



## Air Quality

### C1.1 Which chemicals make up air?

**How do we decide which chemicals are pollutants?**

**How do I make sense of data about air pollution?**

I should be able to:

- recall that the Earth is surrounded by a thin layer of atmosphere;
- recall that this atmosphere is made up mainly of nitrogen (78%), oxygen (21%) and argon (1%), plus small amounts of carbon dioxide, water vapour and other gases;
- explain that human activity adds small amounts of carbon monoxide, nitrogen oxides and sulfur dioxide to the atmosphere;
- explain that human activity also adds extra carbon dioxide and small particles of solids (e.g. carbon) to the atmosphere;
- explain that some of these substances, called pollutants, are directly harmful to humans and some are harmful to the environment and so cause harm to humans indirectly.

When using my own and given data relating to measured concentrations of atmospheric pollutants,

I should be able to comment on:

- why a range of readings is taken, to include:
  - imperfections or limitations of measuring equipment;
  - human error;
  - inability to maintain constant conditions;
- the treatment of outliers:
  - identification of outliers;
  - reasons for discarding outliers.

With my own practical work or given secondary data on the properties of the atmosphere, I should be able to :

- obtain a 'best estimate' by ignoring outliers and determining the mean;
- *report measurements and mean value with appropriate precision;*

*recognise the range in which the best estimate lies and that differences may not be 'real' if the estimates lie within one another's ranges.*

## **C1.2 What happens to pollutants in the atmosphere?**

### **Where do these pollutants come from?**

#### I should be able to:

- recall that coal is mainly carbon;
- recall that petrol, diesel fuel and fuel oil are mainly compounds of hydrogen and carbon (hydrocarbons);
- describe how, when fuels burn, atoms of carbon and/or hydrogen from the fuel combine with atoms of oxygen from the air to produce carbon dioxide and/or water (hydrogen oxide);
- recognise that atoms are rearranged during a chemical reaction;
- interpret representations of rearrangements of atoms during a chemical reaction;
- appreciate that during the course of a chemical reaction the numbers of atoms of each element must be the same in the products as in the reactants;
- comment on the implications of the conservation of atoms during combustion reactions for air quality;
- appreciate that the properties of the reactants and products are different;
- explain how sulfur dioxide is produced if the fuel contains any sulfur;
- describe how burning fossil fuels in power stations and for transport pollutes the atmosphere with:
  - carbon dioxide and sulfur dioxide,
  - carbon monoxide and particulate carbon [from incomplete burning],
  - nitrogen monoxide [from the reaction between atmospheric nitrogen and oxygen at the high temperatures inside engines],
- relate the formulas for carbon dioxide,  $\text{CO}_2$ , carbon monoxide,  $\text{CO}$ , sulfur dioxide,  $\text{SO}_2$ , nitrogen monoxide,  $\text{NO}$  and water  $\text{H}_2\text{O}$ , to visual representations of their molecules;
- recall that nitrogen monoxide,  $\text{NO}$ , is formed during the combustion of fuels in air, and is subsequently oxidised to nitrogen dioxide,  $\text{NO}_2$ . ( $\text{NO}$  and  $\text{NO}_2$  are jointly referred to as 'NO<sub>x</sub>');
- recall that atmospheric pollutants cannot just disappear: they have to go somewhere:
  - particulate carbon is deposited on surfaces, making them dirty;
  - sulfur dioxide and nitrogen dioxide react with water and oxygen to produce acidic rain;
  - carbon dioxide is used by plants in photosynthesis;
  - carbon dioxide can react with dissolved chemicals in sea-water.

### **C1.3 Is air pollution harmful to me, or to my environment?**

#### I should be able to:

When given data relating respiratory diseases and / or deaths to atmospheric pollutants, candidates should be able to:

- identify, factors that do, or do not correlate with particular outcomes;
- use the distinction between correlation and cause;
- explain why it is necessary to control (hold constant) all factors thought likely to affect the outcome other than the one being investigated;
- when using a graph:
  - explore the relationship between a factor and an outcome,
  - discuss the type of relationship shown by a line graph,
- interpret the slope of a graph as the rate of change of one variable with the other.

### **C1.4 What choices can we make personally, locally, nationally or internationally that will make a difference to air quality?**

#### **How can we improve air quality?**

#### I should be able to:

- explain how atmospheric pollution caused by power stations which burn fossil fuels can be reduced by:
  - using less electricity,
  - removing sulfur from natural gas and fuel oil,
  - removing sulfur dioxide and particulates (carbon and ash) from the flue gases emitted by coal-burning power stations;
- appreciate that the only way of producing less carbon dioxide is to burn less fuel;
- explain how atmospheric pollution caused by exhaust emissions from motor vehicles can be reduced by:
  - burning less fuel by having more efficient engines,
  - providing low sulfur fuels,
  - using catalytic converters, which convert nitrogen monoxide to nitrogen and oxygen and carbon monoxide to carbon dioxide,
  - adjusting the balance between public and private transport,
  - having legal limits to emissions which are checked during MOT tests.
- In the context of actions to improve air quality, I should be able to:  
explain and apply the idea of sustainable development.

