BIOLOGY 2.8

Internally assessed
3 credits

AS 91160

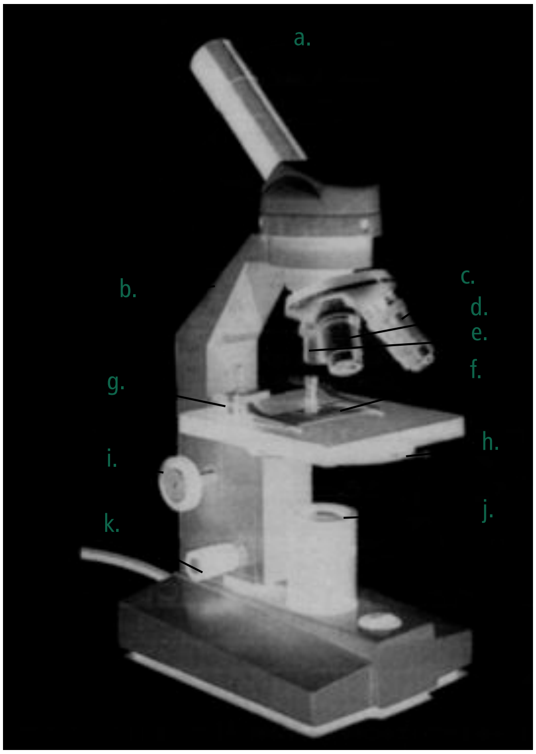
Investigate biological material at the microscopic level

Using a microscope and making a slide

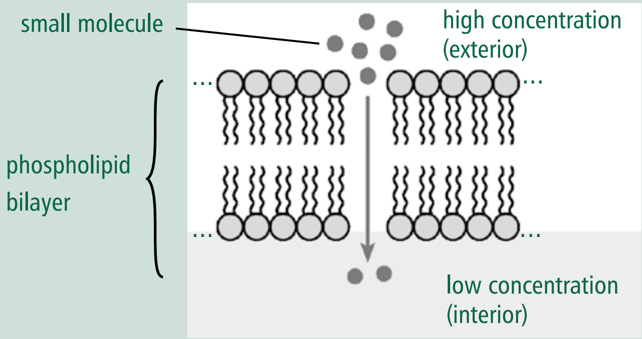
Cells were first observed nearly 350 years (by Hooke in 1665) when the first simple microscopes were developed. Today, biology students get their first view of cells using standard **compound microscopes**.

Unit 1A: Compound microscope

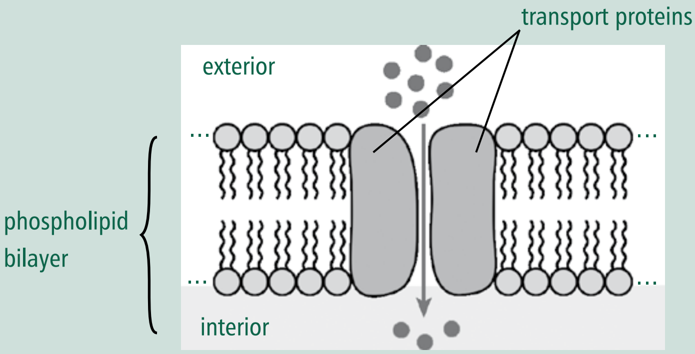
1. Complete the table to give the name and the function of each of the parts of the compound microscope.



Part	Name	Function
a.		
b.		
c.		
d		
e.		



Molecules that cross the membrane faster than is possible by simple diffusion do so by **facilitated diffusion** – transport proteins provide channels for the process. Such carrier proteins are specific.



Both glucose and oxygen can be facilitated into cells (e.g. the protein cytochrome P450 can transport O_2 up to 1.8 times faster than by simple diffusion; the hormone insulin may activate transport channels into cells and so facilitate transport of glucose into the cell).

Unit 2C: Diffusion

1. The difference in concentration between two areas is called the *concentration gradient*. The higher the concentration gradient, the faster the rate of diffusion. Other factors that affect the rate of diffusion are: temperature, size of particles, state (i.e. solid, liquid or gas) of particles.

