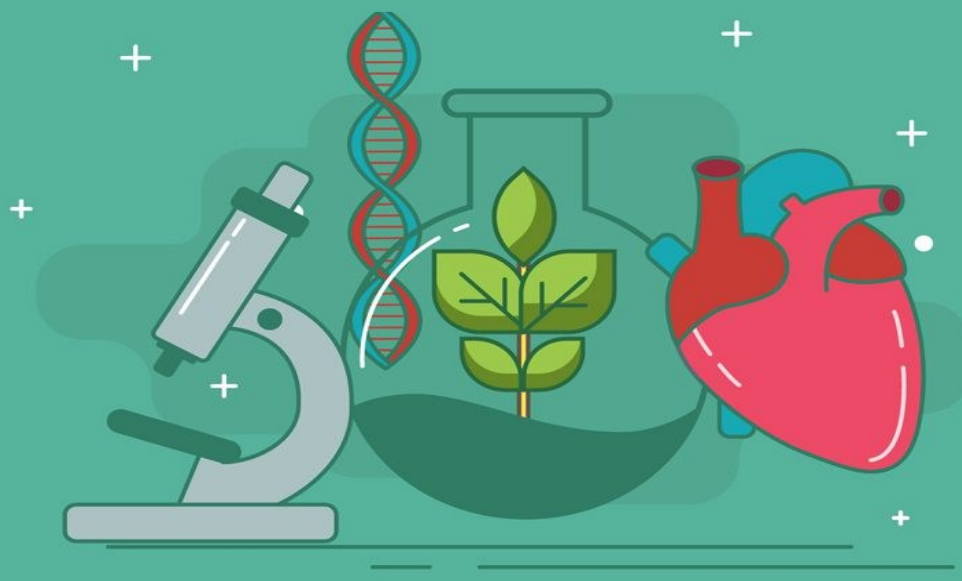
ST PETER'S
CATHOLIC SCHOOL

St. Peters Catholic School
Science Department

A-Level Biology Transition Pack



Welcome and Introduction to the Course

Welcome to the A-Level Biology course. Biology is a fascinating subject which spans a huge range of topics from molecular biology to the interrelationships of population in ecosystems. You will be learning about the fields of physiology, biochemistry, microbiology, genetics, ecology, neuroscience and more during the course!

Course Specifics:

The course we follow at St. Peters is 'Edexcel Biology A (Salters-Nuffield)'. The specification can be found here (https://qualifications.pearson.com/en/qualifications/edexcel-a-levels/biology-a-2015.html).

Our lessons follow the specification in order of content with topics being split into the two years of the course as follows:

Year	Topics
12	1 (Lifestyle, Health and Risk), 2 (Genes and Health), 3 (Voice of the Genome) and 4 (Biodiversity and Natural Resources).
13	5 (On the Wild Side), 6 (Immunity, Infection and Response), 7 (Run for your Life) and 8 (Grey Matter).

Preparation for Beginning Year 12:

The work in this transition packs will be focussed on the topics included in Year 12 and has been designed to help you both bridge the gap between GCSE knowledge and A-Level, as well as provide you will opportunity to explore your personal interest in the subject so we can get to know you as Biologists and you can get to know yourself!

Section	Purpose
Organisation	Recommendations of what to do, how much to do and when to do it.
Key Concepts	Ensuring you are comfortable with key knowledge from GCSE needed for A-Level.
Exploring the Subject	Find out more about the different fields of Biology from incredible TED talks and some recommended reading.
Your Passion	A guide to researching and presenting an area of personal interest in Biology
Resources	Some worksheets and links to resources to aid your transition.

Organisation and Timings

One key component of your studies at sixth form will be an increased level of independence and autonomy surrounding when, and how you go about your studies. During this transition period while we will set some recommended "check ins", the work you do between those points will be up to you.

We would expect you to be completing 3-4 hours of work per week**. The structure below shows how long you should spend on each component in a week**, but the exact activities in will be up to you (suggestions are included in each sections with examples below):

Activity	Time Spent	Example
Key Concepts	1.5 Hours	Went through the structure of the heart ensuring I know the sequence of blood flow. Realised I did not know that much about the blood vessels so made some diagrammatic revision cards on those and learned their functions. Looked at the GCP transition revision guide PDF and answered the questions at the bottom.
Exploring the Subject	1.5 Hour	Watched a ted talk on "Molecular Machines" it was fantastic! I didn't realise how important computer modelling was to the field of Molecular Biology and that we knew about the molecules structures in such detail. I think this will tie in with Topic 2 of the A-level.
Your Passion	1 Hour	I have always wanted to understand how we can help to prevent climate change with Biological concepts and discovered scientists have made bacteria which can digest plastic! I'm going to make a poster project on how this works.

You are encouraged to email Mr Brewer (ebrewer@st-peters.surrey.sch.uk) with the work you complete each week on Thursday morning (08:30). I can then make further recommendations or comments/answer any questions.

Key Concepts in Biology

Having a knowledge of fundamental biological concepts is key to getting a good start to the A-Level course and prevents you from having to play 'catch up' as you encounter topics.

Below are a few resources to aid you in ensuring you are comfortable with key concepts in GCSE and link these to areas of the A-Level course. In order to act on areas you may not know so well, you will need to identify these. The "Key Concepts Breakdown" should aid you with this. So, what should you actually do?

1. **RAG rate the "Key Concepts Breakdown" table (see the next pages).** Read through the topics and rank them on how well you think you know them already. If you did not recognise a topic or know you find it hard rank it red, if you recognise it but don't remember details rank it amber and if you both recognise it and are confident you know the fundamentals, rank it green.
2. **Acting on Rs and As -** Now you have identified areas to work on, here are some ways you can fill in gaps of your knowledge.

a. **Create a "Cornell Notes" page on the topic using a CGP revision guide or BBC Bitesize -** A PDF of the CGP transition guide will be shared with you on Teams. Some notes and worksheets from the EDEXCEL Transition Guide are also included in the "Resources" Section. BBC Bitesize can be found here (https://www.bbc.co.uk/bitesize/examspecs/zpgcbk7). The following is a tutorial on making Cornell Notes (https://www.youtube.com/watch?v=WtW9IyE04OQ).

b. **Create a glossary of "Key Biological Terms" -** If you encounter a word or definition which either you don't know or think may be important, include this in a glossary! Not only will this aid you in remembering the definition, but you can look it up in the future. I would suggest a format such as the below (example included);

Term	Definition	Example
Homozygous Recessive	A genotype which includes two copies of a recessive allele . These are often associated with genetic disease.	Those who suffer from cystic fibrosis have the genotype ff and surer from symptoms of the disease.

c. **Answer questions and self-assess using your notes -** Some questions are included at the bottom of the CGP transition guide provided. You should also have those from past lessons and tests in your notes/books.

d. **Create testable revision cards and use the 'Leitner System' -** The following is a tutorial on how to do this (https://www.youtube.com/watch?v=C20EvKtdJwQ)

Key Concepts Breakdown

As the new specification is EDEXCEL and your GCSE was AQA, there are some topics which may be new and are worth looking at. For these, I have included the EDEXCEL Spec points, the others I have included AQA. The AQA Biology GCSE Spec can be found here (https://www.aqa.org.uk/subjects/science/gcse/biology-8461). Some spec points cover content from the AQA Chemistry GCSE which can be found here (https://www.aqa.org.uk/subjects/science/gcse/chemistry-8462).

Topic 1- Lifestyle, Health and Risk	9 - 1 GCSE
1.1 Understand why many animals have a heart and circulation (mass transport to overcome limitations of diffusion in meeting the requirements of organisms).	4.2.2.2 The heart and blood vessels
1.3 Understand how the structures of blood vessels (capillaries, arteries and veins) relate to their functions. 8.7 Explain how the structure of the blood vessels is related to their function.	4.2.2.2 The heart and blood vessels 4.2.2.3 Blood
1.4 i) Know the cardiac cycle (atrial systole, ventricular systole and cardiac diastole) and relate the structure and operation of the mammalian heart, including the major blood vessels, to its function. ii) Know how the relationship between heart structure and function can be investigated practically.	4.2.2.2 The heart and blood vessels
1.6 Understand the blood-clotting process (thromboplastin release, conversion of prothrombin to thrombin and fibrinogen to fibrin) and its role in cardiovascular disease (CVD).	4.2.2.4 Coronary heart disease: a non-communicable disease 4.2.2.6 The effect of lifestyle on some non-communicable diseases
1.8 Be able to analyse and interpret quantitative data on illness and mortality rates to determine health risks, including distinguishing between correlation and causation and recognising conflicting evidence.	4.2.2.5 Health issues
1.13 Know how monosaccharides join to form disaccharides (sucrose, lactose and maltose) and polysaccharides (glycogen and amylose) through condensation reactions forming glycosidic bonds, and how these can be split through hydrolysis reactions.	4.2.2.1 The human digestive system Required practical activity 4: use qualitative reagents to test for a range of carbohydrates, lipids and proteins.
1.14 i) Know how a triglyceride is synthesised by the formation of ester bonds during condensation reactions between glycerol and three fatty acids. ii) Know the differences between saturated and unsaturated lipids.	The following spec points are from the Chemistry GCSE: 4.7.2.3 Alcohols, 4.7.2.4 Carboxylic acids, 4.7.3 Synthetic and naturally occurring polymers (chemistry only)
1.16 Understand how people use scientific knowledge about the effects of diet, including obesity indicators, body mass index and waist-to-hip ratio, exercise and smoking to reduce their risk of coronary heart disease.	4.2.2.6 The effect of lifestyle on some non-communicable diseases

