BIOZONE

VCE | BIOLOGY UNITS 1&2

SAMPLE PACKET
FOR CLASSROOM TRIAL

CHAPTER 2

Cellular Structure and Function

Key terms

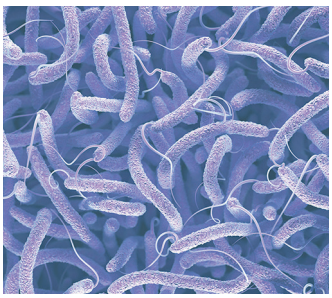
active transport
carrier protein
cell wall
centrioles
channel protein
chloroplast
cilia
concentration gradient
cytoplasm
diffusion
electron micrograph
endoplasmic reticulum
eukaryotic cell
facilitated diffusion
flagella
Golgi apparatus
hypertonic
hypotonic
ion pump
isotonic
light microscope
lysosome
magnification
mitochondrion
nucleic acid
nucleolus
nucleus
organelle
osmolarity
osmosis
partially permeable
passive transport
phospholipid
plasma membrane
plasmolysis
prokaryotic cell
protein
resolution
ribosome
rough ER (rER)
smooth ER (sER)
surface area: volume ratio
turgor
vacuole

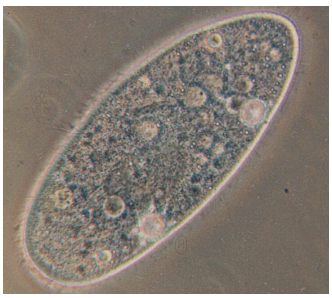
Cells are the unit of life

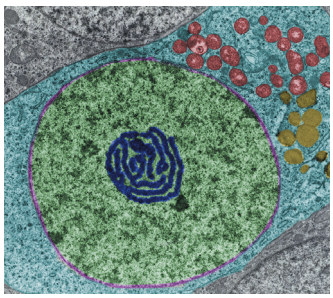
Key skills and knowledge

Activity number

- ☐ 1 Recognise cells as the basic unit of life on Earth. Describe the characteristics of living organisms and explain why viruses do not fulfil the criteria for being living cells. — 9
- ☐ 2 List the basic biochemical components of cells. Appreciate the role of water in life on Earth and summarise its biologically important properties. — 10
- ☐ 3 Describe the requirements of cells in terms of their immediate environment. Explain how unicellular and multicellular organisms meet the challenges for surviving in different environments. — 11
- ☐ 4 Describe the main differences between eukaryotic and prokaryotic cells. Recognise the cells of fungi, plants, protists, animals, and bacteria by their characteristic features. — 9 12 14
- ☐ 5 Use drawings and electron micrographs to compare and contrast the structure of prokaryotic cells and eukaryotic cells. — 13 14







Limitations to cell size: surface area to volume ratios

Key skills and knowledge

- ☐ 6 Describe the range of cell sizes. Express cell sizes in different units of measurement. — 15
- ☐ 7 Describe how cells exchange substances by diffusion. Identify the factors affecting rates of diffusion, explain their effect, and relate these to biological systems. — 16
- ☐ 8 PRAC Investigate diffusion across membranes using a model system. — 16
- ☐ 9 Explain the importance of surface area to volume ratio in limiting cell size and describe the role of cellular organelles in creating cellular compartments with specific functions. — 17
- ☐ 10 PRAC Investigate the effect of cell size on the rate and efficiency of diffusion. — 18
- ☐ 11 Explain how cells overcome the limitations to cell size by changes in shape and by the way they are organised in tissues. — 19

The structure and specialisation of cell organelles

Key skills and knowledge

- ☐ 12 Compare and contrast the ultrastructure of plant cells and animal cells in terms of their organelles. Identify these organelles in drawings and in light and electron micrographs. — 20-22
- ☐ 13 Describe the specialisations of plant and animal cellular organelles for specific functions. — 20-22

The structure and function of the plasma membrane

Key skills and knowledge

- ☐ 14 Describe the structure of the plasma membrane and its role as a partially permeable boundary between the internal and external environments of the cell. Recognise that internal membranes, e.g. of membranous organelles, have the same basic structure. — 23-25
- ☐ 15 PRAC Investigate factors affecting membrane structure and permeability. How might your findings be relevant to survival in different environments? — 26
- ☐ 16 Explain the role of the plasma membrane in the movement of substances by diffusion, facilitated diffusion, and active transport (including ion pumps, cotransport, and cytosis). Include an explanation of the movement of water by osmosis. Explain the effects that solutions of different solute concentration can have on plant and animal cells. — 16 27 29-33
- ☐ 17 PRAC Investigate the effects of solutions of different solute concentration on plant cells. Use your results to estimate the osmolarity of a cell, e.g. a potato cell. — 28

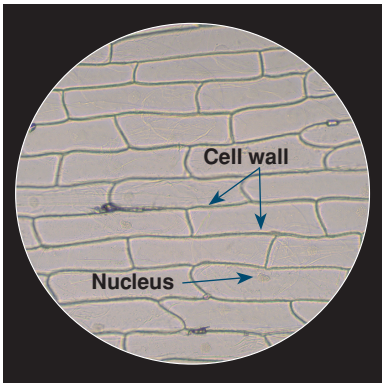
13 Interpreting Images of Cells

Key Idea: Different microscopy techniques produce different views of cells and their features.

The microscope is an important tool in biology for viewing cells and their features, which are far too small to be seen by the human eye. High power compound light microscopes use visible light and a combination of lenses to magnify objects up to several 100 times. Electron microscopes use beams of electrons and computer imaging to capture extremely fine detail of either surface or internal cellular features. They can magnify images up to 500,000 times. Scanning Tunnelling Microscopes (STMs) can magnify object ten times more than that. With a resolution of 0.1 nanometers, STMs operate at the edge of the quantum realm and are able to image some types of atoms.

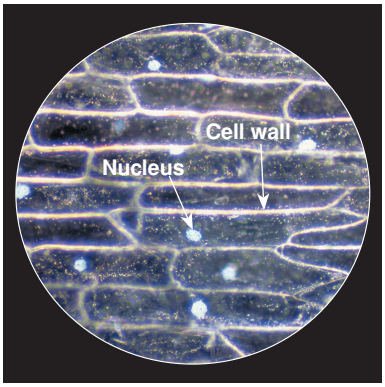
JDG

Dissecting microscopes are used for dissections, observing microbial cultures, and for identifying and sorting organisms, like this small crustacean.



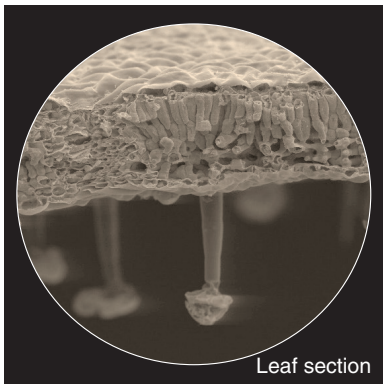
EII

These onion epidermal cells are viewed with standard **bright field** lighting. Very little detail can be seen. The cell nuclei are barely visible.



