Welcome to A-Level Biology

Congratulations on your GCSE results and on gaining a place on the A-level Biology course. This pack (hopefully) contains all the information you will need to get started.

Biology Specification

We are studying the OCR Biology A specification. If you wish to ever go back to the specification to ensure that you are not missing anything then it can be found on the OCR website, or alternatively, here's a link (https://rb.gy/hbcpwb).

Textbook

You will able to take a copy of our textbook out on a two year long loan from the library. We are using the Oxford University Press OCR A Biology textbook. This textbook covers the entire two year course, and you will be required to bring it to every lesson.

We will also be giving an opportunity to purchase revision guides later in the year.

Biology Trips

Each year we have attended the Biology In Action lectures that are held at the University of Warwick. These are wonderful days out, where five outstanding leading scientists each spend around 45 minutes talking about their area of expertise. Previous speakers have included Dr Robert Winston (the lead scientist who invented IVF) and many other scientists that you would recognise from TV science programmes. Please note that due to the current situation we are not sure if these trips will definitely be operating.

Biology Support

We are very lucky to have a large and experienced biology team. If you have any queries you are very welcome to email Mr Hawksley, Mrs McCormick, Mrs Annable, Mrs Black, Miss Hutchinson or Miss Wells. We want to support you with any problems that you have, and we would rather you spend 5 minutes sorting out your misunderstanding with one of us, rather than an hour sat by yourself feeling lost. So please do make use of us!

In addition to this we normally hold a weekly drop in session. Your teachers will instruct you when this is happening.

Biology Communication

Microsoft Teams will be used as the primary platform for all group or cohort wide messages. To this end, I would recommend that you check on a daily basis for any new messages. We will also upload resources to the platform that will benefit you.

Folders

You will need a folder (ring binder or lever arch file) in which to keep your A-level Biology work. You should keep this booklet, a copy of the specification and your notes/homework booklet in the front of your folder. It is up to you to keep your work organised. We would recommend that you have different sections for each of your teachers. At any time, your teacher may ask to see your folder to check for evidence of the following:

- Work being up to date without any gaps
- The work being to an appropriate standard
- Self/peer marking
- Students know the level they are working at
- Students know what they need to do in order to improve
- Students act on the advice they have been given

Unsatisfactory folders will be discussed and appropriate follow-up action implemented with the Mr Hawksley (Head of Biology).

Practical Books

Throughout the course you will be completing a range of practicals. We will be issuing a lab-book. This lab-book will be your location to record all your practical data, as well as complete your write ups as necessary.

Homework/Structured Study lessons

At Brooke Weston, we recommend that for every hour you spend studying in lessons, you follow up with another hour outside of lesson time. Formal homework takes many forms, for example past paper questions, practical write-ups, essays, reading or research. In addition to this, you are expected to review your notes each week and complete the appropriate questions in the notes/homework booklet.

Revision of work covered is more than reading the notes made in class. You must ***actively*** review them. Make additions or redraft them as necessary; make revision aids such as mind maps or flash cards as you study the material the first time around. Failure to do this will leave you inadequately prepared for your exams in May/June.

This means that there are no weeks in which you have no homework but there may be weeks in which you do not have to submit work for marking. It is up to you to ensure you meet the deadline for each piece of work. 'I didn't know' is not an excuse. Failure to submit work promptly will result in appropriate follow-up actions.

BioAdvanced

As part of the program of support for you, each week on the Monday morning you will be set (via Teams) a BioAdvanced activity. These activities consist of a short past exam question of around 10 marks. Your responsibility is to complete this activity under timed exam conditions (i.e. no notes and in silent conditions). You will then self-assess your progress against the mark scheme and you need to submit your mark to Mr Hawksley before 16:05 on the Friday of that week.

Assessments

Throughout each year of sixth form there are formal assessments that will be completed in the Sports Hall. There will also be further assessments that are completed within your classrooms. Each module is available to be tested. As part of your ongoing review of work each week you should be preparing your notes in such a way that you are ready for an assessment on the work covered to date **AT ANY TIME!**

What this means in practice is that your teacher may, or may not, give you notice that there will be an assessment on the topic(s) you have been working on in the next lesson, week or whenever. It is ***up to you*** to stay on top of your work so as to be prepared for the next assessment.

