

# Human influences on the environment

Revision notes · Air pollution by sulfur dioxide and carbon monoxide, greenhouse gases and global warming, water pollution by sewage, and eutrophication.

For Edexcel International GCSE Science (Double Award) 4SD0.

## Human influences on the environment Spec 4.12–4.18B

### Air pollution: sulfur dioxide and carbon monoxide Spec 4.12

Burning fuels releases pollutant gases into the air. Two that you must know about are **sulfur dioxide** and **carbon monoxide**.

#### Sulfur dioxide (SO<sub>2</sub>)

Sulfur dioxide is released when fossil fuels that contain sulfur, such as coal and oil, are burned (for example in power stations). It dissolves in rain water to form acidic solutions, so the rain becomes **acid rain**.

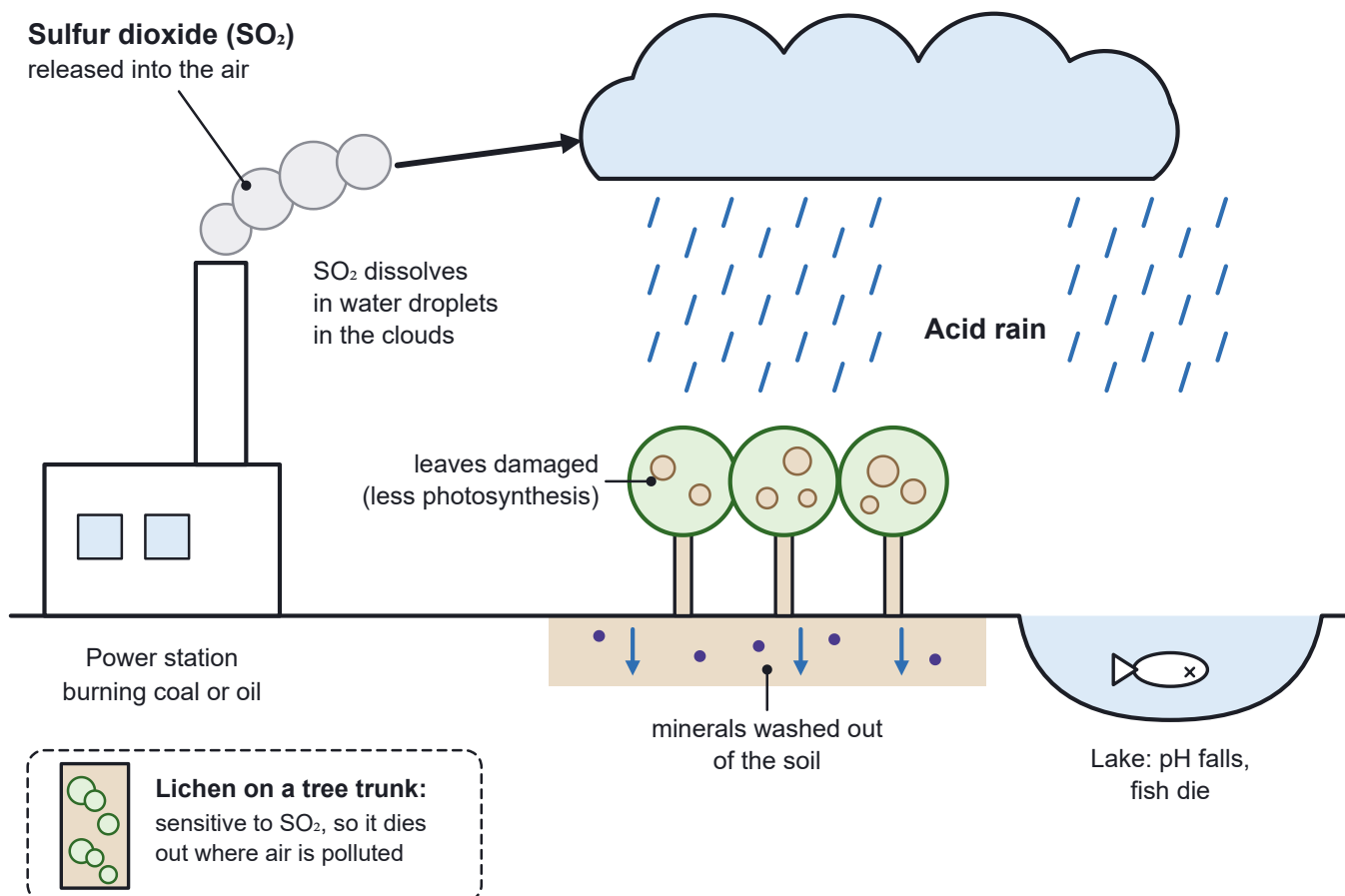
- Acid rain lowers the pH of lakes and rivers. Many fish and other aquatic organisms cannot survive in acidic water, so their numbers fall.
- Acid rain damages the leaves of trees, so they photosynthesise less. It also washes minerals out of the soil, so the trees grow poorly or die.
- Some lichens are very sensitive to sulfur dioxide, so they die out where the air is polluted. Their absence shows that the air is polluted.
- Sulfur dioxide gas also irritates the lungs and can cause breathing problems.

