Life Sciences IEB

CLASS TEXT & STUDY GUIDE

Liesl Sterrenberg, Helena Fouché & Grace Elliott

GRADE

10

IEB

3-in-1

THE ANSWER SERIES *Your Key to Exam Success*

Grade 10 Life Sciences 3-in-1 IEB

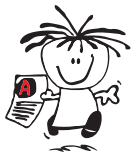
CLASS TEXT & STUDY GUIDE

This Grade 10 Life Sciences 3-in-1 study guide covers all strands of the IEB curriculum. It enables you to understand the basic concepts of the Grade 10 curriculum and creates a strong foundation for success in Grades 11 and 12.

Key Features:

- Comprehensive, learner-friendly notes per module
- Carefully selected, graded questions and answers per module
- 'Rapid-fire' questions for key concepts and terms
- Clear, explanatory diagrams
- Up-to-date, relevant material

This study guide will stimulate your understanding of Life Sciences and, as you work through the material, boost your exam performance.



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THIS CLASS TEXT & STUDY GUIDE INCLUDES

1 Notes

- Environmental Studies
- Diversity, Change and Continuity
- Life at the Molecular, Cellular and Tissue Level
- Life Processes in Plants and Animals

2 Questions and Rapid Fire Questions

3 Detailed Memos

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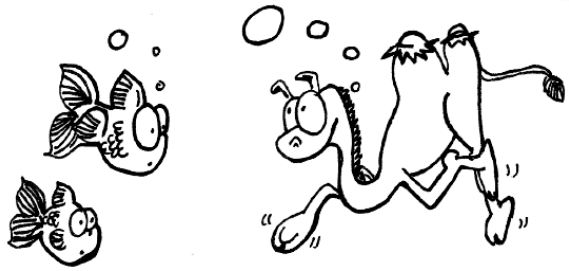


SCIENTIFIC SKILLS

SPECIFIC SKILLS IN LIFE SCIENCES

Relationship between surface area and volume

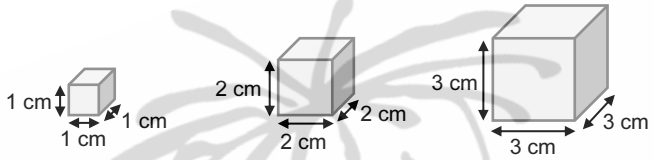
The following diagrams compare the surface area to volume ratios of three cubes of different sizes.

Remember:

Volume = *length (ℓ) × breadth (b) × height (h) ; and is measured in cm^3*

Area = *length (ℓ) × breadth (b) ; and is measured in cm^2*

Surface area = *the sum of the six surfaces of the cube ; and is measured in cm^2*



Surface area	$6(1 \times 1) = 6$ cm^2	$6(2 \times 2) = 24$ cm^2	$6(3 \times 3) = 54$ cm^2
Volume	$1 \times 1 \times 1 = 1$ cm^3	$2 \times 2 \times 2 = 8$ cm^3	$3 \times 3 \times 3 = 27$ cm^3
Surface area : Volume	6 : 1	3 : 1	2 : 1

It can be seen from the above that the volume of the biggest cube is 27 times larger than that of the smallest cube, but its surface area is only 9 times larger.

Therefore: The surface area to volume ratio of the big cube is much smaller (2 : 1) than that of the smallest cube (6 : 1).

So we can say: 'The smaller the volume, the larger the surface area to volume ratio'.

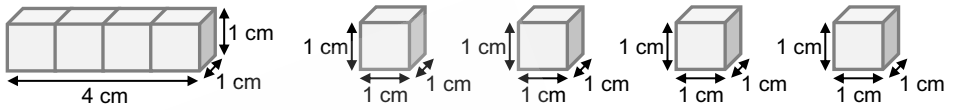
This principle is very important in living organisms. The surface area of an organism is the part that is in contact with the environment.

Small organisms, such as unicellular organisms, have a large surface area to volume ratio. This means that all parts of the organism are close to the surface. This facilitates diffusion in: gaseous exchange to and from the environment, the uptake of nutrients from the environment and the excretion of wastes to the environment.

Larger organisms, like vertebrates (fish, amphibians, reptiles, birds and mammals) have a small surface area to volume ratio. This means that many internal tissues are not close to the surface of the animal. Therefore effective gaseous exchange, nutrition and excretion cannot take place by diffusion. These animals need specialised transport systems to perform these functions.

Larger animals have many different structures, folds or outgrowths to increase the surface area. The human small intestine is long and has folds and finger-like projections (villi) to increase the absorption surface.

The following diagrams compare the surface area to volume ratio of a rectangular prism with that of the four separate cubes that make up the prism.



Surface area $4(4 \times 1) + 2(1 \times 1)$
$= 18$ cm^2

Total surface area of all four cubes
$= 6(1 \times 1) + 6(1 \times 1) + 6(1 \times 1) + 6(1 \times 1)$
$= 24$ cm^2

Note that the surface area increased when the large block was divided into four equal-sized blocks. Six new surfaces of 1 cm^2 each are exposed to the environment.

Volume $4 \times 1 \times 1$
$= 4$ cm^3

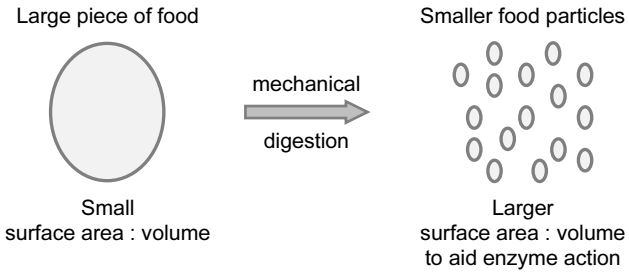
Total volume of all four cubes
$= (1 \times 1 \times 1) + (1 \times 1 \times 1) + (1 \times 1 \times 1) + (1 \times 1 \times 1)$
$= 4$ cm^3

Note that the volume remained constant.

Surface area : Volume 4,5 : 1 6 : 1

From the above we see that the smaller blocks have a larger surface area to volume ratio than the single large block.

During digestion of food in humans, larger food particles (with a small surface area : volume ratio) must first be broken down to smaller food particles (with a larger surface area : volume ratio) by mechanical digestion (e.g. chewing). The smaller food particles have a larger surface area to aid enzyme action.



