Contents

CLASSROOM GUIDE

STUDENT EDITION

First Edition 2022

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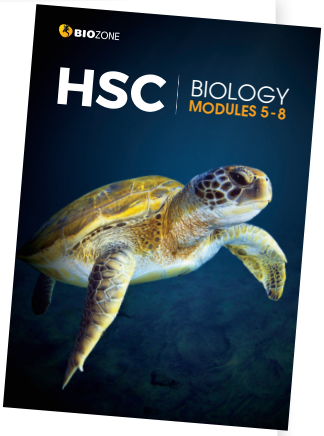
BIOZONE Learning Media Australia

P.O. Box 2841, Burleigh BC,
QLD 4220, Australia

07 5535 4896
07 5508 2432
sales@biozone.com.au

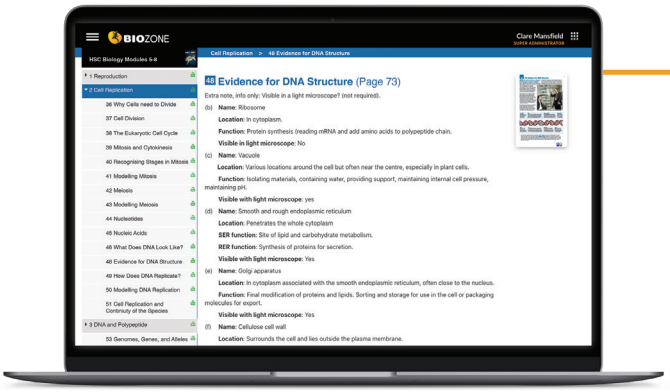
www.BIOZONE.com.au

FAQs
ABOUT HSC BIOLOGY MODULES 5-8



Teacher Support Materials

BIOZONE's *HSC Biology, Modules 5-8* is supported by a suite of resources. These additional resources provide tools to help you teach remotely or in the classroom, provide online answers which you can share with students for self assessment if you wish, and use interactively to promote class discussion and efficient review. Some features of these supporting resources are described below. More information about the Digital Teacher's Edition can be found on page CG16.



ONLINE MODEL ANSWERS

Online Model Answers provide model answers to each of the activities, including working, where appropriate, e.g. calculations.

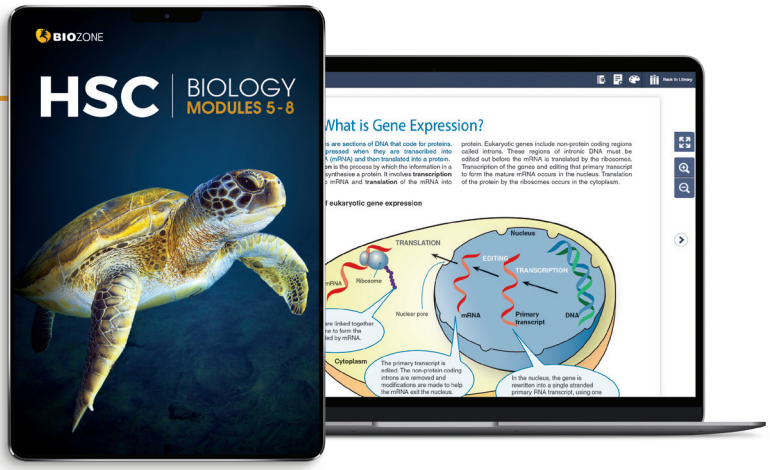
Online Model Answers are accessible via a login that is unique to your school. Your access as a teacher means you're able to control how much and when students can view individual answers, making it easier for you to support homework and revision. Controlled access to answers promotes deeper understanding and encourages students to be self critical. The online model answers also provide an effective tool to support your students with remote learning.

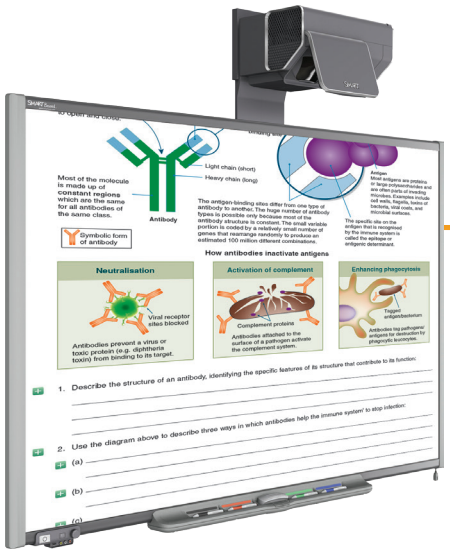
EBOOK TEACHER'S EDITION

Our eBooks provide a digital replica of the printed pages for access in or out of the classroom.

The eBook TEACHER'S EDITION has the Classroom Guide and **answers in place** for each activity.

Visit: **biozone.com.au/ebooks** for more information.





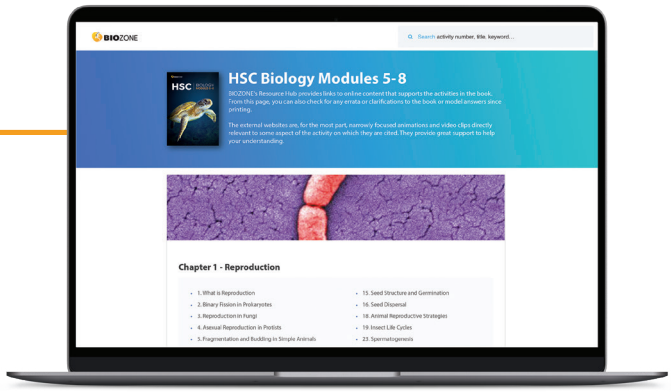
DIGITAL TEACHER'S EDITION

This teacher's resource features a non-printable PDF Teacher's Edition, with a useful feature allowing you to hide and display the suggested answers. It is ideal for introducing and reviewing activities using an interactive whiteboard. The Digital Teacher's Edition includes an introductory guide to using *HSC Biology, Modules 5-8* in the classroom and online. It is supplied as a direct download.

RESOURCE HUB

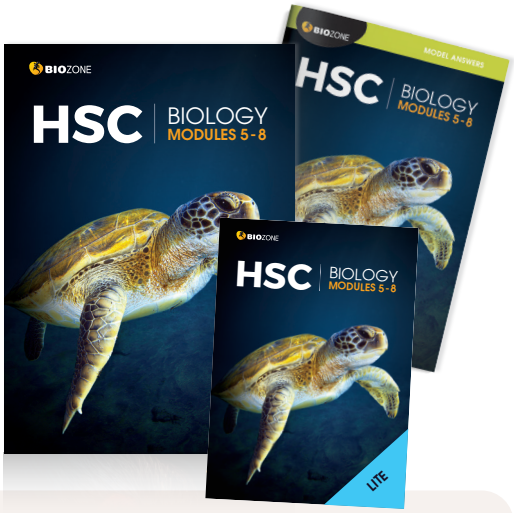
Be sure to visit **BIOZONE's Resource Hub**, which is fully accessible and free of charge to you and your students. It offers a curated collection of videos, animations, 3D models, and supporting content for the activities in this worktext.

Visit: **www.BIOZONEhub.com** Your code is **HSC12-1-6559**



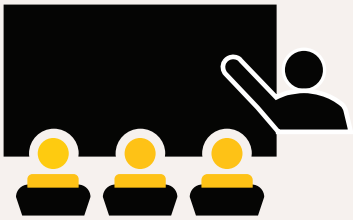
Meeting Key Competencies

We want today's biology students to be self-motivated, lifelong learners. We want them to develop a sound grasp of biological knowledge, to plan and evaluate their work, and to think critically and independently. In developing *HSC Biology*, we have put the aims and structure of the **NSW Biology Stage 6 syllabus** first and foremost. This title fully supports scientific investigation, critical and creative thinking, and individual and collaborative approaches to scientific endeavour. An understanding of ethical behaviours, and acknowledgement of the knowledge and cultures of Aboriginal and Torres Strait Islander peoples, are integral to this title. This guide will highlight some of the strategies BIOZONE has used to meet the aims and scope of the study design.



Lesson planning

- The structure of *HSC Biology, Modules 5-8* follows the module structure specified in the **NSW Biology Stage 6 syllabus**. Teachers can be assured that all of the essential components of the syllabus are covered, ensuring easy and efficient lesson planning with no content gaps.
- Use the chapter introductions to assign work to students for each lesson.
- Add interest to your lessons by utilising the FREE, curated resources on **BIOZONE's Resource Hub** in your planning. Resources for specific activities are identified on the Resource Hub, saving you time and extending your range of tools. You can use these to prepare students for upcoming topics, or consolidate understanding after lessons.
- Use the contents pages to help with lesson planning too. A green bullet next to an activity in the contents pages identifies where there is a practical investigation. Incorporate these activities into your schedules.



Teaching

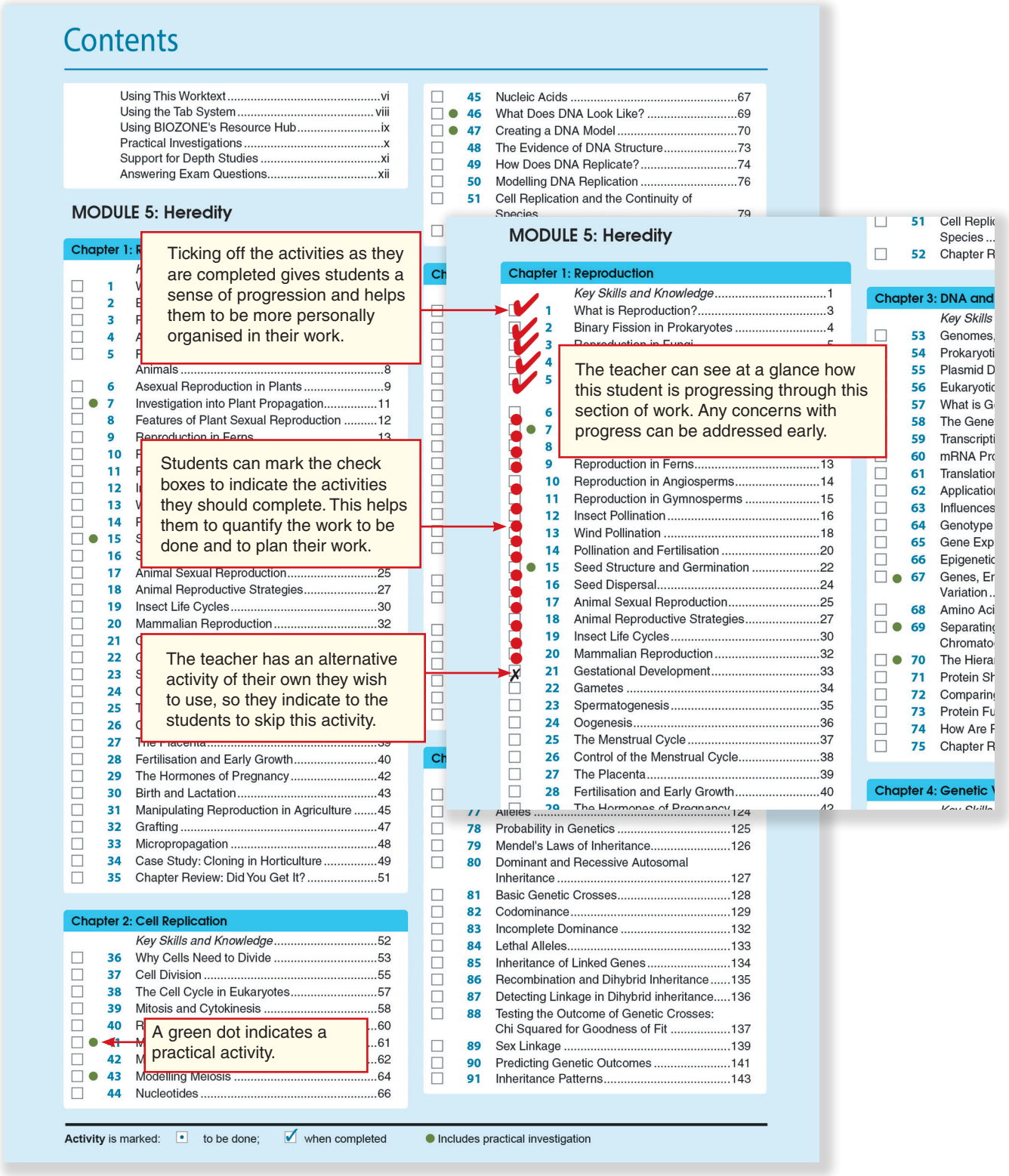
- Teach the content in the order presented in *HSC Biology, Modules 5-8*. This will ensure foundation knowledge is covered before students need to apply the information to more complex topics.
- Encourage peer-to-peer learning by assigning students to groups of mixed abilities when carrying out group research projects or practical investigations.
- Activities that manipulate data using formulae may be supported by spreadsheets on **BIOZONE's Resource Hub**. You can tailor how you use the spreadsheets and students can analyse the data sets provided (including graphs) to save time.
- Extend students' scientific vocabulary by encouraging them to look up unfamiliar words in the **glossary** (Appendix 1).
- Use the **Digital Teacher's Edition** to introduce an activity and give any direction required. It can be used to review answers in class or on-line quickly and efficiently. Choose when and how you reveal the answers. To promote student discussion, reveal answers only once the students have shared their ideas. Reveal all the answers if you want the students to self mark their own work.

