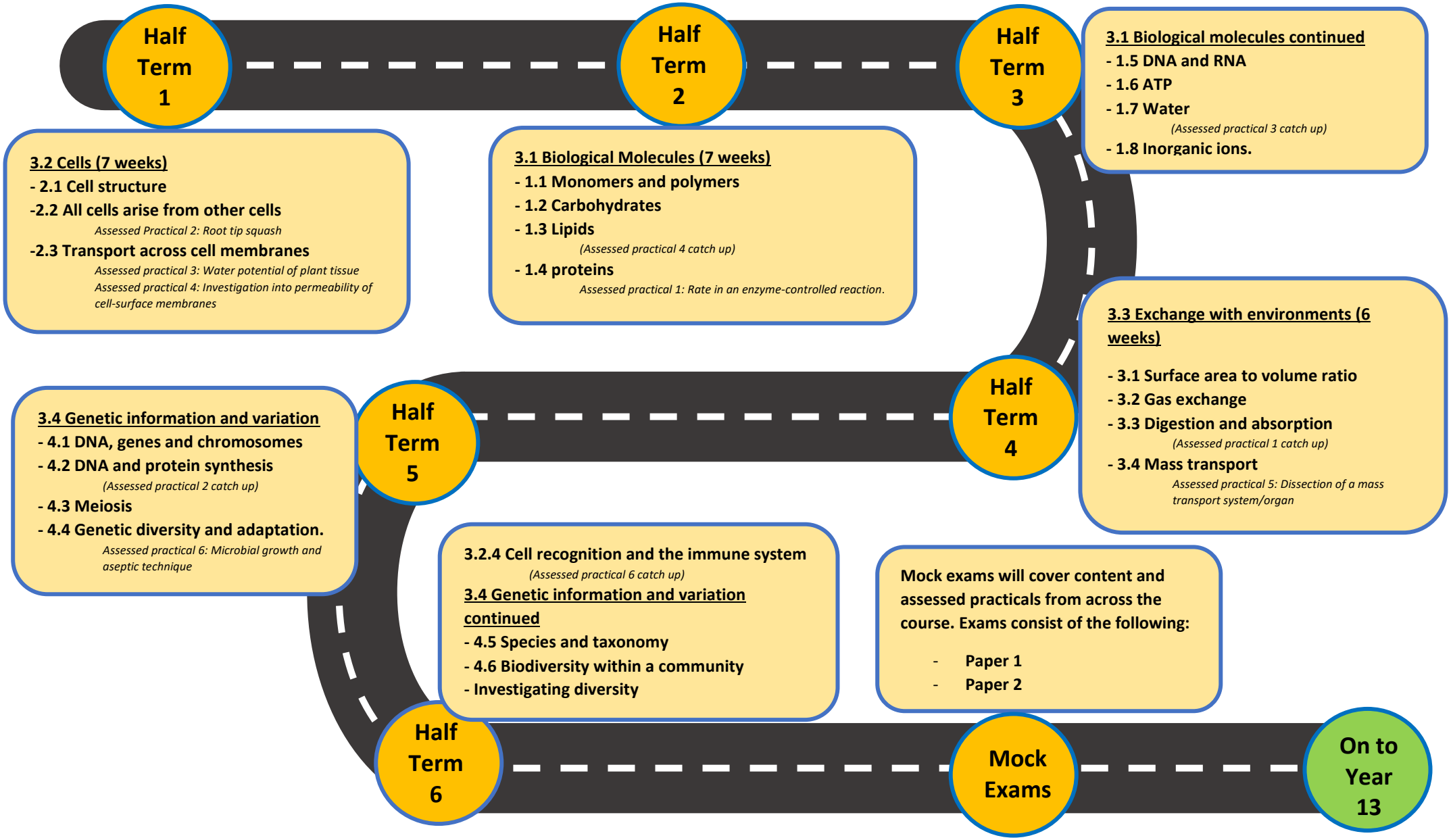
Eastbrook Sixth Form

Independent Study Guide

A Level Biology

Year 12 A Level Biology ROADMAP



Year 12 Term One

Summary	Assessment Objectives
During HT1, you will be looking at the organelles covered in GCSE in more detail including mitochondria, chloroplasts, endoplasmic reticulum and Golgi apparatus. We will investigate the movement of substances in and of the cell membranes through passive diffusion, facilitated diffusion, co-transport, active transport and osmosis. You will also be studying the process of mitosis and cell division in further detail and compare this to cellular division in prokaryotes and viruses 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. 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.	• AO1: Demonstrate knowledge and understanding of scientific ideas, processes, techniques and procedures • AO2: Apply knowledge and understanding of scientific ideas, processes, techniques and procedures: - in a theoretical context - in a practical context - when handling qualitative data - when handling quantitative data • AO3: Analyse, interpret and evaluate scientific information, ideas and evidence, including in relation to issues, to: - make judgements and reach conclusions - develop and refine practical design and procedures.

Required Reading List	Additional Reading List
AQA A Level Biology specification https://www.aqa.org.uk/subjects/biology/a-level/biology-7402/specification AQA practical handbook Oxford AQA A Level Biology 2nd edition Textbook, pg 56-82 and 564-581 Hodder Education AQA A Level Biology For A-level Year 1 and AS, pg 1-19, 36 – 53 and 239 - 266 Bio Facts Sheet 456	Biologist magazine articles - The speed of life - Harnessing the power of peptides - Synthesising success https://www.alevelbiologytutor.com/tutoring-blog/2025/1/19/key-concept-mitosis-amp-the-cell-cycle https://pmt.physicsandmathstutor.com/download/Biology/A-level/Notes

Self-Study Questions	What the mark scheme says?
Describe the function of a chloroplast and the structural features that enable it to carry out these functions (5 marks) Describe how a sample of chloroplast could be obtained from leaf tissue using cell fractionation techniques. (3 marks)	The function of a chloroplast is not energy production, this is factually incorrect and would not gain a mark. The chloroplast converts energy. Points to consider: • How would you release the organelles? • How can we separate the organelles from the remainder of the cell fragments? • How can the sample be refined?
Biologists use two main types of microscope to examine cellular structure: optical microscopes and transmission electron microscopes (TEMs). Describe two advantages and two limitations of using a TEM to investigate cell structure. (5 marks)	Points to consider: • Magnification, resolution and the definition of these terms. • Size of the beam • The requirements needed for the specimen.

