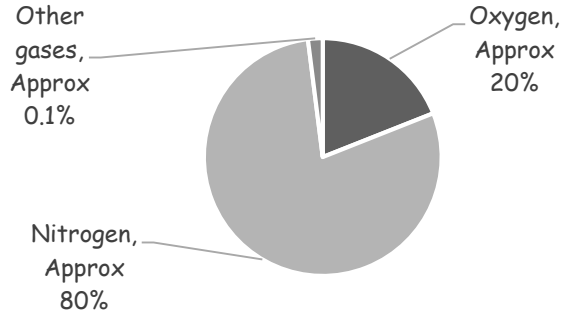


# Trilogy C13 - The Earth's Atmosphere Page 1

## The modern atmosphere

For 200 million years, the proportions of gases in the atmosphere have been the same as they are today:

- about four-fifths (approximately 80 %) nitrogen
- about one-fifth (approximately 20 %) oxygen
- small proportions of various other gases, including CO<sub>2</sub>, water vapour and noble gases.



## Climate Scientists

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**.

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.

## Greenhouse gases

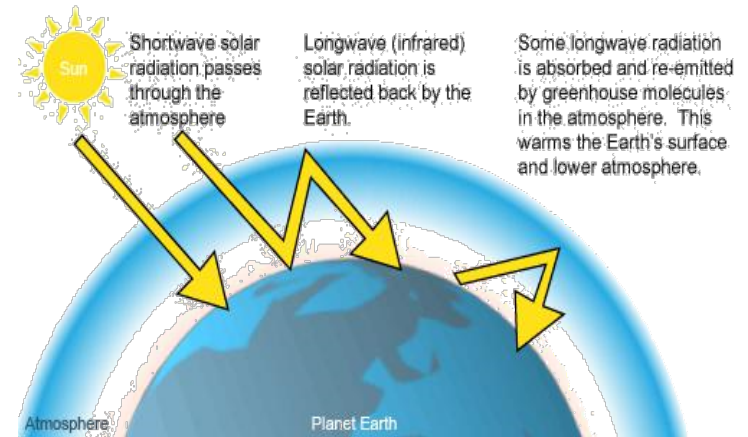
Greenhouse gases include:

Water (H<sub>2</sub>O)

Carbon dioxide (CO<sub>2</sub>)

Methane (CH<sub>4</sub>)

Without them, the Earth would be too cold to sustain life, but too much of them can cause Earth's atmosphere to heat up and lead to extreme weather.



## The Earth's early atmosphere

It is hard to say exactly how the atmosphere has developed because it has taken 4.6 billion years.

One theory suggests that the first **billion years** of the Earth's existence included **intense volcanic activity**. This released large amounts of **carbon dioxide**, and **nitrogen** and a little **methane** (CH<sub>4</sub>) and **ammonia** (NH<sub>3</sub>). It may also have released the **water vapour** that later formed the oceans. There was little or no oxygen.

This would make Earth's early atmosphere similar to **Venus** or **Mars** today.

Greenhouse gases like CO<sub>2</sub> allow **shortwave** radiation to easily pass through the atmosphere

They reach the ground, where they begin to **heat the Earth's surface**.

This transfers the radiation into longer wavelengths.

The CO<sub>2</sub> then absorbs some of the outgoing **longwave** radiation, causing the atmosphere to warm up, and the radiation not to escape.

Too much CO<sub>2</sub> means less longwave radiation escapes, causing global warming.

## Changes to the early atmosphere

As Earth cooled, water vapour **condensed** and formed **oceans**.

CO<sub>2</sub> dissolved in the oceans which formed **precipitates** (solids). Some of it was used by sea creatures to make shells, and these later formed **rocks** like **limestone**. **Fossil fuel** formation also trapped CO<sub>2</sub>.

2.7 billion years ago, **algae** began producing O<sub>2</sub> by **photosynthesis**, which also reduced the CO<sub>2</sub> in the atmosphere. **Plants** then evolved, followed by O<sub>2</sub> increasing so animals evolved.

### Photosynthesis



# Trilogy C13 - The Earth's Atmosphere Page 2

## Global Climate Change

An increase in average global temperature is a major cause of **climate change**. This may lead to:



Global weather patterns changing (leading to flooding in some areas and drought in others)



Extreme weather events (e.g. hurricanes)



Ice caps and glaciers melting



Sea-levels rising, causing flooding in coastal regions



Desertification

Reduced yields of crops

## Human Activities

CO<sub>2</sub> levels are increased by:

- Combustion of fossil fuels
- Deforestation

CH<sub>4</sub> levels are increased by:

- Farming cattle
- Growing rice
- Use of landfill

## Know your formulas



Carbon monoxide



Carbon dioxide



oxygen



nitrogen



ammonia



methane

## Atmospheric pollutants from fuels

Pollutant	Cause	Problem
Carbon dioxide (CO <sub>2</sub> )	Complete combustion (sufficient oxygen)	Global warming
Carbon monoxide (CO)	Incomplete combustion (insufficient oxygen)	Toxic gas. Colourless and odourless
Sulfur dioxide (SO <sub>2</sub> )	Oxidation of sulfur impurities in fossil fuels	Acid rain & respiratory problems (asthma)
Oxides of nitrogen (NO and NO <sub>2</sub> )	Oxidation of nitrogen in air at high temperatures in a vehicle engine	
Carbon particulates (unburnt hydrocarbons)	Burning diesel	Global dimming, health problems

**Carbon footprint** = the total amount of carbon dioxide and other greenhouse gases emitted over the full life cycle of a product, service or event. One small part of a life cycle assessment.

It includes:

- extracting raw materials
- production
- use
- disposal
- transport at any point in its life cycle

Carbon footprints can be reduced by reducing emission of CO<sub>2</sub> and CH<sub>4</sub> either:

- **Directly**, using green energy sources that don't emit CO<sub>2</sub> e.g. solar power and wind power, instead of burning fossil fuels.

OR

- **Indirectly**, e.g. by insulating a building so it requires less heating, using local materials and products that don't get transported as far.

This will then require less fossil fuels to be burned for electricity or transport.