



Aitchison College Academic Resources.

IGCSE BIOLOGY (0610) RESOURCES

This document includes complete notes of each unit with unsolved and solved past paper questions. Don't forget to go through it and we hope this document will help you preparing for your exams.
Best of Luck!



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Paper Pattern:

Extended assessment

Extended candidates take Paper 2 and Paper 4. The questions are based on the Core and Supplement subject content:

Paper 2: Multiple Choice (Extended)

45 minutes

40 marks 30%

40 four-option multiple-choice questions

Externally assessed

Paper 4: Theory (Extended)

1 hour 15 minutes

80 marks 50%

Short-answer and structured questions

Externally assessed

Paper 6: Alternative to Practical

1 hour

40 marks 20%

Questions will be based on the experimental skills in Section 4

Externally assessed

Specimen Papers:

[Specimen Paper 2](#)

[Specimen Paper 4](#)

[Specimen Paper 6](#)



Chapter 1 : Characteristics and classification of living organism

1 Characteristics and classification of living organisms

1.1 Characteristics of living organisms

Core

Supplement

- 1 Describe the characteristics of living organisms by describing:
 - (a) movement as an action by an organism or part of an organism causing a change of position or place
 - (b) respiration as the chemical reactions in cells that break down nutrient molecules and release energy for metabolism
 - (c) sensitivity as the ability to detect and respond to changes in the internal or external environment
 - (d) growth as a permanent increase in size and dry mass
 - (e) reproduction as the processes that make more of the same kind of organism
 - (f) excretion as the removal of the waste products of metabolism and substances in excess of requirements
 - (g) nutrition as the taking in of materials for energy, growth and development



1.2 Concept and uses of classification systems

Core

- 1 State that organisms can be classified into groups by the features that they share
- 2 Describe a species as a group of organisms that can reproduce to produce fertile offspring
- 3 Describe the binomial system of naming species as an internationally agreed system in which the scientific name of an organism is made up of two parts showing the genus and species
- 4 Construct and use dichotomous keys based on identifiable features

Supplement

- 5 Explain that classification systems aim to reflect evolutionary relationships
- 6 Explain that the sequences of bases in DNA are used as a means of classification
- 7 Explain that groups of organisms which share a more recent ancestor (are more closely related) have base sequences in DNA that are more similar than those that share only a distant ancestor



1.3 Features of organisms

Core

- 1 State the main features used to place animals and plants into the appropriate kingdoms
- 2 State the main features used to place organisms into groups within the animal kingdom, limited to:
 - (a) the main groups of vertebrates: mammals, birds, reptiles, amphibians, fish
 - (b) the main groups of arthropods: myriapods, insects, arachnids, crustaceans
- 3 Classify organisms using the features identified in 1.3.1 and 1.3.2

Supplement

- 4 State the main features used to place all organisms into one of the five kingdoms: animal, plant, fungus, prokaryote, protocist
- 5 State the main features used to place organisms into groups within the plant kingdom, limited to ferns and flowering plants (dicotyledons and monocotyledons)
- 6 Classify organisms using the features identified in 1.3.4 and 1.3.5
- 7 State the features of viruses, limited to a protein coat and genetic material

Every living organism displays some particular characteristics which are:

- **Movement**- an action by an organism or part of an organism causing a change of position or place



- Respiration- chemical reactions in cells that break down nutrient molecules and release energy for metabolism
- **Sensitivity**- the ability to detect and respond to changes in the internal or external environment
- **Growth**- a permanent increase in size and dry mass
- **Reproduction**- the processes that make more of the same kind of organism
- **Excretion**- the removal of the waste products of metabolism and substances in excess of requirements
- **Nutrition**- the taking in of materials for energy, growth and development

This can be better remembered through the acronym MRS GREN. These characteristics are part of every single living organism.

How organisms are classified

- A species is defined as a group of organisms that can reproduce to produce fertile offspring
- Species can be classified into various groups by the features that they share anatomically and morphologically.
- Organisms are named using the binomial naming system (an internationally agreed upon naming system) where each name consists of 2 words; the first being of the genus (given by a capital letter) and the next of the species (starting with a lower-case letter)
- The sequence of classification starts from Kingdom and ends at Species shown in the diagram
- Classification systems aim to reflect evolutionary relationships
- Traditional classification systems used to classify using the anatomy or morphology
- However, it had many limitations
- Thus, DNA classification is used to classify organisms today



- Studies of DNA sequences of different species show that the more similar the base sequences in the DNA of two species, the more closely related those two species are (and the more recent in time their common ancestor is)
- This means that the base sequences in a mammal's DNA are more closely related to all other mammals than to any other vertebrate groups
- As DNA base sequences are used to code for amino acid sequences in proteins, the similarities in amino acid sequences can also be used to determine how closely related organisms are

Dichotomous keys

- These keys are used to identify organisms based on questions about their features; a commonly occurring question in the examinations.

Features of organisms

- There are 5 main kingdoms: Animalia, Plantae, Fungi, Protocista, and Prokaryotes

Features of Animalia:

Multicellular

Cells contain a nucleus but not a cell wall or chloroplasts

They feed on organic substances made by other organisms

Features of Plantae:

Multicellular

Cells contain a nucleus, cell wall and chloroplasts

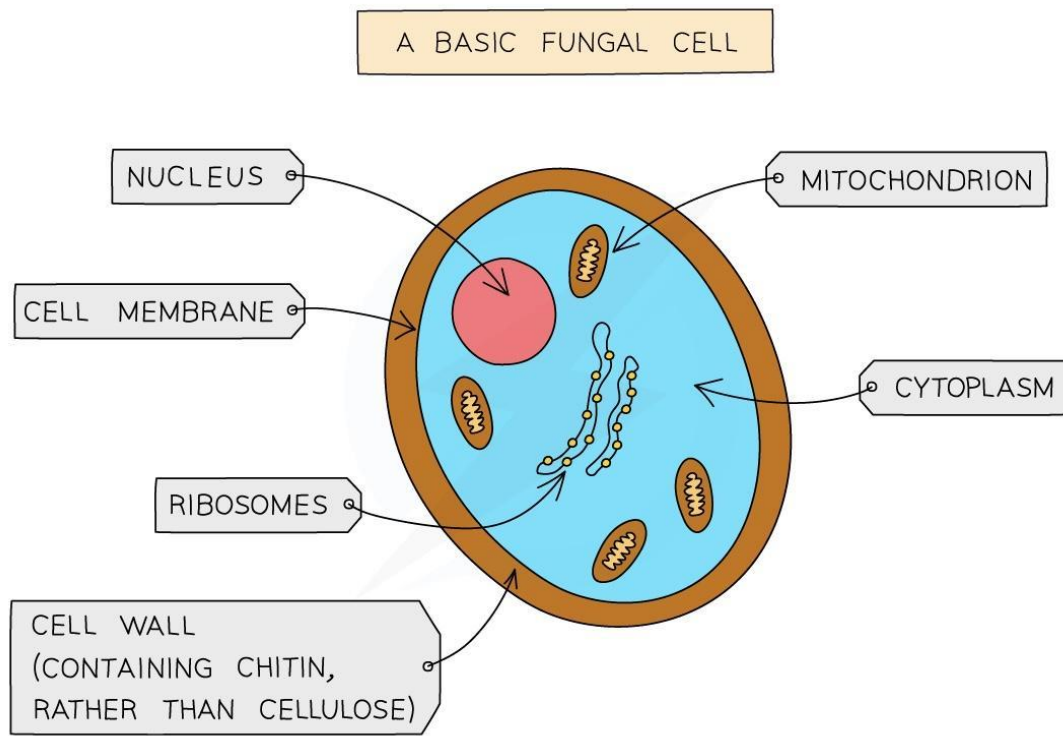
They all feed by photosynthesis and aren't reliant on other organisms as they make their own food

Features of Fungi:

Multicellular usually

Cells have nucleus and cell walls not made of cellulose but chitin

Feed saprophytically on dead or decayed material

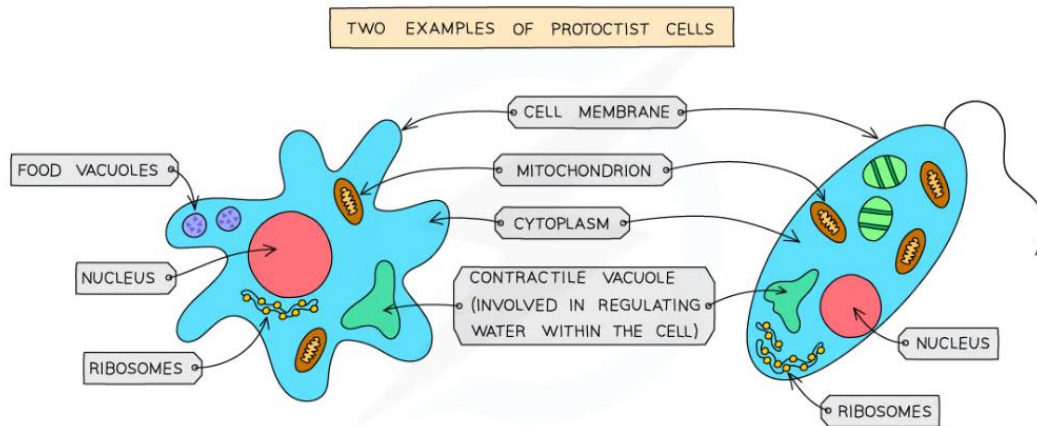


Features of Prototista:

Usually unicellular

All have nucleus, some have animals features and some have plant features

Some photosynthesis and some feed on other organic substances made by other living organisms



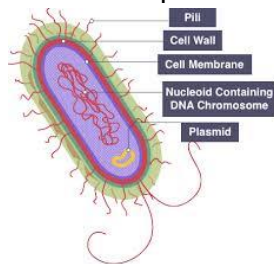


Features of Prokaryotes:

Unicellular

Cells have cell walls made of peptidoglycan but no nucleus or mitochondria

Often have plasmids



Within the animal kingdom, several main features differentiate various organisms into groups - vertebrates and invertebrates

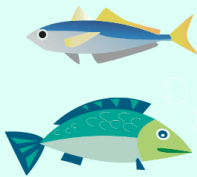
All vertebrates have a backbone and are classified into 5 classes

Class	Characteristic Features	Examples
Mammals	Hair/Fur on skin Have placenta Young feed on milk from mammary glands Endothermic Pinna visible	Human, Dog, Elephant, Lion
Birds	Feathers on skin 2 legs and 2 wings instead of forelimbs Lay eggs with hard shells on land Have a beak Endothermic Scales on leg sometimes	Eagle, Sparrow, Dove
Fish	Loose scales on skin Lay eggs without shells in water Gills to breathe	Salmon, shark, trout
Reptiles	Dry scales on skin	Snake, crocodile, turtle



	Lay eggs with soft shells on land	
Amphibians	Smooth, moist skin with no scales Lay eggs without shells in water Larvae live in water and have gills Adults usually live on land and have lungs	Frogs, salamanders, toads

5 Groups of Vertebrates

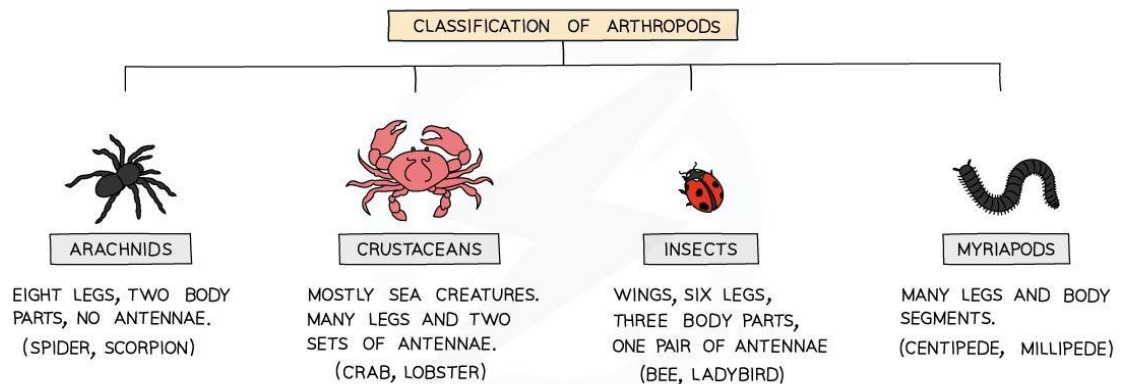
Fish	Amphibians	Reptiles	Birds	Mammals
				
• Cold-blooded • Gills • Scales and fins • Lay eggs or live birth in water	• Cold-blooded • Gills and lungs • Thin moist skin • Lay jelly-like eggs in water	• Cold-blooded • Lungs • Scales • Lay leathery eggs on land or live birth	• Warm-blooded • Lungs • Feathers • Lay hard eggs on land	• Warm-blooded • Lungs • Hair • Live birth and feed young milk