   State, with a reason, the effect of each of these three factors on the rate of diffusion.

   a. Temperature: ______________________________

   ____

   ____

   b. Size of particles: ______________________________

   ____

   ____

   c. State of particles – liquid and gas only: ______________________________

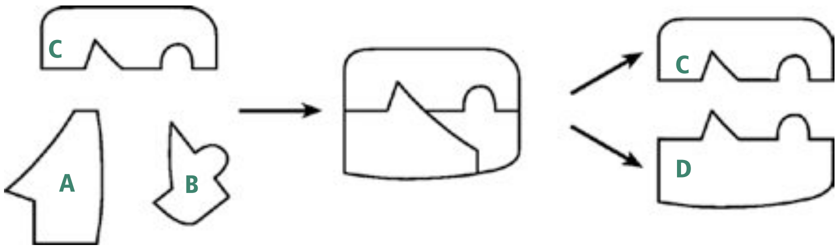
   ____

   ____

AS 91156

d. Ligase: ___

2. a. Use the diagram following to describe how an enzyme catalyses a reaction.



b. Explain why enzymes are *not* used up in a reaction, and give the advantage of this.

3. Catalysis can be very rapid. *Peroxidase* (also known as *catalase*) in liver cells can catalyse the breakdown of several million hydrogen peroxide molecules into water and oxygen every minute.
Give a reason why this particular catalytic reaction occurs.

Factors affecting enzyme activity

Temperature

The shape of an enzyme is held together by hydrogen bonds which are broken when temperatures exceed a certain limit (the *optimum*). The enzyme loses its shape (it has been **denatured**) and can no longer act as a catalyst. In *homeotherms* ('warm-blooded' animals – all mammals and birds), the optimum is the core body temperature – which is 37 °C in humans.

pH

Most enzymes work within cells (e.g. DNA replication, protein synthesis) so their optimal pH will be approximately 7 (i.e. neutral). The exception is the digestive enzymes – e.g. amylase (in saliva), lipase (produced by pancreas, acts in small intestine), and pepsin (in the stomach). When the pH exceeds an enzyme's tolerance, the enzyme denatures so it no longer acts as a catalyst.

Concentration

The rate of enzyme activity increases as the concentration of the substrate increases until a saturation point is reached.

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Unit 3F: Case Study 3 – Effect of temperature on the action of the enzyme catalase (practical investigation)

Catalase is an enzyme (-*ase* ending) that catalyses the breakdown of hydrogen peroxide, H_2O_2, in living cells into H_2O and O_2:

$$2H_2O_2 \xrightarrow{catalase} 2H_2O + O_2$$

Hydrogen peroxide is a toxic waste product of metabolism and must be broken down rapidly so that the organism is not poisoned. In humans, this breakdown occurs in liver cells.

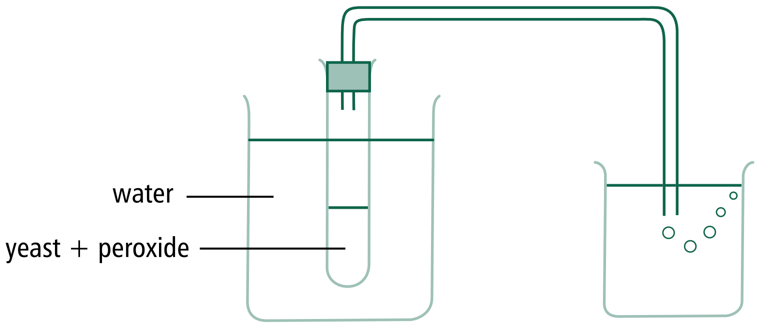
Yeast, made into a solution (your science technician will be able to provide this), is a suitable source of catalase. A suitable concentration will need to be determined for the hydrogen peroxide (your science technician will be able to determine and provide this – *do not* use H_2O_2 in its concentrated form). Because of the toxic nature of hydrogen peroxide, care needs to be taken when handling it and your teacher will provide you with the necessary safety instructions.

Plan and carry out an investigation into: 'The effect of temperature on the activity of catalase.'

You will need to do some practice runs before deciding on the final method.

- What will be used for the dependent variable? (Hint: Look at the equation to see what is produced in the breakdown of H_2O_2.)
- What are suitable values for the independent variable?
- What precautions will you need to take to ensure the method is valid?