Study Skills

You all will have worked hard to earn the grades you achieved at GCSE but some of the study skills you may have used will need refining and, for some of you, new skills will need to be learnt. The good news is that we do have some suggestions; the bad news is we will not be spoon feeding you all the answers and writing all the notes for you.

We will be spending a lot of time having whole year sessions looking at developing these skills, but in addition, The Learning Toolbox website (http://coe.jmu.edu/learningtoolbox/studentstart.htm) has lots of tips and strategies to help you study.

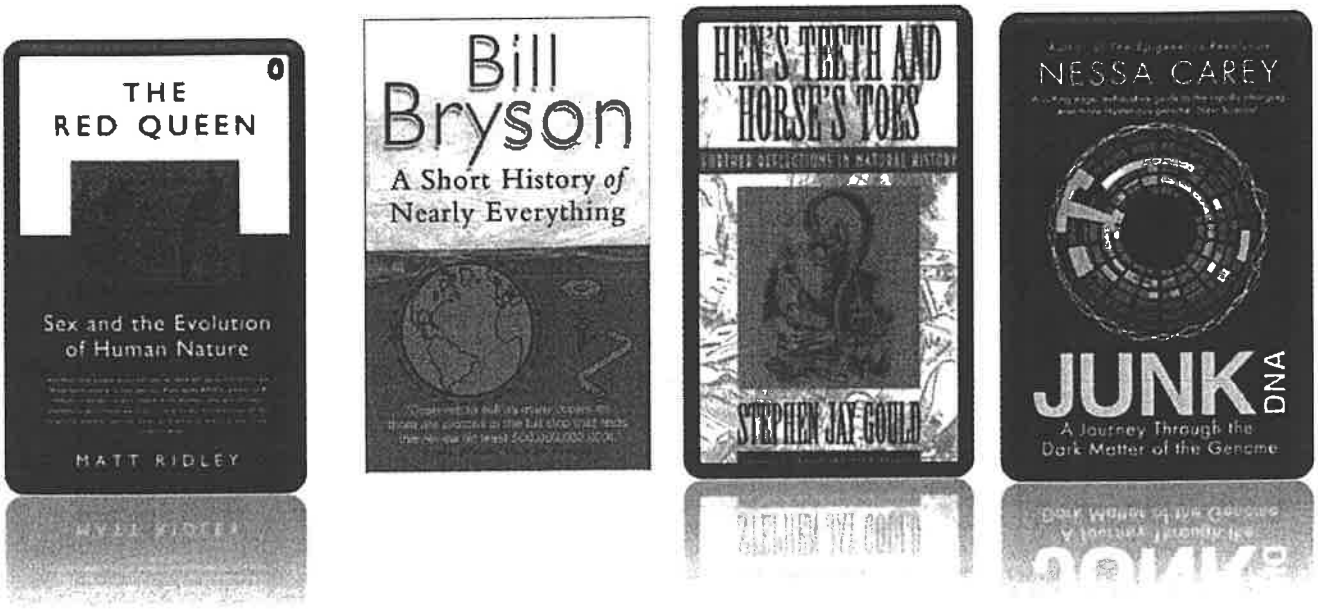
Written Work

Please note that all work that is written needs to be neat and legible. Work that you submit needs to have your name at the top!

A good A-level student shows a genuine interest in their subject! 'Reading around' is an excellent way to develop your interest in Biology. The school library has an excellent collection of appropriate books, a subscription to 'Biological Sciences Review' and New Scientist and access to a number of online journals (ask the librarians).

In addition to your reading around the subject, we also require to undertake pre-reading in preparation for each of your biology lessons. Your Programme of Studies contains the information of which pages of your textbook you need to have read and tried to understand prior to entering the classroom.

