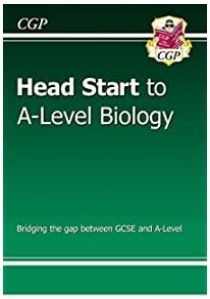
Preparing for A-Level: Biology

We have created this support resource to help students make the transition from GCSE to A-level Biology.

Contents



Prime ★★★★½ (47 Reviews)

Head start to A-Level Biology

Free accredited Biology courses

As part of preparation for our 6th form courses in Biology, click on the link below to access free accredited biology courses (see suggestions for each course)

Link to Open Learning free qualifications
https://www.open.edu/openlearn/free-courses/full-catalogue

Suggested Biology courses

Biology skills	Biology knowledge
Basic science: understanding experiments	Cell signalling (advanced)
Basic science: understanding numbers	Evolution through natural selection
Diagrams, charts and graphs	Forensic science and fingerprints
Health and safety in the laboratory and field	Gene therapy
Mathematics for science and technology	Infection and immunity
More working with charts, graphs and tables	Inheritance of characters
Numbers, units and arithmetic	Intracellular transport (advanced)
Presenting information	Introducing the environment: Ecology and ecosystems
Ratio, proportion and percentages	Introduction to ecosystems
Starting with maths: Patterns and formulas	Introduction to microscopy
Using a scientific calculator	Meiosis and mitosis
Using numbers and handling data	Nucleic acids and chromatin (advanced)
	Nutrition: Proteins
	Proteins (advanced)
	The science of evolution
	A tour of the cell
	Vaccination
	What do genes do?
	What is the genome made of?

You are not expected to complete all these courses. Choose the knowledge that you are most interested in or the skills that you feel you most need to develop. They are all relevant to you're A-Level Biology studies.

You’re studying A-level Biology, congratulations!

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

Why study A-level Biology?

Biology A-level will give you the skills to make connections and associations with all living things around you. Biology literally means the study of life - and if that’s not important, what is? Being such a broad topic, you’re bound to find a specific area of interest, plus it opens the door to a fantastic range of interesting careers.

Many people use an A-level in Biology in their future studies or work. Even if you don’t decide to work in biology, studying it still develops useful and transferable skills for other careers. You’ll develop research, problem solving and analytical skills, alongside teamwork and communication. Universities and business regard all of these very highly.

Possible degree options

According to bestcourse4me.com, the top seven degree courses taken by students who have A-level Biology are:

- Biology
- Psychology
- Sport and exercise science
- Medicine
- Anatomy
- Physiology and pathology pharmacology
- Toxicology and pharmacy chemistry.

This list is by no means exhaustive. Biology can prove useful for a wide variety of degree courses.

For more details, go to the bestcourse4me.com, or UCAS.

Which career appeals to you?

Studying Biology at A-level or degree opens up all sorts of career opportunities, such as:

- doctor
- clinical molecular geneticist
- nature conservation officer
- pharmacologist
- research scientist
- vet
- secondary school teacher
- marine biologist
- dentist.

Specification at a glance

First year of A-level

1 Biological molecules.

2 Cells.

3 Organisms exchange substances with their environment.

4 Genetic information, variation and relationships between organisms.

Second year of A-level

5 Energy transfers in and between organisms.

6 Organisms respond to changes in their internal and external environments.

7 Genetics, populations, evolution and ecosystems.

8 The control of gene expression.

The assessment for the A-level consists of three 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

Places to go for help

1. AQA website is a great place to start

AQA Biology webpages are aimed at teachers, but you may find them useful too. Information includes:

- The specification – this explains exactly what you need to learn for your exams.
- Practice exam papers
- Lists of command words and subject specific vocabulary – so you understand the words to use in exams
- Practical handbooks explain the practical work you need to know
- Past papers and mark schemes from the old specifications. Some questions won't be relevant to the new A-level, so please check with your teacher.
- Maths skills support

2. Royal Society of Biology

"A single unified voice for biology". They work with everyone from government policy makers to students, as well as universities and researchers studying biology. Their website includes a dedicated student section. Have a look at rsb.org.uk

3. The student room

Join the A-level Biology forums and share thoughts and ideas with other students if you're stuck with your homework. Just be very careful not to share any details about your assessments, there are serious consequences if you're caught cheating. Visit thestudentroom.co.uk

4. Textbooks

Our approved textbooks are published by Collins, Hodder and Oxford University Press. Textbooks from other publishers will also be suitable, but you'll need to double check that the content and formula symbols they use match our specification.

