

# Biology

## Y11 to Y12 Bridging Work



Our Lady's Catholic College

Science Department

2020

## Welcome to OLCC Biology!

This bridging work is designed to help you to bridge the gap between your GCSE Science studies and the AS/A Level Biology course.

### Why do bridging work?

Preparation is crucial for studying A Level Biology. After completing these exercises you will need to highlight any areas that you really had trouble understanding. We are expecting you to put 100% effort into these tasks to show your commitment to studying biology. All of these are essential in the understanding of the foundations of biology.

We want you to be successful at A-level Biology and some students find the change from GCSE quite a challenge. Although you have fewer subjects, there are different skills post-16 and the volume of work is greater due to the increased demand of depth and detail.

Bridging work should help you to gauge your current understanding of the subject and introduce you to the depth of understanding that is required for study at post-16.

### Is the bridging work assessed?

You will be asked to bring your bridging work to your interview for sixth form, and to your first biology lesson. Please keep all the work you complete in a folder until then.

### Biology A-level

We study **AQA Biology A Level** and your Year 12 Biology Qualification will cover the following 4 units:

1. Biological Molecules
2. Cells
3. Organisms exchange substances with their environment
4. Genetic information, variation and relationships between organisms

If you would like to find out more about the course content, you can find the specification on the AQA website: <https://www.aqa.org.uk/subjects/science/as-and-a-level/biology-7401-7402/specification-at-a-glance>

Studying biology (or, in fact any subject) at A-level will require you to be highly organised and effective with your own independent work. Not only will you have to balance the workload of this subject and the other subjects you have chosen, you will also be required to commit to the subject and do the very best that you can.

If you cannot remember the answers to these tasks from your GCSE learning, please use the internet (we have suggested relevant links for each topic) and your GCSE notes or revision guides to help you complete the booklet. We do not expect to see blank pages! You may also choose to keep evidence of notes you take from the internet and other resources in the file with your answers to the tasks.

As part of your AS/A-Level studies you will have nine hours each fortnight in your timetable. In these lessons you will cover all the theory and practical work required for the course. You are also expected to spend at least five hours a week on your biology work outside of lessons. This will include homework tasks, pre-reading, independent study tasks, making additional notes, reviewing lesson materials and reading around the subject. To allow you to make a start on this, a suggested reading list has been included at the end of this pack.

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but to be  
more

This bridging work has 2 sections:



**Section A** contains tasks based on 12 important topics that you covered at GCSE and need a good understanding of to build upon these at A-Level. Each topic has some suggested links to help you revise them, and some questions to test your knowledge and understanding. The answers are at the back of the booklet. Please look at these after you have completed the task. The links we have sent are to the Edexcel Combined Science sections of Bitesize and to the Seneca Learning course Combined Science Biology: Edexcel GCSE Higher. We recommend you create a free Seneca account if you don't already have one. It will allow you to keep track of your progress. You can also use other sites. **You must complete all this section.**

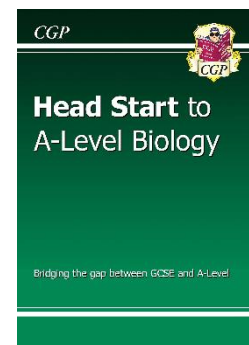
1. Cells
2. Microscopes and magnification
3. The cell cycle and mitosis
4. Diffusion, osmosis and active transport
5. Monomers and polymers
6. DNA
7. Genetics
8. Enzymes
9. Photosynthesis and respiration
10. Vocabulary for practical work
11. Units for biology
12. Analysing data in tables and graphs

**Section B** contains a mixture of research tasks, and extension and enrichment activities. **You should choose at least one research task to complete from this section.** You may like to read some of the suggested books or watch some of the films that have a biology basis.

### If you feel you want or need to do more preparation...

You could try '**Head Start**' to A-Level Biology. It is available from Amazon and other places at £4.95 <https://www.amazon.co.uk/Head-Start-level-Biology-Level/dp/1782942793>

It recaps all the tricky topics from GCSE that AS builds on. It is ideal preparation for September no matter what GCSE option you have followed. It will also be useful for reference throughout the course.



Please don't think you have to buy this book. To support your learning, you will be provided with a textbook for the current AS/A-Level course, this will be in exchange for a deposit, which will be returned once you give your book back in good condition. Your teachers are, of course, an excellent source of support, both in and out of lessons.



You could also try the Seneca Learning Course  
"Biology: AQA A Level Preparation – Summer 2020"

<https://app.senecalearning.com/classroom/course/76917ca0-ac10-43c9-8742-e49b861417b2>

**Section A – complete all tasks in this section**

**Topic 1 – Cells** Revise the parts and functions of eukaryotic and prokaryotic cells and then complete the tasks below:

<https://www.bbc.co.uk/bitesize/guides/zg9mk2p/revision/1>

Seneca Learning 1.1.1 Eukaryotes and Prokaryotes, 1.1.2 Animal, Plant and Bacteria Cells

<https://app.senecalearning.com/classroom/course/681e2220-1d4e-11e8-b373-d7e35435fc8a>

Complete the table to describe the function of these cell parts. Tick/cross to show whether the part is present in each type of cell (you may want to indicate if it is only present in some cells)

Cell part	Function	Eukaryotic		Prokaryotic
		animal	plant	bacteria
cell-surface membrane				
cell wall				
nucleus				
cytoplasm				
chloroplasts				
mitochondria				
flagellum				
ribosomes				
plasmid				
vacuole				
circular DNA				
slime capsule				

Draw the structure of a typical animal, plant and bacterial cell. Label the parts that are present in the cells.

**Topic 2 – Microscopes and magnification** Microscopes have led to huge advances in biology and a number of the required practical activities use microscopes.

<https://www.bbc.co.uk/bitesize/guides/zg9mk2p/revision/5>

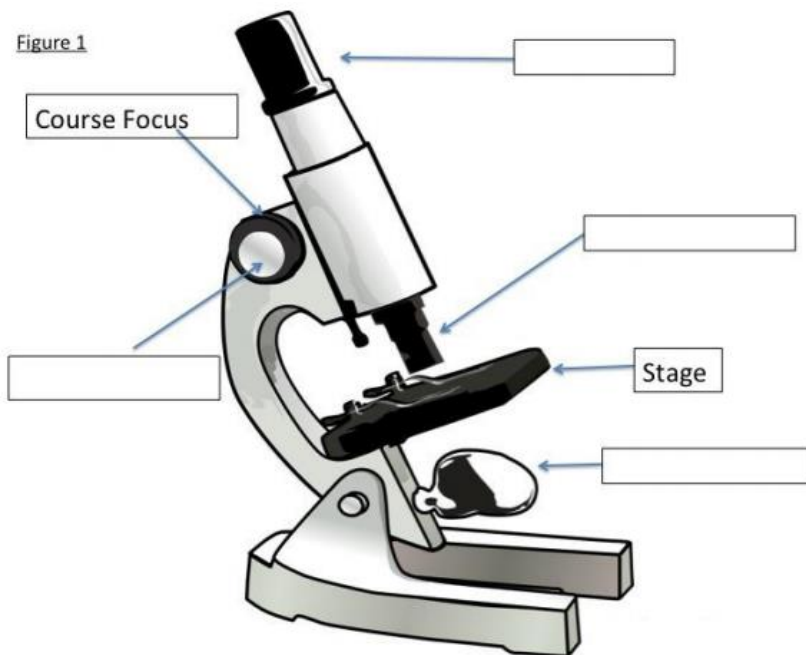
Seneca Learning 1.1.4 Microscopy and 1.1.5 Microscopy 2

<https://app.senecalearning.com/classroom/course/14a5e0a0-1e12-11e8-82e4-c9ec1e8bc494/section/473af190-1e12-11e8-82e4-c9ec1e8bc494/session>

What key terms are being described below?

	How much bigger something appears than its actual size
	The smallest distance between two points where they can still be seen as separate
	A dye used to colour parts of a specimen to make the easier to see
	The part of the microscope you look down
	The part of the microscope that is closest to the specimen

Label the parts of the optical (light) microscope:



How do you calculate the total magnification of an optical microscope?	
What would be the total magnification if a 10x eyepiece lens and a 20x objective lens were being used?	
How do you calculate the actual size of an object viewed under a microscope?	
Calculate the actual size of an onion cell if it measures 20mm using a 1000X magnification.	

