BIOLOGY

TRANSITION RESOURCES

EXAM BOARD: AQA

The Coleshill School 6th Form

A-Level Biology Transition Booklet

So you have chosen to study A level Biology?

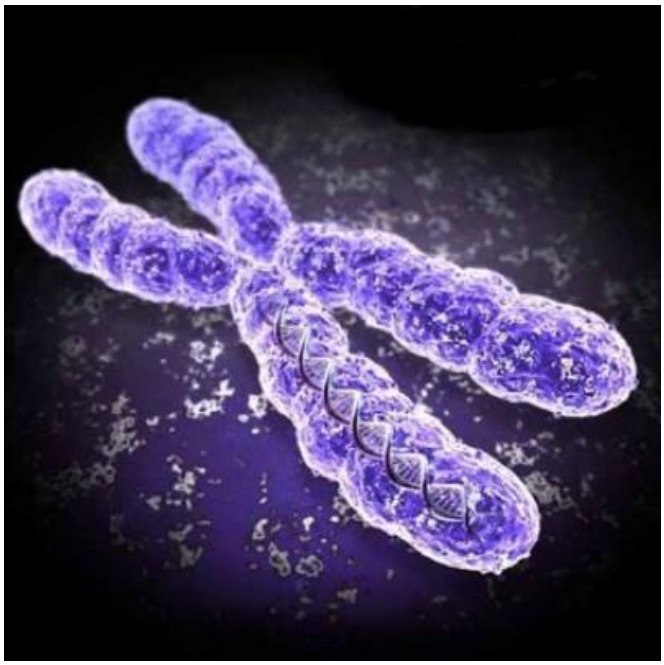
Biology is the study of living things, but not just animals and plants. You'll also learn about the molecules that make living things work, the cells that they're made from, the systems within plants and animals, and the interconnections between organisms.

Biology is different from physics and chemistry, in that living things don't always do what you expect them to do. You can't test one organism and assume all the rest will be the same, so you'll learn about the statistical analysis behind making claims.

At first, you may find the jump in demand from GCSE a little daunting, but if you follow the tips and advice in this guide, you'll soon adapt.

We recommend you keep this information somewhere safe, as you may like to refer to the information in it throughout your studies.

It is to be used after you complete your GCSE throughout the remainder of the Summer term and over the Summer Holidays.



What will you learn about?

At The Coleshill School, we teach AQA Biology. The topics you will learn about are shown in the tables below. Topics are broken down into 8 units.
You can use these tables as a guide, however you will need to become accustomed to using the specification for your course. This gives you more detailed information about what you need to learn and could be tested on. Although it is our job to teach you, we believe you should take a responsibility for ensuring you are aware of what you need to know. In our experience, the students that are most aware of the course content get the best grades.

Year 1			
Unit 1	Unit 2	Unit 3	Unit 4
Biological Molecules	**Cells**	**Organisms exchange substances with their environment**	**Genetic information, variation and relationships between organisms**
• Biological molecules • Nucleic Acids	• Cell structure • Transport across membranes • Cell recognition and the immune system	• Exchange • Mass transport	• DNA, genes and protein synthesis • Genetic diversity and adaptation • Biodiversity
Year 2			
Unit 5	Unit 6	Unit 7	Unit 8
Energy transfers in and between organisms	**Organisms respond to changes in their internal and external environments**	**Genetics, populations, evolution and ecosystems**	**Control of gene expression**
• Photosynthesis • Respiration • Energy and ecosystems	• Survival and response • Nervous Coordination • Skeletal muscle • Homeostasis	• Inherited change • Populations and evolution • Populations in ecosystems	• Gene expression • Recombinant DNA technology

How will you be assessed?

AQA A level Biology is assessed at the end of Year 13 with three exams.
See below for details of which topics are on each exam, and some more detail about the structure of these exams.

Paper 1	+	Paper 2	+	Paper 3
What's assessed • Any content from topics 1–4, including relevant practical skills		What's assessed • Any content from topics 5–8, including relevant practical skills		What's assessed • Any content from topics 1–8, including relevant practical skills
Assessed • written exam: 2 hours • 91 marks • 35% of A-level		Assessed • written exam: 2 hours • 91 marks • 35% of A-level		Assessed • written exam: 2 hours • 78 marks • 30% of A-level
Questions • 76 marks: a mixture of short and long answer questions • 15 marks: extended response questions		Questions • 76 marks: a mixture of short and long answer questions • 15 marks: comprehension question		Questions • 38 marks: structured questions, including practical techniques • 15 marks: critical analysis of given experimental data • 25 marks: one essay from a choice of two titles

Things to do before September

To maximise your learning you will need to have the following before you arrive in September and begin you're A-level course.

Things you need to have:

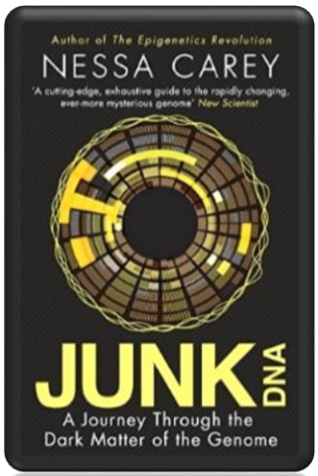
- a ring-binder folder
- a pad of paper or workbook in your folder
- a highlighter
- red and green pen
- pencil
- ruler
- Calculator

Things you need to do:

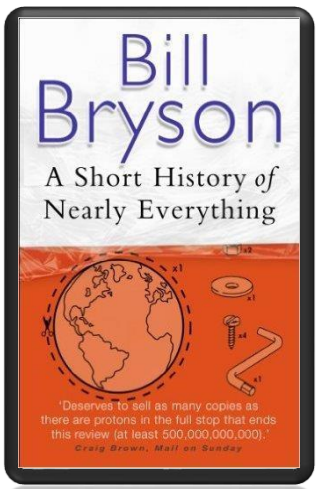
- create folder dividers for the 4 units you will study in year 1.
- complete the transition booklets.
- completed self-reflection of current knowledge.

Reading Around the Subject

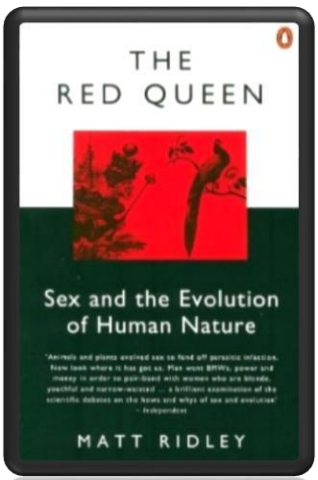
It is important that you regularly read around the subject. This will help you become more familiar with the language of Biology, understand concepts, and make links between different areas of the course. Below is a list of books that Biology teachers at Coleshill have read and recommended to past students, and most of the books are available on Audible if you prefer to listen. Kick back this summer with a good read. The books below are all popular science books and great for extending your understanding of Biology.



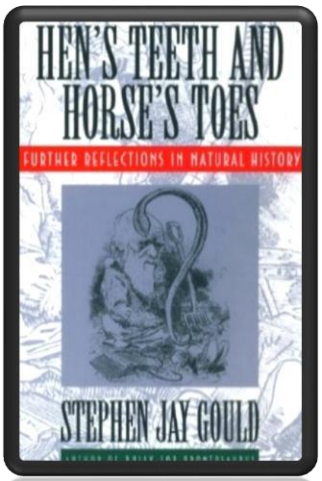
Junk DNA
Our DNA is so much more complex than you probably realize, this book will really deepen your understanding of all the work you will do on Genetics



A Short History of Nearly Everything
A whistle-stop tour through many aspects of history from the Big Bang to now. This is a really accessible read that will re-familiarise you with common concepts and introduce you to some of the more colourful characters from the history of science!

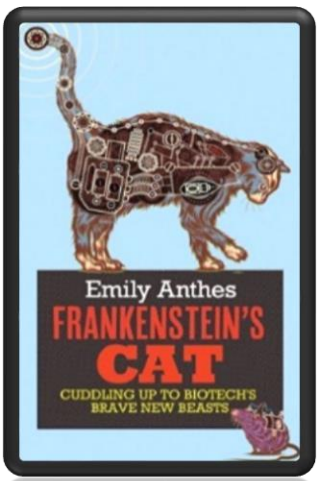


The Red Queen
Its all about sex. Or sexual selection at least. This book will really help your understanding of evolution and particularly the fascinating role of sex in evolution.



