

## History

Air pollution has been around since the beginning of time. In the stone age, some 10,000 years ago, smoke produced from fires covered the walls of caves in black soot and was breathed in by the cavemen. Lungs of mummified bodies that are thousands of years old from Egypt and Peru are frequently black.

As man evolved so too did the pollution he created. The smelting of lead became widespread during the time of the Roman empire. Lead was used for piping & water storage and the particles & emissions from the smelting process were spread across the globe, appearing in studies of arctic ice for signs of historic global pollution. It was also noted by the writers and philosophers of the time who noted the pollution was visibly scarring the buildings of ancient Rome & affecting their health.

The next major pollutant culprit in history was coal.

King Edward the First was among the first to tackle Britain's growing pollution problem. In 1306 he banned the burning of coal when it had gotten so bad that even his own mother was forced to flee Nottingham because of the conditions. At first the laws were simply ignored. With few other options for heat most people had no choice but to burn coal to heat their homes & cook their food, forcing the king to impose huge fines and the destruction of offenders furnaces. Yet still it had no effect, once again people had little choice when it came to energy sources and the risks of being caught outweighed those of going without heat or food. With so many flaunting the law it would be an arduous task to enforce it across the land. So, as a final measure, the King installed the death penalty in an attempt to shock the people into changing their ways and stop burning coal. However even this extreme measure was ignored too, even after the execution of one offender. People had become dependent on coal; it was the difference between life & death for many so much so that even the death penalty offered little in the way of deterrent. Edward reasoned that he couldn't execute his whole kingdom – tho it did cross his mind. Besides, even if he could have, then he wouldn't have had anybody to tax or torture. Consequently, the law was simply ignored.

The Industrial Revolution destroyed any hopes of banning coal burning. Coal usage in the UK multiplied by 100 between 1800 and 1900 as factory owners put making money ahead of health concerns. The air was heavily polluted from the chimneys of factories and other industry. Around 1860 it was noticed that air pollution was so bad in some areas it was killing crops and other plant life.

It all came to a head in 1952 with the Great Smog of London. Smog is a mixture of smoke and fog, the cold weather at the time meant that Londoners were burning even more coal than usual to keep warm. It was a fog so thick and polluted it left 4,000 people dead. It was even reported to have choked cows to death in the fields and an Arsenal football game had to be abandoned.

It was this that made the Government realise that more action had to be taken to improve air quality. The result of this was the introduction of the Clean Air Acts 1956 and 1968. These acts banned emissions of black smoke and made residents in urban areas and factories use smokeless fuel. However history would repeat itself as the curbs on coal would arrive as the rise of another pollutant, the automobile.

The first petrol car was invented by Karl Benz in 1886. At first there were very few cars on the road, so they didn't have a huge effect on air quality but through the 20th century the numbers exploded and by the 1980s, the numbers of vehicles on the road was rapidly increasing and so were emissions of nitrogen dioxide and fine particles.

At this time the catalytic converter was introduced to reduce the amount of dangerous emissions from car exhausts by filtering them out. By 1993 all new cars sold in Europe had to be fitted with one and this led to a rapid decline in emissions.

The Electric Car is believed to be the next step in the reduction of traffic emissions. Electric Vehicles do not produce any emissions directly, as they are battery powered and don't have an exhaust. However, the way the Electricity to power them is generated could be a source of pollution but as we move towards renewable energy sources the Electric Car becomes even cleaner for the environment.

In the UK today, various laws have been brought in, as people's knowledge and awareness of air pollution has increased. As well as new laws there have been advances in technology so that pollution from vehicles, factories and other polluting sources can be cleaned up before they reach the atmosphere.

# Major Pollutants

After years of research into various pollutants and how they can affect us, experts have identified eight pollutants that are more harmful to us than others. In Scotland we only have problems with a few of these.

## Nitrogen Dioxide (NO<sub>2</sub>)

This is a gas made up of nitrogen and oxygen. It forms in air from the exhaust emissions from cars, buses, trucks and power plants. One of the biggest man-made sources of nitrogen dioxide in Scotland is from road traffic emissions, with some emissions also arising from power stations and other industrial sources.

## Carbon monoxide (CO)

This is a colourless, odourless, tasteless gas that is a bit lighter than air. High levels of carbon monoxide are toxic to humans. It is produced from incomplete combustion (burning).

## Fine Particles (PM<sub>10</sub>)

Fine particles, or PM<sub>10</sub>, are tiny specks of dust that float around in the air. The size of dust we are interested in is much smaller than the width of a human hair, so tiny it cannot be seen by the naked eye.

This size of particle is of most interest to us because it can be breathed deep into our lungs where it can cause health problems, making existing breathing problems and asthma worse.

Fine particles can be made up of natural things like sea salt, pollen and sub-Saharan dust, which has been carried high into the atmosphere and deposited in Scotland!

One of the biggest man-made sources of fine particles in Scotland is road traffic emissions. This can be directly from the exhaust pipe of vehicles and also from dust from brakes and tyres which gets stirred up and goes back into the air as traffic drives over it.

After exploring the three main pollutants: carbon monoxide, nitrogen dioxide and fine particles, the pupils can then explore other pollutants that affect the quality of our air we breathe.

Possible pollutants to consider are:

- Sulphur Dioxide
- Ozone (which is formed in the air by other pollutants)
- Methane (although this is not 'measured', it still has an affect on the environment)

## Monitoring and Measurements

The first step in finding out how good or bad our air is to carry out some testing and monitoring of the air around us and as part of this teaching package you have the chance to monitor the air quality around your school.

In days gone by, the main source of air pollution in Central Scotland was industry. Now that much of the heavy industry of the area has gone air quality in some areas has improved, but unfortunately, there is a new culprit polluting the skies – the automobile.

