BIOZONE

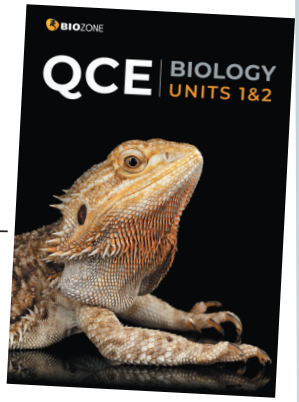
QCE | BIOLOGY UNITS 1&2

CLASSROOM GUIDE

Contents

Making the most of *BIOLOGY FOR QCE UNITS 1 & 2*

FAQs ABOUT OUR BIOLOGY FOR QCE UNITS 1 & 2 STUDENT WORKBOOK



Meeting Key Competencies

The three skill sets underpinning senior syllabuses in Queensland (literacy, numeracy, and 21st century skills) are well supported in Biology for QCE. We have utilised the 5Es instructional model as a basis for developing materials for this series. The 5E sequence is not a linear one, but an iterative spiral in which student explanation leads to further exploration and so on. In this manner, related activities build connections and deepen understanding. By successfully completing the activities students can demonstrate competence in key skills and knowledge, learn to plan and evaluate their work, think critically and independently, and respect the view and values of others. BIOZONE's workbooks and associated products provide a varied and interesting suite of resources which, if used effectively, can help your students achieve key competencies in all areas of biology.

Encouraging independent learning and collaboration using the 5 Es model

The Five Es

Engage:	make connections between past and present learning experiences.
Explore:	become actively involved in the activity.
Explain:	communicate the learning experience.
Elaborate:	expand on the concepts learned.
Evaluate:	assess understanding of the concepts.

ENGAGE: **Highly visual activities**	Use activities in class to engage a student when introducing a topic, or to consolidate student understanding and summarise the material covered by other methods. Using activities in class provides valuable opportunities for peer-to-peer learning.
ENGAGE: **A connected plan of study**	The check-box format of the contents pages and the chapter introductions provides a focus for planning achievement.
EXPLORE: **Independent, self directed study**	Activities encourage students to be independent learners and seek the answers to questions posed by the activity. They do this through creating their own models, analysing their own or second-hand data, or interpreting diagrams. Most activities are supported by web-based resources in the form of animations and video clips.
EXPLAIN: **Communicating is the key to consolidation**	All activities first engage the student with a key idea and a visual delivery of content. Student engagement with this material leads them to the questions that require them to communicate their understanding of the content. Students are encouraged to use appropriate biological terms as referenced in the chapter introduction (key terms).
ELABORATE: **Building up**	Most introductory activities are supported by activities in which students apply their understanding of ideas to a new situation. These 'follow-on' activities often involve data analysis, and support science practices.
EVALUATE: **Easy assessment**	Many activities contain moments for student evaluation and formative assessment, but each unit also concludes with a more comprehensive synoptic activity, which may be used as a formative or summative assessment to evaluate a student's understanding of key skills and knowledge.
WHAT ABOUT HOMEWORK?	Assign activities as homework to review a completed topic, explore a related concept, or introduce a topic prior to in-class practical work.

The Contents: A Planning Tool

The contents pages are not merely a list of the activities in the workbook. They serve as a planning tool for the programme of work to be completed. Students can identify the activities they are to complete and then tick them off when completed. The teacher can also see at a glance how quickly the student is progressing through the assigned material.

Contents

CODING: **Activity** is marked: ☐ to be done ☑ when completed

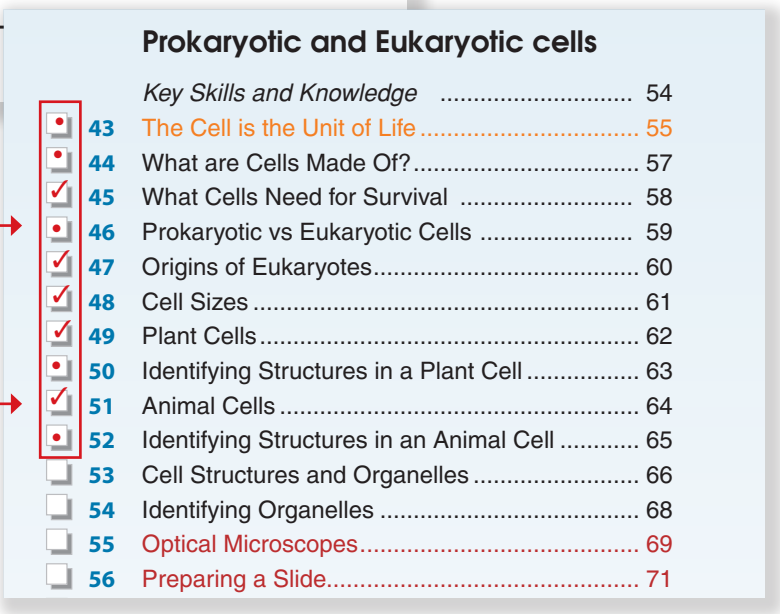
The teacher can see at a glance how this student is progressing through this unit of work. Any concerns with progress can be addressed early.

Activities supporting mandatory practicals are shown in RED.

Activities supporting "Science as a Human Endeavour" (SHE) are shown in ORANGE.

Students can mark the check boxes to indicate the activities they should complete. This helps them to quantify the work to be done and plan their work.

Ticking off the activities as they are completed gives students a sense of progression and helps them to be more personally organised in their work.



Prokaryotic and Eukaryotic cells

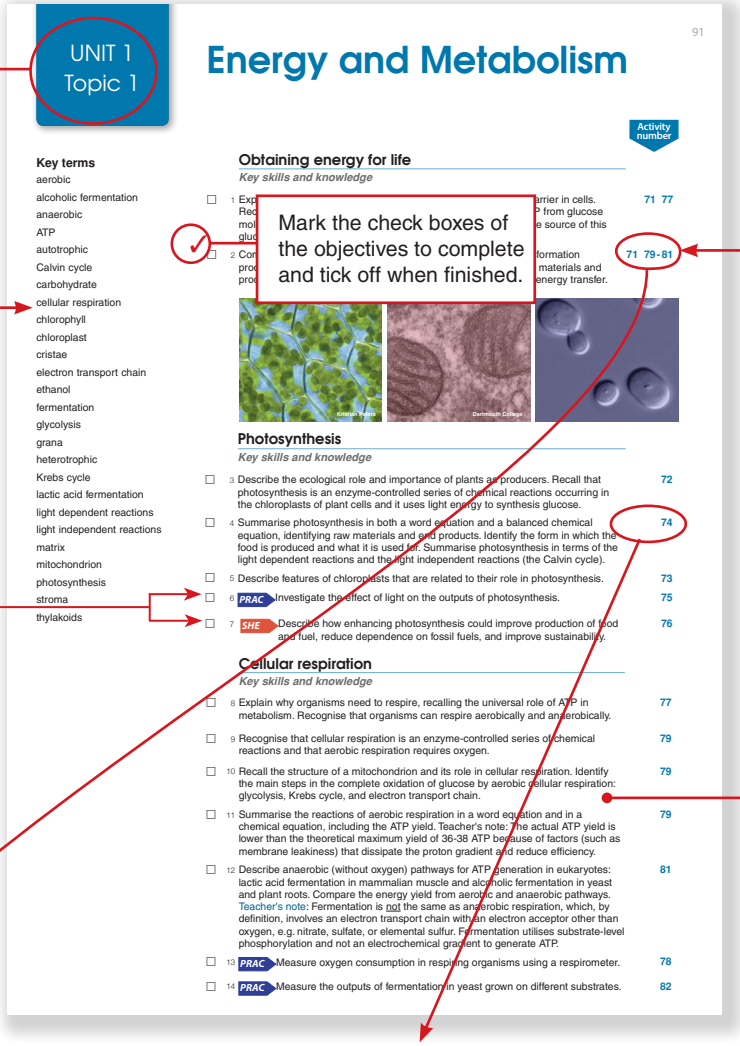
Introducing the Biology for QCE Content

Each chapter in Biology for QCE 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, 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.

This identifies the part of the course to which this chapter applies.

The list of **key terms** can be used to create a glossary for revision and encourages appropriate use of the correct terms when answering questions.

Coloured flags identify points related to "Science as a Human Endeavour" (*SHE*), manipulative skills (*SKILL*), and mandatory (red) and suggested (blue) practicals (*PRAC*)



UNIT 1
Topic 1

Energy and Metabolism

91

Activity number

Key terms
aerobic
alcoholic fermentation
anaerobic
ATP
autotrophic
Calvin cycle
carbohydrate
cellular respiration
chlorophyll
chloroplast
cristae
electron transport chain
ethanol
fermentation
glycolysis
grana
heterotrophic
Krebs cycle
lactic acid fermentation
light dependent reactions
light independent reactions
matrix
mitochondrion
photosynthesis
stroma
thylakoids

Obtaining energy for life
Key skills and knowledge

1 Exp… arrier in cells. 71 77
Rec… P from glucose
mol… e source of this
glu…
2 Cor… formation 71 79-81
proc… materials and
proc… energy transfer.

Kristian Peters — Dartmouth College

Photosynthesis
Key skills and knowledge

3 Describe the ecological role and importance of plants as producers. Recall that photosynthesis is an enzyme-controlled series of chemical reactions occurring in the chloroplasts of plant cells and it uses light energy to synthesis glucose. 72

4 Summarise photosynthesis in both a word equation and a balanced chemical equation, identifying raw materials and end products. Identify the form in which the food is produced and what it is used for. Summarise photosynthesis in terms of the light dependent reactions and the light independent reactions (the Calvin cycle). 74

5 Describe features of chloroplasts that are related to their role in photosynthesis. 73

6 PRAC Investigate the effect of light on the outputs of photosynthesis. 75

7 SHE Describe how enhancing photosynthesis could improve production of food and fuel, reduce dependence on fossil fuels, and improve sustainability. 76

Cellular respiration
Key skills and knowledge

8 Explain why organisms need to respire, recalling the universal role of ATP in metabolism. Recognise that organisms can respire aerobically and anaerobically. 77

9 Recognise that cellular respiration is an enzyme-controlled series of chemical reactions and that aerobic respiration requires oxygen. 79

10 Recall the structure of a mitochondrion and its role in cellular respiration. Identify the main steps in the complete oxidation of glucose by aerobic cellular respiration: glycolysis, Krebs cycle, and electron transport chain. 79

11 Summarise the reactions of aerobic respiration in a word equation and in a chemical equation, including the ATP yield. Teacher's note: The actual ATP yield is lower than the theoretical maximum yield of 36-38 ATP because of factors (such as membrane leakiness) that dissipate the proton gradient and reduce efficiency. 79

12 Describe anaerobic (without oxygen) pathways for ATP generation in eukaryotes: lactic acid fermentation in mammalian muscle and alcoholic fermentation in yeast and plant roots. Compare the energy yield from aerobic and anaerobic pathways. Teacher's note: Fermentation is not the same as anaerobic respiration, which, by definition, involves an electron transport chain with an electron acceptor other than oxygen, e.g. nitrate, sulfate, or elemental sulfur. Fermentation utilises substrate-level phosphorylation and not an electrochemical gradient to generate ATP. 81

13 PRAC Measure oxygen consumption in respiring organisms using a respirometer. 78

14 PRAC Measure the outputs of fermentation in yeast grown on different substrates. 82

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

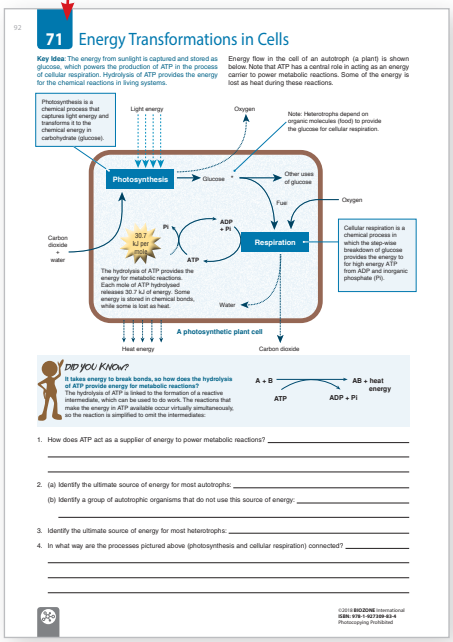
The activities in the workbook pertaining to these key knowledge outcomes

For students:

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

Introduce the concept with a grounding activity

Follow with an activity expanding on that concept



92

71 Energy Transformations in Cells

Key Idea: The energy from sunlight is captured and stored as glucose, which powers the production of ATP in the process of cellular respiration. Hydrolysis of ATP provides the energy for the chemical reactions in living systems.