Autotrophic component

- The autotrophic component consists of all green plants that can photosynthesise and produce their own organic food (carbohydrates).
- This component is also known as the **producers**.

Heterotrophic component

- The heterotrophic component consists of organisms that cannot produce their own food.
- These organisms are directly or indirectly dependent on the producers for food.
- This component is also known as the **consumers** and is subdivided into the **primary**, **secondary** and **tertiary** consumers, as well as the **decomposers**.

Primary consumers

- Primary consumers feed directly on the producers and include the following:
  - Herbivores that live only on plant matter.
  - Omnivores that live partially on plant matter.

Secondary consumers

- Secondary consumers feed on the primary consumers and include the following:
  - Carnivores (meat eaters) that live only on animal matter.
  - Scavengers that eat the remains of dead animals.
  - Omnivores that live partially on animal matter partially on plant matter.

Tertiary consumers

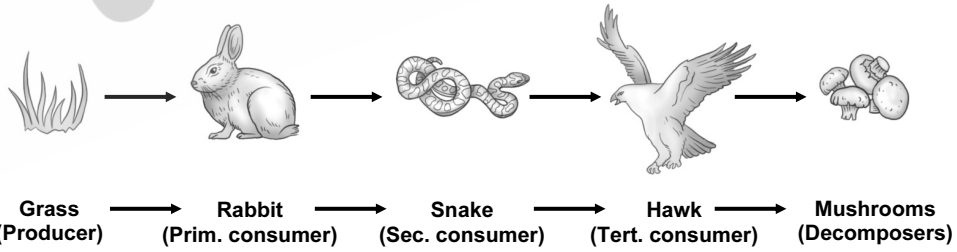
- Tertiary consumers feed on the secondary consumers and are all carnivores.

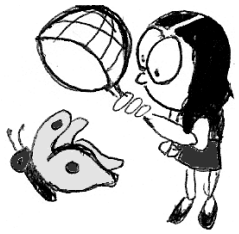
Decomposers

- Decomposers are mainly saprophytic bacteria and fungi that feed on dead organic matter.
- They break down organic compounds into simple inorganic substances that are released back into the environment.

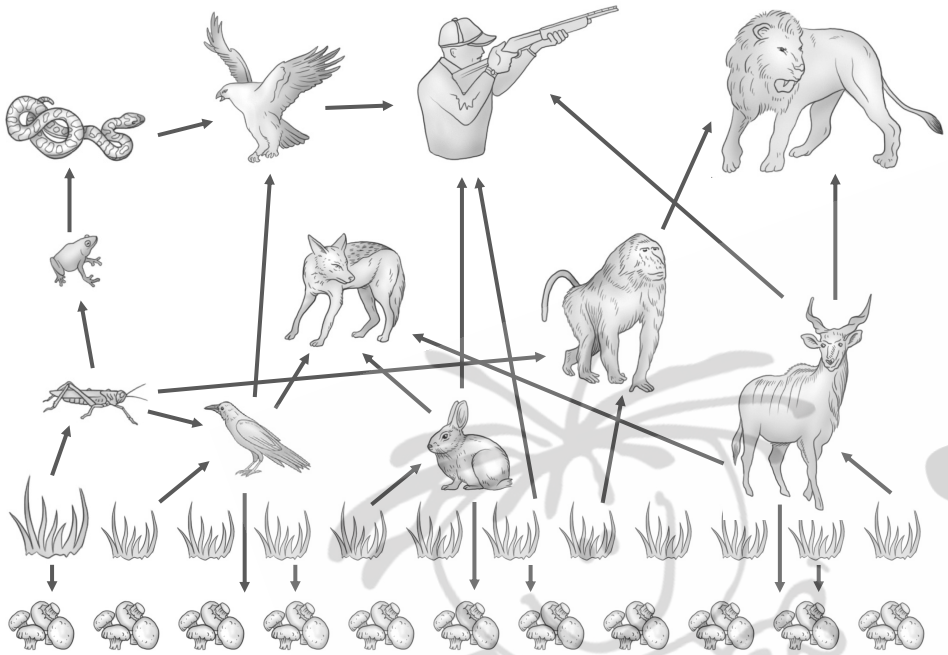
ENERGY FLOW

- Radiant energy from the sun is converted into chemical potential energy during photosynthesis and carbohydrates are stored in green plants (producers).
- Primary consumers obtain their energy from the plants (producers) that they eat.
- In turn, secondary consumers obtain their energy by eating the primary consumers.
- Tertiary consumers obtain their energy by eating the secondary consumers.
- Finally, the producers and consumers die and are decomposed by bacteria and fungi (decomposers). Energy is released into the environment.
- This transfer of energy from the sun, through green plants and the various consumers, is known as a **food chain**.
- A food chain always starts with the producers, followed by the consumers and ends with the decomposers.





- A food chain never occurs in isolation, but is usually linked to other food chains to form a **food web**.



