Clearing the Air
Education Resource User Guide

heatsmart

HAWKE'S BAY
REGIONAL COUNCIL

Clearing the Air
User Guide

All the educational material for this resource can be accessed and downloaded at:

www.hbrc.govt.nz

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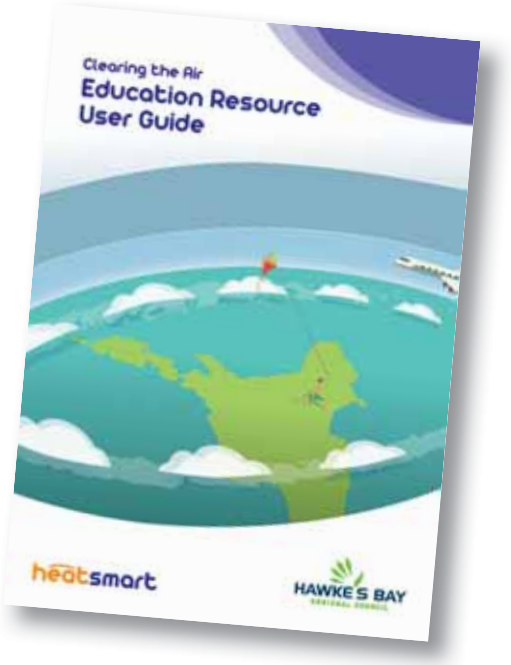
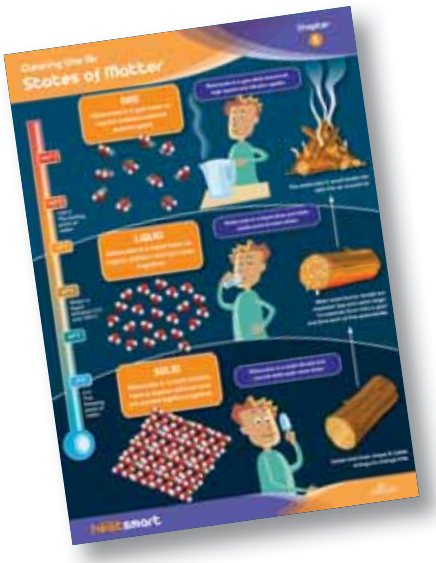
Contents



User Guide for Teachers

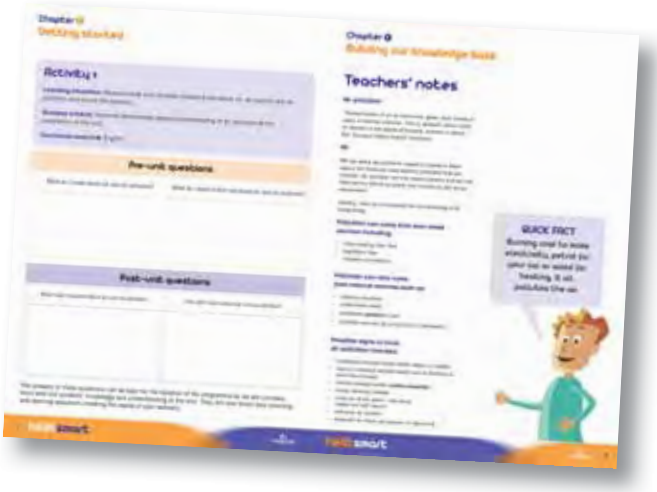
This User Guide has been put together to give teachers an overview of the Clearing the Air Education Resource.

The chapters are:



Activities

There are a range of activities in each chapter to help student learning.



Posters

Each chapter begins with a poster which doubles as a teaching resource. *These are also provided as high resolution images at www.hbrc.govt.nz keyword:heatsmart*

Clearing the Air
User Guide

Acknowledgements

Thank you to...

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Hawke's Bay Regional Council Staff: Amelia Morris, Philippa Green, Emily Rockwell, Kathleen Kozyniak, Mark Heaney, Belinda Riley and Michelle Armor

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Introduction

Welcome to Clearing the Air, an Education Resource for Hawke's Bay schools.

This kit has information about air quality in Hawke's Bay, why winter air pollution happens, and most importantly, what we can all do at home to help. We've included individual and class activities, and science experiments.

Clearing the Air is an environmental education programme designed by Hawke's Bay Regional Council that aims to give students the opportunity to:

- learn about air and air pollution
- develop environmental awareness of air pollution
- gain the skills needed to act responsibly
- take action to keep air healthy and clean
- learn key messages to share at home.

This resource supports the Ministry of Education's Education for Sustainability guidelines which says environmental learning should be in the environment, about the environment and for the environment.

We hope you find this resource useful and look forward to your feedback. Please direct any comments to the Community Engagement team at Hawke's Bay Regional Council. You can reach us at 0800 108 838.

Students will gain an understanding of:

- **air as a gas, made up of a mixture of many different gases**
- **Hawke's Bay's winter air quality problem**
- **how all living things need air**
- **green plants using photosynthesis to absorb pollution and clean the air**
- **a smoky fire - it pollutes our air!**

QUICK FACT

Even the most day-to-day actions - driving children to school, heating the house, leaving the lights on - come at a cost to the air we breathe, the atmosphere, and sometimes, our health.

How to use this Resource

This resource is arranged in five sections:

User Guide

Chapter 1 – *States of Matter (online)*

Chapter 2 – *Atmospheric Layers (online)*

Chapter 3 – *The Inversion Layer (online)*

Chapter 4 – *Photosynthesis (online)*

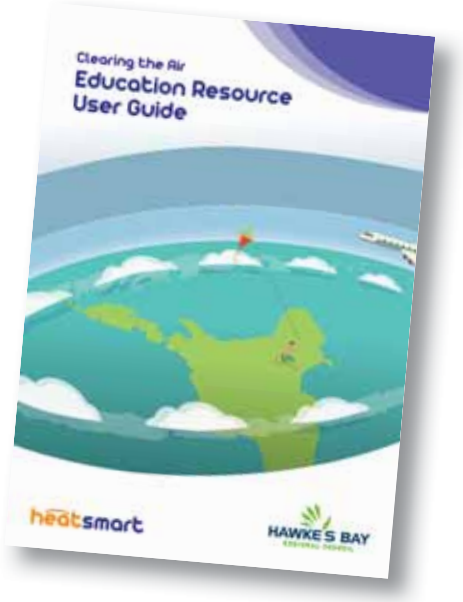
Each chapter includes Teacher Notes and a range of Student Activities. The chapters start with a poster that can be used to begin discussions about the topic or you can refer to the posters as you progress through your learning.

It's up to you how you use this resource!

How teachers use it will depend on what sort of information you are looking for, how involved in the study of air quality you would like to get, and how much you would like to tailor the information to your requirements. The chapter contents online are yours to print and photocopy as you like.

User Guide

This User Guide includes information on what the resource covers, how to use it, and provides an overview of how the resource fits into the education curriculum.



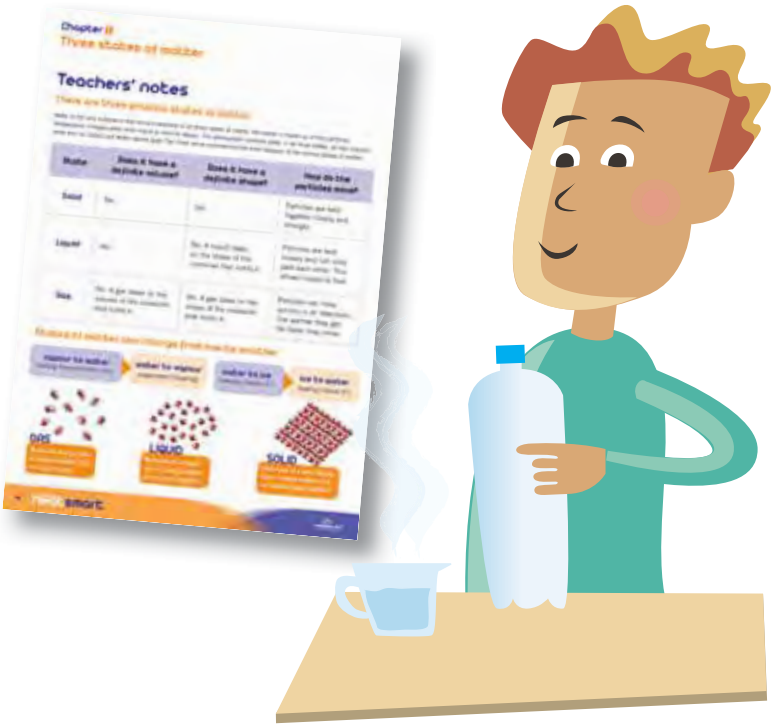
Clearing the Air
User Guide

Chapter 1 States of Matter

This section of Clearing the Air gives background to air quality in Hawke's Bay. It introduces air quality issues, along with an understanding of air pollution, air sheds, the physical states of air and who can help to fix the situation.

This section has 8 Student Activities, including Pre and Post Unit Questions to help check learning outcomes.

The curriculum links apply to: English, Science, Learning Languages, and Technology.

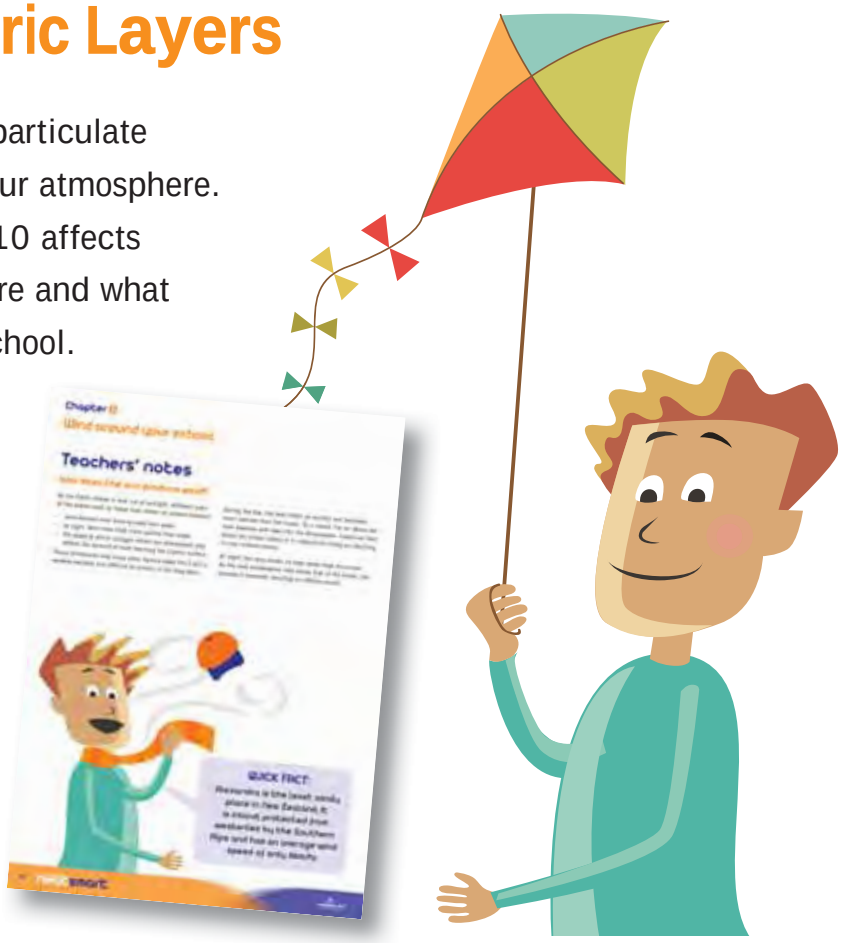


Chapter 2 Atmospheric Layers

This section of Clearing the Air looks at particulate matter or PM10 and how it operates in our atmosphere. It helps students to understand how PM10 affects us, what particulate matter is, air pressure and what influences air as it travels around your school.

This section has 5 Student Activities.

The curriculum links apply to: Science, Health and Physical Education, and Mathematics and Statistics.



Clearing the Air
User Guide

Chapter 3 The Inversion Layer

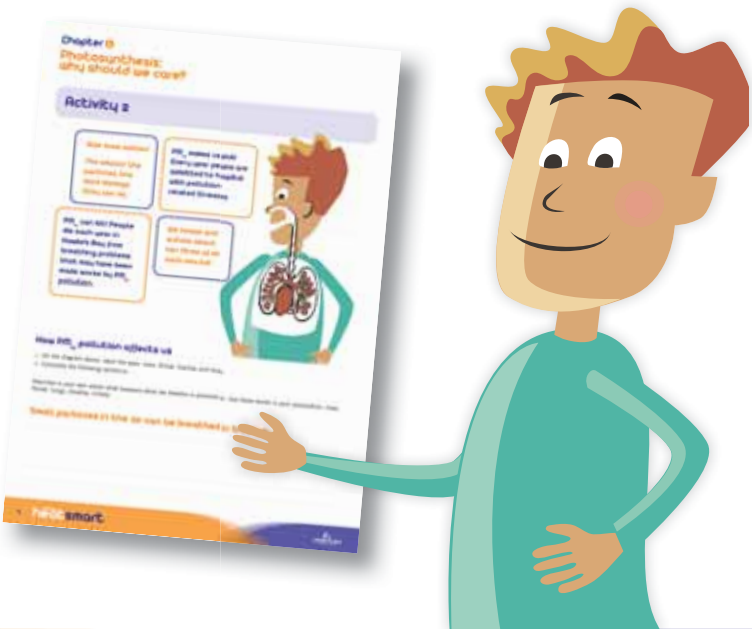
This section of Clearing the Air covers the inversion layer which occurs during winter. The inversion layer is where cold, polluted air containing smoke from house fires, becomes trapped near the ground.

This is a short section introducing some technical concepts.
It offers 4 Student Activities.

The curriculum links apply to:
Science, Mathematics, Statistics and English.

Chapter 4 Photosynthesis

This section of Clearing the Air looks at the origins of clean air and introduces some perspective to the air quality issue. It will help students to understand where our air comes from, the importance of air, its effect on our lungs, cultural linkages, how wood burns, what should and should not be burnt, home heating sources and the actions that students can take.



This section has 10 Student Activities.

The curriculum links apply to:
Science, Health and Physical Education, Learning Languages, Social Sciences, and Technology and Mathematics.

New Zealand Curriculum

The New Zealand Curriculum material in this resource is designed for students in Years 4 to 8 (primary/ intermediate level).

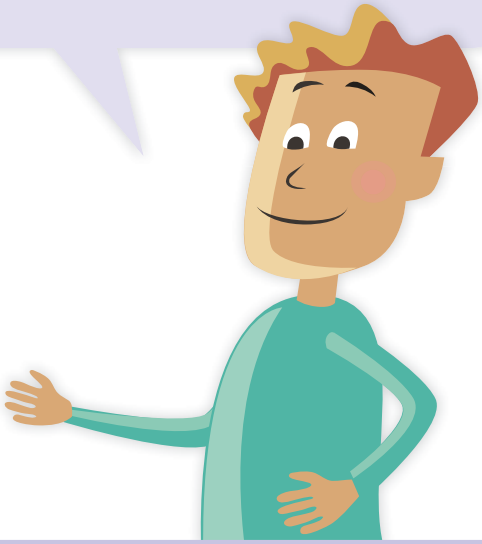
The resource is intended for teachers to use at their discretion, applying the activities, exercises and learning outcomes in various means to meet the needs or levels of their students.

A broad curriculum guide is provided below to select and adapt as required.

For more detailed listings of the Achievement Objectives, or for further information, go to www.nzcurriculum.tki.org.nz.

VISION

Young people who will be confident, connected and actively involved, lifelong learners



Activity Name	Curriculum Link	Learning Objective
Getting Started	English	Measure what your students already know about air, air quality and air pollution and record the answers
Houston, we have a problem!	Learning Languages and English	Hawke's Bay has an air quality problem in winter Identify the areas of interest in the unit for students to research
Building our knowledge base	Science and English	There are many possible sources of air pollution in Hawke's Bay Some forms of pollution you cannot see
Air Quality Detectives	Technology and Science	Students become air scientists to monitor and examine the air quality at school
Looking at Particulate Matter (PM_{10})	Science	Particulate matter is tiny particles that float in the air caused by domestic fires and motor vehicles Particulate matter can cause breathing problems

Clearing the Air
User Guide

Activity Name	Curriculum Link	Learning Objective
Three States of Matter	Science	There are 3 physical states of matter – gas, liquid and solid All matter is made up of tiny particles Temperature changes the water from liquid to solid to vapour
What is Air?	Science	Air is a mixture of many different gases Gas does not have a definite shape or volume Gas particles move in all directions
Looking at Air!	Science	Heated air expands and rises Cooled air sinks and contracts
Hot Air Expands, Cold Air Contracts	Science	Hot air takes up more space than cold air
The Earth's Atmosphere	Mathematics and Statistics	Understand the layers of the atmosphere – our atmosphere is like a blanket, keeping Earth warm
Air Pressure	Science	Understand how air pressure works Air has weight and pressure can change
Wind around your School	Mathematics and Science	Understand how the wind blows in your school Physical barriers can change the direction of wind
Tawhirimatea Story	The Arts and Learning Languages	Use drama techniques to learn about Tawhirimatea
How PM_{10} affects our Health	Health and Physical Education	Particulate matter (PM_{10}) can cause breathing and health problems
Photosynthesis	Science and Health and Physical Education	Plants make their own food using sunlight and carbon dioxide Oxygen is a product of the photosynthesis process. Forests are the earth's lungs (clean air filters)
Air and Animals Lungs	Science	Air is essential for life because all animals need air to survive Animals have evolved different ways to get oxygen from the environment
What Causes Winter Air Pollution	Mathematics and English	PM_{10} can come in different forms. Wind and weather can affect the distribution of pollution and the particle size can determine how far the particle travels. Hence pollution can change depending on the season.

Clearing the Air
User Guide

Activity Name	Curriculum Link	Learning Objective
The Inversion Layer	Science	The shape of the land in some areas of Hawke's Bay can trap pollution Still, frosty weather prevents pollution from being blown away
What happens when wood burns?	Mathematics and Statistics	There are four stages of wood burning A fire needs to burn very hot to be effective
What can I burn?	Health and Physical Education	Only clean, seasoned wood, fireplace logs, and non-glossy paper should be burnt Burning bad materials will produce poisonous, corrosive smoke and fumes which will affect the health of your family and neighbours
Maui Obtains the Secret of Fire	Learning Languages	We need fire to live and stay warm and it must be handled with care
Home Heating Interview	Social Science	Inefficient, unhealthy woodburners cause air pollution and cost families more to heat their home
We can make a difference – Take Action	Social Science	We can all take action and make a positive difference to our air quality

Glossary

Word	Definition	Resource topic reference
Air exchanges	A measure of how often the air within a room or house is replaced.	Hot Air Expands, Cold Air Contracts
Air	A gas; actually air is a mixture of many different gases.	Building our knowledge base
Air pressure	The weight of the atmosphere pushing on to the earth. Our atmosphere is pushing onto us from every direction but we usually don't feel it.	Air pressure Activity
Air pollution	Contamination of air by chemicals, gases, dust, fumes or odour in harmful amounts. That is, amounts which could be harmful to the health of humans, animals or plants.	Building our knowledge base
Airsheds	Specific areas of Napier and Hastings that are most affected by air pollution.	Houston, we have a problem!
Airzone	The Napier and Hastings airsheds are divided into two airzones. Airzone 1 covers the more densely populated urban areas where most of the air pollution is generated. Airzone 2 covers the remaining areas the air pollution reaches within the wider airshed.	Investigating Your Home Heating
Amphibian	Amphibians can breathe on land as well as in water. E.g. frog, newt.	Air and Animals Lungs
Atmosphere	A mixture of gases which surround the earth. It reaches 800km into space. There are different layers in the atmosphere.	The Earth's Atmosphere
Barometer	A tool used to measure the current air pressure at a particular location	Air Pressure Activity
Carbon	The sixth most abundant element in the universe. It is a non- metal element found in all living things and one of the building blocks of life.	Building our knowledge base
Carbon Dioxide (CO2)	A colourless, odourless, non-poisonous gas present in air.	Photosynthesis
Carbon Monoxide (CO)	A very poisonous, colourless and odourless gas formed when material containing carbon isn't burned completely. E.g. Vehicle emissions.	What is Air?
Chlorophyll	A green chemical found in plants which enables them to turn sunlight into food by photosynthesis.	Photosynthesis Activity

Glossary

Word	Definition	Resource topic reference
Combustion	The process of burning.	What Happens When Wood Burns?
Contract	To get smaller. E.g. air contracts when it is cooled.	Hot Air Expands, Cold Air Contracts
Creosote	A highly flammable substance produced by the incomplete burning of wood.	Investigating Your Home Heating
Cycle	A system or process that doesn't have a beginning or end	Photosynthesis
Density	How much something of a set volume (the amount of space it takes up) weighs. For example the density of a cubic centimetre of wood is 0.7 grams and the density of the same size piece of lead is 11.35 grams.	Looking at Air!
Electricity	A form of energy produced by the movement of electrons	Building our knowledge base
Element	A substance that cannot be broken down by chemical means	Definition of Carbon
Evaporation	To change something from a liquid to a gas by heating. E.g. water into steam or water vapour.	Three States of Matter
Exosphere	The fifth and last layer of the atmosphere, going from around 690 km and thinning into space, about 800 km above earth.	The Earth's Atmosphere
Expand	To grow larger. E.g. air expands when it is heated.	Looking at Air!
Gills	These allow aquatic animals such as fish to take in oxygen from the water and get rid of carbon dioxide, as they breathe.	Air and Animals Lungs
Inversion layer	A layer of air in which temperature increases with height, trapping colder air near the ground.	The Inversion layer activity
Invertebrate	Any animal without a back bone. E.g. spider, ant, slug, weta.	Air and Animals Lungs
Lungs	A pair of breathing organs located within the chest which remove carbon dioxide from and bring oxygen to the blood. There is a right and left lung in humans.	How PM_{10} Affects our Health

Glossary

Word	Definition	Resource topic reference
Matter	An item which is physical or which exists in space and can be smelled, touched, heard, seen or tasted. The three states of matter are gas, liquid and solid.	Three States of Matter
Mesosphere	The third layer in the atmosphere; from about 50 to 80 km. In this layer the temperature usually decreases the higher you go.	The Earth's Atmosphere
Microscopic	So small it can only be seen under a microscope.	Air Quality Detectives
Molecule	A tiny piece of anything.	Hot Air Expands, Cold Air Contracts
National Environmental Standards (NES)	The rules set by the Ministry for the Environment, so that we all have clear air to breathe, clean water to drink and clean land on which to live.	Air Quality Detectives
Northerly	Wind that blows from the north.	Wind Around Your School
Ozone	A form of oxygen formed naturally in the atmosphere. In the lower atmosphere it is a harmful pollutant and can cause breathing problems when it reacts with other pollutants to form smog. In the upper atmosphere it is incredibly important as it stops harmful ultraviolet rays from reaching earth.	The Earth's Atmosphere
Particle	Tiny piece or speck of something.	Air Quality Detectives
Particulate matter	Tiny particles of soot and dust.	Looking at particulate matter (PM_{10})
Photosynthesis	The process plants use to turn the energy from sunlight into food (starches and sugars), using chlorophyll.	Photosynthesis Activity
PM_{10}	Very small particles - both natural and man-made - including sand, dust, soil, pollen and sea spray. 'PM' stands for particulate matter. PM_{10} is particulate matter less than 10 microns in diameter.	Looking at particulate matter (PM_{10})
Poison	Any substance that causes injury or illness or death of a living organism	What Can I Burn?
Pollution	A substance which contaminates or harms the environment.	Building our knowledge base

Glossary

Word	Definition	Resource topic reference
Precipitation	Water in any form that is pulled to the earth's surface by gravity. E.g. snow, rain or hail.	Three States of Matter
Seasoned Firewood	Firewood that has been dried properly (for at least 6 months)	What Can I Burn?
Southerly wind	Wind that blows from the south.	Wind Around Your School
Spiracles	Tiny tubes (trachea) which insects with a hard shell (exoskeleton) use to breathe. The tubes go from the outside of the exoskeleton and connect to the organs inside.	Air and Animals Lungs
Stratosphere	The second layer in the atmosphere, going from around 18 to 50 km. The temperature usually increases as you go higher in the stratosphere.	The Earth's Atmosphere
The Ozone Layer	A layer in the stratosphere (at approximately 32 Kilometres) that contains a concentration of ozone which is able to block most of the harmful ultraviolet radiation from the sun	The Earth's Atmosphere
Thermal energy	Heat	Hot Air Expands, Cold Air Contracts
Thermal expansion	The spreading out of molecules due to an increase in temperature.	Looking at Air!
Thermosphere	The fourth and largest layer in the atmosphere, from about 80 to 690 km. In the mesosphere the temperature usually increases as you get higher. Topography The state of the surface of the land, such as rolling hills, steep mountains, a gully or flat paddocks.	The Earth's Atmosphere
Troposphere	The first layer of the atmosphere where we live and breathe which is about 17 km high.	The Earth's Atmosphere
Volatile gases	Formed from a substance which changes quickly from solid (or liquid) to a gas.	Investigating Your Home Heating
Volume	The quantity of three-dimensional space occupied by a liquid, solid, or gas. Common units used to express volume include litres, cubic meters, gallons, millilitres, teaspoons and ounces.	What is Air?
Wind	Moving air	Wind Around Your School

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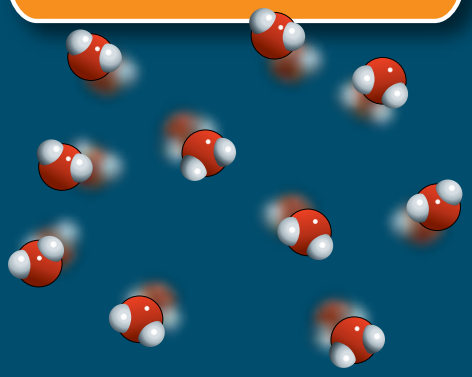
Clearing the Air

States of Matter

Chapter 1

GAS

Molecules in a gas have no regular pattern and are spaced apart



Molecules in a gas whiz around at high speed and vibrate rapidly

The molecules in wood smoke mix with the air around us.

