KS2-KS3 linking

Key principles

KS2 prior learning

Links to other topics
(threads)

Main learning aims

Practical suggestions

Particles

Key principles

Particle zoom – small to big/big to small
It is essential that students develop their idea of atomic structure and particle theory and density which unpins their science learning throughout yr 7-11
They need a solid understanding of what the PT represents in terms of RAM, AtN, p,n,e
Competency in using ideas of particle theory and use appropriate models to demonstrate understanding

KS2 prior learning

What S,l and g are
States of matter
Basic sep techniques
Reversible reactions

Links to other topics

(threads)
Everything! Must be taught first

Practical suggestions

Main learning aims

1. Atomic structure
2. periodic table and elements
3. density
4. Atomic number, RAM

Sub atomic particle with charges and relative masses

Energy

Key principles

Introduction to the phenomena of energy. Develop ideas of conservation of energy (not created or destroyed) and energy transfers and stores (8 potential). 4 types of energy transfer (mechanically, electrically, heating and radiation). Energy transfer diagrams including scale (Sankey) and link to the idea of 'efficiency' (not efficiency calculation)
Energy resources – non-renewable and renewable all linked to energy transfer and advantages and disadvantage
Generating electricity from fossil fuels and renewable energy resources

KS2 prior learning

Energy as a concept was removed from primary science. They do investigate heat transfer with different materials (conductors and insulators)

Links to other topics

(threads)
Particles
Food chains and webs
Respiration/photosynthesis
electricity
Chemical reactions
Nutrition
Waves

Main learning aims

1. What is energy? Where did it come from?
2. Conservation of energy (transfer and stores)
3. Efficiency and Sankey diagrams (energy diagrams)
4. Energy resources

Practical suggestions

Nb – any energy circus need to focus on these transfers – clear language of energy

Cells

Key principles

From the big to the small (like particle zoom. Start with tangible knowledge - the body/plant)).
Going through from organism – organ system – organ – tissue and then cell and then parts of the cell once they have established that they 'know' what a cell is.
Need to know the cell structure, organelles and function both for plants and animals (nucleus, cell m, cytoplasm, mitochondria, ribosomes and chloroplasts, large vacuole and cell wall).
Develop ideas of specialization. Sperm, egg, different blood cells, ciliated, palisade and guard. Focus on organelle adaptations.
Unicellular organisms: Euglena and Amoeba
Microscope parts and the magnification calculation (in preparation for KS4 core practical)

KS2 prior learning

Food types, organs in the digestive system, muscular and skeletal system (big ideas in biology)

Links to other topics

(threads)
Particles
Energy
Diffusion and osmosis
Body systems

Main learning aims

1. Big ideas first – organism – cell organisation to the cell (plant and animal)
2. Cell structure and function
3. Specialised cells
4. Microcopes and magnification

Practical suggestions

Microscopes

Compounds

Key principles

Building on from the particles topic. Understanding of what a bond is. Elements are chemically bonded together, this involves electrons. Begin to develop the idea that energy is required to make and break bonds. Begin to develop idea of conservation of mass using word equations including understanding of reactant and products. Students will develop practical competence in chemical reactions.

KS2 prior learning

What S,l and g are
States of matter
Basic sep techniques
Reversible reactions
Irreversible reactions

Links to other topics

(threads)
Particles
Acids and alkalis
Energy

Main learning aims

1. Definition of a compound
2. Bonding involving electrons (not ionic or covalent)
3. Conservation of mass
4. word equations

Practical suggestions

Forces

Key principles

Introduction to the phenomena of forces, starting with the idea of forces, balanced, and unbalanced
Basic introduction to Scalars and vectors, students should proficient in identifying examples from KS4 Y10 physics A. Balance and unbalanced forces with calculating the resultant force and introduce Newton and his first law to be able to describe what will happen to the motion of the object. Students need to develop understanding of mass, weight and air resistance and their skills in drawing free body/vector diagrams (keep the diagrams simple to 2 opposite forces only). Speed/velocity s=d/t (rearrange) and d-t and v-t graphs – which will require development of graph skills (scales, axis etc)

KS2 prior learning

Pushes and pulls
Gravity, frictional forces (air and water), magnetic force, levers, pulleys and gears

Links to other topics

(threads)
Particles
Magnetism
Motor effect/electricity
Hookes law/elastic limit

Practical suggestions

Main learning aims

1. Scalar and vector
2. Resultant force – Newton's first Law
3. Free body diagrams – application of forces in practical
4. Air resistance
5. D-t and v-t graphs

Diffusion

Key principles

This is now where we start to draw on the earlier principles (particles, cells energy). The students need to be able to describe and explain how substances move into and out of cells in different parts of the body (big to small again).
Key idea of what concentration of solute means is key so students can self-discover the link between movement and concentration. Introduce idea of Brownian motion (random movement of particles) Definition of diffusion including an understanding of concentration (solute) gradient (passive, not requiring energy) and net movement of particles. Emphasis linking to processes in the body involving cell membranes (lungs, intestine, leaf)
No reference to osmosis at this stage.
Mechanics of breathing – how the lungs, rib cage and diaphragm enable inhalation and exhalation (RESPIRATION IS NOT BREATHING)

KS2 prior learning

Very little in terms of particle theory. KS2 links to big biology. Food types, organs in the digestive system, blood

Links to other topics

(threads)
Particles
Energy
cells
osmosis
Body systems

Practical suggestions

Main learning aims

1. Concentration
2. Definition of diffusion
3. Links to the body and cell membrane and plants and the stomata
4. Mechanics of breathing

Equations

Key principles

Students will familiar with products, reactants and word equations from the compounds topic, this topic then needs to build on symbol equations, including the use of state symbols. Students should be looking to develop an understanding of balancing equations at this point.
Students should finish the topic feeling confident in using their Ar knowledge from particles to then use the symbol equations to work out the Mr of the compounds.
Students should develop their practical skills throughout this unit.
The students will do a specific unit based on specific reactions and products next year.

Practical suggestions

KS2 prior learning

Students have not talked about reactions in scientific terms but know that reactions happen and signs they are occurring.
Looked at reversible and irreversible.
Students know what S,L,G are

Links to other topics

(threads)
Respiration and photosynthesis
Digestion
Acids and Alkalis
Reactions
Electrolysis
Compounds
Particles

Main learning aims

1. Writing symbol equations for reactions
2. Balancing equations
3. Using state symbols
4. Calculating Mr

Electricity

Key principles

Students should begin to conceptualize the phenomenon of electricity and what it is before beginning the topic. A 'zoom' into what is happening in an electrical wire and the current that flows.
Students should finish this unit competent in their knowledge of the electrical units of amps, volts, ohms and what they are a measure of. The students should also think of voltage as potential difference with an explanation of change in voltage.
Students should be aware of the rules in terms of current and voltage for series and parallel circuits.
Students should develop an understanding of what is meant by resistance- i.e. the 'slowing' of the current.
Students should also use the formula of charge = current x time.