Representation of a food web

TROPHIC LEVELS

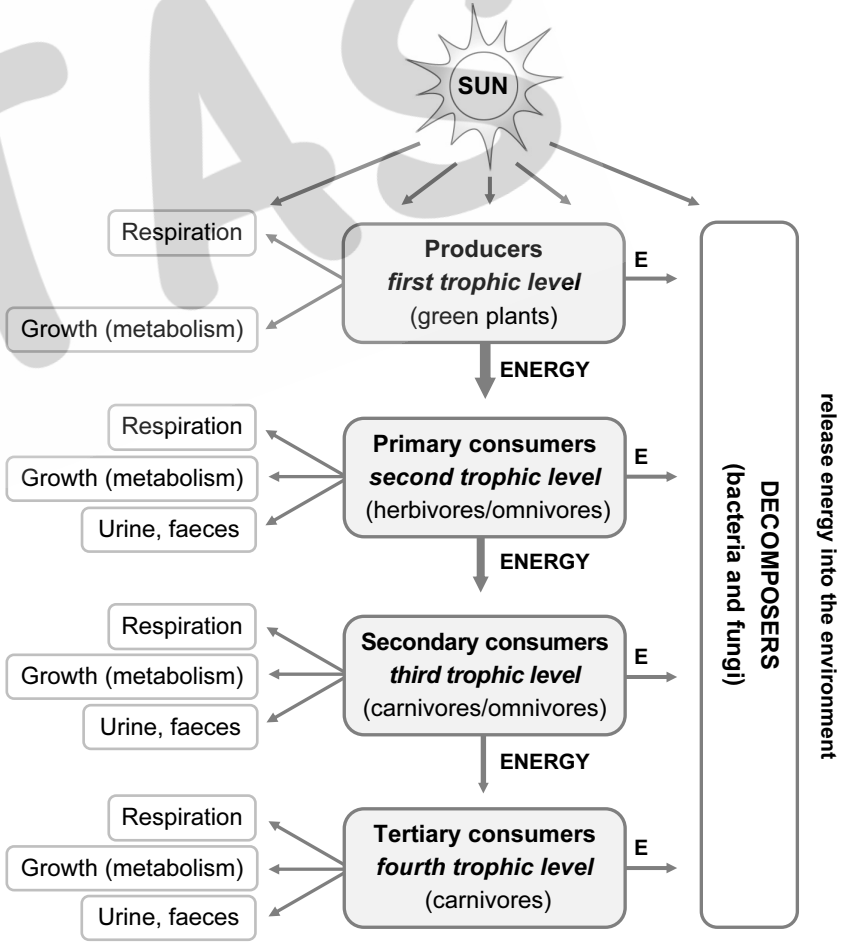
Living organisms occur at different feeding levels, known as **trophic levels**, of the ecosystem:

- **Producers** (green plants) that produce their own food through photosynthesis form the **first trophic level** and have the greatest amount of energy.
- **Primary consumers** (herbivores) form the **second trophic level**.
- **Secondary consumers** (carnivores) form the **third trophic level**.
- **Tertiary consumers** that consist of carnivores feeding on other carnivores form the **fourth trophic level**.
- **Omnivores** may be part of the second, third or fourth trophic levels, depending on their food.

- **Decomposers** (bacteria and fungi) may be part of any of the trophic levels, as it depends on which organisms are being decomposed.
- Energy is used by the organisms at each trophic level for **growth** (metabolism) and energy is released via **respiration**, **urine** and **faeces**. Therefore, this energy is not available for the next trophic level.

The longer a food chain, the less energy is transferred from one trophic level to another.

Flow of energy and the relationship between different trophic levels



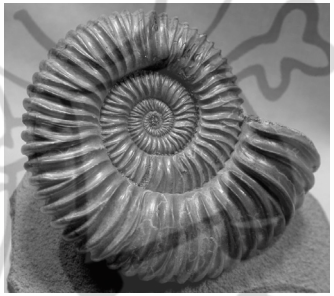
Fossil evidence

- **Fossils** are complete organisms or the remains, imprints or traces/tracks of organisms, usually preserved in rock.

*The study of plant and animal fossils is known as **palaeontology** and a scientist who studies fossils is a **palaeontologist**.*

- Fossils provide evidence of earlier life (extinct organisms) on earth and give information regarding the history of life on earth.
- Fossils also give indications of the climate and the environment of millions of years ago.
- Examples of fossil evidence include:
  - Fossils of **bivalves** and **ammonites** found on the Makhatini plains of northern Kwazulu-Natal.

A bivalve (mussel)



An ammonite

Bivalve? *A marine or freshwater snail/mollusc with a soft body that is compressed in a shell consisting of two separate parts (valves) that is joined with a strong, flexible, muscular hinge, e.g. oysters, mussels and clams/scallops.*

Ammonite? *An extinct marine snail with a flat, spiral shell divided into chambers with wavy interlocking walls. They became extinct about 65 mya.*

- Fossils of **trilobites** found in the Karoo.

A trilobite fossil

Trilobite? *Extinct arthropods, their bodies divided into horizontal segments and three vertical lobes. They are related to crabs and lobsters and became extinct 250 mya.*

- **Whale fossils** discovered in the Sahara desert.
- The above fossils suggest that the areas where they were discovered were once covered by the sea.
- Whales and some species such as the bivalves still exist today and have not changed much over millions of years.
- However, ammonite and trilobites have become extinct, although similar species are found today.

THE GEOLOGICAL TIMESCALE

- You already know that scientists estimate that the earth is approximately 4,6 billion years old.
- Geologists divide the history of the earth into geological time units.
- The purpose of a geological timescale is to represent a timeline of life on earth, from the origin of the earth.
- Time units are divided according to the age of the fossils that have been discovered.

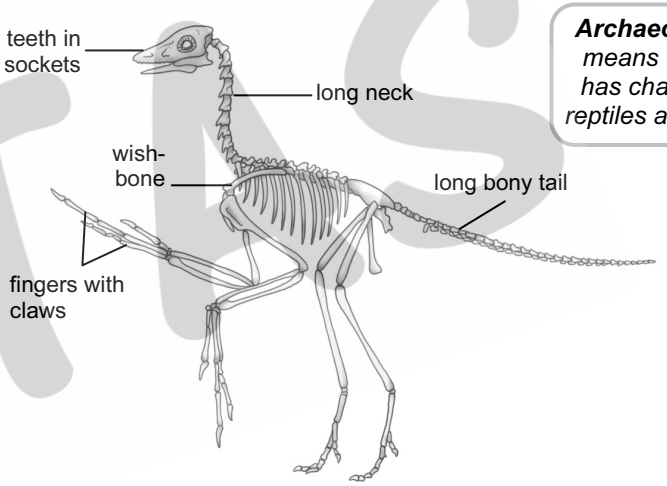
Each time unit is characterised by a specific group of fossils.

- The largest defined unit of time is the aeon. An aeon is divided into three eras, i.e. the **Palaeozoic**, the **Mesozoic** and the **Cenozoic**.
- Each of these is further divided into periods, i.e. the Quaternary, Tertiary, Cretaceous, etc.
- The period that precedes the Palaeozoic (4 600 - 570 mya), is known as the '**Precambrian**.'

