BIOZONE

CIE BIOLOGY 1

Cambridge International Examination

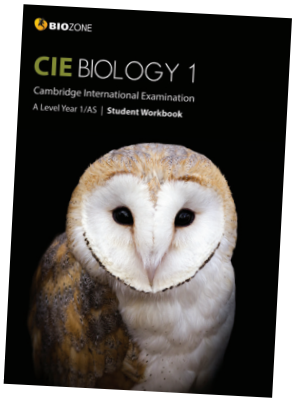
A Level Year 1/AS | **Student Workbook**

CLASSROOM GUIDE

Contents

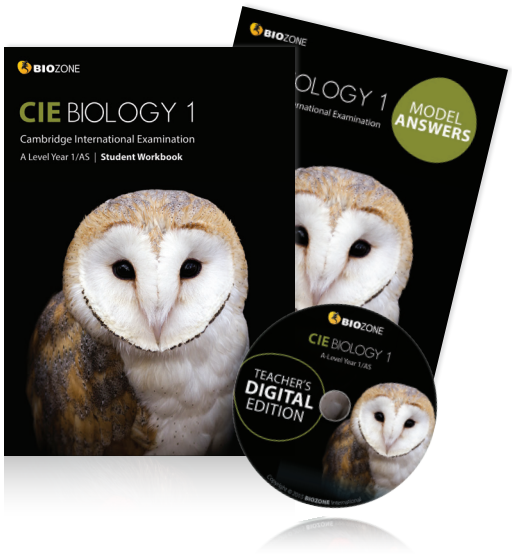
Making the most of *CIE BIOLOGY 1*

FAQs ABOUT OUR CIE BIOLOGY 1 STUDENT WORKBOOK



Meeting Key Competencies

We want today's biology students to be self-motivated, lifelong learners, to develop a sound grasp of biological knowledge, to plan and evaluate their work, and to think critically and independently. In developing CIE Biology 1, we have utilised the 5Es instructional model as a basis for developing materials to specifically address the CIE Biology syllabus. By successfully completing the activities, which make up the bulk of the student workbook, students can demonstrate competence in skills and knowledge. 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.



BIOZONE encourages the development of an independent learner profile 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 summarize 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 are self-contained so students are encouraged to be independent learners and seek the answers to questions posed by the activity. Capable students can work quickly and independently through the material and can use the time for extension. Less able students can review or finish activities at home. 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 visually inviting delivery of content. Student engagement with this material leads them to the questions in which they must 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**	Encourage self assessment with chapter reviews (these can be graded if desired) or use specific activities to evaluate a student's skills and understanding or ideas.
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 glance how quickly the student is progressing through the assigned material.

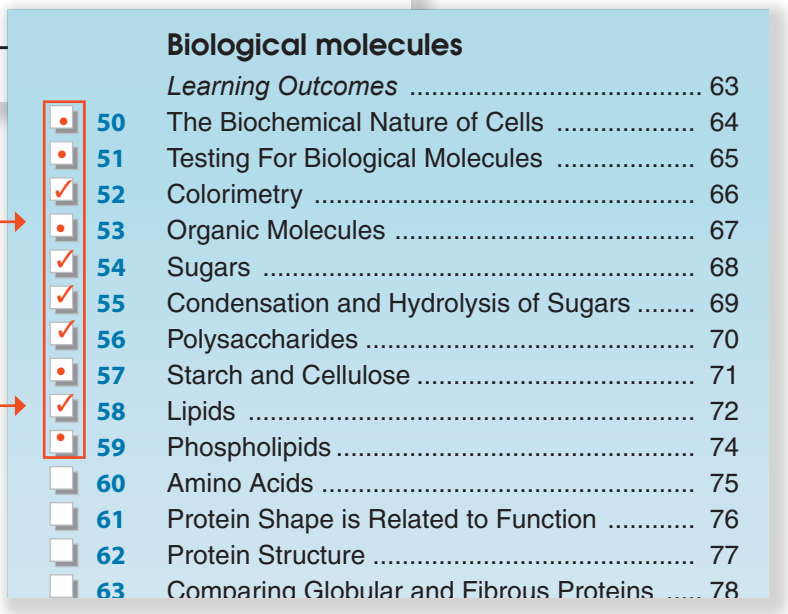
Contents

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.

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.



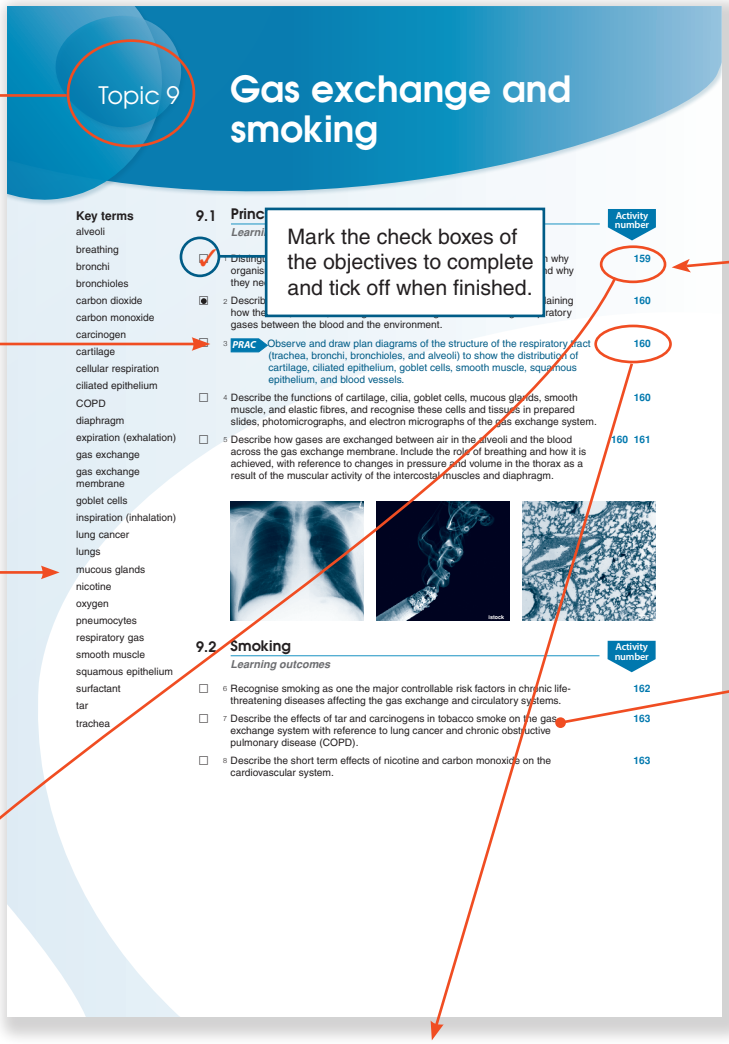
Introducing CIE Biology 1 Content

Each chapter in CIE Biology 1 is prefaced with a one page introduction, providing students with an overview of the chapter content and organisation. Each of the numbered learning outcomes pertains to a point of key knowledge or a skill, and is matched to one or more activities. A list of key terms for the chapter is also included. The comprehensive, but accessible, list of learning outcomes encourages students to approach each topic confidently. Familiarity with the scientific terms used in each topic is implicit in this.

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

Activities that cover practical skills are identified.

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.



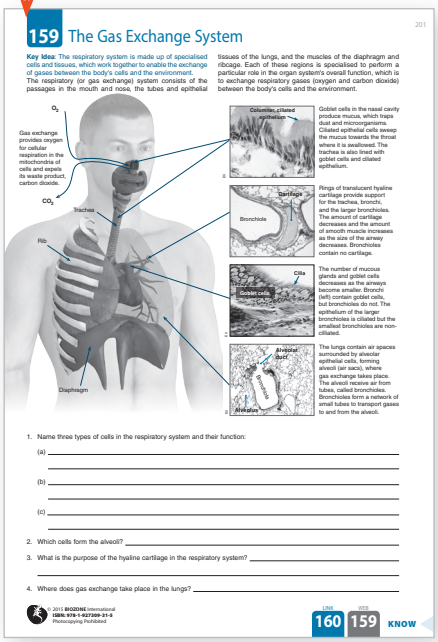
The activities in the workbook with the activities pertaining to these learning outcomes.

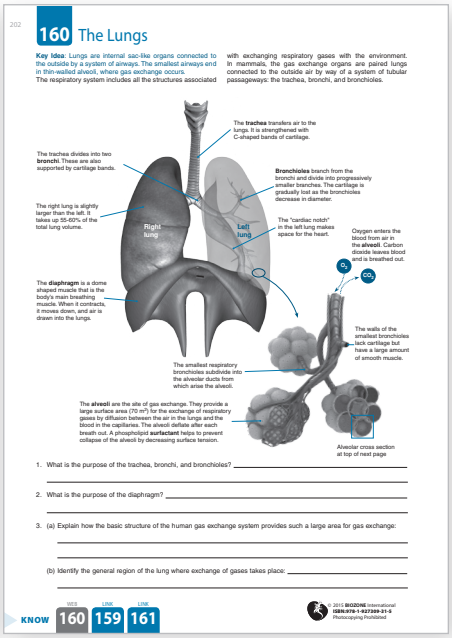
For students:

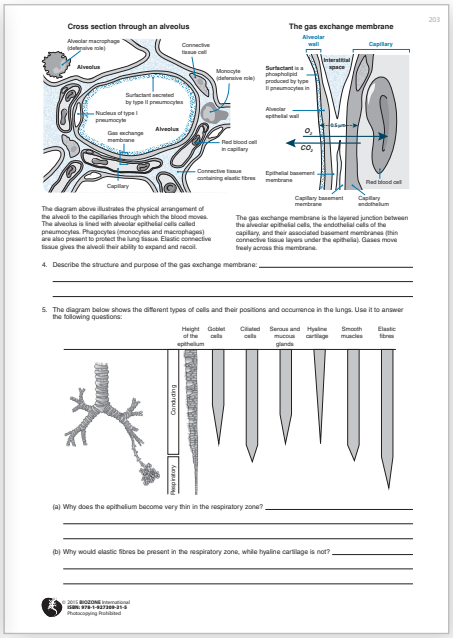
Key knowledge and skills are drawn from the CIE Biology syllabus. They are purposefully brief, with enough information to provide a framework, but not so much that students are overwhelmed.

