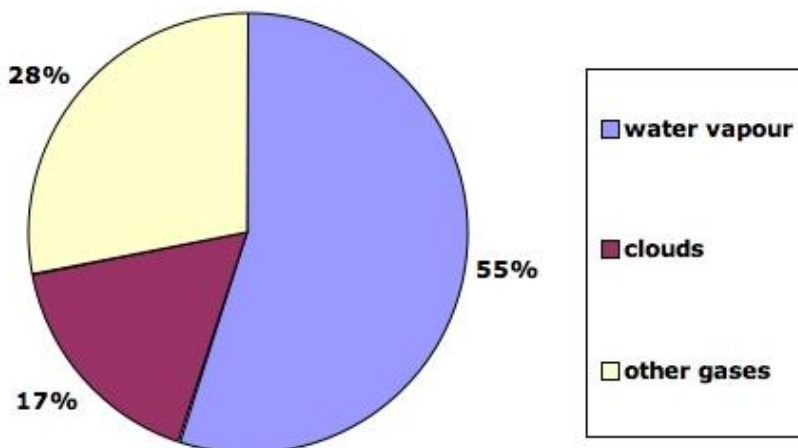


Understandings:

1. State that carbon dioxide and water vapour are the most contributing greenhouse gases.

- Earth is kept warmer than what it would have been by gases in air. What they do is that they serve like the glass of a greenhouse, hence the name greenhouse gases.

This is the proportion of contribution.



As we can see, water contributes to most of our warm climate due to the high heat capacity.

The next best greenhouse gas is carbon dioxide although it is not shown in the diagram.

Just to review, water ends up in the atmosphere by transpiration of plants, respiration of animals, and natural evaporations in the oceans.

2. State that other gases have less impact.

- The next most contributing gases in the atmosphere are nitrous oxide (N₂O) and methane. They do not do as much as water and carbon dioxide, but they still show significant effects.

Methane is formed by methanogenesis (review if forgotten), extraction of fossil fuels and probably other processes.

Nitrous oxide is formed naturally by bacteria.

Since the two most common gases nitrogen and oxygen are not greenhouse gases, only 1% of gases in atmosphere are greenhouse gases.

Be aware that water, methane, carbon dioxide and also oxides of nitrogen are greenhouse gases!

3. Explain that the impact/contribution depends on its ability to absorb long wave radiation and its concentration in atmosphere.

- So how did we draw the conclusion that water and carbon dioxide were the two most significant greenhouse gases? Simply, by considering two things:

1. The molecule's ability to absorb long-wave radiation (which is heat).

2. The overall concentration of the molecule.

Methane has got a better ability to absorb long-wave radiation than carbon dioxide, but much lower concentration. Hence overall, carbon dioxide contributes much more.

4. State that heat is a long wave radiation.

&

5. Explain how the longer wave radiations are reabsorbed by greenhouse gases.

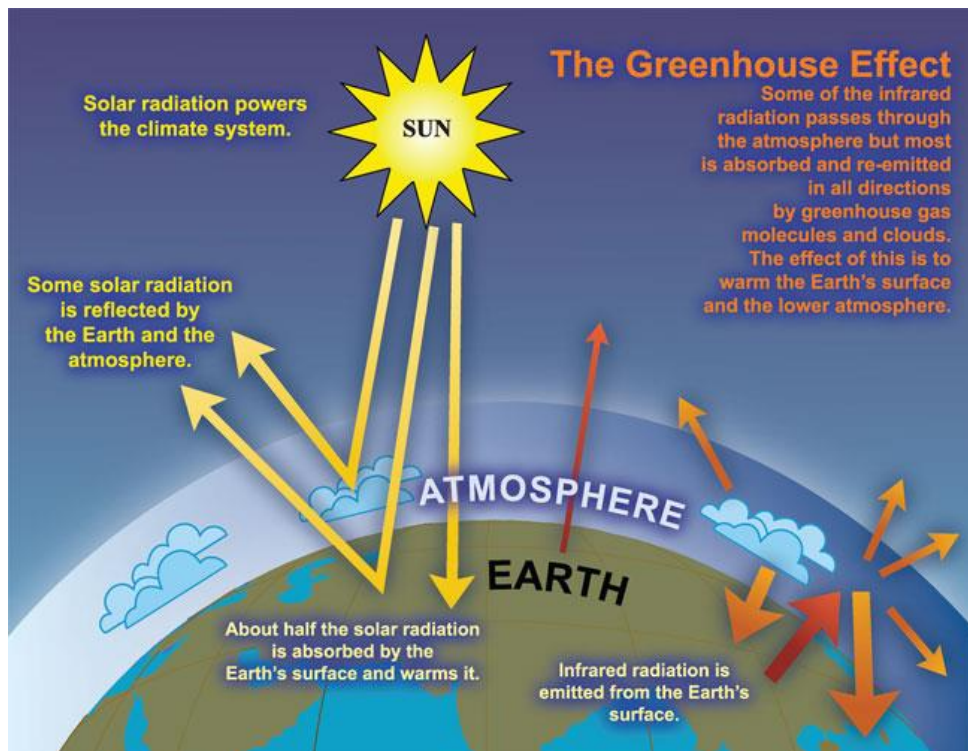
- So how does this greenhouse effect happen in real life?