During interphase in eukaryotic cells. DNA replication takes place. Explain why one strand of DNA replicates continuously whereas the opposite strand replicates discontinuously (5 marks)	Points to consider: • Direction of the DNA and its orientation • Specificity of enzymes • The position of the replication fork in comparison to the enzyme
The food manufacturing industry tends to favour the use of saturated fats in processed foods. Healthy-eating campaigners prefer the use of unsaturated fats wherever possible. Use your knowledge of lipids to analyse the two sides of this debate. (4 marks)	You have been specifically asked to talk about both sides of the debate in your answer. If you fail to mention a point for both sides, then you cannot score full marks. Points to consider: • Availability • Health risk factors • Conditions for transportation
Sucrose can be hydrolysed with the enzyme invertase. In an experiment to measure the effect of temperature in human invertase activity, researchers treated solutions of sucrose with invertase solution and measured the quantity of glucose produced at various temperatures; 4°C, 25°C 37°C, 80°C and 100°C. The measurement involves treating the experimental mixture with a dye and measuring its absorbance of visible light. The greater the absorbance, the higher the invertase activity observed. Suggest four variables that the researchers would have to control and state how each variable would be controlled. (5 marks)	Points to consider: • How will you manage deviations in concentration? • How will you control pH? • How will you account for deviations in equipment? • How will you ensure that volumes are consistent? • What pieces of equipment would you use and why?
Essay: The membranes of different types of cells are involved in many different functions. (25 marks)	The maximum number of marks that can be awarded is: • Scientific content 16 • Breadth of knowledge 3 • Relevance 3 • Quality of written communication 3. The emphasis in answers should be on the involvement of membranes in processes, not just the processes themselves. Breadth: one mark for use of an example from each of the following approaches: 1. Membranes – basic functions 2. Organelle membranes 3. Cell surface membranes 4. Processes – eg protein secretion, synaptic transmission, cell division

Where this term links with Career Prospects

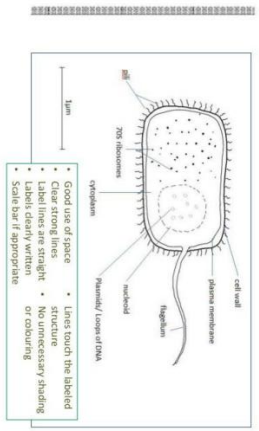
Your knowledge of cells and biological molecules can help you to pursue a career in:

1. Biomedical scientist to analyse cell abnormalities or work with proteins and enzymes within a lab setting.
2. biotechnology is for you where you can apply your knowledge of the cell structure and biological molecules to genetically engineer bacteria to produce human proteins

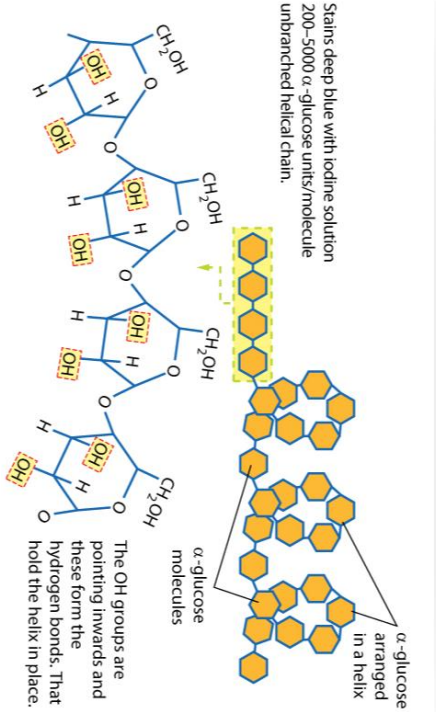
Top Tip from the Department

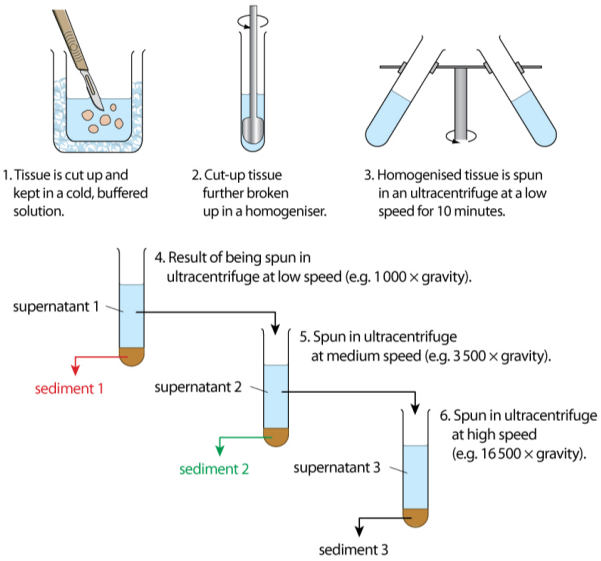
"Understand the specification: Familiarize yourself with your exam board's A-level Biology specification and ensure you can complete the items listed on your checklists. **Stay organized: Create a study schedule and stick to it as much as possible. Make sure you have all your assessed practical work correctly filed, titled and dated."**

A Good Drawing...



Structure of a starch molecule – Labelled





Year 12 Term Two

Summary	**Assessment Objectives**
Proteins form many cell structures. They are also important as enzymes, chemical messengers and components of the blood. Nucleic acids carry the genetic code to produce 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 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.	• AO1: Demonstrate knowledge and understanding of scientific ideas, processes, techniques and procedures • AO2: Apply knowledge and understanding of scientific ideas, processes, techniques and procedures: - in a theoretical context - in a practical context - when handling qualitative data - when handling quantitative data • AO3: Analyse, interpret and evaluate scientific information, ideas and evidence, including in relation to issues, to: - make judgements and reach conclusions - develop and refine practical design and procedures.
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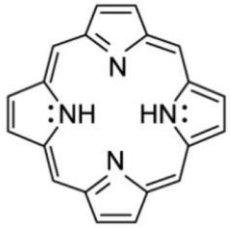
Self-Study Questions	**What the mark scheme says?**
A porphyrin ring is a structure found in certain biological molecules. This structure can have an inorganic ion at its centre, which gives the molecules its unique function.	You are not specifically required to know about magnesium in chlorophyll, however wider reading around the subject of inorganic ions will reveal the similarities between the structures of the prosthetic groups. You should also recall from GCSE content that magnesium is an important plant nutrient needed for the synthesis of chlorophyll.

