The solution of this riddle tells you what this book is about.

We can't see it
but it is all around us.

We can't hear it
but it makes may sounds.

We can't smell it
but it carries many smells.

We can't really touch it
because it is touching us all of the time,
but we can feel it when it moves.

(of course)!

Contents

Using this booklet in the Curriculum

This information booklet on air quality has been developed to support teachers in the **Senior Phase (Grade 7 – 9).** It is a source of simple information to help learners develop an understanding of air and air pollution.

Beyond the provision of introductory information, an important feature of this booklet is its section of concluding activities. These **audit exercises** challenge learners to apply classroom learning to their local community by investigating air quality issues. The materials can thus be used as an extension of any OBE activities in a wide range of learning areas.

Learning Areas most directly supported by this booklet are:

Natural Sciences -	investigative work (LO 1,2 and 3)
Social Sciences -	impact of environmental factors on human health (LO - geographical - 1,3)
Mathematics -	opportunities for graphing and analysing date (LO 4 and 5)

This list is by no means exhaustive and the creative teacher who is looking for some good ideas, simple information and challenging learning opportunities can adapt these materials in a variety of ways in the OBE Curriculum

A guiding principle of the Revised National Curriculum Statement is that curriculum activities can create awareness of “the relationship between human rights, a healthy environment, social justice and inclusivity”. This principle is a very powerful starting point for learners to engage with issues of air pollution and quality of life. To what extent do the issues associated with air pollution relate to people’s right to live in a healthy environment? What choices are available to communities who want to make a difference?

We hope that you enjoy the booklet and will find it useful for enriching the learning opportunities in your learning area.

PART 1: Air and Air Pollution

What are the common gases in the air we breathe?

Air in the atmosphere contains different gases. The main components are Nitrogen (N). Oxygen (O_2) and Carbon Dioxide (CO_2).

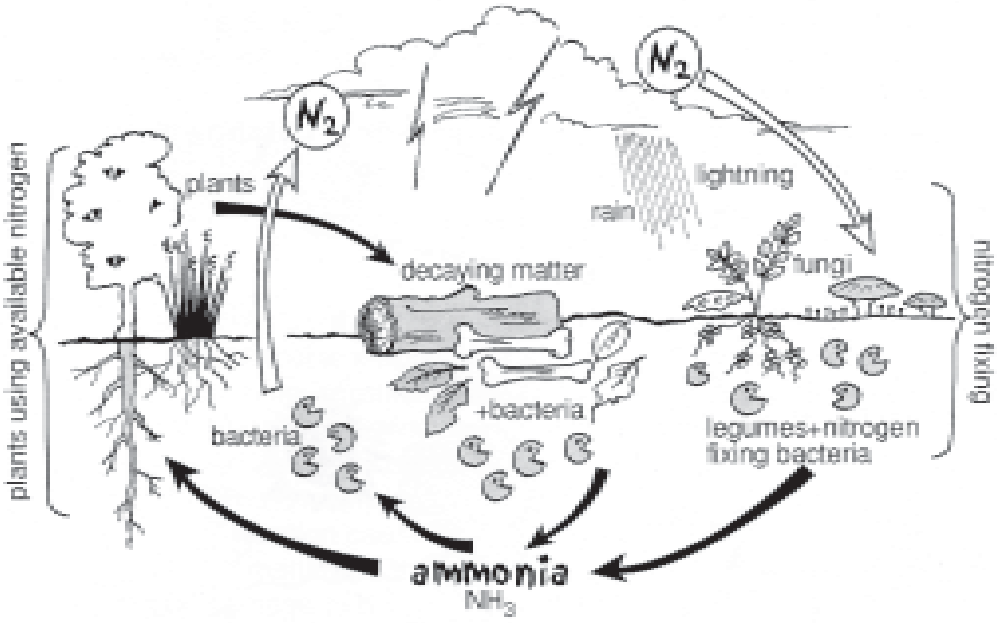
Atmospheric gases	**volume %**
Nitrogen	78,084
Oxygen	20,946
Carbon dioxide	0,034
Inert gases	0,936

Without this air, there would be no life on Earth! Green plant use **carbon dioxide** and water to produce **oxygen** and glucose during a process called **photosynthesis**. During **respiration**, however, people and animals inhale oxygen and exhale the carbon dioxide that is produced. Carbon dioxide is also released into the atmosphere through motor vehicle emissions, the combustion of fossil fuels in industries and burning processes like veld fires and household cooking fires. (Read more about these on pages 5 - 7).

What can you conclude about the relationship between oxygen producers and carbon dioxide producers?

Nitrogen is the most commonly occurring gas in our lower atmosphere.

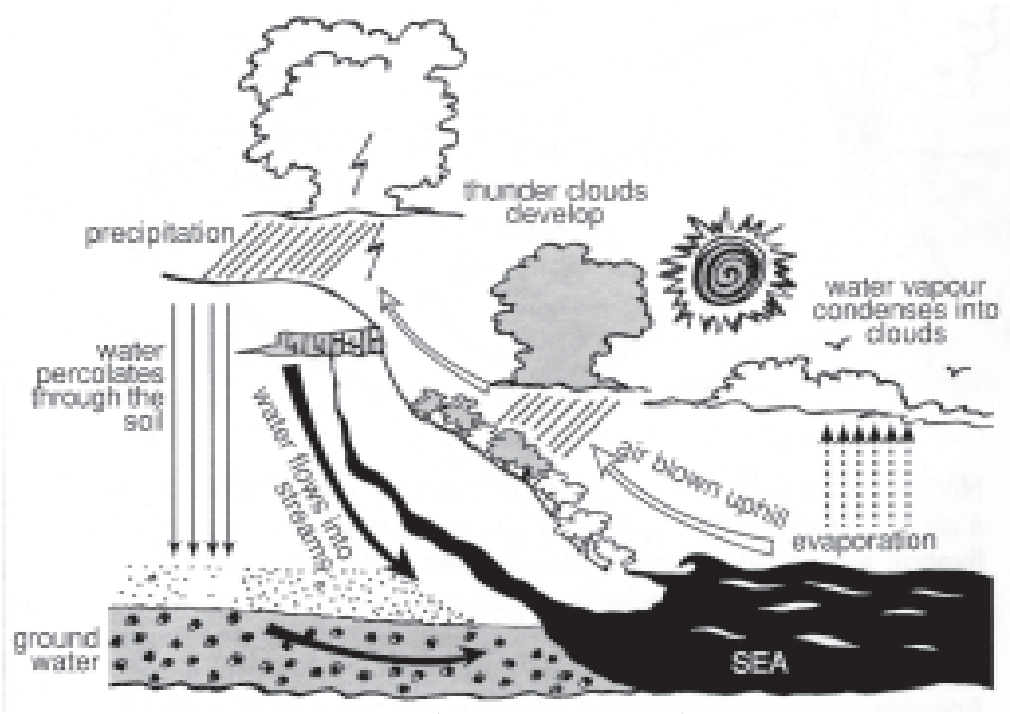
But where does nitrogen in the air come from?