Studying Geography as well?
Hen's teeth and horses toes

Stephen Jay Gould is a great Evolution writer and this book discusses lots of fascinating stories about



An easy read..
Frankenstein's cat
Discover how glow in the dark fish are made and more great Biotechnology breakthroughs.

In case nothing on the previous list took your fancy, here are some more books to keep you going over the next two years.

1. *The Incredible Unlikeliness of Being*, Alice Roberts. Alice Roberts combines embryology, genetics, anatomy, evolution and zoology to tell the incredible story of the human body
2. *The Epigenetics Revolution*, Nessa Carey. A fascinating introduction to epigenetics. If you enjoy this, follow up with *Seed to Seed* (see below).
3. *The Immortal Life of Henrietta Lacks*, Rebecca Skloot. How one woman's cancer cells changed the medical world forever, and because a multi-million dollar industry.
4. *Bad Science*, Ben Goldacre. Looking objectively at popular science reporting.
5. *The Botany of Desire*, Michael Pollan. A very different approach to science writing, Michael Pollan turns our normal perspective on its head to consider how plants manipulate humans.
6. *Almost Like A Whale*, Steve Jones. Using contemporary science to update Charles Darwin's "The Origin of the Species".
7. *Blood Work: A Tale of Medicine and Murder in the Scientific Revolution*, Holly Tucker. The dramatic history of blood transfusions, from 17th century France onwards.
8. *Seed to Seed*, Nicholas Harberd. A research scientist tells the story of ten years of discovery in his own laboratory. A very valuable insight into contemporary genetics and epigenetics research, and what it means to be a scientist.
9. *Calculus Diaries*, Jennifer Ouellette. A non-mathematician finds out how maths can help you tackle anything – even a zombie apocalypse.
10. *Life Ascending*, Nick Lane. Where does DNA come from? How did the eye evolve? A reconstruction of evolutionary history through ten of its greatest landmarks.
11. *Genome*, Matt Ridley. 23 human chromosomes in 23 chapters.
12. *The Energy of Life*, Guy Brown. Introduction to the cutting-edge science of Bioenergetics
13. *Behave,* Robert M Sapolsky. The Biology of Humans at Our Best and Worst
14. *Sapiens,* Yuval Noah Harari. A Brief History of Humankind
15. *Guns, Germs* & *Steel*, Jared Diamond. The Fates of Human Societies

Prefer to Read Online?

Some students prefer to use websites than reading books. There are a lot of useful websites with amazing biological content, and we appreciate this can be a little bit overwhelming. Try starting with the websites below and then let us know if you find others you have found to be helpful. Some of them require you to pay for a subscription so make sure you are going to use them before spending money!

Magazines and Articles:

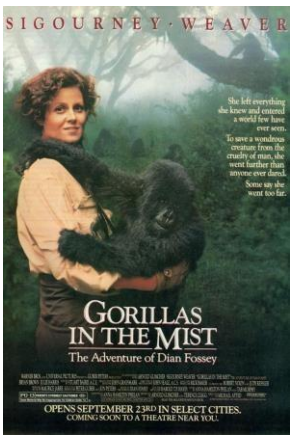
1. Biological Sciences Review:
   Written specifically for students of A level Biology to first year Biological Sciences undergraduates. It is very readable and bridges the gap between text books and scientific journals.
2. Big Picture:
   This is a free magazine produced by the Wellcome Trust. It is written for post 16 Biology students and explores the innovations and implications of cutting edge biomedical science.
3. New Scientist:
   This is a weekly science magazine that keeps you up to date with what's new in science.
4. Nature:
   This is an international weekly journal of science.
5. The Naked Scientists:
   Articles about biology, genetics, ecology and evolution, insects, mammals, marine science, plants and zoology.

Other Useful Web Resources:

1. Cells Alive:
   Animations, images and interactives about cell biology.
2. DNA Interactive:
   Video footage and animations on DNA replication and expression.
3. Learn.Genetics:
   Animations and interactives on genetics, biosciences and health.

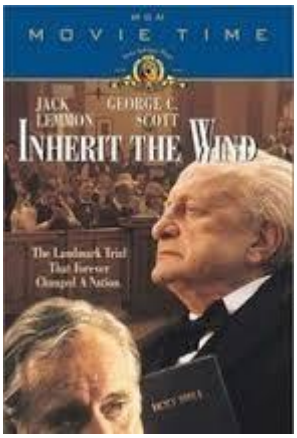
Movie Recommendations

Everyone loves a good story and everyone loves some great science. Here are some of the picks of the best films based on real life scientists and discoveries. You won't find Jurassic Park on this list, we've looked back over the last 50 years to give you our top 5 films you might not have seen before. Great watching for a rainy day.



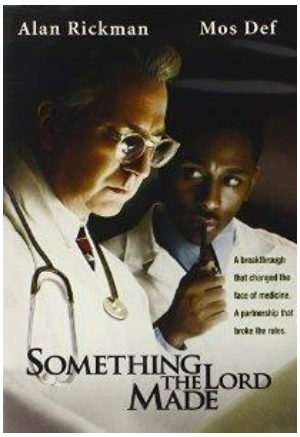
Gorillas in the Mist (1988)
An absolute classic that retells the true story of the life and work of Dian Fossey and her work studying and protecting mountain gorillas from poachers and habitat loss. A tear jerker.

Inherit The Wind (1960)
Great if you can find it. Based on a real life trial of a teacher accused of the crime of teaching Darwinian evolution in school in America. Does the debate rumble on today?



Andromeda Strain (1971)
Science fiction by the great thriller writer Michael Cricthon (he of Jurassic Park fame). Humans begin dying when an alien microbe arrives on Earth.

Lorenzo's Oil (1992)
Based on a true story. A young child suffers from an autoimmune disease. The parents research and challenge doctors to develop a new cure for his disease.



Something the Lord Made (2004)
Professor Snape (the late great Alan Rickman) in a very different role. The film tells the story of the scientists at the cutting edge of early heart surgery as well as issues surrounding racism at the time.

There are some great TV series and box sets available too, you might want to check out: Blue Planet, Planet Earth, The Ascent of Man, Catastrophe, Frozen Planet, Life Story, The Hunt and Monsoon.

If you have 30 minutes to spare, here are some great presentations (and free!) from world leading scientists and researchers on a variety of topics. They provide some interesting answers and ask some thought-provoking questions. Use the link or scan the QR code to view:

A New Superweapon in the Fight Against Cancer
Available at :
http://www.ted.com/talks/paula_hammond_a_new_superweapon_in_the_fight_against_cancer?language=en
Cancer is a very clever, adaptable disease. To defeat it, says medical researcher and educator Paula Hammond, we need a new and powerful mode of attack.

Why Bees are Disappearing
Available at :
http://www.ted.com/talks/marla_spivak_why_bees_are_disappearing?language=en
Honeybees have thrived for 50 million years, each colony 40 to 50,000 individuals coordinated in amazing harmony. So why, seven years ago, did colonies start dying en-masse?

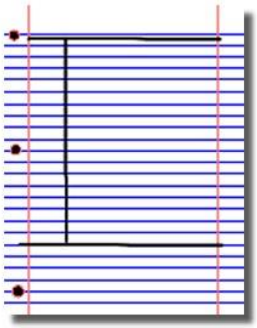
Why Doctors Don't Know About the Drugs They Prescribe
Available at :
http://www.ted.com/talks/ben_goldacre_what_doctors_don_t_know_about_the_drugs_they_prescribe?language=en
When a new drug gets tested, the results of the trials should be published for the rest of the medical world — except much of the time, negative or inconclusive findings go unreported, leaving doctors and researchers in the dark.

Growing New Organs
Available at :
http://www.ted.com/talks/anthony_atala_growing_organs_engineering_tissue?language=en
Anthony Atalla's state-of-the-art lab grows human organs — from muscles to blood vessels to bladders, and more.

