

# Teachers Pack

## Young Dragons

Monitoring Air Quality in Wales



Dragons are the ancient guardians of the skies, and they don't like air pollution

## Introduction:

The aim of these young dragons' teachers' notes is to provide teachers with the knowledge and steps required to get the most out of the educational resources on the Air Quality in Wales website. The teachers pack provides a background to air quality and works through the pages and activities on the website. The aim of the website and related activities is to teach children about air quality and provide them with the knowledge to inspire behaviour change to do something about the situation at their school.

These notes provide teachers with additional information they may find useful in delivering this topic.

## Young Dragons Website:

Young dragons is designed for Year 3-6 (ages 8-11 years). It is an educational resource which introduces air quality and climate change and aims to engage classes and promote group discussion and interactive learning. Having worked through the resources provided, the aim is to inspire children to change their own behaviour and that of their teachers, the school community and parents.

## Eco-Schools in Wales:

Eco-Schools is an international education programme developed by the Foundation for Environmental Education (FEE) involving more than 60 countries around the world. In Wales it is managed by Keep Wales Tidy.

It is a programme designed to empower and inspire young people to make positive environmental changes to their school and wider community, while building on their key skills and encompassing Education for Sustainable Development and Global Citizenship.

Eco-Schools is student-led, with the young people themselves driving and delivering the programme, to bring about positive behaviour change.

Learning about Air Quality links closely to the Eco-Schools topic areas of transport, energy and healthy living. The activities introduced in this resource can be linked to the Eco-Schools international "seven-step" criteria. Each step should be considered when collating evidence for Eco-Schools status.

When carrying out investigations pupils are encouraged to develop practical solutions to issues they are tackling, helping them to understand they can make a difference and influence the environmental impact of their actions.

For more detailed Eco-Schools information please visit: [www.keepwalestidy.cymru/eco-schools-getting-started](http://www.keepwalestidy.cymru/eco-schools-getting-started).



## Let's Learn about Air Quality:

The website provides resources which can be structured into a number of lessons about air quality, sources of air pollution and the effect of air pollution. The website also includes information on actions pupils can take to have a positive effect on air quality in their area.

The proposed learning outcomes of the website include:

- To discover the main pollutants in the air.
- The main sources of air pollution.
- The effects of air pollution on both people and the environment.
- How pupils' actions can improve air quality in their local area.

## Let's Learn about Climate Change:

The website also offers an introduction to climate change. The climate change materials aim to give pupils an understanding of:

- What climate change is and what causes it.
- What the impacts of climate change are.
- What pupils, their families and their school Eco-Committees can do to make a difference.

## Understanding Air Quality:

This section is intended to provide teachers with a basic understanding of air quality. This will give teachers the required background information and understanding to deliver the materials on the website and allow pupils to gain the most from undertaking the activities.

## Air Quality

Air quality refers to the state of the air at ground level. As the air is filled with more pollutants, air quality reduces. Poor air quality is the result of increased pollutants from a variety of sources, both human and natural. The main sources of air pollution are transport and industry.

The Welsh Government hosts the Air Quality in Wales website which uses the daily air quality index to indicate the current level of air pollution in Wales. This can be accessed at: <http://www.welshairquality.co.uk/index.php>

The index is applied to each air quality monitoring site giving them a banding of 1-10 based on the pollutant concentrations measured, with 1 being low and 10 being very high.



## Air Pollution

Air pollution occurs as a direct result of the introduction of harmful substances into the air. These substances are known as pollutants. There are 5 main pollutants which are measured across Wales in both urban and rural locations:

- Nitrogen Dioxide
- Sulphur Dioxide
- Particulate Matter (PM<sub>10</sub> and PM<sub>2.5</sub>)
- Ozone
- Carbon Monoxide



## The Pollutants in detail:

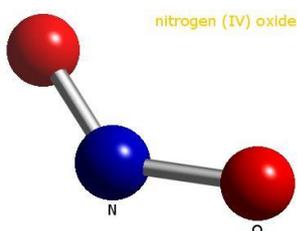
This section describes the main pollutants and should be used with the pollutants section of the young dragons website.

### Nitrogen Dioxide:



Nitrogen dioxide ( $\text{NO}_2$ ) has an unpleasant, sharp smell and at high concentration it has a red/brown colour. Nitrogen dioxide is made of 1 Nitrogen atom and two oxygen atoms joined together.