Suggested titles to read include:



The Red Queen

Its all about sex. Or sexual selection at least. This book will really help your understanding of evolution and particularly the fascinating role of sex in evolution. Available at amazon.co.uk

A Short History of Nearly Everything

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

Hen's teeth and horses toes

Studying Geography as well? Stephen Jay Gould is a great Evolution writer and this book discusses lots of fascinating stories about Geology and evolution. Available at amazon.co.uk

Junk DNA

Our DNA is so much more complex than you probably realize, this book will really deepen your understanding of all the work you will do on Genetics. Available at amazon.co.uk

Movie Recommendations

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.

Andromeda Strain (1971)

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

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.

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.

Advice from Previous Students

- "It's ok to not get something straight away. Spend time trying to figure it out after the lesson. Go and talk to your teacher about it. Don't just ignore it. "
- "Ask questions!"
- "Start work straight away, don't put it off."
- "Some topics are harder than others, so if you are struggling with one, there will be another that you excel at. "
- "Talk to your teacher!"
- "Complete as many exam questions as you can."
- "Go to all the extra talks/seminars/visits."
- "Revise little and often"
- "If you get a U on the first assessment it doesn't mean that you are rubbish. Keep going!"

Equipment

For most Biology lessons, you should ensure you have the following equipment:

- Black/blue pen
- 30cm ruler
- Pencil (and a sharpener)
- Eraser
- Scientific calculator

The entire course can be split into six modules:

- Module 1 – Development of practical skills in biology
  - Practical skills assessed in a written examination
  - Practical skills assessed in the practical endorsement
- Module 2 – Foundations in biology
  - 2.1.1 Cell structure
  - 2.1.2 Biological molecules
  - 2.1.3 Nucleotides and nucleic acids
  - 2.1.4 Enzymes
  - 2.1.5 Biological membranes
  - 2.1.6 Cell division, cell diversity and cellular organisation
- Module 3 – Exchange and transport
  - 3.1.1 Exchange surfaces
  - 3.1.2 Transport in animals
  - 3.1.3 Transport in plants
- Module 4 – Biodiversity, evolution and disease
  - 4.1.1 Communicable diseases, disease prevention and the immune system
  - 4.2.1 Biodiversity
  - 4.2.2 Classification and evolution
- Module 5 – Communication, homeostasis and energy
  - 5.1.1 Communication and homeostasis
  - 5.1.2 Excretion as an example of homeostatic control
  - 5.1.3 Neuronal communication
  - 5.1.4 Hormonal communication
  - 5.1.5 Plant and animal responses
  - 5.2.1 Photosynthesis
  - 5.2.2 Respiration
- Module 6 – Genetics, evolution and ecosystems
  - 6.1.1 Cellular control
  - 6.1.2 Patterns of inheritance
  - 6.1.3 Manipulating genomes
  - 6.2.1 Cloning and biotechnology
  - 6.3.1 Ecosystems
  - 6.3.2 Populations and sustainability.

You will sit three external examinations at the end of Year 13.

1 Biological Process – Examining Modules 1,2,3&5 (2hr 15mins)
2 Biological Diversity – Examining Modules 1,2,4&6 (2hr 15mins)
3 Unified Biology – Examining Modules 1,2,3,4,5&6 (1hr 30mins)

The fourth and final component of the qualification is the Practical Endorsement. Over the two years you will complete set practicals which will also be examined during the written examinations. If you successfully demonstrate the necessary skills during the practicals and in their write-ups, you will also gain this additional qualification.

Laboratory Rules

Safety is incredibly important. When we are back in labs the following rules apply.

1. Never rush about or throw things in the lab. Keep your bench and floor area clear, with bags and coats well out of the way.

2. Follow instructions precisely. Check bottle labels carefully and keep tops on bottles except when pouring liquids from them. Only touch or use equipment and materials when told to do so by a teacher. Never remove anything from the lab without permission.

3. Wear eye protection when told to do so and keep it on from the very start until all practical work is finished and cleared away.

4. When using naked flames (e.g. Bunsen or spirit burners or candles) make sure that ties, hair, loose clothing, etc. are tied back or tucked away.

5. Always stand up when working with hazardous substances or when heating things so that you can quickly move out of the way if you need to.

6. Never taste anything or put anything in your mouth in the laboratory. If you get something in your mouth spit it out at once and wash your mouth out with lots of water. Tell your teacher.