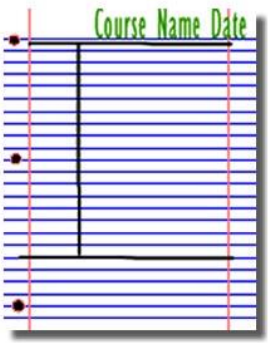
Research Activities

Research, reading and note making are essential skills for A level Biology study. For the following task you are going to produce 'Cornell Notes' to summarise your reading.

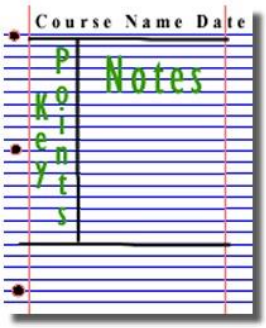
1. Divide your page into three sections like this:



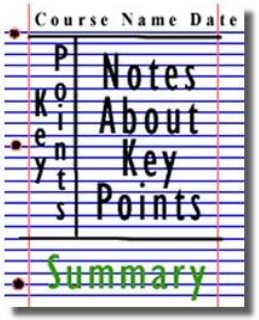
2. Write the name, date and topic at the top of the page



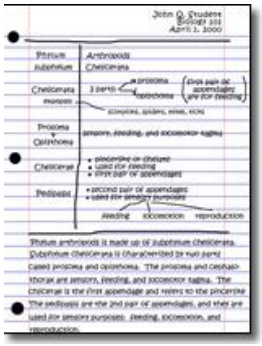
3. Use the large box to make notes. Leave a space between separate ideas



4. Review your notes and identify the key points on the left hand side



5. Write a summary of the main ideas in the bottom space

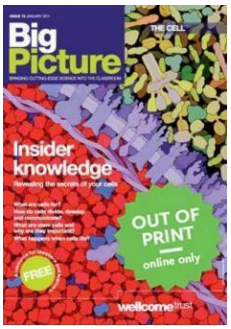


The Big Picture is an excellent publication from the Wellcome Trust. Along with the magazine, the company produces posters, videos and other resources aimed at students studying for GCSEs and A Level.

For each of the following topics, you are going to use the resources to produce one page of Cornell style notes.

Use the links or scan the QR code to take you to the resources.

Topic 1: The Cell
Available at: http://bigpictureeducation.com/cell
The cell is the building block of life. Each of us starts from a single cell, a zygote, and grows into a complex organism made of trillions of cells. In this issue, we explore what we know – and what we don't yet know – about the cells that are the basis of us all and how they reproduce, grow, move, communicate and die.



Topic 2: The Immune System
Available at:
http://bigpictureeducation.com/immune
The immune system is what keeps us healthy in spite of the many organisms and substances that can do us harm. In this issue, explore how our bodies are designed to prevent potentially harmful objects from getting inside, and what happens when bacteria, viruses, fungi or other foreign organisms or substances breach these barriers.

Topic 3: Exercise, Energy and Movement
Available at:
http://bigpictureeducation.com/exercise-energy-and-movement
All living things move. Whether it's a plant growing towards the sun, bacteria swimming away from a toxin or you walking home, anything alive must move to survive. For humans though, movement is more than just survival – we move for fun, to compete and to be healthy. In this issue we look at the biological systems that keep us moving and consider some of the psychological, social and ethical aspects of exercise and sport.

Topic 4: Populations Available at: http://bigpictureeducation.com/populations What's the first thing that pops into your mind when you read the word population? Most likely it's the ever-increasing human population on earth. You're a member of that population, which is the term for all the members of a single species living together in the same location. The term population isn't just used to describe humans; it includes other animals, plants and microbes too. In this issue, we learn more about how populations grow, change and move, and why understanding them is so important.

Topic 4: Populations
Available at: http://bigpictureeducation.com/health-and-climate-change
The Earth's climate is changing. In fact, it has always been changing. What is different now is the speed of change and the main cause of change – human activities. This issue asks: What are the biggest threats to human health? Who will suffer as the climate changes? What can be done to minimise harm? And how do we cope with uncertainty?

Pre-Knowledge Topics

A level Biology will use your knowledge from GCSE and build on this to help you understand new and more demanding ideas. Due to COVID, there are some topics from GCSE you have missed. Complete the following tasks to make sure your knowledge is up to date and you are ready to start studying:

DNA and the Genetic Code

In living organisms nucleic acids (DNA and RNA have important roles and functions related to their properties. The sequence of bases in the DNA molecule determines the structure of proteins, including enzymes.

The double helix and its four bases store the information that is passed from generation to generation. The sequence of the base pairs adenine, thymine, cytosine and guanine tell ribosomes in the cytoplasm how to construct amino acids into polypeptides and produce every characteristic we see. DNA can mutate leading to diseases including cancer and sometimes anomalies in the genetic code are passed from parents to babies in disease such as cystic fibrosis, or can be developed in unborn foetuses such as Downs Syndrome.

Read the information on these websites (you could make more Cornell notes if you wish):
http://www.bbc.co.uk/education/guides/z36mmp3/revision http://www.s-cool.co.uk/a-level/biology/dna-and-genetic-code

And take a look at these videos: http://ed.ted.com/lessons/the-twisting-tale-of-dna-judith-hauck
http://ed.ted.com/lessons/where-do-genes-come-from-carl-zimmer

Task:

Produce a wall display to put up in your classroom in September. You might make a poster or do this using PowerPoint or similar Your display should use images, keywords and simple explanations to:

Define gene, chromosome, DNA and base pair

Describe the structure and function of DNA and RNA Explain how DNA is copied in the body

Outline some of the problems that occur with DNA replication and what the consequences of this might be.

Evolution

Transfer of genetic information from one generation to the next can ensure continuity of species or lead to variation within a species and possible formation of new species. Reproductive isolation can lead to accumulation of different genetic information in populations potentially leading to formation of new species (speciation). Sequencing projects have read the genomes of organisms ranging from microbes and plants to humans. This allows the sequences of the proteins that derive from the genetic code to be predicted. Gene technologies allow study and alteration of gene function in order to better understand organism function and to design new industrial and medical processes. Read the information on these websites (you could make more Cornell notes if you wish): http://www.bbc.co.uk/education/guides/z237hyc/revision/4 http://www.s-cool.co.uk/a-level/biology/evolution

And take a look at these videos:
http://ed.ted.com/lessons/how-to-sequence-the-human-genome-mark-j-kiel http://ed.ted.com/lessons/the-race-to-sequence-the-human-genome-tien-nguyen

Task:

Produce a one page revision guide for an AS Biology student that recaps the key words and concepts in this topic. Your revision guide should:

Describe speciation

Explain what a genome is

Give examples of how this information has already been used to develop new treatments and technologies.

Biodiversity

The variety of life, both past and present, is extensive, but the biochemical basis of life is similar for all living things. Biodiversity refers to the variety and complexity of life and may be considered at different levels. Biodiversity can be measured, for example within a habitat or at the genetic level. Classification is a means of organising the variety of life based on relationships between organisms and is built around the concept of species. Originally classification systems were based on observable features but more recent approaches draw on a wider range of evidence to clarify relationships between organisms. Adaptations of organisms to their environments can be behavioural, physiological and anatomical. Adaptation and selection are major factors in evolution and make a significant contribution to the diversity of living organisms.

Read the information on these websites (you could make more Cornell notes if you wish): http://www.s-cool.co.uk/a-level/biology/ecological-concepts http://www.s-cool.co.uk/a-level/biology/classification

And take a look at these videos:
http://ed.ted.com/lessons/why-is-biodiversity-so-important-kim-preshoff http://ed.ted.com/lessons/can-wildlife-adapt-to-climate-change-erin-eastwood

Task:

Write a persuasive letter to an MP, organisation or pressure group promoting conservation to maintain biodiversity. Your letter should:

Define what is meant by species and classification
Describe how species are classified
Explain one way scientists can collect data about a habitat, giving an example
Explain adaptation and how habitat change may pose a threat to niche species

Ecosystems

Ecosystems range in size from the very large to the very small. Biomass transfers through ecosystems and the efficiency of transfer through different trophic levels can be measured. Microorganisms play a key role in recycling chemical elements. Ecosystems are dynamic systems, usually moving from colonisation to climax communities in a process known as succession. The dynamic equilibrium of populations is affected by a range of factors. Humans are part of the ecological balance and their activities affect it both directly and indirectly. Effective management of the conflict between human needs and conservation help to maintain sustainability of resources.

