

QCE | BIOLOGY UNITS 1&2

**CLASSROOM
GUIDE**



Contents

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

Meeting Key Competencies	2
The Contents: A Planning Tool	3
Introducing the Biology for QCE Content	4
Finding Your Way Around	5
Using the Tab System	6
Making Use of Weblinks	8
Building Understanding	9
Links - Making Connections	11
Differential Instruction with BIOZONE	12
Choosing Activities for Home Study	14
Literacy and Comprehension.....	15
The Teacher's Digital Edition	16

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



What is its pedagogical approach?	2
How do I use the tab system?	6
How do we help students with the practical components of QCE?	6
What are weblinks?	8
How do students demonstrate understanding of ideas?	11
How can I evaluate student performance?	12
How do I use the workbook in the classroom?	9-13
How can I use it to build scientific literacy and understanding?	15
What is the Teacher's Digital Edition	16

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

Using This Bookvi
 Using The Tab Systemviii
 Using BIOZONE'S Resource Hubix
 Answering Exam Questionsx

Basic Skills for QCE

Key Skills and Knowledge 1

- ☐ 1 How Do We Do Science? 2
- ☐ 2 Systems and Systems Models 4
- ☐ 3 Types of Data 5
- ☐ 4 Planning a Quantitative Investigation 6
- ☐ 5 Accuracy and Precision 8
- ☐ 6 Working with Numbers 10
- ☐ 7 Fractions, Percentages and Ratios 11
- ☐ 8 Dealing With Large Numbers 12
- ☐ 9 Practicing With Data 13
- ☐ 10 Apparatus and Measurement 14
- ☐ 11 Drawing Graphs 15
- ☐ 12 Interpreting Line Graphs 17
- ☐ 13 Correlation and Causation 18
- ☐ 14 Mean, Median, and Mode 19
- ☐ 15 What is Standard Deviation? 21
- ☐ 16 Reliability of the Mean 22
- ☐ 17 Detecting Bias in Samples 24
- ☐ 18 Statistical Tests: Which One to Use? 25
- ☐ 19 Linear Regression 26
- ☐ 20 Student's t Test 27
- ☐ 21 Chi-squared Test for Goodness of Fit 28
- ☐ 22 KEY TERMS AND IDEAS: Did You Get it? 29

UNIT 1: CELLS AND MULTICELLULAR ORGANISMS

TOPIC 1: Cells as the Basis of Life

Cell Membrane

Key Skills and Knowledge 30

- ☐ 23 The Plasma Membrane 31
- ☐ 24 Phospholipids and the Properties of Membranes 32
- ☐ 25 The Structure of the Plasma Membrane 33
- ☐ 26 How Do We Know? Membrane Structure 35
- ☐ 27 Cell Membrane Research 36
- ☐ 28 Diffusion 37
- ☐ 29 Investigating Diffusion 38
- ☐ 30 Diffusion and Cell Size 39
- ☐ 31 Investigating the Effect of Cell Size 40
- ☐ 32 Overcoming Limitations to Cell Size 43
- ☐ 33 Osmosis 43
- ☐ 34 Estimating Osmolarity 43
- ☐ 35 Water Relations in Plant Cells 45

Active Transport

- ☐ 36 Active Transport 46
- ☐ 37 Ion Pumps and Cotransport 47
- ☐ 38 Investigating Transport Across Membranes 48
- ☐ 39 Membranes and the Export of Proteins 49
- ☐ 40 Endocytosis 51
- ☐ 41 Active and Passive Transport Summary 52
- ☐ 42 KEY TERMS AND IDEAS: Did You Get it? 53

Prokaryotic and Eukaryotic cells

Key Skills and Knowledge 54

- ☒ 43 The Cell is the Unit of Life 55
- ☒ 44 What are Cells Made Of? 57
- ☒ 45 What Cells Need for Survival 58
- ☒ 46 Prokaryotic vs Eukaryotic Cells 59
- ☒ 47 Origins of Eukaryotes 60
- ☒ 48 Cell Sizes 61
- ☒ 49 Plant Cells 62
- ☒ 50 Identifying Structures in a Plant Cell 63
- ☒ 51 Animal Cells 64
- ☒ 52 Identifying Structures in an Animal Cell 65
- ☐ 53 Cell Structures and Organelles 66
- ☐ 54 Identifying Organelles 68
- ☐ 55 Optical Microscopes 69
- ☐ 56 Preparing a Slide 71
- ☐ 57 Staining a Slide 72
- ☐ 58 Calculating Linear Magnification 73
- ☐ 59 Making Biological Drawings 74
- ☐ 60 Observing and Recording Using a Microscope 76
- ☐ 61 KEY TERMS AND IDEAS: Did You Get it? 77

Internal Membranes and Enzymes

Key Skills and Knowledge 78

- ☐ 62 Enzymes 79
- ☐ 63 Models of Enzyme Activity 80
- ☐ 64 How Enzymes Work 81
- ☐ 65 Enzyme Kinetics 83
- ☐ 66 Enzyme Inhibition 85
- ☐ 67 Investigating Enzyme Activity 86
- ☐ 68 Achieving Metabolic Efficiency 88
- ☐ 69 Enzymes and Membranes 89
- ☐ 70 KEY TERMS AND IDEAS: Did You Get it? 90

Energy and Metabolism

Key Skills and Knowledge 91

- ☐ 71 Energy Transformations in Cells 92
- ☐ 72 The Role of Photosynthesis 93
- ☐ 73 Chloroplasts 94
- ☐ 74 Photosynthesis: Inputs and Outputs 95
- ☐ 75 Investigating Photosynthetic Rate 96
- ☐ 76 Photosynthesis and Productivity 98
- ☐ 77 The Role of ATP in Cells 99

Internal Membranes and Enzymes

Key Skills and Knowledge 78

- ☐ 62 Enzymes 79
- ☐ 63 Models of Enzyme Activity 80
- ☐ 64 How Enzymes Work 81
- ☐ 65 Enzyme Kinetics 83
- ☐ 66 Enzyme Inhibition 85
- ☐ 67 Investigating Enzyme Activity 86
- ☐ 68 Achieving Metabolic Efficiency 88
- ☐ 69 Enzymes and Membranes 89
- ☐ 70 KEY TERMS AND IDEAS: Did You Get it? 90

Energy and Metabolism

Key Skills and Knowledge 91

- ☐ 71 Energy Transformations in Cells 92
- ☐ 72 The Role of Photosynthesis 93
- ☐ 73 Chloroplasts 94
- ☐ 74 Photosynthesis: Inputs and Outputs 95
- ☐ 75 Investigating Photosynthetic Rate 96
- ☐ 76 Photosynthesis and Productivity 98
- ☐ 77 The Role of ATP in Cells 99

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**.

CODING: Activity is marked: ☐ to be done ☒ when completed

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

Key Skills and Knowledge 54

- ☒ 43 The Cell is the Unit of Life 55
- ☒ 44 What are Cells Made Of? 57
- ☒ 45 What Cells Need for Survival 58
- ☒ 46 Prokaryotic vs Eukaryotic Cells 59
- ☒ 47 Origins of Eukaryotes 60
- ☒ 48 Cell Sizes 61
- ☒ 49 Plant Cells 62
- ☒ 50 Identifying Structures in a Plant Cell 63
- ☒ 51 Animal Cells 64
- ☒ 52 Identifying Structures in an Animal Cell 65
- ☐ 53 Cell Structures and Organelles 66
- ☐ 54 Identifying Organelles 68
- ☐ 55 Optical Microscopes 69
- ☐ 56 Preparing a Slide 71



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*)

Introduce the concept with a grounding activity

Follow with an activity expanding on that concept

92

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.

