



Wath Sixth Form Subject Preparation Pack

BIOLOGY

World-class learning

World-class learning every lesson, every day

The highest expectations

Everyone can be successful; always expect the highest standards

No excuses

Create solutions not excuses; make positive thinking a habit

Growth mindset

Believe you can improve; work hard and value feedback

Never give up

Resilience is essential; be relentless in the pursuit of excellence

Everyone is valued

Diversity is celebrated; see the best in everyone

Integrity

Be trustworthy and honest; deliver on promises and walk the talk

What is Biology?

Biology is the science of life. Its name is derived from the Greek words "bios" (life) and "logos" (study). Biologists study the structure, function, growth, origin, evolution and distribution of living organisms. Biology is an exciting and rapidly developing subject with a central place in the future of our society. Every week Biology is in the news with developments in our understanding of genetics, evolution and disease.

Why should I study Biology?

A qualification in Biology aims to not only equip students with sound scientific knowledge and understanding of biological concepts and scientific processes, but to also offer opportunities to explore the ethical and moral issues related to the effects of human activities on biological systems. Throughout the course you will be given the opportunity to develop key practical skills, which will give you the opportunity to gain an additional qualification: The Practical Skills Endorsement. Additionally, at A Level, it develops a number of essential skills that will benefit your study of other A Levels, future university courses and future employment. These include but are not limited to:

- Critical thinking
- Reasoning and logic
- Communication
- Independent research skills
- Data analysis and interpretation of data
- Empathy
- Oracy
- Teamwork
- Technical ability
- Organisation
- Attention to detail

What careers could A level Biology lead to?

Due to the nature of Biology, it complements a range of different other A level subjects, as a result it leads to a range of possible careers. As a result it is impossible to put together a definitive list of careers that Biology would benefit. That said, below are some of the most common careers of Biology students

- Science and Research – Research Scientist, Biologist, Forensic Scientists.
- Medicine and Healthcare – Doctors, Nurses, Pharmacists, Pharmacologists, NHS professional.
- Agriculture – Farmer, Tree Surgeon, Ecologist.
- Sports and Fitness – Athlete, Nutritionist, Personal Trainer.
- Engineer – Biochemical Engineer, Civil Engineer, Mechanical Engineer
- Law Enforcement and Emergency Services – Paramedic, Police Officer, Lawyer, Barrister, Crime Scene Investigator.
- Education sector

What will I study?

At Wath Academy we cover the AQA syllabus, which covers a breadth of knowledge, split across 3 papers.

Paper 1

Topic 1 - Biological molecules

This topic covers the biochemical structure of many key biological molecules such as carbohydrates, fats, proteins and DNA.

Topic 2 - Cells

The detailed study of Eukaryotic and Prokaryotic cells, as well as the structure of Viruses. You will build on knowledge of cell division from GCSE and look at DNA replication.

Topic 3 – Organisms exchange substances with their environment

Most students love this topic; it looks at mass transport and the organs involved in transporting substances around the body. It also looks at the transport of substances in plants.

Topic 4 – Genetic information, variation and relationships between organisms

During this topic you will study DNA in more detail and build on prior knowledge of protein synthesis. This unit also covers variation and biodiversity; you will begin to look at how we can sample the environment.

Paper 2

Topic 5 - Energy transfers in and between organisms

In this topic we will study the biochemistry of photosynthesis and respiration. It also focuses on energy transfers between organisms in food chains and through the ecosystem.

Topic 6 – Organisms respond to changes in their internal and external environments

This unit builds on your knowledge of homeostasis and looks in detail how the nervous system and hormonal system works to maintain a constant internal environment. It also looks at the kidney and how it functions.

Topic 7 – Genetics, populations, evolution and ecosystems

During this unit we look at inheritance. It will also focus on population studies, building on knowledge gained during AS.

Topic 8 – Control of gene expression

This topic looks at how our bodies are able to control what genes are expressed in our cells. It also looks at new genetic technologies that allow us to develop our knowledge and understanding of genetic diseases and the ethical issues associated with this.

Paper 3

Paper 3 is a synoptic paper that contains questions on all 8 units. There is a 25 Mark essay at the end of this paper that will require you to demonstrate your rounded understanding of Biology.

Topic 1 - Biological molecules

Topic 2 - Cells

Topic 3 – Organisms exchange substances with their environment

Topic 4 – Genetic information, variation and relationships between organisms

Topic 5 - Energy transfers in and between organisms

Topic 6 – Organisms respond to changes in their internal and external environments

Topic 7 – Genetics, populations, evolution and ecosystems

Topic 8 – Control of gene expression

How will I be assessed?

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 questions		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.

Meet the team



Ms Stocks

Biology Teacher - Head of Science Faculty

I enjoy teaching biology because it allows me to inspire and motivate young people to learn about life and how organisms survive, thrive and change. Biology is inherently fascinating and I enjoy sharing my passion for the subject with students. I love how everyday is different and I find teaching incredibly rewarding.