Assessment

- Provide feedback (formative and summative) to students to update them on their progress. This can highlight areas of strength or areas needing work.
- Use formative assessment to identify areas the class needs to revisit before progressing to the next topic or unit. Methods of formative assessment include reviewing student answers on the chapter reviews, observing students carrying out practical work, or evaluating their contribution and understanding in practical work.
- Use the **Synoptic Assessments** at the end of each module to assess student understanding. This could be carried out as a test in class. Alternatively, you can set them as homework or open book assessments if you wish.

The Contents: A Planning Tool

The contents pages are not merely a list of the activities in the book. Encourage your students to use them as a planning tool for their programme of work. Students can identify the activities they need to do and then tick them off when completed. Teachers can see at a glance how quickly the student is progressing through the assigned material.



Introducing the Content

Each chapter in *HSC Biology Modules 5-8* is prefaced with a one page introduction, providing students with an overview of the chapter content and organisation. Each of the numbered learning outcomes pertains to a point of key knowledge or a skill, and is matched to one or more activities. A list of key terms for the chapter is also included. The comprehensive, but accessible, list of learning outcomes encourages students to approach each topic confidently. Familiarity with the scientific terms used in each topic is implicit in this. Encourage your students to use the glossary (Appendix 1) to expand their scientific vocabulary.

For ease of navigation, chapters are numbered sequentially throughout the book.

The chapter title corresponds to the section heading in each module.

The relevant inquiry question for each chapter is clearly stated. Encourage students to keep this in mind as they work through the content and try to relate their learning back to it.

The list of **key terms** highlights important terms to students. They can look them up in the **glossary** at the back of the book if they are unsure of what they mean. This encourages use of the correct terms when answering questions and builds scientific literacy.

Key skills and knowledge are drawn from the syllabus. They are purposefully brief, with enough information to provide a framework, but not so much that students are overwhelmed.

Activities that cover practical skills are identified with a green bookmark and blue text.

The activities relating to these key knowledge outcomes.


CHAPTER 3

DNA and Polypeptide Synthesis

Activity number

Key terms
allele
amino acid
anticodon
autosome
chromosome
codon
epigenetics
exon
gene
genome
genotype
homologous chromosomes
intron
phenotype
plasmid
polypeptide
primary structure
protein
quaternary structure
secondary structure
sex chromosome
tertiary structure
transcription
translation

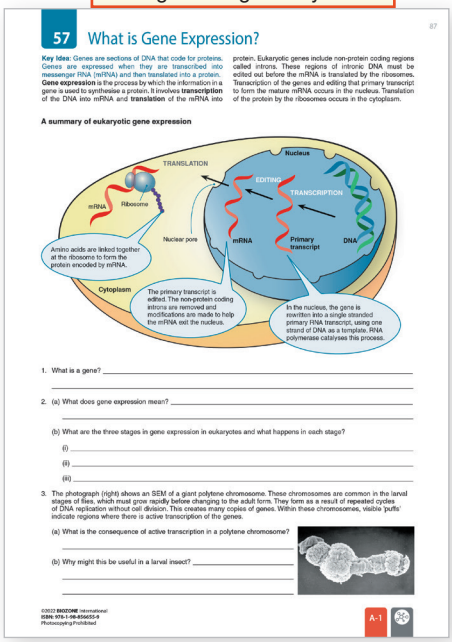
Inquiry question: Why is polypeptide synthesis important?

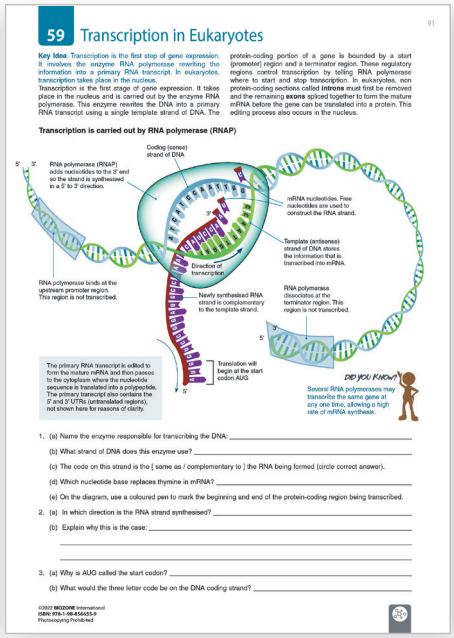
Mark the check boxes of the objectives to complete and tick off when finished.

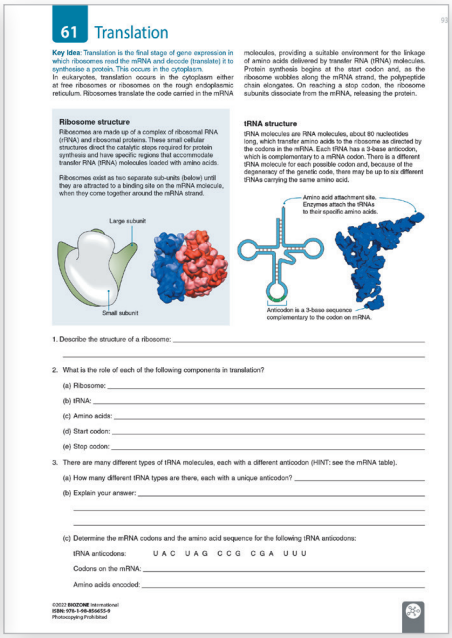
Chromosomes, genes and genomes
Key skills and knowledge
Gene expression
Key skills and knowledge
4 Describe the relationship between the base sequence in mRNA and the order of the amino acids in a polypeptide chain. 57
5 Describe the features of the genetic code. Use the genetic code to identify the amino acid sequence produced by a specific DNA sequence. 58
6 Describe the steps involved in protein synthesis including transcription, RNA processing (eukaryotic cells), and translation. Identify where in the cell each step occurs. Assess the importance of mRNA and tRNA in transcription and translation. 59 -61
7 Investigate how gene expression influences phenotype and how investigation of the genes being expressed can be used to treat disease, e.g. cancer. 62
Influence of environment on gene expression
Key skills and knowledge
8 Describe how genetic make-up (genotype), environmental factors, and epigenetic factors contribute to produce the phenotype of an organism. 63 64 67
9 Use examples in both plants and animals to explain how the environment of an organism during or after development can alter the expression of the genotype and produce variable phenotypes. Investigate how phenotypes, including height and weight, have continuous variation. 65 66
10 PRAC Measuring continuous variation 66
Protein structure and function
Key skills and knowledge
11 Explain how a polypeptide is synthesised from amino acid monomers. Explain how the properties of amino acids determine how they interact and how these interactions create the hierarchical levels of structure that produce a functional protein. 68 70
12 PRAC Separating amino acids. 69
PRAC Modelling protein structure 70
14 Explain how protein shape is related to function and compare the functional roles of globular and fibrous proteins. Identify and describe the diverse roles of proteins making up an organism's proteome. 71-73
15 Describe how proteins are modified after translation for different roles. Interpret diagrams to explain how various organelles are involved in the packaging and export of proteins from the cell. 74

