A-LEVEL
AND AS-LEVEL

LONGMAN
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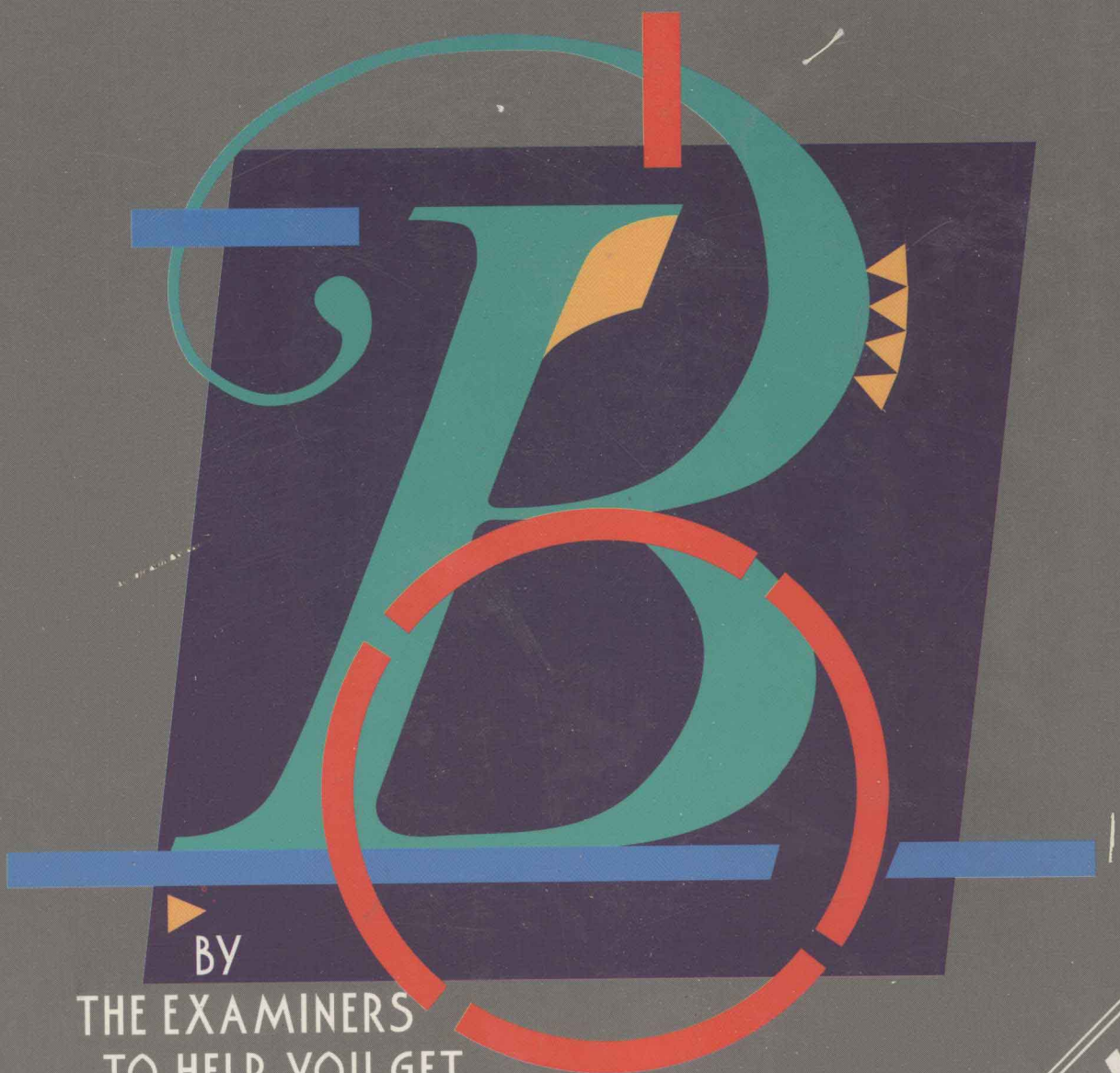
BIOLOGY



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THE EXAMINERS
TO HELP YOU GET
THE RIGHT RESULT

NEW
EDITION

A-LEVEL AND AS-LEVEL

BIOLOGY

Alan Cornwell
Ruth Miller

Longman

LONGMAN A-LEVEL AND AS-LEVEL REVISE GUIDES
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Longman Group Limited
Longman House, Burnt Mill, Harlow,
Essex CM20 2JE, England
and Associated Companies throughout the world.

