Meden School Curriculum Planning							
Subject	Chemistry	**Year Group**	10	**Sequence No.**	17	**Topic**	C9/C10 Chemistry of the atmosphere and Using resources

Retrieval	Core Knowledge	Student Thinking
What do teachers need to **retrieve** from students before they start teaching **new content**?	What **specific ambitious knowledge** do teachers need teach students in this sequence of learning?	What real life examples can be applied to this sequence of learning to **development of our students thinking, encouraging them to see the inequalities around them** and 'do something about them!'
KS3: Year 9 Chemistry of the atmosphere. Students learn how the current levels of gases in our atmosphere came to be. **KS2: Plant growth.** In KS2 students learnt that plants need carbon dioxide and water to make their own food. **KS3: Year 8 Plant structure and reproduction.** Students learnt about the process photosynthesis.	**L1: Evolution of the atmosphere.** (Recap) The current atmosphere contains 20% oxygen and approximately **78% nitrogen, 0.04% carbon dioxide and trace amounts of argon and water vapour**. It has remained the same for the past 200 million years. When the earth was first formed billions of years ago, it was so **hot** that any gases were driven away and no atmosphere could form. Eventually the earth began to **cool** and a **crust** began to form. The earths first atmosphere came from the intense **volcanic activity** that released gases into the air. Gravity then held them in place to form our first atmosphere. The first atmosphere consisted of approximately **95% carbon dioxide, 4% water vapour and trace amounts of nitrogen, ammonia and methane**. The earth continued to cool and the **water vapour condensed** into the oceans. The levels of carbon dioxide partially decreased due to it being **dissolved in the oceans**. Once in the oceans, the **carbonates formed precipitates**. These precipitates formed **sediments** such as calcium carbonate on the seabed which later formed **sedimentary rocks** such as limestone. Marine organisms also used these carbonate precipitates to form their **shells and skeletons**. Carbon from carbon dioxide has also been **locked up** in fossil fuels. When trees and plants died in the absence of oxygen in swamps, they became compressed under heat and pressure over millions of years and formed **coal**. **Natural gas and oil** were produced from the burial of marine organisms such as plankton on the seabed under intense pressure and temperatures. **Photosynthesis reduced** the levels of **carbon dioxide** and **increased the levels of oxygen**. Oxygen reacted with the ammonia in the air to form nitrogen and water.	L1: Our atmosphere is essential to life. It blocks some of the Sun's dangerous rays from reaching Earth. It traps heat, making Earth a comfortable temperature. The oxygen present is used in a variety of processes including respiration of plants and we need it to survive.

KS3: Year 9 Chemistry of the atmosphere topic. Students learn about the greenhouse gases, what the greenhouse effect is and how it can lead to climate change.	**L2: The greenhouse effect and climate change.** (Recap) The greenhouse effect is where certain gases, called **greenhouse gases**, act as an insulating layer around the earth keeping it warm enough to support life. If we didn't have this, it would be too cold for life to exist. These greenhouse gases include **carbon dioxide, methane and water vapour**. **Short wavelength ultraviolet radiation** from the sun passes through the atmosphere and is **absorbed** by the earths surface. The earth then emits this radiation as **long wavelength radiation**, **infrared radiation**, in order to cool itself. This thermal radiation then warms the surface of the earth. Some of this radiation will escape into space but some will be **trapped** by the greenhouse gases. It is then re-radiated back down to earth, continuing to warm the surface of the earth. Global warming where the Earth's temperature is increasing, this is sometimes known as the **enhanced greenhouse effect**. Many human activities have led to the increase in greenhouse gases in the atmosphere. These activities include **burning fossil fuels** which has released locked up carbon dioxide into the atmosphere, **deforestation** which reduces the reduces the amount of carbon dioxide removed from the atmosphere by photosynthesis, we call these **'CO_2 sinks'**. Increased animal farming releases more methane into the atmosphere (it is a by-product of digestion and decomposition of waste) as well as the paddy fields that grow rice. Methane is also released into the atmosphere due to the decomposition of rubbish in landfill sites. Global warming can lead to **climate change**. Climate change is any **significant long-term change** in the expected patterns of average weather in a region (or the whole Earth) over a significant period of time. Global warming and climate change results in many devastating effects such as **rising sea levels, polar caps and glaciers melting**, leading to **flooding**. More areas will suffer from **drought** as they become drier from increased temperatures. These droughts result in **famine** as crops are unable to grow. More extreme weather will occur such as more **frequent storms, hurricanes and tornadoes**. Animals will become **extinct** due to **habitats being destroyed**. **L3: Carbon footprint.** Carbon footprints are a measure of the amount of carbon dioxide and other greenhouse gases that are released over the full life cycle of something. This could be a service, an event or the manufacture of a product. Carbon footprints can only give a rough estimate as not every part of the life cycle can be given a quantifiable number for example, how much damage the emissions cause. There are several ways to reduce carbon emissions including using **alternative energy supplies, carbon capture and storage and the use of carbon taxes.** There are some problems with trying to reduce carbon footprints including that there is still a lot of work to be done on alternative technologies that result in lower carbon dioxide emissions, and that there is an incomplete international co-operation, not everyone is willing to make changes.	L2: Global warming and climate change are very prevalent in the news. In 2021, The COP26 summit brought parties together to accelerate action towards the goals of the Paris Agreement and the UN Framework Convention on Climate Change. Scientists have warned that we are already at a tipping point that might lead to "non-linear, abrupt environmental change within continental- to planetary-scale systems". Lots of measures are being put in place to avoid this such as The UN's Sustainable Development Goals including universal calls to action to protect life on land and in water, producing clean water and tackling climate change. Meanwhile, the EU's Environmental Action Plan includes nine priority objectives that aim to ensure "we live well, within the planet's ecological limits". The most recent report from the IPCC (published April 2022) states that if the goal of only a 1.5°C global warming increase is to be achieved, net zero carbon dioxide emissions globally needs to be achieved by the early 2050's. It is happening around us now, in our lifetimes, as scientists have reported that the last seven years have been the warmest years on record, with global temperatures rising more than 1°C above pre-industrial levels and edging closer to the limit laid out under the Paris agreement.
KS3: Year 9 Chemistry of the atmosphere topic. Students learn about the various	**L4: Air pollution.** (Recap) Air pollution refers to the presence of **dangerous or poisonous substances** and chemicals in the air that we breathe. These include **soot, sulfur dioxide, nitrogen oxides, methane, carbon monoxide and carbon dioxide**. Carbon monoxide and soot are produced when fuels undergo	