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 more

**Topic 3 – The cell cycle and mitosis** Revise the cell cycle and mitosis and then complete the tasks below:



<https://www.bbc.co.uk/bitesize/guides/zpkx8mn/revision/2>

Seneca Learning 2.1.1 Mitosis

<https://app.senecalearning.com/classroom/course/681e2220-1d4e-11e8-b373-d7e35435fc8a/section/cb3462b0-1d4f-11e8-b373-d7e35435fc8a/session>

True or false?

Mitosis is another name for the cell cycle	
Mitosis produces genetically identical cells	
Mitosis is important for growth, repair and sexual reproduction	
Mitosis produces haploid cells	
Mitosis produced two daughter cells	

Complete the table below to name the stages of the cell cycle and describe what happens in each stage:

Diagram	Stage	What happens

**Topic 4 – Diffusion, osmosis and active transport** Revise transport in cells and then complete the tasks below:

<https://www.bbc.co.uk/bitesize/guides/z9myxfr/revision/1>

Seneca Learning 1.3.1 Diffusion, 1.3.2 Osmosis, 1.3.3 Active Transport

<https://app.senecalearning.com/classroom/course/681e2220-1d4e-11e8-b373-d7e35435fc8a/section/bfd4b410-1d4f-11e8-b373-d7e35435fc8a/session>

Complete the definitions of the three processes:

diffusion	The _____ movement of _____ from an area of _____ concentration to an area of _____ concentration (_____ the concentration gradient).
osmosis	The _____ movement of _____ from an area of _____ concentration to an area of _____ concentration, through a _____ permeable membrane.
active transport	The movement of _____ from an area of _____ concentration to an area of _____ concentration (_____ the concentration gradient). It requires _____ from respiration and _____ in the cell membrane.

Match the examples to the principles involved (write the letter in the correct box of the correct principle involved)

diffusion	<ul style="list-style-type: none"> <li>a) Drinking a sports drink after exercise</li> <li>b) Gas exchange in the lungs</li> <li>c) Absorbing nutrients from food into the body</li> <li>d) Moving ions into cells</li> <li>e) The effect of salt on slugs</li> <li>f) Penguins huddling to keep warm</li> <li>g) Potato pieces get heavier when put into pure water</li> <li>h) Potato pieces get lighter when put in very salty water</li> <li>i) Cacti do not have thin, large leaves</li> </ul>
osmosis	
active transport	
changing surface area or length	
	<b>Extension:</b> try to explain how the principles are involved in each example (complete on lined paper)





## Topic 5 – Monomers and polymers

Proteins, lipids (fats and oils) and DNA are all large molecules (polymers) that are made of smaller molecules (monomers). Carbohydrates can also exist as polymers and monomers

Revise the functions of these polymers and revise the monomers that make them up.

These links will get you started but you might need to do some of your own research too for the questions in **BOLD**

<https://www.bbc.co.uk/bitesize/guides/zwxv6yc/revision/4>

Why does the body need these large molecules?	
How do we get a supply of these molecules?	

### Carbohydrates

Name four carbohydrates (at least two of which are polymers)	
What are the two polymers in that list?	
What are the functions of starch and glycogen?	Starch  Glycogen
<b>What is a monosaccharide? Give two examples.</b>	
<b>What is a disaccharide? Give two examples.</b>	

### Proteins

What are the monomers that make proteins?		
Name four proteins.	1.	2.
	3.	4.
For each of those four proteins state their function	1.	2.
	3.	4.

## Lipids

What are the two kinds of lipids?	
What are the smaller units that make up a lipid?	
Why are lipids needed in the body?	

## Digestion

Polymers are digested into monomers so they can be absorbed into our blood.

What is the definition of digestion?	
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Complete this table using information from <https://www.bbc.co.uk/bitesize/guides/zwxv6yc/revision/4>

	Type of enzyme that breaks them down	Where those enzymes are made	The products of digestion
Carbohydrates			
Proteins			
Lipids			

**Topic 6 – DNA** DNA is an extremely important polymer that carries the genetic information.

Revise DNA and complete the tasks below:



Seneca Learning 3.2.3 DNA structure <https://app.senecalearning.com/classroom/course/14a5e0a0-1e12-11e8-82e4-c9ec1e8bc494/section/7838cb40-1e13-11e8-82e4-c9ec1e8bc494/session>

a) What is DNA an abbreviation for?	
b) Where is DNA found in a eukaryotic cell?	
c) What is the name given to the shape of a DNA molecule?	
d) What is the name of the monomer that makes up DNA?	
e) Draw and label one of the monomers that make up DNA	
f) Which parts of DNA make up the backbone?	
g) What are the names of the 4 bases found in DNA?	
h) What are the complementary base-pairing rules?	
i) If the base sequence on one strand of DNA was AAT CGC ATA CAT, what would be the sequence on the other strand?	
j) What type of bonds hold the two strands of DNA together?	
k) Which part of DNA carried the genetic code?	
l) What does DNA code for?	
m) What is meant by a triplet code?	

## Topic 7 – Genetics

Genetics is the study of genes, the genetic variation those genes cause and how those genes are inherited.

Before you start on the questions revise the topic here:

<https://www.bbc.co.uk/bitesize/guides/znhgrwx/revision/1>

On Seneca the work is 3.3.2 to 3.3.3 <https://app.senecalearning.com/classroom/course/681e2220-1d4e-11e8-b373-d7e35435fc8a/section/28df7744-60af-4a88-8cf7-b50a814273fe/session>

There are lots of words we need to be able to use and understand in this topic. Find the definitions of these and learn them.

Word	Definition
Genotype	
Phenotype	
Mutation	
Gene	
Chromosome	
Natural selection	
Evolution	
Alleles	
Genome	
Homozygous	
Heterozygous	
Dominant	
Recessive	



The height of pea plants is controlled by a single gene which has two alleles: tall and short. The tall allele is dominant and is shown as T. The small allele is recessive and is shown as t.

Complete this Punnett square to show the possible allele combinations of the offspring produced when two pea plants are bred. Parent 1 is TT tall. Parent 2 is tt short

	T	T
t		
t		

Describe and explain the characteristics of the offspring.

The inheritance of fur colour in mice is controlled by a single gene with two alleles. White fur is recessive (g). Grey fur is dominant (G). One mouse is homozygous recessive and the other is heterozygous. Use a Punnett square to determine the probability of getting a white mouse in the next generation.


Huntington's disease is caused by a dominant allele (H) the recessive allele (h) is healthy.

		Paternal (father's) alleles	
		H	h
Maternal (mother's) alleles	h		
	h		

Cystic fibrosis is caused by a recessive allele (f) the healthy allele is dominant (F)

		Paternal (father's) alleles	
		F	f
Maternal (mother's) alleles	F		
	f		

For each of the Punnett squares:

1. Complete the diagrams to show the alleles for each child.
2. For each parent and child state whether they are healthy, have the disease or a carrier.

Each of the following statements is false. Re-write each one so that it becomes true:

1. The first Punnett square shows that one in every four children from this couple will have Huntington's disease.
2. The second Punnett square shows that there is a one in three chance that a child born to this couple will have cystic fibrosis.
3. All children of the second couple will either be carriers or suffer from cystic fibrosis.
4. The percentage of children who are sufferers on the diagram is the same as the percentage of children each couple will have who are sufferers.
5. Having one child who is born with cystic fibrosis means that the next three children will not have the disease.

## Topic 8 – Enzymes

Enzymes are proteins that are able to speed up chemical reactions. They are very important in biology because they control all the reactions that happen in cells.

We need to revise how enzymes work, how they are affected by conditions like temperature and pH. We also need to revise how to investigate them through practical experiments.