5. Revision guides

These are great if you want a quick overview of the course when you're revising for your exams. Remember to use other tools as well, as these aren't detailed enough on their own.

6. YouTube

YouTube has thousands of Biology videos. Just be careful to look at who produced the video and why because some videos distort the facts. Check the author, date and comments – these help indicate whether the clip is reliable. If in doubt, ask your teacher.

7. Magazines

Focus, New Scientist or Philip Allan updates can help you put the biology you're learning in context.

8. Videos

We have a selection of course videos you can get your teeth stuck into to help you. Biology course videos

Useful information and activities

There are a number of activities throughout this resource. The answers to some of the activities are available on our secure website, e-AQA. Your teacher will be able to provide you with these answers.

SI units

Every measurement must have a size (eg 2.7) and a unit (eg metres or °C). Sometimes, there are different units available for the same type of measurement. For example, ounces, pounds, kilograms and tonnes are all used as units 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.

The seven SI base units are:

Physical quantity	Usual quantity symbol	Unit	Abbreviation
mass	m	kilogram	kg
length	l or x	metre	m
time	t	second	s
electric current	I	ampere	A
temperature	T	kelvin	K
amount of substance	N	mole	mol
luminous intensity	(not used at A-level)	candela	cd

All other units can be derived from the SI base units.

For example, area is measured in square metres (written as m^2) and speed is measured in metres per second (written as ms^{-1}).

It is not always appropriate to use a full unit. For example, measuring the width of a hair or the distance from Manchester to London in metres would cause the numbers to be difficult to work with.

Prefixes are used to multiply each of the units. You will be familiar with centi (meaning 1/100), kilo (1000) and milli (1/1000) from centimetres, kilometres and millimetres.

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

The most common prefixes you will encounter are:

Prefix	Symbol	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 1

Which SI unit and prefix would you use for the following quantities?

1. The time between heart beats
2. The length of a leaf
3. The distance that a migratory bird travelled each year
4. The width of a cheek cell
5. The mass of a rabbit
6. The mass of iron in the body
7. The volume of the trunk of a large tree

Sometimes, there are units that are used that are not combinations of SI units and prefixes.

These are often multiples of units that are helpful to use. For example, one litre is 0.001 m^3, or one day is 86 400 seconds.

Activity 2

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

1. The mass of an elephant
2. The mass of an earthworm
3. The volume of water in a teardrop
4. The volume of water in a pond
5. The time taken for a sunflower to grow
6. The temperature difference between the blood in the heart and in the ear on a cold day
7. The width of a hair
8. The length that your fingernails grow each day
9. The total length of each of the hairs on your head

Activity 3

Put the following in order of size:

height of an elephant; length of 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.

Important vocabulary for practical work

You will have come across most of the words used in practical work in your GCSE studies. It is important that you use the right definition for each word.

Activity 4

Join the boxes to link the word to its definition.

Accurate	A statement suggesting what may happen in the future.
Data	An experiment that gives 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 (input) of a measuring instrument that gives a perceptible change in the reading.
Uncertainty	The interval within the true value can be expected to lie.
Variable	The spread of data, showing the maximum and minimum values of the data.
Control variable	Measurements where repeated measurements show very little spread.
Dependent variable	Information, in any form, that has been collected.

Cells

All life on Earth exists as cells. These have basic features in common.

Activity 5

Complete the table.

Structure	Function
Cell-surface membrane	
Chloroplast	
Cell vacuole	
Mitochondria	
Nucleus	
Cell wall	
Chromosomes	
Ribosomes	

Draw the structure of a plant cell and an animal cell.