Invertebrates don't possess a backbone. All invertebrates with jointed legs are termed as arthropods. Arthropods also possess exoskeletons. Arthropods are grouped into more groups:

Arthropod Group	Characteristic Features	Examples
Myriapods	Body has many segments	Centipede



	Each segment contains at least one pair of jointed legs 1 Pair of antennae	
Insects	Body consists of the head, thorax and abdomen 3 pairs of jointed legs 2 pairs of wings (one or both may be vestigial) 1 pair of antennae	Butterfly
Arachnids	Body consists of the cephalothorax and abdomen 4 pairs of jointed legs No antennae	Spider
Crustaceans	More than 4 pairs of jointed legs 2 pairs of antennae Breathe through gills	Crab



The plant kingdom includes ferns and flowering plants

Ferns:

Ferns have leaves called fronds

Don't produce flowers but reproduce by spores produced on the underside of fronds



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Flowering plants:

Reproduce sexually by flowers and seeds

Are divided into monocotyledons and dicotyledons

Monocots:

Flower parts in multiples of 3

Leaves have parallel veins

Seeds have one cotyledon

Dicots:

Flower parts in multiples of 4 or 5

Leaves have branched veins

Seeds have two cotyledons

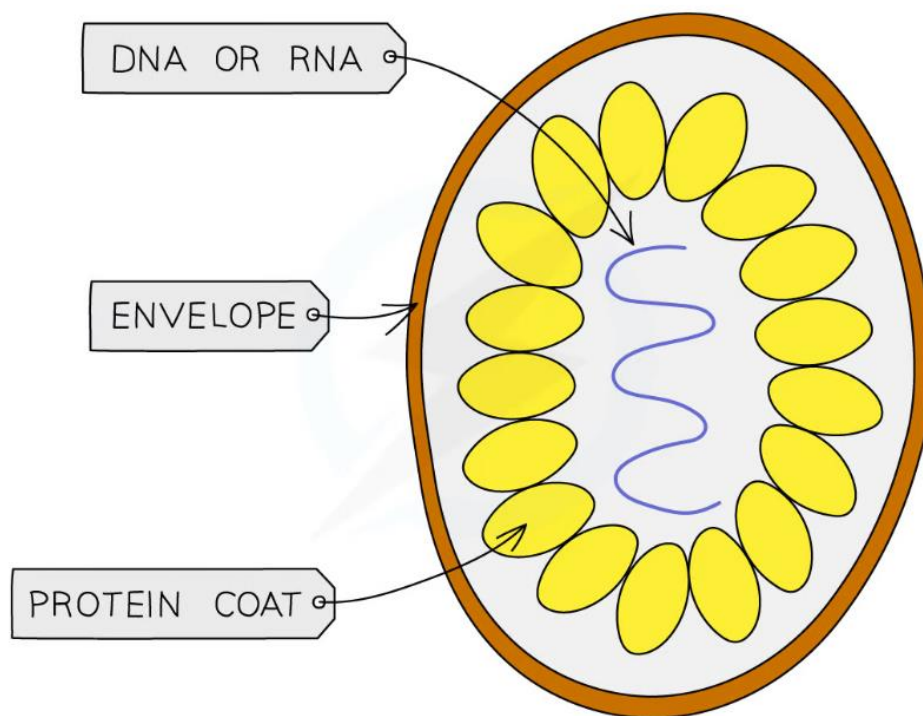
Viruses:

Aren't deemed as living things

Don't carry out all 7 life processes

Take over host cell and use it to make multiple copies of itself

Made up of genetic material inside a protein coat



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MCQ Questions

Phototropism demonstrates which two characteristics of living organisms?

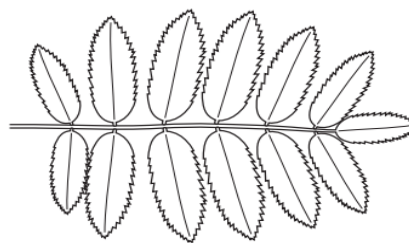
- A growth and nutrition
- B growth and sensitivity
- C movement and nutrition
- D nutrition and sensitivity

A rat has the scientific name *Rattus rattus*.

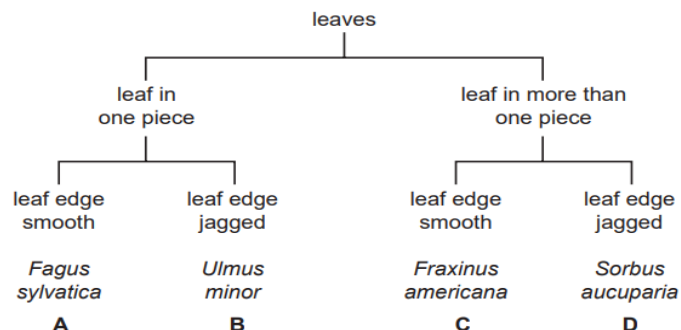
What do the two parts of this name refer to?

- A genus and species
- B kingdom and genus
- C kingdom and species
- D variety and genus

The diagram shows a leaf.



Use the key to identify the plant to which the leaf belongs.





The diagram shows a flower seen from above.



Use the key to find the name of the family to which it belongs.

- | | | |
|---|-----------------------|----------------------------------|
| 1 | four petals | go to 2 |
| | five petals | go to 3 |
| 2 | two stamens | A <i>Scrophulariaceae</i> |
| | six stamens | B <i>Brassicaceae</i> |
| 3 | petals joined..... | C <i>Caryophyllaceae</i> |
| | petals separate | D <i>Rosaceae</i> |

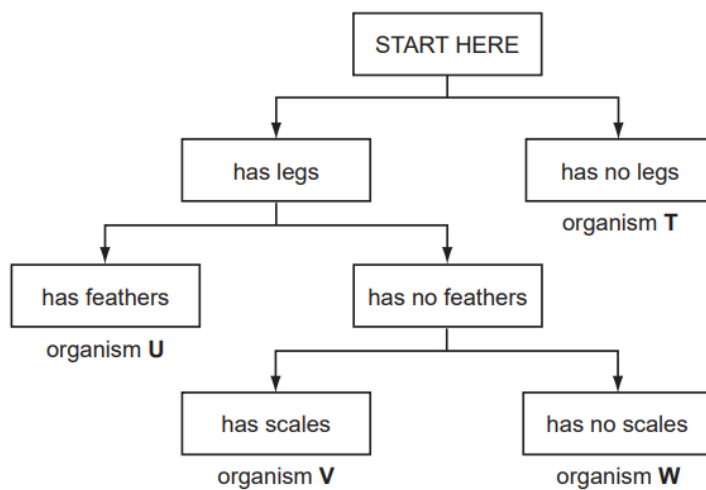
Some lizards detach their tails when threatened by a predator.

Which characteristic is shown?

- A** excretion
- B** growth
- C** reproduction
- D** sensitivity



The diagram shows a key for five vertebrates.



Which class of vertebrates does organism **W** belong to?

- A** amphibians
- B** birds
- C** fish
- D** reptiles

What are the features of the leaves of a plant that is a eudicotyledon (dicotyledon)?

	broad leaves	parallel veins
A	✓	✓
B	✓	x
C	x	✓
D	x	x



Use the key to identify which group is amphibians.

- | | | |
|---|------------------------|---------|
| 1 | hair present | mammals |
| | hair absent | go to 2 |
| 2 | feathers present | group A |
| | feathers absent | go to 3 |
| 3 | dry scaly skin..... | group B |
| | moist skin | go to 4 |
| 4 | four limbs | group C |
| | no limbs | group D |

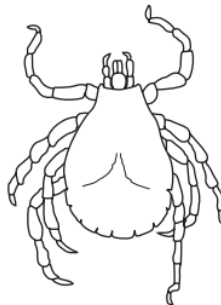
The diagram shows four arthropods.



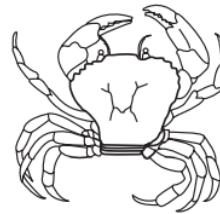
Pediculus ×20



Anopheles ×10



Dermacentor ×7



Carcinus ×0.5

How many of these arthropods are insects?

- A 1 B 2 C 3 D 4



The statements describe four different plants.

Which plant must be a monocotyledon?

- A** The flowers are wind-pollinated.
- B** The flowers each have five petals.
- C** The leaves are large with a clear network of veins on them.
- D** The leaves have parallel veins.

Answers

- B
- A
- D
- B
- D
- A
- B
- C
- B
- D



Structured Questions

Fig. 1.1 shows five species of mollusc.

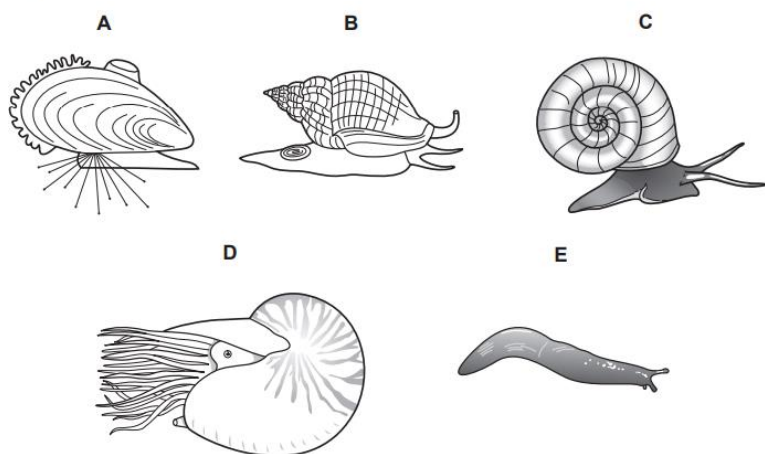


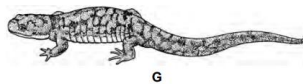
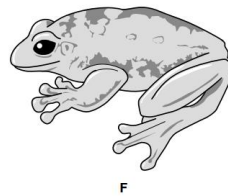
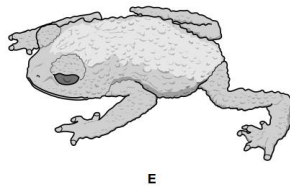
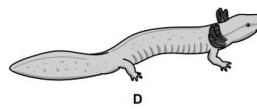
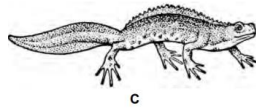
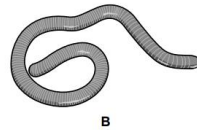
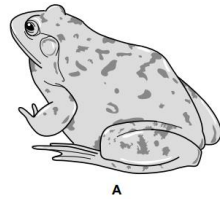
Fig. 1.1

Use the key to identify each species. Write the letter of each species (A to E) in the correct box beside the key.

Key

1 (a)	body is completely or partly covered in a shell	go to 2	
(b)	body is not completely covered or partly covered in a shell	<i>Limax flavus</i>	
2 (a)	shell is attached to rocks by thin threads	<i>Mytilus edulis</i>	
(b)	shell is not attached to rocks by thin threads	go to 3	
3 (a)	shell is a spire that comes to a point	<i>Buccinum undatum</i>	
(b)	shell is not a spire that comes to a point	go to 4	
4 (a)	animal has tentacles	<i>Nautilus pompilius</i>	
(b)	animal has 2 tentacles	<i>Planorbis planorbis</i>	

[3]



not drawn to scale

- (a) Use the key to identify each species. Write the letter of each species (A to G) in the correct box beside the key. One has been done for you.