Topic 2 – Genes and health	9 - 1 GCSE
2.1 i) Know the properties of gas exchange surfaces in living organisms (large surface area to volume ratio, thickness of surface, difference in concentration). ii) Understand how the rate of diffusion is dependent on these properties and can be calculated using Fick's Law of Diffusion. iii) Understand how the structure of the mammalian lung is adapted for rapid gaseous exchange.	4.2.2.2 The heart and blood vessels 4.1.3.1 Diffusion
2.2 i) Know the structure and properties of cell membranes. ii) Understand how models such as the fluid mosaic model of cell membranes are interpretations of data used to develop scientific explanations of the structure and properties of cell membranes.	4.1.1.1 Eukaryotes and prokaryotes 4.1.1.2 Animal and plant cells 4.1.3 Transport in cells
2.3 Understand what is meant by osmosis in terms of the movement of free water molecules through a partially permeable membrane (consideration of water potential is not required).	4.1.3.2 Osmosis
2.4 i) Understand what is meant by passive transport (diffusion, facilitated diffusion), active transport (including the role of ATP as an immediate source of energy), endocytosis and exocytosis. ii) Understand the involvement of ca	4.1.3 Transport in cells
2.6 i) Understand the process of protein synthesis (transcription) including the role of RNA polymerase, translation, messenger RNA, transfer RNA, ribosomes and the role of start and stop codons. ii) Understand the roles of the DNA template (antisense) strand in transcription, codons on messenger RNA and anticodons on transfer RNA.	4.6.1.5 DNA structure (biology only)
2.8 Know that a gene is a sequence of bases on a DNA molecule that codes for a gene.	4.6.1.5 DNA structure (biology only) 4.6.1.6 Genetic inheritance
2.10 i) Understand the mechanism of action and the specificity of enzymes in terms of their three-dimensional structure. ii) Understand that enzymes are biological catalysts that reduce activation energy. iii) Know that there are intracellular enzymes catalysing reactions inside cells and extracellular enzymes produced by cells catalysing reactions outside of cells.	4.2.2.1 The human digestive system Required practical activity 5: investigate the effect of pH on the rate of reaction of amylase enzyme
2.13 i) Know the meaning of the terms: gene, allele, genotype, phenotype, recessive, dominant, incomplete dominance, homozygote and heterozygote. ii) Understand patterns of inheritance, including the interpretation of genetic pedigree diagrams, in the context of monohybrid inheritance.	4.6.1.6 Genetic inheritance 4.6.1.7 Inherited disorders

Topic 3 – Voice of the genome	9 - 1 GCSE
3.2 Know the ultrastructure of eukaryotic cells, including nucleus, nucleolus, ribosomes, rough and smooth endoplasmic reticulum, mitochondria, centrioles, lysosomes, and Golgi apparatus.	4.1.1.1 Eukaryotes and prokaryotes 4.1.1.2 Animal and plant cells
3.4 Know the ultrastructure of prokaryotic cells, including cell wall, capsule, plasmid, flagellum, pili, ribosomes, mesosomes and circular DNA.	4.1.1.1 Eukaryotes and prokaryotes 4.1.1.2 Animal and plant cells
3.5 Be able to recognise the organelles in 3.2 from electron microscope (EM) images.	4.1.1.1 Eukaryotes and prokaryotes 4.1.1.2 Animal and plant cells 4.1.1.5 Microscopy
3.6 Understand how mammalian gametes are specialised for their functions (including the acrosome in sperm and the zona pellucida in the egg).	4.1.1.3 Cell specialisation 4.1.1.4 Cell differentiation
3.9 Understand the role of meiosis in ensuring genetic variation through the production of non-identical gametes as a consequence of independent assortment of chromosomes and crossing over of alleles between chromatids (details of the stages of meiosis are not required).	4.1.2.1 Chromosomes 4.1.2.2 Mitosis and the cell cycle
3.10 Understand the role of mitosis and the cell cycle in producing identical daughter cells for growth and asexual reproduction.	4.1.2.1 Chromosomes 4.1.2.2 Mitosis and the cell cycle 4.6.1.2 Meiosis
CORE PRACTICAL 5: Prepare and stain a root tip squash to observe the stages of mitosis.	4.1.1.5 Microscopy 4.1.2.2 Mitosis and the cell cycle
3.11 i) Understand what is meant by the terms 'stem cell, pluripotency and totipotency'. ii) Be able to discuss the way society uses scientific knowledge to make decisions about the use of stem cells in medical therapies.	4.1.1.4 Cell differentiation 4.1.2.3 Stem cells 4.6.2.4 Genetic engineering

Topic 4 – The Ecosystem and Natural Resources	9 - 1 GCSE
4.3 Understand the concept of niche and be able to discuss examples of adaptation of organisms to their environment (behavioural, physiological and anatomical).	4.7.1.4 Adaptations 4.7.1.3 Biotic factors , 4.7.1.2 Abiotic factors 4.7.1.1 Communities
4.4 Understand how natural selection can lead to adaptation and evolution.	4.6.2.1 Variation 4.6.2.2 Evolution 4.6.1.3 Advantages and disadvantages of sexual and asexual reproduction
4.6 i) Understand that classification is a means of organising the variety of life based on relationships between organisms using differences and similarities in phenotypes and in genotypes, and is built around the species concept. ii) Understand the process and importance of critical evaluation of new data by the scientific community, which leads to new taxonomic groupings, including the three domains of life based on molecular phylogeny, which are Bacteria, Archaea, Eukaryota	4.6.4 Classification of living organisms
4.7 Know the ultrastructure of plant cells (cell walls, chloroplasts, amyloplasts, vacuole, tonoplast, plasmodesmata, pits and middle lamella) and be able to compare it with animal cells.	4.1.1.3 Cell specialisation 4.1.1.2 Animal and plant cells 4.2.3 Plant tissues, organs and systems
CORE PRACTICAL 6: Identify sclerenchyma fibres, phloem sieve tubes and xylem vessels and their location within stems through a light microscope.	4.2.3.1 Plant tissues 4.2.3.2 Plant organ system
4.11 Know the similarities and differences between the structures, position in the stem and function of sclerenchyma fibres (support), xylem vessels (support and transport of water and mineral ions) and phloem (translocation of organic solutes)	4.2.3.1 Plant tissues 4.2.3.2 Plant organ system
CORE PRACTICAL 9: Investigate the antimicrobial properties of plants, including aseptic techniques for the safe handling of bacteria . 4.14 Understand the conditions required for bacterial growth.	4.1.1.6 Culturing microorganisms (biology only) 4.3.1.9 Discovery and development of drugs
4.5 i) Understand how the Hardy-Weinberg equation can be used to see whether a change in allele frequency is occurring in a population over time. ii) Understand that reproductive isolation can lead to accumulation of different genetic information in populations potentially leading to the formation of new species.	4.6.2.1 Variation 4.6.1.6 Genetic inheritance

Exploring the Subject

Exploring the fringes of a subject you enjoy can be fascinating and thrilling. Throughout the course I would encourage you to explore talks, books and articles around the subject and attempt to connect them to your current learning.

I have included below a list of talks, books and articles for you to look at with recommendations on what to do with each of them. Enjoy!

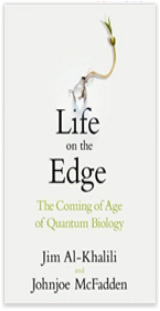
TED Talks - These talks are a fantastic resource from visionaries and leaders in their fields of study. The website (https://www.ted.com/talks) allows you to explore topics of your choosing, but I have summarised some favourites and new discoveries in the table below to correspond with large areas of study.

When you watch the talk I would recommend trying to write a summary paragraph which would answer the following:

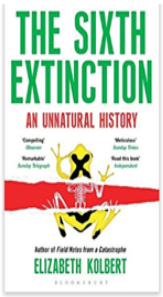
1. What is the message the speaker is trying to get across?
2. What did any experiments/data show and achieve to evidence this idea?
3. How does this link to your GCSE and can you link it to the A-Level?
4. Did you find this interesting? Why? Would you research this further in a project?

Field of Study	Talk Title	Link
Physiology	How we'll all become cyborgs and extend human potential	https://www.ted.com/talks/hugh_herr_how_we_ll_become_cyborgs_and_extend_human_potential
Biochemistry	How we discovered DNA	https://www.ted.com/talks/james_watson_how_we_discovered_dna
Microbiology	The mysterious microbes living deep in the earth and how they could help humanity.	https://www.ted.com/talks/ka-ren_lloyd_the_mysterious_microbes_living_deep_insid
Genetics	CRISPR lets us edit our DNA	https://www.ted.com/talks/jennifer_doudna_how_crispr_lets_us_edit_our_dna
Ecology	Why we need Bugs	https://www.ted.com/talks/danae_wolfe_why_we_need_bugs
Neuroscience	Re-engineering the Brain	https://www.ted.com/talks/gero_miesenboeck_re_engineering_the_brain

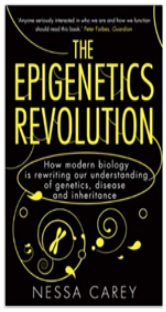
Popular Science Books - These have all been read by members of the Biology department! While they may currently be a bit of a challenge it is great to launch into the world of popular science. Even if you were to read one or two of these books before the course, it will aid you in developing your scientific literacy.



Life is the most extraordinary phenomenon in the known universe; but how does it work? Even in this age of cloning and synthetic biology, the remarkable truth remains: nobody has ever made anything living entirely out of dead material. Life remains the only way to make life. Are we missing a vital ingredient in its creation? Guiding the reader through the maze of rapidly unfolding discovery, Al-Khalili and McFadden communicate vividly the excitement of this explosive new field of quantum biology, with its potentially revolutionary applications, and also offer insights into the biggest puzzle of all: what is life? As they brilliantly demonstrate here, life lives on the quantum edge.