First published 1990
Second edition 1995

British Library Cataloguing in Publication Data
A catalogue record for this book is available from the British Library.

ISBN 0 582 27771 X

Set by 26 in 10/12pt Century Old Style

Produced by Longman Singapore Publishers (Pte) Ltd
Printed in Singapore

EDITORS' PREFACE

Longman A-level Revise Guides, written by experienced examiners and teachers, aim to give you the best possible foundation for success in your course. Each book in the series encourages thorough study and a full understanding of the concepts involved, and is designed as a subject companion and study aid to be used throughout the course.

Many candidates at A-level fail to achieve the grades which their ability deserves, owing to such problems as the lack of a structured revision strategy, or unsound examination techniques. This series aims to remedy such deficiencies, by encouraging a realistic and disciplined approach in preparing for and taking exams.

The largely self-contained nature of the chapters gives the book a flexibility which you can use to your advantage. After starting with the background to the A-level, AS-level and Scottish Higher courses and details of the syllabus coverage, you can read all other chapters selectively, in any order appropriate to the stage you have reached in your course.

Geoff Black and Stuart Wall

ACKNOWLEDGEMENTS

We are indebted to the following examination boards for permission to reproduce questions which have appeared in their examination papers.

The Associated Examining Board; Northern Ireland Council for Curriculum, Examinations and Assessment; Oxford and Cambridge Schools Examination Board; University of London Examinations and Asessment Council; University of Oxford Delegacy of Local Examinations; Northern Examinations and Assessment Board.

The examination boards are not responsible for the suggested answers to the questions. Full responsibility for these is accepted by the authors.

The authors would like to thank Vicky Cornwell for invaluable assistance in the preparation of the manuscript and Joanna Becker for many of the student's answers. We would also like to thank Eric Turner for his expert advice.

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Welsh Joint Education Committee (WJEC)
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CHAPTER 1

EXAMINATION TOPICS AND COURSES

GETTING STARTED

Advanced-level Biology syllabuses contain a core of topics which are common to them all, so the variations which occur are minor ones, involving differences in emphasis or in the scheme of examination. The syllabus sections may vary in the way they are set out, in their titles and in how the different topics are combined. The chapters in this book cover the content which is common to *all* the syllabuses and also a selection of topics which are included in most of them. This content will also be found in the other Biology syllabuses which are of equivalent standard, such as the Business/Technical Education Council (BTEC) and the Scottish Higher examinations.

Most candidates for A-level Biology now have a more general but less detailed scientific background than previously. A-level syllabuses have been modified to take this into account. All the current syllabuses incorporate the agreed common core for A-level Biology but, overall, the syllabus content has been reduced. The other major changes are in the schemes of assessment where there is less emphasis on essay style questions.

At GCSE, 20 per cent of the marks are awarded for teacher-assessed practical work and this emphasis on the assessment of coursework is carried through to A-level. Many candidates will welcome the chance to gain credit for good work that they do throughout the course.

MODULAR SYLLABUSES

A-LEVELS AND SCOTTISH HIGHERS

AS-LEVELS

TYPES OF ASSESSMENT

ESSENTIAL PRINCIPLES

MODULAR SYLLABUSES

Most of the A-level Biology syllabuses for examination in June 1996 are modular. Some modules are already being set and the full range of modules will be examined in June 1996 and at each examination thereafter. With the modular examination there is some element of choice as to which modules are studied. Some modules are, however, compulsory as the set of modules taken by any candidate must cover the common core. Modules can be banked for up to four years and any module can be re-taken to improve a candidate's grade. All the modular courses include a synoptic element where knowledge and skills from different modules are brought together. It should be noted that although the organisation of content and the method of examination is different for a modular A-level, the range and depth of knowledge and skills has not changed. The major topics listed in Table 1.1 still form the majority of A-level syllabuses.