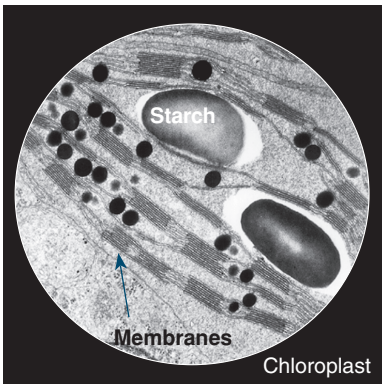
EII

Dark field illumination is excellent for viewing specimens that are almost transparent. The nuclei of these onion epidermal cells are clearly visible.

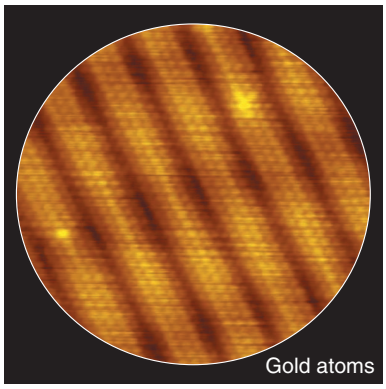


Dartmouth

Scanning Electron Microscopes (SEMs) produce extremely high resolution images of the surface of cells and objects.



Transmission Electron Microscopes (TEMs) produce extremely high resolution images of the interior of cells and transparent objects.

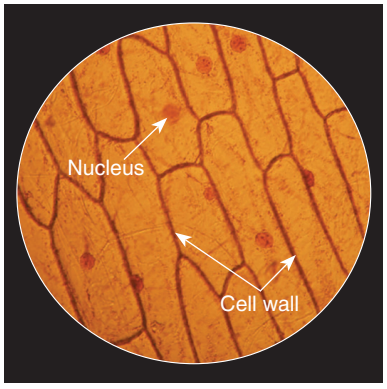


STM Erwinrossen

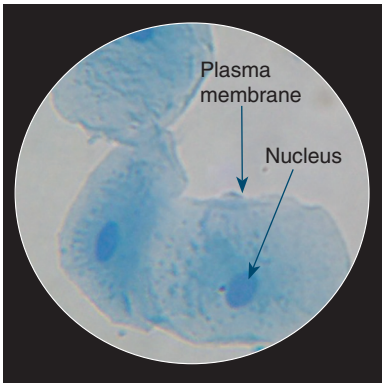
Scanning Tunnelling Microscopes (STMs) produce images based on current variation between an extremely fine needle and the object it moves over.

Staining

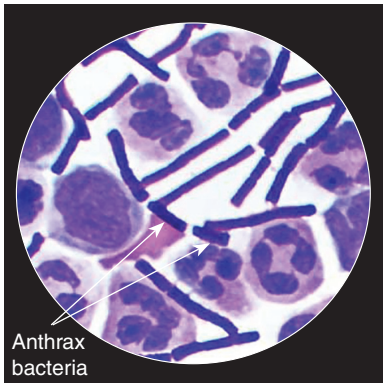
Some parts of the cell take up stains (chemical dyes) better than others. Stains can be used to highlight parts of the cell for better viewing with a microscope or they can improve contrast. A wide range of chemicals act as stains, including iodine and methylene blue.



Iodine is used to increase the contrast in transparent tissues, such as this onion epidermis. Iodine stains are also used to show the presence of starch, binding starch to produce a blue-black colour.



Methylene blue is a positively charged stain commonly used when viewing animal cells. It has a strong affinity for DNA (in the nucleus) and a weaker affinity for RNA (in the cytoplasm).



Some bacteria can be identified and viewed using Gram staining. Bacteria are classed as Gram positive and Gram negative depending on whether or not the stain is retained by the cell wall.

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What is magnification?

Magnification refers to the number of times larger an object appears compared to its actual size.

$$\text{Magnification} = \frac{\text{measured size of the object}}{\text{actual size of the object}}$$

$$\text{Actual object size} = \frac{\text{size of the image}}{\text{magnification}}$$

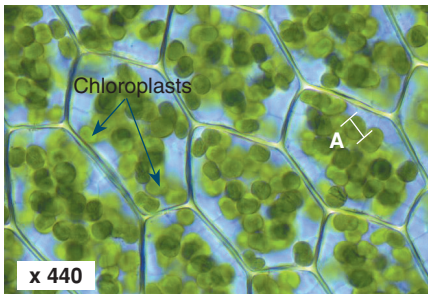
What is resolution?

Resolution is the ability to distinguish between close together but separate objects. Resolution is a function of wavelength of light used to view the object. Examples of high and low resolution for separating two objects viewed under the same magnification are given below.

High resolution

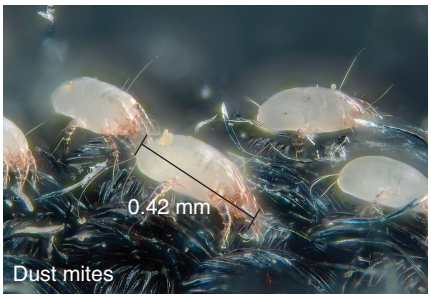
Low resolution

1. Calculate the length or magnification of the object or organism:



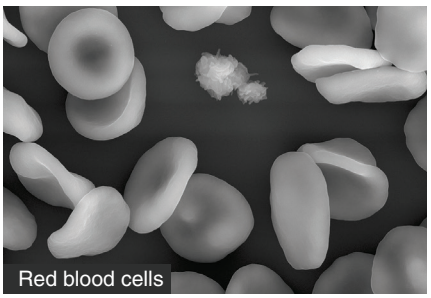
Kristian Peters

Eli

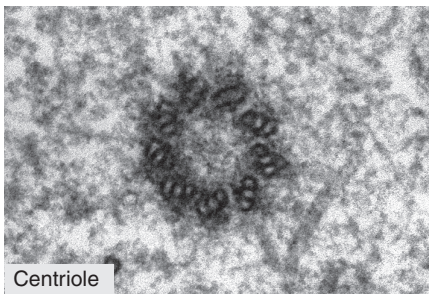


(a) Length of A: _____ (b) Magnification: _____ (c) Magnification: _____

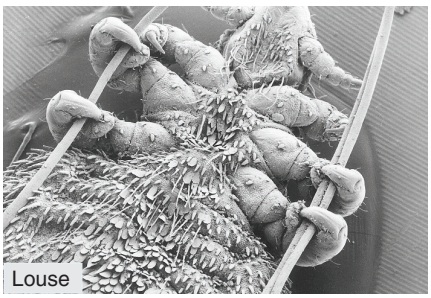
2. Identify which type of microscope (optical microscope, SEM, or TEM) was used to produce each of the images in the photos below (a to f):



