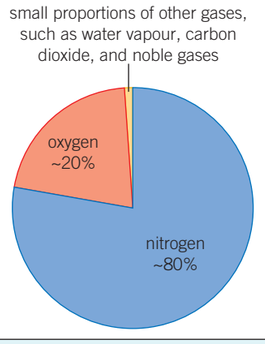
Chapter 13: The Earth's atmosphere

Knowledge organiser

The Earth's changing atmosphere

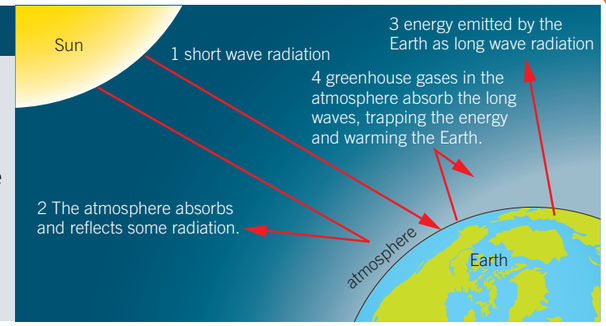
Period	Proportions of gases	Evidence
about 4.6 billion years to about 2.7 billion years ago	• **carbon dioxide, CO_2** Released by volcanoes. Biggest component of the **atmosphere**. • **oxygen, O_2** Very little oxygen present. • **nitrogen, N_2** Released by volcanoes. • **water vapour, H_2O** Released by volcanoes. Existed as vapour as Earth was too hot for it to condense. • **other gases** Ammonia, NH_3, and methane, CH_4, may also have been present.	Because it was billions of years ago there is very little evidence to draw upon.
about 2.7 billion years ago to about 200 million years ago	• **carbon dioxide, CO_2** Amount in atmosphere begins to reduce because: • water condenses to form the oceans, in which CO_2 then dissolves • algae (and later plants) start to photosynthesise carbon dioxide + water $\xrightarrow{\text{light}}$ glucose + oxygen $6CO_2 + 6H_2O \longrightarrow C_6H_{12}O_6 + 6O_2$ • CO_2 precipitates in the oceans as solid carbonates (sediments) that form rocks • CO_2 taken in by plants and animals. When they die, the carbon in them is locked up as fossil fuels • **oxygen, O_2** Starts to increase as a product of photosynthesis. • **nitrogen, N_2** Continues to increase. Nitrogen is a very stable molecule so any process that produces it causes the overall amount to build up over time. • **water vapour, H_2O** Starts to decrease. As the Earth cools, the vapour condenses and forms the oceans.	Still limited as billions of years ago, but can look at processes that happen today (like photosynthesis) and make theories about the past.
about 200 million years ago until the present	• **carbon dioxide, CO_2** about 0.04% • **oxygen, O_2** about 20% • **nitrogen, N_2** about 80% • **water vapour, H_2O** Very little overall. Collects in large clouds as part of the water cycle. • **other gases** Small proportions of other gases such as the noble gases. 	Ice core evidence for millions of years ago and lots of global measurements taken recently.

Greenhouse gases

Greenhouse gases, such as carbon dioxide, methane, and water vapour, absorb radiation and maintain temperatures on the Earth to support life.

However, in the last 150 years, more greenhouse gases have been released due to human activities.

- carbon dioxide – combustion of fossil fuels, deforestation
- methane – planting rice fields, cattle farming



Global warming

Scientists have gathered peer-reviewed evidence to demonstrate that increasing the amount of greenhouse gases in the atmosphere will increase the overall average temperature of the Earth. This is called **global warming**.

However, it is difficult to make predictions about the atmosphere as it is so big and complex. This leads some people to doubt what scientists say.

Global climate change

Global warming leads to another process called **global climate change** – how the overall weather patterns over many years and across the entire planet will change.

There are many different effects of climate change, including:

- sea levels rising
- extreme weather events
- changes in the amount and time of rainfall
- changes to ecosystems and habitats
- polar ice caps melting.

Carbon footprints

Increasing the amount of greenhouse gases in the atmosphere increases the global average temperature of the Earth, which results in global climate change.

As such, it is important to reduce the release of greenhouse gases into the atmosphere. The amount of carbon dioxide and methane that is released into the atmosphere by a product, person, or process is called its **carbon footprint**.

Other pollutants released in combustion of fuels

Pollutant	Origin	Effect
carbon monoxide	incomplete combustion of fuels	colourless and odourless toxic gas
particulates (soot and unburnt hydrocarbons)	incomplete combustion of fuels especially in diesel engines	**global dimming**, respiratory problems, potential to cause cancer
sulfur dioxide	sulfur impurities in the fuel reacting with oxygen from the air	**acid rain** and respiratory problems
oxides of nitrogen	nitrogen from the air being heated near an engine and reacting with oxygen	acid rain and respiratory problems

Key terms

Make sure you can write a definition for these key terms.

acid rain *atmosphere* *carbon footprint* *global climate change* *carbon monoxide* *global dimming* *global warming* *greenhouse gas* *particulate* *pollutant*

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Retrieval questions

Learn the answers to the questions below then cover the answers column with a piece of paper and write as many as you can. Check and repeat.

C13 questions		Answers
1	What is the atmosphere?	a layer of gas surrounding the Earth
2	What was the early atmosphere composed of?	mostly carbon dioxide
3	How did the oceans form?	water vapour condensing as the Earth cooled
4	How did the amount of carbon dioxide in the atmosphere decrease to today's levels?	dissolved in the oceans, photosynthesis, converted to fossil fuels, precipitated as insoluble metal carbonates
5	When did life start to appear, and what was the impact of this on oxygen in the atmosphere?	about 2.7 billion years ago; amount of atmospheric oxygen increased as it was released in photosynthesis
6	How has the amount of nitrogen in the atmosphere changed over time?	increased slowly as it is a very stable molecule
7	Why can scientists not be sure about the composition of the Earth's early atmosphere?	it was billions of years ago and evidence is limited
8	What is the current composition of the atmosphere?	approximately 80% nitrogen, 20% oxygen, and trace amounts of other gases such as carbon dioxide, water vapour, and noble gases
9	What is a greenhouse gas?	a gas that traps radiation from the Sun
10	What type of radiation do greenhouse gases absorb?	longer wavelength infrared radiation
11	Name three greenhouse gases.	methane, carbon dioxide, water vapour
12	Give two ways recent human activities have increased the amount of atmospheric carbon dioxide.	burning fossil fuels, deforestation
13	Give two ways recent human activities have increased the amount of atmospheric methane.	rice farming, cattle farming
14	What is global warming?	an increase in the overall global average temperature
15	What is global climate change?	the change in long-term weather patterns across the planet
16	What are some possible effects of climate change?	sea levels rising, extreme weather events, changes in the amount and time of rainfall, changes to ecosystems and habitats, polar ice caps melting
17	What is a carbon footprint?	the amount of carbon a product, process, or person releases into the atmosphere over its lifetime
18	How is carbon monoxide formed, and what is the danger associated with it?	incomplete combustion; colourless and odourless toxic gas
19	How are particulates formed, and what are the dangers associated with them?	incomplete combustion; global dimming, respiratory problems, potential to cause cancer
20	How is sulfur dioxide formed, and what are the dangers associated with it?	sulfur impurities in fossil fuels react with oxygen during combustion; acid rain, respiratory problems
21	How are oxides of nitrogen formed, and what are the dangers associated with them?	atmospheric oxygen and nitrogen react in the heat of a combustion engine; acid rain, respiratory problems

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