Figure 1  Identify two inorganic ions that can associate with this kind of structure, and in each case, name the molecule and describe its function. (6 marks)	
The total volume of water on Earth is estimated to be 1.4×10^{21} dm^3. The number of molecules in one mole of a substance (Avogadro's number) is 6.02×10^{23}. A teaspoon measures 5cm3 of liquid. 1 cm^3 of water has a mass of 1.0g. Calculate whether the number of water molecules in one teaspoon of water is greater than or less than the number of teaspoonfuls of water on Earth. Show your calculations to back up your claim. (5 marks)	Points to consider: - Convert to dm^3 - Find the number of teaspoons of water on Earth - Find the number of moles in 5cm^3 of water - Find the number of molecules of water in a teaspoon - Compare number off teaspoons of water on Earth
Describe the term 'frame-shift mutation' and evaluate the likely impact of this kind of mutation on the phenotype of the organism (6 marks)	Points to consider: - Define frame-shift mutation and where it occurs - What effect does this have downstream? - How will the mutation effect proteins? - How would this affect the function? - In what instances might a frameshift mutation have no effect?
Essay: DNA and the transfer of information (25 marks)	The maximum number of marks that can be awarded is: • Scientific content 16 • Breadth of knowledge 3 • Relevance 3 • Quality of written communication 3. Topics that could be linked: 1. Genes/how information is carried on; 2. DNA 3. Replication of DNA; 4. Cell division - Mitosis and meiosis; 5. Transcription and translation; 6. Mutation; 7. Genetic engineering; 8. Gene therapy; 9. Genetically modified organisms; 10. Variation (in populations); 11. Evolution; 12. Inheritance NB: A* includes where candidates use information about a topic in the specification but go beyond what is expected for our A-level
A student wanted to investigate the effect of changing the surface area: volume ration on the rate of diffusion in agar block. They decided to use agar made up with NaOH and the pH indicator, phenolphthalein. The agar was cut up into cubes with sides of length 5, 10, 20, 30, and 40mm. Identify the variables within the experiment and explain how the student could use this agar to investigate the effect of surface area: volume ratio on the rate of diffusion.	When answering questions that ask you to design an experiment you will need to consider the details of the procedure: - What will be changed and measured? - How will you ensure that the results are valid? - What observations are you expecting to see? - What safety precautions would you take?

(6 marks)	- How many repeats would you include? - What calculations would you be including?
Describe the role of an inorganic ion required for the absorption of important food molecules in the small intestine. Name the substances concerned. (5 marks)	Make sure to name the substances and the process concerned even though the question does not explicitly ask you to do this. Naming them will add important clarity to your answer.
Oedema is a condition characterised by an abdomen and limbs that are swollen with fluid. It is prevalent in regions where people are known to have a low protein diet. Explain how a low protein diet could result in oedema. (4 marks)	Tissue fluid is forced out of the capillaries at the arteriole end due to high pressure generated by the heart. In a normal situation the proteins remaining in the blood vessel at this point lowers the water potential of the remaining blood. The blood pressure decreases as the blood travels through the capillary network due to slower flow speeds and lower fluid content. By the time the venule at the end of the capillaries is reached, osmotic pressure in the blood is greater than the blood pressure causing water to be drawn into the blood by osmosis. Consider how this would be affected if the protein levels are low.

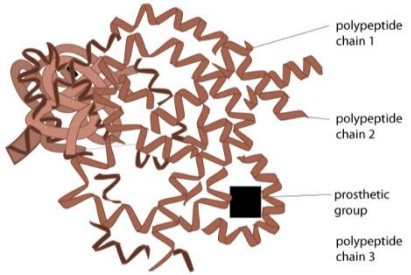
Where this term links with Career Prospects

Your knowledge of cells and biological molecules can help you to pursue a career in:

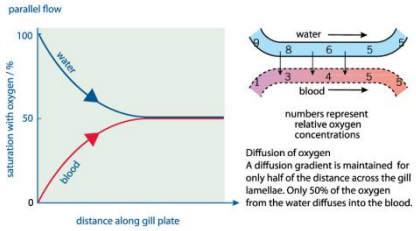
1. Biotechnology is for you where you can apply your knowledge of the cell structure and biological molecules to genetically engineer bacteria to produce human proteins
2. Biochemistry allows you investigate how biological molecules behave under different condition

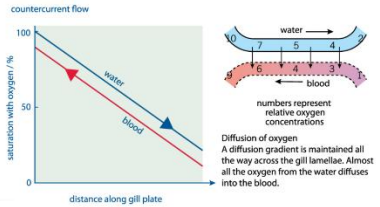
Top Tip from the Department

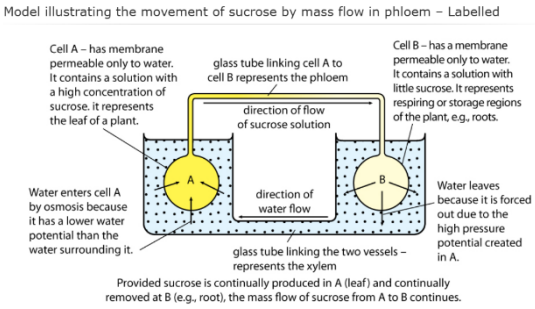
"Make summaries: Create concise summaries of key topics to aid recall. These can be visual summaries using diagrams, written summaries using mind maps, audio summaries such as a mini podcast or even video summaries and use online content. Seek help when needed: Don't hesitate to ask teachers or tutors for help with challenging topics. We are here to help you!"

