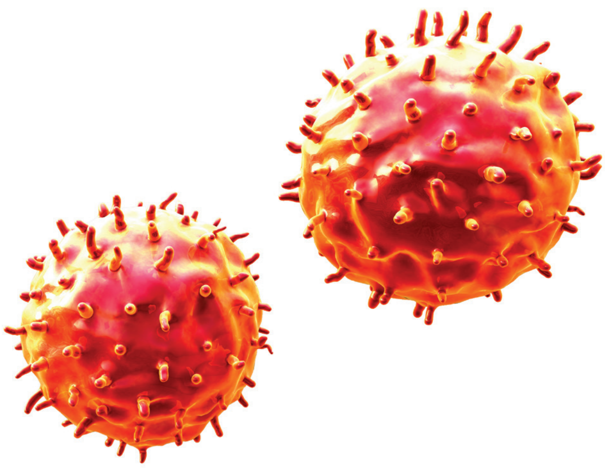
Cambridge Secondary 2

Learner Guide

Cambridge IGCSE® (9–1)
Biology **0970**



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Contents

How to use this guide

This Learner Guide can be used to help you to plan your revision programme for the theory exams and will explain what we're looking for in the answers you write. It can also be used to help you revise by using the revision checklist in section 4. You can check what you know, which topic areas you have covered and the topics you need to spend more time on.

The guide contains the following sections:

1: How will you be tested?
This section will give you information about the different types of theory and practical exam papers that are available.

2: Exam advice
This section gives you advice to help you do as well as you can. Some of the ideas are general advice and some are based on the common mistakes that candidates make in exams.

3: What will be tested?
This section describes the areas of knowledge, understanding and skills that you will be tested on.

4: What you need to know
This shows the syllabus content in a simple way so that you can check:
- the topics you need to know about
- how the Extended syllabus (Supplement) differs from the Core syllabus
- details about each topic in the syllabus
- how much of the syllabus you have covered

5: Useful websites

6: Mathematical skills

7: Appendices
This section covers the other things you need to know, including:
- information about terminology, units and symbols, and the presentation of data
- the importance of the command words the examiners use in the exam papers

Not all the information will be relevant to you. For example, you will need to select what you need to know in Sections 1 and 3, by finding out from your teacher which exam papers you're taking.

1: How will you be tested?

About the papers

You will be entered for **three** exam papers, **two** theory papers and **one** practical paper.

You will need to ask your teacher which practical paper you're taking. Nearer the time of the exam, you will also need to ask which theory papers you're being entered for:

- If your teacher thinks that you should enter for the exam based on the Core syllabus, you will take Paper 1 (theory), Paper 3 (theory) and **one** of the practical Papers (5 or 6).
- If your teacher thinks that you should enter for the exam based on the Extended syllabus, you will take Paper 1 (theory), Paper 4 (theory) and **one** of the practical Papers (5 or 6).

Whether you take the Core or Extended papers will depend on the progress your teacher thinks you have made and which option most suits your particular strengths. You should discuss this with your teacher.

About the theory papers

The table gives you information about the theory papers.

Paper	How long and how many marks?	What's in the paper?	What's the % of the total marks?
Paper 1	45 minutes (40 marks)	40 multiple-choice questions. You choose one answer you consider correct from a choice of four possible answers. The paper tests the Core syllabus.	30% (you do either Paper 1 or Paper 2)
Paper 2	45 minutes (40 marks)	40 multiple-choice questions. You choose one answer you consider correct from a choice of four possible answers. The paper tests the Extended syllabus (Core plus Supplement topics).	30% (you do either Paper 1 or Paper 2)
Paper 3	1 hour 15 minutes (80 marks)	Short-answer questions and structured questions. You should write your answers in the spaces provided. The paper tests the Extended syllabus (Core plus Supplement topics).	50% (you do either Paper 3 or Paper 4)
Paper 4	1 hour 15 minutes (80 marks)	Short-answer questions and structured questions. Questions will be based on the Extended syllabus content (Core and Supplement).	50%

About the practical papers

Twenty per cent of the marks for Cambridge IGCSE Biology are for practical work. Practical work is not based on specific syllabus content. You will need to practise the experimental skills listed in the syllabus, and any other information you need will be given in the questions.

You will do **one** of the practical papers shown in the table. Your teacher will tell you which practical paper you will do.

Paper	How long and what it's marked out of?	What's in the test/paper?
Paper 5 Practical Test	1 hour 15 minutes (40 marks)	You do a practical exam, which is supervised by a teacher. There are usually two questions testing five skill areas.
Paper 6 Alternative to Practical	1 hour (40 marks)	You answer a written paper about practical work. There are usually two or three questions, which test the same skill areas as Paper 5.

Here is some more detail about each of the practical papers. If you're unsure of anything, ask your teacher.

Paper 5 Practical Test

You do a practical exam, which is supervised by a teacher. In the exam you're given an instruction sheet which enables you to carry out the experiments, handle the data and draw appropriate conclusions. You may be asked to:

- carefully follow a set of instructions in a particular order.
- use familiar and unfamiliar methods to record observations and make deductions from them by performing simple tests, for example tests for food substances, using hydrogen carbonate indicator, litmus and Universal Indicator paper.
- use a scalpel or razor blade, forceps, scissors and mounted needles skilfully.
- use a hand lens to observe and record information about biological specimens.
- make clear line drawings of specimens.
- perform simple arithmetical calculations, e.g. the magnification of a drawing.

Paper 6 Alternative to Practical

This is a written paper. You may be asked to:

- carefully follow a set of instructions in a particular order.
- follow familiar and unfamiliar methods to record observations and make deductions from simple tests, for example tests for food substances, using hydrogen carbonate indicator, litmus and Universal Indicator paper.
- observe and record information about biological specimens from images.
- make clear line drawings of specimens from photographs or micrographs.
- perform simple calculations, including the magnification (enlargement) of a drawing.

2: Exam advice

How to use this advice

Much of this advice is given in response to the types of answers that candidates have written in the past. The advice is presented under various subheadings to help you when you prepare for your exams. Some examples of questions and answers are included to illustrate some of the advice.

- Make sure you read all the general advice. These can be important in any of the papers that you take.
- Have a copy of the syllabus to look at as you read through these tips. Note the different columns – the left hand side has all the Core topics; the right hand side has the Supplement topics.
- Make sure you know which exam papers you're taking before you look at the advice for the different papers.
    - You will take a multiple choice paper, either Paper 1, which is set on the Core syllabus, or Paper 2, which is set on the Core and Supplement.
    - You will take EITHER Paper 3, which is set on the Core syllabus, OR Paper 4 which is set on the Core and the Supplement.
    - You will take EITHER Paper 5, which is the Practical Exam, OR Paper 6, which is the written paper about practical work known as the Alternative to Practical (often called the ATP).

General advice

- Use your syllabus all the time while you're revising and preparing for the exam papers.
- You must know which topics you will be tested on.
- Make sure you have all the equipment you will need for the exam in a clear, plastic container. You need two pens, pencils (preferably HB or B), a clean eraser, a ruler (which measures in mm), a pencil sharpener and a calculator.

Answering questions

- The questions are meant to let you show the biology that you have studied. When you're writing your answers remember that another person has to be able to read it.
    - Don't waste time by writing out the question before you start to answer.
    - Keep your handwriting clear and legible.
    - Keep your answers on the lines on the question paper. Don't write in the left hand side of the paper or in the column marked *For Examiner's use*. This is because papers are scanned and the examiners mark them online. If you write in the margin your answers may not be visible.
    - If you wish to change an answer, cross out your first answer and rewrite. Don't write over what you have already written.
    - If you have to cross out something, put a line through it, don't scribble over it.
    - If you run out of space, use white space on another part of the exam paper for a continuation answer; don't try to squeeze in your answer by using very small writing.
    - If you have to use a different space for a rewritten another answer or to continue an answer, put a note to tell the examiner where it is, e.g. 'see page 5'.
    - Always try to write accurately using the correct biological terms. Candidates often lose marks because they don't use the vocabulary of biology correctly.
    - Don't use words like 'it', 'they', 'effect', 'affect' without any more explanation. A sentence like 'It has an effect on the body' or 'They affect the process' does not say anything.

Example 1

Question:
State why magnesium ions are important for healthy plant development. [1]

Answers:
"*They are needed by the plant*" is true but too vague.

"*They are needed by the leaves*" is still too vague.

If these are the first answers that come into your head, ask yourself: What is it or they? What is the "*need*"?

"*Magnesium is needed to make chlorophyll*" is a better answer and would gain the mark

"*Magnesium is part of each chlorophyll molecule*" Good answer, one mark!

- If you want to use the word 'it' or 'they' – think 'what is it?' or 'what are they?' and then phrase your answer more precisely.
- If you want to use the word 'affect' or 'effect' – think 'how do they affect' or 'what is the effect that they have?'

Terms

- These are the names used in biology. Many of them are given in the syllabus. These terms will be used in questions. You should make sure you use them correctly in your exam. Ask your teacher if you're unsure of the meanings of the biological terms used in the syllabus and in any textbook you're using. It is a good idea to write your own biological dictionary using the glossaries at the back of books. You will notice that many terms are defined in the syllabus, so that is a good place to start when making your own dictionary.
    - Try to use the correct spelling. The person marking your answer will try to recognise what word you mean, but if the spelling is too far out or ambiguous, then they can't allow you a mark.
    - Some biological terms have very similar spelling. One example is 'ureter', urethra' and 'uterus'. If the answer is ureter and your mis-spelling is 'uretus', it is not clear enough as you could have thought the answer is 'uterus'. Other common examples are ovum/ova, ovary and ovule; testes and testa; sucrose and sucrase. Make sure you write clearly and always try to spell as accurately as you can.
    - Don't try to mix the spellings of two words when you're not sure which of them is the correct answer. For example, you might write 'meitosis' when you're not sure whether the answer is mitosis or meiosis, or urether, when you're not sure if the answer is ureter or urethra. In both cases you would not get the mark.
    - You need to check carefully that you have used the right word when similar terms are used in the same topic, e.g. urea and urine, ureter and urethra, semen and sperm.

Writing in your own words

- You sometimes have to write two or more sentences to answer a question.
    - Use short sentences. If you write long sentences you can become confused and your meaning is lost. You might also write something contradictory. It is hard for the examiner to find correct statements in a muddled answer.
    - You're often asked to write down something you have learned. Make sure you have learnt the meanings of the common terms used in biology, e.g. photosynthesis, osmosis and fermentation.
    - In the revision checklist there is a list of the terms which you should be able to define. You also need to be able to write down the meaning of more complicated ideas, e.g. levels of organisation, natural selection, artificial selection, global warming and eutrophication.

Exam questions and marks

Example 2
It helps to highlight the main features of a question. You can't use a highlighter pen, so the best thing to do is to underline or circle key words in the questions.

Question
Name the tissue that transports the sugars made by photosynthesis to other parts of the plant [1]

This tells you that should write a one word answer about plant transport of sugars. Underline the command word (which is not always at the start of the question) and the biological terms as you read the question.

- Make sure you know which part of your biology is being tested.
- Read the whole of a question including all the stimulus material and parts (a), (b), (c) (i) and (c) (ii), etc. carefully before you begin to answer. Some of the parts have similar answers so you need to work out the differences between them. If you write exactly the same thing in different parts of the same question, then only one of them might be a correct answer.
- There is often stimulus material for each question. This might be a photograph, diagram, drawing, flow chart, table of data, graph or just some text. Read all of this information carefully and study any pictures, tables or graphs that are included. All of it is relevant to the questions.
- The stimulus material is often about something you have not studied. Don't panic. There will be enough information in the question for you to work out an answer. You're being tested on your ability to **apply** your knowledge to new information.
- All the different parts of a question may be about the same topic, e.g. digestion or photosynthesis, but you should be prepared for questions that test different topics, e.g. digestion, enzymes and assimilation.
- Look for clues in the words of the question. For example, if you see the word mammal in the question, you know that the animals are warm blooded and have biological systems like ours.
- If you're only given a Latin name or a name you don't recognise, e.g. eland, look to see if you're told anything about it. If you're told that an eland is a herbivore, then you know it eats plants.
- Answer each question as far as you can. Don't spend a long time staring at a question.
- If you don't know the answer or how to work it out, then leave it and come back to it later. It is best to put a mark by the side of the question so you can find it easily. An asterisk (*) is a good idea or a large question mark against the letter of the part question. Not all part questions have answer lines so you may not see a question that you have left out when you turn through your script towards the end of the exam.
- Try not to leave blanks. Always check through your script towards the end of the exam. When you come back to a question you may remember what to write as an answer to a question that you left out earlier in the exam.
- Don't waste time by writing about things unrelated to the question.
- In Papers 1 and 2 there is one mark for each question.
- The number of marks is printed on the exam papers for Papers 3, 4, 5 and 6. The mark available for each part question is printed in square brackets, e.g. [2]. The number of marks helps you decide how much to write. The total number of marks for each question is printed at the end of the last question, e.g. [Total: 12].
- The number of marks is a guide to how long to spend on each question or parts of a question.
- Don't waste time and write a long answer for a question which has one or two marks. You will not get any extra marks even if your answer is full of many correct and relevant statements.
- If there are two or more marks don't write the same thing in two different ways, e.g. "The leaf is very large. The leaf has a large surface area". Notice that the second sentence is more accurate and is preferable to the first one.

Command words

- These are called command words and tell you what to do.
- You can find all the command words in the Glossary of terms used in science papers which is at the end of your syllabus.
- If a question asks you to 'Name' or 'State' **two** things only the first two will be marked. Use the numbered lines for your answers if they are given on the question paper. If you write more than two and the first is correct, the second one is wrong, and the third one correct, you will only get one mark.
- Some questions have two commands in the question, for example 'Predict and explain'. This means you have to say what you think will happen AND then say why you think it will happen. Usually the word **and** is printed in bold type to help you. See the section below for advice about answering questions that have two command terms and require an extended answer.
- The table on the following page has a list of terms used in biology papers to tell you what to do in an answer. Make sure you know what you should do in response to each command word.

Example 3

Question 1

Name the process by which green plants make sugars. [1]

All you need to write for your answer is '*photosynthesis*'.

Question 2

Define the term *photosynthesis*. [2]

This requires a full sentence:

'*The process by which green plants make carbohydrates from raw materials using energy from light.*'
This is very similar to the definition given in the syllabus so would easily gain both marks.