7. Always wash your hands carefully after handling chemicals, microbes or animal and plant materials.

8. If you are burnt or a chemical splashes on your skin wash the affected part at once with lots of water. Tell your teacher.

9. Never put waste solids in the sink. Put them in the bin unless your teacher instructs you otherwise.

10. Wipe up small spills and report bigger ones to your teacher.

11. Report all breakages to your teacher. Do not touch broken glass!

Glossary of terms

You will need to understand these terms and be able to use them correctly, particularly for the practical assessment.

Accuracy	An accurate measurement is one which is close to the true value.
Anomalous data	Anomalous data are those measurements that fall outside the normal, or expected, range of measured values. Variation is a characteristic of all living organisms, and it is often difficult in biological investigations to distinguish between data that reflect this variation and those that are genuinely anomalous. A large number of readings allows anomalous data to be identified with greater certainty.
Calibration	When using a measuring instrument, calibration involves fixing known points and constructing a scale between these fixed points.

Causal link	A change in one variable that results from or is caused by a change in another variable.
Chance	Chance is essentially the same as luck. If a coin is tossed in the air, whether it comes down heads or tails is purely due to chance. The results of any investigation could have a genuine scientific explanation but they could be due to chance. Scientists carry out statistical tests to assess the probability of the results of an investigation being due to chance.
Confounding	A confounding variable is one that may, in addition to the variable independent variable, affect the outcome of the investigation. Confounding variables must be kept constant or the investigation will not be a fair test. In some investigations, ecological investigations in particular, it is not always possible to keep confounding variables constant. In such cases, these variables should be monitored. In this way it may be possible to decide whether or not the factor concerned affects the outcome of the experiment. Confounding variables are sometimes referred to as control variables.
Control experiment	A control experiment is one that is set up to eliminate certain possibilities. In a well designed investigation, the independent variable is changed and all confounding variables are kept constant. The possibility exists, however, that something else other than the independent variable might have produced the results that were obtained. A control experiment is one that is designed to eliminate this possibility.
Control group	A control group is one that is treated in exactly the same way as the experimental group except for the factor that is being investigated. This allows scientists to make a comparison. It ensures that the data that are collected are valid because any differences between the results for the experimental group and those for the control group will be due to a single independent variable.
Control variable	See confounding variable
Correlation	A correlation shows that there is a relationship between two variables, however, it might not be a causal one.
Dependent variable	The dependent variable is the variable the value of which is measured for each change in the independent variable.
Double-blind trial	A trial, usually used in the context of medicine, when assessing the effects of a new drug or treatment on humans. Neither the patients nor the scientists concerned know which treatment a particular individual is receiving until after completion of the trial. This helps to avoid bias and increase the validity of the trial.

Errors	Errors cause readings to be different from the true value.
Evidence	The data or observations that are used to support a given hypothesis or belief.
Fair test	A fair test is one in which only the independent variable has been allowed to affect the dependent variable. A fair test can usually be achieved by keeping all other variables constant or controlled.
Hypothesis	Sometimes known as an experimental hypothesis, this is a possible explanation of a problem that can be tested experimentally.
Independent variable	The independent variable is the variable for which values are changed by the investigator.
Null hypothesis	A statistical test requires a clear hypothesis to test. It is often difficult to predict what would happen as the result of an investigation. It is much easier to phrase a hypothesis in terms of there being no difference or no association. A hypothesis worded in this way is called a null hypothesis. As the result of carrying out a statistical test, a decision can be made about whether to accept or reject this null hypothesis.
Placebo	A placebo is a dummy pill or injection given to members of a control group in medical trials. Where a placebo is in the form of a pill, it should be identical to the pill used with the experimental group. The only difference should be that that the placebo does not contain the drug being trialled. The use of placebos helps to ensure that the data collected from a trial are valid.
Precision	Precision is related to the smallest scale division on the measuring instrument that is being used. A set of precise measurements will have very little spread about the mean value.
Probability	Probability is the likelihood of an event occurring. It differs from chance in that it can be expressed mathematically. In statistical tests, probabilities are usually expressed as a decimal fraction of one. Thus a probability of 0.05 means that an event is likely to occur 5 times in every 100.
Protocol	Once an experimental method has been shown to produce valid and reliable results, it becomes a protocol used by other scientists.