Read the information on these websites (you could make more Cornell notes if you wish):
http://www.bbc.co.uk/education/guides/z7vqtfr/revision http://www.s-cool.co.uk/a-level/biology/ecological-concepts

And take a look at these videos:
https://www.youtube.com/watch?v=jZKIHe2LDP8
https://www.youtube.com/watch?v=E8dkWQVFAoA

Task:

Produce a newspaper or magazine article about one ecosystem (e.g. the arctic, the Sahara, the rainforest, or something closer to home like your local woodland, nature reserve or shore line). Your article should include:

Key words and definitions
Pictures or diagrams of your chosen ecosystem.
A description of the changes that have occurred in this ecosystem
An explanation of the threats and future changes that may further alter this ecosystem.

Scientific and Investigative Skills

As part of your A level you will complete a practical assessment. This will require you to carry out a series of practical activities as well as planning how to do them, analysing the results and evaluating the methods. This will require you to: use appropriate apparatus to record a range of quantitative measurements (to include mass, time, volume, temperature, length and pH), use appropriate instrumentation to record quantitative measurements, such as a colorimeter or photometer, use laboratory glassware apparatus for a variety of experimental techniques to include serial dilutions, use of light microscope at high power and low power, including use of a graticule, produce scientific drawing from observation with annotations, use qualitative reagents to identify biological molecules, separate biological compounds using thin layer/paper chromatography or electrophoresis, safely and ethically use organisms, use microbiological aseptic techniques, including the use of agar plates and broth, safely use instruments for dissection of an animal organ, or plant organ, use sampling techniques in fieldwork.

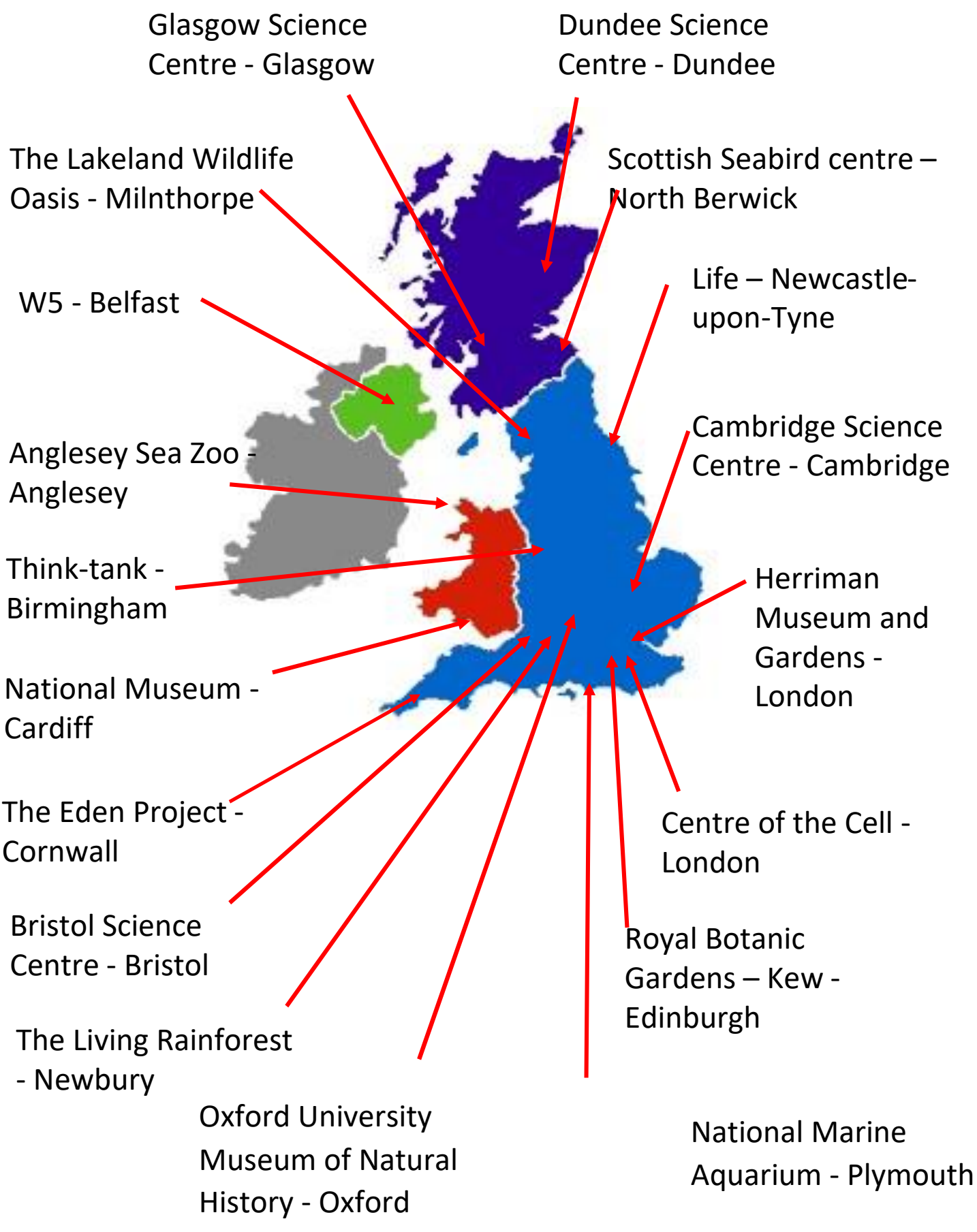
Task:

Produce a glossary for the following key words:

accuracy, anomaly, calibration, causal link, chance, confounding variable, control experiment, control group, control variable, correlation, dependent variable, errors, evidence, fair test, hypothesis, independent, null hypothesis, precision, probability, protocol, random distribution, random error, raw data, reliability, systematic error, true value, validity, zero error,

Ideas for Day Trips

If you are on holiday in the UK, or on a staycation at home, why not plan a day trip to one of these :



Remember there are also lots of zoos, wildlife and safari parks across the country, here are some you may not have heard of or considered:
Colchester Zoo, Cotswold Wildlife Park, Banham Zoo (Norfolk), Tropical Birdland (Leicestershire), Yorkshire Wildlife Park, Peak Wildlife Park, International Centre for Birds of Prey (York), Blackpool Zoo, Beale Park (Reading)

There are also hundreds of nature reserves (some of which are free) located all over the country including: RSPB sites at Lochwinnoch, Saltholme, Fairburn Ings, Old Moor, Conwy, Minsmere, Rainham Marshes, Pulborough Brooks, Radipole Lake, Newport Wetlands.

Wildlife Trust Reserves and others at Rutland Water, Pensthorpe, Insh Marshes, Attenborough Centre, Inversnaid, Skomer, Loch Garten, Donna Nook, Chapmans Well, Woodwalton Fen, London Wetland Centre, Martin Down and Woolston Eyes Reserve.

Many organisations also have opportunities for people to volunteer over the summer months, this might include working in a shop/café/visitor centre, helping with site maintenance or taking part in biological surveys. Not only is this great experience, it looks great on a job or UCAS application.