Energy flow in the cell of an autotroph (a plant) is shown below. Note that ATP has a central role in acting as an energy carrier to power metabolic reactions. Some of the energy is lost as heat during these reactions.

Photosynthesis is a chemical process that captures light energy and transforms it to the chemical energy in carbohydrate (glucose).

Light energy — Oxygen — Note: Heterotrophs depend on organic molecules (food) to provide the glucose for cellular respiration.

Photosynthesis — Glucose — Other uses of glucose — Fuel — Oxygen — Carbon dioxide — water — 30.7 kJ per mole — ADP + Pi — ATP — Respiration

Cellular respiration is a chemical process in which the step-wise breakdown of glucose provides the energy to for high energy ATP from ADP and inorganic phosphate (Pi).

The hydrolysis of ATP provides the energy for metabolic reactions. Each mole of ATP hydrolysed releases 30.7 kJ of energy. Some energy is stored in chemical bonds, while some is lost as heat.

Water — A photosynthetic plant cell — Heat energy — Carbon dioxide

DID YOU KNOW?

It takes energy to break bonds, so how does the hydrolysis of ATP provide energy for metabolic reactions?

The hydrolysis of ATP is linked to the formation of a reactive intermediate, which can be used to do work. The reactions that make the energy in ATP available occur virtually simultaneously, so the reaction is simplified to omit the intermediates:

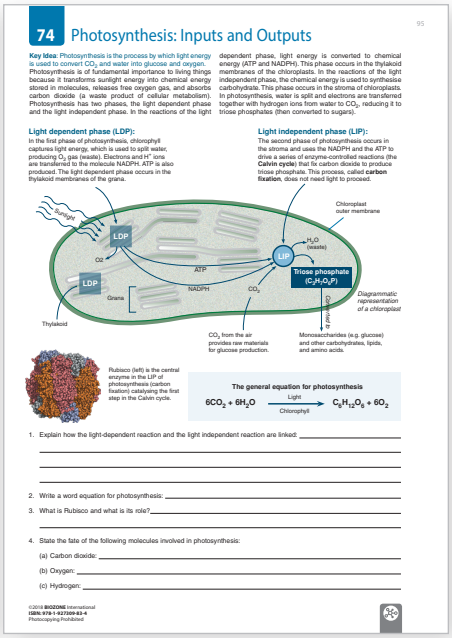
A + B — ATP — AB + heat energy — ADP + Pi

1. How does ATP act as a supplier of energy to power metabolic reactions? _____

2. (a) Identify the ultimate source of energy for most autotrophs: _____
(b) Identify a group of autotrophic organisms that do not use this source of energy: _____

3. Identify the ultimate source of energy for most heterotrophs: _____

4. In what way are the processes pictured above (photosynthesis and cellular respiration) connected? _____



95

74 Photosynthesis: Inputs and Outputs

Key Idea: Photosynthesis is the process by which light energy is used to convert CO_2 and water into glucose and oxygen. Photosynthesis is of fundamental importance to living things because it transforms sunlight energy into chemical energy stored in molecules, releases free oxygen gas, and absorbs carbon dioxide (a waste product of cellular metabolism). Photosynthesis has two phases, the light dependent phase and the light independent phase. In the reactions of the light dependent phase, light energy is converted to chemical energy (ATP and NADPH). This phase occurs in the thylakoid membranes of the chloroplasts. In the reactions of the light independent phase, the chemical energy is used to synthesise carbohydrate. This phase occurs in the stroma of chloroplasts. In photosynthesis, water is split and electrons are transferred together with hydrogen ions from water to CO_2, reducing it to triose phosphates (then converted to sugars).

Light dependent phase (LDP):
In the first phase of photosynthesis, chlorophyll captures light energy, which is used to split water, producing O_2 gas (waste). Electrons and H^+ ions are transferred to the molecule NADPH. ATP is also produced. The light dependent phase occurs in the thylakoid membranes of the grana.

Light independent phase (LIP):
The second phase of photosynthesis occurs in the stroma and uses the NADPH and the ATP to drive a series of enzyme-controlled reactions (the **Calvin cycle**) that fix carbon dioxide to produce triose phosphate. This process, called **carbon fixation**, does not need light to proceed.

Sunlight — LDP — O_2 — H_2O (waste) — LIP — ATP — NADPH — CO_2 — Triose phosphate ($C_3H_5O_3P$) — Grana — Thylakoid — Chloroplast outer membrane — Diagrammatic representation of a chloroplast

CO_2 from the air provides raw materials for glucose production. — Monosaccharides (e.g. glucose) and other carbohydrates, lipids, and amino acids.

Rubisco (left) is the central enzyme in the LIP of photosynthesis (carbon fixation) catalysing the first step in the Calvin cycle.

The general equation for photosynthesis

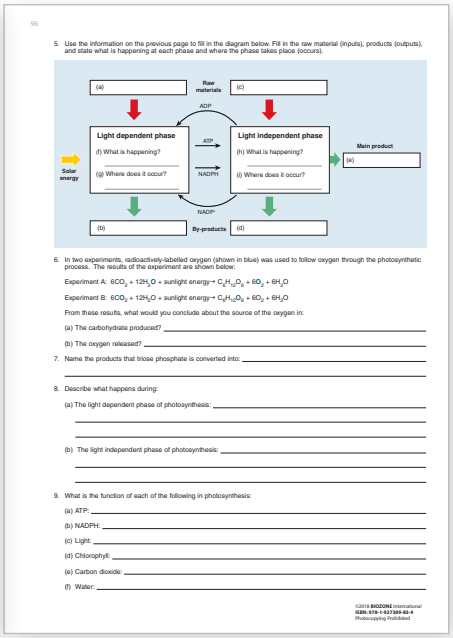
$$6CO_2 + 6H_2O \xrightarrow[\text{Chlorophyll}]{\text{Light}} C_6H_{12}O_6 + 6O_2$$

1. Explain how the light-dependent reaction and the light independent reaction are linked: _____

2. Write a word equation for photosynthesis: _____

3. What is Rubisco and what is its role? _____

4. State the fate of the following molecules involved in photosynthesis:
(a) Carbon dioxide: _____
(b) Oxygen: _____
(c) Hydrogen: _____



96

5. Use the information on the previous page to fill in the diagram below. Fill in the raw material (inputs), products (outputs), and state what is happening at each phase and where the phase takes place (occurs).

(a) — Raw materials — (c) — ADP — ATP — NADPH — NADP+ — Light dependent phase — (f) What is happening? — (g) Where does it occur? — Light independent phase — (h) What is happening? — (i) Where does it occur? — Solar energy — Main product — (e) — (b) — By-products — (d)

6. In two experiments, radioactively-labelled oxygen (shown in blue) was used to follow oxygen through the photosynthetic process. The results of the experiment are shown below:

Experiment A: $6CO_2 + 12H_2O$ + sunlight energy → $C_6H_{12}O_6 + 6O_2 + 6H_2O$

Experiment B: $6CO_2 + 12H_2O$ + sunlight energy → $C_6H_{12}O_6 + 6O_2 + 6H_2O$

From these results, what would you conclude about the source of the oxygen in:

(a) The carbohydrate produced? _____

(b) The oxygen released? _____

7. Name the products that triose phosphate is converted into: _____

8. Describe what happens during:

(a) The light dependent phase of photosynthesis: _____

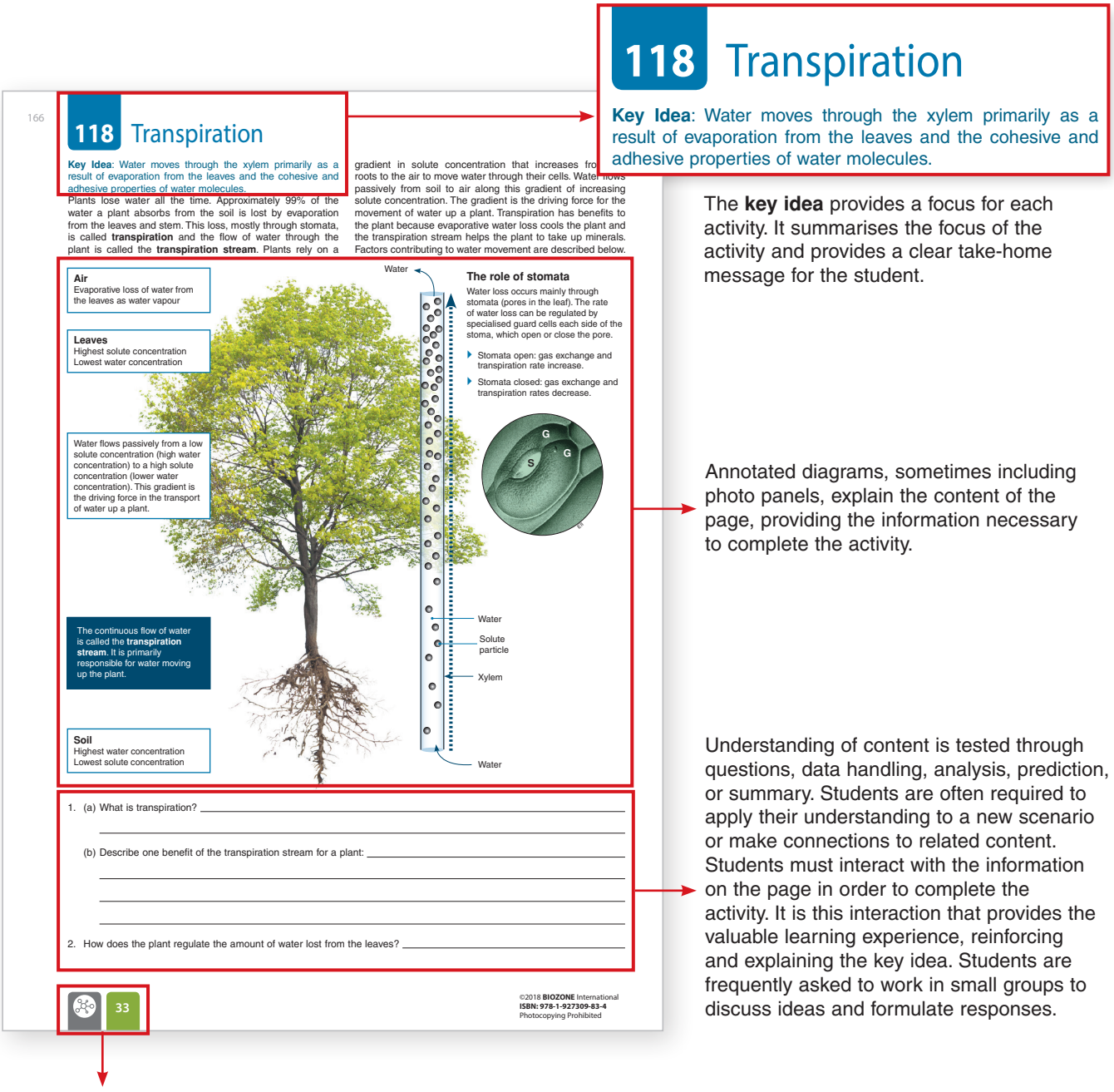
(b) The light independent phase of photosynthesis: _____

9. What is the function of each of the following in photosynthesis:

(a) ATP: _____
(b) NADPH: _____
(c) Light: _____
(d) Chlorophyll: _____
(e) Carbon dioxide: _____
(f) Water: _____

Finding Your Way Around

The content of the Biology for QCE Units 1 & 2 is organised into 17 chapters, each one beginning with an introduction and concluding 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, data analysis or interpretation, or biological drawing. An important feature of each activity is the key idea, which encapsulates the activity's main focus. Clear annotated diagrams and photographs are a major part of almost all activities and the student's understanding of the information is tested through a series of questions and/or data handling and interpretation tasks. The tabs for each activity identify the nature of the activity, and identify related material and external weblinks, which provide support for the activity.