Nitrogen has to be converted into nitrates before plants can use it as a nutrient. Plants that carry bacteria needed for nitrogen fixation are called legumes. These bean plants offer homes in their root nodules for bacteria, which convert the nitrogen from the atmosphere into nitrates. The bacteria enable nitrates to enter the soil where the roots of plants can receive them with water. Animals get nitrogen from the nitrogen compounds found in the plants they eat. After digestion, this is expelled as ammonia (NH_3) in their faeces. Nitrogen also returns to the soil when dead plants and animals decompose and bacteria convert the nitrogen into nitrates again. Nitrogen can also be fixed (made available as nitrates) when lightning fixes nitrogen in the air into nitrates which fall to the ground in rainwater and flow into the soil.

Water vapor is also an important component of air because it is responsible for the formation of clouds and rain. Warm air can carry more water vapor than cold air, so when air warms up during the day, the concentration of water vapor increases as water from the land, rivers, lakes, dams and seas **evaporates.** But warm air also moves upwards and, while it is moving, it cools down again. Clouds are thus formed and eventually, when the air can't carry all the water vapor anymore, rain falls to the land.

Which other living and non-living components are involved in the water cycle?

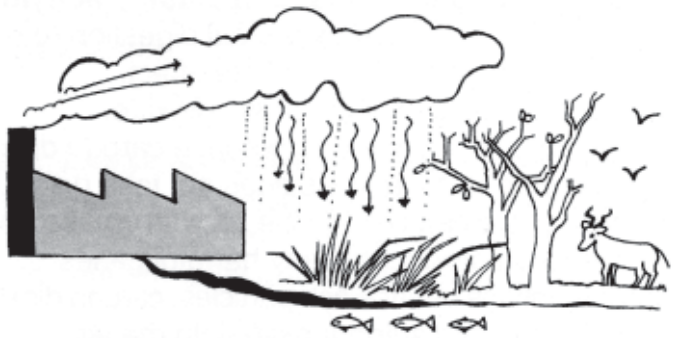


The Water Cycle

Particulate matter is found in the air. Particles consist of different materials such as specks of dust, ash, minute sand particles or pollen from plants. Particles in the air play and important role in the process of forming clouds. You can read more about this on page 15.

What is air Pollution?

Air Pollution is the presence of one or more contaminants in the air which may negatively affect human, animal or plant life.



Throughout history there have been natural events that result in air pollution. Volcanic eruptions, veld fires and chemical reactions with organic material that release particles and harmful gases into the air. Weather conditions, wind and rain quickly disperse these pollutants and maintain the atmosphere's natural balance.

In modern times, however, population growth, rapid urbanisation and industrialisation cause more pollution than these natural air cleaners can manage. The consequence is increased respiratory diseases, damage to buildings and threats to plant life, animal life and entire ecosystems. People most severely affected are the employees of these companies and those living close to the pollutant source.

Primary air pollution is caused directly by emission of gases or particles. These are called 'primary pollutants', for example carbon monoxide from car emissions. **Secondary air pollution** occurs when primary pollutants cause reactions that lead to further pollution. Ozone in the troposphere in an example of such secondary air pollution.

Main problems related to air pollution are acid rain, poisonous particles and gases in the air, the greenhouse effect, smog and the displacement of ozone.

Air pollution is caused by natural processes and human activities.

Which of the following are caused by human activities?

- **?** Methane gases produced by animal digestion (e.g. cows) contribute to the greenhouse effect.
- **?** People and animals exhale carbon dioxide.
- **?** Green plants use *oxygen* and produce *carbon dioxide* at night when photosynthesis does not take place.
- **?** In dry seasons, veld fires fill the air with smoke and the combustion produces many harmful gases.
- **?** Volcanic eruptions release ash particles, carbon dioxide, nitrogen oxides and sulphur oxide into the air.
- **?** Particles in the air also originate from living things like pets, people and plants. Dead skin cells, hair, small fragments of decomposing leaves and bark are a few examples of such particles.

Human activities that contribute the most to air pollution are wood and coal-burning household fires, industrial emissions, vehicle emissions and, in the mining industry, combustion on mine dumps.

Causes of air pollution

All forms of combustion emit carbon dioxide (CO_2). Industrial **processes** that involve burning coal, oil or other fuels can thus cause serious air pollution. For example, thermal electric power plants burn coal, which contains sulphur, that turns into sulphur oxides (SOx) in the atmosphere. This poisonous gas irritates the eyes, nose and throat, damages the lungs, kills plants and rusts metal.

Brickworks, steelworks, smelters, plants converting coal into oil, chemical manufacturing plants, sawmills, pulp-and-paper-mills and cement manufacturers also contribute to air pollution and are required to conform to air quality regulations.

Mining and its waste on dumps are also responsible for air pollution. Asbestos mine dumps are a serious health hazard and poorly managed coal mines can leak methane into the atmosphere. Coal waste contains materials that can burn on their own (self-combustion) and produce poisonous particles and gases. Coal fields in southern Africa are situated under stone layers that are easily ignited. In South Africa for instance, the coal dump in Grootpan burned for many years without being extinguished.

Still under-researched in South Africa, but well monitored in other parts of the world, are the negative effects on human health of **burning waste on dumps.** Most municipal dumps burn slowly and release polluting gases and particles.

Household cooking and heating poses a major health threat to many people. Two thirds of the South African population lack access to electricity. Instead they burn coal,

wood or paraffin to warm their homes or cook. This combustion produces **sulphur dioxide, carbon dioxide, carbon monoxide and particles.** The result is poor air quality and an unhealthy environment, especially as these gases and particles linger in poorly ventilated rooms.

Vehicles that run on petrol and diesel are the main source of carbon monoxide (CO). Diesel-using cars produce ten times more particles than cars with petrol engines. Also, the combustion in motor engines produces hydrocarbons and contributes approximately 50% of the planet's **nitrous oxides** (NOx) emissions. In some southern African countries, poisonous lead (Pb) is still added to petrol.

Farming also contributes to air pollution. **Methane** (CH_4) arises from animal dung, biological decay and fermentation in the stomachs of livestock. Vast quantities of dust are also generated during harvesting and ploughing. Pesticides (that kill insects) and herbicides (that kill weeds) are sprayed on crops to increase crop quality and quantity. These chemicals, however, remain in the soil and air, killing plants and animals and affecting the ecosystem. The spreading of nitrogen fertilizers on agricultural fields increases the content of nitrous oxide (NOx) in the atmosphere.

Air: A Part of Our History

Through modern scientific knowledge we now know that air is made up of different gases and that its quality is very important for human health. Prior to this, early indigenous peoples of southern Africa had a keen sense of air as wind - *umoya.* The word *umoya* means both 'wind' and 'spirit' and links human health to spiritual well-being.