Introduce the concept with a grounding activity

Follow with an activity expanding on that concept

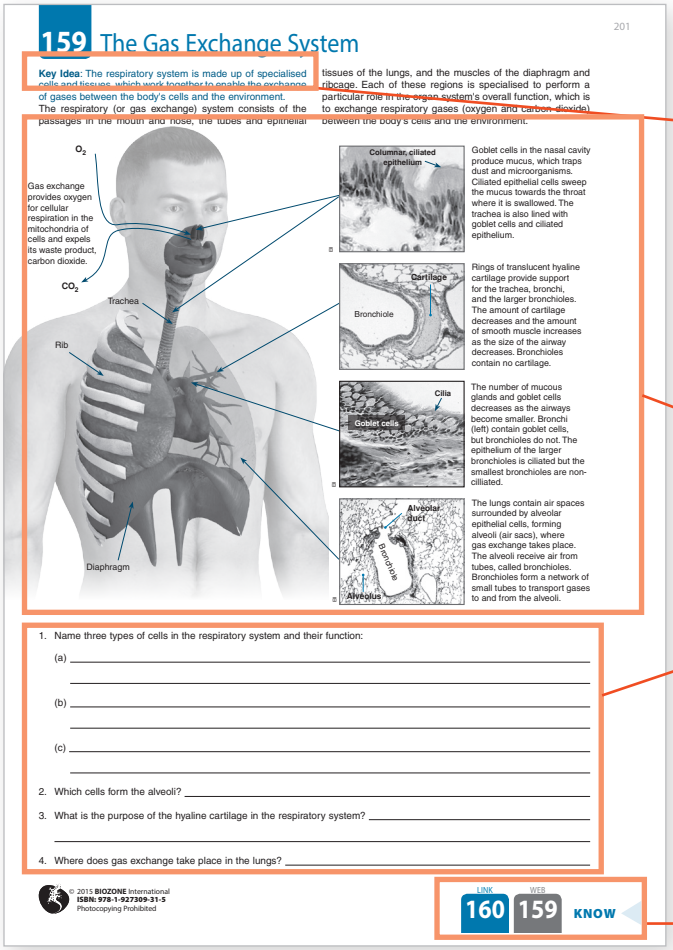






Finding Your Way Around

The content of the CIE Biology 1 is organised into 12 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 biological drawing. An important feature of each activity is the key idea, which encapsulates the main focus of the content provided. 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.



159 The Gas Exchange System

201

Key Idea: The respiratory system is made up of specialised cells and tissues, which work together to enable the exchange of gases between the body's cells and the environment.

The respiratory (or gas exchange) system consists of the passages in the mouth and nose, the tubes and epithelial tissues of the lungs, and the muscles of the diaphragm and ribcage. Each of these regions is specialised to perform a particular role in the organ system's overall function, which is to exchange respiratory gases (oxygen and carbon dioxide) between the body's cells and the environment.

O_2

Gas exchange provides oxygen for cellular respiration in the mitochondria of cells and expels its waste product, carbon dioxide.

CO_2

Trachea

Rib

Diaphragm

Columnar ciliated epithelium

Goblet cells in the nasal cavity produce mucus, which traps dust and microorganisms. Ciliated epithelial cells sweep the mucus towards the throat where it is swallowed. The trachea is also lined with goblet cells and ciliated epithelium.

Cartilage

Bronchiole

Rings of translucent hyaline cartilage provide support for the trachea, bronchi, and the larger bronchioles. The amount of cartilage decreases and the amount of smooth muscle increases as the size of the airway decreases. Bronchioles contain no cartilage.

Cilia

Goblet cells

The number of mucous glands and goblet cells decreases as the airways become smaller. Bronchi (left) contain goblet cells, but bronchioles do not. The epithelium of the larger bronchioles is ciliated but the smallest bronchioles are non-ciliated.

Alveolar duct

Bronchiole

Alveolus

The lungs contain air spaces surrounded by alveolar epithelial cells, forming alveoli (air sacs), where gas exchange takes place. The alveoli receive air from tubes, called bronchioles. Bronchioles form a network of small tubes to transport gases to and from the alveoli.

1. Name three types of cells in the respiratory system and their function:
   (a) _____
   (b) _____
   (c) _____
2. Which cells form the alveoli? _____
3. What is the purpose of the hyaline cartilage in the respiratory system? _____
4. Where does gas exchange take place in the lungs? _____

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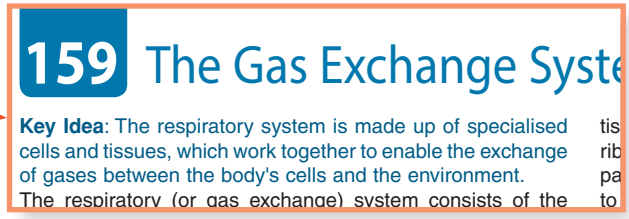
LINK 160 WEB 159 KNOW



159 The Gas Exchange Syste

Key Idea: The respiratory system is made up of specialised cells and tissues, which work together to enable the exchange of gases between the body's cells and the environment.
The respiratory (or gas exchange) system consists of the

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 and reinforcement and explanation of the key idea.

Related content is identified through the tab system. This activity also has a **weblink** assigned to it (see below).

Links

These blue tabs indicate activities that provide content that is related to or builds on the content on the page.

Weblinks

This grey tab indicates a weblink. Bookmark the weblinks page:

www.biozone.co.uk/weblink/CIE-1-9315

Access the external URL for the activity by clicking the link next to its number.

THE ACTIVITY CODING SYSTEM

Main focus of the activity is:

COMP	= comprehension of text
DATA	= data handling and interpretation
KNOW	= content you need to know
PRAC	= a paper practical or a practical focus
REFER	= reference - use this for information
REVISE	= review the material in the section
SKILL	= a specific skill to be demonstrated
TEST	= test your understanding

Practical Investigations

The basic techniques and skills required for practical work and mathematical skills are addressed in the introductory chapter (*Experimental and investigative skills*) and in context throughout the workbook. Activities that support practical investigations are identified in the introduction of the relevant chapters.

Papers 3&5

Experimental and investigative skills

Key terms

accuracy
assumption
bar graph
control
controlled variable
dependent variable
fair test
histogram
hypothesis
independent variable
line graph
mean
median
mode
observation
percentage error
precision
prediction
quantitative data
qualitative data
sample
scatter graph
variable

Practical and investigative skills

Learning outcomes supported as indicated and throughout CIE 1&2

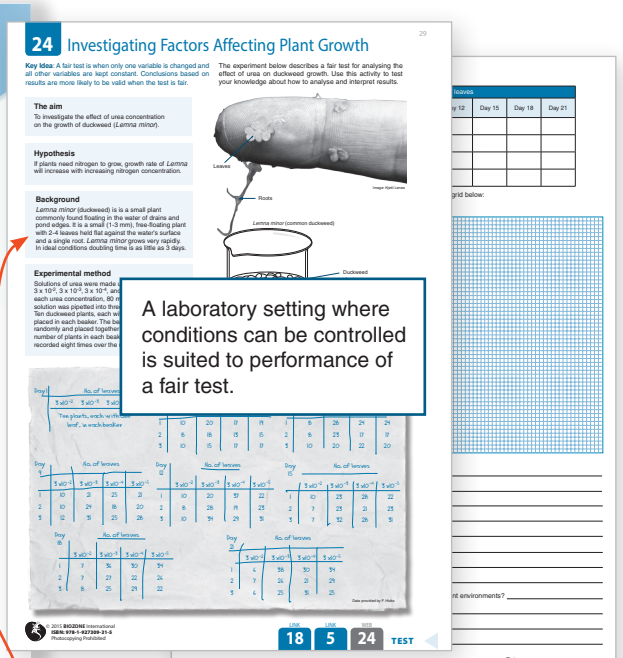
		Activity number
☐ 1	Demonstrate an understanding of science as inquiry.	1 2
☐ 2	Demonstrate an understanding of experimental design including identification of dependent, independent, and controlled variables, choice of a control and range of the independent variable, and awareness of assumptions in your design.	2 3 4 5
☐ 3	Use laboratory glassware for a range of techniques, including serial dilution.	5 11 90
☐ 4	Use a range of apparatus, materials, and techniques correctly, including use of a light microscope with eyepiece graticule and stage micrometer.	11 28 29 30 32 137
☐ 5	Demonstrate an ability to use appropriate units for measurement and record your data systematically and accurately, e.g. in tables or spreadsheets.	6 12
☐ 6	Use graphs and tables appropriately to present observations and data.	13 15-19
☐ 7	Process, analyse, and interpret qualitative and quantitative experimental data.	4 5 24 25
☐ 8	Evaluate results and draw valid conclusions based on evidence. Identify and explain anomalies in experimental measurements.	24 25
☐ 9	Identify limitations in experimental procedures and suggest how these could be overcome through improvements to design, apparatus, or technique.	5 24 25
☐ 10	Recognise and evaluate the precision and accuracy of collected data, including margins of error, percentage errors and uncertainties in apparatus.	6 11



Mathematical skills

Learning outcomes supported as indicated and throughout CIE 1&2

		Activity number
☐ 1	Recognise and use appropriate units in calculations and experimental work.	6 7
☐ 2	Use an appropriate number of significant figures in reporting calculations.	6
☐ 3	Manipulate equations to calculate size and magnification of objects in drawings and photomicrographs or viewed with a light microscope.	33
☐ 4	Carry out calculations involving fractions, percentages, and ratios.	8 10
☐ 5	Use a calculator to find and use power, exponential, and logarithmic functions.	9
☐ 6	Estimate results to assess if calculated values are appropriate.	7
☐ 7	Find arithmetic means for data. Understand use of mean, median, and mode.	21
☐ 8	Select an appropriate format to plot two variables from experimental or other data (including histograms, bar graphs, pie graphs, line graphs, and scatter graphs).	14
☐ 9	Predict or sketch the shape of a graph with a linear relationship ($y = mx + c$).	20
☐ 10	Determine the intercept of a graph.	20
☐ 11	Calculate rate of change from a graph showing a linear relationship. Draw and use the slope of a tangent to a curve as a measure of rate of change.	74
☐ 12	Make annotated scientific drawings from observations.	22 23



24 Investigating Factors Affecting Plant Growth

Key Idea: A fair test is when only one variable is changed and all other variables are kept constant. Conclusions based on results are more likely to be valid when the test is fair.

The experiment below describes a fair test for analysing the effect of urea on duckweed growth. Use this activity to test your knowledge about how to analyse and interpret results.

The aim
To investigate the effect of urea concentration on the growth of duckweed (*Lemna minor*).

Hypothesis
If plants need nitrogen to grow, growth rate of *Lemna* will increase with increasing nitrogen concentration.

Background
Lemna minor (duckweed) is is a small plant commonly found floating in the water of drains and pond edges. It is a small (1-3 mm), free-floating plant with 2-4 leaves held flat against the water's surface and a single root. *Lemna minor* grows very rapidly. In ideal conditions doubling time is as little as 3 days.

Experimental method
Solutions of urea were made u... 3 x 10⁻³, 3 x 10⁻⁴, 3 x 10⁻⁵, and... each urea concentration, 80 m... solution was pipetted into thre... Ten duckweed plants, each w... placed in each beaker. The be... randomly and placed together... number of plants in each beak... recorded eight times over the...

Leaves
Roots
Lemna minor (common duckweed)
Duckweed

A laboratory setting where conditions can be controlled is suited to performance of a fair test.

LINK 18 5 24 TEST

25 Test Your Understanding

Key Idea: Systematic recording and analysis of results can help identify trends and draw conclusions about a biological response in an experiment.

Using the information below, analyse results and draw conclusions about the effect of a nitrogen fertiliser on the growth of radish plants.


Radishes

The aim
To investigate the effect of a nitrogen fertiliser on the growth of radish plants.

Hypothesis
If plants need nitrogen to grow, radish growth will increase with increasing nitrogen concentration.

Background
Inorganic fertilisers revolutionised crop farming when they were introduced during the late 19th and early 20th century. Crop yields soared and today it is estimated around 50% of crop yield is attributable to the use of fertiliser. Nitrogen is a very important element for plant growth and several types of purely nitrogen fertiliser are manufactured to supply it, e.g. urea.