Dartmouth College

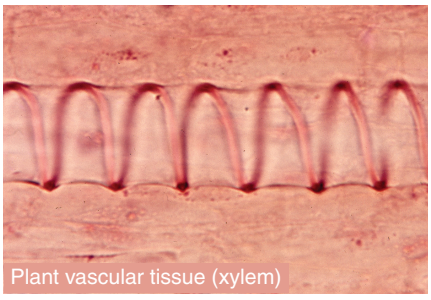


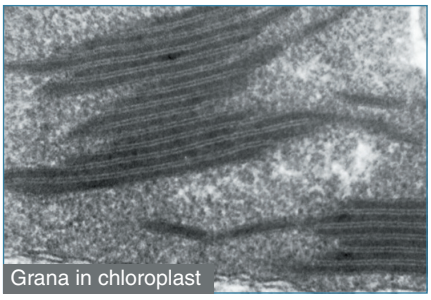
Louisa Howard Dartmouth College



(a) _____ (b) _____ (c) _____

BAN127

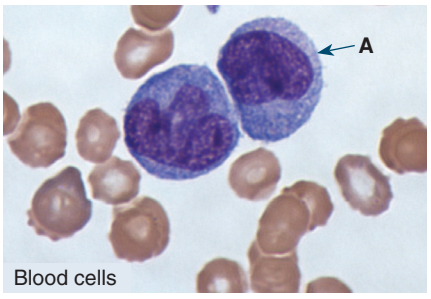




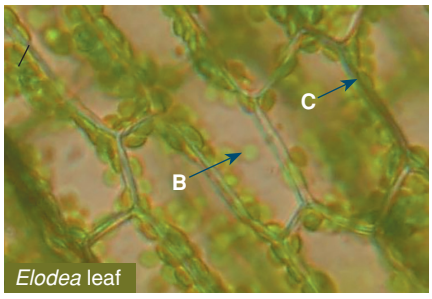
Dartmouth College

(d) _____ (e) _____ (f) _____

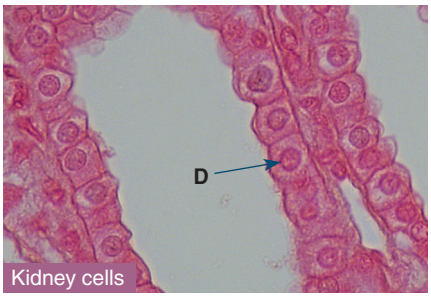
3. Identify the labelled structures:



Dr Graham Beards



tooony



(a) _____ (b) _____ (c) _____ (d) _____

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28 Estimating Osmolarity of Cells

Key Idea: Determining loss or gain of mass in tissues allows us to determine the osmolarity of the tissue's cells.

The osmolarity (a measure of solute concentration) of a cell or tissue can be estimated by placing part of the cell or tissue into a series of solutions of known concentration and observing if the tissue loses (hypertonic solution) or gains (hypotonic solution) water. The solution in which the tissue remains unchanged indicates the osmolarity of the tissue.

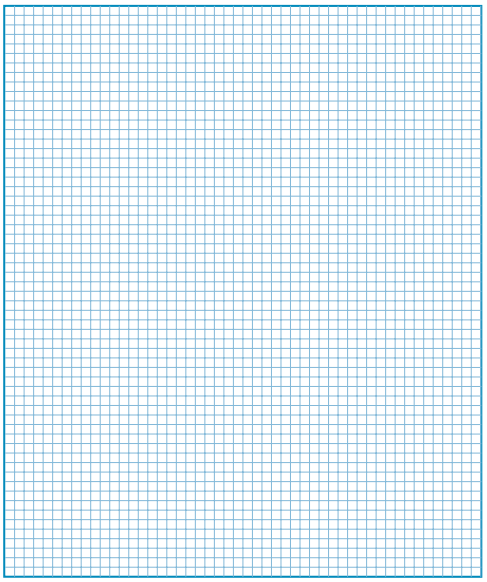
Investigation 2.3 Estimating osmolarity

See appendix for equipment list.

1. Prepare 6 beakers of sucrose ($C_{12}H_{22}O_{11}$, table sugar) solution with the concentrations of 0.0 (distilled water), 0.1, 0.2, 0.3, 0.4, and 0.5 mol/L of sucrose (0, 34.2 g , 68.5 g, 102.6 g, 136.9 g, and 171.1 g per litre). Label the beakers so that they can be easily identified at the end of the experiment.
2. Peel a potato and cut it into 18 identical cubes 1 cm^3 (1 cm x 1 cm x 1 cm) or use a cork borer to produce 18 identical cylinders of potato. Pat the potato cubes dry with a paper towel.
3. Weigh three cubes together, record their mass in the table below under initial mass. Place the cubes in the beaker of distilled water.
4. Repeat step 3 with the other 15 potato cubes and concentrations. Make sure you identify each beaker so the cubes can be weighed at the end of the experiment.
5. Leave the potato cubes in the solutions for at least 40 minutes (or up to 24 hours).
6. Remove the potato cubes from the distilled water and pat dry with a paper towel. Weigh all three together and record their mass in the table below under final mass.
7. Repeat for all the other concentrations of sucrose.
8. Calculate the change in mass (if any) for all the concentrations. Then calculate the % change (+ or -) (this removes any error based on the masses of the potato cubes not being identical).
9. Plot the % change vs sucrose concentration on the grid provided.

Sucrose concentration (mol/L)	Initial mass (I) (g)	Final mass (F) (g)
0.00		
Change (C) (F-I) (g)		
% Change (C/I x 100)		
0.1		
Change (C) (F-I) (g)		
% Change (C/I x 100)		
0.2		
Change (C) (F-I) (g)		
% Change (C/I x 100)		
0.3		
Change (C) (F-I) (g)		
% Change (C/I x 100)		
0.4		
Change (C) (F-I) (g)		
% Change (C/I x 100)		
0.5		
Change (C) (F-I) (g)		
% Change (C/I x 100)		

1. Use the grid below to draw a line graph of the sucrose concentration vs total % change in mass:



2. Use the graph to estimate the osmolarity of the potato (the point where there is no change in mass):

_____

3. Which of the solutions are hypotonic? Which are hypertonic?

_____

_____

5 A-1 A-4

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34 Chapter Review: Did You Get It?

1. Match each term to its definition, as identified by its preceding letter code.

active transport .....

concentration gradient .....

diffusion .....

osmosis .....

passive transport .....

A The energy-requiring movement of substances across a biological membrane against a concentration gradient.

B Movement of substances across a biological membrane without energy expenditure.