#### Carbon monoxide (CO)

Carbon monoxide is a poisonous gas formed by the **incomplete combustion** of carbon-containing fuels, when there is not enough oxygen. Sources include car engines and faulty gas heaters. It is colourless and has no smell.

- Carbon monoxide combines with **haemoglobin** in red blood cells, much more strongly than oxygen does.
- Haemoglobin that is combined with carbon monoxide cannot carry oxygen, so less oxygen is transported to the tissues.
- Cells then cannot respire aerobically enough. The effects are headaches, dizziness and fainting, and a high dose can cause death.

*Exam tip: For carbon monoxide, link three ideas: it binds to haemoglobin, so less oxygen is carried, so less aerobic respiration. For sulfur dioxide, link it to acid rain and then to the effect on lakes or trees.*



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Sulfur dioxide forms **acid rain**, which harms trees, soil and the organisms in lakes.

## Greenhouse gases and human activities Spec 4.13, 4.14

The **greenhouse effect** keeps the Earth warm enough for life. The gases that cause it are called **greenhouse gases**. You must know five of them and how human activities add to them.

| Greenhouse gases and human sources                     |                                                                                                                                                                        |
|--------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Greenhouse gas                                         | How human activities add to it                                                                                                                                         |
| <b>Carbon dioxide (<math>\text{CO}_2</math>)</b>       | Burning fossil fuels in power stations, vehicles and homes; burning forests when land is cleared (deforestation, which also removes trees that take in $\text{CO}_2$ ) |
| <b>Methane (<math>\text{CH}_4</math>)</b>              | Cattle and other farm animals, which release it from their digestion; rice paddy fields; rotting waste in landfill sites                                               |
| <b>Nitrous oxide (<math>\text{N}_2\text{O}</math>)</b> | Use of nitrogen fertilisers on fields; burning fuels in vehicles                                                                                                       |
| <b>CFCs (chlorofluorocarbons)</b>                      | Released from old refrigerators, air conditioners and aerosol sprays (CFCs are now banned in most countries)                                                           |
| <b>Water vapour (<math>\text{H}_2\text{O}</math>)</b>  | Mostly from evaporation of water from oceans and land. Burning fuels also releases it, and a warmer atmosphere holds more of it.                                       |

Most of the increase in carbon dioxide over the last 200 years is from burning fossil fuels and deforestation. Methane and nitrous oxide increase as more land is farmed to feed a growing human population.

*Exam tip: Give a specific source. 'Pollution' or 'factories' is too vague. Say 'burning fossil fuels' for carbon dioxide and 'cattle' or 'rice fields' for methane.*