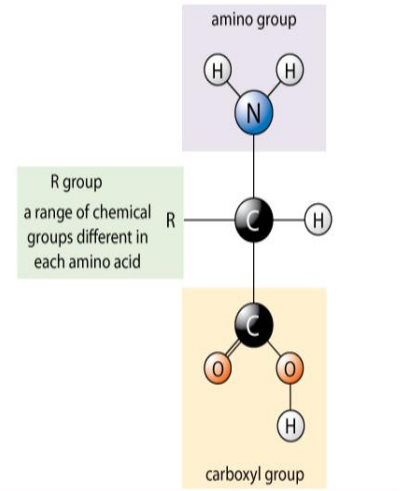


d The quaternary structure arises from the combination of a number of different polypeptide chains and associated non-protein (prosthetic) groups into a large, complex protein molecule, e.g., haemoglobin.









Year 12 Term Three

Summary

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. 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 later if exposed to the same antigen, or antigen-bearing pathogen.

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. The variation within a species can be measured using differences in the base sequence of DNA or in the amino acid sequence of proteins whereas biodiversity within a community can be measured using species richness and an index of diversity.

Assessment Objectives

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Required Reading List

AQA A Level Biology specification
https://www.aqa.org.uk/subjects/biology/a-level/biology-7402/specification

Oxford AQA A Level Biology 2nd edition Textbook, pg 36-54, and pg 102- 128 and 200 -262

Hodder Education AQA A Level Biology For A-level Year 1 and AS, pg 87-108, 192-239 and 266 - 275

Bio facts sheets: 104, 114, 221, 344

Additional Reading List

Biologist magazine articles
- Back to the future
- Sparking new life
- Next generation nanopores
- Taxonomic trolling

https://www.alevelbiologytutor.com

https://pmt.physicsandmathstutor.com/download/Biology/A-level/Notes

Self-Study Questions

Before the development of DNA sequencing, scientists had to use other methods of determining relatedness between organisms. In 1960 an experiment was carried out on chicks to see whether a skin graft was an effective method of doing this. A group of scientists used the procedure outlined below:

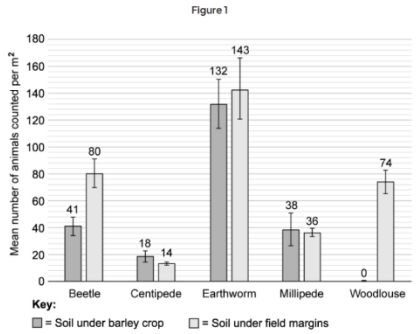
1. A group of 40 chicks of the same variety, were selected as skin graft recipients.
2. Each chick received 4 small skin grafts; one from a full siling, one from a half sibling, one from an unrelated chick of the same variety and one from a different variety of chick.
3. The skin grafts were examined everyday for 20 days and scored the condition of the graft. A healthy graft scored 5 and the score decreased with decreased graft health.

Explain why the scientists thought that the skin grafting and assessment of graft health might be an effective way to determine relatedness between organisms.

What the mark scheme says?

Points to consider:
- What feature is present in cell surface membranes?
- What is this feature made of?
- How does DNA link to the production of this feature?
- How does the immune system recognise self and non-self?

A skin graft from a close relative will have more similar antigens due to similarities in DNA. This is less likely to be rejected by the immune system

(3 marks)	
MRSA (Methicillin Resistant Staphylococcus Aureus) is a prominent form of antibiotic-resistant bacteria prevalent in hospitals. MRSA developed as the result of a series of genetic mutations but has now become widespread on a global scale. `One MRSA variant has a mutation in the gene coding for the MeCA protein. This mutation resulted in alterations to the structure of proteins on the surface of the Staphylococcus Aureus bacteria meaning that the Methicillin antibiotic could no longer bind. Explain how this mutation may lead to a change in the MeCA protein. (4 marks)	Points to consider: - Define the term mutation - Describe the effects of mutations - Refer to the level of structure that may be altered The sequence of amino acids greatly impacts the structure and shape of proteins due to a large number of different interactions that occur between them
Essay: There are many different types of relationships and interactions between organisms (25 marks)	The maximum number of marks that can be awarded is: • Scientific content 16 • Breadth of knowledge 3 • Relevance 3 • Quality of written communication 3. The emphasis in answers should be on the relationships and interactions between organisms not just the topics themselves Breadth, one mark for use of an example from each of the following approaches – 3 max: 1. Pathogen and host 2. Evolution (related topics) 3. Ecological 4. Human intervention in relationship NB: A* includes where candidates use information about a topic in the specification but go beyond what is expected for our A-level
A piece of UK upland that has been grazed by sheep has, in the last 10 years, been left ungrazed. Design an investigation to estimate the population density of thistle plants that have colonised the area since grazing has been discontinued. Include how your investigation will give a result in thistle plants per hectare (1 hectare = 10 000m^2 (5 marks)  Using the data in the figure above, assess the effectiveness of the practice of leaving field margins for promoting biodiversity. Outline other investigative work that could provide more information on the effect of field margins on biodiversity (4 marks)	Points to consider: - Size of quadrat used **and** the area covered by the quadrat. Remember the most used quadrat is 50cm x 50 cm. This covers an area of 0.25m^2 - Details of how you would obtain a random sample **and** how you will collect the data - How you will obtain an average - Relate the average to the area of upland sampled The principle of difference of >2 standard deviations being significant or not due to chance is important in the first 2 marks of this question. In a normal distribution, 2 standard deviations either side of the mean captures approximately 95% of the data. If standard deviations of 2 sets of results overlap, they n there is a high likelihood that any difference observed is due to chance and so it is not statistically significant. Non-overlapping SD error bars are always a better suggestion that the difference observed is due to the independent variable, (rather than due to chance) and is statistically significant.

