



BIOLOGY

TEACHING & LEARNING SUPPLEMENT

Teaching and Learning Supplement

BIOLOGY

ADVICE FOR TEACHERS

This document helps to describe the nature and sequence of teaching and learning necessary for students to demonstrate achievement of course outcomes.

It suggests appropriate learning activities to enable students to develop the knowledge and skills identified in the course outcome statements.

Tasks should provide a variety and the mix of tasks should reflect the fact that different types of tasks suit different knowledge and skills, and different learning styles. Tasks do not have to be lengthy to make a decision about student demonstration of achievement of an outcome.

COURSE SPECIFIC ADVICE

This Biology level 3 Teaching and Learning Supplement must be read in conjunction with the *Biology* level 3 course document and relevant External Assessment Specifications and Examination Guidelines.

It contains advice to assist teachers delivering the course and can be modified as required. This Teaching and Learning Supplement is designed to support teachers new to or returning to teaching this course. The practical component of this course may include off campus experiences.

For the content areas of *Biology*, three interrelated strands - *Science Inquiry Skills*; *Science as a Human Endeavour*; and *Science Understanding* will be integrated into all sections of study.

Science Inquiry Skills are common to all TASC science courses and are contextualised for each discipline.

Experimental design is an integral part of all TASC science courses and are used as a means of teaching and consolidating the course content as well as a means of assessment.

The application and impact of biological science in society is also an integral part of the course.

COURSE CONTENT

Specific teaching advice is given in this supplement about of the following criteria:

	Content or process for criterion	Sequence
Criterion 2	develop, interpret and evaluate biological experiments	For use throughout the course in conjunction with criteria 5 to 8
Criterion 4	discuss the application and impact of biology in society	
Criterion 5	the chemical basis of life	Content can be delivered in any particular order
Criterion 6	cells	
Criterion 7	organisms	



	Content or process for criterion	Sequence
Criterion 8	continuity of organisms and survival of changes	

Biology has a complexity of TASC level 3 and a design time of 150 hours. Content is divided into four sections based on four levels of biological organisation the Chemical Basis of Life, Cells, Organisms, Continuity of Organisms and Survival of Changes. These relate directly to Criteria 5 to 8, respectively, in the course. The order of delivery of the content is not prescribed. Each of the four content sections is compulsory and students must participate in a minimum of 45 hours of practical activities. Learning activities for Criteria 2 and 4 should be related to and support one or more of the four content areas.



TEACHING AND LEARNING

Develop, interpret and evaluate biological experiments (criterion 2)

All practical activities should follow the common structure to assist with student learning and prepare students to be assessed externally for this criterion. Data handling, tabulating and graphing exercises are also important skills that need to be developed and dovetail with this criteria but should be assessed under Criterion 3. Practical reports can be used to assess both the content and understanding of scientific method within the context of Biology.

Understanding

Formulate a workable hypothesis / concept based on observations of events

Design experiments to investigate a suitable workable hypothesis /concept

Teaching strategies/evidences

make observations

formulate questions relating to the observations

suggest possible explanations /causes relating to observations

formulate a hypothesis / concept which is testable

formulate a hypothesis / concept includes an independent and a dependent variable.

recognise controlled and uncontrolled variables in an experimental design

understand the need to have only one uncontrolled variable

understand the need to minimize the impact of uncontrolled and sometimes unrecognized variables

understand the need for a control that is either a stand- alone control or built in

understand the use of a placebo group in controlled clinical trials on humans and or the need for double blind testing

understand the need for replicates within the experiment and repeating experiments.

understand the need for experiments to be repeated by different groups of workers

understand the need for a suitable sample size/ repetitions of measurements

understand economic constraints which influence the method

show creativity in suggesting methods for experiments.



Understanding

The sorts of ethical considerations that need to be taken into account in designing experiments.

How to evaluate experiments

How to design further experiments to extend an investigation

Safety issues relating designs of experiments

Teaching strategies/evidences

follow guidelines for the recognised handling of material / organisms

show understanding of limiting sample size when environmental or ethical constraints apply

show environmental awareness of impact of experiment e.g. responsible disposal

show understanding in using human trials

state whether results are consistent or inconsistent with the hypothesis / concept being tested

realise that a hypothesis / concept can be negated

realise that a hypothesis / concept can be supported but not proven by an experiment

be able to evaluate the strengths and weaknesses of an experimental design

evaluate key historical experiments.

identify limitations in a method and suggest adjustments

state a new hypothesis / concept which is consistent with the results obtained.

identify hazards associated with particular experimental work

know accepted laboratory routines which influence safety

identify safety constraints which influence the method.

