



# Lesson insert 1:

## Things in Air

### Presenters' guide

#### Aim

The aim of this lesson insert is for students to gain an overview of key pollutants, their sources of emission and ways of classifying them. Students will also gain an understanding of why air pollution is a global issue and how breathing poor air can affect ill-health.

#### Equipment

- One set of the classification activity per pair of students
- Lesson insert 1 PowerPoint slides
- Students pre and post evaluation questionnaires and workshop feedback postcard.

#### Preparation

You will need time to print the classification activity linked with this lesson insert and evaluation materials. More information regarding evaluation materials can be found at the end of this document.

#### Curriculum links across all the MANAPRE educational resources

Our lesson inserts have been designed with links to the national curriculum. The list is not extensive and we are keen to work with teachers and presenters to make these links clearer and more comprehensive.

Subject	Level	Link
Geografía	Secundaria 1	<b><i>Medioambiente y sustentabilidad</i></b> Analiza la relación entre el deterioro del medioambiente y la calidad de vida de la población en diferentes países.
Química	Secundaria 3	<b><i>Propiedades</i></b> Caracteriza propiedades físicas y químicas para identificar materiales y sustancias, explicar su uso y aplicaciones.
Química	Secundaria 3	<b><i>Ecosistemas</i></b> Argumenta acerca de las implicaciones del uso de productos y procesos químicos en la calidad de vida y el medioambiente.
Matemática	Secundaria 1	<b><i>Estadística</i></b> Recolecta, registra y lee datos en tablas; usa y interpreta moda, media aritmética y mediana.



## Introduction [5 minutes]

**NOTE:** Please give your student the pre evaluation questionnaire ahead of this lesson. Mode retails regard evaluation can be found at the end of this document.

## Air and the atmosphere

Begin by splitting the room into pairs of students. Give students 1 minute to discuss what is air made of. Shows them the slide with the different gases in air until you reach to the rest. The rest (0.03%) contain traces of other gases such as neon, helium.

The Earth's atmosphere contains all of the gases in air, but also water vapour (which varies locally and seasonally). There are also air pollutants.

## Air pollutants

Air pollutants are by definition any solid, liquid (and some gas) particles which are suspended in air and therefore contaminate the atmosphere and the air we breathe.

## Where do air pollutants come from ?

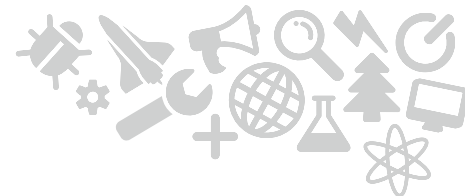
Both natural processes (such as volcanic eruptions) or human activity (burning of fossil fuels) can generate air pollution. For instance, pollen released by trees is an example of a natural air pollutant. Nitrogen Dioxide (NO<sub>2</sub>) is a by-product of burning petrol and therefore is increased by human activity. There are many more air pollutants and we will explore them in more details later on.

There are several sources of information available regarding the nature of these air pollutants such as the [CDMX Air webpage](#). The World Health Organisation (WHO) also has some information regarding air outdoors pollutants [here](#) and indoors pollutants [here](#).

## Who studies air quality? – STEM person of the week

Jane Entwistle is one of the scientists featured in our *Who studies air pollution ? - STEM Person Of The Week* resource, which is a 5 week intervention in schools designed to broaden students perceptions of people working in STEM and their attributes. If you are running this intervention in parallel we recommend to align the STEM person of the week with the one featured in this resource. For more information please refer to our presenter's guide 4.

For this lesson insert we decided to highlight Jane's work as an environmental geochemist keen to understand how people come into contact with certain air pollutants and how these are absorbed by the human body.



## How to classify air pollutants ?

Just like Jane and many other environmental scientists classifying individual air pollutants according to certain characteristics is an important task to conduct research. Studying large samples of air pollutants allows to gather more accurate statistical information regarding their physical properties (size, volumes, densities) but also to establish clearer links with their composition and sources of contamination, health impacts etc.

A single air pollutant will fall into multiple categories and will be studied according to whichever categories are more appropriate to the purpose of the research.

This is a complex issue, but one that environmental (and other) scientists are used to deal with when trying to extract valuable information from the data sample available.

