Airwatch

WHO CARES ABOUT OUR AIR?
A workbook on air pollution for primary schools
Who cares about our air?
A workbook on air pollution from primary schools

AirWatch
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Introduction

The aim of this workbook is to develop environmental awareness in students, specifically about air pollution. It will help students realise how their own and their family’s behaviour contribute to air pollution problems and that they are the key to the solutions.

On completing this workbook, students should be able to:

• list the causes of air pollution
• discuss simple weather phenomena
• describe how weather affects air quality
• discuss how air pollution can be controlled
• examine alternatives for action
• relate air quality to their own activities
• develop positive feelings about clean air.

Student activities, located on the right hand pages of this workbook, are designed to be copied and given to students as required. Teachers notes are on the left hand pages.

Some of the activities can be carried out by individual students, while others are designed for small groups. Space is provided in many of the worksheets for written answers.

Further activity sheets headed ‘Eddie’s Extras’ can be used for extension work across the curriculum.
Unit 1: Let’s check out the air!

Unit summary
This unit encourages students to investigate the physical properties of air through observations, using their senses and some simple equipment. Students will also identify the ways they use air and the importance of clean air to them.

Background notes

The atmosphere
The atmosphere is a layer around the Earth which extends more than 100 kilometres from its surface. It is made up of air which has weight and exerts a pressure. There are four layers of the atmosphere – troposphere, stratosphere, mesosphere and thermosphere. The troposphere is the layer closest to the ground and contains the air which maintains all life.

Air
Air is colourless, odourless and tasteless, and is made up of a mixture of gases, some of which are essential for life, such as oxygen. Air exerts pressure around us and affects many of our daily activities. The gases in air are essential for the survival of the plants and animals on this earth and it is important for many things which we take for granted, such as the transmission of sound and the use of fire.

Clean air
Clean air is something we take for granted and rarely think about until its quality is so reduced that we start to observe health problems, especially in our very young and our elderly or those who already have respiratory conditions. Poor air quality can also have harmful effects on our plants or property.
What do we know about air?

Summary
These activities encourage students to think about aspects of their environment that they value. It captures students' interest, finds out what they think they know about air, and elicits students' questions about it.

Activity 1.1

Part A
Take the class for a walk outside the classroom and find a suitable place to sit down.

Ask students to look around and think about aspects of their environment that they value. Ask students to list on a piece of paper three things that they like most about the area in which they live, and explain why they chose those.

Divide the class into small groups. Students choose a leader for their group. The leader gives each person in the group two minutes to read out their choices regarding the best things about where they live and their explanations. Each leader makes a list of the aspects chosen by the group, and reports back to the rest of the class on the group's decisions.

Discuss with the class:
- What things do most people seem to like about this area?
- Which of these were present before roads and houses were built?
- How many students listed clean air as one of the aspects they liked about the area?

Part B
Ask students to close their eyes and think about the air around them. What does it feel like? What does it sound like? What does it taste like? What does it smell like? Ask students to open their eyes and then think about what the air looks like.

Discuss with the class:
- Their findings when using all of their senses and come up with words to describe air.

Activity 1.2

Ask students to write down what they know about air. Explain that this may be about the air they observed while outside or that it might be about other air that they have experienced.

Provide students with time to share what they have written down with the class and record their information about what they know about the air on a large piece of paper. (Post piece of paper somewhere up in the classroom so that students can refer back to it during the unit).

Ask students to share questions they may have about the air and record them on another large piece of paper. Questions may include:
- What is air made up of?
- Why do we need air?
- How clean is the air?
- How do we know air is there?

Refer to this question page as you go through this unit to see if any questions have been explored or answered through the activities and investigations in the unit, and to elicit and record further student questions about the air.
What do we know about air?

Activity 1.1
Think about aspects of your environment that you value. Picture the area in which you live. List three things which you like most about the area where you live.

1. ____________________________
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2. ____________________________
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3. ____________________________
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   Explain why you chose those:
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Activity 1.2
Make a list of all the things you know about air.

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Air – is it there?

Summary
Air is all around us and is essential for us to live. It cannot be seen, but by doing the following activities, the students will see that it does exist. They should be able to describe air as a colourless, odourless and tasteless gas.

Activity 1.3
Provide each student with a plastic bag. Have the students blow up the bag and observe.

Discuss with the class:
- What changes have occurred to the bag? (Increase in size, walls have become rigid, maybe the bag has gone misty on the inside)
- What has caused this? (The air from our lungs)
- Describe the air. (Colourless)
- Why are the walls of the bag rigid? (The air is pushing against them)
- Does it smell and taste? (No)
- Why do you think the walls are misty? (Water from our breath)

Activity 1.4
Give each student (or group of students) a small drink bottle and a balloon. Ask students to follow instructions on the activity sheet to undertake experiment.

The purpose of this activity is to show students that air takes up space (and has weight) so the balloon will not blow up.

Discuss with the class:
- What happened to the balloon? (It couldn’t be blown up)
- Why do you think this happened? (Because the air took up the space)

Activity 1.5
Provide each group of students a large glass jar, a clear glass and a cork. Ask students to follow instructions on the activity sheet to undertake experiment.

This activity shows that air takes up space.

Discuss with the class:
- Can you see the air in the glass? (No)
- How does this experiment show that air is present in the glass? (Because it pushes the water out of the way)
Air – is it there?

Activity 1.4
Air is all around us and is essential for us to live. It cannot be seen, but by doing the following activities, you will see that it does exist.

Materials
• One small plastic drink bottle
• One balloon

Instructions
1. Push a deflated balloon into a drink bottle and stretch the open end of the balloon back over the bottle’s mouth.
2. Predict what will happen if you tried to blow the balloon up.
3. Now blow up the balloon.

Questions
What happened?

Why do you think this occurred?

Was your prediction correct?

Activity 1.5

Materials (per group)
• Large glass jar
• Clear glass
• Cork

Instructions
1. Pour water into a large glass jar until it is half full.
2. Float a cork on the top of the water.
3. Lower a drinking glass, mouth downward, over the cork.

Questions
What do you observe?

Draw your results.

Summary
What have these two experiments shown you about air?
Pushy air

Summary
These activities show that air exerts a force which can be observed through experiments. Normally, air pressure acts in all directions so we are often unaware of it.

Activity 1.6
In this activity, when the air is driven out of the can by boiling the water (hot air rises when heated), the air pressure on the outside crushes the can.

Materials
- Tin can with an airtight lid
- Gas stove
- Water

Teacher demonstration only
Put a small amount of water into a new tin can. Heat the tin without the lid on until the water is boiling. Allow to boil for several minutes. Take the can off the heat and quickly screw on the lid. Observe what happens.

Discuss with the class:
- What happened to the tin? (The tin buckles inwards).
- Why do you think this happened? (Air pressure outside is greater than pressure inside the can).
- Air exerts pressure. Scientists use a special instrument to measure air pressure. What is this instrument called? (Barometer)

Experiment (d) shows that air flows from an area of high pressure (in the balloon) to an area of low pressure (the air). This can help initiate a discussion on winds.

Experiment (e) shows that when air pressure on top of the water is no longer pushing down the air pressure outside the can stops it from flowing out.

Experiment (f) shows the power of the column of air trapped in the straw.

Arrange students into groups and provide each group with materials listed on the activity sheet. Ask students to follow instructions as per the activity sheet.

Discuss with the class:
- What is keeping the water in the straw and the cardboard on the glass? (Air pressure).
- Why can’t you suck up through the straw? (Because the air can’t push down on the water surface).
- What’s happening to the air in the balloon? (It’s moving from high pressure to low pressure).
- What’s keeping the water from coming out of the can? (Air pressure on the outside of the can).

Activity 1.7
This activity is made up of several simple exercises illustrating the effect of air pressure, which normally acts equally in all directions:

Experiments (a), (b) and (c) show the effect of air pressure acting in one direction.
Pushy air

Activity 1.7
These activities show you that air exerts a force which can be observed. Normally, air pressure acts in all directions so we are often unaware of it.

Materials (per group)
- 2 straws
- Heavy paper
- Balloon
- Opened can
- Water

Instructions
a. Place the end of a straw into water. Cover the other end with your finger; raise the tube out of the water. What do you observe?

b. Cover a glass tumbler full of water with a square of heavy paper. Hold the paper and turn it on its side, then upside down. Describe what happens when you take your hand away.

c. Fill a small jar with water. Make a hole in the lid big enough for a straw to go through. Put a straw into the water through the hole and seal up the space around the straw with modelling clay. Now try to suck water through the straw. Be sure there are no leaks. What happens?

d. Prick an inflated balloon with a pin. What happens? Why do you think it happens?

e. Put a hole near the bottom of an opened can and then put some water in the can. What happens to the water? Put some more water in the can. This time put your hand over the top of the can to completely seal it. What happens now? Why do you think this happens?

f. Place your finger over one end of a straw and hold a potato in the other. Now quickly jab the straw into the potato. Describe what happens. Explain your results.

Extension
These experiments show you air pressure in action. In your own words try to explain what you think air pressure is?
The atmosphere

Summary
In this activity, students learn that the air forms a layer around the Earth called the atmosphere and explore its characteristics. It can be done as a library activity or homework exercise.

Background information
The world’s atmosphere extends more than 100 kilometres from its surface. It is made up of air which has weight and exerts a pressure. This air is a mixture of gases including oxygen, nitrogen, carbon dioxide, water and other gases as well as water particles.

It also contains some solid particles such as ash, dust, sea salt and particles from fires. The four layers of the atmosphere are shown in the diagram.

The troposphere is about 15 kilometres high and contains about three quarters of the air in the atmosphere. This is where the weather occurs. As you go higher in the troposphere, the cooler it becomes.

The air is also less dense (more spread out) the higher you go. That is why it is difficult to breathe at high altitudes.

The stratosphere is the next layer from 15 to 50 kilometres. As you go higher in the stratosphere the temperature increases due to the presence of ozone which absorbs energy from the sun, heating the air in this region.

Activity 1.8
Using background notes above, explain to students that air forms a thin layer around the Earth called the atmosphere. Demonstrate this by cutting an apple in half. If the apple was the Earth the skin is about as thick as the atmosphere surrounding the Earth.

Hand out activity sheets to students and ask students to find out more about the four layers of the atmosphere.

Once students have read about the atmosphere, ask them to draw and label a picture to show its layer, and to answer questions on the activity sheet.

The following answers can be expected from the students’ research.

Q1. Troposphere – it is the layer in which we live and contains the air and other gases we need (Discussion may also include the stratosphere and how it protects us from the sun).

Q2. Troposphere.

Q3. Troposphere – but high up usually 10–15 kilometres, near the edge of the stratosphere.

Q4. Rockets travel so fast that there is a great deal of friction on the outside of the rocket which causes it to become red hot.

Q5. Troposphere – this is where the pollutants accumulate in the air and we have to breathe them in.

Q6. a. Jet streams – very fast winds found about 10–12 kilometres above the ground in the troposphere. Used by pilots to increase the speed of their aeroplane.

b. Trade wind – atmospheric winds caused by the different heating of the Earth at the Equator compared to the Poles. These are twisted to the east because of the spinning of the Earth.

c. Coriolis Force – the force produced because of the differences in speed between the movement of one place to another (Equator area moves faster than Poles) causing winds in southern hemisphere to be deflected west.

Summary
In this activity, students learn that the air forms a layer around the Earth called the atmosphere and explore its characteristics. It can be done as a library activity or homework exercise.
The atmosphere

The gases surrounding the earth make up the atmosphere, which is many hundreds of kilometres thick and has four layers.

Activity 1.8
Find out more about the four layers of the atmosphere. Draw and label a picture to show the layers of the atmosphere.

1. Which is the most important layer to us and why?

2. In which layer does the weather occur?

3. In which layer do aeroplanes usually fly?

4. Why do rockets need special shielding on the outside?

5. Which layer in the most important to us when we consider local air pollution?

6. Find out about the following:
   a. Jet streams
   b. Trade winds
   c. Coriolis Force

Activity 1.10
See how many new words you can make from the following air words.
- ATMOSPHERE
- TROPOSPHERE
- AIR POLLUTION
- POLLUTANTS

Count the number of words you have made from the words above. Highest score wins!
Eddie’s Extras

Find the following words in the word sleuth below:

- AIR PRESSURE
- OXYGEN
- ATMOSPHERE
- POLLUTANTS
- JET STREAM
- CORIOLIS
- CLEAN AIR
- EXPERIMENT

Start a class news board. Look for newspaper articles about air and air pollution. Don’t forget to look in your local newspaper.

Draw a picture of yourself doing your favourite activity that involves using air.