KS2 prior learning

Electricity is a type of energy
Circuit diagrams and symbols
Conductors and insulators in terms of testing materials
Switches and their meaning to on/off circuits
More voltage = brighter bulb

Links to other topics

(threads)
Particles
Energy
Magnetism and induction
Electrical formula at GCSE

Practical suggestions

NB. Access to electrical equipment is important but not for basic circuits as in KS2

Main learning aims

1. Units of electrical measurements of resistance, voltage (potential difference) and current
2. Rules of series and parallel circuits in terms of voltage and current
3. Understanding of resistance
4. Calculation of charge from current and time

Environmental Biology

Key principles

Students need to understand that everything interacts and human interacts have a much wider impact on populations and the environment.
Key ideas include food webs and the transfer of chemical energy
This moves onto pyramids of numbers and biomass and predator prey relationships and competition. Students need to be aware of the importance of interdependencies and the impact population changes will have.
Students need to link adaption, variation and evolution to environmental changes and human impact such as plastics and bioaccumulation. Students need to be able to interpret data relating to populations
Students need to be aware of different types of variation and the causes and be aware of genetic mutations. They should be able to link this to adaptations and evolution

KS2 prior learning

Classification
Vertebrates/invertebrates
Using keys
Protecting environments
Adaptation
Variation
Evolution
fossils

Links to other topics

(threads)
Particles and Energy
Cells and osmosis
Body systems
Genetics - cloning/mutations (GCSE and yr 9)
Earth sciences
Ecosystems and material science (GCSE

Practical suggestions

Main learning aims

Interactions between organisms
Interpretation of relationships such as food webs, pyramids, graphs
Human impact
Adaptations linked to genetic mutations

Unit: Environmental Biology	Number of Lessons: 11
• Students need to understand that everything interacts and that human interactions have a much wider impact on populations and the environment. • Students must develop an understanding of the impacts of specific human activities on global ecosystems • Students will develop an understanding of the possible reasons as to why we may be having a greater impact on the environment than ever before • Key ideas include food webs and the transfer of chemical energy- students must understand that the arrows on a food chain or web represent the transfer of chemical energy. • This moves onto pyramids of numbers and biomass and predator prey relationships and competition. Students need to be aware of the importance of interdependencies and the impact population changes will have. • Students need to link adaption, variation and evolution to environmental changes and human impact such as plastics and bioaccumulation. Students need to be able to interpret data relating to populations. • Students need to be aware of different types of variation and the causes and be aware of genetic mutations. They should be able to link this to adaptations and evolution.	**<u>Progression</u>** **At KS2 pupils should already have been taught:** Classification • Be able to group and classify organisms into groups (e.g. mammals, reptiles) Vertebrates/invertebrates • Know the difference between vertebrates and invertebrates Producing food chains • Be able to construct food chains and understanding that arrows represent an organism "being eaten" • Use the terms "producer", predator" ad "prey" • Understand the terms "carnivore", "herbivore" and "omnivore" Adaptation / Evolution / Fossils • Know about the concepts of "adaptation" to an environment and "evolution" over time • Understand that habitats provide for the basic needs of an organism (and what the basic needs of living things are) **Links to other FUNDAMENTALS UNITS:** • Particles • Energy • Cells- Body systems • Diffusion- respiration **Future links and progression into ESTABLISHING UNITS:** • Microbiology- variation and mutations • Photosynthesis and respiration • Electricity- use of fossil fuels • Earth and the atmosphere • Natural selection and genetics **Future links and progression onto KS4 UNITS** • Genetics (B)- mutations • Ecosystems and Material Cycles (B)- human impact, conservation biodiversity • Earth science (C)- climate change, greenhouse effect • Energy (P)- Conservation of energy, Sankey diagrams

Possible Key Learning Points	Skills	Prerequisites

<table>
<tr>
<td>
- All ecosystems are interconnected
- (A range of) Human activities are causing (damaging) changes to the planet's ecosystems
- The possible reasons why human impacts are increasing (e.g. overpopulation)
- The benefits of using food webs over food chains and that arrows represent the flow of chemical energy
- The use of pyramids of numbers and pyramids of biomass as other ways of representing populations
- The differences between pyramids of numbers and pyramids of biomass and the potential benefits / limitations of both
- Understand how adaptation may lead to some species surviving when others do not
- The different types of variation understand how differences arise within populations (i.e. mutations)
- Understand or have knowledge of the theory of evolution
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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- producing graphs/graphics to represent data
- Science- understand the interconnectedness of the planet's ecosystems
- Science- predict the potential effects of removing a single species from an ecosystem
- Science- Produce food webs from written information
- Creativity- develop novel solutions to the problem of producing a food web
- Science- predict the effect of human activities of the planet's ecosystems
- Science- understand how predator/prey relationships occur and predict the outcomes or increasing / decreasing population numbers
- Science- Predict the outcomes if an organism is no longer well adapted to its environment
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<td>
Students should already:
- Be able to group and classify organisms into groups (e.g. mammals, reptiles)
- Know the difference between vertebrates and invertebrates
- Understand the terms "carnivore", "herbivore" and "omnivore"
- Be able to construct food chains and understanding that arrows represent an organism "being eaten"
- Use the terms "producer", predator" ad "prey"
- Know about the concepts of "adaptation" to an environment and "evolution" over time
- Understand that habitats provide for the basic needs of an organism (and what the basic needs of living things are)
- Hold basic numeracy skills- including interpretting a graph
- 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 (progression)
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<tr>
<td>Subject Specific Language</td>
<td>Pedagogical Notes</td>
<td>Make it Stick Activities</td>
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<tr>
<td>
- Vertebrate / invertebrate
- Carnivore / herbivore / omnivore
- Ecosystem / habitat
- Producer / predator / prey
- Primary /secondary consumer
- Chemical energy
- Interdependency
- Overfishing / deforestation / invader species
- Biodiversity / Extinction
- Overpopulation
- Competition
- Biomass
- Adaptation / evolution / variation
</td>
<td>
Students have learned about "habitats" from KS1. They will understand adaptation to the environment but, even if they have a limited understanding of it, will struggle with the concept of evolution and that it can take thousands (if not millions) of years.

Students will likely not consider the interconnectedness of ecosystems and will think that one ecosystem has no impact on other. The same may also be true for food chains/webs; they will have been used to displaying this information in a chain (with arrows representing "being eaten") but introducing food webs can help to show the reliance of predator/prey relationships for maintain an ecosystem. Students also now need to refer to "the flow of chemical energy".

Students will likely have a limited knowledge of the problem of plastic pollution and may understand about the rising global population. Students now need to be able to link the rapidly changing environment (caused by human activities) to extinction due to a lack of adaptation.
<u>Assessments:</u>
- 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
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Tips for Teachers to Help Learning 'Stick'
• Active learning methods: See suggested activities for detail
• 'Desirable difficulties': Varied difficulty levels when using information, Extension questions, complex map-from-memory, questioning
• Feedback: live-marking, questioning, home learning (SA FHL), EoT tests- SA/TA
• Testing: AO1 questions as starts, questioning, plenary questions, plenary activities (331, gap fill, 321, exam questions)
• Reflection/elaboration: group discussion (Voice21- roles), class discussions, SA, DIRT
• Interleave: energy
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	2. Seen Applications Questions (AO2/3) – PA 3. Unseen Application Questions (AO2/3) – TA	

