KS3 Sequencing

Requirements for each unit:

- Spelling & definitions homework to be set L1 & tested L3 for each unit, pupils to peer / self-assess in class;
- L1 - knowledge organizer to be given to pupils to stick in book
- Knowledge organiser homework to be set L4/5 and completed prior to end of unit teacher review, pupils to green pen peer / self-assess in class. Mats are differentiated as appropriate for pupils – supported mat good progress target L3 & below; medium challenge good progress target L4-L5; high challenge L6+. Note these are minimum – pupils may choose to take a higher challenge. Green penned completed revision mats should be stuck in exercise books.
- The revision for the topic should incorporate a task across the units which applies the learning in the topic context e.g. for Forensics this could be the prosecution & defense submitting and challenging evidence in the court case for the murder.
- In Y7 and Y8 end of unit teacher review to be completed in class following completion of teaching sequence. Pupils should be given notice of the review. **Teacher review MUST be teacher assessed with AIM feedback. This review must also include a standard check of the exercise book as per presentation stickers on front of book**. Pupils improvements should be completed in green pen. Completed end of unit reviews should be stuck in exercise books.
- Teachers should record completion / marks for spelling test & end of unit review in their own mark book.

Assessment Point requirements:

- In Y7 and Y8 pupils MUST complete 3 AP assessments per year. Pupils should be given 2 weeks notice of these assessments. **AP tests must be teacher assessed**. Pupils should complete a green pen improvement of the test as feedback. Pupils improvements should be completed in green pen. Completed AP tests should be stuck in exercise books.
- In Y9 pupils will sit 3 separate science AP tests following completion of the Space units. **Each AP test must be teacher assessed** with both AIM feedback and pupil reflection. Pupils should complete a green pen improvement of the test as feedback. Pupils improvements should be completed in green pen. Completed AP tests should be stuck in exercise books.
- Teachers should record completion / marks for Assessment Point test on the SIMs database.

Timings as per sequencing document issued annually.

Working scientifically

Through the content across all three disciplines, pupils should be taught the key skills in the table below. These skills should be embedded in to the units where appropriate. Language should mirror that used in the table.

Scientific attitudes

- pay attention to objectivity and concern for accuracy, precision, repeatability and reproducibility
- understand that scientific methods and theories develop as earlier explanations are modified to take account of new evidence and ideas, together with the importance of publishing results and peer review
- evaluate risks

Experimental skills and investigations

- ask questions and develop a line of enquiry based on observations of the real world, alongside prior knowledge and experience
- 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
- apply sampling techniques

Analysis and evaluation

- apply mathematical concepts and calculate results
- present observations and data using appropriate methods, including tables and graphs
- interpret observations and data, including identifying patterns and using observations, measurements and data to draw conclusions
- present reasoned explanations, including explaining data in relation to predictions and hypotheses
- evaluate data, showing awareness of potential sources of random and systematic error
- identify further questions arising from their results

Measurement

- understand and use SI units and IUPAC (International Union of Pure and Applied Chemistry) chemical nomenclature
- use and derive simple equations and carry out appropriate calculations
- undertake basic data analysis including simple statistical techniques

Year 7 Sequencing

TOPIC 1: Introducing science at Alsager

Year 7 Passport to science induction

Career link – e.g. H&S manager

9 lessons – 8 taught lessons, 1 lesson for revision AIM feedback of booklets.

- This unit uses the great hot chocolate experiment to introduce pupils to laboratory equipment, techniques and staying safe in the laboratory.
- Utilise experiment scaffold which has been cascaded to feeder primaries to introduce Alsager experiment ways of working.

From KS2 most pupils will:

- Planning different types of scientific enquiries to answer questions
- Taking measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate and controlling variables where necessary
- Recording data and results using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs
- Using test results to make predictions
- Including conclusions, causal relationships and explanations of and degree of trust in results,
- Identifying scientific evidence that has been used to support or refute ideas or arguments.

Leads to KS4 units:

- Required practical across all of KS4

Common confusion & misconceptions with this unit:

Unit Title - It's a small world

Career link – e.g. NHS – sample testing labs using microscopes e.g. pathologists, biomedical scientists

9 lessons – 8 taught lessons, 1 lesson for revision AIM feedback of booklets.

Biology National curriculum: Structure & function of living things - Cells & organization

- 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

From KS2 most pupils will:

• be able to name and locate some organs of their bodies

• be able to name and explain the functions of some parts of a flower

Leads to KS4 units:

Biology paper 1: Cell biology, Organisation

- Identifying the correct variables within scientific experiments
- Correctly labelling axes on graphs and correct units in graphs
- Full results table headings
- Understanding an applying the correct vocabulary in the correct context e.g prediction, conclusion, evaluation etc.

Link to further reading & support:
https://www.youtube.com/watch?v=_TfT9q36754 (results tables)

https://www.youtube.com/watch?v=iaewZmc4TYQ&t=66s (variables)

https://www.youtube.com/watch?v=0A55QRyJHPM (variables)

https://www.bbc.co.uk/bitesize/articles/zfh296f (graphs)

Common confusion & misconceptions with this unit:

- The heart is traditionally thought of as lying on the left of the body. It is in fact in a fairly central position but more of it lies on the left of the body. There is much more muscle in the left side of the heart since this side has to pump blood around the whole body whereas the right side only has to pump blood to the lungs.
- There is often confusion about whether the liver is found in front of or behind the stomach. The answer is a bit of both, and a human torso model is useful to demonstrate this. One of the lobes of the liver lies over the intestinal end of the stomach. The liver is also the most difficult organ to give a precise function to at this level. It is described here as 'making and destroying substances'.
- There is often some confusion as to what is a tissue and what is not. As far as this text is concerned, all the cells in a tissue are the same and they all do the same job. In reality, many tissues are composed of different types of cell; blood for example. If asked about blood or skin, it is suggested that pupils are told that the skin is an organ and blood is a 'complex tissue' (somewhere between a tissue and an organ).
- It should be noted that the root hair is not a hair in the sense of a human hair. It is an extension of the cell wall that increases the surface area of the cell allowing the absorption of water from the soil more efficiently.

Link to further reading & support:

- BBC Bitesize: Living organisms: https://www.bbc.co.uk/bitesize/topics/znyycdm

AP1 test

TOPIC 2: The Adventures of Little Frances

Follow the adventures of Little Frances to learn where she came from and what mischief she gets up. Discover the world of reproduction, impure substances, and acids and alkalis through the world of Frances & explore the science of parties for Frances' birthday!

Summary cross unit task – *groups to act as party planners & produce a guide for the Baby's birthday party*

Career link *– midwife, environmental scientist – impact of the ice-water anomaly on marine life in the Arctic*

- **Structure & function of living things** – Little Frances - This is your life: Explore the full human life cycle through the life of Frances. Discover where baby Frances came from and what will happen to her next during puberty and beyond.

- **Chemical & physical reactions -** Little Frances wants to explore the house! Follow her adventure as she finds out that chemicals can be classed as acids or alkalis, mixtures can be separated in different ways and experiments can teach you a lot when done properly.

- **Physical changes - the particulate nature of matter – Party Science** – Shhhh – don't tell Frances she's going to have a party. We will explore the science of parties – why do lollipops stay in their shape, why balloons float or pop and how smoke machines work!

Unit title - Structure & function of living things – reproduction

10 lessons – 8 taught lessons, 1 lesson for revision & teacher review, 1 lesson for feedback of teacher review.

Biology National curriculum: Structure & function of living things – reproduction

- reproduction in humans (as an example of a mammal), including the structure and function of the male and female reproductive systems, menstrual cycle (without details of hormones), gametes, fertilisation, gestation and birth, to include the effect of maternal lifestyle on the foetus through the placenta

From KS2 most pupils will:

- be able to recognize the main stages in the growth and development of humans.
- be able to recall that cells are adapted to their functions.