- You can find out more about command terms in the 'Glossary of terms used in science papers' towards the end of the syllabus. These notes should help you know how to respond to each of the command words.

Command words	What you should do in response to each command word
Define	Give a definition – use the definitions given in the syllabus
What do you understand by the term .....?	Give a definition or a fairly brief explanation of what the term means. You can use an example to illustrate if this seems appropriate
State	Brief answer – maybe one word or a phrase
List	A number of brief answers should be given; usually you're asked for a specific number of points. You don't gain extra marks by writing more than the number stated
Describe	You may have to describe the steps in a process or describe the appearance of a biological structure You may also have to describe some data given in a table or a graph. Make sure you have the correct vocabulary for such a description. Use the words increase, decrease, constant, peak, maximum, minimum, etc.

Explain	This is **not** the same as describe. You should give an answer that has some reasons. You may have to explain why something happens or how it happens
Discuss	You may be asked to discuss advantages and disadvantages – so make sure you give some of both. Much depends on the type of question, but 'discuss' usually means you should give different sides of a story or an argument
Outline	This is not the same as describe. You should give the main important points without any detail
Predict	This means you should state what you think will happen. You may be asked to justify your prediction or explain it; explanation is not required if all the question says is "predict...."
Suggest	This is often used when there is no single correct answer; you should look through the information you have been given for some clues as to what to 'suggest' in response to the question. Many problem-solving questions use this command word
Calculate	This is obvious; make sure you know how to calculate percentages, percentage changes, rates and ratios (for genetics). Always give your working even if not asked. Always make sure you use the correct units
Measure	You should use a suitable measuring instrument to take a reading. Usually this involves using a ruler to measure to the nearest mm. Make sure you write down the unit after the numerical answer
Determine	This is **not** the same as 'measure'. Either you should explain how an experiment should be set up to take measurements or how you should make a calculation from some results or data given in a table or graph
Estimate	You don't have to give an accurate answer – but your answer (which is usually numerical) should only be approximate
Sketch	This is usually used about graphs. You should put a line (straight or curved) on a pair of axes. This may be a graph that has a line on it already or it may be pair of axes printed on the exam paper without a line or curve

The style of questions

Identify features of cells, tissues, organs or other structures

- You may be expected to name some structures that are identified by letters on a diagram or drawing.
- You may have to put labels on a diagram using label lines.

Example 4

Question:
Use label lines to identify the following on the drawing of a flower: petal, sepal and stamen. [3]

To answer this question:
You have to know the structure of a flower.

You also have to be able to find the structures on a diagram of a flower that you may never have studied.

You then have to draw a label line to the structure and write the name next to the labelling line.
If you don't draw a label line you may not get any marks even if you have found the correct structure.

Use information given in the question

- Questions may ask you to 'Use examples from...' or 'Use **only** the information in ....' or 'With reference to Fig. 6.2'. If you read instructions like these, find out what you're expected to use as examples or take information from. You will not get any marks if you use examples from somewhere else. The information can be given to you in different ways:
  - a diagram, such as a food web, a set of apparatus or a biological structure;
  - a graph, which could be a line graph, a bar chart or a histogram – always check the headings and units carefully;
  - a table – always read carefully the headings of the columns and/or rows and look for any units.

Example 5

You may have to give examples to show that you understand an idea in biology.

Question that includes a food web as its stimulus material.

Name one example of each of the following from the food web: producer, primary consumer and tertiary consumer.

To answer this question you have to know definitions of producers, primary consumers and tertiary consumers. Then you have to show that you understand how these terms apply to the food web shown in the diagram. If you put examples from other food webs you have learned, you will not get any marks.

Example 6
Question that includes a diagram of a cross section of a leaf.

Describe **and** explain the advantage of the distribution of chloroplasts in leaves, as shown in the diagram.

To answer this question you have to observe the diagram and describe which cells have the most chloroplasts. Then you have to work out why this arrangement might help photosynthesis. If you only write about the functions of chloroplasts you will not get any marks.

Interpreting tables and graphs

- The stimulus material may be in the form of a table, line graph, bar chart or histogram.
- Always read the introductory text very carefully before you study the table or graph. Underline key points in the information that you're given. In Paper 4, there may be quite a bit of introductory text explaining how the information was collected, e.g. from an investigation.

Tables

- Look at the column and row headings in a table and make sure you understand them. If you have read the introduction carefully, then you will.
- Find the units that have been used. Make sure you use them if you give any figures in your answer.
- Use a ruler to help read the table. Start on the left with the first column. This should be the independent variable and should increase in steps. Now put the ruler to the right of the next column and look at the figures in this second column. Look for a pattern or trend in the figures. Identify the pattern or trend first before thinking of an explanation. Move the ruler across to the right of the third column if there is one and continue in the same way. It may help to sketch a little graph on the exam paper to help you identify any pattern or trend.

Line graphs

- Look carefully at the *x*-axis which is the independent variable and make sure you understand what has been changed. Look carefully at the *y*-axis which is the dependent variable. Both variables should be described in the introduction to the question.
- Put your ruler against the *y*-axis and move it gradually across the graph from left to right. Follow the pattern or trend of the line (or each line if there is more than one). Mark on the graph where something significant happens. For example, the line might show that the dependent variable becomes constant (gives a flat horizontal line).

Bar charts and histograms

- Look carefully at the *x*-axis and the *y*-axis to see what has been plotted. Again, it is a good idea to move a ruler across the bar graph or histogram to help you concentrate on one aspect at a time. You can identify the highest and lowest figures and see if there is any pattern.
- You should make yourself some notes about the table, graph or histogram before answering the questions.
- On Papers 3 and 4, you might be asked to complete a graph, bar chart or histogram. If so, you should look carefully at the question to see what you're being asked to do. You may have to add one or more points to a line graph and then add a suitable line. There is advice about how to draw lines on line graphs in the section of general advice for Papers 5 and 6.

Calculations

- If you're asked to do a calculation:
    - You may have to find the figures from a table or graph.
    - Write out all the working for your calculation. If you make a mistake and give the wrong answer, you may well be given marks for showing how to do the calculation.
    - Make sure that you show the units in the calculation.
    - If the units are not given on the answer line, then make sure you write them after your numerical answer.
    - Often you will be asked to carry out a calculation and add the result to a table. Always express your answer in the same way as the figures given in the table. If the other figures are 5.6 and 4.6, then your answer should be given to one decimal place, even if the answer is a whole number where you should write 7.0, not 7.
    - If you use a calculator, round up or down the figures – don't copy all the figures after the decimal point.

Equations

- If you're taking Paper 3, then you should know word equations for photosynthesis, aerobic and anaerobic respiration. If you're taking Paper 4, then you should also know the chemical equations and be able to use the chemical symbols correctly. You should know the correct formulae for the compounds involved.
- If you're asked to give either a word or a symbol equation, don't combine symbols and words in the same answer.

Example 7

Question:
Write the word equation for anaerobic respiration in yeast [2]

Correct answer:

glucose → carbon dioxide + ethanol + energy

This is an incorrect answer: '*glucose* → CO_2 + *ethanol and energy*', as there is a mixture of words and symbols. It would probably get one mark out of two.

Question:
Write the chemical equation for anaerobic respiration in yeast [2]

Correct answer:

$$C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2 + \text{energy}$$

Note that you should use subscripts correctly when writing out the formulae of glucose, alcohol (ethanol), carbon dioxide, lactic acid and water in these equations.

Example 8

Question:
State **two** ways in which arteries differ from veins. [2]

Correct answer:
1 Arteries have thicker walls than veins.
2 Veins have semi-lunar valves, but arteries don't.

Ambiguous answer:
1 They have thick walls.
2 They don't have valves.

No marks would be given to the second answer as the comparisons have not been made.

Question:
Complete the table to compare the structure of arteries with the structure of veins. [2]

Correct answer:

Arteries	Veins
has thick wall	has thin wall
thick muscle layer	very thin muscle layer

Incorrect answers as the comparisons are not made between the same features.

Arteries	Veins
thick wall	thick elastic layer
no valves	small amount of muscle

In cases like this, it is much better to have an extra column that gives the features to be compared:

Feature	Arteries	Veins
thickness of wall	thicker	thinner
valves	absent	present

This ensures that you make direct comparisons in each row of the table. You can always add a first column if it is not included in the question.

Making comparisons

- If you're asked to compare two things make sure you make it clear which thing you're writing about.
    - The question may ask you to compare two structures or two processes that you have learnt about.
    - Sometimes you may be expected to do this on answer lines in which case you must make clear the items that you're comparing (see Example 8).
    - You may be given a table to complete. This may be blank and you have to fill it in, or it may already have some entries and you complete it.
    - If you're given lines to make the comparison, it is perfectly acceptable to draw a table for your answer.
    - A question may give a table of data and then ask you about it. Make sure you only use information from the table; for example, in a table that shows the composition of normal breast milk and colostrum, you can see which milk contains more fat, protein and sugar. Your answers should start with 'colostrum has more …….. than breast milk' or 'breast milk has more …… than colostrum'. Don't put 'It has more protein'.
- **Extended writing.** You're required to write longer answers to questions that have four or more marks. There are more of these questions in Paper 4 than in Paper 3.

Example 9

Question:
Explain what happens if excess nitrogen fertiliser is washed into a stream or pond [4]

The mark scheme for a question like this will have a list of points that the examiner will be looking for in your answer. There will be more points than there are marks, so you don't need to put them all in your answer.

The points for this question could be:
- Algae and aquatic plants grow faster using the fertiliser.
- Algae cover the water surface.
- Light can't pass to aquatic plants lower down.
- These plants die.
- Bacteria/decomposers, decay or feed on the dead plants.
- Bacteria/decomposers, increase in numbers.
- Bacteria/decomposers use aerobic respiration.
- They use up oxygen.
- There is not enough oxygen for the respiration of other organisms which live in the water.
- These organisms die.
- The process is called eutrophication.

If your answer is something like 'The fertiliser causes low oxygen and it affects animals in the water' you will not get any marks. The answer is much too short and too vague. If your answer is something like 'The animals don't have enough oxygen for their respiration and they die' you may get two marks.

    - When you answer these questions always use full sentences if you can. If you find it helps to write bullet points, then make sure each bullet point is a full sentence. If you abbreviate your answer too much by writing notes, then you may not convey enough information to gain the marks.
    - If you're giving a sequence of events (as in Example 9), then you should make sure they are in a logical order. If you're explaining a biological principle or making comparisons, then give the main points first.
    - If you're describing something that moves from one place to another, then make sure you include the direction of movement. For example, 'water moves by osmosis' is unlikely to gain a mark unless you include the direction; 'water enters the cell by osmosis' is a much better answer.

Advice for Papers 1 and 2

- You have about one minute to read and answer each question. Each question tests just one topic.
- Some questions test what you know and understand. For example: What tissue in the eye detects light?
- Some questions test if you can apply what you have learned to understand new data. These questions will often have a diagram, graph or table to use.
- Try to decide what the question is testing as you're reading it. The sequence of questions usually follows the sequence of topics in the syllabus.

Example 10

Question:
Four blood vessels are labelled as **A**, **B**, **C** and **D** on a diagram of the human circulatory system.

This is followed by the question:
In which vessel will absorbed alcohol first be found?

You need to think about what the question is asking.
- Is it about digestion?
- Is it about excretion (of alcohol)?
- Is it about the circulation?

The question is asking about something absorbed from the gut to be transported, so it is about circulation.

Which vessel carries substances absorbed by the gut?

Answer:
The hepatic portal vein.

So you have to decide whether the vessel is an artery or a vein, then realise that it is a vein taking blood away from the organ that absorbs alcohol.

Then choose the letter, which labels the hepatic portal vein.

- Don't try to find a pattern in the order of your answers (e.g. A, B, C, D, A, B....)
    - The same letter could be the correct answer for several questions in a row.
    - Letter **A** might be the correct answers for more questions than **B**, **C** or **D**. Or there could be fewer correct answers shown by letter **D** than any of the others.
    - Don't let what you have chosen for the previous questions influence which letter you choose.

Advice for Paper 3

- Most of the questions require short answers. This means that you write mainly one word or one sentence answers worth one mark.
- Longer answers will need two or three sentences with two or three different ideas. Always look at the number of marks for each part question to help you decide how much to write.
- Look at the number of command words: ask yourself 'do you have to do one or two things?'
- Use the lines given. Stick to the point and don't write too much.
- Only give the number of answers that are asked. Use the numbered lines and give one answer per line.
- There will only be a few parts of questions that need extended writing. These will have four [4] or [5] marks. The question will often be related to some information you're given. You will need to write four or five sentences in a sequence that makes sense. You can think of it like 'telling a story with a beginning, a middle and an end'. Remember to refer to any information you're given.

Advice for Paper 4

- There is more to read in this paper than in Papers 1, 2 or 3.
- Many questions will be based on one, two or three sentence answers. Always look carefully at the number of marks for each part question.
- Look carefully at the number of command words – do you have to do one or two things, for example describe **and** explain.
- Look carefully to see if you're asked for an actual number of answers. Only give that number. Use the numbered lines and give one answer per line.
- There are questions that may start in one part of the syllabus and link to another, e.g. the information could be about the animals in a particular habitat and what they eat. The first parts of the question might be about the food chains or food webs which include these animals. A later part of the question could be about teeth or about factors in the environment.
- You're likely to be asked to interpret unfamiliar data, e.g. results from an experiment that you may not have carried out or could not be carried out in a school. Don't be put off. Follow the same advice as before. There will always be enough information in the question for you to answer it.
- You're likely to have questions about events and situations that are new to you. Don't be put off. The question will tell you all you need to know. Read the information carefully and if it is not immediately apparent, look for clues that will tell you which part of the syllabus the question is about.

Advice for Papers 5 and 6

General advice

- Read through the questions carefully, looking to see how many marks are given for each question.
- In Paper 5, you have to follow a set of instructions. Read these to the end first, before you start.
- In Paper 6, you will have to read some information about an experiment. Again, read these very carefully.
- Divide the time of your exam in proportion to the marks given.
- If you're taking Paper 6, make sure that you have done plenty of practical work so you can imagine what has happened to obtain the results that you will process, analyse and interpret in the questions.
- Make sure that you have a **sharp pencil** to use for making drawings and drawing graphs and charts. Don't draw in ink because you can't make changes as you can when using a pencil.
- Make sure you have a good, clean eraser for rubbing out your pencil lines if necessary. Don't press too hard when using a pencil for making drawings, graphs or charts. Sometimes it is hard for an examiner to tell what your final line on a scanned script is.