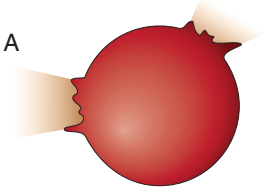
C The passive movement of molecules from high to low concentration.

D The gradual difference in the concentration of solutes in a solution between two regions. In biology, this usually results from unequal distribution of ions across a membrane.

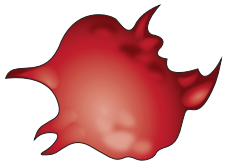
E Passive movement of water molecules across a partially permeable membrane down a concentration gradient.

2. The diagrams below depict what happens when a red blood cell is placed into three solutions with differing concentrations of solutes. Describe the tonicity of the solution (in relation to the cell) and describe what is happening:

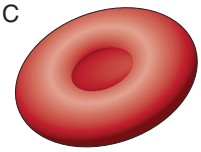
A



B



C



3. Explain how the properties of the phospholipid molecule result in the bilayer structure of membranes:

4. Using the formulae: cuboid SA = 2(lh + lw + hw), cuboid volume = lwh, calculate the surface area to volume ratio of the following cell shapes:

(a) A cubic cell 6 µm x 6 µm x 6 µm: _____

(b) A cuboid cell 1 µm x 12 µm x 5 µm: _____

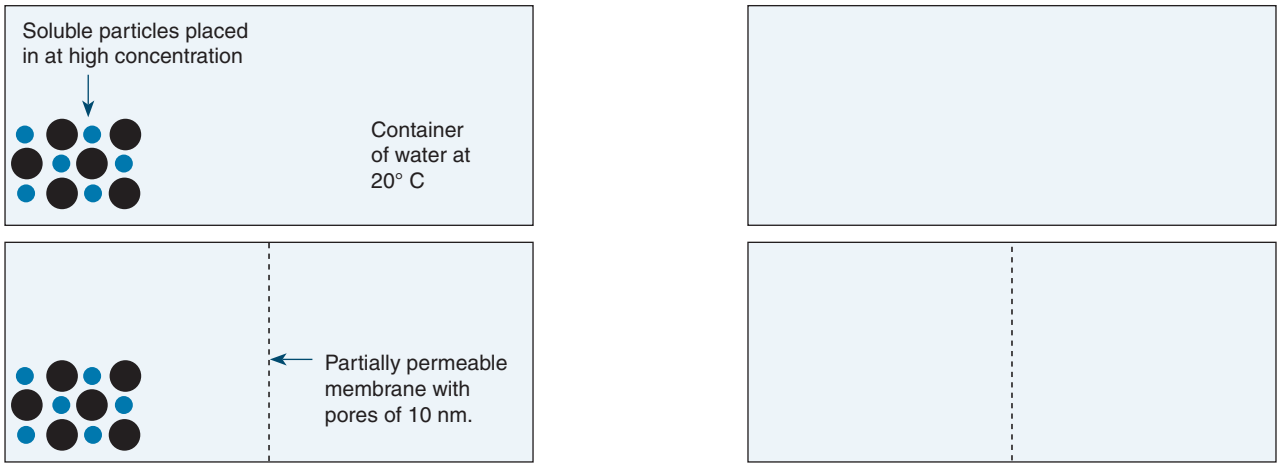
(c) Which of these cells would exchange substances with its environment most efficiently and why: _____

5. Consider the two diagrams below. For each, draw in the appropriate box what you would expect to see after one hour.

Particle with diameter of 5 nm ●

Particle with diameter of 20 nm ●

After one hour:



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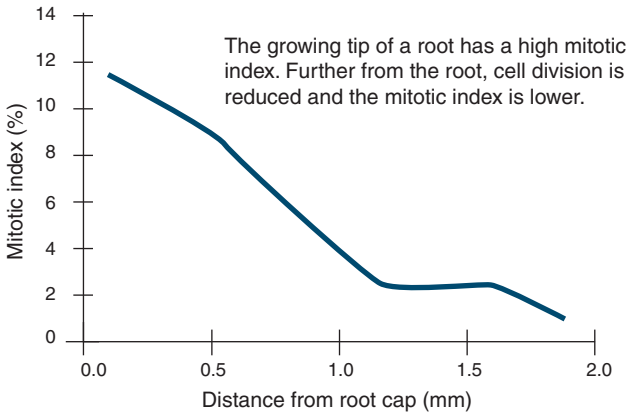
39 Recognising Stages in Mitosis

Key Idea: The stages of mitosis can be recognised by the organisation of the cell and chromosomes.
Although mitosis is a continuous process it is divided into four stages (prophase, metaphase, anaphase, and telophase) to more easily describe the processes occurring during its progression.

The mitotic index

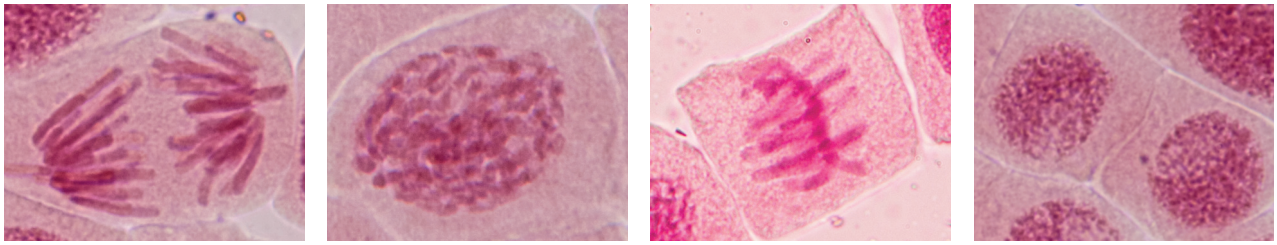
The mitotic index measures the ratio of cells in mitosis to the number of cells counted. It is a measure of cell proliferation and can be used to diagnose cancer (because cancerous cells divide very quickly). In areas of high cell growth the mitotic index is high such as in plant apical meristems or the growing tips of plant roots. The mitotic index can be calculated using the formula below:

$$\text{Mitotic index} = \frac{\text{Number of cells in mitosis}}{\text{Total number of cells}}$$



The growing tip of a root has a high mitotic index. Further from the root, cell division is reduced and the mitotic index is lower.

1. Use the information in the previous activity to identify which stage of mitosis is shown in each of the photographs below:



(a) _____ (b) _____ (c) _____ (d) _____

2. (a) The light micrograph (right) shows a section of cells in an onion root tip. These cells have a cell cycle of approximately 24 hours. The cells can be seen to be in various stages of the cell cycle. By counting the number of cells in the various stages it is possible to calculate how long the cell spends in each stage of the cycle. Count and record the number of cells in the image that are in mitosis and those that are in interphase. Cells in cytokinesis can be recorded as in interphase. Estimate the amount of time a cell spends in each phase.