Until recently, scientists have not recognised that rural communities held much refined environmental knowledge. Malaria, cholera and the nagana cattle disease were associated with 'bad-air' said to be found in lower river valleys and at the coast. In a similar way to other indigenous societies, the Nguni use of 'bad air' *(umoya omubi)* had an association with swampy places that smelled bad and the wider outside world of unknown threats. It may be no accident that the French word Malaria, is made up of 'mar and 'air', meaning 'bad air'! (It was only fairly recently that transmission of malaria from an infected to a healthy person was associated with the mosquito that breeds in swampy areas).

In eastern southern Africa great care was taken to site an Nguni homestead on an east-facing slope. If you talk to rural people you find that much thought is given to the siting of a homestead, notably the importance of the prevailing winds that switch from north-east and south-east. The

cooling evening breezes that rise out of a valley in the late afternoon are of equal significance. *Phuzumoya,* the place where you can 'drink in the air', is a common expression associated with the grassy uplands where people sited their homes.

The strong spiritual link between air and health meant that when the first signs of a calling to traditional medicine were detected, the person was said to have *unomoya* (spirit air). The use of the plant called *"impepho"* (incense) by traditional healers and sangomas is for dispelling bad air. The plant is also burnt in a saucer to welcome ancestral spirits.

It may not have been coincidental that protection from 'bad air' was a ceremonial cleansing of hands. Hand-washing when strangers visited or when people returned from being away was said to wash away the 'bad airs' associated with illness. Modern science now tells us that this practice was an effective way of stopping the spread of cholera and diarrhoeal diseases, both of which were associated with bad air, but were actually transmitted by physical contact with, for example, contaminated hands.

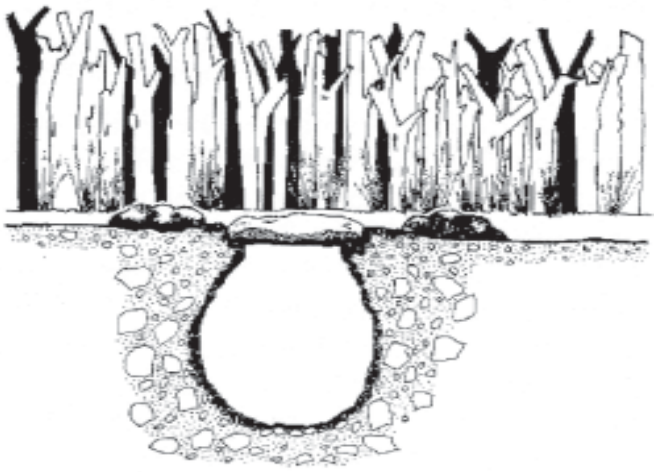
Through day-to-day common sense and experience, the Nguni knew which sticks to put onto the fire in the early evening to best create the smell that would repel mosquitoes. Smoke made with dry dung and grass was used to protect cattle from tsetse flies as young herders ventured deep into valleys for good grazing during the late winter and early spring months. Scientists tell us that the smell of smoke causes tsetse fly to return to the protection of the moist river

valleys where they breed. Today we use mosquito coils and insect repelling sprays, the scent of which repels insects.

The Nguni knew about other gases and to watch for *'isimoko',* the blend of gases that condensed over a grain pit that protected stored food from weevils and rodents. They also knew to wait for the gases to clear and for one person at a time to enter the pit to take out the grain needed by the family during late winter when food was in short supply.

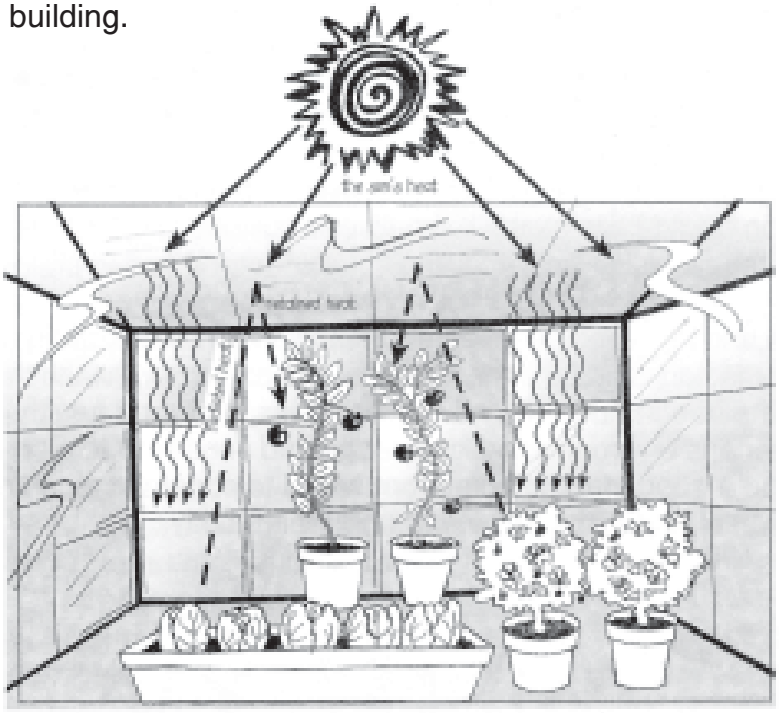
Today, grain storage facilities are switching back to the use of carbon dioxide gas as an alternative to poisons to kill weevils that threaten stored grain.

More and more indigenous people now live in cities, often near smelly factories and dumps. With this has come new health threats and the need to develop new sensitivities to air and health. Indigenous environmental knowledge and sensitivity to air quality can be a good starting point from which to construct a clearer understanding of the threats to our health today.



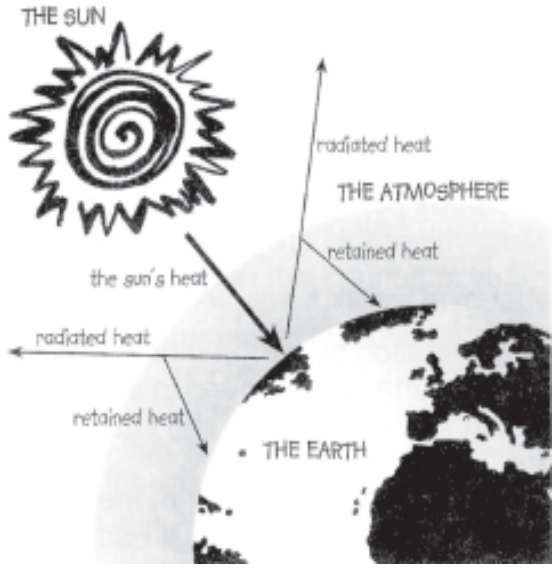
PART 2: Pollution Problems
The Greenhouse Effect

Greenhouses are used in colder regions to cultivate plants which grow best in a warm climate. (Examples of these are tomatoes and cucumber plants). Greenhouses are built almost entirely of glass; this lets the sun shine in but prevents the heated air leaving the building.