The diagram following may assist you in designing a suitable method.



1. Give a suitable hypothesis.

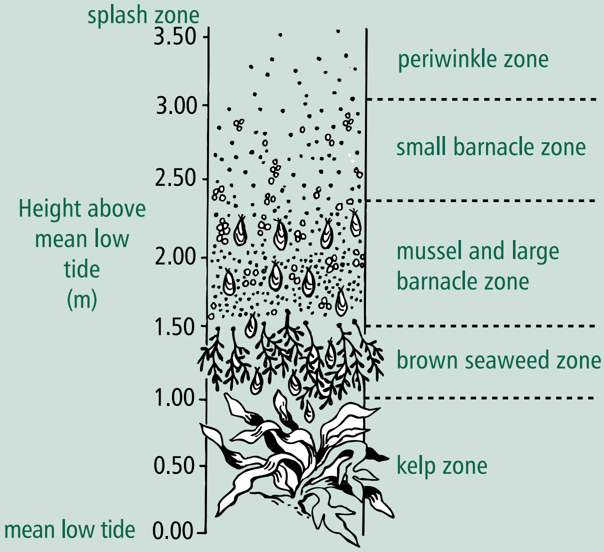
2. Give the dependent variable, and how you will measure it.

3. Give a suitable range of values for the independent variable, and say why this range of values is suitable.

Diagram alongside shows a typical zonation pattern on an intertidal rocky shore.

The (twice daily) ebb and flow of the tide is the main abiotic factor determining zones on the intertidal shore.

The pattern of zonation on the rocky shore varies, depending on how exposed the shore is to wave action.

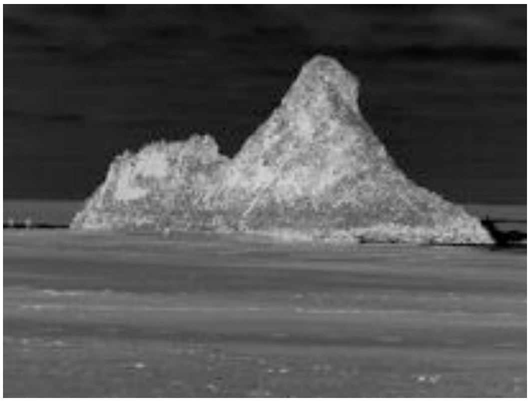


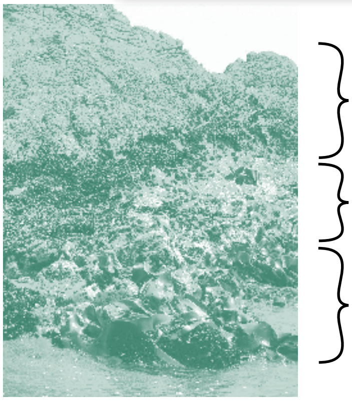
Unit 4K: Zonation (2)

1. Paratahi Island on Auckland's west coast is on an exposed shore, getting pounded by waves from the Tasman Sea. Rotoroa Island on Auckland's east coast is on a sheltered shore as it is in the Hauraki Gulf and sheltered from the Pacific Ocean by other islands.

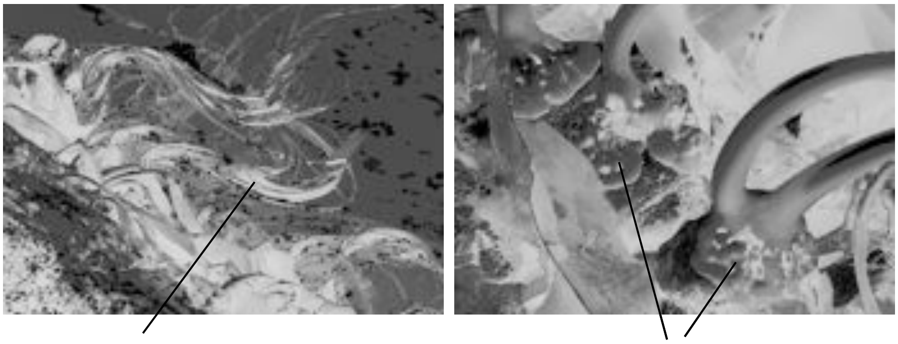
   The photos show Paratahi Island and the main zones on its rocks. The dominant species as seen in the zonation photo are seaweeds at LT, mussels at MT and barnacles at HT.