For opportunities keep an eye out in your local press, on social media, or look at the websites of organisations like the RSPB, Wildlife Trust, National Trust or Wildlife & Wetland Trust.
There are also probably lots of smaller organisations near you who would also appreciate any support you can give

Science on Social Media

Science communication is essential in the modern world and all the big scientific companies, researchers and institutions have their own social media accounts. Here are some of our top tips to keep up to date with developing news or interesting stories:

Follow on Twitter:
Commander Chris Hadfield – former resident aboard the International Space Station
@cmdrhadfield

Tiktaalik roseae – a 375 million year old fossil fish with its own Twitter account!
@tiktaalikroseae

NASA's Voyager 2 – a satellite launched nearly 40 years ago that is now travelling beyond our Solar System
@NSFVoyager2

Neil dGrasse Tyson – Director of the Hayden Planetarium in New York
@neiltyson

Sci Curious – feed from writer and Bethany Brookshire tweeting about good, bad and weird neuroscience @scicurious

The SETI Institute – The Search for Extra Terrestrial Intelligence, be the first to know what they find!
@setiinstitute

Carl Zimmer – Science writer Carl blogs about the life sciences
@carlzimmer

Phil Plait – tweets about astronomy and bad science
@badastronomer

Virginia Hughes – science journalist and blogger for National Geographic, keep up to date with neuroscience, genetics and behaviour @virginiahughes

Maryn McKenna – science journalist who writes about antibiotic resistance
@marynmck

Find on Facebook:
Nature - the profile page for nature.com for news, features, research and events from Nature Publishing Group

Marin Conservation Institute – publishes the latest science to identify important marine ecosystems around the world.

National Geographic - since 1888, National Geographic has travelled the Earth, sharing its amazing stories in pictures and words.

Science News Magazine - Science covers important and emerging research in all fields of science.

BBC Science News - The latest BBC Science and Environment News: breaking news, analysis and debate on science and nature around the world.

Science Websites

These websites all offer an amazing collection of resources that you should use again and again throughout your course.

Probably the best website on Biology… Learn Genetics from Utah University. There is so much that is interactive to explore everything from why the Giant Pangolin is the only mammal with scales, only some people can taste bitter to how we clone mice or make glow in the dark jellyfish.

http://learn.genetics.utah.edu

ZSL
LIVING CONSERVATION

In the summer you will most likely start to learn about Biodiversity and Evolution.

Many Zoos have great websites, especially London, pitched at an appropriate level. Read about some of the case studies on conservation.

https://www.zsl.org/conservation

At GCSE you learnt how genetic diseases are inherited. In this virtual fly lab you get to breed fruit flies to investigate how different features are passed on.

http://sciencecourseware.org/vcise/drosophila/

DNA from the beginning is full of interactive animations that tell the story of DNA from its discovery through to advanced year 13 concepts. One to book mark! http://www.dnaftb.org/

Ok, so not a website, but a video you definitely want to watch. One of the first topics you will learn about is the amazing structure of the cell. This BBC film shows the fascinating workings of a cell… a touch more detailed than the "fried egg" model you might have seen. http://www.dailymotion.com/video/xz h0kb_the-hidden-life-of-thecell_shortfilms If this link expires – google "BBC hidden life of the cell"

Science Things to do

Want to stand above the rest when it comes to UCAS? Now is the time to act! MOOCs are online courses run by nearly all Universities. They are short FREE courses that you take part in. They are usually quite specialize, but aimed at the public, not the genius!

There are lots of website that help you find a course, such as edX and Future Learn.

You can take part in any course, but there are usually start and finish dates. They mostly involve taking part in webchats, watching videos and interactive activities.

Day 4 of the holidays and boredom has set in? There are loads of citizen science projects you can take part in either from the comfort of your bedroom, out and about, or when on holiday Wikipedia does a comprehensive list of all the current projects taking place Google 'citizen science project'

Bumblebee Conservation Trust

AgeGuess

OPAL EXPLORE NATURE

big butterfly count 15th July - 7th August

eoceans www.eoceans.org

THE SHORE THING GET INVOLVED!

WildlifeLog SPOT IT - SHARE IT - SAVE IT

The Big Moss Map

MOOC

canvas network · edX · coursera · OPEN 2 STUDY · UDACITY · FUTURELEARN · KHAN ACADEMY · ed2go

Preparing for September

The following activities cover some of the key skills from GCSE science that will be relevant at AS and A-level. They include the vocabulary used when working scientifically and some maths and practical skills.

You can do these activities independently or in class. The booklet has been produced so that it can be completed electronically or you can print them out.

The activities are **not a test**. Try the activities first and see what you remember and then use textbooks or other resources to answer the questions. **Don't** just go to Google for the answers, as actively engaging with your notes and resources from GCSE will make this learning experience much more worthwhile.

The answer booklet guides you through each answer. It is not set out like an exam mark scheme but is to help you get the most out of the activities.

Understanding and using scientific vocabulary

Understanding and applying the correct terms are key for practical science. Much of the vocabulary you have used at GCSE for practical work will not change but some terms are dealt with in more detail at A-level so are more complex.

Activity 1 Scientific vocabulary: Designing an investigation

Link each term on the left to the correct definition on the right.

Hypothesis	The maximum and minimum values of the independent or dependent variable
Dependent variable	A variable that is kept constant during an experiment
Independent variable	The quantity between readings, eg a set of 11 readings equally spaced over a distance of 1 metre would give an interval of 10 centimetres
Control variable	A proposal intended to explain certain facts or observations
Range	A variable that is measured as the outcome of an experiment
Interval	A variable selected by the investigator and whose values are changed during the investigation

Activity 2 Scientific vocabulary: Making measurements

Link each term on the left to the correct definition on the right.

True value	The range within which you would expect the true value to lie
Accurate	A measurement that is close to the true value
Resolution	Repeated measurements that are very similar to the calculated mean value
Precise	The value that would be obtained in an ideal measurement where there were no errors of any kind
Uncertainty	The smallest change that can be measured using the measuring instrument that gives a readable change in the reading

Activity 3 Scientific vocabulary: Errors

Link each term on the left to the correct definition on the right

Random error	Causes readings to differ from the true value by a consistent amount each time a measurement is made
Systematic error	When there is an indication that a measuring system gives a false reading when the true value of a measured quantity is zero
Zero error	Causes readings to be spread about the true value, due to results varying in an unpredictable way from one measurement to the next

Understanding and using SI units

Every measurement has a size (eg 2.7) and a unit (eg metres or kilograms). Sometimes, there are different units available for the same type of measurement. For example, milligram, gram, kilogram and tonne are all units used for mass.

To reduce confusion, and to help with conversion between different units, there is a standard system of units called the SI units which are used for most scientific purposes.

These units have all been defined by experiment so that the size of, say, a metre in the UK is the same as a metre in China.

There are seven SI base units, which are given in the table.

Physical quantity	Unit	Abbreviation
Mass	kilogram	kg
Length	metre	m
Time	second	s
Electric current	ampere	A
Temperature	kelvin	K
Amount of substance	mole	mol
luminous intensity	candela	cd

All other units can be derived from the SI base units. For example, area is measured in metres square (written as m^2) and speed is measured in metres per second (written as m $s^{-1,}$ this is a change from GCSE where it is written as m/s).

Using prefixes and powers of ten

Very large and very small numbers can be complicated to work with if written out in full with their SI unit. For example, measuring the width of a hair or the distance from Manchester to London in metres (its SI unit) would give numbers with a lot of zeros before or after the decimal point, which would be difficult to work with.

So, we use prefixes that multiply or divide the numbers by different powers of ten to give numbers that are easier to work with. You will be familiar with the prefixes milli (meaning 1/1000), centi (1/100), and kilo (1 × 1000) from millimetres, centimetres, and kilometres.

There is a wide range of prefixes. Most of the quantities in scientific contexts will be quoted using the prefixes that are multiples of 1000. For example, we would quote a distance of 33 000 m as 33 km.

The most common prefixes you will encounter are given in the table.

Prefix	Symbol	Power of 10	Multiplication factor	
Tera	T	10^{12}	1 000 000 000 000	
Giga	G	10^{9}	1 000 000 000	
Mega	M	10^{6}	1 000 000	
kilo	k	10^{3}	1000	
deci	d	10^{-1}	0.1	1/10
centi	c	10^{-2}	0.01	1/100
milli	m	10^{-3}	0.001	1/1000
micro	μ	10^{-6}	0.000 001	1/1 000 000
nano	n	10^{-9}	0.000 000 001	1/1 000 000 000
pico	p	10^{-12}	0.000 000 000 001	1/1 000 000 000 000
femto	f	10^{-15}	0.000 000 000 000 001	1/1 000 000 000 000 000

Activity 4 SI units and prefixes

What would be the most appropriate unit to use for the following measurements?