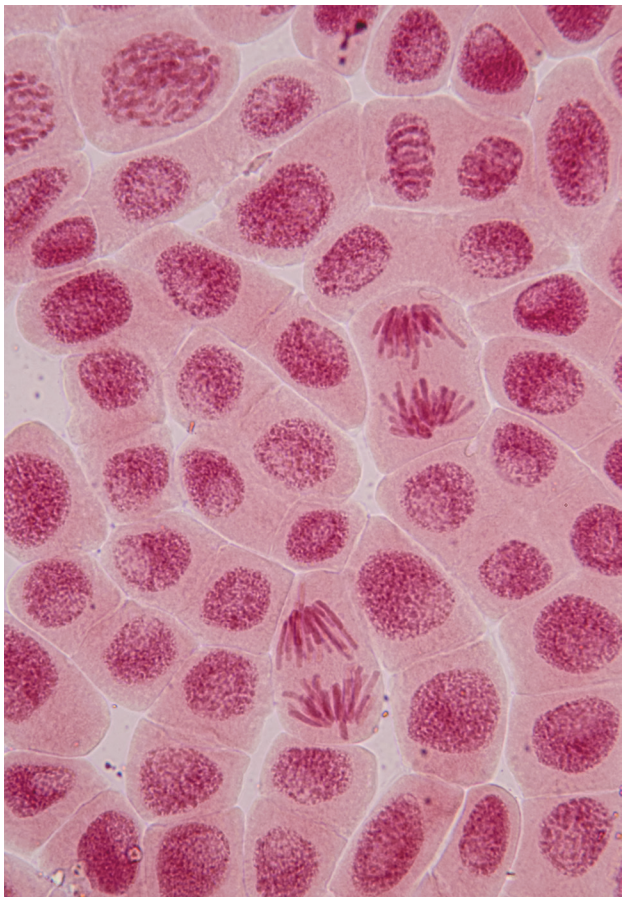
Stage	No. of cells	% of total cells	Estimated time in stage
Interphase			
Mitosis			
Total		*100*	

(b) Use your counts from 2(a) to calculate the mitotic index for this section of cells.

_____

_____

Onion root tip cells



3. What would you expect to happen to the mitotic index of a population of cells that loses the ability to divide as they mature?

_____

_____

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40 Regulation of the Cell Cycle

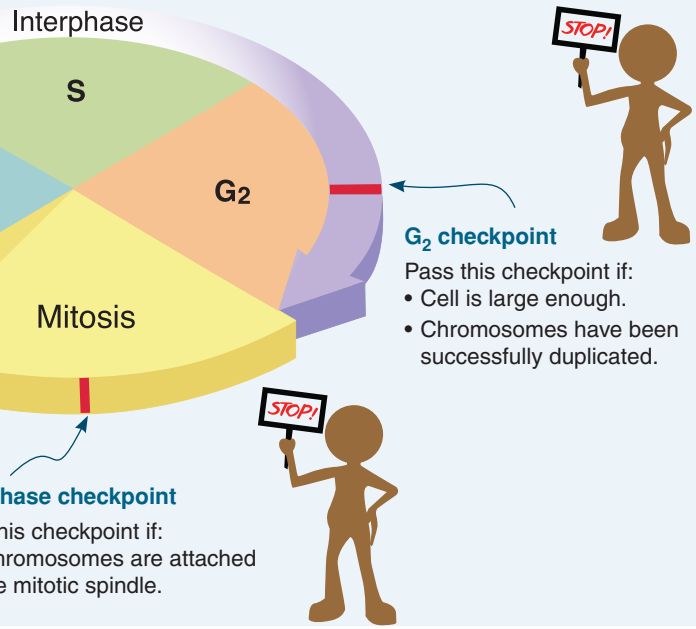
Key Idea: Regulatory checkpoints are built into the cell cycle to ensure that the cell is ready to proceed from one phase to the next. The failure of these systems can lead to cancer.

Cell checkpoints give cells a way to ensure that all cellular processes have been completed correctly before entering the next phase. There are three checkpoints in the cell cycle. At each checkpoint, a set of conditions determines whether or not the cell will continue into the next phase. Cancer can result when the pathways regulating the checkpoints fail. Non-dividing cells enter a resting phase (G_0), where they may remain for a few days or up to several years. Under specific conditions, they may re-enter the cell cycle.

Checkpoints during the cell cycle

G_1 checkpoint

Pass this checkpoint if:
- Cell is large enough.
- Cell has enough nutrients.
- Signals from other cells have been received.



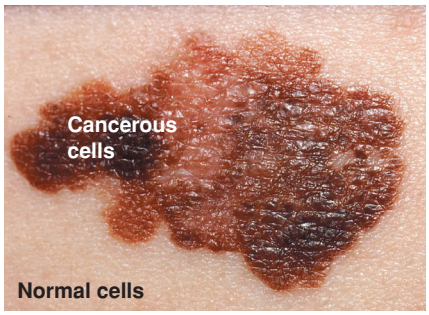
G_2 checkpoint

Pass this checkpoint if:
- Cell is large enough.
- Chromosomes have been successfully duplicated.

Resting phase (G_0)
- Cells may exit the cell cycle in response to chemical cues.
- Cells in G_0 may be quiescent (waiting), differentiated, or senescent (aged).
- Quiescent cells may reenter the cycle in response to chemical cues.

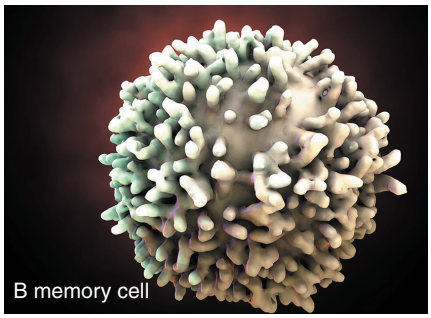
Metaphase checkpoint

Pass this checkpoint if:
- All chromosomes are attached to the mitotic spindle.

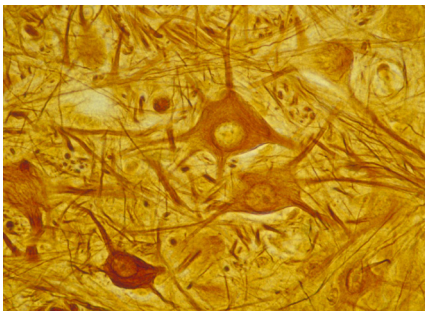


NCI

Skin cancer (melanoma). The cancer cells grow more rapidly than the normal skin cells because normal cell regulation checkpoints are ignored. This is why the cancerous cells sit higher than the normal cells and can rapidly spread (metastasize).



Most lymphocytes in human blood are in the resting G_0 phase and remain there unless they are stimulated by specific antigens to re-enter the cell cycle via G_1. G_0 phase cells are not completely dormant, continuing to carry out essential cell functions in reduced form.