Introduce the concept with a grounding activity

Follow with activities exploring the concept

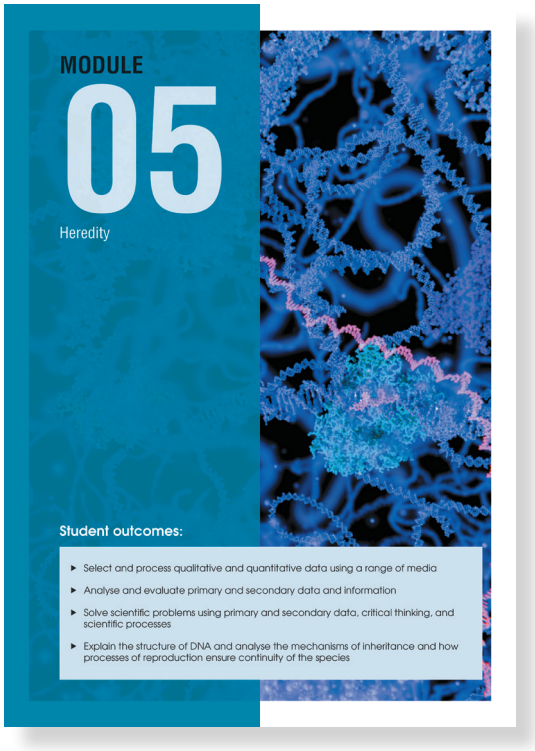

57 What is Gene Expression?

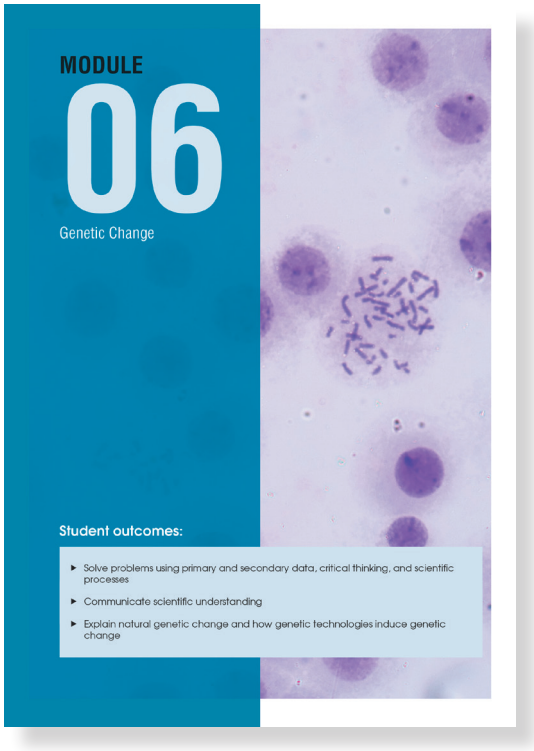

59 Transcription in Eukaryotes

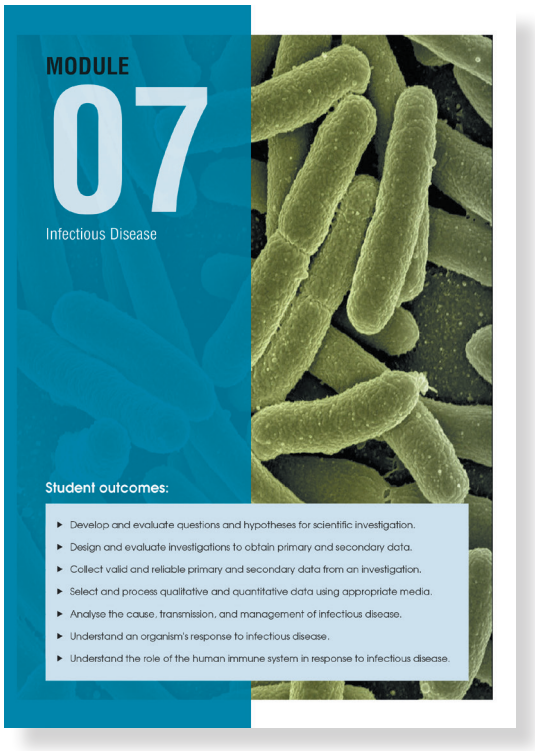

61 Translation

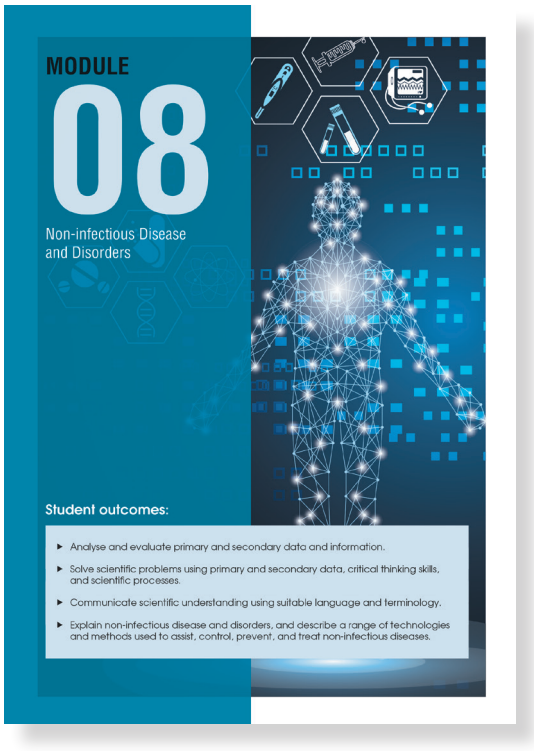
Finding Your Way Around

The content of the *HSC Biology Modules 5-8* is organised into 18 chapters, numbered sequentially and nested within their module (below). Each chapter begins with an introduction and most conclude with a student's self-test of understanding and vocabulary. Inviting, concept-based activities make up the bulk of each chapter, with each activity focussing on the student developing an understanding of a concept, applying that understanding to another scenario, and/or developing an essential skill, such as graphing or data analysis. The tabs for each activity identify the nature of the activity, and identify related material and external supporting resources. These features are explained further on the opposite page.







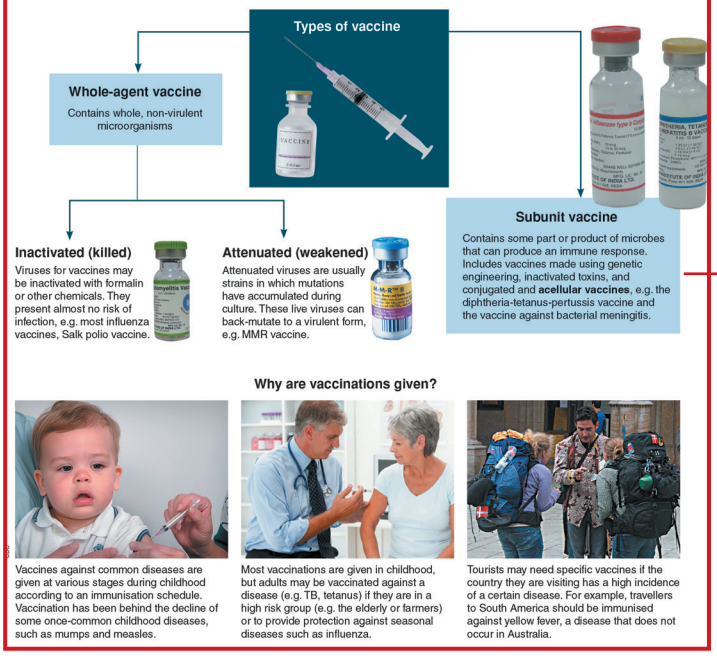


The module breaks divide the book into four sections covering related material. This structure provides students with a clear indication of where they are in the course. Each unit break summarises the student outcomes covered in each module, so students have a clear idea of what is coming up.

181 Vaccines and Vaccination

Key Idea: A vaccine is a suspension of antigens that is deliberately introduced into the body to protect against disease. If enough of the population is vaccinated, herd immunity provides protection to unvaccinated individuals.

A **vaccine** is a preparation of a harmless foreign antigen that is deliberately introduced into the body to protect against a specific disease. The antigen in the vaccine is usually some part of the pathogen. It triggers the immune system to produce antibodies against the antigen but it does not ca... the disease. The immune system remembers its response and will produce the same antibodies if it encounters the antigen again. If enough of the population is vaccinated, herd immunity (indirect protection) provides unvaccinated individuals in the population with a measure of protection against the disease. There are two basic types of vaccine: subunit vaccines and whole-agent vaccines (below).



Why are vaccinations given?

Vaccines against common diseases are given at various stages during childhood according to an immunisation schedule. Vaccination has been behind the decline of some once-common childhood diseases, such as mumps and measles.

Most vaccinations are given in childhood, but adults may be vaccinated against a disease (e.g. TB, tetanus) if they are in a high risk group (e.g. the elderly or farmers) or to provide protection against seasonal diseases such as influenza.

Tourists may need specific vaccines if the country they are visiting has a high incidence of a certain disease. For example, travellers to South America should be immunised against yellow fever, a disease that does not occur in Australia.

1. (a) What is a vaccine? _____

(b) Provide some examples of when vaccinations are needed: _____

181 Vaccines and Vaccinat

Key Idea: A vaccine is a suspension of antigens that is deliberately introduced into the body to protect against disease. If enough of the population is vaccinated, herd immunity provides protection to unvaccinated individuals.

The **key idea** provides a focus for each activity. It summarises the focus of the activity and provides a clear take-home message for the student.

Annotated diagrams, sometimes including photo panels, explain the content of the page, providing the information necessary to complete the activity.

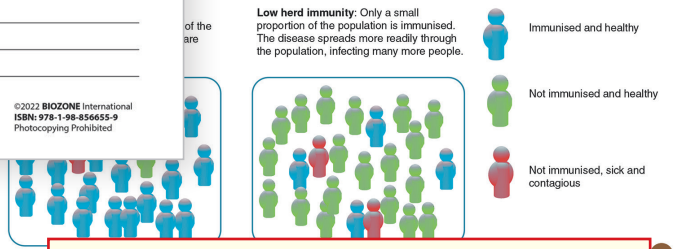
d immunity

e vaccination of a significant portion of a population provides some protection for individuals who .g. have not been vaccinated and are not immunised). In order to be effective for any particular he population needs to be vaccinated against that disease. High vaccination rates make it difficult se there are very few susceptible people in the population.

eople who cannot be vaccinated (e.g. the very young, people with immune system disorders, or as cancer patients).

of the are

Low herd immunity: Only a small proportion of the population is immunised. The disease spreads more readily through the population, infecting many more people.



2. Atte... thin... you

3. (a)

(b) Why are health authorities concerned when the vaccination rates for an infectious disease fall? _____

4. Some members of the population are unable to be vaccinated. Give an example and explain why herd immunity is very important to them:

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A **colour-coded tab system** identifies:

- When an activity is supported with content on **BIOZONE's Resource Hub**
- The general capabilities covered within the activity
- The cross-curriculum priorities covered within the activity
- Other syllabus learning areas covered within the activity
- Related content
- Where referral to the relevant appendices is required (glossary term or equipment list)

For a full description of the tabs see page viii of the Student Edition.

Understanding of content is tested through questions, data handling, analysis, prediction, or summary. Students are often required to apply their understanding to a new scenario or make connections to related content. Students must interact with the information on the page in order to complete the activity. It is this interaction that provides the valuable learning experience, reinforcing and explaining the key idea. Students are frequently asked to work in small groups to discuss ideas and formulate responses.

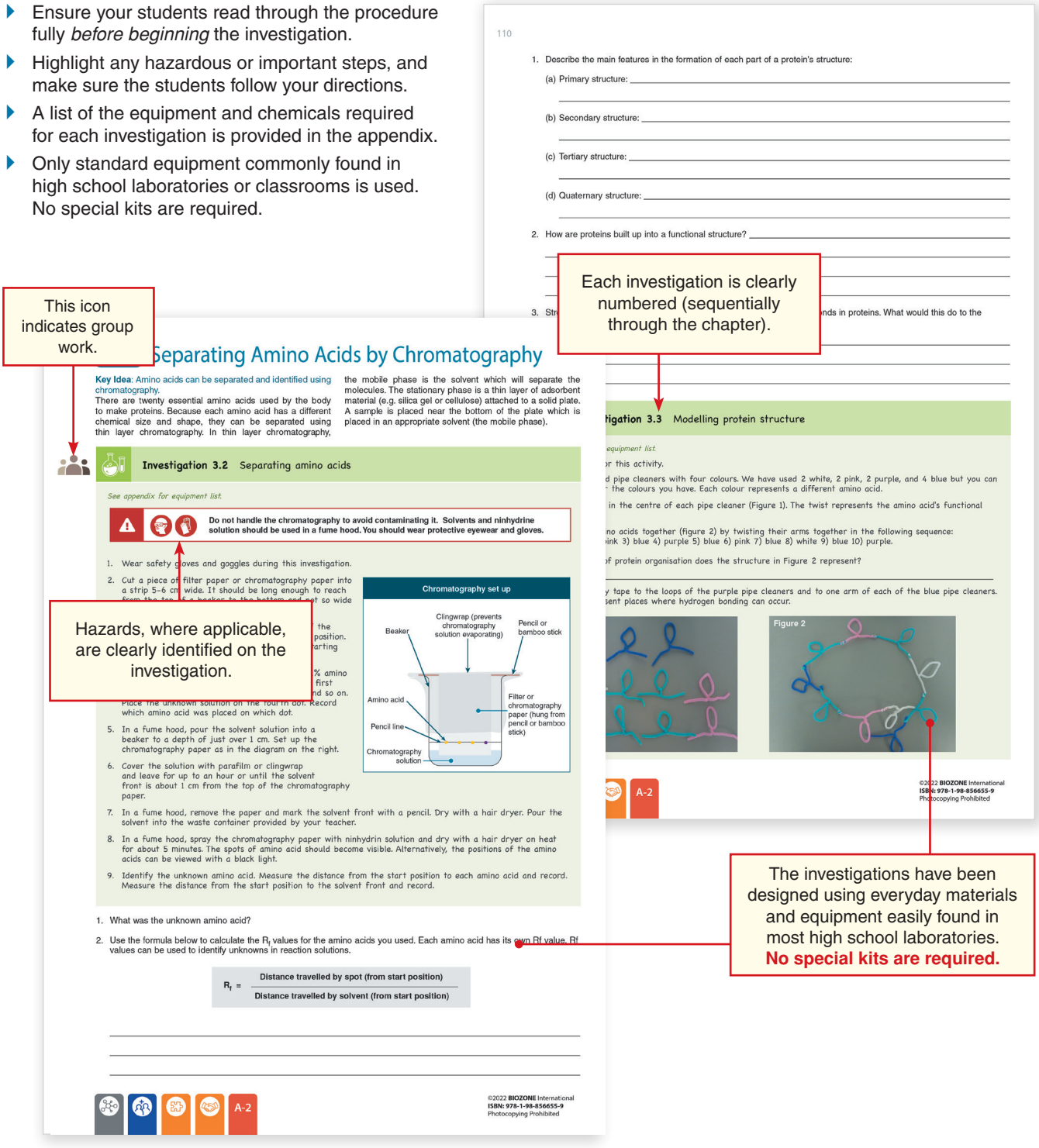
Support for Science Skills and Practical Investigations

The *Working Scientifically Skills* (right) are well supported throughout the worktext. Throughout the HSC Biology course, students practise these skills by applying them in practical situations. Regular practise helps students become proficient in using these skills when they encounter them in assessments.