Mr Brown

Biology Teacher - Head of Biology, Second in Science

I believe cultivating a reverence for the wonders of the Natural World is at the core of intellectual, emotional, physical and spiritual development; to discover the intricacies that hold together the web of life and know our own place within it is paramount to living a good life.

My research before teaching centred around investigating links between nutrition, epigenetics and cervical cancer, whereby I used bioinformatic techniques to identify novel genes candidates for de/methylation in the development of cervical cancer. Besides from those topics, my interests also include: human evolution, microbiology, consciousness and bioethics. These topics, amongst others, help position, and continuously reposition, our outlook on life and our place in it.



Ms Boyd

Biology Teacher – Associate Assistant Vice Principal

Being a biology teacher combines my passion for my subject and working with young people to make a difference. I love to see students engaging with and discovering biology. Seeing students progress throughout their school career and continuing their biological education beyond Wath is so rewarding. There is nothing more paramount and fascinating than understanding how the living world exists and interacts. My favourite aspect of Biology is human Biology and I have a particular interest in anatomy, genetics, inheritance and how understanding gene expression can control the process of development.



Mr Gibson

Biology Teacher

I enjoy A level Biology as it is inherently fascinating. It is fantastic to learn about the complexity of living things and how they interact with each other and the environment. Though Biology as a whole is interesting I do have my favourites, Microbiology and Plant Biology.

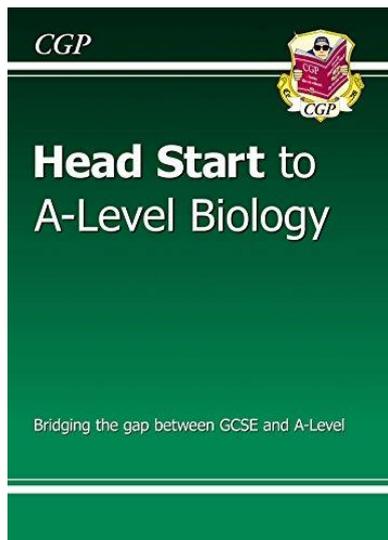


Ms Hayes

Biology Teacher- Assistant Head of Sixth Form

I enjoy teaching biology because it relates to lots of aspects of life and provides many diverse opportunities for pupils to excel in a successful and meaningful career. Alongside investigating interesting concepts that surround us daily – biology is the pathway to understanding life.

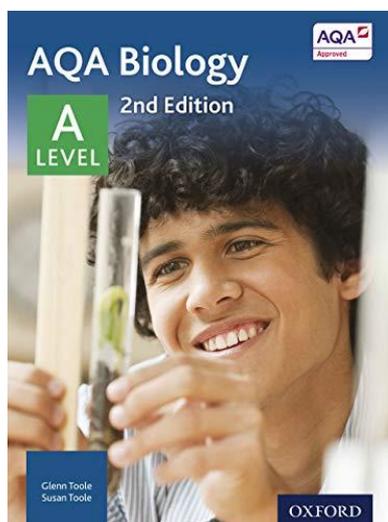
Recommended resources



This book provides a summary to some of the fundamental principles of A Level Biology that you will cover when you first start the course. It takes the knowledge you gained at GCSE and allows you to build on your knowledge in preparation for the start of A level.

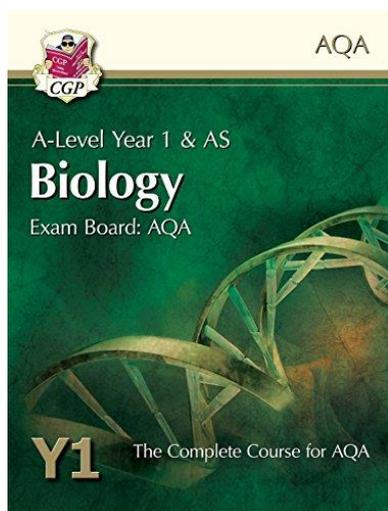
The notes are written in a succinct, easy to follow way, which is typical of CGP. There are also a few questions at the end of each page to assess your own progress.

These are free to download on Kindle at the moment on Amazon.



This book is the one we use to study the course in school. It follows the specification and contains everything you will need to know to pass the course.

You will be loaned a copy of this text if you start the course with us in September.



Students have also found this book to be very useful and it gives a slightly different approach to the Oxford book above.

Again it follows the specification, this particular book only covers the content for Year 1 which is Topic 1-4 and is covered in paper 1.