Reasoning opportunities and probing questions	Suggested Activities	Possible Misconceptions
- What is a habitat? - Are habitats separate? - Do organisms in a habitat stay separated? - Doesn't an ecosystem stay the same? - What can cause changes to an ecosystem? - What are the effects of these changes? - What might the disadvantages of a food chain be? - Why might food webs be better? - What might happen if just 1 organism goes extinct? - What might the effect of introducing a new predator be? - In what ways are humans having an impact on their environment? - Why are humans having an impact on the environment? - What does "X" mean? - Why might this organism go extinct? - What are the similarities / differences between pyramids of biomass / number? - Why might this species no longer be well adapted? Effect? - Why can't organisms just adapt to their new environment?	- Students will have some knowledge of habitats and what habitats may contain to support life- they now need to extend their understanding to think about how these habitats (and the organisms they contain) interact and influence each other in an "ecosystem". This is done by students ***constructing food webs*** followed by ***discussions*** and/or activities where ***changes are made to food webs*** and students have to ***predict immediate and wider outcomes***. - Students should have knowledge of the terms "carnivore", "herbivore" but should now begin to use the terms "primary consumer", "top carnivore" and "omnivore" etc. There is a lot of key vocabulary that students need to learn and be able to use during this topic- ***quick recaps*** during lessons or ***producing glossaries*** may help with this. There are also opportunities for students to ***predict definitions*** of terms. - Students need to understand that humans are having an impact on the planet's ecosystem- this is done using ***videos with questions*** and ***gap fill activities***, as well as ***comprehension from case studies***. - Students need to understand why the human impact may be growing in terms of the overpopulation of humans. This involves analyzing graphs, usually ***through discussion*** with ***peers*** and the ***class*** as a whole, developing students' abilities in data analysis. This topic then requires students to ***SUGGEST*** how increased human activities are leading to damage to the planet. This idea of "suggesting" ideas is revisited during establishing, preparing students for KS4 and beyond. - The particular issue of plastic pollution is addressed using ***group discussions*** and then a ***3-3-1*** plenary where students must come up with their own paragraph before ***selecting the most relevant information*** - Students learn about predator-prey relationships using a ***map-from-memory*** of graphical representations of this. These graphs are revisited at KS4. In the same lesson, students use ***dingbats*** to work out what organisms might compete for. These concepts are revisited at KS4. - Students use ***comparison tables*** to understand the differences between pyramid of numbers and biomass. ***Venn diagrams*** or ***double bubble*** activities may also be used here. - ***Group discussions***, ***answering*** key questions (following ***whole-class discussions***) are used to investigate the concept of adaption to a changing environment. - ***Dingbats*** are used in order to present the definition of variation before ***students gather information*** for themselves on (dis)continuous and genetic / environmental variation. - Students use their ***research-based home learning*** about evolution to ***answer questions*** and then use ***iPads to research species*** that are good evidence for evolution.	- Ecosystems are not connected - Food chains show organism "being eaten" - Predators only ever have one prey - An organism going extinct nearly always leads to the collapse of a food chain - Humans are only affecting Earth by increasing greenhouse gases - Adaptation to the environment can happen over a few years or instantly

Unit: Y7 Fundamentals Cells	Number of Lessons: 11
Key Principles Cells and organisation • Recognise cells as the fundamental unit of living organisms, including how to observe, interpret and record cell structure using a light microscope • The functions of the cell wall, cell membrane, cytoplasm, nucleus, vacuole, mitochondria and chloroplasts • The similarities and differences between plant and animal cells • The role of diffusion in the movement of materials in and between cells • The structural adaptations of some unicellular organisms • The hierarchical organisation of multicellular organisms: from cells to tissues to organs to systems to organisms.	**The Big Picture (Progression): At KS2 pupils should already have been taught to:** • identify and describe the functions of different parts of flowering plants: roots, stem/trunk, leaves and flowers • identify that humans and some other animals have skeletons and muscles for support, protection and movement • recognise that they need light in order to see things and that dark is the absence of light • describe the simple functions of the basic parts of the digestive system in humans • describe how living things are classified into broad groups according to common observable characteristics and based on similarities and differences, including micro-organisms, plants and animals • give reasons for classifying plants and animals based on specific characteristics • identify and name the main parts of the human circulatory system, and describe the functions of the heart, blood vessels and blood **Links to other FUNDAMENTALS UNITS:** • Particles (for reference to scale of size) • Diffusion • Environmental Biology **Future links and progression into ESTABLISHING UNITS:** • Body Systems • Respiration and Photosynthesis **Future links and progression onto KS4 UNITS** **B2 – Cells** **B3 – DNA & Genetic Engineering** **B4 – Cell Cycle & Variation** **B8 – Plant Structures & Their Functions**

Possible Key Learning Points	Skills	Prerequisites

Defining organisms, systems, organs Fundamental similarities and differences in animal and plant cells Basic cell structure and function of organelles Specialised cells, their adaptations and roles Examples of unicellular organisms The importance of a light microscope How to prepare and view slides on a light microscope Calculations involving magnification	Literacy - many new key words to learn and spell correctly in the topic – particularly organelles. Opportunity to write a practical method for using the microscope Numeracy – rearranging a simple formula, using division and multiplication, prefixes and standard form Main practical skills will be working with the microscopes. Opportunity for independent research within the unit, particularly when looking at unicellular organisms	As above in 'big picture' section
Subject Specific Language	Pedagogical Notes	Make it Stick Activities
Cell Cell membrane Cell wall Mitochondria Cytoplasm Nucleus Chloroplast Ribosome Vacuole Organ System Root hair cell Nerve Cell Red blood cell White blood cell Palisade cell Bacteria Amoeba Microscope Lens Focusing wheel Eyepiece lens Objective lens Magnification Actual size Image size	Cells is a great topic for questioning given the knowledge students already have about the human body and plants from KS2. The aim with the flow of this topic is to start big, using what students will already know, about organisms, recapping what a living thing is (revisiting MRS GREN), and then to gradually look at the smaller units which make up an organism. The concept of cells may be challenging for students, but by starting off with something tangible like a person, or a plant, and exploring organs, cells, and organelles in sequence, it should prove more logical to students compared to jumping straight in with an abstract idea like cells. Encourage lots of questions about the scale of size – particularly with it being taught around the same time as the 'particles' topic where students having just learned about the size of an atom. Many students will question whether a cell is bigger or smaller than an atom, so it's important to make clear that cells are made up of atoms, roughly 100 trillion per cell, and are therefore considerably bigger. Worth pointing out that there are roughly equivalent numbers of atoms in a cell as there are cells in a human body to get an idea of scale. **Assessments:** **Literacy Key Assessed Task possibilities:** KAT is to consolidate practical skills, describe how to prepare a slide to view onion cells. Alternatively, you could get students to write about 'similarities and differences between plant and animal cells' or have	Starter for 5 (recall questions) Hot seat Interleave particles topic – size of atoms/particles Lots of questioning and debate Challenge tasks KAT and DIRT opportunities Independent research and peer assessment Metacognition Revision of flash cards

	them write about adaptations of specialized cells, and how that supports their function. **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	
Reasoning opportunities and probing questions	Suggested Activities	Possible Misconceptions
How do we know something is a living thing? Introduce cognitive conflict to MRS GREN – e.g. a fire could be argued to fulfil most criteria, or a plant doesn't seem to move much/we can't see it excrete. Why isn't a robot classed as an organism? Why are organs important? Is there a 'most important' one? Could we survive without any? What makes organs so different from each other? If humans are made of organs, what are organs made of? If organs are made of cells, what are cells made of? How do we know what a cell looks like? Question roles of organelles – why don't humans have chloroplasts/cell walls etc? Why do some cells need to be specialised? How are specialised cells adapted to perform their roles? Important to use pictures here and probe for deeper understanding Who might use a microscope? Why do we need the sample to be very thin? How could we work out the actual size of a sample?	Lots of class discussion, bounce ideas around, get students to question each other Quick quiz on organelles Hot seat questioning Regular fact recall to help AO1 retention Use of iPads to research and peer assess Use of plasticine and modelling to consolidate ideas and use higher order thinking to justify and reason Using pre-made slides to become familiar with microscopes KAT to help consolidate core practical method – needed again for GCSE Maths skills: converting between prefixes (micro- to milli- and centi- and vice versa) Plenty of practice with magnification calculations	Cells are smaller than atoms A cell is a molecule Organs are made up of one type of cell All organs work completely independently of each other There are only two types of cell – animal and plant Cells are 2D in shape All animal cells are the same All plant cells are the same Cells grow as a person grows Bacteria are made of many cells All bacteria is harmful An organism must have more than one cell Cells survive indefinitely – although not essential for students to understand the fact that cells get damaged and are replaced at this stage, could still be worth mentioning General misconceptions about light travelling through the sample (not in straight line, originating from eye etc)