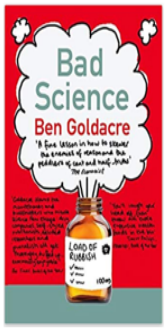


Over the last half a billion years, there have been five mass extinctions of life on earth. Scientists around the world are currently monitoring the sixth, predicted to be the most devastating extinction event since the asteroid impact that wiped out the dinosaurs. Elizabeth Kolbert combines brilliant field reporting, the history of ideas and the work of geologists, botanists and marine biologists to tell the gripping stories of a dozen species - including the Panamanian golden frog and the Sumatran rhino - some already gone, others at the point of vanishing. The sixth extinction is likely to be mankind's most lasting legacy and Elizabeth Kolbert's book urgently compels us to rethink the fundamental question of what it means to be human.

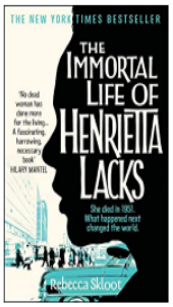


At the beginning of this century enormous progress had been made in genetics. The Human Genome Project finished sequencing human DNA. It seemed it was only a matter of time until we had all the answers to the secrets of life on this planet. Why can identical twins develop different diseases like schizophrenia? Why are tortoiseshell cats always female? Why do we age, develop disease or become addicted to drugs. Astonishingly, the answers to all these questions lie in epigenetics. A fast moving field in biology today, it has at its heart the realisation that cells can read genetic code more like a script to be interpreted than a blueprint that replicates the same result each time.

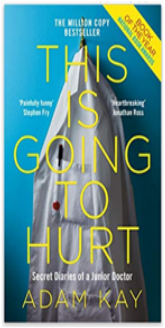
As globalization spreads and as we destroy the ancient ecosystems, we encounter strange and dangerous infections that originate in animals but that can be transmitted to humans. Diseases that were contained are being set free and the results are potentially catastrophic. In a journey that takes him from southern China to the Congo, from Bangladesh to Australia, David Quammen tracks these infections to their source and asks what we can do to prevent some new pandemic spreading across the face of the earth.



Since 2003 Dr Ben Goldacre has been exposing dodgy medical data in his popular *Guardian column*. In this eye-opening book he takes on the MMR hoax and misleading cosmetics ads, acupuncture and homeopathy, vitamins and mankind's vexed relationship with all manner of 'toxins'. Along the way, the self-confessed 'Johnny Ball cum Witchfinder General' performs a successful detox on a Barbie doll, sees his dead cat become a certified nutritionist and probes the supposed medical qualifications of 'Dr' Gillian McKeith. Full spleen and satire, Ben Goldacre takes us on a hilarious, invigorating and ultimately alarming journey through the bad science we are fed daily by hacks and quacks.



Rebecca Skloot's fascinating account is the story of the life, and afterlife, of one woman who changed the medical world forever. Balancing the beauty and drama of scientific discovery with dark questions about who owns the stuff our bodies are made of, *The Immortal Life of Henrietta Lacks* is an extraordinary journey in search of the soul and story of a real woman, whose cells live on today in all four corners of the world.



Welcome to the life of a junior doctor: 97-hour weeks, life and death decisions, a constant tsunami of bodily fluids, and the hospital parking meter earns more than you.
Scribbled in secret after endless days, sleepless nights and missed weekends, Adam Kay's *This is Going to Hurt* provides a no-holds-barred account of his time on the NHS front line. Hilarious, horrifying and heart-breaking, this diary is everything you wanted to know – and more than a few things you didn't – about life on and off the hospital ward.

In his most extraordinary book, *The Man Who Mistook His Wife for a Hat,* Oliver Sacks recounts the stories of patients lost in the bizarre, apparently inescapable world of neurological disorders. These are case studies of people who have lost their memories and with them the greater part of their pasts; who are no longer able to recognize people or common objects; whose limbs have become alien; who are afflicted and yet are gifted with uncanny artistic or mathematical talents. In Dr Sacks's splendid and sympathetic telling, each tale is a unique and deeply human study of life struggling against incredible adversity.

Alternatively, browse some of the most popular books on amazon in the science section and see if any of them pique your interest! It would be fantastic to hear about any new discoveries (https://www.amazon.co.uk/s/ref=lp_266239_nr_n_27?fst=as%3Aoff&rh=n%3A266239%2Cn%3A%21102561 2%2Cn%3A57&bbn=1025612&ie=UTF8&qid=1587989992&rnid=1025612) .

While you read, you could also keep a book journal, jotting down your ideas on what your read and how it links to ideas you have learnt about or will explore as a result.

Popular Science Podcasts - These Podcasts have some excellent episodes which apply to the course and are produced by the BBC. Both are available on the apple podcast app or on the BBC sounds app/website.

The curious cases of Rutherford and Fry:

In these podcasts, Biologist Adam Rutherford and Mathematician Hannah Fry answer scientific questions posed by the public supposted by the public.

I would recommend the episodes on Smell, Water and Colour Vision.

https://www.bbc.co.uk/programmes/b07dx75g

The Infinite Monkey Cage:

In these podcasts, Professor Biran Cox and Comedian Robert Ince discuss a number of scientific phenomena in depth supported by guest professors and comedians.

I would recommend the episodes on human evolution and the immune system.

https://www.bbc.co.uk/programmes/b00snr0w

While you listen, jot down now ideas you come across and white a reflection on what you take from the podcast

Your Passion - Producing a research project

It would be excellent to get to know you all as Biologists through the production of a passion project. This could include a research poster, a video, animation, presentation, or any inventive way of exploring an area of interest and sharing it with us!

Your project should aim to also help you to write about scientific ideas, link your subject knowledge to real work ideas and read scientific research articles. The following page contains a poster presentation passion project made by one of the current Year 12s into 'The effects of trauma on epigenetics and stress regulation'. It goes into a bit more detail than I would currently expect from you guys, but is an excellent example of detailed and rigorous research surrounding a concept she found interesting.

Alternatively, you could attempt a practical experiment at home over the course of the 6 weeks we do this work! As you have such a long time period this would be enough to experiment with growing plants and changing the conditions within which they do so to see an affect or other such ideas. The following article could give you some ideas as a starting point. (https://www.thoughtco.com/biology-science-fair-project-ideas-373329). If you get on particularly well, you could even produce an academic research paper on the results of the experiment using a template similar to that below.

Your Name

Date

The title of my project/practical as an interesting question (Research Question)

(Scientific background): Why are you interested in what you're investigating?

(Method) – What did you do?

(Results) – Say what happened

(Discussion) – Why do you think you got the results you did?

Diagram/Sketch or Data of Some Kind

(Variables): What is the thing you are changing? (Independent Variable)

What is the thing you are measuring? (Dependant Variable)

(Conclusion) – What do your results mean?

(References) – Did you use a website to help you?

I look forward to seeing what you come up with, both in terms of the area you choose to explore and how you choose to do this!

The effects of trauma on epigenetics and stress regulation

Why question genetic architecture?

For years, since suffering was a known experience to man, victims of genocide, sexual assault and other such trauma have pondered to what extent these macarbe events have scarred them, whether physically or emotionally. However after over 500 studies and half a century worth of academic literature, peripheral tissues, like buccal cells, and post-mortem brain samples have revealed that the oppressive legacy could lie in their epigenetically changed genes. Induced by their environment, genes expressing trauma responses are quietly being burdened by their children who may succumb to a disposition of PTSD. The question lies knowing to what extent the environment has changed their gene expression, what external stresses induce changes and what mechanisms are altered as a result ?

What is the Transgenerational transmission of Trauma Theory?

The process transgenerational transmission of trauma has been described as a way in which unconscious trauma could be inherited through epigenetic modifications. PTSD itself is characterized by 4 major symptom clusters: active avoidance of stimuli linked with trauma, re-experiencing, re-occurring negative thoughts/beliefs and hyperarousal symptoms. Due to a high frequency of traumatic events experienced by many individuals, 31.4% of adults in the UK reported experiencing a traumatic event, overall, positive screening results for PTSD tested:4.4%. This result as obtained from individuals that completed the 17-item PTSD Checklist. For patients treated with mental health treatment, 47.9% were tested positive for PTSD. (Adult Psychiatric Morbidity Survey: Survey of Mental Health and Wellbeing, England, 2014 - NHS Digital).

Interesting outcomes induced by Genocide

Instances where holocaust survivors endured starvation, a greater portion of off-spring became more prone to developing metabolic syndrome. (Flory J.D., Bierer L.M). A study from the Rwandan population, of those pregnant during the 1995 Tutsi genocide demonstrated 20% meeting the criteria for PTSD. Intigueingly, in 2011, the study obtained peripheral blood samples which concluded that there was a negative correlation between NR3C1 methylation and glucocorticoid levels in the plasma in addition to lower cortisol levels compared to the control group. On the other hand such research is limited to create a a conclusion since we are unable to distinguish whether diet, parenting methods or alcohol consumption implicated contributed to these changes. (Yehuda R., Bierer L.M.)

Stress and the HPA Axis

The 'flight or fight' model of Walter B. Cannon (Figure 3)is used to describe the body's response to stress (Cannon WB.) In more updated research, evidence has suggested that alterations to the HPA axis has been recognised to impact the stress maintaining process and induce toxic stress-induced health circumstances.

The process works where the Hypothalamus releases a Corticotropin-releasing factor (CRF). Once this binds to CRF receptors on the Anterior pituitary gland, ACTH will be released and then binds onto ACTH (**Adrenocorticotropic hormone**) recptors on the adrenal cortex which stimulates adrenal release of cortisol. Cortisol, allows he body to access glucose and facilitate the metabolism of fat, protein and carbohydrate under the pressure of the stressor. Cortisol will remain until it will enforce negative feedback which will cause the hypothalamic release of CTH and pituitary relase of ACTH to cease so Homeostastis returns to normal.