Eli

Many fully differentiated (specialised) cells, e.g. neurones (above), exit the cell cycle permanently and stay in G_0. These cells continue their functional role in the body, but do not proliferate. Senescent cells have accumulated mutations, lose function, and die.

1. Explain the importance of cell cycle checkpoints: _____

2. In terms of the cell cycle and the resting phase (G_0), distinguish between the behavior of fully differentiated cells, such as neurones, and cells that are quiescent, such as B memory cells

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125 Adaptations of Xerophytes

Key Idea: Xerophytes are plants with adaptations that allow them to conserve water and survive in dry environments.

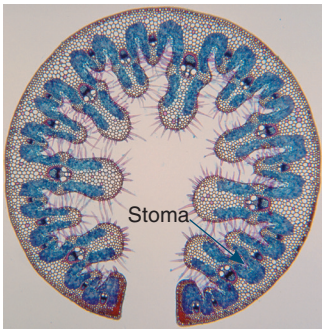
Plants adapted to dry conditions are called **xerophytes**. Xerophytes are found in a number of environments, but all show adaptations to conserve water. These adaptations include small, hard leaves, an epidermis with a thick cuticle, sunken stomata, succulence, and permanent or temporary absence of leaves.

- Most xerophytes are found in deserts, but they may be found in humid environments, provided that their roots are in dry micro-environments (e.g. the roots of epiphytic plants that grow on tree trunks or branches).
- Many xerophytes have a succulent morphology. Their stems are often thickened and retain a large amount of water in the tissues, e.g. *Aloe*.
- Many xerophytes have a low surface area to volume ratio, reducing the amount of water lost through transpiration.
- Salt tolerant plants and many alpine species may show xeromorphic features in response to the lack of free water and high transpirational losses in these often windy, exposed environments.

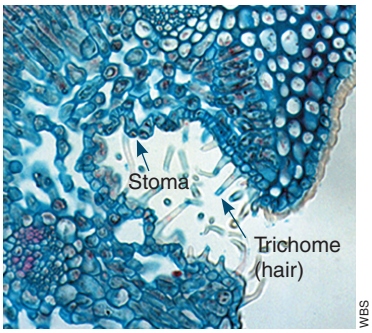
Acacia trees have deep root systems, allowing them to draw water from sources deep underground.

An outer surface coated in fine hairs traps air close to the surface and reduces the transpiration rate.

Desert xerophytes in Arizona have a succulent photosynthetic stem



Grasses on coastal sand dunes (e.g. marram grass, above) curl their leaves. Stomata are sunken in pits, creating a moist microclimate around the pore, which reduces transpiration rate.



Oleander has a thick multi-layered epidermis and the stomata are sunken in trichome-filled pits on the leaf underside which restrict water loss. Trichomes (leaf "hairs) maintain a layer of still air at the leaf surface.

1. What is a xeromorphic adaptation? _____

2. Describe three xeromorphic adaptations of plants that reduce water loss:

   (a) _____

   (b) _____

   (c) _____

3. (a) How does creating a moist microclimate around the areas of water loss reduce the transpiration rate? _____

   (b) How do trichomes contribute to reducing the transpiration rate? _____

4. How does a low surface area to volume ratio in a plant such as a cactus reduce water loss? _____

5. How does a cactus photosythesise given it has no leaves? _____

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Adaptations in cacti

- Desert plants, such as cacti (below), must cope with low or sporadic rainfall and high transpiration rates.

Leaves modified into spines or hairs to reduce water loss. Light coloured spines reflect solar radiation.

Rounded shape reduces surface area.

Stem becomes the major photosynthetic organ, plus a reservoir for water storage.

The surface tissues of many cacti are tolerant of temperatures over 50°C.

Cacti have a shallow, but extensive fibrous root system. When in the ground the roots are spread out around the plant.

DID YOU KNOW?

Australia has no native cacti although many have become naturalised. However, two endemic species, the Wongan cactus (*Daviesia euphorbioides*) and the Dunna Dunna (*Lawrencia helmsii*) resemble cacti and are often mistaken for them (an example of convergence, opposite).

Convergent adaptation in unrelated xerophytes

- The North American cactus and African *Euphorbia* species shown above are both xerophytes. They have evolved similar structural adaptations to conserve water and survive in a hot, dry, desert environment. Although they have a similar appearance, they are not related. They provide an excellent illustration of how unrelated organisms living in the same environment have independently evolved the same adaptations to survive.
- Their appearance is so similar at first glance that the *Euphorbia* is often mistaken for a cactus. Both have thick stems to store water and both have lost the presence of obvious leaves. Instead, they have spines or thorns to conserve water (a leafy plant would quickly exhaust its water reserves because of losses via transpiration). In cacti, spines are highly modified leaves. In *Euphorbia*, the thorns are modified stalks. It is not until the two flower that their differences are obvious.

6. (a) Explain why the North American cactus and African *Euphorbia* species have evolved such similar adaptations:

(b) Identify two ways in which a cactus and a euphorbia can be distinguished:

7. Why would a shallow fibrous root system be an advantage to a cactus?

8. Identify the features of the xerophyte shown that help it conserve water:

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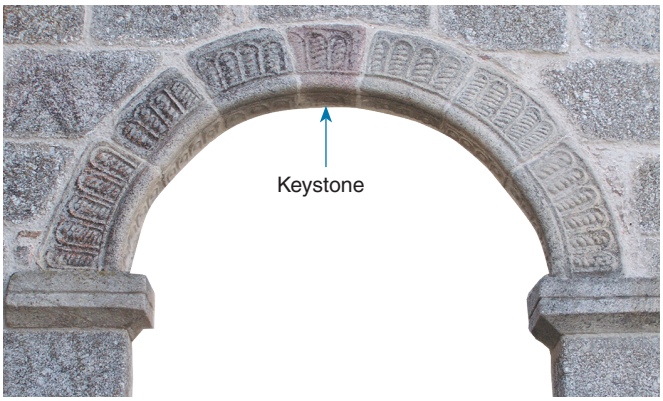
133 Interdependencies: Animal Keystone Species

Key Idea: All organisms within an ecosystem contribute to its structure and functioning, but keystone species have a disproportionate effect on ecosystem processes.

Although every species has a role in ecosystem function, some have a disproportionate effect on ecosystem processes and stability (how unchanging the ecosystem is over time). These species are called **keystone species** and they are important because they play a pivotal role in the way the ecosystem works, e.g. as top predators or by recycling nutrients. The loss of a keystone species can have a large and rapid impact on the structure and function of an ecosystem, changing the balance of relationships and leading to instability. This has important implications for ecosystem management because many keystone species are endangered.

Why are keystone species important?