Experimental method
This experiment was designed to test the effect of nitrogen fertiliser on plant growth. Radish seeds were planted in separate identical pots (5 cm x 5 cm wide x 10 c... temperature (22°C) con...
The radishes were wate... 1.25 L per treatment. Wa... with the first watering on... concentrations used were... 0.30 g dm⁻³ with each tre... The plants were grown fo... and the root (radish) was...

Students can use raw data from laboratory studies to interpret results and draw conclusions.

Fertiliser concentration / g dm⁻³	Sample / #					Total mass	Mean mass
	1	2	3	4	5		
0	80.1	83.2	82.0	79.1	84.1	408.5	81.7
0.06	109.2	110.3	108.2	107.9	110.7		
0.12	117.9	118.9	118.3	119.1	117.2		
0.18	128.3	127.3	127.7	126.8	DNG*		
0.24	23.6	140.3	139.6	137.9	141.1		
0.30	122.3	121.1	122.6	121.3	123.1		

* DNG: Did not germinate

1. Identify the independent variable for the experiment and its range: _____
2. What is the sample size for each concentration of fertiliser? _____

LINK 18 5 DATA

18 Drawing Line Graphs

Key Idea: Line graphs are used to plot continuous data in which one variable (the independent variable) directly affects the other (dependent) variable. They are appropriate for data in which the independent variable is manipulated.

Guidelines f...
Line graphs are... variable) affect... be drawn witho... some calculati...
Important featu...
- The data m...
- The depen...
- The indepe... treatment.
- In cases wi... increases v... through the...
- If fluctuatio... climate and... usually con...
- Line graphs... presented ... bars above... spread in th... 95% confid...
- Where no x... shown by p... and below t... indicate the...

1. The results (... the effect of t...
   (a) Using the... below:
   (b) Estimate...

DATA LINK 72

20 Interpreting Line Graphs

Key Idea: The equation for a straight line is $y = mx + c$. A line may have a positive, negative, or zero slope.

The equation for a linear (straight) line on a graph is $y = mx + c$. The equation can be used to calculate the gradient (slope) of a straight line and tells us about the relationship between x and y (how fast y is changing relative to x). For a straight line, the rate of change of y relative to x is always constant. A line may have a positive, negative, or zero slope.

Measuring gradients and intercepts

The equation for a straight line is written as:

$y = mx + c$

Where :
y = the y-axis value
m = the slope (or gradient)
x = the x-axis value
c = the y intercept (where the line cross the y-axis).

The intercept (c) on a graph is where the line crosses the y-axis.

Determining "m" and "c"
To find "c" just find where the line crosses the y-axis.
To find m:
1. Choose any two points on the line.
2. Draw a right-angled triangle between the two points on the line.
3. Use the scale on each axis to find the triangle's vertical length and horizontal length.
4. Calculate the gradient of the line using the following equation:

For the example above:
c = 1
m = 0.45 (5 ÷ 11)

Once c and m have been determined you can choose any value for x and find the corresponding value for y.

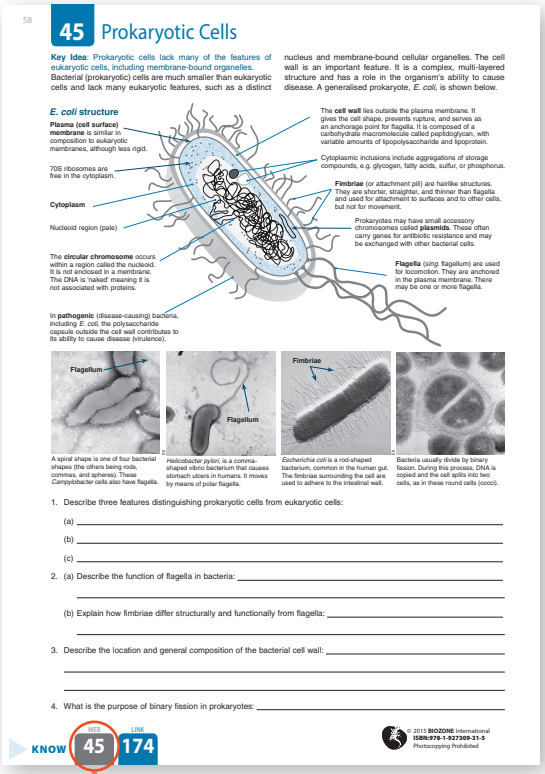
Positive gradients: the line slopes upward to the right (y is increasing as x increases).
Negative gradients: the line slopes downward to the right (y is decreasing as x increases).
Zero gradients: the line is horizontal (y does not change as x increases).

Students can gain experience in drawing graphs and determining the intercept of a line graph.

1. State the gradient for graphs a, b, and c (above): (a) _____ (b) _____ (c) _____
2. For a straight line $y = 3x + 2$,
   (a) Identify the value of c: _____ (b) Determine y if x = 4: _____
3. For the graph (right):
   (a) Identify the value of c: _____
   (b) Calculate the value of m: _____
   (c) Determine y if x = 2: _____
   (d) Describe the slope of the line: _____

DATA

Making Use of Weblinks



58

45 Prokaryotic Cells

Key Idea: Prokaryotic cells lack many of the features of eukaryotic cells, including membrane-bound organelles.

Bacterial (prokaryotic) cells are much smaller than eukaryotic cells and lack many eukaryotic features, such as a distinct nucleus and membrane-bound cellular organelles. The cell wall is an important feature. It is a complex, multi-layered structure and has a role in the organism's ability to cause disease. A generalised prokaryote, *E. coli*, is shown below.

***E. coli* structure**

Plasma (cell surface) membrane is similar in composition to eukaryotic membranes, although less rigid.

70S ribosomes are free in the cytoplasm.

Cytoplasm

Nucleoid region (pale)

The **circular chromosome** occurs within a region called the nucleoid. It is not enclosed in a membrane. The DNA is 'naked' meaning it is not associated with proteins.

In **pathogenic** (disease-causing) bacteria, including *E. coli*, the polysaccharide capsule outside the cell wall contributes to its ability to cause disease (virulence).

The **cell wall** lies outside the plasma membrane. It gives the cell shape, prevents rupture, and serves as an anchorage point for flagella. It is composed of a carbohydrate macromolecule called peptidoglycan, with variable amounts of lipopolysaccharide and lipoprotein.

Cytoplasmic inclusions include aggregations of storage compounds, e.g. glycogen, fatty acids, sulfur, or phosphorus.

Fimbriae (or attachment pili) are hairlike structures. They are shorter, straighter, and thinner than flagella and used for attachment to surfaces and to other cells, but not for movement.

Prokaryotes may have small accessory chromosomes called **plasmids**. These often carry genes for antibiotic resistance and may be exchanged with other bacterial cells.

Flagella (*sing.* flagellum) are used for locomotion. They are anchored in the plasma membrane. There may be one or more flagella.

Flagellum | Flagellum | Fimbriae

A spiral shape is one of four bacterial shapes (the others being rods, commas, and spheres). These *Campylobacter* cells also have flagella.

Helicobacter pylori, is a comma-shaped vibrio bacterium that causes stomach ulcers in humans. It moves by means of polar flagella.

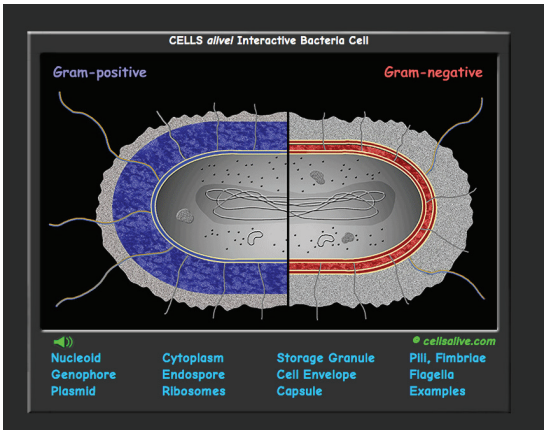
Escherichia coli is a rod-shaped bacterium, common in the human gut. The fimbriae surrounding the cell are used to adhere to the intestinal wall.

Bacteria usually divide by binary fission. During this process, DNA is copied and the cell splits into two cells, as in these round cells (cocci).

1. Describe three features distinguishing prokaryotic cells from eukaryotic cells:
   (a) _____
   (b) _____
   (c) _____
2. (a) Describe the function of flagella in bacteria: _____
   (b) Explain how fimbriae differ structurally and functionally from flagella: _____
3. Describe the location and general composition of the bacterial cell wall: _____
4. What is the purpose of binary fission in prokaryotes: _____

WEB KNOW 45 LINK 174

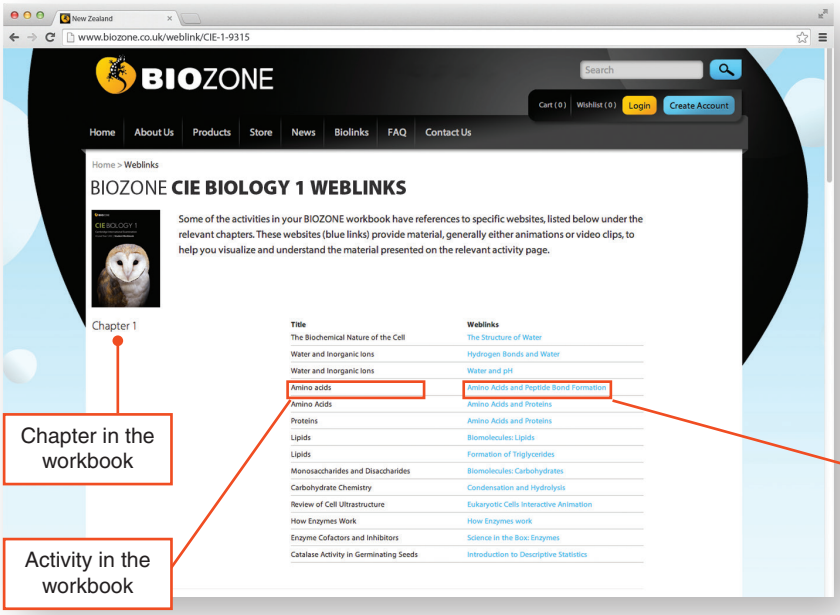
The tab system at the base of each activity identifies if there is a weblink available to support the activity's content. The weblinks are distinct from the general Biolinks area of BIOZONE's website. They are coded with the activity number and are only accessible through a specific url (below), so bookmark the address at the beginning of your teaching year and always have them on hand. 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.

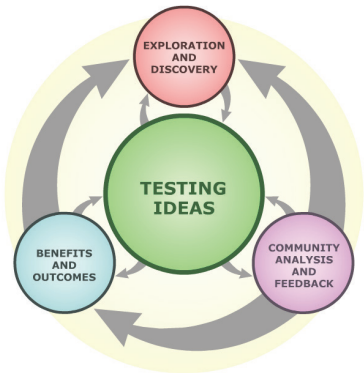


Weblinks exist for most of the activities in the workbook, from cells to evolution.

www.biozone.co.uk/weblink/CIE-1-9315

This WEBLINKS page provides links to **external web sites** with supporting information for the activities. Almost exclusively, they are narrowly focussed animations and video clips relevant to the activity on which they are cited. They offer great support to aid student understanding of basic concepts, especially for visual learners.





