Physics
KS3 Curriculum

ASPIRE – ENDEAVOUR - SUCCEED

Purpose and aims

Students:

- develop scientific knowledge and conceptual understanding through the specific disciplines of biology, chemistry and physics
- develop understanding of the nature, processes and methods of science through different types of science enquiries that help them to answer scientific questions about the world around them
- are equipped with the scientific knowledge required to understand the uses and implications of science, today and for the future.

Threshold concepts

Year 7

- 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 friction and some knowledge of air resistance
- Substances are made of particles (covered in Chemistry)
- Recognize states of matter and changes between each state
- Explain that we see things because light travels from light sources to our eyes
- Compare and group together everyday materials on the basis of their properties
- Use recognised symbols when representing a simple circuit in a diagram
- Compare and give reasons for variations in how components function e.g. the on/off position of switches
- Recognise different substances can conduct electricity

Year 8

- Some knowledge of planets in the solar system and their locations.
- Idea of endo and exothermic reactions involve changes in thermal energy levels from Chemistry
- Know that photosynthesis transfers light energy into chemical energy from Biology
- Recognise that some metals are magnetic and magnets can attract or repel

Year 9

- Know that energy is required for movement and that this energy is transferred into work done by our muscles from Biology

Sequence of learning

- **Contact Forces, speed and pressure (Y7):** This topic should build on KS2 knowledge of pushes and pulls. It does not immediately require any prior knowledge of particles (which is covered in Chemistry). Ideas of contact forces are applied in the speed and pressure sections of the topic. The concept of forces is built upon in future topics Energy Transfers, and Gravity and Universe in Y8 and the Work and Energy Costs topics in Y9.

- **Sound and Light (Y7):** Builds on the particles topic covered at the start of Y7 in Chemistry. Tangible concepts which pupils will have come into contact with before. These topics will be built upon in during the Heating and Cooling topic in Y8 and the Wave Properties and Effects topic in Y9.

- **Current, voltage and resistance (Y7):** Builds on the Particles topic covered at the start of Y7 Chemistry. Should have some knowledge of simple circuits in KS2. Further built on during Magnetism and Electromagnets topic in Y8.

- **Gravity and Universe (Y8):** Builds on the idea of Contact forces in Y7, relates back to knowledge of the Solar System from KS2. Links into Energy transfers and Work done topics (Y8 and Y9).

- **Energy Transfers and Heating (Y8):** Build on topics of Contact forces and Particles from Y7. Links back to light topic in Y7 also. Links to Chemical Energy topic in Y8 Chemistry and Photosynthesis topic in Y8 Biology. Will feed into Work done and Energy costs topic in Y9.

- **Magnetism and Electromagnets (Y8):** Builds on basic ideas of magnets taught at KS2, and links to Contact forces and Current, voltage and resistance topics in Y7.

- **Work done and energy costs (Y9):** Builds on Energy transfers and heating from Y8 and Contact forces in Y7, also links to Gravity from Y8 and Healthy Bodies topic in Y9 Biology.

- **Wave properties and Effects (Y9):** Builds on Sound and Light topic delivered in Y7 and Energy Transfers in Y8.

Subject knowledge

Contact Forces, speed and pressure (Y7)

- What is a force:
  - Identify that forces can be pushes or pulls and is measured in Newton's.
  - Explain that forces can result in deformation of objects or changes in movement.
  - Draw force diagrams to show the forces acting on an object.
- Resultant forces:
  - Calculate the resultant force from a diagram.
  - Explain whether an object in an unfamiliar situation is in equilibrium.
  - Predict the effect of resultant forces on an object
- Stretching and squashing:
  - Describe the effects forces have on a spring.
  - Predict the effect changing a force will have on the compression/extension of a material.
- Hookes Law:
  - Investigate the effect of a force on extension of a spring.
  - Identify it as a linear relationship using Hookes law equation.
  - Compare the behaviour of different materials in deformation using the idea of proportionality.
- Friction/drag:
  - Describe the effect of friction/drag on an object as it moves through a fluid.
  - Explain the causes of friction/drag.
- Moments:
  - Identify the effect balanced and unbalanced forces will have on a lever.
  - Calculate the turning force on a lever.
  - Investigate the effect changing the force and distance from pivot has on the turning force applied.
- Speed formula:
  - Know the effect of balanced and unbalanced forces on the speed of an object.
  - Calculate the average speed of an object.
- Distance time graph:
  - Draw a distance time graph to show speed changes over a journey.

- Analyse a distance time graph to compare speeds at different gradients.
- Relative motion:
  - Describe how two objects moving at different speeds in the same/different directions would appear to each other.
- Pressure/stress equation:
  - Use the formula to calculate the pressure exerted on a surface.
  - Explain how surface area can be utilised to reduce/increase the pressure.
- Pressure in liquids:
  - Know how pressure changes with depth.
  - Describe how floating/sinking occurs in fluids.
  - Explain how pressure contributes to up-thrust.
- Atmospheric pressure:
  - Describe how atmospheric pressure changes with height.
  - Explain, using ideas of particles, the reason for pressure changes in fluids.