1. The time between heart beats
2. The diameter of a cheek cell
3. The distance that a migratory bird travelled each year
4. The thickness of a DNA helix
5. The mass of a rabbit
6. The mass of iron in the body
7. The diameter of a glucose molecule

Activity 5 Units

Choose the most appropriate unit and estimate the size of each of the following.

1. The mass of an earthworm
2. The volume of water in a teardrop
3. The volume of water in a garden pond
4. The time taken for a sunflower to grow
5. The temperature difference between the blood in the heart and in the ear on a cold day
6. The diameter of a human hair
7. The length that your fingernails grow each day
8. The total length of DNA in one human body cell

Activity 6 Converting data

Re-write the following.

1. 0.00224 metres in millimetres
2. 104 micrograms in grams
3. 6.2 kilometres in metres
4. 10 micrograms in nanograms
5. 70 decilitres in litres
6. 10 cm^3 in litres

Practical skills

The practical skills you learnt at GCSE will be further developed through the fieldwork and practicals you undertake at A-level. Your teacher will explain in more detail the requirements for fieldwork, practical work, and the research methods.

There is a practical handbook for Biology which has lots of very useful information to support you in developing these important skills.

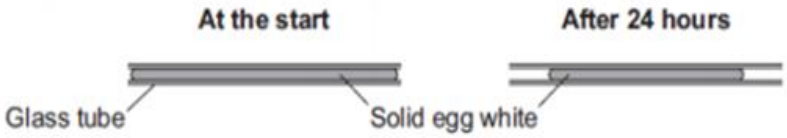
Activity 7 Investigating how temperature and pH affect enzymes

Egg white is made of protein. The students were investigating how temperature and pH affect the digestion of protein

The students carried out the following procedure:

- Filled six narrow glass tubes with fresh egg white
- Boiled the tubes so the egg white became solid
- Placed each tube into a different beaker containing human protease enzyme at different pH values at room temperature and 3 in neutral pH but at different temperatures for 24 hours
- Measured the length of solid egg white in each tube after 24 hours

The diagram shows the investigation.



The results were recorded in the tables below:

pH	Original length of solid egg white (cm)	Final length of solid egg white (cm)	% change
4	6.0	5.6	
7	6.0	3.8	
9	6.0	5.8	

Temperature (°C)	Original length of solid egg white (cm)	Final length of solid egg white (cm)	% change
15	6.0	5.7	
35	6.0	3.8	
55	6.0	5.3	

1. State a hypothesis for this investigation.
2. The students predicted that the enzyme would be most effective in conditions similar to those found in the human body. Was their prediction correct?
3. Identify the independent and dependent variables in this investigation.
4. Suggest the control variables for this investigation.
5. Describe the difference between repeatable and reproducible.
6. What would be the most likely resolution of the ruler you would use in this investigation.
7. Suggest how repeating the investigation would be an improvement.
8. Calculate the % change for each result in this investigation. Show your answers to 3 significant figures.

Analysing data

Biological investigations often result in large amounts of data being collected. It is important to be able to analyse this data carefully in order to pick out trends.

Activity 8 Mean mode median and scatter graphs

A student investigated an area of moorland where succession was occurring. The student used quadrats to measure the area covered by; different plant species, bare ground and surface water.
They did this every 10 metres along a line transect. The student also recorded the depth of soil at each quadrat. Their results are shown in the table.

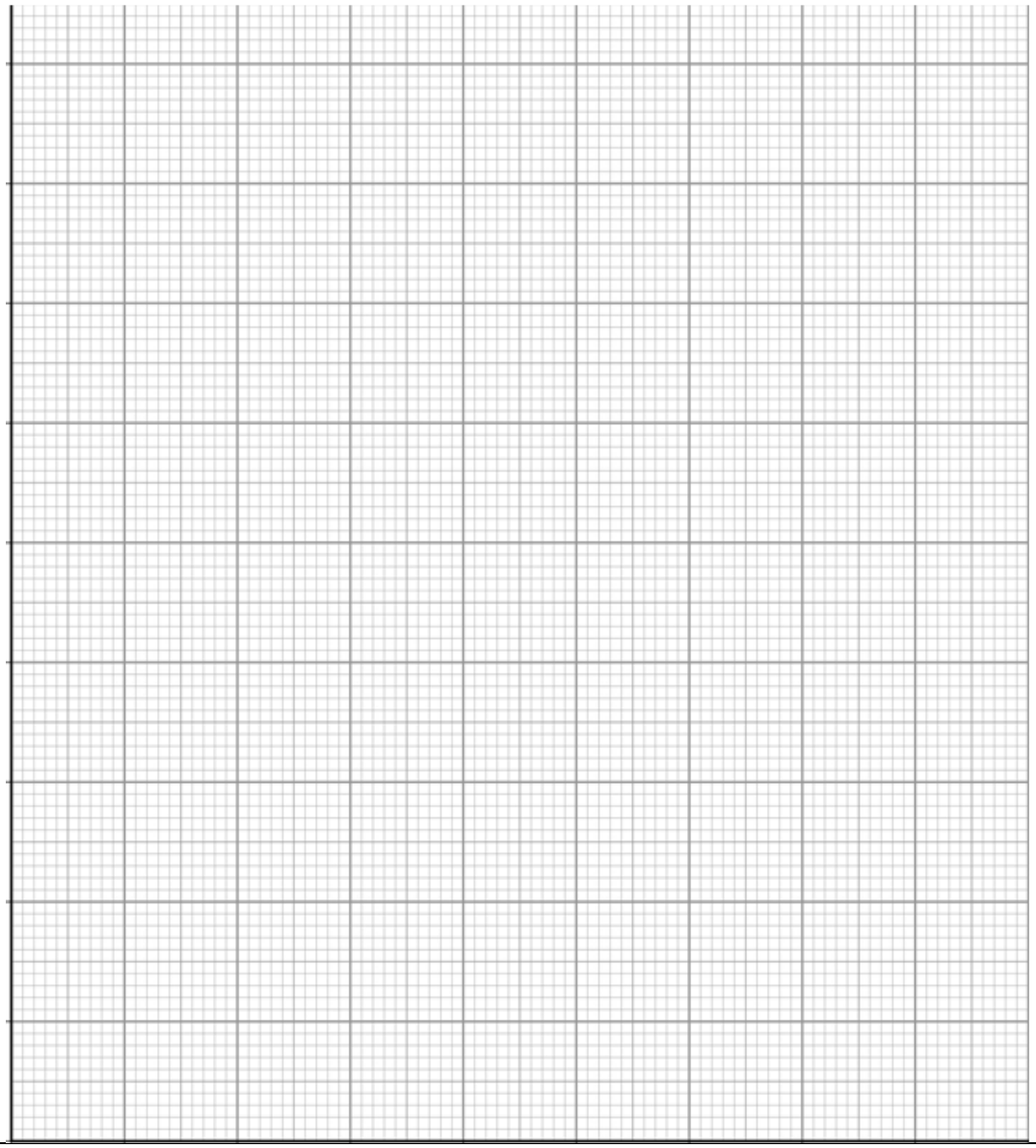
	Area covered in each quadrat A to E in cm^2				
	A	**B**	**C**	**D**	**E**
Bog moss	55	40	10	–	–
Bell heather	–	–	–	15	10
Sundew	10	5	–	–	–
Ling	–	–	–	15	20
Bilberry	–	–	–	15	25
Heath grass	–	–	30	10	5
Soft rush	–	30	20	5	5
Sheep's fescue	–	–	25	35	30
Bare ground	20	15	10	5	5
Surface water	15	10	5	–	–
Soil depth / cm	3.2	4.7	8.2	11.5	14.8

Calculate:

1. Calculate the mode area of soft rush in the sample.
2. Calculate the mean soil depth of the area of moorland sampled.
3. Calculate the median amount of bare ground in the sample.

4. Using the data in the table plot a **scatter graph** of the soil depth against the area covered by bare ground, soft rush and bog moss (use different colours or markers for each).

