

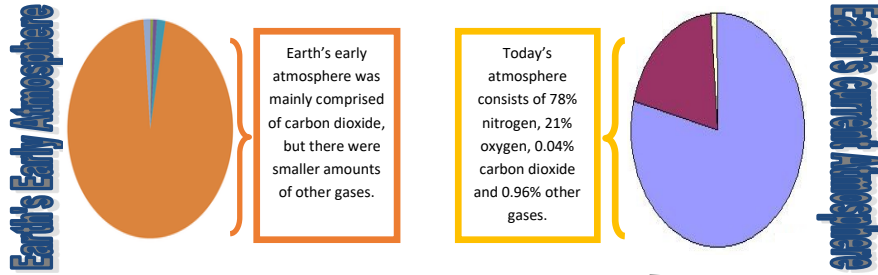
Topic: Earth and Atmosphere

Duration: 3 lessons

Composite:

Key vocabulary:

Core knowledge:



| 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 |

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

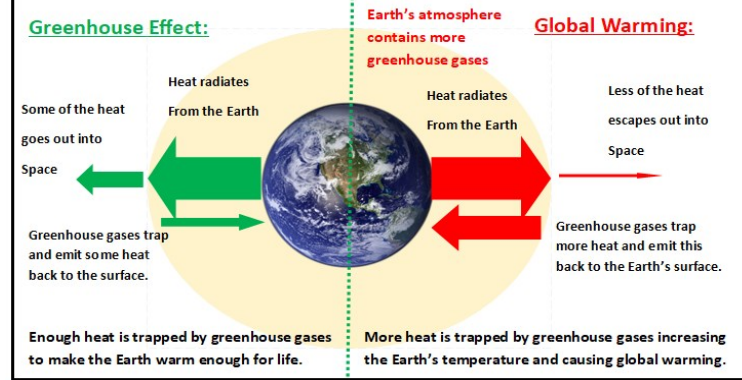
Calculating angles of pie chart

States of matter

Fuels and Earth Science

Plant structures and functions

Light and the electromagnetic spectrum



1 Volcanic eruptions release gasses that formed the Earth's early atmosphere. This is thought to have been mainly comprised of CO₂, 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 CaCO₃).

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 ₆ H ₁₂ O ₆ + 6O ₂ → 6CO ₂ + 6H ₂ O |
| Photosynthesis | carbon dioxide + water → glucose + oxygen | 6CO ₂ + 6H ₂ O → C ₆ H ₁₂ O ₆ + 6O ₂ |
| Combustion | hydrocarbon + oxygen → carbon dioxide + water | CH ₄ + 2O ₂ → CO ₂ + 2H ₂ O |

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 CO₂, some water vapor and other gases.
- 3) Describe the composition of today's current atmosphere as 21% - O₂, 78% - N₂, 0.04% - CO₂ 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 CO₂ 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 (CO₂, CH₄ and H₂O), absorb heat radiated from the Earth, subsequently releasing energy which keeps the Earth warm (the greenhouse effect).
- 7) Increasing the concentration of greenhouse gases (CO₂, CH₄ and H₂O) is meaning more energy is absorbed and emitted back to Earth by these gases causing global warming.

| Impressive reading | Impressive speaking | Impressive writing | Resilience | Employability |
|---|--|--|---|--|
| 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. | 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. | 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! | 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. | 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

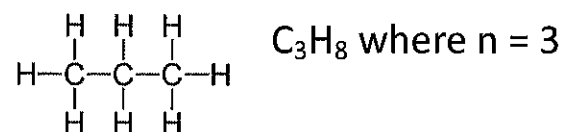
Core Knowledge Powerful Knowledge

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.

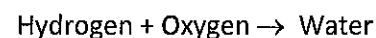
For example, the general formula for the alkanes is C_nH_{2n+2} (where n is the number of carbon atoms in the molecule).



Hydrogen as a Fuel Compared with Petrol in Cars

Advantages

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



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.

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.