On each cell, add labels showing each of the structures in the table, if they exist.

Photosynthesis and respiration

Two of the most important reactions that take place in living things are photosynthesis and respiration. They both involve transfer of energy.

Activity 6

Complete the table.

	Photosynthesis	Aerobic respiration
Which organisms carry out this process?		
Where in the organisms does the process take place?		
Energy store at the beginning of the process	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		

Which of the answers for aerobic respiration would be different for anaerobic respiration? Add these answers to the table in a different colour.

Principles of moving across boundaries

In biology, many processes involve moving substances across boundaries.

Activity 7

Match the examples to the principle(s) involved. For each, give a brief description of why it is relevant.

Osmosis

Diffusion

Active transport

Changing surface area or length

Examples

Drinking a sports drink after exercise

Gas exchange in the lungs

Absorbing nutrients from food into the body

Moving ions into cells

The effect of salt on slugs

Penguins huddling together to keep warm

Potato pieces get heavier when put in pure water

Potato pieces get lighter when put in very salty water

Cacti do not have thin, large leaves

Activity 8

Huntington's disease is an example of a disease where the mutation causing the disease is dominant.

h: normal (recessive)

H: mutation (dominant)

		Paternal alleles	
		H	h
Maternal alleles	h		
	h		

Cystic fibrosis is an example of a disease where the mutation causing the disease is recessive.

F: normal (recessive)

f: mutation (dominant)

		Paternal alleles	
		F	f
Maternal alleles	F		
	f		

For each of the Punnett squares:

1. Complete the diagrams to show the alleles for each child.
2. State which parent and child is:
   - healthy
   - has the disease
   - a carrier.

Activity 8 (continued)

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.

6. A 50:50 chance is the same as a 0.25 probability.

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 9: Mean, media, 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 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

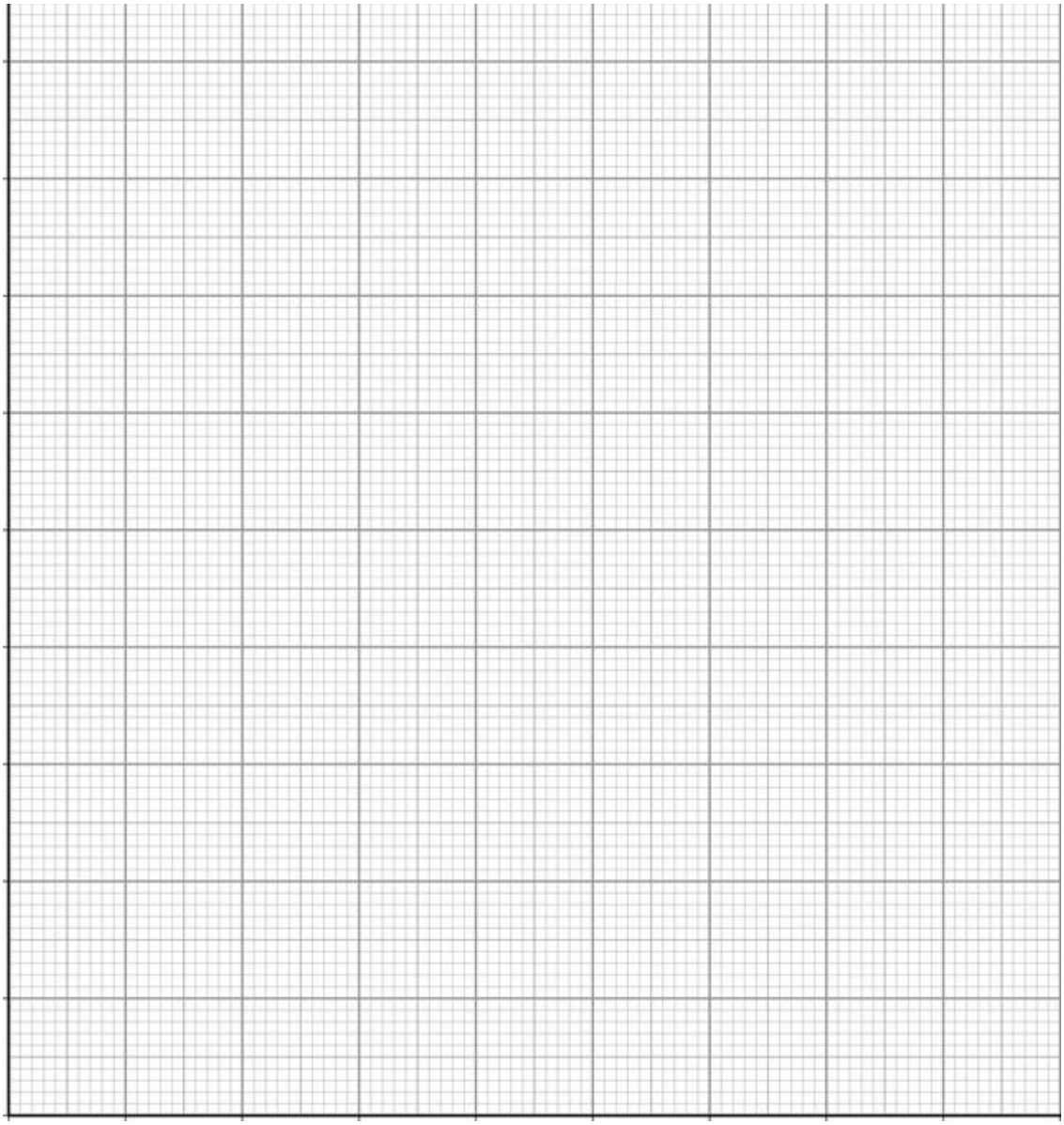
– indicates zero cover.

