Solutions, mixtures and separation techniques

Key principles

Students should be very clear after this topic about the difference between a compound and a mixture.
Students should begin by recapping physical changes of state from the particles topic and extending understanding to include drawing and explanation of cooling curve graphs –including change of state with reference energy and intermolecular forces
Define solvent, solute and solution and use them to explain the process of dissolving.
Students will then learn the process of chromatography, fractional distillation and production of potable water to including learning the method and applications of each process.

KS2 prior learning

The students study changing state (changing temperature) and properties of s,l,g. Basic understanding of mixture and dissolving to form solutions. The water cycle and separating techniques include sieving, filtering, evaporation and basic condensing

Links to other topics

Particles
Compounds
Equations
Acids and Alkalis
All reaction topics

Main learning aims

1. What is a mixture
2. Drawing and explaining cooling curves
3. The methods for carrying out chromatography, fractional distillation and making potable water
4. Understand the applications of when we use each process

Practical suggestions

Students should have access to look at each technique practically where possible

Body systems

Key principles

Ensure students recap the idea that systems are made from cells, tissues and organs and connects those ideas together.
To look at **skeletal and muscular systems** to include making blood cells as well as antagonistic muscle pairs- talk in terms of contracting and relaxing.
Digestive system to include the order and function of the organs but also a real oportunity to introduce enzymes. Talk only in general terms in terms of enzyme action and specificity as well as why they are needed but NOT specifics of enzyme names. Include importance of bacteria in gut.
Circulatory system basics (transport of oygen and glucose – link to diffusion topic). Vessels, heart structure and blood composition
(not reproduction)

KS2 prior learning

tudents know main parts of a plant, They talk plant pollination and fertilization including the terms stigma, stamen and pollen. They know sexual reproduction produces babies including the terms egg, sperm and fertilisation.

Links to other topics

(threads)
Diffusion
Cells
Particles
Environmental biology
Respiration and photosynthesis

Practical suggestions

Skeleton models
Enzyme practicals
Dissection

Main learning aims

1. Concept of large systems being crucial to life and their make up in terms of organs, tissues and cells
2. The role of each system to include: skeletal/ muscular/ digestive/circulatory
3. To review and link all previous learning from year 7
4. Ensure students know role of enzymes in the digestive system

Waves

Key principles

The big concept with waves is to link them to the transfer of energy.
Students should develop their understanding of the two types of waves and discuss them as longitudinal or transverse paying attention of direction of travel vs direction of energy transfer. They should develop their ability to draw ray diagrams and talk about the spectrum of light. They should investigate refraction and also look at the eye and pin-hole cameras. They should also develop a concept of visible range of sight and electromagnetic spectrum (simple idea).
For sound waves they should also develop understanding of the different parts of the ear and sound as vibrating particles. They need to be able to appreciate the speed of light and sound and how sound speed changes depending on the density of the material.
Students should develop their understanding of the wave properties- frequency, amplitude and wavelength including units. They should also learn the wave equation- wave speed = wavelength x frequency.

KS2 prior learning

Students are familiar with light - sources of light, how we see, mirrors and reflection and shadows. Sound key ideas are making and hearing sound, volume and pitch.

Links to other topics

(threads)
Energy
Particles
States of matter (density)

Main learning aims

1. Develop a concept of what a wave is and define longitudinal and transverse waves in terms of energy transfer
2. Draw ray diagrams of refraction and investigate the visible spectrum including lenses, the eye and cameras
3. Describe how sound travels and is processed in the ear
4. Understand frequency, amplitude and wavelength and calculate wave speed using the wave equation.

Practical suggestions

Anything suitable – including intro to KS4 core practs

Reactions 1: Acids and Alkalis

Key principles

Students should spend time becoming familiar with what acids, alkaline and neutral substances are and how we check for them using indicators (note use different indicators as in KS4). Students should know the pH of strong, weak acids and alkalis and neutral substances.
Students should investigate and understand what neutralisation means and produce word and formula equations (using their understanding from the equations unit in year 7) for the following neutralisation reactions: acid and alkali, acid and metal, acid and metal oxide, acid and metal carbonate. Production of soluble and insoluble salts
The general principle of what an indicators does – UI and litmus (only)– similarities and differences

KS2 prior learning

The students talk about reactions being reversible and irreversible and signs of reactions but have no prior knowledge of acids and alkalis.

Links to other topics

Particles
Compounds
solutions/mixtures
Equations
Other reactions topics - displacement
Digestion/enzyme action

Practical suggestions

Students should have access to look at each neutralisation reaction and indicator where possible

Main learning aims

1. Knowledge of pH of acid, alkali and neutral substances using a variety of indicators
2. Neutralisation of acid and alkali
3. Preparing soluble and insoluble salts
4. Neutralisation reactions of metals

Reproduction and health

Key principles

Reproduction in humans (ie as a mammal). Include structure and function of the male and female reproductive organs and systems- make this very clear especially for females as KS4 understanding of menstrual cycle needs this! Menstrual cycle information without specifics of hormones. Talk in terms of gametes and fertilization through gestation and birth. Talk about effect of maternal lifestyle on fetal health- explicitly mentioning the placenta.

Reproduction in plants recapping flower structure from KS2- discuss wind and insect pollination, fertilisation, seed and fruit formation and dispersal.

Health topic to include recreational drugs, alcohol and smoking (including substance misuse) link to behaviour, health and life processes (body system – eg lungs/heart).

KS2 prior learning

tudents know main parts of a plant, They talk plant pollination and fertilization including the terms stigma, stamen and pollen. They know sexual reproduction produces babies including the terms egg, sperm and fertilisation.

Links to other topics

(threads)
Diffusion
Cells
Body systems
Chemical reactions
Environmental biology

Practical suggestions

Quantitative investigation of seed dispersal

Main learning aims:

1. Human reproductive organs and systems and their roles
2. Menstrual cycle (NOT TO INCLUDE HORONES SPECIFICS)
3. Human fertilisaton, gestation and birth and impact of maternal health on this
4. Plant reproduction
5. Health and drug misuse

Heating and cooling

Key principles

Students need to be thinking of heat transfer at a particle level.
Students should be able to describe conduction, convection and radiation with confidence but the end of the unit. Conduction should be explained with reference to both particle arrangement in solids and free electrons in metals as they will have electron knowledge from electricity and particles.
Heating and cooling should also be seen as an energy transfer from hotter to cooler areas.
Students should develop their understanding of insulators reducing temperature loss and link this to contexts.
Students should be able to calculate fuel costs and power ratings and link to efficiency.

Practical suggestions

Conduction
Covection
Radiation
Insulating

KS2 prior learning

Students are familiar with properties of materials and the terms conductors and insulators of heat but have not learnt this at a particle level.

Links to other topics

(threads)
Particles
Electricity
Energy transfer and efficiency
Habitats

Main learning aims

1. Description of conduction (including in metals), convection and radiation at a particle level
2. Heating and cooling in terms of energy transfer
3. Understanding of insulators reducing heat loss in different contexts
4. Calculation of fuel costs and power ratings linking to insulation and efficiency

Reactions 2: Combustion, Decomposition, Endothermic and Exothermic

Key principles

Students should know what combustion is, the equation for it and why it is useful. Compare complete and incomplete combustion. Specifically teach oxidation as the gain of oxygen, using combustion as the example.
Thermal decompostion- be able to describe and write word (and symbol) and review reactant and products in chemical reactions.
Exothermic as energy being released, using a thermometer to observe temperature increase. Endotherimc as energy being taken in (decrease in temperature)
Allow students to develop practical competencies in carrying out methods/handling equipment and analysing results
With extra time in this unit. Ensure recapping of word, symbol and balanced equations throughout the topic. More able can review reacting masses/calculating RAM/RFM.

KS2 prior learning

The students are familiar with reactions being reversible and irreversible and signs of reactions but have no prior knowledge of these specific reactions

Links to other topics

Particles
Compounds
Equations
Acids and Alkalis

Practical suggestions

Students should have access to look at each type of reaction

Main learning aims

1. Combustion reactions
2. Thermal decomposition
3. Endothermic and exothermic reactions
4. Retrieval and recall of reactant/products, conservation of mass and word/symbol equations

Respiration and photosynthesis

Key principles

First ensure interleaving of plant and animal cells including job of organelles- obviously with the aim of homing in on the chloroplasts and mitochondria.
Both the photosynthesis and respiration equations must e memorised in word and symbol form- link these word equations clearly to them being chemical reactions.
Teach both aerobic and anaerobic respiration including fermentation.
MAKE EXPLICIT RESPIRATION ALSO OCCURS IN PLANTS.
Review of leaf structure from diffusion. Factors affecting photosynthesis.
Discuss photosynthesis in terms of the importance of green plants as producers and the reason why photosynthesis is so vital including the uses of the glucose produced.
Could include the atmospheric changes due to evolution of green plants.

KS2 prior learning

Students know main parts of a plant, They talk plant pollination and fertilization including the terms stigma, stamen and pollen. Will know the things plants need to grow and animals need to survive

Links to other topics

(threads)
Diffusion
Cells
Particles
Environmental biology
Body systems
Chemical reactions

Practical suggestions

Fermentation practical
Factors affecting photosynthesis

Main learning aims:

1. Link to where occurs in organelles in cells
2. Equations and understanding of what they show/mean
3. Aerobic and anaerobic respiration including fermentation
4. Investigating factors affecting photosynthesis
5. Importance of photosynthesis in terms of products, food chains and evolution of the atmosphere (brief ideas)

Magnets and electromagnets

Key principles

Students need to know about bar magnets, build on learning from KS2 including field lines, plotting compasses and the Earth's magnetic field. Force acting at a distance (and as a vector quantity with size and direction). Draw field lines for attracting and repelling and direction is North to South. Link concept to using a compass.
Review electricity from year 7. Review and recap what electricity is/circuits. Introduce solenoid (electromagnet) and a current flowing through a wire induces (causes) a magnetic field around the wire. How to increase the strngth of the elecromagnet. The idea of the magnetic force being temporary (switch on and off). Brief introduction into motor effect.

KS2 prior learning

Students are familiar with bar magnets, magnetic poles., repling and attracting and magnetic materials

Links to other topics

(threads)
Particles
Forces
Electricity
Energy transfer and efficiency

Main learning aims

1. Description of a magnetic field and the plotting of one with a plotting compass
2. Describe magnetism as a non-contact VECTOR quantity
3. Draw field diagrams for attraction and repulsion
4. Solenoid description and how to increase the strength of an electromagnet
5. Investigating the temporary nature of an electromagnet
6. Brief introduction of the motor effect

Practical suggestions

Bar magnets/field lines
electromagnet

Earth and the Atmosphere

Key principles

Students should spend time exploring the structure of planet Earth to include the core, crust and mantel. They need to link the rock types in the crust to elements and compounds (this then links to KS4 metal extraction).
Rocky cycle – 3 types of rock and how these are cycled with temperature and pressure.
Carbon cycle needs to link respiration and photosynthesis to the re-cycling of carbon in the atmosphere, this is almost identical to what is required at KS4. Students must begin to link importance of carbon dioxide and the impact on climate change.
The recycling section needs to include for and against on recycling and the community aspects of keeping our environment clean (link to North Sea in North Tyneside).

KS2 prior learning

The students have considered protecting the environment by conservation and human impact on food chains. They have studied rocks as materials but not the rock cycle, but they have studied the water cycle.

Links to other topics

Particles
Compounds
Energy
Equations
Photosynthesis and respiration
Environmental biology

Practical suggestions

Modelling ideas for rock and carbon cycle
There is a lesson using different types of chocolate for rock types
Could do a litter pick as part of the recycling lesson

Main learning aims

1. **Earth structure**
2. **Rocks and rock cycle**
3. **Carbon cycle**
4. **Atmosphere and climate change and recycling**

Microbiology

Key principles

Ensure students understand the concept of scale and magnification- introduce the units of mm, micrometres and nm and what those measurements mean. Recap microscope use and link heavily with the cells topic.
Teach the different types of microbes and their size, cellular structure and function and examples of each- use the KS4 examples of each.
Plate bacteria using aseptic technique- this is a KS4 core practical.
Teach about the immune response to pathogens entering the body to include phagocytosis and antibody production and action.
Vaccination to include the current vaccination debate and antibotic resistance and link to 'science for public understanding'

KS2 prior learning

Students know about the fact blood circulates around the body and the heart pumps it. They learn about bacteria causing tooth decay.

Links to other topics

(threads)
Diffusion
Cells
Particles
Body systems

Main learning aims

1. Concept of scale and units in terms of magnification
2. Types of microbes including size, celllular structure and function and examples
3. Aseptic technique
4. Immune response to pathogens including phagocytosis and antibody response
5. Vaccination

Practical suggestions

Micrroscopes
Aseptic technique

Forces and Energy

Key principles

Students need to be able to build on key ideas from the yr 7 forces topic.
Moments
Begin with the key principles of moments to include investigating and apply the equation moment = force x distance. Review and retrieval of ideas of scalar, vector linking to direction of moment. Linking balanced and unbalanced to the clockwise motion of moments.
Elasticity
Moving onto elasticity and an opportunity to review and retrieval of energy store transfers, especially the key terminology and descriptions, introducing work done as energy transferred. Use Hook's law to investigate force and extension, developing idea of elastic limit (seen in KS4). This concept begins to formulate understanding of equilibrium and Newton's 3rd Law. Students need to develop understanding of N3, building ideas from the concrete (balanced forces) to the abstract (equilibrium, starting to link N1, N2 and N3 – seen in KS4).
Pressure
Students need to investigate and apply p = f/a and to use Pascal and N/m2 as SI units. Use particle theory to explain atmospheric (gas) pressure and the relationship with height above sea level. Use particle theory to explain liquid pressure and the relationship with depth. Linking water pressure to up thrust; making things float (linking back to equilibrium) .