## The enhanced greenhouse effect and global warming Spec 4.15

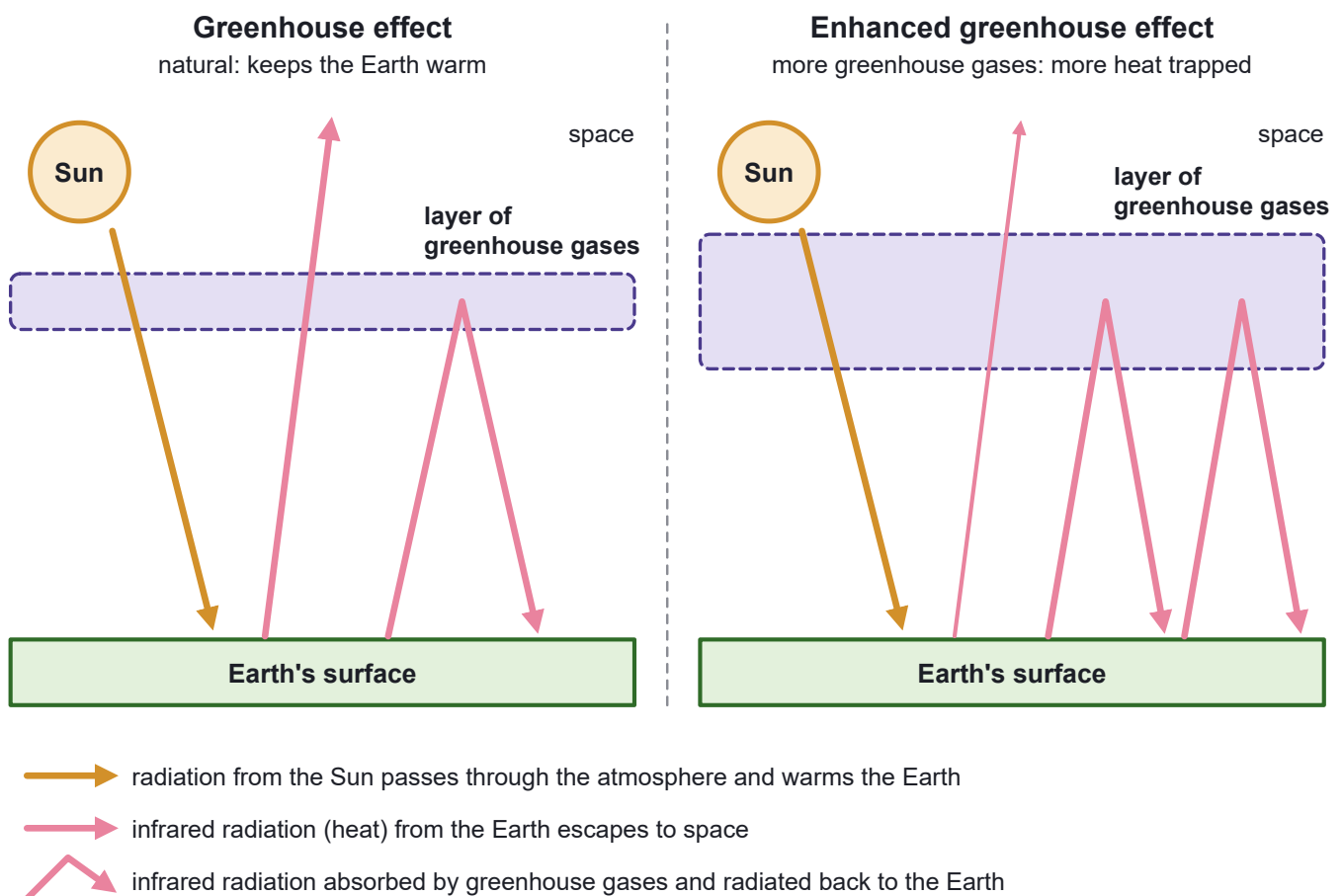
Some greenhouse effect is natural and necessary. The **enhanced greenhouse effect** is the extra warming caused by human activities that increase the amount of greenhouse gases.

1. Radiation from the Sun passes through the atmosphere and warms the surface of the Earth.
2. The warm Earth gives out **infrared radiation** (heat) towards space.
3. Greenhouse gases in the atmosphere absorb some of this infrared radiation and radiate it in all directions, including back towards the Earth. This keeps the Earth warm.
4. When humans increase the amount of greenhouse gases, more infrared radiation is absorbed and sent back to the Earth. This is the enhanced greenhouse effect.
5. The average temperature of the Earth's surface rises. This is **global warming**.

### Possible consequences of global warming

- Ice caps and glaciers melt and the oceans expand as they warm, so sea levels rise. Low-lying coastal land can flood.
- Weather patterns change, with more extreme events such as droughts, floods and storms.
- Habitats change, so the distribution of species changes. Species that cannot move or adapt may become extinct, so biodiversity falls.
- Crop yields may change in some regions, which affects food production.

*Common mistake: The greenhouse effect is not the same as the hole in the ozone layer. Do not mention ozone when explaining global warming.*



**Greenhouse gases: carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O), CFCs and water vapour**

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More greenhouse gases absorb **more infrared radiation**, so more heat is trapped and the Earth warms.

