IMS329	EDClass Science – Biology Rationale	
Issue number 1		
Approved by Danielle Myles	Date: 04.04.2024	

EDClass Science - Biology Rationale

Why is the study of biology important?

Biology is one of the three sciences that learners have the opportunity to study during Key Stage 3 (KS3) and Key Stage 4 (KS4). It involves the study of life, aiming to help learners understand living organisms and fundamental processes. By learning how organisms form, grow, function and interact with the environment, learners build upon their knowledge and understanding of the world around them. Studying biology, therefore, fosters curiosity and develops questioning skills and analytical thinking.

By making learners aware of advancements in medicine, biotechnology, agriculture and food security, they will see how the subject contributes to improvements in the quality of life, hopefully inspiring young people, and driving future innovation.

Furthermore, learning about the environment will allow our learners to gain an appreciation of the world they live in, encouraging an awareness of their actions and the impact they may have. Biology gives learners the tools to become more conscientious citizens who make informed choices. Furthermore, the study of biology can then reveal how we can then conserve and protect our environment, biodiversity and the world around us.

Studying biology is key to helping humans improve their own lives and to understand the world around them. The real world applications of biology support and empower young people to make decisions that will impact themselves, and others in the world around them.

Why study biology in this order?

Within biology, the topics taught in KS3 align with the national curriculum, this ensures they appropriately build on knowledge and allow progression from Key Stage 2 (KS2). This approach helps learners to develop a secure understanding in key themes, and components of knowledge, before transitioning to KS4. As the curriculum spirals, KS4 learners revisit learning, allowing them to deepen their understanding of the topics, and therefore enabling our learners to make good progress in biology.

For example, in KS3, learners begin by studying cells, covering fundamental ideas to establish a basic understanding. This knowledge is referred back to throughout various KS3 topics, including human reproduction and nutrition and digestion. As learners progress to KS4, they expand into specialised topics, such as coordination and control or inheritance and genetics, building upon the previous fundamentals.

The sequencing of the biology curriculum encourages learners to make connections between different topics and, therefore, start thinking about the big ideas which underpin our scientific

knowledge and understanding. For example, learners link together ideas related to the structure and function of organisms.

What previous learning is needed?

When beginning KS3 biology, learners should have an understanding of living organisms from Key Stage 1 (KS1) and KS2. This prior learning may include naming and classifying living organisms based on observations, their structures, functions, and adaptations, which could lead to evolution. Additionally, learners may have learned about relationships between organisms and the habitats in which they are found, as well as what is needed for living things to survive, grow and stay healthy. Learners may be able to describe some life processes and the life cycle of living things. Furthermore, learners in KS2 should have developed skills in identifying patterns and relationships, as well as taking simple measurements and recording data.

Throughout the curriculum, learners will be assessed to identify specific topics that may need revisiting before progressing further.

What are the links to literacy?

Throughout the biology curriculum, learners are provided with opportunities to use and progress their literacy skills. These opportunities allow students to develop their language alongside their scientific knowledge.

Learners are introduced to subject-specific vocabulary relevant to biology. They are taught the meanings and correct spellings of key terms. Furthermore, learners are consistently encouraged to use scientific vocabulary. To support this, vocabulary is modelled and learners can access key definitions as needed.

Reading and listening skills are also embedded into the curriculum with the purpose of informing learners, developing their understanding, and decoding different question types. Understanding the command words commonly used in science questions is essential for learners to succeed. Examples of command words include: describe, this requires recalling facts, processes or pathways; explain, learners need to provide a scientific reason; and evaluate, learners discuss both advantages and disadvantages. By understanding the expectations surrounding these words, learners can approach science questions more effectively and better demonstrate their understanding.

Furthermore, model answers help learners to structure, organise and link ideas while writing. This is important as it supports learners in understanding the requirements of written pieces and

developing their answers. This could include longer 6-mark questions or questions based on writing methods.

What are the links to numeracy?

The biology curriculum provides various opportunities for numeracy development. Learners frequently perform calculations, such as calculating surface area to volume ratios or determining percentage gain and loss. Additionally, learners are taught to substitute numerical values into equations, including the magnification formula. As learners progress, they develop numeracy skills to manipulate equations, allowing them to change the subject of an equation. Answers to calculations should be given in appropriate units. This may involve order of magnitude calculations, for instance when demonstrating an understanding of the scale and size of cells. Furthermore, responses to calculations should be expressed with the correct number of significant figures or decimal places.