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

Engage, Explore, Explain, Elaborate, and Evaluate

In developing CIE Biology 1, we have focussed on the learning outcomes and skills requirements identified in the CIE Biology syllabus. The activities in CIE Biology 1 have been specifically written to address this content. Our focus is student engagement through the use of a concept-based, highly visual design and opportunity to demonstrate skills and understanding.


Topic 7 Transport in plants

Key terms

7.1 Structure of plant transport tissues

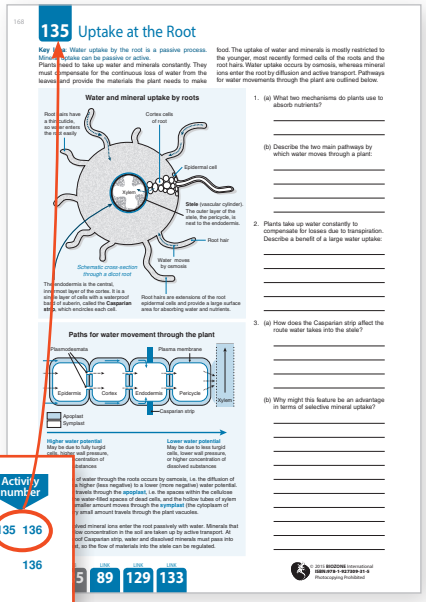
Learning outcomes

7.2 Transport mechanisms

Learning outcomes

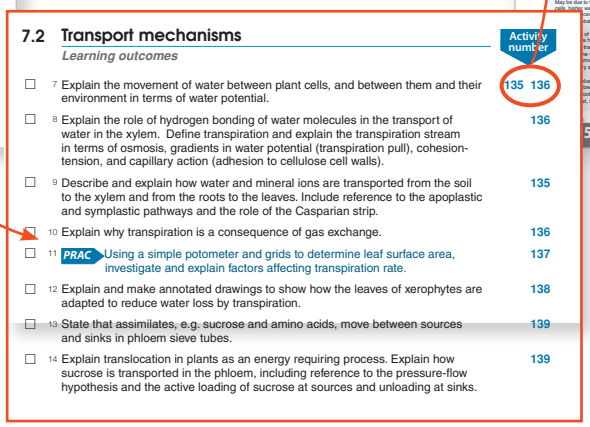
The introduction to each chapter provides a summary of the learning outcomes and appropriate practicals, presented as a series of short student learning aims. The students achieve understanding of each statement by completing its corresponding activity.

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.


135 Uptake at the Root

Water and mineral uptake by roots

Paths for water movement through the plant


7.2 Transport mechanisms

Learning outcomes

Activity number

7 Explain the movement of water between plant cells, and between them and their environment in terms of water potential. 135 136

8 Explain the role of hydrogen bonding of water molecules in the transport of water in the xylem. Define transpiration and explain the transpiration stream in terms of osmosis, gradients in water potential (transpiration pull), cohesion-tension, and capillary action (adhesion to cellulose cell walls). 136

9 Describe and explain how water and mineral ions are transported from the soil to the xylem and from the roots to the leaves. Include reference to the apoplastic and symplastic pathways and the role of the Casparian strip. 135

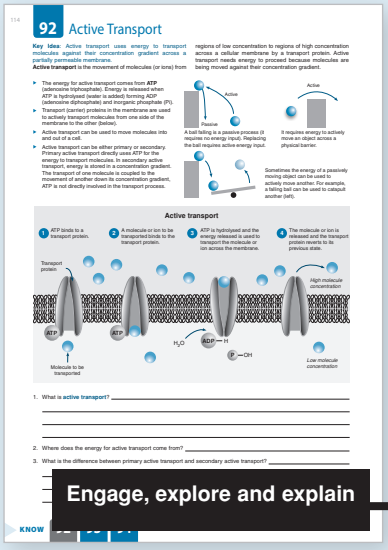
10 Explain why transpiration is a consequence of gas exchange. 136

11 PRAC Using a simple potometer and grids to determine leaf surface area, investigate and explain factors affecting transpiration rate. 137

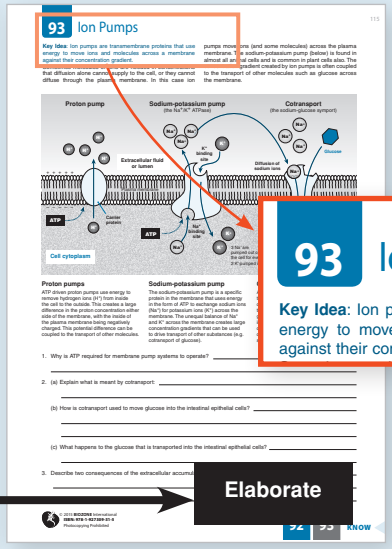
12 Explain and make annotated drawings to show how the leaves of xerophytes are adapted to reduce water loss by transpiration. 138

13 State that assimilates, e.g. sucrose and amino acids, move between sources and sinks in phloem sieve tubes. 139

14 Explain translocation in plants as an energy requiring process. Explain how sucrose is transported in the phloem, including reference to the pressure-flow hypothesis and the active loading of sucrose at sources and unloading at sinks. 139


92 Active Transport

Active transport


93 Ion Pumps

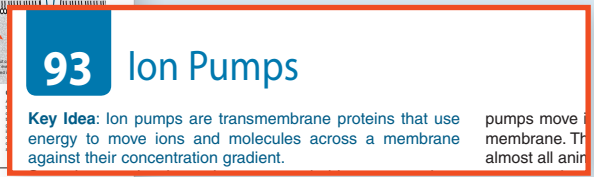
Proton pump

Sodium-potassium pump

Cotransport

Engage, explore and explain

Elaborate

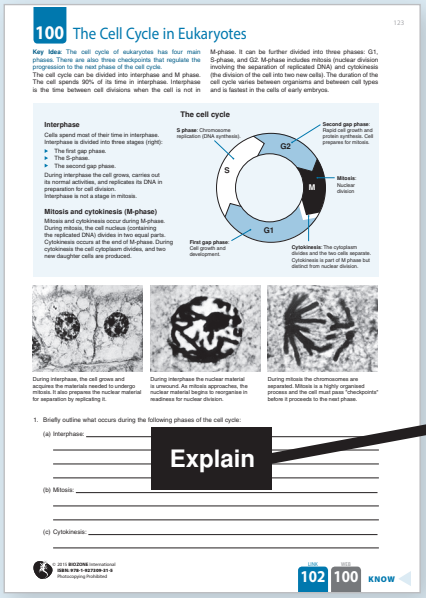

93 Ion Pumps

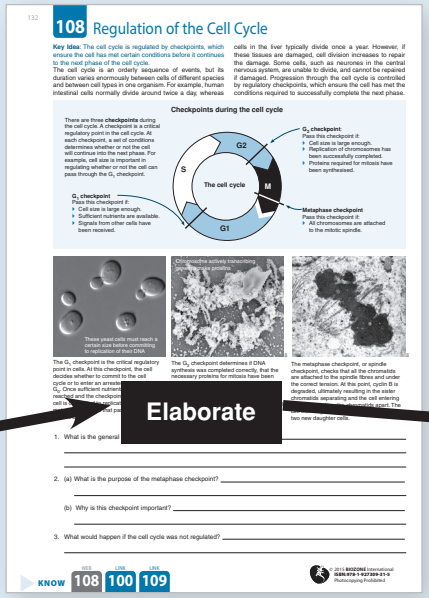
Key Idea: Ion pumps are transmembrane proteins that use energy to move ions and molecules across a membrane against their concentration gradient.

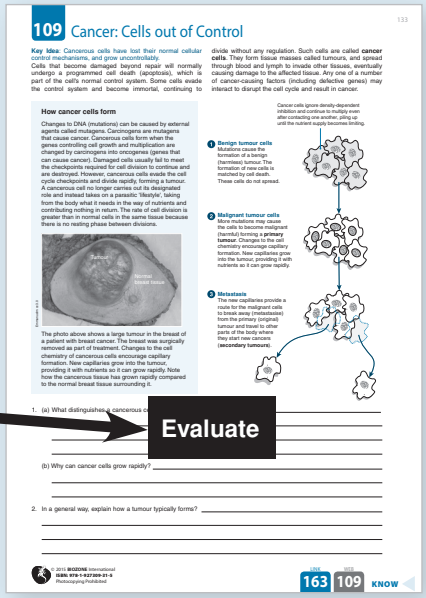
The KEY IDEA provides a focus for each activity. The key ideas through a chapter provide a concise summary of the chapter content.

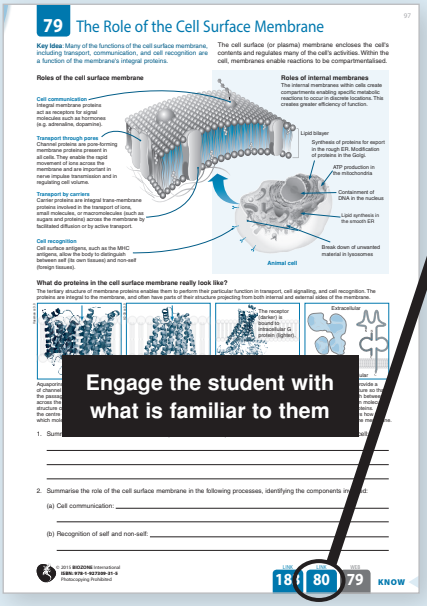
Students become actively involved in the learning activity by interacting with the material, answering the question and completing the set tasks. Many activities are suitable as assessment tasks.

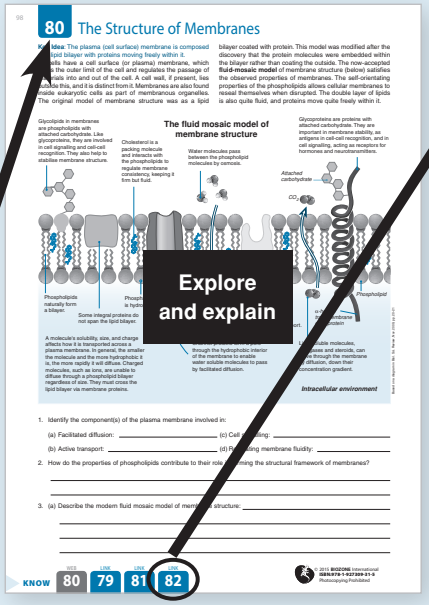
Engage, explain, elaborate, and evaluate: Activities are nested. An introductory activity introduces and builds understanding of a specific core idea, and a subsequent activity involves applying that understanding to a new situation, e.g. analysing data, finding a solution, or interpreting new information.