Practical investigations and hands-on activities appear in context throughout the worktext. The practical investigations provide opportunities for students to develop many essential science skills. Working in groups promotes collaboration and the development of communication skills. Stronger students can mentor and support those who are less confident, providing benefit for both sets of students. A list of equipment for each investigation is provided in Appendix 2 (see next page).

WORKING SCIENTIFICALLY SKILLS
Questioning and predicting
Planning Investigations
Conducting Investigations
Processing Data and Information
Analysing Data and Information
Problem Solving
Communicating

- Ensure your students read through the procedure fully *before beginning* the investigation.
- Highlight any hazardous or important steps, and make sure the students follow your directions.
- A list of the equipment and chemicals required for each investigation is provided in the appendix.
- Only standard equipment commonly found in high school laboratories or classrooms is used. No special kits are required.



110

1. Describe the main features in the formation of each part of a protein's structure:
   (a) Primary structure: _____
   (b) Secondary structure: _____
   (c) Tertiary structure: _____
   (d) Quaternary structure: _____
2. How are proteins built up into a functional structure? _____
3. Str… …nds in proteins. What would this do to the

…tigation 3.3 Modelling protein structure

…equipment list.

…r this activity.

…d pipe cleaners with four colours. We have used 2 white, 2 pink, 2 purple, and 4 blue but you can … the colours you have. Each colour represents a different amino acid.

… in the centre of each pipe cleaner (Figure 1). The twist represents the amino acid's functional …

…no acids together (figure 2) by twisting their arms together in the following sequence: …ink 3) blue 4) purple 5) blue 6) pink 7) blue 8) white 9) blue 10) purple.

…f protein organisation does the structure in Figure 2 represent?

…y tape to the loops of the purple pipe cleaners and to one arm of each of the blue pipe cleaners. …sent places where hydrogen bonding can occur.

Figure 2

A-2

…Separating Amino Acids by Chromatography

Key Idea: Amino acids can be separated and identified using chromatography.

There are twenty essential amino acids used by the body to make proteins. Because each amino acid has a different chemical size and shape, they can be separated using thin layer chromatography. In thin layer chromatography, the mobile phase is the solvent which will separate the molecules. The stationary phase is a thin layer of adsorbent material (e.g. silica gel or cellulose) attached to a solid plate. A sample is placed near the bottom of the plate which is placed in an appropriate solvent (the mobile phase).

Investigation 3.2 Separating amino acids

See appendix for equipment list.

Do not handle the chromatography to avoid contaminating it. Solvents and ninhydrine solution should be used in a fume hood. You should wear protective eyewear and gloves.

1. Wear safety gloves and goggles during this investigation.
2. Cut a piece of filter paper or chromatography paper into a strip 5–6 cm wide. It should be long enough to reach … position. …arting …% amino … first …d so on. Place the unknown solution on the fourth dot. Record which amino acid was placed on which dot.
5. In a fume hood, pour the solvent solution into a beaker to a depth of just over 1 cm. Set up the chromatography paper as in the diagram on the right.
6. Cover the solution with parafilm or clingwrap and leave for up to an hour or until the solvent front is about 1 cm from the top of the chromatography paper.
7. In a fume hood, remove the paper and mark the solvent front with a pencil. Dry with a hair dryer. Pour the solvent into the waste container provided by your teacher.
8. In a fume hood, spray the chromatography paper with ninhydrin solution and dry with a hair dryer on heat for about 5 minutes. The spots of amino acid should become visible. Alternatively, the positions of the amino acids can be viewed with a black light.
9. Identify the unknown amino acid. Measure the distance from the start position to each amino acid and record. Measure the distance from the start position to the solvent front and record.

Chromatography set up

1. What was the unknown amino acid?
2. Use the formula below to calculate the R_f values for the amino acids you used. Each amino acid has its own Rf value. Rf values can be used to identify unknowns in reaction solutions.

$$R_f = \frac{\text{Distance travelled by spot (from start position)}}{\text{Distance travelled by solvent (from start position)}}$$

A-2

This icon indicates group work.

Each investigation is clearly numbered (sequentially through the chapter).

Hazards, where applicable, are clearly identified on the investigation.

The investigations have been designed using everyday materials and equipment easily found in most high school laboratories. **No special kits are required.**

158 Testing Food for Microbes

Key Idea: Testing food for the presence of dangerous microbes ensures the food we consume is safe.

Food poisoning (foodborne poisoning) occurs when a person consumes food or water contaminated with a pathogen and becomes sick. Food poisoning is quite common, affecting 4.1 million Australians each year. Sometimes the illness is so severe a person needs to be hospitalised, and every year 80 people die from food poisoning. In Australia, food and beverages must meet strict testing guidelines to make sure the food is safe from microbial contamination. However, contamination can still occur. Sometimes this is the result of poor manufacturing, transport, or storage processes from the manufacturer or supplier, but most often it occurs due to poor food handling techniques at home. In this activity you will design and carry out a practical investigation to test for microbial contamination in food.

Sometimes it is easy to tell when food has been contaminated and shouldn't be eaten, like the spoiled jam, above left. However, most of the time microbial contamination is not so obvious, and people eat contaminated food and become sick. High risk foods include chicken, seafood, rice, eggs, deli meats, and dairy products.

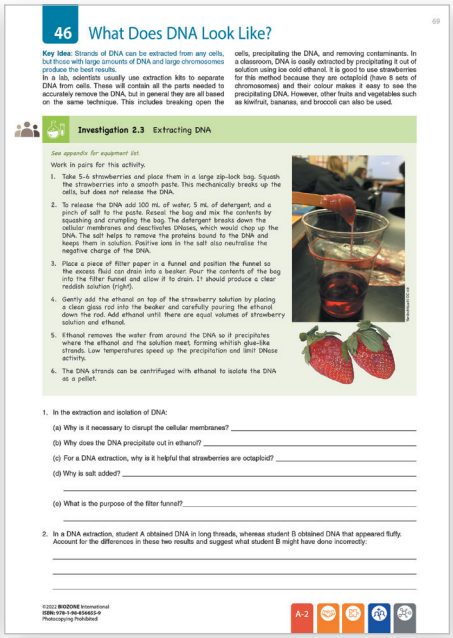
Investigation 9.1 Investigating microbial contamination in food samples

See appendix for equipment list.

Treat all samples and equipment as though they contain pathogenic microorganisms. Wear protective eyewear and gloves. Wash surfaces and your hands thoroughly.

Design and carry out a practical investigation to determine the level of microbial contamination present in food samples. You may work in pairs or groups.

1. Decide what food you want to test (e.g. milk, meat, yoghurt etc).
2. Decide if you want to test the food simply for microbial contamination or do you want to do a comparative study. Comparative studies could include comparing microbial content of:
   - Refrigerated food or food left at room temperature
   - Cooked versus uncooked food
   - Food handled with unwashed hands vs washed hands
3. Design your own investigation using the following equipment list: food sample, agar plates, inoculation loops, Bunsen burner, sterilising alcohol, test tubes, glass rods, distilled water, tape, marker pens, incubator (if available). You may want to carry out some research to help you design your investigation. At the end of the investigation you should be able to count the number of fungal and bacterial colonies to determine the level of contamination. NOTE: It is important to exclude any environmental microbial contamination (e.g. from the air or your hands) when you carry out your investigation. Some information on aseptic technique is provided at the top of the next page.
4. Use the space below to plan your investigation. Use extra paper and staple it to this page if you need to.
5. Once you have completed your investigation, answer the questions on the following page.



46 What Does DNA Look Like?

Key Idea: Strands of DNA can be extracted from any cells, but those with large amounts of DNA and large chromosomes produce the best results.

In a lab, scientists usually use extraction kits to separate DNA from cells. These will contain all the parts needed to accurately remove the DNA, but in general they are all based on the same technique. This includes breaking open the cells, precipitating the DNA, and removing contaminants. In a classroom, DNA is easily extracted by precipitating it out of solution using ice cold ethanol. It is good to use strawberries for this method because they are octaploid (have 8 sets of chromosomes) and their colour makes it easy to see the precipitating DNA. However, other fruits and vegetables such as kiwifruit, bananas, and broccoli can also be used.

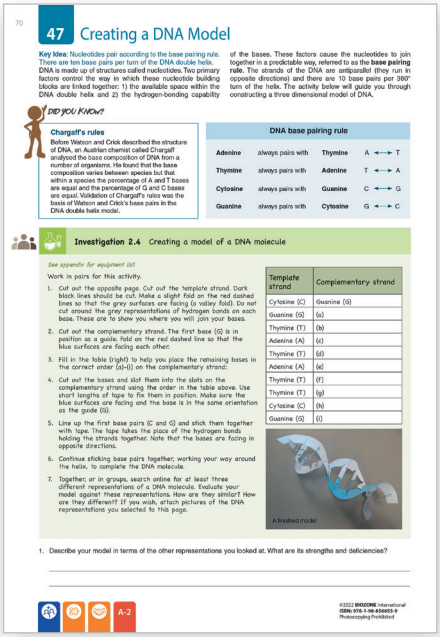
Investigation 2.3 Extracting DNA

See appendix for equipment list.

Work in pairs for this activity.

1. Take 5–6 strawberries and place them in a large zip-lock bag. Squash the strawberries into a smooth paste. This mechanically breaks up the cells, but does not release the DNA.
2. To release the DNA add 100 mL of water, 5 mL of detergent, and a pinch of salt to the paste. Reseal the bag and mix the contents by squashing and crumpling the bag. The detergent breaks down the cellular membranes and deactivates DNases, which would chop up the DNA. The salt helps to remove the proteins bound to the DNA and keeps them in solution. Positive ions in the salt also neutralise the negative charge of the DNA.
3. Place a piece of filter paper in a funnel and position the funnel so the excess fluid can drain into a beaker. Pour the contents of the bag into the filter funnel and allow it to drain. It should produce a clear reddish solution (right).
4. Gently add the ethanol on top of the strawberry solution by placing a clean glass rod into the beaker and carefully pouring the ethanol down the rod. Add ethanol until there are equal volumes of strawberry solution and ethanol.
5. Ethanol removes the water from around the DNA so it precipitates where the ethanol and the solution meet, forming whitish glue-like strands. Low temperatures speed up the precipitation and limit DNase activity.
6. The DNA strands can be centrifuged with ethanol to isolate the DNA as a pellet.