<https://www.bbc.co.uk/bitesize/guides/zwxv6yc/revision/1>

Seneca Learning 1.2 Enzymes

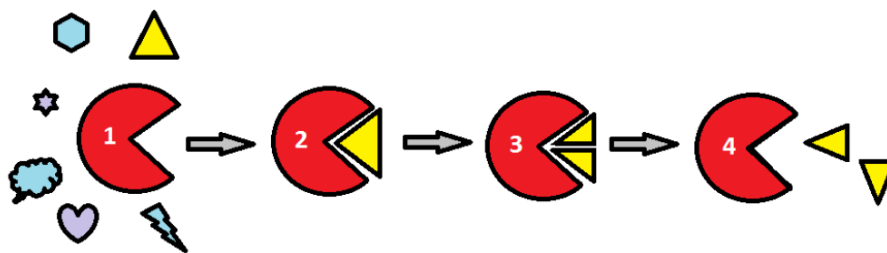
<https://app.senecalearning.com/classroom/course/681e2220-1d4e-11e8-b373-d7e35435fc8a/section/afce87d0-1d4f-11e8-b373-d7e35435fc8a/section-overview>

Use the bitesize site to help you answer these questions

What are enzymes?

What are the monomers that make proteins	
What is a catalyst?	

The lock and key hypothesis



Use the bitesize link to help you explain what is happening in each stage: 1,2,3 and 4

1	
2	
3	
4	

### Denaturing

<p>Explain why an enzyme won't work if it is denatured</p> <p>Use key words and ideas to give a full explanation</p>	
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### Rate of reaction

<p>If 10g of substrate is all used up in 5 minutes what is the rate of reaction?</p>
<p>If 0.5g of product is produced in 5 seconds what is the rate of reaction?</p>

### Affecting the rate of reaction

	<p>Why is the reaction slow at low temperature?</p> <p>Why does the reaction slow down at high temperatures?</p> <p>What is the optimum temperature for most enzymes found in human cells?</p>
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### Investigating enzymes

Read the method on <https://www.bbc.co.uk/bitesize/guides/zwxv6yc/revision/3>

What is the enzyme in the experiment?	
What is the substrate?	
What is the independent variable?	
Why did they use iodine?	

### Results

pH	Time taken to digest all the starch (s)
5	240
6	120
7	60
8	140

Draw or sketch a graph of pH and time taken to digest the starch

What is the optimum pH of this enzyme?

## Topic 9 – Photosynthesis and Respiration

Two of the most important reactions to take place in living things are photosynthesis and respiration.

To revise photosynthesis start here: <https://www.bbc.co.uk/bitesize/guides/ztc297h/revision/1>

And for respiration start here: <https://www.bbc.co.uk/bitesize/guides/zw9x8mn/revision/6>

On Seneca the work is 6.1.1 and 6.1.2 for photosynthesis:

<https://app.senecalearning.com/classroom/course/681e2220-1d4e-11e8-b373-d7e35435fc8a/section/9c28aa20-1d50-11e8-b373-d7e35435fc8a/session>

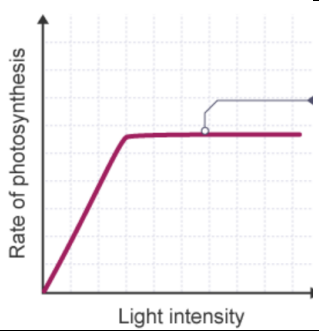
And also 8.3.1 respiration: <https://app.senecalearning.com/classroom/course/681e2220-1d4e-11e8-b373-d7e35435fc8a/section/f888e370-1d50-11e8-b373-d7e35435fc8a/session>

### Photosynthesis

Photosynthesis makes glucose. Much of that glucose is used for respiration, but not all of it.

Make a list of the uses of glucose (apart from respiration)	
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Many factors control the rate of photosynthesis. For each of these factors sketch the graph and give a short explanation.

Factor	Graph	Explanation
Light intensity		<p>At low light levels, light is the limiting factor so, as light intensity increases, the rate of photosynthesis increases</p> <p>At high light levels, light is not the limiting factor so, when light intensity increases there is no increase in the rate of photosynthesis</p>
Carbon dioxide concentration		
Temperature		





## Respiration

Make a list of the processes that the energy from respiration is used for in organisms	
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The rate of respiration increases when we exercise. If the exercise is very strenuous cells can switch to anaerobic respiration.

Explain why the heart and breathing rate increase during exercise	
Explain why we cannot do strenuous exercise for a long time.	

Complete the table

	Photosynthesis	Aerobic respiration
Which organisms carry out the process?		
Where in the organism does the process take place?		
Energy store at the beginning of the process	the sun	
Energy store at the end of the process		in cells
Reactants needed for the process		
Products of the process		
Overall word equation		
Balanced symbol equation for the overall process		

## Topic 10 – Vocabulary for practical work

You should have come across most of these words at GCSE. Match the keyword to its definition.

accurate	A statement suggesting what may happen in the future
data	An experiment that give the same results when a different person carries it out, or a different set of equipment or technique is used
precise	A measurement that is close to the true value
prediction	An experiment that gives the same results when the same experimenter uses the same method and equipment
range	Physical, chemical or biological quantities or characteristics
repeatable	A variable that is kept constant during an experiment
reproducible	A variable that is measured as the outcome of an experiment
resolution	This is the smallest change in the quantity being measured of a measuring instrument that gives a perceptible change in the reading
uncertainty	The interval within which the true value can be expected to lie
variable	The spread of data, showing the maximum and minimum values of the data
independent variable	Measurements where repeated measurements show very little spread
control variable	Information, in any form, that has been collected
dependent variable	A variable that has its values chosen or changed by the person carrying out the practical



## Topic 11 – Units for Biology

You should be confident with using SI units and prefixes in biology. Complete the tables and then try the questions.

SI units:

Physical quantity	Unit	Abbreviation
	kilogram	
length		m
		s
		K
amount of substance		mol

(although we commonly use °C in biology)

Prefixes:

Prefix	Symbol	Multiplication factor	
Giga		$10^9$	
	M		1 000 000 000
deci	d	$10^{-1}$	
		$10^{-2}$	
milli			0.001
	$\mu$		
			0.000 000 001
pico			

We most commonly work with nano to kilo in biology, and we often have to convert from one measurement to another.

Which SI unit and prefix would you use for the following quantities? (the first is completed as an example)

a) The width of a virus	nm
b) The time between heart beats	
c) The length of a leaf	
d) The distance that a migratory bird travelled each year	
e) The width of a cheek cell	
f) The mass of a rabbit	
g) The mass of iron in the body	
h) The volume of the trunk of a large tree	

Extension (complete on paper)

Try to put these in order of size from largest to smallest:

height of an elephant; length of a DNA strand; width of a hair; height of a tree; width of a sodium ion; length of a nerve cell; length of a heart; width of a red blood cell; size of a virus; length of a finger; length of a mosquito; length of a human digestive system; width of a field; length of a water molecule

**Topic 12 – Analysing data in tables and graphs** Biological investigations often result in large amounts of data being collected. It is important to be able to analyse this data carefully to pick out trends.