The emphasis is on the use and application of biological principles

A-LEVELS AND SCOTTISH HIGHERS

Table 1.1 gives a broad indication of the major topics covered by the various A-level and Scottish Higher syllabuses; it also indicates the chapters in this book which are relevant to each syllabus. It should be noted that titles of syllabus sections do vary from syllabus to syllabus: for example, 'Diversity of Organisms' is sometimes called 'Variety of Life'.

CHAPTER AND TOPIC	Associated Examining Board (AEB)	Cambridge Syndicate (UCLES)	Northern Board (NEAB)	London Board (ULEAC)	Northern Ireland (NICCEA)	Oxford Delegacy (ODLE)	Oxford and Cambridge (OCSEB)	Southern Universities (JBSE)	Welsh Joint Examinations (WJEC)	Scottish Higher (SEB)
3 DIVERSITY OF ORGANISMS/VARIETY OF LIFE	✓	✓	✓	✓	✓	✓	✓	✓	✓	
4 CELL BIOLOGY/CELLS AND ORGANELLES	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
5 AUTOTROPHIC NUTRITION/PHOTOSYNTHESIS	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
6 HETEROTROPHIC NUTRITION	✓	✓	✓	✓	✓	✓	✓	✓	✓	
7 HOMEOSTASIS	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
8 RESPIRATION AND GAS EXCHANGE/RELEASE OF ENERGY	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
9 CHEMICAL CO-ORDINATION IN PLANTS	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
10 CO-ORDINATION IN ANIMALS	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
11 TRANSPORT IN ANIMALS AND PLANTS	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
12 REPRODUCTION AND DEVELOPMENT IN MAMMALS	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
13 REPRODUCTION AND DEVELOPMENT IN FLOWERING PLANTS	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
14 SUPPORT, MOVEMENT AND LOCOMOTION	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
15 GENETICS AND EVOLUTION	✓	✓	✓	✓	✓	✓	✓	✓	✓	
16 ECOLOGY	✓	✓	✓	✓	✓	✓	✓	✓	✓	
17 BIOTECHNOLOGY AND GENETIC ENGINEERING	✓	✓	✓	✓	✓	✓	✓	✓		
18 MICROBIOLOGY		✓	✓	✓		✓		✓	✓	

Table 1.1 Syllabus coverage chart: A-level and Scottish Higher examinations

Table 1.1 outlines the topics relevant for A-level and Scottish Higher.

AS-LEVELS

In 1989 advanced supplementary-level examinations were sat for the first time. AS-level syllabuses are shorter than A-level ones; they either cover fewer syllabus areas, or there is a reduction in overall content (see Table 1.2). It should be emphasised that the topics are examined at A-level depth, and we have included a number of AS-level questions in this book.

CHAPTER AND TOPIC	AEB	UCLES	NEAB	ULEAC	ODLE	OCSEB	JBSE
3 DIVERSITY OF ORGANISMS/VARIETY OF LIFE		✓		✓		✓	✓
4 CELL BIOLOGY/CELLS AND ORGANELLES	✓	✓	✓	✓	✓	✓	✓
5 AUTOTROPHIC NUTRITION/PHOTOSYNTHESIS	✓	✓	✓	✓	✓	✓	✓
6 HETEROTROPHIC NUTRITION	✓				✓		
7 HOMEOSTASIS					✓	✓	
8 RESPIRATION AND GAS EXCHANGE/RELEASE OF ENERGY	✓	✓	✓	✓	✓	✓	✓
9 CHEMICAL CO-ORDINATION IN PLANTS		✓		✓	✓		✓
10 CO-ORDINATION IN ANIMALS	✓	✓		✓	✓	✓	✓
11 TRANSPORT IN ANIMALS AND PLANTS	✓	✓		✓		✓	✓
12 REPRODUCTION AND DEVELOPMENT IN MAMMALS			✓				
13 REPRODUCTION AND DEVELOPMENT IN FLOWERING PLANTS							
14 SUPPORT, MOVEMENT AND LOCOMOTION							
15 GENETICS AND EVOLUTION		✓	✓	✓	✓	✓	✓
16 ECOLOGY		✓		✓	✓	✓	✓
17 BIOTECHNOLOGY AND GENETIC ENGINEERING	✓	✓	✓		✓		✓
18 MICROBIOLOGY	✓	✓	✓		✓		✓