GCSE

- New Grade 9-1 GCSE Science: Essential Maths Skills - Study & Practice (CGP GCSE Combined Science 9-1 Revision) - <https://www.amazon.co.uk/New-Grade-9-1-GCSE-Science-ebook/dp/B01MXYL7TO/>

A Level

- New Head Start to A-level Biology (CGP A-Level Biology) - <https://www.amazon.co.uk/Head-Start-level-Biology-Level-ebook/dp/B00VE2NIOI>

University

- Practical Skills in Biology - <https://www.amazon.co.uk/Practical-Skills-Biology-Rob-Reed-ebook/dp/B01B1WBK1I>
- Practical Skills in Forensic Science - <https://www.amazon.co.uk/Practical-Skills-Forensic-Science-Langford-ebook/dp/B07JM5SNCM>
- Practical Skills in Biomolecular Science - <https://www.amazon.co.uk/Practical-Skills-Forensic-Science-Langford-ebook/dp/B07JM5SNCM>
- Practical Skills in Chemistry - <https://www.amazon.co.uk/Practical-Skills-Chemistry-John-Dean-ebook/dp/B073R5L653>

Links to useful websites

s-cool - this is a good revision website with lots of condensed notes and practise questions

<https://www.s-cool.co.uk/a-level/biology>

AQA – this website contains useful information on the course, including a copy of the specification and exemplar materials including past papers.

<https://www.aqa.org.uk/subjects/science/as-and-a-level/biology-7401-7402>

YouTube – contains some good clips that talk you through key concepts

<https://www.youtube.com/>

Additional resources

The following resources may or may not link directly to the specification but are useful in developing your wider understanding of key theories and concepts.

Netflix



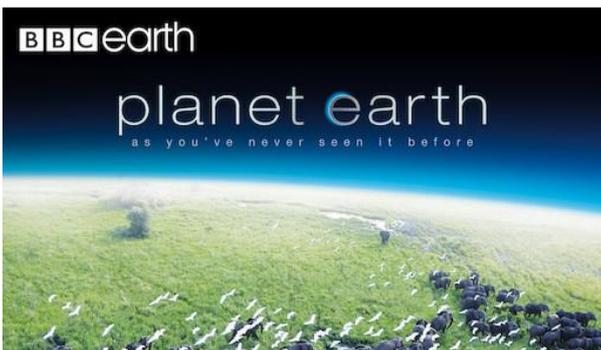
Unnatural Selection



Our Planet



The Mind Explained



Planet Earth II



Blue Planet II

Some of our favourite biology TED talks:

Electrical experiments with plants that count and communicate | Greg Gage:

<https://www.youtube.com/watch?v=pvBISFVmoaw>

How our microbes make us who we are | Rob Knight

<https://www.youtube.com/watch?v=i-icXZ2tMRM>

How a long-forgotten virus could help us solve the antibiotics crisis | Alexander Belcredi

<https://www.youtube.com/watch?v=tFFyh9THuGo>

Growing new organs | Anthony Atala

https://www.ted.com/talks/anthony_atala_growing_new_organs?language=en

Why are bees disappearing | Marla Spivak

https://www.ted.com/talks/marla_spivak_why_bees_are_disappearing?language=en

Reading

Kick back this summer with a good read. The books below are all popular science books that are great for extending your knowledge and understanding of Biology.

- What a Plant Knows (A field guide to the senses): Daniel Chamovitz
- Origins (how the nine months before birth shape the rest of our lives): Annie Murphy Paul
- Life from an RNA world: Michael Yarus
- The Selfish Gene: Richard Dawkins (***this book enriched Mr Brown's understanding of biology, he puts his A* in Biology down to reading this book in college***)
- March of the Microbes: John Ingraham
- A Planet of Viruses: Carl Zimmer
- Here comes the sun: Steve Jones
- The Epigenetics Revolution: Nessa Carey
- Blossoms: And the genes that make them: Maxine F. Singer
- Buzz: The Nature and Necessity of Bees: Thor Hanson
- 10% Human: How Your Body's Microbes Hold the Key to Health and Happiness: Alanna Collen
- This is Going to Hurt: Secret Diaries of a Junior Doctor: Adam Kay (gives a good insight into the truth behind being a Junior Doctor)

Activities

This pack contains lots of different activities that will allow you to become fully prepared for the start of A Level Biology. I can not recommend completing the tasks at the end of this pack enough, they will give you a comprehensive understanding of key principles you will cover during your studies.