Examples of learning activities

Learners:

investigate seed germination with different salinity levels / fertiliser levels / using different seeds e.g. rye / clover / barley etc.

design and complete experiments inquiring into factors that affect:

- rate of photosynthesis
- pH and/or temp on enzyme activity

develop an hypothesis that could be investigated on a rocky shore. For example investigating how the distribution varies from high tide to low tide mark as exposure to air / lack of cover or some other abiotic factor varies



design their own experiment by varying the temperature or the amount of yeast / sugar or even use different sugars as the respiratory substrate.

Further examples can be found below in the Criteria 5 to 8 advice.

Discuss the application and impact of biology in society (criterion 4)

Understanding

Teaching strategies/evidences

The science relating to the topic / issue

identify links to historical contexts
identify relevant scientific concepts
apply their understandings to a real world example

The technologies relating to the topic / issue

identify costs/ detrimental effects of a technology
explain the costs / benefits of the technology

The complexity of an issue

present a balanced discussion of different views
present pros and cons of an issue
articulate / argue both sides of issues, discriminate what is important and form a sound, logical point of view
identify appropriate channels to take personal action
critically evaluate the scientific validity and bias of a media presentation of a significant biological issue.

The holistic way in which science impacts on all areas of society

identify the interest groups / stakeholders within the community who are impacted by the issue
identify the potential conflicts of interest by the different groups in the community.

The tensions between ethical, social, cultural, scientific, economic and political influences on impacts of decisions

identify ethical, social, cultural, economic and political questions as appropriate.
justify a decision on ethical, social, cultural, economic, scientific and political questions as appropriate.

This criterion should be embedded as part of any content area in order to deepen understanding. Various other criteria could be included in assessment.



Examples of learning activities

Learners:

Collect articles from the media about a particular topic or issue in a scrap book, display folder or electronically. This material can form the basis of a reflective journal to focus on different points of view and established scientific understanding in relation to that topic or issue.

Survey members of the school community to analyse the general level of awareness about genetic engineering and compare to current scientific debate and conversation. **

Examine in-depth the latest research in a field of study can be expressed as a detailed literature review.

Brainstorm contrasting viewpoints on a biologically based controversy (e.g. GMOs) to lead into a speed debate on the subject. Use this initial discussion as the inspiration to evaluate the validity of arguments and the veracity of sources of information.

The chemical basis of life (criterion 5)

Content summary

Material input/output; biological compounds:

- organic and inorganic compounds
- vitamins
- minerals
- water

Structure reflecting function, enzymes:

- function
- role
- affecting factors
- action

Energy input/output:

- energy release and transfer
- photosynthesis
- respiration
- ATP

DNA: the code of life:

- protein synthesis
- gene (or point) mutation



Content area

Examples of learning activities

Material input/output; biological compounds

construct a model of a biomolecule; answer a series of structured questions related to biomolecular composition; consider proteins as a series of linked amino acids with a 3D structure; monosaccharides, disaccharides and polysaccharides; lipids; nucleic acids

prepare a table describing some proteins that are formed within cells and the roles that they carry out within living things

Structure reflecting function, enzymes

model how an enzyme operates and explain the action modelled (induced fit as most recognised theory in comparison to lock and key)

form a hypothesis related to a factor affecting enzyme activity; plan and conduct an experiment to test the hypothesis. Examples include: starch / amylase, pineapple / bromelase, milk agar / trypsin and Catalase and hydrogen peroxide / liver or potato

Energy input/output

collect, process and record information systematically in the form of an annotated flowchart of the inputs and outputs in photosynthesis (carbon dioxide + water + \rightarrow glucose + oxygen) and cellular respiration (glucose + oxygen \rightarrow carbon dioxide + water), using scientific terminology and conventions

design a flowchart of the inputs and outputs in photosynthesis, related to supplying energy to autotrophs and heterotrophs

annotate a diagram of a chloroplast to show the main stages and sites in photosynthesis and a mitochondrion to show the main stages in cellular respiration

respond to a series of questions related to cellular energy transformations and a comparison of the energy changes in the different stages in photosynthesis and respiration

DNA: the code of life

model the structure of DNA and RNA; draw and label a diagram of the models

use a web-based multimedia learning program to become familiar with the processes of transcription and translation (for example, DNA interactive); write an account of protein synthesis

complete a series of questions related to the complementary base-pairing occurring during protein synthesis and the resultant amino acid sequencing

be able to read the genetic code to determine amino acid sequence coded for by DNA

Detailed example

Aim: To investigate factors affecting rate of photosynthesis.