Many numeracy opportunities within the biology curriculum link to the handling of data related to practical activities. These numeracy skills focus on collecting, recording, presenting and analysing data. When learners learn about collecting data, they should know how to draw tables, record numerical values and understand which unit of measurement is appropriate to use. Calculations, such as finding the mean and the range of data may need to take place before it is presented in tables, charts or graphs. Learners should identify and describe patterns and trends when interpreting data. When analysing data learners need to draw conclusions from given observations from data presented in a variety of tabular, graphical and other forms. Examples of experiments requiring these skills include: investigating the concentrations of solutions on the mass of plant tissue, using continuous sampling techniques to determine the time taken for starch to digest in a range of pH values or collecting data from quadrats to calculate the abundance of an organism.

Questions focussing on numeracy will consider the level of demand required for appropriate for that key stage and the skills required.

How is SMSC embedded?

Opportunities for Spiritual, Moral, Social and Cultural (SMSC) development are highlighted throughout the biology curriculum. The aim of including these areas of opportunity is to help learners develop a range of personal and social skills.

Spiritual development focuses on learners developing their own sense of identify, set of beliefs and values. These areas are present when learning about stem cell research, drug testing and genetic modification, as they encourage learners to form their own viewpoints on these topics.

Learners explore moral issues by connecting their values to topics related to society, ethics and personal choices. When studying hormonal coordination in humans, learners consider family planning, contraception and fertility treatment. Additionally, learners consider moral issues, within the evolution and natural selection topic, exploring ideas to do with selective breeding and antibiotic resistance. In ecology, learners consider issues surrounding land use, deforestation, maintaining biodiversity, global warming and waste management.

Within social development, learners understand developing relationships with others. They do this by appreciating the importance of collaboration in science, for example the contributions of scientists within the human genome project and the discovery of DNA. Learning about having a healthy lifestyle is also part of the social development of learners.

Cultural development is about learning to respect different beliefs and values and cultural perspectives. Ability to interact respectfully with people from different backgrounds. For example, with evolution, we teach students that there are different views but all views must be respected, speciation, variation in different cultures, stem cells. Encouraging learners to engage with the world around them.

How are British Values embedded?

Links to British Values are integrated into the biology curriculum. Within democracy, learners will be taught about the scientific community's collaborative nature, including the human genome project, and drug testing, where research findings are peer-reviewed. These topics aim to help learners gain an appreciation for democratic processes. When considering rule of law, the biology curriculum encourages the following of health and safety regulations, as these are essential in practical work. Students learn about the risks involved and how methods can be followed safely. Learners are encouraged to explore scientific questions and express their ideas when answering 'evaluate' questions, linking to individual liberty. Furthermore, learners could be inspired to pursue independent research on topics they find interesting. Mutual respect and tolerance through respect for diverse viewpoints is crucial. Students learn to appreciate different cultural, religious and scientific perspectives, for example, ethical issues with stem cell research, embryonic screening, fertility treatments, cloning and genetic modification.

How are equal opportunities embedded?

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Equal opportunities are embedded into the biology curriculum by ensuring that lesson materials are accessible to learners. This is achieved through providing information in various forms, including text, diagrams and videos. Additionally, the content includes scaffolding and model answers to support learners, along with a range of question types to assess and check for understanding. Furthermore, subject-specific support is offered to learners, allowing the language used to be adapted and appropriate questions targetted towards the learner. These strategies allow all learners to make good progress in biology. In biology we aim to include diverse examples and use inclusive language when planning new lesson content.

How are links made to the Wider World / Cultural Capital / Experiences / Cross-Curricular?

The biology curriculum is contextualised within the wider world, allowing learners to appreciate how biology connects to their everyday lives. By studying scientific advancements in areas such as stem cell research, vaccinations, medicine and food security, learners gain insight into real-world applications. Furthermore, the wider world is considered when learners are taught about the interactions between humans and the environment, including how land is used, global warming and considering the impact we have as humans.

Cultural awareness is also important in the biology curriculum. Learners develop an understanding of environmental issues, waste management, and the importance of maintaining biodiversity. Learners recognise their role in preserving the planet. Practical scientific skills, such as using scientific apparatus, analysing data, and following a method, are emphasised in order to encourage an awareness of scientific practice. Real-world examples, such as drug trials and IVF, illustrate how biology influences our lives, prompting reflection on social, moral, spiritual and cultural issues.