KS2 prior learning

Students are familiar air resistance and water resistance and simple mechanism for turning forces and pivots. Levers and gears. Small force can cause a large effect.

Links to other topics

(threads)
Particles
Forces
Energy transfer and efficiency
Body systems – antagonistic muscles

Main learning aims

1. Investigating moments
2. Investigating elasticity
3. Investigating pressure
4. Linking fundamental ideas for balancing forces and energy transfers throughout.

Practical suggestions

Many practical activities – see Laura

Evolution and genetics

Key principles

Ensure students link this topic explicitly to the environmental biology topic in which evolution has been introduced.
Start with general inheritance including basic monohybrid punnet squares- spend time ensuring students understand that the gene is a carrier of information- taking time with the concept of gene code to protein (simplified translation). Talk about the structure of DNA, chromosomes, gene and alleles- zoom into nucleus. History of DNA modelling by Watson, Crick, Wilkins and Franklin.
Discuss continuous and discontinuous variation. Link different DNA codes to variation introducing mutation as a change in the code and how this drives natural selection and extinction.
Also discuss the importance of biodiversity.

KS2 prior learning

Students have looked at what variation means and that we inherit characteristics from our parents. Learnt about adaptations to environments for survival. Looked at evolution as changes over time and survival chance not explicitly genetic link i.e. beneficial alleles. Looked at fossils as evidence of evolution.

Links to other topics

(threads)
Diffusion
Cells
Particles
Environmental biology
Body systems

Main learning aims

1. General inheritance including monohybrid punnet squares
2. An explicit understanding of the role of DNA in making protein and the code it holds
3. Structure of DNA, genes, chromosomes and DNA structure including DNA model
4. Continuous and discontinuous variation and the link to the DNA code with variation
5. How variation and mutation drives natural selection and extinction

Practical suggestions

Lots of time to model DNA-protein to function

Reactions 3: Displacement and reactivity series

Key principles

Students should spend time becoming familiar with the PT and explore the links between elements in groups, for example group 1 metals. Demonstrate reactivity of group 1 metals with water.
Students begin to build ideas on how different metals react with air and water e.g. rusting experiments (not acids as has already been done – good opportunity to reivew) to develop ideas of the 'reactivity' series.
Use knowledge of the reactivity series to explore how we get metals from the Earth - extracting as the pure metal, from an ore by removing the oxygen and by using electricity (very reactive metals) No need to go into details of electrolysis.
Students should understand and be able to use a reactivity series to investigate and evaluate displacement reactions.

KS2 prior learning

The students talk about reactions being reversible and irreversible and signs of reactions link to acids reacting with metals.

Links to other topics

Particles
Compounds
Equations
Acids and Alkalis

Main learning aims

1. Properties of metals (and non metals)
2. reactivity series
3. including how metals are extracted (using C and 'using electricity' - NOT electrolysis yet)

Practical suggestions

Students should have access to look at each type of reaction

Earth and Beyond

Key principles

Students need to be awe of the universe. Students need to investigate the relationship between mass and gravitational field strength. To learn what the gfs on Earth is (10N/Kg) and the difference between mass and weight and linking them using the equation w = m x gfs.
The big bang theory – linking strongly to the fundamental Energy topic. Describe the big bang and the expanding universe.
Sun, stars and planets as luminous and non luminous bodies and that a galaxy is a large group of starts. They need have a simple understanding of a light year (9.5 trillion Km). Opportunities to look at standard form and measurements. Could do brief introduction into birth and death of stars.
Seasons linking the tilt and orbit of planet Earth.
Any details about other planets/links to the universe can be used to inspire (students only get to do this again if they study separate sciences)

Practical suggestions

Newton meters
Trip
Telescope out

KS2 prior learning

Students are familiar with the planets in our solar system. They have discussed the idea of orbits due to a gravitational pull (including moon orbit of 28 days). They have looked at the phases of the moon and how day and night occur, due to spin on axis. They have begun to consider the ides of planet Earth orbiting the stationary sun.

Links to other topics

(threads)
Forces
Elements
Light
Energy

Main learning aims

1. Gravity and orbiting bodies
2. The big bang theory
3. Sun, stars and planets
4. Seasons

Unit: Y8 Electricity and Magnetism	**Number of Lessons:** 11
Key Principles Students will build on learning from KS2. including field lines, plotting compasses and the Earth's magnetic field. Force acting at a distance (and as a vector quantity with size and direction). Draw field lines for attracting and repelling and direction is North to South. Link concept to using a compass. Review electricity from year 7. Review and recap what electricity is/circuits. Introduce solenoid (electromagnet) and a current flowing through a wire induces (causes) a magnetic field around the wire. How to increase the strength of the electromagnet. The idea of the magnetic force being temporary (switch on and off). Brief introduction into motor effect.	**The Big Picture (Progression)** **Links to KS2:** **Year 3** **Forces and magnets** • notice that some forces need contact between 2 objects, but magnetic forces can act at a distance • observe how magnets attract or repel each other and attract some materials and not others • compare and group together a variety of everyday materials on the basis of whether they are attracted to a magnet, and identify some magnetic materials • describe magnets as having 2 poles • predict whether 2 magnets will attract or repel each other, depending on which poles are facing **Year 5** **Properties and changes of materials** • compare and group together everyday materials on the basis of their properties, including their hardness, solubility, transparency, conductivity (electrical and thermal), and response to magnets **Links to other KS3 Units:** **Year 7 FUNDAMENTALS** **Year 8/9 ESTABLISHING** - Electricity - Forces and Energy - Forces - Energy **Links and progression onto KS4 UNITS** - P7 – Electricity in the Home - P8 – Circuits - P9 – Magnetism and Induction

Possible Key Learning Points	**Skills**	**Prerequisites**

Key Learning Principles	**Key Skills Learnt**	**Students should already:**
- Name common magnetic materials - Name everyday devices containing magnets or electromagnets. - Describe rules for when magnets attract and repel - Draw the magnetic field around a bar magnet, including direction as well as shape - Explain how to make an electromagnet and how to increase its strength - Describe how movement can be produced from electric currents and magnetic fields (motor effect). - Describe how electricity can be produced by moving a wire in a magnetic field (dynamo effect) - Make links to careers with magnetism (electrical engineering, MRI Scanners)	- Literacy / Oracy: To understand and use new unit specific vocabulary effectively - Describe and explain observations using correct vocabulary. - Develop fine motor skills and practical safety when using equipment - Revisit explanations and identify gaps and misconceptions in their own understanding. **Interleaving:** - Electric Circuits - Energy [Stores and Transfers - HEPMACK] - Forces	- Be familiar with contact and non-contact forces. - Be able to group materials as being magnetic or non-magnetic - Be familiar with the idea that magnets have poles - Know that magnets can both attract and repel each other - Be aware of the purpose of the curriculum and its links with Y7 Fundamentals and KS4 **KS2 Curriculum Content from National Curriculum Guidelines Above**
Subject Specific Language	Pedagogical Notes	Make it Stick Activities
- Electric Current - Permanent Magnet - Vector Quantity - Magnetic Field - Electromagnet - Electric Motor - Dynamo	The unit begins with a practical circus of 6 experiments. Students explain their observations using their KS2 knowledge and understanding of Magnetism, and their prior learning in Year 7 units on Electricity, Energy and Particles. The aim is to get students thinking hard about their explanations and to 'show off' using good science. However, gaps in knowledge and common misconceptions will also be drawn out, and these should be addressed during the teaching of the subsequent lessons. This circus is revisited at the end of the teaching sequence when students should be able to add to their explanations and address any misconceptions they might have had initially. In these lessons, students study; magnetic materials, magnetic behaviour, magnetic field lines, plotting magnetic fields and the Earth's magnetic field. They will then look at the links between magnetism and electricity which provides an opportunity to review Electricity from year 7. They are introduced to solenoids (electromagnets) and investigate how to increase the strength	Tips for Teachers to Help Learning 'Stick' • Revisiting practical work to improve explanation and address misconceptions. • Focus on active learning methods such as the many practical activities. • Incorporate frequent, low stakes testing during starter and plenary activities • Encourage students to think hard about the links between magnetism and electricity. • Provide opportunities for reflection eg DIRT lesson after assessment **<u>Assessments:</u>** Frequency in-class Live Marking throughout Unit End of Topic Assessment Lesson 11 30 Mark Total

	of an electromagnet. The idea of the magnetic force being temporary (switch on and off). Brief introduction into motor effect and dynamos.	- Section 1: Quizlet Flashcards (AO1) – 10 Marks (PA) - Section 2: Seen Applications Questions (AO2/3) – 10 Marks (PA) Section 3: Unseen Application Questions (AO2/3) – 10 Marks (TA)
Reasoning opportunities and probing questions	Suggested Activities	Possible Misconceptions
- Why are some metals magnetic but most are not? - How can magnets be useful to us? - Name some devices which contain electromagnets. - Why does the earth have a magnetic field? - What would happen if the earth's magnetic field could be switched off? - Can a magnet be de-magnetised? - How can you make a motor from a magnet? - How can you produce electricity using magnets?	- Practical circus of experiments where prior knowledge and common misconceptions can be identified. - Demonstrating magnetic field patterns with iron filings and plotting compasses. - Demonstrating the magnetic field around an electric current. - Thinking about the links between electricity and magnetism. - Practical – making an electromagnet and testing its strength. - Demonstrate an electric motor and a dynamo	- All metals are magnetic. - Magnetism and Gravity are the same thing.

Magnets and electromagnets

Key principles

Students need to know about bar magnets, build on learning from KS2 including field lines, plotting compasses and the Earth's magnetic field. Force acting at a distance (and as a vector quantity with size and direction). Draw field lines for attracting and repelling and direction is North to South. Link concept to using a compass.
Review electricity from year 7. Review and recap what electricity is/circuits. Introduce solenoid (electromagnet) and a current flowing through a wire induces (causes) a magnetic field around the wire. How to increase the strngth of the elecromagnet. The idea of the magnetic force being temporary (switch on and off). Brief introduction into motor effect.

KS2 prior learning

Students are familiar with bar magnets, magnetic poles., repling and attracting and magnetic materials

Links to other topics

(threads)
Particles
Forces
Electricity
Energy transfer and efficiency

Main learning aims

1. Description of a magnetic field and the plotting of one with a plotting compass
2. Describe magnetism as a non-contact VECTOR quantity
3. Draw field diagrams for attraction and repulsion
4. Solenoid description and how to increase the strength of an electromagnet
5. Investigating the temporary nature of an electromagnet
6. Brief introduction of the motor effect

Practical suggestions

Bar magnets/field lines
electromagnet

Unit: Y8 Establishing – Heating and Cooling	**Number of Lessons:** 13
Key Principles **Students need to be thinking of heat transfer at a particle level.** Students should be able to describe conduction, convection and radiation with confidence but the end of the unit. Conduction should be explained with reference to both particle arrangement in solids and free electrons in metals as they will have electron knowledge from electricity and particles. Heating and cooling should also be seen as an energy transfer from hotter to cooler areas. Students should develop their understanding of insulators reducing temperature loss and link this to contexts. Students should be able to calculate fuel costs and power ratings and link to efficiency.	**The Big Picture (Progression): At KS2 pupils should already have been taught to:** • distinguish between an object and the material from which it is made • identify and name a variety of everyday materials, including wood, plastic, glass, metal, water, and rock • describe the simple physical properties of a variety of everyday materials • compare and group together a variety of everyday materials on the basis of their simple physical properties • notice that light is reflected from surfaces • compare and group materials together, according to whether they are solids, liquids or gases • observe that some materials change state when they are heated or cooled, and measure or research the temperature at which this happens in degrees Celsius (°C) • identify the part played by evaporation and condensation in the water cycle and associate the rate of evaporation with temperature • recognise some common conductors and insulators, and associate metals with being good conductorscompare and group together everyday materials on the basis of their properties, including their hardness, solubility, transparency, conductivity (electrical and thermal), and response to magnets • give reasons, based on evidence from comparative and fair tests, for the particular uses of everyday materials, including metals, wood and plastic - **Links to other FUNDAMENTALS UNITS:** - Particles - Energy - Compounds - **Future links and progression into ESTABLISHING UNITS:** - Electricity and Magnetism [Electrical Conduction] - Forces and Energy 2 [Efficiency] - Ecosystems [Energy Transfer in Food Chains] - **Future links and progression onto KS4 UNITS** - **B1 – Transport and Enzymes** - Rate of Diffusion and Enzyme Denaturation

	- **B8 – Plant Structures and their Function** - Limiting Factors for Photosynthesis - Rate of Transpiration - **B9 –** Ecosystems - Changes of State & the Water Cycle - **C1 – Key Concepts 1** - Atomic Structure - **C3 – States of Matter and Mixtures** - Changing State and Cooling Curves - **C6 – Earth Science** - Global Warming and Climate Change - **C9 – Rates of Reaction** - Collision Theory - **C10 –** Chemical Energy Changes - Exothermic / Endothermic and Catalysts - **P4 – EM Spec** - Infra-Red - **P5 – Energy** - Sankey Diagrams and Efficiency - Payback time and Insulation - Latent and Specific Heat Capacity - Particle Motion in Gases - Energy Resources - **P8 – Electricity in the Home** - Current, Heating in Circuits and Thermisters - **P10 – Forces, Energy and Synoptic Links** - Dissipation Closed Systems and Energy - Efficiency and Lubrication