However, in cases where children are exposed to prolonged stressful situations, the long-term dysregulation of the HPA axis can be induced where the HPA is excessively activated.(Kuhlman KR, Geiss EG et al. (2018) (DeBold CR, Sheldon,1984)

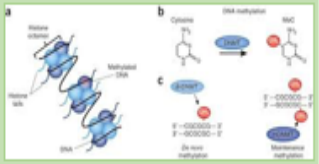


Figure1

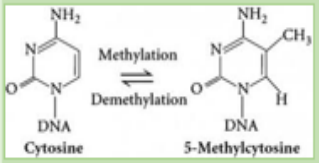


Figure 2

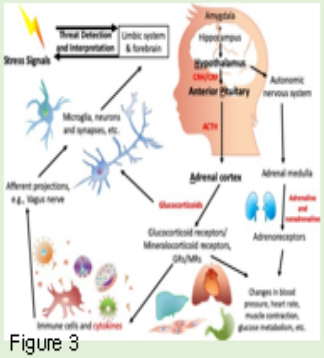


Figure 3

Associations Between Epigenetics and stress response

Gene expression is maintained through transcriptional regulators such as: DNA-binding proteins,… and promotors in addition to translational regulation like: Acetylation, Phosphorylation and Glycation (covalent addition of sugar groups like fructose and glucose) . Epigenetic modifications refer to the non-DNA changing regulation of genes by altering how tightly chromatin wraps around histone proteins which determines how easily RNA polymerase can bind to transcribe genes. (Figure 1) Epigenetic modification occurs with the addition of methyl groups on typically Cytosine. Modifications are often through the following : DNA Methylation, histone modification and RNA-mediated processes. A common example of a Cytosine Methylation is the oxidative product from the demethylation of 5mC (Figure 2). The general function serves to promote gene expression. The nitrogenous based hydroxy-methyl cytosine is commonly found in the neuronal cells of the CNS. (Hack LM, Dick A, Provençal N,2016) These were then associated with neuronal function, learning, memory and stress mediated response.

Using Rats as Models to follow epigenetic influences

A study held by the field of behavioural epigenetics (Weaver *et al*, Endocr Res) had illustrated how LG (low grooming) contrasted with ABN (Arched-back nursing) and had caused changes to methylation on the glucocorticoid receptor promotor in the hippocampus of the off-spring. This maternal outcome had continued into adult-hood.

This was then further tested with cross fostering new-born rats from ABN cared parents to LG-cared parents as a control to demonstrate relevance of environment. The following discovery noted that there was increased methylation of NR3CI gene (similar to the human GR gene), when reduced expression of said gene occurs, less binding of the NGFI-A protein. This research lead to the connection of the environment responsible for the dysregulation of the HPA axis which regulates the response to stress. Glucocorticoid is a stress hormone involved in the everyday functioning of the HPA axis. The GR(glucocorticoid receptors) can be found in all types of cell cytoplasm (Liu D, Diorio J, Tannenbaum B et al) Evidence in humans mothers who were exposed to war violence throughout pregnancy have enabled scientist to create a link between increased DNA Methylation of the NR3CI promoter region in new born babies. In light of such evidence, it can support it's impact with low birth weight. Low birth weight has been further held responsible for chronic health effects experienced later in life.(Flory J.D., Bierer L.M., Yehuda R.. 2011)(Hack M., Klein N.K., Taylor H.G).

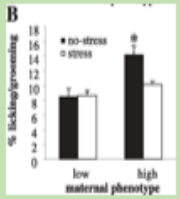
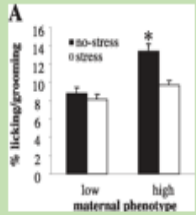


Figure 4



How the twin studies determined the heritability of PTSD

- Various studies were conducted over the years to determine the degree in which the environment coincided with PTSD. The candidates were 222 monozygotic and 184 dizygotic twin pairs using Biometrical modelling used statistical methods.
- The results concluded correlation between genetic effects on assaultive trauma. Assaultive trauma was characterized by experiences like the following (robbery, sexual assault…e.g). In contrast to moderate symptoms obtained from non-assaultive trauma which is characterized by (natural disaster or traffic accident…e.g) (Stein M.B., Jang K.L et al)
- Another study contributed from 1982 through subjects of a 3304 monozygotic and dizygotc male-male twin pair. A genetic model fitting had been used to estimate the genetic contributions that had been able to conclude that risk factors such as alcohol and drug dependence had genetically common contribution with PTSD to as much as 55.7%. (Xian H., Chantarujikapong S.I et al)

Resources

The following pages contain resources which may help you with any of the sections we have discussed. Of course, these are not comprehensive but do provide a good starting point to aid you. If you have any questions, please email Mr Brewer.

Useful Links:

Resource	Link
TED Talks	https://www.ted.com/talks
New Scientist	https://www.newscientist.com/
BBC Science News	https://www.bbc.co.uk/news/science_and_environment
Amoeba Sisters	https://www.youtube.com/user/AmoebaSisters
Snap Revise	https://www.youtube.com/playlist?list=PLkocNW0BSuEH7mxfLrCOXMRfz68wM3zIo
CGP A-Level Revision Guide	https://www.cgpbooks.co.uk/secondary-books/as-and-a-level/science/biology/bear54-a-level-biology-edexcel-a-year-1-as-co
CGP Maths Skills for Biology	https://www.amazon.co.uk/Level-Biology-Essential-Maths-Skills/dp/1847623239/ref=pd_lpo_14_t_1/261-2810776-3149412?_encoding=UTF8&pd_rd_i=1847623239&pd_rd_r=a61e710b-1e1b-4b64-801c-c6ee9c53ec5a&pd_rd_w=J9pDf&pd_rd_wg=j7S1T&pf_rd_p=7b8e3b03-1439-4489-abd4-4a138cf4eca6&pf_rd_r=67PASWDGMEA9XG3DS7W9&psc=1&refRID=67PASWDGMEA9XG3DS7W9
CGP Transition Guide	https://www.amazon.co.uk/Head-Start-level-Biology-Level-ebook/dp/B00VE2NIOI
A-Level Specification	https://qualifications.pearson.com/en/qualifications/edexcel-a-levels/biology-a-2015.html
BBC Bitesize Biology	https://www.bbc.co.uk/bitesize/examspecs/zpgcbk7
BBC Bitesize Maths	https://www.bbc.co.uk/bitesize/subjects/z38pycw

Key Mathematical Principles:

These are included in pages 79-84 of the specification. As with the GCSE content Read through the topics and rank them on how well you think you know them already. If you did not recognise a topic or know you find it hard rank it red, if you recognise it but don't remember details rank it amber and if you both recognise it and are confident you know the fundamentals rank it green. It would be well worth your time reviewing and practicing these principles. The link above to the BBC bitesize maths pages as well at your notes from the maths lessons are a good starting point.

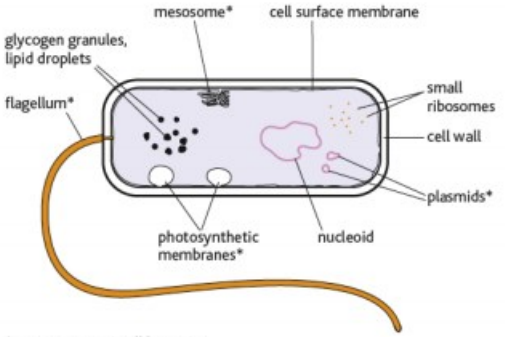
Transition notes and worksheets from EDEXCEL

Summary sheet 1: Cell structure

Prokaryotes are single celled organisms, including bacteria. They are simpler and smaller than Eukaryotic cells.

Bacterial cells have:

- no nucleus with circular DNA free in the cytoplasm
- cell wall made from peptidoglycan
- no membrane-bound organelles
- small ribosomes.

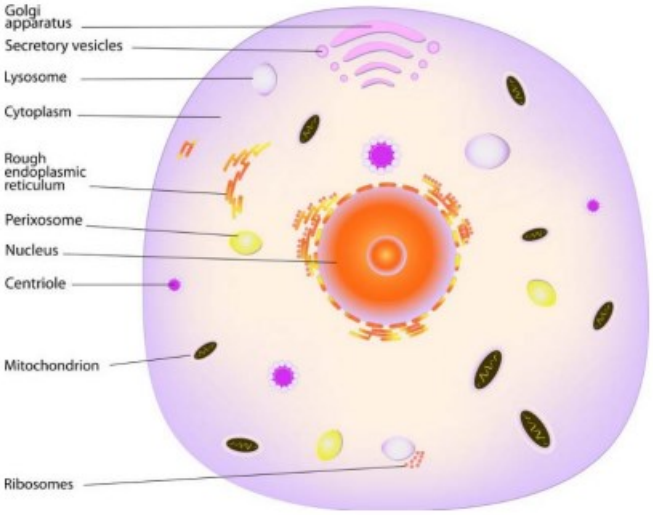


* = not present in all bacteria

Eukaryotic cells include animal and plant cells. They are larger and more complex than prokaryotic cells.

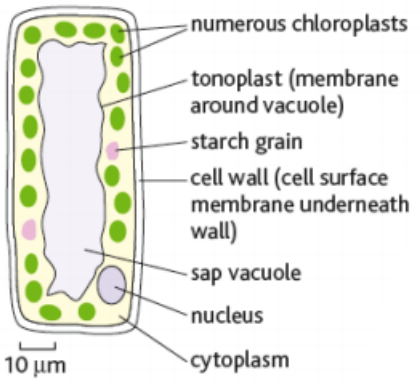
Animal cells have:

- linear DNA contained inside a nucleus
- no cell wall
- larger ribosomes and many membrane-bound organelles including mitochondria where aerobic respiration occurs and endoplasmic reticulum and golgi which are involved in the processing of proteins.