The 'Greenhouse Effect' is the name given to the warming effect of certain gases in the Earth's atmosphere. The 'greenhouse gases' are water vapor, carbon dioxide, methane, nitrous oxide and chlorofluorocarbons (CFCs). These all occur naturally in the atmosphere, but in small quantities. Human activities such as some agricultural practices, burning of fossil fuels, and the destruction of natural vegetation release unnaturally high levels of these gases into the atmosphere. (See pages 5 - 8). This creates a layer of gases which act in a similar way to the glass windows of a greenhouse: the sunlight comes in but the heat cannot escape!

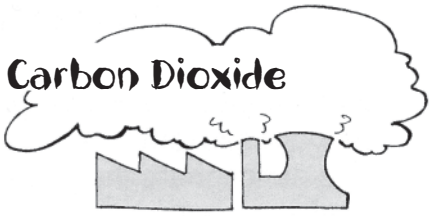
The Sun's rays (shortwave radiation) pass easily through the Earth's atmosphere but when they reflect off the Earth's surface as longwave radiation, they are withheld by the greenhouse gases. The atmosphere then warms up and accumulates even more heat.



This greenhouse effect, also known as global warming, is contributing significantly to climate change. Scientists predict an increase of 1°C of the average global temperature by 2025, and 3°C by 2100. This might seem like an insignificant change, but consider that the last Ice Age (approximately 15 000 years ago) was only 5°C colder than today's average temperatures! Having the planet just a few degrees warmer could result in the Earth's ice caps melting, ocean levels rising to cover existing landmasses, extreme weather conditions (flood and droughts) and rapid species extinction.

Many scientists disagree with this prediction. What do you think?

Carbon Monoxide and Carbon Dioxide



Carbon monoxide (CO) is a very poisonous gas that is difficult to detect because it is odorless, has no colour and no flavour. Even its density is similar to air. Carbon monoxide has devastating effects on the respiratory system. It is strongly attracted to haemoglobin, the red part of blood, which transports oxygen around the body. When carbon monoxide occupies the haemoglobin, cells throughout the body become starved of oxygen, leading to impaired vision, sickness, paralysis, damage to the central nervous system, unconsciousness and even death. Most vulnerable are young children, elderly people and those already suffering from respiratory problems.

The highest concentration of carbon monoxide exists in areas close to the earth's surface. It is found in streets full of traffic, in closed garages, in stuffy rooms burning coal and wood and in tobacco smoke.
Carbon dioxide (CO_2) is a natural part of the atmosphere. Like carbon monoxide, it has no colour, but it has a slightly acidic flavour and smell. It doesn't burn and it is heavier than air. In very high concentrations carbon dioxide is poisonous and can cause death.

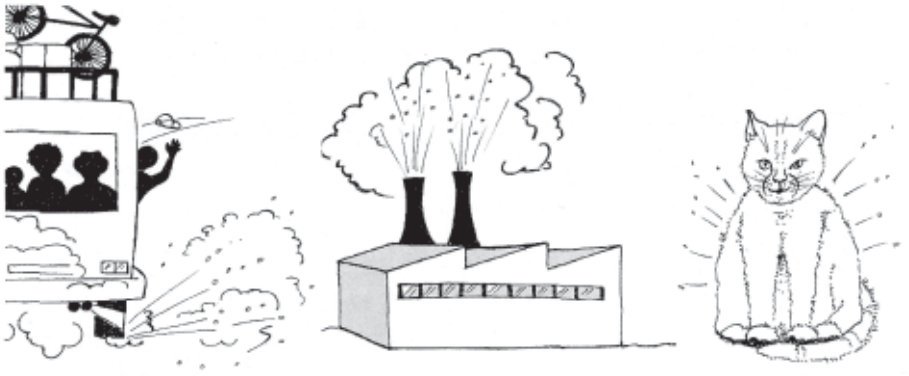
Carbon dioxide is essential for the existence of all ecosystems.
It is necessary for the processes of respiration and combustion. Carbon dioxide is the most significant 'greenhouse gas'. It contributes to 50% of the insulating layer of the atmosphere which maintains the Earth's temperature. This greenhouse effect becomes a problem, however, when CO_2 levels in the atmosphere become too high.

Particles in the Air

Tiny particles occur naturally in the air, but too many of them can cause serious environmental problems, especially for people's health.

As we breathe, tiny dust particles remain in the lungs and cause tissue damage. Allergies, asthma, bronchitis, persistent coughs and even lung cancer can result. If the dust contains poisonous materials (for example lead, cadmium and nitrate), people may suffer the effects of poisoning.

Dust particles vary in size and originate from many different sources such as pets in the home, plant matter dead skin cells, cigarettes, industrial centres and mines. Dust particles are firm, consistently arranged particles from 0,0001 mm in size (particles in tobacco smoke) to 1 mm (cement dust, pollens). Chunky dust with a diameter greater than 100 μm (1 mm) can remain airborne for only a short time before falling to the ground. Particles smaller than 5 μm can drift for up to two weeks in the atmosphere before they enlarge due to chemical reactions and fall to the ground too.



Asbestos dust is very hazardous. It is made up of tiny fibres and even a very low concentration in the air can cause scarring of lung tissue, lung cancer and other lung diseases. Most at risk are people using asbestos products, working in the transport industry, living near asbestos mine dumps or working in asbestos mines.

Lead that is added to petrol is very toxic and technology and legislation have been working to enforce the use of unleaded petrol. Since January 2006 only unleaded and lead replacement petrol have been available to vehicle drivers. Studies in several regions worldwide have reported a high concentration of lead in the air especially beside busy roads. The lead concentration in the blood of people living in areas of heavy traffic is much higher than average.

Lead poisons thousands of people every year, particularly those between the age of 35 and 50. Some effects of lead poisoning are: anaemia, hyperactivity, miscarriages, stillbirths, brain damage, nerve damage and kidney failure.

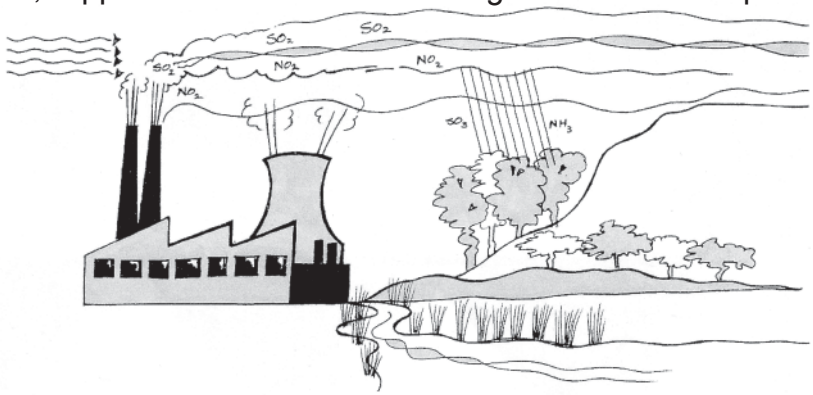
It is not only people who suffer the effects of particulate matter in the air. In plants, tiny holes on the leaf surface, essential for the exchange of gases, get blocked. Consequently, less photosynthesis occurs which means less energy is available for the plant, and less oxygen is produced.