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 content is identified through the tab system. This activity also has a **weblink** assigned to it. See the next page for more information on the tab system.

Using the Tab System

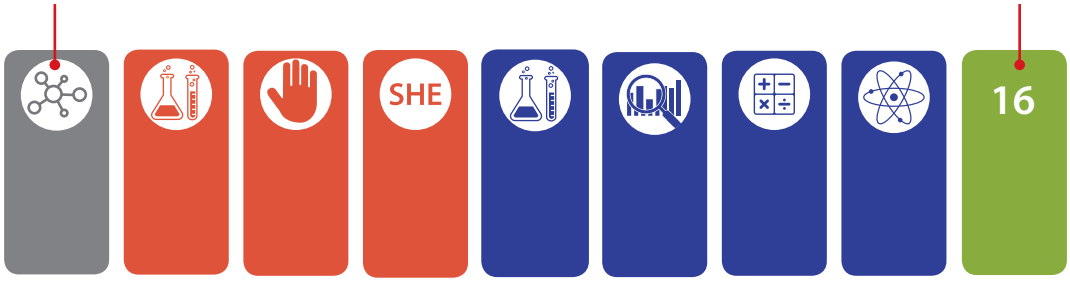
The tab system is a useful way to identify important parts of the QCE Biology syllabus. The colour coded page tabs show where science inquiry skills, practicals, or "Science as a Human Endeavour" material has been incorporated into an activity. The tabs also allow you to see at a glance if online support is provided and if there are content links with other activities.

Weblinks

This tab indicates the activity is supported with online content. Bookmark the weblinks page:
www.biozone.com.au/weblink/QCE1-9834
Access the external URL for the activity by clicking the link

Link

Connections are made between activities in different sections of the syllabus. These activities may contain related concepts or they may provide background information.



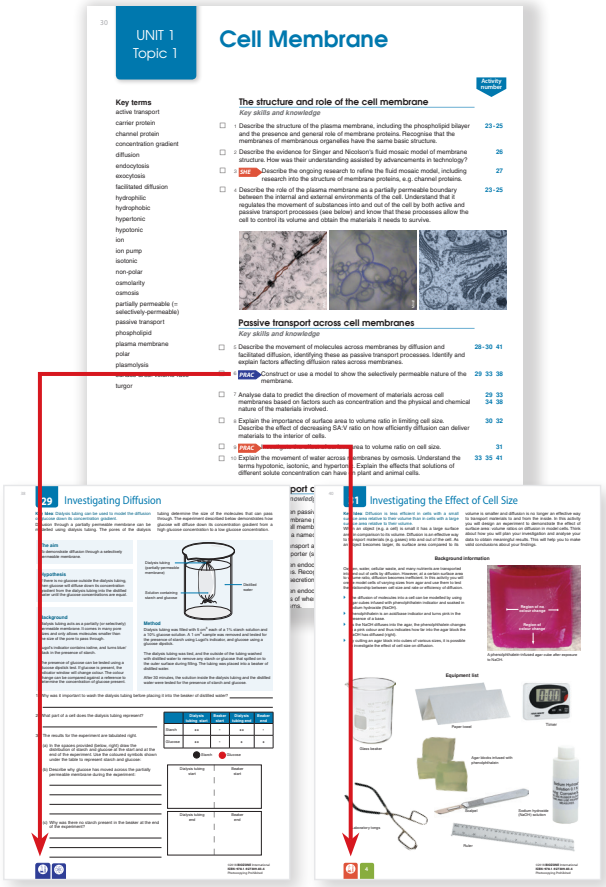
Red tabs indicate that the activity contains the following (L → R):

- Mandatory practical
- Manipulative skill
- Science as a human endeavour

Blue tabs indicate the activity contains the following (L → R):

- Suggested practical
- Data analysis and interpretation
- Tasks involving mathematical or numeracy skills
- Modelling

Identifying practicals

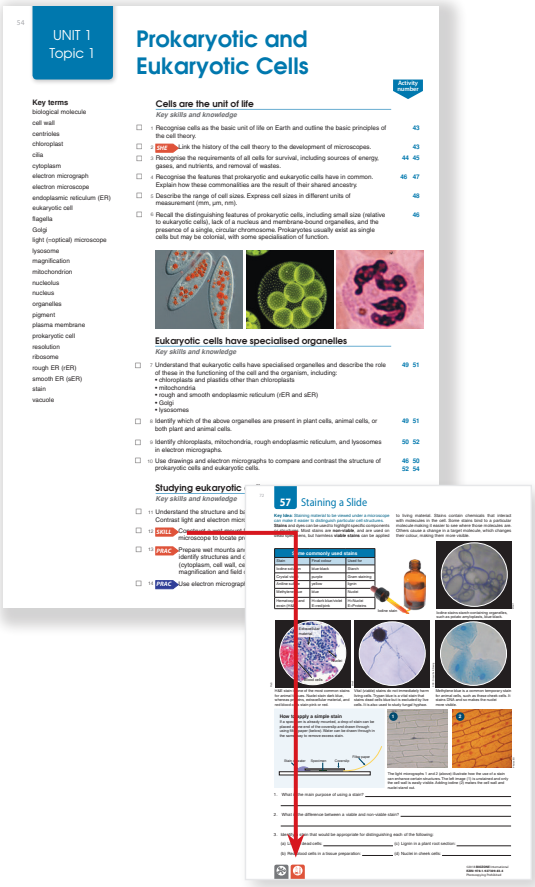


The QCE Biology Syllabus requires students to develop their practical skills. Activities to support practical skills are identified in the workbook via the practical tabs.

A **red** practical tab indicates a **mandatory** practical.

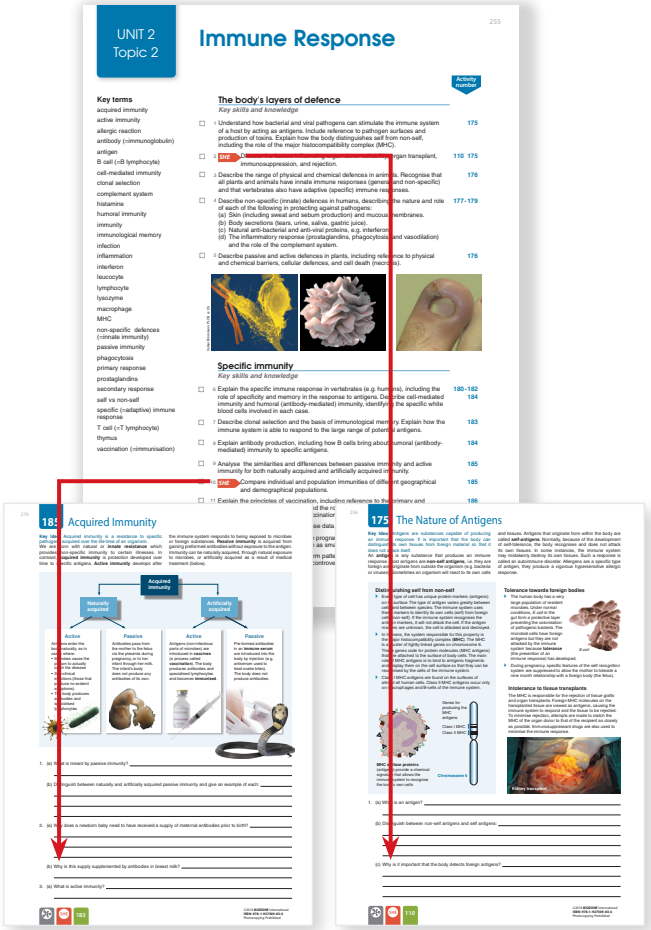
A **blue** practical tab indicates a **suggested** practical.

Identifying manipulative skills



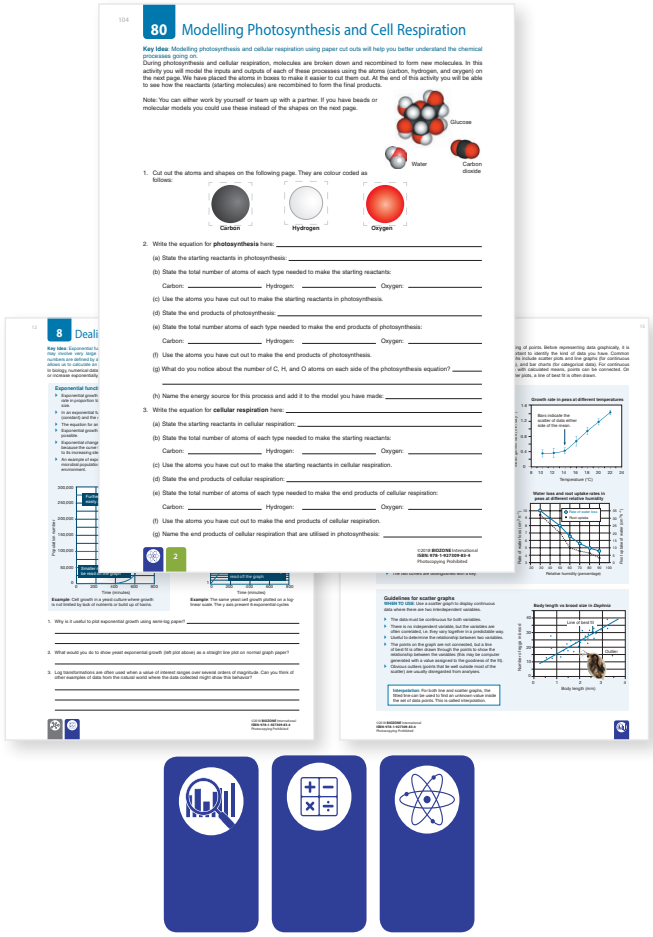
Students need to develop specific manipulative skills in order to be able to complete practical components of the syllabus. These skills are identified on the page with a red manipulative skills tab.

Identifying science as a human endeavour



Through "Science as a Human Endeavour" contexts, students develop an appreciation about the nature and development of science, how science is used, and how it influences society.

Identifying skills

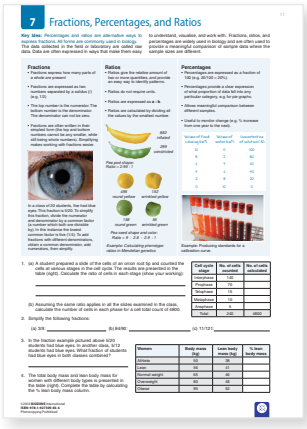


QCE Biology provides students with ample opportunity to practise the skills necessary for scientific inquiry. These skills are identified on the relevant activity pages.

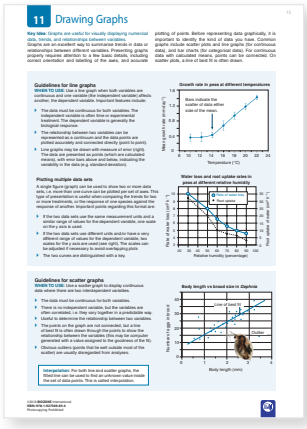
Mathematical skills and numeracy

QCE Biology supports students in developing the mathematical skills needed for scientific enquiry. Fundamental skills are covered in the introductory chapter and are supported throughout the book in a variety of ways, e.g. making and recording observations, evaluating error, graphing, and interpreting and analysing data (including statistical analysis).

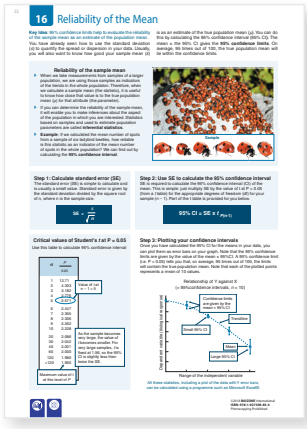
- Skills in this chapter (and throughout the book) help prepare students for the data test in Unit 3.



- Expressing data in ways that make them easy to understand, visualise, and work with.