Recording your observations

In both papers you're expected to make observations and record them.

- You can record your observations:
  - as statements in writing
  - in tables
  - by using drawings
  - by constructing tally charts.
- You can process your observations by:
  - carrying out calculations, e.g. percentages and percentage changes
  - plotting graphs – line graphs, bar charts and histograms.
- Use all the space available on the paper for your observations.
- Don't write an explanation until the question asks for one.
- Use a sharp HB or B pencil. It can be rubbed out easily if you need to correct a mistake. Use a good eraser as traces of pencil lead are detected when your paper is scanned.
- Don't forget headings for the columns and the rows in tables and in axes on graphs. Don't forget to include the units.
- Make drawings as big as the space allows.
- Use a ruler for labelling lines.
- Label in pencil.
- Use one clear continuous outline not an artistic drawing. Don't shade other than using very light dots.

Drawing tables

- If you're asked to draw a table:
  - Use a ruler and a pencil to draw the table. Make sure you rule lines for the columns and the rows.
  - Write headings for each column and/or row of the table.
  - Write in units if they are needed, e.g. volume of water/cm^3, mass of seed/g. The unit should be written after the oblique line (forward slash).
  - Don't put units in the table spaces where you write numbers.
- Make sure you use the same number of decimal places in each column and/or row.
  - If you're asked to draw and/or complete a tally chart for recording data:
  - Make sure that you rule up a table and use clear headings.
  - Record the numbers by using strokes and putting an oblique line to represent 5:
  - /// = 3; //// = 4 and ~~////~~ = 5
  - Include a column to show the total numbers.

Drawing line graphs

- If you're asked to draw a graph:
  - Choose a scale which uses most of the grid provided on the exam paper.
  - Choose a simple scale, e.g. one large square is equal to 1, 2, 5 or 10 units in the data. Don't make it difficult to plot the data by using a scale such as one large square = 3 or 6.
  - Write the name of each axis and the correct unit, e.g. rate of water loss/g per h, temperature/°C, time/s.
  - Plot the points exactly using a sharp pencil. Draw the points lightly so that you can rub them out if you need to. Make them more definite when you're sure they are right.
  - Use a cross (x) or a dot in a circle (0) for your plot points. Don't use a single dot as it may not be seen after you have drawn your line.
  - If you have to plot two lines on a graph, use two different symbols for the plot points. You can use a cross, a dot in a circle or a plus sign (+). Label each line carefully or use a key. Use a pencil for both lines; don't use a blue or black pen or different colours as these don't show up on scanned scripts.
  - Read the question carefully before you put a line in the graph. Look carefully at the points. You have to decide whether to use a straight line of best fit, a smooth curve of best fit or join the points by straight lines. Always use a **sharp** pencil.
  - Remember that lines of best fit don't have to pass through the point where the two axes meet (the origin). If you're sure that 0, 0 is a point then you can include it. For example, in an investigation of the effect of the concentration of enzyme on enzyme activity 0, 0 means that there is no enzyme present. If there is no enzyme there can be no activity, so 0, 0 could be included.
- Don't extend your line graph beyond the last plotted point.

Bar charts have separate columns that don't touch – there are gaps in between; histograms have columns that do touch each other. Bar charts are used to show data on discontinuous variables, for example blood groups, eye colour, etc.; histograms are used to show data on continuous variables, e.g. length, mass, speed, volume, etc.

Drawing bar charts

- You may have to draw a bar chart (Papers 5 or 6) or add some data to a bar chart (Papers 3 and 4). You draw a bar chart when you have different categories, such as the numbers of six different species in a habitat.
  - Choose a scale which uses most of the grid provided on the exam paper; don't make the chart too small.
  - Draw the chart in pencil.
  - Rule the columns evenly so that they are all the same width.
  - Take care to rule the top of each block in the correct place – double check with the table of data each time.
  - The spaces between the columns on the *x*-axis should be identical; they should be the same length, e.g. one large square on graph paper.
  - The *y*-axis should be properly scaled with equal intervals just as in a line graph.
  - The *y*-axis should be labelled with units.
  - The lines or blocks can be arranged in any order, but to make comparisons it helps if they are arranged in descending or ascending order of size.

- You should identify each block by putting a label directly underneath each block. Don't shade the blocks or colour code them.

Drawing histograms

- Histograms are ways of displaying the variation in a particular feature, for example the lengths of leaves on a tree. If you measure the lengths of leaves you would have to divide the data into classes, such as 50–54 mm, 55–59 mm, 60–64 mm, etc. The numbers would be recorded in a tally table.
    - Choose a scale which uses most of the grid provided on the exam paper; don't make the histogram too small.
    - Draw the histogram in pencil. The *x*-axis represents the independent variable and is continuous. It should be properly scaled and labelled with appropriate units.
    - The blocks should be drawn touching.
    - The *area* of each block is proportional to the size of the class. It is usual to have similar-sized classes (as in the example above) so the widths of the blocks are the same.
    - The blocks should be labelled either by putting the class ranges (e.g. 60–64, 65–69 etc.) underneath each block or by putting the lowest number in each range (e.g. 60, 65, 70, etc.) under the left-hand side of the relevant block.
    - The *y*-axis represents the number or frequency and should be properly scaled with equal intervals. It should be labelled with appropriate units.

Planning investigations

Sometimes you're asked to suggest a way of carrying out an investigation or to improve the method that is in the question paper.

- When you read through an investigation try to work out three main things:
    (1) What is being changed – this is called the independent variable.
    (2) What is being measured – this is called the dependent variable.
    (3) What is being kept the same – these are the control variables.

Example 11
In a question to investigate the effect of temperature on enzyme activity:

- the independent variable is temperature.
- the dependent variable may be the time taken for a solution of the substrate to change its appearance.
- the key control variables are the concentration of the enzyme solution, the volume of the enzyme solution, the concentration of the substrate solution and the volume of the substrate solution. These are the variables that must be kept constant if you're to find out the effect of changes in temperature.

- Some investigations need to have two parts:
    - The experimental – which measures the process being studied and contains the living organism, part of an organism (e.g. a leaf) or enzyme being tested.
    - The control – which will be exactly the same as the experimental except that the living organism will be missing or replaced by something non-living. The control shows that the results are due to the activity of the living organism and is not due to the apparatus or an environmental factor.
- All investigations should be repeated to increase the reliability of the results. If the same results are achieved (or the results are very similar) then they are reliable.
- The precision of results taking may not be very good. For example, if you're measuring using a syringe or measuring cylinder it may be difficult to measure to the nearest cm^3. You should think about ways in which the precision can be improved.
- Give quantities in appropriate terms – avoid the use of term 'amount' as this does not convey precise meaning to any specific quantity. 'Amount' could mean volume, mass or concentration. Always be precise and use these words; avoid writing the word 'amount'. For example, you can give the volume in cm^3, mass in grams and concentration in an appropriate unit such as grams per 100 cm^3.

Paper 5 advice

In Paper 5 you're following instructions, using laboratory equipment, making observations, recording results and drawing conclusions.

- Start by reading the entire first question.
- Think about the apparatus that you will use for each step and imagine using it in your mind.
- Check the time to be allowed and imagine following the instructions.
- Do the same when you're ready to begin the next question.

Following the instructions

- Follow the instructions for practical methods exactly. If you make a change in the method you might alter the results.
- Don't take short cuts.
- Always label test tubes and other containers to help you remember which is which.
- If you're told to 'Wash the apparatus thoroughly after each use' make sure you do. If there is anything left in the apparatus the next stage may not work.
- If you have to measure a specimen make sure you draw a line on your drawing to show where you made your measurement.
- It is a good idea to put a tick by the side of each instruction when you have completed it. This helps you to find the right place in the instructions, so that you don't leave out a step or repeat a step when it is not required.
- Keep your exam paper on a part of the bench which you can keep dry. Don't pour liquids or use syringes or pipettes over your exam paper. If you keep our exam paper away from the 'wet' part of your bench you're unlikely to spill anything on it.

Recording your observations

- Don't forget that observations can be seen, heard, felt and smelled, e.g. colour, fizzing, warming, smell of a flower, texture (feel) of a fruit.
- You can always find something to observe, so make sure you record something for each observation.
- Write down **exactly** what you observe.
- e.g. if you add a drop of iodine solution to a drop of starch solution on a white tile, the colour changes.
    - You should write 'the colour changed from yellow to blue-black'.
    - If you write 'it turned black' you have not given all the information.
    - If you add iodine solution to a drop of water on a white tile, you should write down 'the colour stayed yellow'. If you write 'the colour stayed the same', or 'no change', you have left out important information.

Drawings

These will be from specimens or photographs.

- Read the question carefully, the drawing may have to be an accurate size e.g. twice the original.
- Make each drawing as big as the space allows.
- Use a ruler for labelling lines.
- Label in pencil.
- Use one clear continuous outline not an artistic drawing. Don't shade other than using very light dots.
- Observe details carefully, such as number of seeds in a seed case, thickness of a layer in a shell, etc. Show these accurately on your drawing.

Taking measurements

- Make your measurements as accurate as you can. Measure to the nearest unit, e.g. mm. Don't try and 'guess' 0.5 mm.
- Make sure you put units! Use the correct SI units, don't use other units; for example measure in millimetres not inches.
- Always measure in millimetres, not centimetres.
- If you have to make calculations on your measurements, use the blank pages within the paper but indicate if the answer is continued elsewhere on the blank pages. Don't write in the margins.
- Write neatly and show your working. The person marking your paper might be able to give you marks for knowing what to do if you make a mistake or don't finish the calculation.

Conclusions

- Use your own results for your conclusions.
- Before planning what to write for a conclusion, turn back to the beginning of the question and read the introduction. You may have forgotten what you were told about the investigation you have just carried out. Think about the theory and apply it to the results you have obtained.
- Sometimes you're expected to make conclusions about some other data, not the data you have collected.
- Don't write the conclusion you have learned from a class experiment or from theory.

Paper 6 advice

The topics on Paper 6 will be very similar to those on Paper 5, so the advice is very much the same as for that paper. Because you're not doing any practical work, there is usually a third question.

In this paper you're making observations from information given in the paper, recording results and drawing conclusions. Try to imagine doing the practical which has produced the results in the questions and look very carefully at the information you're given as it will almost certainly be unfamiliar to you.

Recording observations

- Some of your observations are based on photographs or diagrams on the paper.
- Write down exactly what you see – as differences or similarities. Measurements may need to be made and magnifications calculation.
- Look carefully at photomicrographs as these will be enlarged, e.g. x 100. If you're asked to calculate a magnification follow these steps:
    - measure the structure in the photograph in millimetres (not centimetres).
    - look for the actual size of the object – you will be given this.
    - divide the length of the structure in the photograph (in mm) by the actual size (in mm).
    - the answer is the magnification; round up or down the answer from your calculator.
    - usually magnifications are given as whole numbers, so don't give the answer to one or more decimal places.

If you're asked to calculate an actual size follow these steps:

- measure the structure in the photograph in millimetres (not centimetres).
- look for the magnification – you will be given this.
- divide the length of the structure in the photograph (in mm) by the magnification.
- the answer is the actual size in millimetres; round up or down the answer from your calculator.
- actual sizes could be given as whole numbers or you could include one or two decimal places, but no more.

3: What will be tested?

The examiners will take account of the following areas in your exam papers:

- your knowledge (what you remember) and understanding (how you use what you know and apply it to unfamiliar situations).
- how you handle information and solve problems.
- your use of experimental skills.

These areas of knowledge and skills are called assessment objectives. The theory papers (Papers 1 and 3, or Papers 2 and 4) test mainly Assessment Objective 1 (knowledge with understanding) and Assessment Objective 2 (handling information and problem solving). The purpose of the practical paper (Paper 5 or 6) is to test Assessment Objective 3 (experimental skills). Your teacher will be able to give you more information about how each of these is used in the exam papers.

The table shows you the range of skills you should try to develop:

Assessment Objective	What the skill means?	What you need to be able to do?
AO1 Knowledge with understanding	remembering facts and applying these facts to new situations	1. use scientific ideas, facts and theories 2. know scientific definitions e.g. what is excretion? 3. know about biological apparatus and how it works 4. know about S I units, quantities (e.g. mass) and symbols (e.g. dm^3) 5. understand the importance of science in everyday life
AO2 Handling information and problem solving	how you extract information and rearrange it in a sensible pattern and how you carry out calculations and make predictions	1. select and organise information from graphs, tables and written text 2. change information from one form to another, e.g. draw chart and graphs from data 3. arrange data and carry out calculations 4. identify patterns from information given and draw conclusions 5. explain scientific relationships, e.g. changes in heart rate in relation to activity 6. make predictions and develop scientific ideas 7. solve problems
AO3 Experimental skills	planning and carrying out experiments and recording and analysing information	1. set up and use apparatus safely 2. make observations and measurements and record them 3. analyse experimental results and suggest how valid they are 4. plan and carry out your own experiment and describe to what extent your plan worked and suggest improvements

4: What you need to know

The table describes the things you may be tested on in the exam. It is arranged in 21 topic areas. If you're studying only the Core material (Papers 1 and 3), you will need to refer **only** to the column headed Core material. If you're studying the Extended syllabus (Papers 2 and 4), you will need to refer to both the Core and Supplement material columns. Read Section 1 if you're unsure about which material to use.

How to use the table

You can use the table throughout your course to check the topic areas you have covered. You can also use it as a revision aid. When you think you have a good knowledge of a topic, you can tick the appropriate box in the checklist column. The main headings in the topic areas are usually followed by the details of what you should know.

Test yourself as follows:

- cover up the details with a piece of paper
- try to remember the details
- when you have remembered the details correctly, put a tick in the appropriate box.

If you use a pencil to tick the boxes, you can retest yourself whenever you want by simply rubbing out the ticks. If you're using the table to check the topics you have covered, you can put a tick in the topic column next to the appropriate bullet point.

The column headed 'Comments' can be used:

- to add further information about the details for each bullet point
- to add learning aids
- to highlight areas of difficulty/things which you need to ask your teacher about.

