Year 12 Biology – Biological Molecules

West Kirby Grammar School

Learning about this topic is important because: **(from the spec – intro blurb)** All life on Earth shares a common chemistry. This provides indirect evidence for evolution. Despite their great variety, the cells of all living organisms contain only a few groups of carbon-based compounds that interact in similar ways. Carbohydrates are commonly used by cells as respiratory substrates. They also form structural components in plasma membranes and cell walls. Lipids have many uses, including the bilayer of plasma membranes, certain hormones, and as respiratory substrates. Proteins form many cell structures. They are also important as enzymes, chemical messengers, and components of the blood. Nucleic acids carry the genetic code for the production of proteins. The genetic code is common to viruses and to all living organisms, providing evidence for evolution. The most common component of cells is water; hence our search for life elsewhere in the universe involves a search for liquid water.

This builds on: The study of digestion, photosynthesis, respiration, enzymes, nucleic acids from studies at GCSE and KS3.

This leads to: the study of biological molecules covers key principles that are fundamental to all studies at A-level. The specific nature of proteins and how they work runs through all modules, and retrieval of this key learning is essential throughout. Specifically, students will study the production and assimilation of organic molecules in biochemical process of photosynthesis and respiration, role of transport proteins, energy transfer, protein synthesis, DNA technology.

We will learn about:

- Monomers and polymers
- Carbohydrates
- Lipids
- Proteins
  - General properties of proteins
  - Many proteins are enzymes
- Nucleic acids are important information-carrying molecules
  - Structure of DNA and RNA
  - DNA replication
- ATP
- Water
- Inorganic ions

We will develop/practise skills including:

- Students could use, and interpret the results of, qualitative tests for reducing sugars, non-reducing sugars and starch.
- Students could use chromatography, with known standard solutions, to separate a mixture of monosaccharides and identify their components.
- Students could produce a dilution series of glucose solution and use colorimetric techniques to produce a calibration curve with which to identify the concentration of glucose in an unknown solution.
- Students could use, and interpret the results of, the emulsion test for lipids.
- Students could use, and interpret the results of, a biuret test for proteins.
- Students could use chromatography with known standard solutions, to separate a mixture of amino acids and identify their components.
- Students could be given the hydrogen ion concentration of a solution in order to calculate its pH
- Students could identify the variables that must be controlled in their investigation into rate of reaction.
- Students could calculate the uncertainty of their measurements of the rate of reaction.
- Students could select an appropriate format for the graphical presentation of the results of their investigation into the rate of enzyme-controlled reactions.
- Students could use a tangent to find the initial rate of an enzyme-controlled reaction. Required practical 1: Investigation into the effect of a named variable on the rate of an enzyme-controlled reaction.

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	• Students could use incomplete information about the frequency of bases on DNA strands to find the frequency of other bases.
Some of the vocabulary that we will use includes: Polymer, monomer, condensation, hydrolysis, monosaccharide, disaccharide, polysaccharide, glycosidic bond, cellulose, starch, glycogen, amino acid, protein, peptide bond, enzymes, induced fit, active site, substrate, activation energy, complementary, lipid, fatty acid, glycerol, ester bond, nucleic acid, DNA, RNA, nitrogenous base, phosphate, ribose, deoxyribose, semi conservative replication, DNA helicase, DNA polymerase, ATP, ions, cohesion, tension, surface tension, specific heat capacity	**You could learn more about this topic by:** Read: Biological Molecules (A Level) — the science hive Watch: Monomers, Polymers and Monosaccharides- A-level biology Biological Molecules topic - YouTube All videos in the Miss Estruch series for this unit are excellent preparation / consolidation resources. Listen: Practical Uses of NMR: Exploring Enzymes to Fight Disease | University of Oxford Podcasts
Your teacher will assess your knowledge & understanding throughout the topic by looking at your work, questioning, discussion and giving you feedback in lots of different ways. The key pieces of work in this topic are: • CPAC assessed required practical work • Recall assessment for carbohydrates, lipids, and proteins • Biological Molecules Assessment 1 – Autumn term • Biological Molecules Assessment 2 – Spring term • Seneca Assignments	

Year 12 Biology – Cells

Learning about this topic is important because: All life on Earth exists as cells. These have basic features in common. Differences between cells are due to the addition of extra features. This provides indirect evidence for evolution. All cells arise from other cells, by binary fission in prokaryotic cells and by mitosis and meiosis in eukaryotic cells. All cells have a cell-surface membrane and, in addition, eukaryotic cells have internal membranes.
The basic structure of these membranes is the same and enables control of the passage of substances across exchange surfaces by passive or active transport.
Cell-surface membranes contain embedded proteins. Some of these are involved in cell signalling – communication between cells. Others act as antigens, allowing recognition of 'self' and 'foreign' cells by the immune system. Interactions between different types of cell are involved in disease, recovery from disease and prevention of symptoms occurring at a later date if exposed to the same antigen, or antigen-bearing pathogen.