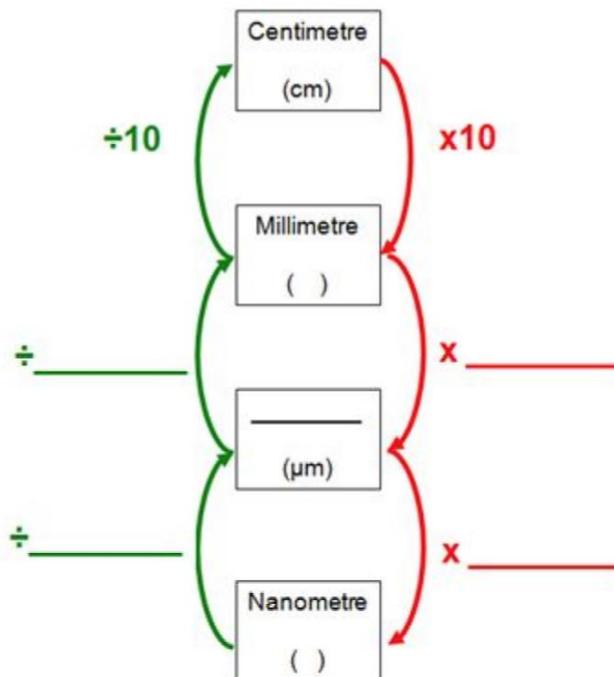
<https://drive.google.com/file/d/1Oyhy2TVbyAOZ8o9QJFm6m4SxRLMhYmJX/view>

Tasks

Please complete the following tasks to support your transition between GCSE and A Level, you might want to use some of the suggested resources to support you.

Microscopy and Magnification

To be able to properly calculate magnification properly, you need to be able to convert units, please completed the following diagram to show how units can be converted.



Complete the table below to show the corresponding value nanometres, micrometres and millimetres for the measurements given in each row. The first row has been completed for you.

<u>Nanometer</u>	<u>Micrometer</u>	<u>Millimeter</u>
5	0.005	0.000005
1		
	1	
		1
	3	
		7
9		

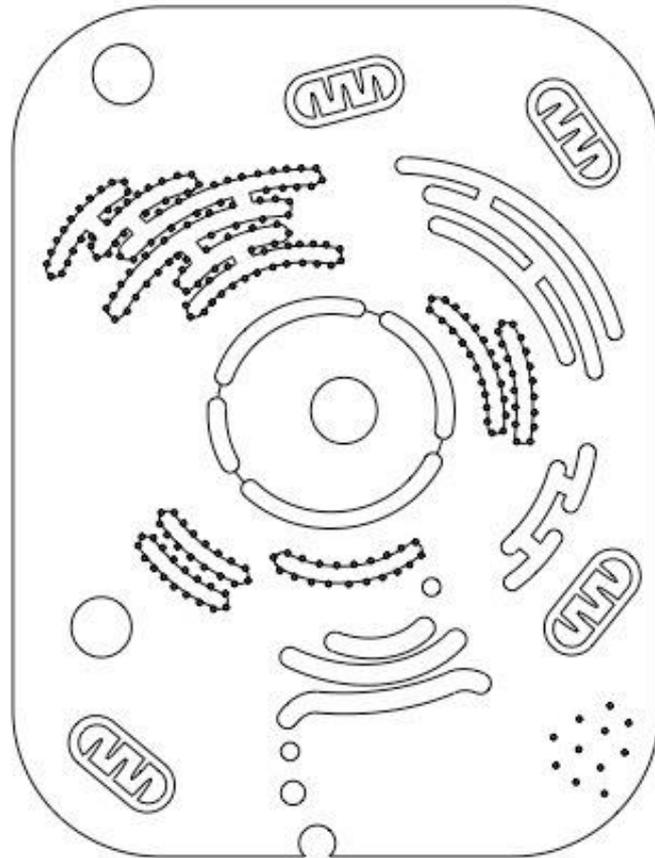
Define the terms

Magnification -

Resolution -

Cells

Label the following Eukaryotic cell



For each organelle you have labelled, find out its function and create a summary table to show your findings.

Describe three structures / organelles that are present in generalised plant cells but absent from animal cells.

1. _____

2. _____

3. _____

What is the difference between eukaryotic and prokaryotic cells? Give at least 3 differences

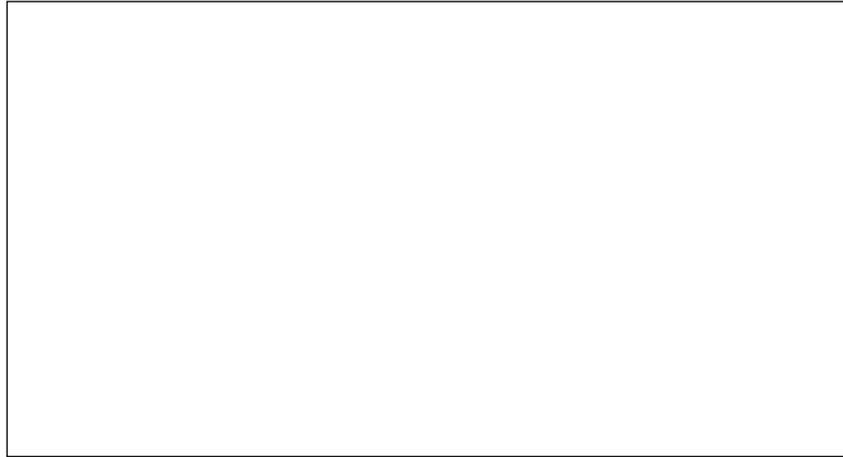
Proteins

You need to research the structure of an amino acid, draw this in the box and label the different regions



What is a condensation reaction?

