

# **CIE** BIOLOGY 1

Cambridge International Examination

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

**CLASSROOM  
GUIDE**

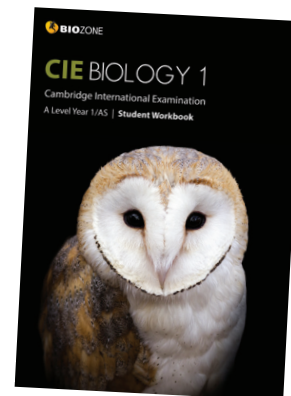


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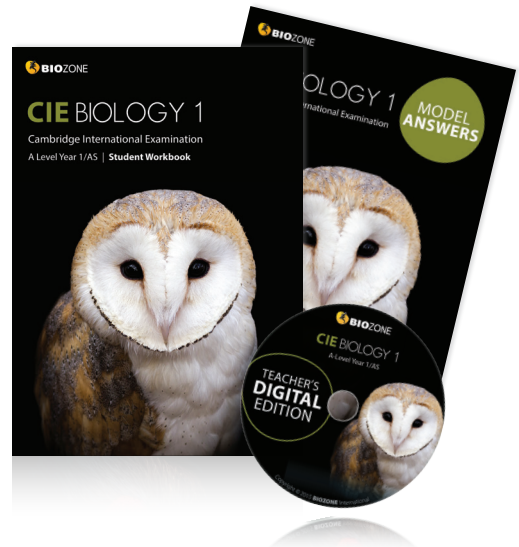
## **FAQs** ABOUT OUR CIE BIOLOGY 1 STUDENT WORKBOOK



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# 2 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.

<b>ENGAGE:</b> <b>Highly visual activities</b>	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.
<b>ENGAGE:</b> <b>A connected plan of study</b>	The check-box format of the contents pages and the chapter introductions provides a focus for planning achievement.
<b>EXPLORE:</b> <b>Independent, self directed study</b>	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.
<b>EXPLAIN:</b> <b>Communicating is the key to consolidation</b>	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).
<b>ELABORATE:</b> <b>Building up</b>	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.
<b>EVALUATE:</b> <b>Easy assessment</b>	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.
<b>WHAT ABOUT HOMEWORK?</b>	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	
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<b>Experimental and investigative skills</b>	
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<input type="checkbox"/> 1	How Do We Do Science? .....
<input type="checkbox"/> 2	Hypotheses and Predictions .....
<input type="checkbox"/> 3	Types of Data .....
<input type="checkbox"/> 4	Making A Qualitative Investigation .....
<input type="checkbox"/> 5	Making A Quantitative Investigation .....
<input type="checkbox"/> 6	Accuracy and Precision .....
<input type="checkbox"/> 7	Working with Numbers .....
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<input type="checkbox"/> 9	Logs and Exponents .....
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<b>Cell structure</b>	
<i>Learning Outcomes</i> .....	
<input type="checkbox"/> 27	History of Microscopy .....
<input type="checkbox"/> 28	Optical Microscopes .....
<input type="checkbox"/> 29	Preparing a Slide .....
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<input type="checkbox"/> 33	Calculating Linear Magnification .....
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<input type="checkbox"/> 40	The Cell's Cytoskeleton .....
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<input type="checkbox"/> 42	Identifying Organelles .....
<input type="checkbox"/> 43	Packaging Proteins .....
<input type="checkbox"/> 44	The Role of ATP in Cells .....
<input type="checkbox"/> 45	Prokaryotic Cells .....
<input type="checkbox"/> 46	Prokaryotic and Eukaryotic Cell Summary .....
<input type="checkbox"/> 47	Viruses .....
<input type="checkbox"/> 48	Chapter Review .....
<input type="checkbox"/> 49	KEY TERMS AND IDEAS: Did You Get it? .....
<b>Biological molecules</b>	
<i>Learning Outcomes</i> .....	
<input type="checkbox"/> 50	The Biochemical Nature of Cells .....
<input type="checkbox"/> 51	Testing For Biological Molecules .....
<input type="checkbox"/> 52	Colorimetry .....
<input type="checkbox"/> 53	Organic Molecules .....
<input type="checkbox"/> 54	Sugars .....
<input type="checkbox"/> 55	Condensation and Hydrolysis of Sugars .....
<input type="checkbox"/> 56	Polysaccharides .....
<input type="checkbox"/> 57	Starch and Cellulose .....
<input type="checkbox"/> 58	Lipids .....
<input type="checkbox"/> 59	Phospholipids .....
<input type="checkbox"/> 60	Amino Acids .....
<input type="checkbox"/> 61	Protein Shape is Related to Function .....
<input type="checkbox"/> 62	Protein Structure .....
<input type="checkbox"/> 63	Comparing Globular and Fibrous Proteins .....
<b>Enzymes</b>	
<i>Learning Outcomes</i> .....	
<input type="checkbox"/> 68	Enzymes .....
<input type="checkbox"/> 69	How Enzymes Work .....
<input type="checkbox"/> 70	Models of Enzyme Activity .....
<input type="checkbox"/> 71	Enzyme Reaction Rates .....
<input type="checkbox"/> 72	Investigating Catalase Activity .....
<input type="checkbox"/> 73	Investigating Amylase Activity .....
<input type="checkbox"/> 74	Enzyme Kinetics .....
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<input type="checkbox"/> 76	Immobilised Enzymes .....
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<input type="checkbox"/> 78	KEY TERMS AND IDEAS: Did You Get it? .....
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<i>Learning Outcomes</i> .....	
<input type="checkbox"/> 79	The Role of the Cell Surface Membrane .....
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<input type="checkbox"/> 92	Active Transport .....
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<input type="checkbox"/> 96	Chapter Review .....
<input type="checkbox"/> 97	KEY TERMS AND IDEAS: Did You Get it? .....

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.

Biological molecules	
<i>Learning Outcomes</i> .....	
<input type="checkbox"/> 50	The Biochemical Nature of Cells .....
<input type="checkbox"/> 51	Testing For Biological Molecules .....
<input checked="" type="checkbox"/> 52	Colorimetry .....
<input type="checkbox"/> 53	Organic Molecules .....
<input checked="" type="checkbox"/> 54	Sugars .....
<input checked="" type="checkbox"/> 55	Condensation and Hydrolysis of Sugars .....
<input checked="" type="checkbox"/> 56	Polysaccharides .....
<input type="checkbox"/> 57	Starch and Cellulose .....
<input checked="" type="checkbox"/> 58	Lipids .....
<input type="checkbox"/> 59	Phospholipids .....
<input type="checkbox"/> 60	Amino Acids .....
<input type="checkbox"/> 61	Protein Shape is Related to Function .....
<input type="checkbox"/> 62	Protein Structure .....
<input type="checkbox"/> 63	Comparing Globular and Fibrous Proteins .....



# 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.

## Topic 9 Gas exchange and smoking

**Key terms**

- alveoli
- breathing
- bronchi
- bronchioles
- carbon dioxide
- carbon monoxide
- carcinogen
- cartilage
- cellular respiration
- ciliated epithelium
- COPD
- diaphragm
- expiration (exhalation)
- gas exchange
- gas exchange membrane
- goblet cells
- inspiration (inhalation)
- lung cancer
- lungs
- mucous glands
- nicotine
- oxygen
- pneumocytes
- respiratory gas
- smooth muscle
- squamous epithelium
- surfactant
- tar
- trachea

**9.1 Principles of Learning**

1.  Describe the organisms they need to survive.

2.  Describe how the gases between the blood and the environment.

3. **PRAC** Observe and draw plan diagrams of the structure of the respiratory tract (trachea, bronchi, bronchioles, and alveoli) to show the distribution of cartilage, ciliated epithelium, goblet cells, smooth muscle, squamous epithelium, and blood vessels.