Key

1 (a)	long, narrow body, with or without legs	go to 2	
(b)	body not long and narrow, back legs are larger than the front legs	go to 5	
2 (a)	body without legs	<i>Gymnopsis multiplicata</i>	B
(b)	body with legs which are all of the same size	go to 3	
3 (a)	raised crest along the back of the body	<i>Triturus cristatus</i>	
(b)	no crest along the back of the body	go to 4	
4 (a)	gills present	<i>Necturus maculosus</i>	
(b)	no gills present	<i>Ambystoma tigrinum</i>	
5 (a)	skin is smooth	go to 6	
(b)	skin is not smooth	<i>Oreophrynella quelchii</i>	
6 (a)	digits end in swellings	<i>Polypedates leucomystax</i>	
(b)	digits do not end in round swellings	<i>Rana temporaria</i>	

Answers:

C, D, G, E, F



Chapter 2: Organization of the organism

2 Organisation of the organism

2.1 Cell structure

Core

- 1 Describe and compare the structure of a plant cell with an animal cell, limited to: cell wall, cell membrane, nucleus, cytoplasm, chloroplasts, ribosomes, mitochondria, vacuoles
- 2 Describe the structure of a bacterial cell, limited to: cell wall, cell membrane, cytoplasm, ribosomes, circular DNA, plasmids
- 3 Identify the cell structures listed in 2.1.1 and 2.1.2 in diagrams and images of plant, animal and bacterial cells
- 4 Describe the functions of the structures listed in 2.1.1 and 2.1.2 in plant, animal and bacterial cells
- 5 State that new cells are produced by division of existing cells
- 6 State that specialised cells have specific functions, limited to:
 - (a) ciliated cells – movement of mucus in the trachea and bronchi
 - (b) root hair cells – absorption
 - (c) palisade mesophyll cells – photosynthesis
 - (d) neurones – conduction of electrical impulses
 - (e) red blood cells – transport of oxygen
 - (f) sperm and egg cells (gametes) – reproduction
- 7 Describe the meaning of the terms: cell, tissue, organ, organ system and organism as illustrated by examples given in the syllabus

Supplement

2.2 Size of specimens

Core

- 1 State and use the formula:
 $\text{magnification} = \text{image size} \div \text{actual size}$
- 2 Calculate magnification and size of biological specimens using millimetres as units

Supplement

- 3 Convert measurements between millimetres (mm) and micrometres (μm)



<u>Structure</u>	<u>Found in?(Plants, Animals or both)</u>
Cell Membrane	Both
Cell Wall	Plants
Cytoplasm	Both
Vacuole	Both
Nucleus	Both
Chloroplast	Plants
Mitochondria	Both
Ribosomes	Both

Cells

The building block of an organism.

Smallest unit of which an organism is made up of

There are 2 types organisms

Unicellular organisms

Organisms made up of only one cell.

E.g Bacteria And Yeast

Multicellular organisms

Organisms made up of multiple cells

E.g Humans

Structure of a cell

A cell is made up of a lot of components. Some of the components are found in both Plants and animals whereas some components are only found in plants and not the animals.

Cell Wall

Made up of only cellulose

Gives support to to cell

stop it from bursting if too much water moves in the cell

Fully permeable as there are large spaces in the structure



Cell Membrane

Around the outside

Thin layer made up of protein and fat

Controls what goes in and out of cell

Partially membrane, meaning some substances will be allowed and others will be not.

Sometimes the cell membrane is not seen because it is tightly attached to the cell wall.

Cytoplasm

Clear jelly like structure; 70% of it is water

Act as a solvent; many substances are dissolved in it

Most of the metabolic reactions takes place in cytoplasm

Vacuole

Fluid-filled space

Has its own membrane

In plants the vacuole is large and permanent and it contains the solution of sugars and other substances called cell sap

Animals have smaller vacuoles called vesicles.

Nucleus

Contains the DNA (stores the genetic information)

Chromosomes make up the DNA.

The information on the DNA determines which proteins to make in cells

Chloroplast

Found in the green parts of the plants

Contain green colored pigment called chlorophyll

Chloroplast contains starch grains(tiny pieces of starch)

Mitochondria

Part of the cell where aerobic respiration takes place

Through aerobic respiration energy is released; that's why mitochondria is called energy powerhouse of cell

Ribosomes

Proteins are made here

The proteins are made according to the instructions on the DNA

Bacterial Cell

Has a cell wall which is made by peptidoglycan

Has cell membrane, cytoplasm, ribosomes

Doent have a nucleus but has a circular DNA

Other than DNA, they have one or smaller circles of DNA called plasmids

Does Not contain mitochondria or chloroplast.

These cells are Prokaryotic cells as they dont have a nucleus. ("Pro" means "before" and "karyotic" means "nucleus")



Specialized cells

These cells have a particular function to perform and their structure is modified to help them carry out their specific tasks. Such cells are known as specialized cells.

Specialized cells	Where is it found	Function
Ciliated cell	Lining in the trachea and bronchi of mammals	Cilia moves upward
Neurone	In the nervous system of animals	Conducting electrical impulses
Red Blood Cells	In the blood of mammals	Transporting oxygen
Sperm Cells	Produced in the testes of mammals	The male gamete in sexual reproduction
Egg Cells	Produced in the ovaries of mammal	The female gamete in reproduction
Root Hair Cell	Near the tips of the roots of the flowering plants	Absorption of water and mineral ions
Palisade Mesophyll Cell	In leaves of flowering plants	Photosynthesis

A group of similar cells that work together to perform a particular function is called a **tissue**

Group of tissues working together to perform a specific task is known as an **organ**
Several organs working together to perform a specific function is known as the **organ system**.

Microscope And Magnification

There are 2 types of microscope

Light Microscope

In it the light shines through the piece of animal or plant you are looking at. It can magnify up to 1500 times. Photo taken by a light microscope is known as **photomicrograph**

Electron Microscope



This microscope uses a beam of electrons instead of light and it can magnify up to 500000 times. Mitochondria and ribosomes can only be seen by using electron microscope because they are very small.

Magnification

Magnification = (Size of Image) / (Size of actual object)

1 micrometer = 0.000001 m or 10^{-6} m

1 meter = 1000000 micrometer or 10^6 m

Questions:

MCQ's:

1.

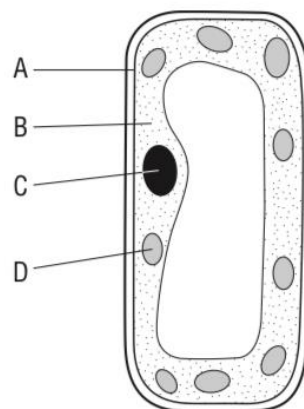
In a plant, what is formed by a group of xylem vessels?

- A a cell
- B a tissue
- C an organ
- D an organ system

2.

The diagram shows a palisade mesophyll cell.

Which structure is **not** found in an animal cell?





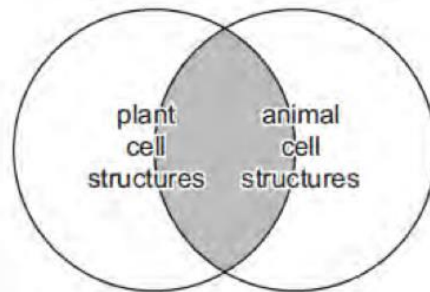
3.

What is the correct order of increasing size of the following structures, from smallest to largest?

- A** chromosome → liver → white blood cell
- B** chromosome → white blood cell → liver
- C** liver → chromosome → white blood cell
- D** white blood cell → liver → chromosome

4.

The shaded area of the diagram represents structures found in both plant and animal cells.



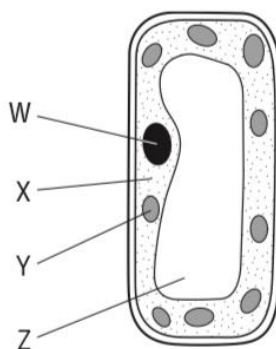
Which cell structure is from the shaded area?

- A** cell membrane
- B** cell wall
- C** chloroplast
- D** large vacuole



5.

The diagram shows a palisade mesophyll cell from a green leaf.



In which labelled part does photosynthesis occur and where is starch stored?

	photosynthesis occurs	starch is stored
A	X	W
B	X	Z
C	Y	X
D	Y	Y

Answers:

1 B

2 D

3 B

4 A

5 D

6 A

7 B

8 A

9 A

10 B



Structured Questions

Fig. 3.1 shows images of red blood cells from a human, **A**, and a bird, **B**.

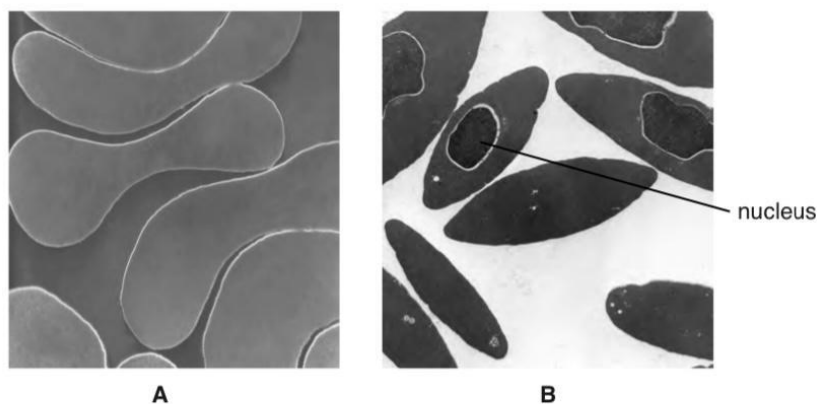


Fig. 3.1

- (a) State the function of red blood cells.

.....
.....
..... [1]

- (b) There is a nucleus present in each of the red blood cells of the bird, as shown in Fig. 3.1.

- (i) State the function of a nucleus.

.....
.....
..... [1]

- (ii) Human red blood cells do not contain a nucleus.

State an advantage of this.

.....
.....
..... [1]



Leaves are made of tissues.

(a) Define the term *tissue*.

.....
.....
.....[1]

Fig. 4.1 is a photograph of a transverse section of a leaf, showing the upper and lower surfaces.

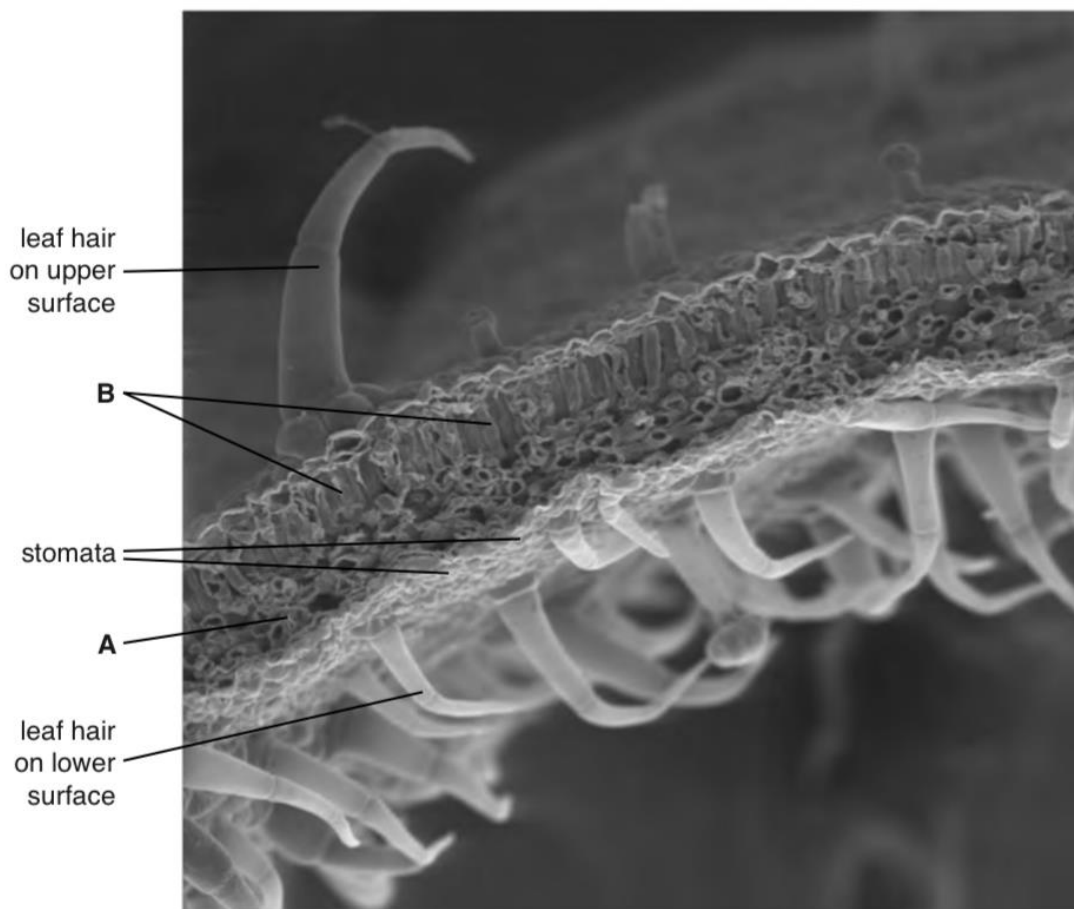


Fig. 4.1

(b) Name:

(i) tissue **A**

.....[1]

(ii) the process by which gases travel through the stomata.

.....[1]



(c) Describe how root hair cells differ from the cells labelled **B** in Fig. 4.1.

.....

.....

.....

.....

.....[2]



Fig. 1.2 shows a cell from region **B** of the leaf shown in Fig. 1.1.