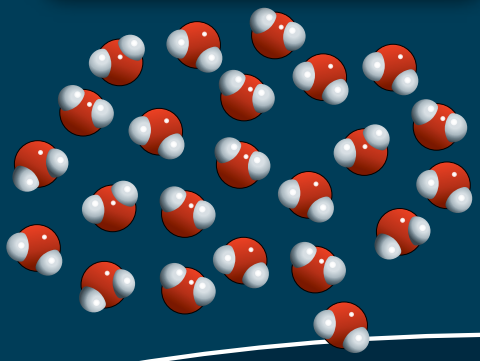
1250° C

100° C

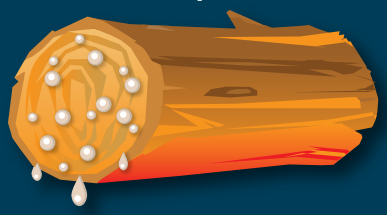
100°C
The boiling point of water

LIQUID

Molecules in a liquid have no regular pattern and are close together.



Molecules in a liquid flow and slide easily around each other



When wood burns, liquids are expelled. Sap and water begin to vaporise (turn into a gas) and form part of the wood smoke.

75° C

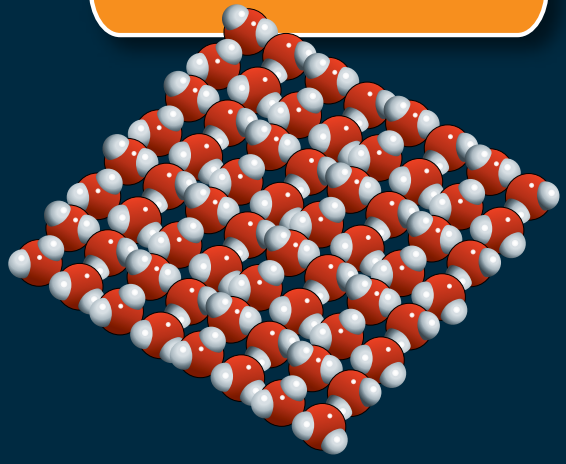
50° C

Water is liquid between 0°C and 100°C

25° C

SOLID

Molecules in a solid usually have a regular pattern and are packed tightly together.



Molecules in a solid vibrate but cannot slide past each other

Solids hold their shape. It takes energy to change this.

0° C

0°C
The freezing point of water.

Teachers' notes

Hawke's Bay has clean and fresh air, but how clean is it really?

We like to think of Hawke's Bay as a clean, healthy place to live. Thankfully, most of the time, this is true. But during the winter months, the air in certain parts of the region can become unhealthy. That's because Hawke's Bay has a winter **air quality** problem.

The problem occurs mainly in Napier and Hastings, and particularly in areas that have been defined as **'airsheds'** (see maps opposite).

Within these 'airshed' areas, **air quality** is not bad all the time. In summer, the air is usually clear, but can have dust, or pollen in it, depending on the wind. In certain weather conditions during winter - particularly cold, still mornings and evenings - the air can get trapped causing an inversion layer forms. Cold air at the base of the ground loses heat and doesn't mix with warm air above it. This traps smoke and other pollution.

Home heating makes a difference

In winter, the main contributor to poor air quality is smoke from wood fires. Small particles from wood smoke stay in the air which we breathe into our lungs. There are increased levels of wood smoke particles in the air during winter as more people heat their homes with wood fires.

We can all see a smoking chimney. But the particles from wood smoke can remain in the air, even when you can't see any smoke. Some people might not even notice. Others, particularly people with health problems such as asthma, can get very uncomfortable and become sick.

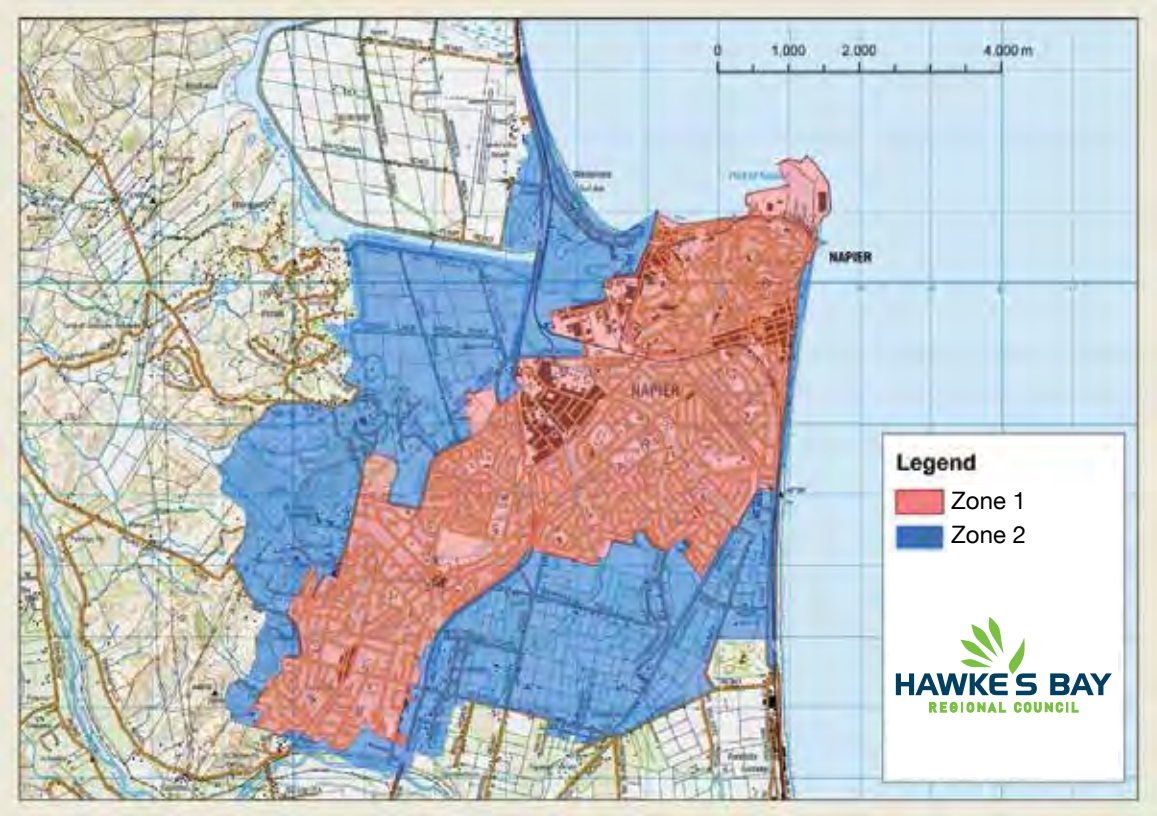
Why is wood smoke such a problem?

Even good fires may smoke a little bit when first lit. The problem is when wood fires smoke a lot. That's when they produce **particulate matter** (PM_{10}) and **carbon monoxide**. This is usually because:

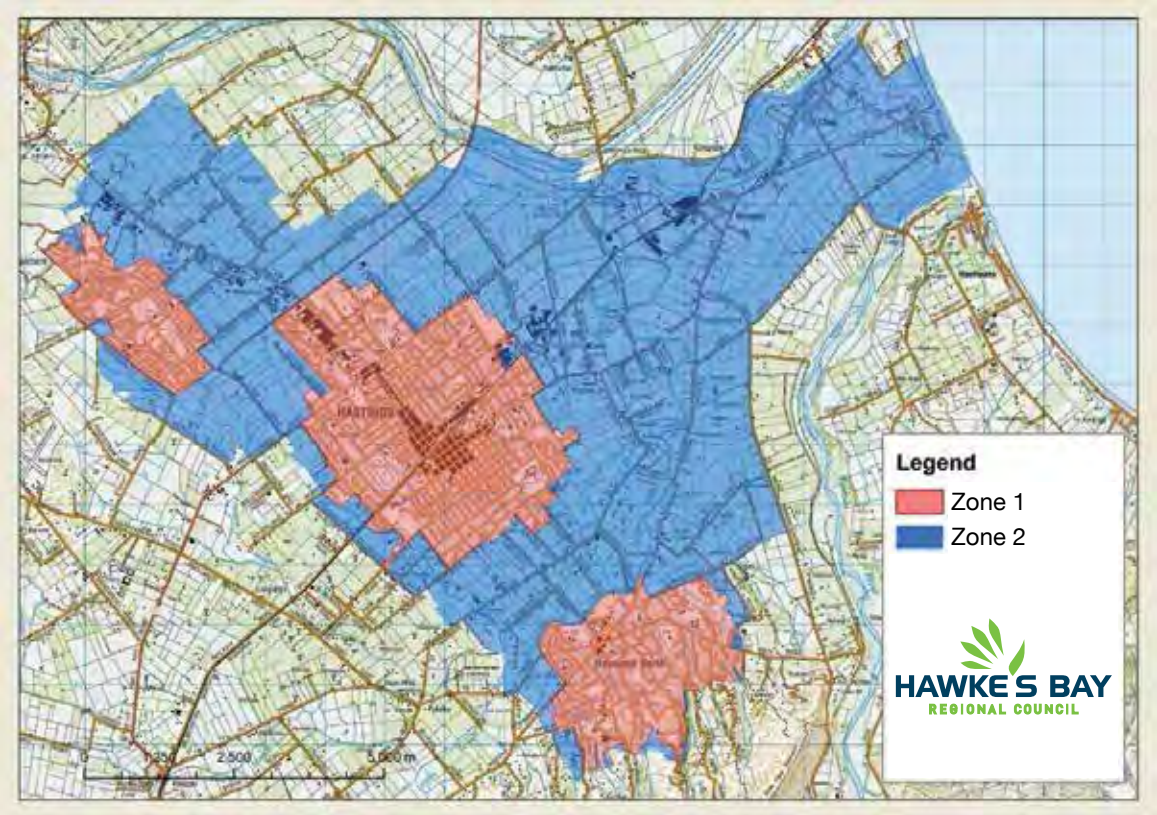
- the firewood is damp or wet
- the fire has been damped down (so its smoulders, rather than burning)
- treated or painted wood is being burnt
- other materials (such as plastics or rubbish) are being burnt
- the chimney hasn't been swept recently

Airsheds

Napier Airshed



Hastings Airshed



Getting started

Activity 1

Learning purpose: Students will be able to express what they know about air, air quality and air pollution and ask questions expressing their curiosity about these.

Success criteria: Students demonstrate greater understanding of air pollution at the completion of the unit.

Curriculum link: English

Pre-unit questions

What do I know about air and air pollution?	What do I want to find out about air and air pollution?

Post-unit questions

What have I learned about air and air pollution?	How did I learn about air and air pollution?

The answers to these questions can be kept for the duration of the programme as we will compare them with the students' knowledge and understanding at the end. They will also direct your planning and learning sequence (meeting the needs of your learners).

Chapter 1

Building our knowledge base

Teachers' notes

Air pollution

"Contamination of air by chemicals, gases, dust, fumes or odour in harmful amounts. That is, amounts which could be harmful to the health of humans, animals or plants."
Ref: Compact Oxford English Dictionary

Air

We can easily see pollution caused by smoke or water vapour but there are many harmful pollutants that are invisible. Air pollution not only makes humans sick but can have serious effects on plants and animals as well as our environment.

Healthy, clean air is important for the well-being of all living things.

Pollution can come from man-made sources including:

- home heating from fires
- vegetation fires
- industry and vehicles

Pollution can also come from natural sources such as:

- volcanic eruptions
- pollen from plants
- windblown **particles** of soil
- pollution can also be in the form of bad smells

Possible signs of local air pollution includes:

- industrial chimney stacks (water vapour or smoke)
- farm or industrial activity (dust) such as fertiliser or farm fires (smoke)
- vehicle exhaust fumes (**carbon monoxide**)
- house chimney (smoke)
- misty air at the beach - sea spray (water and salt vapour)
- yellowish air (pollen)
- brownish air (dust, soil erosion in high wind)

QUICK FACT

Burning coal to make electricity, petrol for your car or wood for heating, it all pollutes the air

Building our knowledge base

Activity 2

Learning purpose:
Students will consider questions about air quality. They will contribute to discussion and begin to investigate how they can deepen their knowledge and understanding about air and air quality.

Success criteria: Students are able to answer the inquiry questions correctly.

Curriculum links: Learning Languages and English

Read the story to get students thinking about air. Then discuss the inquiry questions.

Breath of life

Let's start with the idea of the breath of life.
The air that gives life to living things.
Air is the beginning of life.
The degradation of air impacts on our wellbeing.
If the air is ruined, if it is polluted, it causes illness and even death for living things on earth.
The first sign of life is greeted in the Māori world with the phrase 'fresh breath – it is life'.

Te hā ora

Me tīmata i te taonga nei, i te hā ora.
Mā te whakahā ka ora ngā mea katoa.
Ko te h te tīmatanga o te hau, ā, ki te rarurarū te hau, ki te whakaparungia, ka matemate katoa ngā mea ora i te mata o te whenua, Ina whānau mai te pēpi hou ka whakahuatia ngā kupu whakamihi i te mauri 'tihei Mauriora.'

The inquiry learning approach

Inquiry questions:

- how would you describe air?
- what is air pollution?
- is the air quality in Hawke's Bay good or bad? why?
- what have you noticed about the air in Hawke's Bay in summer and in the winter?
- how does the air around us change throughout the day, the year and the seasons?
- what is an Airshed?

Write these on a class question sheet.
As you move through the chapters you will discover the answers, write them down on the sheet as you go.

Tāwhirimātea story

When the wind blows we think of Tāwhirimātea, the god of the winds.
Tāwhirimātea is one of the many children of Ranginui the Sky-father and Papa-tūānuku the Earth-mother.
The children of these two included Tane, Tangaroa, Tāmatauenga, Rongo-mātāne, Haumia-tiketike, Tawhirimātea and Rūaumoko.
These children lived in the dark.

They thought about how they were squashed between their parents and decided to separate them so their descendants could grow.

The various children tried to separate Rangi and Papa. According to some elders it became the job of Tawhirimātea to clean up all the bits and pieces that were hanging in the edges of the sky after the separation of the parents.

All around the world, he moves around blowing as the wind does and washing everything clean. That is why Hawke's Bay is so lucky. There is little pollution of our airspace and the breeze keeps it fresh.

You can feel how really clean it is. The view is often very clear, but not always - it feels clean to suck it in and breathe it into our lungs.
Mmmm, it's fresh and sweet!

Let's hope we can keep it like that forever!

Ina pupuhi te hau, ka mahara tātou ki a Tāwhirimātea. Ko Tāwhirimātea tētahi o ngā tama a Ranginui rāua ko Papa-tūānuku. Ko ngā tamariki ēnei – ko Tāne, ko Tangaroa, ko Tāmatauenga, ko Rongo-mā-tāne, ko Haumia-tiketike, ko Tāwhirimātea, me Rūaumoko.
I te tīmatanga e noho ana ngā tamariki a Rangi i te pouri. Ka tupu te whakaaro kia wehea ō rātou mātua kia tupu ai he uri ki te ao.

Ka whakamātau ngā tamariki ki te wehe i a Rangi rāua ko Papa. E ai ki ngā kōrero a ētahi o ngā tohunga o mua i riro mā Tāwhirimātea e horoi haere i ngā maramara i waiho iho i te rangi i muri i te wehenga o ngā mātua.

Ina pupuhi te hau, ka mahara tātou ki a Tāwhirimātea. Ko Tāwhirimātea tētahi o ngā tama a Ranginui rāua ko Papa-tūānuku. Ko ngā tamariki ēnei – ko Tāne, ko.

Ka huri i te ao, i te taha o te rangi, ka pupuhi me te horoi haere anō!
Koia te waimarie o Te Matau-a-Māui.
Kāore he para o te takiwā, o te hau, he mā katoa, tino mā rawa nei.

Mārama kehokeho ki te tirotiro haere i ētahi wā, ki te whakahā hoki ki roto i ō tātou tinana.
Mmmm te reka hoki!

Te tūmanako ka pērā anō mō ake tonu atu!

Building our knowledge base

Activity 3

Learning purpose:
There are many possible sources of air pollution in Hawke's Bay. Some forms of pollution cannot be seen easily.

Success criteria: As a class, students can create their own definition of air pollution.

In small groups, students can classify what air pollution is and identify natural and man made contributors. After conducting the experiments, students should be able to explain observations and causes of results.

Curriculum links: Science and English

What you'll need

- photocopy of pictures (opposite) for each group
- access to internet, newspapers or magazines

1. Class definition of 'air pollution'

Have a class or group brainstorming session to develop a pool of knowledge that you can add to as you learn more about air and air pollution. Use this brainstorming session to develop a class definition of 'air pollution'. Compare it with the dictionary definition in Teacher Notes.

2. What is air pollution?

Students use the pictures (opposite) to discover the different types of air pollution. In groups, put the pictures into 3 categories: natural air pollution, man-made air pollution and not air pollution. After completing the exercise, groups justify their answers to the class.

Compare these pictures with images that are in the local media. What evidence can students find in newspapers, magazines or the internet of pollution present?

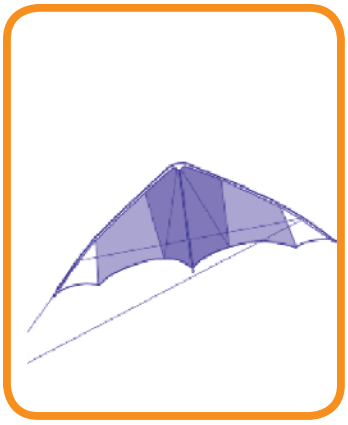
3. The Experiment

What you'll need

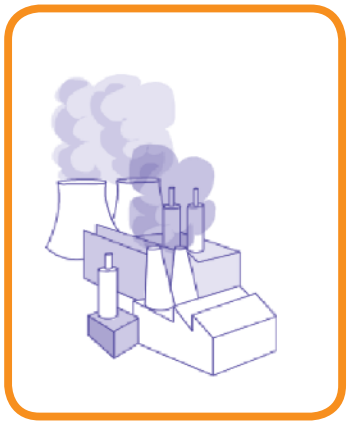
- candle and matches
- white or light-coloured heat proof dish

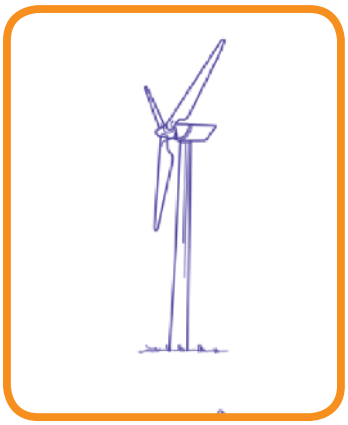
Light the candle and hold a heat proof dish over the yellow part of the flame for 30 seconds. Move the dish from side to side as you do so. Have a look at the bottom of the dish. You should find a black sooty material. This is carbon which comes from the wax when it is burnt. Usually the carbon goes up in the air and is invisible. You may not see it, but it can still get into your lungs.

Building our knowledge base

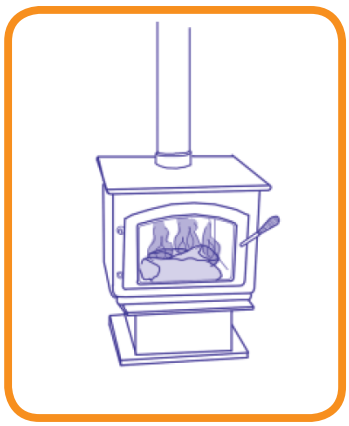






Teachers' notes

Air is a gas. Actually air is a mixture of many different gases and water vapour. The most common types of gases that are found in our air are:

Type of Gas	Formula (Symbol)	What is it?
Carbon Monoxide	CO	Carbon monoxide is a colourless, odourless gas formed when carbon in fuel is not burned completely, for example in industrial **combustion** processes, motor vehicles and domestic fires.
Nitrogen	N_2	Along with carbon and oxygen, Nitrogen is an ingredient of all living tissues. 79% of the Earth's **atmosphere** is made of nitrogen **gas.**
Oxygen	O_2	You're breathing right now and your body is taking in its needed oxygen **molecules.** You need oxygen to survive, as do all other living organisms. It's a good thing that oxygen makes 21% of the Earth's **atmosphere**. We have the only planet in the solar system with enough oxygen available to let us survive.
Argon	Ar	Argon is in the same family as helium and neon. It is a colourless and odourless inert (non moving) gas, one of the six inert gases. Argon makes up 1% of the earth's **atmosphere.**
Carbon Dioxide	CO_2	Carbon dioxide is a heavy, odourless colourless gas formed when we breathe and by the decomposition of organic substances. It is absorbed from the air by plants in photosynthesis.

What is air?

Gas fact 1

Gas does not have a definite volume.

A gas takes on the volume of the container that holds it.

Gas fact 2

Gas does not have a definite shape.

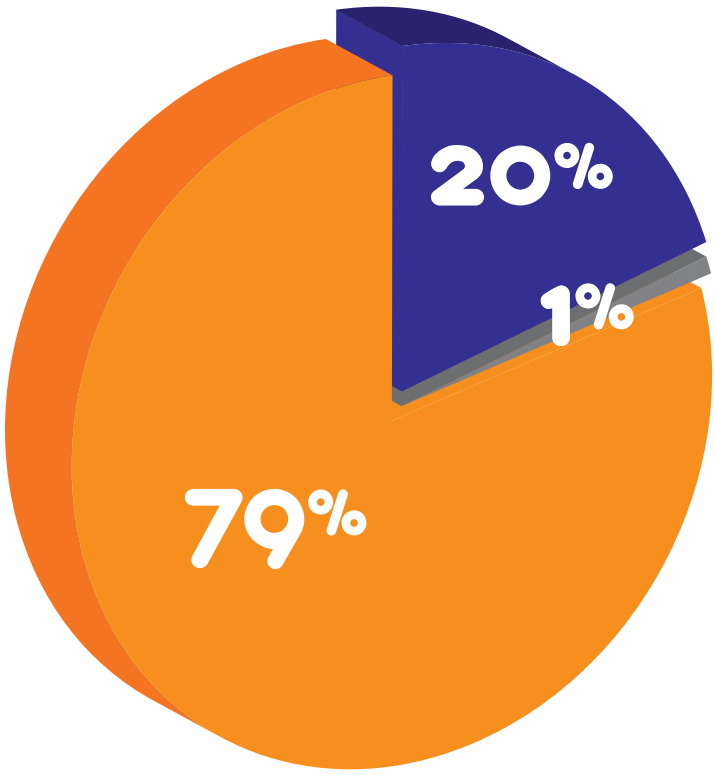
A gas takes on the shape of the container that holds it.