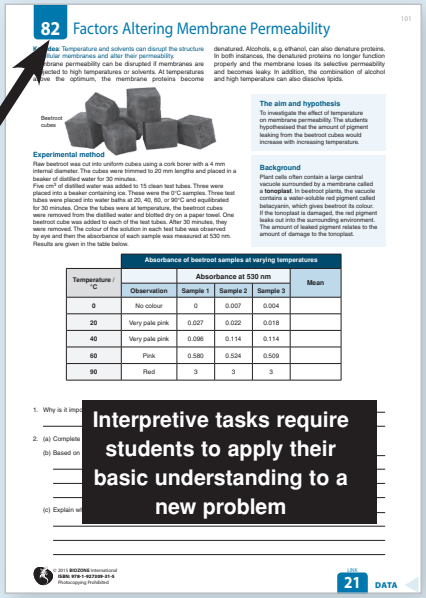












This activity begins by engaging the student with something familiar, the role of the cell surface membrane.

Students then explore in more detail the structure of a membrane and look at the role of its components.

Students analyse and interpret second hand data from an experiment investigating the effect of temperature and ethanol on membrane permeability.

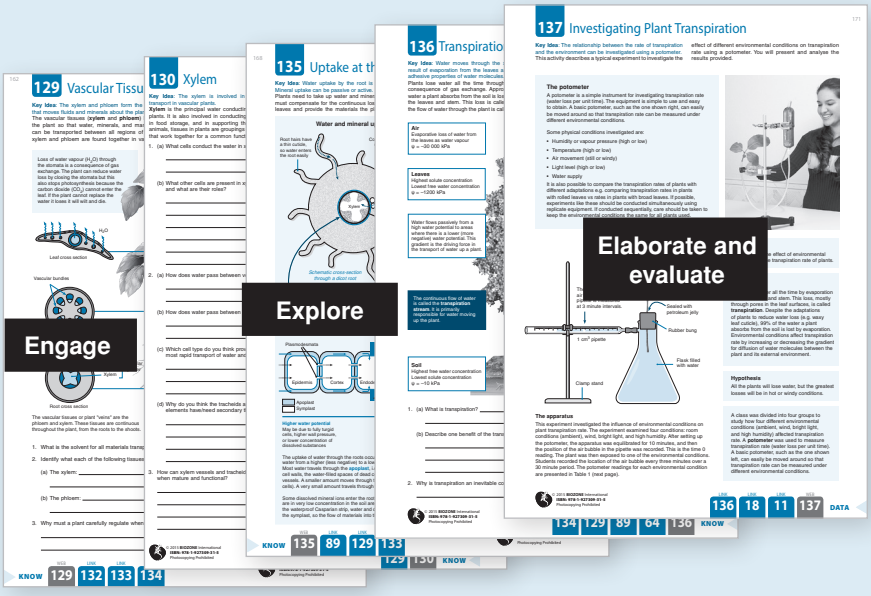
Groups of activities build knowledge and understanding by giving students the chance to learn and apply their knowledge in a series of linked activities.

Engage: visualise the concept of hierarchical organisation

Explore: relate structure to function

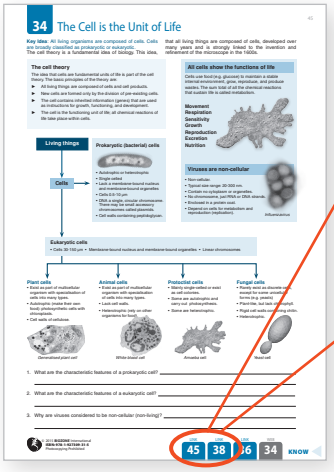
Elaborate: present supporting evidence

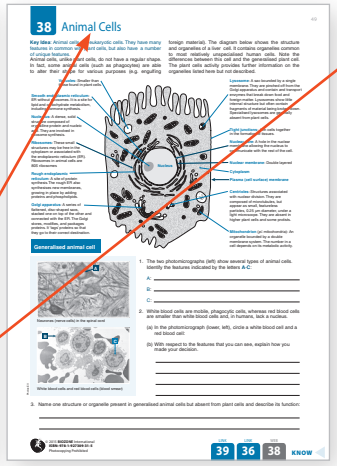
Evaluate: explain trends in light of understanding

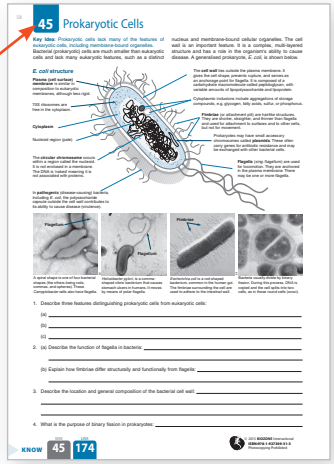


LINKS - Making Connections

The **LINK** tabs help students to connect ideas between different topics in the CIE 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.



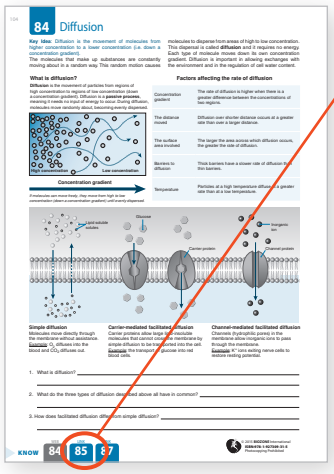


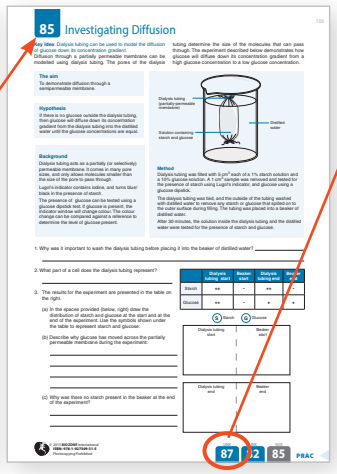


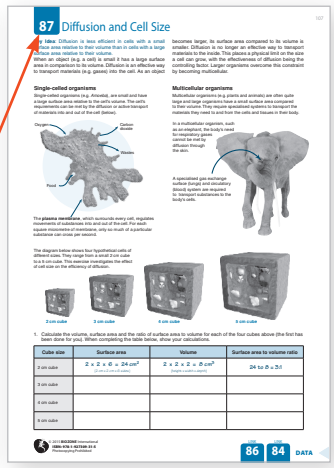
EXAMPLE 1

Types of cells

Understand that cells are the basic unit of life and that there are differences between different cell types.



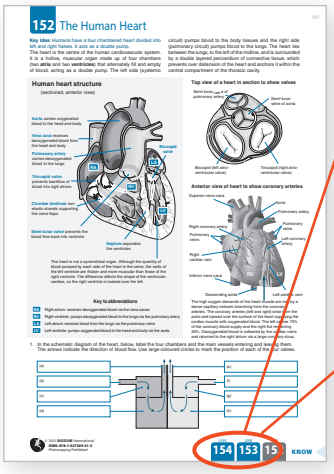


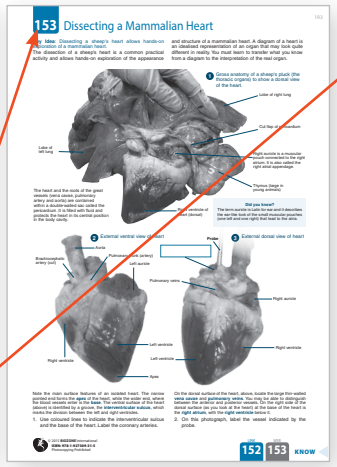


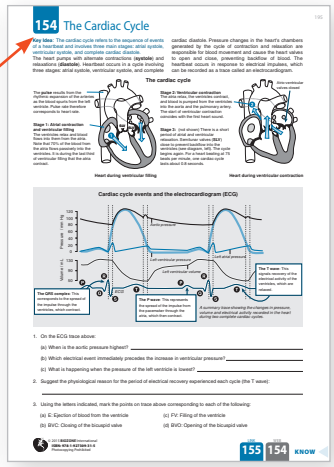
EXAMPLE 2

Membranes and diffusion

The principle of diffusion is reinforced by an experiment investigating the factors affecting diffusion. Finally, the constraints of cell size on diffusion are studied.







EXAMPLE 3

The heart

An understanding of the structure of the mammalian heart is studied through diagrams and a dissection diagrammatic before moving on to study the stages in the cardiac cycle.

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.

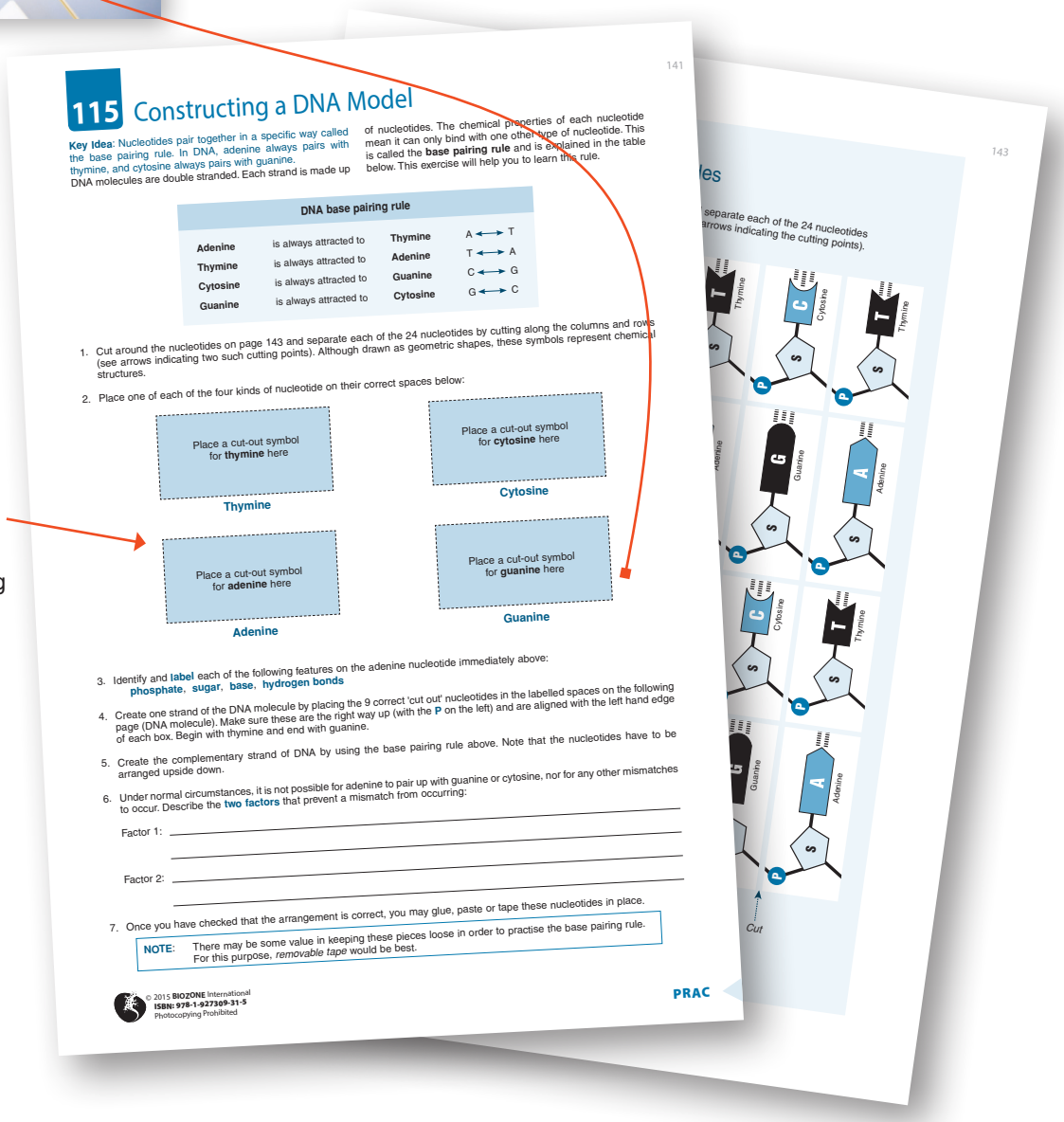
MAKING A START

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 DNA Replication)* are another ideal vehicle for this kind of peer-to-peer learning.