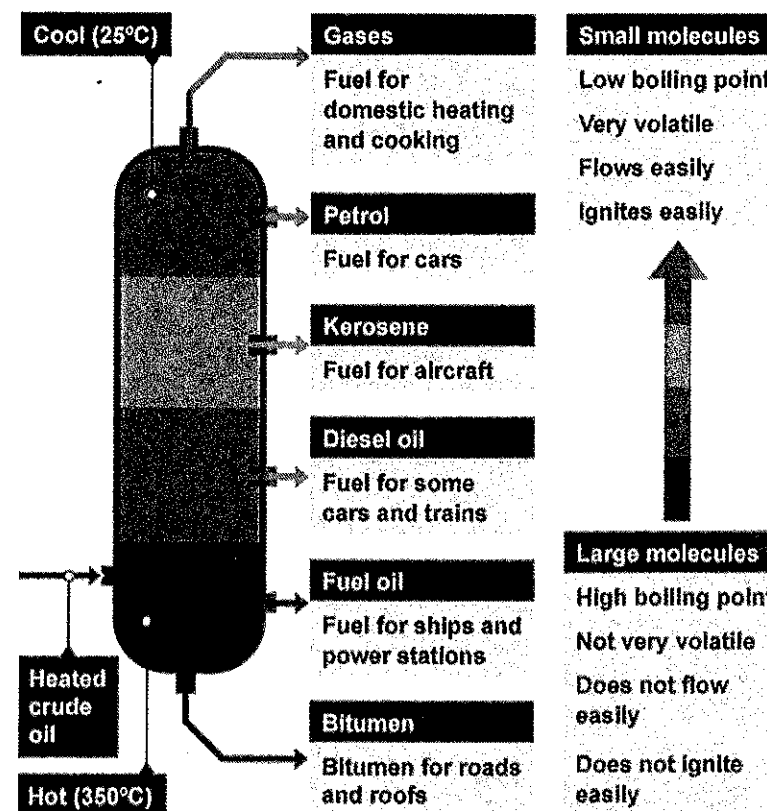
This is the process of FRACTIONAL DISTILLATION which produces simpler more useful mixtures of molecules from crude oil.

- 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



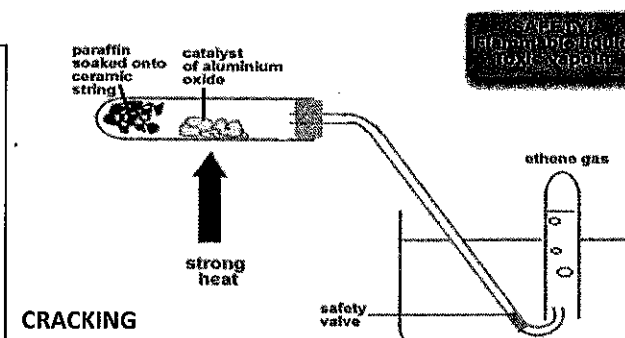
Problems with Burning Fuels:

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

Topic: KS4: Topic 9 Separate Chemistry 2 – Bulk and surface properties of matter including nanoparticles

Duration:

Composite: Unit test

Key vocabulary:

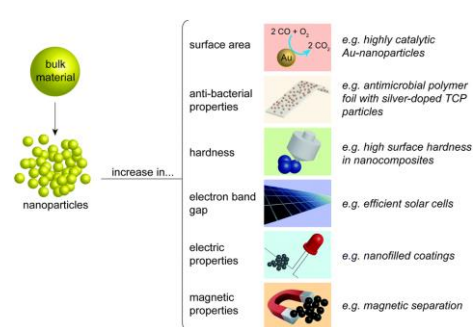
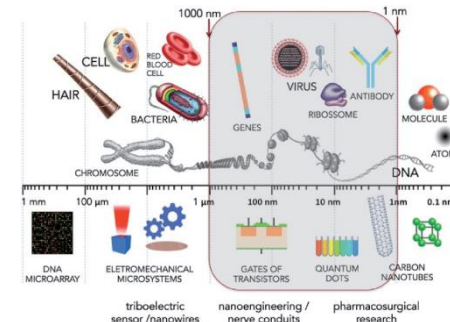
Nanoparticle, Nanoparticulate, Atom, Molecule, Fullerenes, Properties, Risks, Transparent, Brittle, Opaque, Translucent, Ductile, Resistance, Fatigue, Corrosion, Thermal

- Describe the term nanoparticle.
 - Nanoparticles are between 1 and 100 nanometres (nm) in size and usually contain only a few hundred atoms.
- Explain the advantage of using nanoparticles in sunscreens.
 - Sunscreens block harmful ultraviolet light from the sun reaching the skin. Titanium dioxide blocks ultraviolet light, so it is used in sunscreens. In bulk titanium dioxide is white – it is used as a pigment in white paint. However, nanoparticulate titanium dioxide has no colour and cannot be seen when it is spread on the skin. Many people prefer nanoparticulate sunscreen because it is not obvious that they are wearing it.
- Recall how nanoparticles could enter the body.
 - Nose/mouth
 - Skin
 - Cuts
- Describe why many risks of nanoparticles are unknown.
 - Modern nanoparticulate materials have only become common recently, so it is difficult for scientists to determine their risks.
- Identify uses of clay and glass ceramics, polymers, composites, and metals.