1. In the extraction and isolation of DNA:
   (a) Why is it necessary to disrupt the cellular membranes? _____
   (b) Why does the DNA precipitate out in ethanol? _____
   (c) For a DNA extraction, why is it helpful that strawberries are octaploid? _____
   (d) Why is salt added? _____
   (e) What is the purpose of the filter funnel? _____
2. In a DNA extraction, student A obtained DNA in long threads, whereas student B obtained DNA that appeared fluffy. Account for the differences in these two results and suggest what student B might have done incorrectly: _____



47 Creating a DNA Model

Key Idea: Nucleotides pair according to the base pairing rule. There are ten base pairs per turn of the DNA double helix. DNA is made up of structures called nucleotides. Two primary factors control the way in which these nucleotide building blocks are linked together: 1) the available space within the DNA double helix and 2) the hydrogen-bonding capability of the bases. These factors cause the nucleotides to join together in a predictable way, referred to as the **base pairing rule**. The strands of the DNA are antiparallel (they run in opposite directions) and there are 10 base pairs per 360° turn of the helix. The activity below will guide you through constructing a three dimensional model of DNA.

DID YOU KNOW?

Chargaff's rules

Before Watson and Crick described the structure of DNA, an Austrian chemist called Chargaff analysed the base composition of DNA from a number of organisms. He found that the base composition varies between species but that within a species the percentage of A and T bases are equal and the percentage of G and C bases are equal. Validation of Chargaff's rules was the basis of Watson and Crick's base pairs in the DNA double helix model.

DNA base pairing rule			
Adenine	always pairs with	Thymine	A ⟷ T
Thymine	always pairs with	Adenine	T ⟷ A
Cytosine	always pairs with	Guanine	C ⟷ G
Guanine	always pairs with	Cytosine	G ⟷ C

Investigation 2.4 Creating a model of a DNA molecule

See appendix for equipment list.

Work in pairs for this activity.

1. Cut out the opposite page. Cut out the template strand. Dark black lines should be cut. Make a slight fold on the red dashed lines so that the grey surfaces are facing (a valley fold). Do not cut around the grey representations of hydrogen bonds on each base. These are to show you where you will join your bases.
2. Cut out the complementary strand. The first base (G) is in position as a guide. Fold on the red dashed line so that the blue surfaces are facing each other.
3. Fill in the table (right) to help you place the remaining bases in the correct order (a)–(i) on the complementary strand.
4. Cut out the bases and slot them into the slots on the complementary strand using the order in the table above. Use short lengths of tape to fix them in position. Make sure the blue surfaces are facing and the base is in the same orientation as the guide (G).
5. Line up the first base pairs (C and G) and stick them together with tape. The tape takes the place of the hydrogen bonds holding the strands together. Note that the bases are facing in opposite directions.
6. Continue sticking base pairs together, working your way around the helix, to complete the DNA molecule.
7. Together, or in groups, search online for at least three different representations of a DNA molecule. Evaluate your model against these representations. How are they similar? How are they different? If you wish, attach pictures of the DNA representations you selected to this page.

Template strand	Complementary strand
Cytosine (C)	Guanine (G)
Guanine (G)	(a)
Thymine (T)	(b)
Adenine (A)	(c)
Thymine (T)	(d)
Adenine (A)	(e)
Thymine (T)	(f)
Thymine (T)	(g)
Cytosine (C)	(h)
Guanine (G)	(i)

A finished model

1. Describe your model in terms of the other representations you looked at. What are its strengths and deficiencies?

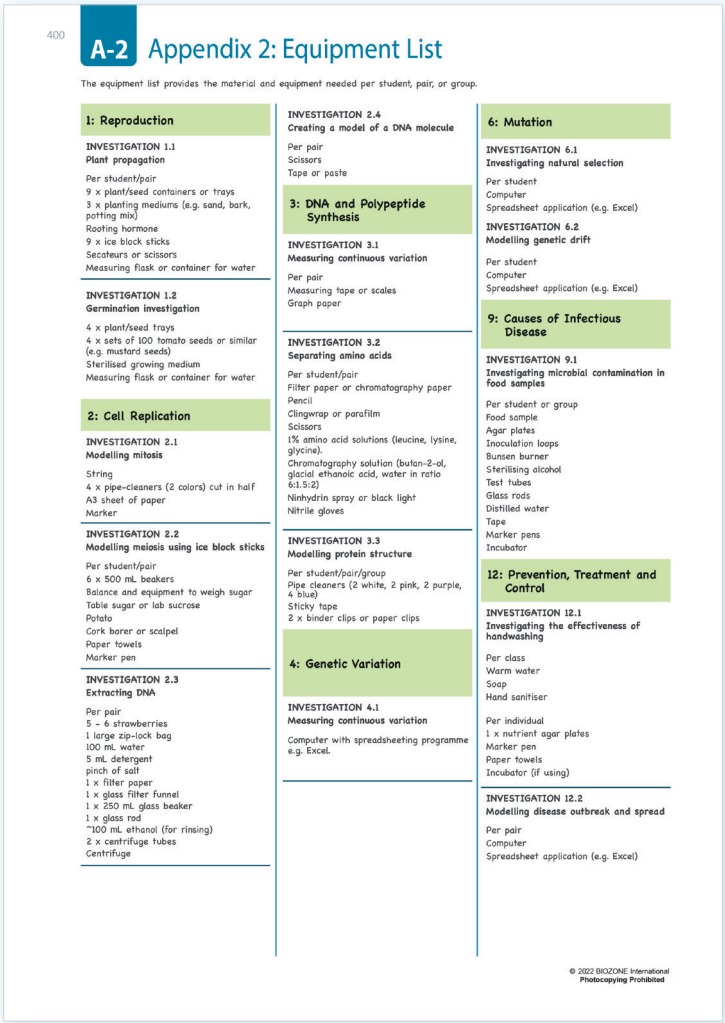
Some 'practical' activities give students a place to develop their skills in planning and designing an experiment. They then carry out the investigation they have designed.

Almost all investigations require students to use a number of science skills. They encourage collaboration, problem solving and attention to detail, as well as analysis and evaluation of data.

Practical investigations may involve setting up and carrying out an experiment, or could involve a paper practical (above) or modelling activity.

Equipment lists

- Equipment lists for each investigation are provided in Appendix 2 at the back of the book.
- Use these lists to plan and prepare the required equipment for each practical investigation.
- The investigations use materials commonly found in most high school laboratories and classrooms.



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A-2 Appendix 2: Equipment List

The equipment list provides the material and equipment needed per student, pair, or group.

1: Reproduction

INVESTIGATION 1.1
Plant propagation
Per student/pair
9 x plant/seed containers or trays
3 x planting mediums (e.g. sand, bark, potting mix)
Rooting hormone
9 x ice block sticks
Secateurs or scissors
Measuring flask or container for water

INVESTIGATION 1.2
Germination investigation
4 x plant/seed trays
4 x sets of 100 tomato seeds or similar (e.g. mustard seeds)
Sterilised growing medium
Measuring flask or container for water

2: Cell Replication

INVESTIGATION 2.1
Modelling mitosis
String
4 x pipe-cleaners (2 colors) cut in half
A3 sheet of paper
Marker

INVESTIGATION 2.2
Modelling meiosis using ice block sticks
Per student/pair
6 x 500 mL beakers
Balance and equipment to weigh sugar
Table sugar or lab sucrose
Potato
Cork borer or scalpel
Paper towels
Marker pen

INVESTIGATION 2.3
Extracting DNA
Per pair
5 – 6 strawberries
1 large zip-lock bag
100 mL water
5 mL detergent
pinch of salt
1 x filter paper
1 x glass filter funnel
1 x 250 mL glass beaker
1 x glass rod
~100 mL ethanol (for rinsing)
2 x centrifuge tubes
Centrifuge

INVESTIGATION 2.4
Creating a model of a DNA molecule
Per pair
Scissors
Tape or paste

3: DNA and Polypeptide Synthesis

INVESTIGATION 3.1
Measuring continuous variation
Per pair
Measuring tape or scales
Graph paper

INVESTIGATION 3.2
Separating amino acids
Per student/pair
Filter paper or chromatography paper
Pencil
Clingwrap or parafilm
Scissors
1% amino acid solutions (leucine, lysine, glycine).
Chromatography solution (butan-2-ol, glacial ethanoic acid, water in ratio 6:1.5:2)
Ninhydrin spray or black light
Nitrile gloves

INVESTIGATION 3.3
Modelling protein structure
Per student/pair/group
Pipe cleaners (2 white, 2 pink, 2 purple, 4 blue)
Sticky tape
2 x binder clips or paper clips

4: Genetic Variation

INVESTIGATION 4.1
Measuring continuous variation
Computer with spreadsheeting programme e.g. Excel.

6: Mutation

INVESTIGATION 6.1
Investigating natural selection
Per student
Computer
Spreadsheet application (e.g. Excel)

INVESTIGATION 6.2
Modelling genetic drift
Per student
Computer
Spreadsheet application (e.g. Excel)

9: Causes of Infectious Disease

INVESTIGATION 9.1
Investigating microbial contamination in food samples
Per student or group
Food sample
Agar plates
Inoculation loops
Bunsen burner
Sterilising alcohol
Test tubes
Glass rods
Distilled water
Tape
Marker pens
Incubator

12: Prevention, Treatment and Control

INVESTIGATION 12.1
Investigating the effectiveness of handwashing
Per class
Warm water
Soap
Hand sanitiser
Per individual
1 x nutrient agar plates
Marker pen
Paper towels
Incubator (if using)

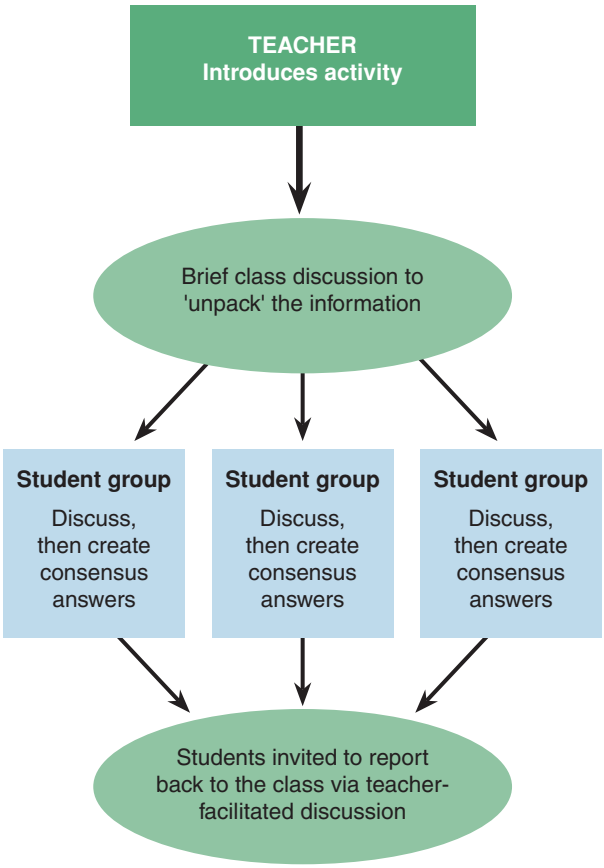
INVESTIGATION 12.2
Modelling disease outbreak and spread
Per pair
Computer
Spreadsheet application (e.g. Excel)

Teaching Strategies for Classroom Use

Achieving effective differentiated instruction in classes is a teaching challenge. Students naturally have mixed abilities, varying backgrounds in the subject, and different language skills. Used effectively, BIOZONE's student books and supporting resources can make teaching a mixed ability class easier. Here, we suggest some approaches for differentiated instruction.