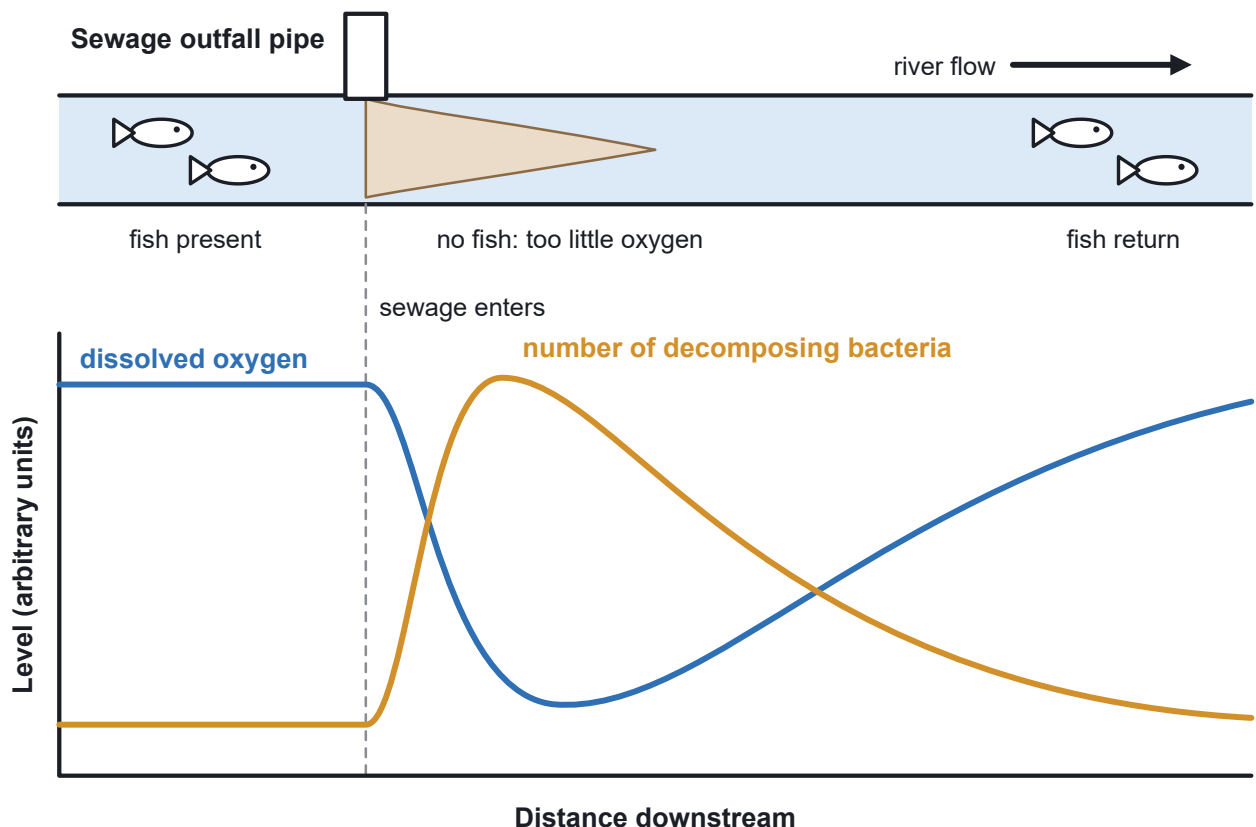
## Water pollution by sewage Spec 4.16

**Sewage** is waste water from homes and industry. If it is released into rivers or lakes without proper treatment, it causes pollution with several biological consequences.

- Sewage contains a lot of organic matter. Bacteria and other decomposers feed on it and respire aerobically, so they use up the dissolved **oxygen** in the water.
- As the oxygen level falls, fish and other aquatic animals that need oxygen die. Only organisms that tolerate low oxygen survive, so biodiversity falls.
- Sewage contains **pathogens** (disease-causing microorganisms). People who drink the water or use it for washing food can catch diseases, such as cholera and typhoid.
- Sewage also contains nitrates and phosphates. These act as fertiliser for algae and can lead to eutrophication.

1. Untreated sewage enters the river.
2. Decomposers multiply, feeding on the organic matter.
3. The decomposers use up oxygen in aerobic respiration.
4. The oxygen concentration of the water falls.
5. Fish and other animals die, so the food web is disrupted.

*Exam tip: The key link is: more decomposers, so more oxygen used, so less oxygen for fish. Do not just say the sewage poisons the fish.*



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Decomposers feeding on the sewage **use up the dissolved oxygen**, so fish cannot survive just downstream.