Gas fact 3

Gas particles can move quickly in all directions.

The warmer they get the faster they move.

Approximate composition of air



Oxygen O_2

Nitrogen N_2

Other gases

NB: 'Other gases' include carbon dioxide (0.03%) and small proportions of others such as argon and water vapour.

Source: www.spacegrant.montana.edu/msiproject/colors.html

Activity for senior students: www.bbc.co.uk/schools/gcsebitesize/science/21c/atmosphere/chemicalsairact.shtml

Activity 4

Learning purpose:
Gas does not have a definite shape or volume. Gas particles move in all directions.

Success criteria: Students can explain what air is and how it works.

Curriculum link: Science

What you'll need

- 1 long balloon
- 1 round balloon
- ice cream container

Let's Discuss

Blow up both balloons (demonstrating the different shapes).

- what is in the balloons?
- what is in the ice cream container?
- what shape did the air take?

Then let the air out of the balloon. Where is the air from the balloon now? The air has spread out around the room because air moves quickly in all directions.

Can you pour out the air in the ice cream container? No, air is all around us and fills up all spaces.

QUICK FACT

Air surrounds us everywhere we go. It's all around the Earth and made up of a mixture of gases

Teachers' notes

Why does hot air rise?

Air takes up more space and expands when it is hot. So, cold air is denser (thicker or more compact) than hot air. Any substance that is less dense than the fluid (gas or liquid) of its surroundings will float. The density is how much something of a set volume (the amount of space it takes up) weighs. For example the density of a cubic centimetre of wood is 0.7 grams and the density of the same size piece of lead is 11.35 grams.

A stone is denser than water and therefore it sinks. Oil is less dense than water and therefore floats.

Similarly, hot air floats on cold air because it is less dense. This is how hot air balloons get their lift.

The temperature of a gas is a measure of the speed of its molecules. Increasing the temperature of a gas increases the average speed (and therefore the kinetic energy) of the molecules. This causes the molecules to 'spread out' – a phenomenon called thermal expansion.

Chapter 1

Three states of matter

Teachers' notes

There are three physical states of matter.

Water is the only substance that occurs naturally in all three states of matter. All matter is made up of tiny particles. Temperature changes water from liquid to solid to vapour. The atmosphere contains water in all three states, as rain (liquid), snow and ice (solid) and water vapour (gas).The chart below summarises the main features of the various states of matter.

State	Does it have a definite volume?	Does it have a definite shape?	How do the particles move?
Solid	Yes	Yes	Particles are held together closely and strongly.
Liquid	Yes	No. A liquid takes on the shape of the container that holds it.	Particles are held loosely and can slide past each other. This allows liquids to flow.
Gas	No. A gas takes on the volume of the container that holds it.	No. A gas takes on the shape of the container that holds it.	Particles can move quickly in all directions. The warmer they get, the faster they move.

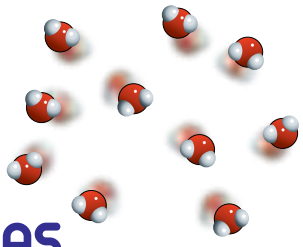
States of matter can change from one to another

vapour to water
cooling (precipitation: rain)

water to vapour
evaporation (heating)

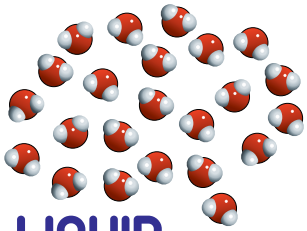
water to ice
freezing (below 0°)

ice to water
heating (above 0°)



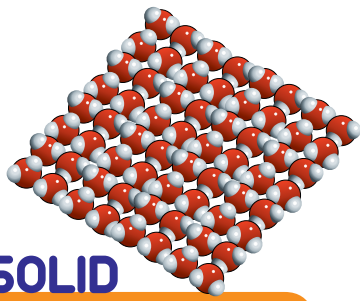
GAS

Molecules in a gas have no regular pattern and are spaced apart



LIQUID

Molecules in a liquid have no regular pattern and are close together



SOLID

Molecules in a solid usually have a regular pattern and are packed tightly together

Three states of matter

Activity 5

Learning purpose: There are 3 physical states of matter – gas, liquid and solid.
All matter is made up of tiny particles.
Temperature changes the water from liquid to solid to vapour.

Success criteria: Students can draw the stages of transformation in order.
Students can identify and describe the 3 states of matter sequence to show understanding.

Curriculum link: Science

What you'll need

- electric jug with water in it
- glass with ice cubes in it
- clear container with water in it
- 3 States of matter poster
- camera

Let's Discuss

What are the three states of matter? – liquid, solid and gas. Water is special because it can naturally occur in all three states. Discuss the 3 states of matter poster found at the beginning of the chapter. Do a class discussion of items that they can identify in each of the 3 states.

Show students the clear container with water, the boiling jug (to show steam) and the glass with ice. Ask students – what is happening? What can you see when water boils and ice melts?

It will become clear to students that ice cannot become vapour without turning into water first and vice versa.

1. Measure 1 litre of water in a container. Mark the water level on the container
2. Put the water in the jug
3. Boil the jug (may take a few times to show significant change)
4. Measure the water in the container again to see change in water level

Take a picture or draw of each of the steps in your notebook to show the change between water and steam. Discuss with the class how you could show change between water and ice.

Activity 6

Learning purpose: Heated air expands and rises and cooled air sinks and contracts.

Success criteria: Students can write an experiment including method, conclusion and explanation of what happened and why.

Curriculum link: Science

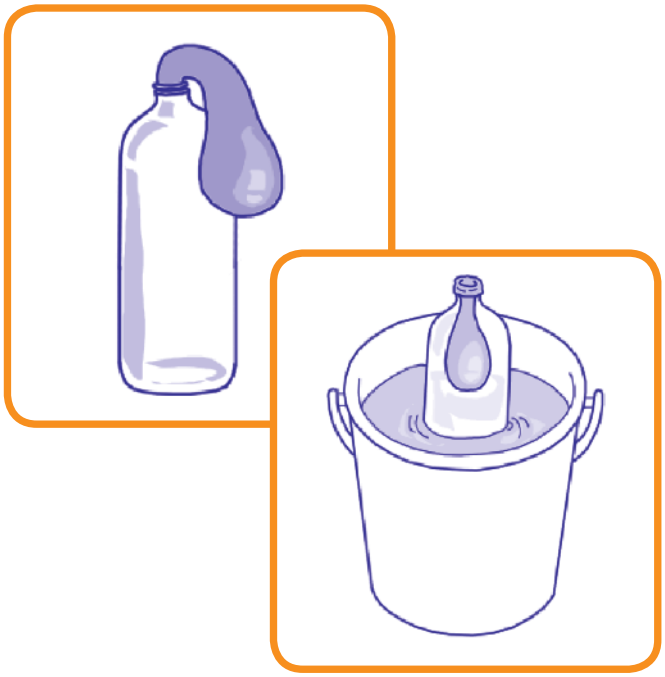
What you'll need

- balloons
- air filled plastic bottle
- bowl or bucket
- glass bottle
- ice
- hot water

The Experiment

Warm a glass bottle by filling it with hot water. Once its warm, pour out the water and stretch a balloon over the bottle opening. Observe what happens to the balloon.

Next put the bottle in cold water. The balloon shrinks and is sucked inside the bottle.



The Explanation

Initially, the gas (air) molecules inside and outside the bottle are at the same temperature and therefore, moving at the same speed. Air molecules collide into the balloon with the same energy inside and outside the balloon.

Temperature has an effect on the gas particles inside the bottle and balloon. When the bottle is heated, the air molecules inside the bottle start moving faster. These molecules now collide into the balloon with more energy resulting in increased pressure. The increased pressure causes the balloon to expand.

Cooling the air inside the bottle causes the particles to slow down and move together. The space they occupy becomes less and the balloon shrinks and is pulled into the bottle.

QUICK FACT
If you put a rugby ball into the freezer, the air will compress and the ball will shrivel up as the air inside is chilled

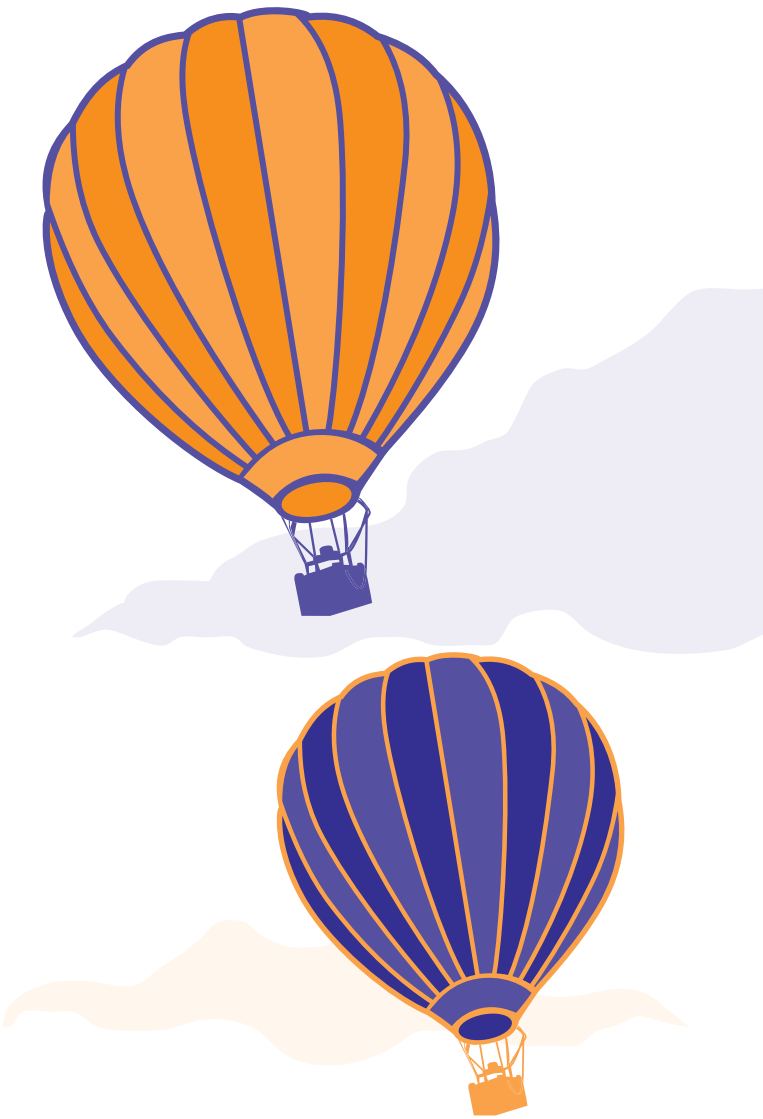
Teachers' notes

The hotter a substance is the more thermal energy it has

As thermal energy increases, the molecules of a substance move faster. These molecules hit other molecules faster and harder and bounce away faster and harder. Without a container to hold it, a gas will simply continue to expand. If the gas being heated is held in a container, the pressure of the gas increases. As the gas gets colder, the molecules contract, or get smaller.

Through thermal expansion, warm air is continually escaping from your house, and is replaced by unheated outdoor air. It gets out through gaps in the walls, roof and floor. The less ceiling and under-floor insulation you have, the faster the air will escape.

A typical house has 1½ to 2 air exchanges (when the air is completely replaced) per hour, and more on windy and/or very cold days. A degree of air exchange is necessary to keep the air inside a house fresh. Fresh air inlets are needed to replace warm air forced out of the house by exhaust fans, dryers, water heaters, or wood fires. The trick is to not have too much.

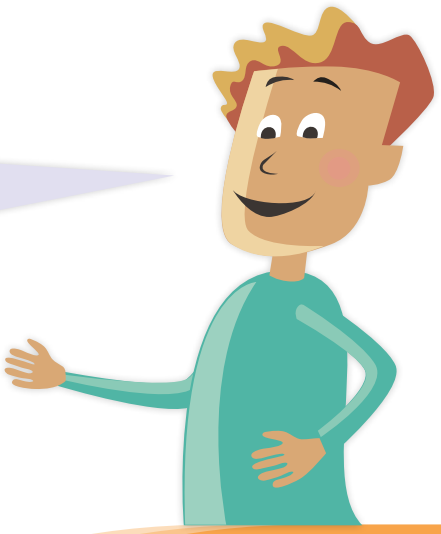


Why does hot air escape from a house in winter?

As the temperature of a gas increases, so does the average speed of its molecules and they begin to 'spread out'. This is called thermal expansion.

QUICK FACT

The Montgolfier Brothers invented the hot air balloon in 1783. On one of the first flights, the balloon went up with a sheep called Montauciel ("Climb-to-the-sky"), a duck and a rooster in the basket!



Hot air expands, cold air contracts

Activity 7

Learning purpose: Hot air takes up more space than cold air.

Success criteria: Students can explain what happens during the experiment and why.

Curriculum link: Science

The 'collapsing bottle' experiment

What you'll need

- plastic bottle with screw-top lid
- very hot water

Let's Discuss

Do you think warm air and cold air take up the same amount of space or different amounts of space? Talk about reasons for this and after the experiments, discuss again. How does this relate to heating the classroom or a house in the winter?

The Experiment

1. Pour hot water into the bottle until it is half full
2. Swirl the water around for about a minute
3. Pour the water out and quickly put the lid on the bottle and twist it tightly. The sides of the bottle should begin to collapse inward.

The Explanation

This happens because the hot water heats the air inside the bottle and, with the lid left off, it fills to the brim with warm air. When the hot water is poured out and the lid is replaced, the air inside the bottle quickly starts to cool. Since cooler air takes up less space than the same amount of warmer air, there is now extra room in the bottle!

To fill that extra space, the sides of the bottle are pushed in by the force of the air pressure outside the bottle, which is constantly pressing in every direction.

Teachers' notes

Who is responsible for managing our air quality?

You, your classmates and your families are ultimately responsible for your actions. Just as it is *your* responsibility to turn off the tap when you brush your teeth to save water, it is *your* responsibility to do your best to keep our air clean.

Hawke's Bay Regional Council is responsible for all activities that impact on the land, water, air or coastal environment. These activities are managed by rules set out in Regional Plans linked to the Resource Management Act 1991 (RMA).

Companies must apply to HBRC for a special permit called a 'discharge permit' if they want to release gases or chemicals into the air. If a company pollutes the air without a permit, they will get a warning, be fined, be asked to stop work until the problem is fixed and/or in serious cases the company could be prosecuted.

Hawke's Bay has to meet standards for air quality (it's the law)

Air quality in Hawke's Bay is generally very good. However, on some calm, cold winter nights, when inversion layers form, levels of very fine smoke particles (PM_{10}) can exceed National Environmental Standards (NES). These particles are mainly produced from wood fires used for home heating.

Using highly-sensitive equipment, HBRC scientists monitor and record air quality at specific sites around the region. The equipment has filters which trap microscopic particles in the air.

Two of the pollutants they measure are particulate matter (PM_{10}) and carbon monoxide (CO). These are some of the pollutants found in wood smoke. To see PM_{10} particles, they need to be magnified 10,000 times.

Two permanent monitoring sites have been set up in Napier (Marewa Park) and Hastings (St John's College). They provide air quality information for regular State of the Environment (SOE) reports and to make sure the Napier and Hastings airsheds meet National Environmental Standards (NES) (see maps overpage).

Vehicle exhaust emissions at peak traffic sites in Hawke's Bay are also monitored every five years and currently fall within New Zealand guidelines. Arsenic concentrations in Hastings were measured in 2006 and exceeded air quality guidelines - this is likely linked to the burning of treated timber.

QUICK FACT

Pollution control officers at Hawke's Bay Regional Council have their noses calibrated so that they can identify the level of odour from pollution and how objectionable or offensive it may be.

Monitoring Site Maps

Activity 8

Learning purpose: Students become air scientists to monitor and examine the air quality at school (Students make air filters that catch small particles of airborne materials).

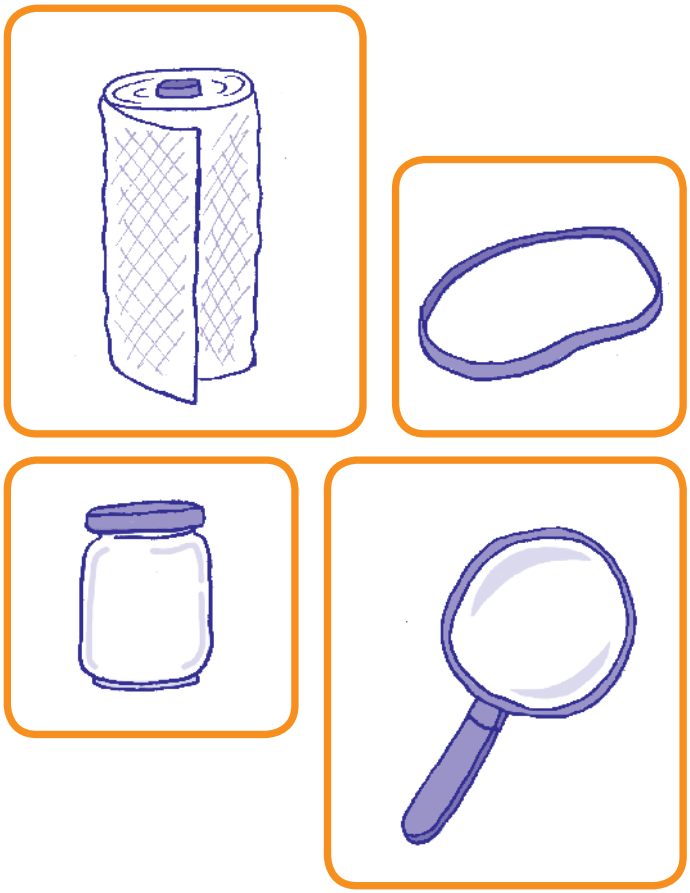
Success criteria: Students can compare and explain the results between experiments.

Curriculum link: Technology and Science

Short Activity: (1 day)

What you'll need:

- a paper tissue / paper towel
- a rubber band
- a microscope or magnifying glass
- an empty jar



The Experiment

Take an empty glass gar and put the slightly damp paper tissue over the top with the rubber band. Put the jar outside and leave for several hours or overnight.

Bring the jar back inside and examine the tissue with a microscope or magnifying glass. Have students write down what they see.

The tissue will have collected various bits and pieces of material like pollen and dust which are natural particles plus soot, man-made particles.

Variations to compare your results

- Place several jars around the school to see if there are any differences
- Test the air during the day and test the air at night and compare the differences

Long Activity : (1 week)

What you'll need:

- four white cardboard rectangles approx 7cm x 9cm (for each group)
- scissors
- string
- vaseline

The Experiment

Discuss with the class different locations to place the cards, e.g. next to an open window, from a tree, a busy road, by a heater or fan, up high or down low, etc.

Once students have chosen their locations (3 or 4 each), write their name, the location, the starting date and the time on each card. Then smear each card with Vaseline and hang them up.

After a week students collect the cards, noting the end date and time on the card. Be careful not to touch the Vaseline!

Make a map of the school and add students' results to the map. Decide on a recording format and symbols to use.

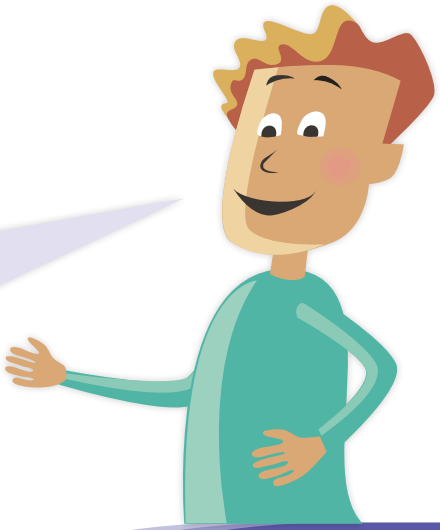
Do this in different weather or seasons.

Let's Discuss

- where have the particles come from?
- how did they get there?
- did the weather make a difference?
- what about the time of year?
- how can we share our results?

QUICK FACT

Did you know that particles in the air change the colour of the sunset?



Clearing the Air

Atmospheric Layers

Chapter 2

Outer space

Only hydrogen and helium here

Distance from the earth to the moon (approx) 382,500kms

2500° C

Exosphere
800 km

Space station

Satellite

Space shuttle

1727° C

Thermosphere
690 km

Meteors

-93° C

Mesosphere
80 km

Aurora

Ozone layer

99% of all air is in these two layers

-3° C

Stratosphere
50 km

Most weather happens here

-57° C

Troposphere
18 km

15° C

You are here

Teachers' notes

Looking at particulate matter (PM_{10}) and our Atmosphere

The tiny particles that float in the air are called particulate matter. Particulate matter is a form of pollution. It is made up of a mixture of liquid droplets and solid particles. These particles are so tiny that we can only see them using a very powerful microscope.

The particles are made by burning materials such as:

- wood (e.g. home fires)
- coal (industry) and
- oil (e.g. in the form of petrol in a car)

They also occur naturally. Sand, dust, soil, pollen and sea spray can also be of particulate matter. They are blown around by the wind.

Because they are so small they can enter the tiniest passages and become lodged in our lungs, where our body can't produce mucous to get rid of them.

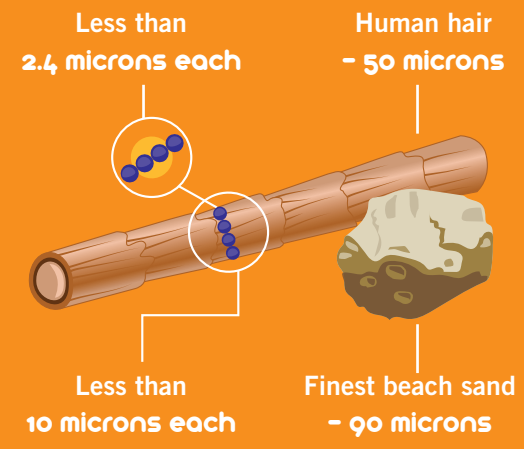
How small is small?

Particulate matter is very small. It is measured in micrometres. A micrometre (micron) is one thousandth of a millimetre. On average a strand of your hair would measure 50 micrometres or 0.05 millimetres.

Type	Definition
Particulate Matter (PM_{10})	Particles found in the air which are less than 10 micrometres. This is small enough to get into the tiny delicate passages in your lungs. Particles can be suspended in the air for long periods of time.
Source	**Effects**
• Domestic fires (burning wood and coal) • Motor vehicles • Industrial combustion processes • Quarrying activities • Natural sources such as sea salt and soil particles.	• Winter time smog • Haze/decreased visibility • Dust • PM can cause respiratory problems and aggravate asthma and bronchitis.

How small is really small?

PM_{10}: PM stands for particulate matter, while 10 is the measurement across the middle of the speck - see the diagram to see just how small that is! $PM^{2.5}$ is even smaller.



Looking at particulate matter (PM_{10})

Activity 1

Learning purpose: Particulate matter is tiny particles that float in the air caused by various things, including domestic fires and motor vehicles.
Particulate matter can cause breathing problems.

Success criteria: Students can identify what particulate matter is and how it affects us.

Curriculum link: Science

What you'll need

- photocopy of pictures (overleaf) cut into cards
- pictures of the air filters (page 4/5)

Let's Discuss

Discuss with the students their results from 'Air Quality Detectives' from Chapter 1 (pages 21-22). Explain that scientists in the Hawke's Bay region also test the air quality. Show the picture of the clean air filter (image 1 on page four and five). It is used to catch whatever is floating in the air. From this, scientists can measure the quality of our air.