Topic	Core material			Supplement material		
	You should be able to:	Checklist	Comments	You should be able to:	Checklist	Comments
1. Characteristics and classification of living organisms						
1.1 Characteristics of living organisms	• Describe the characteristics of living organisms by defining the terms: ○ *movement* as an action by an organism causing a change of position or place ○ *respiration* as the chemical reactions in cells that break down nutrient molecules and release energy ○ *sensitivity* as the ability to detect and respond to changes in the environment ○ *growth* as a permanent increase in size	☐		• Define the terms: ○ *movement* as an action by an organism or part of an organism causing a change of position or place ○ *respiration* as the chemical reactions in cells that break down nutrient molecules and release energy for metabolism ○ *sensitivity* as the ability to detect or sense stimuli in the internal or external environment and to make appropriate responses ○ *growth* as a permanent increase in size and dry mass by an increase in cell number or cell size or both	☐	

Topic	Core material			Supplement material		
	You should be able to:	Checklist	Comments	You should be able to:	Checklist	Comments
	○ *reproduction* as the processes that make more of the same kind of organism ○ *excretion* as removal from organisms of toxic materials and substances in excess of requirements ○ *nutrition* as taking in of materials for energy, growth and development			○ *excretion* as removal from organisms of the waste products of metabolism (chemical reactions in cells including respiration), toxic materials, and substances in excess of requirements ○ *nutrition* as taking in of materials for energy, growth and development; plants require light, carbon dioxide, water and ions; animals need organic compounds and ions and usually need water		

Topic	Core material			Supplement material		
	You should be able to:	Checklist	Comments	You should be able to:	Checklist	Comments
1.2 Concept and use of a classification system	• State that organisms can be classified into groups by the features that they share • Define *species* as a group of organisms that can reproduce to produce fertile offspring • Define and describe the *binomial system* of naming species as an internationally agreed system in which the scientific name of an organism is made up of two parts showing the genus and species	☐ ☐ ☐		• Explain that classification systems aim to reflect evolutionary relationships • Explain that classification is traditionally based on studies of morphology and anatomy • Explain that the sequences of bases in DNA and of amino acids in proteins are used as a more accurate means of classification • Explain that organisms which share a more recent ancestor (are more closely related) have base sequences in DNA that are more similar than those that share only a distant ancestor	☐ ☐ ☐ ☐	

Topic	Core material You should be able to:	Checklist	Comments	Supplement material You should be able to:	Checklist	Comments
1.3 Features of organisms	• List the features in the cells of all living organisms, limited to cytoplasm, cell membrane and DNA as genetic material • List the main features used to place animals and plants into the appropriate kingdoms • List the main features used to place organisms into groups within the animal kingdom, limited to: ○ the main groups of vertebrates: mammals, birds, reptiles, amphibians, fish ○ the main groups of arthropods: myriapods, insects, arachnids, crustaceans	☐ ☐ ☐		• List the features in the cells of all living organisms, limited to ribosomes for protein • synthesis and enzymes involved in respiration • List the main features used to place all organisms into one • of the five kingdoms: Animal, Plant, Fungus, Prokaryote, Protoctist • List the main features used to place organisms into groups within the plant kingdom, limited to ferns and flowering plants (dicotyledons and monocotyledons) • List the features of viruses, limited to protein coat and genetic material	☐ ☐ ☐ ☐ ☐ ☐	
1.4 Dichotomous keys	• Construct and use simple dichotomous keys based on easily identifiable features	☐				

Topic	Core material			Supplement material		
	You should be able to:	Checklist	Comments	You should be able to:	Checklist	Comments
2. Organisation of the organism						
2.1 Cell structure and organisation	• Describe and compare the structure of a plant cell with an animal cell, as seen under a light microscope, limited to cell wall, nucleus, cytoplasm, chloroplasts, vacuoles and location of the cell membrane • State the functions of the structures seen under the light microscope in the plant cell and in the animal cell	☐ ☐		• State that the cytoplasm of all cells contains structures, limited to ribosomes on rough endoplasmic reticulum and vesicles • State that almost all cells, except prokaryotes, have mitochondria and rough endoplasmic reticulum • Identify mitochondria and rough endoplasmic reticulum in diagrams and images of cells • State that aerobic respiration occurs in mitochondria • State that cells with high rates of metabolism require large numbers of mitochondria to provide sufficient energy	☐ ☐ ☐ ☐ ☐	

Topic	Core material			Supplement material		
	You should be able to:	Checklist	Comments	You should be able to:	Checklist	Comments
2.2 Levels of organisation	• Relate the structure of the following to their functions: ○ ciliated cells – movement of mucus in the trachea and bronchi ○ root hair cells – absorption ○ xylem vessels – conduction and support ○ palisade mesophyll cells – photosynthesis ○ nerve cells – conduction of impulses ○ red blood cells – transport of oxygen ○ sperm and egg cells – reproduction	☐				
	• Define *tissue* as a group of cells with similar structures, working together to perform a shared function	☐				
	• Define *organ* as a structure made up of a group of tissues, working together to perform specific functions	☐				
	• Define *organ system* as a group of organs with related functions, working together to perform body functions	☐				
	• State examples of tissues, organs and organ systems from sections 6 to 16	☐				

Topic	Core material			Supplement material		
	You should be able to:	Checklist	Comments	You should be able to:	Checklist	Comments
	• Identify the different levels of organisation in drawings, diagrams and images of familiar material	☐		• Identify the different levels of organisation in drawings, diagrams and images of unfamiliar material	☐	
2.3 Size of specimens	• Calculate magnification and size of biological specimens using millimetres as units	☐		• Calculate magnification and size of biological specimens using millimetres and micrometres as units	☐	
3. Movement in and out of cells						
3.1 Diffusion	• Define *diffusion* as the net movement of particles from a region of their higher • concentration to a region of their lower concentration down a concentration gradient, as a result of their random movement • Describe the importance of diffusion of gases and solutes • State that substances move into and out of cells by diffusion through the cell membrane	☐ ☐ ☐ ☐		• State that the energy for diffusion comes from the kinetic energy of random movement of molecules and ions • Investigate the factors that influence diffusion, limited to surface • area, temperature, concentration gradients and distance	☐ ☐ ☐	

Topic	Core material			Supplement material		
	You should be able to:	Checklist	Comments	You should be able to:	Checklist	Comments
3.2 Osmosis	• State that water diffuses through partially permeable membranes by osmosis • State that water moves in and out of cells by osmosis through the cell membrane • Investigate and describe the effects on plant tissues of immersing them in solutions of different concentrations • State that plants are supported by the pressure of water inside the cells pressing outwards on the cell wall	☐ ☐ ☐ ☐		• Define *osmosis* as the net movement of water molecules from a region of higher water potential (dilute solution) to a region of lower water potential (concentrated solution), through a partially permeable membrane • Explain the effects on plant tissues of immersing them in solutions of different concentrations by using the terms *turgid*, *turgor pressure*, *plasmolysis* and *flaccid* • Explain the importance of water potential and osmosis in the uptake of water by plants • Explain the importance of water potential and osmosis on animal cells and tissues • Explain how plants are supported by the turgor pressure within cells, in terms of water pressure acting against an inelastic cell wall	☐ ☐ ☐ ☐ ☐ ☐	

Topic	Core material			Supplement material		
	You should be able to:	Checklist	Comments	You should be able to:	Checklist	Comments
3.3 Active transport	• Define *active transport* as the movement of particles through a cell membrane from a region of lower concentration to a region of higher concentration using energy from respiration	☐		• Discuss the importance of active transport as a process for movement across membranes: ○ – e.g. ion uptake by root hairs and uptake of glucose by epithelial cells of villi and kidney tubules • Explain how protein molecules move particles across a membrane during active transport	☐ ☐	
4. Biological molecules						
	• List the chemical elements that make up: ○ carbohydrates ○ fats ○ proteins • State that large molecules are made from smaller molecules, limited to: ○ starch and glycogen from glucose ○ cellulose from glucose ○ proteins from amino acids ○ fats and oils from fatty acids and glycerol	☐ ☐				

Topic	Core material			Supplement material		
	You should be able to:	Checklist	Comments	You should be able to:	Checklist	Comments
	• Describe the use of: ○ iodine solution to test for starch ○ Benedict's solution to test for reducing sugars ○ biuret test for proteins ○ ethanol emulsion test for fats and oils ○ DCPIP test for vitamin C	☐				
				• Explain that different sequences of amino acids give different shapes to protein molecules	☐	
				• Relate the shape and structure of protein molecules to their function, limited to the active site of enzymes and the binding site of antibodies	☐	
				• Describe the structure of DNA as: ○ two strands coiled together to form a double helix ○ each strand contains chemicals called bases ○ cross-links between the strands are formed by pairs of bases	☐	

Topic	Core material			Supplement material		
	You should be able to:	Checklist	Comments	You should be able to:	Checklist	Comments
	• State that water is important as a solvent	☐		○ the bases always pair up in the same way: A with T, and C with G (full names are **not** required) • Describe the roles of water as a solvent in organisms with respect to digestion, excretion and transport	☐	
5. Enzymes						
	• Define the term *catalyst* as a substance that increases the rate of a chemical reaction and is not changed by the reaction • Define *enzymes* as proteins that function as biological catalysts • Describe why enzymes are important in all living organisms in terms of reaction speed necessary to sustain life • Describe enzyme action with reference to the complementary shape of an enzyme and its substrate and the formation of a product (knowledge of the term *active site* is **not** required)	☐ ☐ ☐ ☐		• Explain enzyme action with reference to the active site, enzyme-substrate complex, substrate and product • Explain the specificity of enzymes in terms of the complementary shape and fit of the active site with the substrate	☐ ☐	

Topic	Core material You should be able to:	Checklist	Comments	Supplement material You should be able to:	Checklist	Comments
	• Investigate and describe the effect of changes in temperature and pH on enzyme activity	☐		• Explain the effect of changes in temperature on enzyme activity in terms of kinetic energy, shape and fit, frequency of effective collisions and denaturation • Explain the effect of changes in pH on enzyme activity in terms of shape and fit and denaturation	☐ ☐	
6. Plant Nutrition						
6.1 Photosynthesis	• Define *photosynthesis* as the process by which plants manufacture carbohydrates from raw materials using energy from light • State the word equation for photosynthesis: carbon dioxide + water → glucose + oxygen, in the presence of light and chlorophyll	☐ ☐		• State the balanced chemical equation for photosynthesis $6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$ • Explain that chlorophyll transfers light energy into chemical energy in molecules, for the synthesis of carbohydrates • Outline the subsequent use and storage of the carbohydrates made in photosynthesis	☐ ☐ ☐	

Topic	Core material			Supplement material		
	You should be able to:	Checklist	Comments	You should be able to:	Checklist	Comments
	• Investigate the necessity for chlorophyll, light and carbon dioxide for photosynthesis, using appropriate controls • Investigate and describe the effects of varying light intensity, carbon dioxide concentration and temperature on the rate of photosynthesis, e.g. in submerged aquatic plants	☐ ☐		• Define the term *limiting factor* as something present in the environment in such short supply that it restricts life processes • Identify and explain the limiting factors of photosynthesis in different environmental conditions • Describe the use of carbon dioxide enrichment, optimum light and optimum temperatures in glasshouses in temperate and tropical countries • Use hydrogencarbonate indicator solution to investigate the effect of gas exchange of an aquatic plant kept in the light and in the dark	☐ ☐ ☐ ☐	

Topic	Core material			Supplement material		
	You should be able to:	Checklist	Comments	You should be able to:	Checklist	Comments
6.2 Leaf structure	• Identify chloroplasts, cuticle, guard cells and stomata, upper and lower epidermis, palisade mesophyll, spongy mesophyll, vascular bundles, xylem and phloem in leaves of a dicotyledonous plant	☐		• Explain how the internal structure of a leaf is adapted for photosynthesis	☐	
6.3 Mineral requirements	• Describe the importance of: ○ nitrate ions for making amino acids ○ magnesium ions for making chlorophyll	☐		• Explain the effects of nitrate ion and magnesium ion deficiency on plant growth	☐	
7. Human Nutrition						
7.1 Diet	• State what is meant by the term *balanced diet* for humans • Explain how age, gender and activity affect the dietary needs of humans including during pregnancy and whilst breast-feeding • Describe the effects of malnutrition in relation to starvation, constipation, coronary heart disease, obesity and scurvy	☐ ☐ ☐				

Topic	Core material			Supplement material		
	You should be able to:	Checklist	Comments	You should be able to:	Checklist	Comments
	• List the principal sources of, and describe the dietary importance of: ○ carbohydrates ○ fats ○ proteins ○ vitamins, limited to C and D ○ mineral salts, limited to calcium and iron ○ fibre (roughage) ○ water	☐				
				• Explain the causes and effects of vitamin D and iron deficiencies	☐	
				• Explain the causes and effects of protein-energy malnutrition, e.g. kwashiorkor and marasmus	☐	

Topic	Core material			Supplement material		
	You should be able to:	Checklist	Comments	You should be able to:	Checklist	Comments
7.2 Alimentary canal	• Define *ingestion* as the taking of substances, e.g. food and drink, into the body through the mouth • Define *mechanical digestion* as the breakdown of food into smaller pieces without chemical change to the food molecules • Define *chemical digestion* as the breakdown of large, insoluble molecules into small, soluble molecules • Define *absorption* as the movement of small food molecules and ions through the wall of the intestine into the blood • Define *assimilation* as the movement of digested food molecules into the cells of the body where they are used, becoming part of the cells • Define *egestion* as the passing out of food that has not been digested or absorbed, as faeces, through the anus • Describe diarrhoea as the loss of watery faeces • Outline the treatment of diarrhoea using oral rehydration therapy	☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐				

Topic	Core material			Supplement material		
	You should be able to:	Checklist	Comments	You should be able to:	Checklist	Comments
	• Describe cholera as a disease caused by a bacterium	☐		• Explain that the cholera bacterium produces a toxin that causes secretion of chloride ions into the small intestine, causing osmotic movement of water into the gut, causing diarrhoea, dehydration and loss of salts from blood	☐	
	• Identify the main regions of the alimentary canal and associated organs, limited to mouth, salivary glands, oesophagus, stomach, small intestine (duodenum and ileum), pancreas, liver, gall bladder and large intestine (colon, rectum, anus)	☐				
	• Describe the functions of the regions of the alimentary canal listed above, in relation to ingestion, digestion, absorption, assimilation and egestion of food	☐				