MAKING A START

Regardless of which activity you might be attempting in class, a short introduction to the task by the teacher is a useful orientation for all students. For collaborative work, the teacher can then divide the class into appropriate groups, each with a balance of able and less able students. Depending on the activity, the class may regroup at the end of the lesson for discussion.



Using collaboration to maximise learning outcomes

- The structure of *HSC Biology Modules 5-8* allows for a flexible approach to unpacking the content with your students.
- The content can be delivered in a way to support collaboration, where students work in small groups to share ideas and information to answer and gain a better understanding of a topic, or design a solution to a problem.
- By working together to ask questions and evaluate each other's ideas, students maximise their own and each other's learning opportunities. They are exposed to ideas and perspectives they may not have come up with on their own.
- Collaborating, listening to others, and voicing their own ideas is valuable for supporting English language learners and developing their English and scientific vocabularies.
- Use a short, informal collaborative learning session to get students to exchange ideas about the answer to a question. Alternatively, collaboration may take a more formal role that lasts for a longer period of time, e.g. assign groups to work together for a practical activity, to research an extension question, or design a solution to a problem.

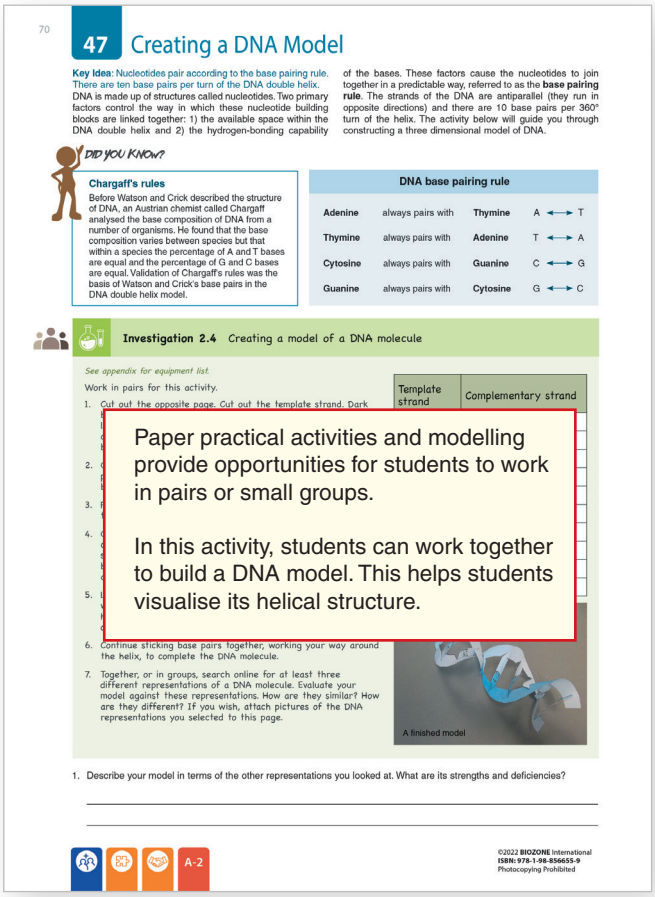
The teacher introduces the topic. They provide structure to the session by providing background information and setting up discussion points and clear objectives. Collaboration is emphasised to encourage participation from the entire group. If necessary, students in a group can be assigned specific tasks.

Students work in small groups so that everyone's contribution is heard. They collaborate, share ideas, and engage in discourse. The emphasis is on discussing questions and formulating a consensus answer, not just sharing ideas.

At the end of the session, students report back on their findings. Each student should have enough knowledge to report back on the group's findings. Reporting consists primarily of providing answers to questions, but may involve presenting a report, model, or slide show, or contributing to a debate.

Peer to peer support

- **Peer-to-peer learning** is emphasised throughout the book, and is particularly valuable for more challenging activities in which the content is more complex, or the questions require students to draw on several areas of their knowledge to solve a problem.
- **Practical activities, investigations** and **group research projects** are an ideal vehicle for peer-to-peer learning. Students can work together to review and discuss their results, ask and answer questions, and describe phenomena.



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47 Creating a DNA Model

Key Idea: Nucleotides pair according to the base pairing rule. There are ten base pairs per turn of the DNA double helix.

DNA is made up of structures called nucleotides. Two primary factors control the way in which these nucleotide building blocks are linked together: 1) the available space within the DNA double helix and 2) the hydrogen-bonding capability of the bases. These factors cause the nucleotides to join together in a predictable way, referred to as the **base pairing rule**. The strands of the DNA are antiparallel (they run in opposite directions) and there are 10 base pairs per 360° turn of the helix. The activity below will guide you through constructing a three dimensional model of DNA.

DID YOU KNOW?

Chargaff's rules

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DNA base pairing rule

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Thymine	always pairs with	Adenine	T ⟷ A
Cytosine	always pairs with	Guanine	C ⟷ G
Guanine	always pairs with	Cytosine	G ⟷ C

Investigation 2.4 Creating a model of a DNA molecule

See appendix for equipment list.

Work in pairs for this activity.

1. Cut out the opposite page. Cut out the template strand. Dark

Template strand | Complementary strand

6. Continue sticking base pairs together, working your way around the helix, to complete the DNA molecule.
7. Together, or in groups, search online for at least three different representations of a DNA molecule. Evaluate your model against these representations. How are they similar? How are they different? If you wish, attach pictures of the DNA representations you selected to this page.

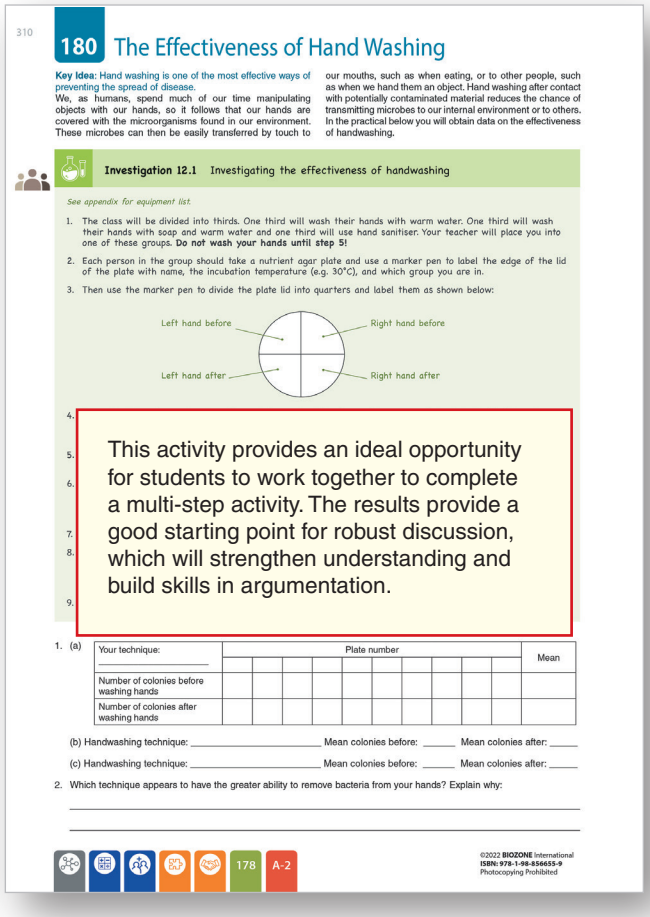
A finished model

1. Describe your model in terms of the other representations you looked at. What are its strengths and deficiencies?

A-2

Paper practical activities and modelling provide opportunities for students to work in pairs or small groups.

In this activity, students can work together to build a DNA model. This helps students visualise its helical structure.



310

180 The Effectiveness of Hand Washing

Key Idea: Hand washing is one of the most effective ways of preventing the spread of disease.

We, as humans, spend much of our time manipulating objects with our hands, so it follows that our hands are covered with the microorganisms found in our environment. These microbes can then be easily transferred by touch to our mouths, such as when eating, or to other people, such as when we hand them an object. Hand washing after contact with potentially contaminated material reduces the chance of transmitting microbes to our internal environment or to others. In the practical below you will obtain data on the effectiveness of handwashing.

Investigation 12.1 Investigating the effectiveness of handwashing

See appendix for equipment list.

1. The class will be divided into thirds. One third will wash their hands with warm water. One third will wash their hands with soap and warm water and one third will use hand sanitiser. Your teacher will place you into one of these groups. **Do not wash your hands until step 5!**
2. Each person in the group should take a nutrient agar plate and use a marker pen to label the edge of the lid of the plate with name, the incubation temperature (e.g. 30°C), and which group you are in.
3. Then use the marker pen to divide the plate lid into quarters and label them as shown below:

Left hand before | Right hand before | Left hand after | Right hand after

4.
5.
6.
7.
8.
9.

1. (a)

Your technique:	Plate number										Mean
Number of colonies before washing hands											
Number of colonies after washing hands											

(b) Handwashing technique: _____ Mean colonies before: _____ Mean colonies after: _____

(c) Handwashing technique: _____ Mean colonies before: _____ Mean colonies after: _____

2. Which technique appears to have the greater ability to remove bacteria from your hands? Explain why:

178 A-2

This activity provides an ideal opportunity for students to work together to complete a multi-step activity. The results provide a good starting point for robust discussion, which will strengthen understanding and build skills in argumentation.

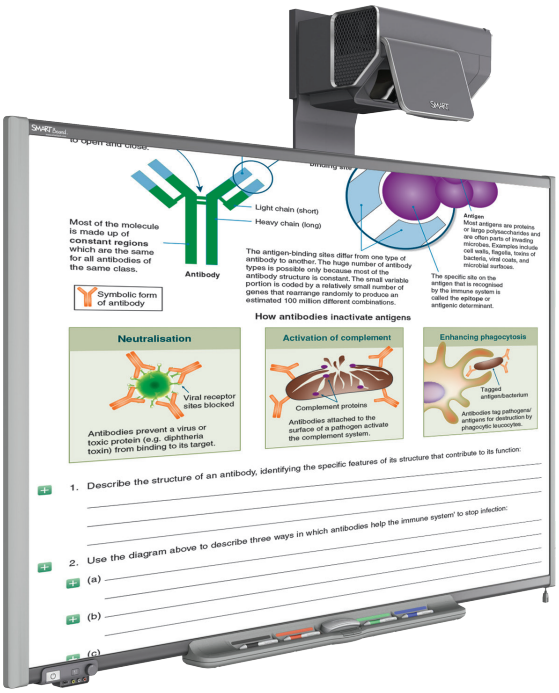
Collaboration and discovery

- BIOZONE's *HSC Biology Modules 5-8* allows for collaboration and discovery. By working together and sharing ideas, students are exposed to different perspectives and levels of knowledge about biological concepts.
- BIOZONE's *HSC Biology Modules 5-8* builds student understanding by providing a range of activities. These include getting students to think about and share what they already know and then build on this knowledge by exploring and explaining phenomena.

Student A is capable. He helps to lead the discussion and records the discussion in a structured way.