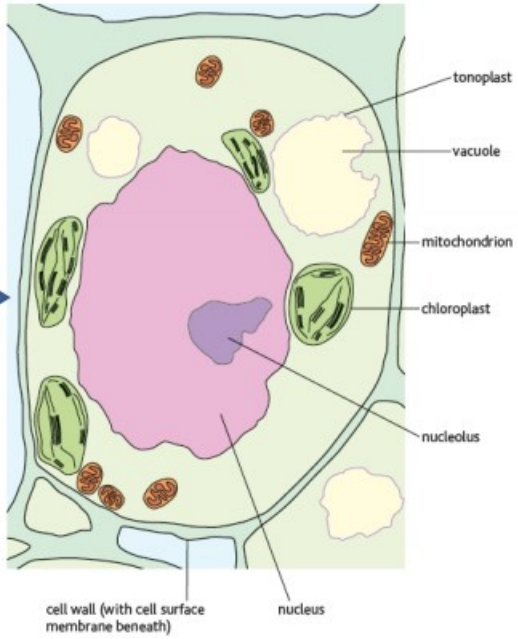


Plant cells have the same organelles as animal
cells but they also have:

- a cell wall
- a large vacuole containing cell sap
- chloroplasts for photosynthesis.



greater detail

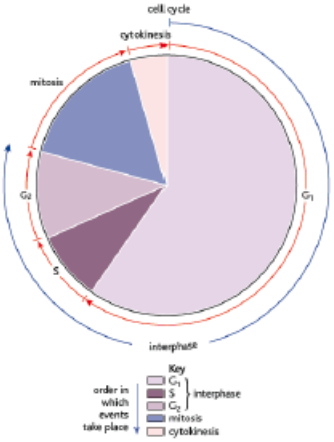


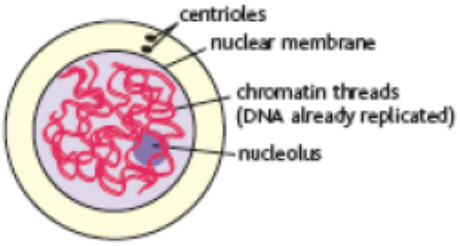
Summary sheet 2: Mitosis

Mitosis results in the production of two genetically identical diploid body cells. It occurs during growth, repair and asexual reproduction.

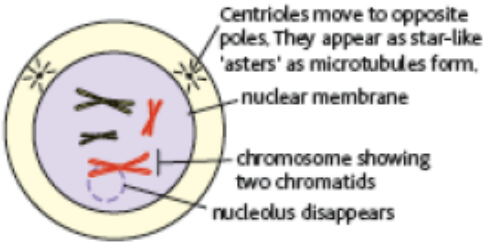
Mitosis occurs during the cell cycle. The cell cycle consists of a period of cell growth and DNA replication known as interphase and then a period of cell division called mitosis followed by cytokinesis where the cytoplasm divides and the cell membrane constricts to form the two daughter cells.

Mitosis is broken down into stages – prophase, metaphase, anaphase and telophase, followed by cytokinesis.

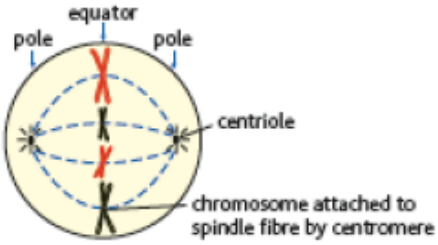




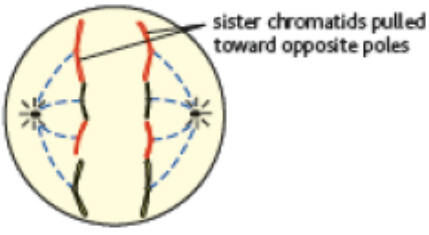
A **Interphase:** before mitosis the tangled, uncoiled mass of chromosomes fills the nucleus. DNA is replicated during this stage.



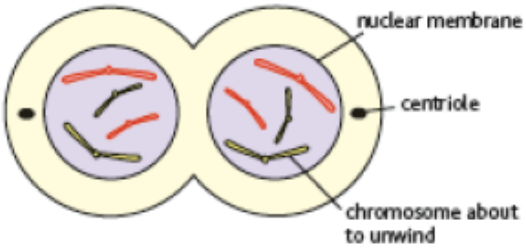
B **Prophase:** the chromosomes coil and condense, each one appearing as two chromatids. The nucleolus breaks down and the centrioles begin to separate and start to form the spindle.



C **Metaphase:** the nuclear membrane breaks down. Spindles made of microtubules have been formed by the centrioles. The chromatids line up on the equator.



D **Anaphase:** the centromeres separate and each chromatid is pulled along a along a spindle tubule towards one of the poles centromere first.



E **Early telophase:** the chromatids reach the poles of the cell where they are now known as chromosomes. The membrane begins to reform and the cytoplasm to divide.

F **Late telophase:** the chromosomes begin to 'decondense'. The nuclear membranes and nucleoli are fully reformed and centrioles are present again. The division of the cytoplasm continues until two new identical cells are formed which once more enter interphase.

Summary sheet 3: Microscopy

Magnification is how much bigger the image is than the specimen on the microscope slide.

The size of the specimen can be calculated using the formula:

$$\textbf{length of the specimen} = \frac{\textbf{length of the image}}{\textbf{magnification}}$$

With a light microscope the magnification is the combination of the magnification of the objective lens and the eye piece lens.

For example a 40× objective lens and a 10× eye piece lens produce a total magnification of 400×.

When you are doing magnification calculations you must have all the lengths in the same units.

1 cm	10 mm
1 mm	1000 µm
1 µm	1000 nm

Calculation

Calculate the actual size of a cell with a diameter of 8 mm using 100× magnification.

$$\text{Actual size} = \frac{8}{100} = 0.08 \text{ mm}$$

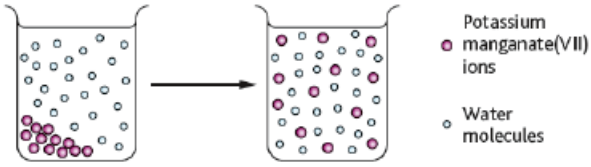
$$= 80 \text{ µm}$$

Resolution is a measure of how easy it is to distinguish between two points that are close together i.e. how much detail can be distinguished. Electron microscopes have a better resolution than light microscopes so they can see more detail.

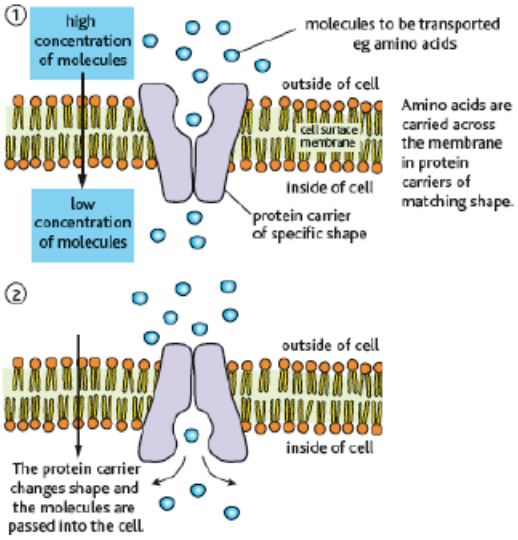
Summary sheet 4: Diffusion, osmosis and active transport

Diffusion

Liquid and gas particles are constantly moving which causes particles to move from an area of high concentration to an area of low concentration.



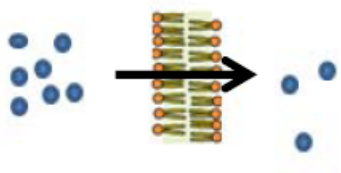
Observing the process of diffusion. If the beaker is left to stand the random motion of both the water and the purple manganate(VII) ions will ensure they are eventually evenly mixed.



Small particles can diffuse across cell membranes and no energy is required. Some molecules, such as glucose, are too large to diffuse across the cell membrane so they must be helped by carrier proteins. Each molecule has its own carrier protein that allows the molecule through the cell membrane without the need for energy. This is known as facilitated diffusion.

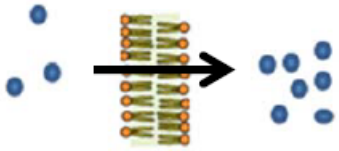
Osmosis

Osmosis is the diffusion of water molecules from an area of higher concentration of water molecules to an area of lower concentration of water molecules across a partially permeable membrane.



Active transport

Active transport uses energy to transport substances across membranes from an area of lower concentration to an area of higher concentration



Worksheet 1: Cell structures 1

Extracting key information from text is an important study skill for A-level candidates.

Read through the passage below about animal, plant and bacterial cells. Use the information and your own knowledge to complete the table to list some of the structural features of animal, plant and bacterial cells.

The plant cell and the animal cell possess a nucleus containing chromosomes and a nucleolus. In a bacterial cell the DNA is located in the cytoplasm. Only the bacterial cell and the plant cell have a cell wall but all three cells have a cell membrane. The plant cell wall is made of cellulose and the bacterial cell wall is made of peptidoglycan.

Centrioles are present only in the animal cell and chloroplasts are found only in the plant cell. Mitochondria and rough endoplasmic reticulum are not present in the bacterial cell. All three cells contain structures called ribosomes which are involved in the synthesis of protein. Bacterial cells can have pili or a capsule.

Features present in animal cells	Features present in plant cells	Features present in bacterial cells

Extension activity – research a function for each feature listed.

Worksheet 2: Cell structures 2

Extracting key information from text is an important study skill for A-level candidates.

