning School Mathematics, Cycle 9: 9.3.10 (Share the Biscuits, page 118) and 9.3.53 (Having a Party, page 119).

Objective 6 of Beginning School Mathematics, Cycle 12 is to identify a half, a quarter, and a third of a set and use the labels $\frac{1}{2}$, $\frac{1}{4}$, and $\frac{1}{3}$. See 12.3.7 (Half, Quarter, or a Third?, page 117), 12.3.49 (Follow the Trail, page 120), 12.3.50 (Make It Up, page 120), 12.3.51 (Two of a Kind, page 121), 12.3.83 (Have You Got This Part?, page 121), and 12.3.84 (Which Attribute for Which Fraction?, page 122).

Links to Figure It Out

The following Figure It Out activities explore fractions of sets.

Number: Book One, Level 2, page 18 (fractions of sets presented within a Pasifika context)

Number: Book Two, Level 2, pages 20 (parts of which extend the problems in "A Bird's Breakfast") and 24 (a fun game, which could be a useful assessment activity)

Number, Levels 2–3, pages 20 to 21 (presenting fractions of sets in a variety of interesting contexts), 23 (including fractions of metric weights and volumes), and 24 (an extension activity involving fractions of dollar amounts, which require an understanding of decimals)

These ideas are further explored on the NZMaths website at **www.nzmaths.co.nz** See the Number section, Operating with Number, level 2, Getting Partial. In this unit, fractions of regions and fractions of sets are explored. The activities encourage students to look for and understand the connection between fractions and division.

"All in a Flap"

Possible Achievement Objectives

Science

Physical World

- 1.1/2/3: Share and clarify their ideas about easily observable physical phenomena.
- 2.1/2: Investigate and describe their ideas about some everyday examples of physical phenomena.
- 2.3: Explore trends and relationships found in easily observable physical phenomena.

Developing the Ideas

It is suggested that the students read “All in a Flap” and then progress to “Air, Air, Everywhere”. “All in a Flap” establishes an engaging fictional context in which to consider the phenomenon of wind and the physical force that moving air exerts on objects and materials. “Air, Air, Everywhere” summarises the key science concepts in “All in a Flap” and broadens the topic by presenting the same ideas in new contexts.

The Specific Learning Intentions

The students will be able to:

- make reasoned predictions about the outcome of simple science investigations;
- recognise trends, patterns, and relationships in the results of simple science investigations;
- relate the results of simple science investigations to science concepts and real-life contexts.

The Key Ideas

- Air is all around us, even though we can’t see it.
- Spaces that look empty usually have air in them.
- We experience moving air as wind.
- Moving air creates a push against the surfaces and materials it collides with.

The specific learning intentions and key ideas are adapted from the concept overview chart for the Ministry of Education’s *The Air around Us*, Book 30 in the Building Science Concepts series. The first three ideas are explored in Activity 1: Air Is Something! (on page 8) and Activity 2: What Is Wind? (on page 9). These activities demonstrate that air is a substance (rather than a “nothingness” as some young students think) and that air can exert a push.

The Main Features of the Suggested Learning Sequence

- Read “All in a Flap” to the students to establish a context.
- The students discuss the general science ideas inherent in the story.
- They carry out activities from the Building Science Concepts series to explore, in a practical way, general science ideas to do with the material nature of air and the physical impact of moving air.
- They carry out activities to explore more specific science ideas to do with the movement of airborne particles.

Before the first reading of the story, you could tell the students that they are about to read a story about moving air and what it can do. Before beginning, you may need to discuss what an unsealed road is like. You could also explain that a grader’s job is to redistribute the loose gravel so that it evenly covers the road surface. This prevents the road from becoming too muddy and slippery in the wet.

Further Activities

Exploring the Physical Force of Moving Objects and Substances

After you have read the story, spend a little time discussing the two things that raised dust off the unsealed road: moving vehicles or animals and moving air. This would be a good time to introduce the two activities from *The Air around Us*. Depending on the ideas that arise in the discussion, these activities can be used to either support or challenge the students’ thinking.

You may need to clarify the point that moving objects and moving air have a combined effect: moving objects raise dust as they impact on the ground, and they cause air movements, which also lift dust from the road. The following demonstrations illustrate these phenomena.

Teacher Demonstration: Moving Objects —› Moving Dust

What You Need

- A shallow tray
- Talcum powder
- A sheet of dark paper

What You Do

- Spread a 1-millimetre layer of talcum powder over the tray. (Icing sugar or another very fine powder might work just as well, but it would be advisable to test out any alternatives first.)
- Ask a student to hold the sheet of dark paper behind the tray. (This will make any puffs of rising powder easier to see.)
- Simulate the passing of a pūkeko by tapping your fingers across the powder like footsteps. (You may need to tap quite sharply to get a good effect.)
- Remind the students that the larger road users raised more dust than the smaller road users. Ask them whether they can think of ways to raise more or less powder from the tray by hitting it or dropping something onto it.
- Collect all their ideas and decide which one(s) to test. Ask them to make simple, reasoned predictions about the likely outcome of whatever test(s) they decide on.
  – For example, they could drop objects of different sizes and weights onto the powdery surface and see which ones cause the widest splatter zones. (One way of seeing a splatter zone clearly is to start out with separate layers of different-coloured powders, for example, a layer of talcum powder with a thinner layer of yellow cornmeal on top.)
  – Alternatively, they could compare how much powder is raised by tapping a closed fist against the surface compared with tapping a finger.

What You Look for

- Are the students able to offer simple scientific reasons for their predictions?
- Do they recognise trends and relationships in the results? (For example, bigger objects create bigger splatter zones, or an object dropped from a height of 5 centimetres creates a smaller splatter zone than the same object dropped from a height of 1 metre.)