Leads to KS4 units:

- Biology paper 1: Cell biology and specialised cells.
- Biology paper 2: Inheritance, variation and evolution.

Common confusion & misconceptions with this unit:

- That sex and reproduction are the same thing (e.g. sex in science means gender, whereas sexual reproduction is fertilization; the joining of the egg and the sperm).
- That 1 sperm and 1 egg are always required for fertilisation, even in same-sex couples and twins.
- Many involving gender inheritance; an older theory that the right testis produces male children, but the left testis had a restricted blood flow which produced substandard sperm cells, which grow into females.
- Inherited information comes from the sperm and the egg, not in your blood.

Link to further reading & support:

- BBC Bitesize: Reproduction: https://www.bbc.co.uk/bitesize/topics/zybbkqt
- https://www.youtube.com/watch?v=jUHokSPkzT

Unit title – Chemical & Physical reactions

10 lessons – 8 taught lessons, 1 lesson for revision & teacher review, 1 lesson for feedback of teacher review.

Chemistry National curriculum: Chemical reactions – acids & alkalis

- defining acids and alkalis in terms of neutralisation reactions
- the pH scale for measuring acidity/alkalinity; and indicators
- reactions of acids with metals to produce a salt plus hydrogen
- reactions of acids with alkalis to produce a salt plus water

Chemistry National curriculum: Pure & impure substances

- the concept of a pure substance
- mixtures, including dissolving
- diffusion in terms of the particle model
- simple techniques for separating mixtures: filtration, evaporation, distillation and chromatography
- the identification of pure substances

From KS2 most pupils will:

- know that solids remain in the solution when they dissolve
- know that there is a limit to how much solid will dissolve in a liquid
- know about several variables which affect the rate at which a solid will dissolve
- know that some materials can be dangerous
- be able to explain why undissolved solids can be separated from a mixture by filtering
- know that solids remain in the solution when they dissolve
- know that a dissolved solid can be recovered by evaporation

Leads to KS4 units:

- Chemistry paper 1: Chemical changes
- Chemistry paper 2: Rates
- Chemistry Paper 1: Atomic Structure and the Periodic Table
- Chemistry Paper 2: Chemical Analysis and Using Resources
- Physics Paper 1: Particle Model of Matter

Common confusion & misconceptions with this unit:

- A common error by pupils and others is to assume that because acids are dangerous, alkalis are safe. In fact, for solutions of equal concentration, alkalis are usually more dangerous than acids.
- the choice of the numbers 1 to 14 is not random – some more enquiring pupils may be satisfied with the explanation that it is linked in some way to the 'amount of hydrogen'
- changing the dilution of an acid or alkali by a factor of ten will alter the pH by one unit (this is the effect of choosing a logarithmic scale)
- addition of a small amount of acid or alkali near the neutral point can have quite a large effect on the pH, whereas adding the same amount to a strong acid or alkali will have very little effect.
- A common error will be to assume that any form of dispersion is evidence of dissolving – the fact that 'soluble' aspirins are often in fact only partially soluble may be a source of this misunderstanding. These mixtures are suspensions (though this word is not used in the Pupil's Book).
- Another common error is the confusion between the meanings of the words 'clear' and 'colourless'. The use of 'clear' as a description of colourless glass bottles at the bottle bank will not help. In the Pupil's Book the word clear is used to mean transparent, with the colour of the liquid being an independent description. A full description of the liquid will therefore involve a minimum of two words (e.g., clear blue, misty yellow, clear and colourless). It may also be worth stressing to some pupils the difference between 'colourless' and 'white', perhaps by showing them a test tube full of water and one containing milk

Link to further reading & support:

- BBC Bitesize: Acids and alkalis: https://www.bbc.co.uk/bitesize/topics/zn6hvcw
- BBC Bitesize: States of Matter: https://www.bbc.co.uk/bitesize/topics/z9r4jxs
- BBC Bitesize: Separating Mixtures: https://www.bbc.co.uk/bitesize/topics/zstp34j

Unit title – Physical changes – the particulate nature of matter

10 lessons – 8 taught lessons, 1 lesson for revision & teacher review, 1 lesson for feedback of teacher review.

Chemistry National curriculum: The particulate nature of matter

- the properties of the different states of matter (solid, liquid and gas) in terms of the particle model, including gas pressure
- changes of state in terms of the particle model

Physics National curriculum: Matter – particle model

- the differences in arrangements, in motion and in closeness of particles explaining changes of state, shape and density; the anomaly of ice-water transition
- atoms and molecules as particles

Physics National curriculum: Matter – energy in matter

- changes with temperature in motion and spacing of particles
- internal energy stored in materials

Physics National curriculum: Matter – physical changes

- conservation of material and of mass, and reversibility, in melting, freezing, evaporation, sublimation, condensation, dissolving
- similarities and differences, including density differences, between solids, liquids and gases
- Brownian motion in gases
- diffusion in liquids and gases driven by differences in concentration
- the difference between chemical and physical changes

Chemistry National curriculum: Energetics

- energy changes on changes of state (qualitative) *(Also taught in "Big bang fireworks: Unit title – Chemical reactions – combustion & oxidation)*

From KS2 most pupils will:

- compare and group materials together, according to whether they are solids, liquids or gases
- observe that some materials change state when they are heated or cooled, and measure or research the temperature at which this happens in degrees Celsius (°C)
- identify the part played by evaporation and condensation in the water cycle and associate the rate of evaporation with temperature
- demonstrate that dissolving, mixing and changes of state are reversible changes
- Know some of the properties of solids, liquids and gases

Leads to KS4 units:

- Chemistry paper 1: atomic structure and structure and bonding.
- Physics paper 1: particle model of matter

Common confusion & misconceptions with this unit:

- In the particle model of a liquid the particles are touching, but can move past each other so are randomly arranged
- When changing state the temperature of a substance remains constant despite energy being taken in or given out.

Link to further reading & support:

- BBC bitesize - What are solids, liquids and gases? https://www.bbc.co.uk/bitesize/topics/z9r4jxs/articles/zqpv7p3
- BBC bitesize – diffusion https://www.bbc.co.uk/bitesize/topics/z9r4jxs/articles/znqbcj6
- BBC bitesize – solids liquids and gases revision pages https://www.bbc.co.uk/bitesize/guides/z2wmxnb/revision/1

AP2 test

TOPIC 3: Can we get the bees back?

Theme is complex interaction of changes - can making a small change, such as using a fertilizer lead to a change in an ecosystem

Summary cross unit task – *design an experiment using different masses held up on string to model the effect of increased mass on gravity drop fruit, using helicopters to mimic wind dispersal. Use results of experiment to theorise impact on bee population & make a reasoned judgement whether use of fertilizer increase bee population.*

Career link *– beekeeper, environmental scientist*

- **Relationships in an ecosystem** – if we encourage plant growth of particular species evaluate the possible impact on numbers of organisms (bees) in the food web & ecosystem.
- **Atoms elements & compounds** – pupils will use the research skills taught in this section to learn about the impact of neonicotinoid pesticides on bees.
- **Forces** – Forces involved seed dispersal – if the fertilizer causes the fruit to grow more quickly how will this impact the forces involved in gravity drop fruit & wind dispersal. Will early / late fruit drop affect bee population?

Unit title – Relationships in an ecosystem

10 lessons – 8 taught lessons, 1 lesson for revision & teacher review, 1 lesson for feedback of teacher review.