## Activity [10 minutes]

### Things in AIR – classification activity

The aim is for students to understand that are different ways of categorising a single air pollutant. Students will be given the following 10 air pollutants and 6 categories:

#### ***Air pollutants***

- Carbon monoxide
- Carbon dioxide
- Ozone
- Nitrogen dioxide
- Sulphur dioxide
- Volcanic ash
- Sea salt
- Bacteria, Fungi & Viruses
- Pollen
- Soot

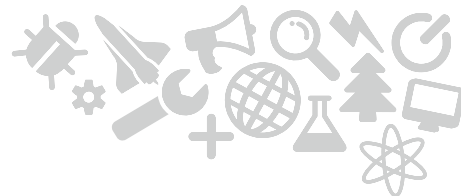
#### ***Categories***

- Natural
- Human-made
- Gas
- Solid
- Biological
- Chemical

Begin by asking students to read through the description of the air pollutants and their sources

### First round

- Ask students to shuffle the categories and randomly choose 2.
- Ask students to group the 10 air pollutants under these 2 categories
- Students can leave some air pollutants in a unknown pile for now



## Second round

- Ask students to choose a 3<sup>rd</sup> category and revisit their current classification. They will for sure start moving some of the pollutants around

## Third round

For the final round students will use all 6 categories and move air pollutants around

**TIP:** Students will sometimes struggle with the categorisation of a particular air pollutant. Reassure students that there isn't one solution to this exercise and it OK to move pollutants from one category to another and have different opinions from other students in their class.

## Wrap up activity – 7 minutes

### Classifying air pollutants

We suggest you asking your students how did they classified Nitrogen Dioxide? See how different their answers are from the following:

- Nitrogen dioxide is a **gas** with a **chemical composition**, mainly produced by **human** activities but also **natural** processes.

You could the repeat the same for sea salt and pollen

- Sea salt is **solid** with a **chemical composition** and present in air by **natural** processes.
- Pollen is a **solid** with a **biological composition** and released in air mainly by **natural** processes.

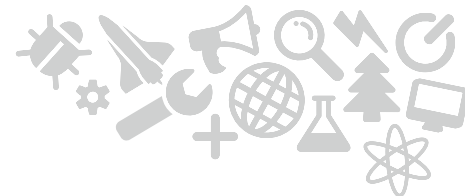
### Ways of classifying air pollutants

The way environmental scientists classify air pollutants depends on what is the research question they are trying to answer.

**Composition:** *Biological, Chemical and Physical* – this classification links with the main origin of the composition of air pollutants: for example a virus has a biological composition, whereas sand has a physical composition.

### Primary or secondary:

Pollutants that are emitted directly from identifiable sources are called *primary pollutants*. An example would be dust. *Secondary pollutants* are manily formed in the atmosphere by chemical interactions between primary pollutants and atmospheric constituents. An example of this would be ozone.



**State of matter:** in this classification system pollutants are classified into their state of matter: *solid* (pollen), *liquid* (mercury) or *gas* (carbon dioxide)

**Origin:** *Natural or human-made*

This classification focus on whether an air pollutant originates from a natural process (e.g. wild fire, natural geyser, volcanic eruption) or is exacerbated by human activities (e.g. burning of fossil fuels, waste treatment plants, agricultural practices)

**Legislation:** this type of classification focus on either an air pollutant has a legislated limit or not. For instance, by clicking on main air pollutants monitored by the [CDMX Aire network](#) you can explore the different legislated limits.

## Sources of air pollution

Now that we have explored different ways of classifying air pollutants a good question to answer is where can we find sources of air pollution.

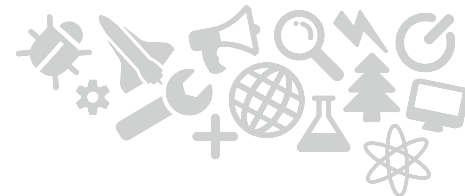
According to the [European Environment Agency \(EEA\)](#) summarises some of the sources contributing to air pollution in Europe as:

- natural sources, including volcanic eruptions, windblown dust, sea-salt spray and emissions of volatile organic compounds from plants
- burning of fossil fuels in electricity generation, transport, industry and households;
- industrial processes and solvent use, for example in the chemical and mining industries;
- agriculture;
- waste treatment;

## Air pollution is everywhere

Air pollution is everywhere (urban and rural areas) even in at home. The way we heat our homes and the way we cook can raise the levels of indoors air pollutants. Dust is an example of an indoor air pollutant.