Table 1.2 Syllabus coverage chart: AS-levels

TYPES OF ASSESSMENT

All examination boards set papers with structured questions and essays, although the trend is to reduce the number of open-ended essays that candidates are required to attempt. Many boards also set questions which require short answers. These papers are printed in books so that the answers can be written on the question paper, where printed lines or spaces are provided for the answers.

Most examination boards have a scheme of assessment for the practical work done during the course, and whilst some boards still set a practical test, it is unlikely that these will continue when the syllabuses are revised.

Table 1.3 gives a quick reference to the different styles of papers and types of assessment that are used by different boards in A-level and Scottish Higher examinations.

Table 1.2 outlines the topics relevant for AS-level

	AEB	UCLES	NEAB	ULEAC	NICCEA	ODLE	OCSEB	JBSE	WJEC	SEB
Structured questions/Short answers	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Essays/Free response	✓	✓	✓	✓	✓	✓	✓		✓	✓
Practical examination		[1]✓	[2]✓	✓		✓	✓		✓	
Teacher-assessed coursework	✓	[1]✓	✓	✓			✓			✓
Multiple choice		✓	✓		✓					✓
Compulsory project (practical investigation)		✓			✓					
Investigative assignment		✓					✓			

Table 1.3 Types of assessment: A-level and Scottish Higher examinations

1 Alternatives; candidates take a practical examination or teacher-assessed coursework is submitted.
2 For external/part-time candidates; internal candidates submit teacher-assessed coursework.

Note: AEB and London have a written alternative to teacher-assessed coursework. Oxford and Cambridge have optional personal work as part of the assessment.

Table 1.4 gives the same information for AS-level syllabuses.

Table 1.4 Types of assessment: AS-levels

	AEB	UCLES	NEAB	ULEAC	ODLE	OCSEB	JBSE
Structured questions/Short answers	✓	✓	✓	✓	✓	✓	✓
Essays/Free response	✓	✓	✓	✓	✓	✓	✓
Teacher-assessed practical coursework	✓	✓		✓	✓	✓	✓
Investigative assignment		✓				✓	✓
Multiple choice			✓				

See footnote to Table 1.3

Note: AS students with London and Cambridge take papers which are common to both AS and A-level. The Oxford and Cambridge and Cambridge syllabuses include options.

CHAPTER 2

EXAMINATION AND ASSESSMENT TECHNIQUES

GETTING STARTED

All biology examinations at A-level or its equivalent (Advanced Supplementary, BTEC, Scottish Higher, etc.) involve papers of various types. **Essay** papers (or sections of papers) are set to test your ability to develop arguments or to give expanded detail of topics. **Structured short-answer papers** test the breadth of your knowledge, as do **multiple-choice** questions or papers. Practical work is usually tested by **teacher assessment**, sometimes along with a written paper testing your knowledge of practical techniques. At present some examination boards still set a practical examination but, as the new syllabuses come out, these are disappearing. Some syllabuses also include a **project** or long-term investigation; this can be optional. The particular combination of papers set will vary from syllabus to syllabus, as will the form of practical assessment. You should check with your own syllabus for exact details of the assessment you will be following. Throughout your period of working towards the examination you should check your **understanding**. Your time may not be well spent rewriting notes you have taken during lessons, but you should read through the notes as soon as possible after the lesson is finished to make sure that you understand them. If there are points that do not make sense, refer to the textbooks and/or go and see your tutor. Having made sure that you do understand the current work, you will have a firm basis for understanding future work. You will also have completed the first stage in remembering the material over the longer term.