   HT = high-tide zone, MT = mid-tide zone, LT = low-tide zone.





Inhabitants of the intertidal shore follow.



Bull kelp (*Durvillaea antarctica*) and close-up of its holdfast in LT zone

Students may select which life process(es) and which taxonomic or functional groups they will investigate. To meet the requirements of AS 91155 (Bio 2.3):

- *Either*: one life process may be investigated over *three* taxonomic or functional groups with *comparisons* being made of how the animals are adapted to their way of life in relation to the life process.
- *Or*: *two related* life processes may be investigated in *one* taxonomic or functional group; how the animals are adapted to their way of life for *both* processes needs to be investigated as well as how the two processes are *connected* (and so work together) to ensure the successful functioning of both systems.

This chapter will investigate:

- the life process of nutrition, in the taxonomic group of mammals *and* include nutrition in the *functional* groups of omnivores, carnivores, herbivores (both foregut and hindgut) within the mammals
- the life process of internal transport in mammals.

Connections between the two life processes are included.

Meerkat

Mammals are distinguished by the presence of body hair and the young are born alive and suckled on milk. Mammals, along with birds, are homeotherms (*warm-blooded*) – i.e. they can maintain a stable core body temperature. This requires a large input of heat energy (released in respiration) – a significant amount of the calories consumed in the diet is needed to maintain body temperature.

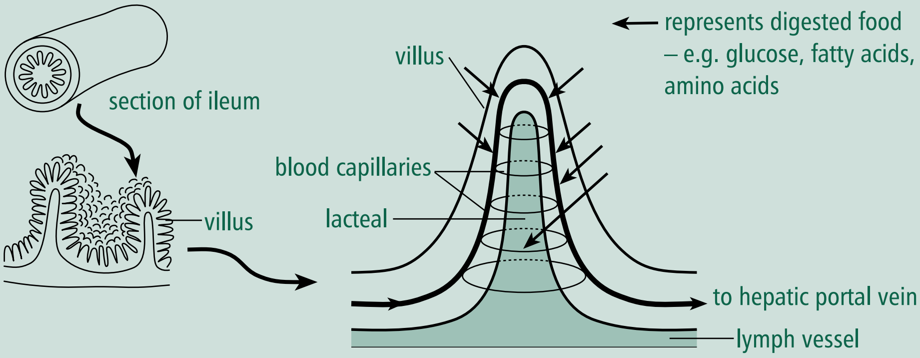
Mammals evolved to live a completely terrestrial life, though marine mammals (e.g. dolphins, whales, manatees, dugongs) have subsequently adapted to living a completely aquatic life (however, unlike fish, they still need to breathe atmospheric oxygen for respiration).

Mammals are comparatively large, active, intelligent animals with complex body systems and high energy demands. They are adapted to finding, consuming and processing large amounts of food. They are the top carnivores in many biological communities. The mammal circulatory system is a completely double, closed system with a four-chambered heart, ensuring efficient transport of oxygen, nutrients, and other substances (e.g. hormones) from site of origin to site of need – e.g. oxygen from alveoli of the lungs to the cells of the muscles.

AS 91155

Unit 5A: Animals – Carnivore and herbivore comparison

Carnivores and herbivores display many adaptations to their way of life. The photos show a typical (predatory) carnivore (lion) and a herbivore (springbok).



Fatty acids enter the lacteal, which connects with the lymph system; all other molecules pass into the blood capillaries. The capillaries connect up to eventually form the *hepatic portal vein* which goes to the liver.

Unit 5I: Animals – Absorption

1. Explain why the small intestine is infolded into villi, and why each of these is infolded into microvilli.

2. Use the preceding diagram to describe the structure of a villus, and say how the villus is adapted to absorption.

Assimilation

Processing of the substances from digestion takes place in the liver, with substances being further broken down, stored or sent to body cells for use. **Assimilation** may occur – the digested substances, directly or indirectly, become part of the body; examples include:

- digested substances used by cells to make new substances, e.g. DNA, proteins
- digested substances stored until needed, e.g. glucose is converted to glycogen for storage
- digested substances used in respiration
- digested substances broken down into other substances, e.g. excess amino acids are *deaminated* – the toxic *amino* part is converted to urea then excreted by the kidneys as urine.

