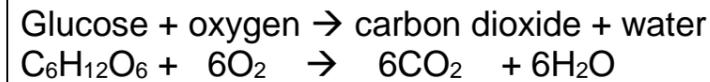


Proportion of gases in the atmosphere

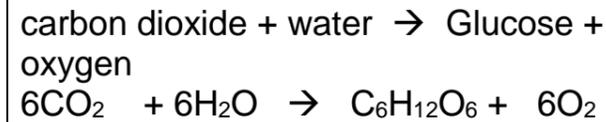
The current atmosphere is a **mixture** of gases. The proportion of these gases are kept in **balance** by two main processes:

- respiration
- photosynthesis

**Respiration** is the release of energy by the use of oxygen and glucose by plants and animals:



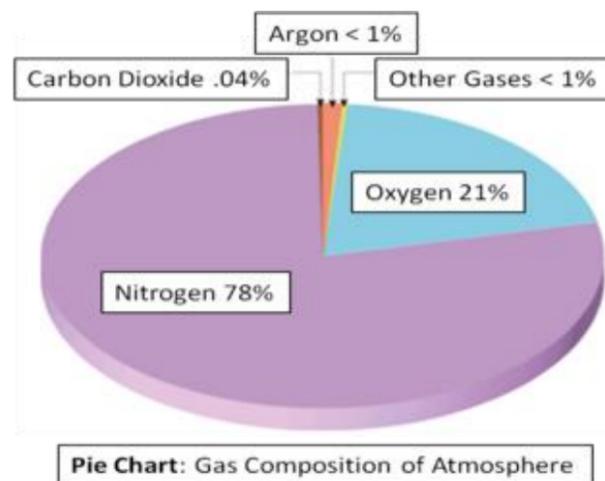
**Photosynthesis** is the use of carbon dioxide by plants to produce glucose:



These two processes are part of the carbon cycle. The process of **combustion** uses oxygen to produce carbon dioxide:

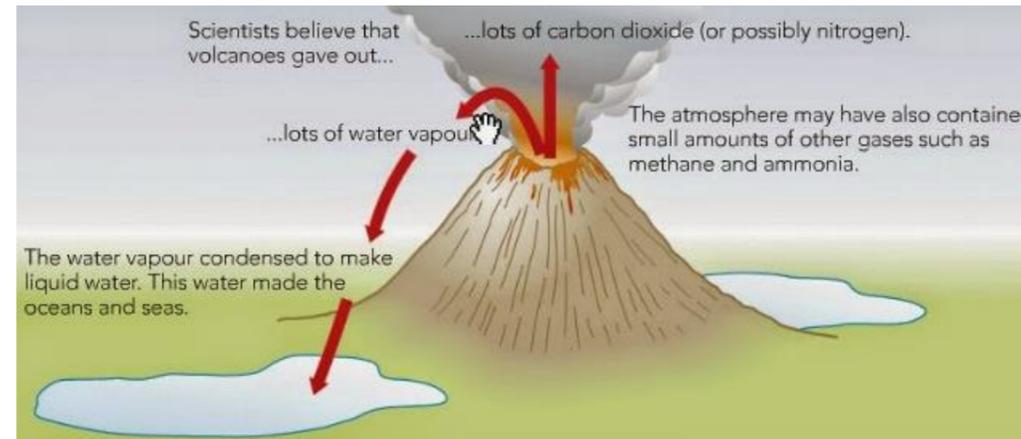


The mixture of gases in the air is:



The Earth's early atmosphere

One theory suggests that the Earth's early atmosphere originated from volcanoes erupting.



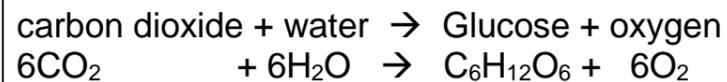
Volcanoes kept erupting releasing steam and carbon dioxide. Volcanoes also produced **nitrogen** which gradually built up in the atmosphere and there may have been small proportions of **methane** and **ammonia**.

The early atmosphere was nearly **all carbon dioxide**.

As the Earth cooled and the surface became more solid the **water vapour condensed**. This pooled forming seas and **oceans**.

Carbon dioxide was removed from the atmosphere by dissolving in the oceans. Carbonates formed precipitated forming sediments.

Algae and sea **plants evolved** removing carbon dioxide from the atmosphere **by photosynthesis** producing **oxygen**.



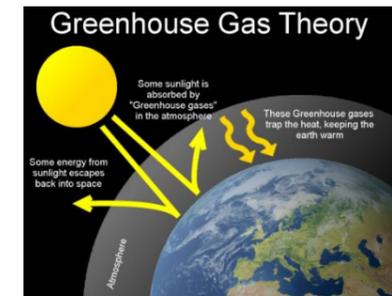
Over the next billion years plants and algae continue to produce oxygen to a level which animals can evolve.

Sea creatures used **dissolved carbon dioxide** in the form of carbonates to produce **bones and shells**. When they died their shells and bones formed layers of sedimentary rock (**limestone**). Their bodies formed **fossil fuels** like oil and gas which contain 'locked up' carbon. This carbon is released as carbon dioxide when the fuels are burned.

The **ozone layer** was formed as oxygen reacted with itself. This layer **protects** animal life from **harmful UV radiation** from the sun.

Carbon dioxide and methane as greenhouse gases

Water vapour, carbon dioxide and methane are classed as greenhouse gases. They act like a greenhouse by trapping the Sun's heat energy – thereby helping to maintain the atmospheric temperatures of the Earth to support life.