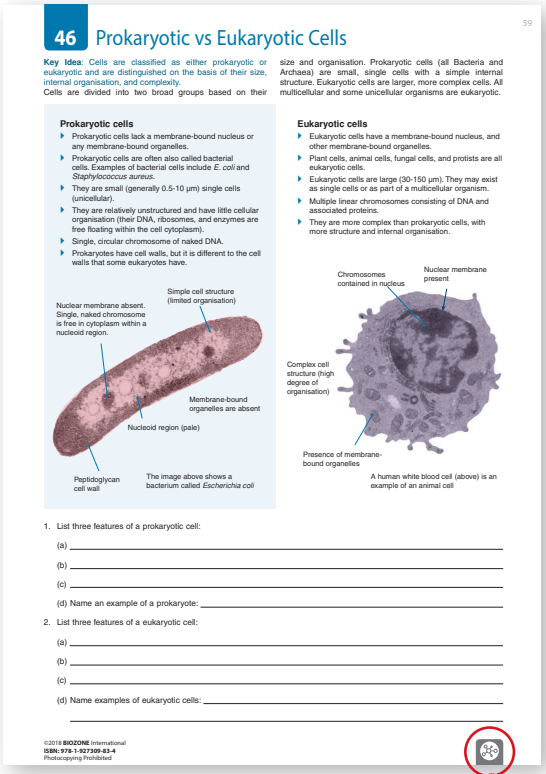


- Graphing skills, including knowing which graph to choose and how to format it correctly.



- Determine the reliability of data by plotting confidence intervals.

Making Use of Weblinks



46 Prokaryotic vs Eukaryotic Cells

Key Idea: Cells are classified as either prokaryotic or eukaryotic and are distinguished on the basis of their size, internal organisation, and complexity.
Cells are divided into two broad groups based on their size and organisation. Prokaryotic cells (all Bacteria and Archaea) are small, single cells with a simple internal structure. Eukaryotic cells are larger, more complex cells. All multicellular and some unicellular organisms are eukaryotic.

Prokaryotic cells
- Prokaryotic cells lack a membrane-bound nucleus or any membrane-bound organelles.
- Prokaryotic cells are often also called bacterial cells. Examples of bacterial cells include *E. coli* and *Staphylococcus aureus*.
- They are small (generally 0.5-10 µm) single cells (unicellular).
- They are relatively unstructured and have little cellular organisation (their DNA, ribosomes, and enzymes are free floating within the cell cytoplasm).
- Single, circular chromosome of naked DNA.
- Prokaryotes have cell walls, but it is different to the cell walls that some eukaryotes have.

Eukaryotic cells
- Eukaryotic cells have a membrane-bound nucleus, and other membrane-bound organelles.
- Plant cells, animal cells, fungal cells, and protists are all eukaryotic cells.
- Eukaryotic cells are large (30-150 µm). They may exist as single cells or as part of a multicellular organism.
- Multiple linear chromosomes consisting of DNA and associated proteins.
- They are more complex than prokaryotic cells, with more structure and internal organisation.

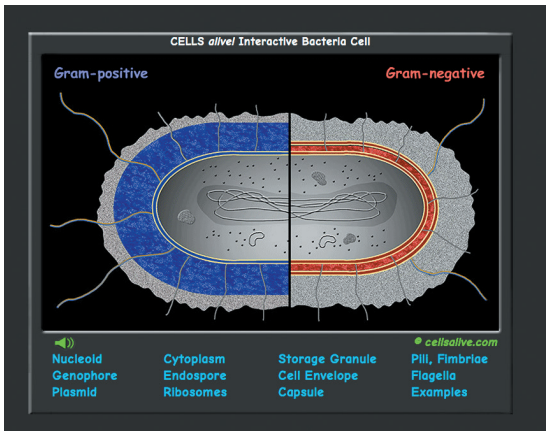
Nuclear membrane absent. Single, naked chromosome is free in cytoplasm within a nucleoid region.
Simple cell structure (limited organisation)
Membrane-bound organelles are absent
Nucleoid region (pale)
Peptidoglycan cell wall
The image above shows a bacterium called *Escherichia coli*

Chromosomes contained in nucleus
Nuclear membrane present
Complex cell structure (high degree of organisation)
Presence of membrane-bound organelles
A human white blood cell (above) is an example of an animal cell

1. List three features of a prokaryotic cell:
   (a) _____
   (b) _____
   (c) _____
   (d) Name an example of a prokaryote: _____
2. List three features of a eukaryotic cell:
   (a) _____
   (b) _____
   (c) _____
   (d) Name examples of eukaryotic cells: _____

ISBN: 978-1-927309-83-4

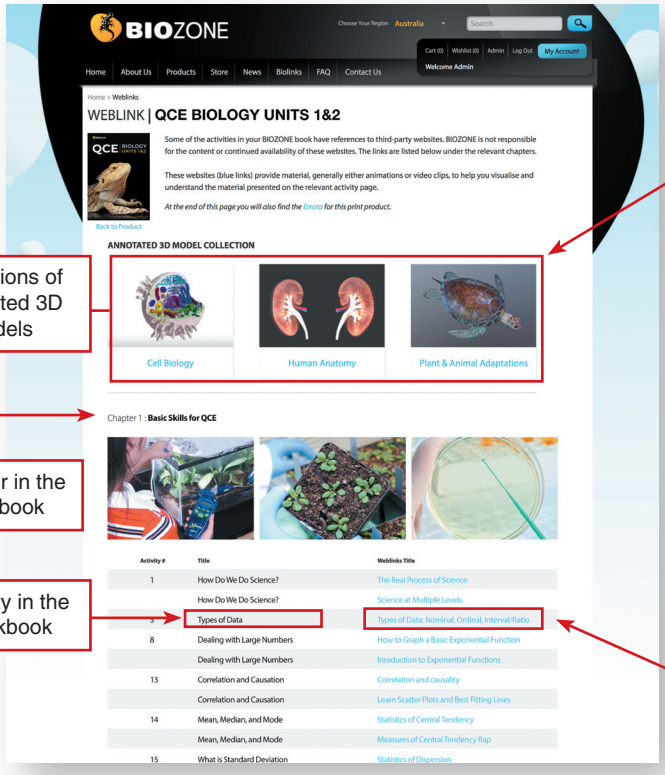
The weblinks tab identifies if there is online content supporting the activity's content. Weblinks are only accessible through a specific url (below), so bookmark the address at the beginning of your teaching year and always have them on hand. For the most part, the weblinks comprise short video clips or animations aimed specifically at the activity content. These are external sites from a wide range of reputable sources and are invaluable as support to explain content or view an animation of a process such as diffusion or active transport. It's easy and we've done the hard work for you. Just click and view.



Weblinks exist for most of the activities in the workbook.

www.biozone.com.au/weblink/QCE1-9834

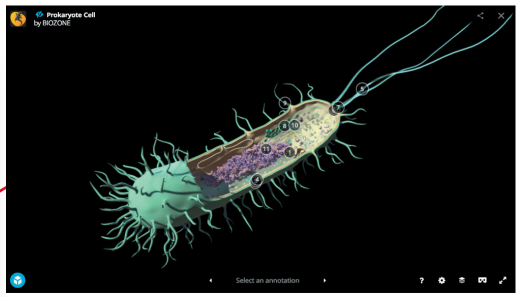
In addition to links to **external web sites**, the WEBLINKS page also provides access to BIOZONEs collection of annotated 3-D models, organised into three broad categories. Explore the models relevant to you.

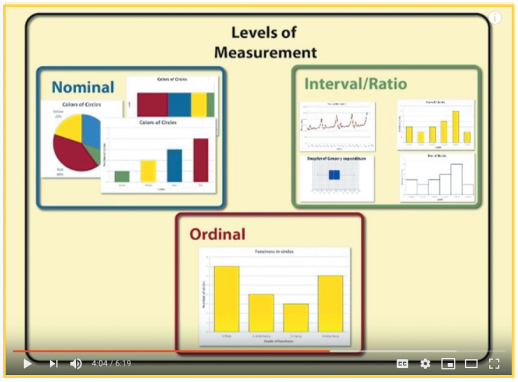


Collections of annotated 3D models

Chapter in the workbook

Activity in the workbook





Types of Data: Nominal, Ordinal, Interval/Ratio - Statistics Help

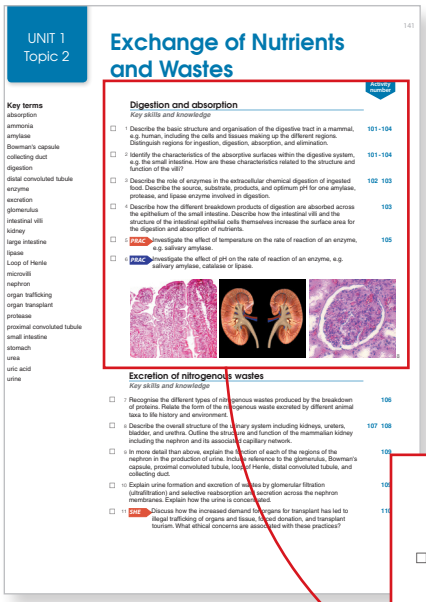
Hyperlink to the external website page.

Bookmark weblinks by typing in the address: it is not accessible directly from BIOZONE's website

Corrections and clarifications to current editions are always posted on the weblinks page

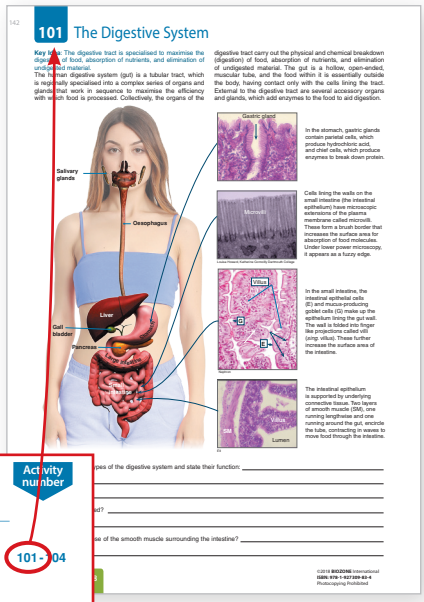
Building Understanding

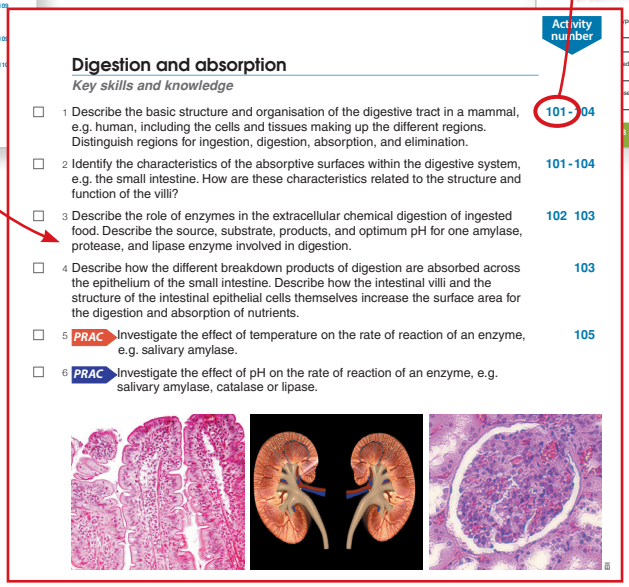
Biology for QCE Units 1 & 2 focusses on the key knowledge and skills requirements identified in the QCE Biology Senior Syllabus, and activities have been provided specifically to address its content. Our focus is student engagement through the use of a concept-based, highly visual approach that provides opportunity to demonstrate skills and understanding.