**1. Mean, median, mode and scatter graphs**

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

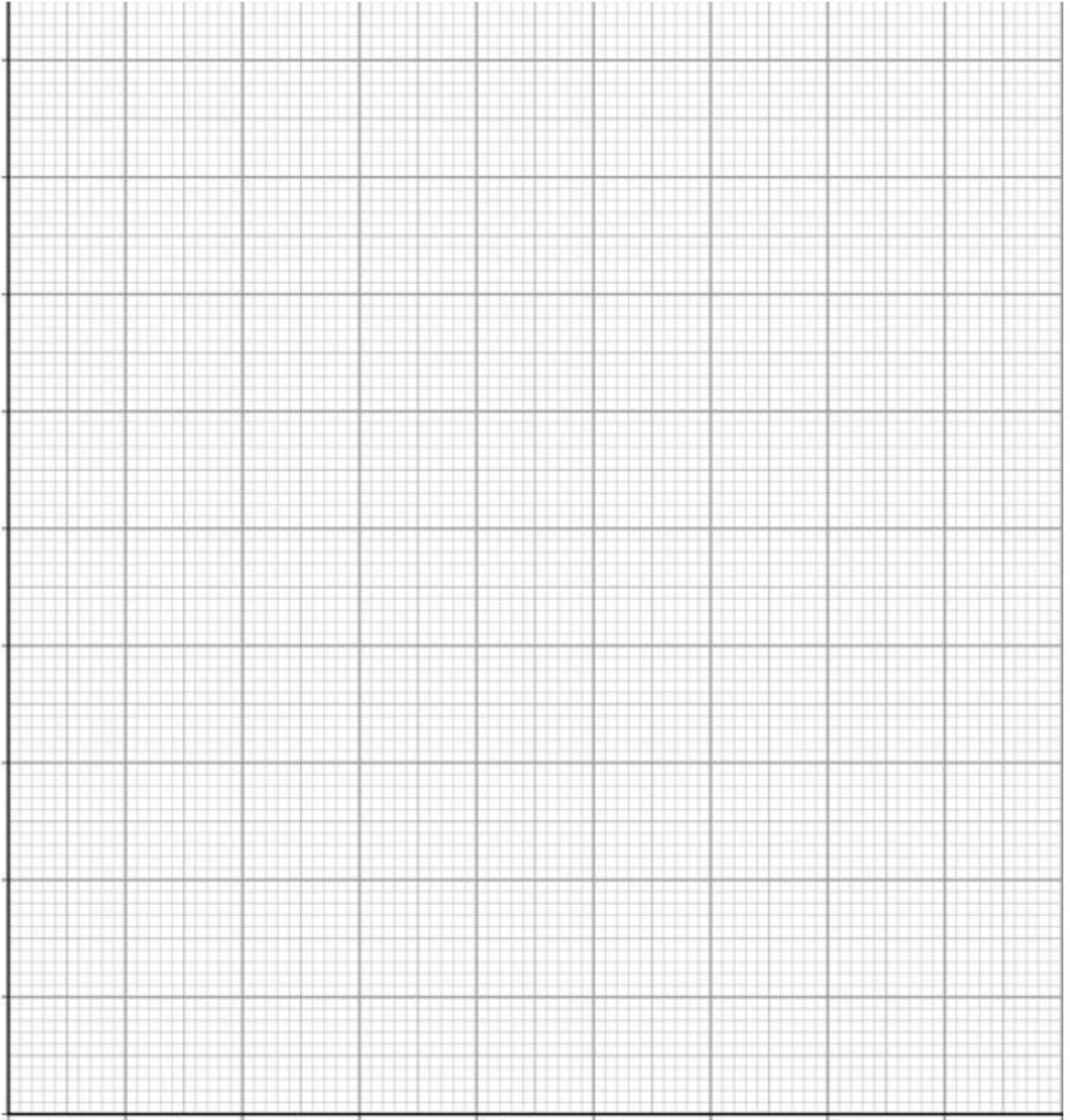
	Area covered in each quadrat A to E in cm <sup>2</sup>				
	A	B	C	D	E
Bog moss	55	40	10	–	–
Bell heather	–	–	–	15	10
Sundew	10	5	–	–	–
Ling	–	–	–	15	20
Bilberry	–	–	–	15	25
Heath grass	–	–	30	10	5
Soft rush	–	30	20	5	5
Sheep's fescue	–	–	25	35	30
Bare ground	20	15	10	5	5
Surface water	15	10	5	–	–
Soil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

– indicates zero cover.

a) Calculate:

- i. The modal area of soft rush in the sample
- ii. The mean soil depth
- iii. The median amount of bare ground in the sample

b) Use the data from the table to plot a scatter graph of soil depth against the area covered by bare ground, soft rush and bog moss (use different colours for each)



c) What conclusions does your graph suggest?

## 2. Analysing tables

Lung cancer, chronic bronchitis and coronary heart disease (CHD) are associated with smoking. Tables 1 and 2 give the total numbers of deaths from these diseases in the UK in 1974.

Table 1 Men

Age/years	Number of deaths (in thousands)		
	lung cancer	chronic bronchitis	coronary heart disease
35-64	11.5	4.2	31.7
65-74	12.6	8.5	33.3
75+	5.8	8.1	29.1
Total (35-75+)	29.9	20.8	94.1

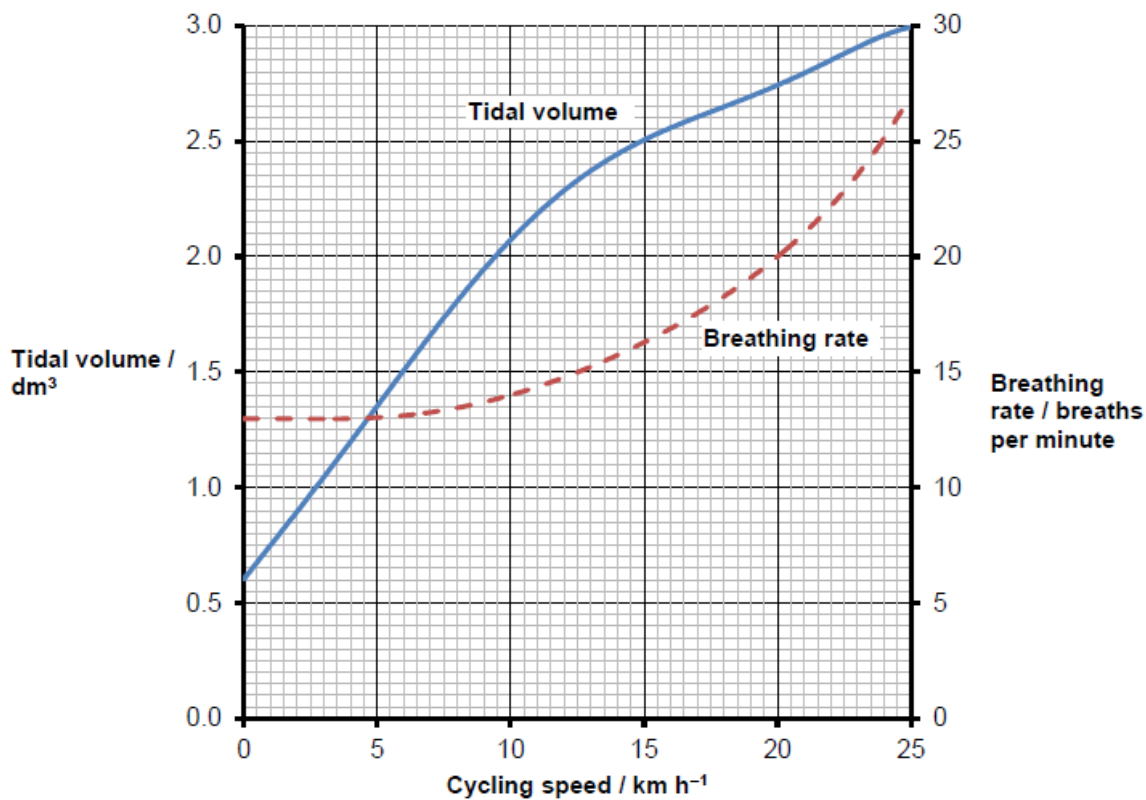
Table 2 Women

Age/years	Number of deaths (in thousands)		
	lung cancer	chronic bronchitis	coronary heart disease
35-64	3.2	1.3	8.4
65-74	2.6	1.9	18.2
75+	1.8	3.5	42.3
Total (35-75+)	7.6	6.7	68.9



### 3. 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 pedalling at different speeds. The graph shows the results.



- What was the tidal volume when the cycling speed was 17 km h<sup>-1</sup>?
- What was the breathing rate when the cycling speed was 8 km h<sup>-1</sup>?
- What was the change in breathing rate when the cyclist change from 10 to 20 km h<sup>-1</sup>? Express this as a percentage.
- At what speed did the breathing rate start to increase?
- The tidal volume increased linearly with cycling speed up to about 10 km h<sup>-1</sup>. Calculate the increase in volume for each increase in speed of 1 km h<sup>-1</sup>.
- For this initial linear section, what is the equation of the tidal volume line? (Hint: use  $y = mx + c$ )



## Section B – You should complete at least one research task from the four choices in this section.



### 2. Cells

The cell is a unifying concept in biology. It features many times in the A level course. Prokaryotic and eukaryotic cells can be distinguished on the basis of their ultrastructure. In complex multicellular organisms, cells are organised into tissues, organs and systems. During the cell cycle, genetic information is copied and passed to daughter cells. This can be during mitosis or meiosis.

Read the information on these websites:

<http://www.s-cool.co.uk/a-level/biology/cells-and-organelles>

<https://app.senecalearning.com/classroom/course/d0ce0c30-6417-11e8-8edc-d9cd1c890408/section/9161a5a9-0b79-4a52-a8fe-011a443df39f/session>

And take a look at these videos:

<https://www.youtube.com/watch?v=gcTuQpuJyD8>

<https://www.youtube.com/watch?v=L0k-enzoeOM>

<https://www.youtube.com/watch?v=qCLmR9-YY7o>

#### **Task:**

**Produce a one-page revision guide summarising one of the following topics: Cells and Cell Ultrastructure, Prokaryotes and Eukaryotes, or Mitosis and Meiosis.**

Whichever topic you choose, your revision guide should include:

Key words and definitions

Clearly labelled diagrams

Short explanations of key ideas or processes.

### 1. Ecosystems

Ecosystems range in size. 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 this website:

<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 shoreline).**

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.

### **3. Control Systems**

Homeostasis is the maintenance of a constant internal environment. Negative feedback helps maintain an optimal internal state in the context of a dynamic equilibrium. Stimuli, both internal and external, are detected leading to responses. Coordination may be chemical or electrical in nature

Read the information on this website

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

And take a look at this video:

<https://www.youtube.com/watch?v=x4PPZCLnVka>

#### **Task:**

**Produce a poster to display in your classroom summarising one of the following topics:**

**Temperature Control, Water and the Kidneys, Glucose, or The Liver.**

Whichever topic you choose, your poster or display should include:

Key words and definitions

Clearly labelled diagrams

Short explanations of key ideas or processes.

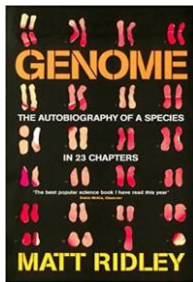
### **4. Scientific and Investigative Skills**

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:**

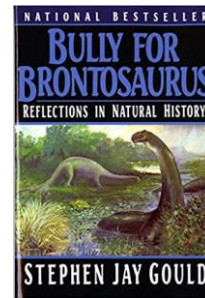
**Produce a glossary for the following key words:**

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,

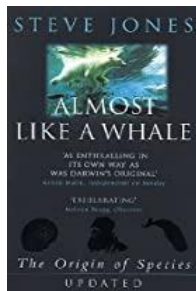


A brilliant explanation of genetics, old and new, one chromosome at a time! By looking at our genes we can see the story of our evolution, what makes us individual, how our sexuality is determined, how we acquire language, why we are vulnerable to certain diseases, how mind has arisen.

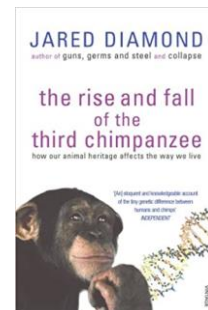
"Provocative and delightfully discursive essays on natural history". This collection of essays on biology is very interesting.



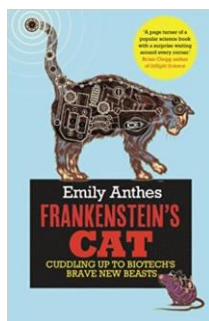
A modern accessible re-writing of Darwin's Origin of Species. From AIDS to dinosaurs, from conservation to cloned sheep, bursting with anecdotes, jokes and irresistible facts, Almost Like a Whale is a popular account of the science that makes biology make sense.



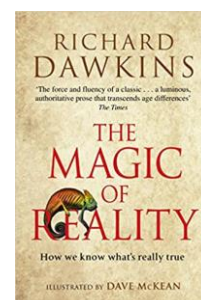
More than 98 percent of human genes are shared with two species of chimpanzee. The 'third' chimpanzee is man. Jared Diamond surveys out life-cycle, culture, sexuality and destructive urges both towards ourselves and the planet to explore the ways in which we are uniquely human yet still influenced by our animal origins



From the petri dish to the pet shop, meet the high-tech menagerie of the near future, as humans reinvent the animal kingdom. Discover how glow in the dark fish are made and more great Biotechnology breakthroughs. Frankenstein's Cat is an eye-opening exploration of weird science and how we are playing god in the animal world.



Packed with inspiring explanations of space, time and evolution, laced with humour and clever thought experiments, it explores a stunningly wide range of natural phenomena. This is a page-turning, inspirational detective story that not only mines all the sciences for its clues but primes the reader to think like a scientist too.

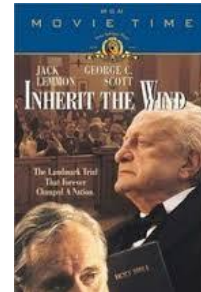


**Film Recommendations** Everyone loves a good story, especially one with some science in it! 😊



### **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?



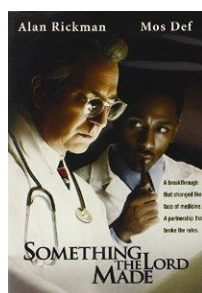
### **Andromeda Strain (1971)**

Science fiction by the great thriller writer Michael Crichton (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.

### **Gattaca (1997)**

A dark, understated film about the dangers of eugenics. This film was ahead of its time.

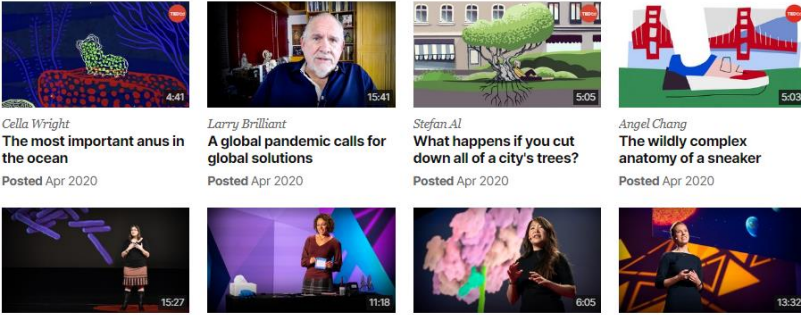


Aspire  
not to  
have more  
but to be  
more

## Other things to watch

<https://www.ted.com/talks> You can filter by subject and duration

Active filters: English Science Clear Sort by: Newest



**Cella Wright**  
The most important anus in the ocean  
Posted Apr 2020

**Larry Brilliant**  
A global pandemic calls for global solutions  
Posted Apr 2020

**Stefan Al**  
What happens if you cut down all of a city's trees?  
Posted Apr 2020

**Angel Chang**  
The wildly complex anatomy of a sneaker  
Posted Apr 2020

**Lara Durgavich**  
An evolutionary perspective on human health and disease  
Posted Apr 2020

**Nadya Mason**  
How to spark your curiosity, scientifically  
Posted Apr 2020

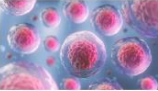







**Janet Iwasa**  
The wonders of the molecular world, animated  
Posted Apr 2020

**Karin Öberg**  
The galactic recipe for a living planet  
Posted Apr 2020

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.**

## Articles

**Biological Sciences Review** This is a great combination of articles and exam hints.

<b>THE CELL</b>  Videos, presentations and lesson plans covering most aspects of cell biology for post-16 students. <a href="#">Browse resources</a>	<b>DRUG DEVELOPMENT</b>  Investigate the role of pharmaceuticals in modern life and where we might go in the future. <a href="#">Browse resources</a>	<b>FAT</b>  Find out what fats and lipids do, not just inside us and other organisms, but in the world around us. <a href="#">Browse resources</a>	<b>GENES, GENOMES AND HEALTH</b>  Explore how science can help us to understand our genes and genetic identity. <a href="#">Browse resources</a>
<b>HEALTH AND CLIMATE CHANGE</b>  Investigate climate change and what can be done to minimise the risks. <a href="#">Browse resources</a>	<b>IMMUNE SYSTEM</b>  Articles, posters and activities to help you learn about health and the immune system. <a href="#">Browse resources</a>	<b>INSIDE THE BRAIN</b>  Explore how imaging research has changed the way we look inside the brain. <a href="#">Browse resources</a>	<b>NUMBER CRUNCHING</b>  A range of articles explaining how data and statistics can help us to understand the world. <a href="#">Browse resources</a>



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.