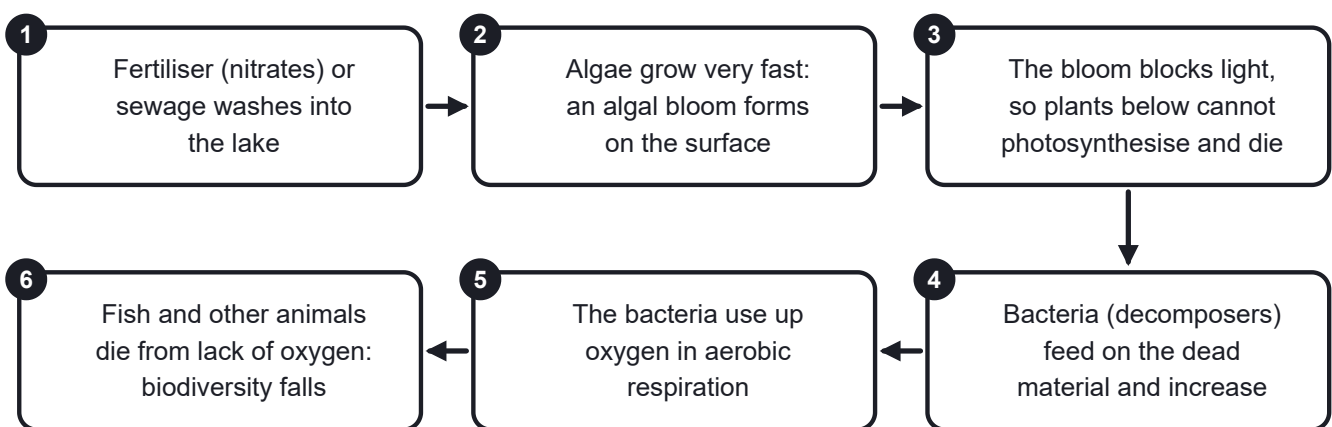
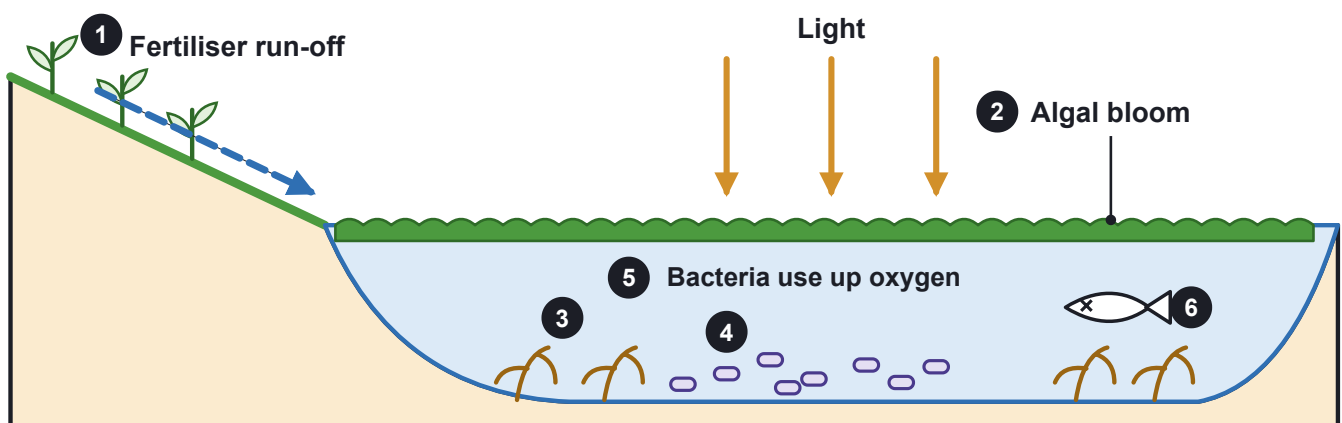
## Eutrophication Spec 4.17

**Eutrophication** happens when too many mineral ions, such as nitrates and phosphates from fertilisers, enter lakes and rivers. **Leaching** is the washing of dissolved minerals out of the soil by rain. Fertiliser

that crops have not taken up is leached into streams and rivers.

1. Nitrates and other minerals from fertilisers are leached from fields into the water.
2. Algae in the water grow very quickly because of the extra minerals, forming a layer on the surface (an algal bloom).
3. The layer blocks light, so plants and algae lower down cannot photosynthesise and die.
4. Bacteria (decomposers) feed on the dead material and their numbers increase.
5. The bacteria use up oxygen in the water for aerobic respiration.
6. Fish and other aquatic animals die from lack of oxygen, so biodiversity falls.

*Common mistake: The fish do not die because the algae poison them. The main cause is the decomposers feeding on the dead plants and algae, which use up the oxygen.*



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Eutrophication: extra nitrates cause an algal bloom, plants die, **decomposers use up the oxygen** and fish die.

### Quick check

1. What gas causes acid rain?
2. Why is carbon monoxide poisonous?
3. Name the five greenhouse gases in the spec.
4. Why does sewage pollution kill fish?

## Quick check answers

### Human influences on the environment

- 1 . Sulfur dioxide.
- 2 . It combines with haemoglobin, so the blood carries less oxygen.
- 3 . Water vapour, carbon dioxide, nitrous oxide, methane and CFCs.
- 4 . Decomposers feeding on it use up the oxygen in the water.