Calculate:

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

Activity 9: Mean, media, mode and scatter graphs (continued)

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 or markers for each).



Activity 9: Mean, media, mode and scatter graphs (continued)

4. What conclusions does your graph suggest?

5. How confident are you in these conclusions?

Activity 10: 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 ofdeaths (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

Activity 10: Analysing tables (continued)

1. Of the men who died aged 35-64 from one of these three causes, what percentage of them died of lung cancer?

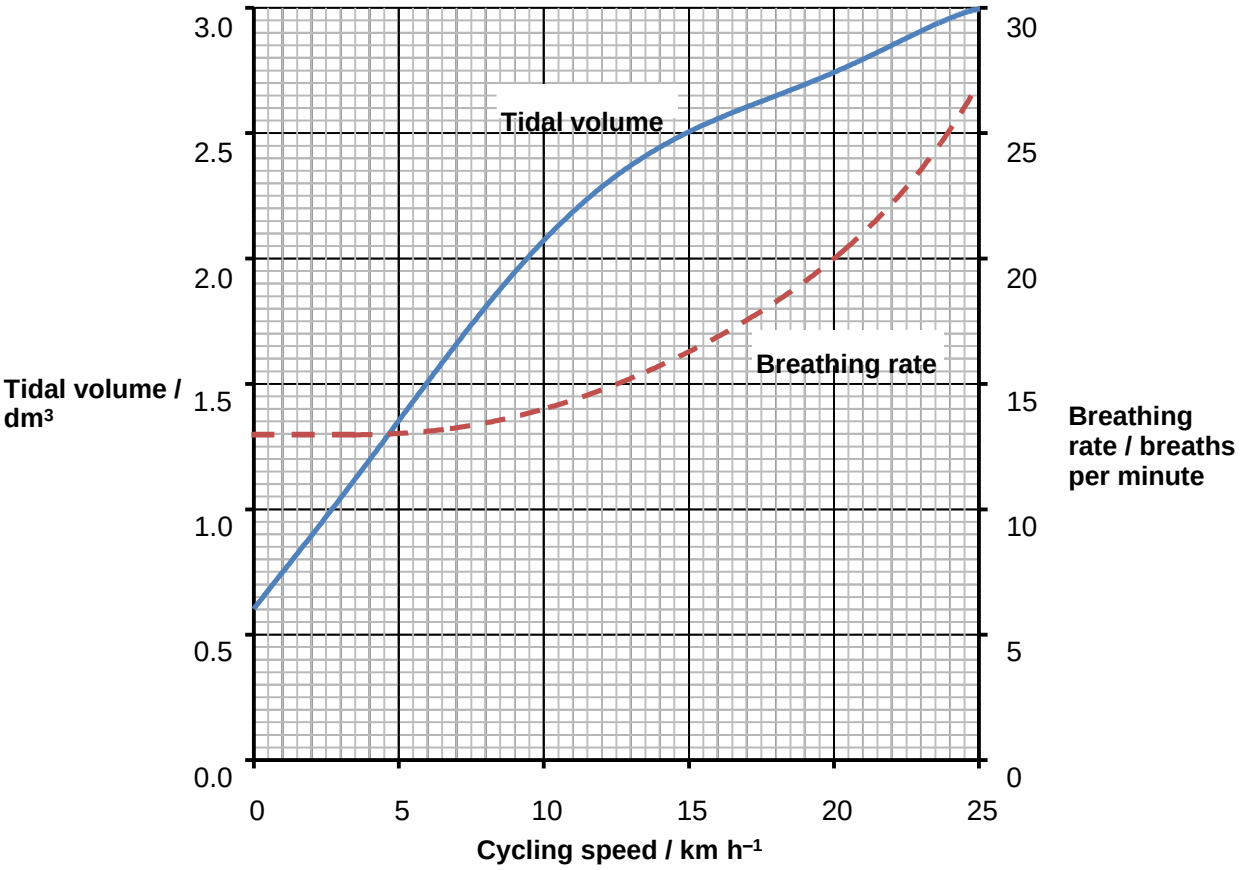
2. What percentage of deaths from chronic bronchitis in women happened to women aged 65-74?

