Topic: Earth and Atmosphere

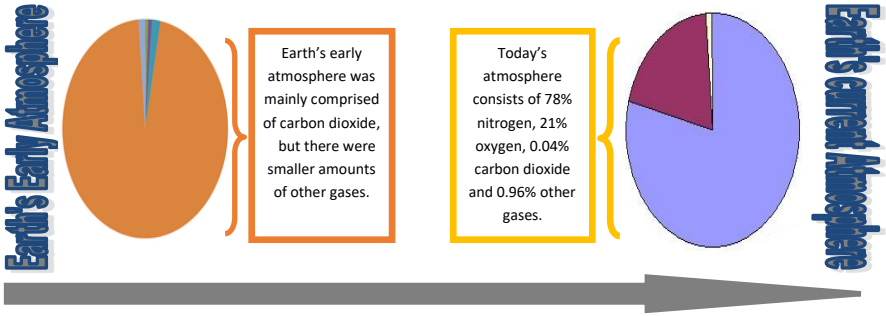
Duration: 3 lessons

Composite:

Key vocabulary:

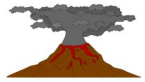
Earth
Volcanic
Gaseous
Eruptions
Inhospitable
Atmosphere
Stabilised
Vapour
Condensing
Absorb
Evolved
Algae
Photosynthesis
Decomposition
Nominal
Insoluble
Concentration
Radiates
Emitted
Respiration
Combustion
Sparse

Core knowledge:

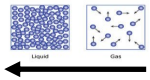


Earth's early atmosphere was mainly comprised of carbon dioxide, but there were smaller amounts of other gases.

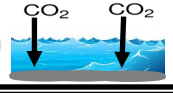
Today's atmosphere consists of 78% nitrogen, 21% oxygen, 0.04% carbon dioxide and 0.96% other gases.

1 

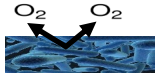
Volcanic eruptions release gasses that formed the Earth's early atmosphere. This is thought to have been mainly comprised of CO_2, water vapour and small traces of other gases. However, there is little or no oxygen present.

2 

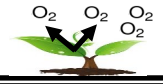
As the Earth cooled the water vapour released by volcanic eruptions cooled down and condensed. Rain fell forming the Earth's first oceans.

3 

Carbon dioxide dissolved in the oceans. This reacted making insoluble carbonate compounds. These fell to the sea bed forming carbonated rocks (calcium carbonate $CaCO_3$).

4 

Photosynthetic bacteria evolved. These gave out oxygen as a waste product of photosynthesis, increasing the concentration of oxygen in the atmosphere.

5 

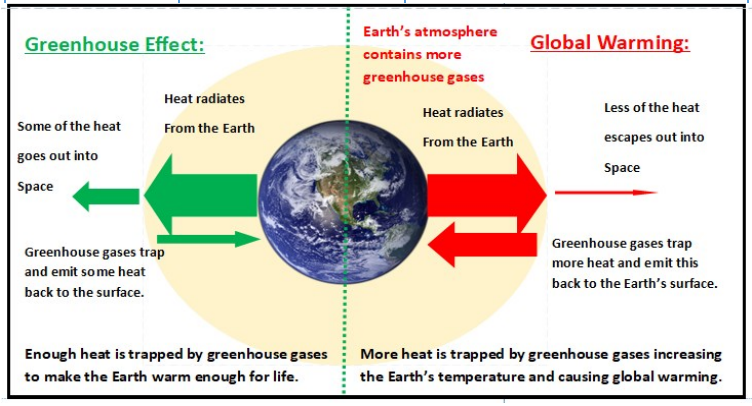
Oxygen concentration reached ~10% of modern day levels. Then primitive plants started to appear which produced more oxygen through photosynthesis.

6 

Oxygen concentration stabilises, making up 21% of the gases in the Earth's atmosphere a percentage which remains at this level today).

Respiration	glucose + oxygen → carbon dioxide + water	$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$
Photosynthesis	carbon dioxide + water → glucose + oxygen	$6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$
Combustion	hydrocarbon + oxygen → carbon dioxide + water	$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$

Gas	Has the gas concentration increased or decreased over time?	What caused this?
Carbon dioxide	Decreased	CO_2 was absorbed in the oceans and also removed by photosynthesis (plants)
Oxygen	Increased	A by-product of photosynthesis carried out by primitive plants and algae
Water vapour	Decreased	As the Earth cooled water vapour in the early atmosphere condensed forming the oceans



Powerful knowledge:

1) Recall that the gases produced by volcanic eruptions formed the Earth's early atmosphere.

2) Describe that Earth's early atmosphere was thought to consist of mainly CO_2, some water vapor and other gases.

3) Describe the composition of today's current atmosphere as 21% - O_2, 78% - N_2, 0.04% - CO_2 and 0.96% - other gases.

4) Recall the cooling of Earth led to water vapour in the early atmosphere being condensed and falling as rain over millions of years. This formed the first oceans.

5) Explain that CO_2 concentration in the early atmosphere was reduced as it was dissolved in the newly formed oceans and taken up by primitive plants and algae performing photosynthesis.

6) Describe that various gases in the atmosphere (CO_2, CH_4 and H_2O), absorb heat radiated from the Earth, subsequently releasing energy which keeps the Earth warm (the greenhouse effect).

7) Increasing the concertation of greenhouse gases (CO_2, CH_4 and H_2O) is meaning more energy is absorbed and emitted back to Earth by these gases causing global warming.

Links to previous and future topics

Links to prior learning in KS3:

Most pupils will have had some experience of topics such as:

Combustion, Photosynthesis, Carbon cycle, Particle model, Renewable energy, Non-renewable energy

Links to future Learning at KS4:

Links to this content can be found in Chemistry, Biology and Physics at KS4:

Ecosystems and material cycles

Calculating angles of pie chart

States of matter

Fuels and Earth Science

Plant structures and functions

Light and the electromagnetic spectrum

Impressive reading

For a homework you will be presented a selection of written materials linked to climate change. You will need to summarise the key points and evidence from both articles. In the following lesson you will then discuss your findings with your peers and express your opinion on the topic broached by the articles supplied.

Impressive speaking

The opinion of many World leaders appears to be very different when it comes to the subject of global warming. In your team you will plan and execute a debate that supports or disagrees with a given statement linked to current global affairs.

Impressive writing

Donald Trump has made it very clear that he believes that global warming is 'fake news'. You will write a letter to Mr Trump either supporting or disagreeing with his statement. You need to justify any statements you make with evidence and clearly explain the Science!

Resilience

There is a lot of new content in this unit. Revisiting new material for just 15-minutes following a lesson will really help firm up and secure your knowledge. This will help you apply your core knowledge to answer exam questions and interpret graphed data in exam styled questions.

Employability

Develop skills to work as part of a team and practice communicating, expressing and sharing ideas.

Debate will allow you to present your ideas and take on-board the ideas of others when making an informed decision or forming an opinion.

Occupations linked to this topic: G7, Environmental Engineer, Environmental Lawyer, Nature Conservation Officer, Marine Biologist, Recycling Officer, Waste Management Officer, Water Quality Sciences and many more!

KS4 Chemistry: Fuels

Composite topic test

Keywords:

Hydrocarbon
Ignition
Combustion
Alkane
Alkene
Unsaturated
Saturated
Viscosity
Volatility
Cracking
Fractions
Fractional
Distillation
Vaporised
Catalyst
Finite
Renewable
Non-renewable
Homologous
Carbon monoxide
Haemoglobin
Impurities
Carbon dioxide
Sulfur dioxide
Nitrogen oxides
Incomplete
Excess
Toxic

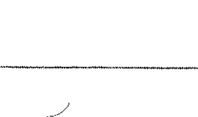
Core Knowledge

Homologous Series - a series of compounds with the same general formula, with each successive member differing by a $-CH_2$ (i.e. They get bigger).

Members of a series show similar chemical properties and a trend in physical properties.

e.g. Boiling points increase with molecular size.

For example, the general formula for the alkanes is $\mathbf{C_nH_{2n+2}}$ (where n is the number of carbon atoms in the molecule).



C_3H_8 where n = 3

Hydrogen as a Fuel Compared with Petrol in Cars

Advantages

When hydrogen burns in oxygen, only water is produced and no pollution.

Hydrogen + Oxygen → Water

Hydrogen can be produced from water which is plentiful.

Disadvantages

Hydrogen is a gas and is therefore more difficult to contain than liquid petrol.

There is no national system for filling a car with hydrogen whereas petrol can be obtained from fuel stations across the country.

Hydrogen is a flammable gas.

Powerful Knowledge

CRUDE OIL - is a complex mixture of molecules called hydrocarbons (which are molecules made of hydrogen and carbon atoms only) and they can be chains or rings in shape but crude oil is not useful in this form. To make it useful, it needs to be sorted into groups of molecules of similar size called fractions using a technique called fractional distillation.

Crude oil can be burned as a fuel or used as a chemical feedstock to make many other useful things e.g. Plastics.

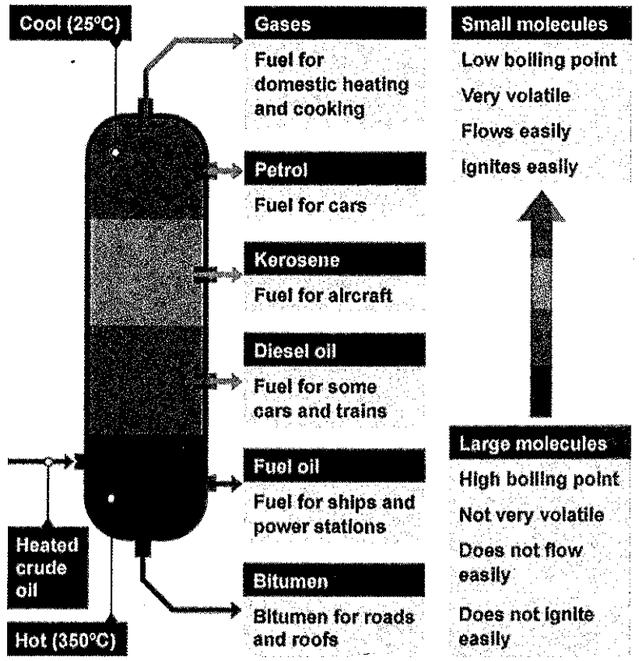
This is the process of FRACTIONAL DISTILLATION which produces simpler more useful mixtures of molecules from crude oil.

- The crude oil is first heated to turn most of it into a vapour.
- The vapour rises up the column.
- The molecules cool and condense at their different boiling points producing groups of molecules of similar size

Petrol, kerosene and diesel are non-renewable fuels produced from fossil fuels, whereas, methane is a non-renewable fuel produced from natural gas.

Non-renewable fuels took millions of years to form and therefore cannot be replaced.

Fractional Distillation



Problems with Burning Fuels:

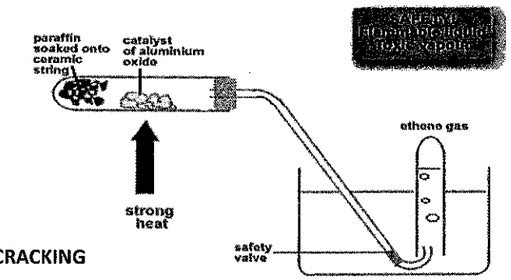
In the presence of excess oxygen (COMPLETE COMBUSTION),

hydrocarbons react with oxygen to make only water and carbon dioxide, but carbon dioxide is a greenhouse gas which causes climate change.

In the presence of insufficient oxygen (INCOMPLETE COMBUSTION), hydrocarbons react with oxygen to make water, carbon monoxide (which is toxic) and/or carbon/soot (which makes things look dirty and can block jets in boilers).

Acid rain can form when sulfur impurities in the fuel burn and react with oxygen to make sulfur dioxide which then dissolves in rain water.

When fuels are burnt at very high temperatures, such as in aeroplane engines, nitrogen and oxygen are able to react with one another forming oxides of nitrogen which can cause also cause acid rain and brown photochemical smog.



CRACKING

Cracking allows the breaking down of larger saturated, hydrocarbons molecules (alkanes containing only single covalent bonds) into smaller, more useful hydrocarbon molecules, some of which are unsaturated (alkenes containing carbon-carbon double bonds).

This helps supply to meet demand.

Cracking is an example of thermal decomposition as heat is used to break bonds in molecules.

Links to other topics

Links to Key Stage 2:

There may be limited links with basic ideas of combustion, plastics and pollution/climate change.

Links to Key stage 3:

There are a number of topics where links can be made to your prior knowledge:

Incomplete Combustion

Complete Combustion.

Renewable and Non-renewable fuels

Climate Change

Carbon Cycle

Earth and Atmosphere

Balancing Equations

Writing Formula

Links to Key stage 4:

There are a number of links to key stage four content:

Biology:

Carbon Cycle

Respiratory System

Circulatory System

Cellular Respiration

Chemistry:

Balancing Equations

Empirical Formula

Molecular Formula

Covalent Bonding

Global Warming

Greenhouse Effect

Acid Rain

Polymers

Hydrocarbons