Students B and C are also capable but less willing to lead discussion. They will add ideas to the discussion but need a little direction from A to do so.

Student D is less able but gains ideas and understanding from the discussion of students A, B, and C. She may add to the discussion as she gains confidence in the material being studied.



Interactive revision of tasks in class

- The **Digital Teacher's Edition** provides a digital rights managed (DRM) version of the student book as PDF files. It features useful HIDE/SHOW answers, which can be used to review activities in class using a data projector or interactive whiteboard (left).
- Students benefit from the feedback in class, where questions can be addressed, and teachers benefit by having students self-mark their work and receive helpful feedback on their responses.
- This approach is particularly suited to activities with questions requiring a discussion, as students will be able to clarify some aspects of their responses. Stronger students can benefit by contributing to the explanatory feedback and class discussion.

Support for the Depth Study

The depth study is an important and exciting component of the HSC syllabus for students, allowing them to explore in detail a topic which interests them. However, it can also be overwhelming for them as they decide (with your guidance) which topic area to study and how best to carry out their investigation. While teacher input is very important to ensure students choose a suitable topic which meets all of the assessment requirements, we have provided resources to help students plan and carry out their depth study with confidence.

Chapter 18 is dedicated to helping students with their depth study. The material has been designed to get students thinking about their study and what exactly they will need to do to be successful. Topics include:

Choosing a depth study

- What types of studies, projects, or investigations can be used for a depth study?
- What type of study is most appropriate for the topic the student wants to study?
- What are the differences between a primary practical investigation and a secondary-sourced investigation?

Critical evaluation of source material

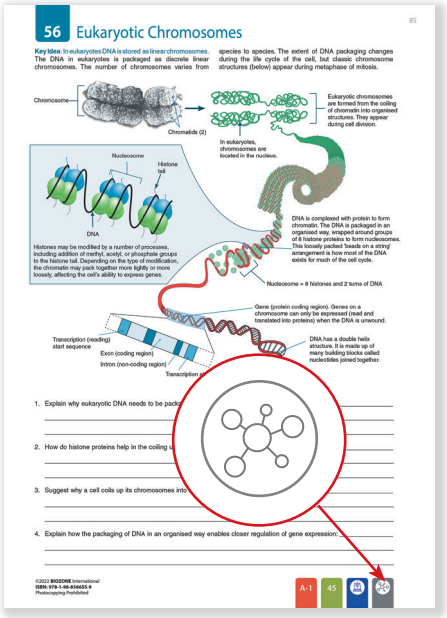
- What types of source material are available?
- Why are some sources of information more trustworthy than others?
- What is the difference between anecdotal evidence and scientific evidence?

Presenting the findings

- What is the best way to communicate and share the findings of a depth study?
- What structure should be used and when, to deliver the findings?
- How should online resources be referenced?

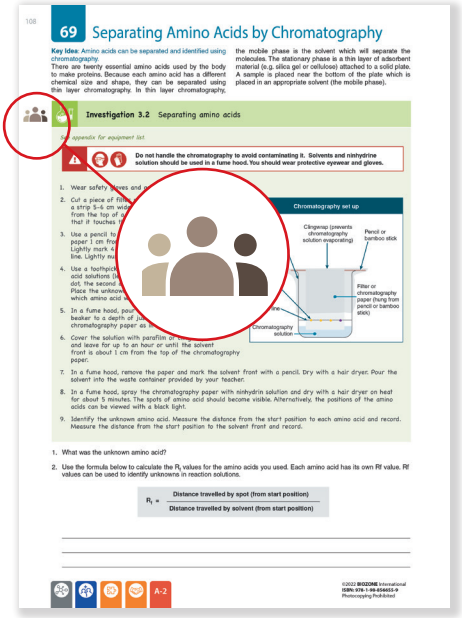
Differentiated Learning

Tools for differentiated instruction within *HSC Biology Modules 5-8* help teachers to support students at all skill levels. BIOZONE's collaborative approach to science inquiry encourages students to share their ideas and knowledge with their peers while reinforcing their own understanding. There are several ways to use *HSC Biology Modules 5-8* in a differentiated classroom:

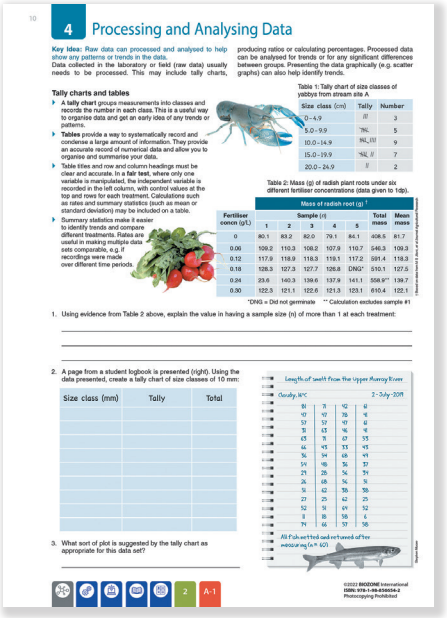


BIOZONE's Resource Hub provides curated content to support the activities in the book. Videos, animations, simulations, and 3D models support students of all abilities, while some resources, including interactive spreadsheets, fact sheets, and reference papers, may be used as part of group work or extension.

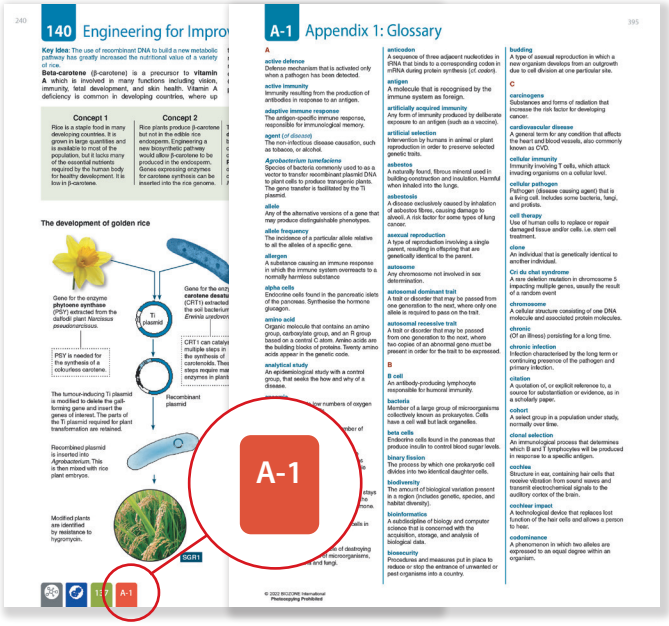
A grey hub tab at the bottom of the page indicates the activity has online support.



A group symbol indicates where students can work together. Group work provides opportunities for student collaboration and peer-to-peer support to explore the principles and concepts they are engaged with in their course. Working in groups, students can experience the benefits of collaboration in the scientific process of discovery. By speaking and listening, they develop and extend their communication skills and scientific vocabulary.



Students requiring extra support in using the working scientifically skills should be encouraged to refer to the *Working Scientifically* chapter in HSC modules 1-4 as often as they need to. Building familiarity with these skills will enable students to apply them confidently within the context of the activities.



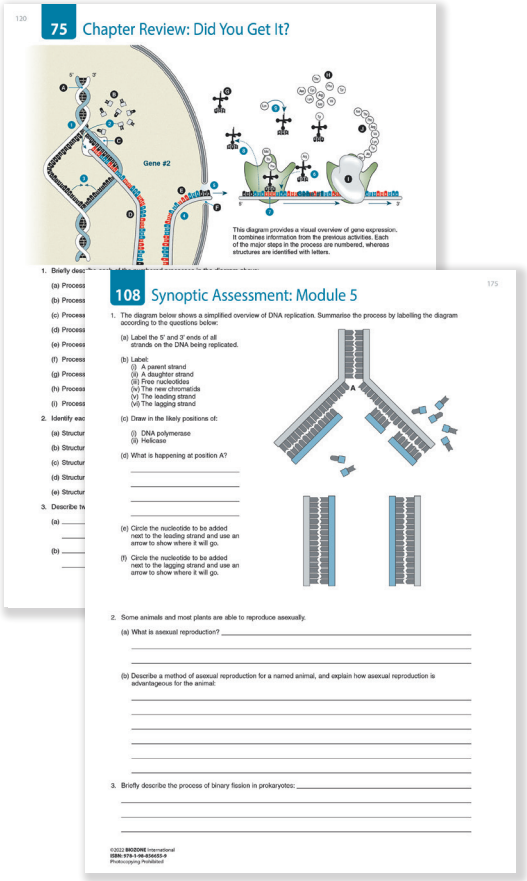
The list of key terms in the chapter introduction provides students with a list of scientific terms they should be familiar with. Encourage students to refer to the glossary (Appendix 1) when they are unsure about the meaning of a scientific term that is unfamiliar to them. A glossary tab at the bottom of a page indicates where a term within the activity has been defined. These strategies build scientific literacy and encourage students to use scientific terms with confidence.

Formative and Summative Assessments

BIOZONE's *HSC Biology Modules 5-8* provides many opportunities to assess your students' progress as they work through the course. The *Contents* check-box list provides a list of activities completed, and the students' own self-tests in the review activities at the end of each chapter provide opportunity to address any misconceptions or lack of understanding. A summary of formative and summative assessments is provided in the tables below. You may also choose to assess practical work as you move through the course.

Module 5: Heredity				
CHAPTER 1 Reproduction	CHAPTER 2 Cell Replication	CHAPTER 3 DNA and Polypeptide Synthesis	CHAPTER 4 Genetic Variation	CHAPTER 5 Inheritance Patterns in a Population
FORMATIVE Activity 35. Chapter Review	FORMATIVE Activity 52. Chapter Review	FORMATIVE Activity 75. Chapter Review	FORMATIVE Activity 95. Chapter Review	FORMATIVE Activity 107. Chapter Review SUMMATIVE Activity 108. Synoptic Assessment

Module 6: Genetic Change		
CHAPTER 6 Mutation	CHAPTER 7 Biotechnology	CHAPTER 8 Genetic Techniques
FORMATIVE Activity 124 Chapter Review	FORMATIVE Activity 130 Chapter Review	FORMATIVE Activity 145 Chapter Review SUMMATIVE Activity 146 Synoptic Assessment