The diagram illustrates the energy flow within a plant cell, represented by a large brown rounded rectangle. On the left, **Photosynthesis** is shown as a process that takes in **Carbon dioxide** and **water** from the environment. It uses **Light energy** (indicated by yellow arrows) to produce **Glucose** and **Oxygen**. A callout box explains that photosynthesis is a chemical process that captures light energy and transforms it into the chemical energy in carbohydrate (glucose). The process is represented by a yellow sun icon with the text "30 J kJ per second" and "The hydrolysis of ATP provides the energy for metabolic reactions. The hydrolysis of ATP releases 30 J kJ of energy. Some energy is stored in chemical bonds, while some is lost as heat." On the right, **Respiration** is shown as a process that takes in **Glucose** and **Oxygen** and releases **Carbon dioxide** and **Water**. A callout box explains that cellular respiration is a chemical process in which the step-wise breakdown of glucose provides the energy to lay high energy ATP from ADP and inorganic phosphate (Pi). The process is represented by a blue flame icon. The diagram shows the cycle of **ATP** and **ADP + Pi** between the two processes. **ATP** is produced during photosynthesis and used during respiration, while **ADP + Pi** is produced during respiration and used during photosynthesis. A note states that **Other uses** include **Protein synthesis**. A **Heat energy** arrow points out from the bottom of the cell, indicating energy loss.

DID YOU KNOW?

It takes energy to break bonds, so the hydrolysis of ATP provide energy for metabolic reactions. The hydrolysis of ATP is needed for the formation of a reaction coordinate, which is the energy barrier that makes the energy in ATP available (or virtually simultaneously) as the reaction is simplified to one intermediate.

$$A - B \xrightarrow[ATP]{AB + \text{heat energy}} AB + \text{heat energy}$$

- How does ATP act as a supplier of energy to power metabolic reactions? _____
- Identify the ultimate source of energy for most autotrophs: _____
- Identify a group of autotrophic organisms that do not use this source of energy. _____
- Identify the ultimate source of energy for most heterotrophs: _____
- In what way are the processes pictured above (photosynthesis and cellular respiration) connected? _____

CC BY-NC-SA
ISBN 978-1-921728-40-4
©2010 University of Wollongong

74

Photosynthesis: Inputs and Outputs

10

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, while using oxygen gas, and absorbs carbon dioxide (as 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 synthesize carbohydrates. 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 form phosphates (then converted to glucose).

Light dependent phase (LDP):

In the first phase of photosynthesis, chlorophyll captures light energy, which is used in light water producing O_2 gas (results). Electrons and H^+ ions are produced by the reaction $\text{NADP}^+ + \text{H}_2\text{O}$ also produced. The light dependent phase occurs in the thylakoid membranes of the plant.

Light independent phase (LIP):

The second phase of photosynthesis occurs in the stroma and uses the NADPH and the ATP from the first phase of enzyme-controlled reactions the **Calvin cycle** that fix carbon dioxide to produce glucose. This process, called **carbon fixation**, does not need light to proceed.

CO_2 from the air

provides raw materials

for glucose production.

Monosaccharides (like glucose) and other carbohydrates, lipids, and amino acids.

The general equation for photosynthesis

$$6\text{CO}_2 + 6\text{H}_2\text{O} \xrightarrow[\text{Chlorophyll}]{\text{Light}} \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$$

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 rate of the following molecules involved in photosynthesis:

(a) Carbon dioxide:

(b) Oxygen:

(c) Hydrogen:

©2018 BSCS BIOLOGY

ISBN 978-1-60308-014-0

©2018 BSCS BIOLOGY

10

95

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).

The diagram illustrates the two phases of photosynthesis as interconnected cycles. On the left, the 'Light dependent phase' (labeled 'f') is shown in a box. It receives 'Solar energy' (indicated by a yellow arrow) and 'Raw materials' (indicated by a red arrow from box 'd'). Inside this box, two questions are listed: '(f) What is happening?' and '(g) Where does it occur?'. Below this box is box 'e', which is labeled 'By-products'. A green arrow points from the light-dependent phase to box 'e'. On the right, the 'Light independent phase' (labeled 'h') is shown in a box. It receives 'Raw materials' (indicated by a red arrow from box 'c') and 'ATP' (indicated by a black arrow from the light-dependent phase). It releases 'NADPH' (indicated by a black arrow to the light-dependent phase). Inside this box, two questions are listed: '(h) What is happening?' and '(i) Where does it occur?'. Below this box is box 'b', which is labeled 'Main product'. A green arrow points from the light-independent phase to box 'b'. A black arrow labeled 'ADP' points from box 'b' back to the light-dependent phase. At the bottom, box 'a' is labeled 'Hy-products'. A green arrow points from box 'e' to box 'a', and another green arrow points from box 'b' to box 'a'.

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 1: $6CO_2 + 12H_2O + \text{sunlight energy} \rightarrow C_6H_{12}O_6 + 6O_2 + 6H_2O$

Experiment 2: $6CO_2 + 12H_2O + \text{sunlight energy} \rightarrow C_6H_{12}O_6 + 6O_2 + 6H_2O$

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

- The carbohydrate produced?
- The oxygen released?

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

8. Describe what happens during:

- The light dependent phase of photosynthesis: _____
- The light independent phase of photosynthesis: _____

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

- ATP: _____
- NADPH: _____
- Light: _____
- Chlorophyll: _____
- Carbon dioxide: _____
- Water: _____

©2018 BAZZONE International
 Phone: 416-321-9949
 Email: info@bazzone.com

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.

166

118 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 a

gradient in solute concentration that increases from 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.

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.

The continuous flow of water is called the **transpiration stream**. It is primarily responsible for water moving up the plant.

Soil
Highest water concentration
Lowest solute concentration

The role of stomata
Water loss occurs mainly through stomata (pores in the leaf). The rate of water loss can be regulated by specialised guard cells each side of the stoma, which open or close the pore.

- Stomata open: gas exchange and transpiration rate increase.
- Stomata closed: gas exchange and transpiration rates decrease.

Water
Solute particle
Xylem
Water

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? _____

33

©2018 BIOZONE International
 ISBN: 978-1-927309-43-4
 Photocopying Prohibited

118 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.

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.

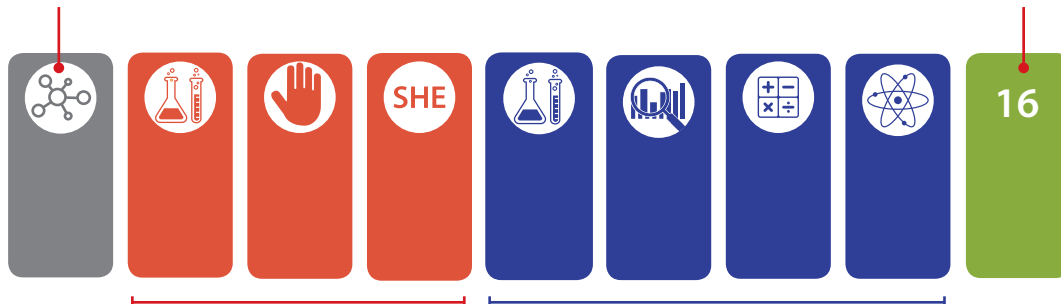
Bookmark the weblinks page:

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):