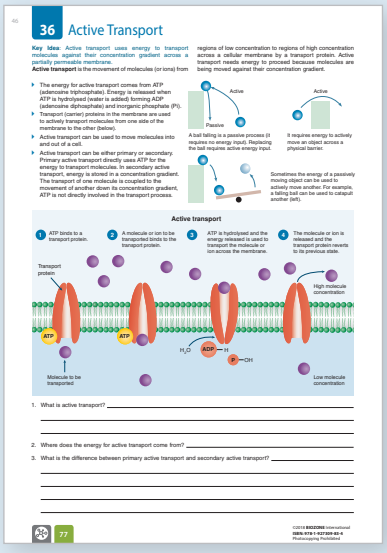


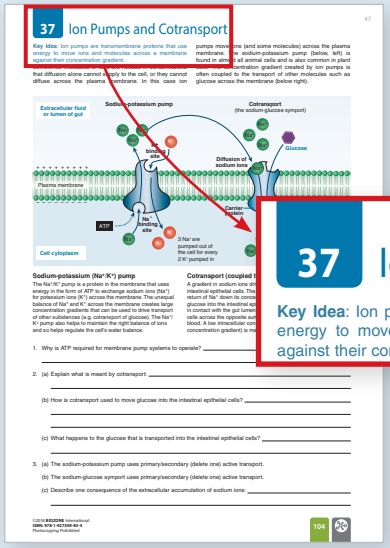
The introduction to each chapter provides a summary of the learning outcomes. Activities supporting practicals, SHE, and manipulative skills are also identified here and presented as a series of short student learning aims. The students achieve understanding of each statement by completing its corresponding activity.

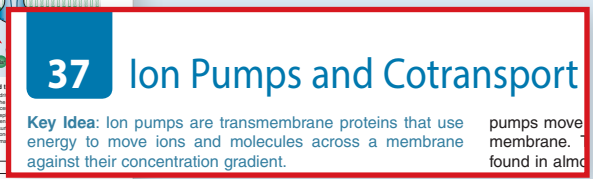
Activities are written and presented so that students progressively extend and deepen their understanding, using what they have learned in earlier activities to complete later related activities and to solve new problems.











The KEY IDEA provides a focus for each activity. The key ideas through a chapter provide a concise summary of the chapter content.

Students become actively involved in the learning activity by interacting with the material, answering the questions and completing the set tasks. Many activities are suitable as assessment tasks.

Engage, explore, explain, elaborate, and evaluate: An introductory activity introduces and builds understanding of a specific core idea. Subsequent activities allow exploration of the topic, and provide opportunities for the student to explain and elaborate on what they have learned. Tasks involving evaluation are towards the end of the chapter or unit.

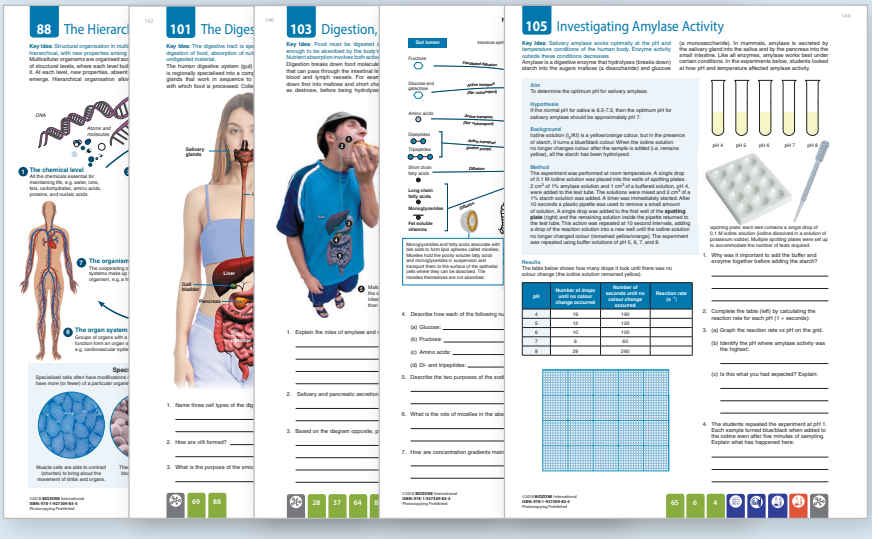
Groups of activities build knowledge and understanding by giving students the chance to learn and apply their knowledge in a series of linked activities incorporating the 5 Es. For the example right, students:

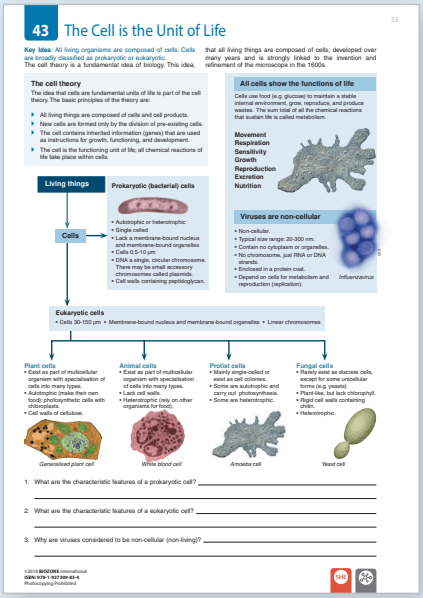
Engage: visualise the concept of hierarchal structure

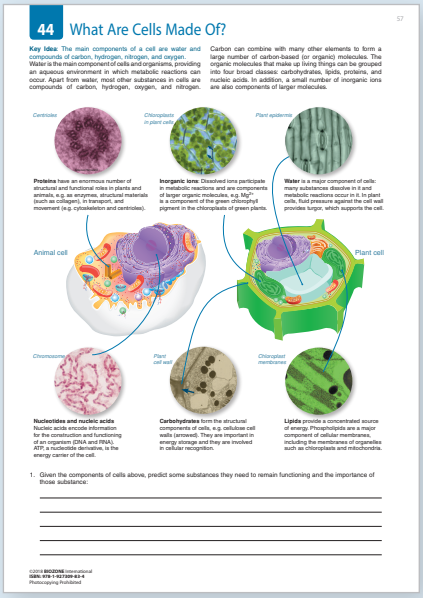
Explore: the relationship between structure and function

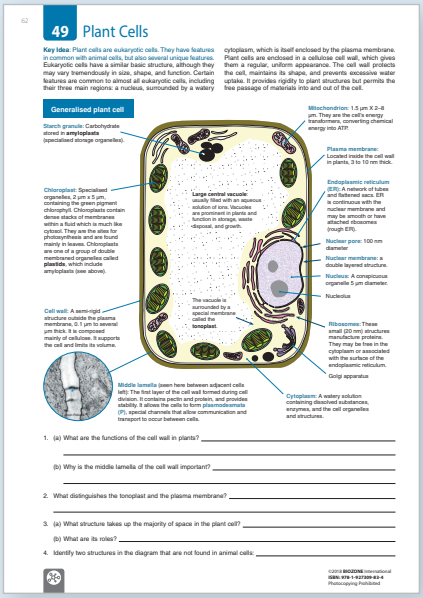
Explain & Elaborate: the processes involved based on understanding of structure and function

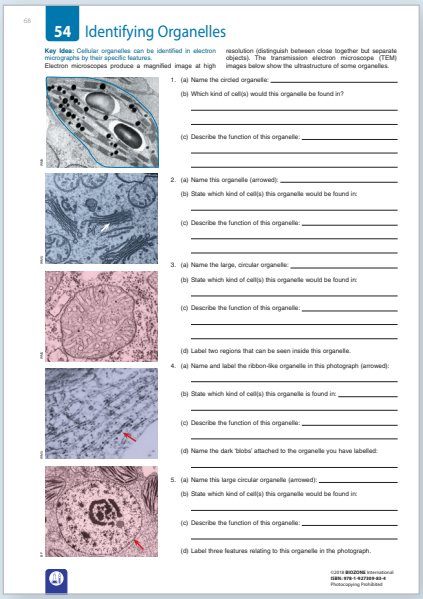
Explore & Evaluate: through experimentation and observation and explain trends in light of understanding.

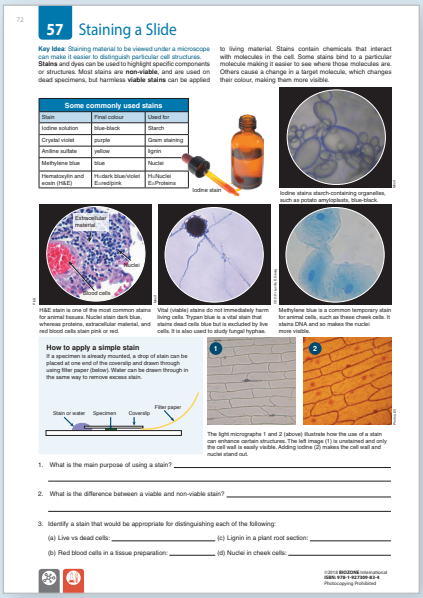


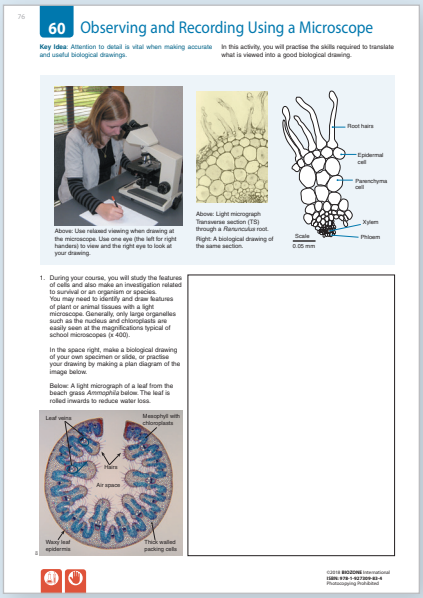








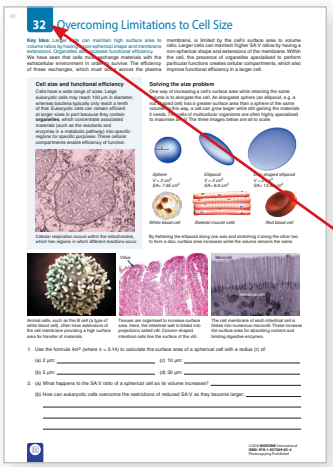


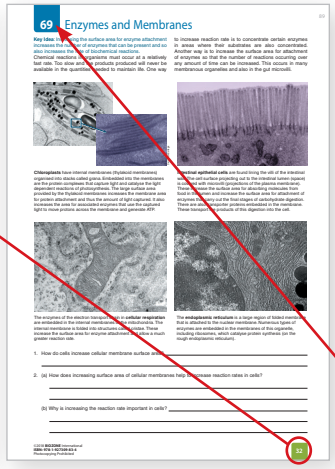


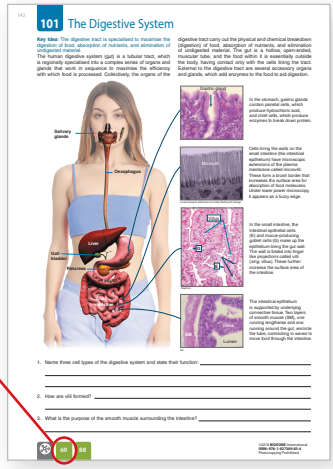
In this sequence students are introduced to an already familiar concept; that the cell is the unit of life. They then learn more detail about cells (e.g. what cells are made of) and explore the features of eukaryotic cells through diagrams and scientific images. Students have an opportunity to explore the features of cells for themselves as they firstly learn how to prepare samples for observation, and then study their samples under a microscope to observe their features first hand.

LINKS - Making Connections

The LINK tabs help students to connect ideas between different topics in the QCE Biology Syllabus. Connections may be made to activities that build on or develop an idea, utilise the same core principles in another biological context, or examine the evidence for a biological process. The connections help students to appreciate that the same core principles underlie many biological phenomena and there is evidence to support them. Understanding these core principles brings understanding to a wide range of contexts and situations, even if they are unfamiliar.