Possible Key Learning Points	**Skills**	**Prerequisites**

Key Learning Principles	**Key Skills Learnt**	**Students should already:**
- Description of conduction (including in metals), convection and radiation at a particle level - Heating and cooling in terms of energy transfer - Understanding of insulators reducing heat loss in different contexts - Calculation of fuel costs and power ratings linking to insulation and efficiency - Make links to careers with insulation (Engineering & Insulation Technician) **Interleaving:** - Particles and Particle Theory - Energy Stores and Transfers - Sankey Diagrams and Efficiency - Electricity Conductions and Insulations - Electrical Current (Hats Model) - Ecosystem Energy Transfers in Food Chains	- Literacy / Oracy: To understand and use new unit specific vocabulary effectively - Be aware of the dangers of heat - Draw tables of results and produce suitable graphs to display data - Formulate conclusions based on evidence collected - Develop fine motor skills and practical safety using heating equipment - Improved logic and problem-solving skills to fix practical issues - Teamwork and communication in practical work - Numeracy: Using negative values, calculating averages and recording times - Use and recall key units correctly - Creativity when building and insulated home - Independent learning during research- based home learning	- Be aware of basic laboratory safety when heating materials - Be aware substances can change states and that these a physical changes - Be able to name the 4 main changes of state with reference to water - Be able to compare and group materials according to their state of matter - Predict and measure temperatures with a thermometer in Degrees Celsius (°C) - Be able to compare different materials and recognize different materials as insulators and conductors [thermal + electrical] - Be aware of the term reflect in the context of light and possibly sound - Hold basic numeracy skills such as negative numbers, using a calculator and competency with simple mathematical processes (add, subtract, divide, multiply, calculate an average) Have key literacy skills such as suitable reading age - Be aware of the purpose of the curriculum and its links with Y8 Establishing and KS4
Subject Specific Language	**Pedagogical Notes**	**Make it Stick Activities**

Heat Temperature Degrees Celsius (°C) Fahrenheit Melting / Melt Freezing / Freeze Evaporating / Evaporate Condensing / Condense Subliming / Sublimation Deposition Melting Point / Freezing Point Boiling Point Conduction / Conduct Particles Solid / Liquid / Gas Collision / Collide Density / Dense Energy (Thermal and Kinetic) Average Convection Convection Current Expand / Contract Radiation Infra-Red Absorb Emit Transmit Reflect Matte / Shiny Insulation Payback Time Efficiency Percentage Thermometer	Heating and cooling is a topic that students will have been learning about from a very young age in KS2, exploring hot and cold is something children are innately aware in all materials. Be aware, they bring a lot of prior learning with them and most of it will be incorrect [see misconceptions below] and these foundations are often very difficult to shift to more correct understanding of the key principles. The concept of hot and cold substances is a simple scientific principle to grasp as students can feel the difference in 'temperature'; however, the difference between this and heat energy is not easily understood. Use the Bill Nye video or demo trying to melt a full ice cube with a match! Why won't this work? Heat is dependent on TOTAL energy of ALL particles of a substance. Whereas temperature is an average kinetic energy of these particles. Size matters after all! During the next lesson on changing state students will already have a lot of knowledge and most of it will be solid. Introduce sublimation and deposition with the most able. Students will not however; be aware of why substances do not change temperature when changing state. Link to chemical bonds here and Y7 FUNDEMENTALS Compounds. Freezing and forms bonds and this requires energy to be stored internally [chemical store of energy] and not dissipated as a loss of heat. From here onwards: you are discussing the 3 primary methods of heat transfer: conduction, convection and radiation. Students will have little knowledge of these terms but will have heard of conduction from Y7 FUNDEMTALS electricity and can simply make a connection. You could even ask pupils to compare both processes. Students may also be aware of radiation in terms of nuclear energy and this confusion should be addressed through short discussion of similarities and differences. Try to use of lots of practical's and demos	Tips for Teachers to Help Learning 'Stick' • Find someone who heat vs. temperature • Flipped home learning insulation research • Energy stores – Jenny's Bedroom (recap of Fundamentals) • Quick Quiz Mini Plenary • Post it Note Summaries • Cooling Curve Map from Memory • PEA Redrafting • Buy and Buy (Give one Get one) • Concept Cartoon • Conduction Teacher Demo (Superpower Hands) • Human Conduction Chain Demo • Flow Diagrams • Exit Tickets • Student Radiation Practical • Design and build and insulated home • IPad Research Marketplace • GCSE Payback time & efficiency questions • Game of Thrones Currency Conversion Challenge – Payback Times • Describe and Explain Practical Planning Sheet (KAT) • Careers in Heating and Cooling Videos • Metacognition Evaluation Hexagon Trail

	during these lessons and constantly referred to the differences between the processes as students tend to confused the terms conduction and convection. Towards the end of the module the flipped HL comes into play to assist students in designing and making their insulated home. I always introduce this early in the module to give a sense of meaning to learning and I always run this a competition with a small prize. When students are planning their building speak with the technicians to ensure the required resources are available for you lesson. Give students the list before planning and I often say “you can only use 3” or “you have £100 to spend” and run like a shop (e.g. sheet of tin foil is £2). This ensures students don’t use EVERYTHING and must think WHY they are choosing their materials. During the KAT give verbal scaffolding as students will likely not use conduction, convection and radiation well in their answer and this is where your feedback should be aimed towards. The amount of new terminology is difficult for students and pupils struggle to distinguish between the different heat transfers. Re-visiting is key terminology is essential to developing knowledge. Try to use quick quizzes and interleaved learning throughout. Students need to be reminded throughout the module how this topic links to Y7 Fundamentals ‘Particles and Energy’: as much confusion will still likely arise regarding the different forms of ‘Energy’ involved. Students will likely enjoy calculating payback times and efficiencies and therefore big this up as a GCSE concept to give students a true sense of achievement. Students often fear the maths of physics and this is a good opportunity to combat this misguided anxiety.	

	<u>Assessments:</u> Frequency in-class Live Marking throughout Unit Key Assessed Task Lesson 9 Students are to complete a 6-mark question in exam conditions after planning during lesson 9 [Insulation and the home] "Describe a suitable method for insulating a beaker of water and explain why this method is likely to be effective. Refer to conduction, convection and radiation". Work is to be marked *via* coded-marking and feedback to be completed by students in green pen. This assessment is vital in ensuring all pupils understand the key learning outlined in this topic. TA. End of Topic Assessment Lesson 10 30 Mark Total - Section 1: Quizlet Flashcards (AO1) – 10 Marks (PA) - Section 2: Seen Applications Questions (AO2/3) – 10 Marks (PA) - Section 3: Unseen Application Questions (AO2/3) – 10 Marks (TA) -	
Reasoning opportunities and probing questions	Suggested Activities	Possible Misconceptions
What is the difference between heat and temperature? Why do we need different scales for temperature? Which has more heat? Which object has more temperature? Why does a substance not change temperature during a change of state? What are the 3 main heat transfers?	- Comparing Different Tubes and their Materials – NASA Space Suit Challenge - Design and Build your Own Insulated Home Competition - Melting Steric Acid Cooling Curve Practical - Conduction Metal Rods Experiment - Convection Demos (possible class practical's here convection in beakers – making tea? Links to dissolving and diffusion)	Heat and Temperature are the Same Celsius and Fahrenheit are the Same Heat is a physical substance Temperature is a property of something (e.g. that metals are naturally cooler than plastic at room temperature) Hot and cold are different things Cold energy exists Cold is transferred from one object to another

Why can a single match not melt a full ice sculpture? Explain conduction? Explain convection? Explain radiation? Is Ketchup a solid, liquid or a gas Is H_20 a solid, liquid or a gas? Which states of matter would the following substances be at [_^oC]? How does heat travel through a solid? Explain why the metal spoon gets hot in the cup of coffee? What does Density mean? Explain which material will be the best for their new space suit? Why is it that houses in hot places are often painted white? Which type of insulation is the best to install?		Insulating materials are heat sources Some substances cannot heat up Objects that become warm readily do not become cold easily Hot objects naturally cool down You cannot get burnt by gases (only liquids and solids) Temperature is a measure of how much heat something has Boiling is the hottest something can get Boiling points are fixed (e.g. water at 100 degrees Celsius) The temperature of ice is 0 degrees Celsius Heat <u>always</u> rises / travels upwards Temperature can be transferred /stored Heating always results in an increase in temperature Insulators heat things up Bubbles always mean boiling Water cannot evaporate at less than 100 degrees Celsius Freezing only happens in the “negative numbers” Radiation is always bad All radiation is the same (heat vs. nuclear)

Heating and cooling

Key principles

Students need to be thinking of heat transfer at a particle level.
Students should be able to describe conduction, convection and radiation with confidence but the end of the unit. Conduction should be explained with reference to both particle arrangement in solids and free electrons in metals as they will have electron knowledge from electricity and particles.
Heating and cooling should also be seen as an energy transfer from hotter to cooler areas.
Students should develop their understanding of insulators reducing temperature loss and link this to contexts.
Students should be able to calculate fuel costs and power ratings and link to efficiency.

KS2 prior learning

Students are familiar with properties of materials and the terms conductors and insulators of heat but have not learnt this at a particle level.

Links to other topics

(threads)
Particles
Electricity
Energy transfer and efficiency
Habitats

Practical suggestions

Conduction
Covection
Radiation
Insulating

Main learning aims

1. Description of conduction (including in metals), convection and radiation at a particle level
2. Heating and cooling in terms of energy transfer
3. Understanding of insulators reducing heat loss in different contexts
4. Calculation of fuel costs and power ratings linking to insulation and efficiency

Unit: Y8 – Establishing – Reactions 1 Acids and Alkali	**Number of Lessons:** 9
Key Principles (from NC) **Students need to be thinking about reactions between chemicals creates a new product. Introduced to the measure of acidity/alkalinity by pH and neutralization reactions.** • chemical reactions as the rearrangement of atoms • representing chemical reactions using formulae and using equations • combustion, thermal decomposition, oxidation and displacement reactions • defining acids and alkalis in terms of neutralisation reactions • the pH scale for measuring acidity/alkalinity; and indicators • reactions of acids with metals to produce a salt plus hydrogen • reactions of acids with alkalis to produce a salt plus water • what catalysts do	**The Big Picture (Progression): At KS2 pupils should already have been taught to:** **YEAR 5** **Properties and changes of materials** • explain that some changes result in the formation of new materials, and that this k of change is not usually reversible, including changes associated with burning and the action of acid on bicarbonate of soda - **Links to FUNDAMENTALS UNITS:** - Particles - Chemical equations - Body systems - **Links to other ESTABLISHING UNITS:** - Reactions 2 - Reactions 3 - **Future links and progression onto KS4 UNITS** - Acids, electrolysis, Groups in the Period table, Key concepts 1, Key concepts 2

Possible Key Learning Points	**Skills**	**Prerequisites**

Key Learning Principles	**Key Skills Learnt**	**Students should already:**
• Identify properties of acids and alkalis (hazards and taste) • Identify common household acid and alkalis • Follow a method to produce an indicator safely • Describe and record observations accurately • Describe and recall the results of the use of different indicators • Recall the pH scale, identifying pHs of acids and alkalis numerically and colour of UI • Plan and carry out a neutralisation reaction • Determine the products of a neutralisation reaction • Determine the experimentally which salts are soluble and which are insoluble • Write word equations for neutralisation reactions **Interleaving:** Particles Compounds Chemical equations	- Literacy / Oracy: To understand and use new unit specific vocabulary effectively - Draw tables of results and produce suitable graphs to display data - Formulate conclusions based on evidence collected - Develop fine motor skills and practical safety using microscale equipment - Determining which equipment will give the most accurate measurements and most suitability for the reactions carried out - Improved logic and problem-solving skills to fix practical issues - Teamwork and communication in practical work - Numeracy: Measuring out volumes	- Be aware of basic laboratory safety when using any chemicals - Know that chemical reactions result in the creation of new substances, some of which are dissolved in solution and the hazards of which can change from reactants to product - Be able to record accurate observations - Hold basic numeracy skills such as using a calculator and competency with simple mathematical processes (add, subtract, divide, multiply, calculate an average) Have key literacy skills such as suitable reading age - Be aware of the purpose of the curriculum and its links with Y7 Fundamentals and 9 Establishing and KS4
Subject Specific Language	**Pedagogical Notes**	**Make it Stick Activities**

Acid Alkali Neutral pH base neutralization soluble insoluble indicator salt observation conclusion reactants products conical flask beaker pipette measuring cylinder	Students will have carried out various different chemical reactions during Year 7 although understanding the the nature and reason behind these reactions may not have been touched on. Students have built their knowledge on particles and the arrangement of particles in chemicals, being able to describe and identify compounds, elements, mixture and molecules and should be using this key language relatively confidently. This topic will introduce them in basic terms to acids and alkalis and the reactions that occur between them. This topic provides a good foundation for topics in GCSE such as acids and electrolysis where a sound understanding and ability to recall pH values are needed. It is also a good opportunity for students to practise their equation writing skills they were introduced to in the fundamentals topic. There are a lot of practical opportunities in this topic for students to gain confidence in choosing and using different laboratory equipment. <u>Assessments:</u> Frequency in-class Live Marking throughout Unit Key Assessed Task Lesson Students are to complete a planning task using the knowledge and understanding they have gained in lessons so far along with research done via home learning. This will be teacher assessed. Work is to be marked *via* coded-marking and feedback to be completed by students in green pen. This assessment is vital in ensuring all pupils understand the key learning outlined in this topic. TA. End of Topic Assessment Lesson 10 30 Mark Total - Section 1: Quizlet Flashcards (AO1) – 10 Marks (PA)	Tips for Teachers to Help Learning ‘Stick’ • Planning their own neutralisation investigation – applied to real life (indigestion) • Flipped home learning research • What’s the link? Acids vs alkali • Application to everyday life – which products are acid or alkali • Taste test • Red cabbage indicator • Investigating different indicators • Quick on the draw • Word equations • Rainbow fizz practical • True or false • Neutralisation practical, comparing indigestion medication • Planning sheet (KAT) • Data analysis and graph drawing • Beat the teacher • Memory slide • Making a soluble salt • Method storyboard