Random distribution	A random distribution is one that arises as a result of chance. When investigating, for example, variation in living organisms, the data collected will only be valid if they have been collected at random. This avoids observer bias and allows statistical tests to be used in an analysis of the results of the investigation.
Random errors	Random errors occur in an unpredictable way. They may be caused by human error, faulty technique in taking measurements or by faulty equipment.
Raw data	Raw data are instrument readings and other data collected at the time of the investigation. These data may subsequently be processed and used to calculate percentages and standard deviations.
Reliability	The results of an investigation may be considered reliable if they can be repeated. If other scientists get the same results, then the results of the initial investigation are more likely to be reliable. The reliability of data within a single investigation can be improved by carrying out repeat measurements.
Systematic errors	These errors cause readings to be spread about some value other than the true value. In other words, all the readings are shifted in one direction from the true value. Systematic errors may occur when using a wrongly calibrated instrument.
True value	This is the accurate value which would be found if the quantity could be measured without any errors.
Validity	Data are only valid if the measurements that have been made are affected by a single independent variable only. They are not valid if the investigation is flawed and control variables have been allowed to change or there is observer bias. Conclusions are only valid if they are supported by valid and reliable data measured to an appropriate level of accuracy.
Zero errors	Zero errors are caused by instruments that have an incorrect zero. A zero error may occur when the needle on a colorimeter fails to return to zero or when a top-pan balance shows a reading when nothing is placed on the pan.

Instructions to candidates in question papers

Sometimes candidates fail to do themselves justice because they do not follow the specific requirements of individual questions. This list defines the meanings of the instructions that are used in question papers. In reading it, the following points must be borne in mind.

Many questions are best asked as direct questions prefaced by the words "What?", "Why?" or "Where?" These words are commonplace and no attempt has been made to define them.

OCR's guiding principle is to set questions that are clear and unambiguous. While instructions will normally be taken from the list that follows, OCR may use alternative expressions if they make the meaning of the question clearer.

Glossary of terms

Calculate

This term is used where the only requirement is a numerical answer, expressed in appropriate units. The additional instruction, "Show your working", will be used if details or methods are required. The working can be used to allow credit where a candidate has made an arithmetical error but has used a correct method for deriving the answer.

Define/What is meant by...?

This requires a statement giving the meaning of a particular term or of a word used in a comprehension passage. A definition requires the use of appropriate scientific terminology. "What is meant by...?" is used more frequently as it emphasises that a formal definition, as such, is not required.

Describe

Means no more than it says: "give a description of ..." This can be used in one of two ways. The first involves the translation of information from one form to another, For example, "Describe the shape of the curve" requires a translation of information from one form to another. This involves a description of the shape of the curve, relating the trends or patterns to key points or values. The second involves giving an account of a process. For example, "Describe an experiment" means give an account of how such an experiment should be carried out.

Describe how you should ....

The expression is often used when asking questions about experimental design. What is required is an account of how something should be done by you as a student working in the context of an A level specification in an ordinary school or college laboratory. Candidates who write that they would do something inappropriate or unsafe would not be given credit.

Evaluate

Evaluating is more than just listing advantages and disadvantages. It means judging the worth of something.

Explain

A reason or interpretation must be given, not a description. The term "Describe" answers the question "What?"; the term "Explain" answers the question "Why?".

Thus, "Explain the curve on a graph" requires biological reasons for any change of direction or pattern which is evident. It is a good idea to start answers that require an explanation with the word "Because ..."

Give

Used when a statement or an account of the similarities/ differences between two or more items is required e.g. 'Give two differences between X and Y'.

Give the evidence from.../Using examples from...

Answers to questions involving these phrases must follow the instructions in the questions. Marks are always awarded for appropriate references to the information provided. Answers that do not, will not gain maximum credit.

List

A number of features or points, each often no more than a single word, with no further elaboration or detail required.

Name/ What is the name of...?

This usually requires a technical term or its equivalent. Answers to this type of question normally involve no more than one or two words.