In "Constructing a DNA Model", students can collaborate in pairs to construct a DNA molecule and practise the base pairing rule. This consolidates understanding by putting theory into practice.



141

115 Constructing a DNA Model

Key Idea: Nucleotides pair together in a specific way called the base pairing rule. In DNA, adenine always pairs with thymine, and cytosine always pairs with guanine. DNA molecules are double stranded. Each strand is made up of nucleotides. The chemical properties of each nucleotide mean it can only bind with one other type of nucleotide. This is called the **base pairing rule** and is explained in the table below. This exercise will help you to learn this rule.

DNA base pairing rule			
Adenine	is always attracted to	Thymine	A ⟷ T
Thymine	is always attracted to	Adenine	T ⟷ A
Cytosine	is always attracted to	Guanine	C ⟷ G
Guanine	is always attracted to	Cytosine	G ⟷ C

1. Cut around the nucleotides on page 143 and separate each of the 24 nucleotides by cutting along the columns and rows (see arrows indicating two such cutting points). Although drawn as geometric shapes, these symbols represent chemical structures.
2. Place one of each of the four kinds of nucleotide on their correct spaces below:

Place a cut-out symbol for **thymine** here — Thymine

Place a cut-out symbol for **cytosine** here — Cytosine

Place a cut-out symbol for **adenine** here — Adenine

Place a cut-out symbol for **guanine** here — Guanine

3. Identify and **label** each of the following features on the adenine nucleotide immediately above: **phosphate**, **sugar**, **base**, **hydrogen bonds**
4. Create one strand of the DNA molecule by placing the 9 correct 'cut out' nucleotides in the labelled spaces on the following page (DNA molecule). Make sure these are the right way up (with the **P** on the left) and are aligned with the left hand edge of each box. Begin with thymine and end with guanine.
5. Create the complementary strand of DNA by using the base pairing rule above. Note that the nucleotides have to be arranged upside down.
6. Under normal circumstances, it is not possible for adenine to pair up with guanine or cytosine, nor for any other mismatches to occur. Describe the **two factors** that prevent a mismatch from occurring:

Factor 1: _____

Factor 2: _____

7. Once you have checked that the arrangement is correct, you may glue, paste or tape these nucleotides in place.

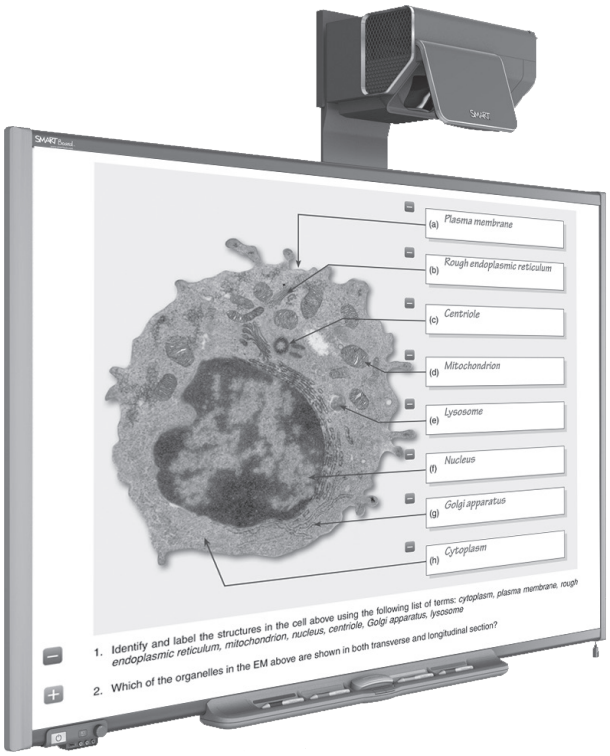
NOTE: There may be some value in keeping these pieces loose in order to practise the base pairing rule. For this purpose, *removable tape* would be best.

PRAC

143

separate each of the 24 nucleotides
arrows indicating the cutting points).

Cut



2 Interactive revision of tasks in class

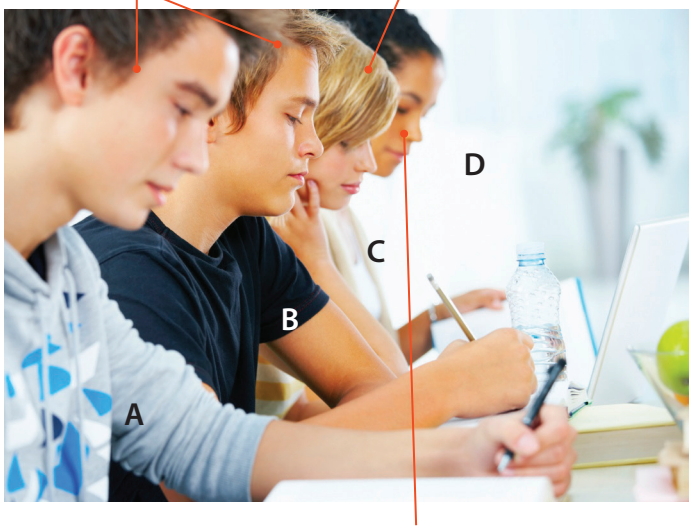
- Use the workbook PDFs with HIDE/SHOW answers on the **Teacher's Digital Edition** to review activities in class using a data projector or interactive whiteboard.
- Students benefit from the feedback in class, where questions can be addressed, and teachers benefit by having students self-mark their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

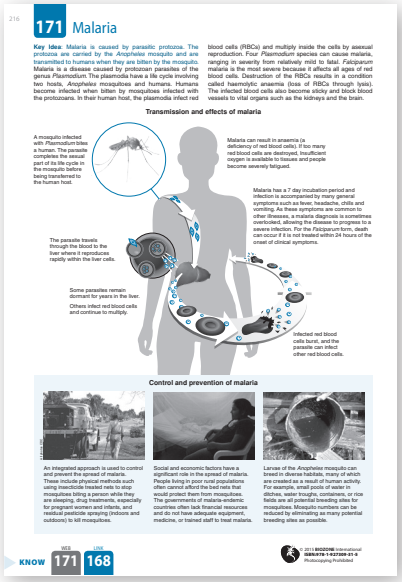
- The questions in BIOZONE's workbook activities have generally been written in a direct questioning style, e.g. "What are the differences between A and B", or "Why are A and B different?". This makes it easier for the students to understand what is required to answer the question.
- Questions are also 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.

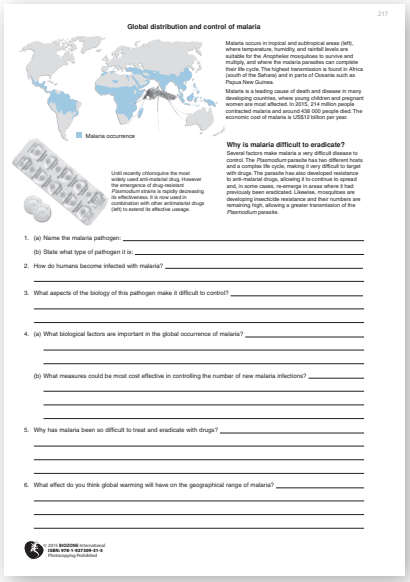


Student D (above) is capable and completes the set work quickly. She can assist her peers and demonstrate her understanding in the relevant section of the review sheets.


171 Malaria

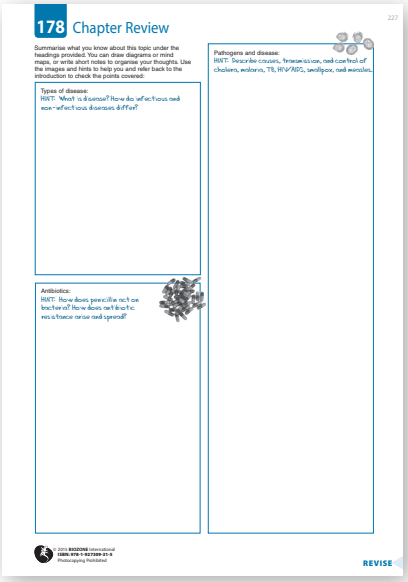
Transmission and effects of malaria

Control and prevention of malaria


Global distribution and control of malaria

Malaria occurrence

Why is malaria difficult to eradicate?


178 Chapter Review

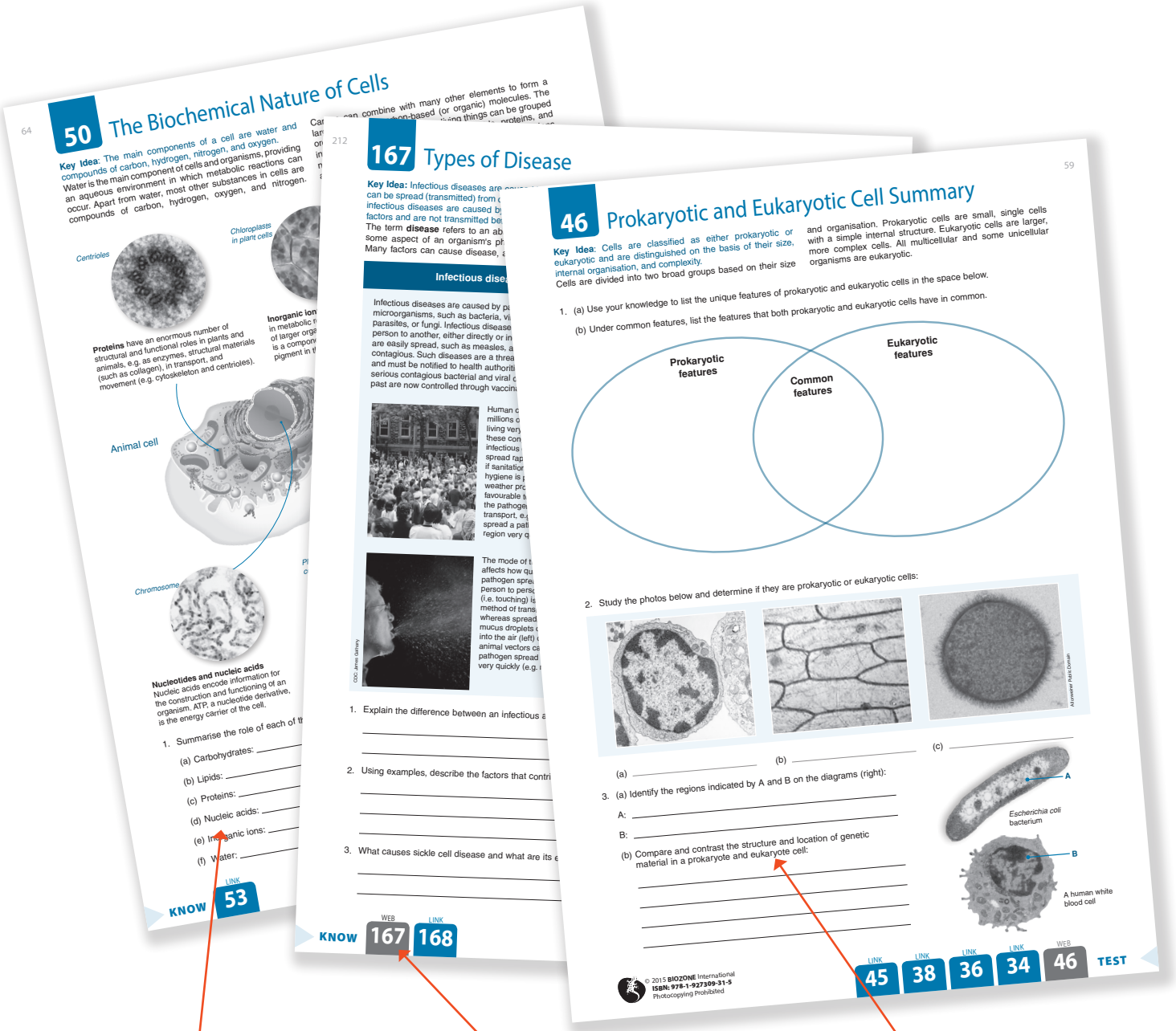
Types of disease:

Pathogens and disease:

Antibiotics:

Choosing Activities for Home Study

Many of the workbook activities are ideal for homework or as vehicles for a quick synoptic 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** where these are provided.

Summary activities are ideal as homework because they involve reviewing completed work. This activity reviews the student's understanding of mitosis and tests their competency in making basic calculations. Such activities can also be used for synoptic, in-class tests.

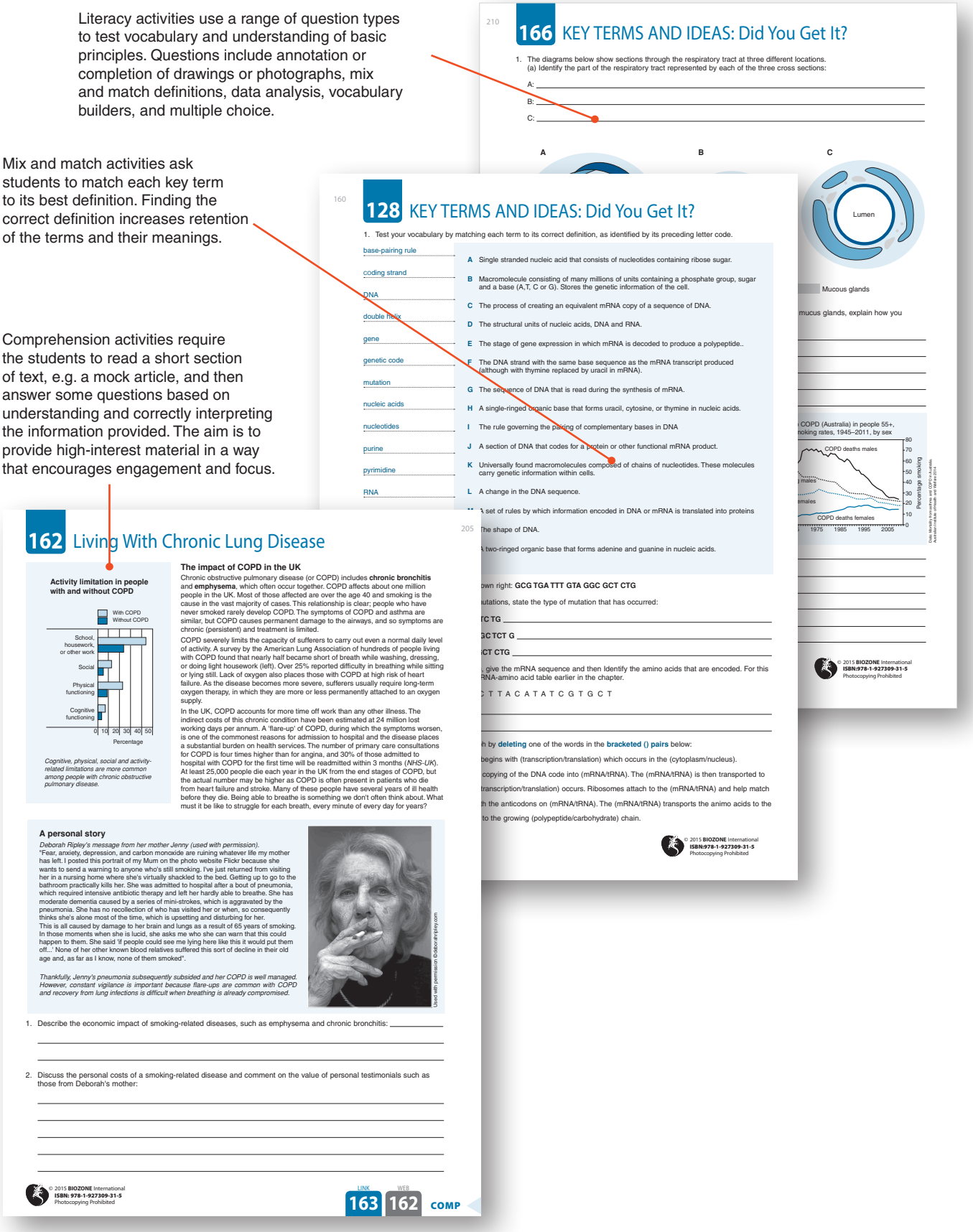
Focus on Literacy

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 annotation or completion of drawings or photographs, mix and match definitions, data analysis, vocabulary 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, e.g. a mock article, 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.



210

166 KEY TERMS AND IDEAS: Did You Get It?

1. The diagrams below show sections through the respiratory tract at three different locations.
(a) Identify the part of the respiratory tract represented by each of the three cross sections:

A: _____

B: _____

C: _____

A B C

Lumen

Mucous glands

mucus glands, explain how you

COPD (Australia) in people 55+, noking rates, 1945–2011, by sex

COPD deaths males

COPD deaths females

Percentage smoking

1975 1985 1995 2005

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160

128 KEY TERMS AND IDEAS: Did You Get It?

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

base-pairing rule
coding strand
DNA
double helix
gene
genetic code
mutation
nucleic acids
nucleotides
purine
pyrimidine
RNA

A Single stranded nucleic acid that consists of nucleotides containing ribose sugar.
B Macromolecule consisting of many millions of units containing a phosphate group, sugar and a base (A,T, C or G). Stores the genetic information of the cell.
C The process of creating an equivalent mRNA copy of a sequence of DNA.
D The structural units of nucleic acids, DNA and RNA.
E The stage of gene expression in which mRNA is decoded to produce a polypeptide..
F The DNA strand with the same base sequence as the mRNA transcript produced (although with thymine replaced by uracil in mRNA).
G The sequence of DNA that is read during the synthesis of mRNA.
H A single-ringed organic base that forms uracil, cytosine, or thymine in nucleic acids.
I The rule governing the pairing of complementary bases in DNA
J A section of DNA that codes for a protein or other functional mRNA product.
K Universally found macromolecules composed of chains of nucleotides. These molecules carry genetic information within cells.
L A change in the DNA sequence.
A set of rules by which information encoded in DNA or mRNA is translated into proteins
The shape of DNA.
A two-ringed organic base that forms adenine and guanine in nucleic acids.

205

own right: **GCG TGA TTT GTA GGC GCT CTG**

utations, state the type of mutation that has occurred:

TC TG _____

GC TCT G _____

CT CTG _____

, give the mRNA sequence and then Identify the amino acids that are encoded. For this RNA-amino acid table earlier in the chapter.

C T T A C A T A T C G T G C T

h by **deleting** one of the words in the **bracketed () pairs** below:

begins with (transcription/translation) which occurs in the (cytoplasm/nucleus).

copying of the DNA code into (mRNA/tRNA). The (mRNA/tRNA) is then transported to

transcription/translation) occurs. Ribosomes attach to the (mRNA/tRNA) and help match

h the anticodons on (mRNA/tRNA). The (mRNA/tRNA) transports the animo acids to the

to the growing (polypeptide/carbohydrate) chain.

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162 Living With Chronic Lung Disease

Activity limitation in people with and without COPD

With COPD
Without COPD

School, housework, or other work
Social
Physical functioning
Cognitive functioning

0 10 20 30 40 50
Percentage

Cognitive, physical, social and activity-related limitations are more common among people with chronic obstructive pulmonary disease.

The impact of COPD in the UK

Chronic obstructive pulmonary disease (or COPD) includes **chronic bronchitis** and **emphysema**, which often occur together. COPD affects about one million people in the UK. Most of those affected are over the age 40 and smoking is the cause in the vast majority of cases. This relationship is clear; people who have never smoked rarely develop COPD. The symptoms of COPD and asthma are similar, but COPD causes permanent damage to the airways, and so symptoms are chronic (persistent) and treatment is limited.

COPD severely limits the capacity of sufferers to carry out even a normal daily level of activity. A survey by the American Lung Association of hundreds of people living with COPD found that nearly half became short of breath while washing, dressing, or doing light housework (left). Over 25% reported difficulty in breathing while sitting or lying still. Lack of oxygen also places those with COPD at high risk of heart failure. As the disease becomes more severe, sufferers usually require long-term oxygen therapy, in which they are more or less permanently attached to an oxygen supply.

In the UK, COPD accounts for more time off work than any other illness. The indirect costs of this chronic condition have been estimated at 24 million lost working days per annum. A 'flare-up' of COPD, during which the symptoms worsen, is one of the commonest reasons for admission to hospital and the disease places a substantial burden on health services. The number of primary care consultations for COPD is four times higher than for angina, and 30% of those admitted to hospital with COPD for the first time will be readmitted within 3 months (*NHS-UK*). At least 25,000 people die each year in the UK from the end stages of COPD, but the actual number may be higher as COPD is often present in patients who die from heart failure and stroke. Many of these people have several years of ill health before they die. Being able to breathe is something we don't often think about. What must it be like to struggle for each breath, every minute of every day for years?

A personal story

Deborah Ripley's message from her mother Jenny (used with permission).
"Fear, anxiety, depression, and carbon monoxide are ruining whatever life my mother has left. I posted this portrait of my Mum on the photo website Flickr because she wants to send a warning to anyone who's still smoking. I've just returned from visiting her in a nursing home where she's virtually shackled to the bed. Getting up to go to the bathroom practically kills her. She was admitted to hospital after a bout of pneumonia, which required intensive antibiotic therapy and left her hardly able to breathe. She has moderate dementia caused by a series of mini-strokes, which is aggravated by the pneumonia. She has no recollection of who has visited her or when, so consequently thinks she's alone most of the time, which is upsetting and disturbing for her.
This is all caused by damage to her brain and lungs as a result of 65 years of smoking. In those moments when she is lucid, she asks me who she can warn that this could happen to them. She said 'if people could see me lying here like this it would put them off...' None of her other known blood relatives suffered this sort of decline in their old age and, as far as I know, none of them smoked".