The main sources of  $\text{NO}_2$  in the UK are from power generation and road transport.  $\text{NO}_2$  can also be formed naturally by lightning and by plants, this a minor source of  $\text{NO}_2$ .



Nitrogen Dioxide can irritate the lungs and airways. Those who have heart or lung problems are more likely to be at risk of poor health if  $\text{NO}_2$  levels are high.

### Sulphur Dioxide:



Sulphur dioxide ( $\text{SO}_2$ ) is a strong smelling gas, with an unpleasant smell and taste, it is a colourless gas that cannot be seen. Sulphur dioxide is made of one Sulphur atom and two oxygen atoms.

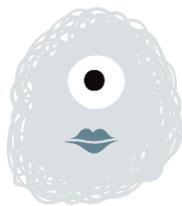
$\text{SO}_2$  can occur naturally in the atmosphere when it is emitted by volcanic activity. Although there are no volcanoes in Wales, during the 2010 Iceland Volcanic eruption pollutants dispersed thousands of miles and resulted in increased pollution

$\text{SO}_2$  is emitted from power stations (that burn coal and oil)



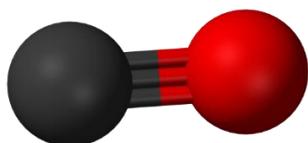
Over the years  $\text{SO}_2$  emissions have reduced and continue to decline as alternative energy generation is used, moving away from traditional fossil fuels.

## Carbon Monoxide:



Carbon monoxide (CO) is a colourless, odourless and tasteless gas. Carbon Monoxide is made up of one carbon atom and one oxygen atom.

CO is produced when fuel is burnt when there isn't enough oxygen - like in a car engine. This means that forms of transport (such as cars, trucks and buses) are the main source of carbon monoxide pollution. However, carbon monoxide is also produced by power stations, and by waste incinerators, which burn our rubbish (usually using it to produce energy).



### How does carbon monoxide affect health?

CO in high concentrations is dangerous because it can prevent our blood absorbing oxygen. This means we have difficulty breathing. Dangerous concentrations of CO can build up indoors, if there is a faulty boiler or heating appliance.

For this reason, heating systems must be well ventilated and regularly checked, and we have carbon monoxide monitors in our home to alert us. Outdoors, CO never reaches lethal concentrations. However, near very busy city roads, concentrations of CO can become high enough to affect the health of people who have heart disease.

## Particulate Matter (PM<sub>10</sub> and PM<sub>2.5</sub>):



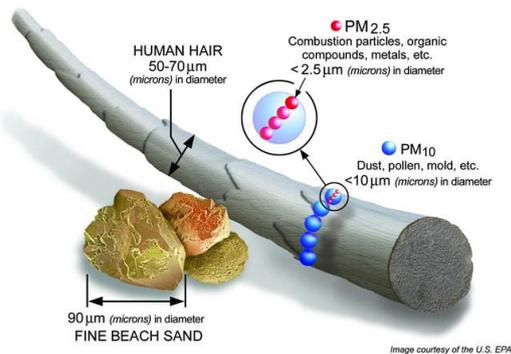
Particulate matter are fine particles made of a wide range of materials including:

- Exhaust emissions from cars, buses, trucks, planes, ships and other transport.
- Combustion of coal, solid fuels and oil in power stations, factories and homes.
- Natural sources such as sea salt (which can be carried far inland) and dust from the Sahara Desert (which can be carried long distances and be deposited throughout Europe).
- Dust from road surfaces and building sites.
- Sulphate and nitrate particles, formed from chemical reactions between other pollutants in the air.

Because particulate matter comes from many different sources it can contain many different materials. Particles are made up of different substances depending on how they are formed and where they come from. The particles themselves can come in different shapes and sizes and can be solid or even liquid droplets.

The size of the particles is important, as it affects the way they behave in air and also how they can affect human health. Smaller particles are lighter they are able to stay in the air longer and therefore they can travel farther. In the summer, forest fires can occur in mainland Europe; if wind conditions are right, particulate matter from the smoke can get transported as far as the UK. This is an example of pollution that is carried across national boundaries.

The picture below shows how the sizes of PM<sub>10</sub> and PM<sub>2.5</sub> compare to the width of a human hair, and to ordinary fine beach sand. Smaller particles are the most harmful to our health as they can be inhaled deeper into the airways and lungs.