4.  Describe the functions of cartilage, cilia, goblet cells, mucous glands, smooth muscle, and elastic fibres, and recognise these cells and tissues in prepared slides, photomicrographs, and electron micrographs of the gas exchange system.

5.  Describe how gases are exchanged between air in the alveoli and the blood across the gas exchange membrane. Include the way of breathing and how it is achieved, with reference to changes in pressure and volume in the thorax as a result of the muscular activity of the intercostal muscles and diaphragm.

**Activity number**

159

160

160

160

160 161



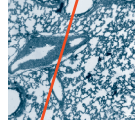
**9.2 Smoking**

**Learning outcomes**

6.  Recognise smoking as one of the major controllable risk factors in chronic life-threatening diseases affecting the gas exchange and circulatory systems.

7.  Describe the effects of tar and carcinogens in tobacco smoke on the gas exchange system with reference to lung cancer and chronic obstructive pulmonary disease (COPD).

8.  Describe the short term effects of nicotine and carbon monoxide on the cardiovascular system.

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

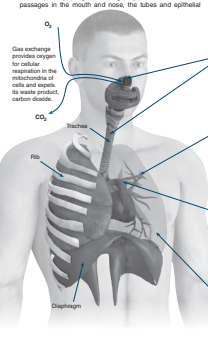
**For students:**  
Key knowledge and skills are drawn from the CIE Biology syllabus. They are purposefully brief, with enough information to provide a framework, but not so much that students are overwhelmed.

Introduce the concept with a grounding activity

Follow with an activity expanding on that concept

**159 The Gas Exchange System**

**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.



1. Name three types of cells in the respiratory system and their function.

(a) \_\_\_\_\_

(b) \_\_\_\_\_

(c) \_\_\_\_\_

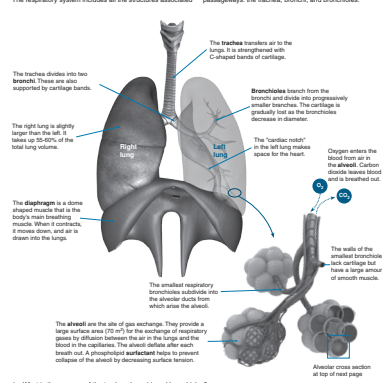
2. Which cells form the alveoli?

3. What is the purpose of the hyaline cartilage in the respiratory system?

4. Where does gas exchange take place in the lungs?

**160 The Lungs**

**Key Idea:** Lungs are internal sac-like organs connected to the outside by a system of airways. The smallest airway and its thin-walled alveoli, where gas exchange occurs. The respiratory system includes all the structures associated with exchanging respiratory gases with the environment. In mammals, the gas exchange organs are paired lungs connected to the outside air by way of a system of tubular passageways, the trachea, bronchi, and bronchioles.



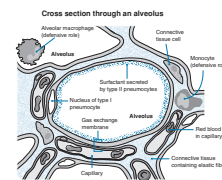
1. What is the purpose of the trachea, bronchi, and bronchioles?

2. What is the purpose of the diaphragm?

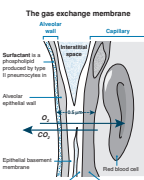
3. (a) Explain how the basic structure of the human gas exchange system provides such a large area for gas exchange.

(b) Identify the general region of the lung where exchange of gases takes place.

**Cross section through an alveolus**



**The gas exchange membrane**



4. Describe the structure and purpose of the gas exchange membrane.

5. The diagram below shows the different types of cells and their positions and occurrence in the lungs. Use it to answer the following questions:

Height of the epithelium	Goblet cells	Ciliated cells	Serous glands	Hyaline cartilage	Smooth muscle	Elastic fibres
--------------------------	--------------	----------------	---------------	-------------------	---------------	----------------

(a) Why does the epithelium become very thin in the respiratory zone?

(b) Why would elastic fibres be present in the respiratory zone, while hyaline cartilage is not?

# 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 gas exchange's overall function, which is to exchange respiratory gases (oxygen and carbon dioxide) between the body's cells and the environment.

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

O<sub>2</sub>

CO<sub>2</sub>

Trachea

Rib

Diaphragm

**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**  
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**  
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.

**Goblet cells**

**Alveolar duct**  
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.

**Alveolus**

- Name three types of cells in the respiratory system and their function:
  - \_\_\_\_\_
  - \_\_\_\_\_
  - \_\_\_\_\_
- Which cells form the alveoli? \_\_\_\_\_
- What is the purpose of the hyaline cartilage in the respiratory system? \_\_\_\_\_
- Where does gas exchange take place in the lungs? \_\_\_\_\_

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LINK WEB  
**160 159 KNOW**

**159 The Gas Exchange System**

**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).

LINK WEB  
**160 159 KNOW**

**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](http://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

# 6 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*

- 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. 5 24 25
- 9 Identify limitations in experimental procedures and suggest how these could be overcome through improvements to design, apparatus, or technique. 6 11
- 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*

- 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 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 a small plant commonly found floating in the water of ponds 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 these conditions, doubling time is as little as 3 days.

**Experimental method:** Solutions of urea were made:  $3 \times 10^{-2}$ ,  $3 \times 10^{-3}$ ,  $3 \times 10^{-4}$ , and each with concentration  $10^{-5}$  solution was pipetted into three 200 duckweed plants, each was placed in each beaker. The beakers were placed together in a number of plants in each beaker recorded eight times over the

**Figure 18.5:24 TEST**

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

**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 doubled and today it is estimated around 60% 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 (15 cm x 6 cm) under a 15°C temperature (22°C) cover.

**Figure 18.5:24 DATA**

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

## 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 one variable (the independent variable) is manipulated.

### 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 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:

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

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

**Figure 18.5:24 DATA**

# Making Use of Weblinks

**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 generalized 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 (nucleus)**

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 lipoteichoic acid.

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

**Fimbriae** (or attachment pills) 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**

**Fimbriae**

**Flagellum**

A spiral shape is one of four bacterial shapes (the others being rods, cocci, and spheres). These Comprokaryotic 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.

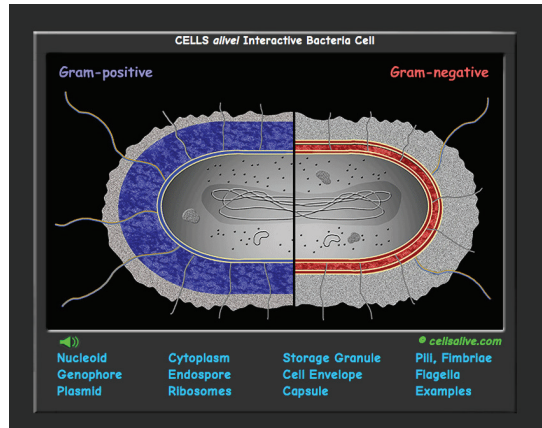
Escherichia coli is a rod-shaped bacterium, common in the human gut. The fimbriae surrounding the cell are used to adhere to the intestinal wall.

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).