Unit 5J: Animals – Assimilation

1. Distinguish between absorption and assimilation.

Plant option

Taxonomic and functional groups

All plants are classified into **taxonomic** groups depending on the features that they have in common and/or how related they are. The main taxonomic groups are.

➡ Increasing number of features plants have in common

➡ Decreasing number of different types of plant

Phylum ➡ Class ➡ Order ➡ Family ➡ Genus ➡ species

For example, tomatoes are classified as:

Tracheophytes ➡ Angiosperms ➡ Scrophulariales ➡ Solanaceae ➡ *Lycopersicon* ➡ *esculentum*

Each plant belongs to a particular species which has a scientific name that combines the genus with the species and is written in *italics* or <u>underlined</u>, e.g. *Lycopersicon esculentum* or <u>Lycopersicon esculentum</u>.

All plants carry out the life processes of: nutrition, internal transport, transpiration, reproduction. Members of a taxonomic group will have *similarities* in ways in which they carry out these processes, but will also have *differences* as the plants are adapted to their particular way of life. For example, all plants obtain food in the process of photosynthesis which takes place in the chloroplasts of cells; however, carnivorous plants have adaptations to catching insects to supplement their nutrient levels. Plants may show adaptations to living in habitats which have reduced or increased light intensities – this results in differences in the structure of the leaves and individual cells.

Plants may also be grouped into certain **functional groups**, dependent on their way of life. For example, for nutrition, within angiosperms (flowering plants), certain plants may be placed into the functional groups of:

- sun-adapted plants
- shade-adapted plants
- carnivorous plants
- parasitic plants.

Body systems *do not work in isolation* but connect with, and depend on, other systems to function successfully and efficiently. For example, photosynthesis provides the nutrients and energy needed for transport, growth and reproduction; however, the transport system is needed to get the raw materials (e.g. water, mineral ions) and the processed materials (e.g. glucose) to where they are needed within the plant, and the transport of water is assisted by the process of transpiration.

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Sundew *Drosera sp*

Pitcher plant *Nepenthes sp*

Unit 5E: Plants – Carnivorous plants

1. Find out about, then describe how each of these plants is adapted to catching insects:

a. Venus fly trap

b. sundew

c. pitcher plant

2. Describe how trapped insects are processed by carnivorous plants.

3. Carnivorous plants typically inhabit bogs/swamps/marshlands. Describe these habitats, and explain how the plants' carnivorous habit helps them live there successfully.

Parasitic plants

A parasite lives on, and feeds from, another living organism. It is a common way of life in animals but rare in plants.

New Zealand mistletoes (*Peraxilla sp*) are **partial parasites** or **hemiparasites** in that they obtain food from photosynthesis but obtain water from a host tree by tapping into the xylem vessels of the host. Native beech trees (*Nothofagus sp*) are common hosts for mistletoe.

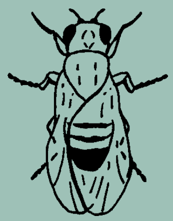
AS 91155

Monohybrid inheritance – lethal alleles

Lethal alleles occur when a mutation results in an allele that produces a non-functional version of an essential protein. If an individual inherits a lethal combination of mutated alleles, it will die before or shortly after birth.

Example

In *Drosophila* fruit flies, a mutated allele which is dominant (**C**) produces 'curly' wings rather than normal wings (**c**).



normal-winged fruit fly

curly-winged fly

Fruit flies that are homozygous for curly wings (i.e. get **C** from one parent and **C** from another to be **CC**) do not survive. The expected 3 curly : 1 normal ratio of flies from a heterozygous cross becomes a 2 curly : 1 normal – the homozygous dominant flies do not survive to hatch.

