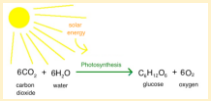
Early Atmosphere evolving

Volcanoes produced **Carbon dioxide, nitrogen (and a bit of methane and ammonia)**

↓ Oceans formed

From condensed water.
Carbon dioxide dissolved in the oceans.
Carbonates precipitated (turned into solid bits) **to form sediments.**

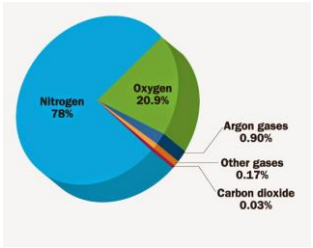
↓ Green plants and algae



Took in CO_2 and released O_2 in **photosynthesis**.

↓ Sedimentary rocks and fossil fuels were formed:

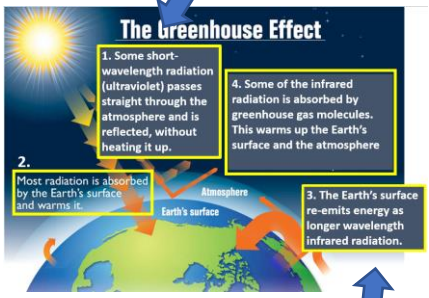
Decreased the CO_2 levels



Greenhouse Gases and Climate change

Carbon dioxide
Methane
Water Vapour

Short wavelength doesn't interact with the gases



Longer wavelength emitted does interact with the gases

Human activities increase the levels of CO_2 and CH_4

CO_2
- burning fossil fuels
- Deforestation

Methane
- Cows (and rice paddies)
- landfill

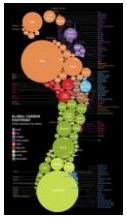
CC2

Effects of climate change:

- Rising sea levels
- Droughts
- Extreme weather events
- Changes in wildlife distribution

Why do some people deny humans cause climate change????

Difficult to model.
Models are simplified.
Media can be biased.
MUST check the evidence is PEER REVIEWED



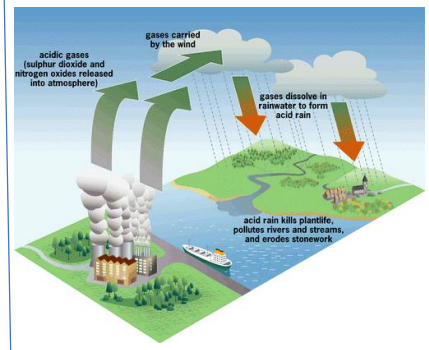
<u>Carbon footprint</u>
'Total amount of CO_2 and other greenhouse gases emitted over the full life cycle of a product, service or event'

Solution:
Reduce carbon footprint (emissions of CO_2 and methane)
- Use less fossil fuels
- Carbon capture and storage
- Eat less meat
- Send less food waste to landfill

Atmospheric Pollutants

Gases released in combustion of fossil fuels and their effects:

Gases	Released when	Effects caused
Carbon dioxide	All fossil fuels burn	Global warming
Water vapour	All fossil fuels burn	None
Carbon monoxide	Incomplete combustion of fuels (not enough O_2)	Poisonous gas
Solid particulates	Solid fuels burn incompletely	Global dimming Asthma
Sulphur dioxide	Coal burns (sulphur is an impurity in coal)	Acid rain Respiratory problems
Nitrous oxides	Nitrogen in air reacts with oxygen at high temperatures	Acid rain Respiratory problems

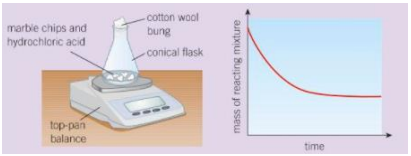


Measuring Rate

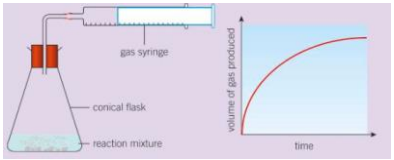
To measure the rate of a reaction you can:

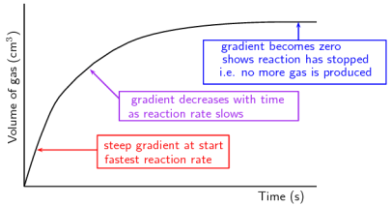
- **Measure how fast the reactants are used up**
- **Measure how fast the products are made**

e.g. Measure mass lost due to gas formed



e.g. Measure volume of gas made

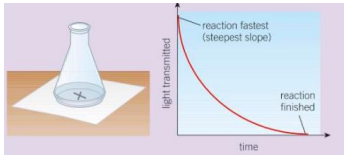




Rate = volume of gas ÷ time

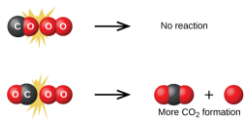
cm^3/s

e.g. Measure time for insoluble product to form



Collision theory

For a reaction to happen reactants must: **collide** with **enough energy** (activation energy)



A successful collision is one that leads to a reaction

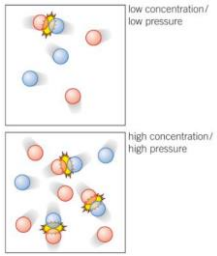
So to increase the rate of a reaction you must either

- **Increase the frequency of collisions**
- **Increase the energy of the collisions**
- **Decrease the energy needed for a collision to be successful**

Factors affecting rate

Concentration and Pressure

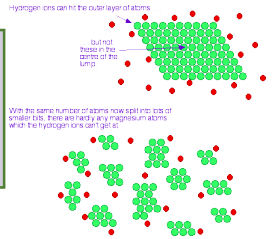
More particles in the same space. **More frequent collisions**



CC2

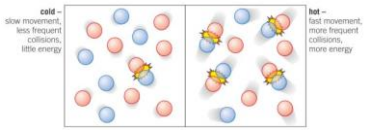
Surface area

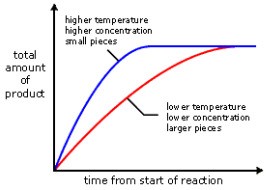
More particles available to react. **More frequent collisions**



Temperature

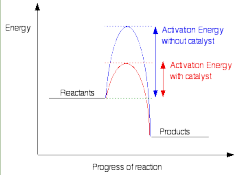
Particles **move faster**.
So they **collide more frequently**.
Particles collide **with more energy**.
So more of the collisions are **successful**.





Catalysts

Lower the energy needed for successful collisions. (Activation energy) **Not used up**. Biological catalysts are called **enzymes**

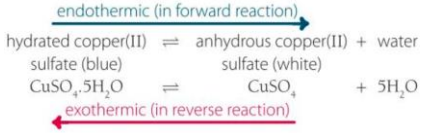


Reversible reactions

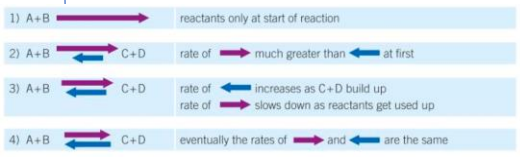
Can go in both directions.

$$A + B \rightleftharpoons C + D$$

If a reaction is exothermic in one direction it is endothermic in the other direction.



In a **closed system** (where nothing can get in or out) an **equilibrium** is reached where the **rate of reaction is the same in both directions**.



At equilibrium:

- Rate of forward reaction = rate of reverse reaction.
- Mount of products and reactants don't change.