- Describe three features distinguishing prokaryotic cells from eukaryotic cells:
  - \_\_\_\_\_
  - \_\_\_\_\_
  - \_\_\_\_\_
- Describe the function of flagella in bacteria:
  - \_\_\_\_\_
  - Explain how fimbriae differ structurally and functionally from flagella: \_\_\_\_\_
- Describe the location and general composition of the bacterial cell wall: \_\_\_\_\_
- What is the purpose of binary fission in prokaryotes: \_\_\_\_\_

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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](http://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.

**BIOZONE CIE BIOLOGY 1 WEBLINKS**

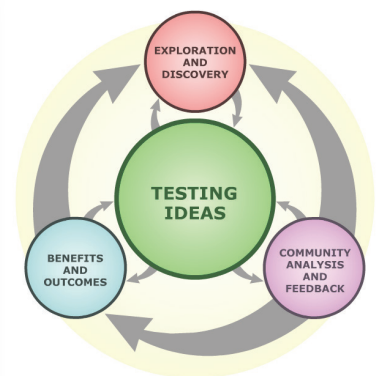
Some of the activities in your BIOZONE workbook have references to specific websites. Listed below under the relevant chapters. These websites (blue links) provide material, generally either animations or video clips, to help you visualize and understand the material presented on the relevant activity page.

Title	Weblinks
The Biochemical Nature of the Cell	The Structure of Water
Water and Inorganic Ions	Hydrogen Bonds and Water
Water and Inorganic Ions	Water and pH
<b>Amino acids</b>	<b>Amino Acids and Peptide Bond Formation</b>
Amino Acids	Amino Acids and Proteins
Proteins	Amino Acids and Proteins
Lipids	Biomolecules: Lipids
Lipids	Formation of Triglycerides
Monosaccharides and Disaccharides	Biomolecules: Carbohydrates
Carbohydrate Chemistry	Condensation and Hydrolysis
Review of Cell Ultrastructure	Eukaryotic Cells Interactive Animation
How Enzymes Work	How Enzymes work
Enzyme Cofactors and Inhibitors	Science in the Box: Enzymes
Catalase Activity in Germinating Seeds	Introduction to Descriptive Statistics

Chapter in the workbook

Activity in the workbook

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**



# 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**  
apical, cohesion-tension hypothesis, hydrolysis, protein, potassium, pressure flow hypothesis, root, root cap, root hair, root nodule, sieve plate, xylem, phloem, translocation, transpiration, transpiration rate, transpiration stream, vascular tissue, water potential, xylem, xylem.

**7.1 Structure of plant transport tissues**

**Learning outcomes**

- 1. With reference to size and growth form, explain why multicellular plants require a transport system. Deduce the general structure of the plant body, identifying the relationship between the support and transport tissues. 129-131
- 2. Describe the structure and function of the vascular system in the roots, stems, and leaves of herbaceous dicotyledonous plants. Describe the composition, translocation, and role of phloem and xylem tissue. 129-131
- 3. **PRAC** Using prepared slides, draw and label diagrams of transverse sections of stems, roots, and leaves of herbaceous dicot plants. Use an eyepiece graticule to show the tissues in the correct proportions. 130-134
- 4. **PRAC** Using prepared slides, draw and label the cells in TS and L.S. sections of xylem, phloem, and primary xylem tube elements and companion cells. Recognise these cells when viewed with a light microscope. 130-131
- 5. Relate the structure of xylem vessel elements, and primary xylem tube elements and companion cells to their functions. 130-131

**7.2 Transport mechanisms**

**Learning outcomes**

- 1. Explain the movement of water between plant cells, and between them and their environment in terms of water potential. 135-136
- 2. 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). 135
- 3. 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
- 4. Explain why transpiration is a consequence of gas exchange. 136
- 5. **PRAC** Using a simple potometer and grids to determine leaf surface area, investigate and explain factors affecting transpiration rate. 137
- 6. Explain and make annotated drawings to show how the leaves of xerophytes are adapted to reduce water loss by transpiration. 138
- 7. State that assimilates, e.g. sucrose and amino acids, move between sources and sinks in primary xylem tubes. 139
- 8. 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

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.

**7.2 Transport mechanisms**

**Learning outcomes**

- 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). 135
- 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

**135 Uptake at the Root**

**Key Idea** Water uptake by the root is a passive process. Plants need to take up water and minerals constantly. They must compensate for the continuous loss of water from the leaves and provide the materials the plant needs to make root.

**Water and mineral uptake by roots**

**Paths for water movement through the plant**

**Activity number**

135 136

89 129 133

**92 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 (or ions) from regions of low concentration to regions of high concentration across a cellular membrane by transport proteins. Active transport needs energy to proceed because molecules are being moved against their concentration gradient.

**Active transport**

**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 sodium-potassium pump (Na<sup>+</sup>/K<sup>+</sup> ATPase) is found in animal cells and is essential for the transport of other molecules such as glucose across the plasma membrane. In this case, the pump moves three sodium ions out of the cell and two potassium ions into the cell.

**Protein pump**

**Sodium-potassium pump**

**Cotransporter**

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

**Engage, explore and explain**

**Elaborate**

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

**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.

pumps move ions and molecules across a membrane. They almost all animals.

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.

### 100 The Cell Cycle in Eukaryotes

**Key Idea** The cell cycle of eukaryotes has four main phases. There are also three checkpoints that regulate the progression to the next phase of the cell cycle. The cell cycle can be divided into interphase and M phase. The cell spends 90% of its time in interphase. Interphase is the time between cell divisions when the cell is at its largest.

**Interphase**  
Cells spend most of their time in interphase. Interphase is divided into three stages (G1, S, and G2).  
• **The G1 phase:** The cell grows and carries out its normal functions.  
• **The S phase:** Chromosome replication (DNA synthesis).  
• **The G2 phase:** The cell grows again and prepares for cell division.  
During interphase, the cell grows, carries out its normal functions, and prepares for cell division. Interphase is not a single event.

**Mitosis and cytokinesis (M phase)**  
Mitosis and cytokinesis occur during M phase. During mitosis, the cell nucleus (containing the replicated DNA) divides into two equal parts. Cytokinesis occurs at the end of M phase. During cytokinesis, the cell cytoplasm divides, and two new daughter cells are produced.

**Checkpoints during the cell cycle**  
There are three checkpoints during the cell cycle. A checkpoint is a control point at which each chromosome, a set of conditions determines whether or not the cell will continue to the next phase. For example, will the cell enter S phase if it has not completed G1, or will it cell enter mitosis if it has not completed G2?

**G1 checkpoint**  
Pass this checkpoint if:  
• Cell size is large enough  
• Sufficient nutrients are available  
• Spinal from other cells has been received

**G2 checkpoint**  
Pass this checkpoint if:  
• DNA replication is complete  
• All chromosomes are attached to the mitotic spindle

**Mitosis checkpoint**  
Pass this checkpoint if:  
• All chromosomes are attached to the mitotic spindle

**Elaborate**

1. What is the general purpose of the cell cycle?
2. (a) What is the purpose of the mitosis checkpoint?  
(b) Why is this checkpoint important?
3. What would happen if the cell cycle was not regulated?

### 108 Regulation of the Cell Cycle

**Key Idea** The cell cycle is regulated by checkpoints, which ensure the cell has met certain conditions before it continues to the next phase of the cell cycle. Cells, such as cancer cells, can bypass these checkpoints, leading to uncontrolled cell division. Progression through the cell cycle is controlled by regulatory checkpoints, which ensure that the conditions required to successfully complete the next phase are met.