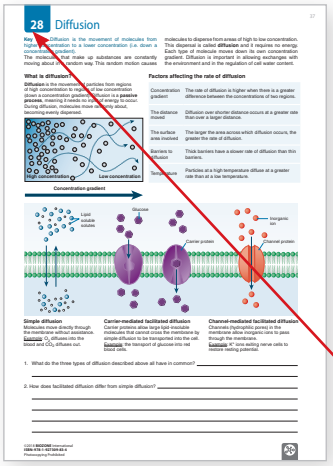


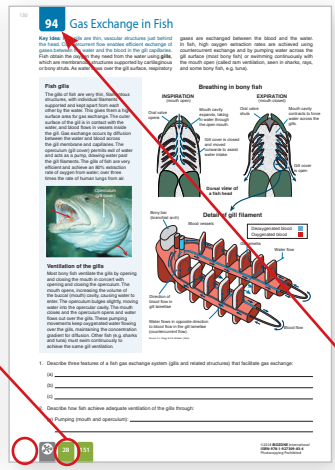


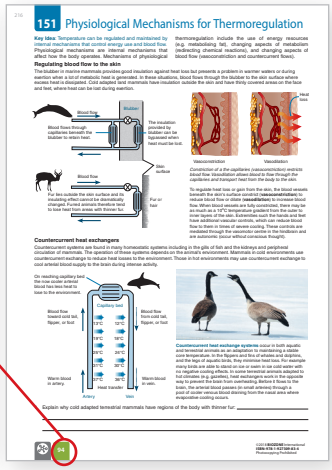
EXAMPLE 1

Increasing surface area

Student's initially learn how cells overcome limitations to cell size. This knowledge is then applied to specific examples in subsequent activities (e.g. increasing surface area for digestion).



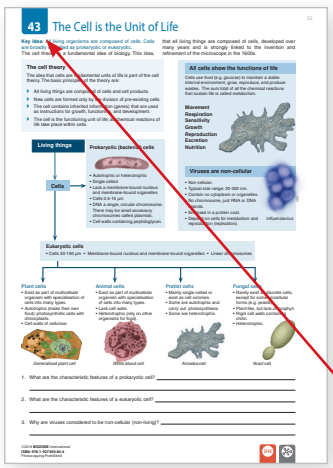


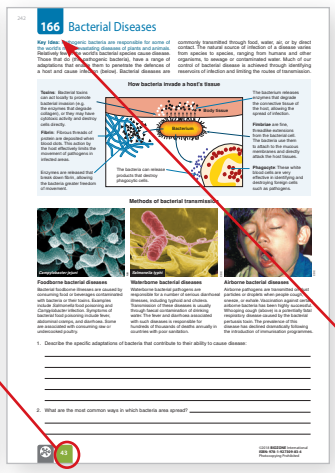


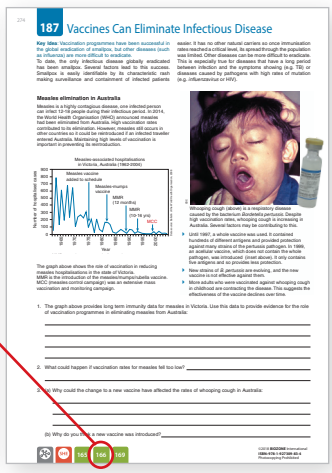
EXAMPLE 2

Maintaining physiological systems

The properties of diffusion can be applied to physiological contexts, such as countercurrent gas exchange in the gills of fish. Students also see that the principles of countercurrent exchange can be used in thermoregulation.







EXAMPLE 3

Bacterial disease

When students learn how vaccines can be used to eliminate bacterial diseases, they are applying knowledge gained from previous activities. In this instance they are recalling that bacteria are prokaryotic cells and that bacteria can cause many types of disease in humans.

Differential Instruction with BIOZONE

Achieving effective differential 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 workbooks and supporting products can make teaching a mixed ability class easier. Here, we offer three approaches for differential instruction.

MAKING A START

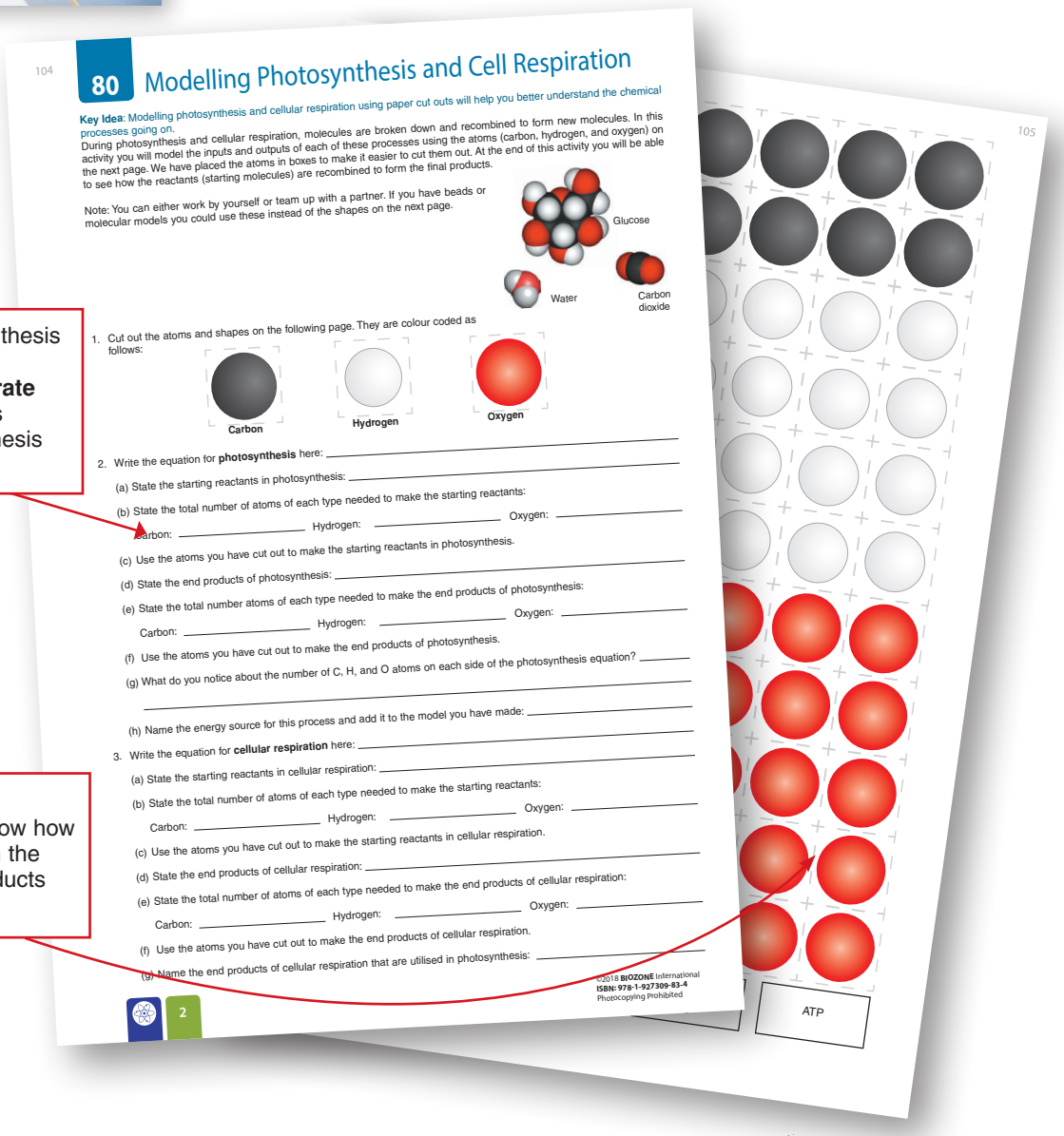
Regardless of which activity you might be attempting in class, a 5-10 minute introduction to the task by the teacher is useful orientation for all students. For collaborative work, the teacher can then divide the class into appropriate groups, each with a balance of able and less able students.

1 Efficient differential instruction

- Use **peer-to-peer learning** for more challenging activities where the level of content is more difficult and the questions require students to draw on several areas of their knowledge to synthesise an answer.
- Stronger peers can assist weaker students and both groups benefit from verbalising their thoughts and presenting them to a group. **ESL students** can ask their peers to explain unfamiliar terms (both scientific and English) and this benefits both parties. **Paper practicals** (e.g. *Modelling Photosynthesis and Cell Respiration)* are another ideal vehicle for this kind of peer-to-peer learning.

In Modelling Photosynthesis and Cell Respiration, students can **collaborate** to model the reactions involved in photosynthesis and respiration.

Students can use the element cutouts to show how matter moves through the system, and how products and by-products form.


104

80 Modelling Photosynthesis and Cell Respiration

Key Idea: Modelling photosynthesis and cellular respiration using paper cut outs will help you better understand the chemical processes going on.

During photosynthesis and cellular respiration, molecules are broken down and recombined to form new molecules. In this activity you will model the inputs and outputs of each of these processes using the atoms (carbon, hydrogen, and oxygen) on the next page. We have placed the atoms in boxes to make it easier to cut them out. At the end of this activity you will be able to see how the reactants (starting molecules) are recombined to form the final products.

Note: You can either work by yourself or team up with a partner. If you have beads or molecular models you could use these instead of the shapes on the next page.

Glucose
Water
Carbon dioxide

1. Cut out the atoms and shapes on the following page. They are colour coded as follows:

Carbon
Hydrogen
Oxygen

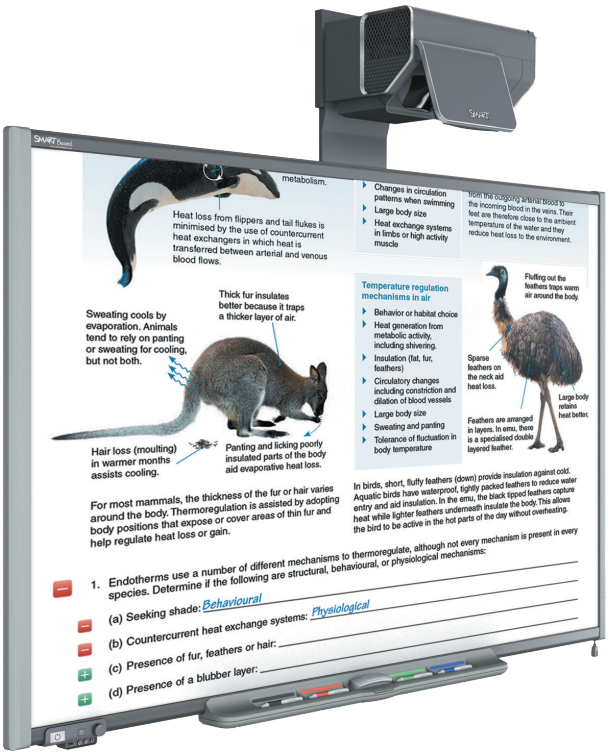
2. Write the equation for **photosynthesis** here:
(a) State the starting reactants in photosynthesis:
(b) State the total number of atoms of each type needed to make the starting reactants:
Carbon: Hydrogen: Oxygen:
(c) Use the atoms you have cut out to make the starting reactants in photosynthesis.
(d) State the end products of photosynthesis:
(e) State the total number atoms of each type needed to make the end products of photosynthesis:
Carbon: Hydrogen: Oxygen:
(f) Use the atoms you have cut out to make the end products of photosynthesis.
(g) What do you notice about the number of C, H, and O atoms on each side of the photosynthesis equation?
(h) Name the energy source for this process and add it to the model you have made:
3. Write the equation for **cellular respiration** here:
(a) State the starting reactants in cellular respiration:
(b) State the total number of atoms of each type needed to make the starting reactants:
Carbon: Hydrogen: Oxygen:
(c) Use the atoms you have cut out to make the starting reactants in cellular respiration.
(d) State the end products of cellular respiration:
(e) State the total number of atoms of each type needed to make the end products of cellular respiration:
Carbon: Hydrogen: Oxygen:
(f) Use the atoms you have cut out to make the end products of cellular respiration.
(g) Name the end products of cellular respiration that are utilised in photosynthesis:

©2018 BIOZONE International
ISBN: 978-1-927309-83-4
Photocopying Prohibited

2

105

ATP



2 Interactive revision of tasks in class

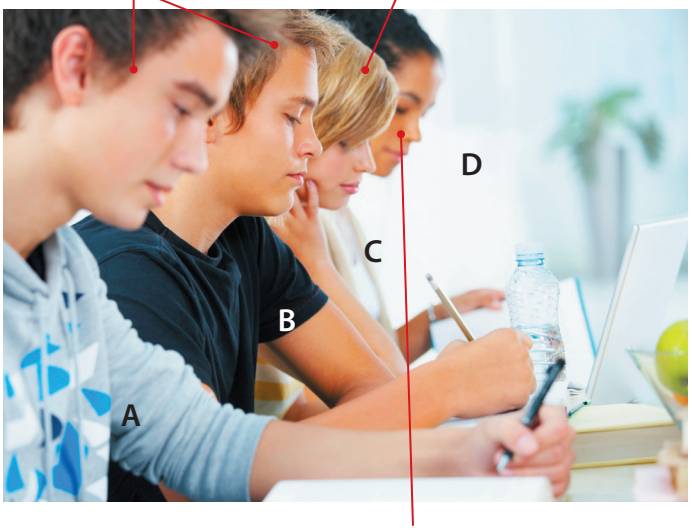
- Use the workbook PDFs with HIDE/SHOW answers on the **Teacher's Digital Edition** to review activities in class using a data projector or interactive whiteboard.
- Students benefit from the feedback in class, where questions can be addressed, and teachers benefit by having students self-mark their 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.