ERA	PERIOD (mya)	PLANTS AND ANIMALS
Cenozoic	**Quaternary** 2	▪ Modern humans ▪ Modern mammal species ▪ Extinction of large mammals e.g. mammoths
	Tertiary 65	▪ First early hominins (human-like) ▪ Birds, mammals and insects
Mesozoic	**Cretaceous** 140 - 65	▪ Extinction of dinosaurs ▪ Flowering plants increase ▪ Gymnosperms decrease
	Jurassic 190 - 140	▪ Dinosaurs (land, sea, air) ▪ First birds
	Triassic 250 - 190	▪ First dinosaurs ▪ First mammals ▪ Gymnosperms, especially cycads
Palaeozoic	**Permian** 280 - 250	▪ Increase in reptiles ▪ Decrease in amphibians ▪ Gymnosperms
	Carboniferous 345 - 280	▪ Increase in amphibians ▪ First reptiles ▪ Ferns dominate
	Devonian 400 - 345	▪ First amphibians ▪ First insects ▪ Primitive vascular plants
	Silurian 435 - 400	▪ First plants and animals on land ▪ Mosses on land
	Ordovician 515 - 435	▪ Algae dominant
	Cambrian 570 - 515	▪ 'Explosion' (rapid appearance) of most animal groups ▪ First vertebrates (fish) ▪ Invertebrates
Precambrian 4600 - 570		▪ First invertebrates ▪ Origin of eukaryotes ▪ Prokaryotes

You do not have to memorise the geological time scale. It is only provided so that you can clearly see that life on earth was initially simple and became more complex and diverse over time.

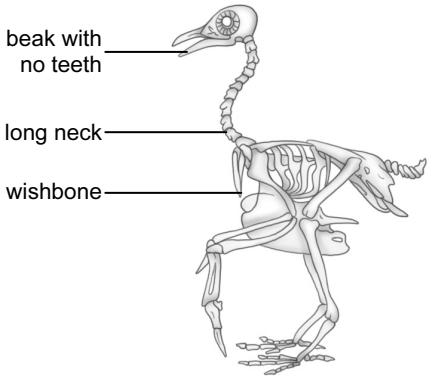
- All the fossils of different ages that have been discovered by palaeontologists are listed and this is known as the **fossil record**. However, fossil records are incomplete and not an indication of all the organisms that lived in a particular period.
- The fossil record has many gaps however, particularly where there is a change from one type of organism to another.
- Fossils of these **transitional forms** are very rare. ***Archaeopteryx*** is an example of a transitional fossil. It is known as the earliest and most primitive bird. It is considered a transitional form between reptiles and birds from the Jurassic period (150 million years ago) and displays both bird and reptile characteristics.



Archaeopteryx *which means 'ancient wing' has characteristics of reptiles as well as birds.*

Archaeopteryx

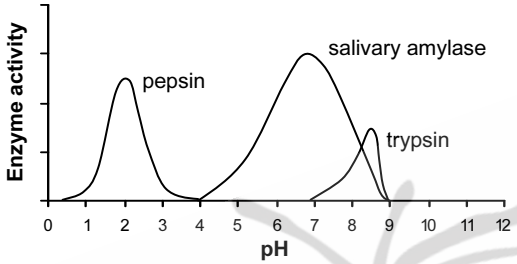
- **Characteristics of reptiles:**
  - sharp teeth in sockets
  - fingers with claws
  - long bony tail
- **Characteristics of birds:**
  - have feathers
  - have wishbone for attachment of muscles for flight



A bird skeleton

pH

- Each enzyme has a narrow pH-range within which it can function. This is known as the **optimum pH**.
- Some enzymes work optimally in an acidic medium, whereas others work better in a neutral or alkaline medium.
- Enzymes denature at extreme pH levels.



The influence of pH on enzyme activity

Properties of enzymes

- Enzymes are spherical proteins.
- Enzymes are sensitive to changes in temperature - high temperatures denature enzymes, whereas low temperatures make them temporarily inactive.
- Enzymes are sensitive to changes in pH - enzymes denature if the pH changes drastically.
- Enzymes are substrate-specific.
- Enzymes can be used over and over again.
- A small amount of enzyme can change a large amount of substrate.

Enzymes in everyday life, e.g. biological washing powders

Biological washing powder such as Bio-classic and Bio-tex contain enzymes that can break up/remove biological stains. These enzymes usually act on proteins and are known as proteases.

Stains caused by blood, egg-yolk and sweat consist of proteins and are difficult to remove from clothes.

The enzymes in the washing powder break the proteins down into smaller, soluble molecules that are easily removed by cleaning agents in the washing powder.

Practical Investigation: The effect of temperature on the enzyme catalase

Catalase is an enzyme found in most plant and animal tissues. In this experiment, chicken liver is used as the source of catalase. Catalase accelerates the breakdown of hydrogen peroxide into water and oxygen.

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

hydrogen peroxide → water + oxygen

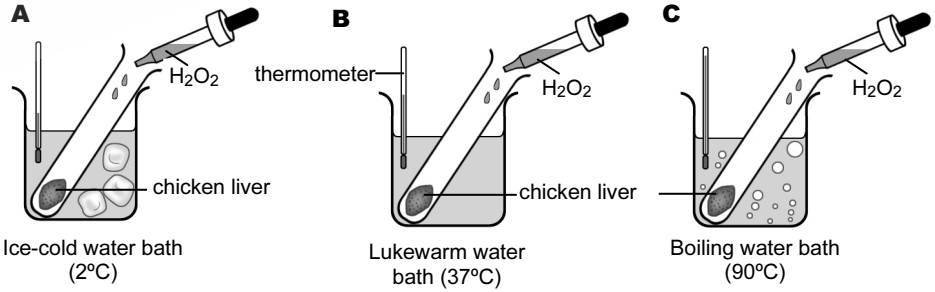
The oxygen that is released during this reaction is visible as bubbles.

Requirements

- chicken liver (mashed)
- 3 test tubes
- Bunsen burner
- 3 thermometers
- hydrogen peroxide
- 3 water baths (glass beakers with water)

Method

1. Add approximately 1 cm^3 of mashed chicken liver to each test tube and mark them A, B and C, respectively.
2. Place test tube A in an ice-cold water bath (2ºC), test tube B in a lukewarm water bath (37ºC), and test tube C in a water bath containing boiling water (90ºC), as shown below.
3. Add the same quantity of hydrogen peroxide (enough to cover the chicken liver) to each test tube.



Results

Test tube A - No bubbles are visible.

Test tube B - Bubbles are released and the liquid is displaced by the bubbles.