**How cancer cells form**  
Changes to DNA (mutations) can be caused by external agents called carcinogens. Carcinogens are mutagens that cause cancer. Carcinogenic cells form when the genes that control cell growth and differentiation are changed by carcinogens into oncogenes (genes that cause cancer). Carcinogenic cells are able to divide and are not controlled by the normal cell cycle. A cancerous cell no longer carries out its regulated cell cycle and instead divides continuously. Cells from the body that are not in the way of damaged and continuing to divide. The cell cycle is not controlled in a normal cell in the same tissue because there is no way for the cell to receive signals from the body that it should stop dividing.

**What distinguishes a cancerous cell from a normal cell?**

- (a) What distinguishes a cancerous cell from a normal cell?
- (b) Why can cancer cells grow rapidly?

**Evaluate**

In general say, explain how a tumour typically forms?

### 109 Cancer: Cells out of Control

**Key Idea** Carcinogenic cells have lost their normal cellular control mechanisms, and grow uncontrollably. Cells that become damaged beyond repair will normally undergo a programmed cell death (apoptosis), which is part of the cell's normal control system. Some cells evade the control system and become immortal, continuing to divide without any regulation. Such cells are called cancer cells. They form tissue masses called tumours, and spread through blood and lymph to invade other tissues, eventually causing damage to the affected tissue. Any one of a number of cancer-causing factors (including defective genes) may be involved in the formation of a cancerous cell.

**How cancer cells form**  
Changes to DNA (mutations) can be caused by external agents called carcinogens. Carcinogens are mutagens that cause cancer. Carcinogenic cells form when the genes that control cell growth and differentiation are changed by carcinogens into oncogenes (genes that cause cancer). Carcinogenic cells are able to divide and are not controlled by the normal cell cycle. A cancerous cell no longer carries out its regulated cell cycle and instead divides continuously. Cells from the body that are not in the way of damaged and continuing to divide. The cell cycle is not controlled in a normal cell in the same tissue because there is no way for the cell to receive signals from the body that it should stop dividing.

**What distinguishes a cancerous cell from a normal cell?**

- (a) What distinguishes a cancerous cell from a normal cell?
- (b) Why can cancer cells grow rapidly?

**Evaluate**

In general say, explain how a tumour typically forms?

### 79 The Role of the Cell Surface Membrane

**Key Idea** Many of the functions of the cell surface membrane, including transport, communication, and cell recognition are a function of the membrane's integral proteins.

**Roles of the cell surface membrane**

**Cell communication**  
Integral membrane proteins act as receptors for signals (e.g. hormones, neurotransmitters, etc.).

**Transport through pores**  
Channel proteins are embedded in the membrane. They provide a pathway for small molecules and ions to pass through the membrane.

**Transport by carriers**  
Carrier proteins are embedded in the membrane. They change shape to move molecules across the membrane.

**Cell recognition**  
Cell surface proteins, such as the glycoproteins, allow the body to distinguish between self and non-self (foreign tissues).

**What do proteins in the cell surface membrane really look like?**  
The basic structure of membrane proteins enables them to perform their specific function in transport, cell signalling, and cell recognition. The proteins are integral to the membrane, and other parts of their structure project from both internal and external sides of the membrane.

**Engage the student with what is familiar to them**

1. Summarise the role of the cell surface membrane in the following processes, identifying the components involved.
  - (a) Cell communication.
  - (b) Recognition of self and non-self.

### 80 The Structure of Membranes

**Key Idea** The plasma (cell surface) membrane is composed of phospholipids and proteins. The phospholipids form a fluid mosaic model of the membrane structure. The proteins are embedded in the phospholipid bilayer and perform various functions, such as transport, cell signalling, and cell recognition.

**The fluid mosaic model of membrane structure**  
The fluid mosaic model of membrane structure describes the phospholipid bilayer and the proteins embedded in it. The phospholipids are arranged in a bilayer, with their hydrophilic heads facing outwards and their hydrophobic tails facing inwards. Proteins are embedded in the bilayer, and some are attached to the surface. The model is called 'fluid' because the phospholipids and proteins can move laterally within the membrane.

**Explore and explain**

1. Identify the components of the plasma membrane involved in:
  - (a) Facilitated diffusion.
  - (b) Active transport.
2. How do the properties of phospholipids contribute to their role in forming the structural framework of membranes?
3. Describe the modern fluid mosaic model of membrane structure.

### 82 Factors Altering Membrane Permeability

**Key Idea** Temperature and solvents can also denature proteins, which affects the membrane's permeability. The membrane's permeability can be disrupted if the structure of the membrane is altered. At high temperatures, the membrane becomes more permeable. At low temperatures, the membrane becomes less permeable. Solvents, such as alcohol, can also denature proteins, which affects the membrane's permeability.

**Experimental method**  
Five beakers were set up in water baths using a cork borer with a 4 mm internal diameter. The tubes were trimmed to 20 mm lengths and placed in a beaker of distilled water for 30 minutes. The tubes were then placed in a beaker of distilled water for 30 minutes. The tubes were then placed in a beaker of distilled water for 30 minutes. The tubes were then placed in a beaker of distilled water for 30 minutes.

Temperature / °C	Absorbance of beetroot samples at varying temperatures			
	Observation	Sample 1	Sample 2	Sample 3
0	No colour	0	0.007	0.004
20	Very pale pink	0.027	0.022	0.018
40	Very pale pink	0.096	0.114	0.114
60	Pink	0.580	0.524	0.569
80	Red	3	3	3

**Interpretive tasks require students to apply their basic understanding to a new problem**

1. Why is it important to control the temperature of the water baths?
- (a) Complete the following table.  
(b) Based on the data, what can you conclude about the effect of temperature on membrane permeability?  
(c) Explain your answer.

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

### 129 Vascular Tissue

**Key Idea** The xylem is involved in transport of water and minerals. The phloem is involved in transport of organic nutrients. The xylem and phloem are part of the vascular tissue. The xylem is made up of tracheids and vessel elements. The phloem is made up of sieve tube elements and companion cells.

### 130 Xylem

**Key Idea** The xylem is involved in transport of water and minerals. The phloem is involved in transport of organic nutrients. The xylem and phloem are part of the vascular tissue. The xylem is made up of tracheids and vessel elements. The phloem is made up of sieve tube elements and companion cells.

### 135 Uptake at the Root

**Key Idea** Water uptake by the root is an active process. The root hairs increase the surface area for water uptake. The water potential in the soil is higher than in the root cells. Water moves from the soil into the root cells through osmosis.

### 136 Transpiration

**Key Idea** Water moves through the root of a plant from the soil to the leaves. The water is then lost from the leaves through transpiration. Transpiration is the loss of water from a plant through its leaves. The water is lost from the leaves through stomata. The water is lost from the leaves through transpiration.

**Engage**

1. What is the function of the xylem?
2. How does water pass between the xylem and phloem?
3. How does water pass between the xylem and phloem?
4. How does water pass between the xylem and phloem?
5. How does water pass between the xylem and phloem?
6. How does water pass between the xylem and phloem?
7. How does water pass between the xylem and phloem?
8. How does water pass between the xylem and phloem?
9. How does water pass between the xylem and phloem?
10. How does water pass between the xylem and phloem?

**Explore**

1. (a) What is transpiration?  
(b) Describe one benefit of the transpiration stream.
2. Why is transpiration an inevitable process?