George Stephenson High School Unit Overview

Unit: Y7 Fundamentals Chemical Equations	**Number of Lessons:** 9
Key Principles Students should understand that all matter consists of chemicals and that chemicals are comprised of elements in the periodic table. Consequently, students should understand that we can assign formulae to chemicals. Students should be aware that not only does chemical formulae relate what elements are present in substances but also the ratio of each element. Students should have an understanding of conservation of mass in a chemical reaction and be able to balance symbol equations. Students should be able to use data from the periodic table to calculate relative molecular mass and use this data to demonstrate conservation of mass.	**The Big Picture (Progression): At KS2 pupils should already have been taught to:** – explain that some changes result in the formation of new materials, and that this kind of change is not usually reversible, including changes associated with burning and the action of acid on bicarbonate of soda **Links to other FUNDAMENTALS units:** – Compounds – Students will have already seen chemical formulae but revisiting the concept is useful given its fairly abstract nature and the age of students. **Links to progression into ESTABLISHING units:** – Reactions 1 – Reactions 2 – Respiration and photosynthesis **At KS4 students should go on to learn:** – C1 Key Concepts 1 – C2 Key Concepts 2 – C5 Acids – C7 Extracting metals and Equilibria – C9 Rates and Equilibrium

Possible Key Learning Points	**Skills**	**Prerequisites**
Key Learning Principles – Use symbols to name compounds – Recognise and use prefixes and suffixes correctly – Identify and name common ions – Use symbols to construct formulae – Recognise charges must balance to create a neutral compound – Use atomic mass data to calculate Molecular mass – use equations to calculate masses of reactants and products **Interleaving** • Y7 Compounds • Y7 Particles	**Key Skills Learnt** – Written literacy & Oracy: Understand and use unit-specific vocabulary accurately with correct spelling – Learn techniques to write formulae – write word equations – use ionic formulas to write symbol equations – balance symbol equations – Obtain atomic mass data from periodic table – Independency for home learning to be assessed in-lesson	**Students should already be aware of the KS2 content outlined above such as:** – Changes can be described as physical or chemical changes – Chemical changes are not reversible – Examples of chemical changes include: burning, reaction of acid with bicarbonate of soda

Subject Specific Language	Pedagogical Notes	Make it Stick Activities
atom bond chemical formula compound element molecule oxide Reversible Irreversible Decomposition Decompose Relative aatomic mass Relative molecular mass Reactants Products ion	Learning in this unit is sequential. For example, before one can balance an equation it is important to understand how to work out the number and type of elements portrayed in a chemical formula. This is a big step up from KS2 but the work done previously in the Compounds unit is very helpful and there is some repetition. This is important given the complexity and allows students a second go at understanding the concepts. There are some useful practicals included which make links between actual mass and how this relates to stoichiometry. A basic understanding of conservation of mass is adequate at this stage since it is revisited at KS4 in the Chemistry Key Concepts. Having said that there is an opportunity to really extend more able students at this stage. **<u>Assessments:</u>** **Literacy Key Assessed Task possibilities:** KAT is to describe how to write and balance a symbol equation. More or less scaffolding can be added to differentiate this task. Alternatively, students may compare the information provided in 2 equations. One a word equation, the other a symbol equation. 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 and is reviewed in detail in lesson 8. TA. **End of Topic Assessment Lesson 12** 30 Mark Total – Section 1: Quizlet Flashcards (AO1) – 10 Marks	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 • Focus on active learning methods such as the Burning Magnesium Practical • Continuous live-marking for immediate personal feedback, including stretch and challenge where appropriate • Create 'desirable difficulties' such as balancing equations and calculating RMM. • 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?"

	– Section 2: Seen Applications Questions (AO2/3) – 10 Marks – Section 3: Unseen Application Questions (AO2/3) – 10 Marks	
Reasoning opportunities and probing questions	Suggested Activities	Possible Misconceptions
– Why is the gain in mass so small when magnesium reacts with oxygen? – Why does the total mass decrease when marble chips react with acid? – How can you tell if a reaction is taking place? – How can you tell if a reaction is finished?	– Learn common symbols – Recap how ions are formed – Learn how to write formulae by balancing charges and cross over method – Pictures of elements, compounds and molecules and atoms and match them with (a) descriptions (b) formula – Identify numbers and types of atoms in formulae – Balance symbol equations – Make links between stoichiometry and increase in mass from practical data – Calculate masses of reactants and products	Common mistakes include: – Inappropriate capitalisation or lack of capitalisation of letters in chemical symbols – Failure to subscript or superscript numbers in formulae – Using atomic number instead of mass number when calculating Ar or Mr

Unit: Y7 – Fundamentals – Compounds	**Number of Lessons:** 8
Key Principles (from NC) **Students need to be confident in identifying the parts of an atom and understand the key terminology of atom, element, compound, mixture and molecule and how to apply this terminology correctly.** • chemical reactions as the rearrangement of atoms • representing chemical reactions using formulae and using equations • a simple (Dalton) atomic model • differences between atoms, elements and compounds • chemical symbols and formulae for elements and compounds • conservation of mass changes of state and chemical reactions Working Scientifically. • make predictions using scientific knowledge and understanding • select, plan and carry out the most appropriate types of scientific enquiries to test predictions, including identifying independent, dependent and control variables • use appropriate techniques, apparatus, and materials during fieldwork and laboratory work, paying attention to health and safety • make and record observations and measurements using a range of methods for different investigations; and evaluate the reliability of methods and suggest possible improvements	**The Big Picture (Progression): At KS2 pupils should already have been taught to:** **YEAR 5** There is very little in the KS2 NC that gives a foundation for the knowledge and understanding in this topic Working Scientifically. • 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 - **Links to other FUNDAMENTALS UNITS:** - Particles - Chemical equations - **Links to ESTABLISHING UNITS:** - Reactions 1 - Reactions 2 - Reactions 3 - **Future links and progression onto KS4 UNITS** - Key concepts 1, Key concepts 2, extracting metals and equilibria, acids, groups in the periodic table, electrolysis

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

Key Learning Principles	**Key Skills Learnt**	**Students should already:**
• Identify and describe the differences between compounds, atoms, elements, mixtures and molecules. • Describe simple properties of ionic, metallic and covalent bonding • Identify the bonding in a molecule by the symbol formula • Follow various practical methods safely • Describe and record observations accurately • Determine the electron configuration of the first 20 elements • Describe the rules for filling shells/energy levels in electron configuration • Synthesise word equations for specific chemical reactions carried out in class • Understand the law of conservation of mass **Interleaving:** Particles 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 whilst engaged in numerous practical carousels - Improved logic and problem-solving skills to fix practical issues - Teamwork and communication in practical work - Numeracy: Measuring out volumes, calculating number of atoms in a compound, electron configuration, conservation of mass, measuring masses.	- 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 Y8 and 9 Establishing and KS4
Subject Specific Language	**Pedagogical Notes**	**Make it Stick Activities**

Atom Element Compound Molecule Particle Mixture Ionic Covalent Metallic Bonding Conservation Mass Electrons Atomic number Mass number Products Reactants Observations	Students had little prior knowledge of the atom before beginning the fundamentals course. The particles topic provides ample opportunity for students to gain confidence and understanding of the atom and of the term element. It will have also provided them with the basic understanding of how to use their periodic table. It is essential in this topic that this understanding is consistently reinforced and direct questioning is used to identify any misconceptions from the previous topic whilst applying the new knowledge of this topic. The course provides many opportunities to address common misconceptions or for students to investigate them. Students will struggle with the amount of new language in this topic and applying it correctly. Be mindful of the language you are using as we can often as teachers use 'weight' instead of 'mass' etc. This topic also includes a lot of practicals, it is most likely the first-time students have used some of the equipment in the lab and some of the chemicals. Please check the structure of the lesson before ordering and adjust to the ability of your class, for example you may want to take 2 lessons for the practical carousel. Students will also need reminded of lab safety and hazards each lesson before they begin. <u>Assessments:</u> Frequency in-class Live Marking throughout Unit Key Assessed Task Lesson Students are to complete a compare questions on compounds and molecules in lesson 2. 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.	Tips for Teachers to Help Learning 'Stick' • 10 question quiz • Compounds, mixture, element card sort • Pass the poster • Writing formula • Spot the pattern • Odd one out • Practical carousel • Back to back • Before after after • Quiz your neighbour • GCSE electron configuration exam question • Bonding marketplace • Identify the bonding • Writing word equations generated from practicals • Beat the teacher • Chili challenge • Conservation of mass