3. Deaths from lung cancer drop as people get older. Is there a bigger percentage difference for men or women from 35-64 to 75+?

4. What fraction of coronary heart disease deaths of men over 34 are in the 75+ bracket? What about for women?

Activity 11: 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. What was the tidal volume when the cycling speed was 17 km h^{-1}?
2. What was the breathing rate when the cycling speed was 8 km h^{-1}?
3. What was the change in breathing rate when the cyclist changed from 10 to 20 km h^{-1}? Express this as a percentage.
4. At what speed did the breathing rate start to increase?
5. The tidal volume increased linearly with cycling speed up to about 10 km h^{-1}. Calculate the increase in volume for each increase in speed of 1 km h^{-1}.
6. For this initial linear section, what is the equation of the tidal volume line?

   Hint: use $y=mx + c$

Retrieval questions

You need to be confident about the definitions of terms that describe measurements and results in A Level Biology.

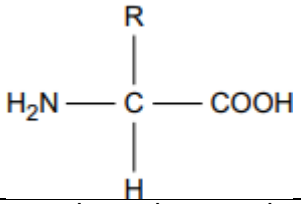
Learn the answers to the questions below then cover the answers column with a piece of paper and write as many answers as you can. Check and repeat.

Practical science key terms:

When is a measurement valid?	when it measures what it is supposed to be measuring
When is a result accurate?	when it is close to the true value
What are precise results?	when repeat measurements are consistent/agree closely with each other
What is repeatability?	how precise repeated measurements are when they are taken by the *same* person, using the *same* equipment, under the *same* conditions
What is reproducibility?	how precise repeated measurements are when they are taken by *different* people, using *different* equipment
What is the uncertainty of a measurement?	the interval within which the true value is expected to lie
Define measurement error	the difference between a measured value and the true value
What type of error is caused by results varying around the true value in an unpredictable way?	random error
What is a systematic error?	a consistent difference between the measured values and true values
What does zero error mean?	a measuring instrument gives a false reading when the true value should be zero
Which variable is changed or selected by the investigator?	independent variable
What is a dependent variable?	a variable that is measured every time the independent variable is changed
Define a fair test	a test in which only the independent variable is allowed to affect the dependent variable
What are control variables?	variables that should be kept constant to avoid them affecting the dependent variable

Biological molecules

Learn the answers to the questions below then cover the answers column with a piece of paper and write as many answers as you can. Check and repeat.