Sketch

This term refers to the drawing of graphs. "Sketch" requires a simple estimate of the expected curve, and can be made on ordinary lined paper. Even in a sketched graph, the axes should be correctly labelled.

Suggest

"Suggest" is used when it is not possible to give the answer directly from the facts required by the specification. The answer should be based on a general understanding of biology rather than on recall of learnt material. It also indicates that there are usually several alternative answers that are valid from the limited information given to candidates.

Units, Measurements and Standard Form

Units are very important part of biology. The common units you should know are:

Unit	Name	Measurement of
m	Metre	Distance or length
kg	Kilogram	mass
A	Amp	current
s	second*	time
°C	degrees Celsius[1]	temperature
M	molar[2]	concentration
J	Joule	energy

*Notice 's' is the abbreviation for seconds, not 'sec'.

[1]You may come across the unit K (Kelvin). To convert a K temperature to °C, take away 273. E.g. 373K = 100°C

[2]Also $moldm^{-1}$ (moles per cubic decimetre).

However, there are several units derived from these basic units that you will come across commonly in biology. These are:

unit	Name	Measurement of
cm^3	cubic centimetres	Volume, usually solids and gases*
ml	Millilitres	Volume, liquids*
mm	Millimetres	length
µm	micrometres or microns	length
nm	Nanometres	length
mV	Millivolts	voltage

*Notice that cm^3 and ml are an equal measure i.e. $1cm^3$ = 1ml

What happened to litres?

Instead of using litres (l), at A level you will be expected to use dm^3 (cubic decimetres). This avoids confusing l for litres with a number 1. Millilitres are still represented as ml.

'Per'

You may have seen metres per second written like this: m/s

A-level Biology uses this notation: ms^{-1}

The minus sign when present in units tells you that it should be read as 'per', e.g.

kilograms per second kgs^{-1}

bubbles per minute bubbles min^{-1}

per litre (cubic decimetre) dm^{-3}

Prefixes

These go before a unit to alter its magnitude. You are familiar with some of them already.

Symbol	Prefix	Meaning	Example
M	mega	x 1,000,000 (million)	MJ
k	kilo	x 1,000	kg
m	milli	÷ 1000	mV
μ	micro	÷ 1,000,000 (millionth)	μm
n	nano	+ 1,000,000,000 (billionth)	nm

Millivolts are often used in measuring voltage in cells.
Micrometres are commonly used in measurements of cells and organelles.
Nanometres are used in measuring wavelengths of light.

Standard form

Biology often uses numbers that are too large to be written down conveniently. Standard form is a short hand way for writing large or small values.

Instead of 1400 m standard form would be 1.4 x 10^3 m

This is the same as saying 1.4 x 10 x 10 x 10. If you work this out, it is the same as 1400m. You can use 1.4km which is the same thing, but as you will see below, it is good practice to get used to using standard form. Notice that the first value will be a number between 1 and 9, so that:

1450 m is 1.49x10^3 m

It gets easier when you start to recognise the relationship between standard form and the prefixes:

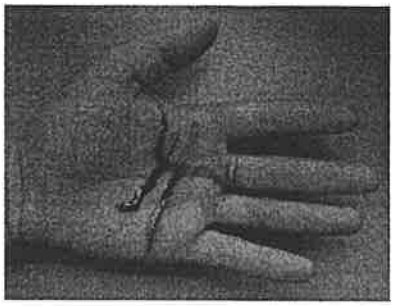
Standard form	Same as	Meaning
$x10^3$	kilo	x1000
$x10^{-3}$	milli	÷10000
$x10^{-6}$	micro	÷1,000,000
$x10^{-9}$	nano	÷1,000,000,000

Biology requires you to use precise, technical language, some of which can be confusing. Many of the words are derived from Greek and Latin; learning to recognize common prefixes, suffixes and roots will help you to identify unusual terms.