In small groups, get the students to look at the air filter cards (pages 4 and 5) and try to figure out what the different objects may be. The students report back about what they think the objects are.

Show the answer cards and discuss with the students.

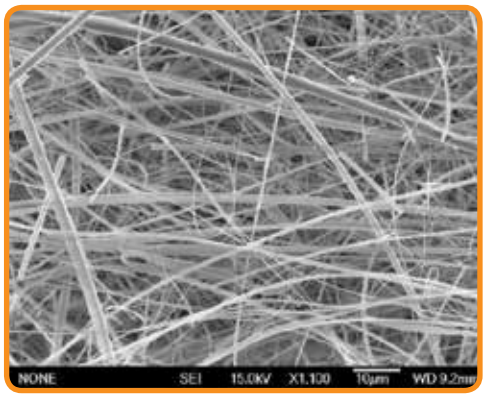
Ask the students what problems small particles cause.

Who has a parent who wears a mask for their work? Why do they do this? For example: Dust masks for painters and people using sanding equipment, full face masks for fire fighters for breathing apparatus, masks used in hospital to prevent the spread of bacteria or infections and gas masks for soldiers.

QUICK FACT

Killer smogs caused by local burning fires in London in 1952 and 1956 killed over 12,000 people and led to the banning of home fires in the city

Particulate matter cards for students



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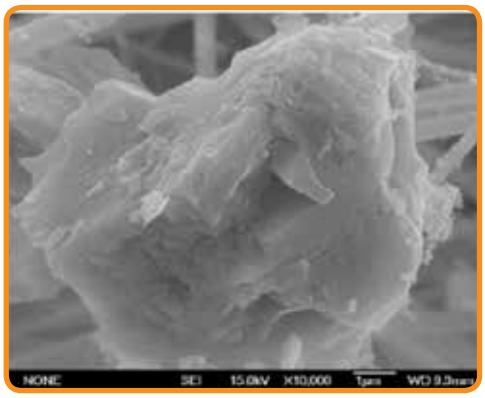

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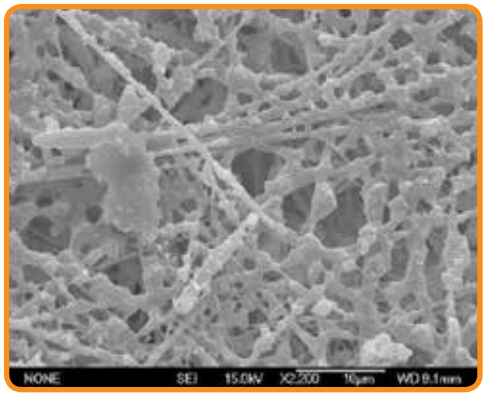

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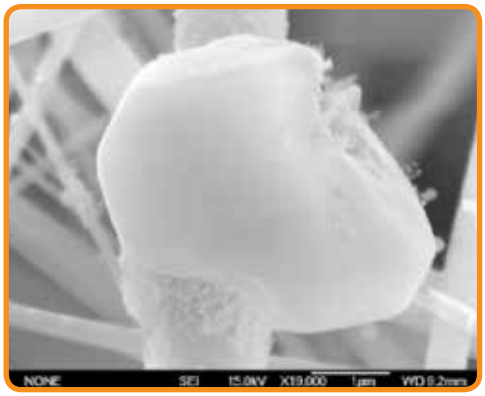

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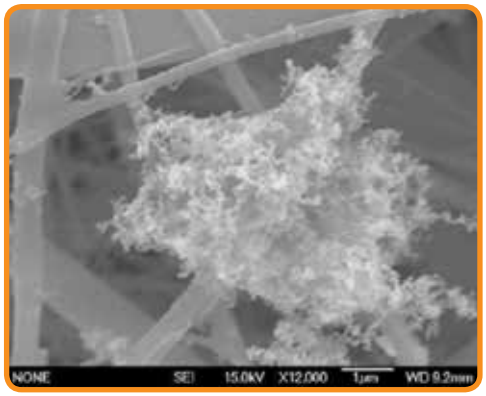

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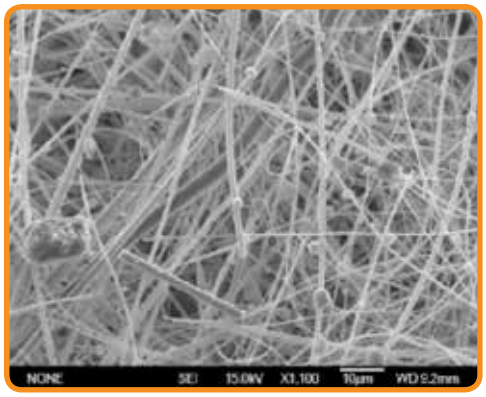

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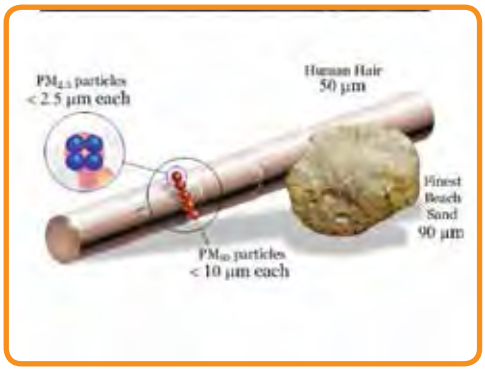


8

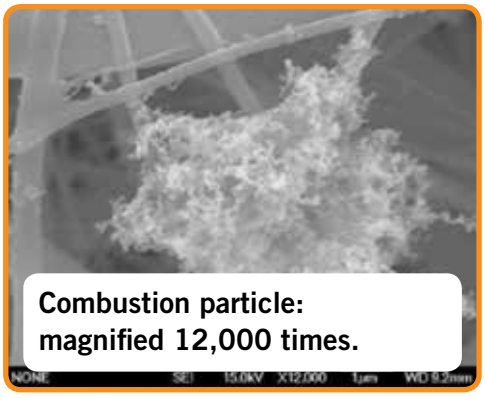
Particulate matter cards for teachers

Blank air filter used by air quality scientists. 1

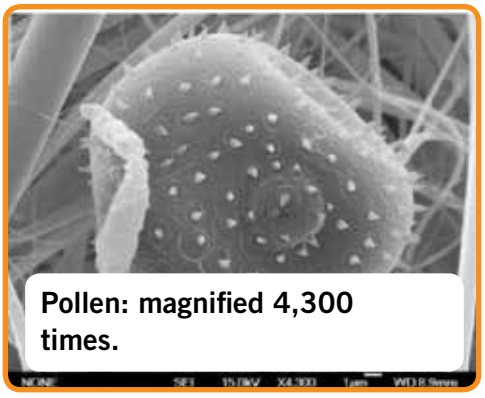
Soil: magnified 10,000 times. 2

Winter air filter from Masterton Main pollutant: smoke from domestic fires. 3

Sea salt: magnified 19,000 times. 4



Combustion particle: magnified 12,000 times. 5



Pollen: magnified 4,300 times. 6

Air filter on a typical summer day. Main pollutants: soil, sea salt and pollen. 7

Diagram comparing particle sizes of grain of sand, human hair and PM_{10}. 8

Looking at particulate matter (PM_{10})

Activity 2

Learning purpose: Particulate matter (PM_{10}) can cause breathing and health problems.

Success criteria: Students can label the human diagram (on page 7) and identify the correct word to complete the activity.

Curriculum links: Health and Physical Education

Complete the following sentences using these words once each.

PM_{10}	size	particles	oxygen
micrometre	microns	litres	day

1. Anything that is in the air including _____can get into our lungs.
2. The '10' in PM_{10} indicates the _____ of the particle of pollution.
3. The smaller the _____, the more damage they can do to our health.
4. Inside our lungs have millions of tiny air sacs, which absorb _____ from the air and release it into our bloodstream.
5. A micron or _____ (µm) is a millionth of a metre or 1/1000th of a millimetre.
6. Particles smaller than 10 _____ can travel deep into our breathing passages and particles less than a micron in diameter can get right into the air sacs.
7. We inhale and exhale about 10 _____ of air each minute!
8. That equals about 600 litres of air per hour or 14,000 litres each _____.

Teachers' notes

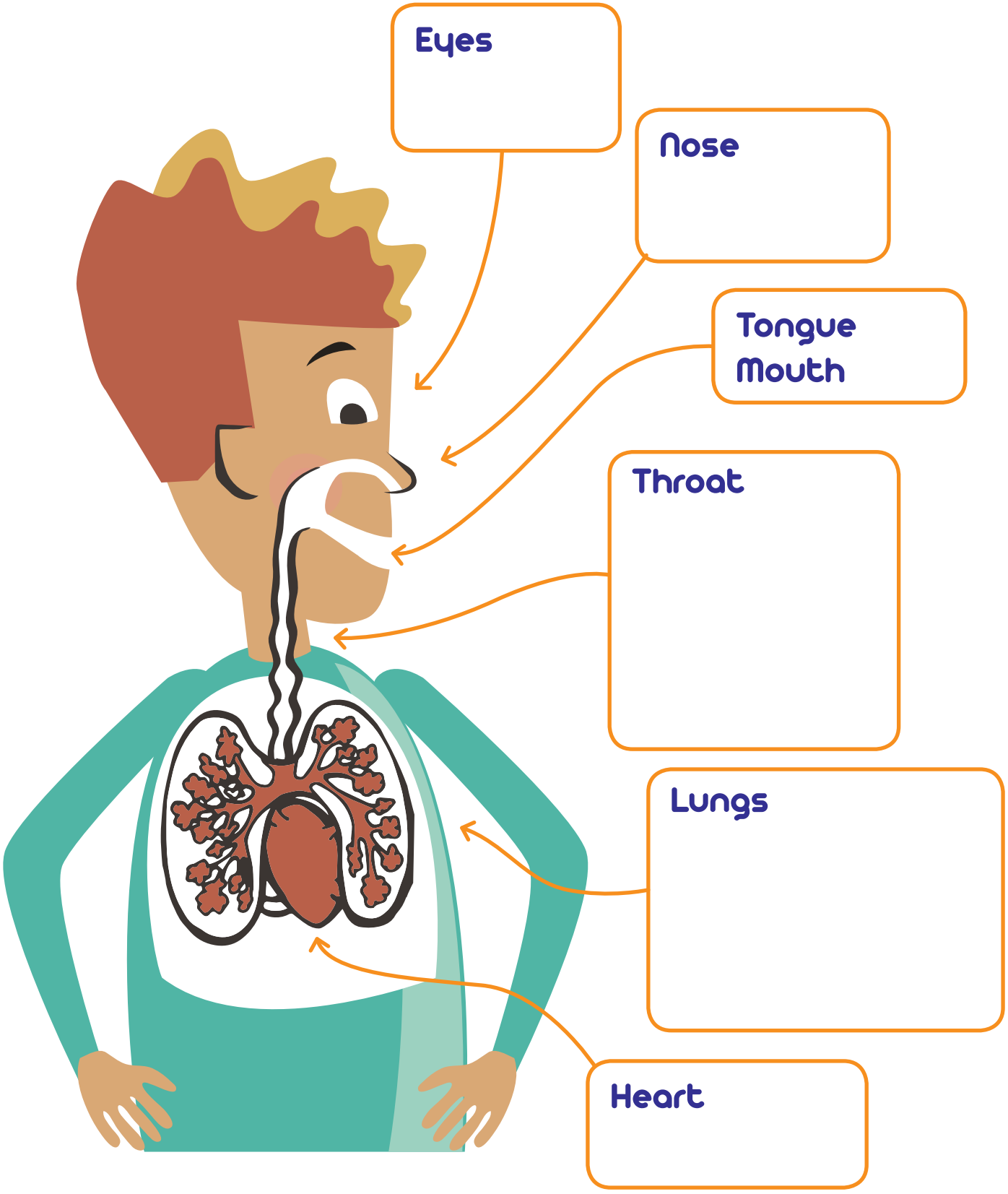
Answers to Activity on page 6:

1. Anything that is in the air including **PM_{10}** can get into our lungs.
2. The '10' in PM_{10} indicates the **size** of the particle of pollution.
3. The smaller the **particles**, the more damage they can do to our health.
4. Inside our lungs are millions of tiny air sacs, which absorb **oxygen** from the air and release it into our bloodstream.
5. A micron or **micrometre** (µm) is a millionth of a metre or 1/1000th of a millimetre.
6. Particles smaller than 10 **microns** can travel deep into our breathing passages and particles less than a micron in diameter can get right into the air sacs.
7. We inhale and exhale about 10 **litres** of air each minute!
8. That equals about 600 litres of air per hour or 14,000 litres each **day**.

QUICK FACT

Healthy indoor plants help keep the air clean in your home or classroom.

Dirty air is bad for you!



From Environment Canterbury's Clearing the Air resource

Teachers' notes

Particulate matter is the term for very small particles of natural and man-made materials found in the air. Naturally occurring particulate matter includes sand, dust, soil, pollen and sea spray.

Burning wood causes pollution indoors too

High levels of smoke pollutants leaking from fireplaces have been measured in some wood burning homes. If anyone living in a house with a wood burning fire suffers from chronic or repeated respiratory problems like asthma or emphysema, or has heart disease, they should be extra careful to reduce the amount of smoke in their home.

Answers to Activity on page 8: Human Diagram

- Eyes
  Visible pollution irritates the eyes
- Nose
  Irritates the nose and sinuses
- Tongue
  Larger particles can lodge in nose and throat.
  Can cause chronic cough.
  Can cause airway obstructive diseases.
  More coughs, colds and chest problems.
- Lungs
  Particles enter the lungs and irritate the air passages and air sacs.
  Can cause chest illnesses in children such as bronchitis.
  Can increase asthma attacks – has increased hospital visits for asthma.
- Heart
  Existing heart problems can become worse.

QUICK FACT

If you can smell smoke, you are breathing smoke!

Chapter 2

The earth's atmosphere

Teachers' notes

The atmosphere is made up of a mixture of gases and can be divided into five layers based on temperature variations.

The atmosphere protects the earth from the harmful effects of the sun during the day and keeps heat from escaping at night. The further away from the warm earth's surface we go, the less heat we feel until we hit the ozone layer in the stratosphere.

1. Troposphere

- The layer closest to the Earth, where we live it reaches approximately 17km above the earth's surface.
- It contains 90% of the air in our atmosphere and is where our weather is made.
- As solar energy hits the earth's surface, it is converted into heat, which radiates up from the earth's surface.
- The temperature in the troposphere decreases steadily until it meets the stratosphere.

2. Stratosphere

- Temperatures increase with height/altitude due to increased absorption of solar energy by the ozone layer (a form of oxygen O^3). The top of the stratosphere is much warmer, and back to near freezing!
- Ozone protects us from most of the sun's ultraviolet radiation, which can cause cancer, genetic mutations, and sunburn.

3. Mesosphere

- The layer where most meteors burn up on entering the atmosphere.
- Temperature decreases with height in the mesosphere.
- The coldest place on Earth where the average temperature is minus 85°C (–120°F).

4. Thermosphere

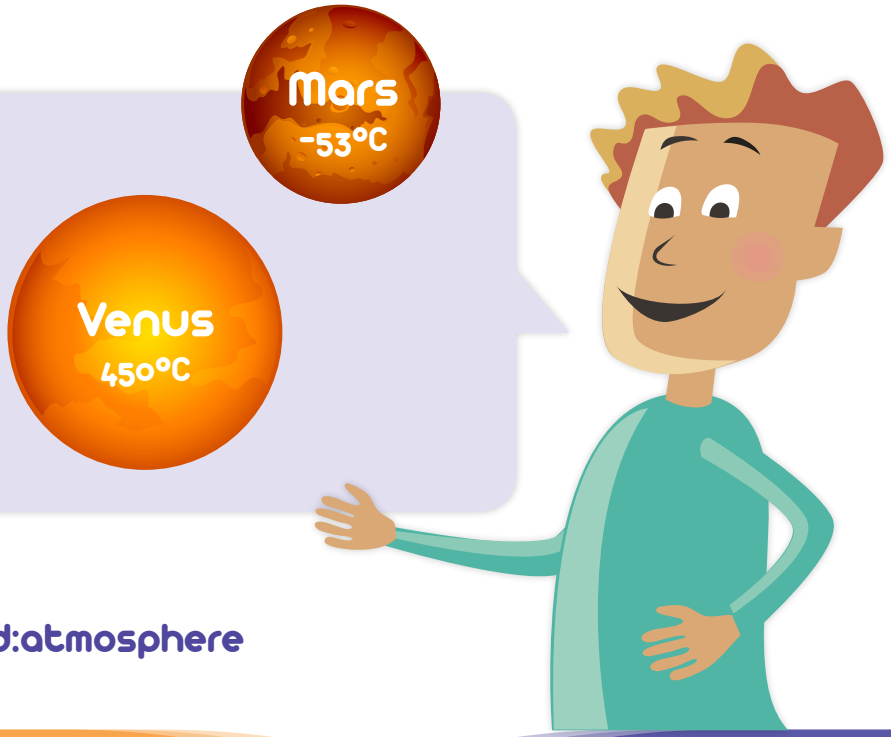
- Temperature increases with height.
- Solar radiation first hits the Earth's atmosphere and heats it.

5. Exosphere

- The outermost layer of Earth's atmosphere.
- Mainly composed of hydrogen and helium.
- The atmosphere particles are so far apart that they can travel hundreds of kilometres without colliding with one another.

QUICK FACT

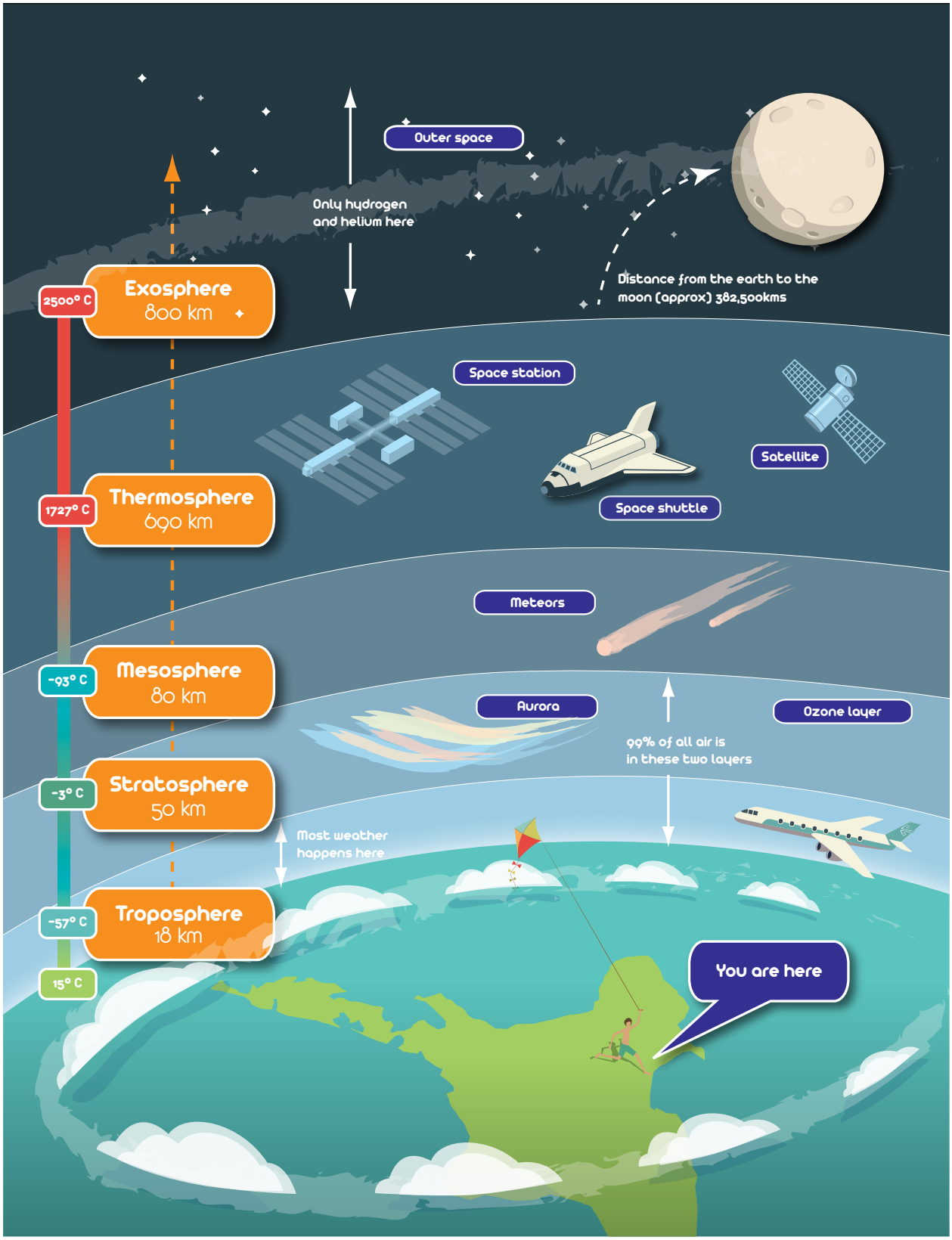
Our moderate temperatures are partly the result of having just the right kind of atmosphere. The average surface temperature on Venus is a very hot 450°C. Mars is a frighteningly freezing -53°C. Their insulating 'blankets' – atmospheres – are very thick (Venus) and very thin (Mars).



A great game for older students:

www.bbc.co.uk/schools/keyworld:atmosphere

The earth's atmosphere



Air pressure

Activity 3

Learning purpose: Understand the layers of the atmosphere.
Our atmosphere is like a blanket, which keeps Earth warm.

Success criteria: Students can explain some aspects about the different layers of the Earth's atmosphere.

Curriculum links: Mathematics and Statistics

What you'll need

- atmospheric layers poster (start of chapter 2)
- access to Google Maps
- an apple and knife

Take the students outside to look at the sky. How far up does the air go?

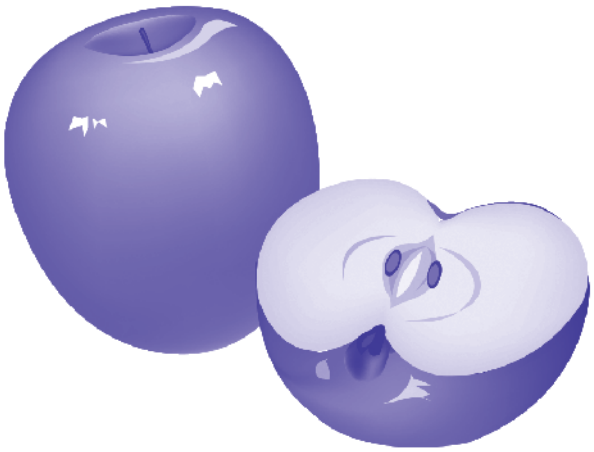
Using the Atmospheric Layers poster, discuss the different layers and what happens in each of the different layers. Use Google Maps to look at the distances between the different places below.

Make the distances relevant:

- the Troposphere is 18 kms thick which is nearly the distance from Napier to Hastings.
- the Stratosphere is approximately 50kms thick which is the distance from Hastings to Waipukurau.
- the Mesosphere is approximately 80 kms thick which is the distance from Flaxmere to Norsewood.
- the Thermosphere is approximately 680 kms thick which is slightly greater than the distance from Auckland to Wellington
- the Exosphere is approximately 1000kms thick which is roughly the distance from Hastings to Invercargill (as a bird flies).
- the total approximate distance of our atmosphere is 1837kms thick which is almost the distance between Cape Reinga at the top of the North Island to Sydney, Australia.

Atmospheric demonstration

- show students an apple and ask them to imagine it is the earth.
- cut the apple in half.
- the skin of the apple is like the earth's troposphere, covering the apple like a snug blanket.
- the whole atmosphere protects the earth from the harmful effects of the sun during the day and keeps the heat from escaping at night.
- the skin of the apple shows how thick the troposphere is in relation to the earth.