Our roads are busier than ever. Car emissions contain a range of toxic substances that can have a serious impact on health and we use different types of monitors to closely watch the levels of pollution in our towns, cities and countryside.

The first, most simple type of air monitor that can be used is called a Diffusion Tube. This is a small plastic tube which absorbs any Nitrogen Dioxide gas that drifts past. The tube is attached onto something close to the source of the pollution, usually on a lamp-post or on the side of a house/wall/fence etc. It is changed each month and it is analysed to give a monthly level of the Nitrogen Dioxide in the area. Your local Council will have some of these tubes set up across their area to give them a good idea of what Nitrogen Dioxide levels are like across their district.

The other, more technical air monitor that we use are Automatic Monitors and they are able to give us up-to-date information on air pollution as it happens. This monitoring records the air quality continuously – 24 hours a day, 7 days a week, 365 days a year, and downloads the information to a computer, which is checked every day. These air monitors are able to tell us if air pollution is bad at certain times of the day, for example, at rush hour, when people are trying to get to school or work, and home again in the evening. They can also tell us if the air pollution is worse at certain times of the year, for example, when there is little or no wind the pollution can be trapped in the air and doesn't disperse easily then levels of pollution can be high. Also if there is a particular pollution event, such as a large fire in the area or even further away in Europe, we can usually see the air pollution levels creeping higher.

In this teaching package you can use a simple type of automatic monitor to measure air pollution around your schools. This can be setup on a lamp-post near to the front of your school and will show you the patterns of air quality changing throughout the day and week.

In order to complete the activities, the pupils will need access to computers. These activities could be completed individually or in pairs.

# Air Quality Around the World

The main organisation interested in air pollution is the World Health Organisation (W.H.O.). Their air quality guidelines are used by countries all around the world to understand and set up healthy air quality limits. These limits are used to control air pollutants, helping to protect people from becoming ill due to polluted air.

The European Parliament has used W.H.O. guidelines to set air quality levels for countries within the European Union (E.U.). As Scotland is a member of the E.U. it must, like other European countries, try to achieve these air quality levels. This is done through Scottish laws which govern air quality. In Scotland our air quality laws not only comply with E.U. levels, but are in fact stricter for certain pollutants, meaning we have cleaner air than the rest of the UK!

So, now we know how air pollution is controlled in Scotland - through laws passed by government, how does the air we breathe compare to the rest of the world? Well, the good news is, our air is relatively clean. Scotland, like many developed countries, has the technology and resources to combat pollution. This sadly is not the case for all countries. According to studies by the World Health Organisation, some of the worst cities for air pollution in the world are Karachi in Pakistan, Beijing in China, Lima in Peru and Cairo in Egypt. Some of these cities are in quite poor countries overall, and they do not have the money to spend on cleaner technologies and vehicles. It may then be easy to assume that air pollution is just a concern for developing nations, but every country across the world makes choices between conflicting goals when it comes to controlling air pollution, and cities closer to home such as Rome and London suffer from high levels of pollution.

# Solutions

## What can we do about it?

Although our air quality in Scotland is relatively good, when compared with other areas of the world, there is still room to make it even better. The Scottish Governments, Local Authorities, SEPA and other organisations all help to reduce air pollution, either in direct or indirect ways. Perhaps one of the most important people involved in tackling air pollution is you.

### You and Your Family

We, as individuals, can work together to help make our air cleaner and air pollution levels will fall. There are many ways you and your family can help improve the air quality in Scotland. It might not seem like much, but if everyone does a little, it will have a great effect.

## Travel and Transport

### USE CAR TRAVEL LESS

Think about your journey: Do you have to go by car, or could you use another method?

- Walking
- Cycling – tried and tested for 190 years. Still zero emissions
- Public Transport – put your feet up and relax, catch up on your reading
- Car Sharing – share the journey, have a laugh

### IF YOU MUST TRAVEL BY CAR

Try to travel outside peak times where possible: less congestion means faster journeys, which in turn creates less pollution. We can't always change when we go to school or work, but less important journeys, such as shopping or visiting friends, can be done at quieter times of the day.

Avoid leaving your engine idling when not in use: New laws mean your parents could be issued with a fine!

Service your car regularly: Keep the engine properly tuned and the tyres at the right pressure. A happy car is an efficient car!

### REDUCE ENERGY USE AT HOME

- Conserve energy wherever possible. Turn off appliances like your television or radio when not in use.
- Don't forget to switch off lights when you leave the room.
- Recycle paper, plastic, glass bottles, cardboard, and aluminium cans. This conserves energy and reduces production emissions.

- Turn down the thermostat in your home.
- Wash clothes with warm or cold water instead of hot.
- Buy rechargeable batteries for devices used frequently.
- Try growing your own fruit and veg rather than buying it
- Plant trees to help green our cities

## Education

Educating people about air pollution is an incredibly important way of reducing improving the quality of our air. Projects in your school will help to raise people's awareness about the causes and impacts of air pollution. It also helps to let people know what they can do to tackle air pollution. Even small changes to our day to day lives can make a big difference to the quality of the air we breathe. Think about passing on some advice or information you have learned so far about air pollution. By passing on what you know you will help others to make a difference.

Part of passing the message on might involve your school or community group taking part in one of the following activities:

1. Create a display within your school
2. Design a leaflet with action points to give to pupils and parents
3. Create a podcast
4. Star in your advert
5. Design posters to put up informing people of what they can do to help
6. Deliver a lesson or presentation to others

You may want to use the knowledge and skills that you have developed to take part in Scotland's Environment Competition – Our Environment.

Further information about the completion can be found here <http://www.environment.scotland.gov.uk/get-involved/the-big-discussion/>