sources of pollution in the air around us and the effects and damage it causes. **KS4: Year 10 Chemical changes.** Students learn about electrolysis and displacement reactions. **KS3: Year 8 Reactivity of metals.** Students are introduced to electrolysis and displacement reactions.	**incomplete combustion**. This is when the fuels burn in an insufficient supply of oxygen. Soot causes **lung damage and respiratory problems** if they are inhaled. Carbon monoxide can cause **fainting, sickness and even death** in large amounts. It is **colourless and odourless** and so is hard to detect. Sulfur dioxide is caused when fossil fuels contain an impurity and are then burned. This causes problems for people with respiratory problems and will then turn into **acid rain** when it combines with the water in the clouds. Another contributor to acid rain is oxides of nitrogen. These are formed when the nitrogen in the air reacts with oxygen in the combustion engines of vehicles. The nitrogen oxides again cause respiratory problems and when it falls as acid rain, causes lakes to become acidic and many **plants and animals die**. Acid rain **also kills trees, damages limestone buildings and ruins statues**. Methane is released from land fill sites, rice fields and cows. It is a **greenhouse gas** and contributes towards **global warming** alongside carbon dioxide which is produced when fuels undergo **complete combustion** (when there is a plentiful supply of oxygen). **L5: Different types of resources and sustainability.** There are different types of resources including **natural and man-made (synthetic) resources**. Natural resources include anything that comes from the earth, sea or air for example wind to generate electricity or timber for building materials. Some natural resources can be replaced with man-made products such as plastics replacing wood or corks made of plastics instead of cork from the bark of a tree. Agriculture is used to **supplement** our natural resources such as fertilisers to increase crop yield. Resources can be classed as **finite or renewable resources**. A finite resource cannot be formed quickly enough to be considered replaceable. Examples include fossil fuels and nuclear fuels such as uranium and plutonium. Renewable resources can be re-formed at a similar rate, or faster than we use them. Examples include timber and vegetable crops. **Sustainable development** is an approach to development that takes into account of the needs of present society while not damaging the lives of future generations. Using finite resources isn't sustainable as they will run out, also to be taken into account is the energy used and waste produced. Chemists have developed and adapted processes in industry and agriculture in order to use lower amounts of finite resources and reduce the damage to the environment. **(Higher only)** New ways to extract copper from low grade ores has been developed as the supply of copper-rich ores is limited and the demand for copper is growing. These new alternative ways include **bioleaching and phytomining**. Bioleaching involves **bacteria** which converts copper compounds in the ore into soluble copper compounds. Ions in the **leachate** that is produced can be extracted by **electrolysis or displacement**. Phytomining uses plants that are grown in soil that contains copper. The **plants** are harvested, dried and burned from which the copper is extracted using electrolysis or displacement.	In 2019, inspired by Greta Thunberg, across the UK thousands of school children walked out of school in a mass protest to shown their concern about the threat of climate change. One of the effects of climate change is the melting of polar ice caps and glaciers. In 2019 the Greenland ice sheet lost 532 billion tonnes of ice. The rate of melting has been monitored since 2003 and 2019's ice lost was more than double the average of 255 billion tonnes and broke the previous record set in 2012 by 15%. L3: Air pollution threatens everyone from unborn babies to children walking to school, to women cooking over open fires. Its effects are equally deadly: asthma, other respiratory illnesses and heart disease are among the adverse health effects known to be caused by polluted air. According to the World Health Organization, every year around 7 million premature deaths are attributable to air pollution—a staggering 800 people every hour or 13 every minute. Overall, air pollution is responsible for more deaths than many other risk factors, including malnutrition, alcohol use and physical inactivity. L5: Humans rely on natural resources for business, activities, and survival. Ignoring sustainability can lead to the exhaustion of natural resources. Business majors

