BIOZONE

CLASSROOM GUIDE

HSC | BIOLOGY
MODULES 5 - 8

Contents

CLASSROOM GUIDE

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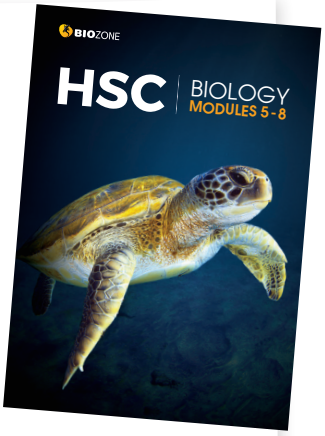
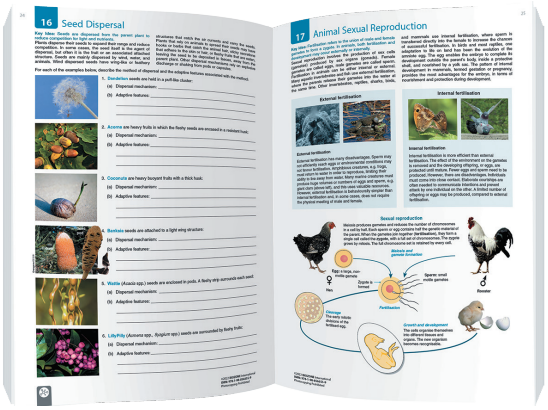
FAQs
ABOUT
HSC BIOLOGY
MODULES 5-8



BIOZONE's Pedagogy

A worktext approach

BIOZONE's delivery method is a departure from a traditional textbook. We combine the very best features of a textbook with the utility of a workbook, producing a worktext resource. Importantly, the worktext is owned by the student: it is their own resource to utilise. Whether they are using the print or digital version, students customise their worktext with notes and annotations, checking off their progress in the contents and chapter introductions, and input their answers on the pages as they work through the activities.



Using a highly graphical approach and short blocks of text, we deliver textbook quality information in an accessible and engaging way, ensuring students are not overwhelmed by large amounts of information. As students interact with the stimulus material and work through activities, they are encouraged to input their answers directly onto the page. This simple act reinforces the learning moment and forms a record of work as they progress through the material. Students find revision a breeze because the stimulus material, questions, and their answers are in one place.

We have included a wide range of activity types in this title. These include practical activities (experimental investigations, modelling, and simulations), research activities, and assessment tasks. The variety of activity types provides flexibility in the way teachers can assign them. For example, work can be assigned to be carried out as homework, completed in class, or set for revision. Teachers can assign students to work on activities individually or set work as a group. The activity based approach simplifies assigning work, and teachers can utilise this approach to set work for substitute teachers in their absence.

Not all answers need to be graded!

Within the activities, there are plenty of opportunities for students to record answers to the questions. This approach reinforces the learning moment, provides space for students to record their work, and acts as a revision tool when students are preparing for assessments. This approach does not mean that teachers are expected to review or grade all student responses. We suggest that only key activities or questions are graded. This might be assessment tasks a the end of each chapter or at the conclusion of a section. You may also choose to grade activities with content that students have traditionally found challenging, or where there is often a misunderstanding of the topic. Teachers can also choose to share answers with students. Sharing the model answers allows students to self report grades: an exercise known to be a powerful pedagogical learning tool (Hattie, 2009). Having access to model answers also allows students to refine their initial response if needed. This provides a powerful second learning moment to consolidate and extend understanding.
Teachers can utilise the show/hide model answer feature in the digital platform to share answers.

Features to accelerate student learning

Student learning can be influenced by many factors. A synthesis of more than 1,400 meta studies by Hattie (2009) involving over 80,000 individual studies and 300 million students has revealed some of the major influences to student learning. Some factors negatively influence student learning (red, right) while others have positive effects (yellow, green, and blue, right). BIOZONE's approach incorporates many of the factors shown to positively influence student learning, these are underlined in red on the diagram (right). By utilsing this resource, these factors are organically incorporated into content delivery and enhance the teacher and learner experience.

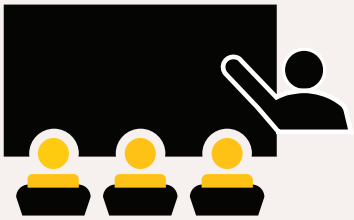
Hattie, J. (2009). Visible Learning. Routledge

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 BIOZONE WORLD 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

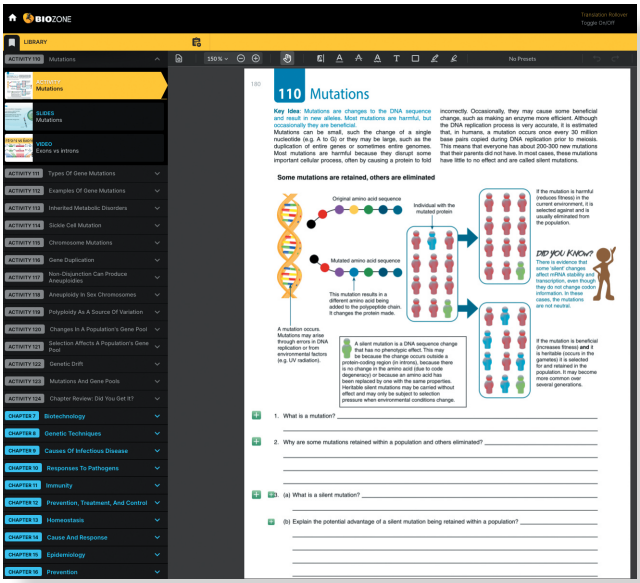
- Provide feedback (formative and summative) to students to update them on their progress. This can highlight areas of strength or areas needing work.
- Use formative assessment to identify areas the class needs to revisit before progressing to the next topic or unit. Methods of formative assessment 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.

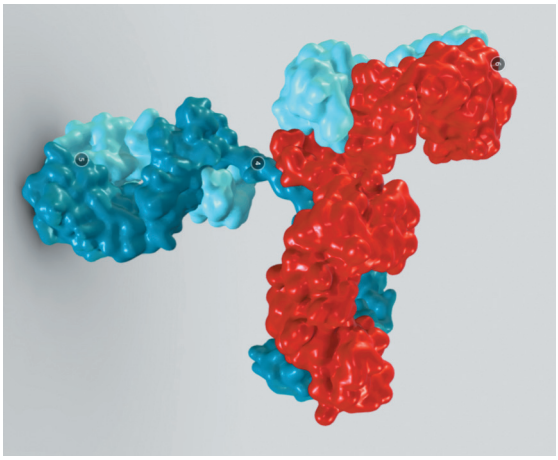
Teacher Support Materials: Teacher Toolkit

BIOZONE's HSC titles are supported by a suite of resources. These additional resources provide flexibility 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.

BIOZONE WORLD

- BIOZONE WORLD, our digital science platform, brings our digital worktexts and rich collection of digital resources together in a single location for easy use. Click on an activity to access the additional resources provided. These include: presentation slides, interactive 3D models, and curated videos and weblinks. Educators can easily plan lessons, assign work, and grade student responses using BIOZONE WORLD.
- Students' access to BIOZONE WORLD allows them to use tools to markup, highlight, and bookmark content. They can also answer questions online, and submit their work for review or grading. Students have access to the curated collection of digital resources (presentation slides, 3D models, and curated videos and weblinks).
- Teacher access to BIOZONE WORLD includes the features available to students plus teacher-only additional features, including:
    - The ability to view, grade, and give feedback on submitted student work.
    - Forced hand-in feature.
    - Ability to display the content on a shared screen (e.g. interactive whiteboard) to introduce or review an activity, or highlight areas of particular importance, e.g. an important step in a practical investigation.
    - Model answers in place. Show/hide buttons toggle answers on and off; ideal for sharing data or answers with students.
      Students do not have access to model answers on BIOZONE WORLD.
- Find out more: **biozone.com/us/biozone-world**

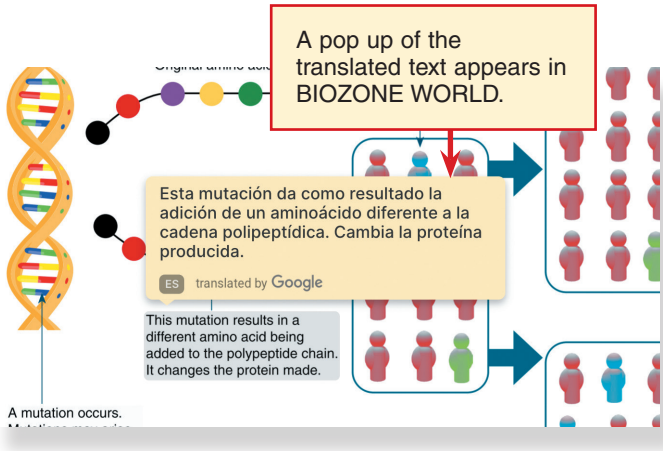




Translation function

BIOZONE WORLD, our digital platform, provides a translation feature to support to students who have English as a second language. The content can be translated into 150 languages.

Simply activate the translation feature, select the language for translation, and roll the cursor over the text to be translated. A pop up box of the translated text appears on the page. The English text is still visible. Having both languages visible supports students with their English language development while having the reassurance of their first language accessible.



RESOURCE HUB

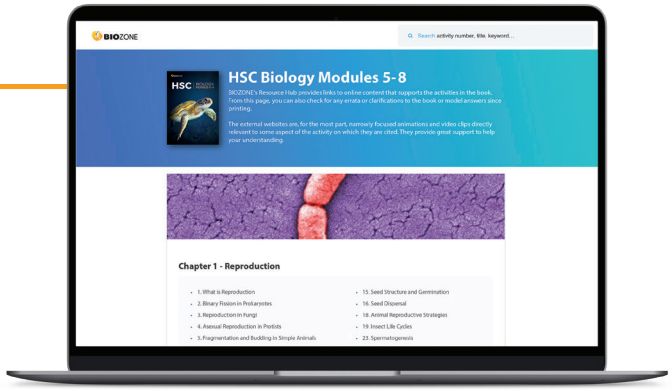
The BIOZONE **Resource Hub** is a **free resource**, available to both students and teachers. It offers a curated collection of Open Educational Resources (OER) specifically chosen to support the content of the worktext. Resources include videos, animations, games, 3D models, spreadsheets, and source material.

Content on the BIOZONE **Resource Hub** can be accessed by both print and digital users. **Print users** can access the material using the QR code in the worktext or bookmark the link provided (below right). For **BIOZONE WORLD users**, these same resources are ingested into the platform and automatically appear with the selected activity.

The BIOZONE **Resource Hub** is an effective tool to engage students of all abilities within a differentiated classroom. Most resources can be used by students of all abilities. 3D models, videos, games, and simulations are great tools for engaging students in a topic, or supporting striving students in their learning journey.

Some components have been tagged as extension material and can be used to extend more capable or gifted students. These types of resources may require more reading or synthesis of information. Our spreadsheet models can be used as is, or you can have students graph the information themselves. You may wish to challenge more capable students to build their own models, or manipulate the ones provided to observe the outcomes.

Some material is tagged as a teacher resource. Teacher resources often provide background or additional material to an activity. Capable students, or students with a particular interest in the topic can be assigned this material at your discretion.

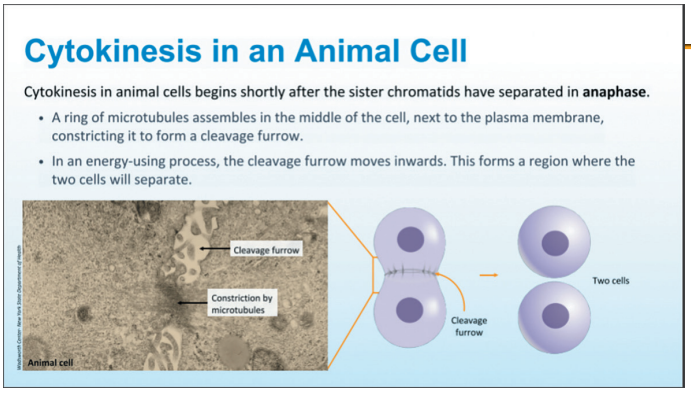


www.BIOZONEhub.com

Then enter the code in the text field

HSC12-1-6559

Or scan this QR code



PRESENTATION SLIDES

Presentation Slides are a very popular way for teachers to deliver a lesson in a presentation style format. Presentation Slides are a useful delivery tool in both face to face or remote teaching.

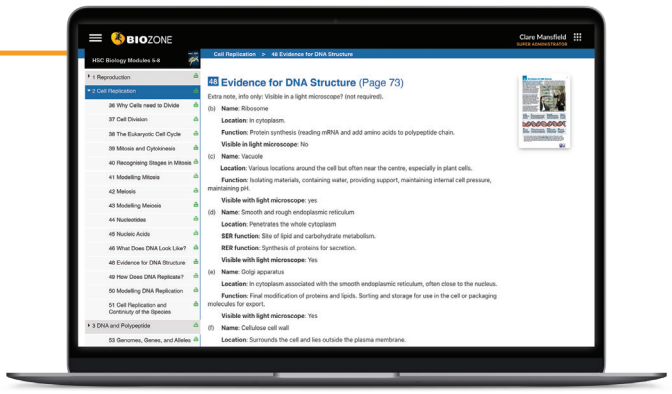
The Presentation Slides are a collection of slides specifically designed to support and enhance the content of the worktext.

The Presentation Slides are fully ingested into BIOZONE WORLD and automatically appear with the selected activity.

ONLINE MODEL ANSWERS

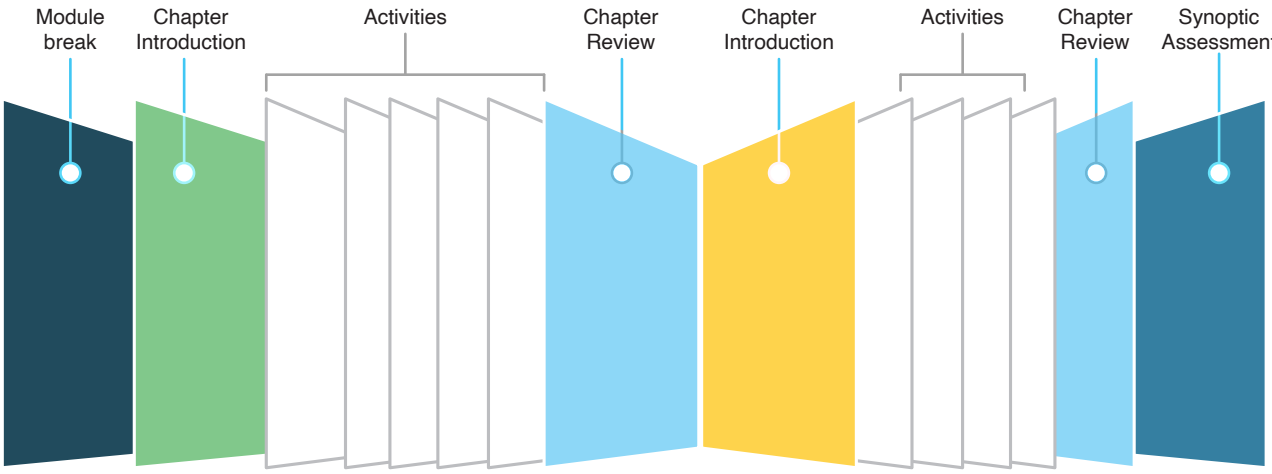
Online Model Answers provide suggested answers to each of the activities, including working where appropriate (e.g. calculations).

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.



Structure of the Worktext

HSC Biology: Modules 5 - 8 has been specifically written to meet the content and skills requirements of the NSW Stage 6 syllabus (Modules 5 - 8). The worktext follows the structure outlined in the Stage 6 syllabus, so it is easy for you to know where you are in the course. The content is organised into 18 chapters, numbered sequentially and nested within their module (below). Module breaks divide the content into sections (the modules) and summarise the student outcomes for each module. Each chapter has an introduction page so you can see the key knowledge and skills requirements for each chapter. The graphic below illustrates the structure of a module and chapters. Use this structure to help navigate through the content.



Chapter introduction

- Inquiry questions are identified.
- A checklist of key knowledge.
- A list of key terms.

Activity pages

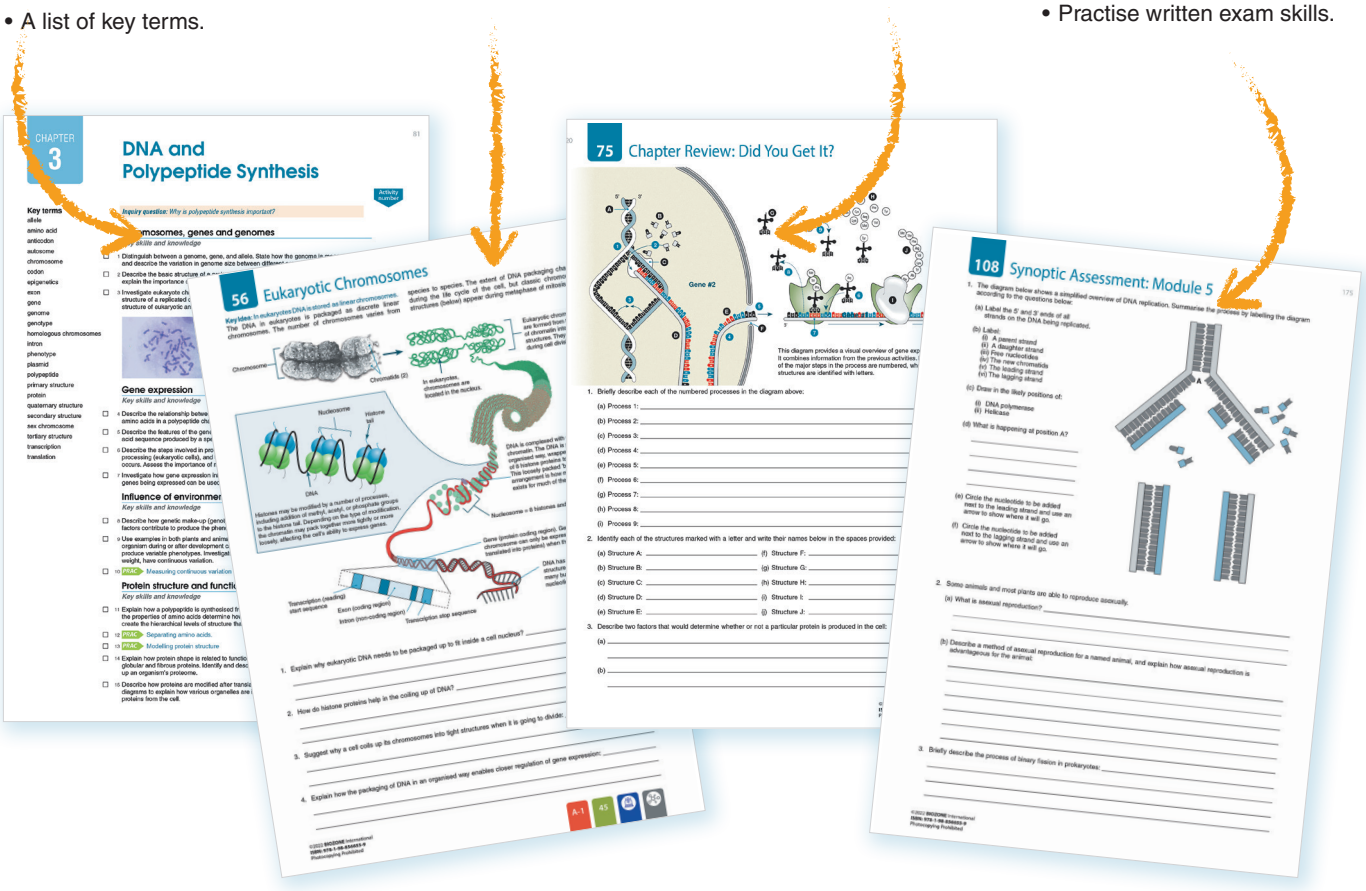
- Contain essential knowledge.
- Questions review the content of the page.

Chapter review

- Test student understanding of the chapter content.
- Develop student scientific vocabulary.

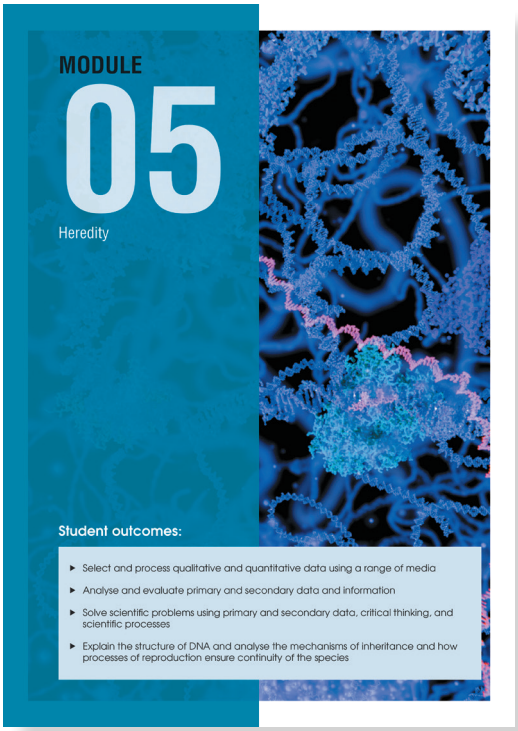
Synoptic assessment

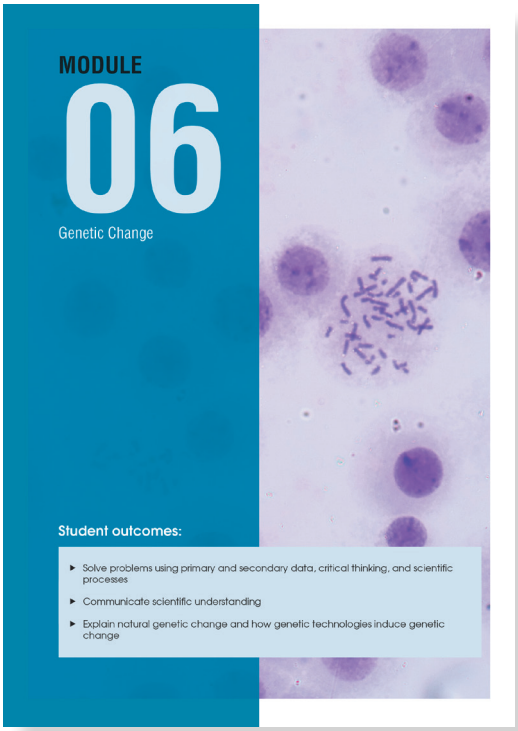
- Synoptic assessments conclude the module of study covered in the workbook.
- Practise written exam skills.

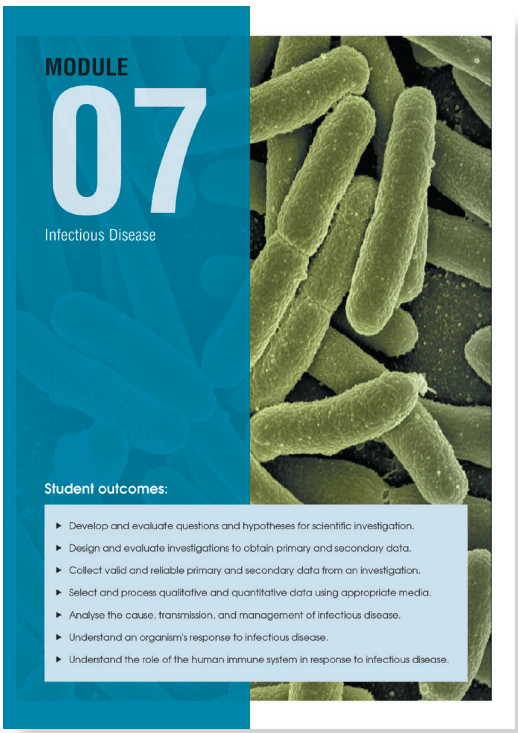


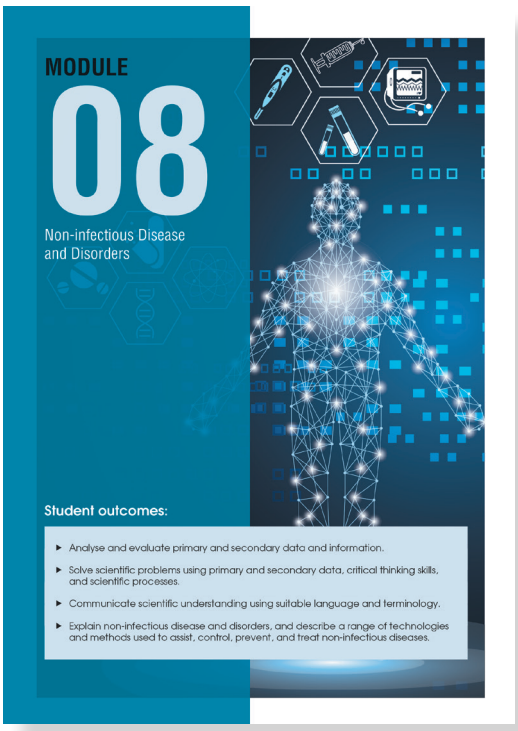
Module Breaks

The content of the *HSC Biology Modules 5-8* is organised into four sections (modules). 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.



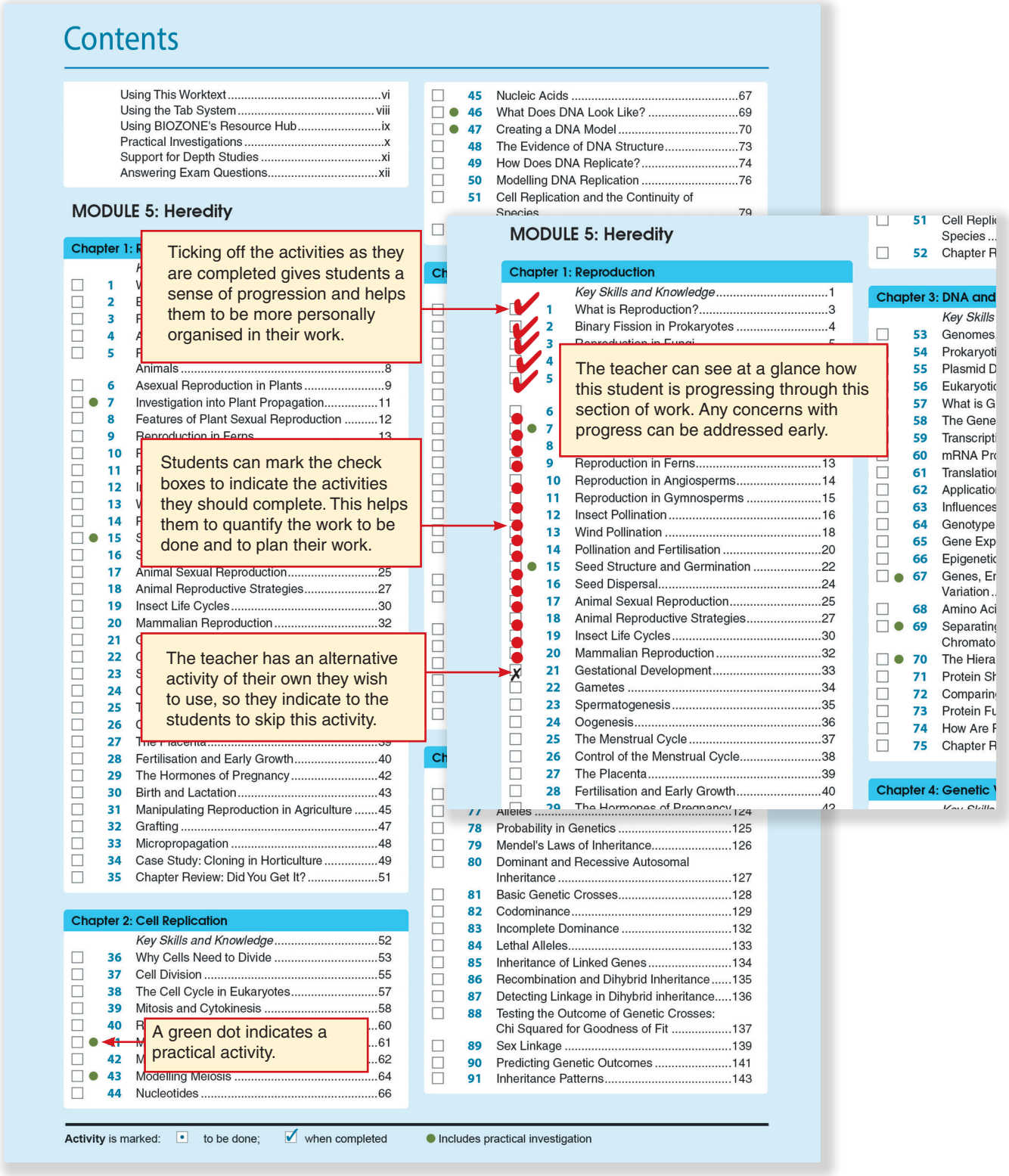






The Contents: A Planning Tool

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 Chapter Content

Each chapter 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.

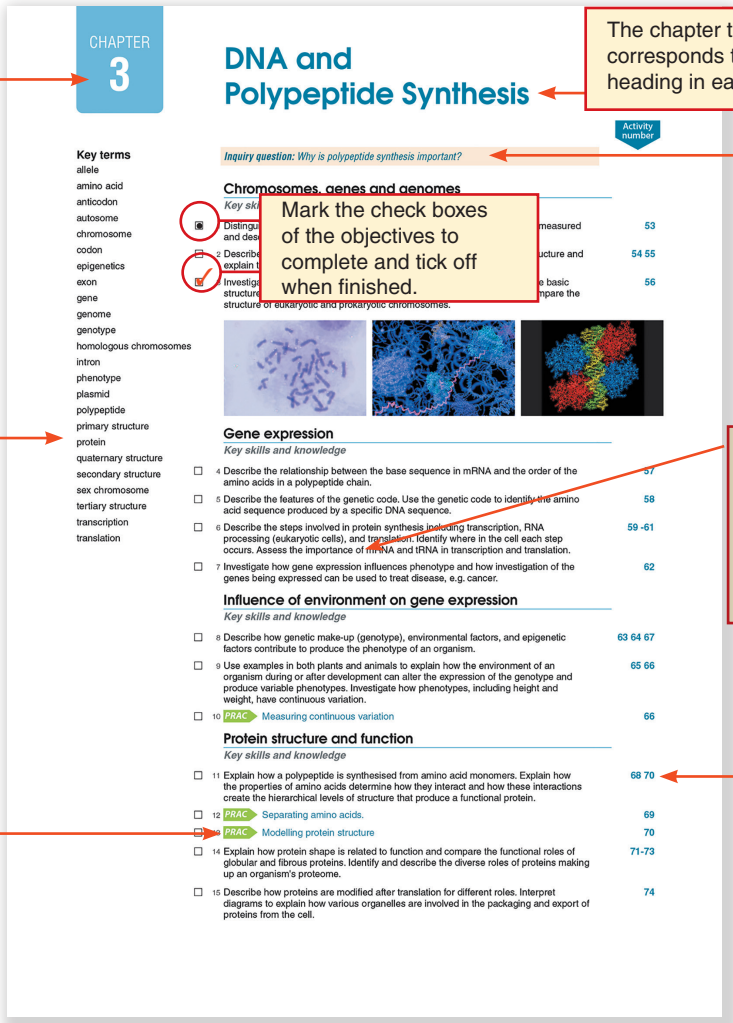
Mark the check boxes of the objectives to complete and tick off when finished.

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.

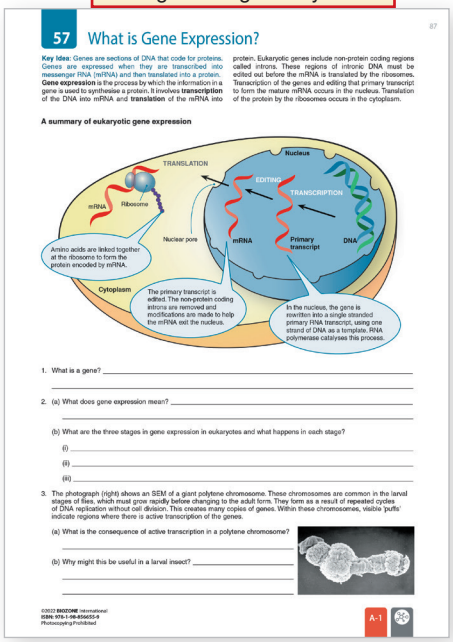
The activities relating to these key knowledge outcomes.

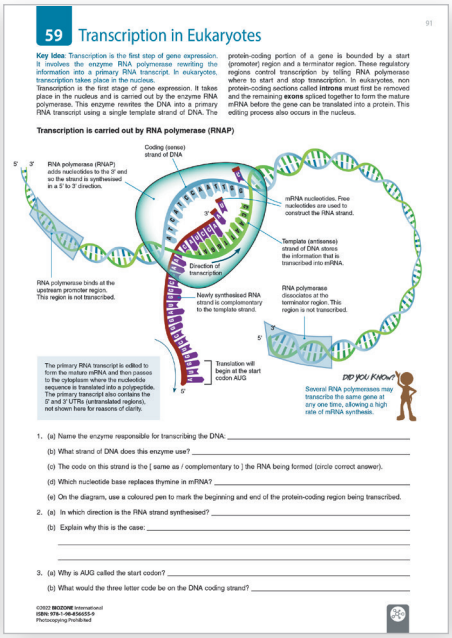
Activities that cover practical skills are identified with a green bookmark and blue text.

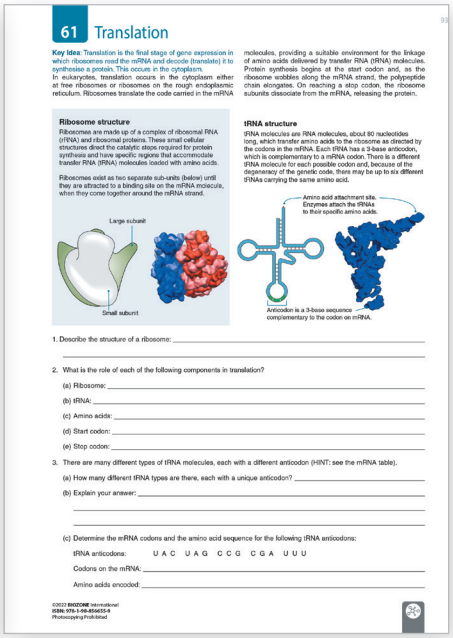


Introduce the concept with a grounding activity

Follow with activities exploring the concept







Structure of an Activity Page

The activity pages have been carefully designed to provide high quality information to students in an easily accessible format. They include a number of features designed to engage students and help them unpack and understand the information. Features include short blocks of text so that students do not feel overwhelmed with too much reading, high quality informative graphics, and links to 3D models that provide another dimension to student engagement and learning. Question and answer sections allow students to demonstrate their understanding of the content. By having the stimulus material and their answers in one place, students can easily revise for assessments. Teachers should guide students through the features of the activity pages to ensure that they make the most of the features on offer.

Key Idea: Summarises the primary focus of the activity and provides a clear take-home message.

Introductory paragraph: Provides background information and an introduction to the activity.

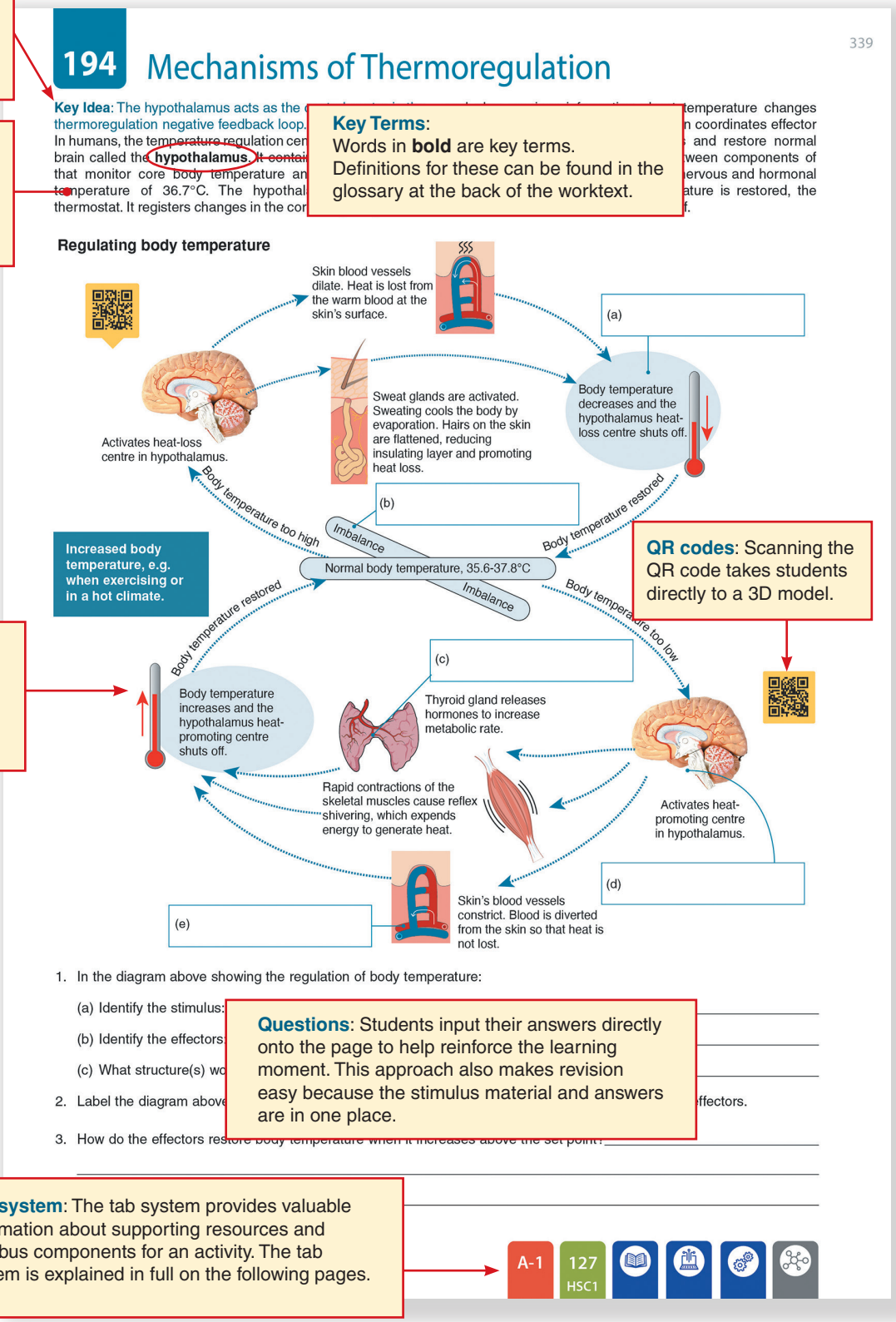
Diagrams: Full colour diagrams and photos help students visualise important information or concepts.

Key Terms: Words in **bold** are key terms. Definitions for these can be found in the glossary at the back of the worktext.

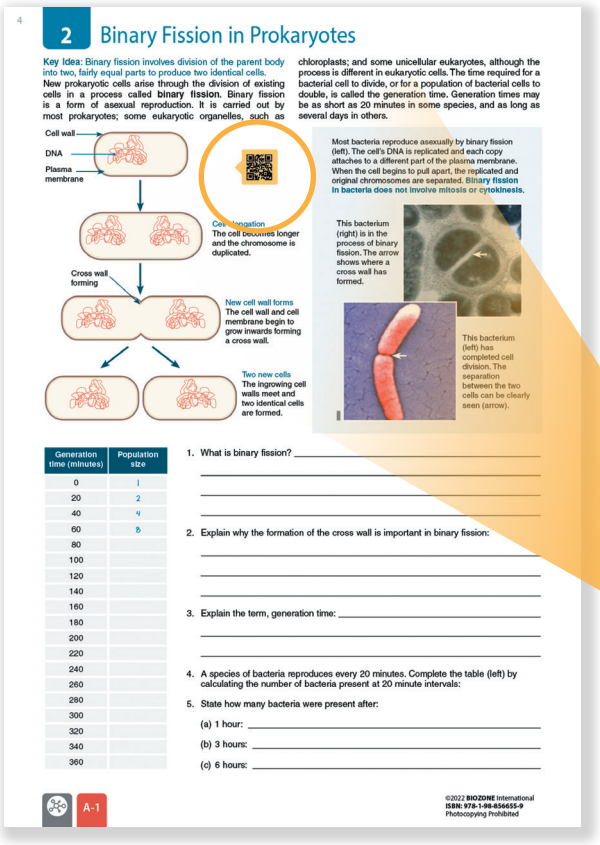
QR codes: Scanning the QR code takes students directly to a 3D model.

Questions: Students input their answers directly onto the page to help reinforce the learning moment. This approach also makes revision easy because the stimulus material and answers are in one place.

Tab system: The tab system provides valuable information about supporting resources and syllabus components for an activity. The tab system is explained in full on the following pages.



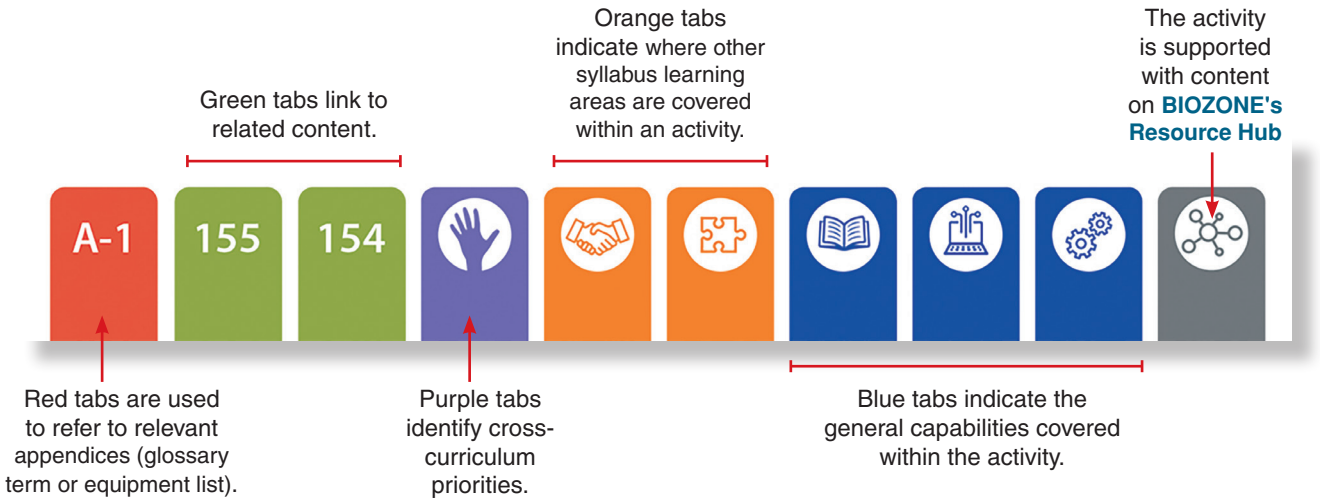
Using the QR codes



Scan the **QR codes** on the activity pages. These link directly to informative and engaging 3D models. All models can be rotated and zoomed, and some contain informative annotations.

Using the Tab System

The tab system helps you identify important parts of the HSC Biology course (general capabilities, cross-curriculum priorities, and other curriculum learning areas). The tabs also allow you to see at a glance if online support is provided on BIOZONE's **Resource Hub**, and if there are content links with other activities. A summary of the icon tabs is provided below and a full description is provided on the following page.



General capabilities

Critical & creative thinking: Develop critical and creative thinking skills through asking questions, making predictions, engaging in practical and secondary-sourced investigations, and anlaysing and evaluating evidence.

Ethical understanding: Apply ethical values and principles to your studies and investigations. Understand the implications of these to others and the environment, and that reasoning can assist in making ethical judgements.

Information & communication technology capability: Use ICT to access information; collect, analyse, and represent data; model and interpret concepts and relationships; process information;and communicate ideas.

Intercultural understanding: Appreciate and respect diverse cultures (yours and others) and understand how cultural perspectives have impacted the development, breadth, and diversity of scientific knowledge and applications.

Literacy: Literacy is the ability to identify, understand, interpret, create, and communicate effectively using written, visual, oral, and digital formats. Apply these skills to communicate scientific concepts and findings.

Numeracy: Numeracy involves recognising and understanding the role of mathematics in the world. Develop numeracy skills by measuring, recording, representing, and anlaysing data.

Personal & social capability: Establish positive relationships, make responsible decisions, work effectively (alone and with others), and constructively handle challenging situations during your scientific endeavours.

Cross-curriculum priorities

Aboriginal & Torres Strait Islander histories & cultures: The traditional knowledge and cultural practices of Aboriginal & Torres Strait Islander peoples provide insight into how the environment and natural world work. Traditional knowledge and Western scientific knowledge can be used together in a complementary way.

Asia & Australia's engagement with Asia: The diverse environments of Australia and Asia provide opportunities to study interactions within and between the two environments, including how human activity influences the region, and the significance of these to the rest of the world.

Sustainability: Sustainability is concerned with the ongoing capacity of the Earth to maintain all life. It provides contexts for exploring, investigating, and understanding the interrelatedness and sustainability of Earth's systems, including both natural and human-made environments.

Other learning across curriculum areas

Civics & citizenship: Understand how civics, the understanding of Australian society, and citizenship can be applied to scientific ideas and technological advances.

Difference & diversity: Australian society is diverse in terms of gender, race, and socio-economic circumstances. Working collaboratively provides opportunities to develop an appreciation of the values and ideas of others.

Work & enterprise: Develop and use safe working practices. Identify risks and carry out hazard assessments when working in the laboratory or field.

Other tabs

Grey hub tabs indicate that the activity is supported by content on BIOZONE's Resource Hub.
See page ix for details about BIOZONE's Resource Hub.

7 Green tabs show connections to related activities and content elsewhere in the book.

A-1 Appendix 1: Glossary of key terms and their definitions.

A-2 Appendix 2: Equipment list for the practical investigations.

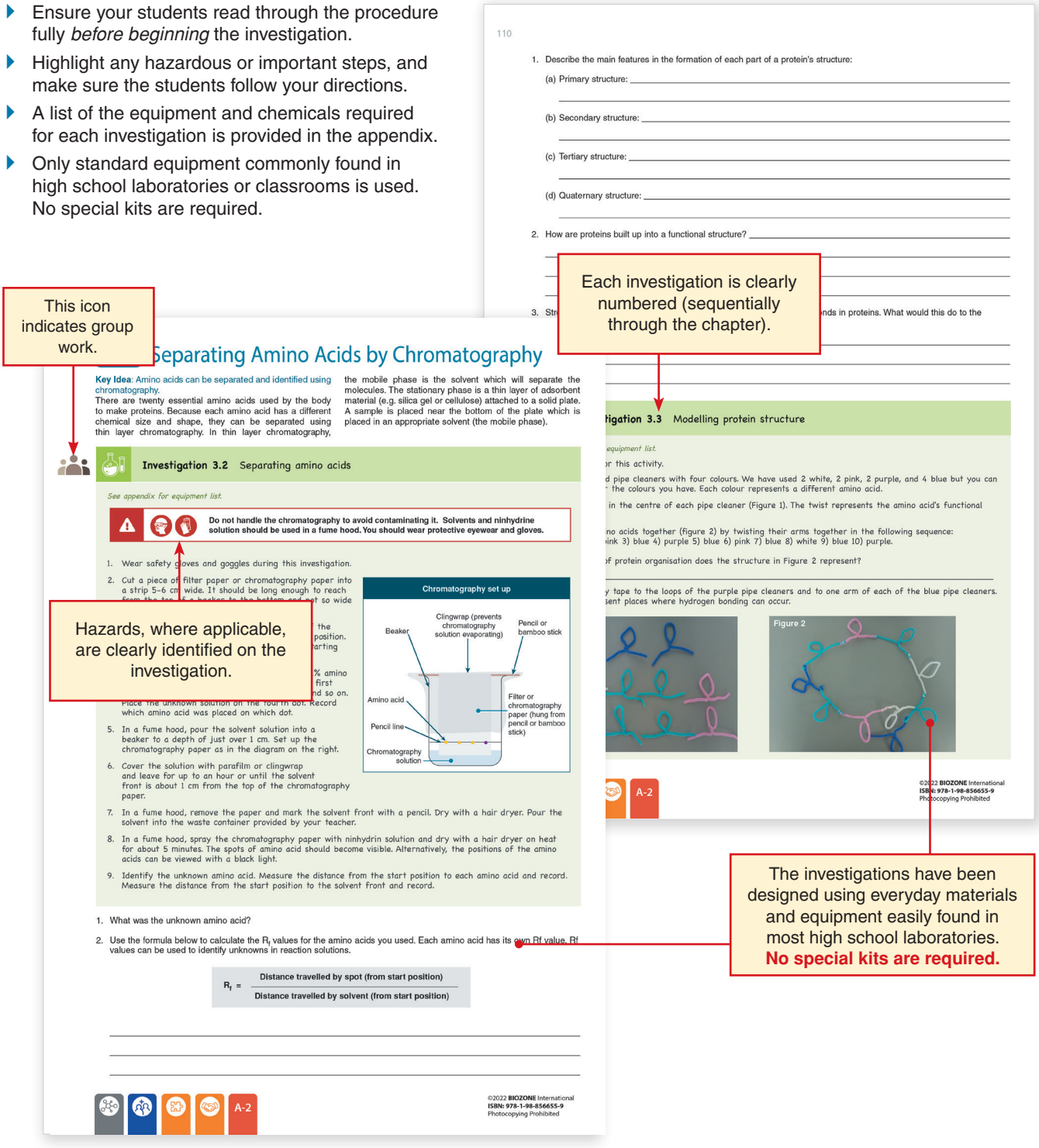
Support for Science Skills and Practical Investigations

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.



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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 …nd 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.

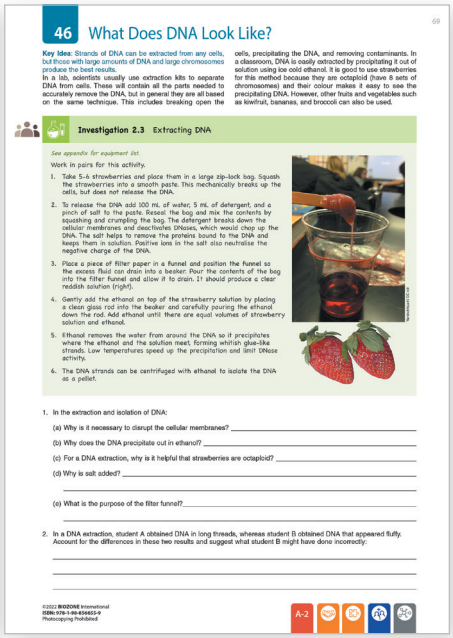
Investigation 9.1 Investigating microbial contamination in food samples

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.

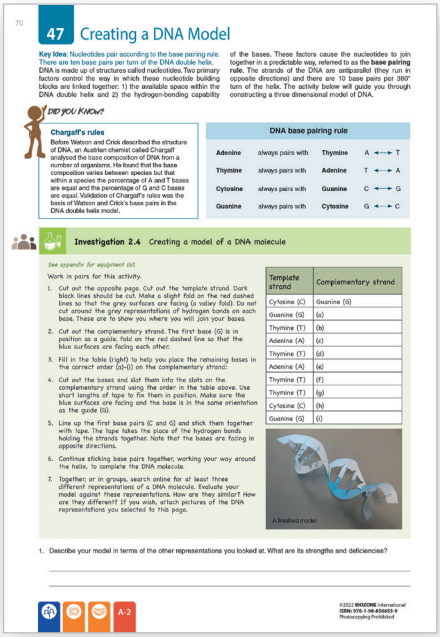
Investigation 2.3 Extracting DNA

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?

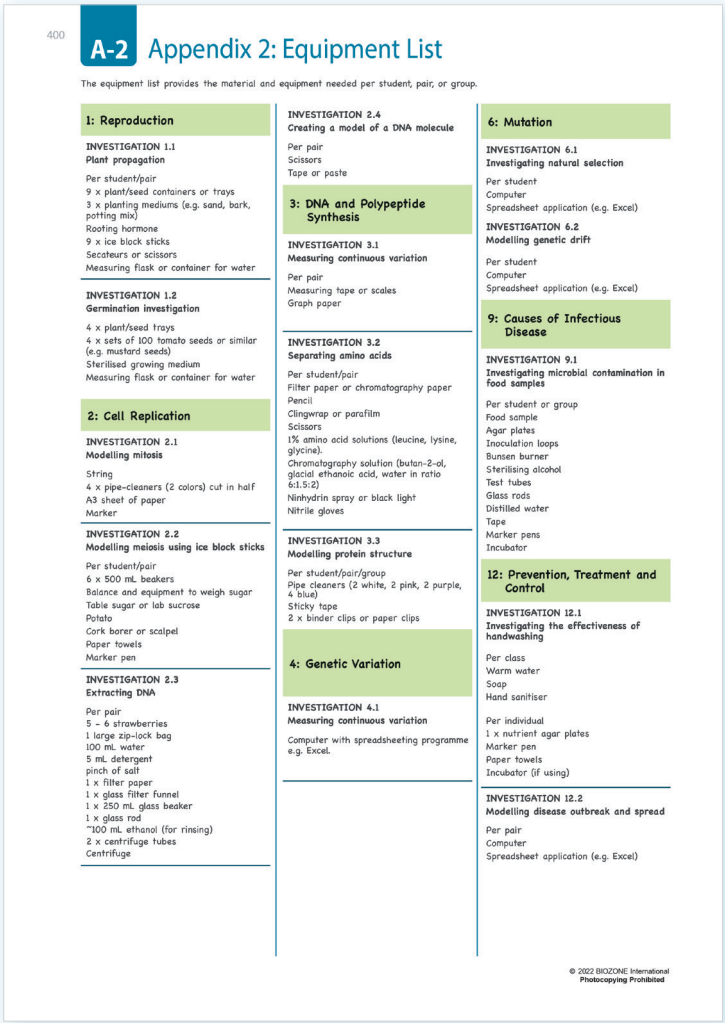
Some 'practical' activities give students a place to develop their skills in planning and designing an experiment. They then carry out the investigation they have designed.

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.



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)

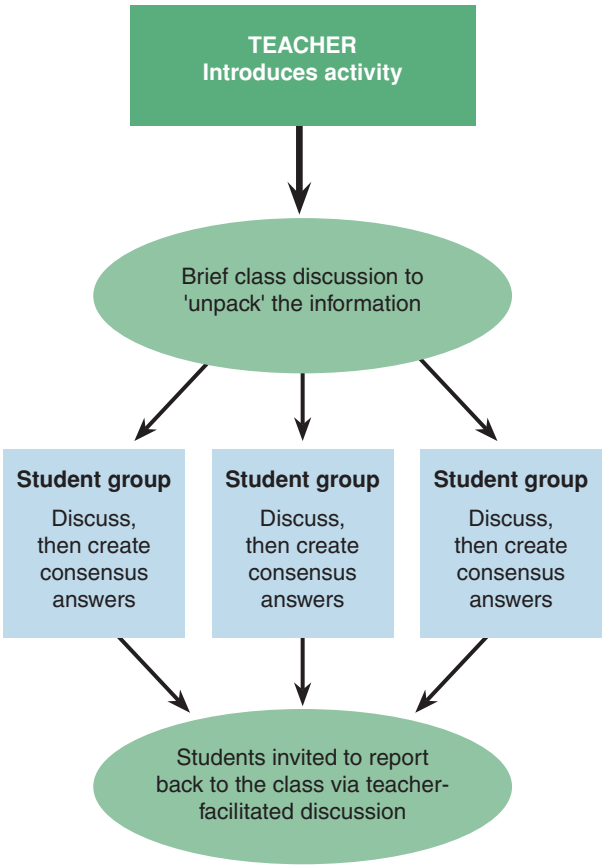
INVESTIGATION 12.2
Modelling disease outbreak and spread
Per pair
Computer
Spreadsheet application (e.g. Excel)

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.

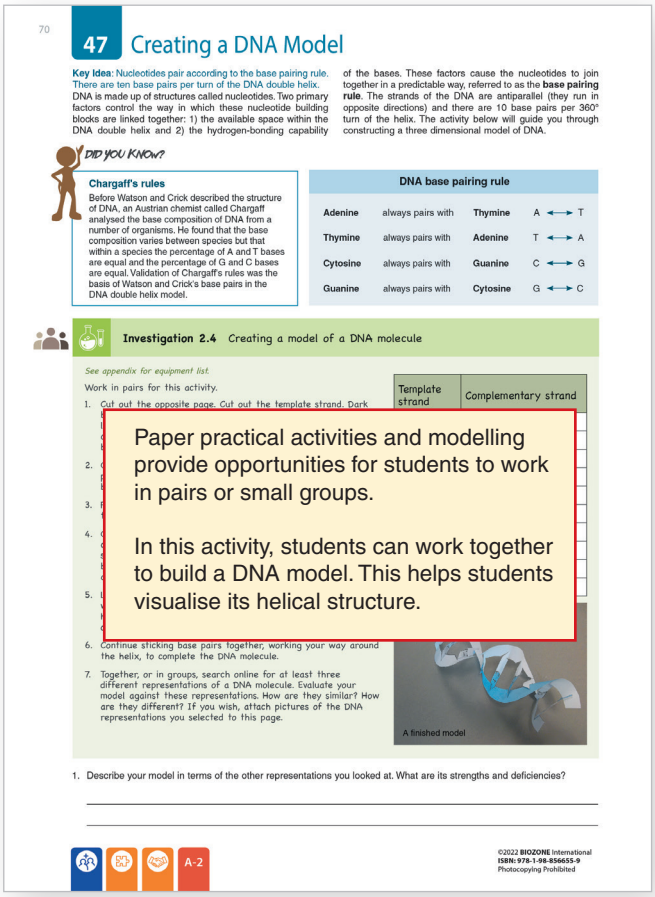
The teacher introduces the topic. They provide structure to the session by providing background information and setting up discussion points and clear objectives. Collaboration is emphasised to encourage participation from the entire group. If necessary, students in a group can be assigned specific tasks.

Students work in small groups so that everyone's contribution is heard. They collaborate, share ideas, and engage in discourse. The emphasis is on sharing ideas, discussing questions, formulating answers. Students may even come up with additional questions and discussion points.

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. Students can revise their original answers providing a powerful second learning moment.

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.



70

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.

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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

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?

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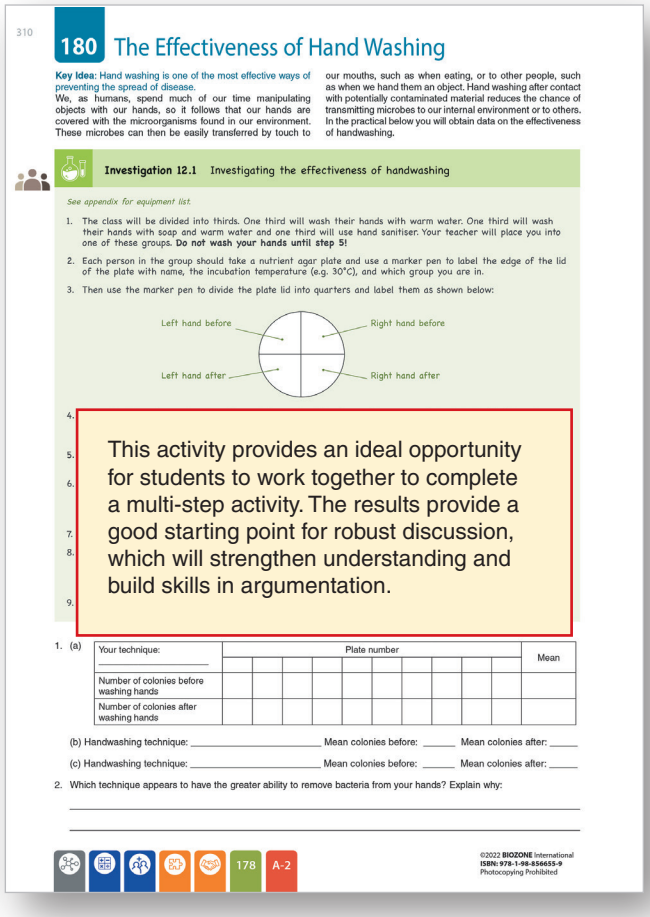
A-2

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:

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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.

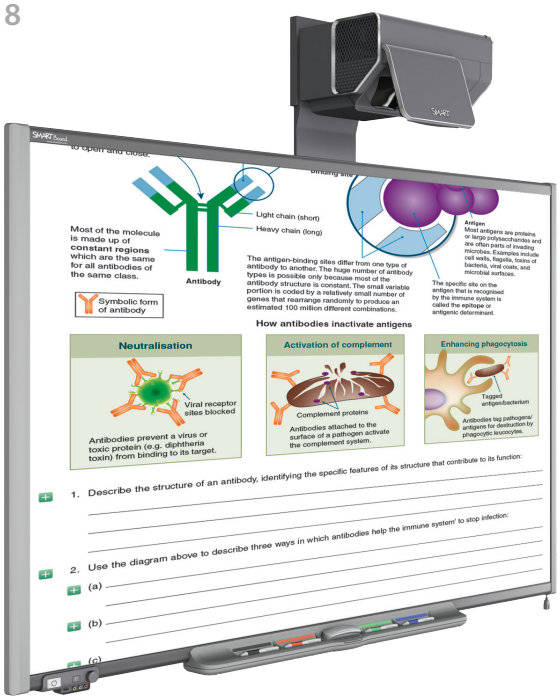
Collaboration and discovery

- 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

Review answers in class via BIOZONE WORLD
The teacher view in BIOZONE WORLD has model answers which can be toggled on and off using the show/hide buttons on an activity page.

View activities in BIOZONE WORLD on a shared screen and reveal the answers as required. This is ideal for:

- Providing a concise model answer after a group or class discussion.
- Self marking by students. Students can amend their answer if necessary, providing a powerful secondary learning moment.
- Providing a quick review of answers if time is short.

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

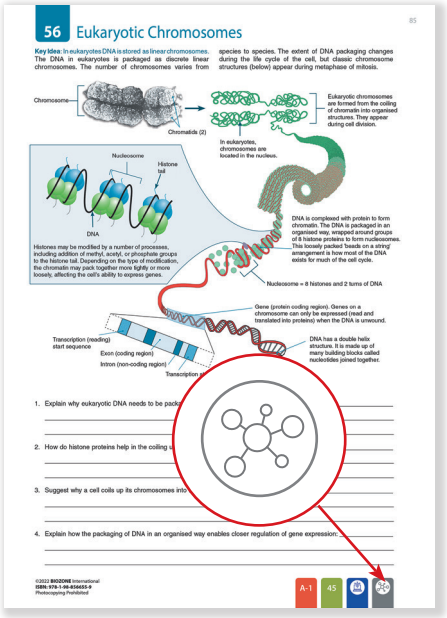
- What types of source material are available?
- Why are some sources of information more trustworthy than others?
- What is the difference between anecdotal evidence and scientific evidence?

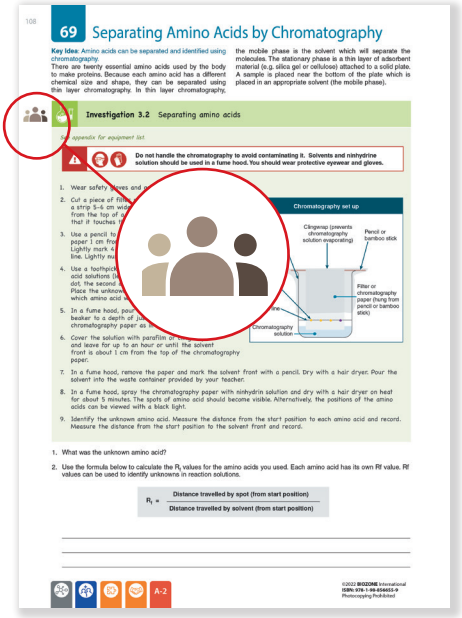
Presenting the findings

- 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:

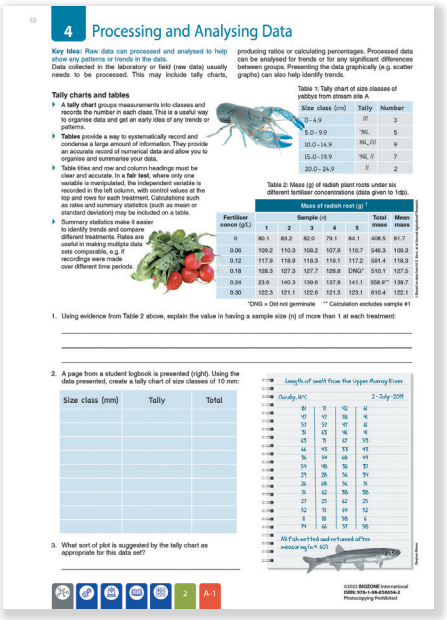


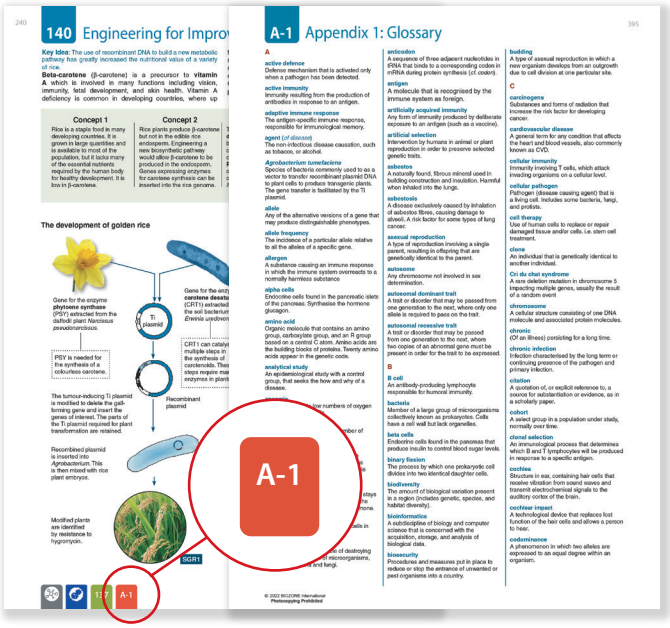


BIOZONE's Resource Hub provides curated content to support the activities in the book. Videos, animations, simulations, and 3D models support students of all abilities, while some resources, including interactive spreadsheets, fact sheets, and reference papers, may be used as part of group work or extension.

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.

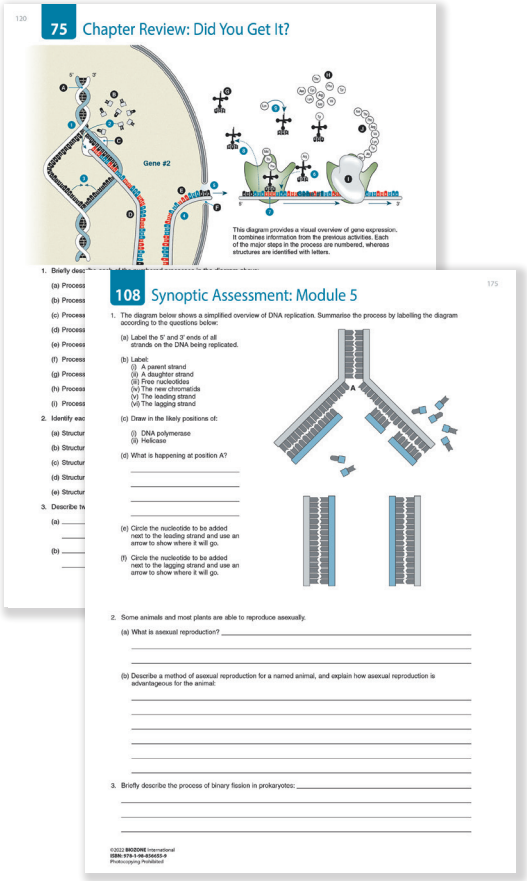
The list of key terms in the chapter introduction provides students with a list of scientific terms they should be familiar with. Encourage students to refer to the glossary (Appendix 1) when they are unsure about the meaning of a scientific term that is unfamiliar to them. A glossary tab at the bottom 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.