<https://www.stem.org.uk/big-picture/resource-collection>


You should keep up to date with science in the news. You can set up the BBC News app to show you news stories about science and environment or genetics

[https://www.bbc.co.uk/news/science\\_and\\_environment](https://www.bbc.co.uk/news/science_and_environment)


**NEWS**

Home Coronavirus UK World Business Politics Tech Science Health Family & Education Entertainment & Arts More


Science & Environment




**Coronavirus lockdown reduces UK ground motions**  
Science instruments sense a big dip in seismic noise as the population stays at home.  
13h | Science & Environment



**Forests 'can take cover to resist alien invaders'**  
Native woodlands can resist the spread of invasive species if they block light reaching the ground.  
13h | Science & Environment



**High plastic concentration found on ocean floor**  
Mediterranean sediments are shown to have up to 1.9 million tiny plastic pieces per square metre.  
1d | Science & Environment



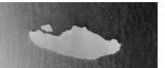


**US authorises Ebola drug for coronavirus treatment**  
The Food and Drug Administration authorises emergency use of the experimental anti-viral drug.  
2h | US & Canada

**Animals in zoos 'lonely without visitors'**

**Nasa names companies to develop Moon landers**

**Space lasers track melting of Earth's ice sheets**

**Our Planet Matters** See All



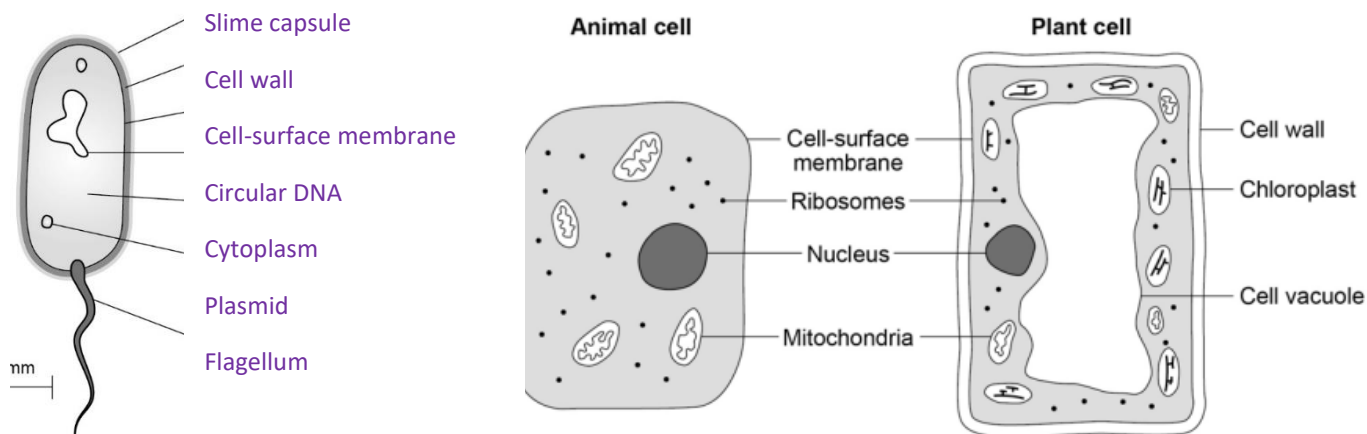
2019 was Europe's warmest year on record

## Answers

### Topic 1 – Cells

Cell part	Function	Eukaryotic		Prokaryotic
		animal	plant	bacteria
cell-surface membrane	Controls what enters and leaves the cell, selectively permeable	✓	✓	✓
cell wall	Provides support, protects the cell	x	✓	✓
nucleus	Contains the genetic material, controls the cell	✓	✓	x
cytoplasm	Where most chemical reactions take place	✓	✓	✓
chloroplasts	Absorb light for photosynthesis	x	some	x
mitochondria	Carry out aerobic respiration to release energy	✓	✓	x
flagellum	Rotates to move the cell	x	x	some
ribosomes	Protein synthesis	✓	✓	✓
plasmid	Small loop of DNA that contains extra genes	x	x	some
vacuole	Contains sap, supports the cell	x	✓	x
circular DNA	Carries most of the genes	x	x	✓
slime capsule	Protects the cell	x	x	some

Diagrams that show:



### Topic 2 – Microscopes and magnification

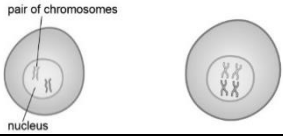


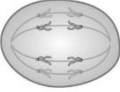
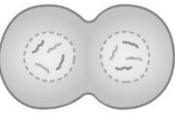
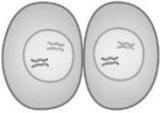
<b>Magnification</b>	How much bigger something appears than its actual size
<b>Resolution</b>	The smallest distance between two points where they can still be seen as separate
<b>Stain</b>	A dye used to colour parts of a specimen to make the easier to see
<b>Eyepiece lens</b>	The part of the microscope you look down
<b>Objective lens</b>	The part of the microscope that is closest to the specimen

Parts of the microscope (clockwise from top) **eyepiece lens, objective lens, mirror, fine focus**

How do you calculate the total magnification of an optical microscope?	<b>Eyepiece magnification x objective magnification</b>
What would be the total magnification if a 10x eyepiece lens and a 20x objective lens were being used?	<b>10 x 20 = 200x</b>
How do you calculate the actual size of an object viewed under a microscope?	<b>Actual size = image size ÷ magnification</b>
Calculate the actual size of an onion cell if it measures 20mm using a 1000X magnification.	<b>20 ÷ 1000 = 0.02mm</b>

### Topic 3 – The cell cycle and mitosis

Mitosis is another name for the cell cycle	F (it's part of the cell cycle)
Mitosis produces genetically identical cells	T
Mitosis is important for growth, repair and sexual reproduction	F (asexual reproduction)
Mitosis produces haploid cells	F (diploid)
Mitosis produced two daughter cells	T

Diagram	Stage	What happens
	Interphase	DNA replication (chromosomes are copied) Other organelles are copied (e.g. mitochondria)
	Prophase	Membrane around the nucleus breaks down Spindle fibres form
	Metaphase	Chromosomes line up in the middle (equator) of the cell
	Anaphase	Chromatids (chromosome copies) are pulled apart to the poles of the cell, by the spindle fibres
	Telophase	Membranes start to form around the two sets of chromosomes to form two nuclei
	Cytokinesis	Cytoplasm divides to produce two daughter cells

### Topic 4 – Diffusion, osmosis and active transport

diffusion	The net movement of particles from an area of higher concentration to an area of lower concentration (down the concentration gradient).
osmosis	The net movement of water from an area of higher water concentration to an area of lower water concentration, through a partially permeable membrane.
active transport	The movement of particles from an area of lower concentration to an area of higher concentration (against the concentration gradient). It requires energy/ATP from respiration and proteins in the cell membrane.

## Osmosis

- Drinking a sports drink after exercise needs to ensure rapid rehydration.
- The effect of salt on slugs, salt causes water to leave slugs by osmosis, killing them.
- Potato pieces get heavier when put in pure water as they take up water by osmosis due to the water potential of potato cell cytoplasm being more negative than water.

## Diffusion

- Gas exchange in the lungs – oxygen into blood down a diffusion gradient and carbon dioxide out down a diffusion gradient.
- Absorbing nutrients from food into the body down a concentration gradient when possible.
- Moving ions into cells by diffusion through channel/carrier proteins.

## Active transport

- Drinking a sports drink after exercise contains glucose and amino acids that will be absorbed by active transport.
- Absorbing nutrients from food into the body against a concentration gradient if needed.
- Moving ions into cells by active transport, for example the Na<sup>+</sup>K<sup>+</sup> ATPase pump to maintain the resting potential.