3 Gaining Confidence

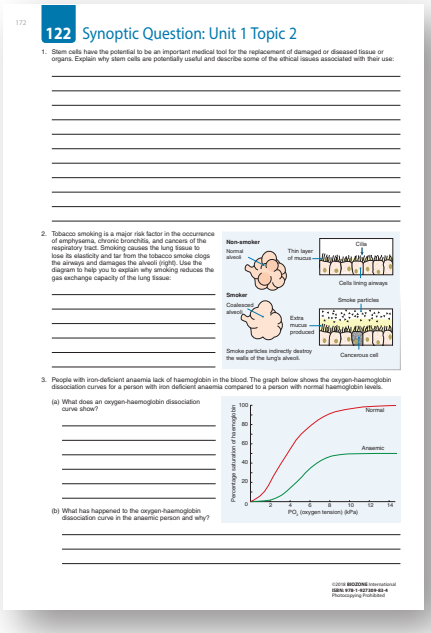
- The questions in BIOZONE's workbook activities have generally been written in a direct questioning style, e.g. "What are the differences between A and B", or "Why are A and B different?". This makes it easier for the students to understand what is required to answer the question.
- Questions are also arranged so that simpler questions (describe, what, identify, name) are generally asked first, followed by questions demanding an explanation (explain, how, why, account for). This allows students to gain confidence from answering the simpler questions first before attempting the questions that require more comprehensive answers.
- This arrangement also allows teachers to direct students appropriately so that some may attempt only the simpler questions themselves and work with peers to attempt the more challenging questions.

Students A and B will work through simpler questions themselves but may require assistance with the more challenging questions in this activity.

Student C is capable. She completes all of this activity including the more challenging questions.



Student D (above) is capable and needs extension. She works quickly, completing her set work. She can demonstrate her understanding in the synoptic question.


122 Synoptic Question: Unit 1 Topic 2

1. Stem cells have the potential to be an important medical tool for the replacement of damaged or diseased tissue or organs. Explain why stem cells are potentially useful and describe some of the ethical issues associated with their use:

2. Tobacco smoking is a major risk factor in the occurrence of emphysema, chronic bronchitis, and cancers of the respiratory tract. Smoking causes the lung tissue to lose its elasticity and tar from the tobacco smoke clogs the airways and damages the alveoli (right). Use the diagram to help you to explain why smoking reduces the gas exchange capacity of the lung tissue:

Non-smoker
Normal alveoli
Thin layer of mucus
Cilia
Cells lining airways
Smoker
Coalesced alveoli
Extra mucus produced
Smoke particles
Smoke particles indirectly destroy the walls of the lung's alveoli.
Cancerous cell

3. People with iron-deficient anaemia lack of haemoglobin in the blood. The graph below shows the oxygen-haemoglobin dissociation curves for a person with iron deficient anaemia compared to a person with normal haemoglobin levels.

(a) What does an oxygen-haemoglobin dissociation curve show?

(b) What has happened to the oxygen-haemoglobin dissociation curve in the anaemic person and why?

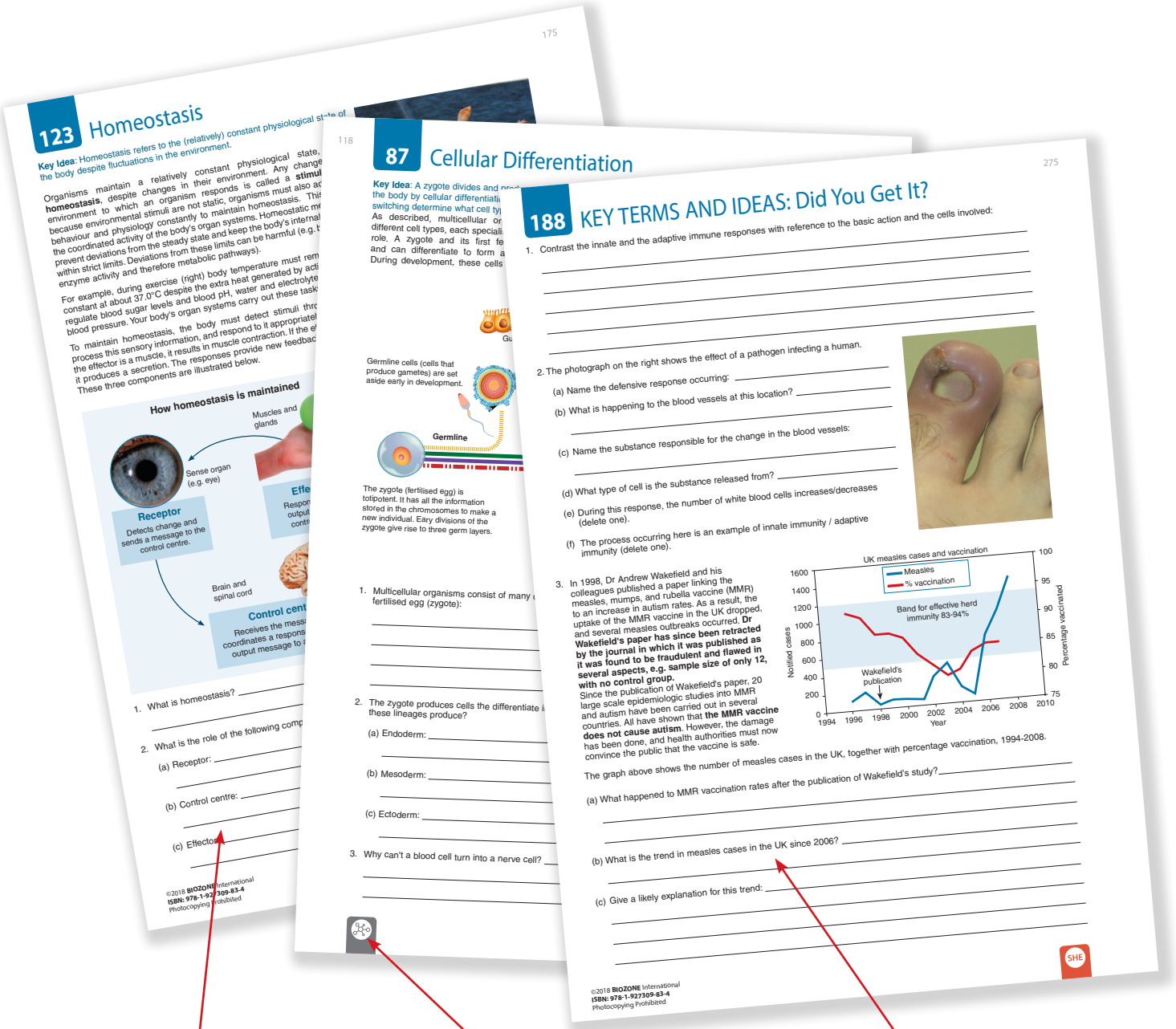
Normal
Anaemic
Percentage saturation of haemoglobin
PO_2 (oxygen tension) (kPa)

Moving on to Synoptic Questions

- BIOZONE's Biology for QCE Units 1 & 2 contains synoptic questions that bring together related content of the workbook. These require students to draw on the knowledge gained in a range of activities to answer the questions.
- The synoptic questions are written in a similar way to the questions in an exam. Students are given introductory information and asked to discuss certain aspects of the topic relating to the information. The examples used in the questions may not directly relate to examples in the workbook, but the ideas and concepts required to answer the question will have been covered in the preceding activities. This makes the synoptic questions suitable for formative assessment.
- Sometimes students will need to interpret the information given in the question's introduction and integrate their interpretation into their answer.

Choosing Activities for Home Study

Many of the workbook activities are ideal for homework or as vehicles for a quick formative assessment. 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.



Tailor your programme so that simpler activities are most often set as homework exercises, especially for less able students who may be easily discouraged.

Most students will have access to the internet. If they are having trouble understanding a subject or visualising a process, encourage them to visit the assigned **weblinks** as homework.

Summary activities are ideal as homework because they involve reviewing completed work. In this activity, students apply their knowledge of bacterial disease and vaccination to complete the activity. Such activities can also be used for formative assessments.

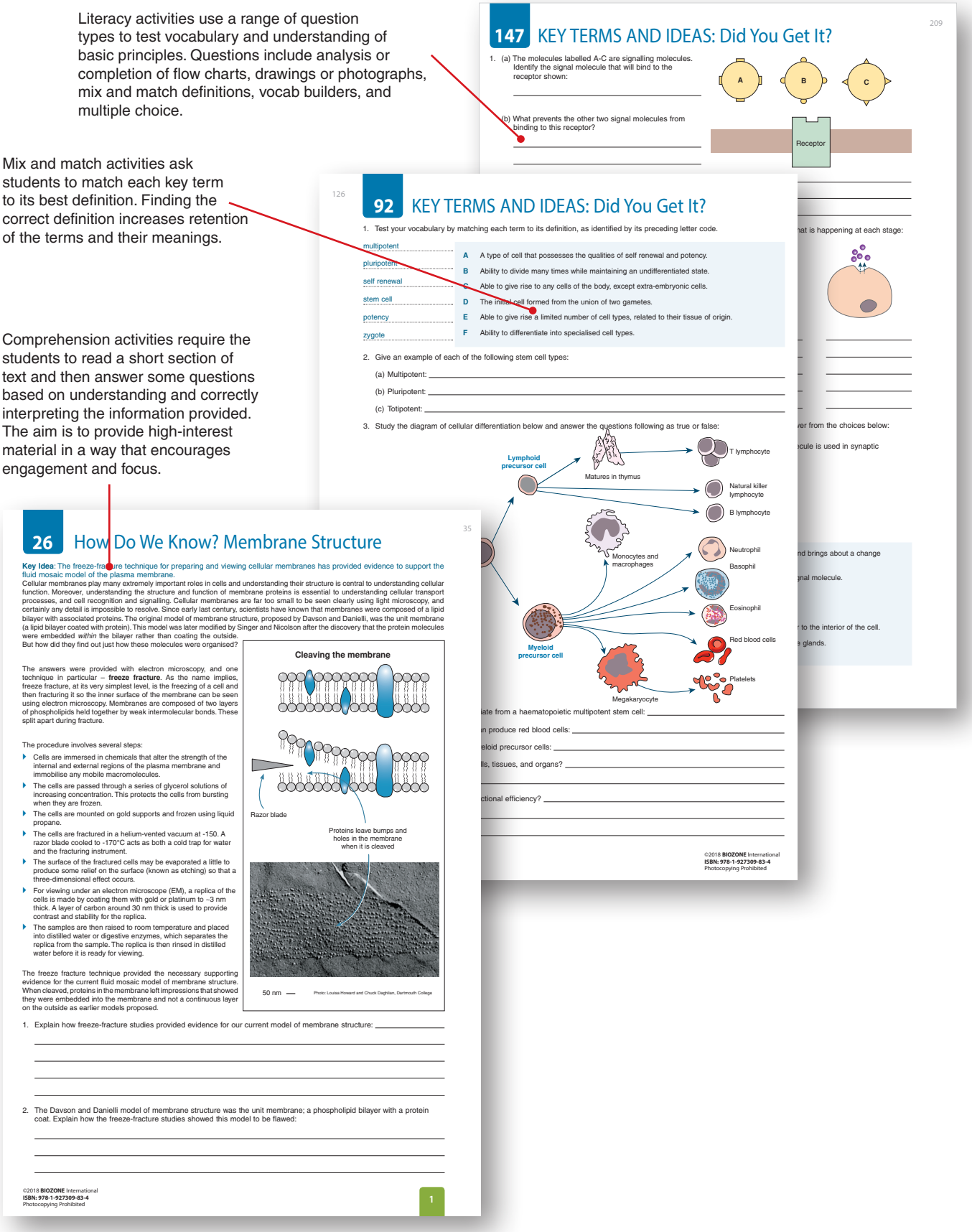
Literacy and Comprehension

Within all areas of science, scientific literacy is an important area of focus. With it, communication in the topic is more effective, more concise, and less cumbersome. BIOZONE's literacy and comprehension activities provide a vehicle for increasing the student's familiarity with the use of scientific terms in various contexts. Beginning with the list of KEY TERMS in the introduction to each chapter, students can create their own glossary of commonly used terms. They can learn to use these key terms appropriately by encountering them in context within the activities, and reinforce their understanding of the term by completing the literacy activities throughout the workbook. These take several forms:

Literacy activities use a range of question types to test vocabulary and understanding of basic principles. Questions include analysis or completion of flow charts, drawings or photographs, mix and match definitions, vocab builders, and multiple choice.