Because our planet has a rich and dynamic atmosphere, air pollutants travel across the world by weather patterns and ocean currents. The video [A Year in the Life of Earth's](#), created by NASA, shows how Carbon Dioxide (CO<sub>2</sub>) sources are dispersed by the dynamics of the atmosphere. This is one of the reasons why air pollution is a global problem and every country must work together to lessen air pollution sources. The idea of air pollution being a global problem which can be tackle by individual citizens is further developed at the end of this lesson insert.



## Air pollution is a global problem

According to the World Health Organisation (WHO) 9 out of 10 people breathe air containing high levels of pollutants which unfortunately resulted in the premature deaths of 7 million people (in 2016). These deaths are associated with both indoors and outdoors air pollutants.

## VIDEO: Ways of coming into contact with air pollutants

This video shows that the human respiratory system acts as a great air filtration system. On the one hand this is a natural barrier of coming into contact with air pollutants. On the other hand it is not a 100% secure system and some air pollutants can penetrate deep into our lungs such as particulate matter. By leaving the vacuum cleaner on and trapping fine particles over a long period of time we are making invisible air pollutants (due to their sizes and concentrations) visible and more tangible.

## Particulate Matter PM

As mentioned particulate matter (PM) is a complex class of air pollutants which encompasses solids and liquids suspended in air. PM varies in size, composition and origin. A good way of classifying PM is according to their sizes:

- PM<sub>1</sub> - refers to particles smaller than 1 micron
- PM<sub>2.5</sub> - refers to particles smaller than 2.5 microns
- PM<sub>10</sub> - refers to particles smaller than 10 microns

By comparison the average diameter of a human hair is about 70 microns.

Particulate matter affects people more than any other air pollutant as PM<sub>10</sub> and PM<sub>2.5</sub> can penetrate deep inside our airways and cause health problems.

There are reasons to believe that PM<sub>1</sub> can reach deepest into lungs and also cause health impacts. Our lesson insert 2, *Monitoring air pollutants*, allows students to study historical PM<sub>10</sub> data across different areas of CDMX over a period of 20 years.

## Air pollution impacts our health

Both natural and human-activity air pollutants can affect health conditions, even if we are exposed to an excess of air pollutants during a short period of time. Examples of links between air pollution and ill-health are heart disease, chronic obstructive pulmonary disease, lung cancer and acute respiratory infections. Our lesson insert 3, *Health implications of air pollution*, explores these links further.

**Tip:** It is worth reinforcing a key message to students regarding the fact that people's health is influenced by many factors. Being exposed to poor air quality is just one of these factors. Others like age, overall general health (e.g. body



mass index) and lifestyle choices (e.g- smoking) will affect people's health. What we do know is that exposure to poor air quality can both initiate and enhance disease in humans. Cardiovascular disease accounts for the majority of deaths from air pollution with additional impacts from lung cancer, chronic obstructive pulmonary disease (COPD) and respiratory infections.

## **Lesson insert wrap up [3 minutes]**

### **Air pollution and Sustainable Development Goals (SDGs)**

As air pollution is a global problem, countries need to work together on solutions for reduce the sources of air pollution, especially those linked with human activity. Examples of these global solutions are:

- addressing sustainable transport
- more efficient and renewable energy production
- better use and waste management.

Addressing air pollution is part of the Sustainable Development Goals number 11, which is one of 17 goals aimed at making the world a better place by 2030.

The goals have been agreed by members of the United Nations (UN). The SDGs should enable young learners to see themselves as global citizens and engage with opportunities to take action for sustainable development at schools, local communities and beyond.

CLEAR AIR FOR ALL! Everyone is responsible, everyone can help, is the common message across all of the MANAPRE educational resources and good call for action for you and your students to think about what can they do to tackle air pollution.

## **Extension**

### **Get your home dust tested for air pollutants.**

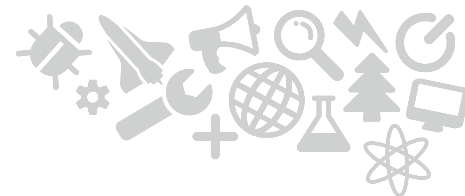
Home dust contains a variable mixture of pollutants from both inside and outside the home. We invite you and your students to collect dust samples from their homes and school for analysis.

In order to do this you need to:

1 - Register at MapMyEnvironment:

<https://www.mapmyenvironment.com/homebiome/>

2- Vacuum, collect, package and send us your sample.