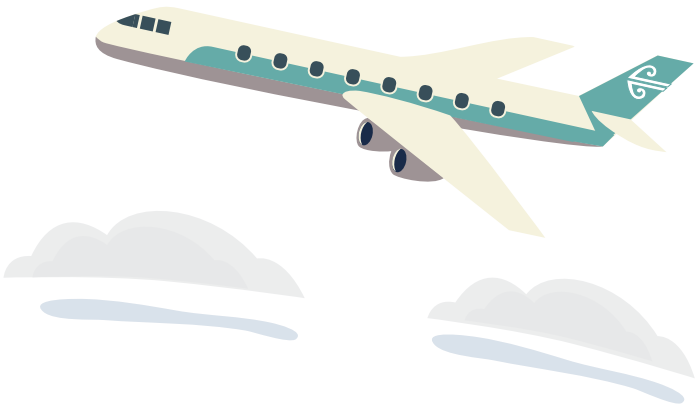


Try this: draw a circle on a piece of A3 paper and add layers around it to show the different thicknesses. Convert kilometres to centimetres i.e. 18km = 1.8cm. Use colours to differentiate the layers

Air pressure

Teachers' notes

Air pressure is the weight of the atmosphere pushing on to the earth. Our atmosphere is pushing onto us from every direction but we usually don't feel it.



Although air molecules are invisible, they still have weight and take up space.

How much pressure are you under?

Earth's atmosphere is pressing against each square inch of you with a force of 1 kilogram per square centimetre. Although we are usually unaware of this pressure, it actually presses down very hard – roughly equivalent to the force of an elephant balancing on a desk!

Why doesn't all that pressure squash me?

You have air inside your body too. That air balances out the pressure outside so you stay nice and firm and not squishy.

Air pressure can tell us about what kind of weather to expect as well. If a high pressure system is on its way, often you can expect cooler temperatures and clear skies. If a low pressure system is coming, then look for warmer weather, storms and rain. Weather forecasters measure air pressure with a barometer. Barometers are used to measure the current air pressure at a particular location.

What happens if air pressure changes?

At the top of a tall mountain or in an aeroplane, you may have noticed that your ears pop. As you climb higher, air temperature decreases. Typically, air temperatures decrease about 6.5° C per 1,000 metres of elevation.

As the number of molecules of air around you decreases, the air pressure decreases. This causes your ears to pop in order to balance the pressure.

Air pressure

Activity 4

Learning purpose: Students will learn that air has varying density, weight and pressure. These can all change.

Success criteria: Students can explain what happened in the experiment and why.

Curriculum link: Science

What you'll need

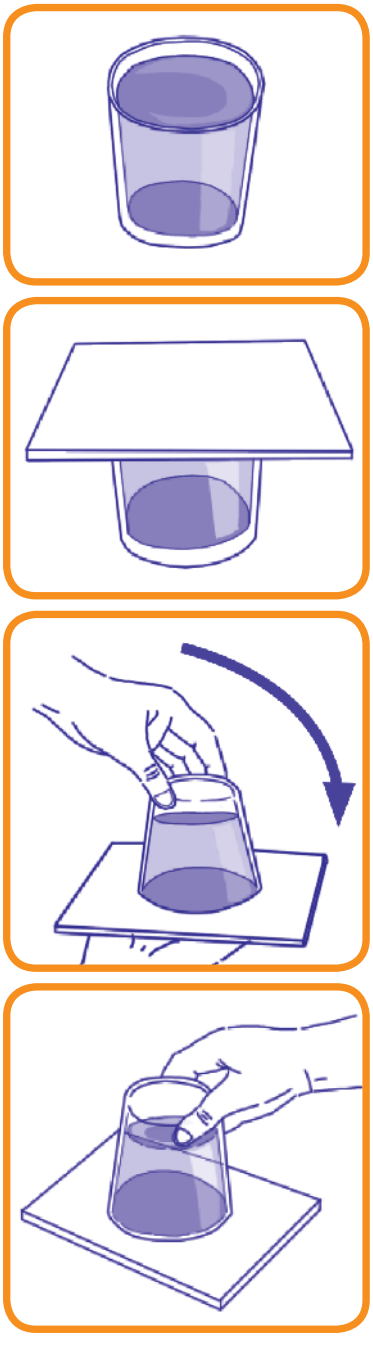
- glass or plastic cup
- water
- sink or large container to catch any water spill
- stiff card just a little larger than the cup

The Experiment

You can turn a glass of water upside down without spilling a drop with the help of air pressure. Do this over the sink the first time!

Fill a glass to the brim with water. Slide a piece of stiff card over the top of the glass and hold it in place. Hold the card in place, and quickly turn the glass upside down. Then, hold the glass with one hand and let go of the card. The water mysteriously stays in the glass.

Try this experiment with larger glasses or cups and larger card, and see if there is any difference between the sizes used.



Let's Discuss

- what do you observe?
- what do you know about it?
- does water have weight?
- is water heavier than the card?
- what is holding the card in place?
- does the water temperature change the result?

The strength of the air pressure pushing up on the card is stronger than the force of the water pushing down on it. So, the strong air pressure outside the glass holds the card in place. This stops the water from falling out of the glass.

Teachers' notes

Without wind, we wouldn't have any change in the weather.

That means no snow, no tans and no singing in the rain. Wind is air moving horizontally. It's the result of air movement over the earth. Air moves because of pressure systems - it travels from areas of high pressure to areas of low pressure.

Two reasons for these pressure changes around the earth are:

The earth moves

As the earth moves, it drags the atmosphere around with it, which causes the air to mix with the higher level atmosphere. This creates turbulence and pressure systems.

The sun's heat

The air around earth changes temperature, depending on the time of day. As the air warms up, it rises. In Polar regions, where the sunlight spreads over a greater area, the result is less warm air. This means the air over the poles is denser than the air over the equator. As air rises, low pressure areas are created below. Air in high pressure areas then rushes to fill in the gap. If there's a big difference between the pressures, the flow of air between the two points will be stronger.

The wind is the main driving force of New Zealand's weather.

QUICK FACT:

The wind also carries air pollution around New Zealand and around the world. In June 2011, Puyehue volcano in Chile erupted and blew ash across the Atlantic Ocean to South Africa, more than 7725 kilometres away.

Teachers' notes

How does the sun produce wind?

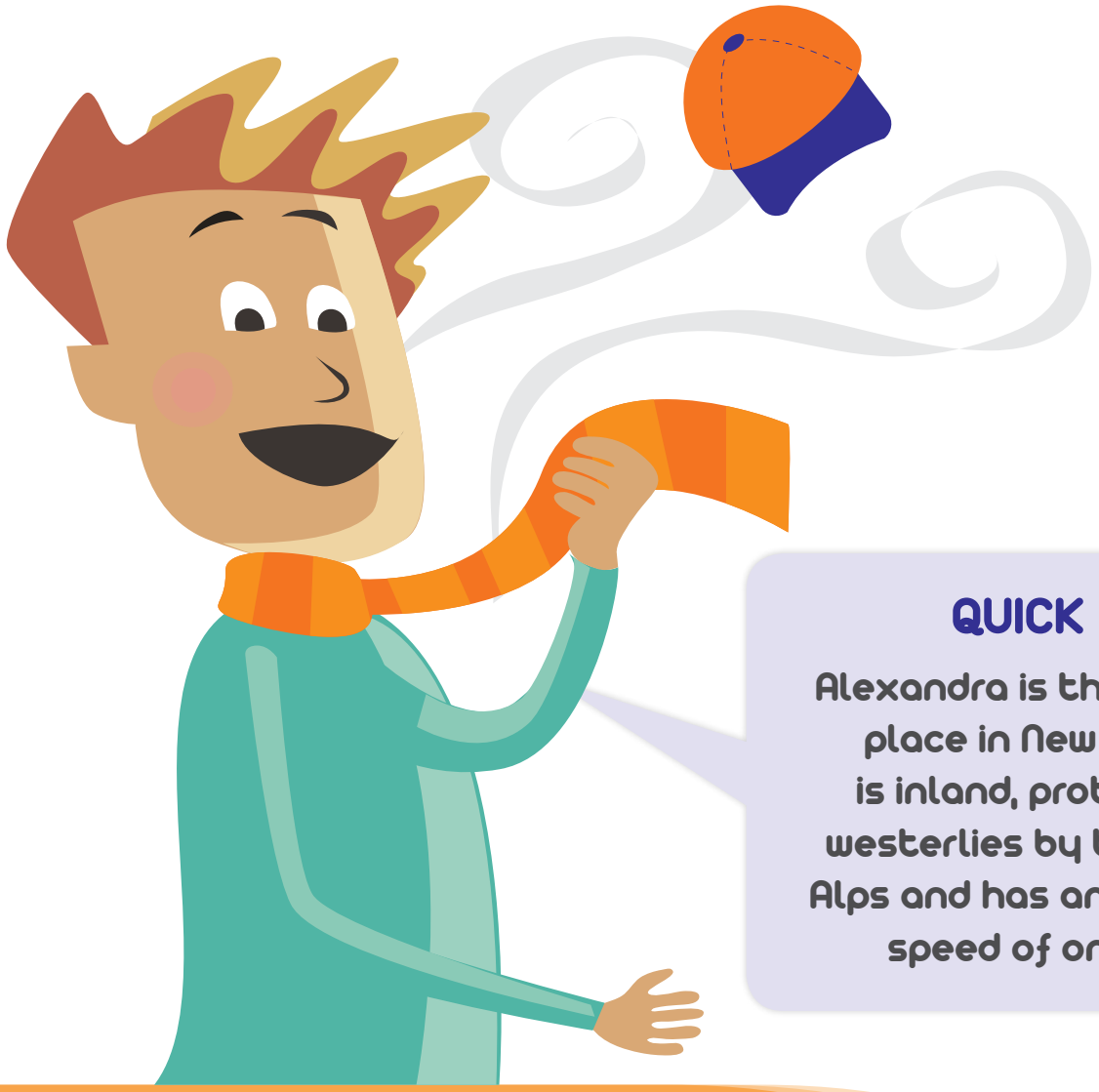
As the Earth rotates in and out of sunlight, different parts of the planet heat up faster than others for several reasons:

- land absorbs heat more quickly than water
- at night, land loses heat more quickly than water
- the angle at which sunlight enters the atmosphere also affects the amount of heat reaching the Earth's surface

These differences and many other factors make the Earth's weather variable and difficult to predict in the long term.

During the day, the land heats up quickly and becomes much warmer than the ocean. As a result, the air above the land expands and rises into the atmosphere. Cooler air from above the ocean rushes in to replace the rising air resulting in cool onshore winds.

At night, the land looses its heat faster than the ocean. As the land temperature falls below that of the ocean, the process is reversed, resulting in offshore winds.



QUICK FACT:

Alexandra is the least windy place in New Zealand. It is inland, protected from westerlies by the Southern Alps and has an average wind speed of only 6km/hr.

Wind around your school

Activity 5

Learning purpose: Understand how the wind blows in your school. Physical barriers can change the direction of wind.

Success criteria: Students can identify and map where wind blows in their school, explaining why there are 'windy' areas and 'calm' areas.

Curriculum link: Science

What you'll need

- A4 size maps of the school grounds (one for each group)
- bubbles and blower set (one for each group)
- compass
- a windy day

The Experiment

Students are going to investigate how air moves around the school by 'wind mapping' using bubbles. Wind is named according to the direction it comes **from,** not the direction it is **going.**

Draw a compass to illustrate that wind blowing to the north is called a southerly because it comes from the south. In New Zealand, the southerly contains cold air. A wind blowing to the south is called a northerly wind because it comes from the north.

In small groups, the students go to different parts of the school and locate themselves on the map. Students blow bubbles and observe the direction they travel. Students draw arrows on the map to show the direction and make observations from different points of a building and different distances from the building.

Let's Discuss

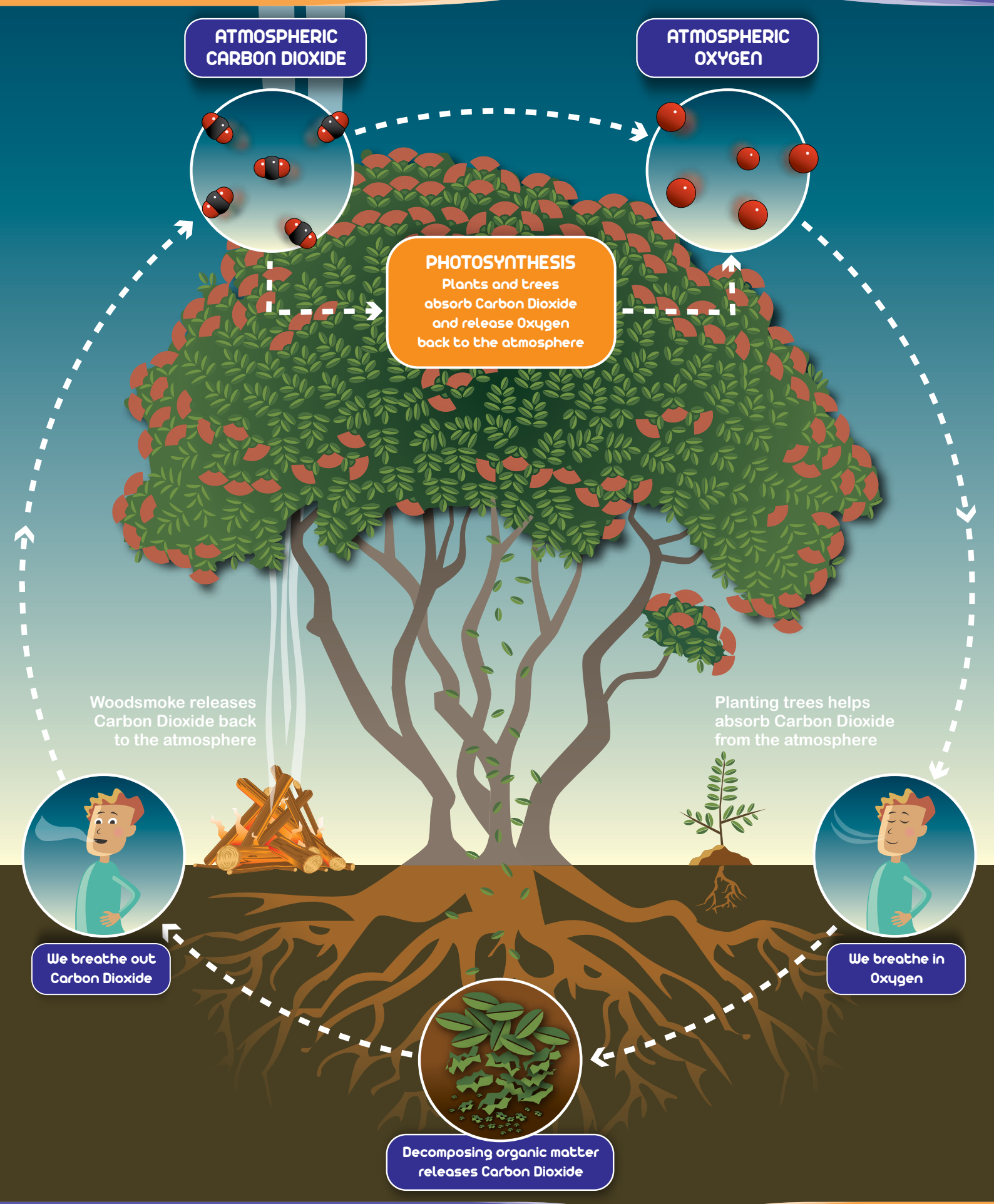
When back in class, get the students to report on their findings. Did they observe any patterns? By taking readings from all around the school they will notice that the wind does not always travel in the same direction. What has caused this?

Try this activity on other days and compare the results.

Clearing the Air

Photosynthesis

Chapter 4



Chapter 4

Photosynthesis:

Why should we care?

We already know that air is made up of invisible, odourless gases.

We can easily see pollution caused by smoke or water vapour (think of industrial chimney stacks and exhaust fumes) but there are many harmful pollutants that are invisible. Air pollution not only makes humans sick but can also have serious effects on plants, animals and the environment. Healthy, clean air is important for the well-being of all living things. As well as obvious pollution from industry and vehicles, pollution can come from natural sources such as volcanic eruptions, pollen from plants, windblown particles of soil and even sea spray. Some pollution can be invisible such as carbon monoxide and nitrogen oxides. Pollution can also be in the form of bad smells. Industries that release gases or chemicals into the air must apply for a special permit called a 'discharge permit'. This includes odours. If a company pollutes the air without a permit, it will get a warning, be fined, or be asked to stop work until the problem is fixed. In serious cases the company could be prosecuted.

Health impacts

There are no safe levels of PM_{10} !
When we breathe in, the hairs in our nose and air passages remove particles larger than 10 µm (micrograms) in size. Particles smaller than 10 µm can penetrate into the lungs, where they cause problems and affect our health.

Health costs

- lower immune system = more sick days and less time at work
- child absent days from school
- increased hospital admissions and emergency department visits
- prescription cost from the chemist
- restricted activity days

Sources

PM_{10} comes from sources such as burning coal, oil, wood and light fuel oil in domestic fires, transportation and industrial processes. Natural sources of particles include sea salt, dust, pollens and volcanic activity.

Seven Hawke's Bay people are killed by pollution annually. The impact on health locally equates to $94m worth of lost time due to related health conditions.

Teachers' notes

The carbon cycle is a natural cycle like the water cycle or the cycle of photosynthesis

This natural cycle keeps the living world in balance. Most carbon in the world is locked up in fossil fuels, growing plants and in the ocean where it is dissolved in sea water. There is only a tiny amount moving freely in our atmosphere. Air contains approx 0.036% carbon dioxide. Carbon is the sixth most abundant element in the universe.

It is a non-metal element found in all living things and is one of the building blocks of all life. Carbon occurs in our atmosphere as carbon dioxide. Carbon is released back in to the atmosphere as carbon dioxide when plants are burnt or die and rot away. It's one way that our planet reuses and recycles.

Photosynthesis: why should we care?

Activity 1

Five reasons why air is important

- Write the reasons into each panel by filling in the gaps.
- Underneath each reason, write an extra fact, e.g. under "Air keeps us alive" you could write that we **breathe** air to stay alive, or that our bodies need **oxygen** from air.

Air keeps us _ _ _ _ _

Air keeps _ _ _ _ _ _ and _ _ _ _ _ _ _ alive

Air affects our _ _ _ _ _ _

Air affects our _ _ _ _ _ _ _ _

Air is _ _ _ _ _ _ _ _ _ _ _

Use key words list to give you ideas:

alive all atmosphere breathe carbon dioxide (CO_2) animals earth feelings health lungs oxygen planet quality us plants around fitness

QUICK FACT

Air pollution causes around 1000 deaths in NZ each year and globally around 2 million deaths are directly related to air pollution.

Photosynthesis: why should we care?

Activity 2

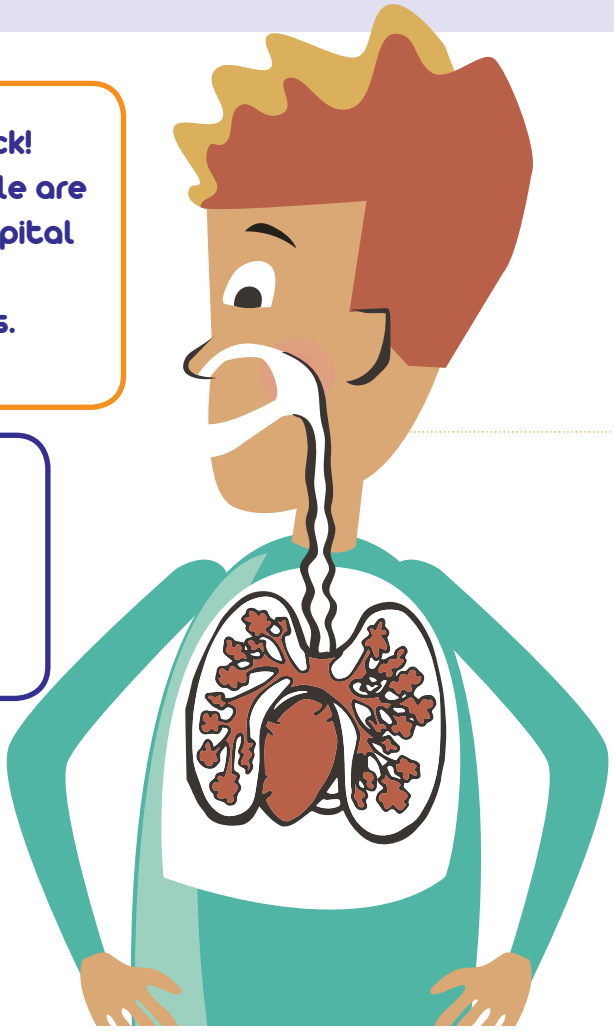
Size does matter!

The smaller the particles, the more damage they can do.

PM_{10} makes us sick! Every year people are admitted to hospital with pollution-related illnesses.

PM_{10} can kill! People die each year in Hawke's Bay from breathing problems that may have been made worse by PM_{10} pollution.

We inhale and exhale about ten litres of air each minute!



How PM_{10} pollution affects us

1. On the diagram above, label the eyes, nose, throat, trachea and lungs.
2. Complete the following sentence.

Describe in your own words what happens when we breathe in polluted air. Use these words in your explanation: nose, throat, lungs, breathe, irritate.

Small particles in the air can be breathed in through...

Chapter 4

Photosynthesis: plants are the lungs of our planet

Teachers' notes

Where do fresh supplies of oxygen come from?

Photosynthesis is the clean air cycle.

People and animals breathe in oxygen and breathe out carbon dioxide. So why hasn't all this breathing out filled the world with carbon dioxide? Because of plants and trees! Plants take in carbon dioxide and let out oxygen. It is a balanced cycle and it all happens through a process called photosynthesis. Without plants, we wouldn't have any food or oxygen.

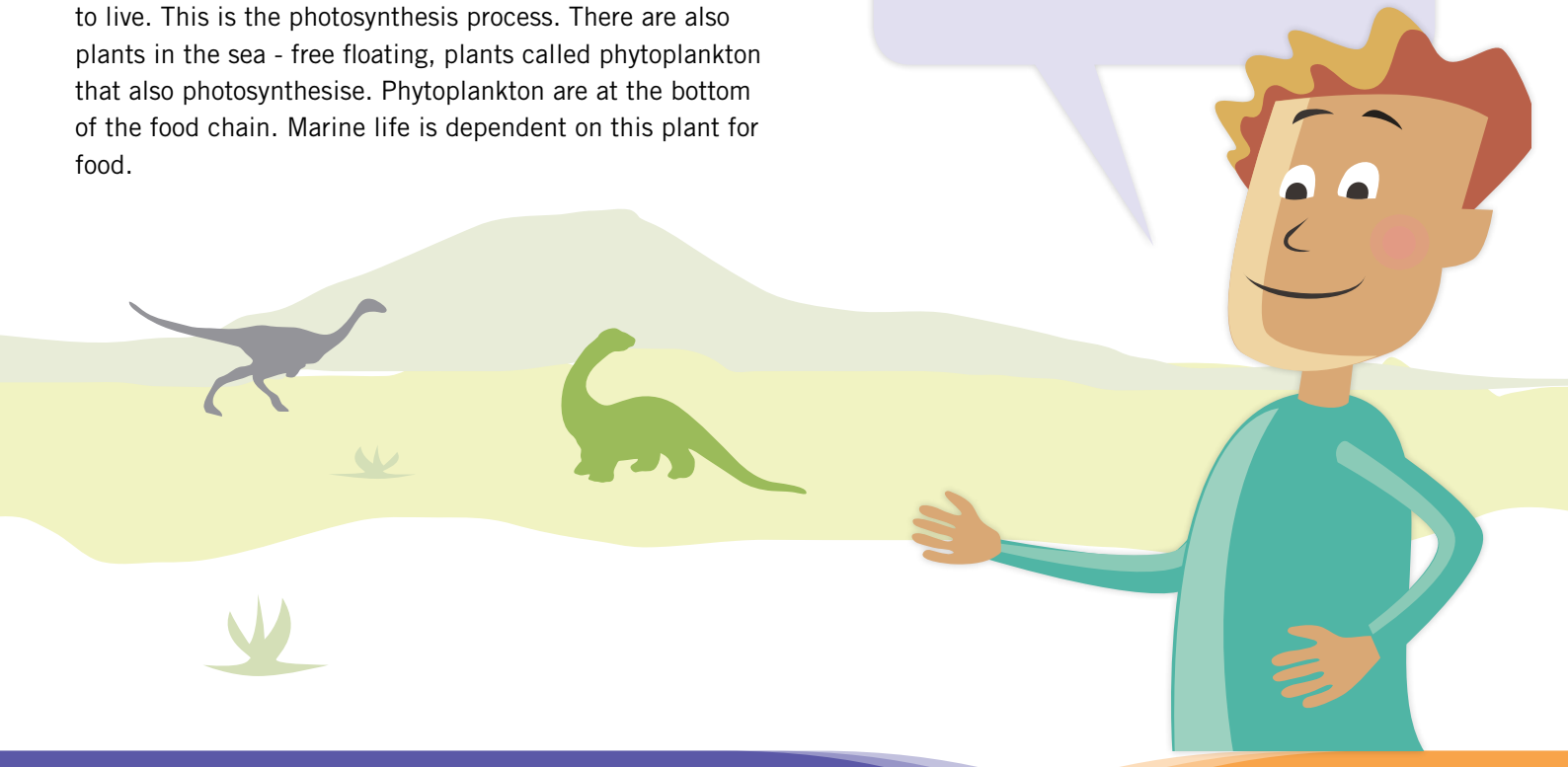
Clean air is necessary for the chemical reaction called photosynthesis which is when a plant produces its own food. The air enters the plant through the stomata on the underside of the leaves. When the air is polluted or when the leaves are covered by something that acts as a pollutant, photosynthesis cannot take place and the plant dies.