Method

Probes can be used to measure CO_2 and O_2 in a sealed container using data logging technology to record the results. The intensity and type of light (sunlight and indoor lighting) can be varied in repeated experiments to measure the effects these have on rate of photosynthesis.

If data logging is unavailable then the algal ball or leaf disc methods can be substituted to measure changes in rate of photosynthesis.

Use graphical means to represent your results.

Questions

1. after some observation what is your initial hypothesis about changing the rate of photosynthesis? Explain
2. what is the dependant variable you will be measuring and how does it relate to photosynthesis?
3. what independent variable do you plan to change, why did you choose it, and how will you change it?
4. what steps will you take in order to ensure you are testing your hypothesis?
5. in light of your results what were the strengths and weaknesses of your hypothesis?
6. what refinements could you make to your hypothesis and your methods of testing it?



CELLS (CRITERION 6)

Content summary

Structure reflecting function:

- types
 - plant/animal
 - eukaryotic/ prokaryotic.
- organelles
 - identification
 - function.
- cell theory.

Characteristics of viruses, prions, plasmids:

- cell
 - differentiation
 - specialisation
 - organisation.
- microscopic study.

Material input/output; biological compounds:

- structure of the cell membrane
- movement across a membrane
- diffusion
- osmosis
- active transport
- endocytosis
- surface area vs volume ratio.

Maintaining equilibrium:

- balance of salts and water in cells
- contractile vacuole mechanism
- osmoregulator / osmoconformer.

DNA: the code of life:

- Mitosis
- Meiosis.
- Binary fission.

Content area

Examples of learning activities

Structure reflecting function

examine the structure and specialisation of a variety of cells using a light microscope and electron micrographs; identify the ways different cells are specialised for biosynthesis (for example, distribution of particular organelles, storage of starch)

examine the structure of a variety of cells under the microscope; include live and prepared specimens



Content area

Examples of learning activities

	<p>draw and label typical plant and animal cells; prokaryotic and eukaryotic cells; apply understandings to identify unfamiliar specimens</p> <p>prepare a summary of the major groups of organic and inorganic molecules found in cells; relate the molecules and cell function to cell organelles</p> <p>examine specialised cells under the microscope and relate the observed structure of each specialised cell to its function; apply understandings to unfamiliar specialised cells</p>
Material input/output; biological compounds	<p>prepare a PowerPoint presentation to describe the sequence of organelles involved in the processing, packaging and transport of a protein</p> <p>conduct a practical investigation into the movement of biomolecules (for example starch and glucose across a membrane, rhubarb in abattoir blood, potato cylinders in salt solution, or eggs in vinegar); draw conclusions from the data collected</p> <p>research and collect information to design a multimedia presentation and/or model and/or poster that shows the structure of a cell membrane and the mechanisms by which materials move across them</p> <p>investigate the effect of alcohol, detergent or acidic solutions on pigment leakage of beetroot squares to draw conclusions about membrane structure and function</p> <p>analyse diagrams of different cells in different environments and predict the outcomes of exchange across the cellular membranes for given situations</p> <p>conduct an experiment to investigate the relationship between surface area and volume (for example, agar or potato cubes) and apply the principles to cellular function (for example, villi, a plant root cell and epidermal cells)</p>
Maintaining equilibrium	<p>compare the urine concentration of terrestrial mammals, marine fish and freshwater fish and relate back to maintaining the balance of salts and water in cells.</p> <p>explore the contractile vacuole mechanism in relation to paramecium in response to differing salinity with reference to an organism with osmoconformer cells (eg. a sea-squirt)</p>
DNA: the code of life	<p>construct a concept map for the purpose and processes of mitosis and cytokinesis, linked to cell replication in prokaryotic and eukaryotic cells</p>

Content area

Examples of learning activities

observe prepared slides showing mitosis and cytokinesis using a monocular light microscope

prepare a concept map to show the events in cell reproduction

observe prepared slides showing meiosis using a light microscope

Detailed example

Investigating Cells

Aim: To become familiar with the internal and external structure of cells. To become familiar with the relative sizes of cells.

Method

Part A: Observing Prepared Slides

Observe a selection of prepared slides under high power using a light microscope and draw a selection of about three cells of each type. Identify the features that are observable. Label each diagram correctly, including the magnification.