Imagine you are an astronaut on the moon or a scuba diver. Suddenly you discover the air in your tanks will run out in two minutes. Write a story about what happens.

Line up 10 empty glass bottles of different sizes with their tops screwed on. Use a ruler or stick and strike them on their sides. Order the bottles from highest to lowest sound they make. Are these bottles really empty? Try composing a tune on these bottles.
Unit 2: What’s in the air?

**Unit summary**

This unit encourages students to find out that air is made up of a mixture of gases, what these gases are called and their characteristics. They will also learn how some of these gases are used by humans and animals, and which of them are recycled by plants and trees.

**Background notes**

Air is made up of a mixture of gases, some of which are essential for life.

<table>
<thead>
<tr>
<th>Gas</th>
<th>Percentage</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen (N₂)</td>
<td>78%</td>
<td>inert gas</td>
</tr>
<tr>
<td>Oxygen (O₂)</td>
<td>21%</td>
<td>used for respiration by plants and animals</td>
</tr>
<tr>
<td>Argon (Ar)</td>
<td>~1%</td>
<td>inert gas</td>
</tr>
<tr>
<td>Carbon dioxide (CO₂)</td>
<td>~0.03%</td>
<td>used by plants to make their own food</td>
</tr>
<tr>
<td>Trace gases</td>
<td></td>
<td>methane, oxides of nitrogen</td>
</tr>
</tbody>
</table>

Water can exist in our air in varying amounts as a gas and comes from evaporation from water bodies, rainy weather or be given off from plants during the day. Humidity is determined by the amount of water vapour in the air. The air also contains tiny particles such as dust, sea salt, volcanic ash and soot, all of which are small enough to float in the air for a long time.

**Pollutants**

The air can also contain other gases and particles which are not normally found. These usually come from some human activity such as car usage or factories. When they reach a high enough level of concentration in the air, they become an air pollution problem.

Pollutants can cause health problems, especially in the young and the elderly, and also damage plants and materials.

**Air quality in South Australia**

Air quality in South Australia is generally good, however even current levels of air pollution can have significant health impacts and costs. Therefore maintaining and improving the quality of air is important.

One of the causes of air pollution in Adelaide is motor vehicles. Industry is also a contributor to air pollution around the state. Another source of air pollution is from domestic wood heaters.

Natural events such as bushfires also contribute significantly to pollution throughout the state. Because South Australia is such a dry state, during summer, certain weather conditions can carry surface dust from the northern parts of the state over to the southern parts. This dust forms a haze over the affected areas.
What’s in the air?

Summary
The first activity enables students to ‘visualise’ air, helping them to realise that air is not homogenous but made up of different types of molecules which do not interact. It also highlights the difference between a compound and a mixture.

In the second activity students collect the water which exists in the air as water vapour. The term ‘humidity’ can be introduced to describe the amount of water vapour in the air.

Activity 2.1
Hand out the activity sheet and ask students (in groups) to make the mixture using the recipe on the sheet. Stir to mix well.

Explain to the class that this is called a mixture and represents the gases which make up air. A mixture is where different substances are mixed together but do not interact with each other. For example, muesli is a mixture with different components which can be separated.

Explain that a compound is where different substances have interacted to form a new substance and cannot be separated into their separate parts again. For example, the ingredients in a cake.

Students can then answer questions on the activity sheet.

As a research or homework activity students can find out about each of the gases that make up our air, and include in the table provided on the activity sheet.

Activity 2.2
As a class, or in groups, place a tin or glass of crushed ice and water outside for several minutes. Bring the tin or glass inside and ask the class to describe what happened and to explain what they think has happened.

Discuss with the class:
• What is the name of the gas we need to survive? (Oxygen)
• What is the name of the waste gas we breathe out? (Carbon dioxide)
• What has formed on the glass? (Condensation)
• Where do you think this water comes from? (The water vapour in the air)
• Describe what the air in the bathroom is like after you have had a shower (Steamy)
• In this situation, would humidity be high or low? (High)
• People, animals and plants have been using the oxygen in air for many millions of years, yet the amount of oxygen in our air has remained almost the same. Try to find out why this is so. (The gases are recycled in the air by plants to animals).
What’s in the air?

Activity 2.1
In a glass jar, make the following mixture using the following recipe. Stir to mix well.
• 78 dried peas
• 21 lima beans
• 1 raisin
• 1 fruit loop
• 1–3 ribbon pasta
This is a mixture. How would you describe a mixture? How is this mixture different to the ingredients in a cake?

Does it make up most of our air?

The amount of oxygen in the air is always about the same. What keeps it that way?

Predict what might happen if the amounts of these gases changed.

Use your school library to find out a bit about each of the gases that make up air and fill in the table below.

Activity 2.2
Place a tin or glass of crushed ice and water outside for several minutes. Describe what happens.

Explain what you think happened.

What’s in the air?

Percentage (%) | Symbol | General Information
---|---|---
Nitrogen | | 
Oxygen | | 
Water vapour | | 
Carbon dioxide | | 
Trace gases | None |  
Solid particles | None | 

Who cares about our air?

Unit 2 – What’s in the air | What’s in the air | Student activity sheet
Changing the air

Summary
This activity is to help the students understand the basics about photosynthesis and the important role that plants play in supplying oxygen for humans and animals. They should also be able to understand that plants will only photosynthesise and give off oxygen in the presence of sunlight.

Background information
When people, plants and animals breathe, they take in oxygen, use it and breathe out carbon dioxide, water and some other gases. The oxygen helps burn food to produce energy which is used to keep the plants and animals alive. This process is called respiration.

Although plants use oxygen they also make it in a process called photosynthesis. The plants absorb carbon dioxide through their leaves. Using sunshine, the green matter in the leaves combines the carbon dioxide with water to make sugars which act as food for the plants to use in respiration which enables them to live and grow.

During photosynthesis, oxygen is given off into the atmosphere to be used by the plants, animals and people. So plants make oxygen for us and use up carbon dioxide which is a waste product. This happens only when the sun is shining.

It is important to note that plants are also using oxygen during the day for the process of respiration but are producing much more photosynthesis than they use, so they give out the excess. At night, however, they no longer produce any oxygen by photosynthesis so they must take it in.

Discuss with the class:
- What gas do plants give off during the day? (Oxygen)
- Do plants give off oxygen at night? Why not? (No sunlight, no photosynthesis)
- What would happen to people and animals if all the plants in the world died? (No oxygen to live)
- What gas do plants take in during the day? (Carbon dioxide)

Activity 2.4
Provide each student with a plastic bag. Go outside and instruct students to put their plastic bag around a branch of a bush or a tree. Fasten it with a rubber band.

Leave it in the sun for the day and collect it before the end of the day.

In this activity students observe that plants give off water vapour which then condenses into liquid droplets.

Activity 2.3
Use the background information above to discuss the two diagrams on the activity sheet with students to allow them to answer questions on the sheet.

Explain to students that if you breathe in and out of a plastic bag for a while, you will faint. Ask students why they think this happens. (If you breathe in and out of a bag, your body uses up the oxygen and high levels of carbon dioxide build up in the bag. Your brain shuts down due to lack of oxygen).

Activity 2.5
As a research or homework activity, ask students to find out more about photosynthesis.

Ask students to also find out what happens to a person who ‘hyperventilates’.
Changing the air

Activity 2.3
Animals and plants are important factors in changing what is in the air.

Using the two diagrams on this page find out what they add and take from the air.

Questions
1. What gas do plants give off during the day?
2. What gas do plants take in during the day?
3. Do plants give off oxygen at night? Explain your answer.
4. What would happen to people and animals if all the plants in the world died?

Activity 2.4
Put a plastic bag around a branch of a bush or a tree. Fasten it with a rubber band. Leave it in the sun for the day and collect it before the end of the day.

What do you observe in the plastic bag?

Try to explain what you see.

Activity 2.5
1. The process by which plants make oxygen is called photosynthesis. Use the library to find out more about it.
2. Find out what happens to a person who ‘hyperventilates’. How do you help them with this problem?
Adding to the air

Summary
The purpose of these activities is to show that other gases can be added to the air, with the following activities focusing on odours. The molecules that make up the smell move forward in a process known as ‘diffusion’. As they reach a person they are detected by special cells in the nose. A fan can change the direction of the smell because the ‘smelly’ molecules are sent in a different direction.

Background information
Substances can be added to the air. Sometimes they are natural; sometimes they are the result of human activity.

When these substances get to a level where they start to affect the health or comfort of humans or are damaging to plants or materials, they are known as pollutants.

Many substances which enter the air cannot be easily detected, as we cannot see, smell or taste them. This is the problem with many of the pollutants in the air. We only know they are there if we use sophisticated equipment. The following activities are to do with adding odours to the air. Odours can be pollutants and the most common complaints to the EPA are odour related.

Activity 2.6
Students break into groups, blindfold a volunteer and pass various smelly substances under their nose asking them to guess the smell.

Activity 2.7
Have six students line up along the front of your classroom and blindfold each of them. One student holding an open bottle of perfume stands at the back of the class and slowly walks to the front. Ask the students in the line to raise their hands when they can smell the perfume. Repeat the experiment with different smells.

Discuss with the class:
- Which substances were the easiest to smell? (Strongest smelling.)
- Who smelt the perfume first?
- Can you explain why this happened? (Molecules closest to the person, move through the air.)
- What did the fan/wind do to the perfume? (Shift the molecules in a different direction.)

Do the experiment again, this time with a fan blowing away from the students. Try with the fan blowing towards the students. (This can be done outside with the wind blowing toward or away from the blindfolded subjects)

Get the students to write this activity up as an experiment.
Often new substances can be added to the air. Let’s see if we can detect some of them.

### Activity 2.6

**Materials**
Chalk, milk, orange, coconut, cabbage, cheese, a crushed gum leaf, vegemite toast, bubblegum, other ‘smelly’ things.

**Instructions**
Blindfold a volunteer and pass different smelly substances under their nose. Ask them to guess the smell. Fill in the results below, using a tick if they correctly identified the substance, a cross if they didn’t.

<table>
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<tr>
<th>Name of smelly substance</th>
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**Questions**
Which substances were the easiest to identify?

Why are some substances hard to identify?

Substances in the air which are harmful are known as pollutants. Can you name one pollutant?

Pollutants are sometimes hard to detect. Can you explain why?

### Activity 2.7

**Materials**
- Strong perfume
- Blindfolds
- Fan

**Instructions**
1. Blindfold six volunteers and get them to stand in a line at the front of the classroom. One student to stand at the back of the class holding an open bottle of perfume. Student holding the perfume is to walk toward the front of the room and ask blindfolded students to put their hands up when they can smell the perfume.

2. Repeat the experiment with a fan blowing away from them and then again with the fan blowing towards them.

3. Repeat the experiment making the line longer and then again making it shorter.

Write up part 1, 2 or 3 of the activity as an experiment.
If nitrogen was blue, oxygen pink and argon green, colour a page using the correct percentages for air. Remember, the molecules are mixed in with each other. Use black to show humidity.

Investigate what the 'air' is like on other planets. Prepare a two-minute talk on a planet of your choice outlining what the air is like and other interesting things about it.

Plants are important because they produce oxygen which we breathe. Write a list of other ways plants are useful to us.

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__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
Unit 3: Polluting the air

Unit summary
This unit introduces students to the concept of air pollution. Air pollution is caused by having particles or molecules in the air in such concentrations that could be harmful to the health or comfort of humans and animals or cause damage to buildings or materials.

Background notes – types of pollution
Below provides a brief description of the types of pollution. More detailed information can be found in Appendix 3.

Photochemical smog
Photochemical smog is a mixture of pollutants that are formed when nitrogen oxides and volatile organic compounds (VOCs) react to sunlight and produce ground level ozone. This type of smog, which creates a brown haze above cities, tends to happen in late spring, during summer and early autumn when there is lots of sunlight, high temperatures and calm weather.

Haze
Haze, also known as winter smog, occurs when many tiny particles from wood smoke and vehicles make our skies look brown. Winter smog occurs mostly on cold, calm, winter mornings.

Carbon monoxide
Carbon monoxide is a colourless, odourless and very toxic gas, which comes from incomplete burning, industrial processes and biological decay.

Oxides of nitrogen
The most common of these are nitric oxide and nitrogen dioxide. These help form photochemical smog and have significant impacts on health.

Air toxics
A range of harmful chemicals, sources of which include cars, cigarette smoke and fuel vapour.

Odours
Odours can be of great concern to many people. Generally odours are annoying. In rare cases, the compound causing the odour may be poisonous and lead to illness in people.

Factors affecting air pollution
Weather conditions and geographical features are important to the amount of pollution experienced in a certain area. For example, local winds may cause pollution to be blown back over a populated area where the pollution has been produced.

Geographical features such as valleys will often trap pollution and make it difficult to disperse.
Pollutants

Summary
Students will observe differences between pollutants which occur as suspended particles (particulates) and those which occur as a solution in the air. These activities will demonstrate that some air pollution can be visible or invisible.

Activity 3.1
This activity takes approximately 15 to 20 minutes. Students can do this in small groups using cups instead of bowls. Explain to the students that the bowl of water represents a model of the air, the milk represents gaseous air pollution and the pepper represents particles in the air. Students will observe the differences between the reactions of the milk and the pepper when put into the water. They will observe how long it takes the pepper to settle to the bottom. Discuss the results with the class.

If this is done as a demonstration with a clear glass bowl, it helps to have a light or white paper behind the bowl so the pepper is easier to observe.

Discuss with the class:
• In winter we can often see a brown ‘smudge’ over the city or in the distance. What do you think this is? (Particles in the air)
• What can cause particles to be present in the air? (Wood fires, burning off, car exhausts)
• Cars put lots of pollutant gases into the air. Can you always see them? (No) Why not? (They are invisible)

Answers to questions for Activity 3.1
1. Gases
2. Particles (particulates)
3. Pepper (in a controlled area, particulates can be removed by filtering the air. Removing gases from the air is more difficult. Some gases can be removed by using industrial ‘scrubbers’)

Visible pollutants are called particulates

Pollutants in the air can be invisible or visible
Pollutants

The visible pollutants we call particles (or particulates) are tiny solid particles or drops of liquid which float in the air. These can be natural like pollen or dust, or man-made from sources such as wood fires, wood heaters, industry, power plants or from cars and trucks.

Invisible pollutants are gases which mix with air and, at times, even react with it to form other gases. An example of this is the invisible gases from car exhausts.

Activity 3.1
Let’s see the difference between visible and invisible pollution.

- Half fill two clear disposable cups with water.
- Add one tablespoon of milk to one cup, stir to mix.
- Add one teaspoons of pepper to the other cup, stir.
- Observe the differences between the milk and the pepper.

1. What kind of pollutant(s) did the milk act like in the water?

2. What kind of pollutant(s) did the pepper act like in the water?

3. Would it be easier to get the milk or the pepper out of the water?

4. Would it be easier to remove the gases or particles out of the air?

5. Suggest how you could get the pepper out of the water.
Collecting particles

Summary
The aim of this activity is for students to collect particles from the air using their own hand-made particle tester and to develop an awareness of what the particle source is likely to be.

Background information
The air around us has never been completely clean. Pollutants such as smoke, dust and pollen, gases from rotting plants and sea-salt were all here before people lived on the earth. However, the activities of humans now add extra pollutants to the air, some of which are poisonous or too concentrated, and which cause health problems for individuals and affect the place in which they live.

The trouble with trying to find the substances that pollute our air is that many of them are invisible gases. However, one visible air pollutant is particulate matter (PM). PM is made up of tiny solid particles or droplets of liquid which float in the air. With time, PM settles on the ground or on surfaces or is washed out of the air by the rain.

The natural kinds of airborne PM include such things as pollen and dust. Man-made particles come from coal and oil burnt in power plants, fuel burning in cars and trucks, wood fires, slow combustion heaters and industry.

Particulates can be harmful to our health, affect plant and animal life and discolour buildings and other structures.

Activity 3.2
To gain an idea of the particle levels in your area, students can try this simple collection method. They can make their own particle testers using cardboard and sticky tape. The testers are put outside and then analysed for particles.

The trick to making these testers useful is to place them somewhere with high particle levels such as near roads, incinerators or cleared land. When looking at the results ensure students use a white background so the particles can be easily seen.

There are some other activities using the testers in Eddie’s Extras at the end of this section.

Discuss with the class:
• In which area did your tester collect most particles?
• Does the tester you made pick up all the pollutants in the air? Explain. (Some are invisible, too small)
• List possible sources of these particles?
• Why do you think the particles are bad for you? (We breathe them in)
Collecting particles

In this activity we are going to investigate a particular type of pollution – particles. These are tiny particles in the air which can come from natural sources or from human activity such as wood heaters and burning off.

Particles can be harmful to our health, and affect plant and animal life around us.

Activity 3.2a

Making a particle collector

To collect these particles you need to make a particle tester, using the instructions below.

• Cut a strip of cardboard that is ~ 5 cm wide and 10 cm long and cut a smaller rectangle out of the middle.

• Cover the inner rectangle with sticky tape. The sticky side of the tape will collect particles from the air. Make sure you do not touch the sticky side of the tape.

Activity 3.2b

One day particle collection study

• Select three locations and site testers at different places around the school or your neighbourhood. Record the date, location and your name on your testers.

• Keep one in a clean plastic bag. This is called a control.

• At the same time on the next day remove the testers and record the information in the table below.

Compare your tester to the one in the plastic bag – the control. Describe the difference.

Compare your tester to those of other students.

Were some areas around your school dirtier than others? If so, list the three dirtiest locations.

Can you explain why these locations would be dirtier?

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<th>Location</th>
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Who cares about our air?
Unit 3 – Polluting the air | Collecting particles | Student activity sheet
Types of pollutants

Summary
This play focuses students’ attention on the causes and hazards of air pollution. Students should be able to list and describe the six major air pollutants.

Background information
There are hundreds of pollutants that float around in the air that we breathe. Australia has established National air quality standards for six of these pollutants: ozone, carbon monoxide, nitrogen dioxide, particulate matter, sulfur dioxide and lead. These air quality standards are designed to protect the health and welfare of people, plants, and animals, and to protect our water, buildings, monuments and other resources.

Activity 3.3
Undertake the role play with the class. The table at the end of the role play can be filled in during the play or used as a follow-up activity.

Reference
The Air Pollution Gremlins were created by the Texas Natural Resource Conservation Commission.
Activity 3.3
What type of substances cause pollution in our air. This play will help you find out.

Characters
• Christina
• Steven
• The Gremlins
• Smelly Sulfur Dioxide
• Nasty Nitrogen Oxide
• Odious Ozone
• Pesky Particulate
• Cranky Carbon Monoxide
• Lumpy Lead
(The Gremlins may be cast singularly or as a group of actors.)

Setting
Christina and Steven are sitting in a lounge room with the television, radio, fan, and three or four lights on. They are watching a television show.

Dialogue
Christina: This is my favourite show!

Steven: Yeah, I just love Saturday Disney. The song that’s playing on the radio right now is pretty cool too. It goes along with the action on the TV.

Christina: (She gets up and looks outside the window) Hey, Steven look at that! (points to the sky).

Steven: Wow! I wonder what it is? Let’s go outside and get a better look.

Steven and Christina go outside. A large cloud comes closer to them. Underneath or behind the cloud are the Air Pollution Gremlins. The cloud stops right in front of Steven and Christina. Immediately, the Gremlins start jumping around and making faces at the audience and Christina and Steven.

Steven: Who are you?

Smelly Sulfur Dioxide: We are the Air Pollution Gremlins. We’ve come to take over your town.

Christina: Why would you want to do that? Only nice people live here.

Pesky Particulate: You may be nice people, but nobody seems to care about the air in this town. So, it looks like a good place to live (sneer).

Steven: I notice each of you have a different name. Why is that? Aren’t you guys all the same?

Cranky Carbon Monoxide: We have different names because we come from different sources and cause different problems.
Steven & Christina: Oh No!!

Cranky Carbon Monoxide: I’m Cranky Carbon Monoxide. I mostly come from car exhaust. I like to make people dizzy and give them headaches (twists hands menacingly).

Smelly Sulfur Dioxide: I’m Smelly Sulfur Dioxide. I come from smokestacks of power plants and industries. I can hurt your eyes, noses and lungs. I can even eat away iron and steel. I like to make the air look hazy (lunges at audience).

Nasty Nitrogen Dioxide: I’m Nasty Nitrogen Dioxide. I have a yellow-brown colour and I come from cars, electric power plants, and other large industries. I can make the air brown and hazy. I like to hurt lungs, plants and metals (makes an evil laugh).

Lumpy Lead: I’m Lumpy Lead. I can contaminate the air, food and water. Also, I am found in some old paints. I’m very harmful to children and fish (does a little dance).

Odious Ozone: I’m Odious Ozone. I’m invisible by myself, but when I get together with my friends, I can help form smog. I can make it hard to breathe (lunges at audience).

Pesky Particulate: I’m Pesky Particulate. I live in the air and like to travel on the wind. I make things dirty and I can carry harmful chemicals into your lungs as well (makes a very loud and evil laugh).

Christina: All of you sound so terrible! We don’t want you to live here.

Lumpy Lead: And by using your wood heaters incorrectly all winter.

Steven: You mean that just because we waste electricity, use wood heaters and ride around a lot in the car, you guys are here to stay?

Nasty Nitrogen Dioxide: Bingo! Thank you for the invitation to live in your town!

Christina: Well from now on, you’re not invited to our town. I’m not wasting electricity anymore and I’m going to walk or ride my bike if I want to go somewhere nearby.

Steven: Yeah! (firmly), and I’m going to find out how to use our wood heater properly! We’re starting right now!

Steven and Christina rush inside and turn off all the lights and appliances they had left on.

Gremlins: OH NO! We can’t live in this town if no one is wasting energy! This doesn’t seem like a very good place to live after all.

Lumpy Lead: I’m sure we can find another town where people are wasting energy. C’mon, let’s go!

The Gremlins leave in their cloud.

Christina: What do you want to do now?

Steven: Let’s go outside and ride our bikes in the fresh, clean air.

Christina: I hope those Gremlins don’t come back.

Steven: They won’t as long as we continue to do things right.

The End

Fill in the table from the information given in the play.
# Who cares about our air?

Unit 3 – Polluting the air | Types of pollutants | Student activity sheet

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Where it comes from</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smelly Sulphur Dioxide</td>
<td></td>
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<tr>
<td>Nasty Nitrogen Oxide</td>
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<td></td>
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<tr>
<td>Odious Ozone</td>
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<td></td>
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<tr>
<td>Pesky Particulate</td>
<td></td>
<td></td>
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<tr>
<td>Cranky Carbon Monoxide</td>
<td></td>
<td></td>
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<tr>
<td>Lumpy Lead</td>
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</tbody>
</table>

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Moving pollutants

Summary
The following activity will allow students to see what the air around them is doing on different days and enable them to get an idea of the various ways in which pollutants may be dispersed. Of course, it may also show them where pollution may be coming from in their local area.

Background information
The layer of air in which we live is called the troposphere. This is the layer in which the pollution we produce is dispersed or scattered. How this pollution moves around us depends on how the air in this layer is moving.

If the air is still, many of the pollutants will stay close to the ground and to us. If it is turbulent (blustery), pollutants will be dispersed. If the air is moving in a constant direction, the pollutants will move with it.

Activity 3.4
Undertake activity as per instructions on the activity sheet.

Students may find that the tethered balloon moves in different directions at different heights and at different times of the day. This shows that the atmosphere does not act as one layer but can have different layers of air moving in different directions.

This activity is best done as a demonstration with the students involved in measuring and recording. Ask the shop for balloons which will hold party gas for several days to stop you having to return for new balloons if you are testing over several days.

Discuss with the class:
Would this air movement have made pollutants in the air:
• stay close to the source
• move around the source
• move away from the source
• move widely
• move away from the source, but not break up and disperse
• other, please describe.

SAFETY!
Civil Aviation Regulations (1988) require aircraft to maintain a minimum height of 1,000 feet (304.8 metres) above ground level (AGL) over built-up areas, and 500 feet (152.4 metres) over all other areas. Therefore it is suggested that this exercise only be carried out up to 100 metres so as to ensure flying aircraft are not endangered by a tethered object.
Moving pollutants

Pollutants do not always stay in the one place because air can move. Let’s investigate this.

Activity 3.5

Materials
- Balloon
- Party balloon gas
- String/fishing line (100m)
- Piece of wood (weight for anchor)

Instructions
Collect a brightly coloured balloon which is filled with balloon gas. Tie one end of the string to the piece of wood and wind the string/fishing line onto it. Tie the other end to the balloon. Let the balloon into the air by paying out the line:
  - at different times during the day
  - from different places on the same day
  - from the same place on different days

Write down comments about what happened to your balloon, eg the direction, the pattern of flight, etc. Record your results for each trial.

NOTE
100 metres is as far as the balloon is allowed into the air while tethered. This is to ensure that planes do not get caught in the lines.

<table>
<thead>
<tr>
<th>Conditions</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height from ground</td>
<td></td>
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<tr>
<td>Time</td>
<td></td>
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<tr>
<td>Place</td>
<td></td>
</tr>
<tr>
<td>Day</td>
<td></td>
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</tbody>
</table>
Who cares about our air?
Unit 4: Understanding weather

**Unit summary**
This unit is designed to provide the students with an understanding of temperature, rainfall and wind. These aspects of weather are very important as they have a significant affect on air pollution. This chapter will focus on weather phenomena and how to make simple weather instruments that the students will enjoy.

**Background notes**
In the previous chapter we concentrated on the main medium of weather – the air. For students to understand air pollution and why air quality can vary from day to day, we must be able to measure meteorological conditions as well.

**Temperature**
Energy from the sun warms the Earth’s surface, in turn heating the air. Temperatures differ around the state based on the intensity of the sun and the proximity to the sea.

**Wind**
Wind is simply moving air and it is very important in understanding the transport of pollutants. Wind speed and direction will help you to calculate the direction the pollutants are travelling and how much mixing there will be with unpolluted air.

Winds in Australia vary with the seasons. However, there are two main wind patterns over Australia known as the south-east trade winds and the westerlies. These winds are known as prevailing winds and frequently come from one direction.

Other winds are named from the direction the wind is blowing, ie: northerlies come from the north.

**Rainfall**
The higher the air temperature, the more water vapour it can hold. If the amount of water vapour exceeds what the air can hold at a given temperature, then the excess will condense to form rain, dew, fog or frost.

Rainfall is measured using an instrument called a rain gauge. The gauge consists of a funnel that leads down to a graduated cylinder, with the rainfall being measured in millimetres.

**Weather and Pollution**
Weather is important when talking about air pollution as temperature, wind and rain can all affect the formation and maintenance of air pollution in our cities.

For example, wind transports pollutants and mixes the pollutants with unpolluted air. The result can be dilution of pollutants in the air.
How hot is it?

Summary
In this activity students will observe temperature in different areas over a day, recording the temperature readings in Fahrenheit and Celsius.

Background information
Temperature is measured around the world in two different scales, Fahrenheit and Celsius. The Celsius scale was named after Anders Celsius (1701–1744) and the Fahrenheit scale was named after Gabriel Fahrenheit (1686–1736). Temperature is measured using a thermometer, which contains mercury that expands as it warms up and moves upwards to indicate temperature in one of these scales. There are also alcohol thermometers which have a red liquid that expands when heated.

Activity 4.1
Undertake activity according to the instructions on the activity sheet.
It is important when using a thermometer to measure outdoor temperature, that the thermometer be kept in the shade.
Taking readings from the thermometer can be conducted several times during the day (morning, midday, afternoon) and will take approximately 10–15 minutes. Students can work in small groups to determine the temperature readings.

Explain to the students how to read a thermometer, using the master sheet ‘Reading a Thermometer’ (Appendix 1). Discuss with students suitable areas around the school to place the thermometers such as in the classroom, under the verandah or a tree, out in the sun, etc. Students will record temperatures over the day in the table and the results can be discussed.

Discuss with the class:
1. Which temperature scale do we use in Australia? (Celsius)

2. Which is hotter – (i) 20 °Celsius or (ii) 20 °Fahrenheit? (20 °Celsius)
There are two scales for measuring temperature. One is called the Celsius scale and was named after Anders Celsius (1701–1744) and the other scale is called the Fahrenheit scale, named after Gabriel Fahrenheit (1686–1736).

Gabriel Fahrenheit was the first person who is believed to have used mercury (a silvery, liquid metal) in thermometer bulbs.

i. Can you name any countries which use the Celsius scale?

ii. What about the Fahrenheit scale?

Activity 4.1

Materials

• Thermometer
• String
• Master ‘Reading a Thermometer’

Instructions

1. Using your sheet titled ‘Reading a Thermometer’ find the temperature in Fahrenheit for the following:

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Celsius (°C)</th>
<th>Fahrenheit (°F)</th>
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</thead>
<tbody>
<tr>
<td>Room temperature</td>
<td>22</td>
<td></td>
</tr>
<tr>
<td>Outside temperature</td>
<td>41</td>
<td></td>
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<tr>
<td>Body temperature</td>
<td>37</td>
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</tbody>
</table>

2. Using the table below, record the temperature readings at different locations around your school.

<table>
<thead>
<tr>
<th>Location</th>
<th>Celsius (°C)</th>
<th>Fahrenheit (°F)</th>
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<tbody>
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Questions

Where was the coldest temperature recorded?

Where was the warmest temperature recorded?

When do you think the minimum temperature for the day would occur?

When do you think the maximum temperature for the day would occur?

Do the maximum and minimum temperatures happen at different times in different seasons? Explain your answer.
Weather check

Summary

In this activity students are to collect a week’s weather data to identify what information is available, where they can find this information and what units are used to measure the different aspects of weather.

Activity 4.2
Start a class weather chart by getting students to draw up a table or use the activity sheet to collect weather information for a selected period of time (usually one week). Students can collect their data by:

a. checking the daily paper or watching the TV weather report;

b. using the data from their electronic weather station if they have one.

Air quality information for Adelaide and other areas around the state can be found on the Environment Protection Authority’s website: www.epa.sa.gov.au

Discuss with the class:
1. What units are used to measure the following:
   - temperature (°C)
   - rainfall (mm)
   - wind speed (m/s)

2. What was the trend with the maximum and minimum temperatures?

3. Was there any rainfall?

4. Have the winds been the same or varied over this time?

5. What air quality information did you collect?

6. What other information can be read from the weather reports on TV and in the newspaper?
Weather check

Activity 4.2
We are going to find out more about weather. To start with, we are going to monitor what it is like for one week. Check your daily newspaper or watch the TV weather report, and record the information in the table below.

Questions
What units are used to measure:
1. Temperature

2. Rainfall

3. Wind speed

What type of pollution information did you find on the EPA’s website www.epa.sa.gov.au?

Describe the wind patterns for the week.

Has pollution been a problem this week? Explain.

Was pollution information the same for all areas around your region? If not, explain why you think it can vary.

Extension
Your teacher will show you how to graph your temperatures. Make a separate graph for the maximum and minimum temperatures or do both on the same graph, but use a different colour for each.

Record any rainfall information on another graph.

<table>
<thead>
<tr>
<th>Date</th>
<th>Maximum temperature (°C)</th>
<th>Minimum temperature (°C)</th>
<th>Rainfall (mm)</th>
<th>Wind direction</th>
<th>Wind speed (m/s)</th>
<th>Pollution information</th>
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Wind direction

Summary
This activity is designed to provide students with an understanding of the direction from which the wind is blowing and how to name winds.

Background
Winds are very important as they have a strong influence over temperature, humidity, cloud formation, rain and air pollution. Wind is measured using a wind vane for direction and an anemometer for speed.

Winds are named by the direction from which they come. The directional arrow on a wind vane will point in the direction from which the wind is blowing. For example, a southeast wind will show the directional arrow pointing southeast and the wind will be moving from the southeast to the northwest.

Activity 4.3
Undertake activity according to the instructions on the activity sheet.

Students need to be reasonably careful when building their weather instrument to ensure it works correctly.

If you wish to extend your students, allow them to build the wind vane, in groups, without giving them any building instructions.

Discuss with the class:
1. What is the wind direction in the morning?
2. What is the wind direction in the late afternoon?
Wind direction

In this activity you will learn how to identify which direction the wind is blowing and how to name winds. You will also make a wind vane to determine wind directions around your school.

Naming winds

Wind direction is given as the direction from which the wind is coming. A wind vane will show the arrow pointing into the wind, indicating the direction from which the wind is blowing. We name the winds from the direction they come. For example, if the directional arrow is pointing to the north, the wind is called a northerly and blows from the north towards the south.

Knowing the wind speed and direction is very important if we are to understand where air pollutants are coming from and moving to.

Name the following winds:

1. 2. 3.
(a) ________ (b) ________ (c) ________

Activity 4.3

When we want to measure winds, we need to determine the direction they are blowing and their speed. This activity will allow you to build your own wind vane, so that you can determine the wind direction.

Materials

- Thick card (for the arrow head and tail piece)
- A piece of dowel or a straw of 30 cm length
- 500 ml plastic bottle
- Small bead for arrow head to spin on
- Thin long nail
- Glue (PVC)
- Compass
- Sand to fill plastic bottle
- Potato, plasticine, corks
- Apple corer

Instructions

1. Make a wind vane – as shown in the diagram.
2. Cut your card to make one arrow head and one tail piece as shown.
3. Attach these cut-out pieces with glue, to each end of the dowel or straw.
4. Balance the dowel or straw to find the exact centre, using a ruler. Mark this spot with a pen.
5. Using the nail, make a hole through the dowel or straw at the marked spot. Place the nail through the hole you have made. Thread the bead onto the nail, so the dowel or straw is between the nail head and the bead.
6. Fill the plastic bottle with sand and using the apple corer, cut out a piece of potato to act as a cork in the bottle.
7. Mount your wind vane onto the plastic bottle by pushing the nail through the centre of the potato in the neck of the bottle.
8. Label each side of the plastic bottle with N, S, W, E, using your compass to determine these directions.
9. Place your wind vane out in the wind, making sure the directions are correct, and see which direction the arrow points.

Questions

1. Using your wind vane, determine the wind direction.
2. Which way is the wind coming from and blowing to?

Acknowledgement

This activity is taken from Project Atmosphere Australia Online, www.schools.ash.org.au/paa2
Wind speed

Summary
In this activity students make a simple device that can help them determine wind speed in kilometres per hour.

Background
The equipment used to measure wind speed is an anemometer which consists of small cups that spin around in the wind. The stronger the wind the faster the cups spin. Measurements are made in metres per second, kilometres per hour or knots.

Knots were the traditional units used and 1 knot is equal to one nautical mile per hour or slightly less than 2 km/h. If the measurement was made in metres per second then 1 m/s is roughly equal to 4 km/h or 2 knots.

There is also another way of estimating wind speed. In 1805, before the advent of weather instrumentation, Admiral Sir Francis Beaufort developed a scale based on observations about wind speed. This scale distinguishes between 12 different levels of wind strength, with the speed being estimated in kilometres per hour. Below is a copy of the Beaufort Scale.

Activity 4.4
Undertake activity according to the instructions on the activity sheet.

It would be appropriate to talk with the students about the accuracy of the various methods of measuring wind speed.

If the school has a weather station students should be able to identify the anemometer.

An alternative
Give students a copy of the Beaufort Scale to use outside on various days to assess wind speed and compare their results if they have made the ping-pong ball equipment.

Discuss with the class:
1. What was the wind speed in the morning? Did it increase in the afternoon?
2. How difficult was it to obtain the wind speed? (Gusting/constant)
3. How could you improve your accuracy?
4. Was the wind speed different in different areas of your school? For example, out in the middle of the school oval compared to under the school verandah. Why do you think this would be?

<table>
<thead>
<tr>
<th>Speed</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 km/h</td>
<td>Calm. Smoke rises vertically.</td>
</tr>
<tr>
<td>1–5 km/h</td>
<td>Light air. Wind direction shown by smoke, not by wind vanes.</td>
</tr>
<tr>
<td>6–11 km/h</td>
<td>Light breeze. Wind felt on face, leaves rustle, ordinary vanes move.</td>
</tr>
<tr>
<td>12–19 km/h</td>
<td>Gentle breeze. Leaves and twigs constantly move, wind extends light flag.</td>
</tr>
<tr>
<td>20–29 km/h</td>
<td>Moderate breeze. Raises dust and loose paper, small branches on trees move.</td>
</tr>
<tr>
<td>30–39 km/h</td>
<td>Fresh breeze. Small trees sway, small waves on lakes.</td>
</tr>
<tr>
<td>40–50 km/h</td>
<td>Strong breeze. Large branches on trees move, difficult to use an umbrella.</td>
</tr>
<tr>
<td>51–61 km/h</td>
<td>Near gale. Whole trees sway, difficult to walk against the wind.</td>
</tr>
<tr>
<td>62–74 km/h</td>
<td>Gale. Twigs broken off trees, very difficult to walk.</td>
</tr>
<tr>
<td>75–87 km/h</td>
<td>Severe gale. Chimney pots and roof tiles break.</td>
</tr>
<tr>
<td>88–101 km/h</td>
<td>Storm. Trees uprooted, buildings damaged.</td>
</tr>
<tr>
<td>102–117 km/h</td>
<td>Violent storm. Very rarely occurs, widespread damage.</td>
</tr>
</tbody>
</table>
Wind speed

Activity 4.4
In this activity you will be making a piece of equipment which can measure wind speed. The equipment which does this is an anemometer. The wind speed will be measured in kilometres per hour.

Materials
• Strong thread or fishing line (40 cm in length)
• One ping-pong ball
• One large protractor/wind chart template (Appendix 2)
• Glue and tape
• A thick piece of cardboard or card to mount the template protractor on (about A4 size)

Instructions
1. Using the glue, mount the template to the cardboard or card.
2. Tape the thread to the ping-pong ball and tape the other end of the thread to the centre of the protractor.
3. Hold your anemometer outside in the wind, keeping the ball and string on 90°. As the wind blows, let the ball go and read the angle it blows to on the protractor.
4. Convert this angle to the wind speed using the chart above your card protractor.
5. Take measurements throughout the day to see how wind speed changes.

Did the wind speed change throughout the day? How?

Where did you take your wind measurements from?

Do you think this spot accurately reflects the wind for today? Explain. (Hint: Look at the tree tops.)

Where do you think is the best place to take wind measurements? (Hint: Look at the tree tops)

Why?

Acknowledgement
This activity is taken from Project Atmosphere Australia Online, www.schools.ash.org.au/paa2

<table>
<thead>
<tr>
<th>String angle</th>
<th>Wind speed (kph)</th>
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<tbody>
<tr>
<td>90°</td>
<td>0</td>
</tr>
<tr>
<td>80°</td>
<td>13</td>
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<tr>
<td>70°</td>
<td>19</td>
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<td>60°</td>
<td>24</td>
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<td>50°</td>
<td>29</td>
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<td>40°</td>
<td>34</td>
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<tr>
<td>30°</td>
<td>41</td>
</tr>
<tr>
<td>20°</td>
<td>52</td>
</tr>
</tbody>
</table>

The wind chart table
Clouds and temperature

Summary
The purpose of this activity is for students to identify different cloud types and the effect they have on surface temperature.

Background
Clouds are made up of water droplets that are much smaller than raindrops. They are only able to form clouds if condensation particles are present. These particles can be dust, sea salt evaporated from sea spray, particles from forest fires, volcanic material or pollution.

The formation of clouds occurs in three different ways:

- As the land warms, the air above warms and rises. This rising air gradually cools and expands, with tiny water droplets forming, resulting in a visible cloud. The processes involved are known as convection.

- Air rising due to topography (land formations), such as a mountain range. The air is forced to rise above the mountains, cooling as it does, resulting in the formation of clouds.

- The heavy air in a cold front moving in under the warm air ahead of it, forcing the warm air to rise. This sudden uplift can cause clouds to form and commonly will generate storm activity.

Cloud names are based on their height, shape and colour. There are three basic cloud types:

- Cumulus – clouds which have a woolly appearance and often produce rain.

- Cirrus – clouds which are high, white and feathery and don’t bring rain.

- Stratus – low grey clouds which can cause drizzle.

In general, high clouds warm the Earth and low clouds have a cooling effect.

Activity 4.5
Undertake activity according to the instructions on the activity sheet.

Discuss with the class:
1. What effect did high clouds seem to have on the Earth’s temperature? (Warming)
2. What effect did the low clouds have? (Cooling)
3. Did the clouds fall easily into the three types given? (No)
4. What do you think a ‘stratocumulus’ cloud might be like? (Part low and grey topped by woolly clouds)
Who cares about our air?
Unit 4 – Understanding weather | Clouds and temperature | Student activity sheet

Clouds and temperature

In this activity you will identify different cloud types and the effect they have on surface temperature.

Clouds are made up of water droplets that are much smaller than raindrops. They are only able to form clouds if condensation particles are present. These particles can be dust, sea salt evaporated from sea spray, particles from forest fires, volcanic material or pollution.

Cloud names are based on their height, shape and colour. There are three basic cloud types:

• Cumulus – clouds which have a wooly appearance and often produce rain.
• Cirrus – clouds which are high, white and feathery and don’t bring rain.
• Stratus – low grey clouds which can cause drizzle.

Activity 4.5

Materials
• Thermometer
• Cloud chart (optional)

Instructions
1. Measure the temperature in a shady location away from buildings over several weeks.
2. Estimate cloud cover. To do this, observe how many eighths of the sky is cloudy. For example, if about half the sky is cloudy, the cover would be 4/8. If only a little is, it would 1/8.
3. Fill in the chart below.

Questions
1. What effect did i) cumulus ii) cirrus iii) stratus clouds have on temperature?
2. Did the clouds fall easily into the three types given?
3. Investigate other cloud types. Draw and describe at least three others.

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Cloud type</th>
<th>Cloud cover</th>
<th>Temperature</th>
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Who cares about our air?
Unit 5: The burning question

Unit summary
In this unit students will learn about the major air pollution problem of haze experienced in the winter and spring months. Haze, or winter smog, is mainly caused by smoke from wood heaters, people burning rubbish in their backyards and burning off. The students will investigate the different conditions for burning which contribute particles to the air and how proper use of wood heaters can reduce their impact on air quality.

Background notes
The major source of particles in our air comes from burning. This may be from using wood heaters, backyard incinerators, burning of garden refuse, natural bushfires or a controlled burn such as those done in our forests to control leaf litter build up.

Smoke consists of very fine particles of carbon and also grit, ash and soot which tend to be larger in size. The larger particles settle to the ground or are washed out of the air by rain and can cause problems because they make buildings, plants, clothes and other things dirty when they fall.

At the same time, smaller particles remain in the air for some time and are more dangerous to health because they can be inhaled deep into the lungs making conditions such as bronchitis and asthma worse. The elderly, young children and those with existing lung or heart disease are most at risk from high particle levels.

One of the sources of particles is the slow combustion wood heater. Unfortunately, because of their popularity, the smoke produced has become a problem, particularly during cold, calm winter nights and mornings where the high levels of smoke particles can be seen as a brown haze over many cities and towns.

To reduce the number of particles in the air produced by our wood heaters we can follow these guidelines:

• Avoid using open fires and wood heaters where possible.
• Burn a hot fire with bright glowing coals so that it produces as little smoke as possible.
• Use small pieces of untreated and well dried wood.
• Control the heat by regulating the amount of wood you put on the fire rather than closing the flue.
• Never use green wood.
• Stack your wood and keep it dry in winter.
• If your chimney is smoking a lot, open up the flue and give the fire more air.
• Don’t burn household rubbish such as plastics in your wood heater.
• Try to use your heater less. If it’s not very cold wear a jumper.
• Do not burn your garden rubbish. Instead, compost your garden clippings and recycle them back into your garden as mulch. If the garden prunings are too big to compost, take them to the tip which can mulch your prunings and recycle them.
Wood smoke

Summary
This activity will help students to recognise that wood fires give off particles which can be seen and collected. Some of the conditions which cause particles to be given off will also be noted.

Activity 5.1 (a, b and c)
In activity (a), students should identify that the lid does not allow as much air (oxygen) to the fire which causes incomplete burning. This gives rise to lots of smoke containing harmful particles.

In activity (b), students will observe that wet fuel means more particles are given off.

Optional: Get some dry or seasoned wood which has been cut and stored for a reasonable time and some ‘green’ or unseasoned wood which has been recently cut. Use small pieces of each on the fire and observe the difference in how they burn. The dry wood should burn with little smoke while the green wood, which still has a high moisture content should give off more smoke. Using damp white material on the end of a long stick, collect particles from the different burning fuel.

Discuss with the class:
1. What causes fires to give off too much smoke? (Lack of air – oxygen, wet or green fuel)
2. What can we do to prevent particles getting into the air? (Burn fires brightly by giving it lots of air; using seasoned, dry wood.)
3. What do you think ‘damping down’ your fire means? (Reducing the air getting to the fire so it burns more slowly)
4. What does it mean when wood is green? (Freshly cut, has not dried out)
5. How should people keep their wood during winter? (Loosely stacked and under cover)

The following messages are the ones which should come out of this exercise.
To reduce particles in the air:
- Never use wet or green wood.
- Stack your wood under cover to keep it dry.
- Burn at a high temperature and do not damp down over night.
Wood smoke

In these activities, you will investigate what conditions cause a lot of smoke when burning a fire.

**Activity 5.1(a)**
Your teacher will light up a fire outside in a suitable container (an old wok is ideal). When the fire is burning well, put a lid on to partially cover the fire. Keep moving the lid until the fire is almost completely covered.

What happens to the fire as you do this?

What is the lid doing to the fire?

Predict what would happen if you made it completely airtight.

**Activity 5.1(b)**
Put some wet wood or wet newspaper onto the fire. At the same time, dangle some white paper or material above the fire (try putting the material on the end of a long stick to do this).

What happens to the fire when wet fuel is used?

Look carefully at the white material that was above the fire.

Describe what you see.

**Activity 5.1(c)**
What is the message in the picture below?

**Summary**
From these activities, what advice would you give to people to stop them having smoky fires?
Wood smoke and health

Summary
This activity will help students learn about wood smoke and the harm it can cause to human health.

Activity 5.2
Undertake activity according to the instructions on the activity sheet.
This activity will require the students to use the library or have access to reference books on the respiratory system.

Answers to Activity 5.2
What does the respiratory system do for us? (Helps us get oxygen into the body and remove the carbon dioxide.)
What is the important gas which gets into our body via this system? (Oxygen)
What gas leaves the body this way? (Carbon dioxide)
Draw arrows showing the paths the woodsmoke particle can take to get into your lungs. (See the diagram on student page)
What have you got in your nose and throat which stop the particles from entering your lungs? (Hairs)
Discuss with the class:
1. Why is oxygen important to our body? (It burns our food to give us energy)
2. Why do we breathe faster when we’ve been running? (More energy is required)
3. Why do you think some particles get past the hairs in our nose and throat? (They are too small to be caught)
4. Give reasons why wood smoke can be bad for you. (Makes old and young people sick, can cause respiratory conditions to get worse)
Wood smoke and health

In this activity you will learn about wood smoke and the harm it can cause to human health.

When particles are breathed in, they can cause health problems, especially in the very young, the elderly or people with lung or heart disease. Very small particles make health problems like bronchitis, emphysema and asthma worse. These particles can also bring in carcinogens with them when they enter the body.

Find out the meaning of the following:

Bronchitis

Emphysema

Asthma

Carcinogens

How many students in your class suffer from asthma?

How many students have someone in their family who has asthma?

These people may be affected by wood smoke in their local area.

Activity 5.2

Using a reference book, label the parts of the respiratory system in the diagram above.

What does the respiratory system do for us?

What is the important gas which gets into our body via this system?

What gas leaves the body this way?

Draw arrows showing the paths the wood smoke particle can take to get into your lungs.

What do you have in your nose which stop the larger particles from entering your lungs?
Wood heaters

Summary
In this activity students will find out what problems incorrectly operated wood heaters cause and how they should use them to reduce the amount of wood smoke in the air.

Activity 5.3
Provide students with activity sheet to complete the crossword.

The EPA produces brochures which are designed to educate and inform the public about the correct use of wood heaters. These can be given to your students to help them complete the crossword puzzle and then taken home to be shared with families.

Answers to crossword:

Across
1. clean
2. summer
6. haze
7. particulate
9. night
10. twenty
14. on
15. ventilated
19. cut
22. burn out
24. lungs
26. heavier
32. local council
34. lead
35. green
36. elderly

Down
2. split
3. EG
4. regulations
5. open
6. hot
8. right
11. wed
12. no
13. young
17. loud
18. art
21. undercover
22. be
23. eye
24. live
25. garbage
27. hollow
28. son
29. bright
30. clear
31. ice
33. logs
Activity 5.3

In this activity you will find out what problems incorrectly operated wood heaters cause and how you should use them to reduce the amount of wood smoke in the air.

Your teacher will provide you with current literature from the Environment Protection Authority to do with wood heaters. Use it to complete the crossword and find out all about the proper use of wood heaters.

ACROSS
1. What you should do to your chimney regularly
2. Best time to store your wood
6. The brown smudge in the sky
7. Wood smoke is the major source of this type of pollution
9. The flue should not be shut at this time
10. Wood is illegal if its moisture content is more than this percentage
14. Opposite to off
15. Store firewood in this type of place
19. Green wood is wood that has just been __
20. Either, _____
21. United Nations (abbreviation)
22. What a fire should do at night (two words)
24. Part of our body which can be damaged by particles
26. Wet wood is _____ than dry wood.
27. Particles in the air can cause these sorts of problems
32. Who you contact if you see a very smoky chimney
34. Another air pollutant
35. This type of wood does not burn properly
36. Others who are most at risk from particles in the air

DOWN
2. This type of log dries faster
3. For example (abbreviation)
4. These control the type of wood heaters sold
5. The flue should be this way when starting a fire
6. A fire must be as _____ as possible
8. Wood must be stored this way
11. To marry
12. The amount of smoke which should come from the chimney
13. Some people most at risk from particles in the air
17. Very noisy
18. Letters 1, 18, 20 of the alphabet
21. Woodpiles should be kept this way to stop getting wet
22. To _____ or not to be, that is the question
23. Part of body needed to observe smoke
24. Live and let _____
25. Something which should never be burnt
27. Dry wood should make this sound
28. Male offspring
29. Fire should always burn this way
30. How we like our air to look
31. Solid water
33. Wood should be split into small _____ for storage

EPA
South Australia
What wood?

