



The Atmosphere

1. For 200 million years, the proportions of different gases in the atmosphere have been much the same as they are today:
 - approximately **80% nitrogen**
 - approximately **20% oxygen**
 - small proportions of various other gases, including carbon dioxide, water vapour and noble gases.
2. One theory suggests that during the first billion years of the Earth's existence there was **intense volcanic activity** that released gases that formed the early atmosphere
3. This included **water vapour** that **condensed** to form the **oceans**.
4. At the start of this period the Earth's atmosphere may have been like the atmospheres of Mars and Venus today, consisting of **mainly carbon dioxide** with little or **no oxygen** gas.
5. Volcanoes also produced nitrogen which gradually built up in the atmosphere and there may have been small proportions of methane and ammonia.
6. When the oceans formed **carbon dioxide** dissolved in the water and carbonates were precipitated producing sediments, reducing the amount of carbon dioxide in the atmosphere.
7. Algae and plants produced the oxygen that is now in the atmosphere by **photosynthesis**.
8. The equation for photosynthesis is:

$$\text{water} + \text{carbon dioxide} \rightarrow \text{glucose} + \text{oxygen}$$
9. Algae first produced oxygen about 2.7 billion years ago and soon after this **oxygen** appeared in the atmosphere.

10. Over the next billion years plants evolved and the percentage of oxygen gradually increased to a level that enabled animals to evolve.
11. Algae and plants decreased the percentage of carbon dioxide in the atmosphere by **photosynthesis**.
12. Carbon dioxide was also decreased by the formation of **sedimentary rocks** and **fossil fuels** that contain carbon.
13. Carbon was **trapped** in living things which were buried under heat and pressure for millions of years to form fossil fuels.
14. **Crude oil** was formed from the remains of ancient **plankton**.
15. **Coal** was formed from the remains of **ancient trees**.

The Greenhouse Effect and Global Warming

16. **Greenhouse gases** in the atmosphere **maintain temperatures** on Earth high enough to support life.
17. **Water vapour, carbon dioxide** and **methane** are greenhouse gases
18. Long wavelength **radiation** is absorbed by the Earth and short wave radiation is emitted by the Earth. Greenhouse gases in the atmosphere trap this radiation.
19. Some **human activities**, such as burning fossil fuels and deforestation, increase the amounts of greenhouse gases in the atmosphere.
20. Based on **peer-reviewed** evidence, many scientists believe that human activities will cause the **temperature** of the Earth's atmosphere to **increase** at the surface and that this will result in global **climate change**.
21. However, it is difficult to model such complex systems as global climate change.





22. This leads to simplified models, speculation and opinions presented in the media that may be based on only parts of the evidence and which may be biased.
23. An increase in average global temperature is a major cause of climate change.
24. There are several potential **effects** of **global climate change**, including melting ice caps, rising sea levels, extreme weather events and possible food shortages.

Using Resources

25. Life cycle assessments (**LCAs**) are carried out to assess the **environmental impact** of products in each of these stages:
- extracting and processing raw materials
 - manufacturing and packaging
 - use and operation during its lifetime
 - disposal at the end of its useful life
 - including transport and distribution at each stage.
26. Use of water, resources, energy sources and production of some wastes can be fairly easily quantified.
27. Allocating numerical values to pollutant effects is less straightforward and requires value judgements, so LCA is not a purely objective process.
28. Selective or abbreviated LCAs can be devised to evaluate a product but these can be misused to reach pre-determined conclusions, e.g. in support of claims for advertising purposes.
29. The **reduction in use, reuse and recycling** of materials by end users **reduces the use of limited resources**,

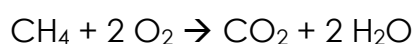
- use of energy sources, waste and environmental impacts.
30. Metals, glass, building materials, clay ceramics and most plastics are produced from limited raw materials.
31. Much of the energy for the processes comes from limited resources.
32. Some products, such as glass bottles, can be **reused**. Glass bottles can be crushed and melted to make different glass products.
33. Other products cannot be reused and so are **recycled** for a different use.
34. The **carbon footprint** is the total amount of **carbon dioxide** and other **greenhouse gases** emitted over the full **life cycle** of a product, service or event.
35. The carbon footprint can be reduced by **reducing emissions** of carbon dioxide and methane.

Pollution

36. The burning of fossil fuels is a major source of **energy** for humans.
37. The **combustion** of hydrocarbon fuels releases energy.
38. During combustion, the carbon and hydrogen in the fuels are oxidised.
39. The complete combustion of a hydrocarbon produces carbon dioxide and water.
40. The general word equation that describes the complete combustion of an alkane is:

alkane + oxygen → carbon dioxide + water

41. Complete combustion reactions of alkanes can be represented by balanced symbol equations, for example:





42. The combustion of fuels is a major source of **atmospheric pollutants**.
43. Most fuels, including coal, contain carbon and/or hydrogen and may also contain some **sulfur**.
44. The gases released into the atmosphere when a fuel is burned may include carbon dioxide, water vapour, carbon monoxide, **sulfur dioxide** and **oxides of nitrogen**.
45. Solid particles and unburned hydrocarbons may also be released that form **particulates** in the atmosphere.
46. **Carbon monoxide** is a toxic gas. It is colourless and odourless and so is not easily detected.
47. Sulfur dioxide and oxides of nitrogen cause **respiratory problems** in humans and cause **acid rain**.
48. Particulates cause **global dimming** and health problems for humans.
49. Rapid growth in the human population and an increase in the standard of living mean that increasingly **more resources** are used and **more waste** is produced. Unless waste and chemical materials are properly handled, more pollution will be caused.
50. Pollution can occur in **water**, from sewage, fertiliser or toxic chemicals, in **air**, from smoke and acidic gases, on **land**, from landfill and from toxic chemicals.
51. Pollution is caused when human waste isn't properly handled, for example: air pollution from smoke, land pollution from landfill rubbish and water pollution from sewage and fertilisers.
52. Pollution can kill or damage animals and plants which **reduces biodiversity**.
53. Indicator species can be used to monitor the level of pollution in a habitat.
54. The main energy resources available for use on Earth include fossil fuels (coal, oil and gas), nuclear fuel, biofuel, wind, hydroelectricity, geothermal, the tides, the Sun and water waves.
55. Pollution can be reduced by using renewable energy resources.
56. A **renewable energy resource** is one that is being (or can be) replenished as it is used.
57. Some renewable resources can be replenished by human actions and some are replenished naturally.
58. A non-renewable energy resource is one that is not being (or can be) replenished as it is used.
59. All energy resources have advantages and disadvantages.