5. What conclusions can you draw from this graph?



6. Suggest how to improve the validity of these conclusions.

Activity 9 Data in tables

A patient with a leaking heart valve may have the valve replaced. A study compared two different types of replacement heart valve:

- mechanical valves
- biological valves from pigs.

The data used in the study was collected from female patients aged 50–69. **Table 4** shows the data

Table 4

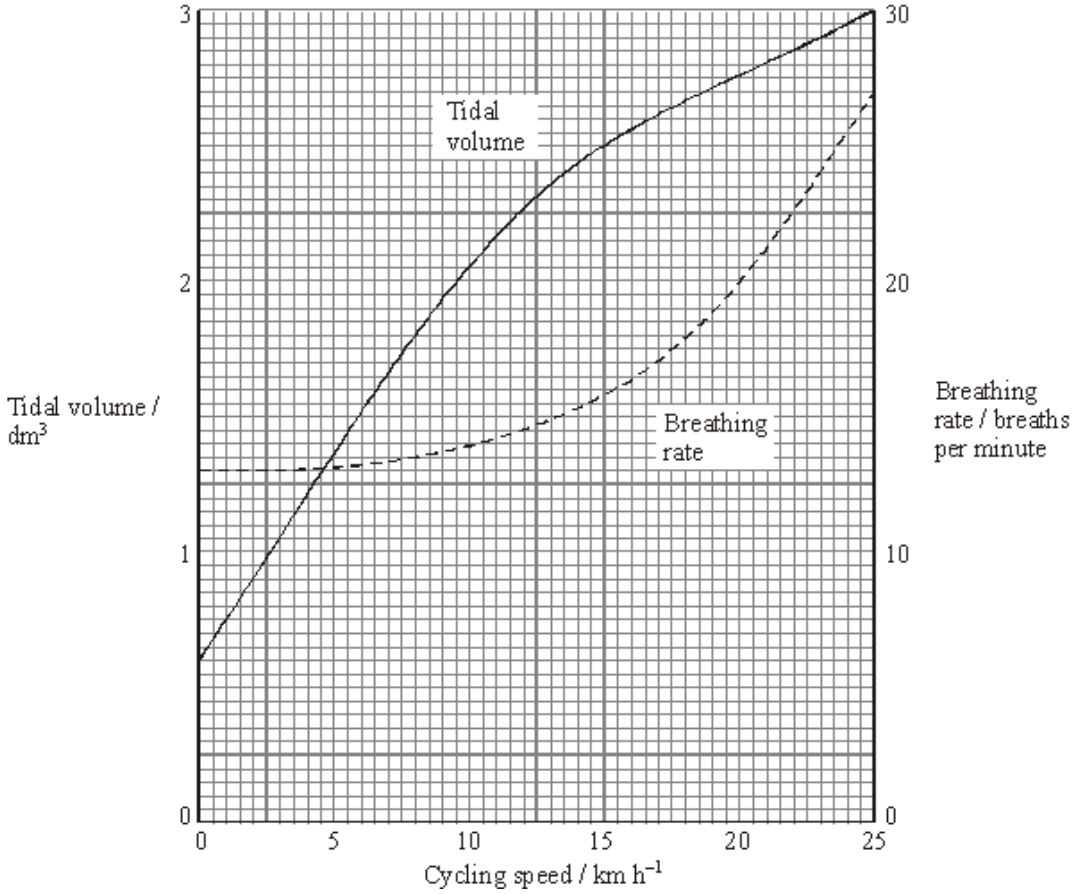
	Type of replacement heart valve	
	Mechanical	**Biological**
Number of patients given the valve	2852	1754
Number of patients who died from heart-related problems after valve replacement	180	178
Percentage of patients alive after 5 years	91	89
Percentage of patients needing a second valve replacement within 6 years	2.2	5.2
Percentage of patients who had a blood clot on the brain after surgery	5.8	0.1

1. Give **one** conclusion about the death of patients from heart-related problems after a valve replacement. Include calculations to support your answer.

2. Evaluate the use of mechanical replacement heart valves and biological replacement heart valves. Use information from **Table 4**.

Activity 10 Analysing complex graphs

The volume of air breathed in and out of the lungs during each breath is called the tidal volume.
The breathing rate and tidal volume were measured for a cyclist pedaling at different speeds. The graph shows the results



1. State the tidal volume when the cycling speed was 17 km h^{-1}.

2. State the breathing rate when the cycling speed was 8 km h^{-1}.

3. Calculate the change in breathing rate when the cyclist speed changed from 10 to 20 km h^{1}. Express this as a percentage.

4. State the speed at which the breathing rate starts to increase.

5. The tidal volume increased linearly with the cycling speed up to about 10 km h^{-1}. Calculate the increase in volume for each increase in speed of 1 km h^{-1}.

Extended writing

The ability to write coherently in a logical, well-structured way is an essential skill to develop. At GCSE the 6-mark extended response questions are used so students can demonstrate this skill. At A-level you need to develop this skill further, and you will be expected to write longer extended response questions, including an essay worth 25 marks. You will practice this skill over the next 2 years.

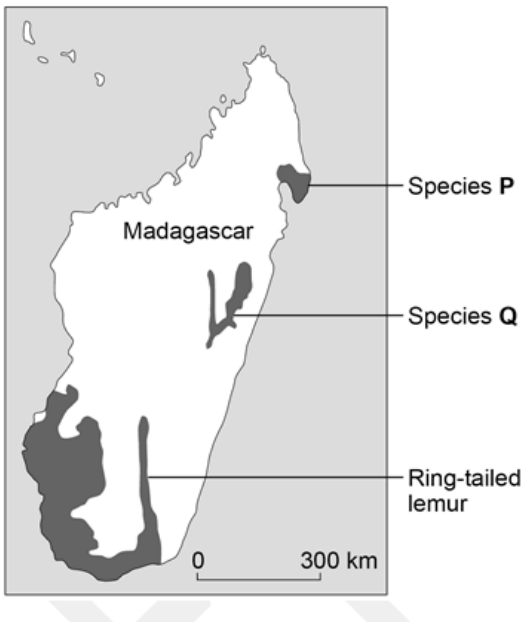
The command word in a question, like at GCSE, is important as it gives you an indication of what to include in your answers. For example, 'explain' means you must give reasons why things are happening, not just give a description. A comparison needs advantages and disadvantages or points for and against. Your teacher will work with you on this skill during the course.

Activity 11 Extended writing

This is an 'open book' activity, meaning you can use notes/ resources to help you.
Before attempting the question below, you might want to remind yourself of the work you did on the following topics at GCSE (using notes/ textbooks/ revision guides etc):

- the theory of evolution
- the role of mutation and natural selection

Lemurs are only found on the island of Madagascar. Madagascar is off the coast of Africa. Scientists think that ancestors of modern lemurs evolved in Africa and reached Madagascar about 50-60 million years ago.
Today there are many species of lemur living on Madagascar
Figure 1 shows the distribution of three species of lemur on Madagascar.



Describe how the ancestors of modern lemurs may have evolved into the three different species shown on the map (species P, species Q and ring tail lemurs)

Progression of content

What you learnt at GCSE forms the foundation to your further study at A-level. Ideas will be developed and refined, new concepts and skills will be introduced. The follow are some **optional** questions which you might like to have a go at. They are designed to help refresh your memory of some of the important concepts you will use during your study of AS and A -level Biology.

Use the questions in each section to help to identify where your knowledge and understanding is secure and which areas you may need to revisit.

Activity 12 Cell structure and magnification

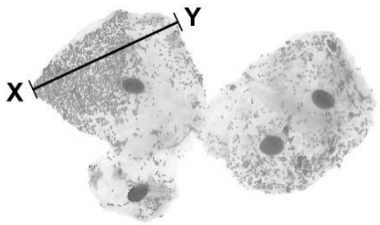
Drawing images from microscope observations must be done carefully, including careful measurements for magnification calculations.
Make sure that you are clear on the organelles within different cells and their functions.
You must also be secure in the method used to make observations using a light microscope and the purpose of each method step.

Figure 1 shows an animal cell viewed using a microscope

The cell contains a nucleus.