Biology National curriculum: Structure & function of living things – nutrition & digestion

- plants making carbohydrates in their leaves by photosynthesis and gaining mineral nutrients and water from the soil via their roots

Biology National curriculum: Interactions & interdependencies – relationships in an ecosystem

- the interdependence of organisms in an ecosystem, including food webs and insect pollinated crops
- the importance of plant reproduction through insect pollination in human food security
- how organisms affect, and are affected by, their environment, including the accumulation of toxic materials

Biology National curriculum: Material cycles & energy – photosynthesis

- the reactants in, and products of, photosynthesis, and a word summary for photosynthesis
- the dependence of almost all life on Earth on the ability of photosynthetic organisms, such as plants and algae, to use sunlight in photosynthesis to build organic molecules that are an essential energy store and to maintain levels of oxygen and carbon dioxide in the atmosphere
- the adaptations of leaves for photosynthesis

Biology National curriculum: Gas exchange systems

- the role of leaf stomata in gas exchange in plants

From KS2 most pupils will:

- Describe the basic structure of plants and flowers.
- Recall the conditions plants need to grow well as well as basic insect pollination (e.g. pollination involving bees).
- Explain why leaves are important for photosynthesis.
- Describe how water is taken in through the roots.
- Recall that respiration releases carbon dioxide.
- Recall the basics of a 'Food Chain' and will recognise key terms from food chains such as: Producer, Consumer, Prey and Predator.

Leads to KS4 units:

- Biology Paper 1: Bioenergetics – Respiration and photosynthesis; cells – plant cells and specialized cells; Organisation – tissues and organs and transport in a plant
- Biology Paper 2: Ecology – Ecosystems and Trophic Levels

Common confusion & misconceptions with this unit:

- Photosynthesis is an immensely complex set of over 80 reactions that occur inside chloroplasts. These reactions are catalysed and controlled by enzymes. At this level only the basics are dealt with: carbon dioxide (from the air) and water (from the soil) combine inside the chloroplasts to form glucose and oxygen. The process requires light and chlorophyll. This green molecule covers the layers of membranes that are found within chloroplasts. It is able to absorb light and make the energy available for the synthesis of glucose molecules.
- Plants DO NOT breathe (they do not have lungs). Photosynthesis IS NOT how plants breathe.
- The glucose made in photosynthesis can be used by the plant in respiration. Respiration RELEASES energy – DO NOT let students use the term "makes" or "creates" energy as this is not correct. Energy cannot be created or destroyed, just changed from one form to another (energy transfer).

- Plants respire 24 hours a day. Some students think that they only respire at night when the plant doesn't photosynthesise.
- It should be noted that the root hair is not a hair in the sense of a human hair. It is an extension of the cell wall that increases the surface area of the cell allowing the absorption of water from the soil more efficiently.
- There is often confusion about the terms 'nutrient', 'mineral salt' and 'mineral'. These are often used interchangeably, although in this course, when dealing with plants the term 'mineral salt' is used in preference to 'nutrient' or 'mineral'. A mineral salt is a chemical compound (from a group of compounds called salts) from which particular elements are needed by a plant.
- In food chains, the arrows point in the direction of energy transfer (energy flow) through the differing organisms. Some students often believe that these arrows point in the direction of 'what eats what'. This is incorrect as if this was the case the arrows would in fact be facing the opposite way.

Link to further reading & support:

- BBC Bitesize - Living Organisms: https://www.bbc.co.uk/bitesize/guides/zpwmxnb/revision/1
- BBC Bitesize - Food Chains and Food Webs: https://www.bbc.co.uk/bitesize/guides/zq4wjxs/revision/1

Unit title - Atoms, elements & compounds

10 lessons – 8 taught lessons, 1 lesson for revision & teacher review, 1 lesson for feedback of teacher review.

Chemistry National curriculum: Atoms, elements & compounds

- 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

From KS2 most pupils will:

- Compare and group materials together, according to whether they are solids, liquids or gases
- Compare and group together a variety of everyday materials based on their simple physical properties
- Demonstrate that dissolving, mixing and changes of state are reversible changes
- Explain that some changes result in the formation of new materials, and that this kind of change is not usually reversible

Leads to KS4 units:

- Chemistry Paper 1 - 5.1.1.1: Atoms, Elements and Compounds
- Chemistry Paper 1 - 5.1.1.3: The Development of the Model of the Atom
- Physics Paper 1 - 6.4.1.3: The Development of the Model of the Atom
- Physics Paper 1 - 6.4.1.1: The Structure of an Atom

Common confusion & misconceptions with this unit:

- Particles are sometimes misrepresented in diagrams. Different substances will need to be represented as different sizes or colours to distinguish them.
- Various elements are present in our bodies but in the form of ions which is chemically and physically different than the pure elements that are studied in this unit
- Elements are discovered rather than invented. All naturally occurring elements were present on Earth when it was formed but they were all discovered at different points in time.
- When matter expands this is due to the particles being further apart rather than the size of the actual particle changing. Particles have fixed sizes, and these do not change.
- All substances can exist as solids, liquids and gases at different temperatures. Some students attribute this property to water only because it is most observed.
- Some students have a prior misconception that if a substance cannot be seen then it does not exist.

Link to further reading & support:

- Online atom, elements and compounds quiz: https://www.footprints-science.co.uk/index.php?quiz=Elements%20Compounds%20Mixtures
- Build an Atom (online interactive simulation): http://phet.colorado.edu/sims/html/build-an-atom/latest/build-an-atom_en.html
- Online tour of the atom: https://pbslm-contrib.s3.amazonaws.com/WGBH/arct15/SimBucket/Simulations/chemthink-atomicstructure/content/index.html
- Create your own compounds: https://molview.org/
- BBC Bitesize: https://www.bbc.co.uk/bitesize/guides/zt2hpv4/revision/1

Unit title – Forces

10 lessons – 8 taught lessons, 1 lesson for revision & teacher review, 1 lesson for feedback of teacher review.

Physics National curriculum: Motion & forces – forces

- forces as pushes or pulls, arising from the interaction between 2 objects
- using force arrows in diagrams, adding forces in 1 dimension, balanced and unbalanced forces
- forces: associated with deforming objects; stretching and squashing – springs; with rubbing and friction between surfaces, with pushing things out of the way; resistance to motion of air and water
- forces measured in newtons, measurements of stretch or compression as force is changed

Physics National curriculum: Motion & forces – balanced forces

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

Physics National curriculum: Motion & forces – forces & motion

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

Biology National curriculum: Structure & function of living things – reproduction

- reproduction in plants, wind and insect pollination, seed and fruit dispersal, including quantitative investigation of some dispersal mechanisms (Related aspects of plant reproduction covered in the topic 'Forensics – cellular respiration unit).

From KS2 most pupils will:

- Be able to compare how things move on different surfaces and notice that some forces need contact between two objects.
- 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.

Leads to KS4 units:

- Physics paper 2 Forces: Contact and Non-contact forces, forces and motion and resultant force.

Common confusion & misconceptions with this unit:

- They must be able to identify balanced forces and action/reaction pairs. A detailed study of forces would make the distinction between balanced forces and action/reaction pairs (as described by Newton's 3rd law of motion
- Air resistance is contact force.

Link to further reading & support:

- https://www.bbc.co.uk/bitesize/topics/z4brd2p/articles/zkcpfcw
- https://www.bbc.co.uk/bitesize/topics/z4brd2p/articles/zr3xh39
- https://www.bbc.co.uk/bitesize/topics/z4brd2p/articles/z7hdqhv

AP3 test

TOPIC 4: Big bang fireworks

Theme for unit is to design an end of year firework display.

Summary cross unit task – *design an end of year firework display.*

Career link – *firework display technicians (pyrotechnician) employed to bid for and design a firework display for Alsager Rotary club.*

- **Chemical reactions – combustion & oxidation** – write the word equations for combustion of fuels & oxidation of metals. This can then be applied to a simplified firework reaction (the energy given out from some reactions excites metals to give out coloured light). Pupils may make a simple splint sparkler or complete flame tests.