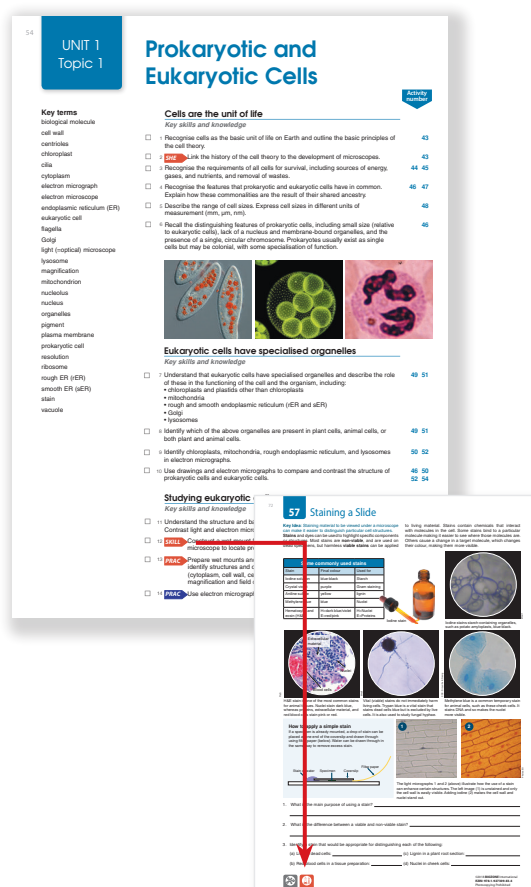
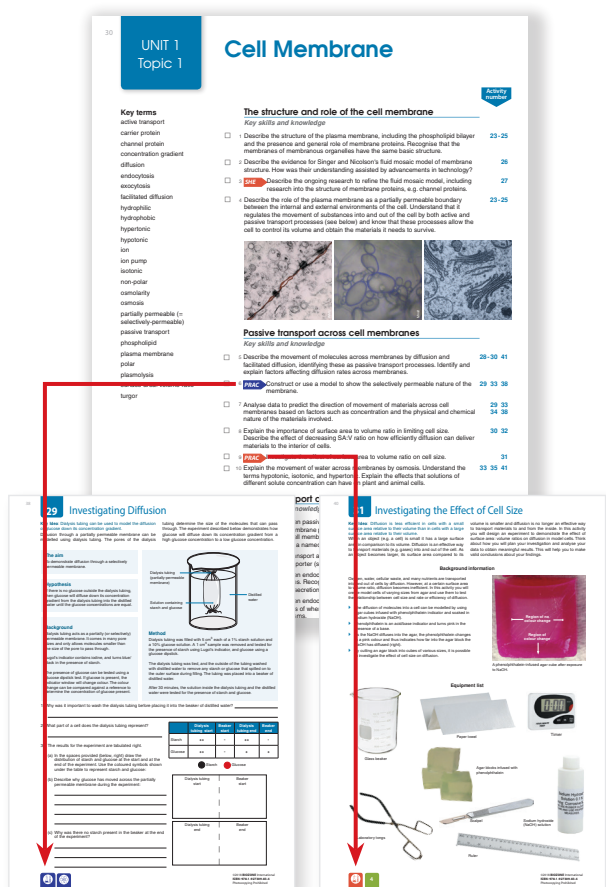
- Mandatory practical
- Manipulative skill
- Science as a human endeavour

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

Identifying manipulative skills



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.

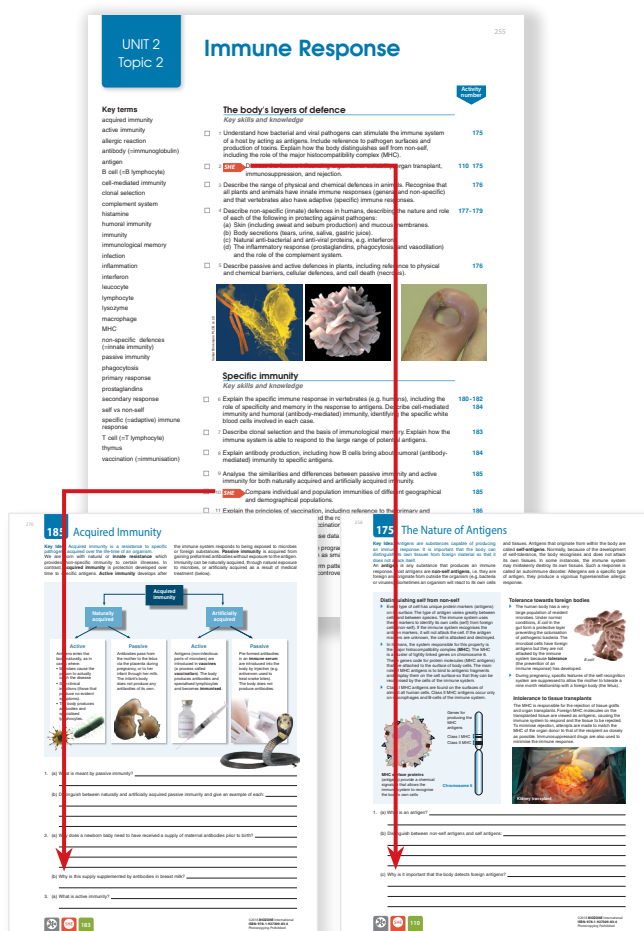
A **red** practical tab indicates a **mandatory** practical.

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

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.

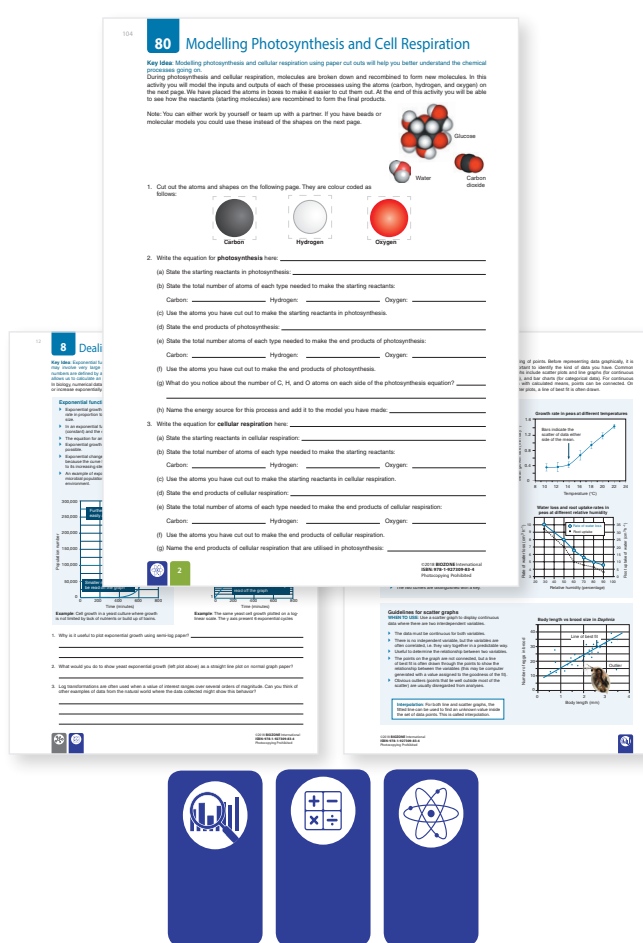


Identifying science as a human endeavour



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.

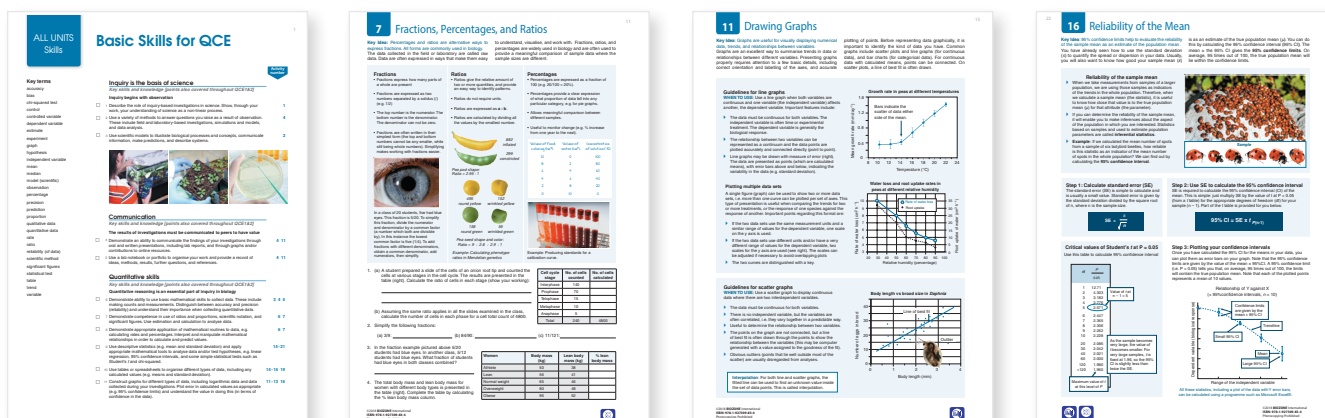
Identifying skills



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.