Plants are green because they contain chlorophyll. Chlorophyll is a green chemical found in plants which enables them to turn sunlight into food through photosynthesis.

Plants need sunlight, water, carbon dioxide and chlorophyll to live. This is the photosynthesis process. There are also plants in the sea - free floating, plants called phytoplankton that also photosynthesise. Phytoplankton are at the bottom of the food chain. Marine life is dependent on this plant for food.

QUICK FACT

Right now you are breathing in air that dinosaurs breathed out. In one minute you breathe in ten litres of air.



Chapter 4

Photosynthesis: air and animal lungs

Activity 3

Learning purpose: Plants make their own food using sunlight and carbon dioxide.
Oxygen is a product of the photosynthetic process.
Forests are the earth's lungs (clean air filters).

Success criteria: Students can identify and map the lungs of their community and explain their importance.

Curriculum links: Science, Health and Physical Education

What you'll need

- map of school and surrounding area (Google maps)
- photosynthesis poster (introduction of chapter 4)
- parent helpers
- health and safety forms

Explore the lungs of your community – field trip

On a map of the area a 1 to 5 kilometre radius of the school, students map the lungs (bush and forest areas) of the local community, identifying where the sources of oxygen are for all the living things that live in the defined area.

Students also map where the cycle ways and walkways are, and where the public transport routes are. Use a stopwatch to measure how far students get when they have walked for five minutes, for 10 minutes or 20 minutes. This information will be useful if the school wants to adopt a School Travel Plan in future.

Let's Discuss

Take the students for a walk in the playground or local bush area to look at trees. If you're near the coast, check out the ocean. Discuss the following questions:

- Are plants living things?
- Why are plants green?
- What do plants need to make their food/survive? Is this present or absent?
- How do plants affect our atmosphere?
- Why are plants important for humans and other animals?
- Are there plants in the sea? What effect do these plants have on the atmosphere of the planet? Expand this concept to look at the town or city, the region, all of New Zealand, or the world.

Chapter 4

Photosynthesis: air and animal lungs

Teachers' notes

Air is found everywhere including in soil and water. All living things have developed ways of taking in oxygen from their environment.

Larger organisms need more complex breathing systems. Most living organisms use oxygen to burn sugars to release energy. Once the living things have used the oxygen, leftover carbon dioxide and some other gases are then released back into the atmosphere.

There are five different ways animals take in oxygen:

- **Spiracles:** Some invertebrates don't have lungs - they use spiracles to breathe. These are tiny holes which connect to tiny tubes (trachea). The tubes go from the outside of the exoskeleton and connect to the organs inside, carrying oxygen in and carbon dioxide out.
- **Gills:** allow aquatic animals such as fish to take oxygen from the water and get rid of carbon dioxide, as they breathe out.
- **Lungs found in invertebrates:** Some invertebrates have lungs but these are not like our lungs. They are much more basic. Spiders breathe through lungs called book lungs. These have layers of soft plates stacked on top of each other, like pages in a book. Other animals like snails have an opening in their body which takes air to a single basic lung inside their shell.
- **Lungs found in vertebrates:** Mammals, birds, reptiles and amphibians all have two lungs of varying complexity.
- **Breathing through the skin:** Worms and amphibians breathe through their skin, which is why they must stay moist. Oxygen is dissolved in the moisture on the skin and passed into the body. Carbon dioxide is passed from inside the body back out into the air, a process called gas exchange. Amphibians are also able to breathe through their skin.

Vertebrates

Animals with a backbone	Where do they live?	How do they breathe?
Fish	Water	Tadpoles have gills
Amphibians	Water/Land	Adults have lungs and also breathe through their skin
Reptiles	Land	Lungs
Birds	Land	Lungs
Mammals	Land	Lungs

Invertebrates

Animals without backbone	Where do they live?	How do they breathe?
Mayflies	Nymphs - water / Adults - land	Nymphs - gills / Adults - spiracles
Weta	Land	Spiracles
Katipo spider	Land	Lungs
Worms	In soil	Breathe through their skin

Chapter 4

Photosynthesis: air and animal lungs

Activity 4

Learning purpose: Air is essential for life because all animals need air to survive. Animals have evolved different ways to get oxygen from the environment.

Success criteria: Students can identify and categorise how different animals get oxygen from the environment and why different animals breathe in different ways.

Curriculum link: Science

What you'll need

- photocopy of the animals (overleaf)
- scissors and large paper for each group

Let's Discuss

Ask the students to take a big breath in and then let it out. Ask the students what they think happens when they breathe in. Explain why your chest gets bigger as your lungs fill with air. The oxygen in the air travels through your body to keep you alive.

Where do these creatures live?

Put the following headings on a large piece of paper. Get students to place pictures of animals (overleaf) in each column. Discuss answers as a class. See "Teachers' notes" for the answers.

On Land | In Water | On Land & In Water | In Soil

How do animals breathe?

Children cut out the drawings (overleaf) and sort them into the groups as discussed on the previous page. Get the students to work in groups to complete the following table. Discuss your answers.

Complex Lungs | Gills | Through the skin | Simple Lungs | Spiracles

Chapter 4

Photosynthesis: air and animal lungs

Teachers' notes

Answer sheet for 'How do animals breathe?'

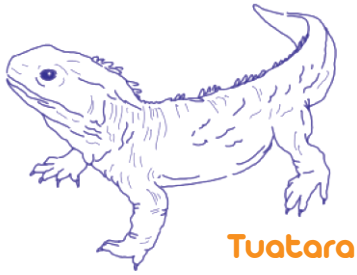
Complex Lungs	Gills	Through the skin	Simple Lungs	Spiracles
Human	Native freshwater fish	Worm	Slug	Weta
Elephant	Shark	Frog (+ simple lungs)	Giant land snail	House fly
Sheep	Mayfly larvae	Lungs	Spider	Butterfly
Lizard	Tadpole	Breathe through their skin	Frog (+ through skin)	Ladybird
Turtle	Koura (crayfish)			Millipede
Kiwi				Ant
Bat				
Whale				
Dolphin				

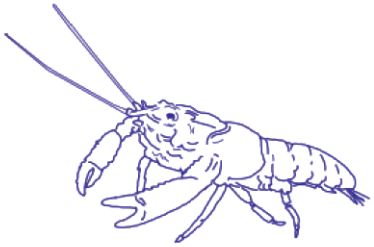
Photosynthesis: air and animal lungs


Bat

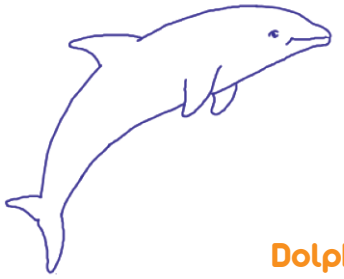

Ant


Butterfly

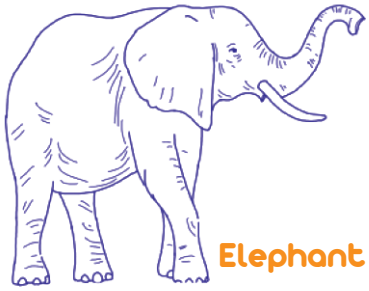

Tuatara


Koura (Crayfish)


Frog


Dolphin


Fly

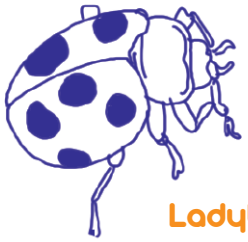

Elephant

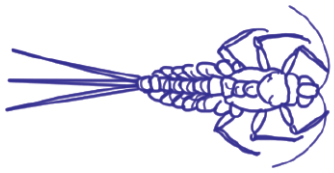

Kiwi


Tadpole

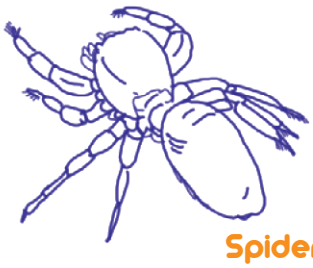

Native freshwater fish

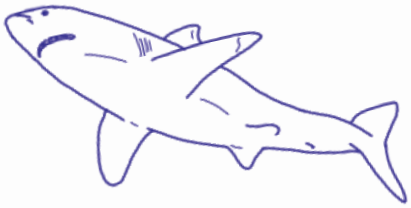
Photosynthesis: air and animal lungs

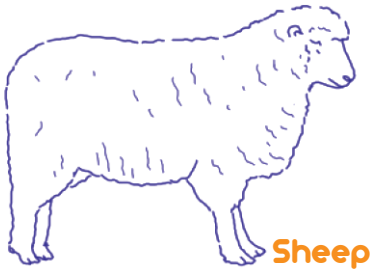

Ladybird


Mayfly larvae

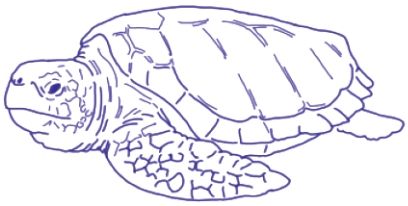

Giant land snail

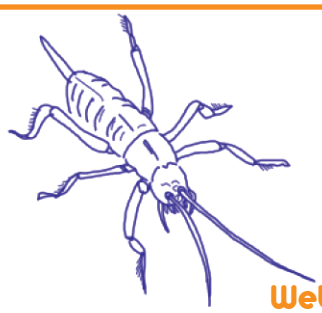

Spider

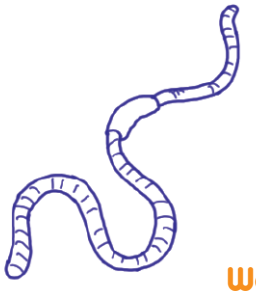

Shark

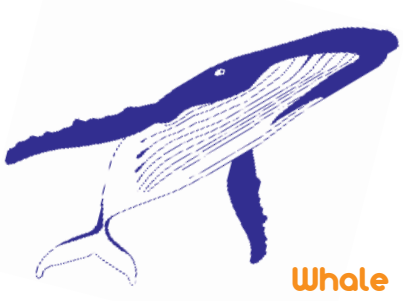

Sheep


Millipede


Turtle


Weta


Worm


Whale


Human

Teachers' notes

Traditional stories & legends

These are a way of exploring cultural knowledge and values which provide an opportunity to understand many aspects of the life of early Māori. Within these stories we can see how everything is inter-connected, related from the beginning of time through to you and I here today.

Traditional stories and legends show geographical aspects, the relationship of people to the land, sea and stars, the distance travelled and the navigational skills of the ancestors. There is an emphasis on the methods of conservation which ensured a continual supply of resources, reinforcing a sustainable relationship with the environment. We are also presented with information about social organisation, relationships with each other and the importance of cooperation.

There are two different types of Māori stories: pūrākau and pakiwaitara. Often these terms are used in different ways. Essentially, pūrākau as stories are related to the deeds and actions of atua or beings which have displayed supernatural talents, for example the stories about Rangi and Papa, Māui, and those that explain landforms. Pakiwaitara in comparison, are those stories associated with mortal humans and often they are more localised because they relate to mortal beings who have a closer link through whakapapa with the people to whom the story belongs.

Māui Obtains the Secret of Fire

The keeper or guardian of all fire was Mahuika. She lived in the depths of the earth in a volcano, and controlled fire and how and when it appeared above the ground. Despite being warned by his parents, Māui decided to seek out Mahuika so that the secret of fire would be revealed to him. When Māui arrived at Mahuika's cave, she tested him by asking different questions so that she could find out who he was, where he came from and the reason for his visit.

Māui told Mahuika that he had come to get fire for his family. To Māui's amazement, Mahuika revealed the source of fire was held in her fingernails. She plucked the fingernail from her small finger and gave it to Māui. Once Māui knew the secret of fire, he devised a plan to get the lot, so he would never have to return again. When he took the first fingernail, he went away and extinguished the fire. He returned to Mahuika to ask for another fingernail. Māui extinguished the second one and did the same for each fingernail until there was only one left. By this time, Mahuika was angry with Māui and realised that he was deliberately trying to trick her. Instead of giving the last fingernail to Māui, she threw it into the ground, reciting an incantation that ignited the flame into a raging fire.

Ka Kimi a Māui i te Ahi a Mahuika

Ko Mahuika te kaipupuri i te ahi kōmau. Ko tōna kāinga i roto tonu i te puku o te whenua. Ko Mahuika tērā e tiaki ana i te ahi, ā, māna hoki ia e whakangiha, e whakakāpura, ka kitea. Ahakoa ngā kōrero whakatūpato ā onā mātua, ka haere tonu a Māui ki te kimi i Mahuika me te ahi huna. Ka tae iho a Māui ki te kāinga o Mahuika, ka makamaka pātai a Mahuika kia mōhio pū a ia ko wai hoki tērā kua puta mai, nō hea ia me te take i haere mai ai.

Ka kī atu a Māui, i haere ia ki te tiki ahi mā tōna whānau. Ka rong a Mahuika i tana īnoi ka kōwhaki ia i te maikuku o tōna kōiti, ā, ka pua mai te ahi i reira. Ka hoatu ki a Māui. Kātahi te mea mīharo ki a Māui. Ka āta whakaaro ia, ka whakatau i tōna rautaki e pau ai te katoa o ngā ahi a Mahuika. Ka ngaro atu ia me te ahi nā Mahuika i hoatu ki a ia, ka tineia. Kātahi ia ka hoki atu ki a Mahuika ki tiki ahi anō. Ka pērā anō tana mahi, ā, ka hoki anō. Ka pau ngā maikuku katoa o tētahi ringa, ka tono a Māui i ērā atu maikuku māna. Tae rawa ki te ahi whakamutunga, kua mārama a Mahuika ki ngā tinihanga a Māui, ā, ka manawa wera ia, ka tino pukuriri. Kāore ia i hoatu te maikuku whakamutunga, engari ka whiua ki te papa me te takutaku i tētahi karakia. Kātahi ka mura mai te ahi, ka rere ki runga, ki raro, ki mua atu ki te wāhi i reira a Māui e tū ana.

Māui turned and fled, with the flames in 'hot pursuit'. In order to escape the fire, Māui changed himself into a rūrū (owl) and flew into the forest to take shelter. Māui was soon overcome by fire so he changed himself into a kārearea (sparrow hawk) to fly faster and escape the fire. However, the fire still raged around him, so he changed himself into a kāhu (hawk) so that he could fly higher up into the sky. Māui then called on Tāwhirimatea – the Atua of winds and all weather for assistance. With his help the fire was soon extinguished and Māui was saved. When the fire had spread through the forest, its seeds remained in certain trees. The most important was the kaikōmako tree, which was used to make a fire-stick or kaunoti.

Ka huri a Māui ka rere, kei hunua a ia e te ahi a Mahuika. Ka tango a Māui ki te āhua o te rūrū, ā, ka rere ki te ngahere ki reira whakarūrū ai. Engari, kua kaha te murara haere o te ahi, kātahi ka huri a Māui hei kārearea, kia rere tawhtiti atu i te ahi. Auare ake, ka whai tonu te ahi i a ia, ka huri a Māui hei kāhu. Ka rere whakarunga ki te rangi me te karanga atu ki a Tāwhirimatea ki te āwhina i a ia.

Ka tuku atu a Tāwhirimatea i te ua nui me te ua roa, ā, ka tineia te ahi, ka ora a Māui. I te muranga o te ahi Mahuika i roto i te ngahere ka whakanohoia ngā kora ki ētahi rākau. Ko te rākau whakahirahira ko te kaikōmako. Mai i tērā wā, ko te kaikōmako te rākau i whakamahia e ngā tīpuna hei kaunoti e hika ai te ahi.

Place names

Māori place names commemorate significant events, people and at times can reveal different aspects of the relationship that Māori have with the natural environment. The following examples help to show these relationships.

Napier region

Keteketerau is the name given to the outlet from the Inner Harbour (Te Whanganui a Orotū) and the sea. The name is associated with an ancestor named Tara, the son of Whātonga and uncle to Rangitāne, the eponymous ancestor of the Ngāti Rangitāne tribe. Tara had travelled from Whangārā in search of his missing dog. He arrived ashore near the outlet of the Inner Harbour, and heard a sound floating on the breeze. It was just like his flute that he used to whistle his dog. He then realised that he had left his flute behind and so he clicked his tongue in annoyance (a sound known in Māori as ketekete).

Mataruahau is the Māori name for Bluff Hill in Napier. One of the explanations for this name was that when the wind blows in from the sea and hits the cliffs on the seaward side, it splits in two in order to move around the hill.

Te Māra a Tāwhao was another name for the Napier Inner Harbour or Te Whanganui a Orotū. It literally means the Garden of Tāwhao. It was named after an

Ngā ingoa wāhi

Kei ngā ingoa wāhi e whakaaturia ana ngā mahi a ngā tīpuna me te whanaungatanga i waenganui i te tangata me tōna ake taiao. Hei whakatauira atu kei te whakaaturia e ngā ingoa e whai ake nei ētahi āhuatanga o tēnei whanaungatanga.

Ahuriri

Keteketerau – ko te pūwaha tawhito tērā o Te Whanganui a Orotū i tere atu ai ngā wai o roto ki te moana o waho. Nā Tara tēnei ingoa i tapa. Hei tama a Tara ki a Whātonga, hei matua kēkē hoki ia ki a Rangitāne te tipuna nui o te iwi o Rangitāne. I ahu mai a Tara i te Tairāwhiti, e kimi haere ana ia i tana kurī. Ka tae tōna waka ki uta, ka rongo hākiri ia i tetahi tangi e kawea mai ana i runga te hau. He rite tonu ki te tangi a tōna kōauau hei i whakatangi i tana kurī. Kātahi ia ka mōhio kua mahue e ia tōna kōauau, ka auē ia, ka ketekete, koia i kīia ai tērā wāhi ko Keteketerau.

Mataruahau – ko te ingoa tērā o Bluff Hill. E ai ki tētahi korero, kia pupuhi mai te hau mai te moana o waho, ka pā ki ngā pari nui ka wāhi ruatia ā, ka haere mā ngā taha e rua o te puke.

Te Māra a Tāwhao – koia tētahi atu ingoa mō Te Whanganui a Orotū. He tipuna a Tāwhao, ā, he uri hoki ia nā Kahungunu. E ai ki ngā kōrero nā Tāwhao i rāhui te wāhi o Te Whanga me ngā kai o roto, ā, koia i kīia ai ko Te Māra a Tāwhao.

ancestor named Tāwhao who reserved the area for his own use. It was referred to as a garden because it was such a rich food source.

Haumoana literally means the sea breeze.

Tiromoana was the name of a pā that was located on the hills behind Te Awanga. The name Tiromoana means to look at, or to view the ocean.

Hastings region

Heretaunga hāro te kāhu – 'Heretaunga whose beauty can only be seen through the eyes of a hawk'. The name for Heretaunga acknowledges that air above Heretaunga was the domain of birds of prey such as hawks, which would soar and swoop above the land in search of food.

Heretaunga haukū nui – Heretaunga of life-giving dews. This name acknowledges that Heretaunga's richness is in the fertility of the land. Because of this, food can be grown so easily. The dampness of the ground also means it is common for the area to be covered in mist.

Heretaunga pongaihu mātaotao – Heretaunga where the tip of one's nose is chilled. This name is given in recognition of the Heretaunga in winter, when the nights are crisp and cool, bringing frost and a clear winter's day.

Te Mata o Rangokako is the full name of Te Mata peak, one of most well-known landmarks in the Heretaunga area. The name literally means the face of Rongokako, who was the grandfather of Kahungunu.

Central Hawke's Bay

Te Haukē – Te Haukē literally means contrary winds and breezes. This name refers to fact that the winds that blow at Te Haukē are localized and different to those that blow elsewhere.

Tukipoho – is the name of a pā that stood on the southern side of the Waipawa river. It is still visible today above the road that runs to from the State highway to Ongaonga. The name Tukipoho refers to a type of head-wind.

Pukekaihau – was the name given to the pā that stood on the hill just behind the town centre of Waipukurau. The meaning is the hill where one tastes or eats the wind.

Haumoana – mārama tonu te tikanga o tēnei ingoa, arā mō te hau o te moana.

Tiromoana – ko te ingoa tēnei o tētahi pā tawhito i tū i runga i ngā puke i muri ake o ngā kāinga o Te Awanga. He wāhi pai te wāhi rā hei mātakitaki, hei titiro ki te moana kei waho e hora ana. Nō konei tōna ingoa.

Heretaunga

Heretaunga hāro te kāhu – E ai ki ngā kōrero, mā te rere ki te rangi pērā i te kāhu kātahi e kitea ia te ātaahua o te whenua o Heretaunga. Ko ngā rangi o Heretaunga he rangi i rērere haere ngā manu pērā i te kāhu me te kārearea. Ka topu, ka tiu, ka hāro haere i ā rātou e mātai haere i te whenua i raro mei kore e kitea he kai mā rātou.

Heretaunga haukū nui – He kōrero tēnei mō te āhua o te whenua, arā, tōna pai mō te whakatipu kai. Arā, he whenua haumako, he whenua mōmona. Nā konei he matomato te tipu o ngā kai. Nā te haukū e kitea ai te kohu e tatao ana i runga i te whenua.

Heretaunga pongaihu mātaoatao – I te wā o te Takurua, he wāhi makariri a Heretaunga, ā, hei ngā pō ka rongohia te makariri, ā, hei ngā ata ka kitea he mā te haupapa kua takoto ki te whenua.

Te Mata o Rongokako – ko tēnei te ingoa tūturu mō Te Mata Peak. Koia anō tētahi o ngā wāhi rongonui puta noa i Heretaunga. Mō te tipuna mō Rongokako tēnei ingoa. Ko Rongokako te tipuna o Kahungunu.

Tamatea

Te Haukē – e kōrero ana tēnei ingoa mō te āhua o ngā hau ka pupuhi i roto o Poukawa, arā, he hau rerekē ki ērā o ētahi wāhi, ā, he hau motuhake.

Tukipoho – he pā tāwhito a Tukipoho kei te taha tonga o te awa o Waipawa. Ka kitea tonutia ōna tohu i ēnei rā, kei runga ake i te huarahi e haere atu ana i Waipawa ki Ongaonga. He momo hau te tukipoho, arā, he hau pā uma.

