Knowledge Organiser Year 9 Earth's Resources and Climate

Earth's Early Atmosphere

Created from **volcanic activity** 4.5 billion years ago, producing lots of **carbon dioxide and water vapour**, and eventually nitrogen. There was **no oxygen**.

How it Changed – Water vapour, H_2O, **condensed** and formed the oceans.

Carbon dioxide, CO_2, **dissolved in the oceans** and carbonate compounds got locked up in sedimentary rocks and fossil fuels.

Key Event - Green plants evolved, **producing oxygen**, O_2, and using up the CO_2 in **photosynthesis**.

$$6\ CO_2 + 6\ H_2O \rightarrow C_6H_{12}O_6 + 6\ O_2$$

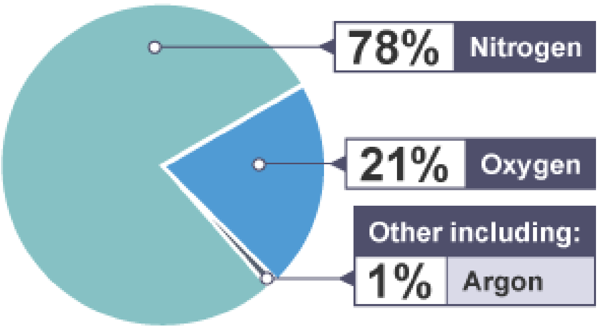
Remember that respiration is the reverse of this equation.

When animals evolved they used CO_2 dissolved in the oceans to form carbonate exoskeletons.

Eventually the CO_2 got locked up in **sedimentary rocks** like limestone and **fossil fuels** (coal, oil and gas) from plants and animals dying.

The newly formed oxygen eventually formed the ozone layer which protects us from harmul UV radiation.

Current atmosphere



Atmosphere has not changed much in the last few hundred million years.

% of carbon dioxide in our current atmosphere is very small (about 0.03 %) but has been steadily increasing over the last 200 years or so (as industry increased, burning more fossil fuels)

Air pollution from burning fossil fuels

Combustion of fuels will oxidise elements present in the fuel.

Complete combustion

Many fuels are **hydrocarbons** (compunds containing carbon and hydrogen only), so **complete combustion** will form **CO_2 and H_2O**

hydrocarbon + oxygen → carbon dioxide + water

Incomplete Combustion

Incomplete combustion (in a poor supply of oxygen) may also produce:

- **carbon monoxide**, CO (toxic)
- **carbon particles or soot** (causes breathing difficulties and global dimming or smog)

hydrocarbon + oxygen → carbon monoxide + water

hydrocarbon + oxygen → carbon (soot) + water

Fuels containing traces of sulfur will produce **sulfur dioxide**, SO_2 during combustion (causes breathing difficulties and **acid rain**)

sulfur + oxygen → sulfur dioxide

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Oxides of nitrogen such as **nitrogen monoxide**, NO, can be formed in car engines as the **high temperature** causes nitrogen and oxygen from the air to react. Oxides of nitrogen can also cause **acid rain**.

nitrogen + oxygen → nitrogen oxide

Many products from burning fossil fuels are **pollutants** - they harm habitats and their organisms.

Acid rain

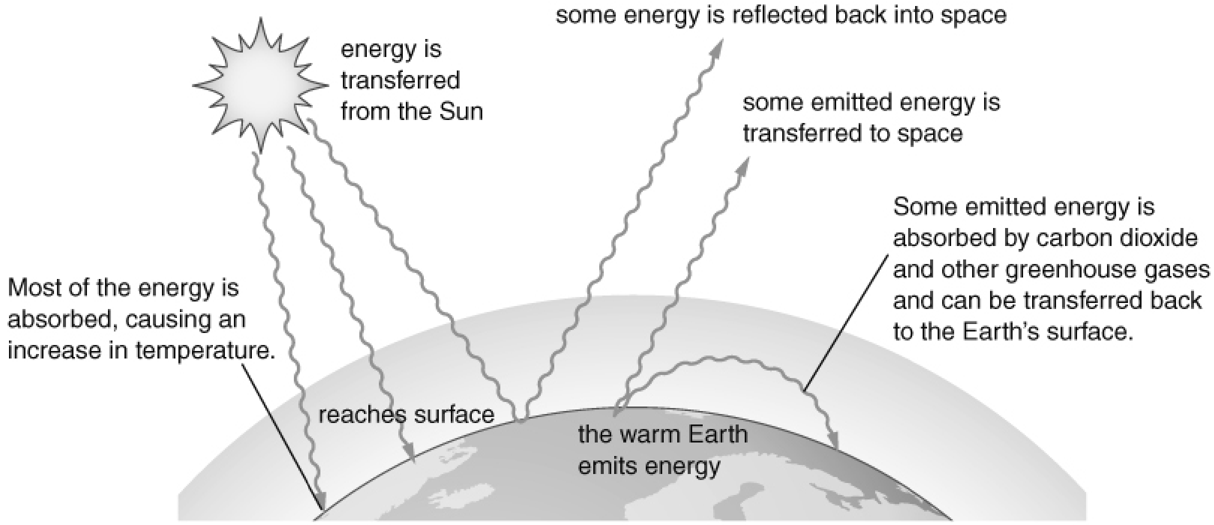
Acid rain is rain water that is made more acidic by dissolved **sulfur dioxide and nitrogen oxides**. (oxides of non-metal atoms are acidic).