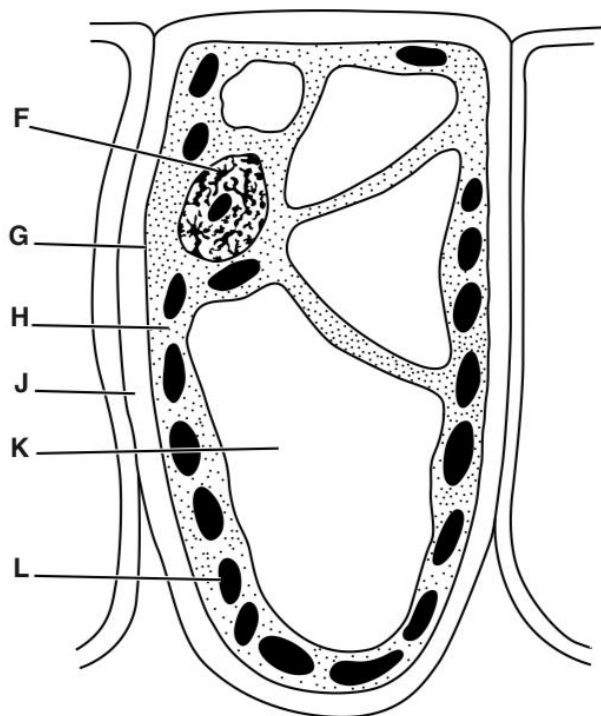


Fig. 1.2

Use the letters from Fig. 1.2 to complete Table 1.1.

Write **one** letter only in each box to identify the function. You may use each letter once, more than once or not at all.

Table 1.1

function	letter from Fig. 1.2
controls movement of substances into and out of the cell	
exerts a pressure to help maintain the shape of the cell	
produces sugars using light as a source of energy	
withstands the internal pressure of the cell	
controls all the activities of the cell	

[5]



Fig. 1.1 shows an animal cell and a plant cell as seen with a light microscope.

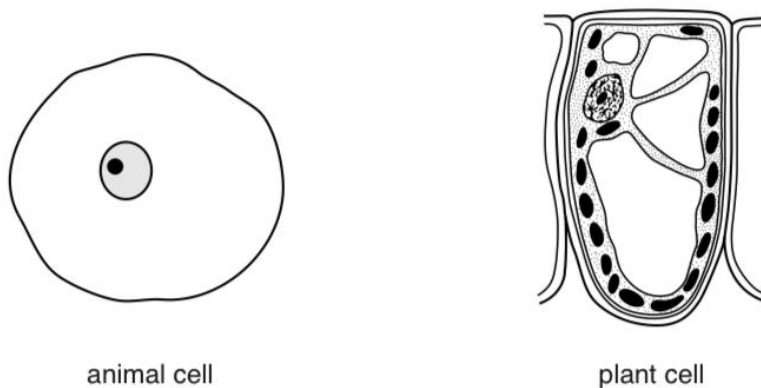


Fig. 1.1

(a) Table 1.1 shows some structural features of the animal cell and the plant cell in Fig. 1.1.

Complete the table by

- finishing the row for nucleus
- adding **three** structural features, visible in Fig. 1.1, and indicating whether they are present (✓) or absent (✗) in the animal cell and in the plant cell.

Table 1.1

structural feature	animal cell	plant cell
cell wall	✗	✓
nucleus		

[4]



Fig. 3.1 shows images of red blood cells from a human, **A**, and a bird, **B**.

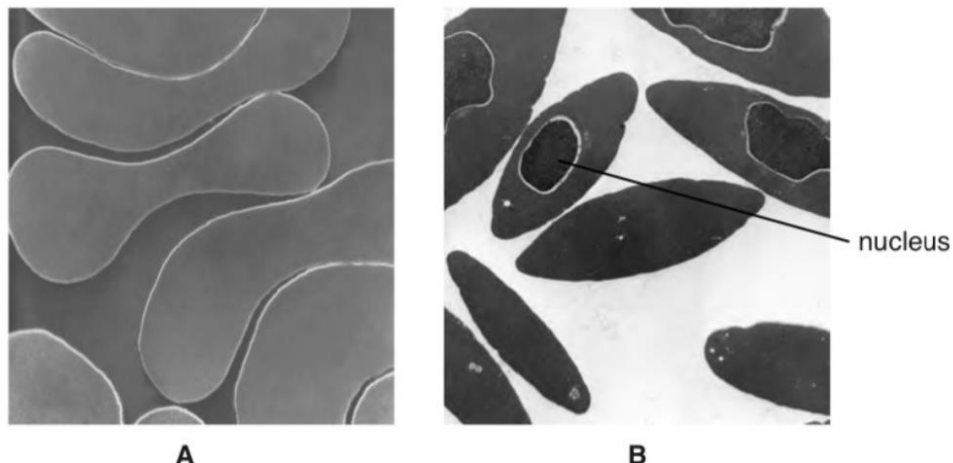


Fig. 3.1

- (a)** State the function of red blood cells.

They transport oxygen around the body.....
.....
..... [1]

- (b)** There is a nucleus present in each of the red blood cells of the bird, as shown in Fig. 3.1.

- (i)** State the function of a nucleus.

It is responsible for controlling the activities
of the cell and contains genetic information.
..... [1]

- (ii)** Human red blood cells do not contain a nucleus.

State an advantage of this.

More space for haemoglobin and more
efficient oxygen carrying ability
..... [1]



Leaves are made of tissues.

(a) Define the term *tissue*.

A tissue is a group of similar cells working
together to perform a specific function

.....[1]

Fig. 4.1 is a photograph of a transverse section of a leaf, showing the upper and lower surfaces.

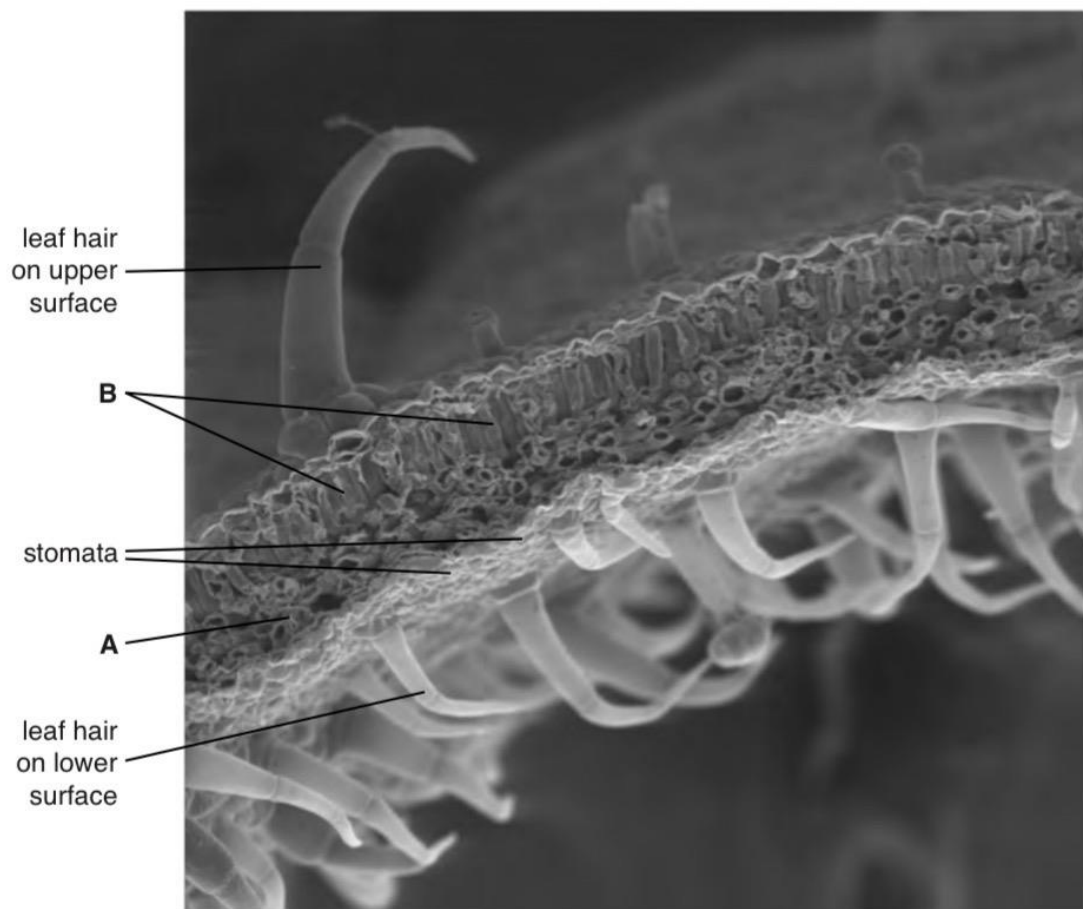


Fig. 4.1

(b) Name:

(i) tissue A

Spongy mesophyll.....[1]

(ii) the process by which gases travel through the stomata.

Diffusion.....[1]



- (c) Describe how root hair cells differ from the cells labelled **B** in Fig. 4.1.

Root hair cells aren't column shaped. Root hair cells.....
don't have chloroplasts

[2]



Fig. 1.2 shows a cell from region **B** of the leaf shown in Fig. 1.1.

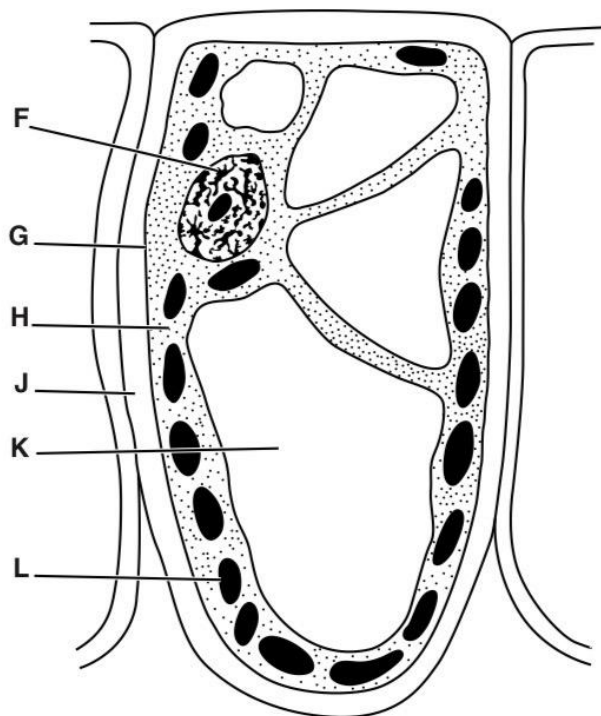


Fig. 1.2

Use the letters from Fig. 1.2 to complete Table 1.1.

Write **one** letter only in each box to identify the function. You may use each letter once, more than once or not at all.

Table 1.1

function	letter from Fig. 1.2
controls movement of substances into and out of the cell	G
exerts a pressure to help maintain the shape of the cell	K
produces sugars using light as a source of energy	L
withstands the internal pressure of the cell	J
controls all the activities of the cell	F

[5]



Fig. 1.1 shows an animal cell and a plant cell as seen with a light microscope.

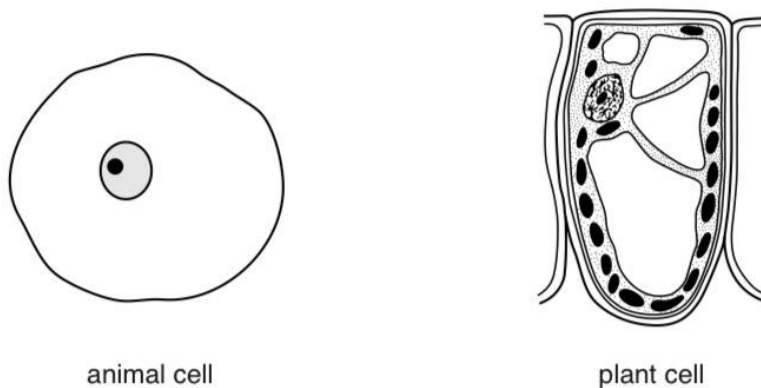


Fig. 1.1

(a) Table 1.1 shows some structural features of the animal cell and the plant cell in Fig. 1.1.

Complete the table by

- finishing the row for nucleus
- adding **three** structural features, visible in Fig. 1.1, and indicating whether they are present (✓) or absent (✗) in the animal cell and in the plant cell.