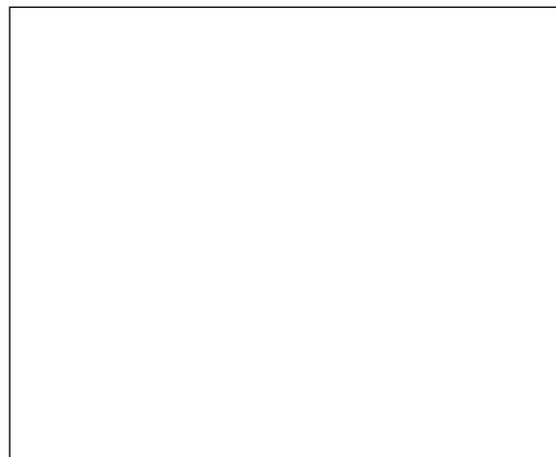
Use the knowledge you have gained about the structure of amino acid and condensation reactions, draw a diagram in the box to show how a peptide bond is formed to join two amino acids together.



How would we test a sample to show if protein is present?

Carbohydrates

You need to research the structure of an alpha glucose, draw this in the box and label the different regions



How would we test a sample to show if a reducing sugar is present in a sample?

Enzymes

At GCSE you studied the lock and key hypothesis to explain how enzymes function. Use your knowledge and diagrams to explain the lock and key hypothesis.

Use this space to draw diagrams of the lock and key hypothesis.

The lock and Key hypothesis was found to have flaws and an alternative hypothesis call the induced fit was proposed, research the induced fit hypothesis and use your findings to explain what the hypothesis suggests.

Use this space to draw a diagram to help with your explanation.

Biodiversity

What do we mean by the term biodiversity?

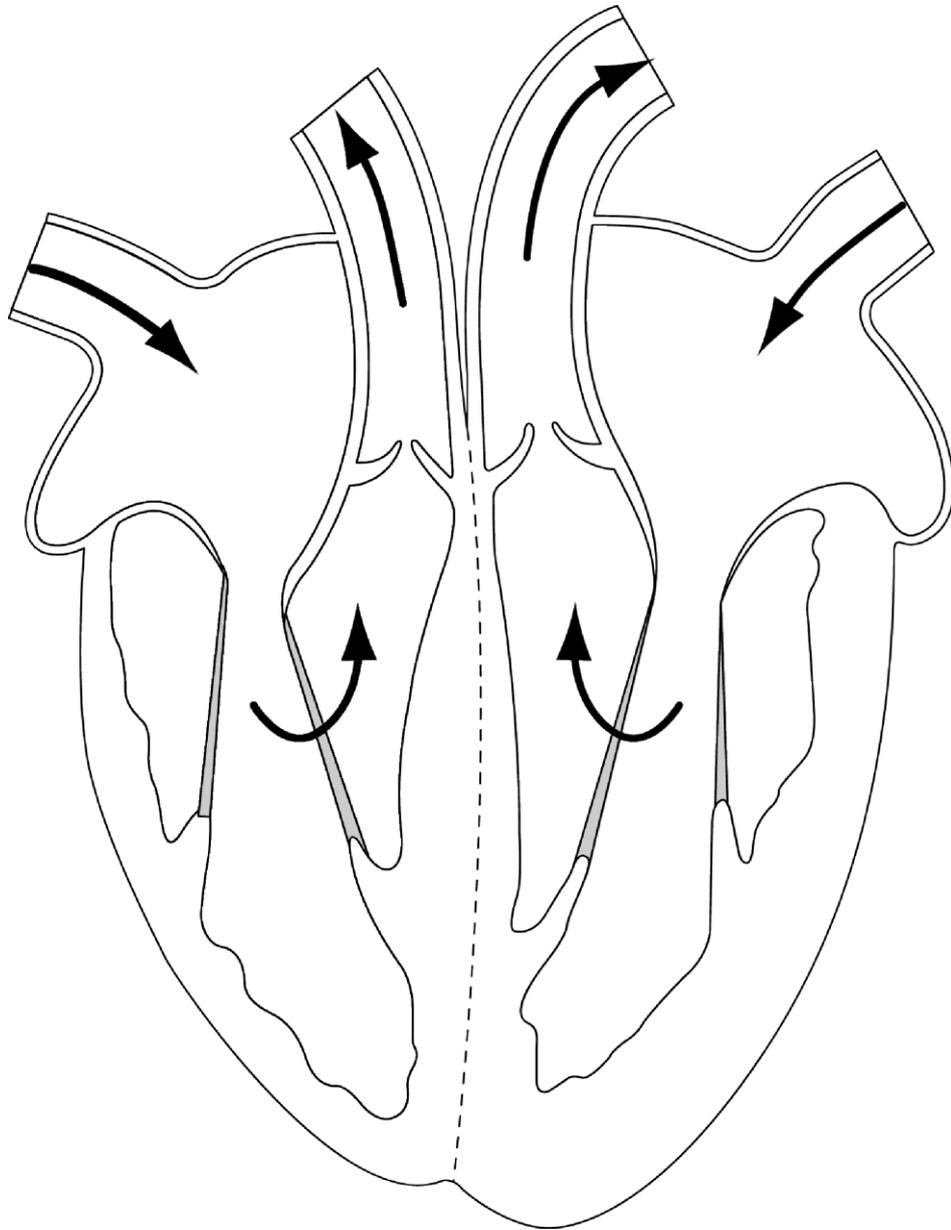
What factors might affect biodiversity?