	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 an atom? What is a compound? What is an element? What is a molecule? What is a mixture? What's the difference between a compound and a molecule? How many elements make up a compound? Where is the electron found in the atom? What type of elements does covalent bonding occur between? What type of elements does ionic bonding occur between? What type of elements does metallic bonding occur in? What does conservation of mass mean? Why does the end product of a reaction have a mass less than the sum of the reactants?	-	Compounds and molecules are the same thing and can be used interchangeably Elements exist as single atoms Compounds only contain 2 different elements Metallic bonding occurs between two different metals The mass of products is higher than the mass of reactants Oxygen and gases don't have a mass Mass and weight are the same thing

Diffusion	Number of Lessons: 10
Key concepts This is now where we start to draw on the earlier principles (particles, cells energy). The students need to be able to describe and explain how substances move into and out of cells in different parts of the body (big to small again). Key idea of what concentration of solute means is key so students can self-discover the link between movement and concentration. Introduce idea of Brownian motion (random movement of particles) Definition of diffusion including an understanding of concentration (solute) gradient (passive, not requiring energy) and net movement of particles. Emphasis linking to processes in the body involving cell membranes (lungs, intestine, leaf) No reference to osmosis at this stage. Mechanics of breathing – how the lungs, rib cage and diaphragm enable inhalation and exhalation (RESPIRATION IS NOT BREATHING)	**The Big Picture (Progression):** **At KS2 pupils should already know:** How to classify materials as solids, liquids and gases Know that some substances dissolve in a liquid to form a solution and describe how to recover a substance from a solution **At KS3 students should already know:** Particle model of solid, liquids and gases taught in fundamental 1 **Future links and progression onto other KS4 units:** B1 Transport and enzymes B2 Cells B5 Adaptation of capillaries B8 Plant Structures and their functions B9 Ecosystems and cycles

Possible Key Learning Points	Skills	Prerequisites
• Retrieval of particle model for solids, liquids and gases • Definition of key terms, solution, dissolve, solute etc, • Linking concentration with particle model • Calculation of concentration • Linking diffusion to particle model, movement of particles and concept of concentration. • Applying knowledge and understanding of diffusion to adaptations of exchange surfaces in the human body and the leaf. • The mechanics of breathing and the role of diaphragm and intercostal muscles in the ventilation of the lungs.	Subject specific: Practical skill, following instructions to investigate rate of diffusion and temperature. Using subject knowledge to make suitable predictions when investigating concentration and rate of diffusion. Literacy: Could use rate of diffusion and concentration practical as an opportunity to practice writing to instruct. Correct use of terminology and key words Numeracy: Calculation of concentration	The concept of diffusion has not Particle model will have been covered in fundamentals 1 Students will be aware of how a solution is formed and key words associated with dissolving. Students should also be aware how to retrieve a substance from a solution. Students should know the function of the small intestine and lungs but not structure
Subject Specific Language	**Pedagogical Notes**	**Make it Stick Activities**
Dissolve Insoluble Mixture Saturated Soluble Solute Solvent Concentration Diffusion	The amount of new terminology is difficult for students. For example, they struggle to distinguish between key terms such as solvent and solute. Re-visiting is key to developing knowledge. Incorporating real life examples such as making a cup of tea will help students visualise abstract concepts in familiar contexts. Visualising abstract concepts such as diffusion can be a barrier to learning, use the potassium permanganate practical will help students with this. Breathing and respiration commonly mistaken as the same thing. Take students through the process of	Additional starter and plenary quizzes based on key terminology: True and false Odd one out Incorporate concepts frequently throughout the course in a variety of contexts Provide constructive feedback

Semi-permeable membrane Alveoli Capillary Villi Diaphragm Intercostal muscles Contract Relax	breathing and the muscles involved in the ventilation of the lungs.	
Reasoning opportunities and probing questions	Suggested Activities	Possible Misconceptions
• Where does the solid go when it has dissolved? • What is the difference between a solution and a solvent? • When does mass of the liquid increase when a solute dissolves in it? • Does diffusion ever stop? • How does concentration affect rate of diffusion? • How does membrane thickness affect rate of diffusion? • Is breathing the same as respiration?	• Dissolving practical to aid understanding of concepts and practice using key words. • Star differentiated challenge • Progress continuum • Back to back • Story boards • Linking scientific principles taught to real life contexts • Exam style question practice	• When things dissolve, they disappear • Melting and dissolving are confused. • Particles of solids have no motion. • Relative particle spacing among solids, liquids, and gases is incorrectly perceived and not generally related to the densities of the states. • When the concentration across a semi-permeable membrane is equal diffusion stops. • Osmosis is a special kind of diffusion. • Respiration is synonymous with breathing

Unit: Y7 Fundamentals Electricity	**Number of Lessons:** 12
Key Principles Students should begin to conceptualize the phenomenon of electricity and what it is before beginning the topic. A 'zoom' into what is happening in an electrical wire and the current that flows. Students should finish this unit competent in their knowledge of the electrical units of amps, volts, ohms and what they are a measure of. The students should also think of voltage as potential difference with an explanation of change in voltage. Students should be aware of the rules in terms of current and voltage for series and parallel circuits. Students should develop an understanding of what is meant by resistance- i.e. the 'slowing' of the current. Students should also use basic electrical formula (e.g. V=IR)	**The Big Picture (Progression): At KS2 pupils should already have been taught to:** - Identify common electrical appliances - Construct simple circuits - Name components in electrical circuits - Identify simple problems with circuits such as switch position - Recognize conducting and insulating materials via testing - Make links between voltage and its effect in circuits / bulbs - Utilize simple circuit symbols - Understand electricity is a type of energy **Year 4** **Electricity** Pupils should be taught to: • identify common appliances that run on electricity • construct a simple series electrical circuit, identifying and naming its basic parts, including cells, wires, bulbs, switches and buzzers • identify whether or not a lamp will light in a simple series circuit, based on whether or not the lamp is part of a complete loop with a battery • recognise that a switch opens and closes a circuit and associate this with whether or not a lamp lights in a simple series circuit • recognise some common conductors and insulators, and associate metals with being good conductors **Year 6** **Electricity** Pupils should be taught to: • associate the brightness of a lamp or the volume of a buzzer with the number and voltage of cells used in the circuit • compare and give reasons for variations in how components function, including the brightness of bulbs, the loudness of buzzers and the on/off position of switches • use recognised symbols when representing a simple circuit in a diagram - **Links to other FUNDAMENTALS UNITS:** - Particles - Energy

	- **Future links and progression into ESTABLISHING UNITS:** - Electricity and Magnetism [Electromagnets and Motor Effect] - **Future links and progression onto KS4 UNITS** - **P7 – Electricity in the Home** - [AC vs. DC, Power Equations: E=IVt, P=E/t, P=IV, P=I2R, Wiring a Plug, Fuses and Circuit Breakers] - **P8 – Circuits** - Q=It, E=QV, Heating in Circuits, LDRs, Thermistors and Core Practical on Ohms Law - **P9 – Magnetism and Induction** - Transformers, Electromagnetism, Motor Effect - **C1 – Key Concepts** - Atomic Structure - **C11 – Electrolysis** - Application of Electricity in Separating Metals