Table 1.1

structural feature	animal cell	plant cell
cell wall	✗	✓
nucleus	✓	✓
Chloroplast	✗	✗
Cell Membrane	✓	✓
Cytoplasm	✓	✓

[4]



Chapter 3: Movement In And Out of Cell

3 Movement into and out of cells

3.1 Diffusion

Core

- 1 Describe diffusion as the net movement of particles from a region of their higher concentration to a region of their lower concentration (i.e. down a concentration gradient), as a result of their random movement
- 2 State that the energy for diffusion comes from the kinetic energy of random movement of molecules and ions
- 3 State that some substances move into and out of cells by diffusion through the cell membrane
- 4 Describe the importance of diffusion of gases and solutes in living organisms
- 5 Investigate the factors that influence diffusion, limited to: surface area, temperature, concentration gradient and distance

Supplement

3.2 Osmosis

Core

- 1 Describe the role of water as a solvent in organisms with reference to digestion, excretion and transport
- 2 State that water diffuses through partially permeable membranes by osmosis
- 3 State that water moves into and out of cells by osmosis through the cell membrane
- 4 Investigate osmosis using materials such as dialysis tubing
- 5 Investigate and describe the effects on plant tissues of immersing them in solutions of different concentrations
- 6 State that plants are supported by the pressure of water inside the cells pressing outwards on the cell wall

Supplement

- 7 Describe osmosis as the net movement of water molecules from a region of higher water potential (dilute solution) to a region of lower water potential (concentrated solution), through a partially permeable membrane
- 8 Explain the effects on plant cells of immersing them in solutions of different concentrations by using the terms: turgid, turgor pressure, plasmolysis, flaccid
- 9 Explain the importance of water potential and osmosis in the uptake and loss of water by organisms



3.3 Active transport

Core

- 1 Describe active transport as the movement of particles through a cell membrane from a region of lower concentration to a region of higher concentration (i.e. against a concentration gradient), using energy from respiration

Supplement

- 2 Explain the importance of active transport as a process for movement of molecules or ions across membranes, including ion uptake by root hairs
- 3 State that protein carriers move molecules or ions across a membrane during active transport



There are 3 types of way through which the particles can spread out or move into and out of the cell:

Diffusion

Osmosis

Active Transport

Diffusion

It is the net movement of particles from the area of high concentration to an area of low concentration as a result of their random movement

Down the concentration gradient

Diffusion in living organisms

An important process in organisms body

Through this way organisms such as human get rid of their waste products and are able to absorb or intake the substances that are necessary to them

No external energy is required to carry out the process of diffusion.

For diffusion it is not necessary to have a cell membrane; diffusion can happen with and without the presence of cell membrane

Example of diffusion taking place in plants and animals

	Site	Particle	From	To
Animal	Lungs	Oxygen	The alveoli in the lungs	Blood capillaries
Plant	Stomata(leaf)	Carbon dioxide	The atmosphere	Onto the leaf

Factors Influencing Diffusion

Temperature



Higher the temperature, faster the diffusion. This is because at high temperature the particles have more kinetic energy so particles will move faster thus higher the rate of diffusion

Distance

More the distance less the rate of diffusion. The particles will have to travel more distance which will lead to slower rate of diffusion

Concentration Gradient

The greater the concentration gradient, the greater the diffusion rate. More concentration gradient means more particles which will lead to particles spreading out quickly .

Surface area

The greater the surface area of an object the more the rate of diffusion. If the surface area of a cell is bigger it means more particles can enter it at a time so faster rate of diffusion.

Osmosis

It is the net movement of water particles from an area of higher water potential to an area of lower water potential.

Also down the concentration gradient

Water can move in and out of the cell through the process of osmosis.

No energy is required for this process

For osmosis to take place the presence of partially permeable membrane is a must

Osmosis in animals

If there is more concentrated solution in the animal cell(less water potential area) and the outside of the cell has more diluted solution(more water potential) then the water particles will travel from outside of the cell(high water potential) to inside of the cell(low water potential). Sometimes in an animal cell so much water enters the cell through osmosis that the cell bursts. This happens because an animal cell doesn't have a cell wall to prevent it from bursting.

Osmosis in plants

In plants osmosis also takes place from an area of higher water potential to an area of less water potential. In plants if too much water enters the cell through osmosis then the cell would not burst because the cell wall will stop it from bursting. The cell becomes turgid. The pressure of the water pushing outwards on the cell wall is known as turgor pressure. Turgor is important to keep the leaves firm and plant upright. If the



plant cells have too little water after osmosis takes place then cells will become flaccid.

Active transport

Net movement of particles from an area of low concentration gradient to an area of high concentration gradient.

Up the concentration gradient

Requires energy(ATP) to carry out the process

Energy is required because the particles have to move against the gradient.

Living partially permeable membrane is required

There are special proteins in cell membranes known as “special carrier proteins” that help to carry out the process. These proteins often have specific shapes to allow them to carry out this process

Through active transport, plants take in nitrate ions from the soil which are necessary for the plant



Chapter 4: Biological Molecules

4 Biological molecules

4.1 Biological molecules

Core

- 1 List the chemical elements that make up: carbohydrates, fats and proteins
- 2 State that large molecules are made from smaller molecules, limited to:
 - (a) starch, glycogen and cellulose from glucose
 - (b) proteins from amino acids
 - (c) fats and oils from fatty acids and glycerol
- 3 Describe the use of:
 - (a) iodine solution test for starch
 - (b) Benedict's solution test for reducing sugars
 - (c) biuret test for proteins
 - (d) ethanol emulsion test for fats and oils
 - (e) DCPIP test for vitamin C

Supplement

- 4 Describe the structure of a DNA molecule:
 - (a) two strands coiled together to form a double helix
 - (b) each strand contains chemicals called bases
 - (c) bonds between pairs of bases hold the strands together
 - (d) the bases always pair up in the same way: A with T, and C with G (full names are **not** required)



Some of the Biological molecules are
Carbohydrates
Fats
Proteins

Carbohydrates

These molecules are made up of three elements: oxygen, carbon and hydrogen.
One molecule contains twice as many hydrogen as oxygen or carbon atoms.
Examples of carbohydrates are starch, cellulose and sugars.

Glucose (a carbohydrate) has a hexagonal shape. It is the way carbohydrates are transported from one place to another in the body.

The glucose is not stored as it is in animals. It is first converted into a bigger molecule known as **glycogen** by joining a lot of glucose together.

In plants glucose is stored in a different way. Plants store them as **starch**.

Iodine test is carried out to check the presence of starch. If the starch is present then the iodine solution turns blue black from brown.

Cellulose (a carbohydrate) made by linking up glucose in spiral shape is used to plant cell walls

Presence of reducing sugars can be tested through **Benedict's solution**. Its color originally is blue but gradually turns to green then yellow and at last orange red.

If the color is green then it means that the concentration of reducing sugars is less but if the color is orange red then it means that the concentration of reducing sugars is very high.

Fats and Oils

Also known as **lipids**

They also contain 3 elements: oxygen, carbon and hydrogen.

Fat molecules are made up of 2 kinds of smaller molecules: **glycerol** and **fatty acids**.

Each glycerol molecule is attached to 3 fatty acids.

Fats are used to make cell membrane. They are also used as energy stores and the layer of fat beneath the skin plays the role of an insulating layer keeping the body warm.

Presence of fats can be checked through **fat emulsion test**. Shake the sample with ethanol so that if there is fat it dissolves in it. Now pour the ethanol solution into water. If there are fats present then tiny droplets appear throughout the solution which gives it a milky appearance.

Emulsion is a liquid containing 2 substances that don't fully mix.



Proteins

Contain 4 elements - carbon oxygen hydrogen and nitrogen. Some proteins also contain Sulphur.

Proteins are made up of many **amino acids** joined together in long chains.

Proteins are needed for various things. They are needed to make **enzymes** and antibodies.

Haemoglobin, the red pigment in mammalian blood, is a protein.

Hair and fingernails are also made from a protein called **keratin**.

Biuret reagent can be used to check the presence of proteins. If protein is present color change from blue to violet is observed

DNA

Found in the nucleus of every cell (except for red blood cells).

Double-helix shape

Carries the instruction which tells the cell which amino acids to link together in which sequence to make a particular gene

Inherited from parents

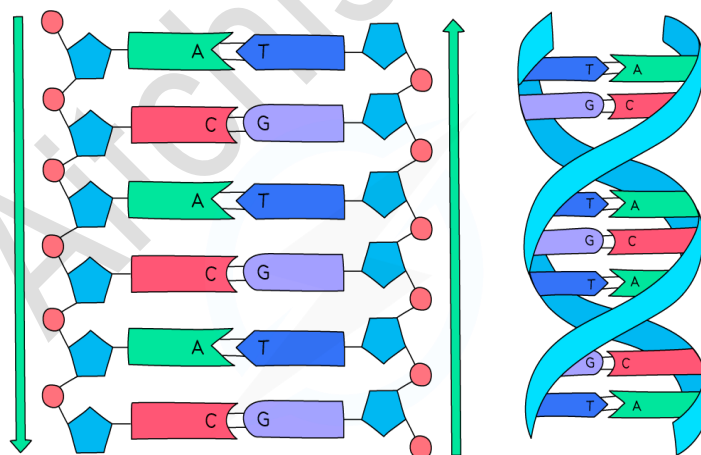
Made up of smaller molecules called **nucleotides**. Nucleotides are linked together to form DNA.

Each nucleotide contains a **base**

There are 4 types of bases: "A,C,G,T"

A is for Adenine, C is for cytosine, G is for guanine and T is for thymine

"A" base always forms a bond with base "T" and base "C" always forms a bond with base "G". This is known as complementary base pairing.



EACH STRAND IS USED SEPARATELY, A GENE IS A SEQUENCE OF BASES – NOT A SEQUENCE OF BASE PAIRS!

For Vit C test is carried out in which a DCPIP solution is added to a solution. If it contains Vitamin C, it goes from blue to colorless



MCQS

- 1 Small molecules are used as the basic units in the synthesis of large food molecules.

Which statement is correct?

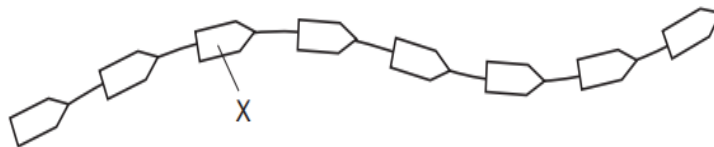
- A Amino acids are basic units of carbohydrates.
- B Fatty acids are basic units of glycogen.
- C Glycerol is a basic unit of oils.
- D Simple sugar is a basic unit of protein.

- 2 When a substance is added to meat, amino acids are produced.

What is this substance?

- A a hormone
- B an enzyme
- C an oil
- D water

- 3 The diagram shows part of a protein molecule.



What does X represent?

- A amino acid
- B fatty acid
- C glycerol
- D sugar



- 4 Four different foods were tested for their composition.

The results are shown in the table.

Which food contains protein but **not** reducing sugar or starch?

	Benedict's test	iodine test	biuret test
A	blue	black	purple
B	blue	brown	purple
C	brick red	black	blue
D	brick red	brown	blue

- 5 What are the smaller basic units of starch and glycogen molecules?

	starch	glycogen
A	amino acids	fatty acids and glycerol
B	amino acids	simple sugars
C	simple sugars	fatty acids and glycerol
D	simple sugars	simple sugars

- 6 The diagram represents a protein molecule.



What do the small circles represent?

- A** amino acids
- B** fatty acids
- C** glycerol
- D** simple sugars



- 7 Which row shows the elements and basic units that are used in the construction of large food molecules?

	food molecules	elements	basic units
A	fats	carbon, hydrogen, oxygen, nitrogen	glucose
B	fats	carbon, hydrogen, oxygen, nitrogen	glycerol
C	starch	carbon, hydrogen, oxygen	glucose
D	starch	carbon, hydrogen, oxygen	glycerol

- 8 Which nutrient produces a purple colour when mixed with biuret solution?

- A** fat
- B** protein
- C** reducing sugar
- D** starch

- 9 Which simple molecules are the basic units of protein?

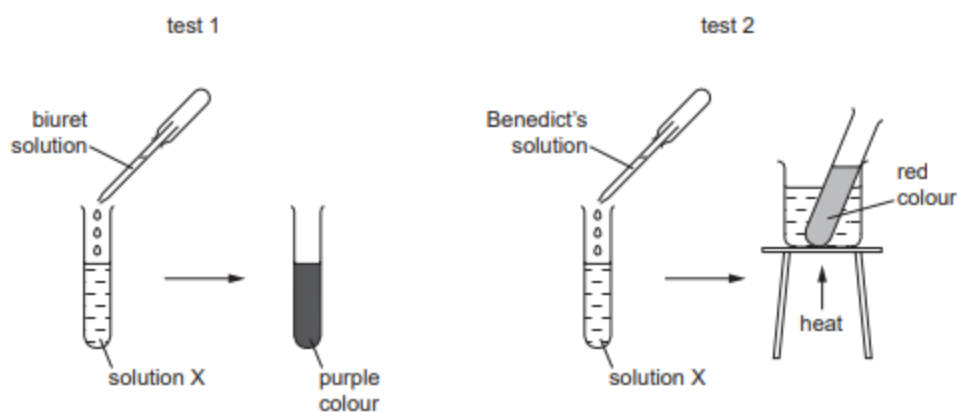
- A** amino acids
- B** fatty acids
- C** sugars
- D** vitamins

- 10 Which food-testing reagent shows a positive result when it turns from blue to purple?