Topic	Core material			Supplement material		
	You should be able to:	Checklist	Comments	You should be able to:	Checklist	Comments
7.3 Mechanical digestion	• Identify the types of human teeth (incisors, canines, premolars and molars) • Describe the structure of human teeth, limited to enamel, dentine, pulp, nerves and cement, as well as the gums • Describe the functions of the types of human teeth in mechanical digestion of food • State the causes of dental decay in terms of a coating of bacteria and food on teeth, the bacteria respiring sugars in the food, producing acid which dissolves the enamel and dentine • Describe the proper care of teeth in terms of diet and regular brushing	☐ ☐ ☐ ☐ ☐				

Topic	Core material			Supplement material		
	You should be able to:	Checklist	Comments	You should be able to:	Checklist	Comments
7.4 Chemical digestion	• State the significance of chemical digestion in the alimentary canal in producing small, soluble molecules that can be absorbed • State the functions of enzymes as follows: ○ amylase breaks down starch to simpler sugars ○ protease breaks down protein to amino acids ○ lipase breaks down fats to fatty acids and glycerol • State where, in the alimentary canal, amylase, protease and lipase are secreted • State the functions of the hydrochloric acid in gastric juice, limited to killing bacteria in food and giving an acid pH for enzymes	☐ ☐ ☐ ☐		• Describe the digestion of starch in the alimentary canal: ○ amylase is secreted into the alimentary canal and breaks down starch to maltose ○ maltose is broken down by maltase to glucose on the membranes of the ○ epithelium lining the small intestine • Describe pepsin and trypsin as two protease enzymes that function in different parts of the alimentary canal: ○ pepsin in the stomach ○ trypsin in the small intestine	☐ ☐	

Topic	Core material			Supplement material		
	You should be able to:	Checklist	Comments	You should be able to:	Checklist	Comments
				• Explain the functions of the hydrochloric acid in gastric juice, limited to the low pH: ○ denaturing enzymes in harmful microorganisms in food ○ giving the optimum pH for pepsin activity • Outline the role of bile in neutralising the acidic mixture of food and gastric juices entering the duodenum from the stomach, to provide a suitable pH for enzyme action • Outline the role of bile in emulsifying fats to increase the surface area for the chemical digestion of fat to fatty acids and glycerol by lipase	☐ ☐ ☐	

Topic	Core material			Supplement material		
	You should be able to:	Checklist	Comments	You should be able to:	Checklist	Comments
7.5 Absorption	• Identify the small intestine as the region for the absorption of digested food • State that water is absorbed in both the small intestine and the colon, but that most absorption of water happens in the small intestine	☐ ☐		• Explain the significance of villi and microvilli in increasing the internal surface area of the small intestine • Describe the structure of a villus • Describe the roles of capillaries and lacteals in villi	☐ ☐ ☐	
8. Transport in plants						
8.1 Transport in plants	• State the functions of xylem and phloem • Identify the position of xylem and phloem as seen in sections of roots, stems and leaves, limited to non-woody dicotyledonous plants	☐ ☐				

Topic	Core material			Supplement material		
	You should be able to:	Checklist	Comments	You should be able to:	Checklist	Comments
8.2 Water uptake	• Identify root hair cells, as seen under the light microscope, and state their functions • State the pathway taken by water through root, stem and leaf as root hair cell, root cortex cells, xylem and mesophyll cells • Investigate, using a suitable stain, the pathway of water through the above ground parts of a plant	☐ ☐ ☐		• Explain that the large surface area of root hairs increases the rate of the absorption of water by osmosis and ions by active transport	☐	
8.3 Transpiration	• State that water is transported from the roots to leaves through the xylem vessels • Define *transpiration* as loss of water vapour from plant leaves by evaporation of water at the surfaces of the mesophyll cells followed by diffusion of water vapour through the stomata	☐ ☐		• Explain how water vapour loss is related to the large surface area of cell surfaces, interconnecting air spaces and stomata • Explain the mechanism by which water moves upwards in the xylem in terms of a transpiration pull that draws up a column of water molecules, held together by cohesion	☐ ☐	

Topic	Core material			Supplement material		
	You should be able to:	Checklist	Comments	You should be able to:	Checklist	Comments
	• Investigate and describe the effects of variation of temperature and humidity on transpiration rate	☐		• Explain how and why wilting occurs • Explain the effects of variation of temperature and humidity on transpiration rate	☐ ☐	
8.4 Translocation				• Define *translocation* in terms of the movement of sucrose and amino acids in phloem: ○ from regions of production (source) ○ to regions of storage OR to regions where they are used in respiration or growth (sink) • Explain that some parts of a plant may act as a source and a sink at different times during the life of a plant	☐ ☐	
9. Transport in animals						
9.1 Transport in animals	• Describe the circulatory system as a system of blood vessels with a pump and valves to ensure one- way flow of blood	☐		• Describe the single circulation of a fish • Describe the double circulation of a mammal • Explain the advantages of a double circulation	☐ ☐ ☐	

Topic	Core material			Supplement material		
	You should be able to:	**Checklist**	**Comments**	**You should be able to:**	**Checklist**	**Comments**
9.2 Heart	• Name and identify the structures of the mammalian heart, limited to the muscular wall, the septum, the left and right ventricles • and atria, one-way valves and coronary arteries • State that blood is pumped away from the heart into arteries and returns to the heart in veins	☐ ☐ ☐		• Name and identify the atrioventricular and semilunar valves in the mammalian heart • Explain the relative thickness: ○ of the muscle wall of the left and right ventricles ○ of the muscle wall of the atria compared to that of the ventricles • Explain the importance of the septum in separating oxygenated and deoxygenated blood • Describe the functioning of the heart in terms of the contraction of muscles of the atria and ventricles and the action of the valves	☐ ☐ ☐ ☐	

Topic	Core material			Supplement material		
	You should be able to:	Checklist	Comments	You should be able to:	Checklist	Comments
	• State that the activity of the heart may be monitored by ECG, pulse rate and listening to sounds of valves closing • Investigate and state the effect of physical activity on the pulse rate • Describe coronary heart disease in terms of the blockage of coronary arteries and state the possible risk factors as diet, stress, smoking, genetic predisposition, age and gender	☐ ☐ ☐		• Explain the effect of physical activity on the heart rate • Discuss the roles of diet and exercise in the prevention of coronary heart disease • Describe ways in which coronary heart disease may be treated, limited to drug treatment with aspirin and surgery (stents, angioplasty and by-pass)	☐ ☐ ☐	
9.3 Blood and lymphatic vessels	• Describe the structure and functions of arteries, veins and capillaries • Name the main blood vessels to and from the: ○ heart, limited to vena cava, aorta, pulmonary artery and pulmonary vein ○ lungs, limited to the pulmonary artery and pulmonary vein ○ kidney, limited to the renal artery and renal vein	☐ ☐		• Explain how the structures of arteries, veins and capillaries are adapted for their functions • State the function of arterioles, venules and shunt vessels	☐ ☐	

Topic	Core material			Supplement material		
	You should be able to:	Checklist	Comments	You should be able to:	Checklist	Comments
				• Outline the lymphatic system in terms of lymphatic vessels and lymph nodes • Describe the function of the lymphatic system in the circulation of body fluids and the protection of the body from infection	☐ ☐	
9.4 Blood	• List the components of blood as red blood cells, white blood cells, platelets and plasma • Identify red and white blood cells, as seen under the light microscope, on prepared slides and in diagrams and photomicrographs • State the functions of the following components of blood: ○ red blood cells in transporting oxygen, including the role of haemoglobin ○ white blood cells in phagocytosis and antibody production ○ platelets in clotting (details are **not** required) ○ plasma in the transport of blood cells, ions, soluble nutrients, hormones and carbon dioxide	☐ ☐ ☐		• Identify lymphocyte and phagocyte white blood cells, as seen under the light microscope, on prepared slides and in diagrams and photomicrographs • State the functions of: ○ lymphocytes – antibody production ○ phagocytes – phagocytosis • Describe the process of clotting as the conversion of fibrinogen to fibrin to form a mesh • State the roles of blood clotting as preventing blood loss and preventing the entry of pathogens	☐ ☐ ☐ ☐	

Topic	Core material			Supplement material		
	You should be able to:	Checklist	Comments	You should be able to:	Checklist	Comments
				• Describe the transfer of materials between capillaries and tissue fluid (details of the roles of water potential and hydrostatic pressure are **not** required)	☐	
10. Diseases and immunity						
	• Define *pathogen* as a disease-causing organism • Define *transmissible disease* as a disease in which the pathogen can be passed from one host to another • State that the pathogen for a transmissible disease may be transmitted either through direct contact, e.g. through blood or other body fluids, or indirectly, • e.g. from contaminated surfaces or food, from animals, or from the air • State that the body has defences: ○ mechanical barriers, limited to skin and hairs in the nose ○ chemical barriers, limited to mucus and stomach acid ○ cells, limited to phagocytosis and antibody production by white blood cells ○ which can be enhanced by vaccination	☐ ☐ ☐ ☐ ☐		• State that antibodies lock on to antigens leading to direct destruction of pathogens, or marking of pathogens for destruction by phagocytes • Explain how each pathogen has its own antigens, which have specific shapes, so specific antibodies which fit the specific shapes of the antigens are needed • Define *active immunity* as defence against a pathogen by antibody production in the body • Explain that active immunity is gained after an infection by a pathogen, or by vaccination	☐ ☐ ☐ ☐	

Topic	Core material			Supplement material		
	You should be able to:	Checklist	Comments	You should be able to:	Checklist	Comments
	• Explain the importance of hygienic food preparation, good personal hygiene, waste disposal and sewage treatment in controlling the spread of disease	☐		• Explain the process of vaccination: ○ harmless pathogen given which has antigens ○ antigens trigger an immune response by lymphocytes which produce antibodies ○ memory cells are produced that give long-term immunity	☐	
				• Explain the role of vaccination in controlling the spread of diseases	☐	
				• Explain that *passive immunity* is short-term defence against a pathogen by antibodies acquired from another individual, e.g. mother to infant	☐	
				• State that memory cells are not produced in passive immunity	☐	
				• Explain the importance of passive immunity for breast-fed infants	☐	
				• State that some diseases are caused by the immune system	☐	
				• targeting and destroying body cells, limited to Type 1 diabetes	☐	

Topic	Core material			Supplement material		
	You should be able to:	Checklist	Comments	You should be able to:	Checklist	Comments
11. Gas exchange in humans						
	• List the features of gas exchange surfaces in humans, limited to large surface area, thin surface, good blood supply and good ventilation with air	☐				
	• Name and identify the lungs, diaphragm, ribs, intercostal muscles, larynx, trachea, bronchi, bronchioles, alveoli and associated capillaries	☐		• Name and identify the internal and external intercostal muscles	☐	
				• State the functions of the cartilage in the trachea	☐	
				• Explain the role of the ribs, the internal and external intercostal muscles and the diaphragm in producing volume and pressure changes in the thorax leading to the ventilation of the lungs	☐	
	• State the differences in composition between inspired and expired air, limited to oxygen, carbon dioxide and water vapour	☐		• Explain the differences in composition between inspired and expired air	☐	
	• Use limewater as a test for carbon dioxide to investigate the differences in composition between inspired and expired air	☐				

Topic	Core material			Supplement material		
	You should be able to:	Checklist	Comments	You should be able to:	Checklist	Comments
	• Investigate and describe the effects of physical activity on rate and depth of breathing	☐		• Explain the link between physical activity and rate and depth of breathing in terms of the increased carbon dioxide concentration in the blood, detected by the brain, causing an increased rate of breathing • Explain the role of goblet cells, mucus and ciliated cells in protecting the gas exchange system from pathogens and particles	☐ ☐	
12. Respiration						
12.1 Respiration	• State the uses of energy in the body of humans: muscle contraction, protein synthesis, cell division, active transport, growth, the passage of nerve impulses and the maintenance of a constant body temperature • State that respiration involves the action of enzymes in cells	☐ ☐				

Topic	Core material			Supplement material		
	You should be able to:	Checklist	Comments	You should be able to:	Checklist	Comments
12.2 Aerobic respiration	• Define *aerobic respiration* as the chemical reactions in cells that use oxygen to break down nutrient molecules to release energy • State the word equation for aerobic respiration as glucose + oxygen → carbon dioxide + water • Investigate the uptake of oxygen by respiring organisms, such as arthropods and germinating seeds	☐ ☐ ☐		• State the balanced chemical equation for aerobic respiration as $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$ • Investigate the effect of temperature on the rate of respiration of germinating seeds	☐ ☐	
12.3 Anaerobic respiration	• Define *anaerobic respiration* as the chemical reactions in cells that break down nutrient molecules to release energy without using oxygen • State the word equations for anaerobic respiration in muscles during vigorous exercise (glucose → lactic acid) and the microorganism yeast (glucose → alcohol + carbon dioxide) • State that anaerobic respiration releases much less energy per glucose molecule than aerobic respiration	☐ ☐ ☐		• State the balanced chemical equation for anaerobic respiration in the microorganism yeast as $C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$	☐	

Topic	Core material			Supplement material		
	You should be able to:	Checklist	Comments	You should be able to:	Checklist	Comments
				• State that lactic acid builds up in muscles and blood during vigorous exercise causing an oxygen debt • Outline how the oxygen debt is removed during recovery, limited to: ○ aerobic respiration of lactic acid in the liver ○ continuation, after exercise, of fast heart rate to transport lactic acid in blood from muscles to the liver ○ continuation, after exercise, of deeper breathing supplying oxygen for aerobic respiration of lactic acid	☐ ☐	

Topic	Core material			Supplement material		
	You should be able to:	Checklist	Comments	You should be able to:	Checklist	Comments
13. Excretion in humans						
	• State that urea is formed in the liver from excess amino acids • State that carbon dioxide is excreted through the lungs • State that the kidneys excrete urea and excess water and salts • Explain that the volume and concentration of urine produced is affected by water intake, temperature and exercise • Identify on drawings, diagrams and images, the ureters, bladder and urethra	☐ ☐ ☐ ☐ ☐		• Describe the role of the liver in the assimilation of amino acids by converting them to proteins, including plasma proteins, e.g. fibrinogen • Define *deamination* as the removal of the nitrogen-containing part of amino acids to form urea • Explain the need for excretion, limited to toxicity of urea and carbon dioxide • Outline the structure of the kidney, limited to the cortex, medulla and ureter	☐ ☐ ☐ ☐	