## Changing surface area or length

- Penguins huddling to keep warm will reduce the surface area exposed to the cold air and so reduce heat transfer to the surroundings
- Cacti do not have thin, large leaves to reduce the surface area so less water is lost by evaporation

## Topic 5 – Monomers and polymers

Why does the body need these large molecules?	Growth, repair and metabolism
How do we get a supply of these molecules?	From our food

### Carbohydrates

Name four carbohydrates (at least two of which are polymers)	Polymers- starch, glycogen, cellulose Others- sucrose, glucose, fructose, maltose, lactose
What are the two polymers in that list?	starch, glycogen, cellulose
What are the functions of starch and glycogen?	Starch - Stores energy in plants Glycogen - Stores energy in animals
<b>What is a monosaccharide? Give two examples.</b>	A carbohydrate monomer e.g. glucose
<b>What is a disaccharide? Give two examples.</b>	Two monosaccharides joined together e.g. sucrose, maltose, lactose

### Proteins

What are the monomers that make proteins?	Amino acids	
Name four proteins. (you may have other answers)	Enzymes	Haemoglobin
	Collagen	Keratin
For each of those four proteins state their function	Enzymes speed up chemical reactions	Haemoglobin Transports oxygen
	Collagen In connective tissue	Keratin Hair and fur



## Lipids

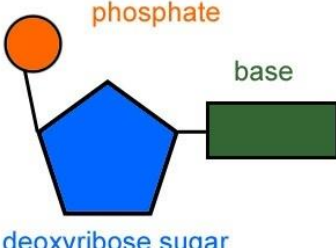
What are the two kinds of lipids?	Fats and oils
What are the smaller units that make up a lipid?	Fatty acids and glycerol
Why are lipids needed in the body?	Store energy, insulation, cell membranes

## Digestion

What is the definition of digestion?	The breakdown of large, insoluble molecules into smaller, soluble molecules that can be absorbed into the blood
--------------------------------------	---

	Type of enzyme that breaks them down	Where those enzymes are made	The products of digestion
Carbohydrates	Carbohydrase/ Amylase	Salivary glands Pancreas Small intestine	Monosaccharides/glucose
Proteins	Protease/ Pepsin/ Trypsin	Stomach Pancreas Small intestine	Amino acids
Lipids	Lipase	Pancreas Small intestine	Fatty acids glycerol

## Topic 6 – DNA

n) What is DNA an abbreviation for?	Deoxyribonucleic acid
o) Where is DNA found in a eukaryotic cell?	Nucleus
p) What is the name given to the shape of a DNA molecule?	Double helix
q) What is the name of the monomer that makes up DNA?	Nucleotide
r) Draw and label one of the monomers that make up DNA	 <p style="text-align: right; font-size: small;">© scienceaid.co.uk</p>
s) Which parts of DNA make up the backbone?	Sugar and phosphate
t) What are the names of the 4 bases found in DNA?	Adenine (A), cytosine (C), guanine (G), thymine (T)
u) What are the complementary base-pairing rules?	A always pairs with T, C always pairs with G
v) If the base sequence on one strand of DNA was AAT CGC ATA CAT, what would be the sequence on the other strand?	TTA GCG TAT GTA
w) What type of bonds hold the two strands of DNA together?	Hydrogen bonds
x) Which part of DNA carried the genetic code?	The bases
y) What does DNA code for?	proteins
z) What is meant by a triplet code?	3 bases on DNA code for 1 amino acid in a protein

## Topic 7 – Genetics

Word	Definition
Genotype	The alleles that an organism has for a particular characteristic
Phenotype	The visible characteristics of an organism
Mutation	Change in DNA/change to a gene
Gene	Basic unit of inheritance/ a section of DNA that codes for one protein
Chromosome	A structure made of DNA
Natural selection	How organisms that are better adapted to an environment survive longer and pass on more of their genes (alleles) to the next generation
Evolution	The change in characteristics of a species/population over time
Alleles	Versions of genes
Genome	All the genes/DNA of an organism
Homozygous	Two of the same allele in the genotype
Heterozygous	Two different alleles in the phenotype
Dominant	Allele that is expressed or shown even when there is only one copy of it
Recessive	The alleles that an organism has for a particular characteristic

	T	T
t	Tt	Tt
t	Tt	Tt

All tall

All have one T allele that makes them tall

	g	g
G	Gg	Gg
g	gg	gg

Half grey/half white

half the offspring have a dominant G allele

half are homozygous recessive

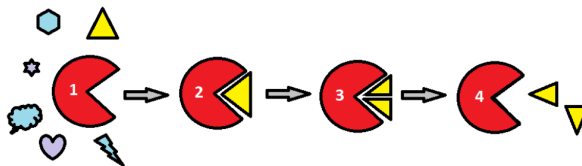
		Paternal (father's) alleles <b>has disease</b>	
		H	h
Maternal (mother's) Alleles <b>healthy</b>	h	Hh (has disease)	Hh (healthy)
	h	Hh (has disease)	Hh(healthy)
		Paternal (father's) alleles <b>(Healthy carrier)</b>	
		F	f
Maternal (mother's) Alleles <b>(Healthy carrier)</b>	F	FF (healthy)	Ff (healthy)
	f	Ff (healthy carrier)	Ff (healthy carrier)

1. The first Punnett square shows that one in every **two** children from this couple will have Huntington's disease.
2. The second Punnett square shows that there is a one in four chance that a child born to this couple will have cystic fibrosis.
3. Three out of four children of the second couple will either be carriers or suffer from cystic fibrosis.
4. The percentage of children who are sufferers on the diagram is not necessarily the same as the percentage of children each couple will have who are sufferers.
5. Each time a child is born the chances of having a child with or without cystic fibrosis remains the same.

## Topic 8 – Enzymes

What are enzymes?

What are the monomers that make proteins	Amino acids
What is a catalyst?	Something that speeds up chemical reactions but are not used up in that reaction



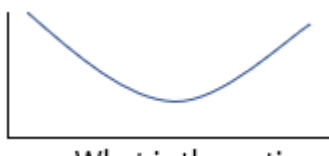
1	The enzyme is specific – it only fits with one substrate
2	The substrate fits into the active site
3	The reaction occurs and products are formed
4	The product are released and the enzyme is unchanged

Explain why an enzyme won't work if it is denatured	If enzymes are exposed to extremes of pH or high temperatures the <b>shape of their active site may change</b> . If this happens then the <b>substrate will no longer fit</b> into the enzymes. This means the key will no longer fit the lock. We say that the enzyme has been <b>denatured</b>
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<p>If 10g of substrate is all used up in 5 minutes what is the rate of reaction?</p> <p>Rate = change/time = 10g/5mins = <b>2g/min</b></p>
<p>If 0.5g of product is produced in 5 seconds what is the rate of reaction?</p> <p>Rate = change/time = 0.5g/5s = <b>0.1g/s</b></p>

	<p>Why is the reaction slow at low temperature? Little kinetic energy/few collisions between enzyme and substrate</p> <p>Why does the reaction slow down at high temperatures? Enzyme denatured/changes shape of active site/substrate no longer fits the active site</p> <p>What is the optimum temperature for most enzymes found in human cells? <b>37°C</b></p>
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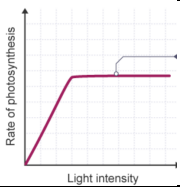
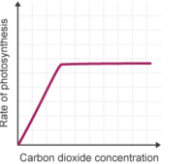
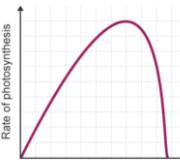
What is the enzyme in the experiment?	amylase
What is the substrate?	starch
What is the independent variable?	pH
Why did they use iodine?	To show when starch has been digested



Optimum pH is around (but not necessarily exactly ) pH 7

## Topic 9 – Photosynthesis and Respiration

Make a list of the uses of glucose (apart from respiration)	Make starch for storage, make cellulose for cell walls, make amino acids (needs nitrates) to make proteins for growth, make lipids to make cell walls
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Factor	Graph	Explanation
Light intensity		At low light levels, light is the limiting factor so, as light intensity increases, the rate of photosynthesis increases  At high light levels, light is not the limiting factor so, when light intensity increases there is no increase in the rate of photosynthesis
Carbon dioxide concentration		At low carbon dioxide concentrations, carbon dioxide is the limiting factor. As CO <sub>2</sub> levels increase the rate increases  At high CO <sub>2</sub> concentrations, CO <sub>2</sub> is no longer the limiting factor As CO <sub>2</sub> increases the rate of photosynthesis does not change
Temperature		The chemical reactions involved in photosynthesis are controlled by <b>enzymes</b> . As with any other enzyme-controlled reaction, the rate of photosynthesis is affected by temperature.  At low temperatures, the rate of photosynthesis is limited by the number of collisions between enzymes and substrate. As temperature increases the number of collisions increases, therefore the rate of photosynthesis increases. However, at high temperatures, enzymes are <b>denatured</b> and this will decrease the rate of photosynthesis.