- A** Benedict's solution
- B** biuret reagent
- C** ethanol
- D** iodine solution



11 The diagram shows two food tests carried out on solution X.



Which nutrients are present in solution X?

- A protein and starch
- B protein and sugar
- C starch and fat
- D starch and sugar

12 The data show the concentrations of sugar and starch in an onion.

total sugar including reducing sugar /g per 100g	starch /g per 100g
3.7	0.

The onion is tested with Benedict's solution and iodine solution.

Which set of results is correct?

	Benedict's solution	iodine solution
A	blue	blue-black
B	blue	brown
C	brick red	blue-black
D	brick red	brown



Answers

- | | |
|----|---|
| 1 | C |
| 2 | B |
| 3 | A |
| 4 | B |
| 5 | D |
| 6 | A |
| 7 | C |
| 8 | B |
| 9 | A |
| 10 | B |
| 11 | B |
| 12 | D |



Structured Questions

- 1 (a) List four chemical elements that are found in proteins.

1.
2.
3.
4. [4]

1	(a)	carbon ; hydrogen ; oxygen ; nitrogen ; sulfur ;	R CHONS
			[4 max]



(c) Proteins and DNA are important nitrogen-containing compounds in cells.

Describe the roles of proteins and DNA in cells.

proteins

.....

.....

.....

.....

.....

.....

..... [3]

DNA

.....

.....

.....

.....

..... [2]

(c) 1 enzymes ; 2 control / catalyse, reactions / AW ; 3 e.g. respiration / photosynthesis ; A ref. to any specific reaction(s) 4 (part of cell) membranes ; 5 carrier proteins / description of role allowing movement in and out of cell ; 6 haemoglobin ; 7 transport of, oxygen / carbon dioxide / gases ; 8 making cytoplasm / (cell) growth ; 9 AVP ; e.g. chloroplast / named organelle / providing energy 10 <i>DNA in cells</i> 11 ref. to, genes / alleles / genetic information / genetic code ; 12 control functions of the cell ; 13 code for proteins ; AVP ; e.g. a specific feature of cells / cell division / mitosis / meiosis		[max 3] [max 2]	R digestion unless clearly inside cell, e.g. in a phagocytosis A protein pumps R antibodies / hormones / collagen / keratin ignore repair R produce / make energy R hereditary material / AW A 'sends messages to the cytoplasm' / 'tells the cells what to do' A ref. to mRNA
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Chapter 5: Enzymes

5 Enzymes

5.1 Enzymes

Core

- 1 Describe a catalyst as a substance that increases the rate of a chemical reaction and is not changed by the reaction
- 2 Describe enzymes as proteins that are involved in all metabolic reactions, where they function as biological catalysts
- 3 Describe why enzymes are important in all living organisms in terms of a reaction rate necessary to sustain life
- 4 Describe enzyme action with reference to the shape of the active site of an enzyme being complementary to its substrate and the formation of products
- 5 Investigate and describe the effect of changes in temperature and pH on enzyme activity with reference to optimum temperature and denaturation

Supplement

- 6 Explain enzyme action with reference to: active site, enzyme-substrate complex, substrate and product
- 7 Explain the specificity of enzymes in terms of the complementary shape and fit of the active site with the substrate
- 8 Explain the effect of changes in temperature on enzyme activity in terms of kinetic energy, shape and fit, frequency of effective collisions and denaturation
- 9 Explain the effect of changes in pH on enzyme activity in terms of shape and fit and denaturation

Enzymes are **biological catalysts**.

They are **proteins**.

Catalysts increase the rate of chemical reactions without altering themselves.

Biological because they are made in living things

Catalysts are necessary because they ensure that metabolic reactions(chemical reactions) happen so fast that life can be sustained.

Enzymes Naming System

Named according to the reaction they perform

Each enzymes catalyzes specific substances

If an enzymes breaks down:

Carbohydrates= then it is called **carbohydrase**

Proteins= then it is called **protease**



Fats and oils (Lipids) = then it is called **Lipases**

Then these enzymes are further divided into groups where they break down specific substances. **E.g**

A carbohydrase(enzyme) that breaks down the carbohydrate **starch** is **amylase**, carbohydrase(enzyme) that breaks down **maltose** is called **maltase**.

How enzymes work?

The substance that enzymes catalyze is called **substrate**.

The substrate is broken down into simpler and smaller substances called **products**.

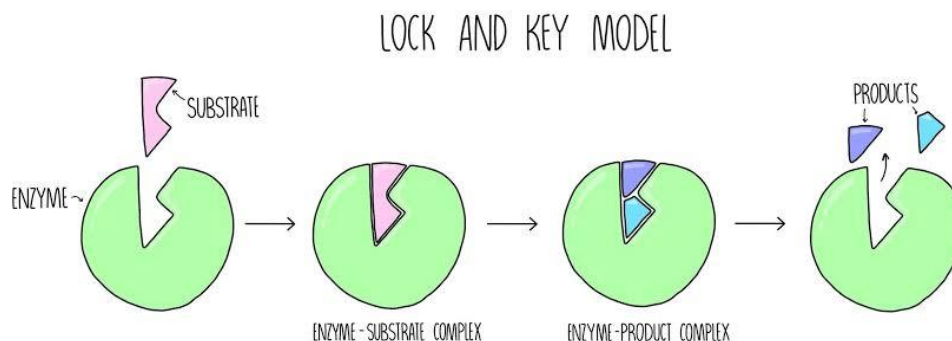
Active site is the part of the enzyme where the substrate is converted into products.

The substrate lands on the active site of the enzyme and binds to the enzyme.

Substrates can only fit in the active site and bind with enzymes if the shape of substrate and enzyme's active site is **complementary** to each other. When binded the enzyme changes the substrate into new substances called the **products**.

Alternatively, catalysts can work to build products from reactants as well, with two or more reactants attaching themselves to the active site to form larger molecules

The enzyme mechanism is called the lock and key mechanism.



Names of some enzymes , their products and substrates

Enzyme	Substrate	Product
Catalase	Hydrogen peroxide	Water + oxygen
Amylase	Starch	Maltose
Protease	Proteins	Amino Acids



Factor affecting Enzymes

Mainly affected by 2 factors

Temperature

pH

Temperature

Each enzyme has a particular temperature at which it works the best, such temperature is known as **optimum temperature**.

If the temperature is very low than the optimum temperature, then the enzyme will be **inactive**.

If the temperature is very low then the kinetic energy of both the enzyme and substrate is very low, they are moving with less speed subsequently very less collisions take place between the enzyme and the substrate so very products are formed.

If the temperature is too high than the optimum temperature then the enzymes become **denature**. It can not catalyze any more reactions.

Denaturation happens because the enzymes start to lose their shape so does the active site. Through this way the shape of the active site is no longer complementary with the shape of the substrate. So when substrate collides with the active site it does not fix in nor does it bind with the enzyme. Through this way no product is formed.

pH

Each enzyme has a particular pH at which it works the best, such temperature is known as **optimum pH**.

If the pH is very low than the optimum pH, then the enzyme will be become **inactive**.

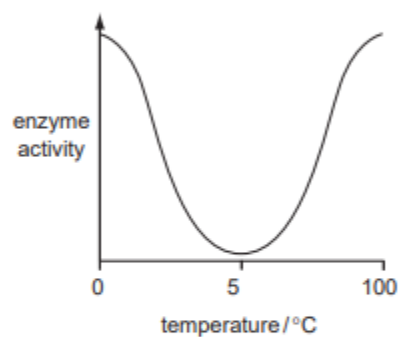
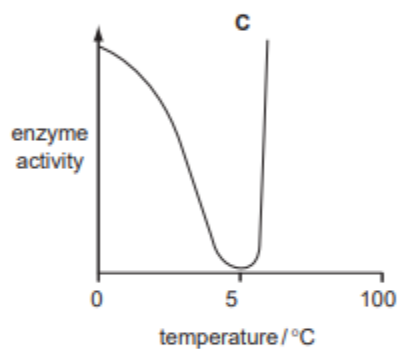
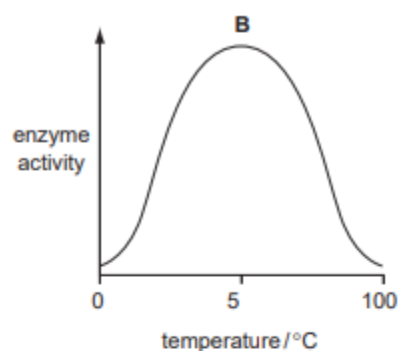
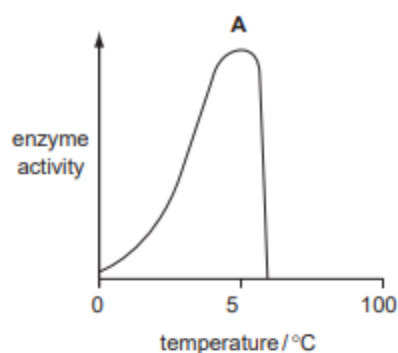
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Denaturation happens because the enzymes start to lose their shape so does the active site. Through this way the shape of the active site is no longer complementary with the shape of the substrate. So when substrate collides with the active site it does not fix in nor does it bind with the enzyme. Through this way no product is formed.



MCQS

1 Which graph shows the effect of temperature on the activity of an enzyme?



2 The diagram represents enzyme action.



What are parts W, X and Y in this chemical reaction?

	enzyme	product	substrate
A	W		Y
B	X		Y
C	X		W
D	Y		X



- 3 The diagram represents a chemical reaction.



Which diagram represents the enzyme for this reaction?



- 4 The table shows the conditions in four test-tubes containing equal amounts of starch and salivary amylase.

In which test-tube is the starch broken down fastest?

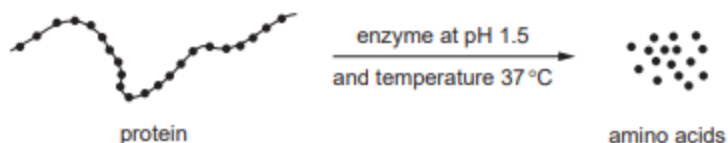
	pH	temperature / °C
A	2	27
B	2	37
C	7	27
D	7	37

- 5 What is true of **all** enzymes?

	they are sugars	they are most effective at pH7
A	✓	✓
B	✓	x
C	x	✓
D	x	x



- 6 The diagram shows the effect of an enzyme working in the human digestive system.

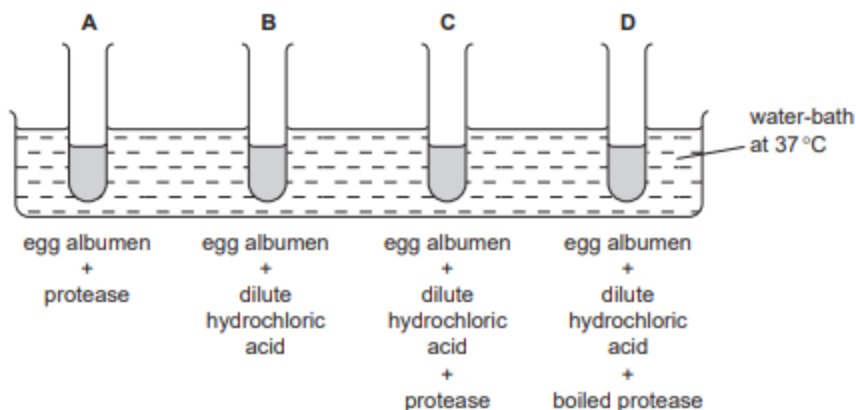


What would **reduce** the rate of production of amino acids?

- A removing the amino acids as they are formed
 - B increasing the amount of protein
 - C raising the temperature to 40 °C
 - D raising the pH to 7.5
- 7 Which group of compounds ensures that metabolic reactions take place effectively?
- A carbohydrates
 - B enzymes
 - C fatty acids
 - D hormones
- 8 The diagram shows an experiment on the digestion of the protein in egg albumen by protease.

The protease was taken from a human stomach.

In which test-tube will the protein be digested most quickly?