Possible Key Learning Points	**Skills**	**Prerequisites**
Key Learning Principles - Compare series vs. parallel circuits - Understand electrical safety - Identify and draw circuit symbols - Describe the role of electrons in current - Explain how batteries relate to voltage - Compare the rules for current and voltage in series and parallel circuits - Practically identify how the length of a wire relates to its resistance (LTSS) - Use basic electrical equations (Ohms Law) - Design and test fruit batteries	**Key Skills Learnt** - Literacy / Oracy: To understand and use new unit specific vocabulary effectively - Understand how to draw circuit symbols and circuit diagrams - 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 electrical equipment - Improved logic and problem-solving skills to fix circuit issues - Teamwork and communication in practical work and hats model - Numeracy: Using and possibly rearranging V=IR equations	**Students should already:** - Be aware of basic electrical safety - Be able to construct simple circuits from circuit symbols and name its components - Be able to make simple links between the number of batteries (i.e. voltage) and its effect on the circuit - Be able to compare different materials based on electrical conductivity - 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

- Make links to careers with electricity (electrical engineering) **Interleaving:** Particles [Atomic Structure] Energy [Stores and Transfers - HEPMACK]	- Use and recall key units correctly - Creativity when building fruit batteries - Independent learning during research- based home learning	Establishing and KS4 **KS2 Curriculum Content from National Curriculum Guidelines Above**
Subject Specific Language	Pedagogical Notes	Make it Stick Activities
Current / Amps Voltage / Potential Difference / Volts Resistance / Ohms Electron Series / Parallel Circuit Battery Wire Voltmeter / Ammeter Energy Stores Energy Transfers Insulator / Conductor Coulombs / Charge [Higher Ability Only]	Electricity is a topic that students will have been learning about from a very young age in KS2, exploring electricity is something children are innately aware exists to "make things work". 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. Electricity is a difficult scientific principle to grasp as it cannot be visualized inside a wire or a device. It is therefore often perceived as either little sparks, little people, wavy lines or particle with a higher level of prior knowledge – see starter hats model (L2). It is therefore essential to continually link back to more tangible content such as Fundamentals Energy and Particles. Incorporating key models such as the 'Hats' Model (Water or Rope) early in the scheme to develop higher level understanding of electrical flow and allow for a tangible example of electrical current and flow. The amount of new terminology is difficult for students and pupils struggle to distinguish between the different electrical units. Re-visiting is key terminology is essential to developing knowledge. Try to use quick quizzes and interleaved learning throughout. Students will also struggle to successfully build their own circuits due to faulty equipment. We recommend spending some time showing pupils how to troubleshoot key issues.	Tips for Teachers to Help Learning 'Stick' • Focus on active learning methods such as the Hats Model of Electricity and Electricity Practical's (LTSS / Fruity Batteries) • Create 'desirable difficulties' such as GCSE Ohms Law Equation Lesson • Provide constructive feedback after the batteries KAT in Lesson 3 via coded marking • Incorporate frequent, low stakes testing during starter and plenary activities • Provide opportunities for elaboration, reflection after KAT and DIRT lesson after assessment • Explain to students how to troubleshoot their own problems when making circuits. Don't do it for them – "Have you tried [this]?"

	Students need to be reminded throughout the module how this topic links to Y7 Fundamentals 'Energy': as much confusion will still likely arise regarding the different forms of 'Energy' involved (e.g. batteries chemical store, bulb thermal transfer, bulb light transfer, electrical transfer in wires) acting as both an Energy Stores and Transfers in different parts of circuits. You will often find yourself say things like "using" "making" electrical energy. Try to avoid this as it confuses students when discussing the law of energy conservation. Try to be more scientifically explicit in your language "stored" & "transferred". You could challenge students to correct you if you get this wrong for some fun! Students will likely struggle with rearranging the V=IR equation as Algebra will only have recently been introduced in the Maths curriculum. However, at KS3 the substitution of numbers is the key learning outcome; so differentiate problems as appropriate and utilise the triangle method which may be familiar from Maths lessons or the phrases "do the same to both sides", "bring it access" and "cancel out". **<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 would electricity look like as it travels through a wire? What is current? How can it be measured? Why is current shared in a parallel circuit? How does a cell / battery store potential energy? How do resistance, voltage and current link? What is a coulomb? Why is this a useful unit? How can a citrus fruit create voltage? What is charge and how is it different to current? Why do birds sit on electrical cables in the winter? What is the different between a heat insulator and an electrical one? How is electricity like the hats model?	- Building simple circuits from circuit diagrams leant at KS2 - Analyzing images of bad electrical safety - Building batteries from different types of fruit - The Hats model of electricity - Let's Think Secondary Science Lesson on Resistance in a Wire - Using V=IR equations - Comparing current and voltage in different circuits through practical analysis	All heat conductors are also electrical conductors That electricity is stored in batteries That electrons are not found within a wire not connected to a circuit That electrons / charges are provided to a circuit when "plugged in" or "turned on" That electrical sockets leak electricity when not plugged into something That wires have "sparks" inside of them That all batteries are the same Electrons flow fast in a circuit Electricity is Weightless Electricity and Electrical Energy are the same thing Electrical current is the flow of a substance called current Electrical energy flows all the way around the circuit (in a circle) That electricity is used up in a circuit Electrons flow at speed of light

Electricity

Key principles

Students should begin to conceptualize the phenomenon of electricity and what it is before beginning the topic. A 'zoom' into what is happening in an electrical wire and the current that flows.
Students should finish this unit competent in their knowledge of the electrical units of amps, volts, ohms and what they are a measure of. The students should also think of voltage as potential difference with an explanation of change in voltage.
Students should be aware of the rules in terms of current and voltage for series and parallel circuits.
Students should develop an understanding of what is meant by resistance- i.e. the 'slowing' of the current.
Students should also use the formula of charge = current x time.

KS2 prior learning

Electricity is a type of energy
Circuit diagrams and symbols
Conductors and insulators in terms of testing materials
Switches and their meaning to on/off circuits
More voltage = brighter bulb

Links to other topics

(threads)
Particles
Energy
Magnetism and induction
Electrical formula at GCSE

Practical suggestions

NB. Access to electrical equipment is important but not for basic circuits as in KS2

Main learning aims

1. Units of electrical measurements of resistance, voltage (potential difference) and current
2. Rules of series and parallel circuits in terms of voltage and current
3. Understanding of resistance
4. Calculation of charge from current and time

Unit: Y7 Fundamentals 7I Energy Resources	**Number of Lessons:** 12
Key Principles Students should begin to conceptualise the phenomenon of energy and what it is before beginning the topic, including energy stores and transfers. Students should be aware of the rule of energy transferring without being created or destroyed. Students should finish this unit competent in their knowledge of the stores, transfers and sources of energy and how they are used to generate electricity. Students' notion of energy may be challenged to exclude 'light' and 'sound' as energy stores. Students should be able to evaluate different sources based upon their efficiency and potential contribution to global warming. Students should develop an understanding of what is meant by efficiency - i.e. maximum productivity with minimum waste. Students should also use the formula of efficiency = useful/total x 100 and use this to calculate energy costs. Students should also use the formula of work done = force x distance. Introduction to careers in renewable energy field	**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**