Summary
These activities show students that they can use simple methods to ensure that they are not producing lots of smoke particles when operating a wood heater or fire.

Background
Freshly cut wood from a living tree will contain about 50% moisture, i.e., about half the weight of the green wood is water. If it is left to dry out, the moisture content will gradually decrease until it reaches about 12–15%. At this point it reaches equilibrium with the air and does not lose any more moisture.

If wood is oven dried so that its moisture content is less than air, and then put back into the air, it will absorb some moisture until its moisture content again reaches 12–15%.

Activity 5.4 (a)
Undertake activity according to the instructions on the activity sheet.

Dry wood produces less smoke. Wood should contain less than 20% moisture if it is to be burnt. This activity shows that dry wood floats higher in a bucket of water than wet wood. If it floats with 1/6 of its length out of the water it has less than 20% moisture. This is an easy way to predict whether wood is dry enough to burn.

Activity 5.4 (b)
Undertake activity according to the instructions on the activity sheet.

Drying your wood and storing it correctly is important preparation for the correct use of your wood heater. Using sponge to represent wood, students will prepare it differently to observe the best conditions for drying their wood before burning.

Things to do to keep your wood dry:
• Cut it into small logs
• Stack it so air can circulate around the wood
• Stack it under cover

Discuss with the class:
1. Why should you use dry wood in your fire or wood heater? (To reduce the amount of particles put in the air)
2. In what way should you stack your wood to ensure it dries most quickly? (With plenty of air spaces between logs and undercover)
3. Who uses wood heaters at home?
What wood?

These activities will show you some simple ways you can ensure that you are not producing lots of smoke particles when operating a wood heater or fire.

Activity 5.4 (a)

Materials
- Dry wood
- Wet wood
- Bucket ¾ filled with water
- Marker pen

Instructions
Get two pieces of similar size wood, one which has been freshly cut and one which is old and dry. With the pen, mark into sixths. Put each into the bucket of water and hold upright. See how much of the log sticks out of the water. Draw your results

Which wood floated lower in the water?

Why would that happen?

The more moisture in the wood the heavier it is.

Which log was the wetter one?

Which of the two logs should you use to burn? Why?

Activity 5.4 (b)

Materials
- Sponges (3)
- Scissors
- Bowl of water

Instructions
This activity will show you the best way to treat your wood to get it ready for burning.

Sponge 1 – wet in the bowl of water and squeeze. Roll it in a ball and use a lacky band to keep in this shape.

Sponge 2 – cut the sponge into long strips and wet in the bowl and then squeeze. Tie loosely together with another lacky band.

Sponge 3 – treat as Sponge 2 but lay strips out beside one another.

Leave all the sponges in a safe place for 15 minutes. Then check for “wetness”. Check again in another 10 minutes. Describe your results.

Can you use this experiment to suggest what you can do to make your wood dry out more quickly?

Can you think of any other practical ways to keep your wood dry?

Describe the type of fire you need to produce the least amount of smoke.

How do you get this type of fire?
Household heating

Summary
As wood smoke can be a major cause of air pollution in winter, students can find out what sort of household heating is used in their local area. This activity introduces students to many important features of social survey work.

Activity 5.5
Each student is to survey approximately 10 households, work out the percentage of each type of heating in their sample, and then put all the survey results together. This illustrates how a small sample (10) will probably give very different results to a large sample (say 200).

The following points should be made about the survey:
- Students should be encouraged to use people they know in the neighbourhood rather than strangers who may not appreciate being surveyed by young students.
- They should appreciate through this survey that the larger the numbers, the more likely they are to get a true picture of household heating in their area.
- Although the formula is given in the activity, students, depending on their age, may need to be helped when working out percentages.

Discuss with the class:
1. What was wood heater usage in i) your sample ii) the class sample?
2. Which one would be more accurate? (Class sample.)
3. Why? (Larger number of surveys.)
4. Does this area have a lot of wood heaters?
5. If we don’t have large numbers of wood heaters in the area, should we still worry about particles in the air? Why? (Yes, because the wind can shift them one area to another.)
Household heating

The type of heating being used in your neighbourhood will affect your local air quality. Wood heaters, if not correctly used, can emit a lot of smoke into the air and cause haze or winter smog, especially in the colder months.

What type of heating do you use in your house? Does everyone in your neighbourhood use the same? These questions are important to answer if we are to understand how your local air quality is being affected by those who live there.

Activity 5.5

1. The following survey will allow you to get some idea of the types of heating used in your neighbourhood. Using the table below, try to collect the information from people you know.

2. Back at school, collate your class results.

3. To calculate the percentage of each type of heating use the following formula:

   \[
   \text{Heating type } \% \text{age} = \frac{\text{Type of heating } \times 100}{10}
   \]

   Calculate the percentage of different heating types for the whole class and add the results to your table.

   What type of heating is used most in your area?

   Which types of heating puts particles into the air?

   Do you think particles may be a problem in your area? Explain.

   Which results do you think are the best to use – your own or the whole class?

   Why?

<table>
<thead>
<tr>
<th>Household</th>
<th>Open fire</th>
<th>Wood heater</th>
<th>Gas heater</th>
<th>Electric heater</th>
<th>Oil heater</th>
<th>Other (specify)</th>
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</thead>
<tbody>
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Who cares about our air?
**Unit 6: Cars – a big headache**

**Unit summary**

In this unit students will investigate the pollution caused by car exhausts. They will also examine issues such as car usage, people’s attitudes to cars, alternative transport and possible actions which students can undertake to help reduce air pollution.

**Background notes**

Much of the pollution in our cities is caused by vehicles such as cars and trucks.

Cars and trucks release pollutants such as carbon monoxide, nitrogen oxides and particulate matter. The nitrogen oxides which are released react further, in the presence of strong sunlight, with the air to form ozone, the major component of photochemical smog. Smog occurs mainly in the summer months when there are high temperatures and long hours of sunlight.

Ozone affects the healthy and the fit as well as the more susceptible members of the population. These include the very young, the elderly and those with lung and heart disease.

**What can we do to reduce photochemical smog?**

As cars are the major source of the chemicals which help to form smog and greenhouse gases, we need to change the way we use them. Here are some hints.

- Don’t drive if you don’t have to. Some trips are short and a quick walk or bike ride will get you there.
- Carpool – try to organise trips with other people who are going in the same direction.
- Catch public transport where possible and convenient.
- Ride or walk to school. You will not only help the air pollution problem but you’ll get fit at the same time.
- When driving, drive smoothly as this leads to less air pollution. Try to avoid peak hour traffic and combine trips if you can.
- Consider buying a small, fuel efficient car.
- Keep your car engine tuned.
- Remove any wind resisting items such as roof racks and reduce the load carried in the car. This saves fuel.
- Keep tyres inflated so they roll more easily.
Car exhausts

Summary
This activity examines the exhausts of various types of cars to see which produces the greatest visible pollution.

Activity 6.1
Undertake activity according to the instructions on the activity sheet.

NOTE: This activity must be done in the open air and the handbrake of the vehicle must be on. Make sure that students do not touch the tailpipe as it will be hot. Students need to stand to the side of the exhaust rather than in front of it while the engine is running to avoid the fumes.

Discuss with the class:
1. Was there a difference between filter papers for different cars?
2. Which car produced the dirtiest filter paper? (Produced the most particulate matter)
3. Was there any relationship between the dirtiest filter paper and the:
   • age of the car
   • type of car
   • fuel used by the car?
4. Is the car with the dirtiest filter paper the most polluting? (No, as other cars may be giving off more invisible pollutants such as nitrogen oxide and carbon monoxide).
Car exhausts

Vehicles which use fuels such as petrol and diesel release pollutants into the air. These can cause us harm directly or change into other forms of pollution, such as photochemical smog, under the right conditions.

Activity 6.1
In this activity, you will be testing cars to see which ones produce the most visible pollution. This type of pollution is called particulate matter (PM).

Materials (per group)
• Tin can
• 1.5 m stick
• Masking tape
• Filter paper (or coffee filters)

Instructions
1. Make up a car testing device – as shown in the diagram.
2. Attach the first filter over one end of the can. Write a label to identify which car you are testing with this filter, eg. Mr Jones, 1987 Camry, unleaded petrol.
3. Test each car by holding the open end of the can over the tailpipe while the car is running. Leave it for at least 30 seconds, or until there is colouration on the paper.
4. Take off the device; wait until cool; remove used filter paper and keep. Draw up a summary table to record your results.
5. Repeat this process for at least three different cars.
6. Back in class, make a class chart and paste onto it the used filter papers and the information about the test cars.

What happened?

_____________________________

_____________________________

What differences do you notice on the filter papers?

_____________________________

_____________________________

Why do you think this might be so?

_____________________________

_____________________________

Does the car which produced the dirtiest filter necessarily produce the most air pollution? Explain (remember you are looking at visible pollution).

_____________________________

_____________________________
Smog

Summary
This activity will help students to understand that looking at air doesn’t always help identify whether it is polluted or not.

Photochemical smog
When we talk about smog we are referring to photochemical smog. This type of smog is invisible to the naked eye and is due to a build up of ozone in the air. Ozone forms when gases such as nitrogen dioxide and reactive organic compounds have reacted together in the air under the influence of sunlight and high temperatures.

Ozone is colourless and odourless in low concentrations but has a pungent odour and bluish colour in higher concentrations.

Ozone causes health problems such as eye, nose and throat irritations and damages the respiratory system. When people come in contact with higher levels of ozone they may feel tightness in the chest and experience wheezing.

There is also evidence that higher ozone levels can trigger asthma attacks and increase our susceptibility to infection.

Activity 6.2
Photochemical smog is becoming a problem in many cities in summer and is largely due to vehicle emissions. Also the weather conditions during this time – higher temperatures and long hours of sunlight often ensures that the smog build-up is greater.

Using the three diagrams on the activity sheet, Discuss with the class:

1. What seems to cause the smog? (Traffic).
2. How do weather conditions make smog worse over Australiana? (Australiana is a large coastal city and the sea breeze blows smog back over Australiana).
3. Why doesn’t this happen in winter? (Incorrect weather conditions, lower temperatures, not enough sunlight and prevailing winds are different).
4. Smog contains ozone which can be harmful. Why then are people worrying about the thinning of the ozone layer? (Ozone depletion is a different problem).

NOTE: Ozone high up in the atmosphere protects us from too much radiation. Ground-level ozone is harmful and affects our health.
Who cares about our air?
Unit 6 – Cars – a big headache | Smog | Student activity sheet

Smog

Photochemical smog contains ozone gas which can affect your health. It occurs mostly in summer when there is lots of sunlight and high temperatures.

Activity 6.2
To understand how photochemical smog can form examine the pictures above carefully and describe what is happening in each.

A

B

C

A cool sea breeze in summer is not as freshening as we expect. Why?

__________________________

__________________________

__________________________

Pleasant island

Australiana

Dingo Ranges

Sea breeze
Family cars

Summary
This activity gets students to look at their own family car usage and its effect on air pollution. They then consider the alternatives to private car usage, benefits and disadvantages.

Background
Cars are responsible for emissions of carbon dioxide, nitrogen oxides, hydrocarbons and lead. When not running properly they give off more of these pollutants and also use up more petrol.

So, what is the best way to use our cars? Is there any way in which we can change our use of cars that might reduce the amount of pollutants being pumped into the air?

Activity 6.3
As a homework exercise ask students to find out a bit about their family’s car use, specifically:

- number of family members who are drivers
- number of cars
- type and age of each vehicle
- number of cars which are used to commute to and from work or school and used as part of work.

Ask students to use the Green Vehicle Guide (www.greenvehicleguide.gov.au) and also find out the air pollution rating for each of their family’s cars. (Other information can also be obtained from this website).

Make a class table of the information collected by each student.

Ask students to answer questions on activity sheet.

Have a class discussion about:

- What cars have the lowest air pollution rating (According to the Green Vehicle Guide)?
- Why do many people choose to own a car rather than use public transport? (Convenience, safety, saves time)
- What could be done to encourage people to use their car less? (Make alternative transport more attractive, better public transport, better cycle/walk paths, increased parking costs).
Family cars

Cars are a big contributor to both local and global air pollution. Let’s look at how your family uses the car.

