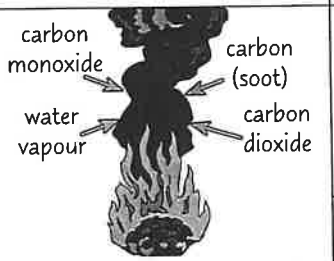
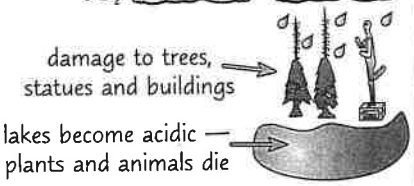
# Pollutants and Fuels

## Air Pollution

**Fossil fuels contain hydrocarbons and sometimes sulfur impurities.**

**Combustion of these fuels releases gases and particles which pollute the air.**

This can happen in appliances that are powered by fossil fuels.

| Pollutant | Formation | Effects |
|---|---|---|
| **Carbon monoxide** |   | **Stops blood from transporting enough oxygen around the body — this can cause fainting, coma or death.** |
| **Carbon (soot)** | **Incomplete combustion of hydrocarbons (occurs when there isn't enough oxygen for complete combustion).** | **Causes respiratory problems**<br>**Reduces air quality**<br>**Makes buildings look dirty** |
| **Sulfur dioxide** | **From sulfur impurities in fossil fuels that react during combustion.** | **Acid rain**<br>oxides mix with clouds to form acids<br>   |
| **Oxides of nitrogen** | **Reaction between nitrogen and oxygen in the air caused by the heat of burning fuels, e.g. in car engines.** |   |

## Hydrogen as a Fuel for Vehicles

| Advantages | Disadvantages |
|---|---|
| **Very clean — only waste product is water.** | **Need a special, expensive engine.** |
| **Obtained from a renewable resource (water), so won't run out.** | **Manufacturing hydrogen is expensive, and often uses energy from fossil fuels.** |
| **Can be obtained from the water produced by the cell when used in fuel cells.** | **Hard to store.** |

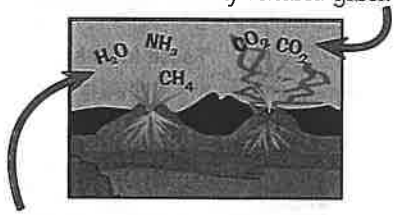




# The Atmosphere

## Volcanic Gases

Intense volcanic activity released gases.

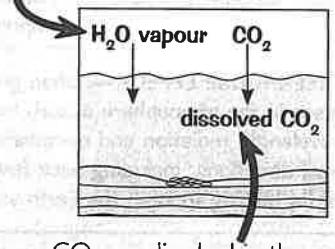



Early atmosphere probably contained mainly carbon dioxide with some water vapour and small amounts of other gases.

**The early atmosphere contained virtually no oxygen gas.**

## Absorption of Carbon Dioxide

Water vapour condensed to form oceans.




$CO_2$ gas dissolved in the oceans.

**This caused an overall decrease in atmospheric $CO_2$.**

## Increase in Oxygen

**When green plants evolved, they began to photosynthesise.**

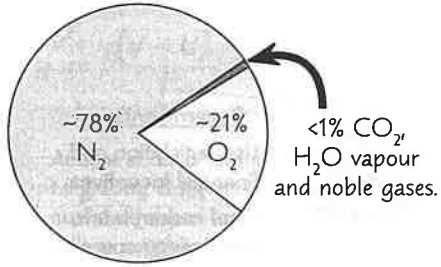

**Photosynthesis:**

**Removes carbon dioxide from the air.**

**Produces oxygen.**

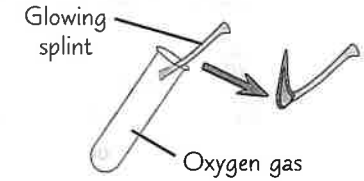
Over time, the amount of $O_2$ in the air gradually built up, and the amount of $CO_2$ decreased.

## Today's Atmosphere




## Test for Oxygen Gas

**Oxygen will relight a glowing splint.**



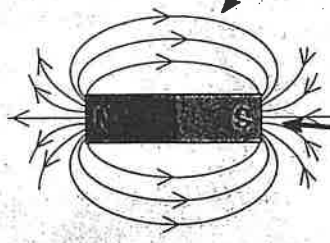
# Magnets

## Magnetic Fields

PERMANENT MAGNET — produces its own magnetic field.

Magnetic field is strongest at the poles.

Magnetic field strength decreases with distance from magnet.



MAGNETIC FIELD — region where other magnets or magnetic materials experience a force.

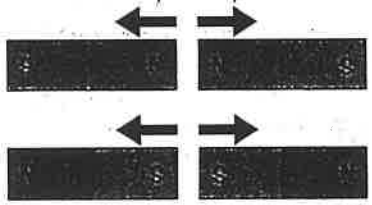
Field is stronger where field lines are closer together.

Field lines show direction force would act on a north pole, if placed at that point.

Forces between magnets are due to their magnetic fields interacting.

## Magnetic Repulsion

Like poles repel.



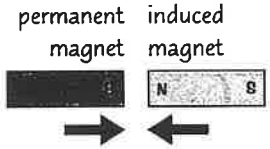
## Magnetic Attraction

Unlike poles attract.

Uniform magnetic field between unlike poles — field lines equally spaced (strength same everywhere) and in same direction.

## Induced Magnets and Magnetic Materials

INDUCED MAGNET — a magnetic material that only produces a magnetic field when it's in another magnetic field.




A permanent magnet and an induced magnet are always attracted to each other.

When the induced magnet is moved away from the permanent magnet, it quickly loses all (or most) of its magnetism.