Suitable cells for observation include photosynthetic plant tissue, cheek cells, nerve cells.

Part B: Preparing and Observing Wet Mounts

Prepare a wet mount of spring onion epithelium cells and observe them under the light microscope under high power.

Add some iodine to the slide and note the differences.

Draw and label a diagram of the cells observed.

Part C: Observing Live Specimens

Observe live specimens under high power using the light microscope. Draw and label a diagram of the cells observed.

Suitable specimens for observation include amoeba, euglena, elodea, paramecium, volvox, spirogyra.

Questions:

1. What are some observed differences between plant and animal cells?
2. What are the main differences between eukaryotic and prokaryotic cells?
3. Describe the effect that staining had on the plant cells. What is one negative effect of staining?
4. Explain the role of each cellular feature that has been observed.
5. Explain why mitochondria and ribosomes were not observed in cells under the light microscope.



Organisms (Criterion 7)

Content Summary

Structure reflecting function for selected organisms:

- input
- breakdown
- transfer
- output

Maintaining equilibrium, homeostasis:

- homeostasis
- basic feedback mechanisms in vertebrates
- negative feedback mechanisms: temperature, blood glucose, water balance

Managing challenges, adaptations of plants and animals:

- Structured
- Physiological
- Behavioural
- Environmental variations
- Temperature
- Osmoregulation

Content areas

Example learning activities

Structure reflecting function for selected organisms

conduct a first-hand dissection, for example the digestive system of a rat, a sheep's pluck (heart/lungs), a kidney, fish gills, and/or a virtual dissection

examine prepared slides of xylem and phloem using a microscope

prepare a multimedia presentation and/or poster that shows the variation in the structure and principles of one of the systems operating in animals

design an experiment to investigate the role of water in transpiration; identifying the variables. For example, comparisons of differences in water loss from upper and lower surfaces of leaves and comparing stomata counts

Maintaining equilibrium, homeostasis

analyse first-hand data from the use of data logging to measure abiotic factors (for example, light, dissolved O₂, CO₂, temperature) in a (temporary) pond; represent the data collected in a graphical format; evaluate the experimental procedures and the reliability of the data; relate the abiotic factors to the habitat provided for organisms

research online and collect information about an organism and the adaptations it has for water control or temperature control



(for example, an Australian mammal); communicate the information and ideas clearly through a presentation to an audience of peers

map stimulus-response models for glucose control and temperature control (related to physiological responses) and apply the principles to other contexts (for example, water control)

Managing challenges, adaptations of plants and animals

analyse given information about the tolerance limits for a range of organisms and describe suitable habitats for these organisms

conduct and report on field investigations related to the detailing components of an ecological niche for one organism; in the report detail the way the organism feeds, describe its activity and describe the habitat, including the resources available to the organism; also, identify the adaptive features that the organism has and the way that the organism uses these to make use of the resources available

investigate the diversity in sets of abiotic and biotic factors that can operate in different habitats using second-hand data, videos, computer simulations (for example, Rock Platform Ecology), a field trip (for example, animal park)

form a hypothesis and conduct an experiment to investigate the effects of environmental conditions on the expression of a trait (for example, light on genetically modified barley); form conclusions from the results obtained

Detailed example

Investigating the relationships between gut and diet

Using a set of diagrams that represent the gut of a variety of identified animals, prepare a PowerPoint presentation. Present these diagrams with associated notes, labelling and additional diagrams/pictures. These should link the gut to diet and identify the animals as heterotrophs and identify linked autotrophs.

Include a bibliography listing the resources used in the research.

Continuity of Organisms and Survival of Changes (Criterion 8)

Content Summary

Managing challenges, adaptations of plants and animals:

- diseases
 - infectious
 - non-infectious
 - transmission
- Pathogens (prions, viruses, bacteria, fungi, protists, parasites)
 - conditions
 - differences

Non-specific immune responses -

- defence barriers
- body's defence mechanisms

Lymphatic system –

- lymph, lymph nodes
- thymus, spleen, tonsils

Specific immune responses

- antibodies
- cell mediated responses
- immune memory
- immunisation
- passive and active immunity – this needs to be separate from immunisation

DNA the code of life:

- reproduction
 - asexual
 - sexual
- variations in genotype
- frequencies in genotypes and phenotypes
 - Punnett squares
- dominance, incomplete dominance and co-dominance
- sex linkage
- blood groups
- pedigrees
- evolution
- natural selection
- speciation, genetic drift, isolating mechanisms
- binomial system of nomenclature