	- Section 2: Seen Applications Questions (AO2/3) – 10 Marks (PA) - Section 3: Unseen Application Questions (AO2/3) – 10 Marks (TA) -	
Reasoning opportunities and probing questions	Suggested Activities	Possible Misconceptions
What is an acid? What is an alkali? What is an indicator? What is a neutralisation reaction? How can we determine if a substance is an acid or an alkali? What pH is an acid? What pH is an alkali? What does soluble mean? What does insoluble mean? What is a salt?	-	All acids burn/ are corrosive Household products and what they contain Alkalis are not dangerous (because acids are) Concentration and strength are interchangeable All salts are table salt/sodium chloride All indicators turn acids and alkalis the same colour All indicators provide a range of colours. '=' sign in word equations Using beakers to measure volume All salts are soluble

Unit: Y8 – Establishing – Reactions 2: Combustion, Decomposition, Endothermic and Exothermic	**Number of Lessons:** 11
From NC: Chemical Reactions • chemical reactions as the rearrangement of atoms • representing chemical reactions using formulae and using equations • combustion, thermal decomposition, oxidation and displacement reactions Energetics • energy changes on changes of state (qualitative) • exothermic and endothermic chemical reactions (qualitative).	**The Big Picture (Progression): At KS2 pupils should already have been taught to:** Pupils should explore changes that are difficult to reverse, for example, burning, rusting and other reactions, for example, vinegar with bicarbonate of soda. - **Links to FUNDAMENTALS UNITS:** - Particles - Chemical equations - Energy - **Links to other ESTABLISHING UNITS:** - Reactions 2 - Reactions 3 - **Future links and progression onto KS4 UNITS** - Fuels, groups in the periodic table, key concepts 1, key concepts 2, rates of reaction, energy changes

Possible Key Learning Points	**Skills**	**Prerequisites**

Students should know what combustion is, the equation for it and why it is useful. Compare complete and incomplete combustion. Specifically teach oxidation as the gain of oxygen, using combustion as the example. Thermal decompostion- be able to describe and write word (and symbol) and review reactant and products in chemical reactions. Exothermic as energy being released, using a thermometer to observe temperature increase. Endothermic as energy being taken in (decrease in temperature) Allow students to develop practical competencies in carrying out methods/handling equipment and analysing results Ensure recapping of word, symbol and balanced equations throughout the topic. More able can review reacting masses/calculating RAM/RFM.	**Key Skills Learnt** • Literacy/Oracy: To understand and use new unit specific vocabulary effectively • Building on practical skills and safety in the lab • Determining which equipment will give the most accurate measurements and most suitability for the reactions carried out • Formulate conclusions based on evidence collected • Numeracy: balancing equations and calculating Mr • Interpreting challenging graphs (e.g. energy profile diagrams)	**Students should already:** • Be aware of basic laboratory safety when using any chemicals • Know that chemical reactions result in the creation of new substances, some of which are dissolved in solution and the hazards of which can change from reactants to product • Be able to record accurate observations • Hold basic numeracy skills such as using a calculator and competency with simple mathematical processes (add, subtract, divide, multiply, calculate an average) • Identify some signs of a chemical reaction
Subject Specific Language	**Pedagogical Notes**	**Make it Stick Activities**

Reactant Product Atom Molecule Compound Physical change Chemical change Equation Reversible Irreversible Conservation Combustion Incomplete combustion Thermal decomposition Endothermic Exothermic Energy profile diagram	Reactions 2 is a topic with a varying level of challenge. The beginning of the unit builds on the knowledge gained during the particles and reactions 1 topics and helps to reinforce the idea of a chemical change vs a physical change. There are many opportunities for developing practical skills, and the practical work should help students to visualise some of the abstract concepts discussed. Although some parts are challenging in theory (lessons 8 onwards in particular), if experimental data can be used this should make it easier for students. The main thread throughout the whole topic should be linking back to the idea that during a reaction, many things can change but fundamentally the number of atoms remains constant, and they just rearrange to form new products. **Assessments:** **Literacy Key Assessed Task possibilities:** Suggested KAT is to write up the combustion practical and analyse the results (Lesson 4 – may need to use 2 lessons to complete the practical and do the KAT). **End of Topic Assessment Lesson 12** 30 Mark Total • Section 1: Quizlet Flashcards (AO1) – 10 Marks • Section 2: Seen Applications Questions (AO2/3) – 10 Marks • Section 3: Unseen Application Questions (AO2/3) – 10 Marks	Tips for Teachers to Help Learning 'Stick' • Interleaving with other units (particularly particles and reactions 1) • Practical investigations into combustion, decomposition, energy changes • KAT to write up combustion practical • Flash cards • Real life applications of reactions included in powerpoints • Flipped HL • Literacy task • Mini quizzes
Reasoning opportunities and probing questions	Suggested Activities	Possible Misconceptions
What happens to an atom during a reaction? Is dissolving a physical or chemical reaction? How do you measure the mass of a gas? Where does energy for a reaction come from? What is a chemical bond?		All reactions are irreversible Atoms appear/disappear in reactions Gases have no mass Difference between reactions – e.g. displacement and combustion *Haven't taught this unit yet, will populate with more misconceptions when I go through it with students.*

Photosynthesis and respiration	Number of Lessons: 10
Key concepts First ensure interleaving of plant and animal cells including job of organelles- obviously with the aim of homing in on the chloroplasts and mitochondria. Both the photosynthesis and respiration equations must be memorised in word and symbol form- link these word equations clearly to them being chemical reactions. Teach both aerobic and anaerobic respiration including fermentation. MAKE EXPLICIT RESPIRATION ALSO OCCURS IN PLANTS. Review of leaf structure from diffusion. Factors affecting photosynthesis. Discuss photosynthesis in terms of the importance of green plants as producers and the reason why photosynthesis is so vital including the uses of the glucose produced. Could include the atmospheric changes due to evolution of green plants	**The Big Picture (Progression):** **At KS2 pupils should already know:** Students know main parts of a plant. They talk plant pollination and fertilization including the terms stigma, stamen and pollen. Will know the things plants need to grow and animals need to survive **At KS3 students should already know:** In fundamental diffusion students will have be taught the structure of the leaf in terms of adaptations for diffusion. They will have also covered the mechanics of breathing so should be aware that breathing is not respiration **Future links and progression onto other KS4 units:** B1 Transport and enzymes B2 Cells B5 Adaptation of capillaries and respiration are within this unit B8 Plant Structures and their functions

Possible Key Learning Points	Skills	Prerequisites
• Link to where occurs in organelles in cells • Equations and understanding of what they show/mean • Aerobic and anaerobic respiration including fermentation • Investigating factors affecting photosynthesis • Importance of photosynthesis in terms of products, food chains and evolution of the atmosphere (brief ideas)	Subject specific: Practical skill, following instructions to investigate products of fermentation Literacy: Memory story to help recall equations which must be learnt. Correct use of terminology and key words Numeracy: Interpretation of graphs for limiting factors of photosynthesis.	Students will be aware of the concept of photosynthesis from primary school and will have an understanding of what a plant needs to grow, however, this will be the first time they are introduction to the word equation. Respiration will have be mentioned in the fundamentals cells topic and students should be able to identify where in the cell respiration takes place. The word equation will now be introduced.
Subject Specific Language	**Pedagogical Notes**	**Make it Stick Activities**
Respiration Aerobic Anaerobic	The amount of new terminology is difficult for students. Formation of word equations for respiration and photosynthesis, use memory stories to aid retention of the reactants and products.	Additional starter and plenary quizzes based on key terminology: • True and false • Odd one out • Memory stories

Glucose Oxygen Carbon dioxide Water Energy ATP Lactic acid Fermentation Ethanol Photosynthesis Chloroplast Chlorophyll Diffusion Limiting factors Enzymes Denature	Breathing and respiration commonly mistaken as the same thing. Students have been taken through the process of breathing and the muscles involved in the ventilation of the lungs in fundamentals diffusion, this could be an interleaving opportunity and another chance to high the difference between breathing and respiration	
Reasoning opportunities and probing questions	Suggested Activities	Possible Misconceptions
• Do plants respire • Is respiration the same as breathing? • Do plants respire during the day? • How to plants get their source of glucose at night? • How do the reactants of respiration and photosynthesis get to cells? • Could you survive in a sealed bubble with only an apple tree?	• Memory stories • Venn diagrams • Fermentation practical	• Respiration is synonymous with breathing • Carbon dioxide, water, and minerals are food. • Plants use heat from the sun as a source of energy for photosynthesis • Sunlight is a food. • Sunlight is composed of molecules. • Sunlight is consumed in photosynthesis. • Plants absorb water through their leaves. • Plants produce oxygen for our benefit.

Unit: Y8 Establishing Body Systems	**Number of Lessons:** 12
Key Principles Students should begin to conceptualize the phenomenon of humans as multicellular organisms and their constituent units before beginning the topic. A 'zoom' into the structure and function of humans as multicellular organisms. Students should finish this unit competent in their knowledge of the structure and function of the building blocks of humans, including cells, tissues, organs, the circulatory, muscular and skeletal systems, as well as the role of enzymes in the digestive system. Students should be able to apply investigative techniques. These include the ethical and practical considerations when dissecting an organ, as well as the quantitative investigation of enzymes in digestion and the factors which affect them. Introduction to careers surrounding cardiothoracic surgery.	**The Big Picture (Progression): At KS2 pupils should already have been taught to:** - Recognise animals and plants as living organisms, including humans - Recognise that organisms grow through life cycles - Identify organs in the human body and plants - Describe the structure of the skeleton - Explain the function of muscles and joints - Understand the concept of circulation in a human - Understand the concept of food digestion in a human - Describe the function of teeth in digestion - **Links to other FUNDAMENTALS UNITS:** - Y7 Cells - [Structure, organelle function] - Y7 Diffusion - [Absorption of products from digestion] - Y8 Respiration and Photosynthesis - [Mitochondria/chloroplast function] - **At KS4 students should go on to learn:** - Y9 Microbiology - [Cellular structure, unicellular organisms, magnification] - Y9 Evolution and Genetics - [Genes, inheritance, cell specialization] - B1 Transport and Enzymes - [Enzyme principles, rates of reaction, factors affecting rates] - B2 Cells - [Cell structure, differentiation, specialization] - B5 Non-communicable Disease - [Cell/tissue/organ/organ system pathology] - B6 Communicable Diseases and Immunity - [Lymphocytes, phagocytes, cell/tissue/organ/organ system pathology]

Possible Key Learning Points	**Skills**	**Prerequisites**

Key Learning Principles	**Key Skills Learnt**	**Students should already:**
- Describe the structure of an animal cell - Describe the structure of a plant cell - Describe the relationships between cells, tissues, organs, organ systems and organisms - Describe the structure of the circulatory system - Explain the role of blood in the circulatory system - Explain the role of the skeletal system - Explain the role of the muscular system - Explain the role of enzymes in digestion - Explain how temperature and pH affect enzymes **Interleaving:** • Y7 Cells • Y7 Diffusion (Digestion) • Y8 Body Systems • Y9 Microbiology • Y9 Evolution and Genetics	- Literacy / Oracy: To understand and use new specific vocabulary effectively - Use and recall key units correctly - Understand how to draw basic animal and plant cells - Describe and define the structures and functions of composite building units of organisms in order of size: cell, tissue, organ, organ system, organism - Develop application of anatomical knowledge to different structures and functions from tissues to organ systems - Develop fine motor skills, practical safety and ethical considerations when dissecting - Develop practical methodology when investigating enzymes - Teamwork and communication in collaborative activities such as modeling and peer teaching - Creativity when modeling - Draw tables of results and produce suitable graphs to display data - Formulate conclusions based on evidence collected - Numeracy: draw bell-shaped curves of enzyme-catalysed reactions. Extension - calculate rate of reaction as rate = change/time - Independent learning during research- based home learning	- Be aware of basic plant and human organ systems with specific structures and functions - Be able to describe life cycles of plants and humans - Be able to identify organ systems and organs within organisms - Be able to identify relationships between organs and organ systems - Be able to define digestion - Hold basic numeracy skills such as negative numbers, using a calculator and competency with simple mathematical processes (add, subtract, divide, multiply) - Have key literacy skills such as suitable reading age - Be aware of the purpose of the curriculum and its links with Y7 Establishing and KS4