Pukekaihau – he pā tawhito hoki a Pukekaihau, ā i tū i runga i te puke i muri tonu i te tāone o Waipukurau. Ko te tikanga o tōna ingoa e mea ana he puke, he wāhi e rongo ai te tangata i te hau pupuhi.

Activity 5

Learning purpose: We need fire to live and stay warm and it must be handled with care.

Success criteria: Students can discuss the reasons we need fire.

Curriculum link: Learning Languages

What you'll need

Maui's story (page 14)

Let's Discuss

- Read the story of how Maui obtains the secret of fire with the class.
- Have the students discuss the answers to these questions:
  - Why did Māui need fire?
  - Why do we need fire?
  - What 5 rules could we have for lighting fires? (1 for each of Mahuika's fingernails)
  - What can we learn from Māui's story?
  - After reading Māui's story create a storyboard to show the story of events – how things were, what happened, who did what, what was achieved and what people thought and felt along the way. Storyboards are also useful for communicating to others about what the process has been.

Chapter 4

What happens when wood burns?

Teachers' notes

Efficient combustion (burning) of wood in a fire or stove creates light, heat, water vapour, carbon dioxide and ash

However, inefficient combustion also produces wood smoke, which contains major air pollutants. As wood burns, there are four different stages that occur as the fire temperature rises:

Stage 1: water boils off

- moisture vaporises, and escapes.
- more energy is used up vaporising the moisture than is used to produce heat.
- heat energy should be warming the house, instead of drying the wood before it burns.

Stage 2: vaporises wood gases

- the wood starts to break down chemically, and explosive gases are formed, including tars.
- temperature is too low to burn gases and tars, so they escape up the chimney.
- some gases will combine with water vapour to form highly flammable creosote that sticks to the chimney walls.
- other gases condense into smoke particles, which you can see.

Stage 3: flames

- the escaping gases start to mix with the air, break into flames and burn.

Stage 4: log charcoal burns

- log charcoal burns and emits heat.
- produces most of the fire's usable heat.
- this temperature must be maintained, along with a sufficient air supply.
- only a small amount of ash will remain.

What happens when wood burns?

Activity 6

Learning purpose: Greenhouse gases such as carbon dioxide (CO_2) stay in the atmosphere and act like a sheet of glass on a glass house.

Success criteria: Students can write up the experiment and explain what happened and why.

Curriculum link: Science

What you'll need

- Green house
- Thermometers
- Jar
- Cardboard
- A rubber band

Ask the question 'Can we grow tomatoes in winter in New Zealand?' Explain what a greenhouse is and how gardeners use them to grow plants that thrive in warm temperatures.

Explain to the class that some gases in our atmosphere act like a greenhouse - a sheet of glass around our earth - trapping some of the heat from the sun. Explain that this is a natural process and keeps our planet warm.

Ask the question 'What would happen if there were no greenhouse gases? '

Answer: the earth would become too cold to support life such as us.

Greenhouse in a jar

Wrap a thermometer in a piece of cardboard and secure with a rubber band.

This is so the thermometer is protected from direct sun (it's the air temperature that you want to measure).

Repeat with the second thermometer. Place the fully wrapped thermometer inside the jar and put the lid on.

Place the other thermometer outside the jar but with the mercury facing down so it's also protected from direct sunlight.

Place the jar and the thermometer on a sunny windowsill, making sure they are shielded from the sun, or place both under a lamp.

Ask the children to record the temperatures of both thermometers on a regular basis, e.g. every 10 minutes for an hour or twice a day for a week.

Children plot this information in a bar chart or graph.

Teachers' notes

Burn only seasoned firewood!

Burning materials other than seasoned firewood will produce poisonous, corrosive smoke and fumes. This can damage your burner and affect the health of your family and neighbours.

Firewood should dry, or season for a minimum of 6 to 12 months after splitting. Hardwoods dry more slowly than softwoods and may take over a year to dry. Seasoned firewood by definition contains no more than 25 percent moisture by weight. Wood dries faster in a warm storage area with air circulation.

When buying wood advertised as "seasoned" you should:

- Look for dark coloured, cracked ends, with cracks radiating from the centre like bicycle spokes.
- Feel how heavy the wood is. Dry wood should be lighter because it contains less moisture (hardwood logs will be heavier than softwood).
- Listen - hit two pieces together. Wet wood makes a dull "thud" sound. Dry wood rings with a resonant "crack", like a ball hitting a cricket bat.
- Look for easily peeled or broken bark. No green should show under the bark.

Start your fire with softwood kindling

Pine is a softwood, low in density; it will ignite easily, burn fast and hot and will heat the firebox and flue quickly. Pine is ideal as kindling and for starting your fires, but forms creosote easily due to its high resin (sap) content.

Burn longer and cleaner with hardwood

Hardwoods (gum and manuka) are denser and take longer to ignite, but burn slower and more evenly, producing less smoke. They also give more heat energy than softwood logs of the same size.

Activity 7

Learning purpose: Only clean, seasoned wood, fireplace logs, and non-glossy paper should be burnt.
Burning bad materials will produce poisonous, corrosive smoke and fumes which will affect the health of your family and neighbours.

Success criteria: Students can correctly identify items that can and should not be burnt.

Curriculum links: Health and Physical Education

What you'll need

- photocopy words below
- big paper for each group

Have students sort the pictures into the chart

Yes	No	Maybe

Rubbish

Rubber (Tyres)

Particleboard

Plywood

Glossy/ coloured paper

Solvent or paint

Oil

Charcoal

Painted / treated wood

Seasoned wood

Newspaper

Chapter 4

Investigating your home heating

Teachers' notes

Volatile gases are formed if the wood is not burned hot enough.

Half of the wood's heat value is contained in these gases. So, if these gases are not completely burned, not only do they contribute to air pollution, but they waste half the energy (and half the cost) of the firewood.

Keeping the fire hot will also reduce creosote deposits inside the chimney. Creosote is a highly flammable substance produced by the incomplete combustion of wood, which is a safety concern if left to build up in the chimney or flue.

The heating efficiency of any wood burning fire depends on the combination of two things:

1. **Combustion efficiency** - how completely the firewood burns.
2. **Transfer efficiency** - how much of the fire's heat gets into the room, rather than going up the chimney.

When it comes to heating, open fires are like open doors...

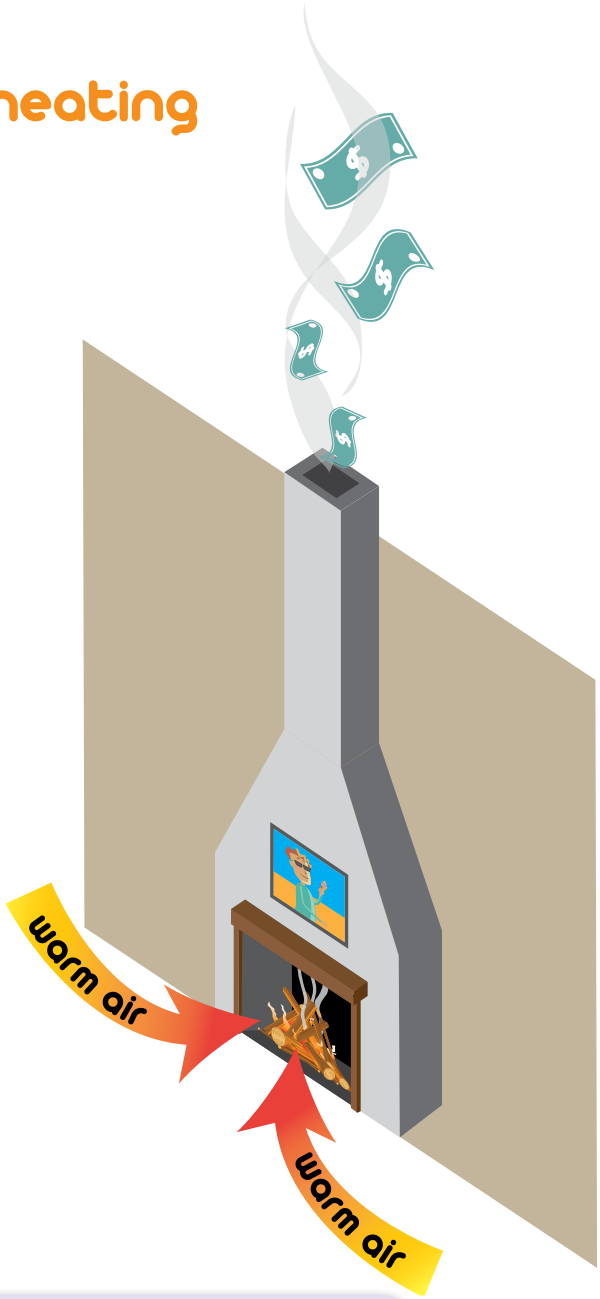
Open fireplaces rob your house of heat because they draw air from the room and send it up the chimney! Outdoor air leaks in to replace the hot air going up the chimney.

Typically, open fires produce warmth for people within six feet of the fire, but fail to heat the rest of the house. They also produce large amounts of air pollution. For these reasons, Hawke's Bay Regional Council banned the use of open fires from 2012 for residents in Airzone 1 in the Napier and Hastings Airsheds.

By banning the use of open fires in Napier and Hastings and only allowing low emission wood burners (which don't pollute the air so much), people have a chance to find cleaner alternatives to heat their homes.

Watch for smoke signals!

Apart from the 15 minutes after lighting and refuelling, a properly burning fire should give off only a thin wisp of white steam. If you see smoke, adjust your dampers or air inlets to let in more air. The darker the smoke, the more pollutants it contains and the more fuel is being wasted.



QUICK FACT

NEVER burn driftwood from the coast or chemically treated timber on an indoor fire. Burning these releases chemicals that can make you very sick!

Family letter

Dear family...

At school, we have been working on a unit called *Clearing The Air.* During the past few weeks we have been learning about how Hawke's Bay has a winter air quality problem.

Hawke's Bay Regional Council developed an education kit that provides our class with information about air quality, why winter air pollution happens, and most importantly, what we can all do at home to help. We have been doing activities and experiments to learn things like:

- Air as a gas that is a mixture of many different gases.
- Air does not have a specific volume or shape.
- All animals need air to live – including humans
- Green plants use a process called photosynthesis to clean the air.
- A smoky fire is a polluting fire.

I encourage you to talk to your child about the learning and experiments that we have been doing in class. As an end to this unit, we would like each student to take some action both at home and at school to positively affect our air quality.

I will be sending home 2 activities to complete as a family. These activities will be the homework activities for the next 2 weeks.

- Home Heating Interview
- We Can Make a Difference –Take Action

I look forward to hearing about the changes that your family has made as a result of these activities. If you have any questions about these activities please contact me.

Kind regards,

Teacher Name

Chapter 4

Investigating your home heating

Activity 8

Learning purpose: Inefficient, unhealthy woodburners cause air pollution and cost families more to heat their home.

Success criteria: Students work with their family to investigate their home heating

Curriculum links: Social sciences, Technology and Mathematics

Home heating interview

1. What is the main source of heating in your home? (e.g. wood burner, open fire, gas fire, flued gas heater, electric heater or heat pump)
2. What second form of heating do you have? (e.g. electric heaters in bedrooms)
3. Does your house have insulation in the ceiling and under floor? (ask your parents/ caregiver to help you look in the ceiling and under the house)
4. Does your house have other insulation? (e.g. in walls)
5. Does every window in your house have curtains?
6. Are the curtains thick enough to keep the cold out?

Energy investigations – you will need adult help with this

7. Compare a February (summer) and a July (winter) electricity bill for your house.

Summer bill total: $ .....

Winter bill total: $ .....

8. Estimate how much your household spends on other heating costs each winter (apart from electricity).

Gas $..... **Firewood $**..... **Other (** ..... **) $**

Remember, energy efficiency is all about saving energy and saving money. This means paying less and staying warmer.

What can you do to help

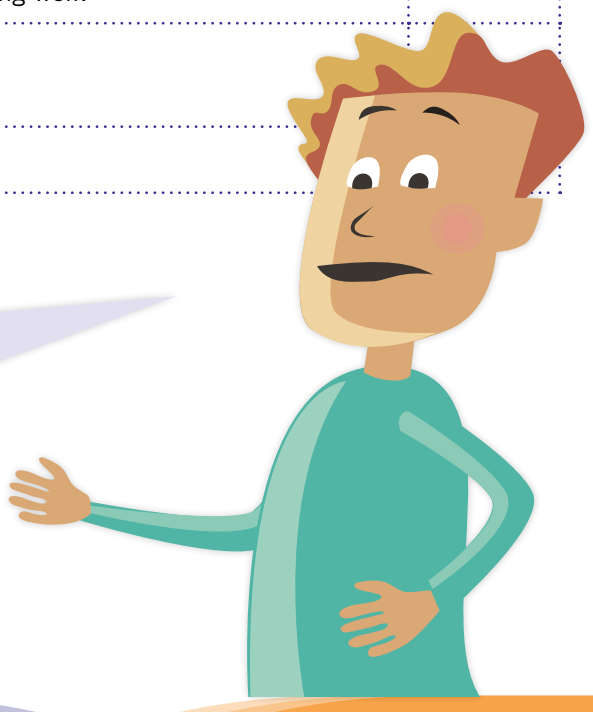
What my family can do	✔	What I can do	✔
Insulation			
Block out draughts around doors and windows with door snakes or draught stopping tape		Make a door snake (see instructions overleaf)	
Install or upgrade ceiling insulation		Shut doors to rooms that aren't being used.	
Buy good thick curtains for all windows		Close all the curtains when it starts to get dark to keep the heat trapped inside.	
Block out draughts around doors and windows with door snakes or draught stopping tape		Insulate yourself first by putting on an extra layer of clothing instead of lighting the fire.	
Cleaner burning			
Only use dry firewood. Don't burn treated or painted timber or driftwood		Help stack firewood correctly	
Store firewood correctly (see more on pg 28)		Bring wood in to dry before burning	
When adding wood to the fire don't overfill - leave plenty of room for air to circulate.		Help with sorting the recycling. Why not make a separate bin inside for unwanted paper?	
Hire a chimney sweep to clean the flue out for more effective burning.		If you are helping with the fire only use small pieces of kindling until the fire is burning well.	
Don't burn household rubbish – plastics and paper are all better to be recycled.			
Burn smaller logs - no more than 15cm			

HOUSTON SAYS:

For more tips check out

www.hbrc.govt.nz

keyword: Clearing the air



Activity 9

Make a draft stopper!

What you will need:

- fabric (twice as wide as your door – for each side)
- measuring tape
- scissors
- needle and thread
- pins
- sewing machine
- a funnel to add the stuffing
- something to stuff the draught stopper – dried beans, gravel stones, rice, scrunched up plastic bags… Use what you have around!

Use found objects where you can.

Instructions

1. Use the measuring tape to measure the width of your door. This is the length of fabric you will need. You can use any kind of fabric – try something you have leftover. Even some old pants could work well. The fabric needs to be approximately 150mm wide also.

2. Fold the material in half lengthwise with the wrong side of the fabric facing up.

3. Sew the long edge and one of the short ends together and turn inside out.

4. Fold the top (unsewn) edge of the fabric over about 15cm towards the middle of the fabric and pin in place.

5. Use the sewing machine to sew this pinned seam. This is the tab that attaches to the door.

6. You can now stuff the tube – use your hands or the funnel to help. Remember to make it quite full so it blocks the draft effectively. If you are using something like rice or dried beans you might like to put it in plastic bags before adding to the tube so it doesn't fall out the sewn seams.

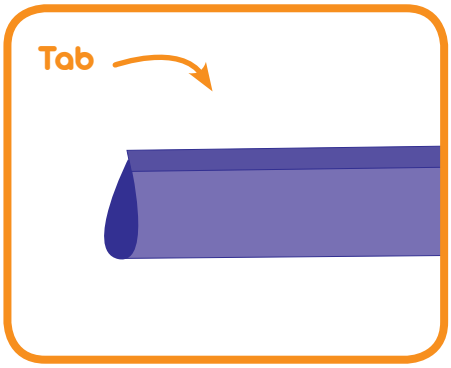
7. When the tube is as full as you would like, sew the final two edges together. Ta-da! You have made one tube!

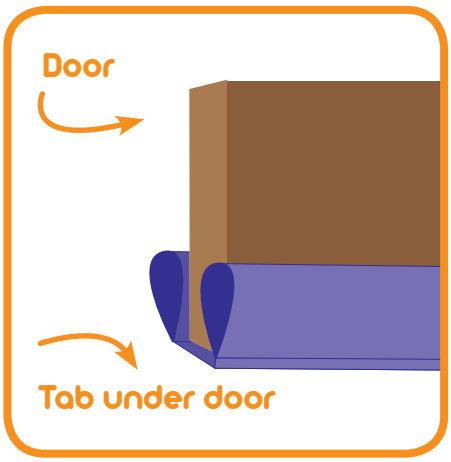
8. Repeat steps 1-7 to make another tube for the other side of the door.

9. When you have your two identical tubes, lay one on top of the other and pin the two tabs together.

10. Sew along this pinned part to join the tubes.

11. To use - slide the sewn tab under the door so the filled tubes are on either side of the door. When you push the door it should push the tubes along the floor rather than rolling over.





What can you do to help

Activity 10

Learning purpose: We can all take action and make a positive difference to our air quality.

Success criteria: Students can report back to class with progress of their action.

Curriculum link: Social Sciences

If we want to have less winter air pollution, we all need to make some changes.

Actions I can take	✔	Results Expected	✔
e.g. Only use dry firewood		Decreased levels of particle matter in the atmosphere	

Your air diary

This activity is best done between June and July, when air pollution levels are highest. Photocopy the diary page so that you have enough pages for a week of monitoring. Each evening, check the weather forecast and make a pollution prediction based on the forecast. Check this with the air pollution forecast made for Hastings, Napier and Central Hawke's Bay on www.hbrc.govt.nz. As late in the evening as you can safely go, take a short walk around your neighbourhood and record what you observe. The next morning, record what the weather was actually, and find the air pollution readings at, www.hbrc.govt.nz.

Day:

Date:

Weather forecast (short description): _____

_____

Your pollution prediction: Hardly any — Slightly smoggy — Getting nasty — Chokin'!

Evening walk: 5-10 minutes: Your observations: _____

_____

Smell of pollution - how bad: Didn't notice — Slight stink — Getting nasty — Can hardly breathe!

How many smoky chimneys did you see tonight? _____

Did you do any outdoor activities (apart from the walk) e.g. sports practice?

_____

Next day:

Weather report: Minimum temperature: _____C. Wind: _____ Frosty? Y / N

Air pollution (PM_{10}) reading from HBRC website: _____ micrograms per cubic metre of air.

Day:

Date:

Weather forecast (short description): _____

_____

Your pollution prediction: Hardly any — Slightly smoggy — Getting nasty — Chokin'!

Evening walk: 5-10 minutes: Your observations: _____

_____

Smell of pollution - how bad: Didn't notice — Slight stink — Getting nasty — Can hardly breathe!

How many smoky chimneys did you see tonight? _____

Did you do any outdoor activities (apart from the walk) e.g. sports practice?

_____

Next day:

Weather report: Minimum temperature: _____C. Wind: _____ Frosty? Y / N

Air pollution (PM_{10}) reading from HBRC website: _____ micrograms per cubic metre of air.

What can you do to help

What family can do	I can do
• Put draught-stopping tape around doors and windows • Install or upgrade ceiling insulation and buy thick curtains for all windows • Consider replacing the fireplace with a cleaner form of heating especially if its an open fire or old wood burner • If using wood, buy it at least 6 months early so it dries out properly before use • Only use dry firewood and never burn treated or painted timber • Store firewood in a dry sheltered place • Visit www.hbrc.govt.nz for funding and suitable firewood and heating options	• Make a door snake • Shut doors to rooms that are not being heated • Close all the curtains when it gets dark • If my family does use a fire, teach everyone how to make it burn cleanly • Bring wood indoors • If I am allowed to help set up the fire, use small pieces of kindling, only add larger pieces once the fire is burning well • Wait about 15 minutes after the family starts the fire and look to see how much smoke is coming out of the chimney

QUICK TIP

1. You can recycle cardboard and waste paper by making fire bricks which can be burnt instead of logs.
2. Fire bricks can take a long time to dry. Make your bricks in Summer and they'll heat your house in Autumn.
3. Don't use glossy paper like magazines it has a coating and ingredients that are toxic when burnt.

Fire brick makers, also called briquette makers are available at fireplace shops and online for around $40.

What can you do to help

I wood, would you?

If you and your family are going to be using a wood burner this winter one of the most important things you can do is make sure your wood is dry and stored correctly. This will not only help prevent air pollution but will also mean your fire will burn better and keep you warm for cheaper!

Storing your wood correctly

Follow these 4 easy steps for the perfect wood pile!

1. Choose a sheltered location with good airflow

Under your deck or under the eaves of your house are ideal places to keep your wood pile. The key is to choose somewhere sheltered from the rain and with good airflow.

2. Keep your wood off the ground

Moisture from the ground can make your wood wet which makes it burn less effectively. An old wood pallet is ideal for keeping wood off the ground.

3. Stack your wood in a criss-cross pattern

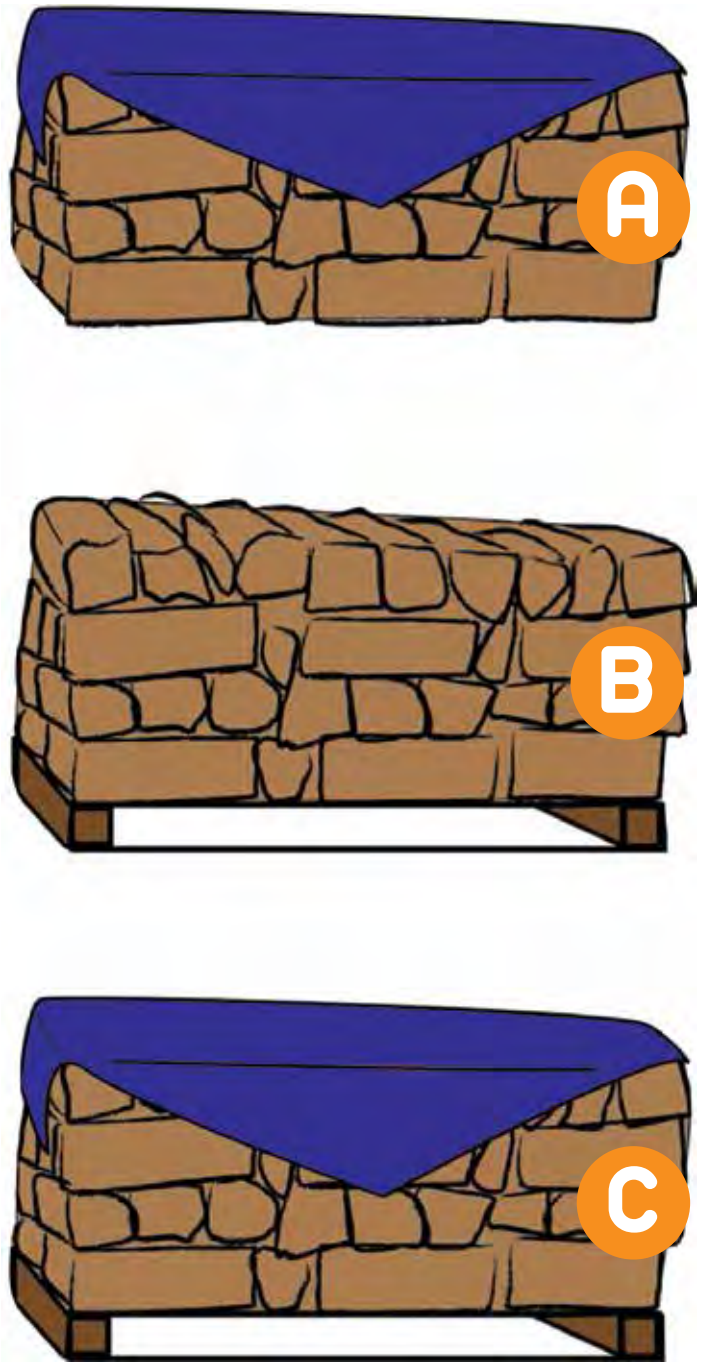
When stacking it is best to do a criss-cross pattern (see pictures) as this will help air circulate through the wood. When there are air gaps, the wood dries quicker.