Transition Activity

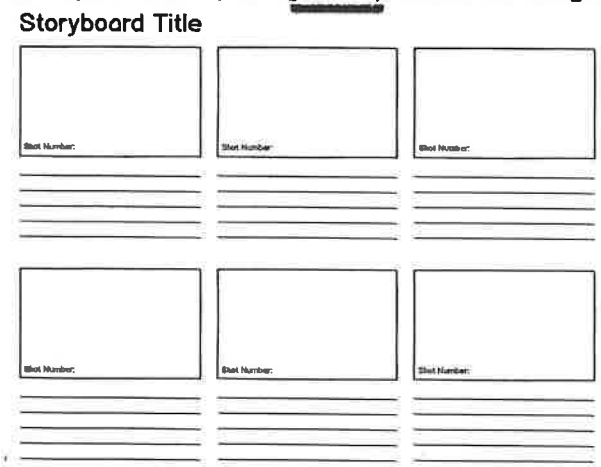
Welcome to your first task for your structured study time. You need to complete either task 1 or task 2.

Task 1 – Why does my cut heal?



Your brother, who is 12, was preparing dinner last night and cut his hand. Although there is quite a lot of damage to his skin new skin will form over the cut in a few weeks. He knows that this is something to do with cells being able to divide but he wants to know more details.
Your parents aren't quite sure about the process and have asked you to explain it to him. So that you don't have to go over it again and again produce a short picture sequence showing how the cell divides to produce new skin cells. You will need to explain each stage. Make sure you use the correct terms listed below.

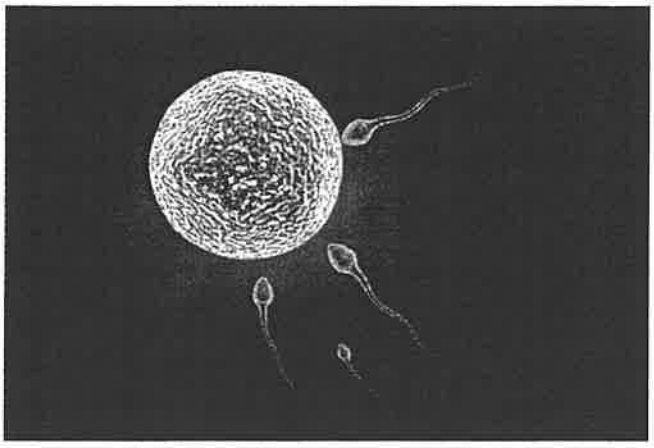
1. Decide on what type of cell division it is
2. Use modelling clay/bluetac/anything else that you can use to make models to produce a model cell. Although human cells have 46 chromosomes you can simplify this so that your model has 4 chromosomes.
3. Make a sequence of models and pictures so that you tell the full story. At each stage you need to explain what is happening. It may look something like:



Terms to use:

- Chromosome
- Cytoplasm
- DNA
- Diploid and/or Haploid
- Mitosis or meiosis
- Nucleus

Task 2 How do sex cells form?



Your sister is in Year 7 and has been studying reproduction in science. She has come home very confused. "The teacher said we all have 46 chromosomes in our cells and that when an egg and a sperm meet the nuclei fuse. But if that happens, why don't babies have 92 chromosomes?"
Your parents aren't sure about it so they have asked you to explain it to her. So that you don't have to go over it again and again produce a short picture sequence showing how sex cells divide. You will need to explain each stage. Make sure you use the correct terms listed below.

1. Decide on what type of cell division it is.
2. Use modelling clay/bluetac/anything else that you can use to make models to produce a model cell. Although human cells have 46 chromosomes you can simplify this so that your model has 4 chromosomes.
3. Make a sequence of models and pictures so that you tell the full story. At each stage you need to explain what is happening. It may look something like the above example.

Terms to use:

- Chromosome
- Cytoplasm
- DNA
- Diploid and/or Haploid
- Mitosis or meiosis
- Nucleus

Biological words – prefixes and suffixes

Biology requires you to use precise, technical language, some of which can be confusing. Many of the words are derived from Greek and Latin; learning to recognize common prefixes, suffixes and roots will help you to identify unusual terms.