Content areas

Example learning activities

Managing challenges, adaptations of plants and animals

examine disease-causing organisms microscopically and macroscopically; prepare a comparative table detailing the characteristics observed

design a multimedia presentation for the adaptations of eukaryotic pathogens to a parasitic way of life (for example, the lifecycle of *Plasmodium*)

using print and electronic resources, research and prepare a report on a disorder of the immune system

describe an example of a disorder of the immune response, highlighting the related mechanisms of the immune response and the cellular involvement

prepare a listing of the vaccination schedules currently in use for children; compare the scheduling of vaccines and antibody serums and discuss views in the community on vaccination

investigate the effect of various factors e.g. detergents, alcohol, antibiotic discs (for bacteria) on agar plates growing bacteria and mould

DNA the code of life

construct hypotheses for the effects of different selection pressures on gene frequencies in a model population; conduct modelling exercises to test the hypotheses and draw conclusions from the data gathered

conduct a dissection of the reproductive system of a rat

process and record information, and prepare comparative summaries about reproduction; suitable topics could include sexual reproduction compared to asexual reproduction; reproduction in a mammal compared to that in a flowering plant

conduct a practical investigation into monohybrid crosses, using beads to model dominance and recessiveness

complete a series of applied exercises relating to monohybrid crosses and pedigree analysis; predict outcomes and/or explain the basis for given outcomes using biological terminology

use a computer simulation to investigate patterns of inheritance in, for example, *Drosophila*

use first-hand data or second-hand data from DNA manipulation experiments to analyse evidence and predict pedigree outcomes

write a comparative account of the mechanism of evolution according to Darwin

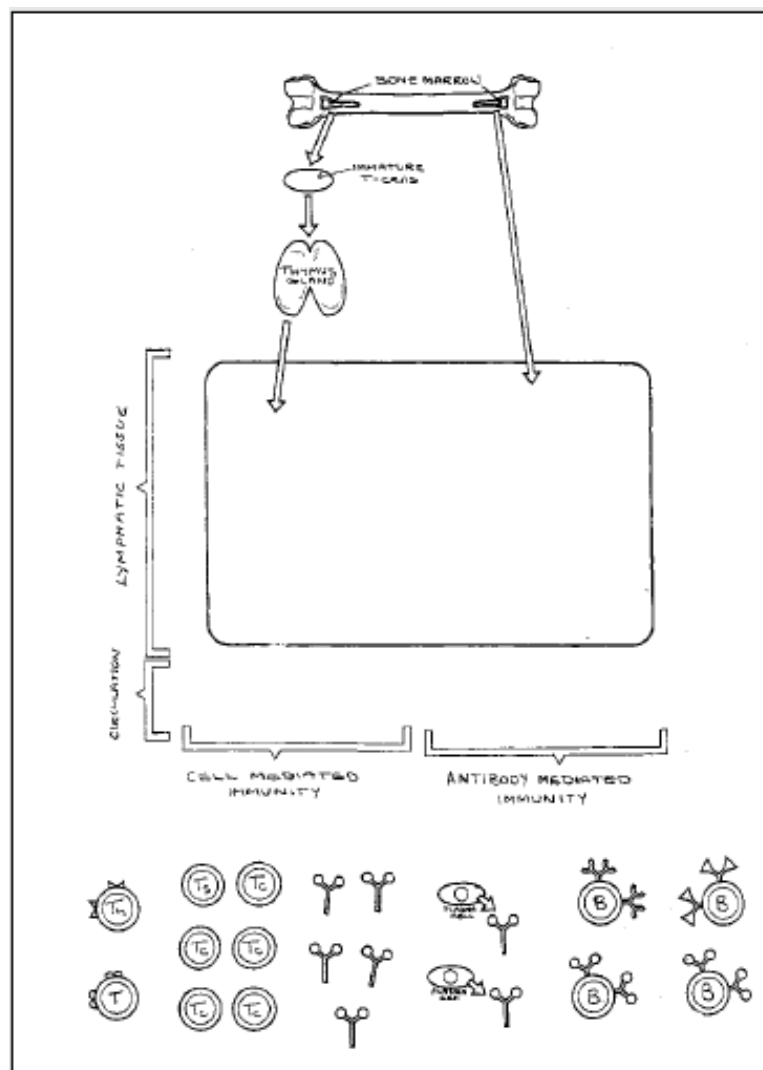
analyse descriptions of different situations and describe a set of likely events related to natural selection as a mechanism of evolution (for example, beak shape and seed type in the finches of Galapagos Islands, the emergence of resistant strains of bacteria)

apply an understanding of the patterns of evolution to categorise and explain descriptions of different examples (for example, comparison of Australian marsupials and American placentals, the Eastern and Western Grey Kangaroo, the finches of the Galapagos Islands)