Subject Specific Language	Pedagogical Notes	Make it Stick Activities
Organelle Tissue Organ Organism Organ system Atrium Ventricle Valve Vessel Plasma Platelet Ligament Tendon Epithelial tissue Glandular tissue Biological catalyst Protease Lipase Amylase Amino acids Glycerol Fatty acids Starch Glucose Denature	Body systems is a topic that students will have been learning intermittently about from a very young age in KS2. Exploring body systems is something children are innately aware exists in larger (multicellular) organisms. Be aware, they bring a lot of prior learning with them and some of it will be incorrect and very difficult to shift to more correct understanding of the key principles – see misconceptions. This may require additional lesson time e.g. digestive system and enzymes. A significant focus of the topic is on microscopic structures which are not visible to the naked eye and therefore may appear more abstract to some students. Similarly, this mindset may also be hindered by availability of scientific equipment at KS2 e.g. microscopes. It is therefore recommended to use not only modeling to reinforce visual learning, but also real life visuals, such as the micrographs used throughout the scheme. Additionally, students may also struggle with the concept of enzyme-catalysed reactions speeding up and slowing down inside their living body, as opposed to a Science lab. Consequently, lots of students develop the misconception of enzymes being living organisms which 'die' when they denature, which needs to be repeatedly challenged. We therefore strongly recommend introducing the concept before focusing on visual and active learning through use of scientific modeling and investigation, before following up to explain data and world applications. Body systems as a topic contains some challenging semantics with umbrella terms and 'Matryoshka' words e.g. organ, organism, organ system. This can introduce misapplication of key terms and structure sizes. It is essential to continually reinforce accurate use of key terms and sizes through frequent low stakes assessment e.g. 6 AO1 starters and visual learning through modeling and dissection. Incorporating such pedagogy throughout encourages a higher level understanding of the relationships between structures and functions, providing a foundation to stretch into the pathology of such structures and functions. Students will be ethically challenged to handle organs with focus and respect. We recommend following a provided method whilst focusing on small, achievable goals to promote progress and student engagement e.g. labels. As some students will not be physically capable of engaging with gross anatomy, it is highly recommended to prepare alternative work for elsewhere within the classroom.	Tips for Teachers to Help Learning 'Stick' • Short AO1 fact recall 'flashcard' questions throughout e.g. starter • Continuous interleaving of class targets/core principles into AO1 fact recall questions e.g. define 'organ' • Focus on visual learning methods such as the heart dissection • Embed visual learning through use of device modeling • Continuous live-marking for immediate personal feedback, including stretch and challenge where appropriate • Create 'desirable difficulties' such as describing and explaining change in enzyme rate • Incorporate frequent, low stakes testing throughout, such as 'pens in pots' and 'hot seat' • Encourage collaboration and responsibility through strategies such as 'pens in pots' and 'hot seat' • Provide opportunities for elaboration, reflection after KAT and DIRT lesson after assessment • Explain to students how to troubleshoot their own problems. Don't do it for them – "Have you tried X?"

	Students will likely struggle with the enzyme bell curve showing both an increase and decrease on the same curve. We recommend reinforcing routine, small steps when describing and explaining data e.g. include both variables, describe the entire curve, back up with data. **<u>Assessments:</u>** **Frequency in-class Live Marking throughout Unit** **Key Assessed Task Lesson 3** Students are to complete a 6-mark question in exam conditions after planning during lesson 3 "Describe what happens to the energy from the battery in an electrical circuit" Work is to be marked *via* coded-marking and feedback to be completed by students in green pen. This assessment is vital in ensuring all pupils understand the key learning outlined at KS2 and reviewed in more detail in lessons 1-3. TA. **End of Topic Assessment Lesson 10** 30 Mark Total - Section 1: Quizlet Flashcards (AO1) – 10 Marks (PA) - Section 2: Seen Applications Questions (AO2/3) – 10 Marks (PA) - Section 3: Unseen Application Questions (AO2/3) – 10 Marks (TA)	
Reasoning opportunities and probing questions	Suggested Activities	Possible Misconceptions
What is a cell? What is a tissue? What is an organ? What is an organ system? Why do we need a circulatory system? Why do we need different types of valves? Why do arteries have thick walls? Why do veins have valves? Why are capillaries 1 cell thick? Do all organisms need blood? Why is the left side of the heart thicker? Why is the heart described as an organ? Why are humans considered to have a double-circulatory system? What is the function of the skeletal system? What is the function of the muscular system? How to the muscular and skeletal systems work	- 6 AO1 fact recall questions to start each lesson - Compare animal and plant cells recap - Map from memory – cells – tissues – organs – organ systems - organism - Modeling – cells – tissues – organs – organ systems – organism e.g. Cells = bricks, Organism = school - Modeling blood components - Heart dissection with accurate use of labels - Modeling antagonistic skeletal muscle pairs - Matching correct enzymes and substrates - Modeling enzyme digestion of substrates - Investigation into rate of enzyme-catalysed reaction and effect of temperature/pH - Time/digestion bell curve drawing – describe and explain	Nucleus is the brain of the cell All cells have a cell wall Plant cells don't need mitochondria There are 2 types of cell – animal and plant Ribosomes synthesise meat All organisms have blood All organisms have a heart The stomach absorbs nutrients The digestive system absorbs nutrients just for its own use Deoxygenated blood is blue Blood is just made from red blood cells Organelles are bigger than cells Organ systems are bigger than organisms Enzymes are alive and can die All enzymes digest all molecules Enzymes and substrates have the same shape As enzyme activity decreases after optimum, the

together? Why is the skeletal system considered an organ system? Why is blood made from more than just red blood cells? How do we separate the components of blood? Why might a person feel fatigued with anaemia or low red blood cell count? How do enzymes digest food? Why do we need different types of enzymes in our body? Why must our temperature remain constant? How might enzymes be used in industry? How might enzymes be used to remove stains? How might an enzyme inhibitor work?		temperature also decreases

Unit: Y8 Establishing – WAVES	**Number of Lessons:** 13

Key Principles (from NC)

Students need to be thinking about waves as transferring energy by radiation (link to FUNDAMENTALS ENERGY)

Sound waves

- frequencies of sound waves, measured in hertz (Hz); echoes, reflection and absorption of sound
- sound needs a medium to travel, the speed of sound in air, in water, in solids
- sound produced by vibrations of objects, in loud speakers, detected by their effects on microphone diaphragm and the ear drum; sound waves are longitudinal
- auditory range of humans and animals.

Energy and waves

- pressure waves transferring energy; use for cleaning and physiotherapy by ultra-sound; waves transferring information for conversion to electrical signals by microphone.

Light waves

- the similarities and differences between light waves and waves in matter
- light waves travelling through a vacuum; speed of light
- the transmission of light through materials: absorption, diffuse scattering and specular reflection at a surface

11

Science – key stage 3

- use of ray model to explain imaging in mirrors, the pinhole camera, the refraction of light and action of convex lens in focusing (qualitative); the human eye
- light transferring energy from source to absorber leading to chemical and electrical effects; photo-sensitive material in the retina and in cameras
- colours and the different frequencies of light, white light and prisms (qualitative only); differential colour effects in absorption and diffuse reflection.

The Big Picture (Progression): At KS2 pupils should already have

Light

Statutory requirements

Pupils should be taught to:

- recognise that they need light in order to see things and that dark is the absence of light
- notice that light is reflected from surfaces
- recognise that light from the sun can be dangerous and that there are ways to protect their eyes
- recognise that shadows are formed when the light from a light source is blocked by an opaque object
- find patterns in the way that the size of shadows change.

Sound

Statutory requirements

Pupils should be taught to:

- identify how sounds are made, associating some of them with something vibrating
- recognise that vibrations from sounds travel through a medium to the ear
- find patterns between the pitch of a sound and features of the object that produced it
- find patterns between the volume of a sound and the strength of the vibrations that produced it
- recognise that sounds get fainter as the distance from the sound source increases.

been taught to:

YEAR 3

YEAR 4

YEAR 6

- **Links to other FUNDAMENTALS UNITS:**
  - Particles
  - Energy

- **Future links and progression into ESTABLISHING UNITS:**
- Forces and Energy Y9
- Possible links to Earth and Atmosphere Y9
- **Future links and progression onto KS4 UNITS**
- B8 – Plant (Chlorophyll) Y11
- C6 – Earth Science – Climate Change Y10
- P2 – Waves Y10
- P4 – EM Spec Y10
- P5 – Energy Y10
- KS5 – BIOLOGY – rods and cones/vision

Possible Key Learning Points	Skills	Prerequisites
Key Learning Principles - Description of waves transferring energy not matter - Comparisons of longitudinal and transverse waves - Introduction of how to calculate wave frequency - Introduction of calculation of wave speed from frequency and wavelength - Making a pin-hole camera - Energy transfers in the ear/sound waves - Understanding white light and visible spectrum, including dispersion and refraction - Speed of light – standard form - Make links to careers - data	**Key Skills Learnt** - Literacy / Oracy: To understand and use new unit specific vocabulary effectively - Draw tables of results and produce suitable graphs to display data - Formulate conclusions based on evidence collected - Develop fine motor skills and practical safety using heating equipment - Improved logic and problem-solving skills to fix practical issues - Teamwork and communication in practical work - Numeracy: wave equation and standard form - Use and recall key units correctly - Independent learning during research- based home learning	**Students should already:** - Be aware of basic laboratory safety when using sound-making resources and using equipment refracting and reflecting light - Be aware of the term reflect in the context of light and possibly sound - Hold basic numeracy skills such as negative numbers, using a calculator and competency with simple mathematical processes (add, subtract, divide, multiply, calculate an average) Have key literacy skills such as suitable reading age - Be aware of the purpose of the curriculum and its links with Y7 Fundamentals and 9 Establishing and KS4

engineer and fibre optics **Interleaving:** - Particles and Particle Theory (sound waves) - Energy Stores and Transfers - Shadow forming and light travelling in straight lines (KS2)		
Subject Specific Language	**Pedagogical Notes**	**Make it Stick Activities**
Energy Wave Frequency Wavelength Amplitude Peak/crest Trough Speed Hertz (lambda) Compressions Rarefactions Transverse Longitudinal Cochlea Auditory nerve Ear drum Visible spectrum Refraction Dispersion Angle of incidence Angle of refraction	students will have been learning about the core principles of light and sound from a young age. The concept of 'waves' as something that transfers energy is a new concept introduced in Y8. Be aware, they bring a lot of prior learning with them and some of it will be incorrect [see misconceptions below] and these foundations are often very difficult to shift to more correct understanding of the key principles. The start of the unit introduces lots of new vocabulary and makes strong links to the Energy topic from Y7. This is a tricky phenomenon itself and met for the first time in Y7, so take time to make links an explore prior learning here. During the KAT give verbal scaffolding as students will likely not use the technical language well in their answer and this is where your feedback should be aimed towards. The amount of new terminology is difficult for students and pupils struggle to distinguish between the different wave types and application of the behaviour of light at a boundary. Re-visiting is key terminology is essential to developing knowledge. Try to use quick quizzes and interleaved learning throughout. Students need to be reminded throughout the module how this topic links to Y7 Fundamentals 'Particles (for sound) and Energy': as much confusion will still likely	Tips for Teachers to Help Learning 'Stick' • Find someone who transverse v longitudinal • Flipped home learning research • Energy Stores Review – from Y7 • Quick Quiz Mini Plenary • Post it Note Summaries • Map from Memory • PEA Redrafting • Buy and Buy (Give one Get one) • Concept Cartoon • Flow Diagrams • Exit Tickets • Refraction practical – links to fibre obtics • IPad Research Marketplace • GCSE Wave equation questions • Describe and Explain Practical Planning Sheet (KAT) • Careers in Engineering and fibre optics Videos • Find and fix • Metacognition Evaluation Hexagon Trail

	arise regarding the different forms of 'Energy' involved. Students will likely enjoy calculating frequencies and wave speed and therefore big this up as a GCSE concept to give students a true sense of achievement. Students often fear the maths of physics and this is a good opportunity to combat this misguided anxiety. <u>Assessments:</u> Frequency in-class Live Marking throughout Unit Key Assessed Task Lesson Students are to complete a 6-mark question in exam conditions after planning during lesson 9 Work is to be marked *via* coded-marking and feedback to be completed by students in green pen. This assessment is vital in ensuring all pupils understand the key learning outlined in this topic. TA. End of Topic Assessment Lesson 10 30 Mark Total - Section 1: Quizlet Flashcards (AO1) – 10 Marks (PA) - Section 2: Seen Applications Questions (AO2/3) – 10 Marks (PA) - Section 3: Unseen Application Questions (AO2/3) – 10 Marks (TA) -	
Reasoning opportunities and probing questions	Suggested Activities	Possible Misconceptions

What is the difference between energy and matter? What do waves do? What is light? What is sound? how do we hear sound? Describe white light Describe a vacuum Compare the speed of sound with the speed of light How are shadows formed? Describe the similarities between a speak and an ear drum Link frequency and speed Link wavelength and speed How do we see the colour red?	- Slinky demo/practical determination of waves speed - MfM - Sage and scribe - Calc of wave speed - Tuning forks/water - Air zooka - Speak/candle and bell jar - Speaker/microphone/oscilloscope for ear drum demo - Ear model - Reflections/refraction and dispersion practicals - Making a pinhole camera -	waves and energy are the Same waves involve 'matter' - and it is the wave moving an object (like boat on water), rather than the wave transferring the energy amplitude and frequencies are linked/or the same much easier for students to conceptualize the motion of a transverse wave compared to longitudinal amplitude is only about loud sounds (rather than energy transferred – large amplitude is a loud sound rather than large amplitude is more energy transferred. Students struggle to explain what happens if you cover an object making a sound (even if they can articulate particle vibrations) Sound being 'carried through the air' on molecules All radiation is the same (wave vs heat vs. nuclear) All waves 'radiating' energy is dangerous Waves eventually die out Very difficult to recognize light as an entity between a source and the effect is produces The light 'ray' is a model used to represent light (stream of photons – massless packets of energy with wave like properties) Darkness is separate to light (as with shadows – possibly similar to the misconception of 'cold') Shadows are 'reflections' of an object and should be the same size as the object Many have the concept that light is different to seeing – some may even believe light is intentionally designed to help us see – such as 'light helps us see' but is not essential – definitely links here to biology and rods and cones and effect of bleaching of photopigments Light transports the colours we see They can perceive light as strands like rope (often

		impacted by the way we draw light ‘rays’) – a strand of light going from A to B Many believe light bounces of a mirror but not off other surfaces The EMS as a continuous wave is very difficult to imagine more for GCSE in EMS topic)

Waves

Key principles

The big concept with waves is to link them to the transfer of energy.
Students should develop their understanding of the two types of waves and discuss them as longitudinal or transverse paying attention of direction of travel vs direction of energy transfer. They should develop their ability to draw ray diagrams and talk about the spectrum of light. They should investigate refraction and also look at the eye and pin-hole cameras. They should also develop a concept of visible range of sight and electromagnetic spectrum (simple idea).
For sound waves they should also develop understanding of the different parts of the ear and sound as vibrating particles. They need to be able to appreciate the speed of light and sound and how sound speed changes depending on the density of the material.
Students should develop their understanding of the wave properties- frequency, amplitude and wavelength including units. They should also learn the wave equation- wave speed = wavelength x frequency.