The quantities of **greenhouse gases** in the atmosphere are increased by human activities (or so many scientists believe). Scientists believe this increase will lead to **increased** surface and atmospheric **temperatures** leading to **climate change**.

The **increase** in greenhouse gases by:

- combustion of fossil fuels (releasing carbon dioxide);
- methane release by rice fields;
- cattle defecation increase methane;
- respiration;
- deforestation;
- volcanic eruptions.

The **global effects** of climate change are:

- increased desert regions;
- polar ice cap melting;
- slowing of the Gulf Stream;
- low level flooding;
- weather system changes;
- sea-level rising.

**However**, it is difficult to model such complex systems as global climate change. 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**

## Carbon footprint and its reduction

The carbon footprint is the **total amount of carbon dioxide** and other greenhouse gases emitted over the full life cycle of a product, event or service.

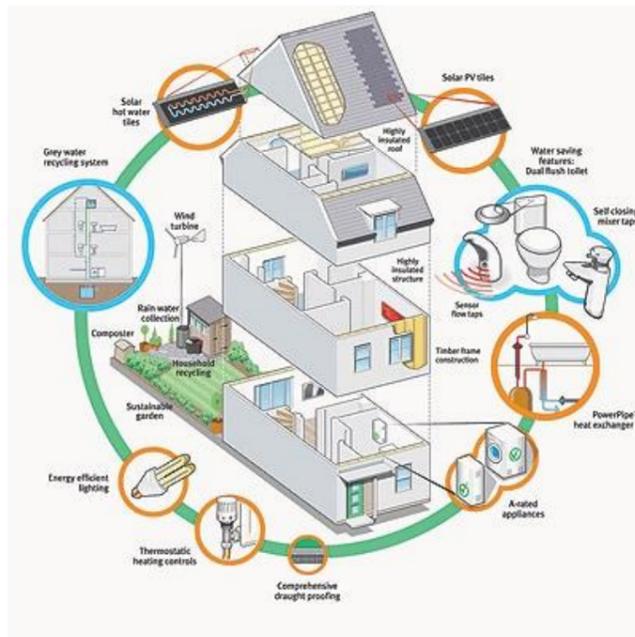
Each person produces their own carbon footprint when heating the house, using electricity (most is produced by the combustion of fossil fuel), using cars etc.

The **International Kyoto Agreement** states that we should all reduce our carbon footprints.

### Reducing carbon footprint

Actions to reduce personal footprints include:

- increase energy supplies from renewable or hydrogen fuel cells;
- increase energy conservation or efficiency in homes;
- drive cars which are more energy efficient (burn less fuels).



## Governments reducing the carbon footprint

**Carbon capture and storage** – taking CO<sub>2</sub> emissions from power stations and depositing into underground geological formations to reduce amount entering the atmosphere.

**Carbon taxes and licenses** – charging polluters tax if they emitted greenhouse gases.

**Carbon offsetting** – increasing carbon sink through tree planting and reforestation.

**Carbon neutrality** – the scheme to take out the same amount of CO<sub>2</sub> from the atmosphere as is released. This idea is to produce zero carbon footprint.

### Problems in reduction

**Methane** (another greenhouse gas) has risen considerably due to:

- grazing animals increase to produce more meat;
- wet cultivation of rice fields;
- more rubbish landfills.

### Common atmospheric pollutants and their sources

The combustion of fuels to produce energy produces unwanted by-products.

| Pollutant       | caused   | problems  | reduction  |
|-----------------|--|---|--|
| carbon monoxide | incomplete combustion  | toxic – reduced respiration, leading to death                       | conversion into CO <sub>2</sub> in catalytic converter           |
| Sulfur dioxide  | burning sulfur impurities in fossil fuels                          | leads to acidic rain  | removed by capturing with limestone in power station chimney     |
| nitrogen oxides | reaction of N <sub>2</sub> and O <sub>2</sub> at high temperatures | can cause respiratory problems especially for asthmatics            | conversion to N <sub>2</sub> in catalytic converters             |
| particulates    | incomplete combustion  | global dimming damages lungs, cause heart attacks and DNA mutations | No safe level of PM <sub>10</sub> – PM <sub>2.5</sub> particles. |

## Unit 9 quiz questions

1. What is the most abundant gas in the atmosphere + what % is it?
2. What is the second most abundant gas and what % is it?
3. What is the third most abundant gas and what % is it?
4. What 2 natural processes make sure the % composition of our atmosphere remains constant?
5. How can % be changed into ppm?
6. What produced the first ever atmosphere on earth?
7. What were the main gases in the first atmosphere?
8. How did the oceans form?
9. How did the oceans cause a decrease in carbon dioxide levels?
10. Why is this the most popular theory about our atmosphere?
11. What caused the first oxygen in the atmosphere?
12. Why didn't oxygen levels increase straight away?
13. Why does eroding limestone effect the atmosphere?
14. Why does burning fossil fuels effect the atmosphere?
15. How is % change calculated?
16. Write the formula of 3 greenhouse gases.
17. Radiation from the sun has a short/UV wavelength, but Re radiated radiation from earth has a..?
18. Which wavelength is trapped by greenhouse gases?
19. Name an activity that increases CO<sub>2</sub> levels and one that increases methane levels.
20. Name one possible negative outcome from climate change.
21. Define a carbon footprint.
22. What is a peer review?
23. How is the air pollutant sulphur dioxide produced?
24. What effects can nitrogen oxides and sulphur dioxide have on humans?