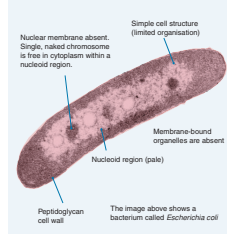
Making Use of Weblinks

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

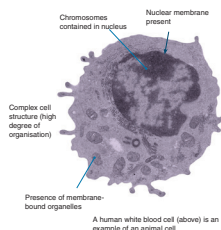
Prokaryotic cells

- 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.



1. List three features of a prokaryotic cell:

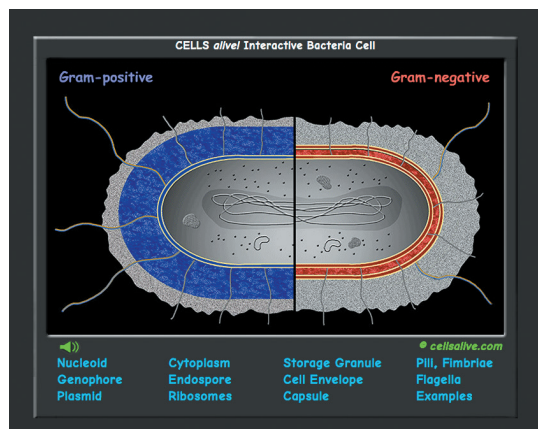
-
-
-
- Name an example of a prokaryote: _____

2. List three features of a eukaryotic cell:

-
-
-
- Name examples of eukaryotic cells: _____

©2018 BIOZONE International
ISBN: 978-1-927330-83-4
Photocopying prohibited

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 BIOZONE's collection of annotated 3-D models, organised into three broad categories. Explore the models relevant to you.

BIOZONE Website Screenshot:

Home | About Us | Products | Store | News | Biolinks | FAQ | Contact Us | Welcome Admin

WEBLINK | QCE BIOLOGY UNITS 1&2

Some of the activities in your BIOZONE book have references to third-party websites. BIOZONE is not responsible for the content or continued availability of these websites. The links are listed below under the relevant chapters.

These websites (blue links) provide material, generally either animations or video clips, to help you visualise and understand the material presented on the relevant activity page.

At the end of this page you will also find the [links](#) for this print product.

ANNOTATED 3D MODEL COLLECTION

- Cell Biology
- Human Anatomy
- Plant & Animal Adaptations

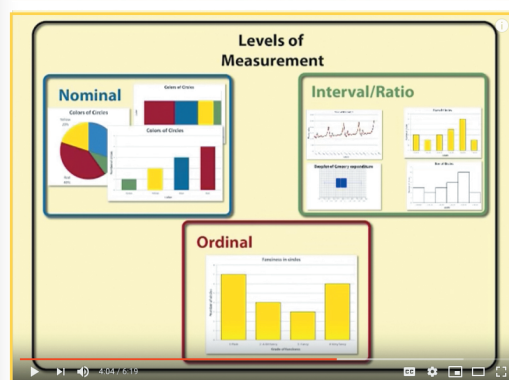
Chapter 1: Basic Skills for QCE

Activity #	Title	Weblinks Title
1	How Do We Do Science?	The Real Process of Science
3	How Do We Do Science?	Science at Multiple Levels
3	Types of Data	Types of Data: Nominal, Ordinal, Interval/Ratio
8	Dealing with Large Numbers	How to Graph a Basic Exponential Function
8	Dealing with Large Numbers	Introduction to Exponential Functions
13	Correlation and Causation	Correlation and causality
13	Correlation and Causation	Learn Scatter Plots and Best Fitting Lines
14	Mean, Median, and Mode	Statistics of Central Tendency
14	Mean, Median, and Mode	Measures of Central Tendency Rap
15	What is Standard Deviation	Statistics of Dispersion

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.

UNIT 1
Topic 2

Exchange of Nutrients and Wastes


Key terms
absorption
amylase
Böhrer's capsule
collecting duct
digestion
distal convoluted tubule
enzyme
excretion
glomerulus
proximal convoluted tubule
large intestine
liver
Loop of Henle
microvilli
nephron
organ trafficking
peristalsis
proximal convoluted tubule
small intestine
stomach
urea
urine

Digestion and absorption
Key skills and knowledge

- Describe the basic structure and organisation of the digestive tract in a mammal, e.g. human, including the cells and tissues making up the different regions. Distinguish regions for ingestion, digestion, absorption, and elimination. **101-104**
- Identify the characteristics of the absorptive surfaces within the digestive system, e.g. the small intestine. How are these characteristics related to the structure and function of the villi? **101-104**
- Describe the role of enzymes in the extracellular chemical digestion of ingested food. Describe the source, substrate, products, and optimum pH for one amylase, protease, and lipase enzyme involved in digestion. **102-103**
- Describe how the different breakdown products of digestion are absorbed across the epithelium of the small intestine. Describe how the intestinal villi and the structure of the intestinal epithelial cells themselves increase the surface area for the digestion and absorption of nutrients. **103**
- Investigate the effect of temperature on the rate of reaction of an enzyme, e.g. salivary amylase. **105**
- Investigate the effect of pH on the rate of reaction of an enzyme, e.g. salivary amylase, catalase or lipase. **105**

Excretion of nitrogenous wastes
Key skills and knowledge

- Phagocytose the different types of nitrogenous wastes produced by the breakdown of proteins. Relate the form of the nitrogenous waste excreted by different animal taxa to its history and environment. **106**
- Describe the overall structure of the urinary system including kidneys, ureters, bladder, and urethra. Outline the structure and function of the mammalian kidney including the nephron and its associated ductwork. **107-108**
- In more detail than above, explain the function of each of the regions of the nephron in the production of urine. How is relevance to the glomerulus, Bowman's capsule, proximal convoluted tubule, Loop of Henle, distal convoluted tubule, and collecting duct. **107-108**
- Explain urine formation and excretion of wastes by glomerular filtration (ultrafiltration) and selective reabsorption and secretion across the nephron membranes. Explain how the urine is concentrated. **109**
- Discuss how the increased demand for organs for transplant has led to illegal trafficking of organs and tissues. What donation, and transplant tourism. What ethical concerns are associated with these practices? **110**



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.

Digestion and absorption

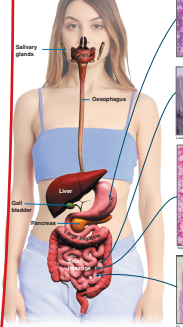
Key skills and knowledge

- Describe the basic structure and organisation of the digestive tract in a mammal, e.g. human, including the cells and tissues making up the different regions. Distinguish regions for ingestion, digestion, absorption, and elimination. **101-104**
- Identify the characteristics of the absorptive surfaces within the digestive system, e.g. the small intestine. How are these characteristics related to the structure and function of the villi? **101-104**
- Describe the role of enzymes in the extracellular chemical digestion of ingested food. Describe the source, substrate, products, and optimum pH for one amylase, protease, and lipase enzyme involved in digestion. **102-103**
- Describe how the different breakdown products of digestion are absorbed across the epithelium of the small intestine. Describe how the intestinal villi and the structure of the intestinal epithelial cells themselves increase the surface area for the digestion and absorption of nutrients. **103**
- Investigate the effect of temperature on the rate of reaction of an enzyme, e.g. salivary amylase. **105**
- Investigate the effect of pH on the rate of reaction of an enzyme, e.g. salivary amylase, catalase or lipase. **105**



101 The Digestive System

Key idea: The digestive tract is specialised to maximise the digestion of food, absorption of nutrients, and elimination of undigested material. The human digestive system (gut) is a tubular tract, which is regularly specialised into a complex series of organs and glands that work in sequence to maximise the efficiency with which food is processed. Collectively, the organs of the digestive tract carry out the physical and chemical breakdown (digestion) of food, absorption of nutrients, and elimination of undigested material. The gut is a hollow, open-ended, muscular tube, and the food enters it is eventually outside the body, having contact only with the cells lining the tract. External to the digestive tract are several accessory organs and glands, which add enzymes to the food to aid digestion.