ESSENTIAL PRINCIPLES

EXAMINATION PREPARATION

Consistent work is the basis for success

The next step is to **revise regularly**. If you do not look at previously understood material for several months, you will have forgotten much of the detail and, probably, much of your understanding of it. **Repetition** is an important tool in learning and in preparing for examinations. Revision is the essence. It is foolish to leave such learning until the last few weeks. Success comes through **consistent** work rather than an attempt to commit everything to memory in, and for, a short time.

KEYWORDS

One technique which many people find useful is to make cards with keywords, diagrams and brief notes. These can be written soon after a lesson and stored as a file. They can be referred to easily and can be used as 'memory joggers'.

PAST QUESTIONS

Another technique which is very valuable is to make use of past questions set by the examination board whose examinations you are taking. Your school or college will have past papers, or if you are an independent student you can obtain papers by writing to the Publications Department of the relevant examination board.

After studying each syllabus section, you will find it useful to attempt questions based on the material. The most valuable way of doing this is to revise the section and then to attempt an answer to questions **without reference to your notes**. Occasionally, write a **full answer** to the question, keeping to the time allowance you would have in the examination; for other questions, just **plan** answers. In each case, when you have completed the answer or the plan, **check with your notes** to make sure that you have remembered and used facts correctly and have not omitted any relevant information. This part of the process is very important because to improve your understanding you must learn from mistakes, whether they be errors or omissions.

Learn from any mistakes

The answers given to questions in this book are not model answers but illustrate one way of selecting and organising material. If your answers differ from the ones given, compare the two and decide whether or not your answer is along the right lines.

EXAMINATION STRATEGY

Follow all instructions

When taking examinations, the first essential when you receive the question paper is to **read the instructions carefully**; they must be followed to the letter. Check how many questions have to be answered; not only the total number but also how many from each section of the paper. Also check whether or not there are any compulsory questions. In **short-answer papers**, the questions will vary in length, so there is no point in dividing the total time available by the number of questions. However, this division of time is very important in **essay** papers. In any examination, be sure to answer the correct number of questions. Remember that if you answer only four questions when five should be answered, your maximum mark is 80 per cent not 100 per cent, so you have diminished your chances of doing well. The effect is even greater if you answer three instead of four questions. The rest of this section gives guidance on how to organise your time and effort in the different types of examination papers.

ESSAYS

Choose your questions

Take care in choosing the questions that you intend to answer. Read through the whole paper and mark the questions that you think you can answer. Then, read through your chosen list again and pick the appropriate number of questions (taking into account any instructions about the number of questions per section).

A plan can help

Plan your answers

When you start to answer each question, plan it out first and write down your plan. This will not only help you to organise your answer logically but will also give you a checklist to which you can refer whilst answering. In this way you will be less likely to repeat yourself or to miss out important sections. When questions are subdivided, use the *mark allocations* given on the exam paper as a guide to the detail needed for each section. In open essays, you can place your own emphasis in your answer, but ensure that you cover all the aspects that you have planned.

Write clearly

Write your answers clearly and carefully. State your facts and express your ideas in detail. Whenever possible, qualify your statements with further details or examples to show that you really understand what you are writing. Do not give the impression that you have just remembered a few 'jargon' words. If the question is divided into parts a), b)i), b)ii), etc., your answer must be similarly divided.

Answer the question actually set

Answer relevantly

Make sure that you keep your answer relevant. Good biology will not obtain any marks if it is not relevant to the question set. Frequent reference to your plan should help you to keep to the question and not be sidetracked into other topics.