The biology curriculum has many cross-curricular links to other subjects. In geography lessons, themes related to ecology are explored, covering topics such as animal and plant adaptations, biodiversity, the human impact on the environment and carbon and water cycles. Mathematical skills are embedded throughout the curriculum, as learners perform calculations, use formulas and learn about data presentation and analysis. Historial links to key scientists including Darwin, Mendel and Watson, Crick, Wilkins and Franklin, enrich the biology curriculum. Another cross-curricular link is with religious studies, where learners discuss different viewpoints within the topics of IVF, stem cells, embryonic screening and contraception, considering and respecting diverse cultural and religious perspectives. Connections to Personal, Social, Health and Economic (PSHE) education include reproduction, contraception, lifestyle choices, and well-being. Within the wider subject of science, there are also close links to chemistry, where learners need to

engage with key knowledge in recognising molecules and understanding reactions, for example in the topics of respiration, photosynthesis and digestive enzymes.

What key knowledge will be covered?

Within KS3 biology, the following topics are covered:

- Cells and Organisation
- The Skeletal and Muscular Systems
- Nutrition and Digestion
- Gas Exchange Systems
- Human Reproduction
- Health
- Plant Biology
- Respiration
- Relationships in an Ecosystem
- Inheritance, Chromosomes, DNA and Genes

Within KS4 biology, the following topics are covered:

- Cell Biology
- Microorganisms
- Transport
- Animal Organisation
- Plant Organisation
- Respiration
- Photosynthesis
- Health and Disease
- Coordination and Control
- Plant Hormones
- Inheritance and Genetics
- Evolution and Natural Selection
- Ecology

What key skills will be covered?

- Literacy skills, understanding command words, using scientific vocabulary and structuring responses.
- Numeracy skills, performing calculations, using formula, using SI units, interpreting and analysing data.

- Investigative skills, using scientific theories and explanations to develop hypotheses, then planning experiments to test these hypotheses and make observations.
- Practical skills, using appropriate apparatus and recognising hazards to perform techniques safely and minimise risk, then recording a range of observations and measurements accurately.
- Presenting observations and other data as tables, graphs or drawings.
- Critical analysis skills, evaluating the method and suggesting possible improvements and further investigations as well as draw conclusions.
- Evaluating skills when given information from various topics.

Are there interleaving opportunities?

To deepen learners' understanding, the biology curriculum aims to provide interleaving opportunities. Knowledge within the curriculum is continuously built upon, with learners revisiting content they may not have engaged with most recently. Furthermore, learners may be required to recall key definitions or numeracy skills. Assessment points involve recalling knowledge from a range of topics and utilise various question types including multiple-choice, short answer, long answer, calculations and graph interpretation. Additionally, historical context is provided within the curriculum to demonstrate how the past can inform present understanding. Finally, highlighting links across different topics, and furthermore different subjects, encourages learners to make connections throughout the curriculum.

How is key vocabulary embedded?

As previously outlined, key vocabulary is embedded into every lesson in the biology curriculum. Learners are taught definitions for tier three vocabulary, and the spelling and use of key words are consistently modelled and encouraged. Key vocabulary will also be modelled in practice questions, giving learners the opportunity to see how to apply key terms to their written answers.

How is level 2 vocabulary embedded?

Embedding level two vocabulary into biology lessons is essential for learners to develop their literacy skills and comprehension. This tier of vocabulary can be found in text that describes or explains various lesson content. Level two vocabulary is also integrated into practice questions, whether in model answers or when learners independently practice and construct their own responses. Using level 2 vocabulary in this way reinforces comprehension and promotes correct usage. Additionally, command words, which are cross-curricular within science, may be taught and overlap.

What are the common misconceptions?

There are many misconceptions within the subject of biology. Some of those include:

- the nucleus is the brain of the cell;
- confusing organelles, for example the cell wall and cell membrane or ribosomes and mitochondria;
- mitochondria make energy;
- plants are not alive;
- plants get their food from the soil;
- plants breathe;
- respiration is breathing;
- all bacteria are bad;
- bacteria become immune to antibiotics;
- deoxygenated blood is blue;
- evolution and natural selection are the same;
- organisms adapt so they can survive;
- the arrows in a food chain show what has been eaten;
- correlation of data equals causation.