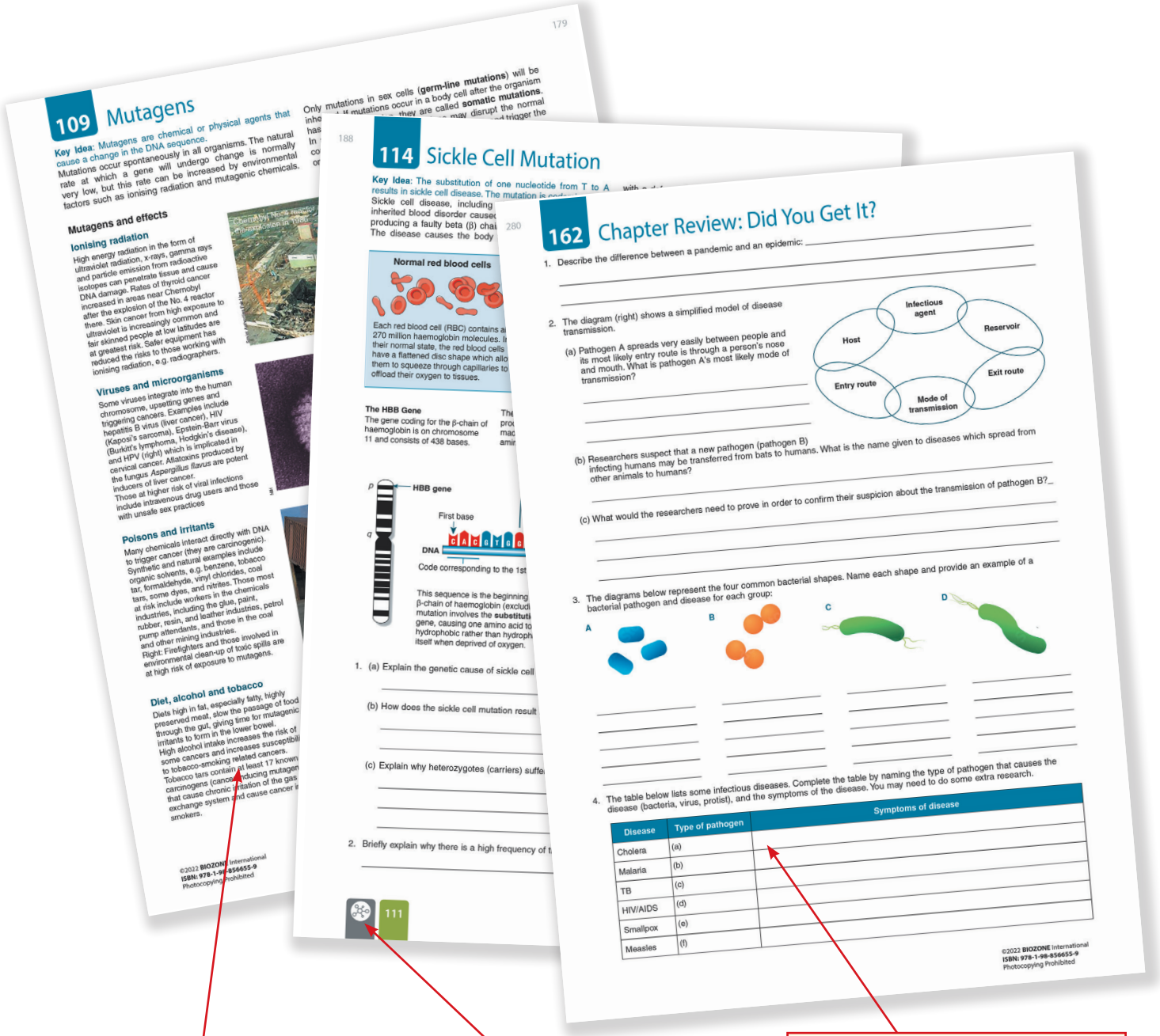


Module 7: Infectious Disease			
CHAPTER 9 Causes of Infectious Disease	CHAPTER 10 Responses to Pathogens	CHAPTER 11 Immunity	CHAPTER 12 Prevention, Treatment, and Control
FORMATIVE Activity 162 Chapter Review	FORMATIVE Activity 167 Chapter Review	FORMATIVE Activity 177 Chapter Review	FORMATIVE Activity 190 Chapter Review SUMMATIVE Activity 191 Synoptic Assessment

Module 8: Non-infectious Disease and Disorders					
CHAPTER 13 Homeostasis	CHAPTER 14 Cause and Response	CHAPTER 15 Epidemiology	CHAPTER 16 Prevention	CHAPTER 17 Technology and Disorders	CHAPTER 18 Depth Studies: Guidance and Ideas
FORMATIVE Activity 201 Chapter Review	FORMATIVE Activity 205 Chapter Review	FORMATIVE Activity 210 Chapter Review	FORMATIVE Activity 212 Chapter Review	FORMATIVE Activity 218 Chapter Review SUMMATIVE Activity 219 Synoptic Assessment	Assessed by teacher

Choosing Activities for Home Study

Many of the book's activities are ideal for homework or as vehicles for a quick formative assessment. End of chapter review activities are ideal as homework. They provide a way to review a topic that has recently been completed, while at the same time facilitating consolidation by presenting the material in a slightly different way. The information for review activities can be found within the chapter, although stronger students may not need to refer back to source material to complete the set work. Generally, homework activities should revise completed topics or provide a basic, entry-level introduction.



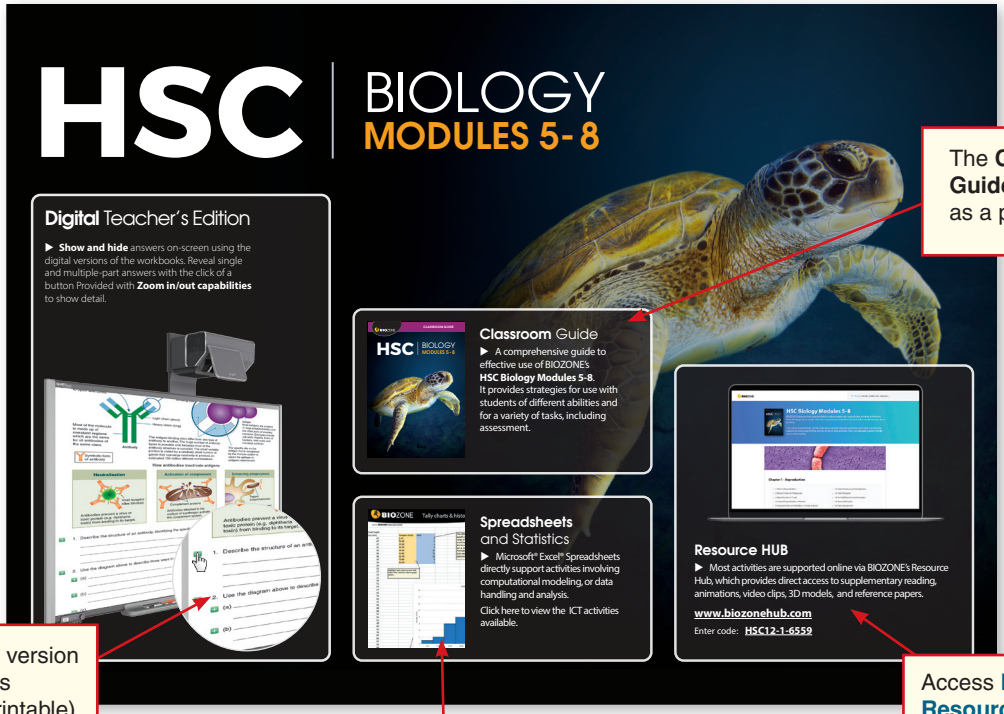
Introductory activities can be useful to set the scene for a chapter. In this activity, students are introduced to the main categories of mutagens. As they progress through the chapter, students explore how mutagens can cause mutations, and analyse specific examples.

Most students will have access to the internet. Sometimes, a homework activity might involve the student reviewing the resources on **BIOZONE's Resource Hub** for the next day's activity.

Review activities are ideal as homework because they involve a self-test of the student's own understanding of completed work. In this activity, students apply their understanding of sources of infectious disease to answer the questions. Such activities allow the teacher to address any misconceptions before formal assessment.

The Digital Teacher's Edition

The *Digital Teacher's Edition* is a DRM product, sold separately, and aimed primarily at extending the pedagogical tools at a teacher's disposal. Many of the features of this resource have been developed in response to requests from teachers.

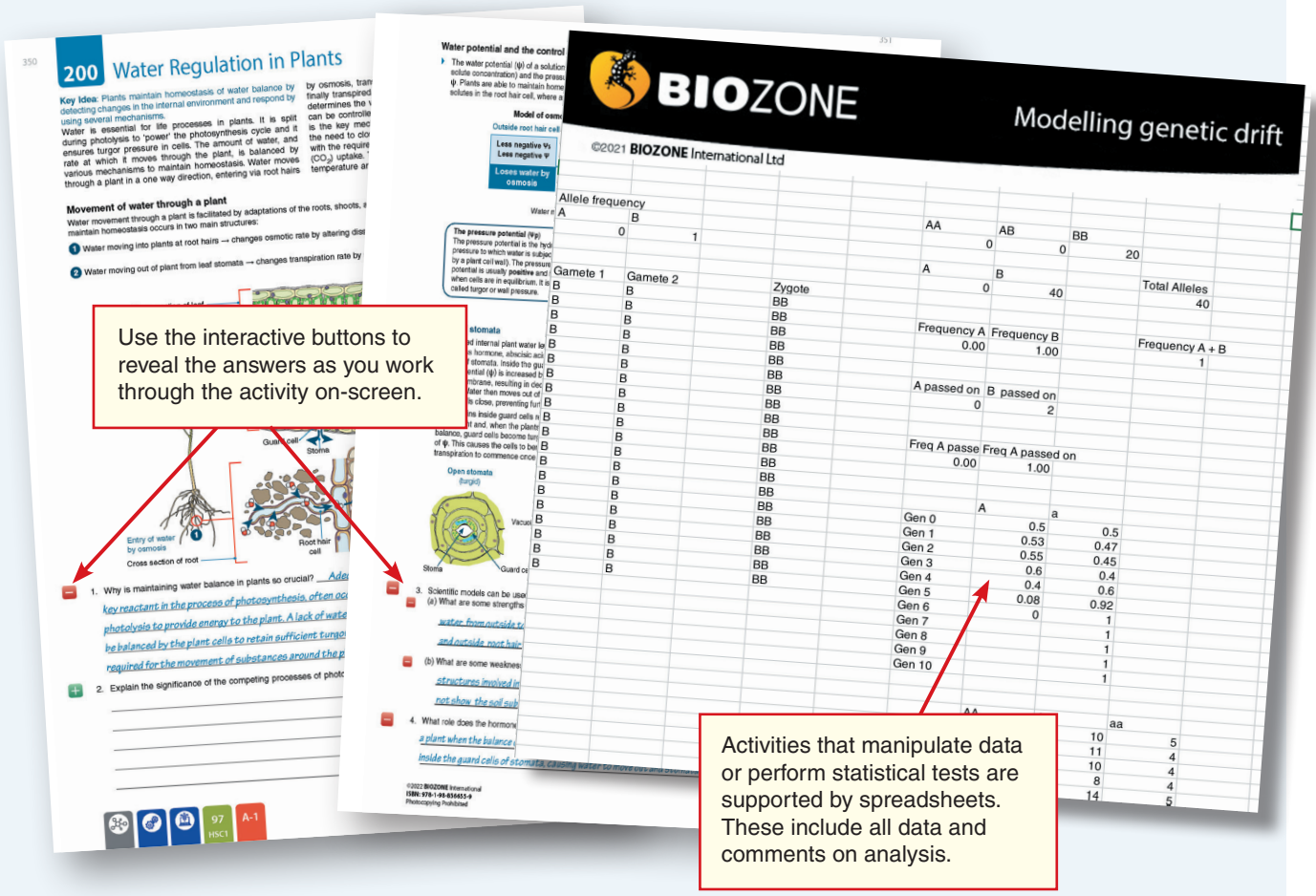


The **Classroom Guide** is provided as a printable PDF.

A digital (PDF) version of the Teacher's Edition (non-printable) is provided. Use the interactive buttons to HIDE or SHOW the answers.

Link to ***Excel*® spreadsheets** for selected activities with a data analysis or computer modelling component.

Access **BIOZONE's Resource Hub** directly from this link for a range of resources to support the activities.



Use the interactive buttons to reveal the answers as you work through the activity on-screen.

Activities that manipulate data or perform statistical tests are supported by spreadsheets. These include all data and comments on analysis.