## Respiration

Make a list of the processes that the energy from respiration is used for in organisms	For chemical reaction that build carbohydrates, protein and lipids Movement, cell division, homeostasis, active transport, nerve impulses
--	--

Explain why the heart and breathing rate increase during exercise	To increase the amount of oxygen and glucose getting to the muscles so they carry out aerobic respiration at a faster rate to release more energy for muscle contraction, and to remove the extra carbon dioxide produced
Explain why we cannot do strenuous exercise for a long time.	Strenuous exercise will involve anaerobic respiration That produces lactic acid that cause pain and fatigue

	Photosynthesis	Aerobic respiration
Which organisms carry out the process?	Plants, algae and some bacteria	All living organisms
Where in the organism does the process take place?	Chloroplasts (cytoplasm in bacteria)	Cytoplasm and mitochondria
Energy store at the beginning	the sun	glucose
Energy store at the end of the process	sun	in cells
Reactants needed for the process	Carbon dioxide and water	Glucose and oxygen
Products of the process	Glucose and oxygen	Carbon dioxide and water
Overall word equation	carbon dioxide + water → glucose + oxygen	glucose + oxygen → dioxide + water
Balanced symbol equation for the overall process	$6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$	$\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O} + 38\text{ATP}$

## Topic 10 – Vocabulary for practical work

1 accurate	4 A statement suggesting what may happen in the future
2 data	7 An experiment that give the same results when a different person carries it out, or a different set of equipment or technique is used
3 precise	1 A measurement that is close to the true value
4 prediction	6 An experiment that gives the same results when the same experimenter uses the same method and equipment
5 range	10 Physical, chemical or biological quantities or characteristics
6 repeatable	12 A variable that is kept constant during an experiment
7 reproducible	13 A variable that is measured as the outcome of an experiment
8 resolution	8 This is the smallest change in the quantity being measured of a measuring instrument that gives a perceptible change in the reading
9 uncertainty	9 The interval within which the true value can be expected to lie
10 variable	5 The spread of data, showing the maximum and minimum values of the data
11 independent variable	3 Measurements where repeated measurements show very little spread
12 control variable	2 Information, in any form, that has been collected
13 dependent variable	11 A variable that has its values chosen or changed by the person carrying out the practical

## Topic 11 – Units for Biology

SI units:

Physical quantity	Unit	Abbreviation
mass	kilogram	kg
length	metre	m
time	second	s
temperature	kelvin	K
amount of substance	mole	mol

- Width of a field
- Height of a tree
- Length of a human digestive system
- Height of an elephant
- Length of DNA strand
- Length of a nerve cell
- Length of a heart
- Length of a finger
- Length of a mosquito
- Width of a hair
- Width of a red blood cell
- Size of a virus
- Length of a water molecule
- Width of a sodium ion

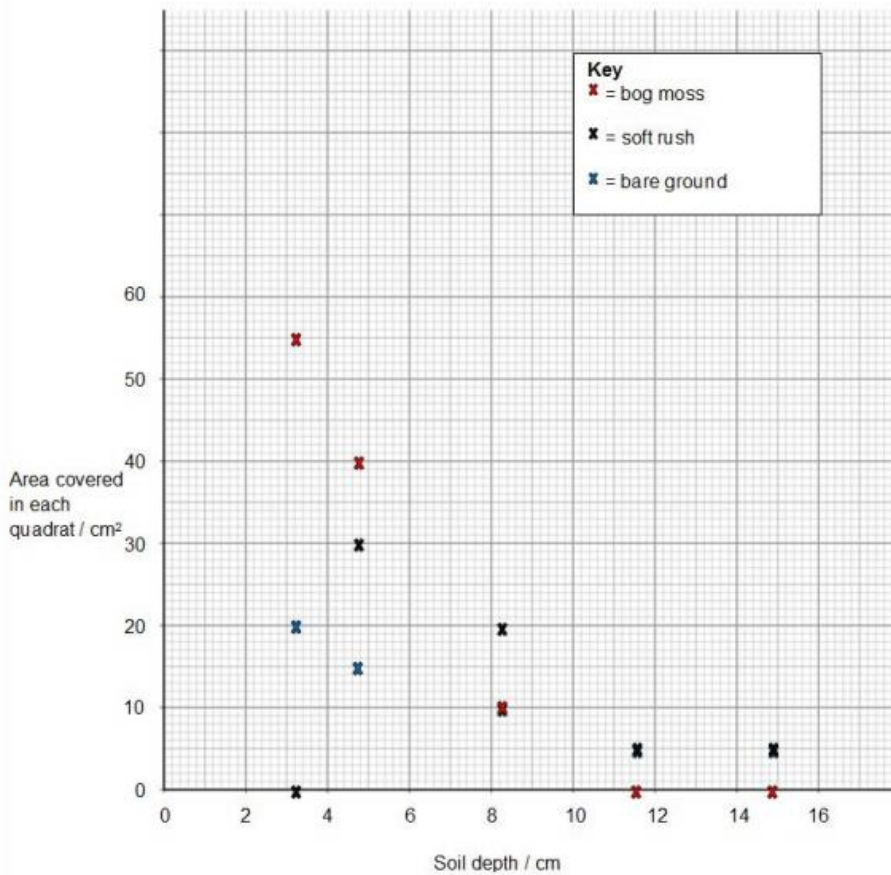
Prefixes:

Prefix	Symbol	Multiplication factor	
Giga	G	$10^9$	1 000 000 000 000
Mega	M	$10^6$	1 000 000 000
kilo	k	$10^3$	1 000 000
deci	d	$10^{-1}$	0.1
centi	c	$10^{-2}$	0.01
milli	m	$10^{-3}$	0.001
micro	$\mu$	$10^{-6}$	0.000 001
nano		$10^{-9}$	0.000 000 001
pico		$10^{-12}$	0.000 000 000 001

a) The width of a virus	nm
b) The time between heart beats	s (or ms)
c) The length of a leaf	cm
d) The distance that a migratory bird travelled each year	km
e) The width of a cheek cell	$\mu\text{m}$ (or mm)
f) The mass of a rabbit	g or kg
g) The mass of iron in the body	g
h) The volume of the trunk of a large tree	$\text{m}^3$

**Topic 12 – Analysing data in tables and graphs**

1.  $5 \text{ cm}^2$
2.  $8.5 \text{ cm}^2$
3.  $10 \text{ cm}^2$



Note that some plots are obscured as plots are on the same coordinates.

The two plant species favour shallow soils as the deeper the soil, the lower the area covered by bog moss, soft rush.

The deeper the soil, the better vegetation grows as the deeper the soil the less area covered by bare ground.

1. 24.3%
2. 28.4%
3. Men have a 49.6% decrease, women have a 43.8% decrease, so greater decrease in men.
4. For men the fraction is  $\frac{291}{941}$  or 0.309, for women the fraction is  $\frac{423}{689}$  or 0.614

1.  $2.6 \text{ dm}^3$
2.  $13.5 \text{ km h}^{-1}$
3. Increased from 14 to 20 breaths per minute. A 42.9% increase.
4.  $5 \text{ km h}^{-1}$
5.  $0.15 \text{ dm}^3$
6.  $y = 0.15x + 0.6$