### 137 Investigating Plant Transpiration

**Key Idea** The relationship between the rate of transpiration and the environment can be investigated using a potometer. The potometer is a device used to measure the rate of transpiration in a plant. The potometer is used to measure the rate of transpiration in a plant. The potometer is used to measure the rate of transpiration in a plant.

**Elaborate and evaluate**

**Interpretive tasks require students to apply their basic understanding to a new problem**

1. Why is it important to control the temperature of the water baths?
- (a) Complete the following table.  
(b) Based on the data, what can you conclude about the effect of temperature on membrane permeability?  
(c) Explain your answer.

# 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.

**34 The Cell is the Unit of Life**

**Key Idea:** All living organisms are composed of cells. Cells are the smallest units of structure and organisation. The cell theory is a fundamental basis of biology. The size, shape and structure of cells are related to their function.

**The cell theory**

- All living organisms are composed of cells.
- The cell is the smallest unit of structure and organisation.
- All cells arise from pre-existing cells.

**All cells show the functions of life:**

- Living
- Reproduction
- Growth
- Response to stimuli
- Excretion
- Respiration
- Photosynthesis

**Living things:** Unicellular organisms (e.g. amoeba, yeast, bacteria, fungi, algae, plants, animals).

**Non-living things:** Crystals, viruses, computer programmes, etc.

**Plant cells:** Cell wall, large central vacuole, chloroplasts, nucleus, cytoplasm, cell membrane.

**Animal cells:** No cell wall, no large central vacuole, no chloroplasts, nucleus, cytoplasm, cell membrane.

**Prokaryotic cells:** No nucleus, no membrane-bound organelles, circular DNA, cell wall, flagella.

**Eukaryotic cells:** Nucleus, membrane-bound organelles, linear DNA, cell wall (in plants), flagella (in some).

1. What are the characteristic features of a prokaryotic cell?  
2. What are the characteristic features of a eukaryotic cell?  
3. Why are viruses considered non-living things?

**38 Animal Cells**

**Key Idea:** Animal cells are eukaryotic cells. They have many organelles. The diagram below shows the structure of an animal cell. The organelles are described in the text. The diagram shows the location of the organelles in the cell. The organelles are: nucleus, cytoplasm, cell membrane, cell wall, chloroplasts, large central vacuole, flagella, cilia, microvilli, rough endoplasmic reticulum, smooth endoplasmic reticulum, Golgi apparatus, lysosomes, peroxisomes, mitochondria, centrioles, and centrosome.

**Generalised animal cell:** Shows the location of the organelles in the cell. The organelles are: nucleus, cytoplasm, cell membrane, cell wall, chloroplasts, large central vacuole, flagella, cilia, microvilli, rough endoplasmic reticulum, smooth endoplasmic reticulum, Golgi apparatus, lysosomes, peroxisomes, mitochondria, centrioles, and centrosome.

1. The two photographs (left) show several types of animal cells. Identify the tissues indicated by the letters A-C.  
2. White blood cells are mostly prokaryotic cells, whereas red blood cells are eukaryotic. (a) In the photograph (down left), circle a white blood cell and a red blood cell. (b) Write the function of each cell. (c) Write the function of each cell. Explain how you make your decision.

**45 Prokaryotic Cells**

**Key Idea:** Prokaryotic cells lack many of the features of eukaryotic cells. They are smaller and simpler in structure. They lack a nucleus and membrane-bound organelles. They have a cell wall and a single circular chromosome. They are found in all environments.

**Cell structure:** Shows the structure of a prokaryotic cell. The organelles are: cell wall, cell membrane, cytoplasm, ribosomes, flagella, cilia, pili, and plasmids.

**Prokaryotic cells:** Unicellular organisms that lack a nucleus and membrane-bound organelles. They are found in all environments.

1. Describe the features distinguishing prokaryotic cells from eukaryotic cells.  
2. Give the function of flagella or cilia.  
3. Explain how flagella differ structurally and functionally from flagella.  
4. Describe the location and general composition of the bacterial cell wall.

**EXAMPLE 1**  
**Types of cells**  
Understand that cells are the basic unit of life and that there are differences between different cell types.

**84 Diffusion**

**Key Idea:** Diffusion is the movement of particles from a region of high concentration to a region of low concentration. It is a passive process. It occurs in all media. It is affected by temperature, surface area, and distance.

**Factors affecting the rate of diffusion:** Temperature, surface area, distance, concentration gradient.

**Simple diffusion:** Movement of small molecules through the phospholipid bilayer.

**Carrier-mediated facilitated diffusion:** Movement of larger molecules through carrier proteins.

**Channel-mediated facilitated diffusion:** Movement of ions through channel proteins.

1. What is diffusion?  
2. What are the three types of diffusion that occur in cells?  
3. How does facilitated diffusion differ from simple diffusion?

**85 Investigating Diffusion**

**Key Idea:** This experiment is designed to investigate the factors that affect the rate of diffusion. The experiment involves measuring the time taken for a dye to diffuse through a gelatin block.

**Factors affecting the rate of diffusion:** Temperature, surface area, distance, concentration gradient.

**Method:** A beaker of distilled water is used. A gelatin block is placed in the water. A dye solution is added to the water. The time taken for the dye to diffuse through the gelatin block is measured.

1. Why was it important to wash the gelatin tubing before placing it into the beaker of distilled water?  
2. What part of a cell does the gelatin tubing represent?  
3. The results for the experiment are presented in the table in the right.  
4. In the diagram of a mammalian heart, the wall of the ventricle is thicker than the wall of the atrium. Explain why this is the case.  
5. The diagram shows the structure of a mammalian heart. Explain how the structure of the heart is related to its function.

**87 Diffusion and Cell Size**

**Key Idea:** Diffusion is more efficient in cells with a small surface area to volume ratio. As a cell grows, its surface area increases more slowly than its volume. This means that the rate of diffusion per unit volume decreases as the cell grows.

**Single-celled organisms:** Have a high surface area to volume ratio. They can rely on diffusion for transport.

**Multicellular organisms:** Have a low surface area to volume ratio. They need specialised transport systems.

**Surface area to volume ratio:** Calculated as  $\frac{\text{Surface area}}{\text{Volume}}$ .

Cube size	Surface area	Volume	Surface area to volume ratio
1 cm side	$6 \times 1 \times 1 = 6 \text{ cm}^2$	$1 \times 1 \times 1 = 1 \text{ cm}^3$	$6 \text{ cm}^2 / 1 \text{ cm}^3 = 6$
2 cm side	$6 \times 2 \times 2 = 24 \text{ cm}^2$	$2 \times 2 \times 2 = 8 \text{ cm}^3$	$24 \text{ cm}^2 / 8 \text{ cm}^3 = 3$
3 cm side	$6 \times 3 \times 3 = 54 \text{ cm}^2$	$3 \times 3 \times 3 = 27 \text{ cm}^3$	$54 \text{ cm}^2 / 27 \text{ cm}^3 = 2$
4 cm side	$6 \times 4 \times 4 = 96 \text{ cm}^2$	$4 \times 4 \times 4 = 64 \text{ cm}^3$	$96 \text{ cm}^2 / 64 \text{ cm}^3 = 1.5$

1. Calculate the surface area to volume ratio for each of the four cubes above. (The first has been done for you.)  
2. How does the surface area to volume ratio change as the size of the cube increases?  
3. How does the rate of diffusion per unit volume change as the size of the cube increases?