SIZE/AMOUNT	
a/an	without
bi	two
demi	half
deut	second
eu	well
haplo	single
hetero	different
homo	same
iso	equal
magni	large
micro	small
mono	one
multi	many
myrio	countless
oligo	few
pan	all
poly	many
prim	first
prot	first
quad	four
semi	half

NUMBER	
un	1
di	2
tri	3
tetr	4
pent	5
hex	6
hept	7
oct	8
non	9
dec	10
dodeca	12

COLOURS	
alb	white
argyr	silver
chrom	colour
chrys	golden
chlor	green
cyan	blue
erythro	red
flav	yellow
iod	violet
irid	rainbow
leuc	white
melan	black
nigr	black
polio	grey
porphyry	purple
rhodo	red
rubr	red
verd	green
xanth	yellow

CHEMICAL STORES	
adip	fat
amyl	starch
aqua	water
calc	stone
glucos	glucose
glyc	sweet
hydr	water
ket	ketone
lact	milk
lecith	egg yolk
lign	wood
lip	fat
lith	stone
sacchar	sugar
sal	salt
stear	fat
steat	fat
sucr	sugar
xyl	wood

WHERE/WHEN	
ab	away from
ad	towards
apo	separate
ante	before
anti	against
cata	down
circum	around
com	with
contra	opposite
dextro	right
dia	through
ecto	outside
endo	within
epi	upon
ex	out of
exo	outside
extra	beyond
hyper	above
hypo	beneath
in	in
infra	under
inter	between
intra	within
laevo	left
meso	middle
meta	after
para	near
per	through
peri	around
post	after
pre	before
pro	in front of
retro	behind
sub	below
super	beyond
supra	above
sym	with
syn	with
sys	sith
trans	across
ultra	above

BODY PARTS

anthro	joint
angi	vessel
aur	ear
cap	head
capill	hair
cardi	heart
ceph	head
cerebr	brain
cheir	hand
cili	eyelash
cord	heart
corp	body
cost	rib
crani	skull
dactyl	finger
dent	tooth
derm	skin
digit	finger
don't	tooth
dors	back
gastr	stomach
genu	knee
gloss	tongue
gnath	jaw
manu	hand
myo	muscle
nas	nose
meur	nerve
odont	tooth
opt	eye
oss	bone
ot	ear
ped	foot
pil	hair
pod	foot
pulmo	lung
rhin	nose
sarc	flesh
som	body
stom	mouth
trich	hair
vas	vessel
ventr	belly

THE END...

-ase indicates substance is an enzyme

-ose indicates substance is a sugar

GENERAL ROOTS

acanth	prickle	lumen	cavity
acro	summit	lysis	loosen
actin	ray	macula	spot
ala	wing	mito	thread
amphi	both	morph	form
andr	male	motor	mover
anthro	man	muri	mouse
asc	sac	neo	new
aster	star	oecious	house of
auto	self	onto	existing
aux	grow	oo	egg
avi	bird	ornith	bird
basi	at the bottom	ovi	sheep
bio	life	pachy	thick
blast	germ	palae	old
bov	ox	petr	rock
brachy	short	phag	eat
brady	slow	pher	carry
branch	gill	phil	love
bursa	pouch	phloe	tree bark
caec	blind	phor	carry
calor	heat	phot	light
cani	dog	phragm	fence
carp	speed	phyll	leaf
cauda	tail	phyto	plant
cera	horn	pisc	fish
clad	branch	platy	flat
clast	broken	pleur	side
conch	shell	plica	fold
copro	dung	pneu	air
corn	horn	porc	pig
cotyl	cup	pseudo	false
crypt	hidden	pter	wing
cten	comb	radi	root
cyst	capsule	rect	straight
cyt	cell	rhiz	root
dendr	tree	schizo	split
dino	terrible	sect	cut
echin	spiny	simi	monkey
eco	house	sperm	seed
equi	horse	stell	star
feli	cat	sten	narrow
fer	carry	stroph	turning
fil	thread	therm	heat
gemin	twin	thero	beast
glia	glue	tom	cut
gono	seed	troch	wheel
gymn	naked	trop	turning
gyb	woman	troph	feed
haem	blood	unc	hook
hippo	horse	uro	tail
hom	man	vitr	glass
hyal	glassy	xer	dry
lacuna	space	zo	animal
lepto	slender	zyg	yoke