Topic	Core material			Supplement material		
	You should be able to:	Checklist	Comments	You should be able to:	Checklist	Comments
				• Outline the structure and functioning of a kidney tubule, including: ○ the role of the glomerulus in the filtration from the blood of water, glucose, urea and salts ○ the role of the tubule in the reabsorption of all of the glucose, most of the water and some salts ○ back into the blood, leading to the concentration of urea in the urine ○ as well as loss of excess water and salts (details of these processes are **not** required)	☐	
				• Explain dialysis in terms of salt balance, the maintenance of glucose concentration and the removal of urea	☐	
				• Describe the use of dialysis in kidney machines	☐	
				• Discuss the advantages and disadvantages of kidney transplants, compared with dialysis	☐	

Topic	Core material			Supplement material		
	You should be able to:	Checklist	Comments	You should be able to:	Checklist	Comments
14. Coordination and response						
14.1 Nervous control in humans	• Describe a nerve impulse as an electrical signal that passes along nerve cells called neurones • Describe the human nervous system in terms of: ○ the central nervous system consisting of brain and spinal cord ○ the peripheral nervous system ○ coordination and regulation of body functions • Identify motor (effector), relay (connector) and sensory neurones from diagrams • Describe a simple reflex arc in terms of receptor, sensory neurone, relay neurone, motor neurones and effector • Describe a reflex action as a means of automatically and rapidly integrating and coordinating stimuli with the responses of effectors (muscles and glands)	☐ ☐ ☐ ☐ ☐		• Distinguish between voluntary and involuntary actions	☐	

Topic	Core material			Supplement material		
	You should be able to:	**Checklist**	**Comments**	**You should be able to:**	**Checklist**	**Comments**
	• Define a *synapse* as a junction between two neurones	☐		• Describe the structure of a synapse, including the presence of neurotransmitter containing vesicles, the synaptic cleft and neurotransmitter receptor molecules • Describe how an impulse triggers the release of a neurotransmitter from vesicles into the synaptic gap and how the neurotransmitter diffuses across to bind with receptor molecules, in the membrane of the neurone after the synaptic gap, causing the impulse to continue • State that in a reflex arc the synapses ensure that impulses travel in one direction only • State that many drugs, e.g. heroin act upon synapses	☐ ☐ ☐ ☐	

Topic	Core material			Supplement material		
	You should be able to:	Checklist	Comments	You should be able to:	Checklist	Comments
14.2 Sense organs	• Define *sense organs* as groups of receptor cells responding to specific stimuli: light, sound, touch, temperature and chemicals • Identify the structures of the eye, limited to cornea, iris, pupil, lens, retina, optic nerve and blind spot • Describe the function of each part of the eye, limited to: ○ cornea – refracts light ○ iris – controls how much light enters pupil ○ lens – focuses light onto retina ○ retina – contains light receptors, some sensitive to light of different colours ○ optic nerve – carries impulses to the brain • Explain the pupil reflex in terms of light intensity and pupil diameter only	☐ ☐ ☐ ☐				

Topic	Core material			Supplement material		
	You should be able to:	Checklist	Comments	You should be able to:	Checklist	Comments
	• Explain the pupil reflex in terms of light intensity and pupil diameter only	☐		• Explain the pupil reflex in terms of light intensity and antagonistic action of circular and radial muscles in the iris • Explain accommodation to view near and distant objects in terms of the contraction and relaxation of the ciliary muscles, tension in the suspensory ligaments, shape of the lens and refraction of light • State the distribution of rods and cones in the retina of a human • Outline the function of rods and cones, limited to greater sensitivity of rods for night vision and three different kinds of cones absorbing light of different colours for colour vision • Identify the position of the fovea	☐ ☐ ☐ ☐ ☐	

Topic	Core material			Supplement material		
	You should be able to:	Checklist	Comments	You should be able to:	Checklist	Comments
14.3 Hormones in humans	• Define a *hormone* as a chemical substance, produced by a gland and carried by the blood, which alters the activity of one or more specific target organs • Identify specific endocrine glands and their secretions, limited to adrenal glands and adrenaline, pancreas and insulin, testes and testosterone and ovaries and oestrogen • Describe adrenaline as the hormone secreted in 'fight or flight' situations and its effects, limited to increased breathing and pulse rate and widened pupils • Give examples of situations in which adrenaline secretion increases • State the functions of insulin, oestrogen and testosterone	☐ ☐ ☐ ☐ ☐		• Discuss the role of the hormone adrenaline in the chemical control of metabolic activity, including increasing the blood glucose concentration and pulse rate • Compare nervous and hormonal control systems in terms of speed and longevity of action	☐ ☐	

Topic	Core material			Supplement material		
	You should be able to:	Checklist	Comments	You should be able to:	Checklist	Comments
14.4 Homeostasis	• Define *homeostasis* as the maintenance of a constant internal environment • Name and identify on a diagram of the skin: hairs, hair erector muscles, sweat glands, receptors, sensory neurones, blood vessels and fatty tissue • Describe the maintenance of a constant internal body temperature in humans in terms of insulation, sweating, shivering and the role of the brain (limited to blood temperature receptors and coordination)	☐ ☐ ☐		• Explain that homeostasis is the control of internal conditions within set limits • Explain the concept of control by negative feedback • Describe the control of the glucose concentration of the blood by the liver and the roles of insulin and glucagon from the pancreas • Outline the symptoms and treatment of Type 1 diabetes (detail of β cells is **not** required) • Describe the maintenance of a constant internal body temperature in humans in terms of vasodilation and vasoconstriction of arterioles supplying skin surface capillaries	☐ ☐ ☐ ☐ ☐	

Topic	Core material			Supplement material		
	You should be able to:	Checklist	Comments	You should be able to:	Checklist	Comments
14.5 Tropic responses	• Define *gravitropism* as a response in which parts of a plant grow towards or away from gravity • Define *phototropism* as a response in which parts of a plant grow towards or away from the direction from which light is coming • Investigate gravitropism and phototropism in shoots and roots	☐ ☐ ☐		• Explain phototropism and gravitropism of a shoot as examples of the chemical control of plant growth • Explain the role of auxin in controlling shoot growth, limited to: ○ auxin made in shoot tip (only) ○ auxin spreads through the plant from the shoot tip ○ auxin is unequally distributed in response to light and gravity ○ auxin stimulates cell elongation • Describe the use in weedkillers of the synthetic plant hormone 2,4-D	☐ ☐ ☐	
15. Drugs						
15.1 Drugs	• Define a *drug* as any substance taken into the body that modifies or affects chemical reactions in the body	☐				

Topic	Core material			Supplement material		
	You should be able to:	Checklist	Comments	You should be able to:	Checklist	Comments
15.2 Medicinal drugs	• Describe the use of antibiotics for the treatment of bacterial infection • State that some bacteria are resistant to antibiotics which reduces the effectiveness of antibiotics • State that antibiotics kill bacteria but don't affect viruses	☐ ☐ ☐		• Explain how development of resistant bacteria such as MRSA can be minimised, limited to using antibiotics only when essential and ensuring treatment is completed • Explain why antibiotics kill bacteria, but don't affect viruses	☐ ☐	
15.3 Misused drugs	• Describe the effects of excessive alcohol consumption and abuse of heroin, limited to: ○ powerful depressant drugs ○ effect on reaction times and self-control ○ addiction and withdrawal symptoms ○ negative social implications, e.g. crime • State that injecting heroin can cause infections such as HIV • State that excessive alcohol consumption can cause liver damage	☐ ☐ ☐		• Explain how heroin affects the nervous system, limited to its effect on the function of synapses	☐	

Topic	Core material			Supplement material		
	You should be able to:	Checklist	Comments	You should be able to:	Checklist	Comments
	• State that tobacco smoking can cause chronic obstructive pulmonary disease (COPD), lung cancer and coronary heart disease • Describe the effects on the gas exchange system of tobacco smoke and its major toxic components, limited to carbon monoxide, nicotine and tar • State that the liver is the site of break down of alcohol and other toxins	☐ ☐ ☐		• Discuss the evidence for the link between smoking and lung cancer • Discuss the use of hormones to improve sporting performance, limited to testosterone and anabolic steroids	☐ ☐	
16. Reproduction						
16.1 Asexual reproduction	• Define asexual reproduction as a process resulting in the production of genetically identical offspring from one parent • Identify examples of asexual reproduction from information provided	☐ ☐		• Discuss the advantages and disadvantages of asexual reproduction: ○ to a population of a species in the wild ○ to crop production	☐	

Topic	Core material			Supplement material		
	You should be able to:	Checklist	Comments	You should be able to:	Checklist	Comments
16.2 Sexual reproduction	• Define *sexual reproduction* as a process involving the fusion of the nuclei of two gametes (sex cells) to form a zygote and the production of offspring that are genetically different from each other • Define *fertilisation* as the fusion of gamete nuclei	☐ ☐		• State that the nuclei of gametes are haploid and that the nucleus of a zygote is diploid • Discuss the advantages and disadvantages of sexual reproduction: ○ to a population of a species in the wild ○ to crop production	☐ ☐	
16.3 Sexual reproduction in plants	• Identify and draw, using a hand lens if necessary, the sepals, petals, stamens, filaments and anthers, carpels, style, stigma, ovary and ovules, of an insect-pollinated flower • State the functions of the sepals, petals, anthers, stigmas and ovaries • Use a hand lens to identify and describe the anthers and stigmas of a wind-pollinated flower • Distinguish between the pollen grains of insect-pollinated and wind- pollinated flowers	☐ ☐ ☐ ☐				

Topic	Core material			Supplement material		
	You should be able to:	Checklist	Comments	You should be able to:	Checklist	Comments
	• Define *pollination* as the transfer of pollen grains from the anther to the stigma	☐		• Define *self-pollination* as the transfer of pollen grains from the anther of a flower to the stigma of the same flower or different flower on the same plant	☐	
				• Define *cross-pollination* as transfer of pollen grains from the anther of a flower to the stigma of a flower on a different plant of the same species	☐	
				• Discuss the implications to a species of self-pollination and cross-pollination in terms of variation, capacity to respond to changes in the environment and reliance on pollinators	☐	
	• State that fertilisation occurs when a pollen nucleus fuses with a nucleus in an ovule	☐		• Describe the growth of the pollen tube and its entry into the ovule followed by fertilisation (details of production of endosperm and development are **not** required)	☐	
	• Describe the structural adaptations of insect-pollinated and wind- pollinated flowers	☐				
	• Investigate and state the environmental conditions that affect germination of seeds, limited to the requirement for water, oxygen and a suitable temperature	☐				

Topic	Core material			Supplement material		
	You should be able to:	Checklist	Comments	You should be able to:	Checklist	Comments
16.4 Sexual reproduction in humans	• Identify and name on diagrams of the male reproductive system: the testes, scrotum, sperm ducts, prostate gland, urethra and penis, and state the functions of these parts • Identify and name on diagrams of the female reproductive system: the ovaries, oviducts, uterus, cervix and vagina, and state the functions of these parts • Describe fertilisation as the fusion of the nuclei from a male gamete (sperm) and a female gamete (egg cell/ovum)	☐ ☐ ☐		• Compare male and female gametes in terms of size, structure, motility and numbers	☐	
	• State the adaptive features of sperm, limited to flagellum and the presence of enzymes	☐		• Explain the adaptive features of sperm, limited to flagellum, mitochondria and enzymes in the acrosome	☐	
	• State the adaptive features of egg cells, limited to energy stores and a jelly coating that changes after fertilisation	☐		• Explain the adaptive features of egg cells, limited to energy stores and the jelly coat that changes at fertilisation	☐	

Topic	Core material			Supplement material		
	You should be able to:	Checklist	Comments	You should be able to:	Checklist	Comments
	• Describe the ante-natal care of pregnant women, limited to special dietary needs and the harm from smoking and alcohol consumption • Outline the processes involved in labour and birth, limited to: ○ breaking of the amniotic sac ○ contraction of the muscles in the uterus wall ○ dilation of the cervix ○ passage through the vagina ○ tying and cutting the umbilical cord ○ delivery of the afterbirth	☐ ☐		• Describe the function of the placenta and umbilical cord in relation to exchange of dissolved nutrients, gases and excretory products and providing a barrier to toxins and pathogens (structural details are not required) • State that some toxins, e.g. nicotine, and pathogens, e.g. rubella virus, can pass across the placenta and affect the fetus • Discuss the advantages and disadvantages of breast-feeding compared with bottle-feeding using formula milk	☐ ☐ ☐	
16.5 Sex hormones in humans	• Describe the roles of testosterone and oestrogen in the development and regulation of secondary sexual characteristics during puberty • Describe the menstrual cycle in terms of changes in the ovaries and in the lining of the uterus	☐ ☐		• Describe the sites of production of oestrogen and progesterone in the menstrual cycle and in pregnancy • Explain the role of hormones in controlling the menstrual cycle and pregnancy, limited to FSH, LH, progesterone and oestrogen	☐ ☐	

Topic	Core material You should be able to:	Checklist	Comments	Supplement material You should be able to:	Checklist	Comments
16.6 Methods of birth control in humans	• Outline the following methods of birth control: ○ natural, limited to abstinence, monitoring body temperature and cervical mucus ○ chemical, limited to IUD, IUS, contraceptive pill, implant and injection ○ barrier, limited to condom, femidom, diaphragm ○ surgical, limited to vasectomy and female sterilisation	☐		• Outline the use of hormones in contraception and fertility treatments • Outline artificial insemination (AI) • Outline *in vitro* fertilisation (IVF) • Discuss the social implications of contraception and fertility treatments	☐ ☐ ☐ ☐	
16.7 Sexually transmitted infections (STIs)	• Define *sexually transmitted infection* as an infection that is transmitted via body fluids through sexual contact • State that human immunodeficiency virus (HIV) is an example of an STI • Explain how the spread of STIs is controlled • Describe the methods of transmission of HIV • State that HIV infection may lead to AIDS	☐ ☐ ☐ ☐		• Outline how HIV affects the immune system, limited to decreased lymphocyte numbers and reduced ability to produce antibodies	☐	