KS3: Year 9 Using resources. Students are introduced to recycling and reusing, in particular how glass is recycled.	**L6: Reusing and recycling.** One way of reducing the use of finite resources is for people to use less. Recycling means turning an item into raw materials that can be used again, usually for a completely new product. This is an energy consuming procedure. Reusing refers to an object as it is without treatment. This produces pollution and waste, therefore making it a more **sustainable process**. Two common examples of recycling are recycling metals and glass. There are advantages to recycling for example recycling metals uses less energy than is needed to mine and extract new metals which also saves money. Recycling also **conserves** the amount of finite resources available. Some types of glass cannot be reused and so need to be recycled. The glass is crushed, melted and reshaped into new glass products or used for a different purpose such as wall insulation. **L7: Life cycle assessments (LCA).** Life cycle assessments assess the **environmental impact** of the entire lifetime of a product. There are four stages to an LCA; getting the raw materials, manufacturing and packaging, using the product and product disposal. In the different stages, factors such as energy required, transportation, pollution and waste need to be considered. LCA's also consider how long a product is used for or how many uses it gets. LCA's is not a fully objective method as they can be biased, they take into account the values of the person carrying out the assessment and not all aspects can be quantified with a number.	need to learn about sustainability because it aids in attractiveness to customers and fulfilling Corporate Social Responsibility. Agriculture, nutrition, and public health students need to focus on sustainability in order to learn how to feed a growing population nutritious and quality food. Education majors spread the knowledge of sustainability to the next generation so they can lead change.
KS4: Year 10 C8 Chemical analysis (Triple only). Students learn how to test for metal ions using a flame test and halide ions. **KS4: Year 10 C4 Chemical changes.** Students learn about pH values and what value is neutral. **KS4: Year 10 C1 Atomic structure and the periodic table and KS3: Year 7 Separating mixtures.** Students learn about the process of distillation. **KS3: Year 7 Separating mixtures.** Students are introduced to the term potable water and the steps involved in purifying water.	**L8/L9: Potable water (required practical).** Potable water is water that is **safe** to drink. It has been treated or is naturally safe for humans to drink. It does not mean it is pure. Potable water has a pH between 6.5 and 8.5, the levels of dissolved salts are not too high and contains no dangerous bacteria or other microbes. Sources of potable water include fresh water and sea water. Rain water is an example of **fresh water** which can be collected as surface water from **lakes, rivers and reservoirs or as ground water** from rocks which trap water underground called **aquifers**. Fresh water has to be treated first using two main processes; filtration to remove solids and sterilisation to kill harmful microbes or bacteria using UV light, ozone or chlorine gas. Sea water has to be **desalinated** using either **distillation or reverse osmosis**. Both methods use lots of energy and are expensive. To test for safe water, first the pH of the water is found. Then to test for salts, sodium chloride in particular, a flame test is carried out to test for sodium then adding nitic acid and silver nitrate solution to test for chloride ions. The water is then distilled using **evaporation and condensation**. The water is then retested for pH and to check that the sodium chloride has been removed. **L10: Waste water.** Waste water comes from different sources, for example our everyday lives where we run baths, have showers, do the washing up or flush the toilet. Agriculture and industry also produce waste water from fields and industrial processes. This waste water ends up in sewers and sewage treatment plants and needs treating before it is safe to be released back into the environment. The four	L10: In Singapore, where there is not much fresh water, the waste water is being treated and recycled back into drinking supplies.

	stages of treating waste water are **screening, sedimentation, aerobic digestion and anaerobic digestion**. Screening removes large bits of material; sedimentation involves separating any remaining solids (forming sludge) and the **effluent** (liquid) and the digestion steps treat the effluent. Aerobic digestion breaks down organic matter in the presence of oxygen where as anaerobic digestion is carried out in the absence of oxygen to break down more organic matter. Methane is produced which is used as an energy source and the remaining digested sludge can be used as a fertiliser. **L11: Revision** **L12: EOTT** **L13: GPA**	Careers: Relevant career paths include climate change analysts, environmental health and safety specialists, environmental scientists.