**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.

**152 The Human Heart**

**Key Idea:** The human heart has four chambers: two atria and two ventricles. It pumps blood to the rest of the body and back to the heart. The heart is a muscular organ. It is located in the chest cavity. It is surrounded by the pericardium.

**Human heart structures:** Right atrium, right ventricle, left atrium, left ventricle, pulmonary artery, pulmonary vein, aorta, and vena cava.

**Anterior view of heart to show coronary arteries:** Shows the coronary arteries that supply the heart with oxygenated blood.

**Key to abbreviations:** RA (Right Atrium), RV (Right Ventricle), LA (Left Atrium), LV (Left Ventricle), PA (Pulmonary Artery), PV (Pulmonary Vein), AO (Aorta), VC (Vena Cava).

1. In the schematic diagram of the heart, label the four chambers and the main vessels entering and leaving the heart.  
2. The arrows indicate the direction of blood flow. Label each of the vessels.

**153 Dissecting a Mammalian Heart**

**Key Idea:** A mammalian heart is a muscular organ. It is located in the chest cavity. It is surrounded by the pericardium. The heart has four chambers: two atria and two ventricles. It pumps blood to the rest of the body and back to the heart.

**Dissection of a mammalian heart:** Shows the internal structure of the heart. The chambers are: right atrium, right ventricle, left atrium, and left ventricle. The major vessels are: pulmonary artery, pulmonary vein, aorta, and vena cava.

**Key to abbreviations:** RA (Right Atrium), RV (Right Ventricle), LA (Left Atrium), LV (Left Ventricle), PA (Pulmonary Artery), PV (Pulmonary Vein), AO (Aorta), VC (Vena Cava).

1. Use a scalpel to cut through the pulmonary artery and the pulmonary vein. Label each of the vessels.  
2. Use a scalpel to cut through the aorta and the vena cava. Label each of the vessels.

**154 The Cardiac Cycle**

**Key Idea:** The cardiac cycle is the sequence of events that occur in the heart during each heartbeat. It consists of three phases: atrial systole, ventricular systole, and diastole. The cycle is controlled by the sinoatrial node, atrioventricular node, bundle of His, and Purkinje fibers.

**Cardiac cycle events and the electrocardiogram (ECG):** Shows the relationship between the ECG trace and the events of the cardiac cycle.

**ECG trace:** Shows the electrical activity of the heart. The P wave represents atrial systole, the QRS complex represents ventricular systole, and the T wave represents ventricular diastole.

1. On the ECG trace, label:  
a) The P wave.  
b) The QRS complex.  
c) The T wave.  
2. What is the relationship between the P wave and atrial systole?  
3. What is the relationship between the QRS complex and ventricular systole?  
4. What is the relationship between the T wave and ventricular diastole?  
5. Using the letters indicated, mark the points on the trace corresponding to each of the following:  
a) Atrial systole.  
b) Atrial diastole.  
c) Ventricular systole.  
d) Ventricular diastole.

**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.

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.

## 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

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

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

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

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.

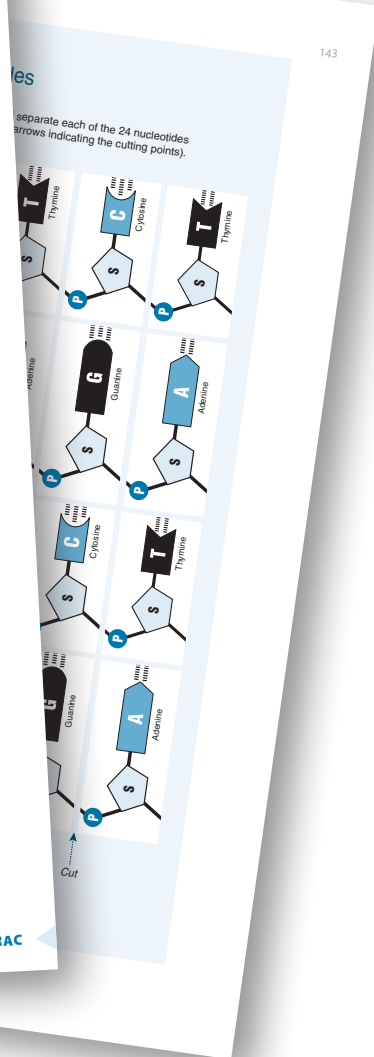
6. Under normal circumstances, it is not possible for adenine to pair up with guanine or cytosine, nor for any other mismatches to occur. Describe the **two factors** that prevent a mismatch from occurring:

Factor 1: \_\_\_\_\_

Factor 2: \_\_\_\_\_

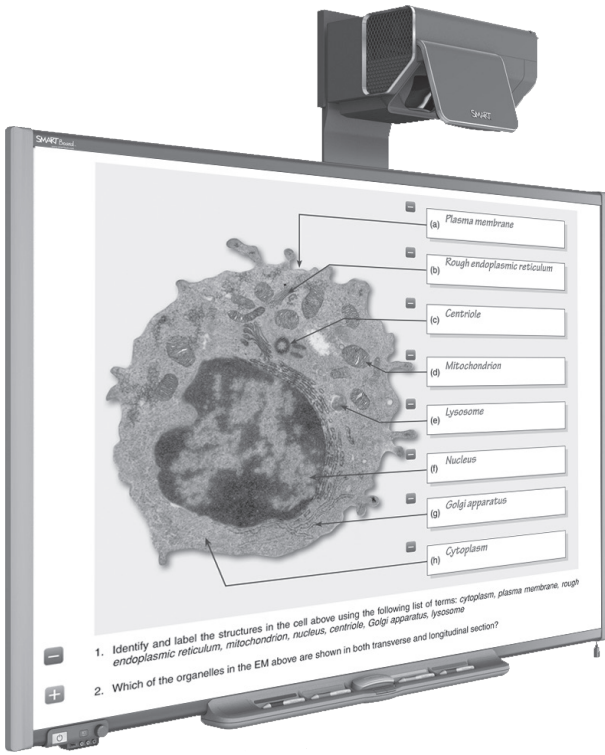
7. Once you have checked that the arrangement is correct, you may glue, paste or tape these nucleotides in place.

**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.



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.





## 2 Interactive revision of tasks in class

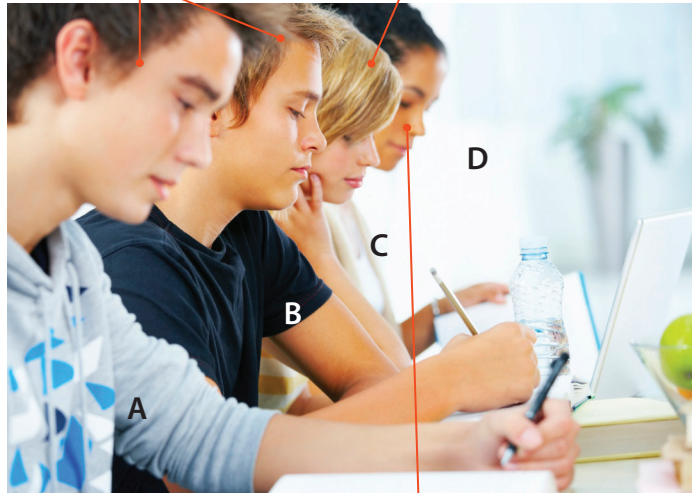
- Use the workbook PDFs with HIDE/SHOW answers on the **Teacher's Digital Edition** to review activities in class using a data projector or interactive whiteboard.
- Students benefit from the feedback in class, where questions can be addressed, and teachers benefit by having students self-mark their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

Key facts: Malaria is caused by parasitic protozoa. The protozoa are carried by the Anopheles mosquito and are transmitted to humans when they are bitten by the mosquito. Malaria is a disease caused by protozoan parasites of the genus Plasmodium. The parasites have a life cycle involving the mosquito, Anopheles mosquitoes and humans. Humans become infected when bitten by mosquitoes infected with the protozoa. In their human host, the parasites infect red blood cells (RBCs) and multiply inside the cells by asexual reproduction. Four Plasmodium species can cause malaria, ranging in severity from relatively mild to fatal. Fatal malaria is the most severe because it affects all ages of red blood cells. Destruction of the RBCs results in a condition called haemolytic anaemia (loss of RBCs through lysis). The infected blood cells also become sticky and block blood vessels to vital organs such as the kidneys and the brain.

