**Key stage 3**

The principal focus of science teaching in key stage 3 is to develop a deeper understanding of a range of scientific ideas in the subject disciplines of biology, chemistry and physics. Pupils should begin to see the connections between these subject areas and become aware of some of the big ideas underpinning scientific knowledge and understanding. Examples of these big ideas are the links between structure and function in living organisms, the particulate model as the key to understanding the properties and interactions of matter in all its forms, and the resources and means of transfer of energy as key determinants of all of these interactions. They should be encouraged to relate scientific explanations to phenomena in the world around them and start to use modelling and abstract ideas to develop and evaluate explanations.

Pupils should understand that science is about working objectively, modifying explanations to take account of new evidence and ideas and subjecting results to peer review. Pupils should decide on the appropriate type of scientific enquiry to undertake to answer their own questions and develop a deeper understanding of factors to be taken into account when collecting, recording and processing data. They should evaluate their results and identify further questions arising from them.

‘Working scientifically’ is described separately at the beginning of the programme of study, but must always be taught through and clearly related to substantive science content in the programme of study. Teachers should feel free to choose examples that serve a variety of purposes, from showing how scientific ideas have developed historically to reflecting modern developments in science.

Pupils should develop their use of scientific vocabulary, including the use of scientific nomenclature and units and mathematical representations.

**Working scientifically**

Through the content across all three disciplines, pupils should be taught to:

**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

**Planning Grid KS3 Groups 1 + 2 + 3 Science 2020-2021**

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| --- | --- | --- | --- | --- | --- | --- |
|  | Autumn 1 | Autumn 2 | Spring 1 | Spring2 | Summer 1 | Summer 2 |
| Unit (s) | **Introduction: Experiments & Investigating Science*** safety in the lab
* **The skeletal and 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

**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

**Atoms, elements and 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

**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)
 | **Nutrition and 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

**Pure and 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**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
 | **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)

**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

**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

**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
 | **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
* **Chemical reactions** chemical reactions as the rearrangement of atoms
* representing chemical reactions using formulae and using equations
* combustion, thermal decomposition, oxidation and displacement reactions
* defining acids and alkalis in terms of neutralisation reactions
* the pH scale for measuring acidity/alkalinity; and indicators
* reactions of acids with metals to produce a salt plus hydrogen
* reactions of acids with alkalis to produce a salt plus water
* what catalysts do

**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
 |  **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**Materials*** 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)

**Earth and atmosphere*** 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 composition of the atmosphere
* the production of carbon dioxide by human activity and the impact on climate
 | **Inheritance, chromosomes, DNA and genes** * heredity as the process by which genetic information is transmitted from one generation to the next
* 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
* 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

**Calculation of fuel uses and 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

**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
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