How might we measure biodiversity?

What is the Simpsons index of diversity? Why do we use this to measure diversity? What measurements do we need to take to calculate the Simpsons index of diversity?

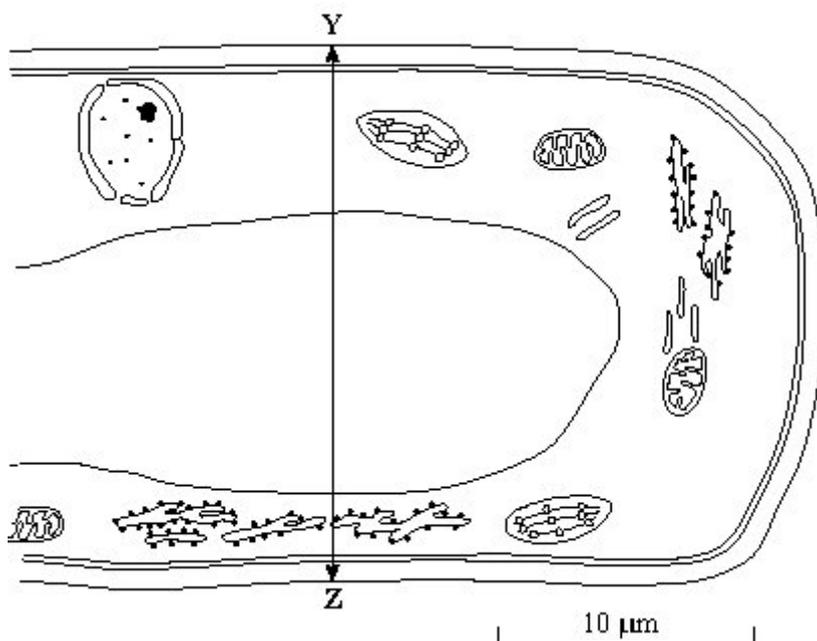
The Heart

Label the diagram of the heart. Colour the chambers that carry oxygenated blood red and the chambers that carry deoxygenated blood blue.



How many valves does the heart have? What are their names? Why are valves important?

Q1. The drawing shows part of a plant cell as seen with an electron microscope.



(i) Give **two** features shown in the drawing which are evidence that this cell is eukaryotic.

1. _____

2. _____

(2)

(ii) Calculate the actual width of the cell from **Y** to **Z**. Give your answer in micrometres (μm) and show your working.

Answer _____ μm

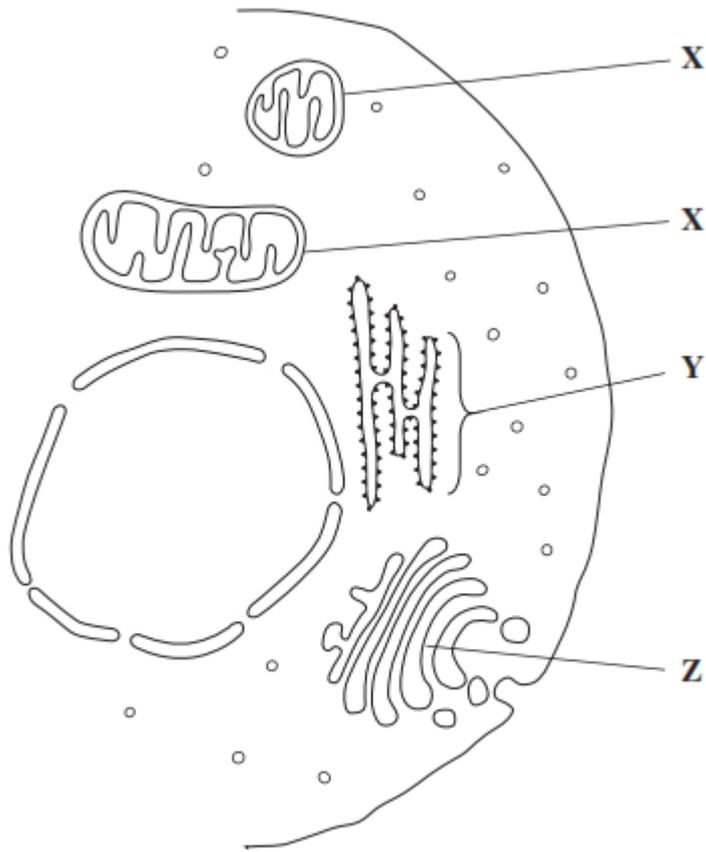
(2)

(iii) Give **one** way in which a typical animal cell differs from the cell shown in the drawing.