P cross: **Cc** × **Cc**

	C	**c**
C	**CC** lethal	**Cc** curly wings
c	**Cc** curly wings	**cc** normal wings

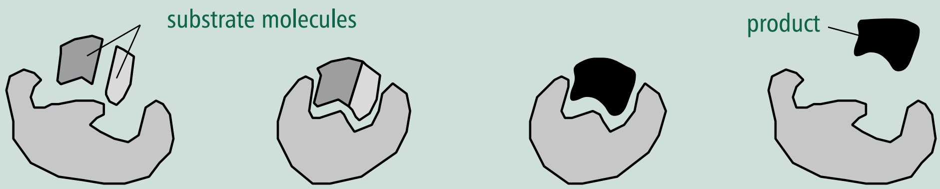
F1 individuals with **CC** die, so the expected 3 : 1 ratio becomes 2 curly wings (**Cc**) : 1 normal wing (**cc**)

Unit 6J: Monohybrid inheritance – lethal alleles

A mutant allele (**Y**) produces yellow fur in mice. Yellow mice were crossed with pure-breeding grey mice. In the F1 generation, a phenotypic ratio of 1 yellow : 1 grey occurred.

1. Use Punnett squares to explain whether the yellow mice used in the breeding were homozygous or heterozygous for fur colour.

AS 91157



If an enzyme loses it shape through denaturing or through a mutation changing the amino acid sequence, the active site may be lost so the enzyme can no longer catalyse its specific reaction. This can have serious consequences in metabolic pathways.

Unit 7A: Proteins

1. Define a gene. ______________________________

2. a. Describe, with examples, the two main types of protein.

   (1) ______________________________

   ____

   (2) ______________________________

   ____

   b. Describe the primary structure of a protein.

   ____

   c. Explain, using examples, why proteins are so important.

   ____

   ____

   ____

   ____

   d. Explain, using examples, why enzymes are so important.

   ____

   ____

   ____

   ____

Protein synthesis

DNA is found in the chromosomes in the nucleus of the cell. The base sequence of a DNA molecule codes for the amino acids that make up a protein (one gene codes for one polypeptide). A sequence of three bases in DNA (a **triplet**) codes for one amino acid.

Protein synthesis occurs in **ribosomes** in the cell cytoplasm. A carrier molecule, **mRNA** (messenger ribonucleic acid), is needed to take the code from DNA to the ribosomes. Ribonucleic acids (RNA) are nucleic acids like DNA but there are some key differences:

Biology 2.2

Internally assessed
3 credits

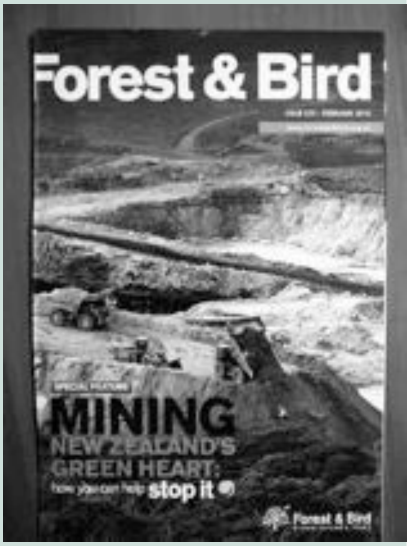
AS 91154

Analyse the biological validity of information presented to the public

Introduction

AS 91154 (Bio 2.2) involves the collection, processing, and *analysis of the biological validity of information* for a given *socio-scientific issue*.

Biological validity refers to scientifically accurate information that is used in an unbiased way to convey biological ideas / concepts / facts.



A *socio-scientific issue* is an issue that is science-based and provokes controversy / conflict within society. Current examples in New Zealand include:

- use of 1080 poison in pest control
- use of fracking in oil exploration / extraction
- pollution of waterways by farming practices
- use of waterways for irrigation and/or hydro-electric power
- overfishing of coastal waters
- mining of conservation lands
- global warming.

Issues tend to be complex, with conflicting points of views; there are no easy answers. You need to *interpret and evaluate* the information presented and reach your own conclusion. Logically, the conclusion should be based on scientific data – typically, however, personal opinions / beliefs / experiences, as well as those of other people, produce bias, clouding one's ability to draw a logical conclusion.

AS 91154 (Bio 2.2) lends itself to an individual investigation outside the class for students who want to extend themselves / improve their ability to process and report on information / increase their number of Level 2 credits. Discuss this with your teacher if you want to take advantage of this opportunity.

Sources of information

The emphasis of AS 91154 (Bio 2.2) is not on collecting information (your teacher may provide this), but on the processing and analysing of information from a number of different sources. Assessment of AS 91154 (Bio 2.2) requires the analysis of information from a minimum of three different *genres*. Genre refers to different categories or different forms of literature, and could include:

- scientific reports
- interviews – TV / radio / newspapers / journals
- documentary films / DVDs
- public lectures

Answers

Achievement Standard 91160 (Biology 2.8)

Unit 1A: Compound microscope (page 1)

1.

Part	Name	Function
a.	eyepiece lens	Magnifies the section being viewed; combines with objective lens to give overall magnification
b.	arm	Used for carrying the microscope
c.	high-power objective lens	Combines with eyepiece lens to give greatest magnification of the section being viewed
d.	medium-power objective lens	Combines with eyepiece lens to give middle magnification of the section being viewed
e	low-power objective lens	Combines with eyepiece lens to give lowest magnification of the section being viewed
f.	slide on stage	Platform for the material being viewed
g.	stage clips	Hold the slide in place
h.	iris diaphragm	Adjusts the amount of light for viewing
i.	coarse (focus) adjustment	Gives the first or rough focus of the section being viewed
j.	light source (or mirror)	Provides the light for viewing
k.	fine (focus) adjustment	Gives detailed focus of the section being viewed

2. Answer will depend on microscope used. Typically, school microscopes have eyepiece lens of 10× and objective lenses of 4×, 10× or 40×

   These combinations give overall magnification of LP 40×, MP 100× and HP 400×

Unit 1B: Focussing a microscope (page 2)

1. Typical steps, in order, for focussing material under highest power/magnification follow. The slide may be put on the stage first rather than third as given here.
   - Switch on the light (or adjust the mirror); adjust the (iris) diaphragm.
   - Put the lowest-power objective lens in place.
   - Place the slide on the stage so it is centred under the lens.
   - Using the coarse adjustment, wind down until the objective lens is as close to the slide as it will get without hitting the slide.
   - Look through the eyepiece and slowly wind it back up until the section is in focus.
   - Bring the section into sharp focus using the fine adjustment.
   - Switch the medium-power objective lens in place and use the coarse and/or fine adjustment to focus as necessary.
   - Switch the highest-power objective lens into place, while watching from the side. Focus using fine focus only.
   - Use the iris diaphragm to give more light if necessary.

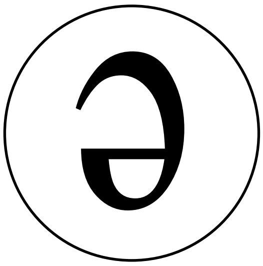
2. **a.** If the section/slide is too thick, then the large HP lens will not fit into place; forcing it may damage both lens and slide.

   b. The large lens will be almost touching the slide and focussing will only need a very small adjustment; the coarse adjustment gives a sufficiently large adjustment that the focus will be lost.

   If focus is lost, go back to medium, even low power, and start again.

   c. The large HP lens is so close to the slide and so zoomed in on the section being viewed that usually more light is needed to allow the section to be clearly seen.

3. **a.**



   b. low power

   c. high power

   d. upside down, back to front

Unit 1C: Slide making (page 4)

1. Typical steps for making a slide follow.
   - Place or smooth a thin layer of material on the centre of the slide.
   - Add a drop of water or stain to the section, removing excess fluid.
   - Place one side of a coverslip at one side of the drop of water or stain and let the coverslip gently 'fall' onto the drop of water or stain.

2. **a.** To allow light through for clear viewing.

   b. To prevent it drying out.

   If dry, can no longer can be viewed clearly.

   c. Stain gets taken up by parts of the section/cell (e.g. nucleus or cell wall); therefore these part(s) stand out so more clearly seen.

   d. Coverslip protects the large HP objective lens which otherwise might go into water or stain and get damaged or reduce clarity of viewing.

   e. To prevent/reduce formation of air bubbles in/on the section.

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