Read through the passage below about animal, plant and bacterial cells. Use the information and your own knowledge to draw and label an animal, plant and bacterial cell. You should include the features listed if appropriate.

The plant cell and the animal cell possess a nucleus containing chromosomes and a nucleolus. In a bacterial cell the DNA is located in the cytoplasm. Only the bacterial cell and the plant cell have a cell wall but all three cells have a cell membrane. The plant cell wall is made of cellulose and the bacterial cell wall is made of peptidoglycan.

Centrioles are present only in the animal cell and chloroplasts are found only in the plant cell. Mitochondria and rough endoplasmic reticulum are not present in the bacterial cell. All three cells contain structures called ribosomes which are involved in the synthesis of protein. Bacterial cells can have pili or a capsule.

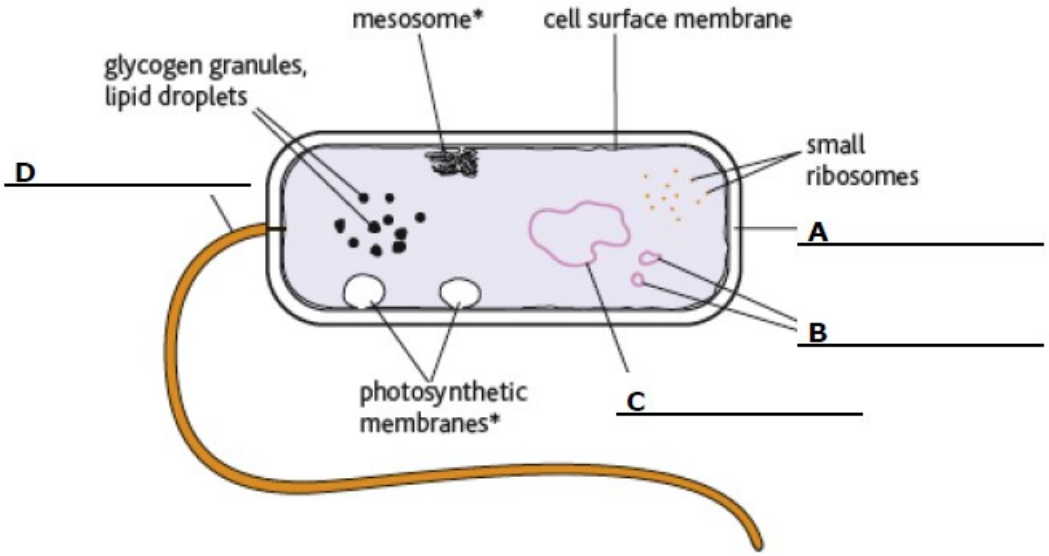
cell wall	nucleus	cell membrane	ribosome	capsule
mitochondria	cytoplasm	chloroplast	plasmid	chromosome

Animal cell	**Plant cell**
Bacterial cell	

Extension activity – research any unfamiliar features and add them to your cell diagrams.

Practice questions

1 The diagram shows a bacterial cell with some of the key features labelled.



a Label cell features A, B, C and D.

b Complete the table to identify three features present in animal cells and describe their function.

Animal cell feature	Function

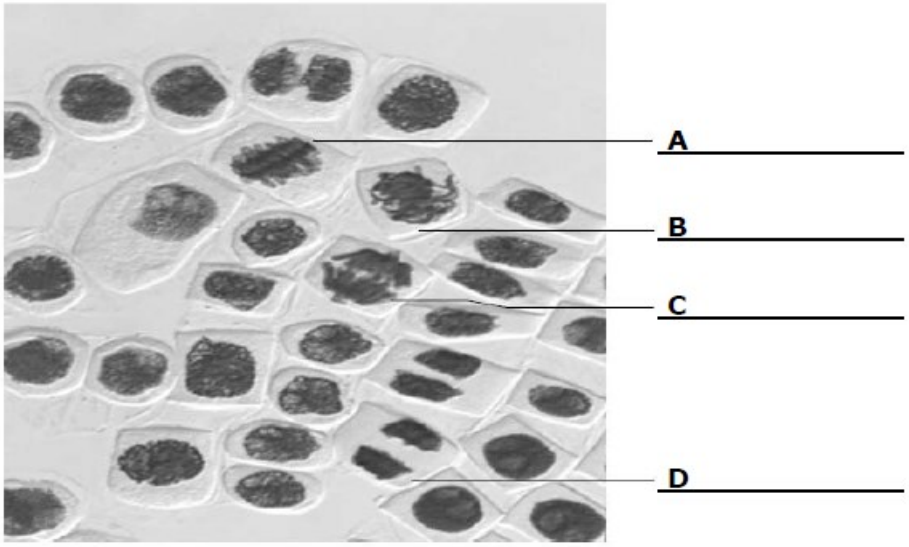
c Some antibiotics prevent protein synthesis by targeting the ribosome.

Ribosomes in eukaryotes have a different structure to prokaryotes.

In no more than 50 words, explain why these types of antibiotics can be used to treat bacterial infections without effecting human cells.

Concise writing which refers to key scientific ideas is effective.

2 The image shows root tip cells at different stages of the cell cycle.



a Identify the stages of mitosis for cells A, B, C and D.

b The microscope used to view the cells had a 10× eye piece lens. Which objective lens was needed to view the cells at this magnification level?

c Calculate the length of cell A.

4 Write a definition for diffusion, osmosis and active transport.

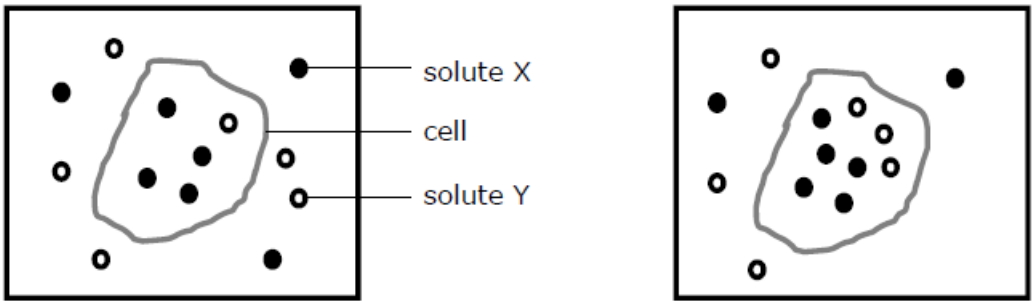
Diffusion:

Osmosis:

Active transport:

5 Cells were placed in a solution containing solute X and solute Y.

The diagram below represents the concentration of the two solutes inside and outside one of the cells, when this cell was placed in the solution and then after 30 minutes.



Initial concentration **After 30 minutes**

Explain the movement of solute X and solute Y into the cell.

6 A red blood cell was placed in a solution of distilled water.

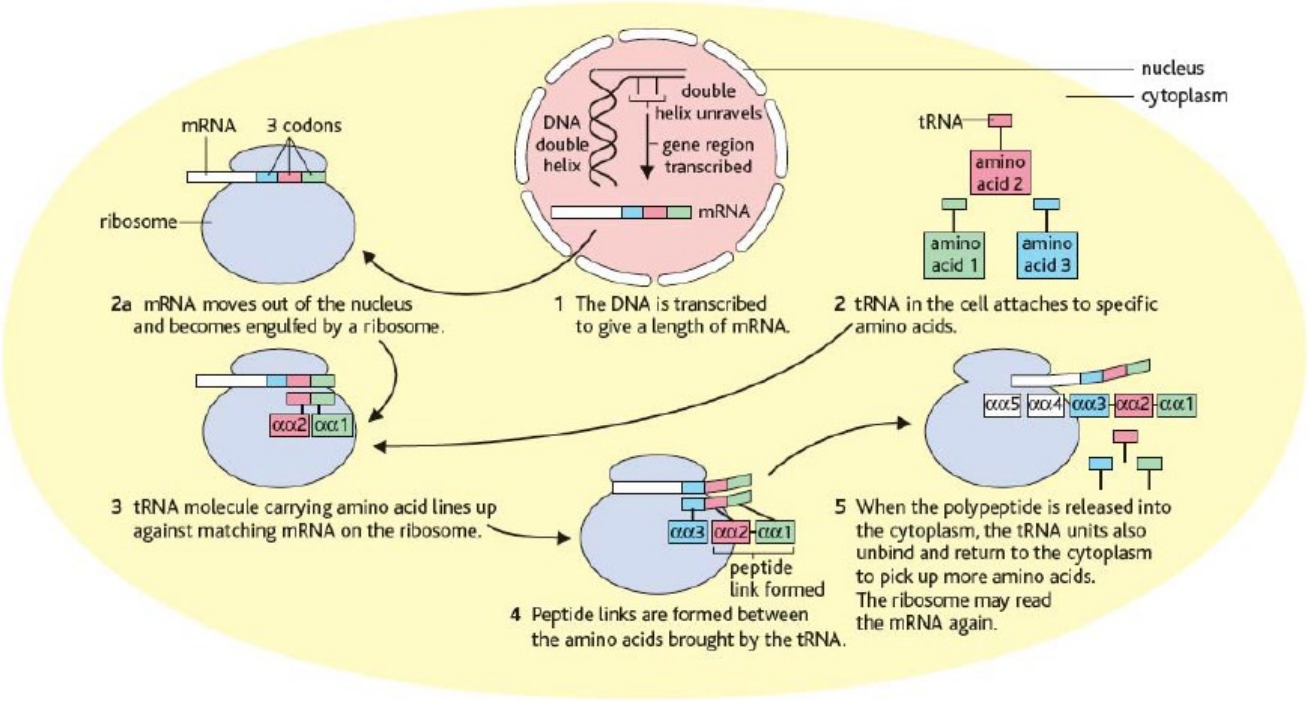
Explain the effect on the red blood cell of being placed in a solution of distilled water.