What are monomers?	smaller units from which larger molecules are made
What are polymers?	molecules made from a large number of monomers joined together
What is a condensation reaction?	a reaction that joins two molecules together to form a chemical bond whilst eliminating of a molecule of water
What is a hydrolysis reaction?	a reaction that breaks a chemical bond between two molecules and involves the use of a water molecule
What is a monosaccharide?	monomers from which larger carbohydrates are made
How is a glycosidic bond formed?	a condensation reaction between two monosaccharides
Name the three main examples of polysaccharides	glycogen, starch, cellulose
Describe Benedict's test for reducing sugars	gently heat a solution of a food sample with an equal volume of Benedict's solution for five minutes, the solution turns orange/brown if reducing sugar is present
Name the two main groups of lipids	phospholipids, triglycerides (fats and oils)
Give four roles of lipids	source of energy, waterproofing, insulation, protection
What is an ester bond?	a bond formed by a condensation reaction between glycerol and a fatty acid
Describe the emulsion test for lipids	mix the sample with ethanol in a clean test tube, shake the sample, add water, shake the sample again, a cloudy white colour indicates that lipid is present
What are the monomers that make up proteins?	amino acids
Draw the structure of an amino acid	
How is a peptide bond formed?	a condensation reaction between two amino acids
What is a polypeptide?	many amino acids joined together
Describe the biuret test for proteins	mix the sample with sodium hydroxide solution at room temperature, add very dilute copper(II) sulfate solution, mix gently, a purple colour indicates that peptide bonds are present
How does an enzyme affect a reaction?	it lowers the activation energy
Give five factors which can affect enzyme action	temperature, pH, enzyme concentration, substrate concentration, inhibitor concentration
What is a competitive inhibitor?	a molecule with a similar shape to the substrate, allowing it to occupy the active site of the enzyme
What is a non-competitive inhibitor?	a molecule that changes the shape of the enzyme by binding somewhere other than the active site.

Basic components of living systems

Learn the answers to the questions below then cover the answers column with a piece of paper and write as many answers as you can. Check and repeat.

What is the formula to calculate magnification?	magnification = $\frac{\text{size of image}}{\text{actual size of object}}$
Why are cells stained before being viewed with a light microscope?	staining increases contrast between different cell components, makes them visible, and allows them to be identified
What is an eyepiece graticule?	a glass disc that fits on top of the eyepiece lens that is marked with a fine scale from 1 to 100
What is a stage micrometer?	a microscope slide with a very accurate scale in micrometers (μ) engraved on it
What is a scientific drawing?	a labelled line drawing that is used to highlight particular features and does not include unnecessary detail or shading, it should always have a title and state the magnification
What is magnification?	how many times larger an image is than the actual size of the object being viewed
What is resolution?	the ability to see individual objects as separate entities
What is the function of the nucleus?	controls the metabolic activities of the cell as it contains genetic information in the form of DNA
What is the nucleolus?	area within the nucleus that is responsible for producing ribosomes
What is the function of mitochondria?	site of production of ATP in the final stages of cellular respiration
What are vesicles?	membranous sacs that are used to transport materials in the cell
What are lysosomes?	specialised forms of vesicles with hydrolytic enzymes that break down waste material in cells
What is the role of the cytoskeleton?	controls cell movement, movement of organelles within the cell, and provides mechanical strength to the cell
Name the three types of cytoskeletal filaments	microfilaments, microtubules, and intermediate fibres
Give two types of extension that protrude from me cells	flagella (whip-like protrusions) and cilia (tail-like protrusions)
What is the endoplasmic reticulum (ER)?	a network of membranes enclosing flattened sacs called cisternae
What are the functions of the two types of ER?	smooth ER – lipid and carbohydrate synthesis, and storage rough ER – synthesis and transport of proteins
What is the function of the Golgi apparatus?	plays a part in modifying proteins and packaging them into vesicles