A keystone species is one that plays a unique and crucial role in the way an ecosystem functions. Often, but not always, keystone species are top predators. The role of the keystone species varies from ecosystem to ecosystem, but the loss of a keystone species from any ecosystem has a domino effect, and a large number of species can be affected. This can lead to can rapid ecosystem change or the collapse of the ecosystem completely.



The term keystone species comes from the analogy of the keystone in a true arch (above). An archway is supported by a series of stones, the central one being the **keystone**. If the keystone is removed the arch collapses.

Ochre starfish: Paine removed these in his study to see what the effect would have on the rocky shore community.

Keystone species in action

The idea of the keystone species was first hypothesised in 1969 by Robert Paine. He studied an area of rocky seashore, noting that diversity seemed to be correlated with the number of predators (ochre starfish) present (i.e. diversity declined as the number of predators declined).

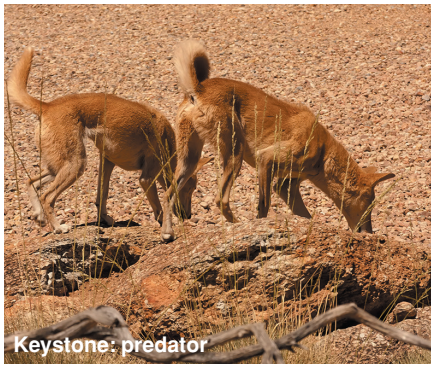
To test this he removed the starfish from an 8 m by 2 m area of seashore. Initially, the barnacle population increased rapidly before collapsing and being replaced by mussels and gooseneck barnacles. Eventually the mussels crowded out the gooseneck barnacles and the algae that covered the rocks. Limpets that fed on the algae were lost and the number of species present in the study area dropped from 15 to 8.

Keystone: seed dispersal

The endangered southern cassowary is a keystone species in Australia's wet tropics. They are obligate fruit eaters, and their gut passes seeds, unharmed, into a pile of manure. More than 200 plant species depend on the cassowary to disperse their seeds, yet their populations are all declining. Their loss would also mean the loss of an ecological role.

Keystone umbrella species

The humphead wrasse is a protected reef fish. It is large, long lived and slow breeding species and an opportunistic predator of a wide range of invertebrates. It is a keystone species because it preys on crown-of-thorns starfish and keeps the populations of this coral predator in check. It is also considered an **umbrella species** because its protection benefits a large number of other species.



Keystone: predator

Top predators, such as Australia's dingo, are often keystone species. Many conservationists regard dingoes as a functional replacement for native predators that are now extinct, such as the Tasmanian tiger. Dingoes have a varied diet and are a major constraint on introduced species, such as a foxes and pigs, thereby helping to maintain native mammal diversity.

1. Why are keystone species so important to ecosystem function? _____

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Albert kok cc3.0

Andrew Mercer cc 4.0

Many sharks are top predators and are keystone species in the waters around Australia. One shark species inhabiting Shark Bay (WA) is the tiger shark. It doesn't even have to kill its prey to exert an effect on ecosystem structure. The presence of the tiger shark causes marine herbivores such as green turtles and dugongs to avoid the area or to spend less time grazing because they are looking out for the sharks. As a result, the seagrass meadows thrive and support many more species than would be possible if they were grazed intensively by herbivores. As a result, biodiversity in Shark Bay is high. Fishing is the main threat to tiger sharks as they hunted for their flesh, fins, and skin. Finning is banned in Australian waters, but still continues illegally because of the difficulty in policing.

The grey-headed flying fox (*Pteropus poliocephalus*) is found in a variety of habitats along the east coast of Australia, including Victoria. The grey-headed flying fox feeds on the fruit and nectar of over 180 species of trees, including Australian natives *Eucalyptus*, *Banksia*, palms, and myrtles. It will fly up to 50 km each night looking for food and this allows it to fulfill an important ecological role by dispersing the pollen and seeds of a wide range of plants. Its role is especially important in the subtropical rainforests as it is the only mammalian species to consume nectar and fruit in these regions. The species is under threat from the loss of foraging and roosting habitat and control measures by horticulturists to prevent crop losses.

2. For each species below, summarise the features of its ecology that contribute to its position as a keystone species:

   (a) Southern cassowary: _____

   _____

   _____

   (b) Humphead wrasse: _____

   _____

   _____

   (c) Dingo: _____

   _____

   _____

   (d) Tiger shark: _____

   _____

   _____

   (e) Grey-headed flying fox: _____

   _____

   _____

3. The arrival of the dingo in Australia probably resulted in the loss or reduction of many top marsupial predators. It now plays a role as a keystone species in modern Australia. How might this have occurred?