Sound and Light (Y7)

- How sounds are produced
  - Know that sounds are produced when something vibrates
  - Describe sounds as longitudinal waves
  - Explain the effect of sound on a receiver such as an ear drum

- How sound travels in different media
  - Know that sound cannot travel in a vacuum
  - Recall the speed of sound in air
  - Describe the speed of sound in gases, liquids and solids
  - Explain why sound can travel faster in liquids and solids than in gases

- Characteristics of sound waves
  - Recognise the pitch and volume of a range of sounds
  - Define the terms frequency, amplitude
  - Explain observations where sound is reflected, transmitted or absorbed by different media
  - Use diagrams of sound waves to compare the pitch and volume of different sounds

- How sounds are heard (auditory range)
  - Recall the basic structure of the ear
  - Use data to compare the auditory range of humans and animals
  - Suggest reasons why peoples hearing can be damaged.
  - Careers link – Audiologist. Activity for students to describe how an audiologist would use equipment to determine if someone has a hearing problem.

- Transmission of light
  - Recall that light can travel without particles
  - Know the speed of light in a vacuum
  - Describe light waves as transverse waves
  - Explain why light can be reflected, absorbed and scattered by different materials

- Reflection and refraction
  - Recall that at a mirror, the angle of incidence is equal to the angle of reflection
  - Draw ray diagrams of light hitting a plane mirror
  - Use ray diagrams to describe how light changes direction when it enters a more or less dense media

- Light and colour
  - Know that white light is made up of 7 colours
  - Describe what happens when white light enters a prism

- Explain why objects appear a certain colour
- Explain observations when coloured lights are mixed or objects are viewed in coloured light

- Using light (ray diagrams)
  - Recall some of the applications of light such as cameras, lenses and the eye
  - Use ray models to explain imaging in pinhole cameras, convex lenses and the eye
  - Careers link – Optician/Photographer

- Effects of light
  - Know that light transfers energy from a source to an absorber
  - Describe the effect of light on photosensitive material and the retina of the eye

Current, voltage and resistance (Y7)

- **Static**
  - Identify objects having a positive or negative charge
  - Describe the transfer of electrons when objects rub together
  - Explain that oppositely charged objects experience an attractive force even when they are not touching
- **Current**
  - State that current is a flow of electrical charge
  - Describe how to measure current in a circuit
  - Use models to describe how current behaves in a series circuit
- **Potential difference**
  - Identify batteries as the source of energy to get electrons moving in a circuit
  - Describe how to measure the potential difference across various components in a circuit
  - Predict the effect of changing the number of batteries, bulbs or other components on the potential difference measured

- **Resistance**
  - Classify materials as electrical conductors or electrical insulators
  - Understand that resistors cause the current to decrease
  - Use Ohms Law to calculate Resistance from Potential Difference and Current (V=IR)

- **Series Circuits**
  - Identify series circuits as having only one loop/pathway for current to flow
  - Recall that current will remain constant throughout a series circuit
  - Describe the sharing of potential difference throughout the components in a series circuit

- **Parallel Circuits**
  - Identify parallel circuits as having components on separate loops
  - Describe what happens to current at a branch in a parallel circuit
  - Use models to explain why components on separate loops can experience the same potential difference

Gravity and Universe (Y8):

- Gravity
  - Describe gravity as an example of a non-contact force caused by a large mass such as a planet.
  - Describe the relationship between mass and magnitude of gravity force and between the size of gravitational force changes with distance away from its source.
- Mass and Weight
  - Explain the difference between gravity, weight and mass.
  - Calculate weight as mass multiplied by gravitational filed strength.
  - Apply calculation for different planets
- Solar system
  - Describe the structure of the solar system

- Identify our Sun as a star and how our solar system fits into galaxies and the universe.
- Use light year as a unit of distance

- Seasons
  - Describe how the tilt of the Earth results in seasons
  - Explain how day length and climate is affected by the earths tilt

Energy Transfers and Heating (Y8)

- Energy stores
  - Name several stores of energy
  - Know the unit for energy and that energy is transferred
- Energy transfers
  - Name the different types of energy transfer
  - Describe how energy is transferred from one type to another and the efficiency of transfer to useful energy
  - Apply ideas of transfer of energy to several unfamiliar situations
- Thermal equilibrium
  - Describe the movement of thermal energy from hotter to cooler until equilibrium is reached.
- Conduction
  - Explain how energy is transferred within different mediums using ideas of particles.
  - Describe the differences in speeds of conduction in solids, liquids and gasses
  - Predict the best properties of an insulator
- Convection
  - Describe the movement of particles resulting in a convection current in a fluid.
  - Explain using ideas of density how a convection current is formed.
  - Apply ideas of convection to different situations.
- Radiation
  - Identify sources of infra-red radiation
  - Describe how energy is transferred through radiation.
- Insulation
  - Careers link – building surveyors/environmental contractors
  - Identify best insulation materials using investigative approached
  - Apply ideas of conduction, convection and radiation to explain how different insulators work
  - Suggest how a house's insulation could be improved to reduce environmental impact

Magnetism and Electromagnets (Y8)

- **Magnetic characteristics**
  - Recognise the poles of a magnet
  - Describe the interaction of magnetic materials with permanent magnets
  - Explain why two permanent magnets will attract or repel depending on the position of their poles

- **Magnetic Fields**
  - Recognise the magnetic field of a permanent magnet
  - Describe how to use plotting compass to find the field lines of a magnet

- **Earth's magnetism**
  - Recall that the Earth has a magnetic field
  - Describe how compasses can be used for navigation
- **Current and magnetism**
  - Recall that the flow of current in a wire causes a magnetic field to be set up around it

- **Electromagnets**
  - Describe the effect of current flowing in a coil of wire with an iron core
  - Explain how to increase the magnetism of an electromagnet

- **Motors**
  - Describe the effect of a direct current within a magnetic field
  - Describe the uses of electromagnets in everyday life

Wave properties and Effects (Y9)

- **Waves transfer energy**
    - Recognise that waves transfer energy from one place to another
    - Describe the effect of a higher frequency or amplitude on the amount of energy transferred
    - Compare how transverse and longitudinal waves transfer energy

- **Water waves**
    - Recognise that water waves are an example of a transverse wave
    - Describe the effects of barriers on waves in terms of reflection
    - Explain what happens when waves are added together in and out of phase

- **Uses of waves**
    - Describe some uses of electromagnetic waves
    - Suggest reasons why sound waves and other pressure waves can be used for cleaning objects
    - Careers link – uses of waves in medicine: sonography, radiology.

- **Effects of waves**
    - Identify how some waves can be damaging to living cells

Curriculum links to careers

Year 7

Sound and Light (Y7)

- Opportunity to discuss the role of an audiologist and how they use sound waves to determine whether someone has a hearing problem. Following demonstrations of the equipment available (oscilloscope, frequency generator and decibel meter) students will be introduced to the role of an audiologist and will then write a short paragraph explaining how they use sound to determine problems with someone's hearing. Alternatively, they could produce an information leaflet for children visiting the audiologist to explain about how they will use sound to determine any hearing problems.
- Further opportunity to discuss the role of an optometrist or photographer in terms of how they use light in their roles.

Year 8

Energy Transfers and Heating

- Opportunity to look at how building surveyors/environmental contractors could assess the environmental affect of heat loss from a building and how this could be mitigated. Students can complete a project/practical to investigate the different types of insulation and produce a recommendation of how to better insulate a house to prevent heat loss. Potential to link with B&K as an example of a career in industry.

Year 9

Wave properties and Effects (Y9)

- Looking at different careers within medicine which use electromagnetic and pressure waves. Dentists/Radiographers that use X-rays to detect broken bones, Sonographers and Midwifes who use ultrasound for looking at foetus' or other soft tissue problems, including the use of ultrasound to break down kidney stones. Students will research different roles and share their research with others by preparing a short presentation.

Procedural knowledge

The skills required for science is addressed in the "How science works" section of the curriculum. This is embedded across all three science disciplines and the skills associated with it are returned to at regular intervals with increasing levels of difficulty/understanding.

The skills are broken down into 13 individual sections. Each section is focused upon a minimum of twice within topics each year, with the skills involved being applied additionally in other topics.

- Quality of Data - Pay attention to objectivity and concern for accuracy, precision, repeatability and reproducibility.
- Evolving ideas - 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.
- Evaluating risks - Evaluate risks in methods
- Hypothesis and Prediction - 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.
- Variables - Identify independent, dependent and control variables.
- Presenting data - Present observations and data using appropriate methods, including tables and graphs.
- Equipment and Practical work - Use appropriate techniques, apparatus, and materials during fieldwork and laboratory work, paying attention to health and safety.
- Developing a method - Select, plan and carry out the most appropriate types of scientific enquiries to test predictions.
- Measurements - Make and record observations and measurements using a range of methods for different investigations including sampling techniques. Understand and use SI units and chemical nomenclature.
- Evaluation - Evaluate the reliability of methods and suggest possible improvements. Evaluate data, showing awareness of potential sources of random and systematic error identify further questions arising from their results.
- Statistical Analysis - Undertake basic data analysis including simple statistical techniques.
- Patterns and Conclusions - 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.
- Calculations - Use and derive simple equations and carry out appropriate calculation. Apply mathematical concepts and calculate results.

See the How Science Works mapping document for a breakdown of where each section is covered within the science curriculum.

Summative Assessment

Assessments occur at the end of each topic of work and include:

- 10-20% of marks on How Science Works skills
- 10-20% of marks on prior knowledge (this may overlap with the how science works marks)
- Higher papers should include questions covering grade 1- grade 4
- Foundation papers should include questions covering grade P1 – grade 2
- Both papers should scale in difficulty throughout the paper.