

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

- Knowledge of the major organ systems
- The structure and function of the breathing and digestive systems.

Year 8

- Plant organs and how plants grow
- Understanding of food chains
- Relationship between organisms and their environment
- Different life cycles of plants and animals.

Year 9

- Knowledge of how to keep their bodies healthy through lifestyle choices such as diet and exercise.
- Adaptations to environment
- The principle that characteristics are inherited
- Fossils show the remains of dead plants and animals, some of which may now be extinct.

Sequence of learning

- **Life processes and cells (Yr7):** This is to ensure that students have a firm understanding of KS2 concepts (such as MRS GREN) before looking at the micro aspect of biological structures. Knowledge of cellular structure underpins all other biological topics so needs to be taught thoroughly at this point. Students will also get their first clear explanation of respiration and diffusion.
- **Food and digestion (Yr7).** This builds upon MRS GREN and uses the digestive system as an example of the hierarchical structure of cells, tissues and organisms. It also challenges pupils to learn about the adaptations of particular organs. It allows the application of diffusion and links to the requirements of respiration. Additionally, pupils will learn about the implications of diet on health.
- **Breathing and respiration (Yr7):** it is important that pupils make clear links between food absorbed from the digestive system, oxygen from breathing and energy released by respiration. Furthermore it will allow further application of learning about cells, tissues and organs and how they are related to their function. It will also provide a further opportunity to recap and apply the process of diffusion.
- **Plants and Photosynthesis (Yr8):** As pupils have established a strong understanding of respiration in year 7, year 8 begins with plants and photosynthesis so that pupils can begin to understand the interaction between bioenergetics processes. Furthermore, by exploring plant organs, pupils can again

recap cell structure and learn more about adaptation to function. As pupils learn that plants produce the chemical energy for almost all life on Earth, this is then explored in greater depth within interdependence and the environment.

- **Interdependence and the environment (Yr8):** Within this topic pupils learn about feeding relationship, other examples of interdependence and how human activity can affect the environment. This unit reflects the gradual move from the micro to the macro in terms of biological concepts.
- **Reproduction (Yr8):** The final topic in year 8 is reproduction. This allows pupils to recap the life processes discussed in year 7 and look at the cells and organ systems involved in reproduction in plants and animals. Pupils will learn about human development from fertilisation to puberty as well as the seed dispersal in plants.
- **Healthy Bodies (Yr9):** Year 9 begins with a focus on health. This links well with the impact of health on pregnancy from the last topic of year 8. The topic will allow pupils to develop further understanding of the impact of a wide range of lifestyle and genetic factors on health and allow them to apply knowledge from previous topics, making links and building schema via an overarching theme. Through investigation into the effects of exercise new information about the skeletal and muscular systems and the process of anaerobic respiration will also be delivered whilst embedding prior knowledge of key processes such as respiration, diffusion, and of nutrition.
- **Variation, independence and evolution (Yr9) :** From the development of the model of the structure of DNA to the importance of maintaining biodiversity, pupils will study the structural, physiological and behavioural adaptations that allow organisms to reproduce successfully and adapt to changing environments. Pupils will look into current issues including human impacts on the environment and efforts to protect and maintain biodiversity.

Subject knowledge

Life processes and cells (Yr7)

- 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

Digestion (Yr7)

- The hierarchical organisation of multicellular organisms: from cells to tissues to organs to systems to organisms
- Content of a healthy human diet: carbohydrates, lipids (fats and oils), proteins, vitamins, minerals, dietary fibre and water, and why each is needed
- 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)

Breathing and respiration (Yr7)

- 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
- Aerobic 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

Photosynthesis (Yr8)

- 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

Interdependence and environment (Yr8)

- 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 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.

Reproduction (Yr8)

- 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
- Reproduction in plants, including flower structure, wind and insect pollination, fertilisation, seed and fruit formation and dispersal, including quantitative investigation of some dispersal mechanisms.

Healthy bodies (Yr9)

- 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.
- Calculations of energy requirements in a healthy daily diet
- The consequences of imbalances in the diet, including obesity, starvation and deficiency diseases
- 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.
- The impact of exercise, asthma and smoking on the human gas exchange system
- The effects of recreational drugs (including substance misuse) on behaviour, health and life processes.

Variation, inheritance and evolution (Yr9)

- 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 means some organisms compete more successfully, which can drive natural selection
- Changes in the environment 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.

Curriculum links to careers

Year 7

Interdependence and the Environment

- Ecologists look at relationships in the natural world; studying how animals, plants and humans interact with each other which ties in well with our topic on Interdependence and environment. Ecologists need to have good analytical skills as they will often be conducting experiments and undertaking fieldwork. Pupils will carry out a fieldwork investigation and analyse their findings.

Year 8

Reproduction

- During the topic of Reproduction the role of the midwife will be discussed. Pupils will learn how a midwife assists women with pregnancy, childbirth and the postpartum period. They will see that the role of the midwife is diverse and includes supporting women and their families, providing information about how to maintain healthy pregnancies and carrying out clinical examinations

Year 9

Healthy Bodies

- The topic of Healthy Bodies will allow pupils to investigate and learn about a range of medical careers including the work of personal trainers, physiotherapists and dieticians, looking at how these professionals apply the knowledge gained in this topic.

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.