Acid Rain

Acid rain is caused by the release of gases SO_2 (sulphur dioxide) and NOx (nitrous oxides) into the atmosphere. When these gases react with water vapor and sunlight, they form sulphuric acid and nitric acid so when the raindrops fall to the land, they are also acidic.

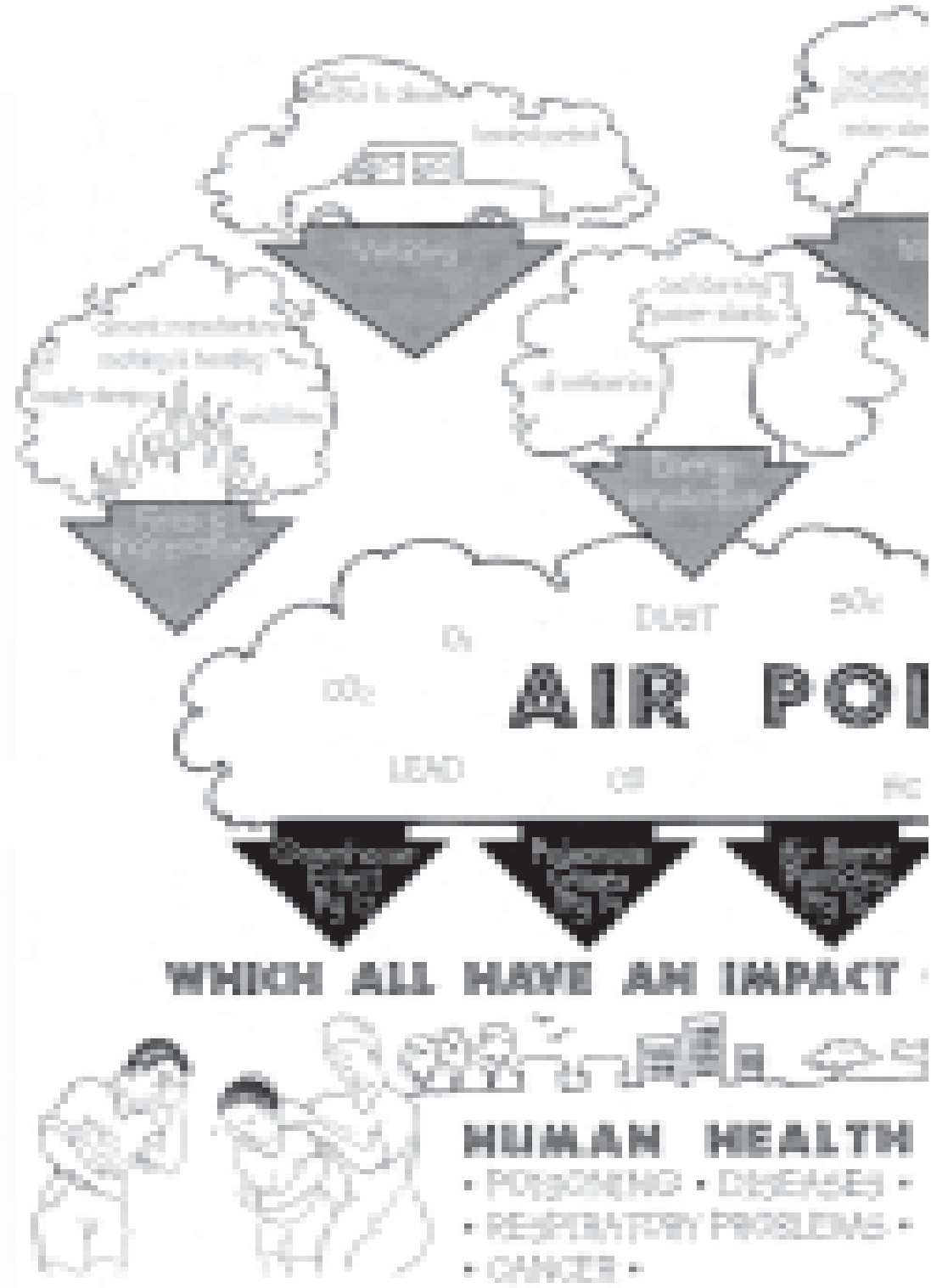
Acidic air pollution has a pH-value below 6 and includes all types of precipitation, for example, acid rain, acid fog and acid snow. The precipitation falls to the earth's surface, gets into the ground and increases the soil's acidity.

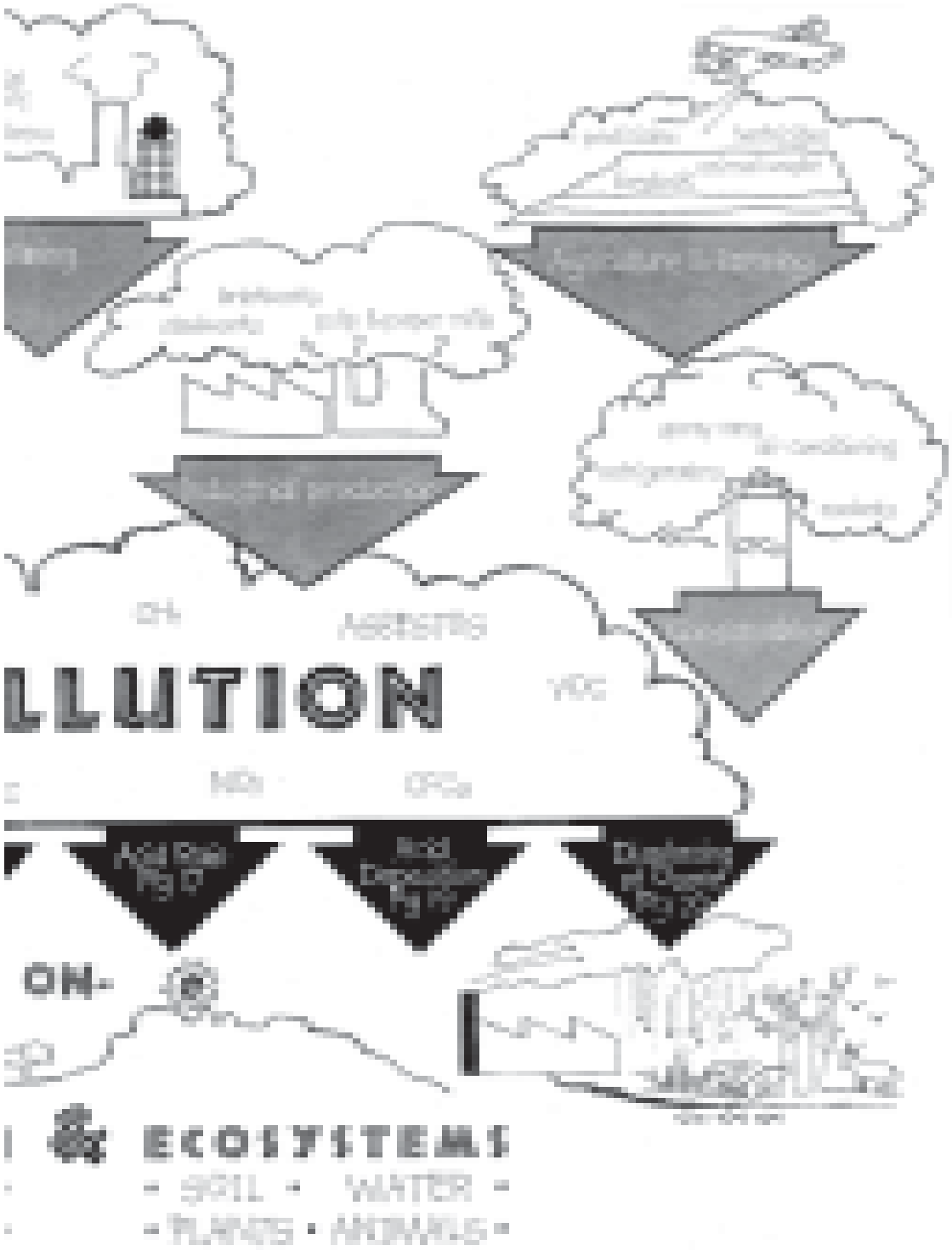
People's health can be affected severely by acid rain. There is a risk of increasing the acidity of drinking water and, depending on the source of the pollution, high concentrations of metals such as lead, copper and aluminium in drinking water can cause poisoning.