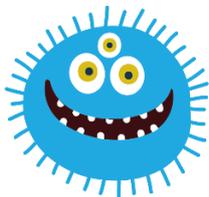


### How does particulate matter affect health?

When you inhale, you breathe in air along with any particles that are present in the air around you. The smaller the particles the further into your body the particles can travel. PM<sub>10</sub> particles can get as far down as the airways in your chest, and PM<sub>2.5</sub> particles can travel right into your lungs.

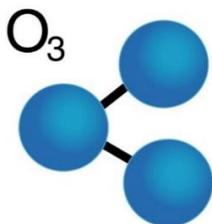
When inhaled, particulate matter can irritate and inflame the airways and lungs. This can worsen the condition of people who already have a heart or lung disease.

### Ozone:



Ozone is a colourless gas made up of three oxygen atoms. The “ordinary” oxygen in the air we breathe (which keeps us alive) is O<sub>2</sub>, two oxygen atoms joined together. Ozone is a special form of oxygen, consisting of three joined oxygen atoms – O<sub>3</sub>.

Most people have heard of the ozone layer – a part of the atmosphere 10 – 50 km above the earth’s surface. This ozone protects life on earth from the sun's harmful ultraviolet rays<sup>1</sup>.



Ozone is also formed in the layer of air near the ground (from 0 to 17 km). At this level, ozone is a harmful air pollutant that can affect the health of humans, animals and plants.

<sup>1</sup> NASA “Ozone Hole Watch” web page at <http://ozonewatch.gsfc.nasa.gov/facts/SH.html> .

Ozone (O<sub>3</sub>) is not emitted directly from any man-made source in any significant quantities. In the lower atmosphere, O<sub>3</sub> is primarily formed by a complicated series of chemical reactions. These reactions take place when sunlight levels are high. The chemical reactions do not take place instantaneously, but can take hours or days, therefore ozone measured at a particular location may have arisen from emissions of other pollutant emissions many hundreds or even thousands of miles away. Ozone irritates the airways of the lungs, increasing the symptoms of those suffering from asthma and lung diseases.

## Climate Change:

The 'climate' is the average pattern of weather in a region that has been recorded over many years. This might be a region like Wales, or a bigger area like the United Kingdom. The climate is not the same as the weather, which is what we experience every day - for example sunshine, rain, wind, snow, fog.

The climate of the earth is always changing. In the past the climate has changed as a result of natural causes. For example, after a volcano has erupted, large quantities of dust are blown high into the atmosphere. That reduces the amount of sunshine reaching the earth's surface. This causes a cooling in the earth's atmosphere.

The term 'climate change' is usually used to mean changes in our climate, which have been seen since the start of the last century (the year 1900). Scientists believe the changes they have seen over this time are mainly because of human behaviour, rather than due to natural changes in the atmosphere.

Climate change is caused by something known as the "greenhouse effect". A greenhouse (or glasshouse) is good for growing plants because it traps heat inside and stays hotter than the air around it. The earth's atmosphere behaves like a gigantic greenhouse, trapping some of the warmth of the sun. This is called the natural greenhouse effect. Without it, the earth would be much too cold to support all the different kinds of plants and animals that live here.

The problem is that human activity is causing a greater warming of the earth. This is because the gases released when we burn fuels are changing the atmosphere.

## What Causes Climate Change?

Scientists think that climate change is being caused mainly by 'greenhouse gases' that we release when we burn fuels (for example, to heat our homes, generate electricity or power industry). Humans have been using energy in far greater quantities since the start of the last century.



When fuels like coal, gas, oil, or petrol are burnt they create a gas called carbon dioxide. Carbon dioxide makes the greenhouse effect stronger. As a result, more of the sun's heat gets trapped in the atmosphere and the planet warms up.

This is what causes climate change. If it continues, it will have a big effect on climates and weather systems all over the world! As the polar ice caps melt, sea levels will rise. In some parts of the world intense weather events could become more common with increased rainfall leading to flooding. Other parts of the world could experience more extreme heat waves and droughts.

There are six important greenhouse gases, but carbon dioxide is the most important of them all, because we produce so much of it. The other 5 gases are methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons and sulfur hexafluoride.

Scientists predict that climate change will affect much of our world. Many scientists and politicians believe that climate change is a threat greater than anything humans have faced in recent history. Unless we tackle the problem soon, it could cause serious problems, by making the climate much more unpredictable. This could make it much harder to grow enough food for everyone, especially in the developing countries where many people are already poor. Some species (types of animals and plants) could become extinct.