	For the 3rd and 4th mark, the question asks about promoting biodiversity, which, includes all species and so plants and microorganisms should be considered. Similarly, organisms that depend on small invertebrates in the soil can be counted (e.g. birds) as a marker of overall biodiversity.
The red panda has 36 chromosomes per somatic cell whereas the giant panda has 42 chromosomes. Offspring are born infertile when the two species mate. Suggest why. (2 marks)	The gametes of the red panda will contain 18 chromosomes and the giant panda's gametes will contain 21 chromosomes. When these two gametes fuse there will be 39 chromosomes. Link this piece if information to your knowledge of meiosis and infertile hybrids. The alleles would not be passed on in infertile hybrids.
Essay: The causes and importance of variation and diversity in organisms (25 marks)	The maximum number of marks that can be awarded is: • Scientific content 16 • Breadth of knowledge 3 • Relevance 3 • Quality of written communication 3. NB: A* includes where candidates use information about a topic in the specification but go beyond what is expected for our A-level

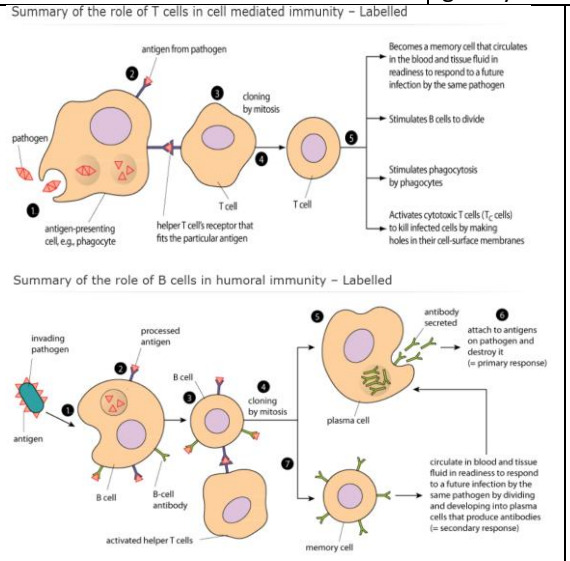
Where this term links with Career Prospects

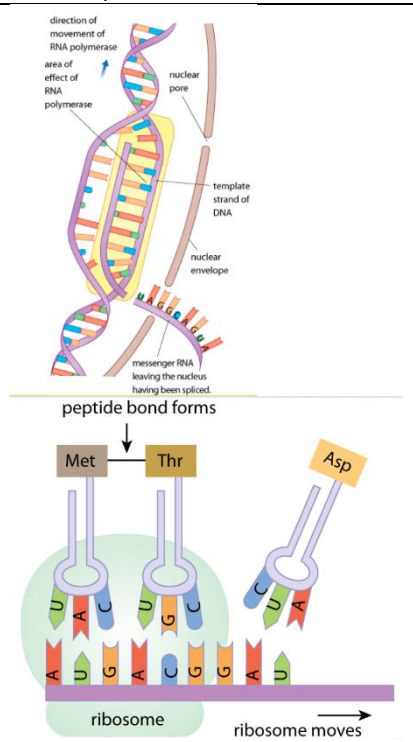
Knowledge gained this term can help you to pursue a career in:

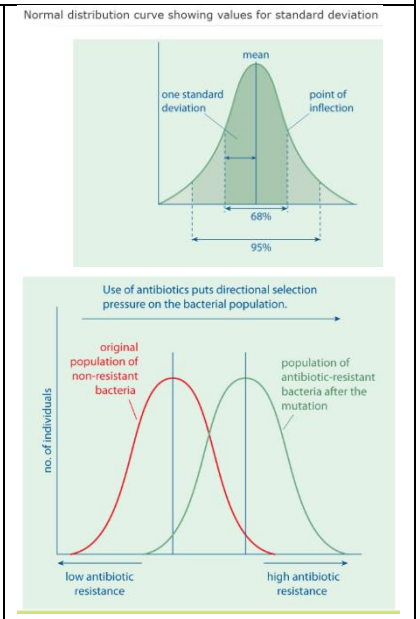
- *Conservation*
- *Environmental science*
- *Preservation*
- *Zoology*
- *Genealogy*
- *Microbiologist*

Top Tip from the Department

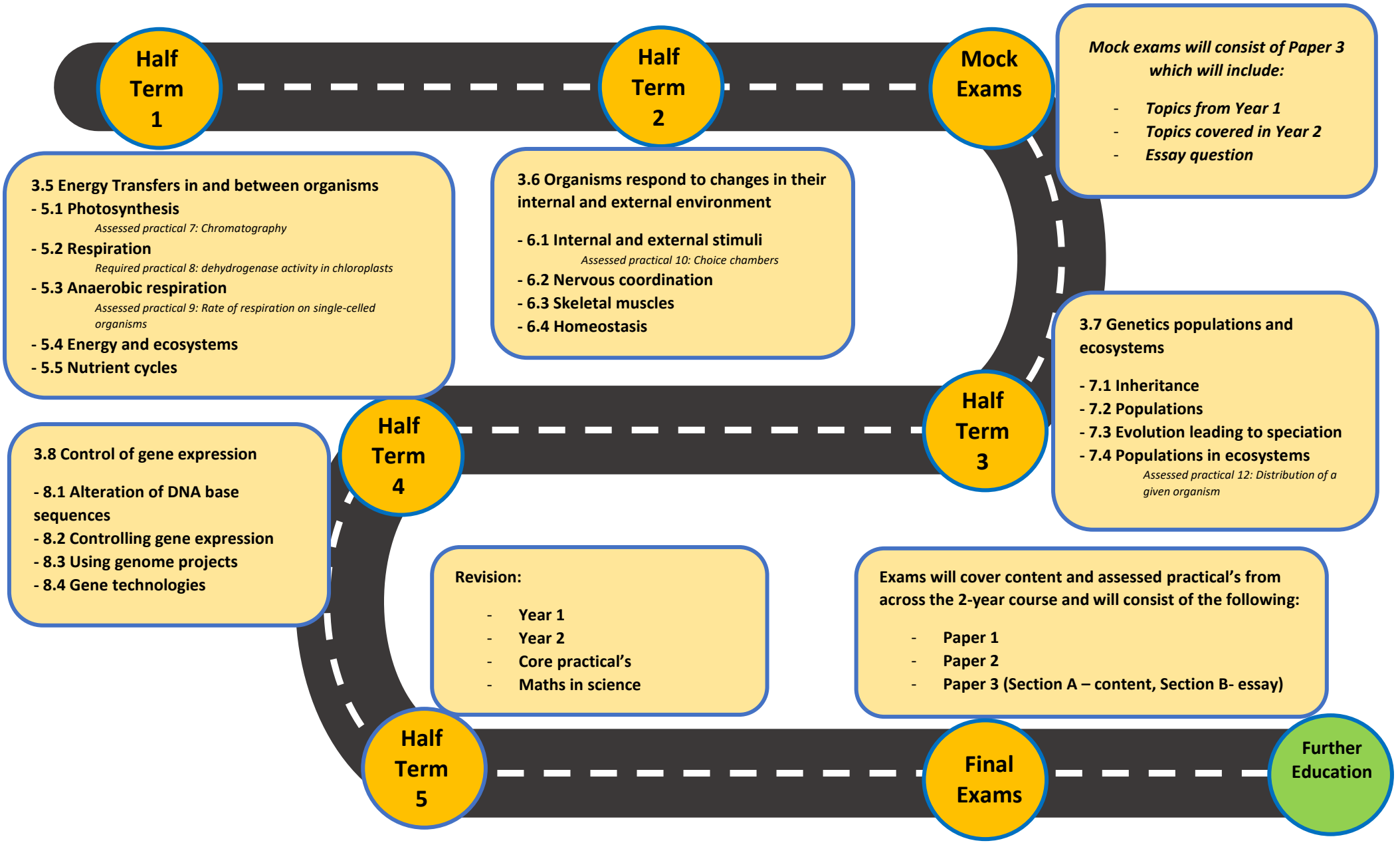
"Practice exam questions: Focus on answering exam-style questions to improve your technique. Be certain to read the question carefully and break it down into chunks or annotate the question. You may be surprised at what you may know or remember. Prioritize your well-being: Ensure you take breaks, get enough sleep, and maintain a healthy lifestyle. Try the 20-20-20 rule during revision to help maintain focus and wellbeing."