Thankfully, Jenny's pneumonia subsequently subsided and her COPD is well managed. However, constant vigilance is important because flare-ups are common with COPD and recovery from lung infections is difficult when breathing is already compromised.

Used with permission @deborahripley.com

1. Describe the economic impact of smoking-related diseases, such as emphysema and chronic bronchitis: _____

2. Discuss the personal costs of a smoking-related disease and comment on the value of personal testimonials such as those from Deborah's mother:

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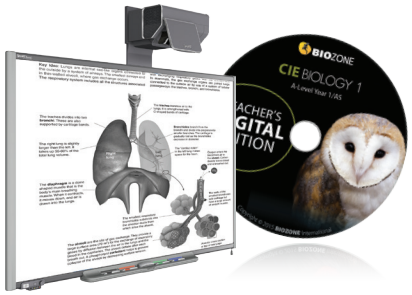
LINK 163 WEB 162 COMP

The Teacher's Digital Edition

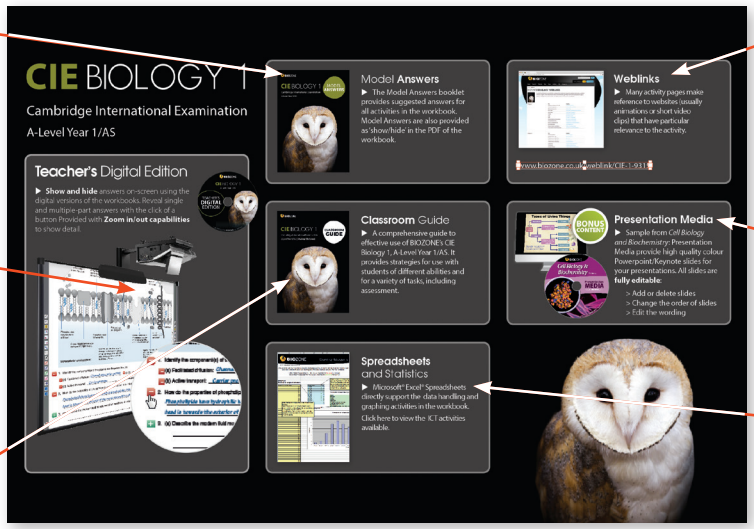
The *Teacher's Digital Edition* is aimed primarily at extending the pedagogical tools at a teacher's disposal. Many of the features of this resource have been developed in response to requests from teachers themselves.



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.

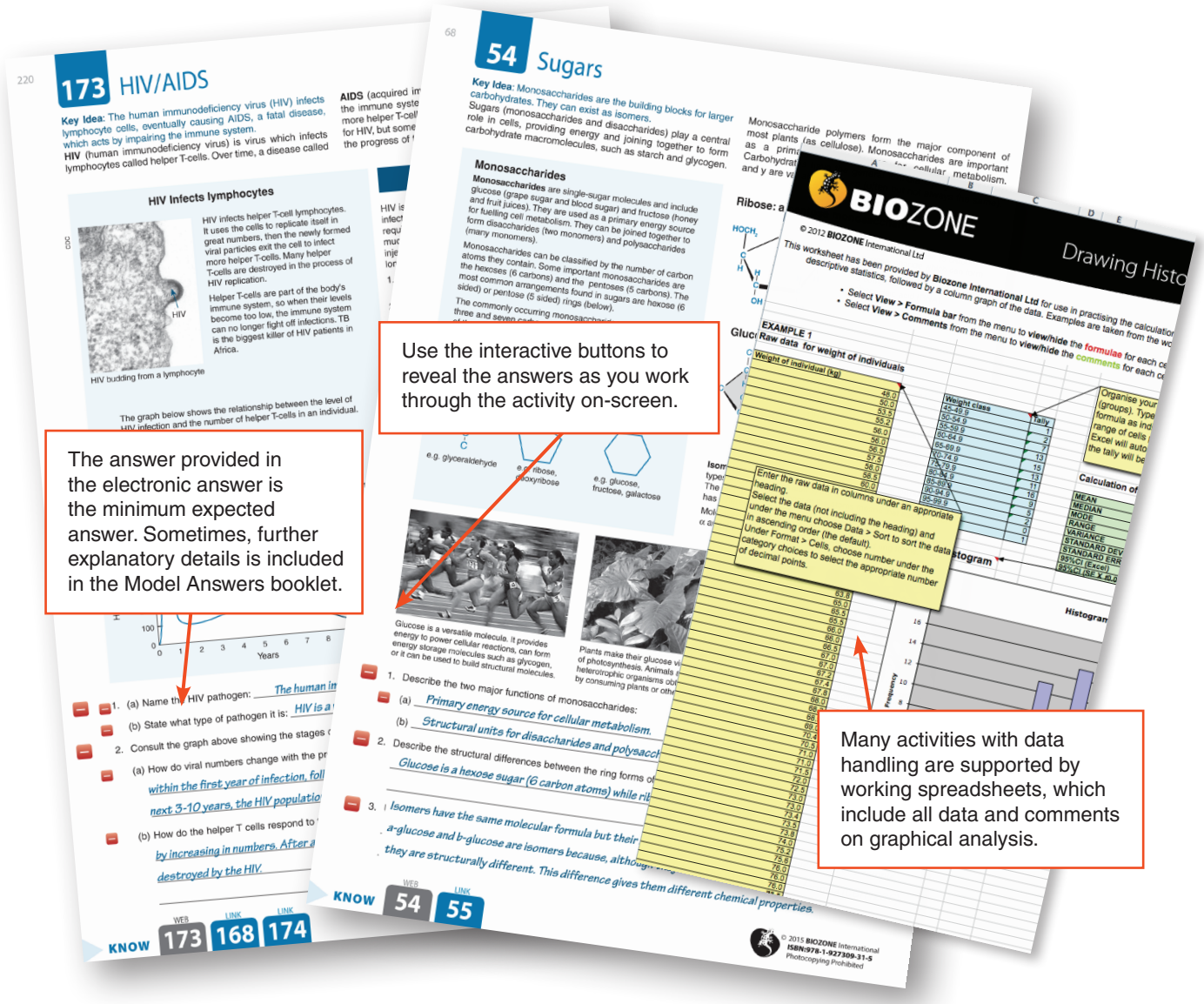
This **Classroom Guide** is provided as a printable PDF.



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

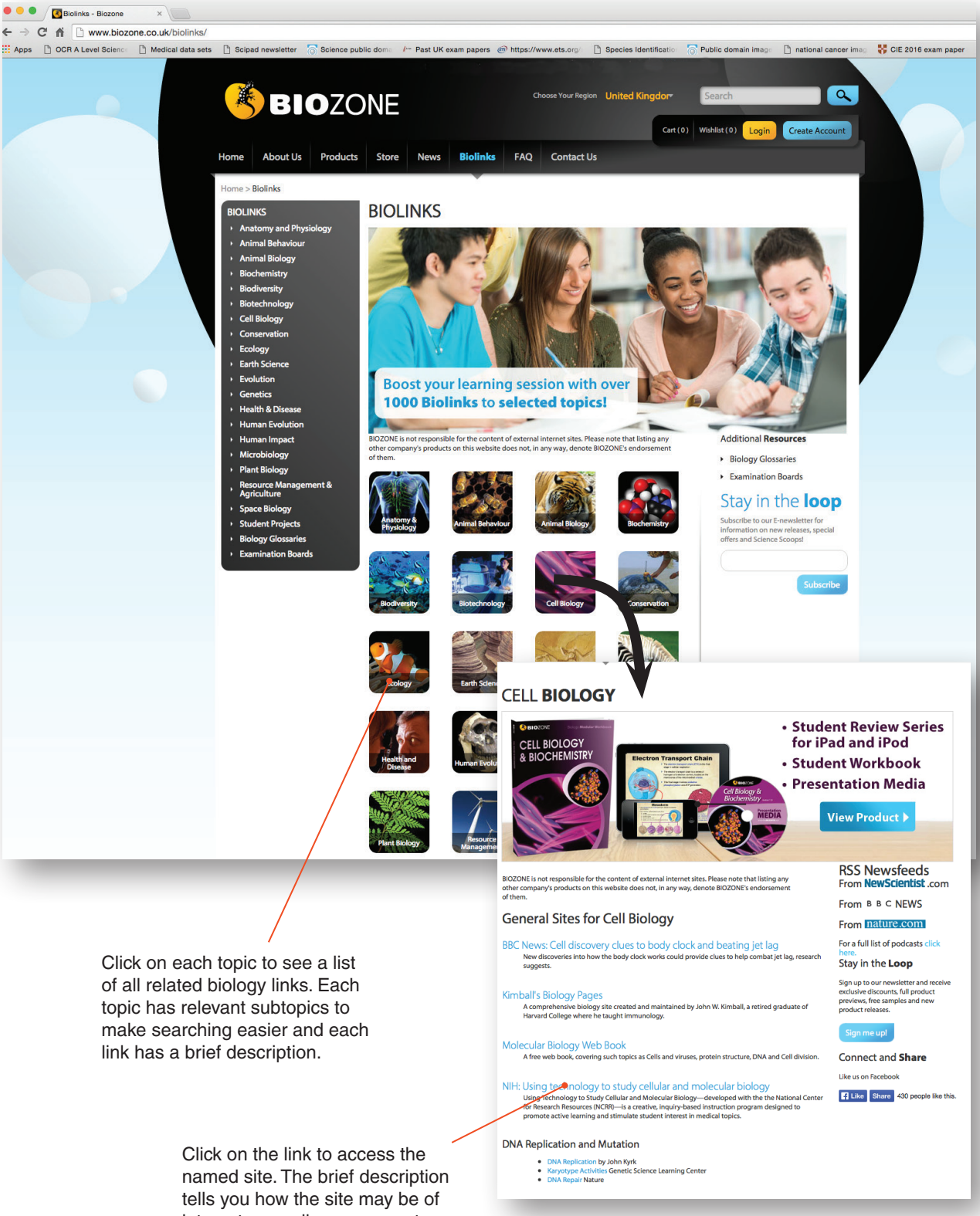
A **BONUS** sample from the Cell Biology and Biochemistry Presentation Media.

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



Using BIOZONE's Website

BIOZONE's web site should be the first stop for biologists. As well as providing all our product information (including shipping dates) and updates, *www.biozone.co.uk* provides quick access to the latest RSS newsfeeds and podcasts from around the world. You can also quickly link to the websites of publishers of references cited in the workbooks. Perhaps of greatest value to students and teachers is the BIOLINKS area of BIOZONE's website. The BIOLINKS pages are distinct from *WebLinks* (which are specific to each workbook edition) and provide a database of well organised hyperlinks pertaining to topics of interest in biology and environmental science. The database is updated regularly, so that outdated, not operational, or no longer relevant sites are removed and new sites are added as they appear.



Click on each topic to see a list of all related biology links. Each topic has relevant subtopics to make searching easier and each link has a brief description.

Click on the link to access the named site. The brief description tells you how the site may be of interest, as well as any country specific bias, if this is relevant.