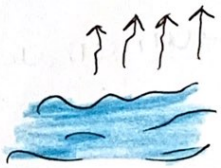
4.4 CLIMATE CHANGE

GREEN HOUSE GASES

- The earth is kept much warmer that it otherwise would be by gases that retain heat.
- These greenhouse gases absorb and emit long-wave infrared radiation. This allows them to trap the heat within the atmosphere.

- Have the largest warming effect on earth - CO_2 and water vapour.

- CO_2 - cell respiration, burning of fossil fuels
  removed via - photosynthesis & absorption by the oceans.
- Water vapour - evaporation of water bodies and transpiration.
  removed via - precipitation



OTHER GREENHOUSE GASES -

- Methane - emitted from waterlogged habitats & landfills, gaseous waste product by ruminants.
- Nitrous oxide - released by certain bacteria, emitted in exhausts by certain vehicles.

O_2 & N_2 aren't greenhouse gases as they don't absorb long er-wave radiation.

Factors that determine the impact of greenhouse gas on heating/warming the atmosphere:

1. Ability to absorb long wave radiation.

• ↑ capacity to absorb long-wave radiation ↑ warming effect.

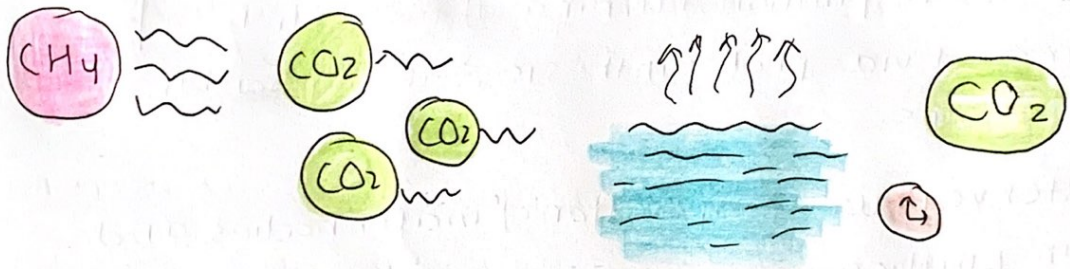
2. concentration within the atmosphere:

• ↑ concentration ↑ warming

◦ concentration is determined by - its rate of release and persistence within the atmosphere.

→ Methane has more capacity to absorb long-wave radiation than CO_2 but is less abundant.

→ water vapours enter the atmosphere fast but remain for less time whereas CO_2 stays longer.



• Human activity ↑ greenhouse effect.

GREEN HOUSE EFFECT -

◦ It is a natural process where atmosphere behaves like a greenhouse to trap and retain heat.

◦ Helps maintain moderate temperatures on earth for the survival of life.

Working:-

↘ The surface of the earth absorbs short wave radiation emitted by the sun.

↘ It re-emits this at a longer wavelength

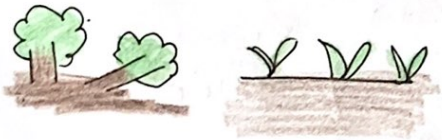
↘ The gases absorb at re-radiate the longer wave radiation which allows it to retain heat.

GLOBAL TEMPERATURES AND CO_2 CONCENTRATIONS

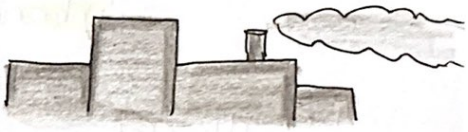
CO_2 concentrations increase because of:

→ deforestation: removal of trees means that less CO_2 is removed from the atmosphere via photosynthesis.

→ increased farming/ agriculture: land clearing for cattles and gaseous waste (methane) from the ruminant cattle.



CO_2 is the greenhouse gas that is increasing most rapidly because of combustion.



→ burning of fossil fuels

→ increased reliance on fuels during industrial revolution. (38% increase in CO_2 levels)

→ there is a correlation between carbon dioxide concentrations & the global temperatures.

→ more concentration, warmer earth.

→ long term weather patterns (climate) may also be effected by greenhouse gases.

Enhanced greenhouse effect results in:

- extreme weather conditions (cyclones, heat waves)
- some areas to become more drought affected, while others have heavy rainfalls.
- changes to circulating ocean currents.

OCEAN ACIDIFICATION

↳ Oceans absorb roughly a third of all human produced CO_2 emissions.

↳ CO_2 only dissolves when the temperatures are cooler, so less CO_2 will be absorbed when the temperatures rise.

100°C  35°C

Modification of CO_2 in the ocean.

$CO_2 + H_2O \rightarrow H_2CO_3$ (carbonic acid) → Bicarbonate (HCO_3^-)

↓ Ca^{2+} ↑ H^+

($CaCO_3$) ↓ Calcium Carbonate ← Carbonate (CO_3^{2-}) → HCO_3^-

- carbon dioxide and water make carbonic acid which dissociates into hydrogen ions and hydrogen carbonate.
- H^+ ions will lower the pH and will combine with carbonate ions to form more hydrogen carbonate.
- ↓ carbonate ions ↓ calcium carbonate

∴ ↑ concentration of CO_2 threatens the viability of coral reefs & molluscs.

Consequences of Ocean Acidification

- disappearance of coral reefs
- loss in revenue from tourism
- growth of invasive species of algae