This builds on (form GCSE): Cell structure: eukaryotes and prokaryotes, animal and plant cells, cell specialisation, cell differentiation, microscopy, culturing microorganisms. Cell division: chromosomes, mitosis and the cell cycle. Transport in cells: diffusion, osmosis, active transport. Principles of organisation. Communicable diseases: communicable (infectious) diseases, viral diseases, bacterial diseases, fungal diseases, protist diseases, human defence systems, vaccination. Monoclonal antibodies: producing monoclonal antibodies, uses of monoclonal antibodies

This leads to: Further studies at A-level… meiosis, most of a cell's DNA is not translated (totipotency)

We will learn about:

- Structure of eukaryotic cells
- Structure of prokaryotic cells and of viruses
- Methods of studying cells
- All cells arise from other cells
- Transport across cell membranes
- Cell recognition and the immune system

We will develop/practise skills including:

- Cell Structure Students could use iodine in potassium iodide solution to identify starch grains in plant cells. Students should be able to appreciate that there was a considerable period of time during which the scientific community distinguished between artefacts and cell organelles.
- All cells arise from other cells: Required practical 2: Preparation of stained squashes of cells from plant root tips; set-up and use of an optical microscope to identify the stages of mitosis in these stained squashes and calculation of a mitotic index. Students should measure the apparent size of cells in the root tip and calculate their actual size using the formula: Actual size = size of image/ Magnification Calculation of a mitotic index.
- Transport across cell membranes Required practical 3: Production of a dilution series of a solute top produce a calibration curve with which to identify the water potential of plant tissue. Required practical 4: Investigation into the effect of a named variable on the permeability of cell-surface membranes. Students could plot the data from their investigations in an appropriate format. Students could determine the water potential of plant tissues using the intercept of a graph of, e.g., water potential of solution against gain/loss of mass.

Some of the vocabulary that we will use includes: Golgi apparatus, endoplasmic reticulum, fractionation, ultracentrifugation, interphase,

You could learn more about this topic by:
Read: Eukaryotic and Prokaryotic Cells AQA — the science hive

Year 12 Biology – Cells

prophase, metaphase, anaphase and telophase, cytokinesis, nucleic acid, phospholipids, glycoproteins and glycolipids in the fluid-mosaic model, lysozymes, agglutination, antigen-presenting cells, antigen-antibody complex.	Watch: A-level EUKARYOTIC CELLS- The structure and function of the organelles found in eukaryotic cells - YouTube (links to all other Cells topics) All videos in the Miss Estruch series for this unit are excellent preparation / consolidation resources. Listen: BBC Radio 4 - In Our Time, The Cell (discusses the origins of the biological cell)
Your teacher will assess your knowledge & understanding throughout the topic by looking at your work, questioning, discussion and giving you feedback in lots of different ways. The key pieces of work in this topic are: • CPAC assessed required practical work • Cells Assessment 1 – Autumn term • Cells Assessment 2 – Spring term • Seneca Assignments	

Year 12 Biology – Genetic information, variation and relationships between organisms

Learning about this topic is important because: Biological diversity – biodiversity – is reflected in the vast number of species of organisms, in the variation of individual characteristics within a single species and in the variation of cell types within a single multicellular organism.
Differences between species reflect genetic differences. Differences between individuals within a species could be the result of genetic factors, of environmental factors, or a combination of both. Genetic diversity within a species can be caused by gene mutation, chromosome mutation or random factors associated with meiosis and fertilisation. This genetic diversity is acted upon by natural selection, resulting in species becoming better adapted to their environment.

This builds on: GCSE – Inheritance, variation and evolution – Meiosis forming 4 genetically varied cells. Gene mutations may be damaging and lead to a number of genetic disorders or death. Very rarely a new mutation can be beneficial and lead to increased fitness in the individual. Variation generated by mutations and sexual reproduction is the basis for natural selection. Selective breeding utilises this to produce livestock with favoured characteristics. Cloning individuals to produce larger numbers of identical individuals all carrying the favourable characteristic. Scientists take genes from one species and introduce them in to the genome of another by genetic engineering. Genetic modification still remains highly controversial.

This leads to: Unit 3.7 - Genetics, population and evolution and Unit 3.8 – The control of gene expression.