Test tube C - No bubbles are visible.

Practical Investigation: Observing cells

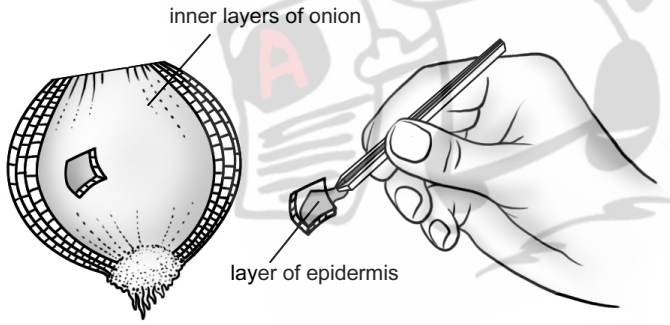
Plant cells - preparing a wet mount with epidermal cells from an onion leaf

Requirements

- specimen slide
- cover slip
- dissecting needle
- onion leaf
- dissecting tweezers
- medicine dropper
- iodine solution

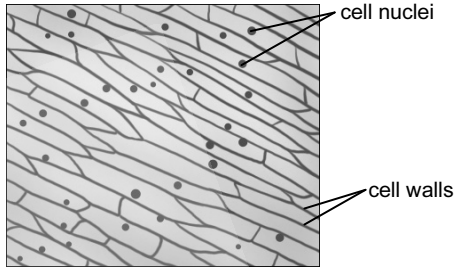
Method

1. Place a drop of the iodine solution, which will serve as the mounting medium, into the middle of the specimen slide using the medicine dropper.
2. Take one of the innermost layers of an onion leaf and cut a small square out of it.
3. Remove the thin membrane (epidermis) on the concave (hollow) side of the small square using the dissecting tweezers.



4. Place the epidermis sample in the middle of the drop of iodine solution on the specimen slide.
5. Place the cover slip over the mount as shown on p. 3.14.
6. Study the wet mount under low magnification and then under higher magnification.

Results



Microscopic view of onion epidermal cells

Animal cells - preparing a wet mount with human cheek epithelial cells

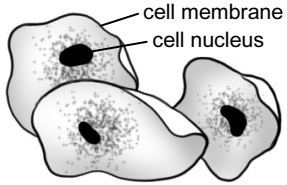
Requirements

- microscope slide
- cover slip
- toothpick
- medicine dropper
- two dissecting needles
- iodine solution

Method

1. Place a drop of the iodine solution, which will serve as the mounting medium, into the middle of the specimen slide using a medicine dropper.
2. Break off the sharp point of a toothpick and use the blunt end to gently scrape the inside of your cheek.
3. Place the scraping in the drop of iodine solution on the specimen slide.
4. Use the two dissecting needles to spread out the scraping in the iodine solution.
5. Cover the mount with a cover slip.
6. First examine the wet mount under a low magnification and then under a higher magnification.

Results



Microscopic view of human cheek epithelial cells

Basic structure

- The cells are more or less cube-shaped, i.e. they are as long as they are wide.
- The cell nuclei are round and occur in the centre of the cell.

Cuboidal epithelium

Functions of cuboidal epithelium

- Secretion (release of useful substances)
- Absorption (taking in substances)

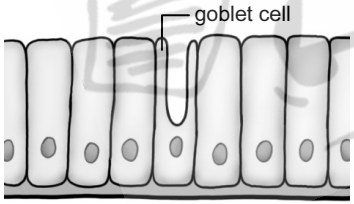
Columnar epithelium

Location

Columnar epithelium lines the alimentary canal, especially the stomach and small intestine. Some columnar epithelial cells perform a sensory function in the nose, ears and taste-buds on the tongue.

Basic structure

- The cells are elongated and column-shaped.
- The cell nuclei are elongated and occur near the base of the cells.
- **Goblet cells**, which secrete mucus, often occur between the columnar epithelial cells.



Columnar epithelium

Functions of columnar epithelium

- Absorption
- Secretion
- Sensation (sensory function)

Columnar and cuboidal epithelial cells are often modified to form specialised gland cells that form multicellular glands. These glands produce and secrete substances such as enzymes, hormones, milk, mucus, sweat, wax and saliva.

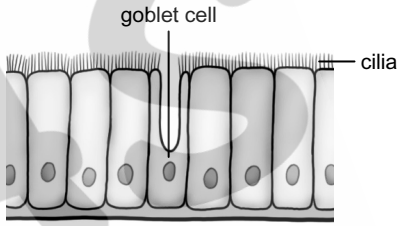
Ciliated epithelium

Location

This type of epithelial tissue lines the nasal cavities, trachea and bronchi in the lungs. It also occurs in sensory organs, e.g. the ear, as well as in the Fallopian tubes and uterus.

Basic structure

- This epithelium consists of columnar epithelial cells with exceptionally fine hairs, known as **cilia**, on the free ends of each cell.
- The cilia perform fast, rhythmical wave-like movements in a specific direction.
- **Goblet cells**, which secrete mucus, often occur between ciliated epithelial cells.



Ciliated epithelium

Functions of ciliated epithelium

- Dust particles are trapped in the mucus; movement of the cilia away from the lungs will ensure that the mucus is expelled.
- It helps to detect stimuli in sensory organs.
- Cilia ensure the movement of the ovum in the Fallopian tube and uterus.

CONNECTIVE TISSUE

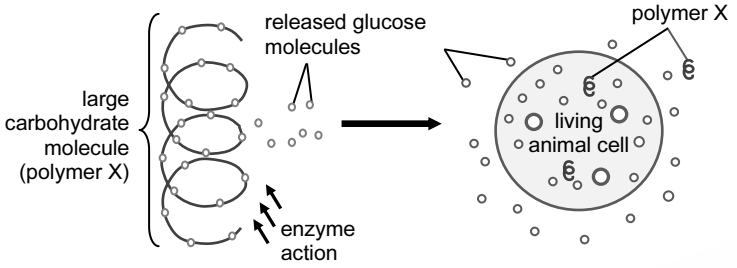
Connective tissue binds, supports or surrounds other tissues or organs. The matrix that occurs between the cells and fibres makes up the largest part of the tissue. The matrix is non-living and can be fluid, semi-fluid/jelly-like or even a solid substance.

There are five types of connective tissue:

- **Areolar connective tissue**
- **Dense connective tissue**
- **Cartilage**
- **Bone**
- **Blood**

QUESTION 27

Use the information given in the diagram below to answer the questions that follow.



27.1 Identify the carbohydrate molecule (polymer X).

27.2 Name the process by which the glucose is formed from the polymer.

27.3 Which part of a living animal cell controls the entry of glucose molecules?

27.4 Some carnivores do not produce 'starch digesting' enzymes in their saliva. Give a reason for this.

QUESTION 28

28.1 To which group of organic compounds do DNA and RNA belong?

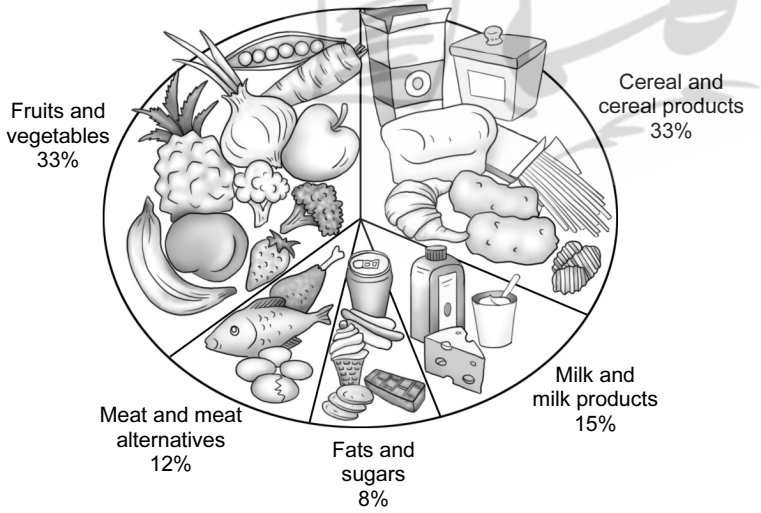
28.2 Distinguish between DNA and RNA with respect to:

28.2.1 location

28.2.2 function(s)

QUESTION 29

Study the accompanying representation of the recommended daily/dietary allowance (RDA) of the different food groups and answer the questions that follow.



29.1 If a total of 18 portions is consumed per day, calculate the number of portions that should come from each of the food groups. Show your calculations. *Round off to the nearest integer.*

29.2 Three people, Zola, Thandi and Patrick, are asked to note the average daily portions of the different food groups they eat. The results are given in the table below. Use these results to answer the following questions.

	Average number of portions per day				
	Cereal and cereal products	**Fruits and vegetables**	**Milk and milk products**	**Meat and meat alternatives**	**Fats and sugars**
Zola	10	1	2	2	3
Thandi	2	2	4	5	5
Patrick	9	1	1	4	3

29.2.1 Draw THREE pie charts for the graphic representation of the information in the table. Use a key to indicate the food groups.

29.2.2 Which person is likely to experience a vitamin deficiency? Give a reason for your answer.

29.2.3 Which person may have high blood cholesterol levels, running a high risk of developing cardiovascular diseases? Give a reason for your answer.

29.2.4 Which problem could Zola probably encounter as a result of the diet she follows? Give a reason for your answer.

29.2.5 What advice would you give Zola that could result in a more balanced diet for her?

29.3 Which vital inorganic compound occurs in each type of food, but should be taken in its pure form on a daily basis?

3.5.1 Eyepiece × high magnification = 10 × 40 = 400
(we can only use two lenses at a time, not three!)

3.5.2 3,5 mm; 3 500 µ

Remember: The higher the magnification, the smaller the field of view and fewer specimens will fit into the diameter of the field of view. However, more detail of the specimens will be clearly visible.

3.5.3 5 cells

3.5.4 700 µm (the diameter of the field of view (3 500) ÷ number of cells (5))

3.5.5 1 750 µm (the ratio of the low to the high magnification is 20/40, (or ½) therefore under a high magnification we will see ½ of 3 500 µm)

3.5.6 2,5 (the ratio of low to high magnification = ½; therefore we will see ½ of 5 = 2,5)

QUESTION 4

4.1
- All living organisms consist of cells.
- A cell is the basic and smallest unit of life.
- All cells arise from pre-existing cells.

4.2 A cell without a true nucleus e.g. bacterium cell

4.3
- Large surface area
- for effective diffusion
- Small volume (content)
- for rapid distribution of diffused substances

4.4 Differentiation - cells change their size, shape and structure

Specialisation - cells become specialised to perform specific functions

QUESTION 5

5.1 middle lamella

5.2 primary cell wall

5.3 plasmodesmata

5.4 facilitates the transport between adjacent cells

5.5 pits

5.6 secondary cell wall

5.7 lignin

QUESTION 6

6.1
- thin
- elastic

6.2 differentially/selectively permeable - controls the movement of substances in and out of the cell

6.3
- consists of a double layer of phospholipid molecules
- large protein molecules are embedded in the phospholipid layers
- some proteins extend through the two phospholipid layers
- proteins also occur on the outside
- each phospholipid molecule consists of a head and tail
  - head (phosphate group) points to the outside, is hydrophilic
  - tail (2 fatty acids) points inwards, is hydrophobic

6.4.1 hydrophobic - repels water

6.4.2 hydrophilic - attracts water

6.5.1 **Diffusion**: The spontaneous movement of molecules in a liquid or a gas from an area with a high concentration to an area with a low concentration, until equilibrium has been reached.

6.5.2 **Osmosis**: The movement of water molecules from an area with a high water potential (ψ) to an area with a low water potential (ψ), through a selectively permeable membrane, until equilibrium has been reached.

6.6 **Passive transport** - movement of molecules **down** a concentration gradient (therefore from ↑ [ ] to ↓ [ ]) - no energy required
Active transport - movement of molecules **against** a concentration gradient (therefore from ↓ [ ] to ↑ [ ]) - requires energy

6.7 When there is a high concentration of molecules in one area and a low concentration of the same molecules in another area.

6.8
- cell membrane
- tonoplast

QUESTION 7

7.1 compartment B (pure water)

7.2 A will increase. B has a higher ψ than A. Water molecules move from compartment B, through the selectively permeable cell membranes of the potato cells, to compartment A. Therefore, water molecules moved from a high ψ to a low ψ. The amount of fluid in A will increase until equilibrium is reached.

7.3 osmosis

QUESTION 8

8.1 Compartment B - has more 'free' water molecules

8.2 B → A

8.3 It is a membrane that allows certain substances through but not others.

QUESTION 9

9.1 B

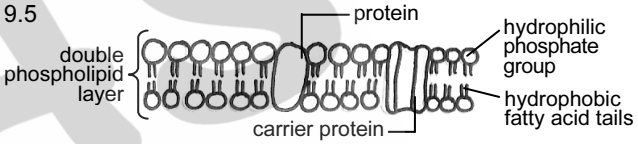
9.2
- chloroplast present
- large vacuole
- cell wall

9.3 See drawing of the *Structure of the nucleus* on p. 3.22 in the notes.

9.4.1 7 9.4.2 5 9.4.3 6 9.4.4 8

9.4.5 1 9.4.6 3 9.4.7 4/9 9.4.8 11

9.5



9.6
1 - ribosome
2 - lysosome
3 - vacuole
4 - cell membrane
5 - centrosome
6 - chloroplast
7 - mitochondrium
8 - ER
9 - cell membrane
10 - cell wall
11 - Golgi body

9.7 $\frac{\text{actual measured length}}{\text{magnification}}$

$= \frac{41\text{ mm}}{1\,625}$

= 0,0252 mm = 25,2 µm

9.8
- cellular respiration takes place here
- energy is released

9.9 Animal cell - animals are more active, looking for food and mates during the mating season

9.10 Muscle cell - more energy needed for contraction

QUESTION 10

10.1.1 The cell wall is a support structure that:
- protects the living contents of the plant cell
- gives rigidity to the plant cell

CELLULAR RESPIRATION

Cellular respiration is the breaking down of **organic compounds** (glucose) with the gradual release of energy that is stored in **ATP** molecules. **Oxygen** is required and **carbon dioxide** and **water** are released as waste products.

- All living organisms are composed of cells. Cells constantly perform work and therefore require **energy**.
- Organisms use energy for the following life processes:
  - growth
  - cell division
  - digestion
  - movement
  - transport of substances in the body
  - active transport against a concentration gradient

According to the **Law of Conservation of Energy**, energy cannot be created or destroyed, only converted from one form to another.

- The **sun** is the **primary source of energy** for life.
- During **photosynthesis**, **radiant energy** from the sun is converted into **chemical potential energy** and built into organic **carbohydrate molecules** (glucose).
- During cellular respiration, these organic compounds (glucose) are broken down, releasing the **stored chemical potential energy**.
- This energy is carried to all the parts of the cell/body by **ATP** (energy carrier).
- Part of the energy is released into the environment as **heat**.

Raw materials needed for cellular respiration

- Glucose
- Oxygen

Products of cellular respiration

- Carbon dioxide
- Water
- ATP (energy)

The energy released during cellular respiration is not always used straight away. Energy is temporarily stored in the energy carrier ATP.

Equation for the process of cellular respiration:

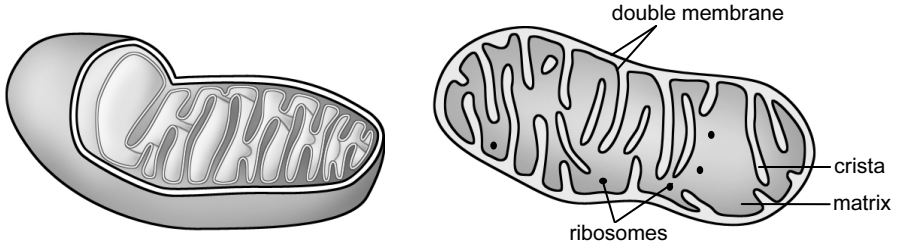
$$\text{Glucose} + O_2 \xrightarrow{\text{enzymes}} CO_2 + H_2O + \text{ATP}$$

Photosynthesis is an **anabolic** (building up) process, because energy-rich glucose is **built up.**

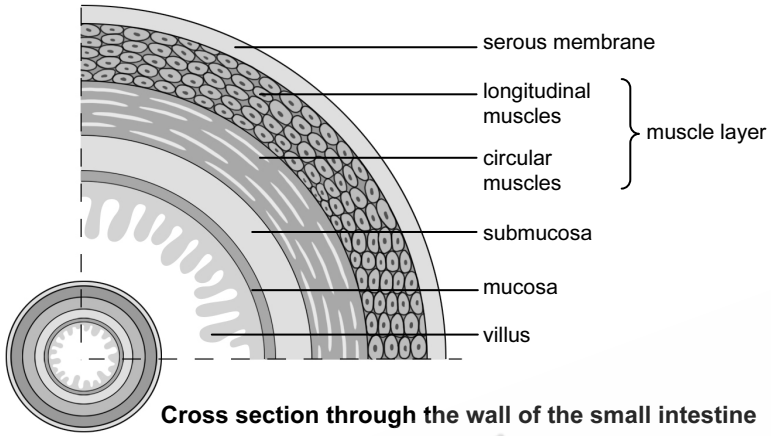
Cellular respiration is a **catabolic** (break-down) process, because energy-rich glucose is **broken down**.

Places where cellular respiration takes place

- The first phase takes place in the cytoplasm outside the mitochondrion, known as the **cytosol**.
- The second and third phases occur **inside** the **mitochondrion**.