| Material | Uses |
|----------------|--|
| Glass ceramics | Windows, bottles |
| Clay ceramics | Bricks, porcelain |
| Polymers | Plastic bags, Bottles |
| Composites | Carbon fibre, chipboard, reinforced concrete, fibreglass |
| Metals | cars, bridges, electrical cables |

Core knowledge Components
Powerful knowledge components crucial to commit to long term memory (in red box)

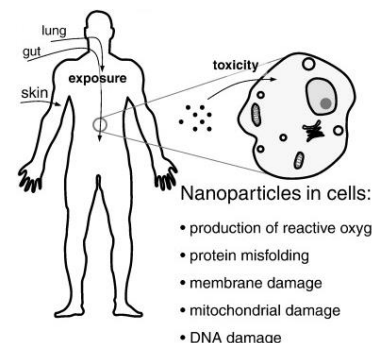
- Compare the size of nanoparticles with the sizes of atoms and molecules.
 - One nanometre is one billionth of a metre, so $1 \text{ nm} = 1 \times 10^{-9} \text{ m}$.
 - Atoms and simple molecules are around 100 times smaller than this.
 - Nanoparticles are much smaller than fine particles which have diameters of between 100 and 2500 nm
 - Nanoparticles are between 1 and 100 nanometres (nm) in size and usually contain only a few hundred atoms.
 - One nanometre is one billionth of a metre, so $1 \text{ nm} = 1 \times 10^{-9} \text{ m}$.
 - As the side of cube decreases by a factor of 10 the surface area to volume ratio increases by a factor of 10
- Describe how the properties of nanoparticulate materials are related to their uses including surface area to volume ratio of the particles they contain, including sunscreens.
 - New cosmetics, e.g. suntan cream and deodorant. They make no white marks.
 - Lubricant coatings, as they reduce friction. These can be used for artificial joints and gears.



KS3: Elements and compounds, The Periodic Table, Separation Techniques, Metals and Reactivity
KS4: Atomic Structure, The Periodic Table

3. Explain the possible risks associated with some nanoparticulate materials

- Due to the small size of nanoparticles, it makes it possible to breathe them in, or for them to pass into cells. Once inside the body, they might catalyse reactions that are harmful. Toxic substances could bind to them because of their large surface area to volume ratios, harming health if the nanoparticles do get into the body.



- Nanoparticles in cells:
- production of reactive oxygen species
 - protein misfolding
 - membrane damage
 - mitochondrial damage
 - DNA damage

- Modern nanoparticulate materials have only become common recently, so it is difficult for scientists to determine their risks.

4. Compare, using data, the physical properties of glass and clay ceramics, polymers, composites and metals

| Material | Properties |
|----------------|---|
| Glass ceramics | Transparent, hard, brittle, poor heat and electrical conductors |
| Clay ceramics | Opaque, hard, brittle, poor heat and electrical conductors |
| Polymers | Can be made transparent/translucent/opaque, poor heat and electrical conductors, can be tough or ductile |
| Composites | High strength, low density, excellent resistance to fatigue, creep, creep rupture, corrosion, and wear; and low coefficient of thermal expansion (CTE). |
| Metals | Good heat and electrical conductors, hard, tough |

5. Explain why the properties of a material make it suitable for a given use and use data to select materials appropriate for specific uses

- for electrical cables: a metal is suitable because it's a good electrical conductor and is ductile, whereas a polymer is unsuitable as it's a poor electrical conductor.

| | | | | |
|--------------------|---------------------|--------------------|------------|--------------------|
| Impressive reading | Impressive speaking | Impressive writing | Resilience | Employability via: |
| | | | | |

SEND

- Opening activity/theme is opening slide to ensure learner buy in
- Opportunities for retrieval practice and building on prior knowledge: knowledge recall slide
- Multi-sensory approach using reading, listening, practical work, watching videos, dual-coding, practical work, paired working, observing teacher demonstrations
- Repetition of key vocabulary in every lesson
- Curriculum time allocated for the explicit teaching of key vocabulary
- Skills ordered logically and sequenced with an increase in complexity
- Links to prior learning explicitly highlighted to support non-verbal reasoning
- Texts used/alternative texts available with a consideration to reading age