A useful video explaining the process is available here:

<https://www.mapmyenvironment.com/homebiome/home-biome-submission/>

3- After the analysis you will receive a report for you home dust which contains information regarding air pollutants found in the sample but also ideas in how to keep you indoors air cleaner.

More information can be found in the MANAPRE website including details of where to send you sample to.

## **Extension**

### **Pollution catchers**

Pollution catchers can be created with inexpensive everyday materials such as paper plates, string and any kind of petroleum jelly based products. Here is an example of how to:

<https://youtu.be/x-61Z50WTFY>

**Suggestion:** make two. Leave one indoors and another outdoors. After a few days what differences can you see?

### **Further reading:**

*List of recommended sources of information for teachers and presenters keen to learn more about air quality and used across all the MANAPRE educational resources*

#### ***WHO health impacts of air pollution overview***

<https://www.who.int/news/item/02-05-2018-9-out-of-10-people-worldwide-breathe-polluted-air-but-more-countries-are-taking-action#:~:text=Air%20pollution%20levels%20remain%20dangerously,outdoor%20and%20household%20air%20pollution>

#### ***SEDEMA health benefits of reducing air pollution in CDMX***

<http://www.data.sedema.cdmx.gob.mx/beneficios-en-salud-por-la-mejora-de-la-calidad-del-aire/descargas/analisis-espanol.pdf>

#### ***Mitigating Exposure to Traffic Pollution in and around schools***

[http://epubs.surrey.ac.uk/857127/1/4564\\_Brochure%20%28FINAL\\_All%29.pdf](http://epubs.surrey.ac.uk/857127/1/4564_Brochure%20%28FINAL_All%29.pdf)

#### ***Sustainable Development goals for teachers***





<https://oxfamlibrary.openrepository.com/bitstream/handle/10546/620842/edu-sustainable-development-guide-15072019-en.pdf?sequence=4#:~:text=The%20SDGs%20are%20a%20set,the%20world%20a%20better%20place.&text=The%20SDGs%2C%20also%20known%20as,protect%20the%20climate%20and%20environment.>

## Evaluation toolkit

The MANAPRE educational resources were created under an evaluation framework which help presenters to quantify changes in students' knowledge and appreciation of air quality. The evaluation is easy to implement and explained below. All the forms are available online and any evaluation collected should be sent electronically to [nustem@northumbria.ac.uk](mailto:nustem@northumbria.ac.uk).

## Student pre and post questionnaires:

These we design to collect a baseline information of knowledge and appreciation of the subject. The pre questionnaire should be given to students ahead of any delivery and *is independent of the number of activities you choose to deliver to your students*. In a similar way the post questionnaire should be given to your students after all the MANAPRE activities you choose to deliver.

## Lesson insert learning feedback

These are quick evaluation postcards to give to your students at the end of the each lesson insert (except lesson insert 4). They were designed to gather information regarding enjoyability of the activities and any to identify any immediate subject knowledge enhancement but also to recognise any misconceptions.



### Workshop Review

What can be found in air pollution besides gases?

How many stars would you give this workshop?

**nustem**

### Workshop Review

Has air quality improved in CDMX over the past 20 years?

How many stars would you give this workshop?

**nustem**

### Workshop Review

How can air pollution affect health?

What new thing did you learn in today's workshop?

How many stars would you give this workshop?

**nustem**

Northumbria University  
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## Teachers and presenters feedback

This form was design to collect the feedback of teachers and presenters regarding the content and delivery experience of any of the MANAPRE educational resources.

### MANAPRE Teacher Feedback Survey

Which of the following MANAPRE activities did you do with your class?

	Yes	No	Not sure	How many pupils did the activity?
1 Things in Air				
2 Monitoring air pollution				
3 Health impacts of air pollution				
4 Who studies air pollution- STEM Person of The Week				

What do you think children in your class have learnt as a result of taking part in this project?  
Please write below

What have you learnt as a result of taking part in this project?  
Please write below

Has taking part in this project made you think about or do anything differently?  
Please write below

**nustem**



## Lesson insert 4 – Who studies air quality ? STEM person the week

For this particular intervention we kindly ask presenters to use the pre and post evaluation tool linked to lesson 4. This is easy to implement as we ask students to use 6 words to describe people working in STEM, before and after the 5 week intervention.

What six words would you use to describe someone who works in STEM?

1. _____	4. _____
2. _____	5. _____
3. _____	6. _____

\* To be completed **before** the STEM Person of the Week activity takes place.