Teacher Demonstration: Moving Air —› Moving Dust

What You Need

- The same set-up as for the previous activity
- A sheet of cardboard

What You Do

- Ask the students to share their ideas about precisely what happened near the end of the story when the grader driver saw the big cloud of dust rise up from the road. Most students will have correctly inferred that the birds all flocked together and flapped their wings in such a way that a cloud of dust rose into the air.
- Demonstrate a similar phenomenon by briskly waving a piece of cardboard over the talcum powder that you used in the previous demonstrations. (This could be messy, so you may wish to lay newspaper around the area or run the demonstration outside.)
- By this stage, most students will understand the basic science ideas behind what is happening. You could confirm this. *In this demonstration, my cardboard didn't touch the powder, so why did the powder move?*

- Ask the students to come up with as many ways as possible to create a current of moving air. For example, they could flap their hands, a magazine, a fan, a sheet of paper, or a cloth. They could run around or jump on the spot. They could inflate a balloon and allow the air to escape. Or they could simply draw in a breath and blow it back out again. (An alternative approach would be to set up small mounds of powder and challenge the students to come up with as many ways as possible to move the powder without touching it.)
- Ask the students to brainstorm ways in which moving air shifts objects or materials in their everyday world. (This discussion point would be a good lead-in to the following article, "Air, Air, Everywhere".)

What You Look For

- Do the students understand that air consists of matter and that, like other matter, moving air creates a perceptible force?
- Can the students link these ideas to other everyday examples and describe them in the same terms?

Air, Air, Everywhere

Possible Achievement Objectives

Science

Physical World

- 1.1/2/3: Share and clarify their ideas about easily observable physical phenomena.
- 2.1/2: Investigate and describe their ideas about some everyday examples of physical phenomena.
- 2.3: Explore trends and relationships found in easily observable physical phenomena.

Developing the Ideas

This article begins with an overview that consolidates and expands on many of the ideas introduced in "All in a Flap" and its supporting activities. If the students have read "All in a Flap" and discussed the nature of moving air, "Air, Air, Everywhere" can be used to confirm or challenge their ideas. "Air, Air, Everywhere" broadens the topic of moving air to include ways in which humans and other living things take advantage of wind. This broadens the focus from the Physical World to include the Living World.

The Specific Learning Intentions

The students will be able to:

- make observations of a familiar environment and explain their observations in terms of simple science ideas;
- follow instructions for carrying out a simple science investigation and discuss the structure of that investigation in terms of planning, implementation, analysis, and reporting;
- make simple, reasoned predictions about the outcome of a science investigation;
- relate the results of a science investigation to simple, familiar science ideas.

The Key Ideas

- Living things use moving air in many ways.
- The air is full of living and non-living things.
- Some things carried by the air are large and easy to see.
- Other things carried by the air are small and very hard, or impossible, to see.

The Main Features of the Suggested Learning Sequence

- Read the article to the students to consolidate and expand on the ideas developed in “All in a Flap” and its associated activities.
- The students go on an observation walk to look for evidence of moving air and to note down living and non-living things that are in the air. (To give structure to the observation, a simple recording chart could be developed beforehand.)
- They follow a set of instructions for a simple activity to explore whether there might be things in the air that were too small to see on the observation walk.
- They then read “A Sprinkle Here, a Sprinkle There”, which models the planning and implementation of a science investigation, including the key processes of focusing and planning, information gathering, processing and interpreting, and reporting.

Discussion and Observation

At the end of the third paragraph of “Air, Air, Everywhere”, the students are asked to think about ways in which people take advantage of moving air. If you are reading the article aloud, you could pause for a short brainstorming session at this point or wait until the end of the reading. Familiar examples of wind technology might include yachts and sailing ships, wind surfers, gliders, windmills, kites, wind chimes, wind farms, and wind instruments. Some devices, for example, electric and hand-held fans, are designed to generate wind rather than to take advantage of natural wind currents.

Many living things take advantage of wind and many living and non-living things are affected by it. You could help the students to focus on the key distinction between living things that actively take advantage of moving air and living or non-living things that are simply affected by it. The students should be able to see plenty of examples of both if they walk around the school grounds and neighbourhood. On a breezy day, you could take the class on an observation walk and ask them to note down anything that is either in the air or is affected by air currents.

Encourage them to take a simple but systematic approach. You could mention that when scientists observe nature, they record what they see in a structured way so that they don’t forget important details. For example, the columns might be headed: living things taking advantage of moving air; living things affected by moving air; non-living things affected by moving air.

Further Activities

Back in the classroom, discuss the students’ observations. You could mention that after scientists carry out a general observation, they often continue with a more detailed follow-up investigation. Most of the things the students observe during their walk around will be fairly large. However, as mentioned in “All in a Flap”, small things are often hard to spot and therefore go unnoticed. Ask the students to name the smallest thing they observed. Then mention that there may have been things in the air that were too small to see during the observation walk. The following activity is designed to raise the students’ awareness of the unseen cargo of dust, pollen, and other particles in the air around us.

As with the observation walk, it will be helpful if the students make brief notes as they go. You could give them a form to fill in as the activity progresses. A simple form might include the following key points.

Question: What I want to find out
Prediction: What I think will happen
Observation: What happens
Explanation: Why I think it happened

Student Activity: What's in the Air?

What You Need

- A sheet of tissue paper
- A magnifying glass
- A wide glass jar
- Some weights (optional)
- A rubber band or piece of string
- Some water or petroleum jelly

What You Do

- Use a magnifying glass to look carefully at the clean sheet of tissue paper.
- Place the tissue paper over the mouth of the jar.
- Tie the paper on with a rubber band or a piece of string.
- Drip water onto the paper until it's very damp. (Instead of water, you could smear a thin layer of petroleum jelly onto the paper.)
- Stand or lay the jar outside in an open area on a breezy day. If you have used water rather than petroleum jelly, return every few hours and dampen the paper again.
- After a day or so, bring the jar inside. Without a magnifying glass, the paper will look the same as it did to start with. *What do you think you might see if you look at it with a magnifying glass? Why?*
- Look at the paper again with a magnifying glass. *Can you see specks on it that weren't there before? Where do you think they came from? How do you think they got onto the paper? What do you think they might be?*

What You Look For

- Can the students make simple predictions based on what they have recently learnt about particles and moving air?
- If the students did not predict the accumulation of particles on the paper, can they offer reasoned explanations for the unexpected evidence?
- Can the students suggest what the specks might be?