Organise your time

Organise your time so that you are able to read through your answers when you have completed the paper to check for errors and omissions.

SHORT-ANSWER PAPERS

Check question styles

These are set in a variety of styles so before sitting the examination use past papers to familiarise yourself with the types of questions set by your examination board.

Keep to time

Assess the relationship between minutes and marks to get an indication of how long you can afford to spend on each question. Work your way through the paper, but if you come across a question which, after reading it a couple of times, you feel you cannot answer, pass on and come back to it later.

Answer appropriately

Remember that the **leader lines** or **spaces** left on the question paper indicate the length of the answer which is expected. Read the questions carefully and do what is asked. If a question says '**list** ...' do not waste time **describing**; if a question gives two lists of data and asks you to graph **one** list do not graph **both**, and so on. If you are asked to calculate, show your workings, as most of the marks will be for your method and not just for the answer. As with essay papers, write clearly and concisely, trying to answer all the questions in the time allowed.

MULTIPLE CHOICE

Work quickly

All the questions will be compulsory and you will have to work quickly to complete this paper. Some questions will be quite straightforward but others will be more complex. With these, make notes or draw diagrams rather than trying to work them out in your head.

Watch out for a negative stem

Read the stem carefully

Always read the stem carefully and make sure that you do not miss vital words. Sometimes questions have a **negative** stem and it is particularly important to notice this. The format would be 'Which of the following does *not* ...'. When you have chosen a response, have another look at the stem before you put your response on the computer sheet.

Keep answers in line

In this type of paper there will inevitably be some questions which you will find easier than others. If you find a question which after a minute or so is still unanswerable, leave it and go on to the next. Remember to mark the question you have missed out and be careful not to get your answers out of line on the computer sheet.

'Educated' guesses

When you go back to a question, if you still cannot decide on the correct response, *eliminate* any that you are sure are wrong and then make an 'educated' guess from those still remaining. Should the questions have two or three alternatives remaining, a guess would have a 50 per cent or $33\frac{1}{3}$ per cent chance of being correct, and so would be better than a blank!

PRACTICAL PAPERS

Check for special instructions

When you are given the paper, read through the instructions and make a special note of whether they suggest starting any particular question at the beginning of the examination. If they do, then follow the instruction as it means that the question will take a long time, often with periods when you are waiting for enzymes to work or tissues and solutions to equilibrate. These are periods during which you can get on with other questions while you are waiting.

Do as question asks

Read all the questions carefully and make sure you understand what you have to do before you start. Take particular note of the wording of questions and do what they say. For example:

- if you are asked to **tabulate**, the information should be given in a table, *not* as a series of sentences
- if you are asked to **annotate a drawing**, the comments should be alongside the labels, *not* as a separate statement
- if you are asked to **make a key** to separate a group of specimens, this means using dichotomous separations, *not* just writing a table of differences

Drawings

Drawings should be large and clear. Label lines should be drawn with a rule and should not criss-cross. Do not put arrowheads on label lines. Labels should be neat and ideally should be placed under each other. When drawing plans of microscope sections make sure that the tissues are shown as clearly marked areas (not collections of cells) and that they are correctly proportioned. High-power microscope drawings of cells should be made with the cell components correctly proportioned and the different types of cells correctly sized relative to each other.

Complete the paper

As with all the other types of examinations it is important that you complete the paper. The questions may not each carry the same number of marks and so again use the mark allocations as a guide to the relative amount of time you should spend on each question. With practical examinations however, the amount of time you need to spend on a question will also depend on your own practical skills. Some techniques will be easier for you and so you will be able to allow more time for questions which do not involve your own particular strengths.

TEACHER ASSESSMENT

The practical element of the assessment will be partly or wholly by teacher-assessed work during the course of your studies. Some boards set specific pieces of practical work for assessment, others have the assessment based on the on-going practical work associated with the syllabus. You should check the requirement of your particular board.