## Can we stop Climate Change?



Most climate experts think we need to act quickly to reduce the amount of greenhouse gases that humans are releasing into the atmosphere. We will probably be unable to stop the effects of climate change completely, but we might be able to limit them. To do this we all need to think about the energy that we use in our everyday lives, and try to use less.

No one can do everything, but if everyone does something to reduce the amount of energy we use, we have a chance to limit the effects of climate change.

## Linking Air Quality to Eco-Schools

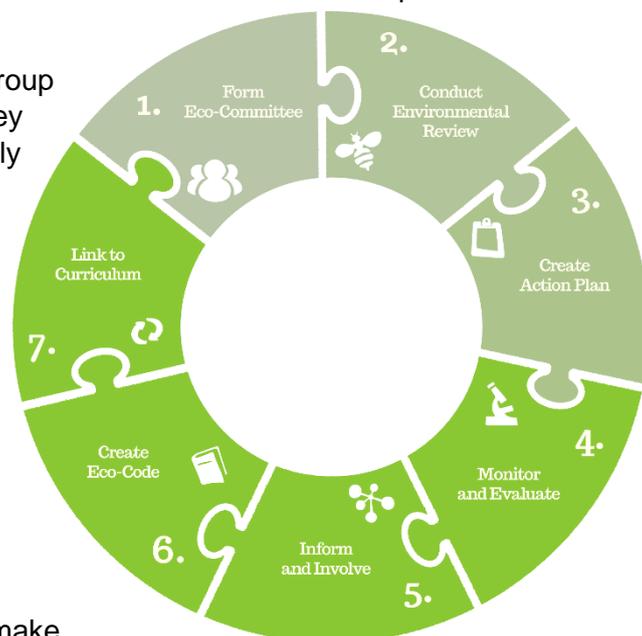
The ideal way to investigate air quality in and around your school grounds and encourage positive behaviour change is to go through the Eco-Schools international seven-step process.

**The Eco-Committee** will need to be involved as a group to discuss air pollution issues around the school. They can drive actions forward, although they are not solely responsible for carrying them all out. Activities and actions can be delegated throughout the school and different classes or departments can take responsibility for specific sections.

Initial investigation, using the Eco-Schools **Environmental Review**, should include examining how pupils and staff get to school, investigating facilities for bikes and scooters, car share options, how safe the road in front of the school is at peak periods and how safe the routes to school are in the community.

From the investigation findings, pupils can discuss, make decisions and decide on focused **actions** for improvement, which must be recorded and **monitored**. **Evaluating** the activities will enable pupils to measure and celebrate the impact of their work. **Informing and involving** a wide range of participants, inside and outside of the school, is most beneficial for raising awareness and bringing about and identifying barriers to behaviour change.

Linking this work to the school **curriculum** will embed environmental issues and air quality and climate change actions could be mentioned in your **Eco Code**



## Carry out an air quality study at your school

Air pollution will vary around your school for different reasons. We expect air pollution to be higher nearest to roads due to the vehicles. Cars, vans and buses which run on petrol or diesel (a fossil fuel) emit pollutants and the closer you are to them, the higher the pollution levels will be.

In the school car park, pollution will be higher at the start and end of the school day. This is because cars will be moving and emitting pollution. Outside of these times the pollution is expected to be much lower.

In open spaces, such as your school playing fields, air pollution is expected to be lower. This is due to there being no pollution being emitted nearby. In large open spaces, any pollutants can be quickly blown away, especially on windy days.

If you would like to carry out a monitoring study around your school contact us at [info@welshairquality.co.uk](mailto:info@welshairquality.co.uk)

## Time to change

We want to change behaviour as a sustainable way of making a difference. So, there are some important things to think about:

- What behaviour do you want to change?
- Who is your audience?
- How do you want them to change their behaviour?

Positive reinforcement, education and working together are all key to changing behaviour.

Be sure to measure success. Without assessing how successful you have been, you won't know what to continue doing or what changes might be needed to improve things in the future.

Make sure to inform and involve your school and the wider community using a range of tactics – school newsletters, website, noticeboards, press releases, assemblies, posters. Social media is also a very powerful tool for communicating the message wider audience, sharing information and getting people involved, so be sure to use the school's twitter account and facebook, tagging in @EcoSchoolsWales



## Examples of Activity

There are many projects that can be carried out to change behaviour, but the first thing to do is find out how everyone gets to school by carrying out a survey – don't forget to include all the staff as well!