The specks are most likely to be dust, soot, or pollen. Depending on how windy it was and where the equipment was positioned, there may be only a sparse smattering of particles on the paper – but the students should see at least a few on close inspection.

Afterwards, you could help the students to write a very simple and brief report. As a class, the students could discuss what they did while you write key points on the whiteboard under simple report headings. The report should explain what the students were trying to find out ("My question was …"), how they went about gathering relevant data ("What I did was …"), what the data was ("My results were …"), and what they learnt from the investigation ("What I found out was …).

A Sprinkle Here, a Sprinkle There

Possible Achievement Objectives

Science

The Nature of Science

- 1.1: Share and compare their emerging science ideas.
- 2.1: Use a variety of methods to investigate different ideas about the same object or event.

Developing Investigative Skills and Attitudes

- All level 1 and 2 achievement objectives could be addressed.

Physical World

- 1.1/2/3: Share and clarify their ideas about easily observable physical phenomena.
- 2.1/2: Investigate and describe their ideas about some everyday examples of physical phenomena.
- 2.3: Explore trends and relationships found in easily observable physical phenomena.

Developing the Ideas

"A Sprinkle Here, a Sprinkle There" builds up its own context and can therefore stand alone. However, it is suggested that the students read "All in a Flap" and/or "Air, Air, Everywhere" beforehand and explore some of the activities that support these items. In this way, they will develop solid basic ideas about the physical force of moving air. They could then focus their minds on the design of the salt and pepper investigation without needing to divert their attention to understand the contextual ideas.

The Specific Learning Intentions

The students will be able to:

- develop and carry out their own simple science investigation with teacher support;
- make simple, reasoned predictions about the outcome of their own science investigation;
- relate the results of their own science investigation to simple, familiar science ideas.

The Key Ideas

- Scientists think and talk about their science ideas and ask questions that can be investigated.
- Scientists make observations that are linked to their science ideas. They try things out in different ways to look for patterns.
- When scientists carry out investigations, they collect data in a variety of ways in order to eliminate competing explanations.

The Main Features of the Suggested Learning Sequence

- Read to the students the article about someone else's science investigation.
- The students then analyse the investigation in terms of the key processes of focusing and planning, information gathering, processing and interpreting, and reporting.
- With your support, they plan and carry out a structured investigation within the topic of the movement of airborne substances.

After you have read the article to the students, you could take them through it again with reference to the key processes of an investigation, as listed on pages 44 to 47 of *Science in the New Zealand Curriculum* (focusing and planning, information gathering, processing and interpreting, and reporting). Using familiar language, you could talk briefly with the students about these four main processes and then reread the article, asking the students to help you link each thought or action with one of those processes. Depending on the age and ability of your students, you may wish to simplify this activity by limiting the analysis to "thinking processes" and "doing processes". In this way, even young students will come to understand the key message that a scientific investigation is carefully planned – the investigator has a clear reason for all actions throughout and reflects on the investigation as it proceeds. The other key message is that all scientific investigations follow the same basic "road rules", even though the precise details vary greatly.

Note that the processes in an investigation are not usually in a linear sequence. The investigation may move backwards and forwards through the various processes, depending on such circumstances as unexpected results, complications, or insights.

Linking the Narrative to Investigative Processes

Focusing and Planning

During this process, the investigator ponders an object or event, using their observations and scientific ideas to develop provisional explanations and/or predictions. Often, the investigator then decides on a simple trial that will probe these initial ideas.

Stimulus questions:
What interesting thing did the narrator's father notice on the family picnic?
Did the narrator have a possible explanation for why the salt ended up on her father's food but not the pepper?
Was her explanation just a wild guess, or did she have sensible reasons for it?
How did she decide to test this explanation?
Would she have been able to come up with an investigation if she'd had no explanation to test?
(Alternatively: Why was it important for the narrator to have a question to test?)

The article begins with a simple observation that sparked the writer's interest. Having pondered this observation, the writer came up with a hypothesis. A hypothesis is a proposed explanation based on observation and/or a limited amount of evidence. A hypothesis is not an end in itself. Rather, it forms the basis for further investigation.

In this case, the writer's hypothesis was that the breeze had blown away the light pepper grains (but not the heavier salt grains) before they reached her father's plate. The next stage was to test this hypothesis. The writer formulated a specific focus question that was designed to test her hypothesis. Without a hypothesis and question, there would have been nothing to test. The narrator might have made further observations but, without a focus question, further observations would have been much less likely to yield useful information.

Information Gathering

During this process, the investigator makes simple observations and measurements. (He or she may also gather background information during this phase. This extra information, which will help in interpreting the results, may be gathered in a variety of ways, for example, by consulting other people, reading books, and searching the Internet. Extra information might also be gathered by carrying out other, related activities and investigations. Sometimes, however, the investigator knows enough about the subject to rely on their own knowledge and experience for the time being.)

Stimulus questions:
How did the narrator test her explanation?
What were the results of her investigation?

In the article, the investigator's hunch seemed correct. Most of the pepper ended up on the second sheet, whereas most of the salt remained on the first. (The investigator subsequently decided she needed more experimental data, but this realisation struck her in the next phase.)

Processing and Interpreting

During this process, the investigator looks very carefully at the recorded observations and measurements in an attempt to identify trends and relationships. He or she also evaluates the investigation. At this time, it may become clear that the question has not been fully answered or another question may arise. At this point, the investigator may initiate another round of investigation to address new or only partially answered questions.