- **Circuits** – Design a circuit detonator system to light a firework display – simple one firework – what can be achieved with series & parallel circuits to light multiple fireworks at delayed timings

Unit title – Chemical reactions – combustion & oxidation

10 lessons – 8 taught lessons, 1 lesson for revision & teacher review, 1 lesson for feedback of teacher review.

Chemistry National curriculum: Chemical reactions

- chemical reactions as the rearrangement of atoms
- representing chemical reactions using formulae and using equations
- combustion, & oxidation reactions
- what catalysts do

Chemistry National curriculum: Energetics

- energy changes on changes of state (qualitative) *(Also taught in 'The adventures of Little Frances: Unit title – Physical changes – the particulate nature of matter)*
- exothermic and endothermic chemical reactions (qualitative)

From KS2 most pupils will:

- be able to name some elements
- state that there are about 100 elements
- state that elements are made up of atoms
- explain that when elements join together compounds are formed.
- recall the three states of matter

- recall that matter is made of particles, and describe how these are arranged in solids, liquids and gases
- explain that heat is a form of energy, and that energy is transferred from hotter to colder object

Leads to KS4 units:

- Chemistry: paper 1 - Bonding, structure, and the properties of matter
- Chemistry: paper 2 - The rate and extent of chemical change
- Physics: paper 1 - Particle model of matter
- Chemistry paper 1- Atomic Structure and the period table- location of metals and non-metals in the periodic table. Link names of elements to their symbols using the periodic table. Definitions of elements, compounds and mixtures. Development of the periodic table
- Chemistry paper 2- Chemical Analysis – what is a pure substance and what is a mixture; link to elements, compounds and mixtures

Common confusion & misconceptions with this unit:

- The qualifying phrase 'using chemical reactions' is used because the transmutation of elements can occur in nuclear reactions. However, this is usually classified as nuclear physics rather than chemistry
- The gain in mass when magnesium burns is likely to come as a surprise to many pupils. In the case of magnesium, both the fuel and the product are solids and so, if care is taken to ensure complete combustion with no loss of product, a gain in mass will occur.
- Confusion between mixture and compound
- Elements are all the same state at room temp
- Some students will think that compounds consist of only one element
- Students will also make the mistake that mixtures are chemically bonded together
- Formulas are confused with symbols e.g. Nitrogen is N2 not N

Link to further reading & support:

- BBC Bitesize: Elements, mixtures and compounds
  https://www.bbc.co.uk/bitesize/guides/zt2hpv4/revision/1

  https://www.bbc.co.uk/bitesize/topics/zstp34j

  https://www.bbc.co.uk/bitesize/guides/zqd2mp3/revision/3

  https://phet.colorado.edu/sims/html/build-a-molecule/latest/build-a-molecule_en.html

  https://phet.colorado.edu/sims/html/reactants-products-and-leftovers/latest/reactants-products-and-leftovers_en.html

  https://www.youtube.com/watch?v=14BEh2EKrM0

  https://www.youtube.com/watch?v=M-1nzFZGaAM

  https://www.tes.com/teaching-resource/exploring-combustion-ks3-chemistry-11912325

  https://edu.rsc.org/cpd/chemical-energetics-words-matter/2000004.article

Unit title – circuits

10 lessons – 8 taught lessons, 1 lesson for revision & teacher review, 1 lesson for feedback of teacher review.

Physics National curriculum: Electricity & electromagnetism – current electricity

- electric current, measured in amperes, in circuits, series and parallel circuits, currents add where branches meet and current as flow of charge
- potential difference, measured in volts, battery and bulb ratings; resistance, measured in ohms, as the ratio of potential difference (p.d.) to current
- differences in resistance between conducting and insulating components (quantitative)

Physics National curriculum: Electricity & electromagnetism – static electricity

- separation of positive or negative charges when objects are rubbed together: transfer of electrons, forces between charged objects
- the idea of electric field, forces acting across the space between objects not in contact

From KS2 most pupils will:

- be able to construct simple circuits and use them to find out whether materials are conductors or insulators
- draw circuit diagrams and construct circuits from diagrams using conventional symbols
- know how switches work
- be able to investigate the effect of changing components in a circuit on the brightness of bulbs.

Leads to KS4 units:

- Physics – Paper 1 - Electricity

Common confusion & misconceptions with this unit:

- Difference between potential difference or voltage, current and resistance
- Direction of conventional current versus direction of electron flow especially where applied to electromagnetism
- Describe current as flow of charge. If desired extend to flow of electrons as the charge carriers in a metal
- In the clashing currents model, two different types of electricity leave the two ends of the cell and meet in the bulb. The reaction of the two currents causes light.
- In the diluted current model, the current becomes weaker as it travels around the circuit, because it is shared between all the components in a circuit.
- In the single wire model, the return wire is not necessary as all the electricity is converted to light in the bulb.
- It is essential that pupils grasp the idea that current is the same everywhere in a series circuit

Link to further reading & support:

- BBC Bitesize Elctricity:

  https://www.bbc.co.uk/bitesize/topics/zgy39j6

  https://www.bbc.co.uk/bitesize/guides/zsfgr82/revision/4

  https://www.bbc.co.uk/bitesize/clips/zpj34wx

  https://phet.colorado.edu/sims/html/circuit-construction-kit-dc-virtual-lab/latest/circuit-construction-kit-dc-virtual-lab_en.html

  https://www.twinkl.co.uk/resource/t3-sc-899-ks3-electricity-lesson-1-introduction-to-circuits-lesson-pack

Year 8 Sequencing

TOPIC 1: Amusement Park

Theme for unit is to design an Amusement Park which serves nutritious food & by understanding energy needed and transfers taking place has green energy

Summary cross unit task – *suggestion – submit a planning application for a new theme park in Alsager*

Career link *– food technologist and an energy resource scientist*

- **Food** – Rationale to be developed for what foods the Amusement Park should sell from understanding what our food contains, how we digest and absorb nutrients, the role of the nutrients in our bodies.

- **Energy** – energy in foods available at the park, supply of energy resources to the park, costs of running the park, energy changes during a rollercoaster ride. Current coaster designs often use steel tracks, thinking about heat transfers and also friction discuss energy transfers during the ride

Unit Title – Food!

11 lessons – 9 taught lessons, 1 lesson for revision & teacher review, 1 lesson for feedback of teacher review.

Biology National curriculum: Structure & function of living things – nutrition & digestion

- the content of a healthy human diet: carbohydrates, lipids (fats and oils), proteins, vitamins, minerals, dietary fibre and water, and why each is needed
- calculations of energy requirements in a healthy daily diet
- the consequences of imbalances in the diet, including obesity, starvation and deficiency diseases
- the tissues and organs of the human digestive system, including adaptations to function and how the digestive system digests food (enzymes simply as biological catalysts)
- the importance of bacteria in the human digestive system

From KS2 most pupils will:

- understand that foods contain a variety of substances needed by the body and recognise the idea of nutrition as a life process
- appreciate that a wide variety of foods needs to be eaten to have a balanced diet
- know that food contains stored energy
- be familiar with the names and positions of some of the organs in the digestive system
- know that substances are carried around the body by the blood –the idea and process of absorption will be unfamiliar to most.
- be familiar with respiration as one of the life processes.

Leads to KS4 units:

- Biology paper 1: Cell biology, Organisation

Common confusion & misconceptions with this unit:

- That glucose can be used to create/made/produced energy – energy is released not created.
- The word 'diet' is losing weight – everything you eat, and drink is your diet.
- Fat is bad within your diet – Fat is used for protection and insulation. It can be a store of energy.
- Water is also an important component of the diet. It is used to carry dissolved chemicals around the body and most biochemical reactions do not occur without the reactants being dissolved in water.
- Being just overweight is unhealthy - Being too thin is also unhealthy.
- Digestion only starts in your stomach – Digestion starts at the mouth when food is chewed, or enzymes secreted.