### Class transport survey: how do you get to school?

This exercise is intended to get the class discussing transport methods, investigating how each pupil travels to school. The class should design a survey based on the example below and then use the table of results to create a variety of charts to display their findings.

Sample Table for transport survey:

Transport	Tally of pupils	Number of pupils
Bus		4
Car		
Car share		
Walk		
Cycle		
Train		
Other		

As a result of the findings further investigation could take place, including:

- If you came to school how many passengers were in the car?
- How far away from school were you dropped off?
- Do you live close to other pupils or school friends?
- Would it be possible to car share?

- Useful BBC clip to support data interpreting:  
<http://www.bbc.co.uk/education/clips/zqtn34j>

Following on from this, activities could include:

- Investigation of the school's facilities to encourage bike or scooter use – are they safe? Are there enough? Do they need improving? If so, can you find some funding to help you do this.
- Carry out a survey to discover how many cars park outside the school when pupils are dropped off, and how many have their engines running with engines left running. Can you produce stickers to put on these cars asking engines to be turned off?
- If there are large numbers of busses, do they turn off their engines while waiting outside the school? Why not have the Eco Committee talk to the drivers about it.
- Do pupils undertake cycle proficiency training to build confidence cycling to school? If not, why not set a course up?
- Running a walk to school week or a walking bus activity



- Bike Maintenance and cycle training day to encourage more pupils to cycle to school safely

Longer term behaviour change could be promoted by the following:

- Production of an information flyer to parents highlighting traffic pollution findings.
- Posters put up around the school and the wider community
- Developing an Air Pollution campaign to raise awareness. This could include looking at the issue on a global scale
- Hold a Climate conversation event as a whole school or in each class and invite parents and the whole community
- Develop a Reward scheme for biking or scooting to school
- Encourage a cycle buddying project
- Promotion of lift sharing
- A car free day event
- Running a regular walking bus with the help of teachers and parents

**Finally, make sure that your great activities are shared with the whole school and wider community, including the change that you have made and the resulting benefits.**

## Useful Links and Resources:

Air Quality in Wales- <http://www.welshairquality.co.uk/>

Eco Schools <http://www.keepwalestidy.cymru/Pages/Category/eco-school>

[Living streets, Walk to school - https://www.livingstreets.org.uk/what-we-do/walk-to-school#pri](https://www.livingstreets.org.uk/what-we-do/walk-to-school#pri)

Active Journeys to school <http://www.sustrans.org.uk/active-journeys-school-wales>

World Health Organisation (WHO) – Ambient (outdoor) air quality and health- <http://www.who.int/mediacentre/factsheets/fs313/en/>

Further information about Air Quality- <https://uk-air.defra.gov.uk/air-pollution/>

Climate change information- Weather, climate: <http://climatekids.nasa.gov/climate-change-meaning/>

Welsh Government- What is Climate Change- <http://gov.wales/topics/environmentcountryside/climatechange/?lang=en> and reducing Welsh emissions <http://gov.wales/topics/environmentcountryside/climatechange/emissions/?lang=en>

## Links to Welsh Curriculum:

Science- in the National Curriculum for Wales- Key Stages 2-4: <https://uk-air.defra.gov.uk/air-pollution/>



- Links with computing skills- to access, collect and analyse relevant scientific evidence.
- Sustainable earth and how things work
- information gathered from observations and measurements
- Learning outcomes-7- Stage 2 Science. How humans affect the local environment.

A curriculum for Wales- A curriculum for life-

<http://gov.wales/docs/dcells/publications/151021-a-curriculum-for-wales-a-curriculum-for-life-en.pdf>

- Young people who... show their commitment to the sustainability of the planet

BBC Bitesize: <http://www.bbc.co.uk/bitesize/ks2/science/>

- Key Stage-2: Solids, Liquids and gases.

BBC Bitesize-Maths-Datasets and Frequency diagrams-

[http://www.bbc.co.uk/bitesize/ks2/maths/data/frequency\\_diagrams/read/1/](http://www.bbc.co.uk/bitesize/ks2/maths/data/frequency_diagrams/read/1/)

BBC- <http://www.bbc.co.uk/education/subjects/z826n39>

OPAL Curriculum Wales- Key stage 2-

<https://www.opalexplornature.org/sites/default/files/7/image/Curriculum%20links%20KS2.pdf>

- Collecting data, displaying results