Year 13 A Level Biology ROADMAP



Year 13 Term One

Summary

Unit 5 focuses on how energy is captured within living organisms through the processes of photosynthesis and respiration. We also investigate how this energy is transferred through ecosystems via food chains and food webs. You will learn that ecosystems are maintained by light energy harvested from the sun. You will also discover that ATP production is formed when protons diffuse down an electrochemical gradient

Unit 6 explores how organisms detect and respond to stimuli to maintain stable internal conditions via the process of homeostasis. Homeostasis is achieved when the nervous and hormonal systems coordinate responses to these stimuli. The nervous system allows for rapid communication via electrical impulses whereas the hormonal systems provides slower responses via the secretion of hormones in endocrine glands which are transported via the blood stream.

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Oxford AQA A Level Biology 2nd edition Textbook, pg 226-412

Hodder Education AQA A Level Biology For A-level Year 2, pg 1-121

Bio facts sheets: 91, 97, 98, 100, 117, 126, 125, 154

Additional Reading List

Biologist magazine articles
- Learning to love Lucilia
- Decoding the diversity of daffs
- The key to the vault
- The sense behind senescence
- The way of the jakal
- The sky's the limit

https://www.alevelbiologytutor.com

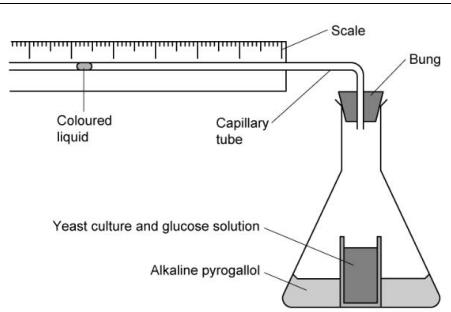
https://pmt.physicsandmathstutor.com/download/Biology/A-level/Notes

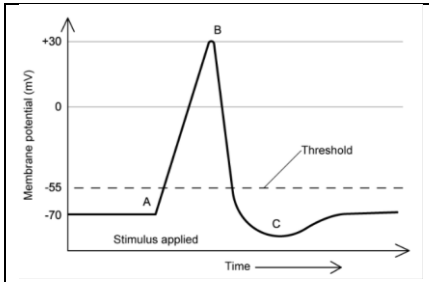
Self-Study Questions

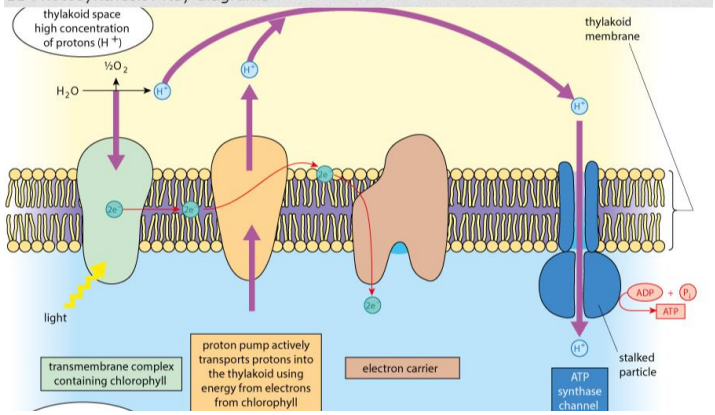
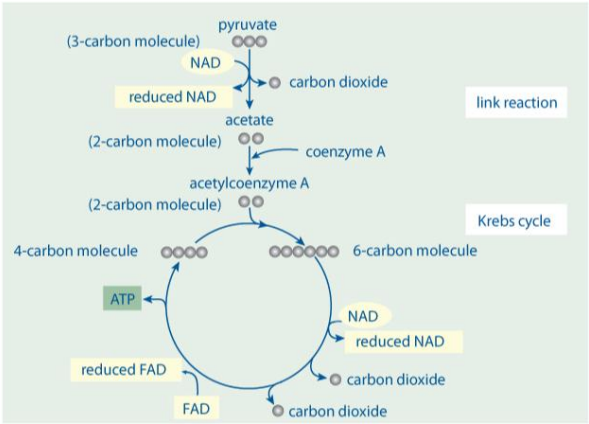
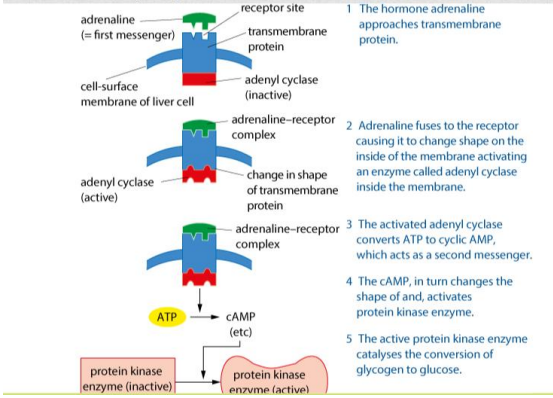
A researcher used the apparatus shown in the figure below to measure the rate of respiration in yeast. The researcher placed the flask in a water bath with the bung open (to maintain temperature) before adding the alkaline pyrogallol. When the researcher inserted the bung and began the experiment, the coloured liquid initially moved to the right. After some time, the coloured liquid slowed, stopped and reversed its direction, moving to the left.