Mix and match activities ask students to match each key term to its best definition. Finding the correct definition increases retention of the terms and their meanings.

Comprehension activities require the students to read a short section of text and then answer some questions based on understanding and correctly interpreting the information provided. The aim is to provide high-interest material in a way that encourages engagement and focus.



147 KEY TERMS AND IDEAS: Did You Get It?

1. (a) The molecules labelled A-C are signalling molecules. Identify the signal molecule that will bind to the receptor shown:

(b) What prevents the other two signal molecules from binding to this receptor?

A B C

Receptor

92 KEY TERMS AND IDEAS: Did You Get It?

1. Test your vocabulary by matching each term to its definition, as identified by its preceding letter code.

multipotent	A A type of cell that possesses the qualities of self renewal and potency.
pluripotent	B Ability to divide many times while maintaining an undifferentiated state.
self renewal	C Able to give rise to any cells of the body, except extra-embryonic cells.
stem cell	D The initial cell formed from the union of two gametes.
potency	E Able to give rise a limited number of cell types, related to their tissue of origin.
zygote	F Ability to differentiate into specialised cell types.

2. Give an example of each of the following stem cell types:

(a) Multipotent:

(b) Pluripotent:

(c) Totipotent:

3. Study the diagram of cellular differentiation below and answer the questions following as true or false:

Lymphoid precursor cell
Matures in thymus
T lymphocyte
Natural killer lymphocyte
B lymphocyte
Monocytes and macrophages
Neutrophil
Basophil
Eosinophil
Red blood cells
Platelets
Myeloid precursor cell
Megakaryocyte

26 How Do We Know? Membrane Structure

Key Idea: The freeze-fracture technique for preparing and viewing cellular membranes has provided evidence to support the fluid mosaic model of the plasma membrane.

Cellular membranes play many extremely important roles in cells and understanding their structure is central to understanding cellular function. Moreover, understanding the structure and function of membrane proteins is essential to understanding cellular transport processes, and cell recognition and signalling. Cellular membranes are far too small to be seen clearly using light microscopy, and certainly any detail is impossible to resolve. Since early last century, scientists have known that membranes were composed of a lipid bilayer with associated proteins. The original model of membrane structure, proposed by Davson and Danielli, was the unit membrane (a lipid bilayer coated with protein). This model was later modified by Singer and Nicolson after the discovery that the protein molecules were embedded *within* the bilayer rather than coating the outside. But how did they find out just how these molecules were organised?

The answers were provided with electron microscopy, and one technique in particular – **freeze fracture**. As the name implies, freeze fracture, at its very simplest level, is the freezing of a cell and then fracturing it so the inner surface of the membrane can be seen using electron microscopy. Membranes are composed of two layers of phospholipids held together by weak intermolecular bonds. These split apart during fracture.

Cleaving the membrane

Razor blade

Proteins leave bumps and holes in the membrane when it is cleaved

50 nm

Photo: Louisa Howard and Chuck Daghlian, Dartmouth College

The procedure involves several steps:

- Cells are immersed in chemicals that alter the strength of the internal and external regions of the plasma membrane and immobilise any mobile macromolecules.
- The cells are passed through a series of glycerol solutions of increasing concentration. This protects the cells from bursting when they are frozen.
- The cells are mounted on gold supports and frozen using liquid propane.
- The cells are fractured in a helium-vented vacuum at -150. A razor blade cooled to -170°C acts as both a cold trap for water and the fracturing instrument.
- The surface of the fractured cells may be evaporated a little to produce some relief on the surface (known as etching) so that a three-dimensional effect occurs.
- For viewing under an electron microscope (EM), a replica of the cells is made by coating them with gold or platinum to ~3 nm thick. A layer of carbon around 30 nm thick is used to provide contrast and stability for the replica.
- The samples are then raised to room temperature and placed into distilled water or digestive enzymes, which separates the replica from the sample. The replica is then rinsed in distilled water before it is ready for viewing.

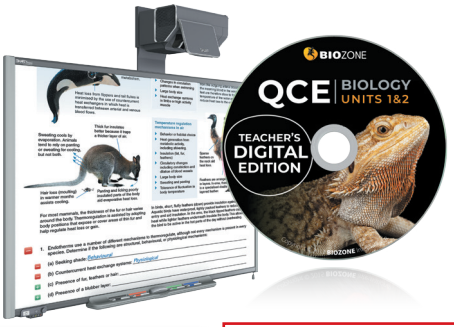
The freeze fracture technique provided the necessary supporting evidence for the current fluid mosaic model of membrane structure. When cleaved, proteins in the membrane left impressions that showed they were embedded into the membrane and not a continuous layer on the outside as earlier models proposed.

1. Explain how freeze-fracture studies provided evidence for our current model of membrane structure:

2. The Davson and Danielli model of membrane structure was the unit membrane; a phospholipid bilayer with a protein coat. Explain how the freeze-fracture studies showed this model to be flawed:

The Teacher's Digital Edition

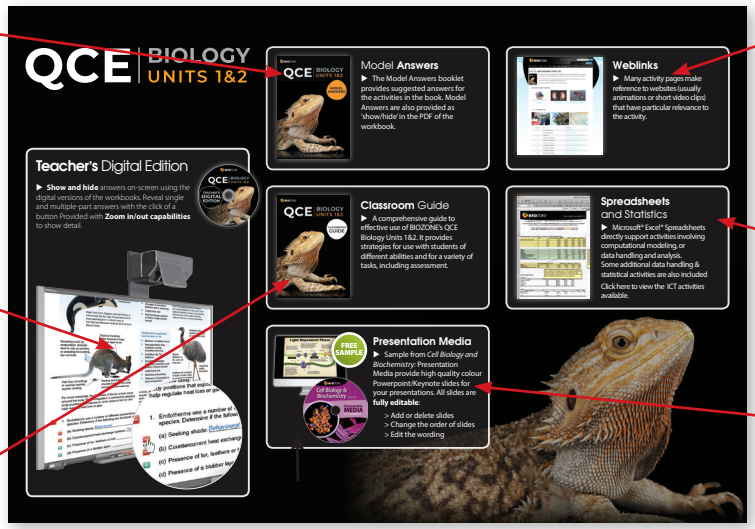
The *Teacher's Digital Edition* is aimed primarily at extending the pedagogical tools at a teacher's disposal. Many of the features of this resource have been developed in response to requests from teachers themselves.



Digital copy of the Model Answers (non-printable). Suggested answers are provided to all activities. Some include explanatory detail.

A digital (PDF) version of the workbook (non-printable). Use the interactive buttons to HIDE or SHOW the answers.

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

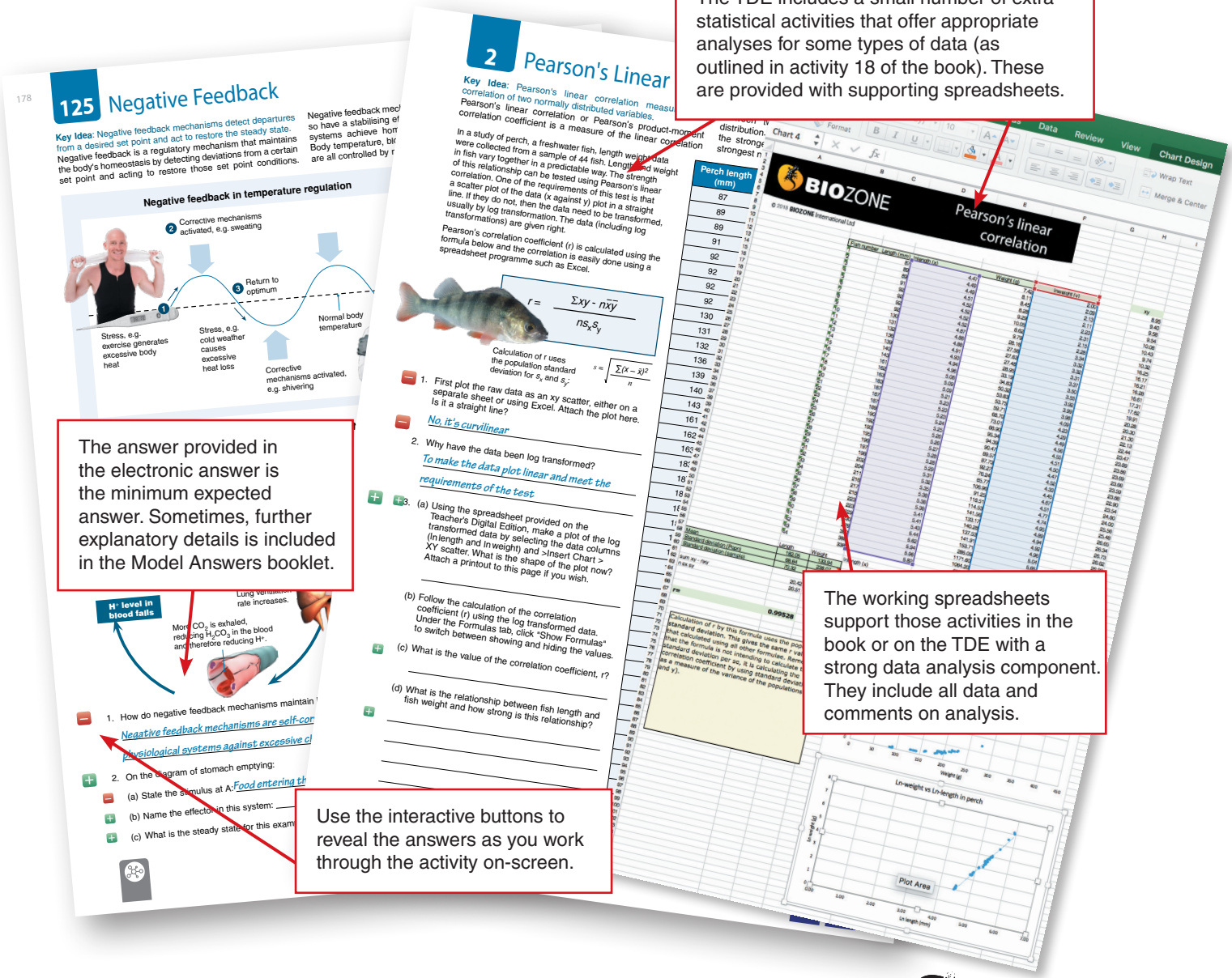


Access the *Weblinks* directly from this link for a range of animations and video clips to support the activities.

Link to ***Excel®* spreadsheets** for all activities with a graphing or data analysis component.

A **BONUS** sample from the Cell Biology and Biochemistry Presentation Media.

The TDE includes a small number of extra statistical activities that offer appropriate analyses for some types of data (as outlined in activity 18 of the book). These are provided with supporting spreadsheets.



The answer provided in the electronic answer is the minimum expected answer. Sometimes, further explanatory details is included in the Model Answers booklet.

The working spreadsheets support those activities in the book or on the TDE with a strong data analysis component. They include all data and comments on analysis.

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