Detailed example

Cell-Mediated and Humeral Immune Responses

Use diagrams and a template to prepare a flowchart that depicts the cell-mediated and humeral immune responses. Use appropriate labels and biological terminology to identify each of the cellular components and to describe the key events occurring.



APPENDIX

General teaching and learning strategies

There is scope in all course units for teachers to select learning activities which will engage their students and challenge them appropriately. All suggested learning strategies in this course supplement can be adapted to allow students to develop the required knowledge and skills in a variety of Biological contexts. Some teaching and learning strategies that are particularly relevant and effective in Biology include some of the following techniques and strategies.

Review learning

- brainstorming, individual, pair and group work
- concept mapping of ideas to make connections
- student reflection of concepts and skills e.g. summaries to be used for assessment tasks
- diagnostic tests
- formative assessment and regular meaningful feedback

Introduce new material

- link topic to prior biological knowledge, practical applications exposure to quality visual imagery / materials through a variety of media
- investigation using a range of technologies / media platforms
- motivate study through the topic and the relevance to future life experiences
- use of online materials
- provide speakers from University faculties, or other expert areas

Provide demonstration, guided practice and application

- teacher demonstration, modelling and peer tutoring
- 'flipping the learning', with students reviewing and previewing topics outside class
- teacher scaffolding to facilitate analysis of concepts
- investigation simulated real life and work scenarios
- opportunities to develop modelling or problem solving skills in practical contexts

Promote independent practice and application

- research strategies and time management
- problem solving strategies



- practice and reinforcement of learning by way of revision, worksheets, tests and demonstrations
- encourage responsibility for their own learning
- mentoring, peer tutoring, discussions, debates and student presentations
- longer-term activities such as investigative, research and project tasks

Review and enhance learning

- use of assignments, structured revision times for feedback and formative assessment
- tests to help build confidence and mastery of concepts and skills and prepare for final examination



Underlying concepts and processes

Six underlying concepts and processes are applied to four levels of biological organisation (Criteria 5 to 8).

	Structure reflecting function	Material input/output	Energy input/output	Maintaining equilibrium	DNA: the code of life	Managing challenges
<p>The chemical basis of life</p> <p>(Criterion 5)</p>	<p>Enzymes</p> <ul style="list-style-type: none"> • function • role • affecting factors • action. 	<p>Biological compounds</p> <p>Organic and inorganic compounds</p> <p>Vitamins</p> <p>Minerals</p> <p>Water</p>	<p>Energy release and transfer</p> <p>Photosynthesis</p> <p>Respiration</p> <ul style="list-style-type: none"> • ATP. 	<p>Product from enzyme controlled reaction can become a competitive/non- competitive inhibitor to slow down reaction in a cell</p>	<p>DNA</p> <ul style="list-style-type: none"> - Protein synthesis - Gene (or point) mutation - Genetic code 	

	Structure reflecting function	Material input/output	Energy input/output	Maintaining equilibrium	DNA: the code of life	Managing challenges
Cells (Criterion 6)	<p>Types</p> <ul style="list-style-type: none"> • plant/animal • eukaryotic/ prokaryotic. <p>Organelles</p> <ul style="list-style-type: none"> • identification • function <p>Characteristics of viruses, prions, plasmids</p> <p>Cell theory</p> <p>Cell</p> <ul style="list-style-type: none"> • differentiation • specialisation • organisation. <p>Microscopic study</p>	<p>Movement across a membrane</p> <ul style="list-style-type: none"> • diffusion • osmosis • active transport • endocytosis. <p>Surface area to volume ratio.</p>		<p>Balance of salts and water in cells</p> <p>Contractile vacuole</p> <ul style="list-style-type: none"> • mechanism • osmoregulation • osmoconformer. 	<p>Mitosis</p> <p>Meiosis.</p>	

	Structure reflecting function	Material input/output	Energy input/output	Maintaining equilibrium	DNA: the code of life	Managing challenges
Organisms (Criterion 7)	<p>For selected organisms materials:</p> <ul style="list-style-type: none"> • input • breakdown • transfer • output. 			<p>Homeostasis</p> <ul style="list-style-type: none"> • basic feedback mechanisms in vertebrates • negative feedback mechanisms: temperature, blood glucose, water balance. 		<p>Adaptations of plants and animals</p> <ul style="list-style-type: none"> • structured • physiological • behavioural. <p>Environmental variations</p> <ul style="list-style-type: none"> • temperature • osmoregulation.

