

1 – Evolution of the atmosphere	
Phase 1 - Volcanoes	The early atmosphere came from intense volcanic activity . Large amounts of carbon dioxide . Small amounts of nitrogen, water vapour, methane and ammonia . Little to no oxygen .
Phase 2 – Absorption of CO ₂	Water vapour condensed and formed oceans . Carbon dioxide dissolved into oceans to form carbonate precipitates. Green plants/algae absorbed carbon dioxide for photosynthesis . Marine animals evolved, their shells and skeletons contained carbonates from the oceans.
Phase 3 – Production of O ₂	Algae and plants evolved . They carried out photosynthesis : water + carbon dioxide → glucose + oxygen The oxygen gradually built up, allowing animals to evolve .
Earth's modern atmosphere	Approximately 80% nitrogen and 20% oxygen . Less than 1% other gases (carbon dioxide, noble gases, water vapour).
2 – Greenhouse effect/Climate change	
Greenhouse gases	Carbon dioxide, methane and water .
The greenhouse effect	<ol style="list-style-type: none"> Short wavelength radiation enters atmosphere. Short wavelength radiation is absorbed by materials. The Earth re-emits the radiation as longer wavelength infrared radiation (IR). Some of the IR goes into space. The longer wavelength radiation is trapped by greenhouse gases which stop it escaping. The lower atmosphere warms up (temperature increases).
Human activity	<ul style="list-style-type: none"> -Deforestation – increases CO₂ (less trees take it in) -Burning fossil fuels – releases CO₂ -Agriculture – increases methane (cattle's digestive systems) -Creating waste – increases methane and CO₂ (decomposition)
Effects of global warming	<ul style="list-style-type: none"> -Glaciers/ice-caps melting – increased flooding, loss of habitats -Sea levels rising – increased flooding, coastal erosion -Rainfall/storms – amount and distribution of rain may change, frequency and severity of storms may increase. -Changing habitats – change in temperature or amount of water may affect wild species.

3 – Carbon footprint	
Carbon footprint	A measure of the amounts of greenhouse gases released by a product, service or event.
Reducing carbon footprints	<ul style="list-style-type: none"> -Use renewable or nuclear energy instead of fossil fuels -Reduce waste -Tax for companies with high greenhouse gas emissions -Carbon capture technology.
Difficulties reducing emissions	<ul style="list-style-type: none"> -More work required on technology -Governments concerned about economic impact of changes -Difficult to make international agreements
4 – Air pollution	
Complete combustion	When fuel burns with enough oxygen . Produces carbon dioxide and water . E.g.: methane + oxygen → carbon dioxide + water $\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}$
Incomplete combustion	When fuel burns without enough oxygen . Produces carbon monoxide or carbon particulates (soot). E.g. ethane + oxygen → carbon monoxide + water <i>OR</i> ethane + oxygen → carbon + water
Carbon monoxide	A toxic gas. No colour and no smell so not easily detected.
Carbon particulates	Cause respiratory problems and global dimming .
Sulphur dioxide	Formed when sulphur impurities are present in fossil fuels . Dissolves in rain water to make acid rain (sulphuric acid)
Oxides of nitrogen	High temperatures and pressures inside car engines causes nitrogen and oxygen in air to react. Different compounds are made but given the general formula NO_x . Dissolves in rain water to cause acid rain (nitric acid).
Effects of acid rain	<ul style="list-style-type: none"> -Kills plants – damages leaves (can't do photosynthesis) -Damages buildings and statues, and makes metals corrode -Causes respiratory problems

GCSE Science

Chemistry C9 – Chemistry of the Atmosphere