1. State the function of the nucleus.
2. Name **one** type of cell that does **not** contain a nucleus.
3. On the diagram label three parts of the cell.
4. Name **one** structure found in a plant cell but **not** found in an animal cell.

The figure below shows some different cells.



The real length from point **X** to point **Y**i s 0.06 mm.

5. Calculate the magnification.

The cells shown above were viewed using a light microscope.

6. Give **two** advantages of using an electron microscope instead of a light microscope.

Activity 13 Cell division

There is sometimes confusion between how and cells divide by mitosis and meiosis. You need to understand the purpose and features of each process and the role of mitosis in the cell cycle.

Cell division is needed for growth and for reproduction.

Table 3 contains three statements about cell division.
Complete **Table 3** by ticking **one** box for each statement.

Table 3

	Statement is true for		
Statement	**Mitosis only**	**Meiosis only**	**Both mitosis and meiosis**
All cells produced are genetically identical			
In humans, at the end of cell division each cell contains 23 chromosomes			
Involves DNA replication			

Activity 14: Transport across cell membranes

In Biology, many processes involve moving substances across boundaries. Ensure that you know what each of diffusion, osmosis and active transport are and where each takes place. Questions on transport across cell membranes often involve data and applying knowledge and understanding to unfamiliar contexts.
One of the required practicals at GCSE is on osmosis, make sure that you can interpret the graph used to show the results.

A student carried out an investigation using chicken eggs. This is the method used.

1. Place 5 eggs in acid for 24 hours to dissolve the egg shell.
2. Measure and record the mass of each egg.
3. Place each egg into a separate beaker containing 200 cm^3 of distilled water.
4. After 20 minutes, remove the eggs from the beakers and dry them gently with a paper towel.
5. Measure and record the mass of each egg. **Table 4** shows the results.

Table 4

Egg	Mass of egg without shell in grams	Mass of egg after 20 minutes in grams
1	73.5	77.0
2	70.3	73.9
3	72.4	75.7
4	71.6	73.1
5	70.5	73.8

Another student suggested that the result for egg **4** was anomalous.

1. Do you agree with the student?
   Give a reason for your answer.

2. Calculate the percentage change in mass of egg **3.**

3. Explain why the masses of the eggs increased.

4. Explain how the student could modify the investigation to determine the concentration of the solution inside each egg.

Chicken egg shells contain calcium. Calcium ions are moved from the shell into the cytoplasm of the egg.

Table 5 shows information about the concentration of calcium ions.

Table 5

Location	Concentration of calcium ions in arbitrary units
Egg shell	0.6
Egg cytoplasm	2.1

5. Explain how calcium ions are moved from the shell into the cytoplasm of the egg.

Activity 15 Digestion and food tests

It is important to understand the role of enzymes in digestion and how enzymes work. Recalling the food tests is important, particularly how to test for protein and sugars.

1. Describe how a student could test cow's milk to show whether it contains protein and different types of carbohydrate.

A scientist investigated the effect of bile on the breakdown of fat in a sample of milk.

The scientist used an indicator that is colourless in solutions with a pH lower than 10, and pink in solutions with a pH above 10

This is the method used.

- Add 1 drop of bile to a test tube and one drop of water to a second test tube.
- Add the following to each test tube:
  - 5 cm^3 of milk
  - 7 cm^3 of sodium carbonate solution (to make the solution above pH 10)
  - 5 drops of the indicator
  - 1 cm^3 of lipase.
- Time how long it takes for the indicator in the solutions to become colourless.

	Time taken for the indicator to become colourless in seconds
Solution with bile	65
Solution without bile	143

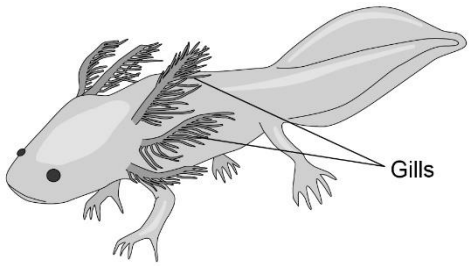
2. Explain why the indicator in both tubes became colourless.

3. Explain the difference in the results for the two test tubes in the table above

Activity 16 Circulatory system and gas exchange

Application of your knowledge and understanding of these key concepts to unfamiliar context is a way examiners can assess the depth of your understanding.

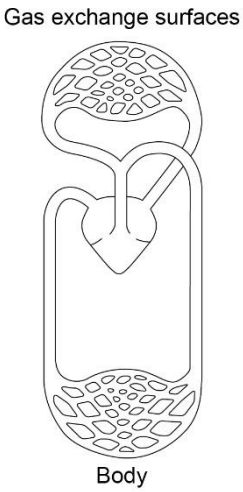
A small animal called an axolotl lives in water.



The axolotl has a double circulatory system.

1. Explain what is meant by the term double circulatory system.

The diagram below shows the double circulatory system of the axolotl.



2. The heart of the axolotl has only one ventricle. Label the ventricle on the diagram.

3. Explain why having only one ventricle makes the circulatory system less efficient than having two ventricles.

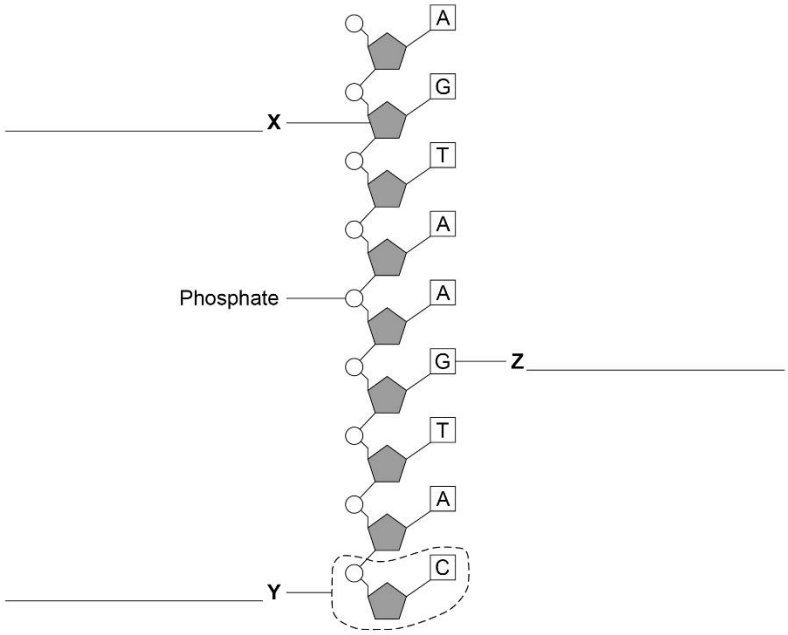
4. Explain why an axolotl may die in water with a low concentration of oxygen. Use the diagram above to help you, remember about surface area: volume ratio in gas exchange.

Activity 17 DNA and genetics

Genetic material is made of DNA.

1. Name the structures in the nucleus of a human cell which contain DNA.

The figure below shows part of one strand of a DNA molecule.



2. Label parts **X**, **Y** and **Z** with the correct word from the list below **:**

   base **fatty acid** **nucleotide** **sugar** **glycerol**

3. A complete DNA molecule is made of two strands twisted around each other.
   What scientific term describes this structure?

DNA codes for the production of proteins.
A protein molecule is a long chain of amino acids.

4. How many amino acids could be coded for by the piece of DNA shown in the figure above?

Activity 18 Monoclonal antibodies

Monoclonal antibodies are identical copies of a specific type of antibody. Antibodies are extremely important as they are a type of protein that is produced by lymphocytes to fight pathogens (disease causing viruses, bacteria, fungi or protists). Pathogens have antigens on them which makes them unique. When a pathogen enters an organism and causes an infection, the lymphocyte recognises the unique antigen on the pathogen and start attacking them by producing antibodies. Monoclonal antibodies (copies) can be made in the lab.

A farmer thinks a potato crop is infected with potato virus Y (PVY). The farmer wants to buy a monoclonal antibody to get rid of the potato virus.
To make the monoclonal antibodies a scientist first isolates the PVY protein from the virus.

1. Describe how the scientist would use the PVY protein to produce the PVY monoclonal antibody for the farmer.