Structure of a mitochondrion

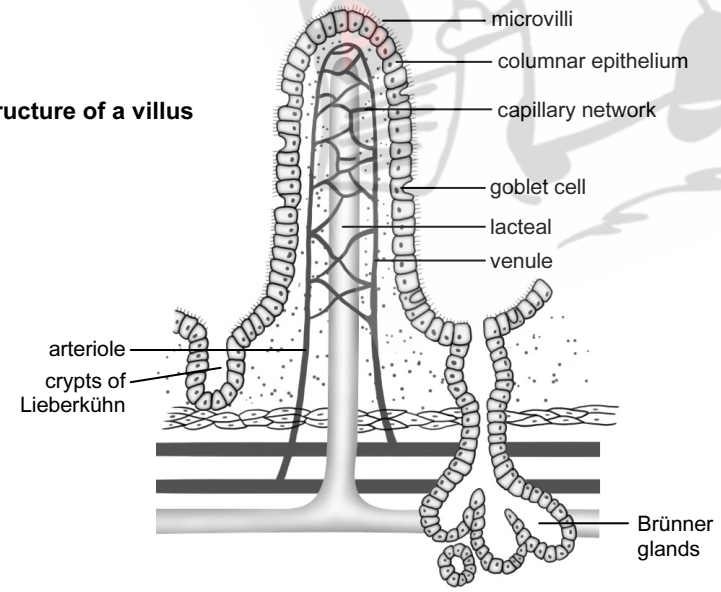


Cross section through the wall of the small intestine

Structure of a villus

- A villus is surrounded by a single layer of **columnar epithelial cells**.
- In the columnar epithelium there are **goblet cells** that secrete mucus.
- On the surface of the columnar epithelial cells there are microscopic projections, known as **microvilli**.
- In the centre there is a capillary lymph vessel, the **lacteal**.
- An **arteriole** brings blood to the villus and forms a capillary network that surrounds the lacteal.
- The capillaries join together and leave the villus as a **venule**.

Structure of a villus



- At the base of the villi there are small cavities known as the **crypts of Lieberkühn**.
- **Brunner glands** occur in the submucosa of the duodenum.

Functions of the small intestine

- The layer of muscles in the wall of the small intestine causes peristaltic movements, which moves the chyme forward and ensures that it becomes thoroughly mixed with the digestive juices.
- Glands in the duodenal wall (crypts of Lieberkühn and Brunner glands) secrete digestive juices (intestinal juice), which play a role in digestion.
- The small intestine has millions of villi to increase the surface area for the absorption of digested nutrients.

Colon

- The colon consists of three parts:
  - **caecum** - the sac-like structure where it joins the small intestine
    - a small appendage is attached to the caecum, the appendix
  - **colon** - this is the largest part of the large intestine
    - it consists of the ascending, transverse and descending colon
  - **rectum** - this is the last muscular portion of the colon
    - it ends with an opening on the outside, the anus

Functions of the large intestine

- The large intestine secretes large amounts of mucus to aid egestion.
- Water and useful substances (certain vitamins and bile salts) are absorbed from the semi-solid waste in the colon.
- Undigested waste (faeces) is stored temporarily in the colon before it is egested via the anus.

Structure and functions of the accessory organs

Tongue

- The tongue is a muscular organ; the back of the tongue is attached to the mouth floor.
- There are small projections on the tongue called papillae; this is where the taste buds occur.

UNIT 2

QUESTION 1

1.1 See p. 4.14 in the notes under the heading *'Five main processes in nutrition'*.

1.2
- Provides energy - carbohydrates and fats
- Growth and repair of damaged tissues - proteins
- Regulation of processes in the body - vitamins, water and mineral salts

QUESTION 2

2.1 Organisms that cannot produce their own food but are dependent on other organisms for their organic nutrients.

2.2 herbivores, carnivores, omnivores

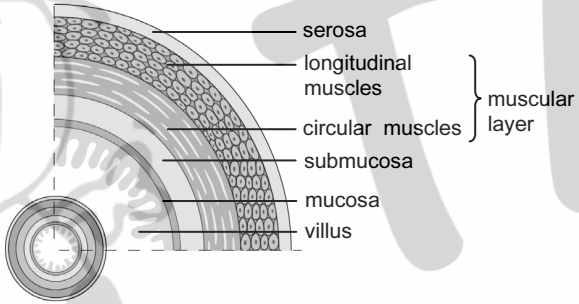
2.3

	Herbivores	Carnivores	Omnivores
Example	sheep/ cattle/ giraffes	lions/cats/ leopards	baboons/ pigs
Type of food	plant material	animal material (meat)	plant and animal material
Amount and energy value of food intake	large volumes of food are ingested - plant material has a very low energy value	ingest less food than herbivores - the protein and fat in meat have higher energy value	the amount of food omnivores consume depends on the energy value of the animal/plant material they eat
Tooth adaptations	sharp incisors to cut off plant material no canines to create more space in the mouth for large amounts of plant material large, flat premolars and molars to grind plant material	incisors have sharp ends to bite off food canines are long and strong to pierce, kill and tear prey apart premolars and molars have protrusions with sharp edges to cut off the food	teeth are similar to those of carnivores, except that their molars do not have such prominent protrusions baboons and pigs have well-developed canines that are mainly used for self-defence and social display

QUESTION 3

3.1
1 - oesophagus
2 - liver
3 - gall bladder
4 - stomach
5 - duodenum
7 - jejunum
8 - ileum
9 - appendix
10 - colon
11 - rectum
12 - anus

3.2



Cross section through the small intestine

3.3
- parotid
- submandibular
- sublingual

3.4 peristaltic movements

3.5
- helps to move food through the alimentary canal
- helps to mix food with other digestive juices

3.6 gastric juice

QUESTION 4

4.1
1 - serosa
2 - longitudinal muscles
3 - circular muscles
4 - submucosa
5 - mucosa
6 - villus

4.2
- very long
- transverse folds in the wall
- millions of villi
- villi lined with microvilli

4.3
- duodenum
- jejunum
- ileum

4.4 See p. 4.17 in the notes under the heading *'Functions of the small intestine'*.

QUESTION 5

5.1
1 - stomach
2 - pancreas
3 - pancreatic duct
4 - common bile duct
5 - duodenum
6 - gall bladder
7 - liver

5.2 See p. 4.19 in the notes under the heading *'Functions of the liver'*.

5.3 stores bile

5.4

	Exocrine glands	Endocrine glands
5.4.1	glands with ducts	ductless glands
5.4.2	normal pancreatic cells	islets of Langerhans
5.4.3	pancreatic juice with digestive enzymes	hormones/insulin and glucagon
5.4.4	duodenum	liver
5.4.5	pancreatic ducts	bloodstream

QUESTION 6

6.1
- incisors - bite or cut food
- canines - hold food in place and tear it off
- premolars, molars } chew and grind food

6.2 See p. 4.18 in the notes under the heading *'Functions of the tongue'*.

6.3
- chewing process
- bolus formation
- churning movements
- peristaltic movements