KS2 prior learning

Students are familiar with light - sources of light, how we see, mirrors and reflection and shadows. Sound key ideas are making and hearing sound, volume and pitch.

Links to other topics

(threads)
Energy
Particles
States of matter (density)

Main learning aims

1. Develop a concept of what a wave is and define longitudinal and transverse waves in terms of energy transfer
2. Draw ray diagrams of refraction and investigate the visible spectrum including lenses, the eye and cameras
3. Describe how sound travels and is processed in the ear
4. Understand frequency, amplitude and wavelength and calculate wave speed using the wave equation.

Practical suggestions

Anything suitable – including intro to KS4 core practs

Unit: Microbiology	Number of Lessons: 11
• Students must be able to use and name the parts of a light microscope. They should be able to describe the method for using a light microscope also. • Ensure students understand the concept of scale and magnification- introduce the units of mm, μm and nm and what those measurements mean. • Students should learn the different types of microbes and their size, cellular structure and function and examples of each- use the KS4 examples of each. • Students should be aware that not all microorganisms are pathogens and some are useful in different industries (for example bread-making, wine, cheese etc.) • Plate bacteria using aseptic technique- this is a KS4 core practical. • Students should learn about the parts of the immune system • Students must know about the immune response to pathogens entering the body (including phagocytosis and antibody production and action) • Students should be able to relate the immune response to vaccination and learn about (and be able to participate in) the current vaccination debate • Students should gain some knowledge of antibiotic resistance- in terms of the importance of taking a full course of antibiotics- and link to 'science for public understanding'	**Progression** **At KS2 pupils should already have been taught:** - Living things are classified into broad groups according to common observable characteristics and based on similarities and differences, including micro- organisms, plants and animals - Tooth decay is caused by bacteria **Links to FUNDAMENTALS UNITS:** • Cells • Body systems (immune) • Diffusion **Links to ESTABLISHING UNITS:** • Natural selection and genetics • Photosynthesis and respiration • Reproduction and health (pathogens) **Future links and progression onto KS4 UNITS** • Cells (B)- size, scale and units, microscopes • Genetics (B)- mutations • Cell cycle and variation (B)- variation, evolution, natural selection • Communicable diseases and immunity (B)- pathogens, defences, immune system, vaccinations

Possible Key Learning Points	Skills	Prerequisites
- Revise how to use and name the parts of a light microscope. - Concept of scale and magnification- introduce the units of mm, μm and nm. - Different types of microbes and their size, cellular structure and function and examples of each - Not all microorganisms are pathogens and some are useful in different industries - Plate bacteria using aseptic technique - Parts of the immune system - Immune response to pathogens entering the body (including phagocytosis and antibody production and action)	**Key Skills Developed:** - Literacy- to understand and be able to use new vocabulary effectively - Literacy- comprehension in case study activities - Oracy- communicate with others effectively during group discussions - Oracy- use oracy skills to develop and explore new ideas - Science/Numeracy- graph reading and predicting / extrapolating from data - Science/Numeracy- comparing graphs / curves - Science/Numeracy- size, scale and units- conversion between them - Science (practical)- using a light microscope / aseptic technique - Science- identify pathogens and know key features of each - Science- know how microorganisms can be used in industry	**Students should already:** - Know that living things are classified into groups based on similarities and differences- including micro- organisms - Know that tooth decay is caused by bacteria - Know the different types of cells and that they can only be seen using microscopes - Know that the body has different systems- including immune - Know that diffusion is the spreading out of particles from high to low concentration - Hold basic numeracy skills- including interpretting a graph - Have key literacy skills such as suitable reading age

- Immune response and vaccination- the current vaccination debate - Antibiotic resistance- importance of taking a full course of antibiotics		- Be aware of the purpose of the curriculum and its links with Y8 Establishing and KS4 (progression)
Subject Specific Language	Pedagogical Notes	Make it Stick Activities
- Stage / coarse and fine focusing wheel / clips / eyepiece and objective lenses / magnification - Millimeter (mm), Micrometer (μm) and Nanometer (nm) - Micro-organism / Pathogen / bacteria / virus / fungi - Yeast / culture - Antibiotics / penicillin / sterilise / inoculate / agar / incubate - Immune system / (chemical/physical) barriers - Phagocytosis / antibody / antigen - Immunisation / vaccine	Students will have learned how to use a light microscope during ***FUNDAMENTALS*** and should have good knowledge of the language to use. Here there should be links drawn to the ***Cells*** topic. Students will find it difficult to convert between units, given that it is an abstract concept; the conversion help sheet should help them to see how each unit relates to another. Students will likely think that micro-organism and pathogen can be used interchangeably- it should be highlighted that not all microorganisms can cause illness. Pathogens should be linked to the ***Health and Disease*** from ***ESTABLISHING***. The uses of microorganisms lesson can be linked to the ***Respiration and Photosynthesis*** topic; it should also be used to highlight that not all microorganisms are pathogens. When discussing the aseptic technique and antibiotics, students may struggle with carrying out the aseptic technique practical; a teaching assistant would be useful for this practical. This topic has good links to the ***Natural Selection and Genetic*** topics in ***ESTABLISHING*** and is later covered in KS4. Students will likely struggle with the terminology and key vocabulary in the lessons covering the immune system and phagocytosis- glossaries or working through definitions together may help with the stickability. This topic is covered again in KS4. During the debate of vaccines students should develop the skill of identifying evidence for/against a proposal and be able to use this to respectfully debate a topic. **Assessments:** - **Live marking of student work throughout unit** - Plenary's at the end of every lesson - Questioning- verbal and written - End of topic assessment: 30 Mark Total 1. Quizlet Flashcards (AO1) – PA 2. Seen Applications Questions (AO2/3) – PA 3. Unseen Application Questions (AO2/3) – TA	Tips for Teachers to Help Learning 'Stick' • Active learning methods: See suggested activities for detail • 'Desirable difficulties': Extension questions, questioning • Feedback: live-marking, questioning, home learning (SA FHL), EoT tests- SA/TA • Testing: AO1 questions as starters, questioning, plenary questions, plenary activies (**what if?, 321, produce a method for…, exam questions, traffic lights, practice questions, pens in pots**) • Reflection/elaboration: class discussions, SA, DIRT • Interleave: cells. Body systems, diffusion, natural selection, photosynthesis and respiration, reproduction and health

Reasoning opportunities and probing questions	Suggested Activities	Possible Misconceptions

- How might you use a microscope? - Why might you need to use a microscope? - Why did you do 'x' step? - Who might use a microscope? - Why might microscopes be useful when studying microorganisms? - What do units allow you to see? - What are the 3 types of microorganisms? - How does this topic link to others? - Are all microorganisms pathogenic? - How might we use microorganisms? - What are antibiotics? - When might you use antibiotics? - Why is it important to sterilise the inoculating loop? - Why is it important to disinfect the area you are using / your hands? - How could your plate be used to decide which antibiotic to use? - What do our results tell us? - What might happen if you don't take a full course of antibiotics? - How do pathogens spread? - How does our body stop us being infected with a pathogen? - What is happening here using your own words? - What is phagocytosis? (after animation) - What does the word specific mean? - Why do we have vaccinations? - What do you think vaccinations do? - Why do you not get ill after a vaccination? - Why are you not immune to all pathogens once you have been vaccinated? - Why might some people not want to be vaccinated? - What makes evidence effective? - Why is this piece of evidence better? - Is this fact or opinion? Why?	- Students have used light microscopes during ***FUNDAMENTALS***- this lesson is designed to reinforce the method for using them as this is a key skill required at KS4. The lesson can also be used to reinforce that microorganisms can only be seen using a microscope. This is done by students ***labelling a light microscope*** to test their prior knowledge. Students will then use ***words into pictures*** as a delivery method for the method, Students will then ***use light microscopes*** followed by ***writing a method***. - Students need to understand the relative size of microorganisms and be able to convert between different size units. ***A match up*** as the starter will allow students to see the relative size of bacteria. An explanation of how to convert between units with ***worked examples*** followed by ***practice questions*** will allow students to develop this skill. - Students must know about the different types of pathogens- ***Corners*** starter will allow students and teacher to establish prior knowledge/thinking. The ***jigsaw task*** followed by ***Go Compare*** will allow students to learn about the 3 different types of pathogens. - Students need to understand how we use microorganisms in industry- ***practical work making bread dough*** will allow students to see microorganisms in action (yeast). The ***video*** explains how bread rises and the ***words into pictures*** allows students to reinforce how microorganisms are used in industry. - Students need to understand what antibiotics are- the ***video and questions*** allows students to understand what antibiotics are used for. The ***aseptic technique practical*** is used to allow students to understand how the effectiveness of different antibiotics can be tested***.*** ***Change-reduce-change*** allows students to develop a method for the aseptic technique. - Students learn about antibiotic resistance using ***teacher explanations and questioning*** using diagrams. There is then a ***storyboard*** for students to complete. This is recovered at KS4. - Students must learn about the defences of the body. This is taught using a ***diagram that students label***. There is then an opportunity for students to ***annotate*** the ***diagram further*** using information provided. - The ***video*** of phagocytosis allows students to describe what is happening in their own words. ***Teacher explanations and questioning*** followed by a ***video explanation*** allows students to correctly understand what phagocytosis is before explaining it in their own words. - After establishing what specific means, making a ***model of antibodies and antitoxins*** allows students to understand why antibodies/antitoxins are specific to one microorganism. ***Change-reduce-change*** allows students to explain the process of neutralising pathogens. - ***Words into pictures*** allows students to develop an understanding of how vaccinations work. ***Analysis of the graphs***, including ***gap-fills***, allows students to understand why you do not get ill once you have been vaccinated. This can then be linked to the previous lesson on specificity as you are not immune to all pathogens after a vaccination. - ***Analysis of news articles*** introduces that some people do not agree with vaccinations. ***Sorting the facts from opinions*** and then establishing whether it is ***for or against*** vaccinations allows students to develop an understanding of what makes good/effective evidence. The ***debate*** allows students to learn how to use evidence effectively. The ***Diamond 9*** then explicitly allows students to establish why one piece of evidence may be better than another.	- All microorganisms are pathogenic - When you covert units, the size of the object changes - Antibiotics can be used to treat all infections - Vaccines make you ill - Phagocytes eat pathogens

George Stephenson High School Unit Overview: Science

Unit: Year 9; Earth and the Atmosphere	**Number of Lessons: 12**

Key Principles
 	
Students will explore the composition of the earth and its atmosphere, and how the processes occurring within them shape the earth's surface and its climate.
 	
Heat from the earth's core causes movement of molten rock.
This leads to movement of the plates that form the earth's crust, creating volcanoes and earthquakes.
 	
The solid surface is constantly changing through the formation and weathering of rock; the rock cycle.
 	
Carbon is an essential element of life. It moves from the atmosphere and oceans into organisms and back again via processes of photosynthesis and respiration.
 	
The carbon cycle balances carbon in the atmosphere vs rocks and in turn controls the earths temperature.
Like a thermostat.
 	
Human activity is altering this natural balance.
 	
Amount of carbon in the atmosphere is greatly increased; global climate impacted.
	Science Learning Journey Progression
	Links to KS2
	• **Yr 1;** Everyday materials; identify and name different materials linking physical properties to use
	• **Yr2**; Uses of everyday materials
	• **Yr3**; rocks learning linked to volcano topic;
	  ○ Compare and group together different types of rock on basis of appearance and physical properties
	  ○ Describe in simple terms how fossils are formed when things that have been living are trapped within rock
	  ○ Recognize that soil is made from rocks and organic matter
	  ○ Exploration of seasonal change
	• **Yr4**; recognize that environments can change, and this can pose danger to organisms.
	  ○ States of matter; materials change state when they are heated or cooled
	  ○ Processes of the water cycle
	  ○ Importance of protecting the environment
	  ○ Human impact on food chains and webs.
	