9 Which effect does a gradual decrease in pH from 13 to 1 have on the action of amylase?

- A slows it down only
- B slows it down then speeds it up
- C speeds it up only
- D speeds it up then slows it down

10 An enzyme in potato cells causes oxygen to be produced from hydrogen peroxide.

Cubes of potato were incubated with hydrogen peroxide at different temperatures.

The numbers of bubbles of oxygen released per minute were counted at each temperature.

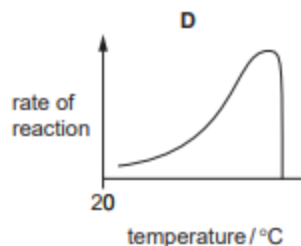
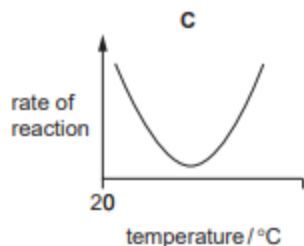
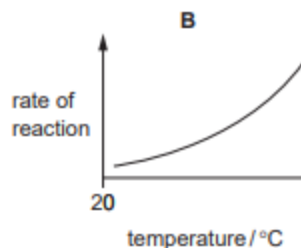
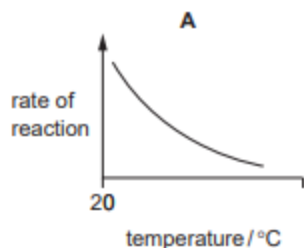
The table shows the results.

temperature / °C	15	25	35	45	55
number of bubbles / bubbles per minute	96	98	82	36	1

The results suggest the optimum temperature for the enzyme is between which two values?

- A 15 °C and 35 °C
- B 35 °C and 45 °C
- C 35 °C and 55 °C
- D 45 °C and 55 °C

11 Which graph shows the effect of temperature between 20 °C and 35 °C on the activity of a human digestive enzyme?





Answers

- | | |
|----|---|
| 1 | A |
| 2 | C |
| 3 | D |
| 4 | D |
| 5 | D |
| 6 | D |
| 7 | B |
| 8 | C |
| 9 | D |
| 10 | A |
| 11 | B |



Structured Questions

2 Microorganisms in the soil release enzymes to digest dead leaves.

(a) Explain how enzymes catalyse chemical reactions.

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.....

.....

..... [3]

(b) Protease and cellulase are two enzymes secreted by soil microorganisms. Protease digests protein.

Suggest what part of the dead leaf cells are digested by the enzyme cellulase.

..... [1]

2 (a)	lock and key mechanism; substrate fits into enzyme; (shape of) substrate is complementary to, enzyme/active site; ref to active site; substrate breaks/product(s) forms/product(s) leaves enzyme; enzyme, free for next reaction/not used up/remains unchanged; AVP;	max 3	e.g. lowers activation ener
(b)	(cellulose) cell wall;	1	



- 3 Enzymes are necessary for many biological processes, such as the digestion of fat.



- (a) (i) Explain why enzymes are necessary for biological processes.

.....

.....

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.....

[3]

- (ii) Lipase, protease and amylase are enzymes secreted into the alimentary canal.

Name **one** organ that secretes each enzyme. Choose your answers from this list.

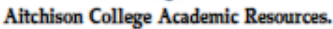
colon	gall bladder	liver
pancreas	rectum	salivary glands

You can use each organ **only once**.

lipase

protease

amylase [3]



3	(a)	(i)	1 without enzymes reactions, occur too slowly / not at all ; A enzymes speed up reactions 2 reduce, activation energy / energy needed for a reaction ; 3 reactions take place at lower temperatures ; 4 enzymes are catalysts ;	[max 3]	MP1 A some aspect of metabolism as an alternative to reactions, e.g. digestion
		(ii)	lipase – pancreas ; protease – stomach / pancreas ; amylase – salivary gland / pancreas ;	[3]	organs have to be different if the answer for lipase is incorrect A pancreas for either protease or amylase but not both

The diagram illustrates the lock-and-key model of enzyme action. It shows a substrate molecule (a trapezoid) fitting into the active site of an enzyme (a shape with a corresponding notch). The enzyme and substrate form a complex. The enzyme then catalyzes the reaction, breaking the substrate into two smaller products (a pentagon and a quadrilateral).

Use the information in Fig. 3.2 to explain how enzymes work to break down nutrient materials, such as starch.

[4]



Enzymes in bean seeds are activated during germination. Some of these enzymes break down protein stored in the seeds.

A large number of bean seeds were soaked and germinated. Researchers took samples of germinating seeds over a period of 15 days. The seeds were chopped into small pieces and crushed with water to make an extract. Equal quantities of the extracts were placed into protein solutions at pH 5 and at pH 8.

The activity of the enzymes in each extract was determined by recording how quickly the protein was broken down. The results are shown in Fig. 3.3.

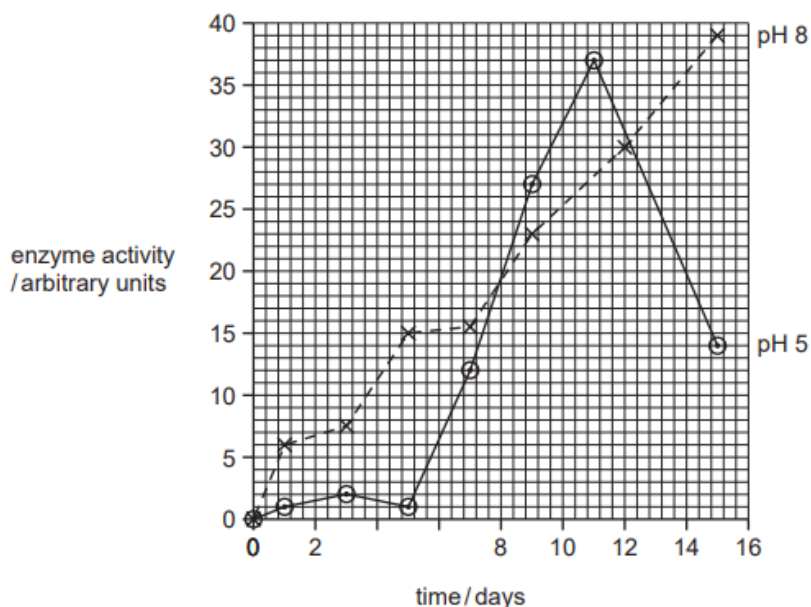


Fig. 3.3

(d) Describe the activity of the enzymes in the extracts at pH 5 over 15 days.

.....

.....

.....

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.....

[3]



Page

- (e) The researchers concluded that the beans contained two different enzymes that break down protein.

State the evidence from Fig. 3.3 for this conclusion.

.....

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.....

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[3]

[Total: 15]

Answers

(c)	MP1 substrate, 'fits' into enzyme ; MP2 active site (of enzyme); MP3 shape is complementary ; MP4 substrate is key, enzyme is lock ; MP5 substrate / starch / nutrient, converted (into products) / AW ; MP6 (2) products (molecules) lea ; MP7 enzyme / amylase, can work again on another substrate ;	[max 4]
(d)	very little activity until day 5 ; increase to day 11 / peak at day 11 ; decrease to day 15 ; data quote with day <u>and</u> activity ;	[max 3]
(e)	ref to different shapes of the lines ; (therefore) there is enzyme activity in both pH ; enzyme activity influenced by / specific to, pH ; data quote ; e.g. quote of activity at pH 8 <u>and</u> pH 5 on a specified day ; suggesting one enzyme prefers acid conditions, but by day 15 less enzyme, produced / available ;	[max 3]



Chapter 6: Plant Nutrition

6 Plant nutrition

6.1 Photosynthesis

Core

- 1 Describe photosynthesis as the process by which plants synthesise carbohydrates from raw materials using energy from light
- 2 State the word equation for photosynthesis as:
carbon dioxide + water → glucose + oxygen
in the presence of light and chlorophyll

Supplement

- 10 State the balanced chemical equation for photosynthesis as:
$$6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$$

6.1 Photosynthesis continued

Core

- 5 Outline the subsequent use and storage of the carbohydrates made in photosynthesis, limited to:
 - (a) starch as an energy store
 - (b) cellulose to build cell walls
 - (c) glucose used in respiration to provide energy
 - (d) sucrose for transport in the phloem
 - (e) nectar to attract insects for pollination
- 6 Explain the importance of:
 - (a) nitrate ions for making amino acids
 - (b) magnesium ions for making chlorophyll
- 7 Investigate the need for chlorophyll, light and carbon dioxide for photosynthesis, using appropriate controls
- 8 Investigate and describe the effects of varying light intensity, carbon dioxide concentration and temperature on the rate of photosynthesis
- 9 Investigate and describe the effect of light and dark conditions on gas exchange in an aquatic plant using hydrogencarbonate indicator solution

Supplement

- 11 Identify and explain the limiting factors of photosynthesis in different environmental conditions

continued

6.2 Leaf structure

Core

- 1 State that most leaves have a large surface area and are thin, and explain how these features are adaptations for photosynthesis
- 2 Identify in diagrams and images the following structures in the leaf of a dicotyledonous plant: chloroplasts, cuticle, guard cells and stomata, upper and lower epidermis, palisade mesophyll, spongy mesophyll, air spaces, vascular bundles, xylem and phloem
- 3 Explain how the structures listed in 6.2.2 adapt leaves for photosynthesis

Supplement



Nutrients are very important to our body
They help to make new parts or repair old ones
Needed to release energy.

Plants make use of inorganic compounds(carbon dioxide, mineral ions etc) to make organic compounds(glucose). They do this through a process of photosynthesis meaning “making with light”

Photosynthesis

Process by which plants synthesis carbohydrates from raw materials by using energy from sunlight

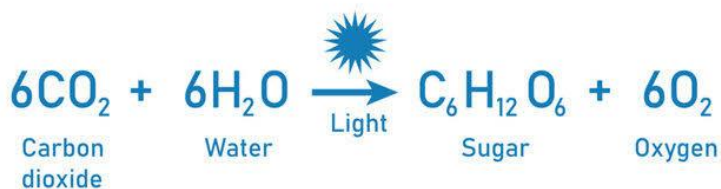
In leaves, chlorophyll(green pigment) captures energy from sunlight

This energy is then used to react the water and carbon dioxide molecules

Equation of photosynthesis:

Carbon dioxide + water = Glucose + Oxygen

Photosynthesis Equation



How Carbohydrate(glucose) is used:

The glucose made in photosynthesis is very important to the plant and it is used in various things

To release useful energy

Glucose is broken down to release useful energy and the energy is used to carry out various activities such as active transport.

2. Stored in form of starch

Glucose molecules are joined together to form a bigger and complex molecule called starch. The starch can be broken down and used when the plant is not photosynthesising



3. Conversion to sucrose

As glucose is made only in leaves so it needs to be transported to other parts of the plant so that they can function properly. Glucose can be utilized to form sucrose, a more suitable molecule for transportation, which then travels through the phloem tube to other parts of the plant.

4. Making cell walls

Some of the glucose made is joined together to make a bigger and more complex structure called cellulose which is then used to make cell walls.

5. Making Nectar

Glucose is used to make nectar. Animals are attracted and feed on this nectar. Through this the male gametes of the plant stick to the insects and sexual reproduction can ensue. Nectar contains different types of sugars which are made from glucose.

6. Making amino acids

Some of the glucose is used to make amino acids which are then used to make proteins. Nitrate ions are also used to make proteins. These nitrate ions move into plant roots from soil through active transports which again uses energy from glucose.

Leaves

Leaves have features allowing for efficient photosynthesis

Leaves have a large surface area and are very thin.

Large surface area allows them to absorb a lot of sunlight. Moreover, a large surface area increases the rate at which carbon dioxide diffuses into the leaf.

A thin structure allows light to pass through and reach as many cells in it and also leaves beneath it.

Leaves can be of 2 types

Dicots

In dicots veins are arranged in a network.

Monocots

In monocots veins are arranged parallel to one another.

Structure of a leaf

Upper Epidermis

Top layer of the leaf. The cells inside are tightly packed together to reduce loss of water vapour. They don't contain chloroplasts so the cells don't photosynthesis. They secrete a waxy substance which forms a thin transparent waterproof covering called the cuticle.



Palisade mesophyll

Tall narrow cells containing very large number of chloroplasts as their main function is to photosynthesis. As they are on the top they receive a large amount of sunlight.

Spongy mesophyll

These cells also contain chloroplasts but not as much as palisade cells. The cells are not packed tightly enough. They contain air spaces which allow carbon dioxide and oxygen to diffuse in and out.