4. Cover your wood

The final step to creating a good wood pile is to cover the top of your stack with a tarpaulin.

Can you spot the correct wood pile?

Take a close look at these wood piles... one of them is the perfect way to stack your wood this winter. Which is it? Do you know why?



Air Quality Word Find

B	Q	D	C	A	M	W	I	N	T	E	R	D	E	U	P
R	E	G	I	O	N	A	L	C	O	U	N	C	I	L	A
I	N	V	E	R	S	I	O	N	L	A	Y	E	R	Y	R
G	A	I	A	I	K	P	B	A	Y	H	F	U	E	L	T
H	I	L	P	A	A	U	W	P	H	T	U	V	G	O	I
T	R	B	N	W	Z	K	G	I	N	R	G	N	U	P	C
F	Q	R	V	G	W	U	T	E	N	C	O	A	L	K	U
L	U	E	T	Y	S	R	V	R	U	D	S	I	A	H	L
A	A	A	C	L	E	A	N	H	E	A	T	O	T	A	A
M	L	T	U	P	X	U	F	M	J	D	A	P	I	S	T
E	I	H	P	O	L	L	U	T	I	O	N	R	O	T	E
S	T	E	J	L	E	D	Q	I	H	A	D	G	N	I	S
M	Y	H	K	B	C	H	E	M	I	C	A	L	S	N	F
O	S	T	B	Y	U	C	R	K	P	S	R	J	Q	G	D
K	W	R	F	C	D	R	Y	W	O	O	D	S	A	S	C
E	M	I	S	S	I	O	N	S	L	A	S	T	H	M	A

AIR QUALITY
ASTHMA
BREATHE
BRIGHT FLAME
BURN
CHEMICALS
CLEAN HEAT
COAL
DRY WOOD
EMISSIONS
FUEL
HASTINGS
INVERSION
LAYER
NAPIER
PARTICULATES
POLLUTION
REGIONAL
COUNCIL
REGULATIONS
SMOKE
STANDARDS
WAIPUKURAU
WAIROA
WIND
WINTER

Big picture thinking ideas

Inefficient, unhealthy wood fires cause air pollution and cost families more to heat their home. If you have a wood burning fire at your home, here's what your family can do.

- Plan ahead and buy firewood in summer so that it dries out in time for winter. If you have to buy firewood in winter, try to find seasoned, dry firewood.
- Store firewood under cover, in a well-ventilated and sunny place. If stored outdoors, cover the top, *but not the sides,* so that air can get in and help dry the wood.
- Do not use lighter fluids or other flammable liquids to start a fire.
- Use the right wood at the right time. Lighter wood (often called 'softwood') like pine is good for making kindling and getting a fire started. Once you have a good bed of embers burning, denser wood (hardwood) will burn for longer and give more heat.
- Build a small, very hot fire first. Keep the fire hot, and the air setting high enough for a clean burn with no smoke. Place logs on a good bed of glowing embers with enough room to let sufficient air move between them.
- Regulate the heat output by adjusting the amount of fuel (wood) you load, not by dampening the air control.
- Never burn rubbish, plastics, wrapping paper, treated wood or driftwood. These can corrode your wood burner and flue and give off poisonous fumes.
- Never burn coal in a wood burning fireplace. Coal emits oxides of nitrogen and sulphur along with carbon monoxide and often burns too hot for the fireboxes in wood burners.
- Close the doors and damper when the fireplace is not in use, so that air does not escape up the chimney.
- Unless you have central heating, close the doors on all unused rooms to keep the heat where its needed.
- Check your insulation in the roof and under the house. This can make a big difference to how warm your house is, and therefore how much wood you need to burn to heat it. The warmer your home, the less money you'll need to spend on heating.

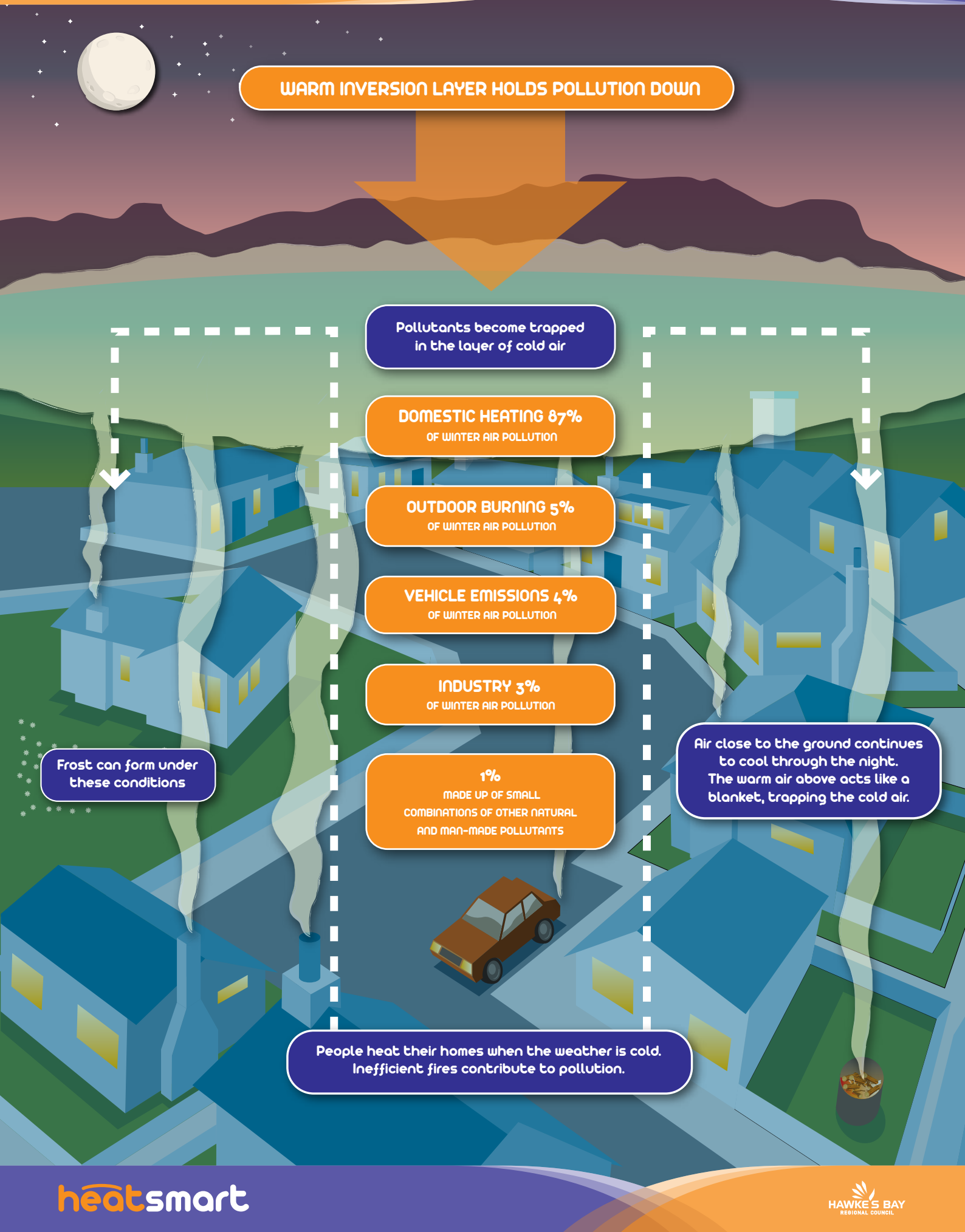
REMEMBER

Always ask an adult to load and light the fire.

Clearing the Air

The Inversion Layer

Chapter 3



Chapter 3

The inversion layer

Teachers' notes

In winter, inversion layers trap pollutants in cold air beneath a layer of warm air.

Normally, the air nearest the ground is warmest, but the climatic condition known as inversion turns this on its head.

How it happens:

- In certain areas, cold air will settle.
- As the sun sets, the air close to the ground cools more rapidly than the air above it and continues to cool through the night.
- The warm air above it acts like a blanket, preventing it from dispersing. If there is no prevailing wind, the air does not circulate, creating still, frosty conditions.

This phenomenon can have a big effect on air pollution in Hawke's Bay during winter. When it's cold and frosty, many people heat their homes with wood fires. The warm blanket of air created by inversion stops the pollutants from rising and traps them close to the ground. If wind is light or blocked by surrounding hills, pollution will settle over the town.

This is not a problem in areas where the air is cleared by strong, frequent winds. However, it is a problem in Napier and Hastings on calm, cold and clear nights. These are when Hawke's Bay has the worst winter air pollution problems.

The good news is that by using dry wood and the right fuel, it's not difficult to keep wood smoke pollution to a minimum. Even better, it can also save your family money on home heating costs.

QUICK FACT

Motor vehicles produce more air pollution than any other single human activity. One full commuter bus can mean 40 less cars going through your neighbourhood.

The inversion layer

Activity 1

Learning purpose: The shape of the land in some areas of Hawke's Bay can trap pollution. Sometimes, still and frosty weather prevents pollution from being blown away.

Success criteria: Students can successfully complete the inversion layer worksheet.

Curriculum link: Science

In the space below, draw a picture to show the shape of the land and the weather that can trap pollution. Include an ARROW to show the directional force of weather and how pollution can travel.

1. What time of year are you most likely to see air pollution? Circle the best answer.
   Summer **Autumn** **Winter** **Spring**
2. What kind of weather conditions cause pollutants to be trapped? Circle the best answer.
   cold & windy **warm & windy** **cold & still** **cold & windy**
3. Why would temperature inversion make air pollution problems worse?

The inversion layer

Activity 2

Learning purpose: Different temperature air moves at different rates. Layers of air at different temperatures.

Success criteria: Students can successfully identify the different methods of movement relative to air temperature.

Curriculum link: Science.

What you'll need:

- two glass cups / jars
- hot water and cold water
- index card
- matches or lighter
- piece of string or twine

The Experiment

Rinse one jar with very cold water and the other with very hot water. Dry them thoroughly. With the index card between them, place the jars with the open ends facing each other. Make sure to put the warm jar on the bottom.

Light the string so that it smokes. Put the smoke in the bottom jar by lifting the index card and top jar. When the smoke fills the bottom jar, pull out the string (and put into water to stop it burning). Pull out the index card and have the students discuss and record what happens to the smoke.

Do the same experiment, but put the cold jar on the bottom and the warm one on top. What happens this time?

The Explanation

When the warm jar is on the bottom, the smoke rises from the lower to the upper jar. The smoke rises to the warm air and the cold denser air sinks.

When the cold air is on the bottom, the smoke is trapped and cannot rise. The warm air is trapped below the cold air and the smoke is also trapped.

This is what happens in the earth's atmosphere when a layer of warm air holds down the dust particles. This is an air inversion.

Let's Discuss

What do the different glass cups represent?
What happened when the warm jar was on the bottom? Why?
What happened when the cold jar was on the bottom? Why?
What would dilute the pollution? (Wind or a storm)

QUICK FACT

We cannot change the topography or weather conditions, but we can improve the way we use our fuel when burning wood fires and using stoves, by burning dry, clean wood and keeping the fire hot. This will result in cleaner air for everyone in the community.

Teachers' notes

What causes Winter air pollution?

The four most common influences on winter air pollution:

- Topography or the shape of the land, such as rolling hills, gullies or flat paddocks.
- Weather conditions. Pollutants released during calm cold nights get stuck in an inversion layer and become more concentrated near the ground.
- The number of wood burners being used for heating and cooking within a particular area.
- Slow (inefficient) burning of wood fires results in incomplete combustion causing an increase of particulates in the air, including carbon monoxide and other harmful pollutants. Inefficient wood burning is usually caused by not enough air supply for the fire, the wrong type of fuel (including wet or damp wood) or the wrong amount of fuel.

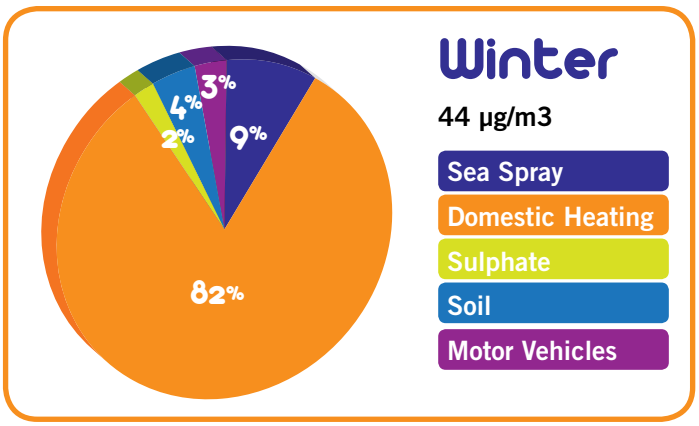
Seasonal air pollution levels

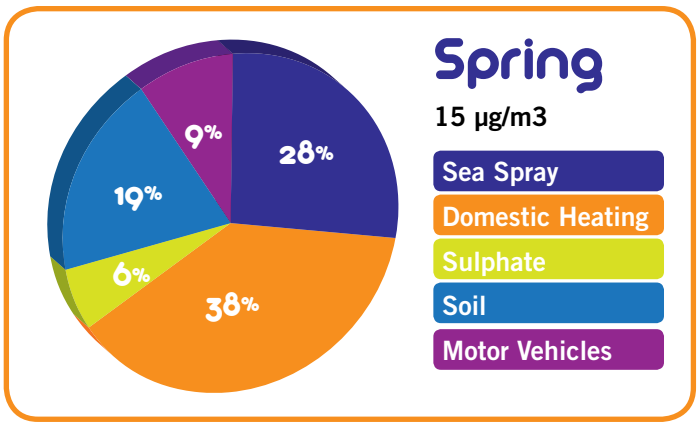
Air pollution affects thousands of Hawke's Bay residents every winter and can damage our health.

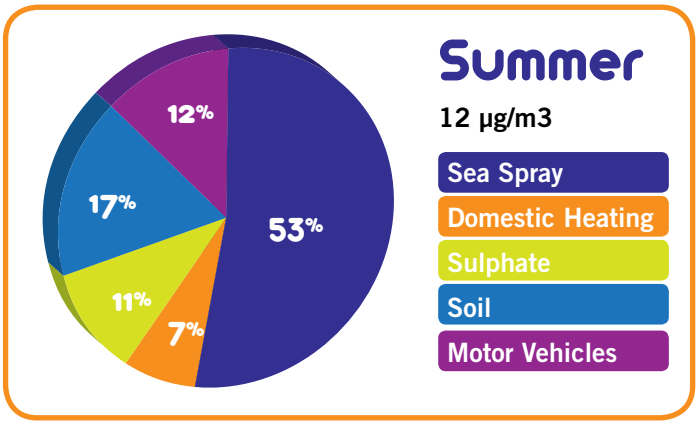
In winter, during cold nights with little wind, smoke and air pollutants stay close to ground level for long periods of time.

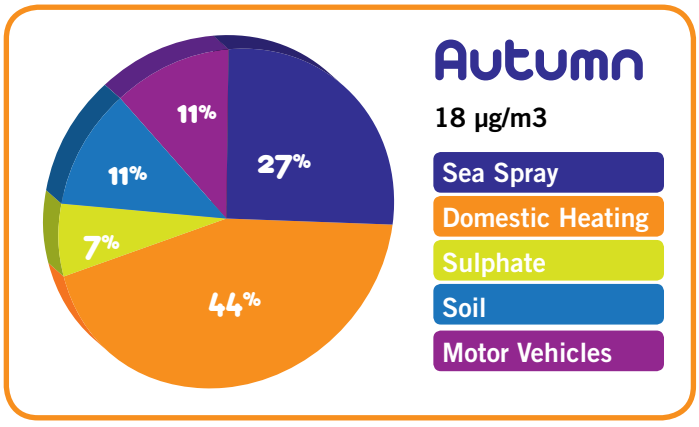
As you can see from the chart below, the contributors to air pollution levels change depending on the season and wood smoke pollution becomes much less of an issue outside of winter.

The tables below shows the seasonal changes to percentage concentrations in Hastings, using seasonally averaged 24hr PM_{10}









µg = micro grams

Source: "Source identification and apportionment of PM_{10} and $PM_{2.5}$ in Hastings and Auckland"

What causes winter air pollution?

Activity 3

Learning purpose: PM_{10} can come in different forms.
There are four main influences for winter air pollution.

Success criteria: Students can read and understand the seasonal comparison charts.
Students can discuss what influences winter air pollution.

Curriculum links: Mathematics, Statistics and English

What you'll need

- pie graph with seasonal variations (Chapter 3 page 5)

Activity 1 using symbols

Use the pie chart to compare the types of PM_{10} during different seasons.

Let's Discuss

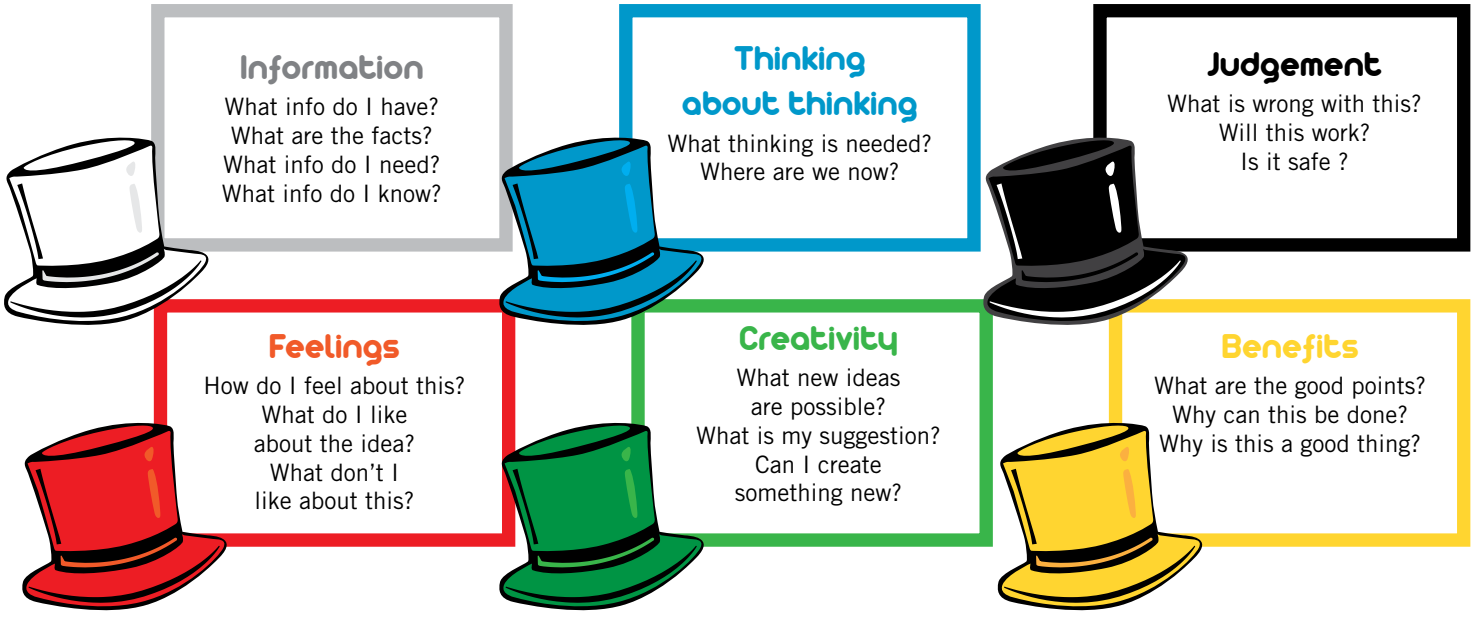
What do the different colours represent?
What are the major differences between the seasons?
What does the number in the corner represent?

Activity 2 learning log (learning talk)

A topic can have numerous ways to look at it in order to get a comprehensive picture. By pretending the user is wearing a specific coloured hat, they can look at a topic from that specific perspective while removing input from other aspects. Students should use their learning log to record their thoughts for each hat.

Here are some suggestions to get you started in the right direction:

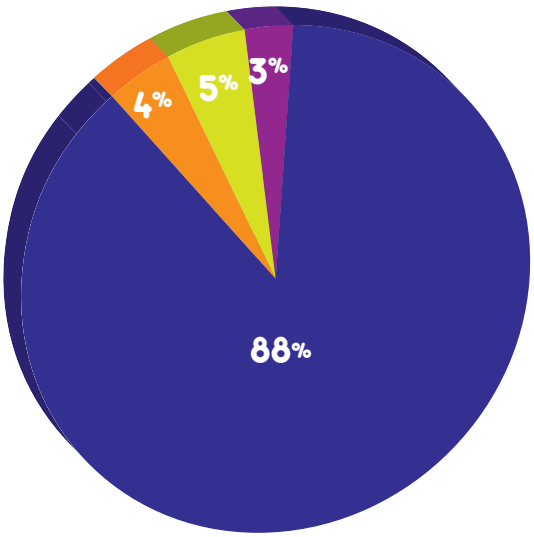
- I was surprised that... (white hat)
- I really liked... (red hat)
- I hope that... (blue hat)
- I didn't really like... (black hat)



What causes winter air pollution?

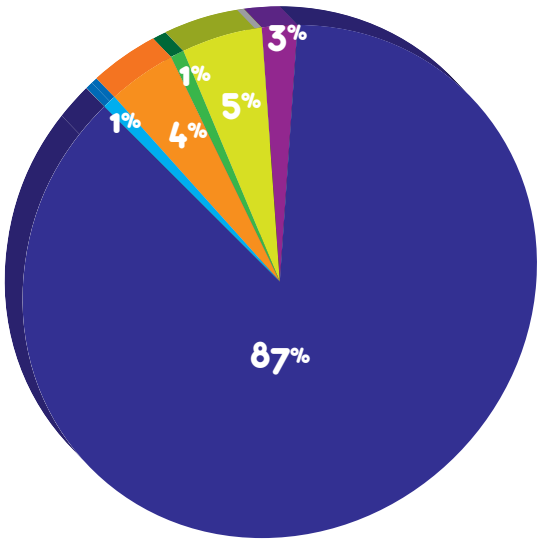
In order to comply with the National Enviromental Standards (NES) for PM_{10} by 2020:

Hastings PM_{10} emissions need to be reduced by 71%
Napier PM_{10} emissions need to be reduced by 47%



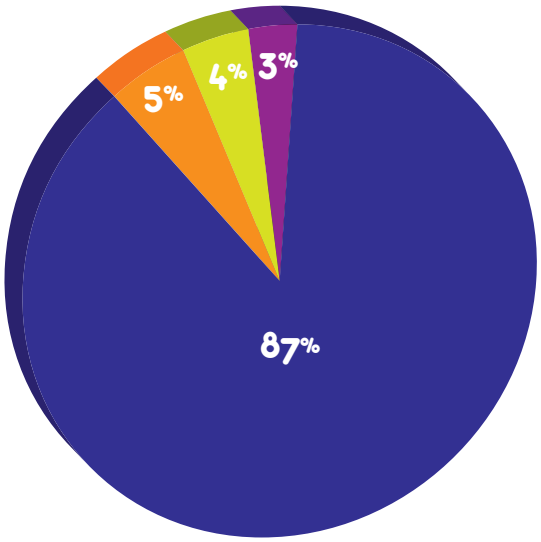
Daily PM_{10}
Winter, Hastings

Domestic Heating
Outdoor Burning
Motor Vehicles
Industry



Daily PM_{10}
Winter, Napier

Domestic Heating
Aviation
Marine
Outdoor Burning
Motor Vehicles
Industry



Air pollution can come from many different sources

A lot of people think our poor air quality is from industry around the area but the biggest cause of air pollution in the Hawke's Bay is home fires, especially wood burners.

Domestic Heating
Outdoor Burning
Motor Vehicles
Industry