Key Learning Principles - State stores of energy - Describe basic energy transfers in a system - 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 - Calculate energy costs - Make links to careers with energy resources **Interleaving** • Y7 Particles • Y7 Forces	**Key Skills Learnt** - Written literacy & Oracy: Understand and use unit-specific vocabulary accurately with correct spelling - Understand how to apply energy stores to different scenarios - Understand how to describe energy transfers with clear sequencing - Understand how to draw energy transfer diagrams - Understand how to calculate efficiency as a percentage - Understand how to evaluate - Understand how investigate to evaluate fuel sources - Understand how to draw a results table and conclusions from personal evidence - Independency for home learning to be assessed in-lesson	**Students should already be aware of the KS2 content outlined above such as:** - Is aware of basic abstract concept of energy - Awareness of different devices using different amounts of energy - Can form hypotheses based upon prior understanding - Can compare sets of data to draw conclusions - Can draw links between rate of temperature increase and energy transfer - Aware of basic laboratory safety when using open flames - Calculate simple percentages
Subject Specific Language	Pedagogical Notes	Make it Stick Activities

Energy Electricity Power Cost Joules Kilojoules Watts Kilowatts Renewable Non-renewable Fossil fuels Greenhouse gases Oil/petrol/gas/methane/nuclear Biomass/wind/solar/tidal/wave Heat/Electrostatic/Elastic Potential/Gravitational Potential/Magnetic/Atomic/Nuclear/Chemica/Kinetic Dissipate Input/Output Displacement Deformation	Learning of the concept of energy and stores is absent in specification at KS2, with core emphasis on electrical energy. Detailed knowledge of transfers, transfer diagrams and Sankey diagrams not required e.g. Heat, electrically, radiation, mechanically. This is revisited at KS4. Light and sound are not stores of energy as they cannot be captured to be used at a later date. Re-visiting is recommended to maintain knowledge of stores and application to devices. This might be through emphasis on HEPMACK with routine interleaving tests and quizzes throughout the scheme to support students struggling to retain this new terminology. Recommend repeat visits of carousel models to develop deeper thinking and understanding of energy stores and transfers. Emphasis is on the stores of energy and the process of fossil fuels being combusted to generate electricity. Students may struggle with energy carousel due to faulty equipment. Highly recommended setting equipment up day prior to fix and issues prior to lesson. Detailed understanding of 'power' and 'watts' not required as this is revisited at KS4. **<u>Assessments:</u>** **Literacy Key Assessed Task possibilities:** Priority KAT is to develop 'evaluation' skill comparing advantages and disadvantages before making own conclusions and opinions: Evaluate the advantages and disadvantages of renewable energy resources. Evaluate the advantages and disadvantages of non-renewable energy resources. 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 12** 30 Mark Total - Section 1: Quizlet Flashcards (AO1) – 10 Marks	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. HEPMACK energy stores • Focus on active learning methods such as the fuel investigation • Embed visual learning through use of device carousel • Continuous live-marking for immediate personal feedback, including stretch and challenge where appropriate • Create 'desirable difficulties' such as calculating efficiencies as percentages and energy costs • 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?"

	- Section 2: Seen Applications Questions (AO2/3) – 10 Marks - Section 3: Unseen Application Questions (AO2/3) – 10 Marks	
Reasoning opportunities and probing questions	Suggested Activities	Possible Misconceptions
What is energy? What is an energy store? Where do you get your energy from? What does it mean if you are running out of energy? Why are light and sound not described as energy stores? Where does energy go? Why is energy conservation a law? Can you give an example of an energy store? E.g. skateboarder skating = kinetic Can you give an example of an energy transfer? E.g. skateboarder skating downhill = GPE to kinetic Where might energy be dissipated? E.g. Skateboarder skating = heat on ground If energy is conserved, how are we running out? Which fuel/device is the best? What makes this fuel/device more efficient? Which energy resource is most appropriate under a certain circumstance e.g. why are solar panels not the most appropriate for the Arctic? What is a fuel? How can you investigate the most efficient fuel/device? How does a fuel generate electricity in your home? Why do we continue to use non-renewable energy resources?	- 6 AO1 fact recall questions to start each lesson - Energy store carousel = state the energy stores for provided examples e.g. Newton's cradle, candle burning, wind-up toy - Describe simple energy transfers using given examples as models, GIFs, diagrams e.g. rocket taking off - Model power plant energy transfers using model steam engine - Burning fuels and measuring temperature to investigate most efficient fuel resource - Using provided data to calculate device efficiency as useful/total input - Making global decisions – using environmental data to evaluate and decide on most appropriate energy resources - Challenge decisions e.g. natural disaster has impacted choice of energy resources	There are different types of energy Energy can be created Energy can be destroyed Energy is lost/disappears Energy is force There are different types of energy Sound is a type of energy Light is a type of energy Heat is the same as temperature Kilojoules and joules are the same Energy in humans is kinetic Gravitational potential energy is only relative to height from the ground Energy is only associated with movement Energy is a product of an activity Energy is running out and therefore not conserved Fossil fuels turn into electricity

Unit:Y7 FORCES	Number of Lessons: 13
• Introduction to the phenomena of forces, starting with the idea of forces, balanced, and unbalanced. • Basic introduction to Scalars and vectors, students should proficient in identifying examples from KS4 Y10 physics. • Balance and unbalanced forces with calculating the resultant force and introduce Newton and his first law to be able to describe what will happen to the motion of the object when the forces are balanced or unbalanced. • Students need to develop understanding of mass, weight and air resistance and their skills in drawing free body/vector diagrams (keep the diagrams simple to 2 opposite forces only). • Speed/velocity s=d/t (rearrange) and plot and interpret D-t graphs – which will require development of graph skills (scales, axis etc). • Introduction to stopping distance (not time) and factors that can affect the thinking and braking distances • Careers lesson linking engineering (civil) to building bridges/infrastructure	**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:** **<u>Forces 1</u>** 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)

1. Scalar and vector quantities 2. Identification of common forces as contact and non-contact 3. Newton as a scientist 4. Newton's first Law and resultant force 5. Free body diagrams – application of forces in practical examples 6. Resistance and frictional forces, using air and water as examples 7. Building bridges to hold a mass – forces linked to Tyne Bridge 8. Building boats to hold a mass. Linking density and balanced and unbalanced forces 9. Interpretation of D-t graphs. Be able to plot D-t graph from a table of data (scales) 10. Factors affecting distance taken stop a moving vehicle (thinking and braking distances) 11. Links to careers using forces (civil engineering) **Interleaving:** Particles (atomic structure/atomic mass) link to 'mass' of objects and ideas of density linked to forces acting on an object	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 Exploring balanced and unbalanced forces Building bridges and boats to apply new learning 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	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. Forces act on all objects, at all times. Most students would say that an object that was still on the desk did not have any forces acting on it... or they might say gravity pulling it down, but not appreciate the upward force exerted by the table. Careful and well-planned questions to enable cognitive conflict is important throughout the unit to allow students to regularly question their pre-existing theories. As with most science topics, the amount of new terminology can be tricky. Students struggle to distinguish accurately between mass and weight, due to the inaccurate use of the word 'weight' in everyday life. They also struggle to fully describe resultant force and in particular when forces are balanced, and resultant force is zero and the idea of unbalanced forces changing the motion of an object (slow down/speed up). Stopping distance is often confused with stopping time. This is a persistent issue at KS4, so needs careful and consistent correction of terminology and clear explanations of 'distance travelled while thinking/braking'. Revisiting and correcting use of key terminology is essential throughout the unit. **Assessments:** Regular in class live marking throughout the unit	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

	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) 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?	• 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	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

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 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?	• 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.	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

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 Students should also understand laboratory safety issues and be able to identify and control risks Students will also explore scientific careers and give short formal presentations Be aware of how to conduct reliable scientific research and discuss the bias/usefulness of information sources	**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 to other FUNDAMENTALS UNITS:
This unit underpins all subsequently 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	**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 Bunsen Burners, thermometers, measuring equipment and more	**Students should already:** **KS2 Curriculum Content from National Curriculum Guidelines Above** - 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

Draw simple graphs and tables and draw conclusions from these Undertake suitable research and analyse the reliability of sources Research future careers and make short formal presentations and give kind feedback to others **Interleaving:** KS2 – Work on Forces and Springs	- Improved logic and problem-solving skills to fix circuit issues - 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 - Presentation skills - Kind peer assessment and feedback - Evaluating sources of information	- 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**
Hazard and Risk Toxic Explosive Corrosive Irritant Flammable Bunsen Burner Safety/Blue/Roaring Flame Control Variable In/Dependent Variable Meter Spring Clamp and Stand Extension / Length Mass Axis Research Method Prediction Hypothesis Scatter Graph	**Please note**: you will need to book IT facilitates twice during this module so get this done in advance (the research, 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 to get all students to the same 'Fundamental Level'. As pupils attend GSHS from different primary schools with different Science teaching experiences and transition experiences, pupils will have differing confidence when dealing with scientific ideas and working in a laboratory. 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.	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"

Line of Best Fit Careers	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 be savvy when identifying and controlling practical risk and should be able to use and name and use all of the basic scientific laboratory equipment (e.g. Bunsen Burners especially). The data gathered is from practical work fairly irrelevant; it is the safety and discussion around students' ideas in conjunction with their effort that is most important here. Try to give out lots of praise / LORIC for safe practical work and attempts at using scientific principles during discussion (oracy). Sitting pupils away from those from the same primary school advised for peer support/mixed ability in 'science confidence'. **Assessments:** **Y7 Diagnostic Assessment to be completed at any point through the unit – See DJN for link (do not duplicate the form so all Y7 data is centralized)** The diagnostic assessment will be feedback to you should be used to inform seating arrangements and interleaving from KS2 as you progress through fundamentals	

Reasoning opportunities and probing questions	Suggested Activities	Possible Misconceptions
What makes a reliable sources 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 research lesson to show how lots of adults misinterpret scientific information Vaccines/YouTube news?	Students may have many misconceptions however in this unit we should not focus on addressing these at this stage. We should simply be mindful not to introduce or solidify any common misconceptions further such as mass vs. weight. These misconceptions will likely present during whole class discussion and should be corrected within reason (but always praise good attempts!). This may be especially prevalent during the research lesson depending on the question you and your class have chosen to investigate (choose you class question carefully to mitigate any big issues or safeguarding risks – e.g. no sexual health questions, drugs questions or religion provoking questions such as evolution etc.). Focus on keeping practical expectations incredibly high and put safety first.

Year 7 Fundamentals: Particles unit overview

Unit: Year 7 Particles	Number of lessons: 12
Key Principles Students should develop their understanding of particle theory and atomic structure throughout the topic. Students should use models to describe the structure of an atom, outlining the location of each subatomic particle and recall the mass and charge of each. They should demonstrate how the periodic table can be used to deduce the number of each subatomic particle in an atom Students should describe how the periodic table is arranged in terms of atomic number, groups and periods. Students should define the term isotope and begin to calculate the RAM from isotopic data. Students should calculate the density of different objects and define the term.	**The Big Picture (Progression): At KS2 pupils should have already been taught:** • States of matter • Changes of state • Basic separation techniques **Links to other fundamentals units:** • Particle theory and understanding of states of matter underpin much of what is taught throughout the rest of the curriculum (Electricity, cells, energy, chemical reactions etc.) **Future links and progression into ESTABLISHING UNITS:** • Mixtures and Separating • Reactions 2/3 • Forces and Magnetism • Earth and beyond • Body Systems • Heating and Cooling **Future links and progression onto KS4:** • C1 and C2 Chemistry key concepts • C3 States of Matter and Mixtures • C8 Groups in the periodic table • C11 Electrolysis • B1 Transport and Enzymes *Diffusion and osmosis – movement of particles.* • B8 Plant Structures and their functions *Limiting factors – collision theory (correlations between temperature and particle movement)* • P3 Forces 2 *Particles and density* • P6 Radioactivity *Atomic Structure and isotopes* • P8 Circuits

Possible key learning points	Skills	Prerequisites
• State everything is made up of atoms • Describe the structure of an atom, and draw different elements (using the Bohr model) to show the number of protons, neutrons and electrons in an atom. • Describe why the periodic table is in the format it is with regards to the atomic number and chemical properties • Use a periodic table to identify the RAM, and then calculate the number of each subatomic particle in an atom of an element • State the charge and mass of each subatomic particle • Explain why atoms are neutral • Define the term isotope and begin to calculate (with scaffolding and support) the RAM from isotopic data. • Use practical techniques to obtain data to determine the density of an object.	• Literacy/oracy: To understand and use new unit specific vocabulary effectively • Numeracy: Calculating number of sub atomic particles, RAM and density. • Use of appropriate units when making measurements (density practical) • Make conclusions from evidence given (identifying an element from description of properties) • Represent atoms and particle drawings using suitable diagrams	At KS2 students study states of matter and how you can change state either by heating or cooling. They should be able to describe basic physical properties (solids have a fixed shape etc.) and be able to classify materials based on physical properties (metals are good conductors of electricity, wood is not etc.). Students are likely to have not heard the term atom or particle and therefore a lot of the learning will be new.

Subject Specific Vocabulary	Pedagogical notes	Make it stick/Greenzone activities
• Atom • Proton, neutron, electron • Element • Relative atomic mass • Atomic number • Isotope • Nucleus • Shell • Group • Period • Density • Mass, Volume • Chemical/physical properties	Particles is a topic that has not been previously taught to students, so whilst they will have an understanding that matter can exist in solid, liquid and gaseous states, students are likely to have very limited knowledge of what matter is. For students to secure their understanding of what an atom is by the end of the topic, lots of modelling should be used to help students visualise what cannot be seen. Students can see objects all around them and everything is made from atoms, so by using the particle zoom you can help students appreciate how tiny a single atom is. Recommend spending time allowing students to familiarise themselves with the periodic table and how to read it correctly (could use visualiser to label it with them). With the numeracy tasks (particularly calculating RAM), lots of teacher modelling the method on the board is recommended. **Assessment** Live marking throughout unit. KAT lesson – choice of task. Lower demand describe the structure of a Boron atom. Higher demand compare and contrast the structure of two isotopes of carbon. Both KATs are 6 marks and come with tick sheets for teacher assessment. End of unit assessment: 10 marks Flashcards (Student assessed) 10 marks seen application (Student assessed) 10 marks unseen application (Teacher assessed)	• Recall questions • Particle zoom • Modelling atoms • PEA paragraphs • Chilli challenge calculating isotopes

Reasoning opportunities and probing questions	Suggested activities	Possible misconceptions
How small is an atom? Why are atoms neutral? Are all atoms the same size? Do atoms change during a reaction? What is the difference between protons, neutrons and electrons? Why does chlorine have a RAM of 35.5? What is the difference between an atom sodium and neon? What are chemical properties? What are physical properties? What is density? How can you find the density of an object? Why do isotopes have the same chemical properties?	• Particle zoom – draw comparisons to help students appreciate the size of an atom (How many atoms in a full stop? Etc.) • Modelling atoms using different material (encourage 3D models) • Element bingo to help students familiarise themselves with element symbols. • Who am I? Give properties or number of protons etc. and students identify the element • Density practical • Writing PEA paragraphs for justifying which group an element should be in • Calculating RAM	• Atoms are solid spheres (as we show them on particle diagrams) • There is air between the nucleus and the electrons in an atom. • All atoms are the same size (only atoms of the same element are the same size) • Particles in a solid cannot move at all • Not appreciating the 3D nature of atoms (as we often represent using 2D diagrams) • Mass and weight confusion during density practical. • Whether an object sinks or floats in water depends on its mass alone.