Acid rain also accelerates the erosion of stones, especially 'soft' stones like sandstone and limestone. Buildings and monuments made of these materials are damaged and may require costly maintenance.

Plant life is negatively affected by acid rain. Trees and whole forests have been known to die and, more commonly, leaves turn a mottled yellow. Leaves damaged in this way are vulnerable to attack by insects and diseases.


DUST
AIR POI
LEAD
WHICH ALL HAVE AN IMPACT
HUMAN HEALTH
• POISONING • DISEASES •
• RESPIRATORY PROBLEMS •
• CANCER •


LLUTION
ON-
ECOSYSTEMS
- SOIL - WATER -
- PLANTS - ANIMALS -

Aquatic animals (living in water) are especially sensitive to pH change caused by acid rain. The death rate is high when their watery environment becomes too acidic to support normal life processes.

Combustion is the main source of the pollutants responsible for acid rain. Water and added gases like carbon dioxide, sulphur dioxide and nitrogen oxides are transformed into acids. These are **carbonic acid, sulphuric acid** and **nitric acid.**

The spreading of acid air pollution depends on the strength and the direction of the wind. High factory chimneys are often responsible for acid rain in areas far away from the pollutant source. Pollutants from South Africa can travel as far as Mozambique, Swaziland, Lesotho and beyond.

Acid Deposition

A significant consequence of industrial air pollution is acid deposition. The sulphur dioxide produced by combustion of coal or oil reacts with **sulphur oxide** in the air. These gases combine with ash particles in the air and fall to the ground as dry, acid deposition.

Acid deposition has many consequences for plants, animals and human health:

Sulphur oxide reacts with acid in leaves, burning holes in the leaf surfaces and destroying protective layers. Indigenous trees that grow slowly are less sensitive to air pollution than fast growing trees such as pine and gum trees.

Acid deposition also changes the pH of soil. This occurs when pollutant gases react with plant nutrients which then make their way into the soil. Other poisonous metals such as aluminum and cadmium dissolve in water and alter the soil's pH. This higher concentration of metals also inhibits nutrient exchange in plants.

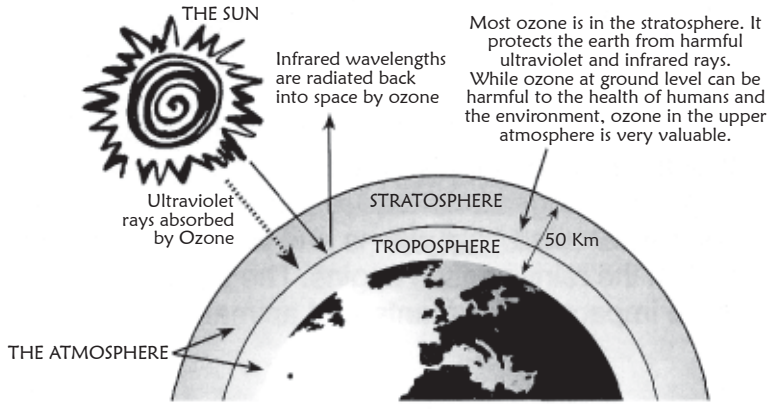
Deposition of acid particles poses a direct threat to wetlands, the habitat of many sensitive plants and animals which are intolerant of even small changes in pH value. During the dry season, acid particles are collected on surfaces and washed into the upper soil layers when the rainy season begins. The sudden pH change has a negative impact on the plants and animals.

Stratospheric Ozone

Ozone (O_3) is an unstable form of oxygen that occurs naturally in the stratosphere (upper atmosphere), about 20 - 50km above the Earth's surface. It is a highly reactive, pale blue gas that consists of three oxygen atoms. Ozone in the stratosphere protects living things by absorbing most of the Sun's dangerous ultraviolet radiation. Without this 'ozone layer', UV-B radiation would suppress photosynthesis in plants, stunt animal growth, disrupt immune systems and increase the risk of skin cancer and eye cataracts.

Unfortunately, the protective ozone layer is being destroyed by man-made chemicals known as ozone depleting substances (ODS). These include CFC's (chlorofluorocarbons), halons, methyl chloroform, carbon tetrachloride, methyl bromide and hydrochlorflourocarbons. These are substances mostly used for refrigerants, foams, aircraft, pesticides and some medicines.

Until recent years CFCs were widely used in aerosol cans, refrigerators, polystyrene products, fire extinguishers and air-conditioning units. Although legislation has radically reduced the use of CFCs, their stable chemical nature means that they will remain in the Earth's atmosphere for at least 200 years! In the atmosphere, they break down ozone molecules and cause a thinning of the protective ozone layer. Scientists estimate that CFCs from one spray can could destroy 3 tonnes of ozone.

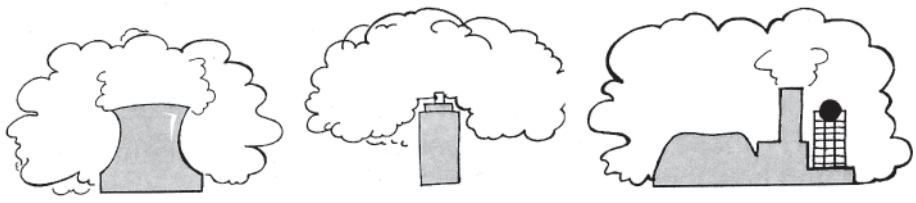


PART 3: What Can Be Done?
What is DEA&T Doing About Air Pollution?