	Structure reflecting function	Material input/output	Energy input/output	Maintaining equilibrium	DNA: the code of life	Managing challenges
<p>Continuity of organisms and surviving changes</p> <p>(Criterion 8)</p>	<p>Phagocytes such as macrophages, dendritic cells, neutrophils – phagocytosis of pathogens</p> <p>Antibodies – antigen binding sites with antigen like 'lock and key'</p> <p>Naïve B-cell specific for certain pathogen/antigen</p>	<p>Endocytosis</p> <p>Presentation of antigen to helper T-cells by antigen presenting cells eg dendritic cells</p>		<p>Regulatory T-cells close down the immune response after invading organisms are destroyed</p>	<p>Reproduction</p> <ul style="list-style-type: none"> • asexual • sexual. <p>Variations in genotype</p> <p>Frequencies in genotypes and phenotypes</p> <ul style="list-style-type: none"> • Punnett squares. <p>Sex linkage</p> <p>Blood types</p> <p>Pedigrees</p> <p>Natural selection.</p> <p>Speciation</p> <p>Binomial system</p>	<p>Diseases</p> <ul style="list-style-type: none"> • infectious • non-infectious • transmission. <p>Pathogens (prions, viruses, bacteria, fungi, protists, parasites)</p> <ul style="list-style-type: none"> • conditions • differences. <p>Non-specific immune responses -</p> <ul style="list-style-type: none"> • defence barriers • defence mechanisms. <p>Lymphatic system</p> <p>Specific immune responses</p> <ul style="list-style-type: none"> • antibodies • cell mediated responses • immune memory • Immunization. <p>Passive and active immunity.</p>

RESOURCES

Some of the print resources contained in this list may be out of print. They have been included because they may still be available from libraries, bookshops and private collections.

At the time of publication the URLs (website addresses) cited were checked for accuracy and appropriateness of content. However, due to the transient nature of material placed on the web, their continuing accuracy cannot be verified. Teachers are strongly advised to prepare their own indexes of sites that are suitable and applicable to the courses they teach, and to check these addresses prior to allowing student access.

General

Books (Please note TASC does not advocate the use of any one particular textbook)

Allen, R & Greenwood, T 2012, *Year 11 Biology*, Biozone Learning Media Ltd, New Zealand (updated annually).

Allen, R & Greenwood, T 2012, *Year 12 Biology*, Biozone Learning Media Ltd, New Zealand (updated annually).

Dirks, R 1991, *Disease and Society: A Resource Book*, Australian Academy of Science, Canberra.

Evans, B, Ladiges, P, McKenzie, J, Sanders, Y & Latimer, H, 2005, *Heinemann Biology 1*, 4th edn (textbook and student workbook), Pearson, Australia.

Evans, B, Ladiges, P, McKenzie, J, Batterham, P & Sanders, Y, 2011, *Heinemann Biology 2 enhanced*, 4th edn (textbook and student workbook), Pearson, Australia.

Kinnear, J & Martin, M 2005, *Nature of Biology*, Book 1, 3E (textbooks and activity manual), John Wiley & Sons (Jacaranda), Australia.

Kinnear, J & Martin, M 2005, *Nature of Biology*, Book 2, 3E (textbooks and activity manual), John Wiley & Sons (Jacaranda), Australia.

Simple, A, Borger-Smith, P, Cotton, C, Cunningham, F, Duncan, J & Jackel, S. 2006. *Nelson Biology VCE Units 3 & 4*, Nelson, Australia.

Thain, M, Hickman, M, Thain, M, Raymond Turvey (Illustrator) 2009, *The Penguin Dictionary of Biology*, 11th edn, Penguin, UK.

