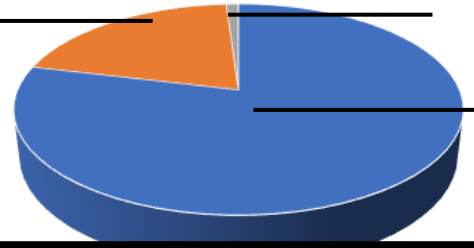
Chemistry 9: Chemistry of the Atmosphere

1. The present atmosphere



Air also contains **0.04% carbon dioxide** and **variable amounts of water vapour**

2. The formation of the Atmosphere

Early Atmosphere

Atmosphere is **mainly carbon dioxide** with **no oxygen**.

4.6 – 3.6 Billion Years Ago

Volcanoes erupted releasing carbon dioxide, water vapour, methane, and ammonia. The **water vapour condensed** and formed the oceans. Some **carbon dioxide dissolved in the oceans**. **Carbon dioxide** is also **locked in fossil fuels and sedimentary rocks**.

2.7-1.7 Billion Years Ago

Photosynthetic bacteria and plants evolve and **release oxygen through photosynthesis**. They take in more carbon dioxide.

Ammonia (CH_4) and methane(NH_3) reacted with rising levels of **oxygen** in the atmosphere, forming **water** and either **carbon dioxide** or **nitrogen.**

$$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$$

$$4NH_3 + 3O_2 \rightarrow 2N_2 + 6H_2O$$

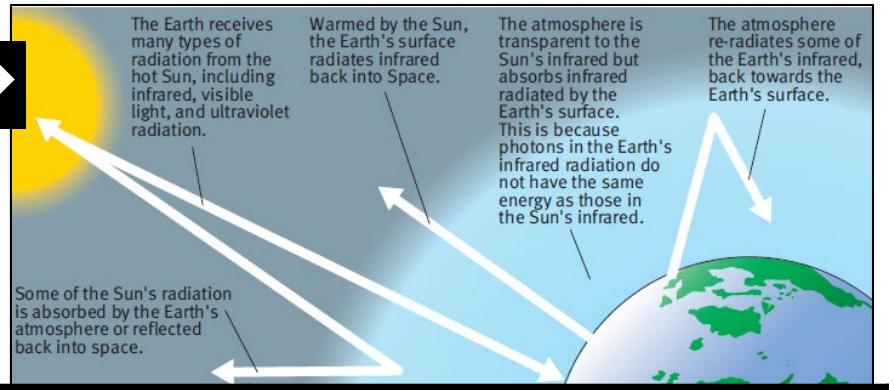
3. The reduction of CO_2 by formation of deposits

Coal	**Plants absorbed CO_2**. They **died and decayed**. This layer of decaying plants was **compressed to form coal**.
Oil and natural gas	**Plankton absorbed CO_2**. Plankton died and were **deposited in muds on the sea floor**. They were covered over and **compressed over millions of years.**
Limestone	**Shelled animals absorbed CO_2** to make their **calcium carbonate shells**. The remains of these animals were **compressed to form limestone**.

4. The greenhouse Effect and Global Warming (key terms)

Greenhouse effect	The process by which the **temperature** on **Earth** is kept **high enough to support life** by greenhouse gases absorbing radiation radiated by the Earth.
Greenhouse gas	Greenhouse gases keep temperatures on Earth high enough to support life. **Water vapour, methane** and **carbon dioxide** are greenhouse gases.
Short wavelength radiation	The **radiation from the Sun**. Is able to **pass through the Earth's atmosphere** and **warm the surface** of the Earth **without being absorbed** by greenhouse gases.
Long wavelength radiation	The **radiation from the Earth's surface (infrared radiiation)**. Some is **absorbed** by greenhouse gases and **doesn't escape the atmosphere**.
Carbon footprint	The **total amount** of **carbon dioxide** and other **greenhouse gases** emitted over the **full life cycle** of a product or event.
Global warming	The **increase** of the **average temperature** of the **Earth**.

5. Describing the greenhouse Effect



6. Human impact on the atmosphere

How humans increase atmospheric CO_2	How humans increase atmospheric methane
Combustion of **fossil fuels**	Increased **animal farming,** in particular cattle
Deforestation	Decomposition of **rubbish in landfill**

How humans can decrease CO_2 concentration	How humans can decrease methane concentration
Use **alternative forms of energy** e.g. wind turbines, thus reducing C02 released from combustion of fossil fuels	Increased **recycling so less methane** is released during decomposition of landfill waste
Energy efficiency e.g. more efficient cars	
Carbon capture – capturing CO_2 from power stations and trapping it so less is released.	**Alternative foods – non-animal based – so less methane is released.**
Carbon off-setting – planting **more trees** to take in the CO_2 released from an activity.	
Reduce levels of deforestation/plant more trees so more CO_2 is taken in.	

7. The effects of global warming

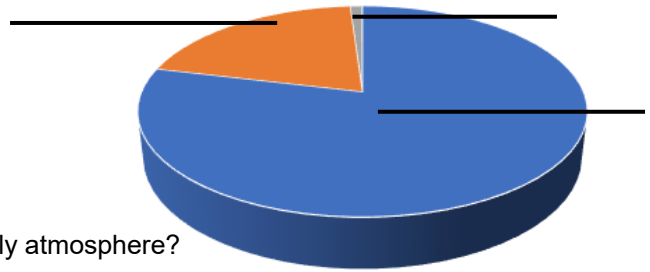
Some regions will **not** be able to produce **enough food** because of **drought**.
Changes to distribution of plant and animal species and migration patterns.
Increase in sea levels because of melting of polar ice caps.
Reduction of water supplies in some regions.

8. Common Pollutants

Pollutant	Formula	Cause	Effect
Carbon monoxide	CO	**Incomplete combustion** of a **hydrocarbon** fuel.	**Toxic** gas which reduce the red blood cells capacity to carry oxygen. Can lead to death. Colourless and odourless so hard to detect.
Sulfur dioxide	SO_2	**Burning coal or petrol**. Both contain sulfur that reacts with oxygen	Cause **respiratory problems** (e.g. for those with asthma). Combine with water vapour to cause **acid rain**.
Nitrogen oxides	NO_x	In **car engines**. **N_2** and **O_2 from air** react at **high temperatures**.	
Particulates	CnHn	**Incomplete combustion** of a hydrocarbon fuel.	**Global dimming** (reduction in sunlight reaching Earth) leading to a possible fall in temperature.

Self quizzing support (model of questions you could ask yourself)

1. Label the % gases in the Earth's current atmosphere



2. What was the main gas found in the early atmosphere?

3. Which gas was absent from the early atmosphere? Why?

4. What gases were released by volcanic eruptions between 4.6 – 3.6 Billion Years Ago?

5. How did the levels of steam fall?

6. How did the levels of carbon dioxide fall?

7. Describe and explain what happened to the atmosphere when plants/photosynthetic bacteria evolve on Earth (longer answer).

8. Describe what happened to ammonia and methane in the Earths atmosphere (longer answer).

9. Give a symbol equation of one of these reactions.

10. Describe how atmospheric CO_2 became locked inside (longer answer)

a) Coal

b) Oil and natural gas

c) Limestone

11. Define the following key terms

Greenhouse effect

Global warming

Carbon footprint

12. Describe the role of CO_2 and methane in the greenhouse effect (longer answer).

13. Give two ways that CO_2 levels are being increased by human activity.

14. Give two ways that methane levels are being increased by humans activity.

15. Describe two ways that CO_2 levels can be reduced.

16. Describe one way that methane levels can be reduced (longer answer).

17. Describe two effects of global warming (longer answer).

18. Complete the table about other atmospheric pollutants and their effects.

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Nitrogen oxides			
Particulates	CnHn		