Whatever method is used, the basic essential is the development of an **efficient technique** for practical work and of the **basic skills** needed for practical biology, all of which will be assessed. You will need to show your ability to:

Skills to be tested

- handle apparatus and materials
- observe and measure accurately
- formulate hypotheses
- design and carry out investigations
- handle data and carry out statistical analyses
- record and communicate results and conclusions

The following are examples of areas which may be tested in teacher assessment:

MICROSCOPY

You will need to be able to set up and use a microscope at a range of magnifications and to record your observations by drawing and possibly by using a micrometer eyepiece to make measurements. You may be expected to make temporary preparations and use appropriate staining techniques.

EXPERIMENTAL LABORATORY WORK

A whole range of experimental work, covering biochemistry as well as both plant and animal physiology, will be included. In this work you will need to show your ability to carry out a suitable method and to record it in detail. You will have to record your results and draw valid conclusions from them. Your discussion of results should include consideration of the biological principles involved and their significance in the life of organisms.

FIELDWORK

You will need to show your ability to select and use suitable methods for obtaining numerical as well as qualitative data. You will have to use and perhaps produce keys for identifying both animals and plants. Results should be presented in both tabular and graphical form and you should subject your data to simple statistical treatment. Your performance will be judged on the appropriateness of your techniques, the suitability of your chosen form of data presentation and your discussion of the significance of your findings.

PROJECTS

Many A-level syllabuses include either a compulsory or an optional project as part of the assessment. If your examination includes a project the syllabus will contain all the necessary details and it is wise to study these before starting work on it. Usually a suggested format for the report is given and also a list of criteria against which the project will be marked. You will find these very useful as they indicate what information and discussion you should include. The normal procedure for choice of topic is for you, in consultation with your tutor, to choose an area of investigation which interests you. This, usually with a brief synopsis, will be submitted to the examination board for approval. When choosing a topic, it is very important to bear in mind the amount of time you will have available and select your topic accordingly. Remember that carrying out experiments or collecting field data may often take longer than you anticipate.

Writing up your project

When writing up your project be sure that you know the length that is expected and bear this in mind all the time. The assessment will be based mainly on your **own work** and your **own analysis** of it. So, although you will have to research **published reports** covering your field of study, you should mention these only briefly when writing up your project. The emphasis should be on your own methods, statistical analysis of your data and any relevant discussion.

POSTSCRIPT

From the beginning of your course, **aim high**. Make the assumption that all the topics are important. Some you will find more difficult than others, but persevere with them; do not be discouraged. Nobody finds the whole of a subject easy and there is a great feeling of achievement when you get on top of an area of difficulty. Looking back on it you will have a sense of satisfaction and will probably wonder why, at one time, you found it difficult.

CHAPTER 3

THE DIVERSITY OF ORGANISMS

LEVELS OF ORGANISATION

PRINCIPLES OF CLASSIFICATION

THE FIVE KINGDOMS

PRACTICAL WORK

GETTING STARTED

This chapter deals with **levels of organisation**, the concept of the **species** and the principles of **classification** before considering a range of different organisms. It is essential to check the relevant syllabus very carefully so that you are quite clear what is required. Some syllabuses are very specific about the organisms included for study and types are listed, but others refer to groups of organisms only. It is also worth checking all sections of the syllabus for reference to specific organisms, not just a section headed 'Variety of Life' or 'Diversity of Organisms'. In some syllabuses, the diversity of organisms is linked to the fieldwork.

Most syllabuses give some direction as to how the organisms should be studied; the emphasis is usually on the recognition of external features characteristic of the group to which they belong. An understanding of the different levels of organisation is necessary in order to appreciate the taxonomic position of species, and also to be capable of identifying specimens using keys or guides. The external features of an organism can also be used to show how it is adapted to its environment and to its mode of life. It should be appreciated that in order to gain a good understanding of this section of the syllabus, reference should be made to actual specimens wherever possible. A great deal of benefit can be derived from making drawings of living or preserved specimens with clear labels and annotations of the features displayed.