Activity number

101-104

102-103

103

105

36 Active Transport

Key idea: Active transport uses energy to transport molecules against their concentration gradient across a partially permeable membrane. Active transport is the movement of molecules from low concentration to high concentration against their concentration gradient.

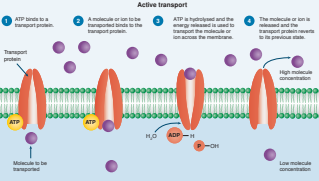
The energy for active transport comes from ATP (adenosine triphosphate). Energy is released when ATP is hydrolysed to ADP (adenosine diphosphate) and inorganic phosphate (P_i). Transport carrier proteins in the membrane are used to actively transport molecules from one side of the membrane to the other (below).

Active transport can be used to move molecules into and out of a cell.

Active transport can be either primary or secondary. Primary active transport directly uses ATP for the energy. Secondary active transport uses the energy stored in a concentration gradient. The transport of one molecule is coupled to the movement of another down its concentration gradient. ATP is not directly involved in the transport process.

Active transport

- ATP binds to a transport protein.
- A molecule or ion is bound to the transport protein.
- ATP is hydrolysed and the energy released is used to change the shape of the transport protein.
- The molecule or ion is released on the other side of the membrane.



1. What is active transport?

2. Where does the energy for active transport come from?

3. What is the difference between primary active transport and secondary active transport?

37 Ion Pumps and Cotransport

Key idea: Ion pumps are transmembrane proteins that use energy to move ions and molecules across a membrane against their concentration gradient.

Key idea: Ion pumps are transmembrane proteins that use energy to move ions and molecules across a membrane against their concentration gradient.

Sodium-potassium pump (Na⁺/K⁺ pump)

The Na⁺/K⁺ pump is a protein in the membrane that uses energy in the form of ATP to exchange sodium ions (Na⁺) for potassium ions (K⁺) across the membrane. The overall effect of the pump is to move Na⁺ out of the cell and K⁺ into the cell. This creates a concentration gradient that can be used to drive transport of other substances (e.g. cotransport of glucose). The Na⁺/K⁺ pump also helps to maintain the right balance of ions and so helps regulate the cell's water balance.

Cotransport (coupled transport)

A gradient in sodium ions and glucose in the extracellular fluid (ECF) can be used to drive the transport of glucose into the cell. The Na⁺/K⁺ pump creates a gradient in Na⁺ ions across the membrane. A low intracellular Na⁺ concentration gradient is used to drive the transport of glucose into the cell.

Why is ATP required for membrane pump systems to operate?

What is meant by cotransport?

How is cotransport used to move glucose into the intestinal epithelial cell?

What happens to the glucose that is transported into the intestinal epithelial cell?

The sodium-potassium pump uses primary/secondary/tertiary/active transport.

The sodium-glucose symport uses primary/secondary/tertiary/active transport.

Describe one consequence of the extracellular accumulation of sodium ions.

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

37 Ion Pumps and Cotransport

Key Idea: Ion pumps are transmembrane proteins that use energy to move ions and molecules across a membrane against their concentration gradient.

pumps move molecules across a membrane. found in all

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 hierarchical 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.

88 The Hierarchy

Key Idea: The hierarchy of life is a series of nested levels, from the smallest to the largest. The hierarchy of life is a series of nested levels, from the smallest to the largest. The hierarchy of life is a series of nested levels, from the smallest to the largest.

101 The Digestive System

Key Idea: The digestive system is a series of organs that work together to break down food into nutrients that can be used by the body. The digestive system is a series of organs that work together to break down food into nutrients that can be used by the body.

103 Digestion

Key Idea: Digestion is the process of breaking down food into nutrients that can be used by the body. Digestion is the process of breaking down food into nutrients that can be used by the body.

105 Investigating Amylase Activity

Key Idea: Amylase is an enzyme that breaks down starch into sugar. The activity of amylase can be measured by the rate at which it breaks down starch. The activity of amylase can be measured by the rate at which it breaks down starch.

43 The Cell is the Unit of Life

Key Idea: All living organisms are composed of cells. Cells are the basic units of life. Cells are the basic units of life.

The cell theory

- All living things are composed of cells and cell products.
- New cells are formed only by the division of pre-existing cells.
- The cell contains inherited information (genes) that are used as instructions for growth, functioning, and development.
- The cell is the functioning unit of life of chemical reactions of life take place within cells.

All cells show the functions of life

- Cells can feed, grow, respond to stimuli, and reproduce.
- The four basic functions of life are: Movement, Response, Sensitivity, Growth, Reproduction, and Nutrition.

Living things

- Prokaryotic (bacterial) cells**
 - Unicellular or multicellular
 - Single celled
 - Lack a membrane-bound nucleus and membrane-bound organelles
 - Cells 2-10 µm
 - DNA is a single, circular chromosome
 - There may be small accessory chromosomes called plasmids
 - Cell walls containing peptidoglycan
- Eukaryotic cells**
 - Cells 10-100 µm
 - Membrane-bound nucleus and membrane-bound organelles
 - Linear chromosomes

Plant cells

- Exist as part of multicellular organisms with specialization of cells into many types
- Autotrophic (make their own food) photosynthetic cells with chloroplasts
- Cell walls of cellulose

Animal cells

- Exist as part of multicellular organisms with specialization of cells into many types
- Lack cell walls
- Heterotrophic (rely on other organisms for food)

Fungal cells

- Many exist as unicellular, yeast-like cells
- Some are multicellular, forming hyphae
- Plant-like, but lack chloroplasts
- Fungal cell walls containing chitin

Viruses are non-cellular

- Non-cellular
- Typical size range 20-300 nm
- Contain no cytoplasm or organelles
- No chromosomes, just RNA or DNA
- Enclosed in a protein coat
- Depend on cells for metabolism and reproduction (parasitism)

44 What Are Cells Made Of?

Key Idea: The main components of a cell are water and organic molecules. The main components of a cell are water and organic molecules.

Water

- Water is a major component of cells.
- Water is a major component of cells.

Organic molecules

- Organic molecules are molecules that contain carbon.
- Organic molecules are molecules that contain carbon.

Proteins

- Proteins are made of amino acids.
- Proteins are made of amino acids.

Carbohydrates

- Carbohydrates are made of sugars.
- Carbohydrates are made of sugars.

Lipids

- Lipids are made of fatty acids.
- Lipids are made of fatty acids.

Nucleic acids

- Nucleic acids are made of nucleotides.
- Nucleic acids are made of nucleotides.

49 Plant Cells

Key Idea: Plant cells are eukaryotic cells. They have a cell wall, a large central vacuole, and chloroplasts. Plant cells are eukaryotic cells. They have a cell wall, a large central vacuole, and chloroplasts.

Generalized plant cell

- Cell wall:** A semi-rigid structure outside the plasma membrane. It is composed of cellulose and other polysaccharides. It provides structural support and protection.
- Chloroplasts:** Specialized organelles that perform photosynthesis. They contain chlorophyll and other pigments that capture light energy.
- Large central vacuole:** A large, fluid-filled sac that occupies most of the cell's volume. It is surrounded by a single membrane called the tonoplast.
- Plasma membrane:** A phospholipid bilayer that separates the cell from its environment. It is selectively permeable.
- Nucleus:** A large, spherical organelle that contains the cell's genetic material (DNA).
- Ribosomes:** Small, spherical structures that are the site of protein synthesis.
- Endoplasmic reticulum (ER):** A network of membranes that is involved in the synthesis and transport of proteins and lipids.
- Golgi apparatus:** A series of stacked, flattened sacs that are involved in the processing and transport of proteins and lipids.

54 Identifying Organelles

Key Idea: Cellular organelles can be identified in electron micrographs by their specific features. Cellular organelles can be identified in electron micrographs by their specific features.

Electron microscope produces a magnified image of a high resolution image that shows the structure of organelles.

1. (a) Name the organelle.

(b) Which kind of cell(s) would this organelle be found in?