DEPARTMENT : ENVIRONMENTAL AFFAIRS AND TOURISM

One of the functions of the Department of Environmental Affairs and Tourism (DEA&T) is to make policies and laws to protect the environment from degradation and pollution. DEA&T will promulgate new laws that recognise the importance of public awareness and education of communities on air quality issues so that everyone can take a role in looking after the environment.

Environmental Forums (Committees) are being formed in hot-spot areas such as Vaal, Witbank, Estcourt, Durban South Basin and Cape Town so that air quality issues can be discussed, problems identified and solutions to those problems found. These Environmental Forums are quite successful, because people, at least in those areas, are now aware of air pollution issues. However, forums alone cannot achieve environmental protection. Legislation must be developed by the government to strengthen community education and environmental protection. In 2005 the National Environmental Management Air Quality Act (No 39 of 2004) was promulgated by the Minister of the DEAT. This new Act provides the government with the necessary tools to protect the right of every South African to an environment that is not harmful to their health and well being a Constitutional right.



What Can We Do To Prevent Air Pollution?

You have seen that air pollution is a vast problem with many different causes and effects. One person's efforts might not make much difference in reducing the major sources of air pollution, but collective efforts by communities of people CAN make a difference!

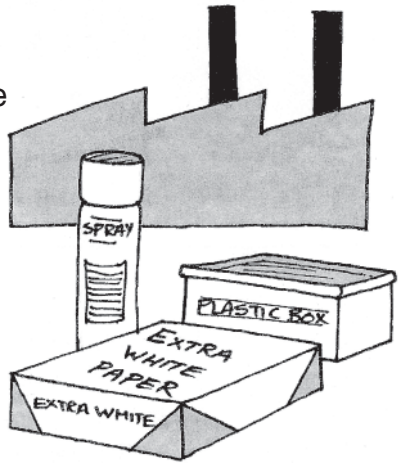
Begin by conducting an Air Quality Audit in your area. (Audit sheets are provided at the back of this booklet to guide you through this activity.) Use your findings to make or motivate for practical changes to improve air quality in your area.

Wise environmental management and lifestyle choices can lead to cleaner air which has direct health benefits for everyone. Here are some ideas of what you can do, but try to think of other ways too.

If you live in a house of smokers, ensure that the rooms are well-ventilated or, better still, ask people to smoke outside. Similarly, houses which use gas heaters, fuel stoves or open fires should also be well-ventilated to allow stale, pollutant-carrying air to escape.

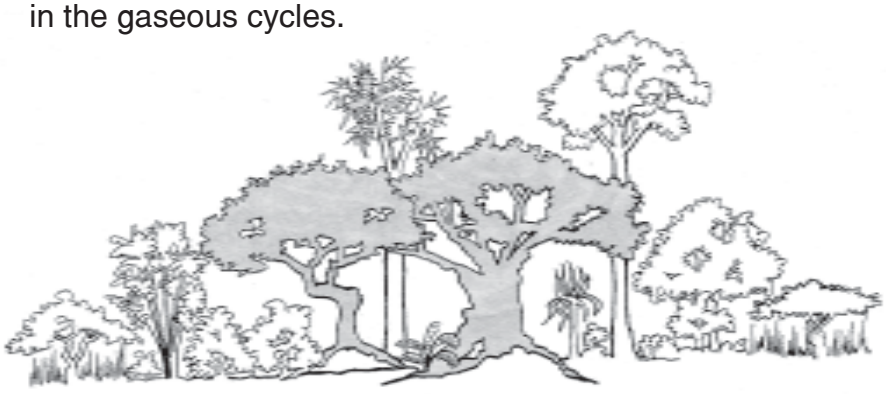
Investigate strange smells in your area. Don't just accept that the odour or particles in the air come from a nearby factory or dump! Find out WHY these pollutants are being emitted, how harmful they are and how long they will persist.

Many buses, taxis, trucks and cars emit clouds of diesel fumes which pollute the air in our towns and cities. Where possible, politely discuss the health consequences of this pollution with the vehicle's driver.



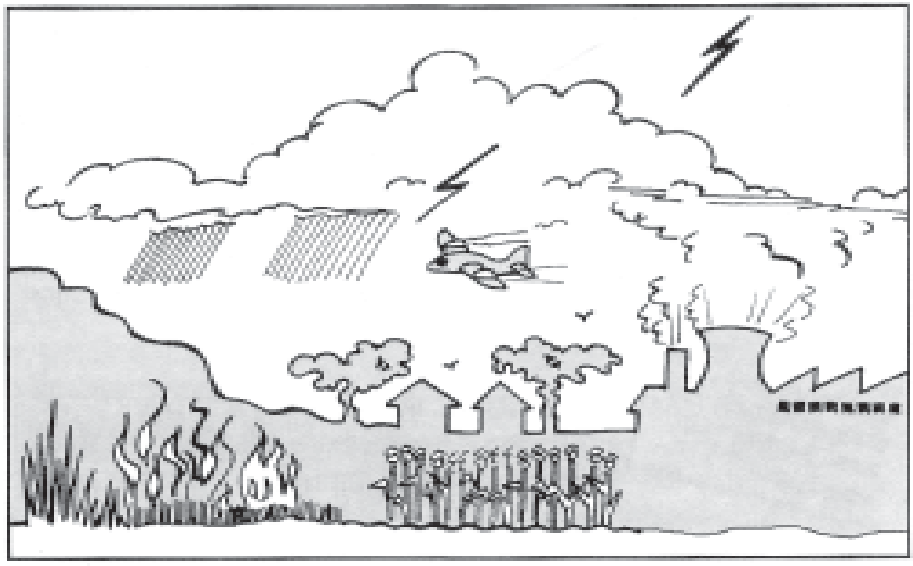
Dispose of rubbish wisely and avoid burning it. Burning plastics can be especially harmful because they emit toxic chemicals. Become a wise consumer, committed to using products that have a 'clean history'. Find out which products originate from highly pollutant factories and avoid these where possible. Is having that product worth the higher levels of sulphuric acid, nitric acid, carbonic acid in the air? At least write a letter to the manufacturers explaining your concern about the health consequences of their production line.

Protect trees in your area and plant indigenous trees where possible. These trees will help to filter impurities from the air and maintain the levels of oxygen and carbon dioxide in the gaseous cycles.



PART 4: Audit Air Quality

AUDIT AIR QUALITY



Particulate Matter

How many particles are in the air?

You will need a white sheet of plastic paper (10x10cm), Vaseline and a magnifying viewer.

1. Carefully draw a grid on the paper, each square = 1cm^2
2. Smear the sheet thinly with Vaseline.
2. Place the sheet inside or outside a building overnight.
3. On the following day, use the magnifying glass to count the particles per square centimeter.
4. Calculate the quantity of particles that would occur over one square meter (i.e. 100cm x 100cm). It is easily done if you multiply the number of particles per cm^2 by 10 000 or the number of particles per 10cm^2 by hundred.