7 Explain the key word 'isotonic'.

Summary sheet 1: Protein synthesis

A gene is a sequence of DNA which codes for a protein. Proteins are synthesised in a two-step process – transcription and translation.

Transcription takes place in the nucleus and translation takes place at the ribosome. A complementary mRNA strand is made using the DNA as a template. The mRNA leaves the nucleus and attaches to the ribosome in the cytoplasm. A triplet of bases on the mRNA (a codon) code for specific amino acids. The amino acids are delivered to the ribosome by tRNA. Peptide bonds are formed between the amino acids to make the polypeptide.



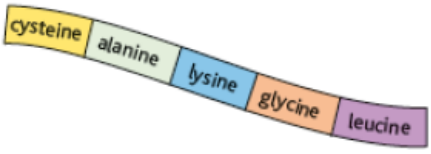
The DNA gene sequence is ACA CGG AAA CCT GAC.

The mRNA sequence is UGU GCC UUU GGA CUG.

This codes for the amino acid sequence is:

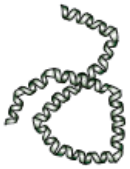
Cys-Ala-Lys-Gly-Leu

The protein folds into a specific structure.
For enzymes this means that the active site forms a specific shape that binds specific substrates.

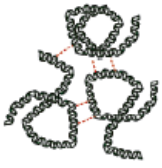


Primary structure – the linear sequence of amino acids in a peptide

Secondary structure – the repeating pattern in the structure of the peptide chains, such as an α-helix or pleated sheets.



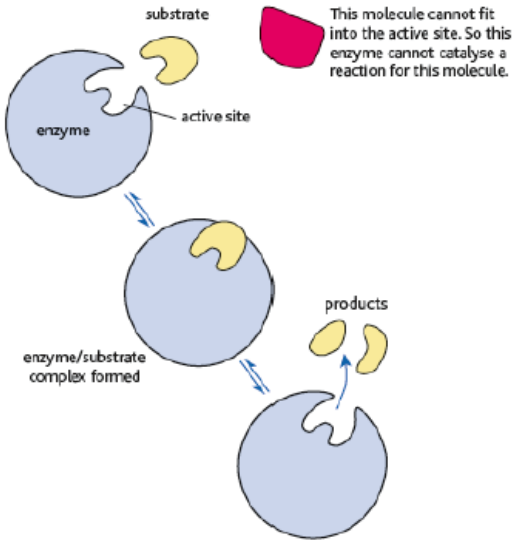
Tertiary structure – the three-dimensional folding of the secondary structure.



Quaternary structure – the three-dimensional arrangement of more than one tertiary polypeptide.

Summary sheet 2: Enzymes activity

Enzymes are biological catalysts that speed up chemical reactions. Enzymes work by reducing the amount of activation energy needed for the reaction to occur.

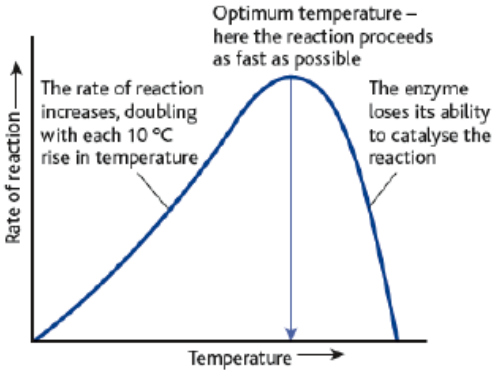


The active site of the enzyme is where the substrate binds. It has a specific shape which means enzymes can only bind to a specific substrate.

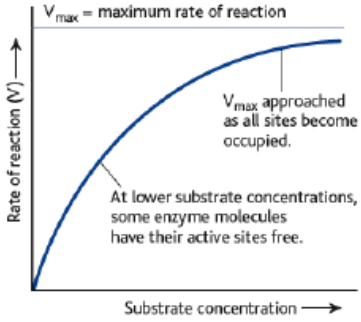
The substrate binds to the active site forming an enzyme-substrate complex. The reaction is catalysed and the products released.

Different factors can affect how quickly the enzymes work. These include temperature, pH, enzyme concentration and substrate concentration.

As temperature increases there is more chance of a collision between the enzyme and substrates, as they have more kinetic energy. This continues until the optimum temperature where the rate of reaction is highest. As the temperature continues to rise the enzyme denatures, as the active site changes shape, when bonds holding the protein together break.



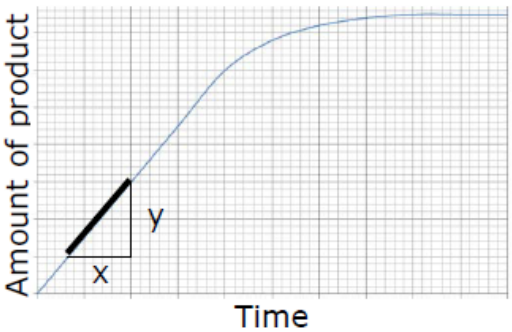
Enzymes also have an optimum pH, above and below the optimum pH the enzyme denatures.



As the substrate concentration increases there is more chance of a collision between the substrate and the enzyme. The rate of reaction increases until all the actives sites are occupied.

The rate of reaction increases as enzyme concentration increases until all the substrate is bound to an enzyme.

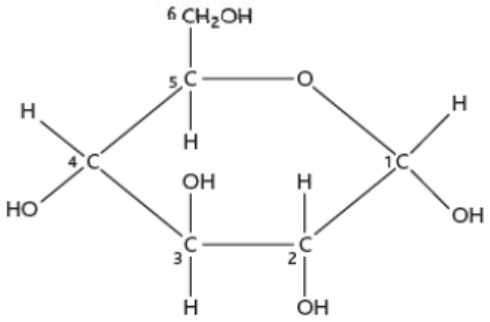
In practical situations you can sometimes measure the amount of product formed over time. The initial rate of the reaction for an enzyme can be calculated by measuring the gradient of the graph. If the line is curved a tangent to the curve can be used : gradient = y ÷ x.



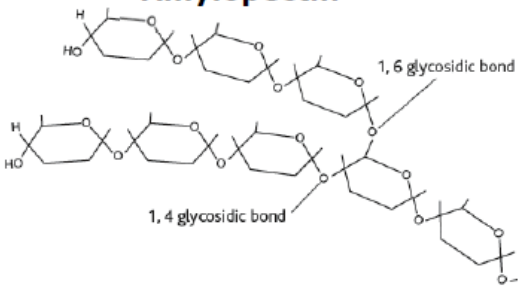
Worksheet 1: Carbohydrates

The diagram shows the chemical structures of some monosaccharides, disaccharides and polysaccharides. Giving a reason, separate the molecules into these three groups.

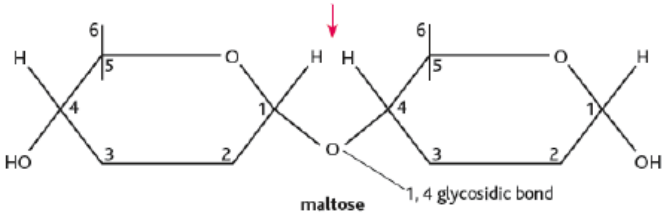
Glucose



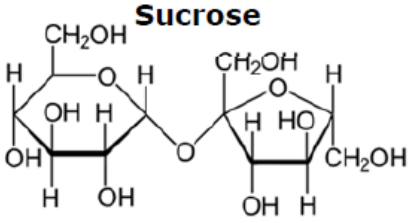
Amylopectin



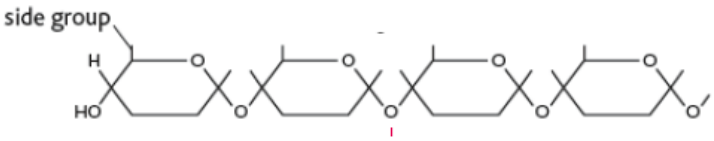
Maltose



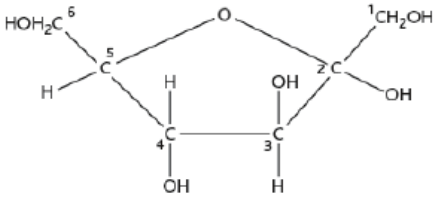
Sucrose



Amylose



Fructose



Worksheet 2: Data analysis

Processed data should be recorded to the same number of decimal places as the primary data

This table shows the same data recorded to different numbers of decimal places.