Link to further reading & support:

- BBC Bitesize: Digestive System https://www.bbc.co.uk/bitesize/guides/z9pv34j/revision/1

Unit title – Energy

11 lessons – 9 taught lessons, 1 lesson for revision & teacher review, 1 lesson for feedback of teacher review.

Physics National curriculum: Energy – calculation of fuel uses & costs in the domestic context

- comparing energy values of different foods (from labels) (kJ)
- comparing power ratings of appliances in watts (W, kW)
- comparing amounts of energy transferred (J, kJ, kW hour)
- domestic fuel bills, fuel use and costs
- fuels and energy resources

Physics National curriculum: Energy – energy changes & transfers

- simple machines give bigger force but at the expense of smaller movement (and vice versa): product of force and displacement unchanged
- heating and thermal equilibrium: temperature difference between 2 objects leading to energy transfer from the hotter to the cooler one, through contact (conduction) or radiation; such transfers tending to reduce the temperature difference; use of insulators
- other processes that involve energy transfer: changing motion, dropping an object, completing an electrical circuit, stretching a spring, metabolism of food, burning fuels

Physics National curriculum: Energy – changes in systems

- energy as a quantity that can be quantified and calculated; the total energy has the same value before and after a change
- comparing the starting with the final conditions of a system and describing increases and decreases in the amounts of energy associated with movements, temperatures, changes in positions in a field, in elastic distortions and in chemical compositions
- using physical processes and mechanisms, rather than energy, to explain the intermediate steps that bring about such changes

Physics National curriculum: Motion & forces – forces & motion

- moment as the turning effect of a force

From KS2 most pupils will:

- recall how to construct simple series and parallel circuits
- recall that some energy resources (e.g. fossil fuels) are non-renewable
- recall that there are a range of renewable energy resources, and some of the advantages and disadvantages of these
- explain that heat is a form of energy, and that energy is transferred from hotter to colder object

Leads to KS4 units:

- Physics Paper 1: Energy
- Physics Paper 1: Electricity

Common confusion & misconceptions with this unit:

- Energy as a concept has always been difficult to teach, as the underlying concepts are really only suitable for A-level teaching. Various inaccuracies are therefore inevitably introduced when simplifying concepts to teach energy to younger pupils.
- When talking about energy, it is best to avoid talking about 'using energy'. Previously the language was mostly about 'using energy resources', or 'using fuels'. The emphasis in this unit is mostly on energy transfers, both from place to place, and from one form to another. Avoiding the word 'use' will help to avoid the misconception that energy is 'used up'. Energy resources can be 'used up', in the sense that the energy originally stored in them has been transferred and dissipated into less useful forms, but the total amount of energy remains the same.
- Efficiency is a ratio of two energies or powers; it is therefore dimensionless, meaning it has no units. Efficiencies are always a number between (and including) 0 and 1.
- Ensure careful differentiation between 'energy types' (e.g. kinetic) and 'energy resources' (e.g. solar [not the Sun]).

Link to further reading & support:

- BBC Bitesize – Energy: https://www.bbc.co.uk/bitesize/topics/zc3g87h
- BBC Bitesize: conduction, convection and radiation - https://www.bbc.co.uk/bitesize/clips/zhdyr82

AP1 test

TOPIC 2: All change - Dalton to DNA

Theme – changing environment how & why do some species adapt. Which chemicals exhibit similar properties and could perform a similar function in other species. Throught the unit pupils have the opportunity to earn science explorer badges for completing set tasks!

Summary cross unit task – *pupils imagine a new species which may have been discovered on the plateau. The pupils describe and explain the creature's adaptations and what elements may be present instead of carbon and iron in the species tissues. If successful they will earn the rare 'Grape soda' badge!*

Career link – *zookeeper (or any job in a zoo); material scientist*

Genetics & evolution – Pizzlys and pandas - the planet is changing how might a polar bear evolve to adapt to a warmer plant – are there new emergent species due to new variations – what are pizzly bears and why is a panda bear a potential evolutionary dead end? Should we bother to protect it?

The periodic table – A new species has been discovered which has evolved in very remote plateau (similar to the one in Up!). Pupils to predict & explain which metal may be present in the blood rather than iron, which element may be the basis of life rather than carbon, which simple test could be used to test for the acids in DNA

Unit title – Genetics & evolution

11 lessons – 9 taught lessons, 1 lesson for revision & teacher review, 1 lesson for feedback of teacher review.

Biology National curriculum: Genetics & evolution – inheritance, chromosomes, DNA & genes

- heredity as the process by which genetic information is transmitted from one generation to the next
- differences between species
- the variation between individuals within a species being continuous or discontinuous, to include measurement and graphical representation of variation
- the variation between species and between individuals of the same species meaning some organisms compete more successfully, which can drive natural selection
- changes in the environment which may leave individuals within a species, and some entire species, less well adapted to compete successfully and reproduce, which in turn may lead to extinction
- the importance of maintaining biodiversity and the use of gene banks to preserve hereditary material

From KS2 most pupils will:

- be able to recall that genetic information comes from both parents.
- be able to recall that sexual reproduction involves the fusion of male and female gametes.

Leads to KS4 units:

- Biology paper 1: Cell biology
- Biology Paper 2: Inheritance, Variation and Evolution.

Common confusion & misconceptions with this unit:

- Eye colour, skin colour and hair curliness are traditionally thought of as being inherited; but the can all be altered by the environment (e.g. coloured contact lenses, sunbathing and perming).
- Misuse of the term's chromosome, gene and DNA. Inherited characteristic is controlled by part of a chromosome called a gene. Chromosomes are passed from parent to offspring during reproduction. DNA is the substance that genes are made up of and consists of a molecule made of repeating units. The repeating units determine what kind of protein is made; each gene produces one protein. Proteins are responsible for characteristics.
- A misconception of the difference between identical and non-identical twins. Identical twins are when a fertilized egg cell splits to form two separate cells, both of which grow into embryos. Non-identical twins are caused by the fertilization of two egg cells.
- Many pupils may assume that fruit and vegetables all look essentially the same because that is the way that they are presented in supermarkets. The true range of characteristics is not observed or known.
- Genetically modified (GM) food is something many people are worried about. Many pupils will not appreciate that they eat produces made using GM organisms, cheese being the main example. The rennet needed to make cheese traditionally comes from the stomachs of young calves, but it is easier to use rennet made by GM bacteria, grown in huge vats.

Link to further reading & support:

- BBC Bitesize: Living organisms: https://www.bbc.co.uk/bitesize/topics/zpffr82

Unit title – The periodic table

11 lessons – 9 taught lessons, 1 lesson for revision & teacher review, 1 lesson for feedback of teacher review.

Chemistry National curriculum: The periodic table

- the varying physical and chemical properties of different elements
- the principles underpinning the Mendeleev periodic table
- the periodic table: periods and groups; metals and non-metals
- how patterns in reactions can be predicted with reference to the periodic table
- the properties of metals and non-metals
- the chemical properties of metal and non-metal oxides with respect to acidity

Chemistry National curriculum: Chemical reactions

- thermal decomposition & displacement reactions

From KS2 most pupils will:

- Have an understanding about what a metal is.
- Will be able to describe a simple use of metal.
- identify metals and non-metals from their properties
- know the reaction of metals with oxygen and with acids
- be able to name some elements
- state that there are about 100 elements
- state that elements are made up of atoms
- explain that when elements join compounds are formed.

Leads to KS4 units:

- Chemistry paper 1 – Atomic structure and the periodic table
- Chemistry paper 1 - Bonding and structure
- Chemistry paper 1 - Chemical Changes
- Chemistry paper 2- Chemical Analysis – what is a pure substance and what is a mixture, link to elements, compounds and mixtures
- Chemistry paper 2 – Using resources – Life Cycle Assessments and reusing and recycling materials

Common confusion & misconceptions with this unit:

- The reactivity of metals is a general property. Often reactivity is confused and not associated with properties.
- Writing of a word/symbol equation must be written in a set format. The reactants to the left of a reaction arrow and the products to the right. Students often write the equations as a sentence.
- Students often get confused with the addition of carbon into reactivity of metals. Carbon is a non-metal however, if often used in displacement reactions to extract metals for metals less reactive than carbon.
- Students will think that all metals are hard
- All metals are solid at room temperature
- All metals rust and have the same reactivity
- Confusion between mixture and compound
- Elements are all the same state at room temp
- Some students will think that compounds consist of only one element
- Students will also make the mistake that mixtures are chemically bonded together
- Formulas are confused with symbols e.g., Nitrogen is N_2 not N

Link to further reading & support:

- BBC Bitesize: Elements, mixtures and compounds https://www.bbc.co.uk/bitesize/guides/zt2hpv4/revision/1
- BBC Bitesize: https://www.bbc.co.uk/bitesize/guides/zqwmxnb/revision/1
- BBC Bitesize: Reactivity of metals: https://www.bbc.co.uk/bitesize/topics/zypsgk7

AP2 test

TOPIC 3: Forensics

Theme – To use science to investigate a crime scene when a body is found. The murder occurred in another location & the body was transported to the laboratory.

Summary cross unit task – *courtroom drama - use the evidence to provide expert witnesses for the prosecution & to provide expert witnesses for the defence to discuss the limitations of the evidence.*

Career link – *forensic scientist*

Cellular respiration – Initial idea that absence of cellular respiration will result in death & subsequent decay will be by microorganisms which respire. Use forensic botany to determine location of murder crime scene & forensic entymology related to decay of body.

Earth – initial examination of the crime scene using chemical tests (flame tests) & biochemical tests (food tests) to analyse samples found at the scene. Use knowledge of rock types to provide evidence to relate soil samples found on shoes to geographical location e.g. shoe contain igneous & sedimentary rock & two possible locations one is metamorphic rock & other is lakeside which has igneous & sedimentary matching the soil sample

Motion, forces & light – use knowledge of motion and forces to determine if the body could have been transported from murder scene to the lab between the time of the murder & the discovery of the body. How far could the murderer have travelled in the 'Golden hour' of investigation? The murder weapon is missing – if this has been disposed of in the lake will it have sunk or floated? Use of the knowledge of refractive index to write secret messages or to hide transparent objects

Unit title – Cellular respiration

11 lessons – 9 taught lessons, 1 lesson for revision & teacher review, 1 lesson for feedback of teacher review.

Biology National curriculum: Material cycles & energy – cellular respiration

- aerobic and anaerobic respiration in living organisms, including the breakdown of organic molecules to enable all the other chemical processes necessary for life
- a word summary for aerobic respiration
- the process of anaerobic respiration in humans and micro-organisms, including fermentation, and a word summary for anaerobic respiration
- the differences between aerobic and anaerobic respiration in terms of the reactants, the products formed and the implications for the organism

Biology National curriculum: Structure & function of living things – reproduction

- reproduction in plants, including flower structure, fertilisation, seed and fruit formation (Related aspects of plant reproduction covered in the topic 'Can we get the bees back – forces unit)

From KS2 most pupils will:

- • know the gases in air
- • know what digestion does
- • know that organs are made of tissues and tissues are made of cells
- • know that the breathing rate varies.

Leads to KS4 units:

- Biology paper 1: Cell biology, Organisation, Bioenergetics

Common confusion & misconceptions with this unit:

- The term 'breathing system' is preferred at this level because it helps to ensure that pupils are able to differentiate between breathing (a process involving muscles which change the size of the thorax), ventilation (the movement of air into and out of the lungs) and respiration (a cellular process used to release energy)

Link to further reading & support:

- BBC Bitesize: Respiration and gas exchange - https://www.bbc.co.uk/bitesize/topics/zvrrd2p

Unit title – Earth

11 lessons – 9 taught lessons, 1 lesson for revision & teacher review, 1 lesson for feedback of teacher review.

Chemistry National curriculum: Earth

- the composition of the Earth
- the structure of the Earth
- the rock cycle and the formation of igneous, sedimentary and metamorphic rocks
- Earth as a source of limited resources and the efficacy of recycling
- The carbon cycle
- the composition of the atmosphere
- the production of carbon dioxide by human activity and the impact on climate

From KS2 most pupils will:

- To describe and group rocks and soils on the basis of their characteristics, including appearance, texture and permeability.
- To describe changes that occur when materials are heated or cooled.
- Seen different rocks and noticed they are different properties
- Recall that global warming is causing the mean temperature of the Earth to rise, and that this is linked with burning fossil fuel.
- Understand the nature of some chemical reactions including combustion.
- Know that when a material is burnt, new materials are formed; they may know that this change cannot be reversed.

Leads to KS4 units:

- Fossils KS4 biology
- Chemistry paper 2: Using Resources, Organic Chemistry
- KS4 geography – plate tectonics, structure of earth, rocks

Common confusion & misconceptions with this unit:

- Lava is molten rock above ground, magma is underground
- Incorrectly think all rocks are the same
- Weathering V Erosion. Weathering is being broken/changed in situ, erosion is when the rock breaks away/moves
- The rock on earth has been here form millions of years but can be recycled through many different forms but heat and/or pressure
- The earth is made up of different internal layers
- The continents are drifting apart due to continental plate theory.
- The depletion of ozone in our upper atmosphere is often confused with other environmental problems such as acid rain and global warming. Some of the causes are the same but the effects are different. In 1985, a team of British scientists led by Joe Farman reported finding a 'hole' in the ozone layer above Antarctica.
- This was not really a hole in the atmosphere, but an area where there was less ozone than normal. The scientists were particularly concerned as the ozone seemed to be disappearing very quickly.

Link to further reading & support:

- https://www.bbc.co.uk/bitesize/guides/zwd2mp3/revision/1
- https://www.bbc.co.uk/bitesize/guides/zgb9kqt/revision/1
- https://www.youtube.com/watch?v=_hhwkMagUV0

Unit title – Motion & forces

11 lessons – 9 taught lessons, 1 lesson for revision & teacher review, 1 lesson for feedback of teacher review.

Physics National curriculum: Motion & forces – describing motion

- speed and the quantitative relationship between average speed, distance and time (speed = distance ÷ time)
- the representation of a journey on a distance-time graph
- relative motion: trains and cars passing one another

Physics National curriculum: Motion & forces – pressure in fluids

- atmospheric pressure, decreases with increase of height as weight of air above decreases with height
- pressure in liquids, increasing with depth; upthrust effects, floating and sinking
- pressure measured by ratio of force over area – acting normal to any surface

Physics National curriculum: Waves – light waves

- the similarities and differences between light waves and waves in matter
- light waves travelling through a vacuum; speed of light
- the transmission of light through materials: absorption, diffuse scattering and specular reflection at a surface
- use of ray model to explain imaging in mirrors, the pinhole camera, the refraction of light and action of convex lens in focusing (qualitative); the human eye
- light transferring energy from source to absorber, leading to chemical and electrical effects; photosensitive material in the retina and in cameras
- colours and the different frequencies of light, white light and prisms (qualitative only); differential colour effects in absorption and diffuse reflection

From KS2 most pupils will:

- Describe what speed means
- Draw basic graphs
- Have seen general equations
- be able to identify light sources
- know that light cannot pass through some materials, and how this leads to the formation of shadows
- be able to use mirrors and know about reflective surfaces
- know that we see things only when light from them enters the eye.
- calculate the area of simple shapes
- describe how pressure relates to force and area
- describe some situations in which high or low pressure is useful

Leads to KS4 units:

- Physics paper 2 – Forces - speed and motion
- Physics paper 1 - equations of energy transfer.
- Physics paper 2 - Waves
- Physics paper 2 - Magnetism and Electromagnetism.

Common confusion & misconceptions with this unit:

- The pupils must know the idea of time in the fact that stopclocks can be used to time movement that is fairly slow or takes place over a long distance (e.g. pupils measuring their own walking speed). This cannot be used for all moments of time.
- They must be able to identify balanced forces and action/reaction pairs. A detailed study of forces would make the distinction between balanced forces and action/reaction pairs (as described by Newton's 3rd law of motion
- The students must know the difference between speed and velocity
- The students would need to know that there is no such a thing as a square second for the acceleration unit.
- When looking at terminal velocity changing in a vertical motion on a skydiver to parachute is that it is a rapid slowing and not that the parachute makes the skydiver "go up".
- Air resistance is contact force.
- The 'lateral inversion' of an image in a mirror can present the problem of why it is not also inverted top to bottom. The problem goes away if pupils consider that the reflection always appears to be in the equivalent place to the relevant part of the object; i.e. the top of the image corresponds to the top of the object, the left side of the image (NOT the left hand of the person in the image) corresponds to the left of the object, etc.
- Note that the amount of refraction that occurs does not depend on the density of the material. This misconception can arise because there is a value called 'optical density', which does correlate to the amount of refraction, but this is concerned with the transmittance of light through the material and is not connected with mass/ volume.
- Students will need to know that there is more than one unit for the pressure The SI units for pressure are newtons per square metre (N/m2, alternatively written as N m–2) or pascals (Pa). Sometimes it is more convenient to measure the area in cm2. In this case the pressure unit is N/cm2.
- Students need to know that pressure in liquids increases with depth because there is more weight of liquid above pressing down.

Link to further reading & support:

- BBC Bitesize: https://www.bbc.co.uk/bitesize/guides/zwwmxnb/revision/1
- https://www.bbc.co.uk/bitesize/guides/z2b9hv4/revision/1 - higher level website
- https://www.youtube.com/watch?v=511rdc8K_TU&t=282s

AP3 test

TOPIC 4: Medicine

Theme – to understand how disease & drugs can affect the body & how the use of waves can enhance our life in communication & medical applications.

Summary cross unit task – *pupils act as medical sales reps for medical devices based on their applications in novel areas*

Career link *– doctor reviewing case studies throughout the drugs, doctors and disease unit and a sonographer*

Drugs, doctors & disease – through understanding gas exchange systems look at the damage smoking causes to the lungs, define what is meant by a drug & relate how abuse can harm physical & mental well-being or that drugs for medicines can be beneficial. Relate to how exercise can help well-being for example to improve lung volume & reduce asthma.

Waves – Following teaching of main areas, pupils will have experienced the broad range of applications to which waves apply. This includes a focus on medical applications, such as what happens when waves meet other waves, hearing and the biology of the ear, the speed of sound waves and echoes, all of which lead to the introduction of ultrasound uses for physiotherapy and pre-natal screening plus the career of sonography

Unit title – Drugs, doctors and disease

11 lessons – 9 taught lessons, 1 lesson for revision & teacher review, 1 lesson for feedback of teacher review.

Biology National curriculum: Structure & function of living things – gas exchange systems

- the structure and functions of the gas exchange system in humans, including adaptations to function
- the mechanism of breathing to move air in and out of the lungs, using a pressure model to explain the movement of gases, including simple measurements of lung volume
- the impact of exercise, asthma and smoking on the human gas exchange system

Biology National curriculum: Structure & function of living things – health

- the effects of recreational drugs (including substance misuse) on behaviour, health and life processes
- how the body fights disease (not specifically required by NC)

From KS2 most pupils will:

- know the gases in air
- know that the breathing rate varies.
- recall that carbon dioxide and oxygen are exchanged in the lungs
- Leads to KS4 units:
- Biology paper 1: Cell biology, Organisation, Bioenergetics and Infection and Response

Common confusion & misconceptions with this unit:

- There is often much confusion between the terms breathing, ventilation and respiration. Breathing is when the diaphragm and intercostal muscles between the ribs change the volume of the thorax. Ventilation is the movement of air into and out of the lungs as a result of breathing. Respiration is a chemical reaction that occurs inside all living cells to release energy from glucose

Link to further reading & support:

- BBC Bitesize: Respiration and gas exchange https://www.bbc.co.uk/bitesize/topics/zvrrd2p
- BBC Bitesize: Health and Disease: https://www.bbc.co.uk/bitesize/topics/znyycdm

Unit title – Waves

11 lessons – 9 taught lessons, 1 lesson for revision & teacher review, 1 lesson for feedback of teacher review.

Physics National curriculum: Waves – observed waves

- waves on water as undulations which travel through water with transverse motion; these waves can be reflected, and add or cancel – superposition

Physics National curriculum: Waves – sound waves

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

Physics National curriculum: Waves – energy & waves

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

Physics National curriculum: Electricity & electromagnetism – magnetism

- magnetic poles, attraction and repulsion
- magnetic fields by plotting with compass, representation by field lines
- Earth's magnetism, compass and navigation
- the magnetic effect of a current, electromagnets, DC motors (principles only)

From KS2 most pupils will:

- know that sounds are made when objects vibrate but that vibrations are not always directly visible
- be able to change the pitch and loudness of sounds produced by some vibrating objects
- know that vibrations from sound sources require a medium through which to travel to the ear
- be able to describe the direction of force between magnets
- be able to classify materials as magnetic or non-magnetic
- be able to describe some uses of magnets

Leads to KS4 units:

- Physics paper 1: Energy
- Physics paper 2: Waves
- Physics paper 2: Magnetism & Electromagnetism

Common confusion & misconceptions with this unit:

- Energy transfer – pupils should be clear that energy transfer does not result in a net transfer of matter.
- That sound travels fastest in air – pupils often believe that the speed of sound decreases as density increases, which is not true.
- Amplitude of a wave is from the mid point to a peak or trough. It is not measured from the trough to the peak.
- Pupils may also believe that bats, which use ultrasound to navigate, have poor eyesight. This is not true. Bats have reasonably good eyesight, but use their ears and ultrasound to find out what is around them when it is dark

Link to further reading & support:

- BBC Bitesize: Features of Waves: https://www.bbc.co.uk/bitesize/guides/zgr8d2p/revision/1
- BBC Bitesize: Sound Waves: https://www.bbc.co.uk/bitesize/guides/z8d2mp3/revision/1
- BBC Bitesize: Electromagnetism & Magnetism: https://www.bbc.co.uk/bitesize/guides/z3g8d2p/revision/1

Year 9 Sequencing

TOPIC 1: Space

Theme – Explore what would be needed to survive & colonise in space

Summary cross unit task *–groups to act as project team to present project plan to get funding for the mission to colonise the new planet*

Career link **–**

- ***biology*** *– personal trainer / sports; technologist; mental health worker e.g. mental health nurse or psychiatrist*
- ***chemistry*** *– planetary scientist*
- ***physics*** *– astrophotographer*

- **Surviving & thriving in Space** – Survival - Photosynthesis – What will be required to start the food chain? What are possible food sources in space? Thriving – Devise a lifestyle program to stay physically & mentally healthy in space to enable the human population to thrive. The search for life in space – DNA as basis for life? How do cosmic rays impact on DNA?