- _____

(1) (Total 5 marks)

Q2. The drawing shows part of a human cell.



(a) Name organelles

X _____

Y _____

(2)

(b) (i) The organelles labelled **X** all have very similar shapes in this cell. Explain why they appear to have different shapes in this drawing.

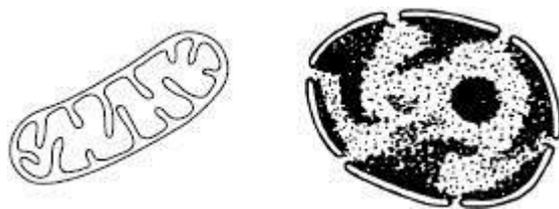
(1)

(ii) Large numbers of organelles **X** and **Z** are found in mucus-secreting cells. Explain why.

(2)

(Total 5 marks)

Q3. (a) The diagram shows two organelles found in a eukaryotic cell.



A

B

(i) Name the organelles.

A _____

B _____

(1)

(ii) Explain how the inner membrane is adapted to its function in organelle **A**.

(2)

(b) Give **one** feature of a prokaryotic cell that is not found in a eukaryotic cell.

(1)

(c) Describe how a sample consisting only of chloroplasts could be obtained from homogenised plant tissue.

(3)

(Total 7 marks)

Q4. (a) Structures **A** to **E** are parts of a plant cell.

- A** Cell Wall
- B** Chloroplast
- C** Nucleus
- D** Mitochondrion
- E** Golgi apparatus

Complete the table by putting the correct letter, **A**, **B**, **C**, **D** or **E** in the box next to each statement.

Statement	Letter
Has stacked membranes arranged in parallel and contains DNA.	
Is made of polysaccharide.	
Is an organelle and is not surrounded by two membranes.	

(3)

- (b) Human breast milk is produced and secreted by gland cells. These gland cells have adaptations that include many mitochondria and many Golgi vesicles. The milk contains a high concentration of protein.

Explain the role of these cell adaptations in the production and secretion of breast milk.

(2)

(Total 5 marks)

Scientists investigated the percentages of different types of lipid in plasma membranes from different types of cell. The table shows some of their results.

Type of lipid	Percentage of lipid in plasma membrane by mass		
	Cell lining ileum of mammal	Red blood cell of mammal	The bacterium <i>Escherichia coli</i>
Cholesterol	17	23	0
Glycolipid	7	3	0
Phospholipid	54	60	70
Others	22	14	30

- (e) The scientists expressed their results as **Percentage of lipid in plasma membrane by mass**. Explain how they would find these values.

(2)

Cholesterol increases the stability of plasma membranes. Cholesterol does this by making membranes less flexible.

- (f) Suggest **one** advantage of the different percentage of cholesterol in red blood cells compared with cells lining the ileum.

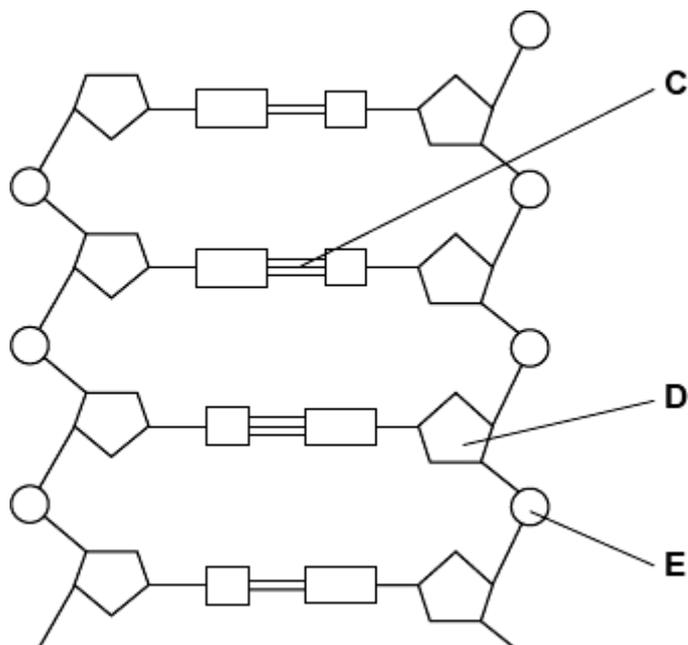
(1)

- (g) *E. coli* has no cholesterol in its cell-surface membrane. Despite this, the cell maintains a constant shape. Explain why.