Four magnetic materials:

1. iron
2. steel
3. nickel
4. cobalt

## Uses of Magnets

Fridge doors

Separating recycling

Maglev trains

Cranes



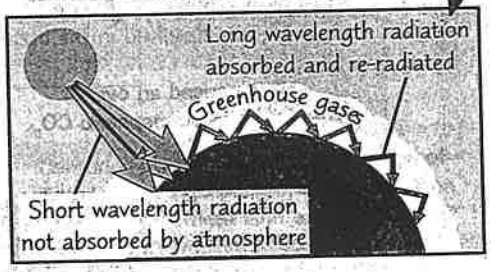



# Greenhouse Gases & Climate Change

## The Greenhouse Effect

| Greenhouse Gases | | |
|---|---|---|
| carbon dioxide | methane | water vapour |

GREENHOUSE EFFECT — when greenhouse gases in the atmosphere absorb long wavelength radiation and re-radiate it in all directions, including back towards Earth, helping to keep the Earth warm.




## Human Activities

Increased population means more greenhouse gases, because more:

Fossil fuels burnt for energy — more $CO_2$ released.

Deforestation — less $CO_2$ removed by photosynthesis.

Farming — more methane produced.

There's strong correlation between increased levels of greenhouse gases and global warming.

Global warming is a type of climate change that can cause other types of climate change.

## Climate Change Consequences

Two possible consequences of climate change:

1. Flooding due to the melting of the polar ice caps causing sea levels to rise.
2. Changing rainfall patterns.

## Historical Climate Data

- Less accurate and less representative of global levels than modern data.
- Hard to estimate precisely.

## Ways of Reducing $CO_2$ Emissions

Individuals

- Walk/cycle instead of driving.
- Turn down central heating.

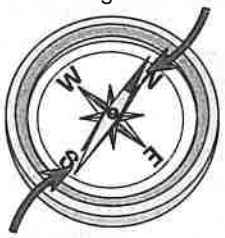
Governments

- Use legislation and financial incentives.
- Fund research into new energy sources.

# Compasses and the Motor Effect

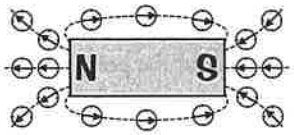
## Compasses

Compass needle points in the direction of the magnetic field it's in.



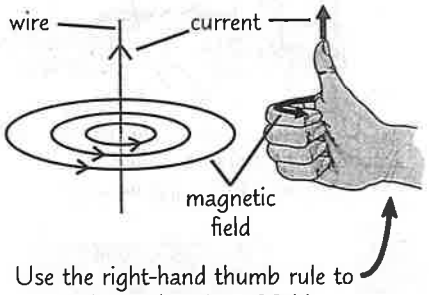

A compass needle is a small bar magnet.

**Place a compass at different positions in a magnetic field to show its shape and direction.**




**When a compass isn't near a magnet, its needle points north. This is because Earth produces its own magnetic field (Earth's core is magnetic).**

## Current-Carrying Conductor



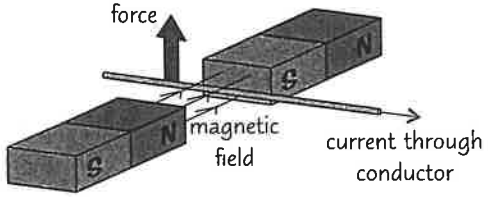

Use the right-hand thumb rule to work out direction of field.

**Two factors the magnetic field strength depends on:**

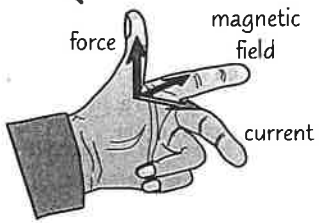
1. **Size of current. Larger current, stronger field.**
2. **Distance from the conductor. Closer = stronger field.**

## Force on a Conductor

**MOTOR EFFECT — when a magnet and a current-carrying conductor exert an equal and opposite force on each other.**




Fleming's left-hand rule.







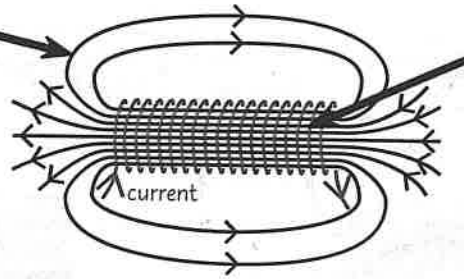

# Solenoids and Induced P.d.

## Solenoids

**SOLENOID — a long cylindrical coil of wire.**

A solenoid is an example of an electromagnet.

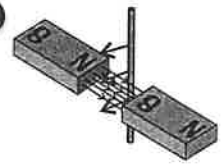
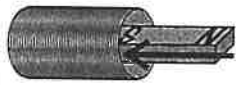
Outside solenoid, magnetic fields cancel to form weaker field, which is same shape as a bar magnet's field.




Inside solenoid, magnetic fields of each turn of wire add together to form strong and almost uniform field.

## Electromagnetic Induction

**ELECTROMAGNETIC INDUCTION — the induction of a p.d. (and current if there's a complete circuit) in a wire which is experiencing a change in magnetic field.**

| Two ways to induce a potential difference... | 1  Move the wire. | 2  Move the magnet. |
|---|---|---|
| To swap the direction of the potential difference... | **Move the wire in the opposite direction. or Start with both magnets the other way round.** | **Move the magnet in the opposite direction. or Start with the magnet the other way round.** |
| To increase the size of the induced potential difference... | **Increase the speed of the movement. or Increase the magnetic field strength.** For a coil, can also increase turns per unit length. | |

**An induced current generates its own magnetic field. This magnetic field always acts against the change that made it.**