- **Materials for Space survival** – which materials will be best suited for various requirements in Space? Will specialised breathing apparatus be required if the composition of the atmosphere is different? Can the materials required be obtained by mining the planet – oxides, versus unreactive elements versus synthetic materials.

- **Space Physics** – How long will it take to reach the area to be colonised? What will the conditions be like? Seasons? Temperature? How will we land on the surface? Will the forces be the same as on Earth? Will there be asteroid impacts? How are satellites used in space?

Unit title – Surviving & thriving in Space

10 lessons – 8 taught lessons, 1 lesson for revision & teacher review, 1 lesson for feedback of teacher review.

Biology National curriculum: Material cycles & energy – photosynthesis – recap only - taught in year 8 topic 'Can we get the bees back?'

- the reactants in, and products of, photosynthesis, and a word summary for photosynthesis
- the dependence of almost all life on Earth on the ability of photosynthetic organisms, such as plants and algae, to use sunlight in photosynthesis to build organic molecules that are an essential energy store and to maintain levels of oxygen and carbon dioxide in the atmosphere
- the adaptations of leaves for photosynthesis
- the role of leaf stomata in gas exchange in plants

Biology National curriculum: Structure & function of living things – health

- Mental health & well-being & the importance of exercise (not required by NC)

Biology National curriculum: Structure & function of living things - the skeletal & muscular systems

- the structure and functions of the human skeleton, to include support, protection, movement and making blood cells
- biomechanics – the interaction between skeleton and muscles, including the measurement of force exerted by different muscles
- the function of muscles and examples of antagonistic muscles

Biology National curriculum: Genetics & evolution – inheritance, chromosomes, DNA & genes

- a simple model of chromosomes, genes and DNA in heredity, including the part played by Watson, Crick, Wilkins and Franklin in the development of the DNA model

From KS2 most pupils will:

- describe the basic structure of plants
- recall the conditions plants need to grow well

Leads to KS4 units:

- Biology Paper 1 – Cell Biology and Organisation
- Biology Paper 2 – Inheritance, Variation and Evolution

Common confusion & misconceptions with this unit:

- Photosynthesis is an immensely complex set of over 80 reactions that occur inside chloroplasts. These reactions are catalysed and controlled by enzymes. At this level only the basics are dealt with: carbon dioxide (from the air) and water (from the soil) combine inside the chloroplasts to form glucose and oxygen. The process requires light and chlorophyll. This green molecule covers the layers of membranes that are found within chloroplasts. It is able to absorb light and make the energy available for the synthesis of glucose molecules.
- Plants DO NOT breathe. Photosynthesis IS NOT how plants breathe.
- The glucose made in photosynthesis can be used by the plant in respiration. Respiration RELEASES energy – DO NOT let students use the term makes energy as this is not correct. Energy cannot be created or destroyed, just changed from 1 form to another.
- Plants respire 24 hours a day. Some students think that they only respire at night when the plant doesn't photosynthesise.
- It should be noted that the root hair is not a hair in the sense of a human hair. It is an extension of the cell wall that increases the surface area of the cell allowing the absorption of water from the soil more efficiently.
- Misuse of the term's chromosome, gene and DNA. Inherited characteristic is controlled by part of a chromosome called a gene. Chromosomes are passed from parent to offspring during reproduction. DNA is the substance that genes are made up of and consists of a molecule made of repeating units. The repeating units determine what kind of protein is made, each gene produces one protein. Proteins are responsible for characteristics.

Link to further reading & support:

- BBC Bitesize: Living organisms: https://www.bbc.co.uk/bitesize/guides/zpwmxnb/revision/1

Unit title: Materials for Space survival

10 lessons – 8 taught lessons, 1 lesson for revision & teacher review, 1 lesson for feedback of teacher review.

Chemistry National curriculum: Materials for Space survival

- the order of metals and carbon in the reactivity series
- the use of carbon in obtaining metals from metal oxides
- properties of ceramics, polymers and composites (qualitative)

From KS2 most pupils will:

- Have an understanding about what a metal is.
- Will be able to describe a simple use of metal and other materials.
- Recall that global warming is causing the mean temperature of the Earth to rise, and that this is linked with burning fossil fuel.
- Understand the nature of some chemical reactions including combustion.
- Know that when a material is burnt, new materials are formed; they may know that this change cannot be reversed.

Leads to KS4 units:

- Chemistry paper 1: Chemical Changes, Energy Changes.
- Chemistry paper 2: Chemistry of the atmosphere, Using Resources, Organic Chemistry

Common confusion & misconceptions with this unit:

- The reactivity of metals is a general property. Often reactivity is confused and not associated with properties.
- Writing of a word/symbol equation must be written in a set format. The reactants to the left of a reaction arrow and the products to the right. Students often write the equations as a sentence.
- Students often get confused with the addition of carbon into reactivity of metals. Carbon is a non-metal however, if often used in displacement reactions to extract metals for metals less reactive than carbon.
- The depletion of ozone in our upper atmosphere is often confused with other environmental problems such as acid rain and global warming. Some of the causes are the same but the effects are different. In 1985, a team of British scientists led by Joe Farman reported finding a 'hole' in the ozone layer above Antarctica.
- This was not really a hole in the atmosphere, but an area where there was less ozone than normal. The scientists were particularly concerned as the ozone seemed to be disappearing very quickly
- The terms 're-use' and 'recycle' are sometimes used interchangeably. Re-use is applied here to the object, with recycling being reserved for the material

Link to further reading & support:

- BBC Bitesize: Reactivity of metals: https://www.bbc.co.uk/bitesize/topics/zypsgk7
- Combustion of a natural gas : https://www.bbc.co.uk/bitesize/clips/zq7b9j6
- Fossil fuels and the environment: https://www.bbc.co.uk/bitesize/clips/z4qb9j6
- Recycling: https://www.bbc.co.uk/bitesize/guides/zt6sfg8/revision/3#:~:text=Recycling%20means%20that%20we%20use,ending%20up%20in%20landfill%20sites.
- Carbon Cycle: https://www.bbc.co.uk/bitesize/guides/z27thyc/revision/2
- Composite materials: https://www.bbc.co.uk/bitesize/guides/ztxnsbk/revision/1

Unit title – Space Physics

10 lessons – 8 taught lessons, 1 lesson for revision & teacher review, 1 lesson for feedback of teacher review.

Physics National curriculum: Matter – space physics

- gravity force, weight = mass x gravitational field strength (g), on Earth g=10 N/kg, different on other planets and stars; gravity forces between Earth and Moon, and between Earth and sun (qualitative only)
- our sun as a star, other stars in our galaxy, other galaxies
- the seasons and the Earth's tilt, day length at different times of year, in different hemispheres
- the light year as a unit of astronomical distance

Physics National curriculum: Motion & forces – forces

- non-contact forces: gravity forces acting at a distance on Earth and in space, forces between magnets, and forces due to static electricity

- From KS2 most pupils will:
- know that the Sun, Moon and Earth are spherical
- be able to explain why shadows move during the day, and why we have day and night
- know that the Earth orbits the Sun and the Moon orbits the Earth

Leads to KS4 units:

- Physics paper 2: Space Physics

Common confusion & misconceptions with this unit:

- Misconception that the sun is not a star
- Lack of appreciation of scale of solar system, planets, etc.
- Differences between solar system, galaxies, universe
- Misconception about orbits:
    - all orbits are circular
    - the sun orbits around the earth
- 'Things are upside down' in the southern hemisphere
- That the earth is flat

Link to further reading & support:

- BBC Bitesize: Astronomy & Space Science: https://www.bbc.co.uk/bitesize/guides/z8wx6sg/revision/1
- BBC Bitesize: Forces (non-contact: gravity): https://www.bbc.co.uk/bitesize/guides/zttfyrd/revision/1

AP1 test

Pupils start Key Stage 4 program of study term 1b