Text listings can be accessed from the publisher's websites:

Australian Academy of Science

www.science.org.au

Biozone

www.biozone.co.nz/products_Aus.html

Jacaranda

www.jacaranda.com.au

Pearson

www.pearson.com.au



Oxford University Press

www.oup.com.au

Nelson Learning

<https://cengage.com.au/secondary/australian-curriculum-resources/senior-science-for-the-australian-curriculum>

Journals, news and articles

Australian Geographic (Journal of the Australian Geographic Society)

Australian Science Teachers Journal

ECOS (CSIRO)

Habitat (Australian Conservation Foundation)

Labtalk (STAV)

Nature

New Scientist

Scientific American

www.abc.net.au/science/

ABC Science – Science articles from the ABC

www.biology-online.org/kb/biology_articles.html

Biology Online – general Biology articles

<http://bugsinthenews.info/>

Bugs in the News – good articles

www.newscientist.com/

New Scientist – Science News from New Scientist

<https://www.science.org.au/learning/general-audience/nova>

Nova – Australian Academy of Science – Science in the News

<http://stories.scienceinpublic.com.au/>

Stories of Australian Science

Useful Websites

www.abc.net.au/tv/enoughrope/transcripts/sl622464.htm

Enough Rope with Andrew Denton, Interview with Professor Ian Frazer, 24 April 2006

www.biozone.com.au/links.html

Bio Links Online Database (with many biology links, updated regularly)

www.education.vic.gov.au/secondary/pages



Victorian Senior Secondary pages

www.science.org.au/scientists

Interviews with Australian Scientists (Australian Academy of Science)

<http://au.expasy.org/sprot/hamap>

HAMAP Proteome, Swiss Institute of Bioinformatics

<http://www.vcaa.vic.edu.au/Pages/vce/studies/index.aspx>

VCAA Study

www.cursions.com.au/

Cursions – a one-stop-shop that enables teachers to search for school excursions, incursions, classroom activities and resources anywhere in Australia

<http://teach.genetics.utah.edu/>

Teach Genetics – Genetic Science Learning Centre, The University of Utah (linked to Learn Genetics, see below)

<http://animaldiversity.ummz.umich.edu/site/index.html>

Animal Diversity Web – University of Michigan, Museum of Zoology – classification of animals

<http://animatedscience.co.uk/>

Animated Science – animations and talks

www.becominghuman.org/

Becoming Human – human evolution

http://www.biology-online.org/dictionary/Main_Page

Biology Online Dictionary – concise definitions and links to other information

<http://archive.industry.gov.au/Biotechnologyonline.gov.au/topitems/resources.html>

Biotechnology online – Australian Government resource for schools (archive)

www.biologymad.com/resources/kidney.swf

Kidney animation

www.biopic.co.uk/cellcity/index.htm

Cell City – interactive, compares cells to cities

www.cellsalive.com/

Cells Alive – cell structure, microbiology, immunology, interactive, video clips

<http://www.biologydir.com/cellupedia-cell-anatomy-info-31735.html>

Cellupedia – a comprehensive site on cells

www.youtube.com/user/crashcourse

Crash course biology – interesting YouTube videos on lots of biology topics



<http://www.dnai.org/>

DNA Interactive – discovering the DNA structure and beyond, covers techniques used in gene technology

www.dnalc.org/websites/

DNA Learning Center – genetics education by an operating unit of Cold Spring Harbor Laboratory, links to online education websites

www.fda.gov/food/default.htm

FDA Food – US Food and Drug Association – good for VCE Unit 3

<http://www.fda.gov/Food/FoodbornellnessContaminants/CausesOfIllnessBadBugBook/>

FDA Bad Bug Book (download copy) – disease causing organisms

www.internet4classrooms.com/gateway_biology.htm

Internet4Classrooms – Gateway Biology

<http://learn.genetics.utah.edu/>

Learn Genetics – very comprehensive, includes genetics, stem cells, drug design, cloning, and health.

www.nlm.nih.gov/medlineplus/

Medline plus – health and medical information from NIH

<http://anthro.palomar.edu/synthetic/Default.htm>

Modern Theories of Evolution – an introduction to the concepts and theories that led to our current understanding of evolution

<http://mrandersonscience.org/about-mr-anderson/>

Mr Anderson's Biology website

www.youtube.com/user/scishow

Scishow – lots of videos covering many different science concepts including pracs

<http://animaldiversity.ummz.umich.edu/>

University of Michigan Museum of Zoology – good for animal classification

www.abc.net.au/science/

zeroBio – good for students, online science/biology quizzes and games

<http://www.vcaa.vic.edu.au/Documents/vce/biology/proteomesdna.pdf>

VCE Biology 2013-2016 Proteomes, Genes and Junk DNA