(2)

(Total 10 marks)

Q6. The diagram shows part of a DNA molecule.



(a) (i) DNA is a polymer. What is the evidence from the diagram that DNA is a polymer?

(1)

(ii) Name the parts of the diagram labelled **C**, **D** and **E**.

Part **C** _____

Part **D** _____

Part **E** _____

(3)

(iii) In a piece of DNA, 34% of the bases were thymine.

Complete the table to show the names and percentages of the other bases.

Name of base	Percentage
Thymine	34
	34

(2)

(b) A polypeptide has 51 amino acids in its primary structure.

(i) What is the minimum number of DNA bases required to code for the amino acids in this polypeptide?

(1)

(ii) The gene for this polypeptide contains more than this number of bases.

Explain why

(1)

(Total 8 marks)

Mark schemes

Q1.

- (i) named organelle e.g. nucleus / nuclear envelope; vacuole; chloroplast; RER; mitochondrion; no membrane bound organelles;

*(only award if no organelles named)
(reject ribosomes, cell membrane, cell wall)*

ref to large(r) size

2 max

- (ii) $94/95/96 \times \frac{10}{44/45/46} \frac{(\text{measured distance } \mathbf{Y} - \mathbf{Z})}{\text{lenght of scale bar}}$

20.4 – 21.8

(correct answer 2 marks)

2

- (iii) no cell wall (permanent) / (large) vacuole / chloroplasts / smaller;

(accept microvilli)

1 max

[5]

Q2.

- (a) X = mitochondria;
Y = (rough) endoplasmic reticulum;

Accept ribosomes/ER/RER for Y

Reject smooth endoplasmic reticulum for Y

2

- (b) (i) (Sections cut at) different angles/in different planes;

Ignore name given to organelle

1

- (ii) Z modifies/packages/transportes/secretetes mucus/ Z adds sugars to proteins;
X provides ATP/energy (for this);

Accept makes in relation to Z but not X

Ignore names of organelles if function correct

2

[5]

Q3.

- (a) (i) A mitochondrion and B nucleus;
(need both for one mark) 1
- (ii) increased surface area;
for respiration / enzymes; 2
- (b) *any suitable feature*
e.g. plasmid / capsule / 70S ribosomes / smaller
ribosomes / complex cell wall / mesosome / no nucleus; 1
- (c) use of differential centrifugation / or description;
first / low-spin pellet discarded / spin at low speed to remove cell
wall material / cell debris;
supernatant re-spun at higher speed / until pellet with chloroplasts is found;
method of identifying chloroplasts e.g. microscopy; 3 max

[7]

Q4.(a) B;

A;

E;

3

- (b) 1. (Many mitochondria) release energy / ATP **for** movement of vesicles / synthesis of
protein / active transport;

*Must include function of organelle **and** use in context of milk
production.*

Ignore reference to lipid / triglyceride

Reject reference to mitochondria undergoing anaerobic respiration

Reject "produce energy".

Reject "energy for respiration"

2. (Many Golgi) vesicles transport protein / glycoprotein / milk **to** cell membrane / **out**
of cell;

*Must include function of organelle **and** use in context of milk
production.*

Ignore reference to lipid / triglyceride

Accept exocytosis as transport and release

Ignore references to protein synthesis

2

[5]

- Q5.(a)** 1. Dissolve in alcohol, then add water;
2. White emulsion shows presence of lipid. 2
- (b) Glycerol. 1
- (c) Ester. 1
- (d) **Y** (no mark)
Contains double bond between (adjacent) carbon atoms in hydrocarbon chain. 1
- (e) 1. Divide mass of each lipid by total mass of all lipids (in that type of cell);
2. Multiply answer by 100. 2
- (f) Red blood cells free in blood / not supported by other cells so cholesterol helps to maintain shape;
Allow converse for cell from ileum – cell supported by others in endothelium so cholesterol has less effect on maintaining shape. 1
- (g) 1. Cell unable to change shape;
2. (Because) cell has a cell wall;
3. (Wall is) rigid / made of peptidoglycan / murein. 2 max
- [10]**
- Q6.(a)** (i) Repeating units / nucleotides / monomer / molecules;
Allow more than one, but reject two 1
- (ii) 1. C = hydrogen bonds;
2. D = deoxyribose;
Ignore sugar
3. E = phosphate;
Ignore phosphorus, Ignore molecule 3

(iii)

Name of base	Percentage
Thymine	34
Cytosine / Guanine	16
Adenine	34
Cytosine / Guanine	16

Spelling must be correct to gain MP1

First mark = names correct

Second mark = % correct, with adenine as 34%

2

(b) (i) 153;

1

(ii) Some regions of the gene are non-coding / introns / start / stop code / triplet / there are two DNA strands;

Allow addition mutation

Ignore unqualified reference to mutation

Accept reference to introns and exons if given together

Ignore 'junk' DNA / multiple repeats

1

[8]