Data set 1	Data set 2
2.4	2.37
3.6	3.55
4.1	4.05
2.8	2.76
3.5	3.51

1 Compare the mean values for data set 1 and data set 2.

2 Express data set 2 to 1 decimal place. What do you notice?

3 Explain why it is incorrect to record 3.28 as the mean for data set 1.

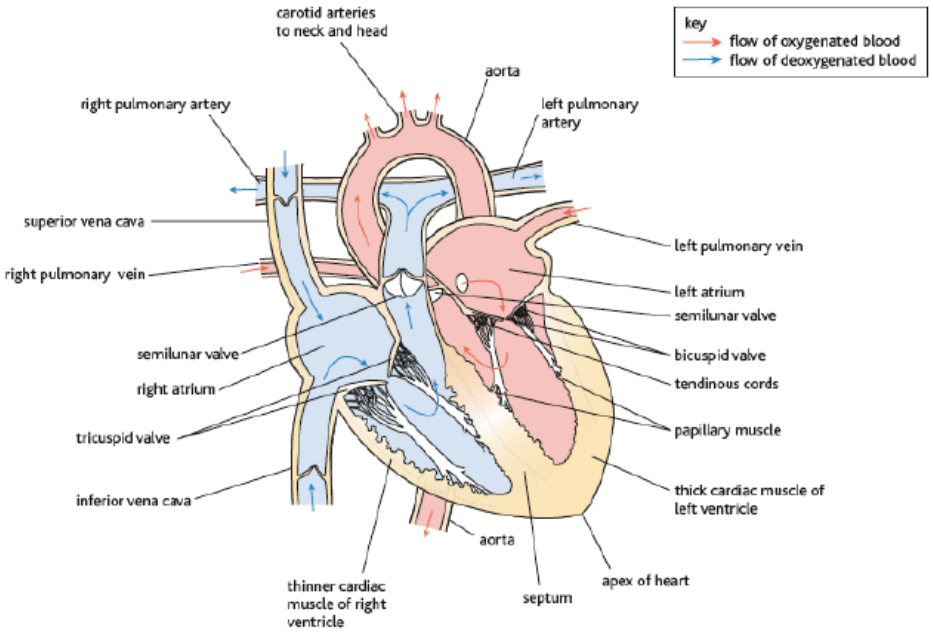
Being able to convert data, using standard form and different units, is an important skill

4 Convert the data in the table below.

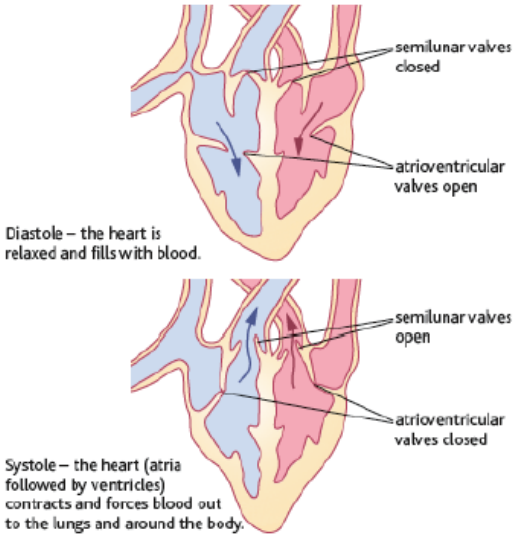
Data		Value
45 100 g	into standard form	
45 100 g	into kilograms	
34 ms	into seconds	
780 μm	into millimetres	
0.25×10^{-9} s	into nanoseconds	

Summary sheet 1: Heart and lungs

The left side of the heart pumps oxygenated blood from the lungs around the body. The blood enters the left atrium from the pulmonary vein. It flows through the atrioventicular or bicuspid valve to the left ventricle. The blood is then pumped into the aorta, through a semi-lunar valve, and around the body.



The right side of the heart pumps deoxygenated blood from the body back to the lungs. The blood returns from the body to the right atrium via the vena cava. It flows through the atrioventicular or tricuspid valve to the right ventricle. The blood is then pumped into the pulmonary artery, through a semi-lunar valve, and to the lungs.

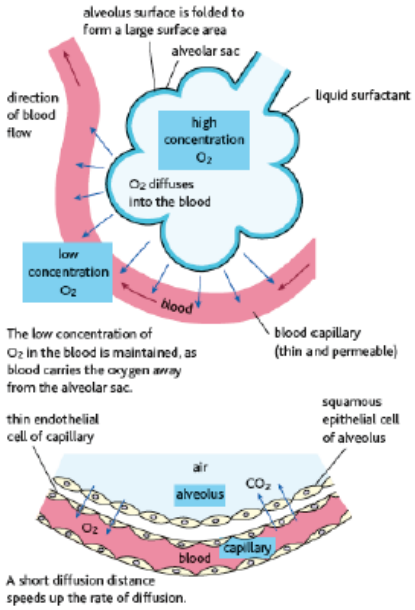


The atrioventricular valves between the atrium and ventricles open to allow blood to flow from the atrium into the ventricles and close when the pressure in the ventricles rises to prevent back flow.

The semi-lunar valves in the aorta and pulmonary artery open to allow blood from the ventricles to flow into the arteries. They close to prevent backflow into the ventricles as the heart relaxes.

Oxygen enters the blood in the alveoli of the lungs. Oxygen in the alveolus is at a high concentration and it diffuses down the concentration gradient into the blood which has a low concentration of oxygen. This low concentration is maintained because the blood is moving and carries the oxygen away.

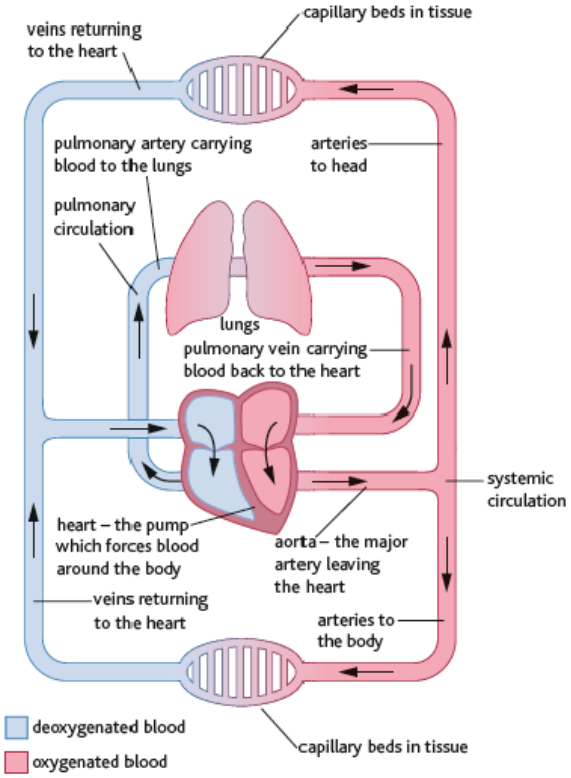
The walls of the alveolus and capillaries are only one cell thick. This creates a short diffusion distance between the alveolus and the blood allowing a high rate of diffusion.



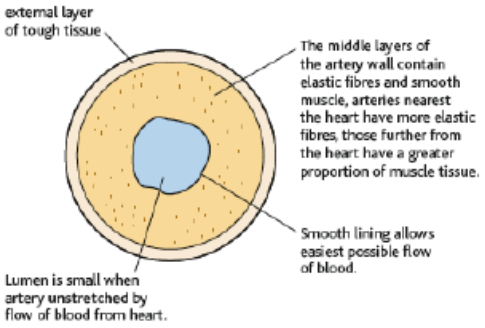
Summary sheet 2: Circulatory system

Blood flows around the body via a network of arteries, veins and capillaries.

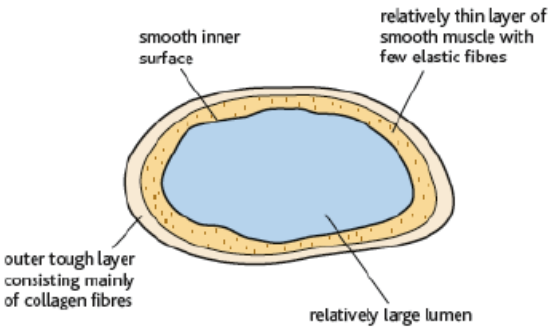
The double circulation system of mammals means that blood flows through the heart twice in one complete cycle of the body.



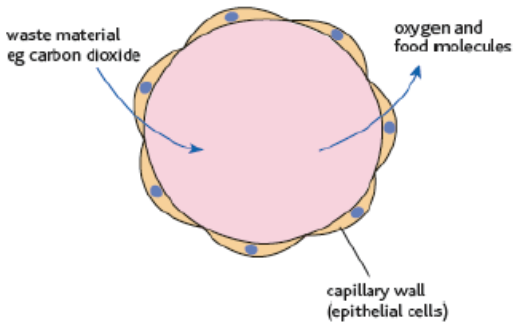
The pulmonary system pumps blood around the lungs and the systemic system pumps blood around the rest of the body.



Arteries carry blood away from the heart. The vessel walls are thick and muscular with elastic fibres to withstand the high pressure generated by the heart.



Veins carry blood from capillary beds back to the heart. The blood is at low pressure and the walls of the vessels are relatively thin with less elastic fibre. The contraction of muscles help push the blood though veins and the vessels have valves to prevent backflow.



Capillaries are thin vessels that form capillary networks around tissues. They allow the exchange of substances such as oxygen, glucose and waste materials between cells and the blood.

Worksheet 1: Prefixes

Scientific terms use common prefixes. Find out the definition/meaning of the prefixes shown in the table.

Word/prefix	Definition/meaning
endo	
exo	
pulmonary	
cardiac	
hepatic	
mono	
di	
photo	
haem	
bio	
chemo	

Worksheet 2: Keywords

Candidates frequently lose marks in examinations because they do not use sufficient key words in detailed responses.

Read the responses to the questions below. Using the keywords from the box write improved answers to the questions.

concentration		capillaries		vein			
	diffusion		thin		semi-lunar		
right		pulmonary		valve			
	gradient		atrioventricular		left		
aorta		vena cava		artery			
	thick		osmosis				

1 Explain how oxygen enters the blood at the alveoli.

In the alveolus oxygen from the air moves into the blood vessels through the walls of the alveolus. The blood is moving so there is always a low concentration in the blood.

2 Describe the route blood takes from the lungs to the body.

Blood from the lungs blood travels through a vein to the atrium. The blood is pumped from the atrium into the ventricle and then into the aorta.

Practice questions

1 **a** Write a definition for each key word in the box. If possible give a structural feature for each key word.

atria	ventricles	aorta	vena cava	pulmonary artery
pulmonary vein	atrioventricular valves	septum		
semi-lunar valves	diastole	systole		

atria:

ventricles:

aorta:

vena cava:

pulmonary artery:

pulmonary vein:

atrioventricular valves:

septum:

semi-lunar valves:

diastole:

systole: