

VCE | BIOLOGY UNITS 1 & 2



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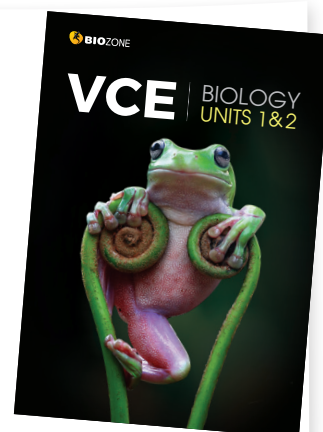
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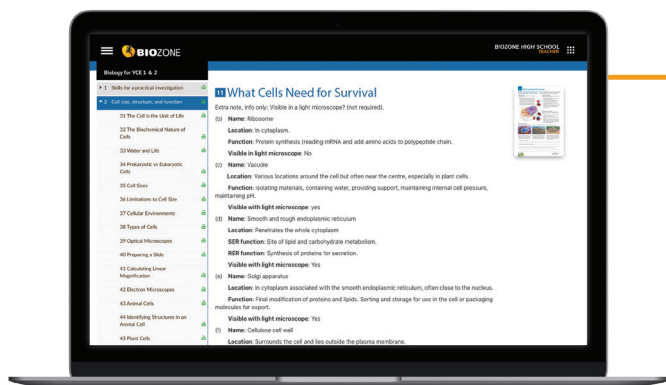
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Teacher Support Materials

BIOZONE's *VCE Biology, Units 1&2* is supported by a suite of resources. These additional resources provide the tools for teaching and learning remotely or in the classroom, support your students in their self-assessment tasks with online answers, and use interactivity to promote class discussion and efficient review. Some features of these supporting resources are described below and you will find further information later in this guide.



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.

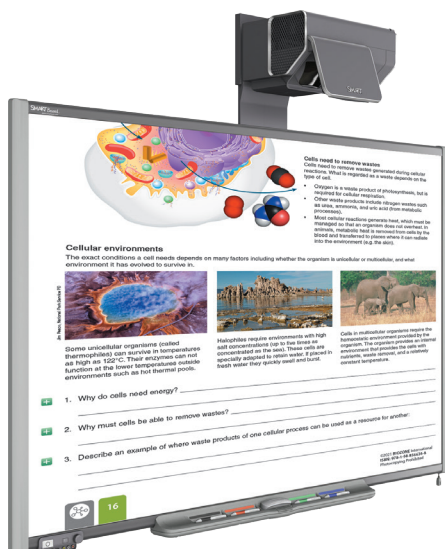
EBOOK VERSION

Our eBooks provide a digital replica of the printed pages.

With our eBook PLUS on a School Managed Licence, students can answer most questions online, although a small number of questions require offline responses or a download. These are mostly associated with key skills, such as plotting and graphical representations.

The eBook TEACHER'S EDITION is also available with answers in place and some additional features.

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 *VCE Biology, Units 1&2* in the classroom and online, as well as a long answers section. Supplied as a direct download.

RESOURCE HUB

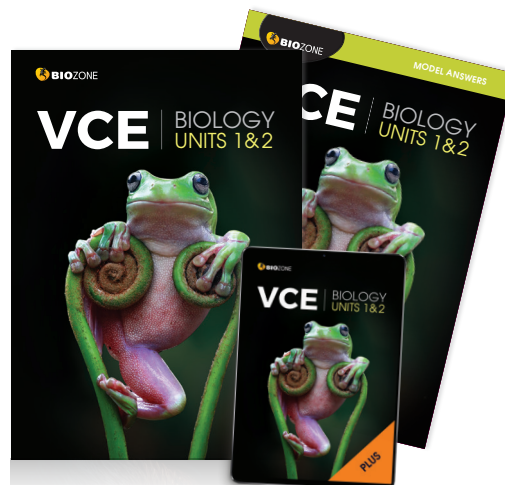
Be sure to visit BIOZONE's RESOURCE HUB, which is fully accessible and free of charge to you and your students. It offers a curated collection of videos, animations, 3D models, and supporting content for the activities in this book.

Visit: www.BIOZONEhub.com Your code is VCE11-2-6368



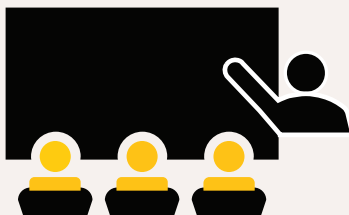
Meeting Key Competencies

We want today's biology students to be self-motivated, lifelong learners, to develop a sound grasp of biological knowledge, to plan and evaluate their work, and to think critically and independently. In developing *VCE Biology*, we have put the aims and structure of the **VCE Biology Study design** (for accreditation 2021-2025) 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 strategies BIOZONE has used to meet the aims and scope of the study design.



Lesson planning

- The structure of *VCE Biology, Units 1&2* follows the Unit-Area of Study structure specified in the **VCE Biology Study Design**. Teachers can be assured that all of the essential components of the Study Design are covered, ensuring easy and efficient lesson planning with no content gaps.
- Use the chapter introductions to assign students work 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. A red bullet indicates an assessment. Incorporate these activities into your schedules.



Teaching

- Teach the content in the order presented in *VCE Biology, Units 1&2*. The content and skills covered in Outcomes 1 and 2 of each unit lay the foundation for tackling Outcome 3 with confidence.
- Have students refer to *Chapter 1: Key Science Skills*, as the need arises, or before attempting an activity that addresses a specific skill (e.g. drawing a line graph). These activities can be assigned as homework, or they can be completed in class.
- Encourage peer-to-peer learning by assigning students into groups of mixed abilities when carrying out group research projects or practical investigations.
- Activities that manipulate data using formulas 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 3).
- 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 Questions** at the end of each Area of Study 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 are to complete and then tick them off when completed. Teachers can see at a glance how quickly the student is progressing through the assigned material.

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Activity is marked: ☐ to be done; ☒ when completed ☒ Includes practical investigation ☒ Assessment task

Introducing the Content

Each chapter in *VCE Biology Units 1&2* 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 to expand their vocabulary.

For ease of navigation, chapters are numbered sequentially throughout the book, separated by Unit and Area of Study breaks (see following pages).

Students can use the list of **key terms** to create their own glossary, or they can look them up in the glossary at the back of the book. This encourages use of the correct terms when answering questions.

Activities that cover an assessment for the Area of Study are indicated by a red bookmark and text.

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 that concept

The chapter title corresponds to the **Key Knowledge** headings under each **Outcome** for each **Area of Study**.

For students:

Key knowledge and skills are drawn from the study design. 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.

CHAPTER 7

Key terms

- allele
- aneuploidy
- chomaid
- chromatin
- chromosome
- crossing over
- diploid
- fertilisation
- gamete
- gene
- genome
- haploid
- histone
- homologous chromosomes
- independent assortment
- interphase
- karyogram
- karyotype
- locus (pl. loci)
- maternal chromosome
- meiosis
- non-disjunction
- paternal chromosome
- sexual reproduction
- syndrome

From Chromosomes to Genomes

Genes, genomes, and alleles

Key skills and knowledge

- 1 Distinguish between a genome, gene, and allele. State how the genome is measured and describe the variation in genome size between different organisms
- 2 Describe the role of chromosomes in the transmission of genetic information
- 3 Describe the role of chromosomes in the transmission of genetic information
- 4 Describe the role of chromosomes in the transmission of genetic information

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

Karyotyping and karyograms

Key skills and knowledge

- 5 Define the term karyotype. Describe how an individual's complete set of chromosomes can be prepared and displayed in an organised way to produce a karyogram.
- 6 Explain how aneuploidies can arise when chromosomes fail to separate during meiosis (non-disjunction). Show in a diagram how non-disjunction in meiosis can produce abnormal gametes and lead to an individual having too few or too many chromosomes.
- 7 Explain how a karyogram can be used to identify chromosomal abnormalities, particularly aneuploidies, e.g. Down syndrome (autosomal trisomy), and Turner and Klinefelter syndromes (sex chromosome aneuploidies).
- 8 **TEST** Create a karyogram to determine phenotype by matching the size and banding pattern of individual chromosomes.

Meiosis

Key skills and knowledge

- 10 Summarise the roles of mitosis and meiosis in the life cycle of sexually reproducing organisms, recognising the role of mitosis in growth and repair and meiosis and fertilisation in producing genetically variable offspring.
- 11 Explain the significance of the following events in meiosis:
 - Crossing over between homologous chromosomes in prophase I of meiosis.
 - Recombination of alleles as a result of crossing over.
 - Independent assortment of homologous pairs in metaphase I.
 - The non-dividing centromere in metaphase I.
- 12 Explain how the events in meiosis lead to production of haploid gametes (or haploid spores in plants) from diploid cells.
- 13 **PRACT** Investigate the key events in meiosis using a simple physical model.

87 Cell Division

Key Idea: There are two types of cell division in eukaryotes, mitosis and meiosis. During mitosis, only mitosis produces cells that are genetically identical to the parent cell. New cells are formed when existing cells divide. There are two forms of cell division in eukaryotes, mitosis and meiosis.

Mitosis produces two identical daughter cells from a parent cell. Meiosis is a special type of cell division, it produces sex cells (gametes or spores) for sexual reproduction. In sexual reproduction, sex cells from two parents combine to form a new individual that is genetically different to its parents.

Mitosis produces genetically identical cells. This chromosome set is passed on to the next generation. This is why family members may look alike, but they're not identical (except for identical twins).

Mitosis produces genetically identical cells. This chromosome set is passed on to the next generation. This is why family members may look alike, but they're not identical (except for identical twins).

The 2N (diploid) number refers to the cells each having two whole sets of chromosomes. For a normal human embryo, all cells will have a 2N number of 46.

Gametes are produced by meiosis, a special division which reduces the chromosome number to half that of a somatic cell. The 1N (haploid) number indicates a single set of chromosomes.

Many mitotic divisions give rise to the adult. Mitosis continues throughout life for cell replacement and repair of tissues. For example, blood cells are replaced at a rate of two million per second, and a layer of skin cells is constantly lost and replaced about every 28 days.

Call division and the life cycle of an organism

1. (a) Where does mitosis take place in animals? _____
 (b) Describe the roles of mitosis in the human body: _____

(c) In mitosis, the daughter cells are genetically identical to the parent cell. True or False (delete one) _____

2. (a) Where does meiosis take place in animals? _____
 (b) What is the purpose of meiosis? _____

(c) In meiosis, the sex cells are genetically different to the parent cell. True or False (delete incorrect answers) _____

88 Meiosis

Key Idea: Meiosis is a special type of cell division. It produces sex cells (gametes) for the purpose of sexual reproduction. Meiosis involves a single chromosomal duplication followed by two successive nuclear divisions, and results in a halving of the diploid chromosome number. Meiosis occurs in the sex organs of animals and the sporangia of plants. It genetic mistakes (gene and chromosome mutations) occur here, they will be passed on to the offspring (they will be inherited).

When a cell is not dividing (interphase), the chromosomes are not visible. But when a cell is being replicated, the cell shown in the diagram (right) is 2N, where N is the number of copies of chromosomes in the nucleus. In a one copy of each chromosome (haploid), 2N = two copies of each chromosome (diploid).

Meiosis I (reduction division)
 The first division separates the homologous chromosomes into two intermediate cells.

Meiosis II (mitotic division)
 The second division is a mitotic one in nature, where the chromosomes are pulled apart, but the number of chromosomes remains the same. This allows large numbers of gametes to be produced.

Meiosis starts here:

Interphase 2N
 Homologous chromosomes pair up. Prior to cell division, the chromosomes condense into visible structures. Replicated chromosomes appear as two sister chromatids held together at the centromere. Homologous chromosomes pair up (syngamy). Crossing over may occur at this time making sister chromatids differ from one another.

Prophase I
 Homologous chromosomes pair up. Prior to cell division, the chromosomes condense into visible structures. Replicated chromosomes appear as two sister chromatids held together at the centromere. Homologous chromosomes pair up (syngamy). Crossing over may occur at this time making sister chromatids differ from one another.

Metaphase I
 Independent assortment: Homologous pairs line up in the middle of the cell independently of each other. This results in paternal and maternal chromosomes separating independently into the gametes. The centromere does not divide as the sister chromatids remain together.

Anaphase I
 Homologous pairs separate, pulled apart by the spindle fibres.

Telophase I
 Spindle apparatus forms. Chromosomes migrate towards the metaphase plate.

Meiosis II (mitotic division)
 The second division is a mitotic one in nature, where the chromosomes are pulled apart, but the number of chromosomes remains the same. This allows large numbers of gametes to be produced.

Prophase II
 Spindle apparatus forms. Chromosomes migrate towards the metaphase plate.

Metaphase II
 Chromosomes line up on the metaphase plate.

Anaphase II
 Centromeres divide and sister chromatids (now individual chromosomes) are separated.

Telophase II
 Four separate gametes are produced.

1. Describe the behaviour of the chromosomes in the first division of meiosis: _____

2. Describe the behaviour of the chromosomes in the second division of meiosis: _____

89 Meiosis and Variation

Key Idea: Meiosis produces genetic variation via the processes of crossing over and independent assortment. Meiosis creates genetic variation in the sex cells through crossing over and independent assortment. Crossing over refers to the mutual exchange of pieces of chromosome and their general behaviour. Homologous chromosomes, in independent assortment, homologous chromosomes are randomly distributed to the gametes.

Crossing over and recombination
 Chromosomes replicate during interphase. Before meiosis, to produce replicated chromosomes with sister chromatids held together at the centromere (see below). When the replicated chromosomes are paired during the first stage of meiosis, sister chromatids may become entangled and segments may be exchanged in a process called **crossing over**. Crossing over results in the recombination of alleles (variations of the same gene) producing greater variation in the offspring than would otherwise occur.

Independent assortment
 Independent assortment is the random alignment and distribution of chromosomes during meiosis. Independent assortment is an important mechanism for producing variation in gametes. During the first stage of meiosis, replicated homologous chromosomes pair up. During the middle of the cell, the way the chromosomes pair up is random. For the homologous chromosomes, there are two possible ways in which they can line up, resulting in four different combinations in the gametes. The intermediate stage of meiosis has been left out for simplicity.

1. How does independent assortment increase the variation in gametes? _____

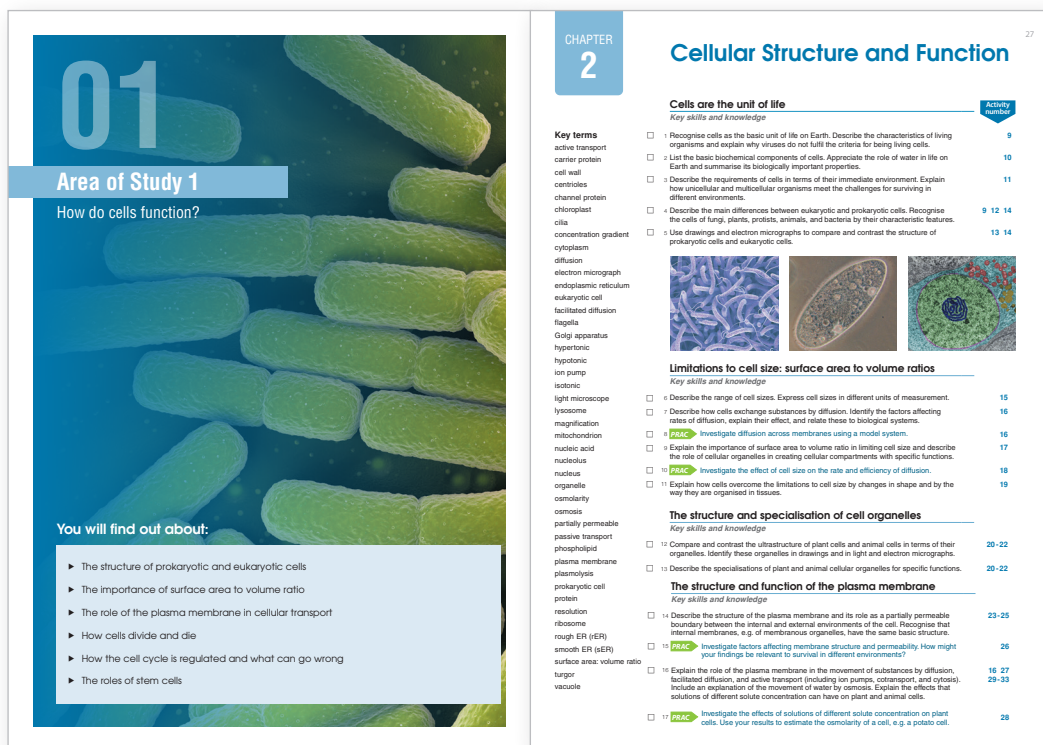
2. (a) What is crossing over? _____
 (b) How does crossing over increase the variation in the gametes (and hence the offspring)? _____

Finding Your Way Around

The content of the *VCE Biology Units 1&2* is organised into 12 chapters, numbered sequentially and nested within their Unit and Area of Study (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 two *Unit* breaks divide the book into two halves, providing students with a clear indication of where they are in the course. Each unit break summarises the topics to be covered in each *Area of Study*, so students have a clear idea of what is coming up.



The *Area of Study* breaks demarcate each group of related topics within the Study Design. Each one provides a short list of what the student will find out about in that section, which helps to prepare them for the upcoming content. An *Area of Study* may include anything from one to three chapters (*Key Knowledge areas*).

56 Transpiration

Key Idea: Water moves through the xylem primarily as a result of evaporation from the leaves and the cohesive and adhesive properties of water molecules.

Plants lose water all the time. Approximately 99% of the water a plant absorbs from the soil is lost by evaporation from the leaves and stem. This loss, mostly through stomata, is called **transpiration** and the flow of water through the plant is called the **transpiration stream**. Plants rely on an

increasing gradient in solute concentration from the roots to the air to move water through their cells. Water flows passively from soil to air along this gradient of increasing solute concentration. The gradient is the driving force for the movement of water up a plant. Transpiration has benefits to the plant because evaporative water loss cools the plant and the transpiration stream helps the plant to take up minerals. Factors contributing to water movement are described below.

1. (a) What is transpiration? _____

(b) Describe one benefit of the transpiration stream for a plant: _____

2. How does the plant regulate the amount of water lost from the leaves? _____



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56 Transpiration

Key Idea: Water moves through the xylem primarily as a result of evaporation from the leaves and the cohesive and adhesive properties of water molecules.

Plants lose water all the time. Approximately 99% of the

increases to the pass solut

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.

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.

Related or supporting content is identified through the **colour-coded tab system** (below).

Grey hub tabs indicate the activity is supported on the Resource Hub. See page v for details.

Green tabs make connections to related activities elsewhere in the book



Blue tabs indicate the activity covers the following **key skills** (L → R):

- Develop aims and questions, formulate hypotheses, make predictions
- Plan and conduct investigations
- Comply with safety and ethical guidelines
- Generate, collate, and record data
- Analyse and evaluate data and investigation methods
- Construct evidence-based arguments and draw conclusions
- Analyse, evaluate and communicate scientific ideas

Red tabs indicate appendices (L → R):

- A-1: Which graph to use?
- A-2: Basic mathematical formulae
- A-3: Glossary
- A-4: Equipment list

See pages 276-283

Key science skills: A checklist for students

Plan and conduct investigations

4

2 Planning and Conducting Investigations

Key Issue: Carefully executed, well-planned investigations are more likely to produce reliable, valid data.

A major aim of any practical investigation is collecting the data. Practical work may be laboratory or field based. The quality of the data collected is affected by a number of factors. A biological response is affected by manipulating a particular variable, e.g. temperature. The data collected for a

quantitative practical task should be recorded systematically, with due attention to safe practice requirements, a suitable quantitative method, and accurate measurement of an appropriate range of precision. If your quantitative practical investigation is well planned, the data collected will allow your analysis of the experimental results will be much more straightforward and less problematic.

Carrying out your practical work

Preparation

Formulate a problem with the experiment and the test set. Gather equipment and resources to carry out the experiment. Read through the methods and identify any stages and how long they may take.

Execution and recording

Know how you will set up your measurements and how often. Use a logbook to record results systematically. Do you have the correct number of repeats? Have you taken the data in a suitable way? A logbook, data table will be required.

Analysis and reporting

Analyse the data. Tables can summarise data. Graphs represent the data in a visual format. Draw tables and graphs. Statistical tests can assess the significance of results. Present your findings, conclusions and your evaluation.

Identifying variables

A **variable** is any characteristic or property able to take any value. It is a measurable quantity. An example is the rate of charging of one variable on another. It is important to identify variables in an investigation: independent, dependent and controlled. Although not essential, it is useful to know which are variables may (or cannot) cause the reaction of which you are interested. In **test** trials, only one variable is changed in the investigation.

Dependent variable

- Measured during the investigation.
- Recorded in the page of the graph.

Controlled variables

- Factors that must be kept constant.
- Not plotted on the graph.
- Not appropriate to your own investigation.

Independent variable

- Plotted by the experimenter.
- Plotted on the graph's x axis.

Experimental controls

A **control** refers to a standard or reference treatment or group. It is used to compare the results of the experimental group (test group) against that of the control group. Controls are used to demonstrate that the response in the test group is due to a specific variable (or variables). The controls undergo the same procedure, controlled conditions, observations, measurements, and analysis as the test group. This helps to ensure that the responses observed in the test group can be reliably interpreted.

- The experiment allows tests the effect of a certain variable on the response. All the other things are kept the same as the control setup.

- Each plate is inoculated from the same stock. Inoculate under the same conditions. Record the bacterial growth. Graph the results. See the bacterial growth above, but seen on the control plate inoculated with the bacteria.

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This activity focusses on how to plan and conduct investigations, including common pitfalls with sampling, and how to identify sources of error and uncertainty.

Generate, collate, and record data

Keeping a log book

Keeping an accurate logbook is an essential part of a scientist or researcher's work and all results and/or can be used without being used to verify the authenticity and integrity of your work.

- Find a notebook to use that will suit your purpose (e.g. a water-resistant logbook and pens are useful for field). A logbook with large margins leaves a good place for notes and sketches. You must make it difficult to include phrasing or extra pages later on.

Name your logbook in a prominent location and number the pages so you can create a good index for a notebook. Write down your logbook's title in your logbook. Write down your keep back of ideas, methods, and results easily.

Date and enter every entry. Entries should be concise, but contain enough information that you can understand the results. (Enter notes and sketches in a separate notebook. You must be able to locate your entries at a later date. Don't worry too much about recording details.)

Logbooks have a purpose as an accurate, legible record of your work, not the final report.

- Your logbook should be used in all phases of your research. It is not just a place to record ideas on methods or analyses, as well as results.

Attach any paper or photos into your logbook so they are not misplaced or lost.

Include any missing, failed, experiments, or changes in methodology in your logbook. These can be used to explain the reasons for the failure or change. Sometimes failed experiments can be just as valuable as successful ones in understanding a result.

Include all observations made during your investigation and any analyses and transformations of the data.

Remember that recording your ideas, hypotheses, and analyses systematically during your investigation will help when you come to organize the material for your write-up. It will also help to clarify any parts of your study that your teacher may find confusing or incorrect, meaning you could get credit for your work.

1. Assume that you have the following measuring devices available: 50 mL beaker, 50 mL graduated cylinder, 25 mL graduated cylinder, 10 mL graduated cylinder, and 5 mL beaker. What would you use to accurately measure:
 - (a) 21 mL _____
 - (b) 49 mL _____
 - (c) 9 mL _____

2. Calculate the percentage error for the following situations (show your working):

(a) A 10 mL pipette delivers a measured volume of 9.98 mL _____

(b) A 10 mL pipette delivers a measured volume of 9.98 mL _____

(c) The pipettes used in (a) and (b) above both under-delivered 0.02 mL, yet the percentage errors are quite different. Use this data to describe the effect of volume on percentage error: _____

3. Why is it important to keep a detailed logbook during a scientific investigation? _____

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This longer activity covers some of the important aspects of collecting, collating, and recording data. Students have the opportunity to practise some of the skills they need, and can refer to the appendices as well if they need extra guidance. Attention to logbook use is an important part of this activity.

Analyse and evaluate data and investigation methods

[illegible]

Construct evidence-based arguments and draw conclusions

[illegible]

Analyse, evaluate, and communicate scientific ideas

7 Evaluating & Communicating Scientific Ideas

7

Key Idea: The analysis, evaluation, and communication of science information are some components or complex tasks of the science and a critical approach to the claims made. The analysis and evaluation of science information involves identifying, analyzing and evaluating primary data, and then evaluating the author's findings or their interpretation. The author also needs to critically evaluate and interpret a range of

published material, both in scientific publications and in popular media. To analyze and evaluate the science you may find on or use online you must think critically and have a good understanding of the concepts, theories, and methods involved. When communicating scientific ideas to others you will need to be explicit about theory and concepts in a way that is appropriate to your audience.

Analysis and evaluation of scientific ideas

A critical approach to science may involve:

- Describing the article
- Identifying the main points or claims
- Describing the author's perspective and assumptions
- Identifying any claims made by the author and any evidence presented to justify them
- Evaluating the article
 - Identifying and describing any bias in the article. How might this have affected the author's claims?
 - Describing the author's conclusions or claims
 - Describing the limitations of an investigative study

What can you investigate?

Biological science covers some controversial or complex topics. Many new ideas about biology may not be confirmed or well understood even by some of our personal belief systems. As a result, people may have their own ideas about what is true. You may have heard biological theories, especially on the Internet, which are not based on scientific evidence. You may have heard, for example, following is a certain article.

Reading biological theories, especially on the Internet, is important that you take note of where the information comes from and whether it makes sense to you. This will allow you to identify biased or false information. Note the site and any other related information. This information is not necessarily true. Comments may identify errors.

Evaluating scientific information

In order to communicate scientific ideas, you must be able to critically evaluate the information. It is not enough to simply describe the information. It is also important to be able to

- Validity of the information. Is it up to date?
- Is the information present or biased? Has it been accepted by the scientific community?
- Does the information present an unbiased view?
 - Is information presented in a way, understood by it based on the fact and on evidence?
 - Is the information presented distorted by the attitudes, beliefs, or values of the person, group, or organization supporting the information?
- Scientific journals are peer-reviewed, meaning the information is checked by experts in the same field of expertise. This makes the information much more reliable. However, journals can be very expensive, requiring a high level of income to access.
- Newspaper articles are a good starting point as a source of information. However, they are often written by journalists, who are not scientists. They may have a lot of bias in their reporting, particularly when. Take notes of the date and time of the article, and make sure the source is reliable.
- Critical thinking is a skill that is essential to be a scientist. It is a skill that is essential to be a scientist. It is a skill that is essential to be a scientist. It is a skill that is essential to be a scientist.

the science. Government officials usually have control and release the information on information from reliable sources.

• Periodicals or technical journals, a National Geographic, Scientific American, or New Scientist, are useful sources of reliable information. They are written by the general public who have a understanding the technical information.

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The analysis and evaluation of data is a longer activity that divides naturally into two areas: 1) basic mathematical routines and the evaluation of validity, and 2) use of descriptive statistics. Students could complete some of this activity in pairs.

One of the most challenging aspects of writing in science is in constructing evidence-based arguments. This activity introduces students to the basic principles, but there are many opportunities throughout the book to develop these skills as students complete the activities.

This skill requires students to think critically and communicate information to an audience in an appropriate way. Students are introduced to the basic principles here, and have the opportunity to implement them in Outcome 3 of Unit 2 (Chapter 12).

Practical Investigations in Context

Practical investigations appear in context throughout the book. For teachers who have used BIOZONE's books before and liked the practice problems that students had in Chapter 1 for plotting and data analysis, these are now included in context throughout the book. The practical investigations provide opportunities for students to develop many of their essential science skills within one activity, and group work enables stronger peers to support those who are less confident.

18 Investigating the Effect of Cell Size

Key Idea: The effect of cell size on the efficiency of diffusion can be investigated using model 'cells' of different sizes.

As described in the previous activity, the efficiency of diffusion decreases as cell size increases. This can be demonstrated easily in a model system. In this activity you

will design an experiment to demonstrate the effect of surface area: volume ratios on diffusion in model cells. Think about how you will plan your investigation and analyse your data to obtain meaningful results. This will help you to make valid conclusions about your findings.

Background Information

Oxygen, water, cellular wastes, and many nutrients are transported into and out of cells by diffusion. However, at a certain surface area to volume ratio, diffusion becomes inefficient. In this activity you will create model cells of varying sizes and agar and use them to test the relationship between cell size and rate of efficiency of diffusion.

- ▶ The diffusion of molecules into a cell can be modelled by using agar cubes infused with phenolphthalein and soaked in sodium hydroxide (NaOH).
- ▶ Phenolphthalein is an end-base indicator and turns pink in the presence of a base.
- ▶ As the NaOH diffuses into the agar, the phenolphthalein changes to a pink colour and thus indicates how far into the agar block the NaOH has diffused (right).
- ▶ By setting up an agar block into cubes of various sizes, it is possible to investigate the effect of cell size on diffusion.

A photograph of a pink agar cube with two labels: 'Region of initial colour change' pointing to the top face and 'Region of early colour change' pointing to the bottom face.

A photograph of a pink agar cube with a label: 'A phenolphthalein-infused agar cube after exposure to NaOH'.

Equipment list

- Agar blocks infused with phenolphthalein
- Sodium hydroxide (NaOH) solution
- Ruler
- Scalpel
- Glass beaker
- Paper towel
- Labatory tongs
- Timer

A collection of laboratory equipment: a glass beaker, a paper towel, a digital timer showing 1:00:00, two agar blocks, a bottle of Sodium Hydroxide Solution (0.1N, 100 mL), a ruler, a scalpel, and a pair of labatory tongs.

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Factors Altering Membrane Permeability

Key Idea: Temperature and solvents can change the structure of cellular membranes and alter their permeability.

Membrane permeability can be disrupted if membranes are subjected to high temperatures or solvents. At temperatures above the optimum, the membrane proteins become

denatured. Alcohol, e.g. ethanol, can also denature proteins. In both instances, the denatured proteins no longer function properly and the membrane loses its selective permeability and becomes leaky. In addition, the combination of heat and high temperature can also dissolve lipids.

Beetroot cubes

Plant cells often contain a large central vacuole surrounded by a membrane called a tonoplast. In beetroot, the cell vacuole contains a water-soluble red pigment called betalain, which gives beetroot its colour. If the tonoplast is damaged, the red pigment leaks out into the surrounding environment. The amount of leaked pigment relates to the amount of damage to the tonoplast.

Investigation 2.2 The effect of temperature on membrane permeability

See appendix for equipment list

- Use a cork borer with an internal diameter of 4 mm to produce 25 cylinders of beetroot 20 mm long. Place them in a beaker of distilled water.
- Set up five racks of three test tubes of 5 mL of distilled water at the following temperatures long using water baths: 0°C (ice bath), 20°C, 40°C, 60°C, 90°C. Leave for a few minutes to equilibrate the distilled water temperatures with the water baths.
- Remove the beetroot from the distilled water and pat dry with a paper towel. Place one cylinder of beetroot into each test tube. Leave them for 30 minutes.
- Remove the beetroot from the test tubes. Observe each group of test tubes and record the colour of the water in the test tube below.
- Zero a colorimeter set to 530 nm with distilled water three times to measure the absorbance of each beetroot sample and record the absorbance in the table below.
- Calculate the mean absorbance for each temperature.

Amplitude of beetroot sample at varying temperatures

Temperature (°C)	Absorbance	Absorbance at 530 nm			Mean
		Sample 1	Sample 2	Sample 3	
0					
20					
40					
60					
90					

- Why is it important to wash the beetroot cubes in distilled water prior to carrying out the experiment?
- Based on the results in the table above, describe the effect of temperature on membrane permeability.

(b) Explain why this effect occurs:

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Practical Skills 2: A-Level Biology

A-4

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67 Analysis of Stomatal Density in Different Plants

Assessment Task, Outcome 2: A data analysis of generated primary evidence collected data

Different plant species have different leaf shapes and structures and these can be correlated with their environments. Some of these leaf adaptations are associated with reducing water loss. These include the position, arrangement, and shape of the stomata.

Plant species show different leaf shapes and structures associated with their environments

The diagram illustrates four plant species and their adaptations to their environments:

- Aloe (arid):** A succulent plant with thick, fleshy leaves. It is adapted to arid environments by storing water in its leaves and having a waxy cuticle to reduce water loss.
- Pine (cold):** A needle-leaved tree. It is adapted to cold environments by having small, needle-like leaves that reduce surface area and water loss, and a thick waxy layer on the leaves.
- Eucalyptus (dry):** A tree with long, narrow leaves. It is adapted to dry environments by having a long, narrow leaf shape to reduce surface area and a waxy cuticle to reduce water loss.
- Sunflower (temperate):** A plant with large, broad leaves. It is adapted to temperate environments by having large, broad leaves that can capture more sunlight and a waxy cuticle to reduce water loss.

Tropical species with this, fleshy leaves are adapted to live in CO₂ during the night and keep themselves cool during the day.

Temperate species with thin, needle-like leaves and a thick waxy leaf cuticle. Stomata are located deep in the leaf.

Sub-tropical drought tolerant species with a broad leaf system and many stomata that have thick cuticle.

Widespread cultivated North American shrub with a showy flower head and very large leaf bases.

Investigation 5.1 Comparing stomatal density

See Appendix for equipment list

- Your teacher will have up to four leaf types from four distinct plants available to different environments, or you may need to ask samples of your own.
- The number of stomata per mm² on the surface of a leaf can be determined by counting the stomata visible under a microscope. Use the clear nail varnish to paint over the lower surface of a leaf. Leave it to dry. This creates a layer with stomata visible on the leaf surface.
- Carefully peel off the nail varnish layer and place on a clean microscope slide.
- Calculate the diameter of the area viewable under a microscope using the field of view divided by the magnification of the eyepiece multiplied by the magnification of the objective lens. For example if the eyepiece magnifies $\times 15$, the objective lens magnification $\times 40$, and the field of view 35, then $35/60 \times 40 \times 15 = 0.25$ mm diameter. The area visible is then $1\pi^2$.
- You could also use a micrometer to measure the diameter of the field of view or use a thin ruler.
- Place the slide with the nail varnish layer up to under the microscope and count the number of stomata you see. If there are too many to count, you could count several fields of view and average them. Try 40x. Do this in several places. Enter your results in the table and calculate a mean.
- You should also take note of where the stomata are on the leaf (are they scattered randomly or in specific places)?
- Repeat on the upper surface of the leaf.
- Repeat for the other leaf types.

The diagram shows a microscope with a black barrel. A label '40x' is on the side. A circular field of view is shown at the bottom, with a diameter of 1.1 cm. The field of view is divided into a central area labeled 'Magnification' and a surrounding area labeled 'Field of View'.

A microscopic image of a leaf surface showing stomata. A scale bar at the bottom indicates 1.1 cm.

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 Phosphoric Acid

Some "practical" activities are not investigations in the true sense, but give students a place to develop their skills in planning and designing an experiment.

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

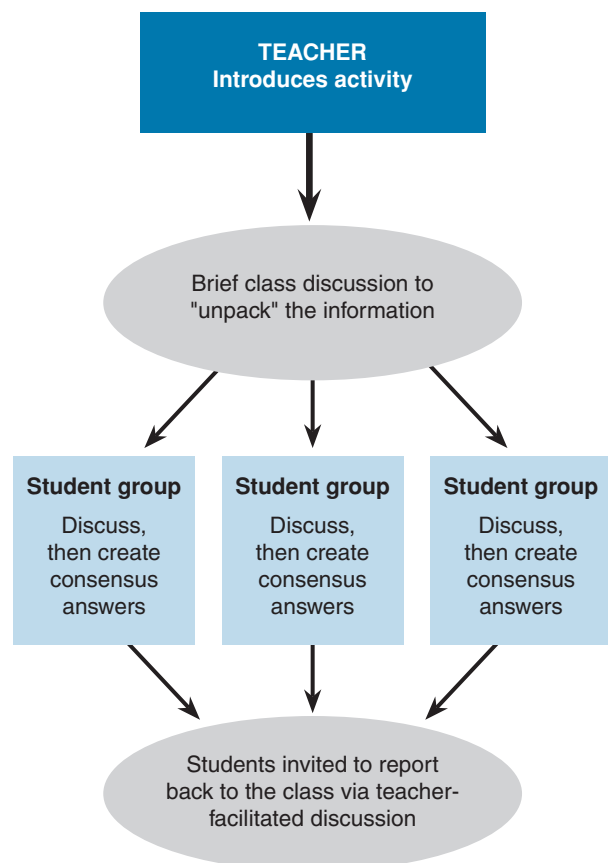
Sometimes an investigation makes up an assessment task. In this example, the assessment is associated with the analysis of the primary data collected.

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 *VCE Biology Units 1&2* 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.
- Collaboration, 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 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.

90 Modelling Meiosis 165

Key Idea: We can simulate crossing over, gamete production, and the inheritance of alleles during meiosis using ice-block sticks to represent chromosomes. This practical activity simulates the production of gametes (sperm and eggs) by meiosis and shows you how crossing over increases genetic variability. This is demonstrated by studying how two of your own alleles are inherited by the "child" produced at the completion of the activity. Completing this activity will help you to visualise and understand some of important aspects of the events in meiosis.

Investigation 7.1 Modelling meiosis using popsicle sticks

See appendix for equipment list.

To study the effect of crossing over on genetic variation, you will work in pairs to simulate the inheritance of two of your own traits: ability to tongue roll and handedness. This activity will take 25–45 minutes.

1. Record your phenotype and genotype for each trait in the table (right). If you have a dominant trait, you will not know if you are heterozygous or homozygous for that trait, so you can choose either genotype.
2. Before you start the simulation, partner up with a classmate. Your gametes will combine with theirs (fertilisation) at the end of the activity to produce a "child". Decide who will be

Chromosome number	Phenotype	Genotype
10	Tongue roller	TT, Tt
10	Non-tongue roller	tt
2	Right handed	RR, Rr
2	Left handed	rr

Step 1

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

In this activity, they can work together to explore how the processes involved in sexual reproduction contribute to variation in the offspring.

5. Simulate the first stage of meiosis by lining the duplicated chromosome pair with their homologous pair (below). For each chromosome number, you will have four sticks touching side-by-side (A, below).

At this stage crossing over occurs. Simulate this by swapping sticky dots from adjoining homologues (B, below).

Step 4

(A)

(B)

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62 Investigating Amylase Activity 107

Key Idea: Salivary amylase works optimally at the pH and temperature conditions of the human body. Enzyme activity outside these conditions decreases. Amylase is a digestive enzyme that hydrolyses (breaks down) starch into the sugars maltose (a disaccharide) and glucose (a monosaccharide). In mammals, amylase is secreted by the salivary glands into the saliva and by the pancreas into the small intestine. Like all enzymes, amylase works best under certain conditions. In this activity, you will investigate the effect of pH and temperature on amylase activity.

Investigation 4.2 Investigating amylase activity

See appendix for equipment list.

1. Obtain solutions of 0.1 mol/L iodine solution (I₂/KI), 1% amylase, and 1% starch and buffer solutions to cover pH 4, 5, 6, 7, and 8. Iodine solution is a yellow/orange colour, but in the presence of starch, it turns a blue/black colour.
2. Use a clean syringe to place a drop of iodine solution in each well of a two 3 x 4 spotting plates.
3. Add 1 mL of pH 4 buffer to a labelled test tube (TT4) and add 2 mL of amylase solution.
4. Add 2 mL of the starch solution to TT4 and start a timer.

Spotting plate: each well contains a single drop of 0.1 M iodine solution (iodine dissolved in a solution of potassium iodide). Multiple spotting plates will accommodate the number of tests required.

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 strength understanding and build skills in argumentation.

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3. (a) Graph the reaction rate vs pH on the grid.
(b) Identify the pH where amylase activity was the highest:
(c) Is this what you had expected? Explain:
4. Some students repeated the experiment at pH 1. Each sample turned blue/black when added to the iodine even after five minutes of sampling. Explain what has happened here:

pH	Reaction rate
4	
5	
6	
7	
8	

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Collaboration and discovery

- BIOZONE's *VCE Biology Units 1&2* 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 *VCE Biology Units 1&2* 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.

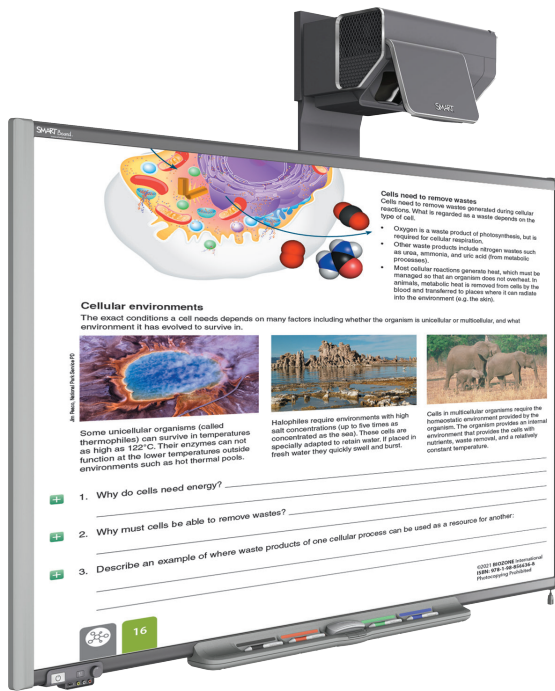


Student A is capable. He helps to lead the discussion and records the discussion in a structured way.

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.

- 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.



Tools for differentiated instruction within *VCE Biology Units 1&2* help teachers to support students 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 *VCE Biology Units 1&2* in a differentiated classroom:

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A-1 Appendix 1: Which Graph to Use?

The first chapter in this book gave you some guidelines for plotting data. Before you graph your data, it is important to identify what type of data you have. Choosing the correct type of graph can highlight trends or reveal relationships between variables. Choosing the wrong type of graph can obscure information and make the data difficult to interpret. A flow chart for selecting an appropriate plot for your data is provided below. You can refer to it at any time in your work.

What type of data do you collected?

- One variable is a category
One variable is a count (e.g. calculated percentages)
 - ➔ Use a **pie graph**
Average household water consumption in Australian cities
- One variable is a category
One variable is continuous data (e.g. measurements)
 - ➔ Use a **bar or column graph**
Average household water consumption in Australian cities
- One variable is continuous data (e.g. measurements)
 - ➔ Use a **histogram**
Household consumption (in litres per year) 1980-2000
- One variable is a count
 - ➔ Use a **histogram**
Household consumption (in litres per year) 1980-2000
- Both variables are continuous
 - ➔ Use a **line graph**
Temperature vs metabolic rate in a rat
- The response variable is dependent on the independent variable
 - ➔ Use a **line graph**
Temperature vs metabolic rate in a rat
- The points are connected point to point
 - ➔ Use a **line graph**
Temperature vs metabolic rate in a rat
- Both variables are continuous
The two variables are inter-dependent but there is no manipulated variable
 - ➔ Use a **scatter plot**
Body length vs head size in Daphnia
- A line of best fit can be drawn through the points
 - ➔ Use a **scatter plot**
Body length vs head size in Daphnia

Graph Descriptions:

- Pie graph:** Water use key: Drinking water, Industrial water, Domestic water, Sewage. Use to compare proportions in different categories.
- Bar or column graph:** Average household water consumption in Australian cities. Use to compare different categories. Can be used for continuous variables.
- Histogram:** Household consumption (in litres per year) 1980-2000. Use to show distribution. Bar height can be continuous variable.
- Line graph:** Temperature vs metabolic rate in a rat. Use to show relationship. Bar height can be continuous variable.
- Scatter plot:** Body length vs head size in Daphnia. Use to describe relationship between two continuous variables.

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62 Investigating Amylase Activity

Key Idea: Salivary amylase works optimally at the pH and temperature conditions of the human body. Enzyme activity outside these conditions decreases.

Amylase is an enzyme that hydrolyses (breaks down) starch into the sugars maltose (α -dissaccharide) and glucose

(a monosaccharide). In mammals, amylase is secreted by the salivary glands into the saliva and by the pancreas into the small intestine. Like all enzymes, amylase works best under certain conditions. In this activity, you will investigate the effect of pH and temperature on amylase activity.

Investigation 4.2: Investigating amylase activity

Materials required for experiment 4.2:

- Dilute solutions of 0.1 mol/L iodine solution (I₂/KI), 0.1% amylose, and starch and buffer solutions to cover pH 4.5, 6, 7, & 8, and Iodine as a yellow/brown colour; but in the presence of starch, it turns brown/black colour.

- 2. Use a clean glass plate or a well 9 x 6 x 4 cm.

- 3. Add 1 mL of pH 4.5 buffer solution.

- 4. Add 2 mL of the starch solution.

- 5. Wait 10 seconds for the blue color and mix.

- 6. Every 10 seconds add 1 drop of iodine.

- 7. Repeat until the color changes from blue to yellow.

- 8. Repeat steps 2 to 7.

- 9. Record the results in table 4.2.

- 1. Why was it important to add the buffer enzyme together before adding the substrate?

- 2. Complete your results table (left) by calculating the reaction rate for each pH (1 = 1 second).

- 3. (a) Graph the reaction rate vs pH on the grid.

- 3. (b) Identify the pH where amylase activity was the highest:

- (c) Is there what you had expected? Explain:

- 4. Some students repeated the experiment at pH 1. Each sample turned black when added to the iodine even after five minutes of waiting. Explain what has happened here:

Spotting plates: each well contains a single drop of 0.1 M iodine solution (added) + 1 mL of 0.1% amylose solution (added) + 1 mL of 0.1% starch solution (added). The number of wells required depends on the volume of reagents used.

The second well of the spotter is the TTX.

On the spotting grids,

this happens record the time as follows:

(1 = 1 s)

pH	Number of drops until change in colour	Number of seconds until colour change occurred	Rate of starch reduction (aw second)
4.5			
5			
6			
7			
8			

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Preparation Worksheet

A-A

A-1

G1

U1

U2

U3

U4

U5

U6

Students requiring extra support with understanding and analysing data should be encouraged to refer to **Appendices 1 and 2**. They provide a quick reference guide to choosing the right graph, basic mathematical calculations, common units of measure, and basic statistical formulae (with a worked example). Support for mathematical routines and data analysis and presentation is also provided in the introductory *Key Science Skills* chapter.

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 (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.

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.

The image shows three overlapping pages from a textbook. The top page is 'Investigation Design' (page 139), featuring a 'Key Idea' about sound design, a 'WHO?' section with questions about data collection, and a 'WHERE?' section with questions about site selection. The middle page is 'Identifying Bioethical Issues' (page 264), featuring a 'Key Idea' about the nature of bioethics, a 'Genetic screening in Australia' section, and a 'Diagnostic testing' section. The bottom page is 'Chapter Review: Did You Get it?' (page 259), featuring a 'Key Idea' about the three parts of biological diversity, a 'Seal pulse' graph, a 'Pisaster' graph, and two diagrams of communities (A and B). Red arrows point from the first few pages of the 'Investigation Design' activity to a text box, and from the 'Chapter Review' activity to another text box.

Investigation Design (Page 139)

Key Idea: A sound design that minimises bias and systematic error is necessary to produce a valid investigation. During the VCE course you will investigate how organisms are able to regulate their functions to enhance their survival. To achieve this, you will need to adapt (change) or design an appropriate investigation to generate primary data, then draw conclusions from the data it generates. Designing a good

WHO?

- Who took part in the data collection (e.g. as a researcher or subject)?
- What was each person's role?
- How did you make best use of the people in your team, e.g. to minimise bias?

WHERE?

- Which specific sites or set-ups were used for the data collection?
- Were there different sites/set-ups? How were different sites/set-ups related?

Identifying Bioethical Issues (Page 264)

Key Idea: The very nature of biology raises ethical issues over just what should be taken, or how we are interested in biology. Bioethical issues arise when as humans for any purpose. Bioethics when humans use technology to biological nature of another human.

Genetic screening in Australia

- The genetic screening of gametes is now possible. Genetic screening and treatment of diseases.
- Genetic screening has many possible bioethical issues. This is particularly true for fetuses because it may result in the even an undesirable genotype (e.g. sickle cell disease).

Diagnostic testing: A person may have symptoms typical of a particular genetic disorder. Genetic screening is used to determine if the person has the gene associated with a particular disease or not.

Arguments for genetic screening

- Testing allows potential carriers to be screened so they can decide whether the disease is important for diseases that do not appear until later in life (e.g. Huntington's).
- Researchers can study individuals with the disease and this may help develop a treatment or cure for that disease.
- Knowing a person's genetic make-up can optimise drug therapies and improve treatment.
- Knowing the risk of developing a disease can be made about medical options. For example, breast cancer can be treated, so an individual may choose to increase the chance of detection. They may choose to reduce risk by breast removal if they are at high risk of breast cancer.
- The discovery of a genetic defect in an unborn child provides an opportunity to come to terms with the situation and prepare for the delivery and ongoing care of a special needs child.

Chapter Review: Did You Get it? (Page 259)

Key Idea: The three parts of biological diversity: 1. Identify and describe the three parts of biological diversity: _____

2. The trace below shows pulse of a seal on the surface and as it dives.

Surface Dive Surface

0 Seconds 10 20 30 40

(a) What happens to the seal's pulse as it dives? _____

(b) What physiological changes are associated with this? _____

3. Define the following:

(a) Keystone species: _____

(b) Adaptation: _____

(c) Consumer: _____

4. The plot right shows the results of the experimental removal of the starfish *Pisaster* from a region of an ecosystem:

Number of species present

Year

(a) What does the graph show? _____

(b) What do the results suggest about *Pisaster*'s role in this ecosystem? _____

5. The diagrams right show two different communities of organisms. Which appears to have a greater biodiversity and how would you justify your answer? _____

A B

The first few pages of an activity can be useful to set the scene for a chapter. In this activity, have students review the considerations when collecting data and start to think about how they might apply them to their own design.

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. Here, reviewing the resources on the Hub may help students decide on the bioethical issue they want to explore in Outcome 3.

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 biodiversity and ecological interdependencies to complete the activity. Such activities allow the teacher to address any misconceptions before formal assessment.

Formative and Summative Assessments

BIOZONE's *VCE Biology Units 1&2* 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 table below. You may also choose to assess practical work as you move through the course.

SKILLS	UNIT 1: How do organisms regulate their functions?				
	AREA OF STUDY 1 How do cells function?		AREA OF STUDY 2 How do plant and animal systems function?		AREA OF STUDY 3
No formal assessment required	CHAPTER 2 Cellular Structure and Function	CHAPTER 3 Cell Cycle, Growth, and Differentiation	CHAPTER 4 Functioning Systems	CHAPTER 5 Regulation of Systems	CHAPTER 6 Investigating Organism Function
FORMATIVE Activity 8. Chapter Review	FORMATIVE Activity 34. Chapter Review	FORMATIVE Activity 48. Chapter Review SUMMATIVE Activity 47. Assessment task: Area of Study 1 <i>Response to a bioethical issue</i> Activity 48. Synoptic Questions	FORMATIVE Activity 65. Chapter Review	FORMATIVE Activity 75. Chapter Review SUMMATIVE Activity 67. Assessment task: Area of Study 2 <i>Data analysis of generated primary and/or collated data</i> Activity 76. Synoptic Questions	ASSESSMENT Report of student-adapted or student-designed investigation. Supported with Activity 80. A Template for Your Investigation

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65 Chapter Review: Did You Get It?

1. (a) What is the name given to the loss of water vapour from plant leaves and stems? _____

(b) What plant tissue is involved in this process? _____

(c) Is this tissue alive or dead? _____

(d) Does this process require energy? _____

2. (a) The leaf right was left in light for 24 hours then tested for starch. In which regions(s) would you expect to find starch (A, B, or C)? _____

(b) Explain your answer: _____

3. (a) What structures from the small intestine of a mammal are shown right? _____

(b) What is their function? _____

4. (a) The drawing right depicts nephrons from what organ? _____

(b) How many nephrons are shown? _____

(c) Identify the structures labelled (i)-(iv):
i) _____ ii) _____
iii) _____ iv) _____

(d) What do the arrows on the diagram indicate? _____

(e) What important molecule is reabsorbed at point A? _____

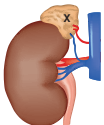
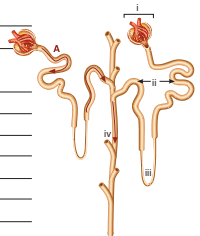

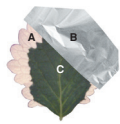
(f) What significant feature is missing from this diagram? _____

5. (a) Identify the endocrine gland labelled X in the diagram on the right: _____

(b) Name the hormones from this gland involved in the fight of flight response: _____

6. (a) Name the endocrine tissue in the pancreas: _____

(b) What are the two important hormones released by this tissue associated with blood glucose levels and what do they do: _____



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67 Analysis of Stomatal Density in Different Plants

Assessment task, Outcome 2: A data analysis of generated primary and/or collated data

Different plant species have different leaf shapes and structures and these can be correlated with their environment. Some of these leaf adaptations are associated with regulating water loss. These include the position, arrangement, and density of stomata.





Plant species show different leaf shapes and structures associated with their environments

Aloe (agave)
A succulent

Pine
A conifer

Eucalyptus
An Australian gum tree

Sunflower
A perennial dicot with large leaves



Tropical species with thick, fleshy leaves. Physiology allows it to fix CO₂ during the night and keep stomata closed during the day.

Temperate species with thin, needle like leaves and a thick waxy leaf cuticle. Stomata are sunken into pits.

Sub-tropical drought tolerant species with a deep root systems and waxy leaves that hang downwards.

Widespread cultivated North American dicot with a showy flower head and very large soft leaves.

Investigation 5.1 Comparing stomatal density

See appendix for equipment list.

1. Your teacher will have up to four leaf types from four dicot plants adapted to different environments, or you may need to obtain samples of your own.

2. The number of stomata per mm² on the surface of a leaf can be determined by counting the stomata visible under a microscope. Use the clear nail varnish to paint over the lower surface of a leaf. Leave it to dry. This creates a layer with impressions of the leaf surface.

3. Carefully peel off the nail varnish layer and place on a clean microscope slide.

4. Calculate the diameter of the area viewable under a microscope using the field of view divided by the magnification of the eyepiece multiplied by the magnification of the objective lens (for example if the eyepiece magnification is 10, the objective lens magnification 40, and the field of view 18, then 18/(10 x 40) = 0.045 mm diameter. The area viewable is then 16π².

5. You could also use a micrometer to measure the diameter of the field of view or use a thin clear ruler.

6. Place the slide with the nail varnish layer on it under the microscope and count the number of stomata you see. If there are too many stomata then count one quarter of the field of view and multiply by four. Do this in several places. Enter your results in the table and calculate a mean.

7. You should also take note of where the stomata are on the leaf (are they scattered randomly or in specific places?)

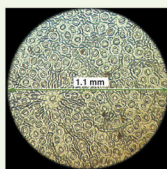
8. Repeat on the upper surface of the leaf.

9. Repeat for the other leaf types.

Magnification

WF10X 16mm

Field of view



56 66 A-4

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End of chapter reviews

Area of Study Assessment Task: Data analysis

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UNIT 2: How does inheritance affect diversity?

AREA OF STUDY 1 How is inheritance explained?			AREA OF STUDY 2 How do inherited adaptations affect diversity?		AREA OF STUDY 3
CHAPTER 7 From Chromosomes to Genomes	CHAPTER 8 Genotypes and Phenotypes	CHAPTER 9 Patterns of Inheritance	CHAPTER 10 Reproductive Strategies	CHAPTER 11 Adaptations and Diversity	CHAPTER 12 Exploring Bioethical Issues
FORMATIVE Activity 91. Chapter Review	FORMATIVE Activity 99. Chapter Review	FORMATIVE Activity 114. Chapter Review	FORMATIVE Activity 122. Chapter Review	FORMATIVE Activity 141. Chapter Review	ASSESSMENT Response to an investigation into a bioethical issue.
SUMMATIVE Activity 86. Assessment task: Area of Study 1 <i>Problem solving involving biological concepts or skills</i>		SUMMATIVE Activity 115. Synoptic Questions		SUMMATIVE Activity 140. Assessment task: Area of Study 2 <i>Case study analysis</i> Activity 142. Synoptic Questions	Supported with Activity 147. Your Research Question and Analysis

115 Synoptic Question: Unit 2, Area of Study 1

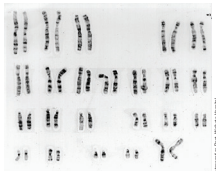
1. The preparation of a karyogram involves arranging the chromosomes of an individual into homologous pairs in order.
(a) Name some applications of this process: _____

- (b) Study the karyogram on the right. Circle the sex chromosomes: _____

- (c) State the sex of this individual: _____

- (d) Determine if the karyotype shown is normal/abnormal: _____

- (e) Explain the reason for the answer you have given in (d): _____



2. (a) What would you expect to see in the karyogram of an individual with Down syndrome? _____

- (b) What type of disorder is Down syndrome? _____

- (c) Explain the cause of Down syndrome: _____

3. The picture shows an albino western grey kangaroo with her grey offspring. Explain the genetics of this relationship, i.e. genotypes of parents and joey: _____



4. Using examples, discuss how phenotype can be affected by:

- (a) Genotype: _____

- (b) Environment: _____

- (c) Epigenetic factors: _____

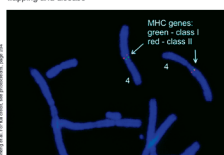
140 Tasmanian Devil: Disease and Populations

Assessment task, Outcome 2: Case study analysis

Recall that the genetic diversity of Tasmanian devils is particularly low. This case study explores the relationship between MHC allelic diversity affects and reproductive success in Tasmanian devils. The MHC genes control self recognition in the immune system.



Tasmanian devils are the largest surviving marsupial carnivore. Although now restricted to Tasmania, devils were once found throughout mainland Australia, but became locally extinct about 3000 years ago. Genetic evidence suggests that the devils went through at least two historic population crashes, one about 30,000 years ago and another about 3000 years ago. Coupled with these historic declines are modern declines (1850 to 1950) as a result of trapping and disease.



MHC genes are located on chromosome 4 of the Tasmanian devil genome.

1. The data on the right is part of a study on the breeding success of a group of captive Tasmanian devils. The data shows the age of the male and female in the pair, the reproductive success of the pair, and the number (out of 6) of MHC class-I heterozygous loci (location of microsatellite alleles) of each male and female in the pair.

You will analyse this data to determine the effect of two separate variables on the breeding success of Tasmanian devils and use your analysis to recommend the best course of action to increase reproductive success in devils.

The variables you will investigate are female age and genetic diversity.

You may require extra paper to work through and organise the data into meaningful groups. Attach all extra paper to this page. Alternatively the data could be entered into a spreadsheet.

No. female heterozygous loci	Female age (yr)	No. male heterozygous loci	Male age (yr)	Successful/Unsuccessful	A
4	4	1	4	successful	
4	3	2	3	unsuccessful	
4	3	3	3	unsuccessful	
3	2	2	3	unsuccessful	
4	3	1	5	successful	
4	2	3	3	successful	
6	4	1	5	successful	
6	2	3	3	successful	
3	2	4	2	unsuccessful	
3	2	3	3	unsuccessful	
4	3	2	2	unsuccessful	
1	3	4	3	successful	
4	3	3	2	unsuccessful	
4	2	1	3	unsuccessful	
4	2	2	2	successful	
6	2	2	2	successful	
6	4	3	4	successful	
5	2	1	3	successful	
5	3	2	3	successful	
5	3	2	3	successful	
3	2	4	4	successful	
1	2	4	2	successful	
1	3	3	3	successful	
5	2	2	3	successful	
5	2	1	3	successful	
5	4	1	3	unsuccessful	
5	4	2	3	unsuccessful	
2	2	3	2	successful	
2	4	2	4	unsuccessful	
5	2	0	2	successful	
3	2	4	2	successful	
3	5	2	5	unsuccessful	
1	3	1	5	unsuccessful	
1	2	4	2	successful	
1	3	3	3	unsuccessful	
2	2	4	2	successful	
5	3	4	4	unsuccessful	
5	2	1	2	unsuccessful	
1	2	4	3	successful	
2	3	4	4	unsuccessful	
2	4	2	4	unsuccessful	
3	2	4	3	successful	
5	3	2	2	successful	
5	5	2	5	unsuccessful	
3	3	6	4	unsuccessful	
2	2	2	3	successful	
2	3	2	3	unsuccessful	
5	2	4	3	successful	
5	3	3	4	successful	

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 themselves.

VCE BIOLOGY UNITS 1 & 2

Digital Teacher's Edition

- Show and hide answers on-screen using the digital versions of the workbooks. Reveal single and multiple-part answers with the click of a button. Provided with **Zoom in/out capabilities** to show detail.

Classroom Guide

- A comprehensive guide to effective use of BIOZONE's VCE Biology Units 1&2. It provides strategies for use with students of different abilities and for a variety of tasks, including assessment.

Spreadsheets and Statistics

- Microsoft® Excel® Spreadsheets directly support activities involving computational modelling, or data handling and analysis. Click here to view the ICT activities available.

Resource HUB

- Most activities are supported online via BIOZONE's Resource Hub, which provides direct access to supplementary reading, animations, video clips, 3D models, and reference papers.

www.biozonehub.com
Enter code: VCE11-2-6368

The Classroom Guide is provided as a printable PDF.

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

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.

56 Transpiration

Key Idea: Water moves through the xylem primarily as a result of evaporation from the leaves and the cohesive and adhesive properties of water molecules. Plants lose water all the time. Approximately 99% of the water a plant absorbs from the soil is lost by evaporation from the leaves and stem. This loss, mostly through stomata, is called **transpiration** and the flow of water through the plant is called the **transpiration stream**. Plants rely on an increasing gradient of water potential from the soil to the air to move water passively from the soil to the leaves.

Air
Evaporative loss of water from the leaves as water vapour

Leaves
Highest solute concentration
Lowest water concentration

Water flows passively from a low solute concentration (high water concentration) to a high solute concentration (lower water concentration). This gradient is the driving force in the transport of water up a plant.

134 Interdependence

Key Idea: Plants are common keystone species. Important food providers, influence a range of other plants and other producers are at the base of food so their role in ecosystems is always going to be important.

Keystone plants

Cockatoo grass (*Allocasuarina acutivalva*) is found through tropical savannas in northern and north western Australia. Cockatoo grass is an early coloniser in the wet season, providing a food source to many animal species before other plant species are available. Cockatoo grass is considered to be a keystone species because at certain times of the year it is the only food source available for two endangered species, the golden-shouldered parrot and the Northern bellbird, a small moustquill. Young cockatoo grass is a preferred food source for cattle and pigs, so it is easily overgrazed, leaving little for the wild species that rely on it. Conservation efforts are made to protect stands of cockatoo grass in some areas.

BIOZONE Tally charts & histograms

Smelt length

Size (mm)	Category (tally)	total
1-10	1	1
11-20	2	2
21-30	6	6
31-40	8	8
41-50	11	11
51-60	15	15
61-70	12	12
71-80	4	4
81-90	1	1

Length of Smelt

Number of fish

Length (mm)

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

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