   _____

   _____

   _____

   _____

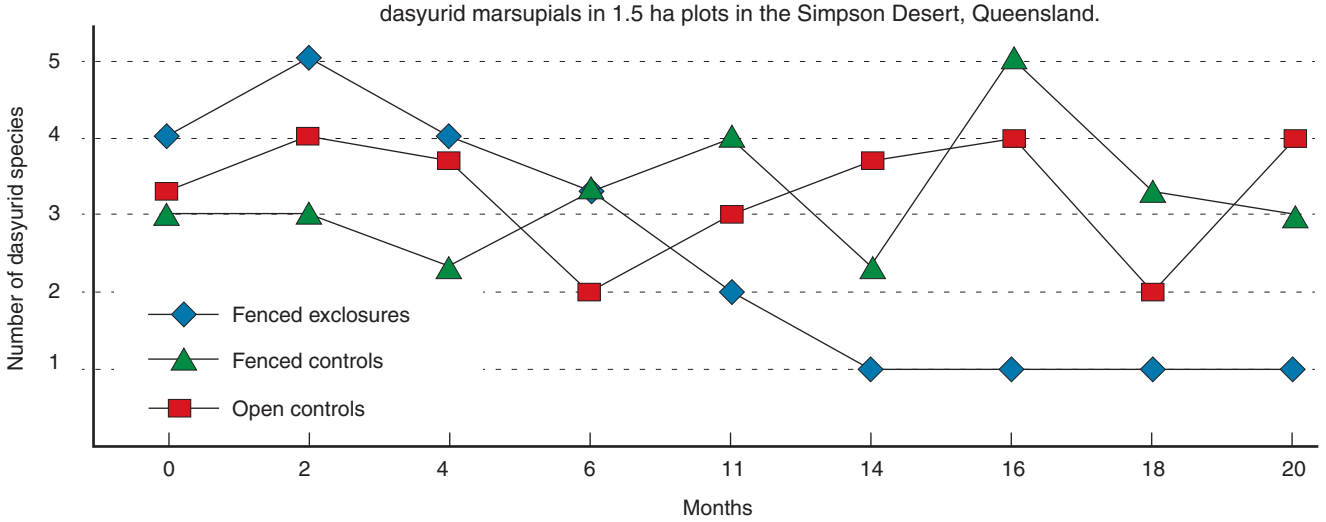
ISBN: 978-1-98-856636-8

Case study: crest-tailed mulgara as a keystone species

- Two species of mulgara (*Dasycercus* genus) are found in Australia, the brush-tailed mulgara and the crest-tailed mulgara. Mulgara are nocturnal marsupials belonging to the family Dasyuridae, which includes the Tasmanian devil and the quolls. Both mulgara species are small (30 cm long from head to tail) and weigh up to 190 g.
- Mulgaras live in arid central Australia, and burrow 50 cm under the surface to avoid the heat. While the brush-tailed mulgara has an extensive range through the middle of Australia, the crest-tailed mulgara is found only in a small part of the Simpson Desert within Queensland's borders.
- The effect of the crest-tailed mulgara (*Dasycercus cristicauda*) as a keystone species was tested by excluding them from a 1.5 ha plot of land. Fenced exclosures were established 10 months after sampling began. All dasyurid species (except mulgara) could access the site. Fenced controls and open controls were established at the same time. All dasyurid species (including mulgara) could access these plots. The results are shown in the graph below.

Bobby Tamayo CC 4.0

Effects of crest-tailed mulgara (*Dasycercus cristicauda*) on the number of smaller dasyurid marsupials in 1.5 ha plots in the Simpson Desert, Queensland.



Data source: Dickman in Attwell, P. and Wilson, B (2003) Ecology: An Australian Perspective.

4. Describe what happens to species numbers after the fences were established (at 10 months) for each of the following:

   (a) Fenced exclosures: _____

   (b) Fenced controls: _____

   (c) Open controls: _____

5. Describe the difference in species numbers between the fenced exclosure and the:

   (a) Fenced control: _____

   (b) Open control: _____

6. (a) Based on the data presented above, do you think the crest-tailed mulgara acts as a keystone species? _____

   (b) Explain your answer: _____

   _____

   _____

   _____

7. Why do you think the researchers included a fenced control and open control? _____

   _____

8. Why let other dasyurid species into the exclosures? _____

   _____

   _____

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Identifying Key Science Skills and Online Support

The tab system is a useful way to identify important parts of the **VCE Biology study design (2022 - 2026)**. The colour coded page tabs show where "**Key Science Skills**" are addressed. The tabs also allow you to see at a glance if online support is provided and if there are content or concept links with other activities.

KEY SCIENCE SKILLS

Develop aims and questions, formulate hypotheses and make predictions

- Identify, research, and construct aims and questions
- Identify variables in controlled experiments
- Formulate hypotheses to focus investigation
- Predict possible outcomes

Plan and conduct investigations

- Determine methodology, classification and identification, controlled experiments, correlational studies, fieldwork, literature review, modelling, simulations
- Design and conduct investigations, considering procedures, error, amount of data
- Work independently and collaboratively adapt methodology

Construct evidence-based arguments and draw conclusions

- Distinguish scientific and non-scientific ideas
- Evaluate data for evidence-based support of aims, prediction, or hypothesis
- Use reasoning to construct scientific arguments and to draw and justify conclusions
- Identify and describe limitations of conclusions
- Discuss implications of findings

Comply with safety and ethical guidelines

- Demonstrate safe lab practices using risk assessments
- Apply relevant health and safety guidelines
- Demonstrate ethical conduct when undertaking and reporting investigations

Analyse, evaluate and communicate scientific ideas

- Use appropriate terminology
- Discuss relevant biological information, ideas, concepts, theories, and models
- Analyse and explain how models and theories are used
- Critically evaluate and interpret scientific and media texts
- Analyse and evaluate bioethical issues
- Use clear and concise expression
- Acknowledge sources of information

Generate, collate, and record data

- Systematically generate and record primary data, collate secondary data
- Record and summarise data, including use of a logbook
- Organise and present data
- Plot graphs showing liner and non-linear relationships

Analyse and evaluate data and investigation methods

- Process quantitative data using mathematics
- Identify and analyse experimental data qualitatively
- Identify outliers and contradictory data
- Repeat experiments and evaluate methods

ONLINE SUPPORT

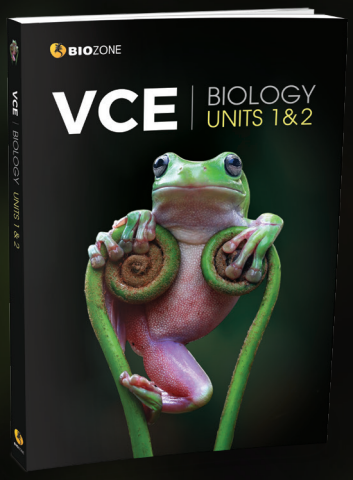
Resource Hub

This tab indicates the activity is supported with online content, through the Resource Hub.

Easy navigation to video clips, animations, 3D models, databases, and spreadsheets to support the activities in the book.

BIOZONE

VCE | BIOLOGY UNITS 1&2



Print: Student Worktext

incorporates the very best of a traditional textbook with a workbook

eBook: Student Worktext

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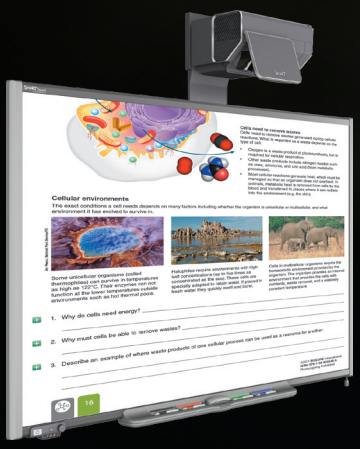


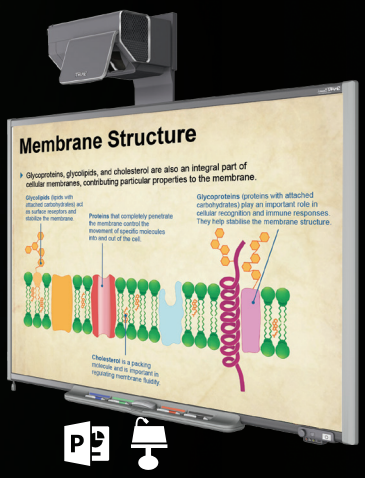
Teacher's Digital Edition

Suggested model answers are included on each page in an interactive HIDE/SHOW format, making it suitable for use with an interactive whiteboard.

Model Answers
(Printed or Online)

*Printed **Model Answers** provide suggested answers to all the activities in the worktext. Where appropriate extra explanatory detail is provided.*

***Online Model Answers** are accessible via a login that is unique to your school. The teachers admin access gives you the ability to control when students can view individual answers, ideal for supporting homework, revision and work on deeper understanding.*



Presentation Media

A collection of editable Powerpoint slides that can be used for a lecture-style presentation explanatory detail is provided.

VCE11-2-SP (int 21-04)

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