Activity 6.3
For homework, collect the following information about your family’s car use:

1. Number of people in your family:

2. Number of people in your family who are drivers:

3. Number of cars your family owns:

4. Type and age of each vehicle:

Visit the Green Vehicle Guide (www.greenvehicleguide.gov.au) and find out what the air pollution rating is for each of your family’s car/s.

How does the number of cars relate to the number of drivers in the family?

Can you suggest ways your family could cope with one less car?

What advantages would there be to your city or town if families got rid of one car? Would there be advantages to the families?

One alternative to using a car is travelling by public transport.

With your group discuss some of the advantages and disadvantages of using public transport. Write them in the space below.

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

What other alternatives are there to using a car?
Car logs

Summary
This exercise enables students to critically analyse how cars are used by families and to examine alternatives which will help reduce the use of the car.

Activity 6.4
Using the car log shown on the activity sheet, have a discussion with your class about how the Butler family uses their car each day.

Following this discussion ask students to answer the questions on the activity sheet.

Ask students to examine their own family’s use of vehicles and report back to the class. A car log is provided on Eddie’s Extras page at the end of this section.

This could be a project or homework assignment.
Car logs

Activity 6.4
Here is a daily car log for the Butler family for three days. Examine how they use their car each day and then answer the questions below.

List the major reasons for the use of both cars.

Which car would use the most petrol and cause the most pollution?

Who is doing most of the trips?

Which of the two cars should Mum drive to reduce pollution?

How could Mum reduce the amount of driving she does?

Where could Dad save on driving?

Outline a way the Butlers could still do all the things they do but have only one car. Which car do you think it should be? (Remember, Dad sometimes uses the car for work.)

<table>
<thead>
<tr>
<th>Day</th>
<th>Driver</th>
<th>Car Used</th>
<th>Distance (km)</th>
<th>Reason for journey</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mon</td>
<td>Mum</td>
<td>Mum’s 4WD</td>
<td>2</td>
<td>Kids to school</td>
</tr>
<tr>
<td></td>
<td>Dad</td>
<td>Dad’s Camry</td>
<td>10</td>
<td>Going to work</td>
</tr>
<tr>
<td></td>
<td>Mum</td>
<td>Mum’s 4WD</td>
<td>3</td>
<td>Grocery shopping</td>
</tr>
<tr>
<td></td>
<td>Mum</td>
<td>Mum’s 4WD</td>
<td>2</td>
<td>Pick kids up</td>
</tr>
<tr>
<td></td>
<td>Mum</td>
<td>Mum’s 4WD</td>
<td>3</td>
<td>Tom to football practice</td>
</tr>
<tr>
<td></td>
<td>Mum</td>
<td>Mum’s 4WD</td>
<td>3</td>
<td>Pick up Tom</td>
</tr>
<tr>
<td></td>
<td>Dad</td>
<td>Dad’s Camry</td>
<td>10</td>
<td>Home from work</td>
</tr>
<tr>
<td>Tues</td>
<td>Mum</td>
<td>Mum’s 4WD</td>
<td>2</td>
<td>Kids to school</td>
</tr>
<tr>
<td></td>
<td>Dad</td>
<td>Dad’s Camry</td>
<td>10</td>
<td>Going to work</td>
</tr>
<tr>
<td></td>
<td>Mum</td>
<td>Mum’s 4WD</td>
<td>20</td>
<td>Family errands</td>
</tr>
<tr>
<td></td>
<td>Mum</td>
<td>Mum’s 4WD</td>
<td>2</td>
<td>Pick kids up</td>
</tr>
<tr>
<td></td>
<td>Mum</td>
<td>Mum’s 4WD</td>
<td>6</td>
<td>Debbie to ballet</td>
</tr>
<tr>
<td></td>
<td>Mum</td>
<td>Mum’s 4WD</td>
<td>6</td>
<td>Pick Debbie up</td>
</tr>
<tr>
<td></td>
<td>Mum</td>
<td>Mum’s 4WD</td>
<td>4</td>
<td>Mum’s netball and back</td>
</tr>
<tr>
<td></td>
<td>Dad</td>
<td>Dad’s Camry</td>
<td>10</td>
<td>Home from work</td>
</tr>
<tr>
<td>Wed</td>
<td>Dad</td>
<td>Dad’s Camry</td>
<td>50</td>
<td>Business trips and home</td>
</tr>
<tr>
<td></td>
<td>Mum</td>
<td>Mum’s 4WD</td>
<td>2</td>
<td>Kids to school</td>
</tr>
<tr>
<td></td>
<td>Mum</td>
<td>Mum’s 4WD</td>
<td>2</td>
<td>Canteen duty at school</td>
</tr>
<tr>
<td></td>
<td>Mum</td>
<td>Mum’s 4WD</td>
<td>2</td>
<td>Home from school</td>
</tr>
<tr>
<td></td>
<td>Dad</td>
<td>Dad’s Camry</td>
<td>4</td>
<td>Squash night and return</td>
</tr>
<tr>
<td></td>
<td>Mum</td>
<td>Mum’s 4WD</td>
<td>5</td>
<td>Pick kids up, visiting friends and home</td>
</tr>
</tbody>
</table>
Vehicle counts

Summary
Using a survey, the class will collect traffic data to determine what sort of vehicles use your local roads. The type and amount of local traffic determines how much air pollution and traffic congestion there is in your area.

Background
Traffic type and flow information is important if you wish to reduce air pollution from vehicles in your area.

Vehicles contribute almost all of the carbon monoxide pollution and about half of the hydrocarbons and oxides of nitrogen. Smog is a direct result of the way we use our cars.

Of particular interest are single occupancy vehicles (SOVs) which increase vehicle numbers, traffic congestion and air pollution.

To reduce traffic congestion and air pollution in major cities, we must reduce the emissions from cars. There have been many suggestions including reducing the large number of SOVs currently on the roads.

Activity 6.5
Organise a group of students to observe traffic at the school on a given day or even over a week’s period.

Students are to base themselves near drop-off/pick-up/parking zones and car parks within the school boundaries.

Students may decide to observe the traffic every hour or every couple of hours during the school day to observe the different traffic conditions at these times, and identify any issues.

Using the table on the activity sheet students then record the type and number of vehicles coming into the school.

Under adult supervision and remembering safety rules, students can also collect similar data standing alongside local roads nearby the school. This will allow them to find out about the type and amount of traffic in the local area.

It is easiest to use a tally system and to assign a vehicle type per student. However on a busy road two students may need to focus on SOVs.

Ask students to answer questions on the activity sheet.

Have a class discussion about:
1. What are the advantages and disadvantages of having more than one person in a car?
2. Car pooling is where a group of people will share a lift to work. What are the advantages and disadvantages of carpooling?
3. How could we encourage car pooling?
4. What are other ways of reducing SOVs? (Using alternative transport).
Vehicle counts

Using a survey, you will collect traffic data to determine what sort of vehicles use your local roads. The type and amount of local traffic determines how much air pollution and traffic congestion there is in your area.

Activity 6.5
Form a group of about six students. Decide which types of vehicles each person is going to count. When out doing your survey, remember your safety rules.

| Van: Classed as a car if there is only 1 rear wheel on each side of van. |
| Truck: A solid body with 2 rear wheels on each side; eg one-tonne truck |
| Semi-trailer: A prime mover with a trailer attached to it. |

Back in class, combine your results to make a class set.

Discussion
What type of vehicles are there in greatest number?

Using the class results, calculate the percentage of single occupancy vehicles (SOV)?

What was the percentage of i) trucks, ii) buses?

Which vehicles do you think are responsible for a lot of the pollution? Explain.

Suggest three ways to reduce the number of cars on the road which have only one person in them.

Date: _____________
Time: _____________
Street: _____________

<table>
<thead>
<tr>
<th>Group results number</th>
<th>Class results number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motorbikes</td>
<td></td>
</tr>
<tr>
<td>Car – 1 person</td>
<td></td>
</tr>
<tr>
<td>Car – 2 people</td>
<td></td>
</tr>
<tr>
<td>Car – 3 or more people</td>
<td></td>
</tr>
<tr>
<td>4WD</td>
<td></td>
</tr>
<tr>
<td>Buses</td>
<td></td>
</tr>
<tr>
<td>Vans</td>
<td></td>
</tr>
<tr>
<td>Trucks</td>
<td></td>
</tr>
<tr>
<td>Semi-trailers</td>
<td></td>
</tr>
</tbody>
</table>
Eddie’s Extras

Complete a family car log with the following information for a week. Tick those journeys which could have been avoided. Discuss the results with your class.

<table>
<thead>
<tr>
<th>Date</th>
<th>Distance (kms)</th>
<th>Type of car</th>
<th>Reason for journey</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>
Unit 7: What can I do?

Unit summary
In this unit students are encouraged to sum up all the information they have about local air pollution. They also need to discuss their feelings and attitudes to develop a stance on air pollution and then to act on their position.

It is easy to talk about these issues, it is far more difficult to act upon them. We would encourage the students to commit to one act, however small, as their contribution to improving air quality in our state. This may take the form of walking or cycling to school for a week instead of using the car, or helping with a shopping centre display on air pollution.

They are further encouraged to translate their information, feelings and values about air pollution into their art, craft, language and drawing activities.

Background notes
There are various actions being undertaken by local, state and national governments as well as industry and communities to improve the quality of our air. We all have a responsibility to look after our local air quality and our personal efforts can help to reduce air pollution and contribute towards a cleaner and healthier environment.
What do you know?

Summary
Using a simple survey, students measure what their family, friends and others in the community know and feel about air pollution. This exercise also enables them to identify good and poor survey techniques.

Activity 7.1
Provide each student with at least two copies of the questionnaire activity sheet.

Ask students to survey family members of friends using the questionnaire.

Ask students to answer the discussion questions on the questionnaire.

Have a discussion about these questions and also discuss with the class:

• Who are the people that they surveyed?

• If they only asked their friends, do they think they are getting a good sample? (They do not reflect the overall population)

• To do a reliable survey, how many and what type of people do you think you should ask? (A cross section of the population)

Answers to survey
2. Yes
3. Yes
4. Yes
5. Yes
6. Yes
7. Yes
1, 8, 9, 10 are opinions and attitudes to which there are no correct answers.
What do you know?

**Activity 7.1**

**Instructions**
Using the questionnaire below survey at least two of your family members or friends to get an idea about what they think about air pollution.
After you have done the survey, add up the number of YES, NO and UNSURE answers for each question. Collect the class results in the table.

**Questionnaire**
1. Do you think this city has an air pollution problem?
   - YES
   - NO
   - UNSURE
2. Photochemical smog is a problem mainly in summer.
   - YES
   - NO
   - UNSURE
3. Photochemical smog is caused by emissions from cars.
   - YES
   - NO
   - UNSURE
4. Haze is a winter problem.
   - YES
   - NO
   - UNSURE
5. Particles in the air cause haze.
   - YES
   - NO
   - UNSURE
6. You should only use dry wood in heaters.
   - YES
   - NO
   - UNSURE
7. Cars should be banned to help improve the air.
   - YES
   - NO
   - UNSURE
8. Would you give up your car to help improve your city’s air quality?
   - YES
   - NO
   - UNSURE
9. Would you give money to help the environment?
   - YES
   - NO
   - UNSURE

**Questions**

Do the people you asked seem to know much about air pollution?

__________________________

Do they seem willing to make changes in their behaviour to help the environment? Explain.

__________________________

What could you do to help make people in your community more informed about air pollution?

__________________________

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
<th>Unsure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
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<tr>
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<td>3</td>
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<tr>
<td>9</td>
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</tbody>
</table>
Using the car less

Summary
This activity asks students to look at the alternatives to using the car and the associated advantages and disadvantages.

Activity 7.2
Work through the activity sheet with students.
Depending on the age of the students, they may need help in developing their answers.
Students should be able to identify that advantages of using the car include time efficiency, safety and convenience. Disadvantages are cost, traffic congestion, prevention of exercise and local pollution.
Alternatives should include walking, cycling, public transport, carpooling and their associated benefits, especially health and cost benefits. Other benefits can include reduction in congestion around the school, safety, social and community interaction as people share lifts or walk together to school.
In this activity, students should be able to identify the positives of alternative transport and develop a positive attitude to changing how they and their family use the car.
It is essential that students realise that if they want to make a difference to the environment, one of the biggest steps they can take is to reduce their reliance on the car for some of their travel needs.
Who cares about our air?
Unit 7 – What can I do? | Using the car less | Student activity sheet

Using the car less

In other activities you have learnt that using your car produces air pollution in your local area. Let’s look at what alternatives we could use and what benefits we can gain from them.

Activity 7.2 (a)
In the table, list all the advantages and disadvantages of using a car for getting to school and other trips you need to do.