	Links to Fundamentals
	• Particles, Compounds, Energy, Equations
	Links to Establishing
	• Reactions 2, Mixtures and Separating, Heating and Cooling, Photosynthesis and Respiration
	Future links to KS4
	• Biology; Ecosystems and Material Cycles; The Carbon Cycle
	• Chemistry; States of Matter, Bonding, Metals extraction, The Atmosphere, Greenhouse Effect, Climate change
	
	Geography
	yr 8 Coasts yr 9 Rivers; erosion, deposition, transportation. Carbon Cycle

Possible Key Learning Points	Skills	Prerequisites

• Activating prior learning and experience • Structure of the earth • Types of rock • The Rock Cycle • Earth's resources and recycling • The Carbon Cycle • Composition of the atmosphere • Human impact	• Applying concept of water cycle to the processes involved in rock and carbon cycle • Literacy link Ext and In prefixes to other keywords exothermic/exit/exoskeleton/external/internal/ • Literacy / Oracy: understand and use subject specific vocabulary effectively • Modelling processes, appreciating the limitations • Numeracy; identify circumstances that indicate fast processes of change on Earth and slow. • Numeracy; % composition of our atmosphere • Numeracy; evaluation of pollution or other environmental data • Numeracy; using data to evaluate proposals for recycling materials. • Communication; ideas are conveyed clearly both in written and verbal work (literacy and oracy)	• An understanding of cyclical change • Appreciation of material uses being directly linked to physical properties • Link physical properties with chemical constitution • Soil formation from the breakdown of larger rocks and organic matter • Effect of heating and cooling on substances • General awareness of environmental issues of global warming and finite resources • Be able to name key substances soil, rock, pebble, limestone, marble, slate
Subject Specific Language	Pedagogical Notes	Make it stick activities
• Atmosphere • Core • Crust • Mantle • Uplift • Burial • Compression • Deposition • Erosion • Weathering • Cementation • Metamorphic • Sedimentary • Igneous • Magma/Lava • Extrusive/Intrusive • Porous • Mineral • Ore • Photosynthesis • Respiration	Important to focus on rock cycle as a model to show the relationships between rocks and their formation and avoid students talking about rocks being formed by the rock cycle. Rock classification depends on formation processes overview of physical appearance characteristics must be taken and linked to formation processes. To avoid misconception eg. Holes/pores sedimentary when is in fact pumice and igneous. Students must appreciate that each stage of a cyclical process is crucial especially the carbon cycle. Disruption of one part disrupts the whole. Understanding of the carbon cycle is crucial to build on for understanding of global warming. Whilst students may have sound experience of bits of the cycle how they fit together and link to climate change must be established. Least known area is what happens after organisms die and the place of decomposers.	• Real life links; NASA mars explorers • Real life links; Careers; engineering • Map from memory • Rock webquest • Fundamentals Flashback; Interleaving of fundamentals • Quick quizzes • Microsoft forms fast feedback quiz •

• Resource • Finite • Carbon footprint • Greenhouse effect • Global warming • Climate change • Process • Extraction • Carbon sink • Mitigation (geography use)	<u>Assessments:</u> Frequency in-class Live Marking throughout Unit Key Assessed Task Lesson Students are to complete a 6-mark question in exam conditions after planning during lesson 9 Work is to be marked *via* coded-marking and feedback to be completed by students in green pen. This assessment is vital in ensuring all pupils understand the key learning outlined in this topic. TA. End of Topic Assessment Lesson 10 30 Mark Total • Section 1: Quizlet Flashcards (AO1) – 10 Marks (PA) • Section 2: Seen Applications Questions (AO2/3) – 10 Marks (PA) • Section 3: Unseen Application Questions (AO2/3) – 10 Marks (TA)	
Reasoning opportunities and probing questions	Suggested Activities	Possible Misconceptions
• How do we know that climate is changing? • How far have we drilled into the earth? • Why are so many children having days off school to protest about climate change? • What does any of this have to do with me? • How bad is climate change? • What can I do? • What do cows / eating beef have to do with climate change?	• Modelling; Salol crystals practical to show effect of cooling time on crystal size • Modelling; chocolate or wax rock cycle • Timelapse photos showing weathering/erosion of rock formations • Use of local examples; Marsden Rock, Bass Rock, The Pits, Whin Sill, why settlements and Hadrian's wall built where they were. • UK rocks • Rock samples to observe; • Quizlet live; topic flashcards; AO1 recall	• Discrepancy between geological and everyday use of key terms. • Discrepancy between human and geological time frames. • All rocks are the same and it is hard to tell how they originated. • Rocks and minerals are the same thing • The rock cycle provides a continuous supply of new rock

• Why is do people think the world might flood? • Why do some people not believe climate change is a problem? • How do we know global warming is real? • How do we know that the human population is impacting the climate? • How has global warming already affected the world? • Who is Greta Thunberg?	• Home made “shakers” sugar cubes in plastic cup or rocks/sand/pebble mix in a bottle.	• Description of certain physical features can detract from linking characteristics to formation processes. • Rocks are always being pushed upwards • Humans make more changes to the earth than the rock cycle. • The rock cycle is the cause of rock formation rather than a model representing relationships and processes. • Carbon dioxide causes ozone depletion and this is why global temperatures are rising due to suns rays getting through holes. • Carbon dioxide is taken in by the plant roots and exhaled back into the atmosphere by animals. • The Greenhouse Effect is bad

Unit:Y9 FORCES AND ENERGY	Number of Lessons: 13
• Linking FUNDAMENTALS topics Forces and Energy and building on these key principles. Relating Energy to force and reviewing scalar and vector quantities ▪ moment as the turning effect of a force ▪ forces: associated with deforming objects; stretching and squashing – springs; with rubbing and friction between surfaces, with pushing things out of the way; resistance to motion of air and water ▪ forces measured in newtons, measurements of stretch or compression as force is changed ▪ force-extension linear relation; Hooke's Law as a special case ▪ work done and energy changes on deformation **Pressure in fluids** ▪ atmospheric pressure, decreases with increase of height as weight of air above decreases with height ▪ pressure in liquids, increasing with depth; upthrust effects, floating and sinking ▪ pressure measured by ratio of force over area – acting normal to any surface. • • **Physical changes** ▪ conservation of material and of mass, and reversibility, in melting, freezing, evaporation, sublimation, condensation, dissolving ▪ similarities and differences, including density differences, between solids, liquids and gases ▪ Brownian motion in gases ▪ diffusion in liquids and gases driven by differences in concentration ▪ the difference between chemical and physical changes.	**The Big Picture (Progression):** **At KS2 pupils should already know:** Pushes and pulls Gravity, frictional forces (air and water), magnetic force, levers, pulleys and gears Contact and non-contact forces Y2 □ find out how the shapes of solid objects made from some materials can be changed by squashing, bending, twisting and stretching Y5 **Forces** **Statutory requirements** Pupils should be taught to: ▪ explain that unsupported objects fall towards the Earth because of the force of gravity acting between the Earth and the falling object ▪ identify the effects of air resistance, water resistance and friction, that act between moving surfaces ▪ recognise that some mechanisms, including levers, pulleys and gears, allow a smaller force to have a greater effect. **Links to other FUNDAMENTALS UNITS:** Particles and density (to a lesser extent) Energy – as objects interact (objects exert equal and opposite forces on each other), energy is transferred **Links to progression into ESTABLISHING UNITS:** Magnetism Forces and Energy 2 **At KS4 students go on to learn:**

Balanced forces

- opposing forces and equilibrium: weight held by stretched spring or supported on a compressed surface.

Forces and motion

- forces being needed to cause objects to stop or start moving, or to change their speed or direction of motion (qualitative only)
- change depending on direction of force and its size.

- Careers lesson linking

Forces 1

Forces and motion including D-t and V-t graphs and use of gradient to calculate acceleration. Area under v-t graph to calculate distance and associated equations
N 1st and 2nd Law. Inertial mass and resultant forces and associated equations

Acceleration and force **core practical**
Forces in springs. Spring constant and associated equations
Stretching a spring **core practical**

Forces 2

Particles and density and density **core practical**
Gravitational field strength, mass and weight and associated equations
Circular motion
N 3rd Law and equilibrium
Momentum and large accelerations and force and associated equations
Stopping distances and reaction time
Electricity, magnetism and the motor effect

Forces, Energy and Synoptic Links

Links to Free Body Diagrams, Vectors and Interacting Forces (Newtons Laws)

Links to FUNDAMENTALS ENERGY UNIT:

The Big Picture (Progression): At KS2 pupils should already have been taught to:
- Understand electricity as a 'type' of energy
- Construct simple electrical circuits
- Describe everyday uses of electricity
- Understand light as a 'type' of energy - misconception
- Understand sound as a 'type' of energy - misconception
- Suggest scientific ideas as hypotheses
- Follow the scientific process to plan investigations and gather evidence to draw conclusions

Links to other FUNDAMENTALS units:
- Forces - can result in energy transfers
- Particles – kinetic energy and random movement of particles

Links to progression into ESTABLISHING units:
- Waves as a transfer of energy without matter
- Heating and cooling as heating is a transfer of thermal energy causing an increase in temperature
- Reactions 2 – endothermic/exothermic reactions involving transfer of thermal energy
- Respiration – release of chemical and thermal energy
- Forces and Energy - relationship between balancing forces and energy transfers
- Magnetism – as a store of energy

At KS4 students should go on to learn:
P5 Energy
This scheme focuses on application of energy stores and transfers to closed systems.
Introduces concept of dissipation and balanced transfers:
GPE – KE.
KE – ½ x m / v2.
GPE – m x h x g
M – m x v
F – change in momentum/time
P10 Forces, Energy and Synoptic Links
Core practical investigating thermal energy

Possible Key Learning Points	Skills	Prerequisites
 **Interleaving:** Particles (atomic structure/atomic mass) link to 'mass' of objects and ideas of density linked to forces acting on an object. Energy transfers and stored. Units of energy and forces Scalar and vector quantities	Literacy/oracy accurate use of key words during class Q and A sessions and within written answers Literacy KAT – compare Accurate spelling of key words Numeracy Recording data in appropriate tables Plotting graphs – scales and axis Recall and use formula s= d/t Recall and use units accurately Practical Creativity Designing a bridge/boat from limited resources/application of key principles from topic Flipped Home Learning Interpersonal Team-work and communication skills during building lessons	As above – KS1 and 2 prior learning: General understanding of a forces as a push or a pull. Forces act on objects Basic understanding of frictional forces including air and water resistance. Gravity and Magnetism as a non-contact force Gravity as a 'force' (not quite correct) linked to size of planets/solar system
Subject Specific Language	Pedagogical Notes	Make it Stick /GREENZONE Activities

Force Weight (as a force due to gravity) Mass Newton (N) Kilogram/Gram (kg/g) Gravity Friction Balanced force Unbalanced force Resultant force Air resistance Energy Joules Moment Lever Pivot Pressure Hydraulic pressure Force magnifier Elastic potential energy Elastic or plastic Elastic limit Limit of proportionality	Forces is a topic that students will have been learning about from a very young age, exploring friction and gravity is some of the earliest learning children have. Be aware, they bring a lot of prior learning with them and some of it will be incorrect and very difficult to shift to more correct understanding of the key principles. Forces is difficult because, as with many scientific phenomena, you can't really see them, you can 'feel' them and you do experience them, so it is important to keep bringing the learning back to those tangible, concrete examples as you move from the concrete through to abstract learning. As with most science topics, the amount of new terminology can be tricky. Students struggle to distinguish accurately **<u>Assessments:</u>** Regular in class live marking throughout the unit **KAT lesson** – compare mass and weight literacy assessment. (differentiated task with scaffolding support available) This is a key are for assessment as the principle is fundamental to understanding. It is a key misconception/difficult concept to understand, so early exposure should help secure learning for KS4 KAT can be marked with coded marking or whole class feedback and feedback by students completed in green pen **End of unit assessment** 15 flash cards to learn via quizlet/paper copies Seen application question used in class to ensure students understand concepts and to demonstrate modeling and decoding of the question (metacognition)	Starter for 5 (recall questions) Interleave particles topic – density Desirable difficulties including a variety of challenge options - 'chilli challenge' KAT and DIRT opportunities Metacognitive mediators to plan, monitor and evaluate own thinking processes Low stakes assessment through recall and interleaving approaches 5/3 and similar challenge tasks using the range of questions

	Final Assessment (30 marks) Section 1 – flash cards 10 marks (AO1) - PA Section 2 – seen application question 10 marks (AO2/3) - PA Section 3 – unseen application question (KAT to assess understanding of unit as a whole) 10 marks (AO2/3) - TA	
Reasoning opportunities and probing questions	Suggested Activities	Possible Misconceptions
What is a force? What forces can we see? What forces can't we see? Do we need forces to keep something moving/keep something still? Can anything float? What are the forces acting on a ball being thrown in the air? Can you describe Newtons 1st Law? What does it mean? How can you use N 1st law to describe the motion of an object that is still/moving at a constant speed/getting faster/getting slower? How can a free body diagram show us N 1st Law? Is anything weightless? What happens to you mass/weight if oyu go to the moon? Why does your weight change on the moon? Why does your mass stay the same, but your weight change if you went to the moon? What	• Starter for 5 (fast 5 recall questions) each lesson • Placemat consensus • Oracy talk partners • Observing forces in the classroom. Identifying balanced and unbalanced forces. • Drawing Free Body diagrams • Calculating resultant forces and applying Newton's first law. • Investigating the relationship between mass and weight – collecting data/plotting graphs • Interpreting/describing distance time graphs • Plotting D-t graphs • Literacy – compare mass and weight • Designing and testing a bridge and a boat from limited resources. Applying key learning • Calculations involving s = d/t. Including rearranging if appropriate • Exactly guess the weight of the chocolate bar and you can keep it to enforce difference between weight and mass.	Newton's first Law is in two parts, students find the 'continue to move at a constant speed' when forces are balanced counter intuitive. It 'feels' like the object should only be still or getting faster/slower. If something is moving there is only one force acting on the object in the direction of the movement Constant motion requires a constant force applied Confuse mass and weight Gravity as the force (weight is the force due to gravity actin on the mass of an object) There is no gravity in space Confusing forces and energy as the same thing Units for mass and gravity g and N Stopping distance as a time. Describing 'thinking distance' and 'braking distance' as the time taken to stop rather than the distance travelled. Heavier objects fall faster than lighter ones

Why does it say ‘keep your distance’ on motorway signs? What would happen to the stopping distance if the road was wet? How would drinking alcohol/being tired effect the thinking distance? How would worn/damaged tyres effect the braking distance?		