Some of these gases are removed from power station chimneys by neutralisation, and by using **catalytic converters** on vehicle exhausts.

Catalytic converters also remove carbon monoxide (another pollutant).

Greenhouse Effect and Global Warming

Greenhouse gases in the Earth's atmosphere keep the Earth's surface warm. This is the **greenhouse effect**.



Carbon dioxide is a greenhouse gas. Carbon dioxide released from burning fossil fuels has increased the temperature of the Earth's surface (**global warming**).

Radiation changes to a **longer wavelength** as it reflects off the earth's surface, and this then interacts with greenhouse gases in the atmosphere.

Global warming, caused by build up of carbon dioxide, CO_2 and methane, CH_4 in the atmosphere, results in **climate change**.

CO_2 is increased by growing energy demands and combustion of fossil fuels, also deforestation.

CH_4 is increased by more animal farming, paddy (rice) fields and increased use of landfill sites.

Main effects of climate change - ice caps melting, rising sea levels and flooding, possible drought, crop failure and starvation in hot areas, more severe weather and storms, changes to fishing patterns and animal distribution.

Carbon footprint can be reduced by lowering emissions, but actions can be limited by lack of international co-operation and disagreement.

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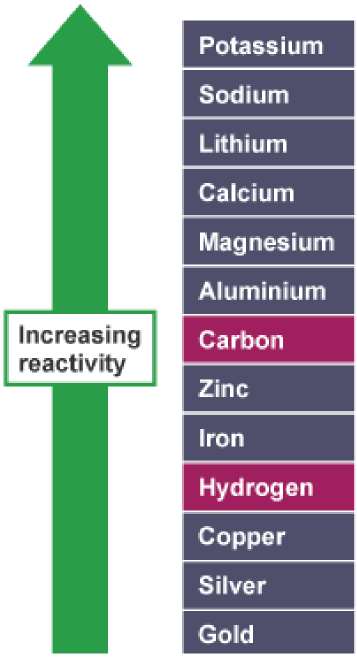
Extracting metals - The reactivity series



The most reactive metals are at the top. The non-metals hydrogen and carbon are often included in the reactivity series for reference.

A more reactive metal can **displace** a less reactive metal from a compound.

- Most metals occur as compounds in ores in the Earth's crust. Only a few, such as silver and gold, occur as the metallic element (found native).
- The metals high in the reactivity series are difficult to extract from their ores.
- The metals lower in the reactivity series are easier to extract from their ores.

Extraction of metals 1 – Heating with carbon

This method works when the **metal is less reactive than carbon**.

eg. iron oxide + carbon → iron + carbon dioxide

eg. zinc oxide + carbon → zinc + carbon dioxide

The carbon displaces the metal as the **carbon is more reactive**.

- Metals from zinc down in the reactivity series can be extracted by heating with carbon.
- Metals above zinc in the reactivity series need electrolysis to extract them from their ores.

Extraction of metals 2 – Electrolysis

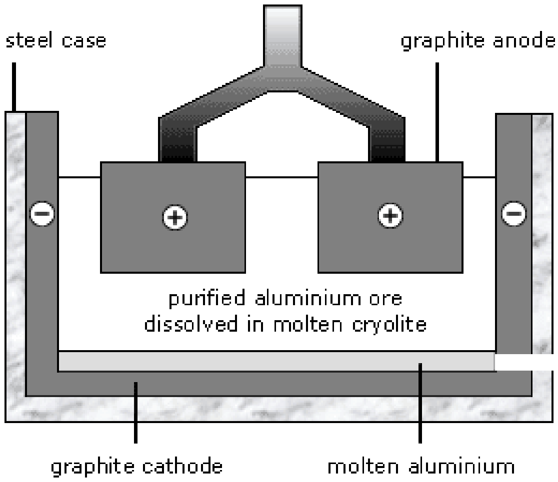
Involves using **electricity** to break the compound apart into elements.

Aluminium oxide is first **dissolved in molten cryolite** (to lower its melting point). This saves energy. The compound must be **molten** so that it will conduct electricity.

During electrolysis the aluminium attracts to the cathode forming **aluminium** metal, and **oxygen** gas forms at the positive anode.

The hot graphite (**carbon**) anode **reacts with the oxygen** to make **carbon dioxide**, so the **anodes burn away** and need replacing.

Electrolysis is expensive due to the high energy costs involved.



Redox Reactions

Redox reactions are where <u>**red**</u>uction and <u>**ox**</u>idation happen at the same time.

Oxidation is the gain of oxygen. **Reduction** is the loss of oxygen.

In the displacement reaction here, the iron oxide is **reduced** (has lost oxygen), and the aluminium is **oxidised** (has gained oxygen)

iron oxide + aluminium —> aluminium oxide + iron