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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<td></td>
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</tbody>
</table>

Activity 7.2 (b)
Now list as many alternatives as you can to making those same trips without using the car.

__________________________

__________________________

__________________________

Activity 7.2 (c)
For each alternative write down the advantages and disadvantages in the table below.

<table>
<thead>
<tr>
<th>Alternative mode of transport</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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</tbody>
</table>

Activity 7.3 (d)
As a whole class, discuss your answers and put a summary on the board.

Questions

What were the disadvantages to using the car?

Do you think these are important disadvantages? Why?

Of all the alternatives ways to get to school, which one would you be able to use? Why?

Why couldn’t you use the other types of transport?

Which do you think is the best reason for not using the car?

Which is the best reason for using your chosen alternative?

Would it be practical to use one of the alternatives for all your travel needs? Explain.
Green Transport Plans

Summary
One practical way your students can help the environment is to develop a Green Transport Plan.

Activity 7.3
Green Transport Planning examines the ways people commute to work or school and promotes the use of “greener” modes of travel, that is walking, cycling, public transport or carpooling.

Your students may develop a plan to get their class to change to greener transport for at least two days of a week. That is, four trips to or from school.

Activity 7.3 helps them identify what is currently stopping students from using the alternatives and finding practical solutions, which may involve asking the school administration for assistance.

Students will need to plan how they will implement their Green Transport Plan and assess whether they have been successful. The older the student, the more sophisticated these plans may become, and could include the whole school community.

Discuss with your class:
1. What seems to be stopping students using alternative transport modes?
2. How can we overcome some of these barriers?
3. Which travel modes will we include in our Green Transport Plan?
4. How will we encourage students to swap to an alternative?
5. Do we need to talk to a) parents? b) the principal, c) other teachers?
Green Transport Plans

One practical way your class, and even your whole school, could help the environment is to develop a Green Transport Plan. ‘What’s that?’ you ask.

A Green Transport Plan looks at the ways people get to work or school and then tries to plan ways they can make those trips using ‘greener’ modes of travel, that is walking, cycling, public transport or carpooling.

Activity 7.3
In a group of 3–4 students, discuss the questions in the boxes below and fill in the most common answers.

How do I get to and from school each day?

Why don’t I use one of the alternatives (eg Mum doesn’t think it’s safe)?

Ideas to get more people using alternative travel (eg introduce people who could walk to school together).

Walk: ________________________________
Ride: ________________________________
Carpool: ____________________________
Bus/train/tram: _______________________

Results
As a whole class put your ideas together on a sheet of butcher’s paper or the board.

Questions
Do most students get to school by car?

What alternative seems the most likely that students could swap to?

What steps need to be taken first to get students to change to this mode?

Writing the plan
Write a summary of all the things which need to be done for your Green Transport Plan.

Implementing the Plan
Assign jobs to different students to make sure your plan works.

Assessing the Plan
At the end discuss with the class: how successful you think the plan was, what worked, what didn’t work, what you would do if you did another one.
What can I do?

Summary
This activity encourages students to take action from what they have learnt. If they value the air they breathe, they should be willing to do one small thing which will help improve its quality.

Activity 7.4
Work through the activity sheet with students.

Often inaction occurs because we do not know what we can do or are not encouraged to think about how we can make a difference to such a big problem as air pollution.

Here are some options that students should be able to suggest in looking at their own and their family’s behaviours:

**Car usage**
- avoid peak hour traffic
- combine car trips
- drive smoothly, avoid excessive acceleration and braking
- buy a small, fuel efficient car which produces fewer emissions
- get your car tuned regularly and keep it well maintained
- make sure fuel caps fit well
- convert to LPG
- remove wind resisting items on your car such as roof racks
- don’t carry luggage if you don’t have to
- keep tyres inflated
- don’t alter the car (‘hotting’ up the car)
- use unleaded petrol.

**At home**
- compost your garden rubbish, don’t burn it
- avoid using two-stroke motors if possible
- use water based paints
- use a gas BBQ rather than a wood-fired one
- make sure people smoke outside.

**Wood heater usage**
- burn the wood brightly
- avoid using wet, green or painted wood
- don’t damp the fire down at night
- avoid burning household rubbish
- make sure your heater conforms to Australian Standards
- put on a jumper rather than increasing the heat.

Discuss with the class:
1. Which actions do you think you could do?
2. How can you get your family to take some action too?
3. Do you think we should try to get the rest of the school involved? If so, how?
What can I do?

Well you’ve learnt a lot about air pollution – but are you going to do anything about it?

You will have learnt that a lot of the problems with our air are caused by the way we live, the way we use our cars and our wood heaters. Here is your chance to take some small actions which will help improve air quality.

Activity 7.4

Materials
• Butcher’s paper
• Coloured dots (sticky)
• Blue tac
• Texters

Instructions
What to do is always a problem. The following activity uses focus groups to decide what you would like to do to help improve air quality.

Split into groups of 4–6 students.

Exercise 1:
Write down as many words as you can which describe how you feel when the air is:
1. clean and clear
2. polluted.

Each person in the group is to give their lists and explain their feelings.

Exercise 2:
As a group, brainstorm what could be done to help reduce air pollution. Write these on a piece of butcher’s paper.

Exercise 3:
A representative from each group presents these solutions to the class.

Exercise 4:
Each group re-forms and discusses which of these solutions the students could actually become involved in.
• Write these on butcher’s paper.
• Add any extras not mentioned on the bottom.
• Put a star next to the two actions you think would be the best for your class to undertake.

Exercise 5:
Each group post their lists around the room and discuss them, focusing on the two preferred actions for their group.

Exercise 6:
• List on the board the two preferred actions from each group.
• The class now has to vote for two to be undertaken by the whole class. To do this give each student three sticky coloured dots. They can use these to pick their most preferred options, one dot against three different items or three dots against one item.

Exercise 7:
The two actions with the most dots are the ones the students have voted to undertake.

Discuss how these could be implemented and ask students to draw up plans to get these actions started.
Plan a campaign on air quality in your community. Here are some ideas, but you may think of better ones yourself:

- Design posters, talks, brochures, etc which can be handed out to people;
- Arrange a shopping centre display in your area; or
- Have an open day at school focusing on air quality.

**Debate the issue**

‘Air pollution in our city is not a problem’

**Report back to the class**

Take one of these actions and make it into a poster or brochure which tells people clearly what they can do and why it needs to be done.

Put these posters around the school. Maybe you can ask your community newspaper about running the best ones in their paper.

Imagine you are a journalist who has to write an article on air pollution in your city. Research your topic and then write an article for your newspaper.

Make up a song or rap which gives the message ‘Do the right thing!’ when it comes to keeping our air clean.

Make a collage from things you can find in the playground showing an environment which has good air quality.

**Class discussion**

Break into groups of 4–6 students and discuss what you could do to take the message to people in your community about helping to keep our air clean and reduce greenhouse gas emissions.
### Appendix 2 – Protractor template

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<tr>
<th>String angle</th>
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</tr>
</thead>
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</tr>
<tr>
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</tr>
<tr>
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<td>40°</td>
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<tr>
<td>30°</td>
<td>41</td>
</tr>
<tr>
<td>20°</td>
<td>52</td>
</tr>
</tbody>
</table>
Appendix 3 – Types of air pollution

Photochemical smog
Photochemical smog is characterised by high concentrations of ground level ozone and usually occurs in late spring, during summer and early autumn when there is lots of sunlight and high temperatures.

Motor vehicles are the major source of summer smog but industry also contributes significantly.

High ground levels of ozone have sometimes been measured during this time. Ozone affects the healthy and fit as well as more susceptible members of the population such as the elderly, the young and those with respiratory problems. The effects of ozone include eye, nose and throat irritations, damage to our respiratory tracts, chest tightness and wheezing. There is also evidence that ozone can increase our sensitivity to allergens, trigger asthma attacks and increase our susceptibility to infection. Ozone can also damage plants and reduce their ability to photosynthesise as well as damage materials such as plastics, rubber, concrete, stone, cloth, dyes and paintwork.

Ground level ozone is harmful to health whereas ozone in the stratosphere protects us from harmful ultra-violet (UV) radiation.

Haze
Haze occurs when many tiny particles from wood smoke and vehicles make our skies look brown. Haze occurs mostly on cold, calm winter mornings.

The largest source of haze forming particles in winter is smoke from domestic wood heaters. In autumn and spring particles come from burning off. Exhaust fumes, especially from diesel engines, also contributes to haze.

Haze is worst when there is a temperature inversion which occurs on cool, calm nights when the ground and the air near the ground cool down. As it cools the air becomes heavier and will not mix with the warmer air above, so the particles are trapped close to the ground where people can easily breathe them in.

Carbon monoxide
Carbon monoxide which is colourless, odourless and very toxic, comes from incomplete burning, industrial processes and biological decay.

Motor vehicles contribute 80 per cent of the carbon monoxide, other sources contribute 18 per cent while industry accounts for only two per cent. Other sources include our homes, gardens, schools, shops and service stations.

One of the most significant individual sources of carbon monoxide is cigarette smoke. Scientific research indicates that smokers, and passive smokers (people who breathe air that contains smoke), are exposed to four times more carbon monoxide than people in a smoke free environment.

Low levels of carbon monoxide can reduce our ability to carry out exercise. Greater levels reduce our ability to concentrate and cause headaches. Very high levels can be fatal.

The health threat of carbon monoxide is greatest for people who suffer from heart disease with a correlation being shown between carbon monoxide levels and hospital admissions of elderly people with heart failure.
Oxides of nitrogen
The most common of these are nitric oxide and nitrogen dioxide. These help form photochemical smog and also have significant impacts on health.

The largest man-made source of nitrogen oxides is the combustion of fossil fuels. Motor vehicles contribute 51 per cent of these emissions and industry contributes about 44 per cent.

While nitric oxide (NO) is relatively safe, it is converted into nitrogen dioxide in the atmosphere. At certain levels, nitrogen dioxide can affect our respiratory system and increase our susceptibility to infection. This is a real problem for babies, older people or for those people with problems such as bronchitis and asthma. There is evidence that nitrogen dioxide can trigger asthma attacks and long term exposure can irreversibly damage our lungs.

Nitrogen dioxide can also age materials such as paint, metals, rubber, fabric, leather, paper and building materials. It can also react with water to form acid rain.

Air toxics
There are many of these, most of which come from cars and other sources such as cigarette smoke and fuel vapour. These have wide ranging effects from reduced consciousness and irritation of the respiratory system to increased levels of cancers.

Odours
Odour causes a great deal of concern for many people. Generally odours are annoying. In rare cases, the compound causing the odour may be poisonous and lead to illness in people.

Most odour complaints are related to industries which deal with animals or animal by-products. Examples include poultry farms, piggeries, cattle feedlots and tanneries.
**Glossary**

**Air pollution** – occurs when the air contains gases, dust, fumes or odour in amounts which are harmful to human health.

**Air toxics** – harmful organic compounds which come from sources such as car exhausts, cigarettes, building materials and cleaning products.

**Allergens** – substances which cause allergic reactions.

**Combustion** – burning in the presence of oxygen.

**Components** – parts which make up the whole.

**Compound** – a substance where its components are chemically combined.

**Carbon monoxide (CO)** – a poisonous gas formed when incomplete burning occurs.

**Emissions** – the gases discharged into the air from cars, trucks, factories and appliances.

**Emphysema** – a disease of the lungs which makes breathing difficult.

**Flue** – the smoke passage in a chimney.

**Haze** – a form of pollution where tiny particles float in the air, decreasing visibility.

**Hydrocarbons** – compounds made of hydrogen and carbon.

**Incinerator** – furnace for burning.

**Incomplete combustion** – burning where there is insufficient oxygen.

**Inversion** – where a warm layer of air is trapped close to the ground by a more dense cool layer above.

**Kindling** – wood chopped into small pieces used to start a fire.

**Mixture** – where two or more substances are mixed but not chemically combined.

**Molecule** – one or more atoms joined together.

**Neutralise** – to counteract and make ineffective.

**Nitrogen oxides (NOₓ)** – gases which form when fossil fuels are burnt. Some forms, such as nitrogen dioxide, are harmful to human health.

**Oxygen (O₂)** – a gas in the air used by humans, plants and animals for respiration.

**Ozone** – the main constituent of smog.

**Particulates** – solid or liquid particles which float and pollute the air.

**Photochemical** – chemical reactions which need light for the reaction to happen.

**Photosynthesis** – a process which uses sunlight to produce an energy source in plants.

**Smog** – a form of pollution which is characterised by high levels of ozone in the air.

**Turbulence** – air movement which is irregular, indicated by gusts and winds.