What the mark scheme says?

It is important to relate your answers to pressure changes inside the apparatus as this can make the coloured liquid move one way or another. You will also need to identify the switch from aerobic to anaerobic respiration due to a lack of oxygen.

 Use the figure and your knowledge of respiration to explain these observations. (5 marks)	
One method of sewage treatment is called activated sludge, in which organic matter is fed, as untreated sewage, to bacteria in the treatment tank. These bacteria include decomposers and nitrifying bacteria. A food chain exists within the tank in which the bacteria are eaten by ciliated Protoctista, which are in turn, eaten by carnivorous protoctists. Explain the roles of the decomposers and the nitrifying bacteria in converting nitrogen from organic compounds in the sewage into a soluble, inorganic form. (3 marks)	Decomposers and nitrifying bacteria have very different roles in this process. Decomposers produce ammonium compounds from large protein molecules in the sewage, whereas nitrifying bacteria convert ammonium to nitrite and then nitrate. This results in the bacteria working as a team in the activated sludge system.
Essay: A cycle is a biological pathway or process in which the end product of one cycle becomes the starting point for the next. Write an essay about cycles in biology. (25 marks)	The maximum number of marks that can be awarded is: • Scientific content 16 • Breadth of knowledge 3 • Relevance 3 • Quality of written communication 3. Topics that you could include: - Nutrient cycles - Carbon and nitrogen cycles - Krebs cycle - Synthesis of ATP - Cardiac cycle - Cell cycle - Mechanisms of breathing - Muscle contraction NB: A* includes where candidates use information about a topic in the specification but go beyond what is expected for our A-level
The changes in membrane potential that take place during an action potential can be seen below:	Don't forget that you have to state **and** explain here so you will need to link your statements to ensure that you are getting the marks. Stating alone will score no marks. Points to consider: - Where do the sodium ion channels open? What does this cause? - Where do both the sodium and potassium ion channels open? What does this cause? - How do we maintain resting potential?

 State the changes that are happening to channel proteins in the axon membrane at the points labelled A, B and C and explain how these changes lead to the membrane potential seen in the figure.	
Malignant hyperthermia (MH) is a dangerous condition during which a patient's skeletal muscles become contracted and rigid. It is caused by a mutation in the gene that codes for intracellular calcium channels. MH is difficult to diagnose until it is triggered by the administration of an anaesthetic. Suggest how the anaesthetic combined with the MH mutation could lease to contracted skeletal muscles in a patient. (5 marks)	Be careful not to get this process confused with the role of calcium ions in synapses. Calium ions are also important in the initiation of muscle contractions but they are found on the cell-surface membrane and so these are not 'intracellular' as indicated in the question. Points to consider: - Where do the calcium ions leave? - Where do calcium ions bind? - What is formed to cause the muscle to contract?
Essay: How energy is transferred within and between organisms (25 marks)	The maximum number of marks that can be awarded is: • Scientific content 16 • Breadth of knowledge 3 • Relevance 3 • Quality of written communication 3. Topics that you could include: - Photosynthesis - Energy in ecosystems - Food production - Digestion and absorption - Respiration and ATP - Stimuli and responses - Nerve impulses and muscle contractions NB: A* includes where candidates use information about a topic in the specification but go beyond what is expected for our A-level

Where this term links with Career Prospects	**Top Tip from the Department**	11 Photosynthesis: Key diagrams	Homeostasis: Key diagrams
Knowledge gained in this term links to careers in: • Radiology • Cancer research • Oncology • Neurology • Environmentalist	***"Active recall helps you to retrieve information from memory rather than passively reviewing it. This is a great way to make sure you're retaining the information you're revising.*** ***Examples of active recall include testing with flashcards, answering exam-style questions without checking your notes, creating mind maps on a topic from memory, and teaching somebody else. "***	 Summary of the link reaction and the Krebs cycle – Labelled 	

Year 13 Term Two

Summary	Assessment Objectives
During this term, in topic 7 we will be building on concepts learned during topic 4 and topic 5you will recap and review genetic crosses, sex-linkage and epistasis to be able to predict inheritance patterns of a given species. You will also be applying the Hardy-Weinberg principle to calculate the frequency of alleles and genes within a population. This will lead onto evolution of species through isolation and the process of genetic drift. We will also be looking at the functions of a variety of factors (abiotic and biotic), succession, conservation play a role in ecosystems. Within topic 8 we will look further into mutations and their effects on proteins including DNA methylation, modification of histones and how this can lead to the formation of cancer. We will also delve into the world of genetic technology including genetic engineering, PCR, electrophoresis, DNA probes. We will also be looking further into the real life application of genetic fingerprinting, gene therapy and genetically modified organisms alongside the ethical and social issues surrounding this. This links into unit 2 cells, deepens your understanding around topic 4 on genetic information and topic 6 where we learnt about control and regulation	• AO1: Demonstrate knowledge and understanding of scientific ideas, processes, techniques and procedures • AO2: Apply knowledge and understanding of scientific ideas, processes, techniques and procedures: - in a theoretical context - in a practical context - when handling qualitative data - when handling quantitative data • AO3: Analyse, interpret and evaluate scientific information, ideas and evidence, including in relation to issues, to: - make judgements and reach conclusions - develop and refine practical design and procedures.