Forces and Energy

Key principles

Students need to be able to build on key ideas from the yr 7 forces topic.

Moments

Begin with the key principles of moments to include investigating and apply the equation moment = force x distance. Review and retrieval of ideas of scalar, vector linking to direction of moment. Linking balanced and unbalanced to the clockwise motion of moments.

Elasticity

Moving onto elasticity and an opportunity to review and retrieval of energy store transfers, especially the key terminology and descriptions, introducing work done as energy transferred. Use Hook's law to investigate force and extension, developing idea of elastic limit (seen in KS4). This concept begins to formulate understanding of equilibrium and Newton's 3rd Law. Students need to develop understanding of N3, building ideas from the concrete (balanced forces) to the abstract (equilibrium, starting to link N1, N2 and N3 – seen in KS4).

Pressure

Students need to investigate and apply p = f/a and to use Pascal and N/m2 as SI units. Use particle theory to explain atmospheric (gas) pressure and the relationship with height above sea level. Use particle theory to explain liquid pressure and the relationship with depth. Linking water pressure to up thrust; making things float (linking back to equilibrium) .

KS2 prior learning

Students are familiar air resistance and water resistance and simple mechanism for turning forces and pivots. Levers and gears. Small force can cause a large effect.

Links to other topics

(threads)
Particles
Forces
Energy transfer and efficiency
Body systems – antagonistic muscles

Main learning aims

1. Investigating moments
2. Investigating elasticity
3. Investigating pressure
4. Linking fundamental ideas for balancing forces and energy transfers throughout.

Practical suggestions

Many practical activities – see Laura

George Stephenson High School Unit Overview

Unit: KS2 Linking	**Number of Lessons:** 12
Key Principles Students should learn: The key aspects of laboratory work including the scientific method including: variables, writing hypothesis, following and creating methodologies, drawing and analyzing results tables/graphs as well as writing simple conclusions and evaluations The unit has a theme of retrieval and metacognition throughout with a dedicated lesson on both Students will also explore scientific literacy and how to spot 'fake scientific news' and select appropriate information sources. Students will also take a look at some obscure scientific careers and challenge some stereotypes about scientists in society. Students will complete a diagnostic assessment reviewing all of Y7 Fundemental's to inform staff seating and interleaving.	**The Big Picture (Progression): At KS2 pupils should already have been taught to:** **Key stage 1 programme of study – years 1 and 2** **Working scientifically** **Statutory requirements** During years 1 and 2, pupils should be taught to use the following practical scientific methods, processes and skills through the teaching of the programme of study content: ▪ asking simple questions and recognising that they can be answered in different ways ▪ observing closely, using simple equipment ▪ performing simple tests ▪ identifying and classifying ▪ using their observations and ideas to suggest answers to questions ▪ gathering and recording data to help in answering questions.

Lower key stage 2 programme of study

Working scientifically

Statutory requirements

During years 3 and 4, pupils should be taught to use the following practical scientific methods, processes and skills through the teaching of the programme of study content:

- asking relevant questions and using different types of scientific enquiries to answer them
- setting up simple practical enquiries, comparative and fair tests
- making systematic and careful observations and, where appropriate, taking accurate measurements using standard units, using a range of equipment, including thermometers and data loggers
- gathering, recording, classifying and presenting data in a variety of ways to help in answering questions
- recording findings using simple scientific language, drawings, labelled diagrams, keys, bar charts, and tables
- reporting on findings from enquiries, including oral and written explanations, displays or presentations of results and conclusions
- using results to draw simple conclusions, make predictions for new values, suggest improvements and raise further questions
- identifying differences, similarities or changes related to simple scientific ideas and processes
- using straightforward scientific evidence to answer questions or to support their findings.

Upper key stage 2 programme of study

Working scientifically

Statutory requirements

During years 5 and 6, pupils should be taught to use the following practical scientific methods, processes and skills through the teaching of the programme of study content:

- planning different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary
- taking measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate
- recording data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs
- using test results to make predictions to set up further comparative and fair tests
- reporting and presenting findings from enquiries, including conclusions, causal relationships and explanations of and degree of trust in results, in oral and written forms such as displays and other presentations
- identifying scientific evidence that has been used to support or refute ideas or arguments.

Links FUNDAMENTALS UNITS:

This unit links to all of the Y7 Fundamentals SoW and underpins all subsequent units from now until A-Level as it builds upon the foundations of the Scientific Method and 'Working Scientifically' SoW at KS2

Possible Key Learning Points	Skills	Prerequisites
Key Learning Principles Identify the hazards and risks in practical work in science and how to control them Complete simple practical's safety and collect accurate data, write simple hypothesis and test conclusions with evidence collected Draw simple graphs and tables and draw conclusions from these Undertake suitable research and analyse the reliability of sources Research scientific careers Learning about scientific literacy and how poor scientific literacy impacts your future Challenge stereotypes on 'What is a Scientist' Retrieve and recall key principles from Y7 Fundamentals **Interleaving:** Y7 Fundamental's Topics 0. LINKING from KS2 1. PARTICLES 2. ENERGY 3. CELLS 4. COMPOUNDS 5. FORCES 6. DIFFUSION 7. CHEMICAL EQUATIONS 8. ELECTRICITY 9. ENVIRONMENTAL BIOLOGY	**Key Skills Learnt** - Literacy / Oracy: To understand and use new unit specific vocabulary effectively - Draw tables of results and produce suitable graphs to display data - Formulate conclusions based on evidence collected - Develop fine motor skills and practical safety when using measuring cylinders, thermometers, and more - Improved logic and problem-solving skills - Teamwork and communication in practical work and hats model - Numeracy: Calculating averages and taking readings - Use and recall key units correctly - Creativity when designing methods - Independent learning during research- based home learning - Retrieval and recall skills - Scientific literacy and metacognition - Kind peer assessment and feedback - Evaluating sources of information	**Students should already:** **KS2 Curriculum Content from National Curriculum Guidelines Above** Students should have good understanding of the following Y7 Fundamental's 0. LINKING from KS2 1. PARTICLES 2. ENERGY 3. CELLS 4. COMPOUNDS 5. FORCES 6. DIFFUSION 7. CHEMICAL EQUATIONS 8. ELECTRICITY 9. ENVIRONMENTAL BIOLOGY - Hold basic numeracy skills such as negative numbers, using a calculator and competency with simple mathematical processes (add, subtract, divide, multiply) - Have key literacy skills such as suitable reading age - Be aware of the purpose of the curriculum and its links with Y8 Establishing and KS4 Units
Subject Specific Language	Pedagogical Notes	Make it Stick Activities

Protons, Neutrons, Electrons Cells Energy Scientific Literacy COVID-19 Vaccination Reliability Source Metacognition Planning, Monitoring, Evaluation Atom / Element Carnivore Diffusion Mass / Weight Vacuole Careers Sweat Evaporation Temperature Thermometer Conical Flash Secretion Gland Absorb Heat of Vaporization Calories Litre / Cm3 Energy Axis E.Coli Petri/Agar Stereotypes STEM	**Please note**: you will need to book IT facilitates twice during this module so get this done in advance (the careers lesson and diagnostic assessment are flexible and do not need to occur at set times/order to facilitate easier booking) **Pedagogical Notes** Everything taught in the module should be a recap and review of KS2 working scientifically curriculum AND the Y7 Fundemental's Curriculum to get all students to the same 'Fundamental Level' before starting the Y8 Establishing Curriculum. As pupils will often gain a new teacher in Y8 the KS3 Diagnostic Assessment should be undertaken to inform planning such as seating and assist with interleaving of poorly understood topics. This will be more important than ever with the impact of remote learning. Please keep in mind that pupils will need VERY CLEAR expectations during all practical work and to keep your expectations as high as possible – no second chances with goggles etc. Always give very clear practical guidance and I suggest completing practical work in a step-by-step / repeat after me style (use of visualizer?). At the end of the module pupils should not really have learnt any new content. The aim is to retrieve and review as well as practice fundamental working scientifically skills; this should be the focus. These skills include: scientific literacy, metacognition, making synoptic links, retrieval skills, understanding of available science careers and practical work.	Tips for Teachers to Help Learning 'Stick' • Create 'desirable difficulties' • Provide constructive feedback (mostly live marking and verbal feedback during practical work) • Incorporate frequent, low stakes testing during starter and plenary activities • Provide opportunities for elaboration, reflection after practical work/analysis • Explain to students how to troubleshoot their own problems during practical work. Don't do it for them – "Have you tried [this]? "Where do you think this piece of equipment might be kept" • Find and Fix • Diamond ranking • Debates and discussion

	Try to give out lots of praise / LORIC for safe practical work and attempts at using scientific principles during discussion (oracy) or showing signs of true metacognition. **<u>Assessments:</u>** **KS3 Diagnostic Assessment to be completed at any point through the unit – See DJN for link (do not duplicate the form so all Y8 data is centralized)** The diagnostic assessment will be feedback to you should be used to inform seating arrangements and interleaving from Y7 as you progress through the Establishing Units	
Reasoning opportunities and probing questions	**Suggested Activities**	**Possible Misconceptions**
Metacognitive questions should be the focus of the unit: What makes a reliable source of scientific information; how can you tell? What makes a good scientific questions / hypothesis? Is this safe? How could it be made safer? Why do you think this happened? What might this piece of equipment be used for? How could you make that measurement more accurate? Is this the best piece of equipment to use in the lab for this? Why not? Why did you choose to do this like this?	Use of something current in the scientific literacy lesson (once COVID-19 is outdated would of course be more useful) to show how lots of adults misinterpret scientific information.	Students may present numerous misconceptions throughout the unit; being especially prevalent in the find and fix and making links lessons. You may also find some media biased misconceptions in the Science Literacy Lesson; such as Bat Soup and Market theories – try to keep the conversation on vaccines wherever possible to alleviate this (remove bat soup source for groups who may take things a little too far – however, this source is included to show lack of relevance. Any misconceptions that do present themselves should be corrected (but always praise good attempts!). During the practical work lesson, be very specific with YOUR use of language to explain variables and the pieces of equipment used – correct pupils on misuse (e.g. beaker/conical flask).

1. Do I see patterns in what I did? 2. Were the strategies & skills I used effective for this assignment? 3. How did my mindset affect how I approached my work? 4. Did I do an effective job of communicating my learning to others? 5. What have I learned about my strengths and my areas in need of improvement? 6. How am I progressing as a learner? 7. What can/should I do next? 8. How can I best use my strengths to learn? 9. What steps should I take or resources should I use to meet my challenges? 10. How can my learning environment be improved?		

Unit:	Number of Lessons:
Mixtures and separating	AV: 12

Possible Themes and Key Learning Points	**Links to KS4 Topics**	**Links to KS2 Topics**
Describe renewable and non-renewable sources of energy Compare sources of energy Describe how electricity is generated Evaluate sources of energy Describe how energy is transferred between stores Calculate energy costs Calculate efficiency	Hydrocarbons Pollutants Cracking The atmosphere and greenhouse effect Climate change Energy transfers and systems Work done and power	Plants as fossil fuels Everyday materials and their uses Seasonal changes Rocks and fossils Living things and their habitats Electricity- circuits
Subject Specific Language	**Interleaving Opportunities with Other Topics**	**Green Zone Activities**
Energy Electricity Power Cost Jules Kilojules Watts Kilowatts Renewable Non-renewable Fossil fuels Greenhouse gases Oil/petrol/gas/methane/nuclear Biomass/wind/solar/tidal/wave Thermal/chemical/kinetic/gravitational potential/elastic potential Dissipate Input/Output Displacement Deformation	Electricity circuits Light Sound Relationships in an ecosystem Energetics Earth and atmosphere Fuel costs Domestic fuel bills and uses Heating and cooling energy transfer Work done (force x distance)	Evaluating fuels Evaluating energy resources – global decisions Comparing device efficiencies and costs

Reasoning opportunities and probing questions	Skills including practical and numeracy	Possible Misconceptions
What is energy? Where does the energy go? Which fuel/device is most efficient? Which energy resource is most appropriate under a certain circumstance? How could you compare the efficiency of 2 energy resources?	Efficiency = (useful output/non-useful output) x 100 Equation rearranging Comparing fuels practical Data analysis Reducing costs Percentages	Heat is temperature Energy is lost, not dissipated Energy in humans is chemical, not food Energy is force
Scheme of work	**Content to be condensed from KS2**	**Content to be included from KS4**
Original: Fracking Sources of energy Comparing fuels practical Fossil fuels Making electricity x 2 Renewables Making global decisions x 2 Energy transfer Making local decisions Assessment Therapy **New:** Energy and types Fossil fuels Making electricity Greenhouse effect and climate change Comparing fuels plan Comparing fuels practical Renewable energy resources Making choices Energy transfer Sankey diagrams and Efficiency Assessment Therapy for previous assessment		Climate change/greenhouse effect Practical variables Efficiency Power