Every physical object has ability to absorb and emit.

Sun emits white light and our ozone and the atmosphere have the ability to absorb the dangerous short-wave lights, particularly UV.

The lights reach us; we absorb both short and long-wave light and emit it as infrared/heat.

Then 80% of infrared/heat gets reflected back by the greenhouse gases and hence makes our planet warm and cosy.



6. State that there is a correlation between global temperature and concentration of carbon dioxide.

- Assuming we do not know that the greenhouse gases actually have an effect on the temperature, we can hypothesise that a change in concentration of one of the possible greenhouse gases will have an impact on the temperature.

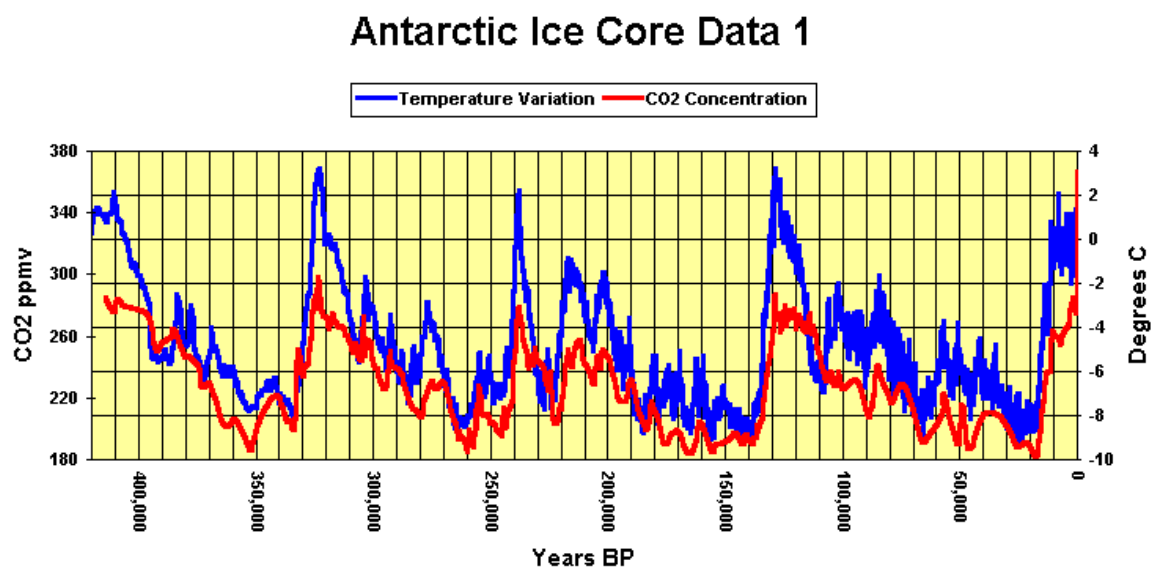
Indeed, this is exactly what scientists have done with carbon dioxide. They have recorded the bubbles of air trapped in long columns of ice in Antarctic.

Two things can be determined:

1. The concentration of carbon dioxide (micromole/mole)
2. The ratio of hydrogen isotopes in water molecules to determine the temperature.

Apparently there is a way to measure it.

Look what we get.



Striking correlation!

However, be aware that correlation does not mean causation. Of course, we know that carbon dioxide is indeed a greenhouse gas through other research.

7. Explain that global temperature is highly affected by concentrations of greenhouse gases. However, it is not the only determinant.

- Concentrations of greenhouse gases do indeed impact the global temperature. However, it is neither the only cause nor directly proportional to the global temperature.

Other things such as Sun's activity, Earth's orbit, amount of cloud, natural disasters etc. will have effects of climate as well.

In addition, just because it says global temperature, it does not mean that all places in Earth get equally warmed up. In fact, some places might be colder. This is because the gulfs might change, rain periods shifting, more thunderstorms and faster wind speeds.

8. State that there is a correlation between the rising concentrations of carbon dioxide since the industrial revolution 1800s.

- Although there were ups and downs in the past as well (refer back to the Antarctic core data), the concentration of carbon dioxide never exceeded above 300ppm (parts per million/permillion).

Ever since late 1800s, some decades after the industrial revolution, the concentration of carbon dioxide is rising significantly, and exceeded 300ppm.

Applications and skills:

1. Explain why coral reefs are threatened due to increasing concentrations of dissolved carbon dioxide.

- Coral reefs cannot live under too acidic areas.

2. State that there is a correlation between global temperature and carbon dioxide concentration on Earth.

- Yes indeed. Many researches have shown that this is true.

3. Evaluate and discuss the claims that human activities are not causing climate change.

- When these claims are made, 9/10 cases, they have made the assumption that ONLY carbon dioxide is causing the global warming. Be careful what you read and think of the possible assumptions the writer has made.

TOK:

1. Explain what precautionary principle is, and discuss it.

- Precautionary principle is basically the agreement that whenever humanity is endangered, such as this global warming issue, the action to protect people must precede the uncertainties of data and statistics.

More specifically, in principle 15 of the 1992 Rio Declaration on the Environment and Development stated the principle in this way:

“Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation”