

**Science: Chemistry of the Atmosphere**

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| 1. Composition of the atmosphere | | | |
| Modern atmosphere  (Today) | | Early Atmosphere  (4 billion years ago) | |
| 78% | Nitrogen | 95% | Carbon dioxide |
| 21% | Oxygen | 4% | Water vapour |
| 0.04% | Carbon dioxide | 1% | Trace amounts of CO2, CH4 and ammonia (NH3) |
| 0.96% | Trace amounts of Ar, He, CH4, NH3, water vapour and other gases |

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| 1. Why carbon dioxide levels decreased | |
| Dissolved in oceans | As water vapour cooled and condensed the carbon dioxide in the air dissolved in the water becoming trapped in the ocean |
| Photosynthesis | Approximately 2.7 billion years ago algae formed and absorbed carbon dioxide from the atmosphere to produce glucose, plants evolved over the next billion years  **Carbon + water 🡪 Glucose + oxygen**  **dioxide**  **6CO2 + 6H2O 🡪 C6H12O6 + 6O2** |
| Trapped in sediments | Plants and animals died and became covered in mud that formed the layers in sedimentary rocks or became fossil fuels. This trapped the carbon dioxide from early life in the rocks |

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| 1. How the Earth and Atmosphere changed | |
| Formation of oceans | As the Earth cooled the water vapour released from volcanic eruptions condensed and fell as rain. This pooled in valleys and crevices and formed the oceans |
| Increase in oxygen | As plants and algae began photosynthesising they released oxygen into the air. |
| Increase in nitrogen | The oxygen in the air reacted with ammonia to form nitrogen and water. |

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| 1. Greenhouse Effect | | |
| The greenhouse effect is an essential process that maintains the warm temperatures on Earth. | | |
| 1 | Radiation from the sun | The sun emits waves of energy with different wave lengths. These can travel through space to the Earth |
| 2 | Refection of shortwave radiation | Short wavelength radiation such as x-ray and some UV is reflected back into space as it cannot pass through the atmosphere |
| 3 | Reflection of light from the Earth’s surface | Visible light, UV radiation and other short wavelength radiation is reflected off the Earth’s surface and passes through the atmosphere back into space |
| 4 | Trapping infra-red radiation | Radiation from the sun that is absorbed by the Earth is then radiated as a longer wavelength infra-red radiation back towards the atmosphere. This is then reflected it back to the Earth. |
| 1  4  3  2 | | |



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| 1. Human Activities that increase the levels of greenhouse gases | | | |
| **Greenhouse gases** | | | |
| **Carbon dioxide** | | **Water vapour** | **Methane** |
| **What** | **How** | | **Why** |
| Deforestation | Large areas of forest are cut down to make way for farm land, houses, building materials and other resources | | This reduces the amount of carbon dioxide absorbed by plants. |
| Burning fossil fuels | Fossil fuels are burned to generate electricity and power transport such as cards, trains and planes | | When the fuels are burned they release carbon dioxide into the air |
| Farming of cattle | An increased demand for beef and milk has led to an increase in the number of cows being farmed | | Cows release methane during the digestion of plant based foods. More cows, means more methane |
| Farming of rice | Increasing amounts of rice are being grown to feed the growing population | | Rice paddies, release methane as the plants grow |
| An increase in greenhouse gases can amplify the effects of the Greenhouse Effect, increasing the amount of IR radiation trapped in the Earth’s atmosphere. This increases the average temperature of the Earth. | | | |

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| Challenge Questions | |
| 1 | How could a person reduce their carbon footprint? |
| 2 | How do new theories about the evolution of the atmosphere and climate change become accepted? |
| 3 | Explain how global dimming could increase the effects of global warming. |
| 4 | Evaluate why it is difficult to reduce the global carbon footprint. |

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| 1. Climate change | | | | |
| Global warming | The gradual increase of average global temperatures due to an increase in greenhouse gases. | | | |
| Global dimming | A decrease in the levels of light reaching the Earth’s surface due to an increase in particulates in the atmosphere. | | | |
| Carbon footprint | The total amount of carbon dioxide released over the lifetime of a process, product or event. | | | |
| Acid rain | Acidic gases dissolved in rain water that can causes damage to buildings, statues, lakes and trees. | | | |
| **Consequences of Climate Change** | | | | |
| Flooding, rising sea levels and melting polar ice caps | | More frequent and intense storms | Drought and difficulty producing foods with changing weather patterns | Changes in distribution of species when habitats change or extinction |

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| 1. Human Activities that increase the levels of greenhouse gases | | |
| **Pollutant** | **Source** | **Effect** |
| Carbon dioxide | All combustion | Global warming |
| Carbon monoxide | Incomplete combustion | Toxic, breathing problems |
| Soot (particulate) | Incomplete combustion | Global dimming |
| Sulphur dioxide | Burning sulphur impurities in fossil fuels | Acid rain |
| Oxides of nitrogen | Vehicle engines | Acid rain |