Stimulus questions:
Was the narrator's question answered in the investigation?
Were the results what she was expecting? (Alternatively: Did the results agree with her explanation?)
Did the results lead to a new question?
How was the narrator's second investigation designed to answer that question?
Can you think of another way in which she could have investigated her second question? (She could have repeated the first investigation with finely ground salt and coarsely ground salt or with finely ground pepper and coarsely ground pepper.)

In this instance, the focusing question was fully answered. (The pepper did move further than the salt.) However, as often happens, this answer sparked a fresh round of investigation.

It is important that the students understand the rationale for running a second investigation. They also need to understand how the second investigation was designed to answer a specific question. The investigator needed to eliminate the possibility that there was a factor at work that had nothing to do with the relative weight of the salt and pepper grains. In other words, some intrinsic quality of salt and pepper might be affecting the results. (For example, perhaps salt is stickier than pepper and therefore moves a shorter distance.) However, if the finely ground salt moves further than the coarsely ground pepper, this will strongly support the original hypothesis that the results hinge on grain size rather than on some other difference between salt and pepper.

Reporting

In this phase, the investigator formally shares the investigation and its results. The precise nature of the report depends on who the audience is. A report may be written or oral, and it may include diagrams and tables of data. A scientific report usually includes the method, the results, and a discussion that focuses on the knowledge gained from the investigation. (At this level, a written report would not necessarily be expected. Rather, you could have the students talk about the process they followed and what they learnt while you summarise and record what they say.)

Further Activities

Having read "A Sprinkle Here, a Sprinkle There" and discussed key aspects of designing and running simple scientific investigations, the students will be ready to develop their own investigations with your ongoing support. The following suggestion is an open-ended investigation that requires self-direction on the part of the students. This will be challenging for many, and so you may wish to run the investigation as a whole-class activity in which you actively participate as well. (The suggested investigation directly relates to the theme in "All in a Flap" and "Air, Air, Everywhere": moving air and airborne substances and objects.)

For additional information about the various types of investigation and a series of charts to help the students to structure their investigations, see pages 11 to 14 of the Ministry of Education's *Making Better Sense of the Living World* (Learning Media, 2001). Note that the series of charts is designed for fair testing situations. You will need to adapt them slightly for use with other types of investigation.

Travelling Perfume Smells

In the teachers' notes for "Air, Air, Everywhere", there is an observation walk followed by an activity called "What's in the Air?". These would be useful lead-in activities for the following investigation. (If time is short, you could simply describe the activities and some plausible results as an oral report of someone else's investigation.) Afterwards, lead the students through a question-and-answer sequence like the following:

- *What was the largest thing that you/they observed in the air?* (a bird or an aeroplane perhaps)
- *What was the smallest thing that you/they observed in the air?* (dust or pollen perhaps)
- *Do you think there might be even smaller things in the air that we can't see?* Lead this question in the direction of airborne bacteria (which the students will probably know as "germs") if they do not suggest these themselves.
- *Why is it important to stay home from school if you have a cold?* There are two main reasons for this – to stay warm and rest and to make sure that you don't pass the infection on to your classmates and teacher.
- Mention that germs can be passed on when we touch each other or touch surfaces that others will come in contact with. Also, by breathing out and sneezing, we release germs into the air.

The students could explore this phenomenon by developing their own investigation to see how quickly a perfume or air freshener scent travels through a classroom. (A spray of perfume is made up of finely misted liquid droplets, much like those we release from our nose and mouth when we sneeze.) Encourage the students to ponder the similarity between a sneeze and a spray of perfume (or simply an exhalation of breath). Ask them to come up with their own suggestions for investigating the speed at which germs can travel through the air. They could do this individually, in groups, or as a whole class, depending on the level of peer support that you think they will need.

If the students are working individually or in small groups, encourage them to share their emerging strategies with you and each other. Take the opportunity to establish a collegial environment in which they gently critique each other's provisional ideas. (You may need to draw some students' attention to weak points in their strategies if these are not picked up by their peers. To avoid being overly directive, you could ask leading questions rather than overtly suggesting improvements.) Choose one experimental method to pursue and ask the students to make simple, reasoned predictions about the likely outcome.

One way of testing the question would be to have someone stand in the back corner of the classroom and release one squirt of air freshener or perfume into the air. The students could sit at their desks and raise a hand as soon as they can smell the scent. Someone would need to time this carefully, and it might be useful to mark the scent arrival times on a map of the classroom on which all seating positions are indicated. (This should be decided during the focusing and planning phase when the students are working out what data to collect and how to do so.)

At the end of the investigation, a second trial could be carried out, this time investigating whether scents/germs travel more quickly if there is a lot of air movement, for example, on a windy day or if the classroom windows are open. Ask them to come up with an investigative method and simple, reasoned predictions. One way of investigating the question without needing to open windows or wait for a windy day would be to release the scent into the air stream of an electric fan. (Note that people become very quickly habituated to scents. So wait at least an hour before running the second part of the trial. In this way, any residual scent from the first trial will have dissipated, and the students' sensitivity to the scent will have returned.)

Discussing Variables and Simple Ideas about Fair Testing

The students may come up with a similar methodology or one that is quite different. In either case, it would be worthwhile to spend a little time identifying the variables at play in the students' proposed investigation. If variables have not arisen in previous discussions, you could explain them in familiar language. *What are the things that might affect our results in this investigation?* You could explain the verb "to vary" and clarify the concept of variables: "All these things might affect our results, and we can vary them. For this reason, scientists call them 'variables'."

In the previous investigation, which is a fair test, the main variables include the place in which the perfume is released, the amount of perfume released (one squirt), which windows, if any, are open or closed, and where each person is sitting. (It would be important to have everyone at the same desks each time because sensitivity to smell varies greatly among individuals, and any changes in the seating plan could affect the results.)

If the students have opted for a fair test, you should clarify the central strategy of fair testing: if you change only a single variable, any differences in the results can be attributed to the changed variable. In this instance, the only variable that changes is the use of a fan. To clarify the point about changing a single variable, you could suggest that if, in the second trial, you not only used a fan but also released two squirts of perfume, you would not know which of those variables affected the results.

The Winds of Tāwhirimātea

Possible Achievement Objectives

Science

Physical World

- 1.1/2/3: Share and clarify their ideas about easily observable physical phenomena.
- 1.4: Describe uses of items of everyday technology, and, in simple terms, suggest how they work.
- 2.1/2: Investigate and describe their ideas about some everyday examples of physical phenomena.
- 2.3: Explore trends and relationships found in easily observable physical phenomena.

The Arts: Music

Developing Practical Knowledge in Music (PK), level 2

- Students will identify through focused listening, and explore, the musical elements of beat, rhythm, pitch, tempo, dynamics, and tone colour.

Developing Ideas in Music (DI), level 2

- Students will invent and represent musical ideas, drawing on imagination and responding to sources of motivation.

Communicating and Interpreting in Music (CI), level 2

- Students will share music making with others, using basic performance skills and techniques, and respond to live or recorded music.

Understanding Music in Context (UC), level 2

- Students will identify music as part of everyday life and recognise that it serves a variety of purposes.

Developing the Ideas

"The Winds of Tāwhirimātea" provides an appropriate context for a science unit or a music unit, with some of the ideas and activities for science supporting those for music and vice versa. In a science context, the students may have read other items in this collection that impart Physical World ideas to do with moving air. They could build on these by considering whistling sounds as another physical phenomenon associated with moving air. In a music context, "The Winds of Tāwhirimātea" could lead on to classroom activities that explore ways of creating a soundscape to accompany or represent this and/or another legend. Creating a soundscape involves the students selecting and organising sounds to create a structured sequence with a particular linking theme or idea. Soundscape development requires a stimulus for the students' creativity, for example, a text, visual image, or experience.

The Specific Learning Intentions for Science

The students will be able to:

- explain the difference between volume and pitch;
- differentiate between different volumes and different pitches;
- identify and describe patterns of pitch changes in everyday sounds;
- explore and describe the relationship between the magnitude of a sound-making movement and the volume of the resulting sound;
- apply their understanding of the link between vibration and sound to the workings of particular musical instruments and sound-makers.

The Key Ideas for Science

- We can hear differences in the characteristics of sounds, for example, their volume and pitch.
- If sound is to be produced, something needs to move.
- Musical instruments all produce vibrations and have features that allow them to make different sounds.
- We make sounds by actions such as striking, blowing, plucking, and scraping musical instruments or sound-makers.
- The particular sound a musical instrument or sound-maker produces depends in part on the way in which we strike, blow, pluck, or scrape it.

The Main Features of the Suggested Learning Sequence for Science

- The students explore ways of producing sound by moving their bodies and clothing. They also consider the qualities of volume and pitch.
- They explore the link between sound and movement, in particular, the type of movement that we call vibration.
- They relate what they have learnt to particular musical instruments by exploring how the player's actions (movements) cause parts of the instrument to vibrate.

The Specific Learning Intentions for Music

The students will be able to:

- identify characteristics of sound (PK, UC);
- explore the elements of music (for example, beat, rhythm, pitch, tempo, tone colour or timbre, and dynamics [volume]) by using a range of sound sources (PK, UC);
- work co-operatively in groups, sharing and developing ideas to create a soundscape that reflects selected aspects of the source of motivation (DI, CI, UC);
- represent a soundscape by using graphic symbols as notation (DI, CI);
- perform a soundscape for others to appreciate and interpret (CI, UC).

The Key Ideas for Music

- We can explore music by experimenting with its elements or key ingredients, for example, beat, rhythm, and pitch.
- We can share ideas about our world by representing them with evocative sounds and music.
- We can create representative soundscapes using a variety of sound sources.
- We can visually represent sounds by using graphic symbols and we can interpret this notation in musical performance.

The Main Features of the Suggested Learning Sequence for Music

- After you have read the legend to the students, they go outside and carefully listen for environmental sounds as part of an "I hear with my little ears" game. Afterwards, they share ideas about how the various sounds are different, how they might have been made, and how we are able to sense them.
- The students then focus on wind sounds. They consider the elements of music and recreate wind sounds, perhaps with reference to Māori words for various types of wind. In doing so, they experiment with a variety of sound sources to produce high/low, loud/quiet, fast/slow, and beautiful/ugly contrasts.
- They listen to traditional Māori musical instruments and experiment with ways of emulating the sounds that they produce.
- Working in groups, they develop a soundscape to represent "The Winds of Tāwhirimātea", beginning with improvisation activities and then combining and rehearsing their best ideas.
- Extension activities might include writing nature songs or waiata, developing notation in order to preserve their compositions as musical scores, and recording their compositions.

Introducing the Legend

Before the reading, you could introduce the legend by asking the class how they sense the wind. Most students will say that you can feel it. Some might mention that you can see it blowing things around. If nobody mentions the fact that you can hear the wind, you could prompt the class by writing the five senses on the board, ticking off touch and sight, and asking the students about the other three (smell, taste, and hearing). You can hear the wind's effect on objects: rustling leaves, rattling windows, and whistling through trees or along narrow passageways.

Ask the students to make a whistling sound like the wind. They will probably enjoy making ghostly wind sounds. At this point, you could tell the class that you are going to read them a Māori legend about the wind and the sound it makes.

Further Activities

Science Activities

The Ministry of Education's *Exploring Sound: Using Sound-makers and Musical Instruments* (Book 18 in the Building Science Concepts series, Learning Media, 2001) and *Making Better Sense of the Physical World* (Learning Media, 1999) contain many useful science activities through which students can develop key ideas about the physics of sound. You could abridge or augment the following sequence of activities depending on your students' existing understanding and the specific focus of your unit.

What Is Sound?

Pages 8 to 10 of *Exploring Sound* include a series of simple activities in which young students explore as many ways as possible to make sound using their own bodies and clothing. They also consider the qualities of volume and pitch. A key outcome from this series of activities is that students should understand that there can be no sound without movement. (You may need to explain that vocal sounds are produced when we force air through our constricted vocal cords as we exhale, causing them to "vibrate" – an unfamiliar word that will be explored next.)

Visible Vibrations

The students could progress to Activity 2: Seeing the Vibrations, Extension on page 26 of *Making Better Sense of the Physical World*. In this activity, they observe puffed rice grains jiggling on the vibrating skin of a drum or a sheet of taut plastic wrap when a person makes vocal sounds through a megaphone. The following activity, Musical Straws, involves the students making a vibrating reed from a drinking straw. Both activities link sound with vibration (a particular type of movement), and the latter mimics the working of our vocal cords.

Vibrating Musical Instruments

Activity 1 on page 13 of *Exploring Sound* involves students investigating a range of musical instruments to find out which parts vibrate and therefore produce sound. This is followed by an assessment activity on pages 14 and 15 in which the students produce various sounds with a comb and a piece of lunch-wrap paper and then with a blade of grass held between their thumbs.

Music Activities

"The Winds of Tāwhirimātea" could lead into an exploration of musical elements as the students create a soundscape to accompany or represent the narrative. The Ministry of Education's *The New Zealand Curriculum Exemplars: The Arts: Music* show student work that emerged from a soundscape unit at level 3. This exemplar relates closely to the following unit of work, which is aimed at level 2 students. The soundscape exemplar can be sourced on CD-ROM (*The New Zealand Curriculum Exemplars: The Arts on CD-ROM*, Learning Media/TKI, 2003, item number 30154) or online at **www.tki.org.nz/r/assessment/exemplars/arts/music**

Exploring Environmental Sounds

After the reading, you could raise the students' awareness of environmental sounds by taking them outside to listen to the world around them. With their eyes closed, instead of playing "I spy with my little eye", the students could play "I hear with my little ears". Conclude by summarising the different sounds that the students have heard during the game. Did the students correctly identify the sounds? Were they foreground sounds (loud, obvious, and nearby) or background sounds (soft, less obvious, and distant)?

Share ideas about how the sounds are different, how they might have been made, and how the students sensed them. (Many music activities also address Physical World achievement objectives at levels 1 and 2. For example, the following questions that are marked with an asterisk can be explored in greater depth by way of the suggested science activities in the previous section.)

*Can we feel, see, taste, or smell sounds?**
How might we remember sounds?
*Can you name sounds that are high, low, loud, quiet, soft, hard, fast, slow, beautiful, or ugly?**
*How do sounds travel to our ears?**
*Can we see sound vibrate? ("Twang this guitar string and tell me whether you can hear, see, and feel it vibrate.")**

Experimenting with Wind Sounds

You could then focus on the sound of wind. The students could recreate wind sounds by experimenting with various sound sources, such as voice, musical instruments, and found sounds. For example, you could ask them to make sounds like the wind whistling through gaps in an old rickety building, smacking the leaves of a tī kōuka (cabbage tree), roaring through a tall kauri forest, and gently and rhythmically tapping a small branch or twig against a window pane.

How could we recreate the sound of the wind ferociously howling through a forest? How could we recreate the sound of the wind moving slowly and gently through the same forest?
How could we recreate the sound of a storm at sea? How could we recreate the sound of a breeze on a lake? How would these sounds differ from those of the forest?
How can we play musical instruments or use other sound sources to create appropriate tone colours?

You could draw up a list of wind words in te reo Māori, and the students could interpret these in sound. (For a selected list, see the Wind Words section later in these notes.)

Encourage the students to think about the elements of music and to employ high/low, loud/quiet, fast/slow, and beautiful/ugly contrasts as they experiment with various sound sources. Help them to explore unconventional ways of playing instruments to make contrasting sound effects. For example, they could use different beaters and stroke techniques on untuned percussion instruments. (Warn them that they will have to take care not to damage the instruments through rough treatment.)

Exploring Traditional Māori Instruments

As part of their soundscape development, the students may wish to experiment with ways of emulating the sounds of traditional Māori musical instruments (taonga puoro). Draw the students' attention to the final section of the text, in which the sweet sound of Hine-Pū-te-Hue's exhalation is linked to traditional wind instruments, especially the hue (gourd), which can be dried and played as a flute. For further background information, see the Traditional Māori Musical Instruments section later in these notes.

A variety of Ministry of Education resources include cassette or CD recordings of traditional instruments. For example, the audiotape that accompanies *Te Wharekura 41: Ngā Taonga Puoro Tawhito a te Māori* (Learning Media, 1994) presents waiata that were specifically composed for each instrument featured in the print resource (book item number 94169, audio item number 95118). *Te Wao Nui a Tāne* (Huia – Te Manu Tuku Kōrero, 1999) is a book and CD resource that includes twenty-eight songs about the forest and its creatures (item number 97599H, currently out of print, but distributed to schools with bilingual or immersion units in 2000). *Toi Puoro: Taonga Puoro* (Tāwera Productions, 2000, item 10053, also out of print) is a kit that includes video, audio, and print components for student and teacher use. If you are unable to locate or order any of the previous resources, you could play the students the Ministry of Education's CD of *The New Zealand National Anthem* (Learning Media, 2000, item 10070), which features a kōauau at the beginning.

Creating a Soundscape for the Legend

Ask the students to describe the sounds they heard inside their heads as you read them "The Winds of Tāwhirimātea". Using the ideas already explored, have them improvise sounds to enhance the story as you read it a second time. Mention the importance of timing in movie or television soundtracks and encourage the students to perform at exactly appropriate times.

Ask them to think about how they might select, combine, and organise sounds to create a soundscape that tells the story musically. Compositions of this sort are called programme music. For a brief learning sequence that introduces key features of programme music, see page 12 of the Ministry of Education's *Into Music 1: Classroom Music in Years 1–3* (Learning Media, 2001), in which the students explore *In the Hall of the Mountain King* by Edvard Grieg. This activity focuses on the very close connections between the elements of the music and the pace and tone of the narrative.

In the students' soundscapes, they could experiment with silence to show how effective it can be for increasing dramatic tension. They could explore various rhythms, tempos, dynamics, pitches, and tone colours that they have recognised in the environment. Encourage them to experiment with these to make their own musical creations interesting and exciting and to achieve a balance between repetition and contrast. Give them feedback on how well they are using their imagination and their growing understanding of music to represent the legend.

Bringing It All Together

To bring together the different soundscape events that the students have developed, they could work in groups, rehearsing appropriate events in sequence (without reading the text aloud). Each group could aim to recreate up to three different sound events to make their completed soundscape. Encourage them to connect their ideas to the story and to work on beginning, middle, and end points in their piece. *How will it start? What will happen next? How will it end?* Encourage the students to use the best sound ideas they have developed through the preceding learning activities.

After sufficient rehearsal time, have the groups perform their soundscapes to each other as programme music (without the text) and reflect on their creations. *What worked well? Why? Which musical elements featured most strongly? How could we improve our musical stories?*

Extension Activities

Nature Songs

The students could listen to and sing songs and waiata about nature and the world around us. They could then create their own songs and sound compositions inspired by the local environment. Useful models for this are the waiata "Tīhore Mai" and "Koromiko". Pages 13 and 25 of Into Music 1 detail learning sequences that explore these beautiful waiata. The accompanying recordings include Māori instruments.

Developing Musical Scores

The students could develop scores with graphic symbols to represent their soundscapes. The scores should show the contrasts in the musical elements, for example, high/low, fast/slow, and loud/soft. They should also detail the various tone colours, for example, by representing each sound source with a particular symbol and/or colour. Thick and thin lines, dots, jagged shapes, waves, and so on are all valid representations. You can see an example of a basic graphic score in *Into Music 1* (page 64) in the context of a poem called "Fireworks" (page 55).

On the classroom walls, the students could hang the scores of their soundscapes as a record of their musical inventions and as a means by which others could interpret and perform the works. The students' music scores will visually reinforce the practical sound experiences that they have had and may be added to at any time as the students' repertoire and ideas develop. Notating and reading music as graphic scores and as conventional notation enhances many musical and non-musical literacies and supports the composition and performance of music.

Recording the Students' Compositions

If the students record their soundscapes in audio or video format, it will help them to reflect on their work and to set goals for future music learning.

Background Information for Science or Music Discussions

The following information came from *Māori Music* by Mervyn McLean (Auckland University Press, 1996) and *Introducing Māori Culture* by Don Stafford (Reed Books, 1997), both available through School Library Services.

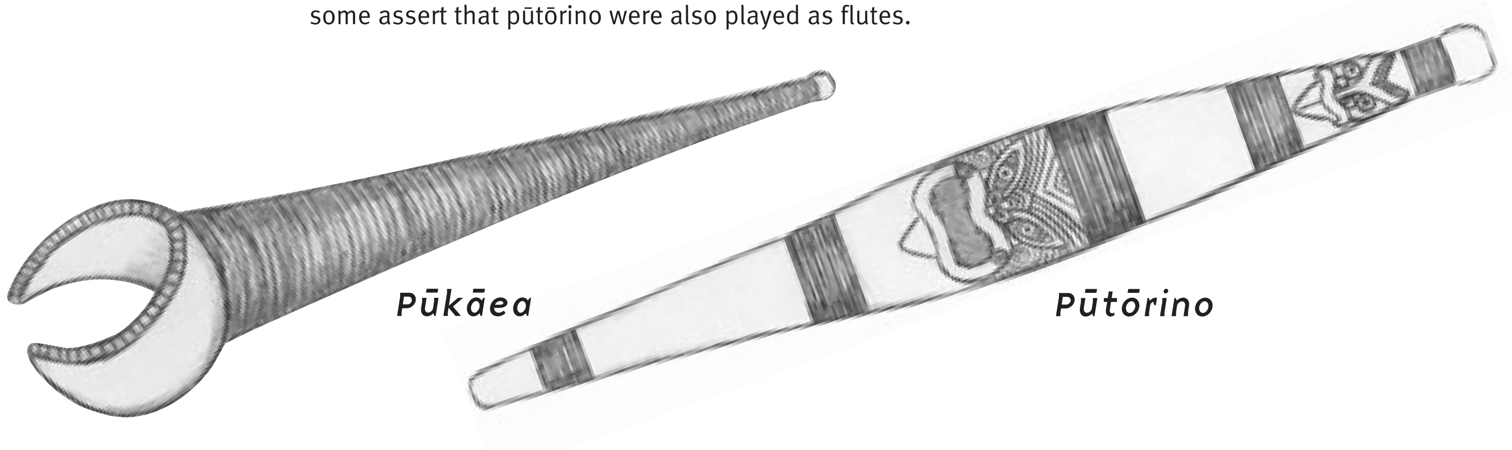
Traditional Māori Musical Instruments

If you wish to focus on taonga puoro in your learning sequence, you could briefly discuss the three main types of musical instrument (percussion, string, and wind). Mention that wind instruments were by far the commonest type of traditional Māori instrument. They can be divided into instruments that are played as trumpets and those that are played as flutes. A small range of percussion instruments are also mentioned in historical records.

Trumpetlike Instruments

Similar to other Polynesian trumpets, the **pūtātara** was made from a triton (sea snail) shell with a wooden mouthpiece attached to the severed tip. Its loud call was used by a chief to announce his impending arrival, to summon a gathering of people, to marshal his troops in battle, or to announce the birth of his eldest son.

The **pūkāea** was made from a 0.9–2.5-metre length of mataī, which was split lengthwise, hollowed out, and rejoined with twine. Sometimes referred to as the "war trumpet", the pūkāea was used to summon warriors to battle. It could be sounded from a watchtower to alert a village to the approach of an enemy war party. It could also be used as a megaphone to hurl curses and taunts at an enemy. The **pūtōrino** was 30–60 centimetres long and was made in a similar way to the pūkāea, except that it was "torpedo"-shaped and had a sound hole in the middle, which was often adorned with the carved face of a god. Changes in pitch could be achieved if the player moved a finger across the sound hole. There is debate about the traditional manner of playing pūtōrino. Most reports describe a trumpetlike technique, but some assert that pūtōrino were also played as flutes.

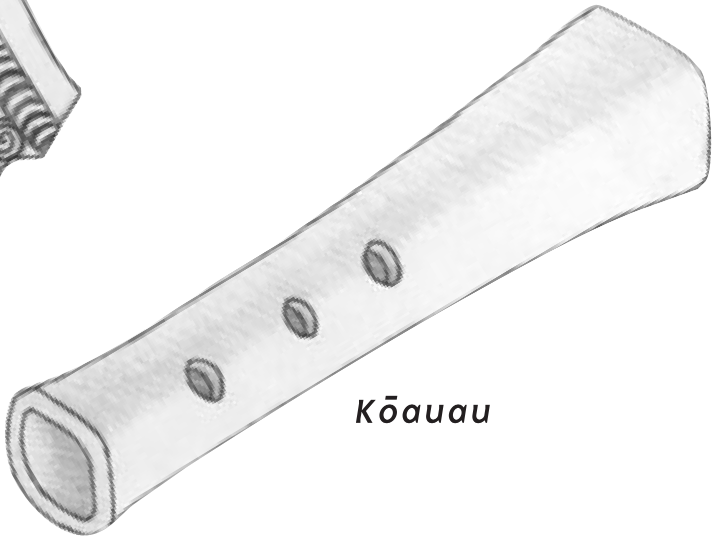


The **pūharakeke** was made by winding a half strip of harakeke (flax) into a 23–60-centimetre cone. It was used as a makeshift trumpet and as a children's toy. It could be played only while still green.

Flutelike Instruments

Hue (gourds) were dried and used as flutelike instruments, which some claim could also have been played as trumpets. It is likely that gourds were the progenitors of **nguru**, 7–10-centimetre wooden or clay flutes with a wide mouth hole at one end and an upwardly curved tip with a smaller hole at the other. Like hue, nguru had two or three finger holes that allowed the player to vary the pitch. **Kōauau** were longer than nguru, and they were straight. Although kōauau are sometimes called nose flutes, many scholars believe that they were actually played by mouth. Kōauau were often made from the thigh bone of a slain enemy. This practice was intended both as an insult and as a way of achieving a sweeter tone than that of wooden versions.

Nguru



Kōauau

Pūrerehua

In S*chool Journal*, Part 1 Number 1, 2001, you will find "Make a Pūrerehua", by Oho Kaa. The pūrerehua (bull-roarer) described is composed of a cardboard disc that spins on a loop of string to create a whirring hum. Traditional pūrerehua were in the form of a wooden paddle that was pointed at both ends. Pūrerehua were tied to the end of a string and spun around the head to produce a whirring sound. Pūrerehua were of various sizes. The large versions made from dense wood were also used as weapons.

Linking Traditional and Scientific Perspectives

You could link the Tāwhirimātea legend with what we know of the early stages in the Earth's evolution. It would be important to emphasise the fact that traditional and scientific explanations exist side by side and neither is superior to the other. They are simply different ways of looking at the world and recording knowledge. Most importantly, avoid any implication that science is somehow sanctioning or validating traditional ideas. Note also that you will need to judge your students' conceptual understanding when deciding how much of the following information to discuss with them.

Until about four billion years ago, you could say that there was no separation between Earth and sky. Like today's Moon, the Earth had no surface water or atmosphere. However, a long period of intense volcanic activity released huge volumes of gases (including water vapour), which eventually formed the Earth's atmosphere and surface water. Thus, the Earth and the heavens had in a sense been "separated" by the newly formed atmosphere. Also, as the legend explains, the water that eventually formed the oceans and other waterways did indeed issue forth from Papatūānuku, the Earth.

The legend goes on to describe the anger of Tāwhirimātea. This also links with current scientific knowledge. The newly formed atmosphere was extremely tempestuous. The Earth's surface was still riddled with active volcanoes and fissures, and the roiling atmosphere was blasted by frequent and intense electrical storms. (Also, the early atmosphere contained no oxygen or ozone and therefore provided no barrier to deadly solar radiation.) It is easy to see how the ancient Earth could be symbolised as a battleground of the gods!

A calming phase followed. This resulted from the gradual abatement of volcanic activity and the slow release of oxygen by incipient plant life in the oceans. (The sea water absorbed much solar radiation while letting enough through to provide the energy for photosynthesis.)
Later, increasing atmospheric oxygen and ozone shielded the Earth and allowed plants to colonise the land.

Wind Words

In both English and Māori, there are many names for wind and other air currents. You could ask the students to help you compile a list of wind words, for example, wind, draught, northerly, southerly, westerly, easterly, gust, gale, puff, tornado, and breeze. In Māori also, there are many words for winds of different force and direction, for example:

hau	wind
matangi/hengihengi	breeze
kōhengi	light wind
pararā (hau)	gust (of wind)
āwhā	gale, storm
huripari	fierce wind, tornado
pūhuka	cold wind
hauraro	northerly
tonga	southerly
kōtonga	cold southerly
pākihiroa	easterly
hauāuru	westerly

Sometimes the word we choose reflects the force of the moving air, and sometimes the word reflects the direction from which the wind is coming. Ask the students to help you organise their wind words into these categories and, for the wind-strength words, you could also ask them to rank the words in order of force and destructiveness.

Why are there so many words for different kinds of wind? If a language has a highly developed vocabulary for a particular subject, this often reflects the importance of that subject for the speakers of the language. For agricultural and seafaring people, the wind is an extremely important influence – a fair wind can bring prosperity, but an ill wind can bring death and destruction.

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