Topic	Core material			Supplement material		
	You should be able to:	Checklist	Comments	You should be able to:	Checklist	Comments
17. Inheritance						
17.1 Inheritance	• Define *inheritance* as the transmission of genetic information from generation to generation	☐				
17.2 Chromosomes, genes and proteins	• Define *chromosome* as a thread-like structure of DNA, carrying genetic information in the form of genes • Define *gene* as a length of DNA that codes for a protein • Define *allele* as a version of a gene • Describe the inheritance of sex in humans with reference to XX and XY chromosomes	☐ ☐ ☐ ☐		• Explain that the sequence of bases in a gene is the genetic code for putting together amino acids in the correct order to make a specific protein (knowledge of the details of nucleotide structure is **not** required) • Explain that DNA controls cell function by controlling the production of proteins (some of which are enzymes), antibodies and receptors for neurotransmitters	☐ ☐	

Topic	Core material			Supplement material		
	You should be able to:	Checklist	Comments	You should be able to:	Checklist	Comments
				• Explain how a protein is made, limited to: ○ the gene coding for the protein remains in the nucleus ○ mRNA molecules carry a copy of the gene to the cytoplasm ○ the mRNA passes through ribosomes ○ the ribosome assembles amino acids into protein molecules ○ the specific order of amino acids ○ is determined by the sequence of bases in the ○ mRNA (knowledge of the details of transcription or translation is **not** required)	☐	
				• Explain that all body cells in an organism contain the same genes, but many genes in a particular cell are not expressed because the cell only makes the specific proteins it needs	☐	

Topic	Core material			Supplement material		
	You should be able to:	Checklist	Comments	You should be able to:	Checklist	Comments
				• Define a *haploid nucleus* as a nucleus containing a single set of unpaired chromosomes, e.g. in gametes • Define a *diploid nucleus* as a nucleus containing two sets of chromosomes, e.g. in body cells • State that in a diploid cell, there is a pair of each type of chromosome and in a human diploid cell there are 23 pairs	☐ ☐ ☐	
17.3 Mitosis	• Define *mitosis* as nuclear division giving rise to genetically identical cells (details of stages are **not** required) • State the role of mitosis in growth, repair of damaged tissues, replacement of cells and asexual reproduction	☐ ☐		• State that the exact duplication of chromosomes occurs before mitosis • State that during mitosis, the copies of chromosomes separate, maintaining the chromosome number (details of stages of mitosis are **not** required)	☐ ☐	

Topic	Core material			Supplement material		
	You should be able to:	Checklist	Comments	You should be able to:	Checklist	Comments
				• Describe stem cells as unspecialised cells that divide by mitosis to produce daughter cells that can become specialised for specific functions	☐	
17.4 Meiosis	• Define *meiosis* as nuclear division giving rise to cells that are genetically different (details of stages are **not** required) • State that meiosis is involved in the production of gametes	☐ ☐		• Define *meiosis* as reduction division in which the chromosome number is halved from diploid to haploid resulting in genetically different cells (details of stages are **not** required) • Explain how meiosis produces variation by forming new combinations of maternal and paternal chromosomes (specific details are **not** required)	☐ ☐	
17.5 Monohybrid inheritance	• Define *genotype* as the genetic make-up of an organism in terms of the alleles present • Define *phenotype* as the observable features of an organism • Define *homozygous* as having two identical alleles of a particular gene	☐ ☐ ☐				

Topic	Core material			Supplement material		
	You should be able to:	Checklist	Comments	You should be able to:	Checklist	Comments
17.5 Monohybrid inheritance	• State that two identical homozygous individuals that breed together will be pure-breeding • Define *heterozygous* as having two different alleles of a particular gene • State that a heterozygous individual will not be pure-breeding • Define *dominant* as an allele that is expressed if it is present • Define *recessive* as an allele that is only expressed when there is no dominant allele of the gene present • Interpret pedigree diagrams for the inheritance of a given characteristic • Use genetic diagrams to predict the results of monohybrid crosses and calculate phenotypic ratios, limited to 1:1 and 3:1 ratios • Use Punnett squares in crosses which result in more than one genotype to work out and show the possible different genotypes	☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐		• Explain how to use a test cross to identify an unknown genotype	☐	

Topic	Core material			Supplement material		
	You should be able to:	Checklist	Comments	You should be able to:	Checklist	Comments
				• Explain co-dominance by reference to the inheritance of ABO blood groups – phenotypes being A, B, AB and O blood groups and alleles being I^A, I^B and I^o • Define a *sex-linked characteristic* as a characteristic in which the gene responsible is located on a sex chromosome and that this makes it more common in one sex than in the other • Describe colour blindness as an example of sex linkage • Use genetic diagrams to predict the results of monohybrid crosses involving co-dominance or sex linkage and calculate phenotypic ratios	☐ ☐ ☐ ☐	

Topic	Core material			Supplement material		
	You should be able to:	Checklist	Comments	You should be able to:	Checklist	Comments
18. Variation and selection						
18.1 Variation	• Define *variation* as differences between individuals of the same species • Distinguish between phenotypic variation and genetic variation • State that continuous variation results in a range of phenotypes between two extremes, e.g. height in humans • State that discontinuous variation results in a limited number of phenotypes with no intermediates, e.g. tongue rolling • Record and present the results of investigations into continuous and discontinuous variation • Define *mutation* as genetic change • State that mutation is the way in which new alleles are formed • State that ionising radiation and some chemicals increase the rate of mutation	☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐		• State that phenotypic variation is caused by both genetic and environmental factors • State that discontinuous variation is mostly caused by genes alone, e.g. A, B, AB and O blood groups in humans • Define *gene mutation* as a change in the base sequence of DNA	☐ ☐ ☐	

Topic	Core material			Supplement material		
	You should be able to:	Checklist	Comments	You should be able to:	Checklist	Comments
				• Describe the symptoms of sickle-cell anaemia • Explain how a change in the base sequence of the gene for haemoglobin results in abnormal haemoglobin and sickle- shaped red blood cells • Use genetic diagrams to show how sickle-cell anaemia is inherited • State that people who are heterozygous (Hb^S Hb^A) for the sickle-cell allele have a resistance to malaria • Explain the distribution of the sickle-cell allele in human populations with reference to the distribution of malaria (Teaching of human inherited conditions should be done with sensitivity at all times.)	☐ ☐ ☐ ☐ ☐	

Topic	Core material			Supplement material		
	You should be able to:	Checklist	Comments	You should be able to:	Checklist	Comments
18.2 Adaptive features	• Define *adaptive feature* as an inherited feature that helps an organism to survive and reproduce in its environment • Interpret images or other information about a species to describe its adaptive features	☐ ☐		• Define *adaptive feature* as the inherited functional features of an organism that increase its fitness • Define *fitness* as the probability of an organism surviving and reproducing in the environment in which it is found • Explain the adaptive features of hydrophytes and xerophytes to their environments	☐ ☐ ☐	
18.3 Selection	• Describe natural selection with reference to: ○ variation within populations ○ production of many offspring ○ competition for resources ○ struggle for survival ○ reproduction by individuals that are better adapted to the environment than others ○ passing on of their alleles to the next generation	☐		• Describe evolution as the change in adaptive features of a population over time as the result of natural selection • Define the *process of adaptation* as the process, resulting from natural selection, by which populations become more suited to their environment over many generations	☐ ☐	

Topic	Core material			Supplement material		
	You should be able to:	Checklist	Comments	You should be able to:	Checklist	Comments
	• Describe selective breeding with reference to: ○ selection by humans of individuals with desirable features ○ crossing these individuals to produce the next generation ○ selection of offspring showing the desirable features	☐		• Describe the development of strains of antibiotic resistant bacteria as an example of evolution by natural selection • State the differences between natural and artificial selection • Outline how selective breeding by artificial selection is carried out over many generations to improve crop plants and domesticated animals	☐ ☐ ☐	
19. Organisms and their environment						
19.1 Energy flow	• State that the Sun is the principal source of energy input to biological systems	☐		• Describe the flow of energy through living organisms including light energy from the sun and chemical energy in organisms and its eventual transfer to the environment	☐	
19.2 Food chains and food webs	• Define a *food chain* as showing the transfer of energy from one organism to the next, beginning with a producer	☐				

Topic	Core material			Supplement material		
	You should be able to:	Checklist	Comments	You should be able to:	Checklist	Comments
	• State that energy is transferred between organisms in a food chain by ingestion • Construct simple food chains	☐ ☐		• Describe how energy is transferred between trophic levels • Define *trophic level* as the position of an organism in a food chain, food web, pyramid of numbers or pyramid of biomass • Explain why the transfer of energy from one trophic level to another is inefficient • Explain why food chains usually have fewer than five trophic levels • Explain why there is a greater efficiency in supplying plants as human food, and that there is a relative inefficiency in feeding crop plants to livestock that will be used as food	☐ ☐ ☐ ☐ ☐	
	• Define a *food web* as a network of interconnected food chains • Define *producer* as an organism that makes its own organic nutrients, usually using • energy from sunlight, through photosynthesis • Define *consumer* as an organism that gets its energy by feeding on other organisms	☐ ☐ ☐ ☐				

Topic	Core material			Supplement material		
	You should be able to:	**Checklist**	**Comments**	**You should be able to:**	**Checklist**	**Comments**
	• State that consumers may be classed as primary, secondary and tertiary according to their position in a food chain	☐		• Identify producers, primary consumers, secondary consumers, tertiary consumers and quaternary consumers as the trophic levels in food webs, food chains, pyramids of numbers and pyramids of biomass	☐	
	• Define *herbivore* as an animal that gets its energy by eating plants	☐				
	• Define *carnivore* as an animal that gets its energy by eating other animals	☐				
	• Define *decomposer* as an organism that gets its energy from dead or waste organic material	☐				
	• Interpret food chains and food webs in terms of identifying producers and consumers	☐				
	• Use food chains and food webs to describe the impacts humans have through over-harvesting of food species and through introducing foreign species to a habitat	☐				
	• Draw, describe and interpret pyramids of numbers	☐		• Draw, describe and interpret pyramids of biomass	☐	
				• Discuss the advantages of using a pyramid of biomass rather than a pyramid of numbers to represent a food chain	☐	

Topic	Core material			Supplement material		
	You should be able to:	Checklist	Comments	You should be able to:	Checklist	Comments
19.3 Nutrient cycles	• Describe the carbon cycle, limited to photosynthesis, respiration, feeding, decomposition, fossilisation and combustion • Discuss the effects of the combustion of fossil fuels and the cutting down of forests on the carbon dioxide concentrations in the atmosphere • Describe the water cycle, limited to evaporation, transpiration, condensation and precipitation	☐ ☐ ☐		• Describe the nitrogen cycle in terms of: ○ decomposition of plant and animal protein to ammonium ions ○ nitrification ○ nitrogen fixation by lightning and bacteria ○ absorption of nitrate ions by plants ○ production of amino acids and proteins ○ feeding and digestion of proteins ○ deamination ○ denitrification	☐	

Topic	Core material			Supplement material		
	You should be able to:	Checklist	Comments	You should be able to:	Checklist	Comments
				• State the roles of microorganisms in the nitrogen cycle, limited to decomposition, nitrification, nitrogen fixation and denitrification (generic names of individual bacteria, e.g. *Rhizobium*, are **not** required)	☐	

Topic	Core material			Supplement material		
	You should be able to:	Checklist	Comments	You should be able to:	Checklist	Comments
19.4 Population size	• Define *population* as a group of organisms of one species, living in the same area, at the same time	☐				
				• Define *community* as all of the populations of different species in an ecosystem	☐	
				• Define *ecosystem* as a unit containing the community of organisms and their environment, interacting together, e.g. a decomposing log, or a lake	☐	
	• Identify and state the factors affecting the rate of population growth for a population of an organism, limited to food supply, predation and disease	☐		• Identify the lag, exponential (log), stationary and death phases in the sigmoid population growth curve for a population growing in an environment with limited resources	☐	
				• Explain the factors that lead to each phase in the sigmoid curve of population growth, making reference, where appropriate, to the role of limiting factors	☐	

Topic	Core material			Supplement material		
	You should be able to:	**Checklist**	**Comments**	**You should be able to:**	**Checklist**	**Comments**
	• Discuss the increase in human population size over the past 250 years and its social and environmental implications • Interpret graphs and diagrams of human population growth	☐ ☐				
20. Biotechnology and genetic engineering						
20.1 Biotechnology and genetic engineering	• State that bacteria are useful in biotechnology and genetic engineering due to their rapid reproduction rate and their ability to make complex molecules	☐		• Discuss why bacteria are useful in biotechnology and genetic engineering, limited to: ○ lack of ethical concerns over their manipulation and growth ○ genetic code shared with all other organisms ○ presence of plasmids	☐	
20.2 Biotechnology	• Describe the role of anaerobic respiration in yeast during production of ethanol for biofuels • Describe the role of anaerobic respiration in yeast during bread-making • Investigate and describe the use of pectinase in fruit juice production • Investigate and describe the use of biological washing powders that contain enzymes	☐ ☐ ☐ ☐				

Topic	Core material			Supplement material		
	You should be able to:	Checklist	Comments	You should be able to:	Checklist	Comments
				• Investigate and explain the use of lactase to produce lactose-free milk • Describe the role of the fungus *Penicillium* in the production of the antibiotic penicillin • Explain how fermenters are used in the production of penicillin	☐ ☐ ☐	
20.3 Genetic engineering	• Define *genetic engineering* as changing the genetic material of an organism by removing, changing or inserting individual genes • State examples of genetic engineering: ○ the insertion of human genes into bacteria to produce human insulin ○ the insertion of genes into crop plants to confer resistance to herbicides ○ the insertion of genes into crop plants to confer resistance to insect pests ○ the insertion of genes into crop plants to provide additional vitamins	☐ ☐		• Outline genetic engineering using bacterial production of a human protein as an example, limited to: ○ isolation of the DNA making up a human gene using ○ restriction enzymes, forming sticky ends ○ cutting of bacterial plasmid DNA with the same restriction enzymes, forming complementary sticky ends ○ insertion of human DNA into bacterial plasmid DNA using DNA ligase to form a recombinant plasmid	☐	

Topic	Core material			Supplement material		
	You should be able to:	Checklist	Comments	You should be able to:	Checklist	Comments
				○ insertion of plasmid into bacteria (specific detail is **not** required) ○ replication of bacteria containing recombinant plasmids which make human protein as they express the gene • Discuss the advantages and disadvantages of genetically modifying crops, such as soya, maize and rice	☐	
21. Human influences on ecosystems						
21.1 Food supply	• State how modern technology has resulted in increased food production in terms of: ○ agricultural machinery to use larger areas of land and improve efficiency ○ chemical fertilisers to improve yields ○ insecticides to improve quality and yield ○ herbicides to reduce competition with weeds ○ selective breeding to improve production by crop plants and livestock, e.g. cattle, fish and poultry	☐		• Discuss the social, environmental and economic implications of providing sufficient food for an increasing human global population • Discuss the problems which contribute to famine including unequal distribution of food, drought and flooding, increasing population and poverty	☐ ☐	

