

Earth's Atmosphere Notes

Science Exams Sorted



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The Earth formed approximately 4.5 billion years ago. Scientists believe, based on the evidence that we have, that Earth's early atmosphere was produced by volcanic activity. Volcanic eruptions released lots of different gases in to the atmosphere.

Earths early atmosphere versus the modern atmosphere	
The earths early atmosphere more than likely had:	The modern atmosphere has:
1. <u>A large amount of carbon dioxide gas.</u>	1. <u>A lot less carbon dioxide gas.</u>
2. <u>A small amount of oxygen gas.</u>	2. <u>A lot more oxygen gas.</u>
3. <u>Lots of water vapour.</u>	3. <u>Much less water vapour.</u>
4. <u>Small amounts of other gases, like ammonia and methane.</u>	4. <u>Similar amounts of gases like ammonia and methane.</u>
Exam Note: A popular exam question that can be asked is: <i>"Why are people unsure about the composition of the earths early atmosphere?"</i> Ideal answer: <u>There were no scientists around when the early atmosphere formed/no eye witnesses. Scientists can analyse evidence that is trapped in rocks and other sources.</u>	

How was the modern atmosphere formed? What happened to each gas?

Gas	Change	Reason
Carbon dioxide	Decrease	<u>CO₂ is very soluble in water.</u> As the oceans formed, carbon dioxide dissolved into the water and the amount in the atmosphere decreased. <u>Photosynthesis</u> – plants evolved and used CO ₂ to make glucose. Over time this reduced the amount in the atmosphere.
Oxygen	Increase	<u>Photosynthesis</u> – plants evolved and use photosynthesis to make glucose. Oxygen is given out as a waste product. Over time this increased the amount of O ₂ in the atmosphere. Carbon dioxide + water → glucose + oxygen $6\text{CO}_2 (\text{g}) + 6\text{H}_2\text{O} (\text{l}) \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 (\text{aq}) + 6\text{O}_2 (\text{g})$
Water vapour	Decrease	<u>Earth cooled after it formed.</u> When it became cool enough, water vapour in the atmosphere condensed to liquid water. It fell as rain, creating the oceans.

Common atmospheric pollutants and their sources

Pollutant	Source
Carbon dioxide, CO ₂	Is the product of combustion of any fuel containing carbon atoms, for example pentane. $\text{C}_5\text{H}_{12} (\text{l}) + 8\text{O}_2 (\text{g}) \rightarrow 5\text{CO}_2 (\text{g}) + 6\text{H}_2\text{O} (\text{g})$
Carbon monoxide, CO	Is the product of incomplete combustion of any fuel containing carbon atoms, for example $\text{C}_5\text{H}_{12} (\text{l}) + 5\text{O}_2 (\text{g}) \rightarrow 4\text{CO} (\text{g}) + \text{C} (\text{s}) + 6\text{H}_2\text{O} (\text{g})$
Particulate carbon, C solid (soot)	Is the product of incomplete combustion of any fuel containing carbon atoms.
Unburned hydrocarbons	Hydrocarbon fuel molecules which have not been oxidised at all this could be due to a fault in the engine.
Sulfur dioxide, SO ₂	Is the product of combustion of a fossil fuel which contains sulfur. <u>This can lead to acid rain.</u>
Nitrogen oxides, NO _x	The oxidation of atmospheric nitrogen inside the engine of a car, lorry or bus etc. This can also lead to the formation of acid rain.

The Greenhouse Effect

The greenhouse effect: is the process by which radiation from a planet's atmosphere warms the planet's surface to a temperature above what it would be without this atmosphere.

A greenhouse gas: a gas that contributes to the greenhouse effect by absorbing infrared radiation. Without greenhouse gases in its atmosphere, the Earth would be about 32°C colder on average than it is.

Examples: carbon dioxide, methane and water vapour.

How do greenhouse gases cause global warming?

There's a bit of explaining in this so it has been condensed to the key information that we need.

- The Sun emits energy in the form of electromagnetic radiation, mostly as visible and ultraviolet light.
- This high-energy, shortwave radiation passes through Earth's atmosphere because most of it is not absorbed by the gases in the atmosphere.
- When this radiation reaches Earth's surface, it is absorbed by land, water, and vegetation, warming the planet.
- The warmed surface then re-emits this energy as infrared radiation, which has longer wavelengths and lower energy compared to the incoming solar radiation.
- Greenhouse gases such as CO₂ and CH₄ absorb this infrared radiation as it tries to return to space.
- After absorbing infrared radiation, greenhouse gas molecules release it again in all directions. Some of this re-emitted radiation goes back down to Earth's surface, while the rest escapes to space.
- The infrared radiation that is sent back toward Earth's surface contributes to additional warming

Human Activities

Sadly, human activities are causing an increase in the amounts of greenhouse gases in the atmosphere. Carbon dioxide gas is mainly coming from the burning of fossil fuels and methane is mostly coming from industry and farming.

Climate Change

The climate describes the average weather over a long time and over a large area. The enhanced greenhouse effect is leading to climate change. The effects of this include:

- Melting polar ice caps and melting glaciers.
- Rising sea levels
- Increasing floods or droughts occurring.
- Reducing the amount of land that can be farmed.

How do we know humans are causing this? The majority of scientists agree that human activities are driving climate change. We can trust this because the evidence has been **peer-reviewed** meaning it has been checked by other independent scientists before it was published.

Gases in the modern atmosphere

How can we have a set of notes about the atmosphere without quickly mentioning the gases that make up earth's atmosphere today and give their percentages? 😊. These are:

Nitrogen: 78%

Oxygen: 21%

Argon: 0.9%

Carbon dioxide: 0.04% (plus small amounts of other noble gases and water vapour).