Required Reading List	Additional Reading List
AQA A Level Biology specification https://www.aqa.org.uk/subjects/biology/a-level/biology-7402/specification Oxford AQA A Level Biology 2nd edition Textbook, pg 416 – 560 and 560 - 603 Hodder Education AQA A Level Biology For A-level Year 2, pg 122-239 and 240-277 Bio facts sheets: 104, 105, 106, 110, 120, 121	Biologist magazine articles - Enough about genes what about 'phenes'? - Harnessing the power of peptides - Synthesising success - Dodo detectives - Next generation nanopores - A giant leap for nanoscience https://www.alevelbiologytutor.com https://pmt.physicsandmathstutor.com/download/Biology/A-level/Notes

Self-Study Questions	What the mark scheme says?
An investigation was carried out on fruit flies to determine the relationship between body colour and wing length. The scientists claimed that independent segregation had taken place. Chi^2 can be used to determine the significance of the data. The critical value for this data is 7.82.	If you add the total number of offspring from the observed columns, we find that 320 offspring are produced. We know the ratio is 1:1:1:1 due to the number of phenotypes. We can use this ratio and the total number of offspring to calculate the expected number. Points to consider: - Is the Chi^2 value larger or smaller than the critical value provided? - Is the difference between the expected and observes values significantly different? - How does this link to the probability of these occurrences being chance?

Phenotype	Observed Numbers	Expected Numbers
Black body and long wings	83	
Black body and short wings	85	
Grey body and long wings	78	
Grey body and short wings	74	

Use the following formula to calculate the value of Ch squared (X^2) and comment on the scientists claim:

$$x^2 = \sum \frac{(observed - expected)^2}{expected}$$

(5 marks)

Essay: Using DNA in Science and technology

(25 marks)

The maximum number of marks that can be awarded is: • Scientific content 16 • Breadth of knowledge 3 • Relevance 3 • Quality of written communication 3.
Topics to include:

- DNA and classification
- Genetic engineering and making useful substances
- Other uses of DNA

NB: A* includes where candidates use information about a topic in the specification but go beyond what is expected for our A-level

The Philadelphia chromosome is an example of a translocation mutation where chromosome 22 has been genetically altered to include a gene usually found on chromosome 9 called the ABL gene. The Philadelphia mutation creates a fusion gene which is a combination of the ABL gene and BCR gene (chromosome 22). It is an example of a mutation which is not inherited but acquired later in life. It is linked to increased cases of leukaemia due to increased activity of tyrosine kinase, an enzyme involved in switching on and off many cellular functions including cell division.

Outline how scientists could use the polymerase chain reaction (PCR) in combination with a labelled gene probe to detect the presence and quantity of the Philadelphia fusion gene

(6 marks)

This question is looking for an outline of what needs to be done during PCR however the important part is how the mutated gene would be labelled and how that label would indicate the quantity of the Philadelphia mutation. Remember to link and identify where the strands of DNA are separated.

Pluripotent stem cells extracted from the early embryo can be used to treats a variety of diseases including muscular dystrophy, osteoporosis and macular degeneration. However, in 2006, scientists in Japan found that adult stem cells could become induced pluripotent stem cells. Some believe that the use of induced pluripotent stem cells. Evaluate the use of pluripotent and induced pluripotent stem cells in treatment of life changing diseases such as those mentioned above

(5 marks)

There are many discussion points in this topic however you need to consider the scientific arguments **alongside** the ethical arguments, not just one or the other. Stem cells which originate from embryos come with many ethical negatives, many of which are overcome with the use of induced pluripotent cells. Adults can give consent to stem cell samples being extracted, however an embryo cannot. Some may also think that it is a waste to not make use of discarded embryos from fertility clinics if this could potentially provide an opportunity to help a patient who is suffering from a disease that is treatable.

	Remember to compare and contrast the two different types of stem cells using clear comparative language. Also remember to add in the definition of stem cells to support your answer.
Essay: The importance to humans of the control of growth, reproduction and development of organisms, including themselves. (25 marks)	The maximum number of marks that can be awarded is: • Scientific content 16 • Breadth of knowledge 3 • Relevance 3 • Quality of written communication 3. Topics you could include: - Pathogens - Cholera - Human influence on biodiversity - Use of fertilisers and pesticides - Control of gene expression - Gene therapy - Human populations NB: A* includes where candidates use information about a topic in the specification but go beyond what is expected for our A-level

Where this term links with Career Prospects

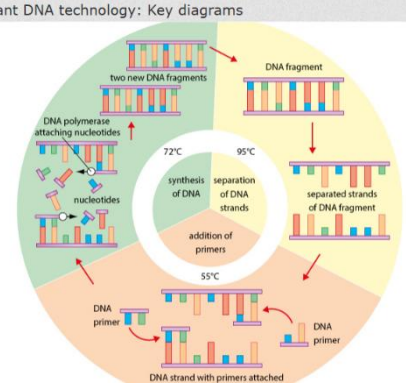
Knowledge in this term links to careers in:

- Data analysis
- Genetic engineering
- Forensics
- Lab researchers
- Medicine

Top Tip from the Department

"Use past papers: Practice with past papers to understand the exam format and question types and be certain to read the question carefully. Prioritize your well-being: Ensure you take breaks, get enough sleep, and maintain a healthy lifestyle. Try incorporating the 20-20-20 rule with other revision strategies such as active recall, the pomodoro technique and spaced repetition."

Recombinant DNA technology: Key diagrams



Applying the chi-squared test – Labelled

Class (category)	Observed (O)	Expected (E)	O – E	$(O-E)^2$	$\frac{(O-E)^2}{E}$
Round, yellow seeds	186	180	+6	36	0.2
Round, green seeds	48	60	−12	144	2.4
Wrinkled, yellow seeds	72	60	+12	144	2.4
Wrinkled, green seeds	14	20	−6	36	1.8
					$\Sigma = 6.8$

Action of restriction endonucleases – Labelled