(c) Describe the function of this organelle.

2. (a) Name this organelle (animal).

(b) State which kind of cell(s) this organelle would be found in.

(c) Describe the function of this organelle.

3. (a) Name the large, circular organelle.

(b) State which kind of cell(s) this organelle would be found in.

(c) Describe the function of this organelle.

4. (a) Name the two regions that can be seen inside this organelle.

(b) State which kind of cell(s) this organelle is found in.

(c) Describe the function of this organelle.

5. (a) Name this large circular organelle (animal).

(b) State which kind of cell(s) this organelle would be found in.

(c) Describe the function of this organelle.

(d) Label three features relating to this organelle in the photograph.

57 Staining a Slide

Key Idea: Staining material is used to view under a microscope. Staining material is used to view under a microscope.

Some commonly used stains

Stain	Preparation	Used for
Cotton blue	Low-magnification	Staining
Cresyl violet	Low-magnification	Staining
India ink	Low-magnification	Staining
Phosphotungstic acid (PTA)	High-magnification	Staining
Phosphotungstic acid (PTA)	High-magnification	Staining
Phosphotungstic acid (PTA)	High-magnification	Staining

How to apply a simple stain

1. Prepare the slide.

2. Apply the stain.

3. Rinse the slide.

4. Dry the slide.

5. View the slide under a microscope.

60 Observing and Recording Using a Microscope

Key Idea: Attention to detail is vital when making accurate and useful biological drawings. Attention to detail is vital when making accurate and useful biological drawings.

1. During your course, you will study the features of cells and also make an investigation related to the use of a light microscope.

2. In the space right, make a biological drawing of a cell and label its main features.

3. Below: A light micrograph of a leaf from the broad-leaved plant, *Impatiens*. The leaf is collected in water to reduce water loss.

4. Below: A light micrograph of a leaf from the broad-leaved plant, *Impatiens*. The leaf is collected in water to reduce water loss.

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.

32 Overcoming Limitations to Cell Size

Key idea: Cells are limited in size by the surface area to volume ratio. As cells increase in size, the surface area to volume ratio decreases, limiting the rate at which materials can enter and leave the cell. Cells overcome this limitation by increasing their surface area to volume ratio through various adaptations.

Cell size and functional efficiency: The surface area to volume ratio is a key factor in determining the efficiency of a cell. As a cell increases in size, the surface area to volume ratio decreases, limiting the rate at which materials can enter and leave the cell. Cells overcome this limitation by increasing their surface area to volume ratio through various adaptations.

Solving the size problem: Cells overcome the size problem by increasing their surface area to volume ratio through various adaptations. These include: increasing the surface area of the cell membrane, increasing the volume of the cell, and increasing the rate of material exchange.

Myofibrils: Myofibrils are the basic units of muscle tissue. They are composed of repeating units called sarcomeres. The length of a sarcomere is determined by the distance between the Z-discs. The thickness of a sarcomere is determined by the length of the myofibrils.

69 Enzymes and Membranes

Key idea: Enzymes are biological catalysts that speed up chemical reactions. They are composed of proteins. Enzymes are specific to their substrates. The rate of an enzyme-catalysed reaction is affected by temperature, pH, and substrate concentration.

Enzymes and membranes: Enzymes are often found embedded in cell membranes. The structure of the membrane affects the activity of the enzyme. The fluid mosaic model describes the structure of the cell membrane.

Transport across membranes: Materials can move across membranes through various mechanisms. These include: simple diffusion, facilitated diffusion, active transport, and osmosis.

101 The Digestive System

Key idea: The digestive system is responsible for breaking down food into nutrients that can be absorbed by the body. The digestive system consists of the mouth, esophagus, stomach, small intestine, and large intestine.

Enzymes in digestion: Enzymes are used to break down food into smaller molecules. The rate of digestion is affected by the concentration of enzymes and the pH of the environment.

Surface area and digestion: The surface area of the digestive tract is increased through various adaptations. These include: the folding of the intestinal lining, the presence of villi, and the presence of microvilli.

EXAMPLE 1

Increasing surface area

Students 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).

28 Diffusion

Key idea: Diffusion is the movement of molecules from an area of high concentration to an area of low concentration. The rate of diffusion is affected by temperature, concentration gradient, and distance.

Factors affecting the rate of diffusion: The rate of diffusion is affected by temperature, concentration gradient, and distance. Higher temperature, higher concentration gradient, and shorter distance all increase the rate of diffusion.

Counter-current exchange: Counter-current exchange is a mechanism used by fish to increase the efficiency of gas exchange in their gills. It involves the flow of water and blood in opposite directions.

94 Gas Exchange in Fish

Key idea: Fish use gills for gas exchange. The gills are composed of many small, thin structures called lamellae. The flow of water over the gills is maintained by the operculum.

Counter-current exchange: Counter-current exchange is a mechanism used by fish to increase the efficiency of gas exchange in their gills. It involves the flow of water and blood in opposite directions.

Ventilation of the gills: The gills are ventilated by the operculum. The operculum is a flap of skin that covers the gills. It moves up and down to create a flow of water over the gills.

151 Physiological Mechanisms for Thermoregulation

Key idea: Thermoregulation is the process by which organisms maintain their body temperature. It involves the use of various physiological mechanisms.

Countercurrent heat exchangers: Countercurrent heat exchangers are found in many vertebrates. They are used to conserve heat and maintain body temperature. They involve the flow of blood in opposite directions.

Behavioral adaptations: Organisms also use behavioral adaptations to maintain their body temperature. These include: seeking shade, hibernation, and migration.

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.

43 The Cell is the Unit of Life

Key idea: The cell is the basic unit of life. All living organisms are composed of cells. Cells are responsible for the structure and function of the organism.

Prokaryotic cells: Prokaryotic cells are simple cells that lack a nucleus. They are found in bacteria and archaea.

Eukaryotic cells: Eukaryotic cells are more complex cells that have a nucleus. They are found in plants, animals, and fungi.

166 Bacterial Diseases

Key idea: Bacterial diseases are caused by bacteria. Bacteria are single-celled organisms that can cause a wide range of diseases. Bacterial diseases are often spread through contact with infected individuals or contaminated food and water.

Transmission of bacterial diseases: Bacterial diseases can be transmitted through various mechanisms. These include: direct contact, indirect contact, and vector-borne transmission.

Vaccines: Vaccines are used to prevent bacterial diseases. They contain weakened or killed bacteria that stimulate the immune system.

187 Vaccines Can Eliminate Infectious Disease

Key idea: Vaccines are used to prevent infectious diseases. They contain weakened or killed pathogens that stimulate the immune system.

Measles: Measles is a highly contagious viral disease. It is caused by the measles virus. Measles can be prevented by vaccination.

Polio: Polio is a viral disease that can cause paralysis. It is caused by the poliovirus. Polio can be prevented by vaccination.

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.

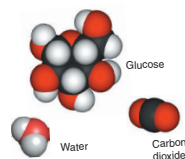
104

80

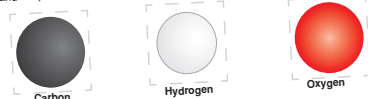
Modelling Photosynthesis and Cell Respiration

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.



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



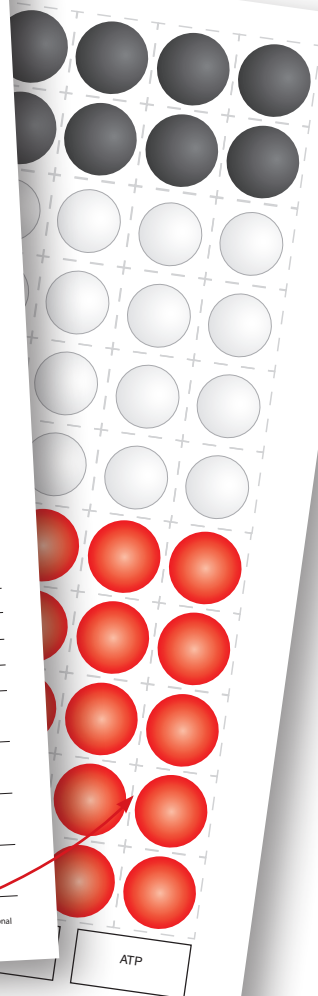
2. Write the equation for **photosynthesis** here: _____
- (a) State the starting reactants in photosynthesis: _____
- (b) State the total number of atoms of each type needed to make the starting reactants:
- Carbon: _____ Hydrogen: _____ Oxygen: _____
- (c) Use the atoms you have cut out to make the 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

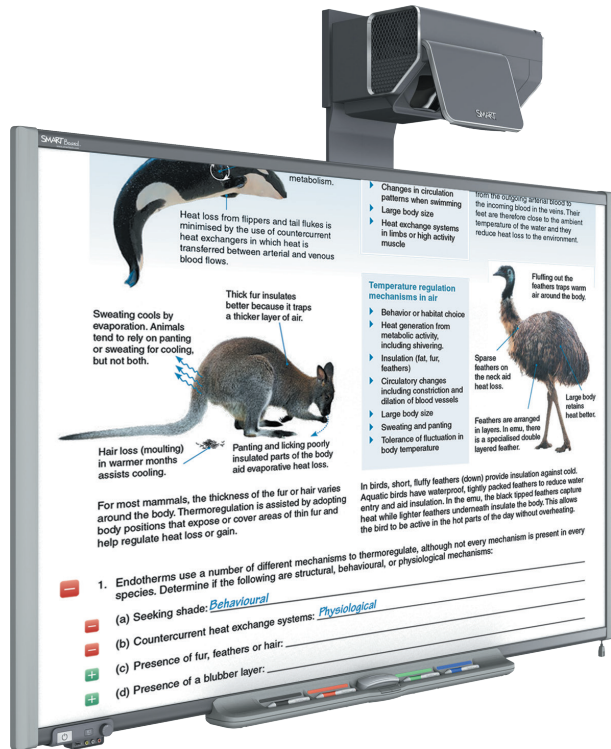


ATP

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.





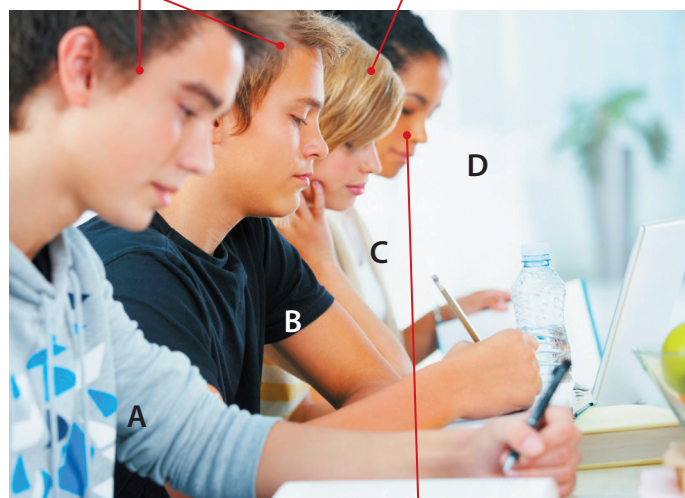
2

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.

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.

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.

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 cancer of the respiratory tract. Smoking causes the lung tissue to lose its elasticity and far from the tobacco smoke clings the airways and damages the alveoli. Use the diagram to help you to explain why smoking reduces the gas exchange capacity of the lung tissue.

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?

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.

123 Homeostasis

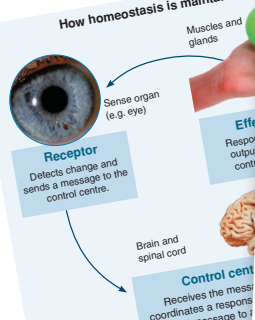
Key Idea: Homeostasis refers to the (relatively) constant physiological state of the body despite fluctuations in the environment.

Organisms maintain a relatively constant physiological state, despite changes in their environment. Any change in the environment to which an organism responds is called a **stimulus**. Organisms must also adapt to changes in their environment to maintain homeostasis. This involves the coordinated activity of the body's organ systems. Homeostatic mechanisms prevent deviations from the steady state and keep the body's internal environment within strict limits. Deviations from these limits can be harmful (e.g. to enzyme activity and therefore metabolic pathways).

For example, during exercise (right) body temperature must remain constant at about 37.0°C despite the extra heat generated by active muscles. Your body's organ systems carry out these tasks to regulate blood sugar levels and blood pH, water and electrolyte balance and blood pressure. Your body must detect stimuli that deviate from the steady state, and respond to it appropriately.

To maintain homeostasis, the body must detect stimuli that deviate from the steady state, and respond to it appropriately. The process this sensory information, and respond to it appropriately. The effector is a muscle, it results in muscle contraction. If the effector produces a secretion. The responses provide new feedback. These three components are illustrated below.

How homeostasis is maintained

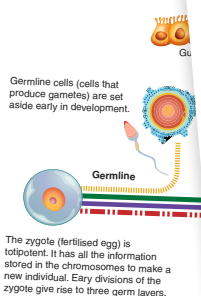


1. What is homeostasis?
2. What is the role of the following components?
 - (a) Receptor:
 - (b) Control centre:
 - (c) Effector:

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

87 Cellular Differentiation

Key Idea: A zygote divides and the body by cellular differentiation, switching determine what cell type. As described, multicellular organisms have different cell types, each specialised for a particular role. A zygote and its first few divisions can differentiate to form a variety of cell types. During development, these cells



1. Multicellular organisms consist of many cell types. What are the three germ layers?
2. The zygote produces cells that differentiate into these lineages produce?
 - (a) Endoderm:
 - (b) Mesoderm:
 - (c) Ectoderm:
3. Why can't a blood cell turn into a nerve cell?

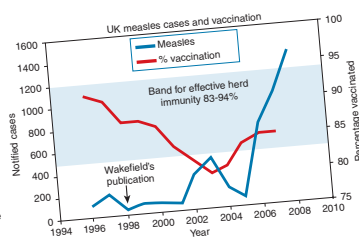
188 KEY TERMS AND IDEAS: Did You Get It?

1. Contrast the innate and the adaptive immune responses with reference to the basic action and the cells involved:

2. The photograph on the right shows the effect of a pathogen infecting a human.
 - (a) Name the defensive response occurring:
 - (b) What is happening to the blood vessels at this location?
 - (c) Name the substance responsible for the change in the blood vessels:
 - (d) What type of cell is the substance released from?
 - (e) During this response, the number of white blood cells increases/decreases (delete one).
 - (f) The process occurring here is an example of innate immunity / adaptive immunity (delete one).



3. In 1998, Dr Andrew Wakefield and his colleagues published a paper linking the measles, mumps, and rubella vaccine (MMR) to an increase in autism rates. As a result, the uptake of the MMR vaccine in the UK dropped, and several measles outbreaks occurred. Dr Wakefield's paper has since been retracted by the journal in which it was published as it was found to be fraudulent and flawed in several aspects, e.g. sample size of only 12, with no control group. Since the publication of Wakefield's paper, 20 large scale epidemiologic studies into MMR and autism have been carried out in several countries. All have shown that the MMR vaccine does not cause autism. However, the damage has been done, and health authorities must now convince the public that the vaccine is safe.



The graph above shows the number of measles cases in the UK, together with percentage vaccination, 1994-2008.

- (a) What happened to MMR vaccination rates after the publication of Wakefield's study?
- (b) What is the trend in measles cases in the UK since 2006?
- (c) Give a likely explanation for this trend:

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:

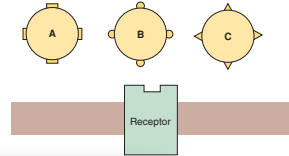
Literacy activities use a range of question types to test vocabulary and understanding of basic principles. Questions include analysis or completion of flow charts, drawings or photographs, mix and match definitions, vocab builders, and multiple choice.

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?

- (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?



92 KEY TERMS AND IDEAS: Did You Get It?

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

multipotent
 pluripotent
 self renewal
 stem cell
 potency
 zygote

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

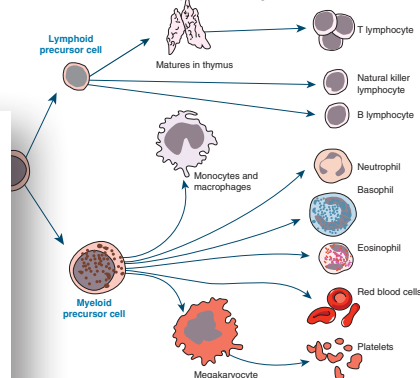
- Give an example of each of the following stem cell types:

(a) Multipotent:

(b) Pluripotent:

(c) Totipotent:

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



1. A myeloid precursor cell can differentiate from a haematopoietic multipotent stem cell.
 2. A myeloid precursor cell can produce red blood cells.
 3. A myeloid precursor cell can produce platelets.
 4. A myeloid precursor cell can produce monocytes, tissues, and organs?
 5. A myeloid precursor cell can produce megakaryocytes.

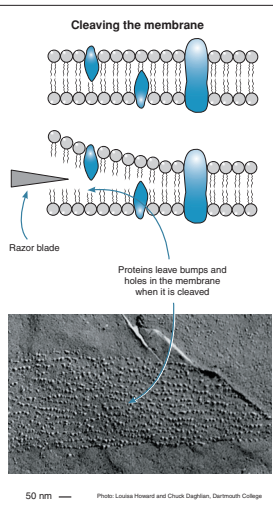
26 How Do We Know? Membrane Structure

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.

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.



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

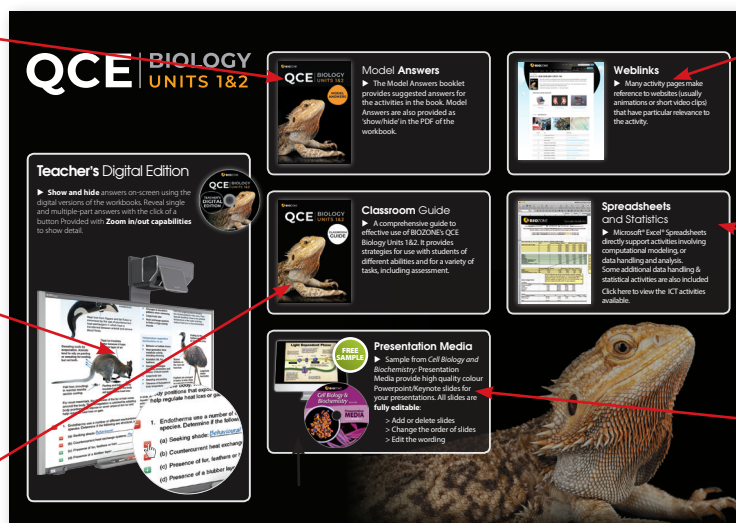
The *Teacher's Digital Edition* is aimed primarily at extending the pedagogical tools at a teacher's disposal. Many of the features of this resource have been developed in response to requests from teachers themselves.



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.

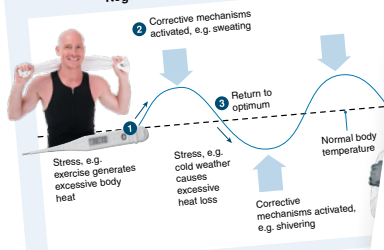
178

125 Negative Feedback

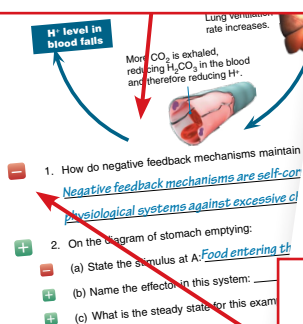
Key Idea: Negative feedback mechanisms detect departures from a desired set point and act to restore the steady state. Negative feedback is a regulatory mechanism that maintains the body's homeostasis by detecting deviations from a certain set point and acting to restore those set point conditions.

Negative feedback mechanisms detect departures from a desired set point and act to restore the steady state. Negative feedback is a regulatory mechanism that maintains the body's homeostasis by detecting deviations from a certain set point and acting to restore those set point conditions.

Negative feedback in temperature regulation



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



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

2 Pearson's Linear

Key Idea: Pearson's linear correlation measures the correlation of two normally distributed variables. Pearson's linear correlation coefficient is a measure of the linear correlation between two variables. The correlation coefficient is a measure of the linear correlation between two variables. The correlation coefficient is a measure of the linear correlation between two variables.

$$r = \frac{\sum xy - n\bar{x}\bar{y}}{n s_x s_y}$$

$$s = \sqrt{\frac{\sum (x - \bar{x})^2}{n-1}}$$

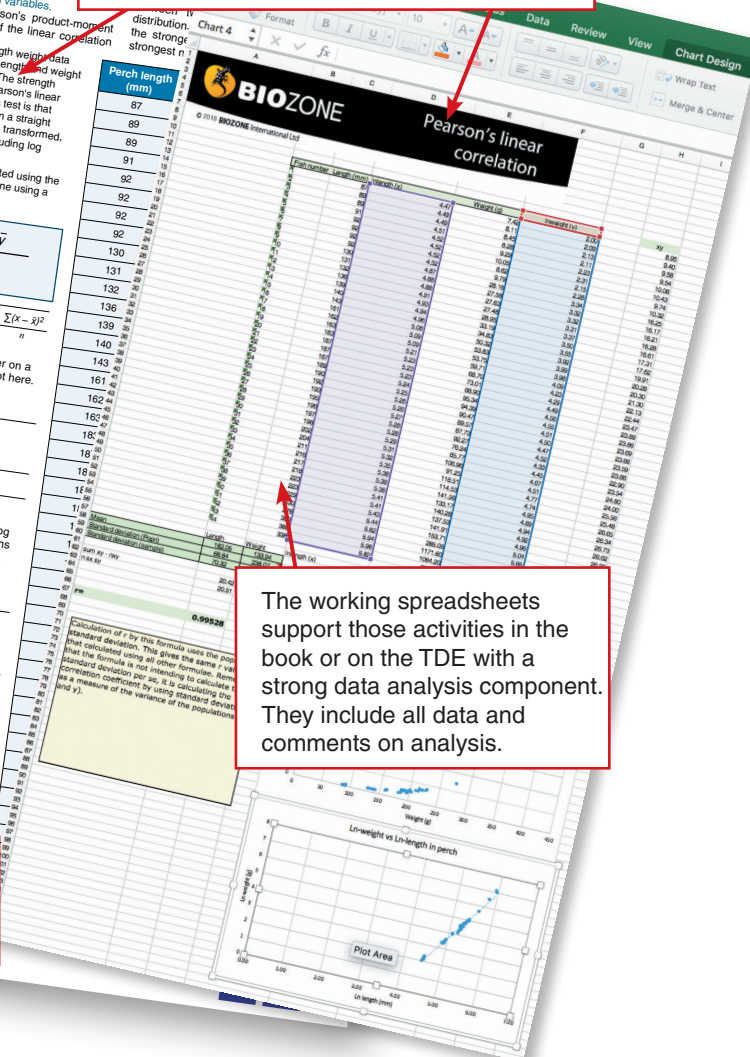
1. First plot the raw data as an xy scatter, either on a separate sheet or using Excel. Attach the plot here.
2. Why have the data been log transformed?

No, it's curvilinear
To make the data plot linear and meet the requirements of the test

- (a) Using the spreadsheet provided on the Teacher's Digital Edition, make a plot of the log (ln length and ln weight) and >Insert Chart> XY scatter. What is the shape of the plot now? Attach a printout to this page if you wish.

- (b) Follow the calculation of the correlation coefficient (r) using the log transformed data. Under the Formulas tab, click 'Show Formulas' to switch between showing and hiding the values.
- (c) What is the value of the correlation coefficient, r?

- (d) What is the relationship between fish length and fish weight and how strong is this relationship?



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.