**Transmission and effects of malaria**

A mosquito infected with Plasmodium bites a human. The parasite completes the sexual part of its life cycle in the mosquito's body. The parasite breeds through the blood to the skin where mosquitoes, rapidly bite the bare cells.

Some parasites remain dormant for years in the liver. Others infect red blood cells and continue to multiply.

Infected red blood cells burst, and the parasite can infect other red blood cells.

**Control and prevention of malaria**

Using a targeted approach to control and prevent the spread of malaria. This involves a combination of strategies, including insecticide-treated nets to stop mosquitoes biting a person while they are sleeping, drug treatments, especially for pregnant women and infants, and a reduced parasite density (by physical and medicinal means) using pyrethroids and malathion, or treated staff to treat malaria.

Social and economic factors have a significant role in the spread of malaria. People living in rural areas, especially those who cannot afford the best nets or other control measures, are at greatest risk from mosquito bites. The governments of malaria-endemic countries often lack financial resources and do not have adequate equipment, medicines, or trained staff to treat malaria.

Larvae of the Anopheles mosquito can breed in diverse habitats. Many of which are close to water. For example, wet pools of water in old tires, water troughs, containers, or rice fields are all potential breeding sites for mosquitoes. Mosquito control can be reduced by removing such potential breeding sites as possible.

**Global distribution and control of malaria**

Malaria occurs in tropical and subtropical areas (left), where temperatures, humidity and rainfall are suitable for the Plasmodium parasites to survive and multiply, and where the mosquito parasites can complete their life cycle. The highest transmission is found in Africa (both of the Sahel and in parts of Central and in Papua New Guinea).

Malaria is a leading cause of death and disease in many developing countries, where about 3 billion and 400 million women are most affected. In 2012, 214 million people contracted malaria and around 628 000 people died. The economic cost of malaria is US\$12 billion per year.

**Why is malaria difficult to eradicate?**

Several factors make malaria a very difficult disease to control. The Plasmodium parasite has a different host and a complex life cycle, making it very difficult to target with drugs. The parasite has also developed resistance to anti-malarial drugs, allowing it to continue to spread and, in some cases, to emerge in areas where it had previously been eliminated. Current resistance to developing insecticide resistance and their continued emergence help, allowing a greater transmission of the Plasmodium parasite.

Until recently (throughout the most widely used anti-malarial drug, however, the emergence of drug-resistant Plasmodium parasites is a major concern). It is now used in combination with other anti-malarial drugs (artemisinin) to reduce its effective range.

**1. Name the malaria pathogen.**

**2. State what type of pathogen it is.**

**3. How do humans become infected with malaria?**

**4. What aspects of the biology of this pathogen make it difficult to control?**

**5. What biological factors are important in the global occurrence of malaria?**

**6. What measures could be most cost effective in controlling the number of new malaria infections?**

**7. Why has malaria been so difficult to treat and eradicate with drugs?**

**8. What effect do you think global warming will have on the geographical range of malaria?**

**178 Chapter Review**

Summarise what you know about this topic under the headings provided. You can draw diagrams or mind maps or write short notes to organise your thoughts. Use the images and facts to help you and refer back to the introduction to check the points covered.

**Types of disease:**  
 BIST: Social factors, transmission, medical treatment, malaria, malaria, TB, HIV/AIDS, antibiotic, and viruses.

**Antibiotic:**  
 BIST: How does penicillin act on bacteria? How does cell lysis work? How does it work?

**REVISE**



# 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.

**50 The Biochemical Nature of Cells**

**Key Idea:** The main components of a cell are water and compounds of carbon, hydrogen, nitrogen, and oxygen. Water is the main component of cells and organisms, providing an aqueous environment in which metabolic reactions can occur. Apart from water, most other substances in cells are compounds of carbon, hydrogen, oxygen, and nitrogen.

**Centrioles**

**Chloroplasts in plant cells**

**Proteins** have an enormous number of structural and functional roles in plants and animals, e.g. as enzymes, structural materials (such as collagen), in transport, and movement (e.g. cytoskeleton and centrioles).

**Inorganic ions** in metabolic reactions are a component pigment in the

**Animal cell**

**Chromosome**

**Nucleotides and nucleic acids**  
Nucleic acids encode information for the construction and functioning of an organism. ATP, a nucleotide derivative, is the energy carrier of the cell.

1. Summarise the role of each of the following:

- Carbohydrates: \_\_\_\_\_
- Lipids: \_\_\_\_\_
- Proteins: \_\_\_\_\_
- Nucleic acids: \_\_\_\_\_
- Inorganic ions: \_\_\_\_\_
- Water: \_\_\_\_\_

**KNOW 53**

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**167 Types of Disease**

**Key Idea:** Infectious diseases are caused by microorganisms that can be spread (transmitted) from one person to another. The term **disease** refers to an abnormal condition of an organism's physical health. Many factors can cause disease.

**Infectious diseases**

Infectious diseases are caused by microorganisms, such as bacteria, viruses, parasites, or fungi. Infectious diseases are easily spread, such as measles, a contagious disease. Such diseases are a threat and must be notified to health authorities. Serious contagious bacterial and viral diseases are now controlled through vaccination.

Human cells are living very quickly. These cells are infectious spread rapidly if sanitation hygiene is poor. Weather is favourable to the pathogen transport, e.g. spread a pathogen very quickly.

The mode of transmission affects how quickly a pathogen spreads from person to person. (i.e. touching) is a method of transmission, whereas spread of mucus droplets into the air (cough) and animal vectors can spread a pathogen very quickly (e.g. malaria).

1. Explain the difference between an infectious disease and a non-infectious disease.

2. Using examples, describe the factors that control the spread of infectious diseases.

3. What causes sickle cell disease and what are its symptoms?

**KNOW 167 168**

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**46 Prokaryotic and Eukaryotic Cell Summary**

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

1. (a) Use your knowledge to list the unique features of prokaryotic and eukaryotic cells in the space below.  
(b) Under common features, list the features that both prokaryotic and eukaryotic cells have in common.