How to explain the phenomena?

At night when the air cools down, the movement of the gases and particulate matter slows down. The particles fall to the ground. The Vaseline on the sheet stops the particles blowing away in the wind.

The particles can consist of different materials: dust, ash, tiny sand particles and soil crumbs, pollen and other parts of plants.

Tips: When preparing your sheet of paper, ensure the surface is white, smooth, and (ideally) water-resistant (for example plastic or fat paper).

Test the air quality indoors and outdoors. Put the sheets in different places for example on the ledge, under a tree, in the carpark, or in an open space. Compare the results and look for trends.

The amount of particulate matter is:		The air quality is:	
many	☐	bad	☐
some	☐	not so good	☐
few	☐	ok	☐

AUDIT Smell

Using your senses, can you observe any air pollution?

Although air is not visible, you can investigate its quality by using your senses. You can see the sources of pollution and you can smell stinky, polluted air.
Think about the following questions and make some notes.
Is your home situated in a city centre, in a suburb or in a small village?
Do you live in a valley or on a hillside?
How intensive is the traffic in your home area?
How many traffic jams can you observe?
Are there lots of old cars still using leaded petrol?
How many factories with chimneys are close to your home?
Do you live close to waste dumps where waste gets burned?
Observe the direction of the wind. In which direction does the wind transport the smoke of the industry?
Does the air smell? What does it smell like?
Can you observe differences of the smell between different times of the day?

The air quality is:

bad ☐

not so good ☐

ok ☐

AUDIT Lichens

What kind of lichens do your find in your area?

Go outdoors and have a look around. You will find lichens growing on trees, rocks, old buildings and other old surfaces at any time of the year. Don't worry if you can't find them on most buildings or rocks: lichens grow very slowly, so you will have to look carefully for them on old surfaces.

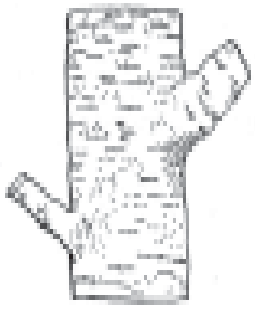
The lichens you find are:

- no lichens ☐
- crusty; slightly leafy ☐
- leafy; bearded ☐

Therefore we can conclude that air quality is:

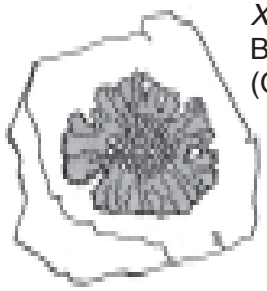
- bad ☐
- not so good ☐
- ok ☐

AUDIT Algae & Lichen i.d.

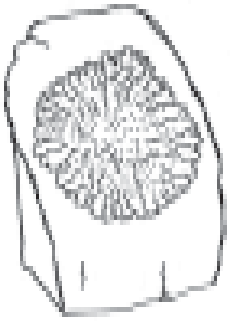


Pleurococcus
Powdery green alga.
No lichens

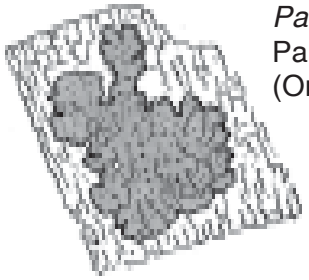
Lecanora dispersa
Greyish greeny-white.
(On tree trunks).



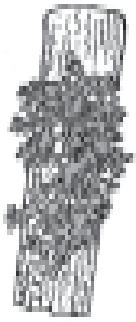
Xanthora sp.
Bright orange.
(On stones).



Parmelia saxatilis
Pale greyish-green.
(On rock).



Parmelia subrudecta
Pale yellowish-green.
(On tree trunks).



Evernia prunastri
Very pale green
(On tree branches).

Usnea subfloridana
Olive green.
(On tree branch).

Health Risk

Are there pollutants that make breathing a health risk?

Interview your family and community using these questions as a guide.

NOTE: Air monitoring studies have found that pollutants are often most concentrated and dangerous inside buildings

Does your family have an open fire, paraffin or gas cooker inside?

.....

.....

Do you burn wood or coals? Do air-bricks allow stale air to escape?

.....

.....

How many people live in the house?.....

Does anyone smoke cigarettes or a pipe, and do they smoke inside?.....

.....

Do people in your community suffer from allergies, bronchitis, asthma or even lung cancer? How many people are ill?

.....

.....

The air quality is:		The health risk is:	
bad	☐	high	☐
not so good	☐	moderate	☐
ok	☐	low	☐

Summary of Audit Results

How clean is the air?

The number of particulate matter is:

many ☐ some ☐ few ☐

Using the senses – the air quality is:

bad ☐ not so good ☐ ok ☐

The lichens you found were:

no lichens ☐ crusty / slightly leafy ☐ leafy / bearded ☐

Health risk in our area is:

high ☐ moderate ☐ low ☐

Overall air quality in our area is:

bad ☐ not so good ☐ ok ☐

LIST OF DEA&T PROVINCIAL CONTACTS

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Glossary

Atmosphere

The layer of *gases* that surrounds the Earth and allows life to continue.

Combustion

Burning processes that break down matter and release carbon dioxide and other gases into the air.

Emission

By-products of combustion that are released into the air. Emissions are usually associated with car fumes and factories that use combustion in their production process.

Evaporation

In the presence of sunlight, water gets taken up into the air in a gaseous form which is known as water vapor.

Exhale

Breathe out

Industrial areas

Areas where many factories (industries) are situated. These are usually on the outskirts of cities and urban areas; they are often associated with poor air quality and pollution.

Inhale

Breathe in

pH

The level of acidity or alkalinity of a substance or liquid.

Photosynthesis

The process by which plants, in the presence of sunlight, use green-coloured chlorophyll in their leaves to produce glucose ($C_6H_{12}O_6$). During this process, carbon dioxide is used and oxygen is released.

Pollutant

Any substance present in the environment which is considered harmful to the natural functioning and health of that area.

Precipitation

When water vapor in the air cools and condenses, it is deposited on the ground as 'precipitation', such as rain, snow, dew, frost, mist or hail.

Respiration

In humans, 'to respire' means 'to breathe'. In plants, it means to take in oxygen and release carbon dioxide.

Respiratory system

In people, respiration involves the intake of oxygen by the nose and into the lungs, for use by the body as energy for metabolic processes. Carbon dioxide is the waste product from this process that is expelled when we exhale.

Toxic

Poisonous.

Urban areas

These are areas where communities of people live. Urban areas are usually organised with streets, electricity, water services and other community services such as a post office, bus depot, police station, clinic and schools.

Water vapor

When water evaporates, it is suspended in the air in its gaseous form which cannot be seen.

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The Department of Environmental Affairs and Tourism (DEA&T) through the capacity building directorate co-ordinated the development of this booklet.
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