Topic	Core material			Supplement material		
	You should be able to:	Checklist	Comments	You should be able to:	Checklist	Comments
	• Describe the negative impacts to an ecosystem of large-scale monocultures of crop plants • Describe the negative impacts to an ecosystem of intensive livestock production	☐ ☐				
21.2 Habitat destruction	• Describe the reasons for habitat destruction, limited to: ○ increased area for food crop growth, livestock production and housing ○ extraction of natural resources ○ marine pollution • State that through altering food webs and food chains, humans can have a negative impact on habitats • List the undesirable effects of deforestation as an example of habitat destruction, to include extinction, loss of soil, flooding and increase of carbon dioxide in the atmosphere	☐ ☐ ☐		• Explain the undesirable effects of deforestation on the environment	☐	
21.3 Pollution	• State the sources and effects of pollution of land and water, e.g. rivers, lakes and the sea, by insecticides, herbicides and by nuclear fall-out	☐				

Topic	Core material			Supplement material		
	You should be able to:	Checklist	Comments	You should be able to:	Checklist	Comments
	• State the sources and effects of pollution of water (rivers, lakes and the sea) by chemical waste, discarded rubbish, untreated sewage and fertilisers	☐		• Explain the process of eutrophication of water in terms of: ○ increased availability of nitrate and other ions ○ increased growth of producers ○ increased decomposition after death of producers ○ increased aerobic respiration by decomposers ○ reduction in dissolved oxygen ○ death of organisms requiring dissolved oxygen in water	☐	
				• Discuss the effects of non-biodegradable plastics in the environment, in both aquatic and terrestrial ecosystems	☐	
	• State the sources and effects of pollution of the air by methane and carbon dioxide, limited to the enhanced greenhouse effect and climate change	☐				

Topic	Core material			Supplement material		
	You should be able to:	Checklist	Comments	You should be able to:	Checklist	Comments
				• Discuss the causes and effects on the environment of acid rain • State the measures that are taken to reduce sulfur dioxide pollution and reduce the impact of acid rain • Explain how increases in carbon dioxide and methane concentrations in the atmosphere cause an enhanced greenhouse effect that leads to climate change • Describe the negative impacts of female contraceptive hormones in water courses, limited to reduced sperm count in men and feminisation of aquatic organisms	☐ ☐ ☐ ☐	
21.4 Conservation	• Define a *sustainable resource* as one which is produced as rapidly as it is removed from the environment so that it does not run out • Explain the need to conserve non- renewable resources, limited to fossil fuels	☐ ☐		• Define the term *sustainable development* as development providing for the needs of an increasing human population without harming the environment	☐	

Topic	Core material			Supplement material		
	You should be able to:	**Checklist**	**Comments**	**You should be able to:**	**Checklist**	**Comments**
	• State that some resources can be maintained, limited to forests and fish stocks • State that products can be reused or recycled, limited to paper, glass, plastic and metal • Outline how sewage is treated to make the water that it contains safe to return to the environment or for human use • Explain why organisms become endangered or extinct, limited to climate change, habitat destruction, hunting, pollution and introduced species • Describe how endangered species can be conserved, limited to monitoring and protecting species and habitats, education, captive breeding programmes and seed banks	☐ ☐ ☐ ☐ ☐		• Explain how forests and fish stocks can be sustained using education, legal quotas and re-stocking • Explain that sustainable development requires: ○ management of conflicting demands ○ planning and co-operation at local, national and international levels • Explain the risks to a species if the population size drops, reducing variation (knowledge of genetic drift is **not** required) • Explain reasons for conservation programmes, to include: ○ reducing extinction ○ protecting vulnerable environments ○ maintaining ecosystem functions, limited to nutrient cycling and resource provision, e.g. food, drugs, fuel and genes	☐ ☐ ☐ ☐	

5: Useful websites

These websites are useful resources to help you study IGCSE Biology.

www.bbc.co.uk/schools/gcsebitesize/biology – A secondary revision source for GCSE exams. The site contains revision material, tests and SOS teacher. The site also gives references to other relevant websites.

www.clickbiology.com/igcse-biology-2/ – A number of videos, animations and games for revision resources for IGCSE Biology.

www.skoool.com/ – You will need to select your location before accessing this revision site. There are numerous quizzes on topics, but like with many general revision sites, check which topics match the Cambridge IGCSE syllabus.

www.s-cool.co.uk – A revision guide that can be used to complement your learning.

purchon.com/biology/revision.htm – This website has information about revising and lots of useful resources about GCSE Biology which are also are relevant to IGCSE.

revisioncentral.co.uk/gcse/biology/index.html – There are lots of Biology revision notes on this website including notes on Classification, Cells, Tissues and Organs and Transportation in Plants.

revisionlink.co.uk/biology/index.html – This site is a portal to lots of useful Biology and other educational web sites.

www.abpischools.org.uk/ – The Association of the British Pharmaceutical Industry (ABPI) has a numer of useful interactive revision activities and games on many of the physiology topics. Revision for human physiology.

Apps

itunes.apple.com/gb/app/biology-gcse-revision/id367827149?mt=8

These are new resources which are being developed.

- iPad: **www.educationapps.co.uk/ipad/revisionguide/gcse/biology/**
- iPhone: **www.educationapps.co.uk/apps/iphone/self-assessment/gcse/biology**
- Android: **www.educationapps.co.uk/apps/android/gcse/science/biology-revision**

6: Mathematical skills

This is a checklist of the mathematical skills you need for your Biology exam. You should tick each box in the checklist when you know that you have learned the skill. Ask your teacher to explain any skill you're unsure about. The 'Comments' column is for extra notes and examples.

You can use a calculator for all the exam papers. If your calculator is one that can be programmed, you should make sure that any information in it is removed before the exam.

You should be able to:	Checklist	Comments
• add • subtract • multiply • divide	☐ ☐ ☐ ☐	
• use averages • use decimals • use fractions • use percentages • use ratios • use reciprocals	☐ ☐ ☐ ☐ ☐ ☐	
• recognise standard notation (notation is putting symbols for numbers e.g. $x = 2$, $y = 5$, atomic mass, $Z = 12$) • use standard notation	☐ ☐	
• understand significant figures and use them appropriately	☐	
• use direct proportion (stepwise increases) • use inverse proportion (inverse means turned upside down)	☐ ☐	The inverse of 4 is ¼ (= 0.25).
• use numbers to the 'power of 10' e.g. $1 \times 10^2 = 100$	☐	Your calculator will often show number to the power of 10 when you do calculations. Don't worry too much though – your calculator does the work for you.
• draw charts • draw graphs with line of best fit	☐ ☐	You will be given the data.

• interpret bar graphs • interpret pie charts • interpret line graphs • find the gradient and intercept of a graph • select suitable scales and axes for graphs • make approximations	☐ ☐ ☐ ☐ ☐ ☐	
recall and use the formulas: • area of a rectangle = length × width • volume of a rectangular block = length × width × height • area of a circle = π × radius^2 • area of a triangle = base × height / 2 • volume of a cylinder = π × radius^2 × height • use and convert metric units into one another	☐ ☐ ☐ ☐ ☐ ☐	
• use mathematical and measuring instruments e.g. ruler, compasses, protractor	☐	
understand the meaning of: • angle • curve • circle • radius • diameter • square • circumference • rectangle • parallelogram • diagonal	☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐	
• solve equations of the form $x = y + z$ and $x = yz$ for any one term when the other two are known	☐	

7: Appendices

Other important information

The terms used in biology exam papers are given in the sections that follow. It is very important that you know and understand all of them before you take your exam. You should ask your teacher to explain anything that you're unsure about.

Numbers

The decimal point will be placed on the line, e.g. 52.35.

Numbers from 1000 to 9999 will be printed without commas or spaces.

Numbers greater than or equal to 10 000 will be printed without commas. A space will be left between each group of three whole numbers, e.g. 4 256 789.

Units

The International System of units will be used (SI units). Units will be indicated in the singular not in the plural, e.g. 28 kg.

(a) SI units commonly used in biology are listed below.

N.B. Care should be taken in the use of *mass* and *weight.* In most biological contexts, the term mass is correct, e.g. dry mass, biomass.

Quantity	Name of unit	Symbol for unit
length	kilometre, metre, centimetre, millimetre, micrometre	km, m, cm, mm, µm
mass	tonne (1000 kg), kilogram, gram, milligram, microgram	(no symbol), kg, g, mg, µg
time	year, day, hour, minute, second	y, d, h, min, s
amount of substance	mole	mol

(b) Derived SI units are listed below.

energy	kilojoule, joule (calorie is obsolete)	kJ, J

(c) Recommended units for area, volume and density are listed below.

area	hectare 10^4 m^2 square metre square decimetre square centimetre square millimetre	ha m^2 dm^2 cm^2 mm^2

volume	cubic kilometre cubic metre cubic decimetre (preferred to dm^3 litre) litre dm^3 (**not** l) cubic centimetre cm^3 (**not** ml) cubic millimetre mm^3	km^3 m^3
density	kilogram per cubic metre *or* kg m^{-3} gram per cubic centimetre *or* g cm^{-3}	

(d) Use of Solidus
The solidus (/) must **not** be used for a quotient, e.g. m / s for metres per second.

Presentation of data

The solidus (/) is to be used for separating the quantity and the unit in tables, graphs and charts, e.g. time/s for time in seconds.

(a) Tables
(i) Each column of a table will be headed with the physical quantity **and** the appropriate unit, e.g. time / s.

There are three acceptable methods of stating units:

- metres per sec
- m per s
- m s^{-1}

(ii) The column headings of the table can be directly rewritten on to the axes of a constructed graph.

(b) Graphs
(i) The independent variable should be plotted on the x-axis (horizontal axis) and the dependent variable plotted on the y-axis (vertical axis).
(ii) Each axis will be labelled with the physical quantity and the appropriate unit, e.g. time/s.
(iii) The scales for the axes should allow more than half of the graph grid to be used in both directions, and be based on sensible ratios, e.g. 2 cm on the graph grid representing 1, 2 or 5 units of the variable.
(iv) The graph is the whole diagrammatic presentation. It may have one or several curves plotted on it.
(v) Curves and lines joining points on the graph should be referred to as 'curves'.
(vi) Points on the curve should be clearly marked as crosses (x) or encircled dots (t:i). If a further curve is included, vertical crosses (+) may be used to mark the points.
(vii) Large 'dots' are penalised. Each data point should be plotted to an accuracy of better than one half of each of the smallest squares on the grid.
(viii) A best-fit line (trend line) should be a single, thin, smooth straight line or curve. The line does not need to coincide exactly with any of the points; where there is scatter evident in the data, examiners would expect a roughly even distribution of points either side of the line over its entire length. Points that clearly don't fit should be ignored when drawing the best-fit line.

(c) Numerical results
(i) The independent variable should be plotted on the *x*-axis (horizontal axis) and the dependent variable plotted on the *y*-axis (vertical axis).
(ii) Each axis will be labelled with the physical quantity and the appropriate unit, e.g. time/s.

(d) Pie Charts

Use pie charts with the sectors in rank order, largest first, beginning at 12:00 and proceeding clockwise, with no more than six sectors.

(e) Bar Charts

Use bar charts when one of the variables are categories, e.g. percentage of vitamin C in different fruits. They should be made up of narrow bars of equal width with a **gap** (not touching) between each bar.

(f) Histograms

Use histograms to plot frequency graphs with continuous data, e.g., frequency of occurrence of leaves of different lengths. The blocks should be drawn in order of increasing or decreasing magnitude and they **should** be touching.

Taxonomy

Taxonomy is the study of how organisms are arranged into groups. There are seven levels of taxon – kingdom, phylum, class, order, family, genus and species. These are the rule you need to know:

(a) The Five Kingdoms are:
- Prokaryotes (Prokaryotae), including bacteria and blue-green bacteria
- Protoctists (Protoctista), including green, red and brown algae and protozoans
- Fungi (Fungi)
- Plants (Plantae)
- Animals (Animalia)

The viruses can't be fitted into this classificatory system.

(b) The binomial system of naming gives each organism a two-word name. The first word is the generic name and the second word is the trivial name, e.g. *Homo sapiens*. The trivial name should never be used without the generic name as well.

(c) Generic and trivial names are distinguished from the rest of the text either by underlining (when written or typed) or by being set in italics (in print).

(d) The generic name always takes an initial capital letter. The trivial name can be left off if it is clear which organsism it is. e.g. *Plasmodium*, and in these circumstances can stand alone.

(e) The common name should not normally be written with an initial capital letter, e.g. cat and dog. The exception is Man, where it is the common name for a species where the two sexes are distinguished by the terms man and woman.

(f) A species is not easy to define but an acceptable general definition is as follows. 'A group of organisms capable of interbreeding and producing fertile offspring.'

Genetics

(a) The terms *gene* and *allele* don't mean the same thing.

A gene is a specific length of DNA occupying a position called a locus. A specific function can be assigned to each gene. An allele is one of two or more different forms of a gene.

(b) Use this standard form of presenting genetic crosses:
- Use P for the cross of pure-breeding (homozygous) individuals
- Use F1 for the offspring of homozygous parents
- Use F2 for the offspring produced by crossing F1 parents.

(c) The format for the course of a genetic cross should be labelled in the following order:

- Parental phenotypes
- Parental genotypes
- Gametes
- Offspring genotypes
- offspring phenotypes

(d) Chose a letter for the gene so that upper and lower case versions are ease to see the difference, e.g. B and b. The upper case letter indicates the dominant allele and the lower case letter indicates the recessive allele.

(e) The symbols for gametes should be circled to indicate the discrete nature of each gamete.

(f) Use a checkerboard to show genotypes that can result from random fusion of gametes.

(g) Use the word 'codominance' if the alleles are equally dominant, e.g. the AB blood group in humans.

Terminology

Use English terms rather than Latin or Greek terms, e.g. red blood cell (**not** erythrocyte) unless there is none e.g. atrium, brinchi, villi.

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