**Prokaryotic features**      **Eukaryotic features**

**Common features**

2. Study the photos below and determine if they are prokaryotic or eukaryotic cells:

(a) (b) (c)

3. (a) Identify the regions indicated by A and B on the diagrams (right):  
A: \_\_\_\_\_  
B: \_\_\_\_\_

(b) Compare and contrast the structure and location of genetic material in a prokaryote and eukaryote cell:  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**45 38 36 34 46 TEST**

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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: \_\_\_\_\_

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	A Single stranded nucleic acid that consists of nucleotides containing ribose sugar.
coding strand	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.
DNA	C The process of creating an equivalent mRNA copy of a sequence of DNA.
double helix	D The structural units of nucleic acids, DNA and RNA.
gene	E The stage of gene expression in which mRNA is decoded to produce a polypeptide.
genetic code	F The DNA strand with the same base sequence as the mRNA transcript produced (although with thymine replaced by uracil in mRNA).
mutation	G The sequence of DNA that is read during the synthesis of mRNA.
nucleic acids	H A single-ringed organic base that forms uracil, cytosine, or thymine in nucleic acids.
nucleotides	I The rule governing the pairing of complementary bases in DNA
purine	J A section of DNA that codes for a protein or other functional mRNA product.
pyrimidine	K Universally found macromolecules composed of chains of nucleotides. These molecules carry genetic information within cells.
RNA	L A change in the DNA sequence.

Mucous glands, explain how you

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

Percentage smoking

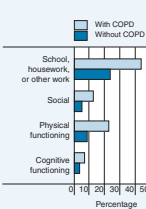
COPD deaths males

COPD deaths females

1975 1985 1995 2005

## 162 Living With Chronic Lung Disease

Activity limitation in people with and without COPD



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

### The impact of COPD in the UK

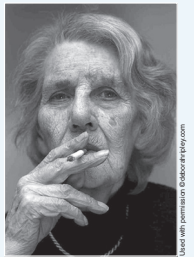
Chronic obstructive pulmonary disease (or COPD) includes **chronic bronchitis** and **emphysema**, which often occur together. COPD affects about one million people in the UK. Most of those affected are over the age 40 and smoking is the cause in the vast majority of cases. This relationship is clear; 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 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.

- Describe the economic impact of smoking-related diseases, such as emphysema and chronic bronchitis: \_\_\_\_\_
- Discuss the personal costs of a smoking-related disease and comment on the value of personal testimonials such as those from Deborah's mother: \_\_\_\_\_

205

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

mutations, state the type of mutation that has occurred:

TC TG \_\_\_\_\_

AC 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 \_\_\_\_\_

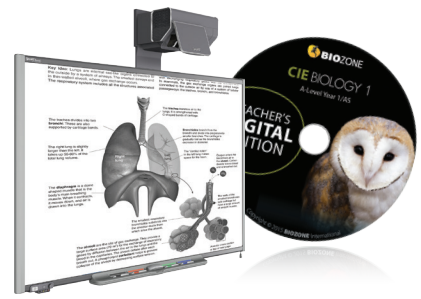
h by **deleting** one of the words in the **bracketed ( )** pairs below:

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

copying of the DNA code into (mRNA/IRNA). The (mRNA/IRNA) is then transported to (transcription/translation) occurs. Ribosomes attach to the (mRNA/IRNA) and help match (the anticodons on (mRNA/IRNA). The (mRNA/IRNA) transports the amino acids to the (to the growing (polypeptide/carbohydrate) chain.

# 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*<sup>®</sup> spreadsheets for all activities with a graphing or data analysis component.

173 HIV/AIDS

**Key Idea:** The human immunodeficiency virus (HIV) infects lymphocyte cells, eventually causing AIDS, a fatal disease, which acts by impairing the immune system.

**HIV infects lymphocytes**

HIV infects helper T-cell lymphocytes. It uses the cells to replicate itself in great numbers, then the newly formed viral particles exit the cell to infect more helper T-cells. Many helper T-cells are destroyed in the process of HIV replication. Helper T-cells are part of the body's immune system, so when their levels become too low, the immune system can no longer fight off infections. TB is the biggest killer of HIV patients in Africa.

The graph below shows the relationship between the level of HIV infection and the number of helper T-cells in an individual.

1. (a) Name the HIV pathogen: *The human immunodeficiency virus*  
 (b) State what type of pathogen it is: *HIV is a virus.*

2. Consult the graph above showing the stages of HIV infection.

(a) How do viral numbers change with the progression of HIV infection? *Within the first year of infection, viral numbers increase sharply. After this, they decrease and then remain relatively stable for the next 3-10 years, after which they begin to rise again.*

(b) How do the helper T cells respond to the progression of HIV infection? *Helper T cell numbers decrease as HIV infection progresses. They are destroyed by the HIV.*

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

54 Sugars

**Key Idea:** Monosaccharides are the building blocks for larger carbohydrates. They can exist as isomers. Sugars (monosaccharides and disaccharides) play a central role in cells, providing energy and joining together to form carbohydrate macromolecules, such as starch and glycogen.

**Monosaccharides**

Monosaccharides are single-sugar molecules and include glucose (grape sugar and blood sugar) and fructose (found in fruit juices). They are used as a primary energy source for fueling cell metabolism. They can be joined together to form disaccharides (two monomers) and polysaccharides (many monomers).

Monosaccharides can be classified by the number of carbon atoms they contain. Some important monosaccharides are the hexoses (6 carbons) and the pentoses (5 carbons). The sided or pentose (5 sided) rings found in sugars are hexose (6 sided) and pentose (5 sided) rings (below).

The commonly occurring monosaccharides are glucose, fructose, and ribose.

e.g. glyceraldehyde, e.g. ribose, e.g. fructose, galactose

Glucose is a versatile molecule. It provides energy to power cellular reactions, can form energy storage molecules such as glycogen, or it can be used to build structural molecules.

Plants make their glucose via photosynthesis. Animals obtain their glucose by consuming plants or other animals.

1. Describe the two major functions of monosaccharides:  
 (a) *Primary energy source for cellular metabolism.*  
 (b) *Structural units for disaccharides and polysaccharides.*

2. Describe the structural differences between the ring forms of glucose and fructose.  
*Glucose is a hexose sugar (6 carbon atoms) while fructose is a pentose sugar (5 carbon atoms).*

3. *Isomers have the same molecular formula but their structures are different. This difference gives them different chemical properties.*

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

BIOZONE Drawing Histogram

This worksheet has been provided by Biozone International Ltd for use in practising the calculator as a primary activity. Examples are taken from the workbook.

Select View > Formula bar from the menu to view/hide the formulae for each cell.  
 Select View > Comments from the menu to view/hide the comments for each cell.

**EXAMPLE 1**

Glucose (Raw data for weight of individuals)

Weight of Individual (kg)	Frequency
45	1
50	2
55	3
60	4
65	5
70	6
75	7
80	8
85	9
90	10
95	11
100	12

Organise your data into groups. Type formulae as indicated. Excel will auto-calculate the frequency for each group.

Weight class	Frequency
45-50	1
50-55	2
55-60	3
60-65	4
65-70	5
70-75	6
75-80	7
80-85	8
85-90	9
90-95	10
95-100	11

Calculation of statistics:

MEAN	MEDIAN	MODE	RANGE	VARIANCE	STANDARD DEV	SPECIFIC ERROR	SPECIFIC ERROR 2
75.0	75.0	75.0	55	100.0	10.0	0.0000000000	0.0000000000

Enter the raw data in columns under an appropriate heading.  
 Select the data (not including the heading) under the menu choose Data > Sort to sort the data in ascending order (the default).  
 Under Format > Cells, choose number under the category choices to select the appropriate number of decimal points.

Many activities with data handling are supported by working spreadsheets, which include all data and comments on graphical analysis.



# 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](http://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.