We will learn about:

- Protein synthesis through transcription and translation
- Cell division by meiosis
- Mutations and how they give rise to variation
- Taxonomy and phylogenetics
- Biodiversity and how we can measure it

We will develop/practise skills including:

- Students could examine meiosis in prepared slides of suitable plant or animal tissue.
- Students could be given data from which to calculate an index of diversity and interpret the significance of the calculated value of the index.
- Students could use standard scientific calculators to calculate the mean values of data they have collected or have been given.

Some of the vocabulary that we will use includes:

Gene, allele, RNA, DNA, transcription, translation, meiosis, mutation, homologous chromosomes, sister chromatids, selection, courtship behaviour, phylogenetic classification, biodiversity.

You could learn more about this topic by:

Read: **Topic 4: Genetic information and variation - AQA A-level Biology**
Watch: **Topic 4 AQA A-level Biology The entire topic.Genetic Code, Meiosis, Biodiversity, Natural Selection**
Listen: **BBC Radio 4 - In Our Time, Genetics**

Year 12 Biology – Genetic information, variation and relationships between organisms

Your teacher will assess your knowledge & understanding throughout the topic by looking at your work, questioning, discussion and giving you feedback in lots of different ways. The key pieces of work in this topic are:

- CPAC assessed required practical work
- Mutations and Meiosis assessment
- Uplearn assignments

Year 12 – Organisms exchange substances with their environment

West Kirby Grammar School

Learning about this topic is important because: The internal environment of a cell or organism is different from its external environment. The exchange of substances between the internal and external environments takes place at exchange surfaces. To truly enter or leave an organism, most substances must cross cell plasma membranes.
In large multicellular organisms, the immediate environment of cells is some form of tissue fluid. Most cells are too far away from exchange surfaces, and from each other, for simple diffusion alone to maintain the composition of tissue fluid within a suitable metabolic range. In large organisms, exchange surfaces are associated with mass transport systems that carry substances between the exchange surfaces and the rest of the body and between parts of the body. Mass transport maintains the final diffusion gradients that bring substances to and from the cell membranes of individual cells. It also helps to maintain the relatively stable environment that is tissue fluid.

This builds on: The study of digestion, cardiovascular system and breathing system from KS3 and KS4.

This leads to: Developing your understanding of the cardiovascular system will enable you to forge links between this topic and unit 6 where we study how to control the cardiac cycle. You will also be able to use your knowledge of tissue fluid formation and transport when learning about the kidney and how molecules are moved due to hydrostatic pressure changes.

We will learn about:

- Gas exchange
- Digestion and Absorption
- Mass transport in animals
- Mass transport in plants

We will develop/practise skills including:

- Students could use agar blocks containing indicator to determine the effect of surface area to volume ratio and concentration gradient on the diffusion of an acid or alkali.
- Students could be given the dimensions of cells with different shapes from which to calculate the surface area to volume ratios of these cells.
- Students could dissect mammalian lungs, the gas exchange system of a bony fish or of an insect.
- Students could use an optical microscope to:
  -Examine prepared mounts of gas exchange surfaces of a mammal, fish and insect, or temporary mounts of gills
  -Examine vertical sections through a dicotyledonous leaf

- Students could use three-way taps, manometers and simple respirometers to measure volumes of air involved in gas exchange.
- Students could be given values of pulmonary ventilation rate (PVR) and one other measure, requiring them to change the subject of the equation:
- $PVR = tidal\ volume \times breathing\ rate$
- Students could design and carry out an investigation into the effect of a named variable on human pulse rate or on the heart rate of an invertebrate, such

Year 12 – Organisms exchange substances with their environment

	as *Daphnia* .Students could be given values of cardiac output (CO) and one other measure, requiring them to change the subject of the equation: • $CO = stroke\ volume \times heart\ rate$ • Students could set up and use a potometer to investigate the effect of a named environmental variable on the rate of transpiration.
Some of the vocabulary that we will use includes: Diffusion, Osmosis, Active transport, Surface area to volume ratio, Ventilation, Haemoglobin, Cardiac cycle, Arteries, Capillaries, Xylem, Phloem, Transpiration, Translocation, Water potential, Cohesion-tension theory	**You could learn more about this topic by:** Complete relevant UpLearn tasks Use MyEdspace notes Topic 3: Exchanges of substances - AQA A-level Biology Watch Miss Estruch Video TOPIC 3 AQA A-level Biology - Learn the entire topic. Gas Exchange, Digestion and Mass Transport
Your teacher will assess your knowledge & understanding throughout the topic by looking at your work, questioning, discussion and giving you feedback in lots of different ways. The key pieces of work in this topic are: • CPAC assessed required practical work • Homework questions on insects, fish and leaves, human exchange, digestion and absorption, haemoglobin, cardiovascular system and mass transport in plants • Assessment 1 – Gas Exchange • Assessment 2 – Mass transport in animals and plants	