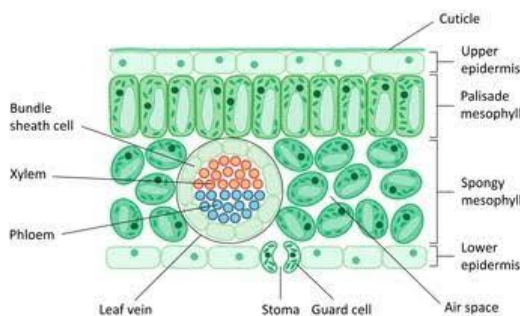
Lower epidermis

Similar to upper epidermis except that it doesn't make cuticle because from underneath the cell the loss of water vapour is very less. In the lower epidermis there is an opening called stomata. Stomata allow the diffusion of carbon dioxide and oxygen in and out of the leaf. Each stomata is surrounded by guard cells. Unlike other cells in epidermis, guard cells contain chloroplast.

Magnesium is needed for making chlorophyll and nitrate ions are needed for making amino acids

Without these ions, a plant has deficiencies and yellowing and paling of leaves occurs consequently

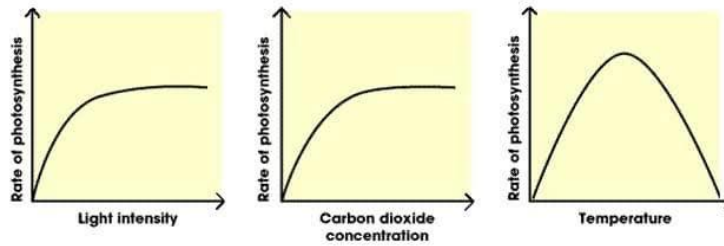
Leaf structure



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Factors affectii

There are various factors affecting photosynthesis
Supply of raw materials(carbon dioxide and water)
Quantity of sunlight
Temperature



A Limiting factor is a factor that is short in supply and stops an activity happening at a faster rate.

On a very hot and sunny day stomata closes to prevent too much water being lost. This means that on a really hot or bright day photosynthesis may slow down.

Photosynthesis is also affected by windy conditions and humidity.

With wind involved, photosynthesis increases because the water vapor is carried away by the wind outside the stomata and the gradient for diffusion is greater

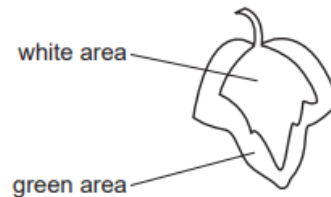
With humidity involved, it is the opposite photosynthesis slows down because the water potential gradient is less since there is more moisture in the air



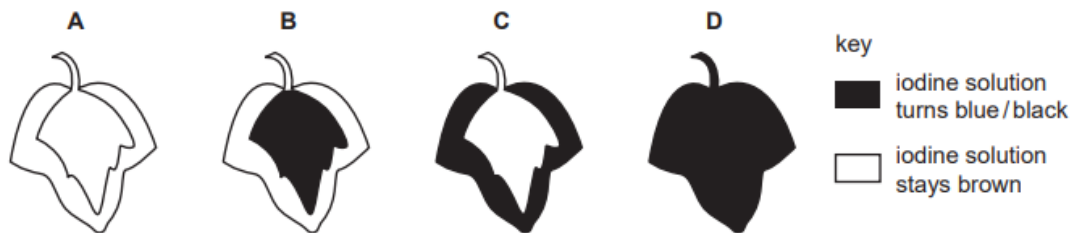
MCQS

- 1 In a photosynthesis experiment, a plant is left in bright sunlight for several hours. A leaf is then removed from the plant and tested for starch, using iodine solution.

The diagram shows the leaf from the plant that was used in the experiment.



Which diagram shows the result of the experiment?



- 2 Which substance, needed for protein synthesis, is carried into a leaf from the stem?

- A carbon dioxide
- B nitrate
- C oxygen
- D starch

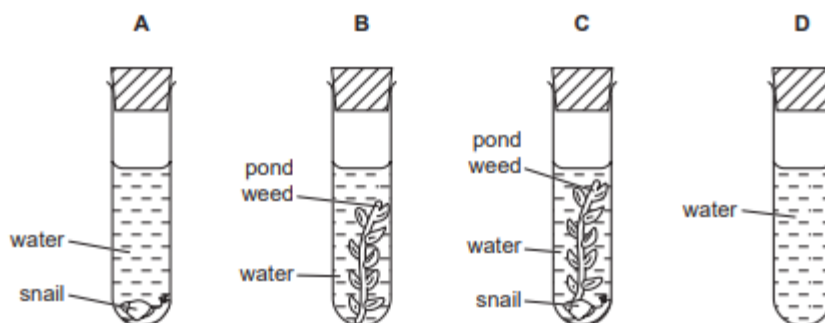
- 3 Which two substances are the products of photosynthesis?

- A carbon dioxide and glucose
- B carbon dioxide and water
- C oxygen and carbon dioxide
- D oxygen and glucose



- 4 Four test-tubes are set up as shown in the diagram and left in full sunlight.

After several hours, which test-tube contains the most dissolved oxygen?



- 5 Plants manufacture their own supplies of carbohydrate.

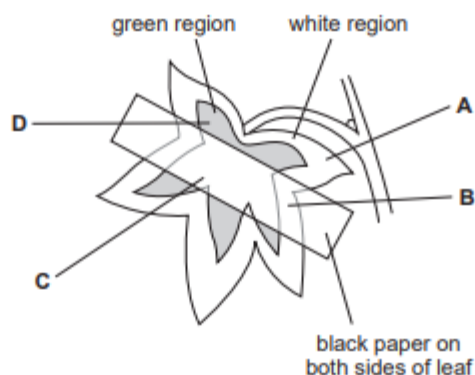
What are the raw materials and the waste product of this process?

	raw materials	waste product
A	carbon dioxide and chlorophyll	oxygen
B	carbon dioxide and water	oxygen
C	oxygen and chlorophyll	carbon dioxide
D	oxygen and water	carbon dioxide

- 6 A plant with variegated leaves has the starch removed from its leaves by placing it in a dark cupboard for 48 hours.

Black paper is then fixed on one leaf as shown and the plant is exposed to light.

After 24 hours, which part of the leaf contains starch?



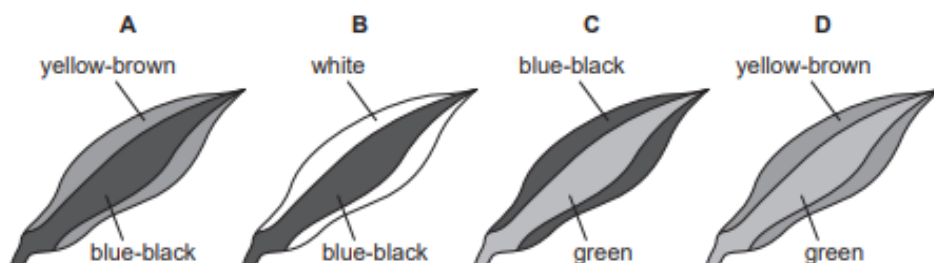


- 7 A plant with striped leaves similar to the one below was kept in bright light for six hours.

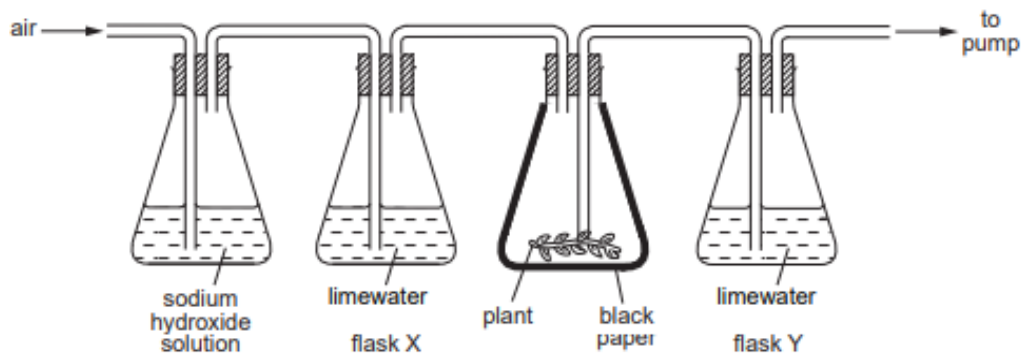


A leaf was taken from the plant and the chlorophyll removed. It was then tested for starch using iodine solution.

Which diagram shows the result of the test?



- 8 Apparatus was set up as shown.



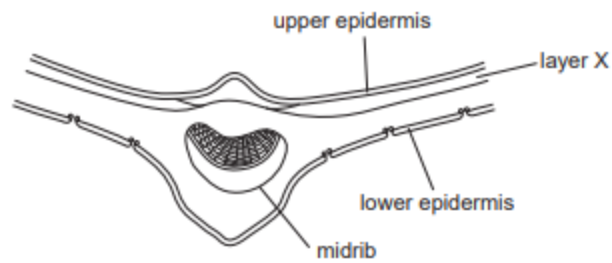
Sodium hydroxide removes carbon dioxide from the air. Limewater goes cloudy if carbon dioxide is bubbled through it.

What happens to the limewater in flasks X and Y when the pump is switched on?

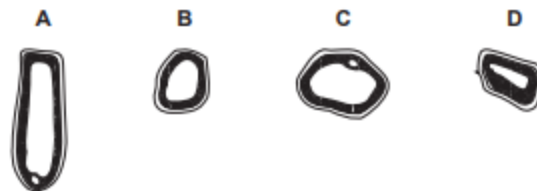
	flask X	flask Y
A	goes cloudy	goes cloudy
B	goes cloudy	stays clear
C	stays clear	goes cloudy
D	stays clear	stays clear



- 9 The diagram shows a cross-section of part of a leaf.



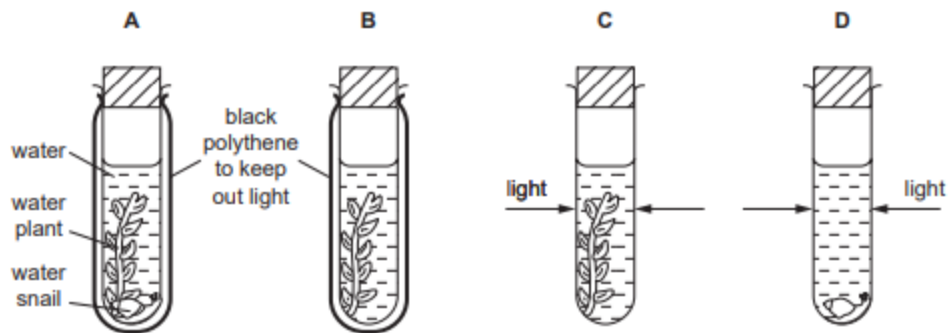
Which type of cell is found in layer X?



- 10 An experiment was done using the apparatus shown in the diagram.

The carbon dioxide content of the water in each tube was measured at the start and again three hours later.

In which tube would there be a **decrease** in carbon dioxide content?





- 11 What is formed first in a leaf as a result of photosynthesis?
- A chlorophyll
 - B glucose
 - C starch
 - D water
- 12 From which part of a leaf does most water evaporate during transpiration?
- A the cuticle
 - B the guard cells
 - C the spongy mesophyll cells
 - D the xylem vessels
- 13 Which substances are transported in the phloem?
- A amino acids and starch
 - B amino acids and sucrose
 - C protein and starch
 - D starch and sucrose
- 14 Which product of photosynthesis moves out of a green leaf through its stomata?
- A carbon dioxide
 - B glucose
 - C oxygen
 - D water
- 15 What is carried by the xylem?
- A chlorophyll
 - B mineral ions
 - C starch
 - D sugars
- 16 Which two substances are needed for photosynthesis?
- A carbon dioxide and glucose
 - B carbon dioxide and water
 - C oxygen and glucose
 - D oxygen and water

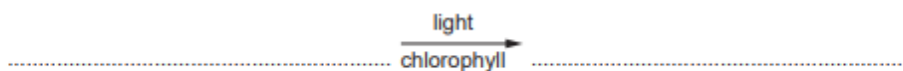


- | | |
|----|---|
| 1 | C |
| 2 | B |
| 3 | D |
| 4 | B |
| 5 | B |
| 6 | D |
| 7 | A |
| 8 | C |
| 9 | A |
| 10 | C |
| 11 | B |
| 12 | C |
| 13 | B |
| 14 | C |
| 15 | B |
| 16 | B |



Structured Questions

- 1 (a) State the balanced chemical equation for photosynthesis.



[2]

A student investigated the effect of different wavelengths of light on the rate of photosynthesis of the water plant, *Cabomba*.

The student used the apparatus shown in Fig. 6.1.

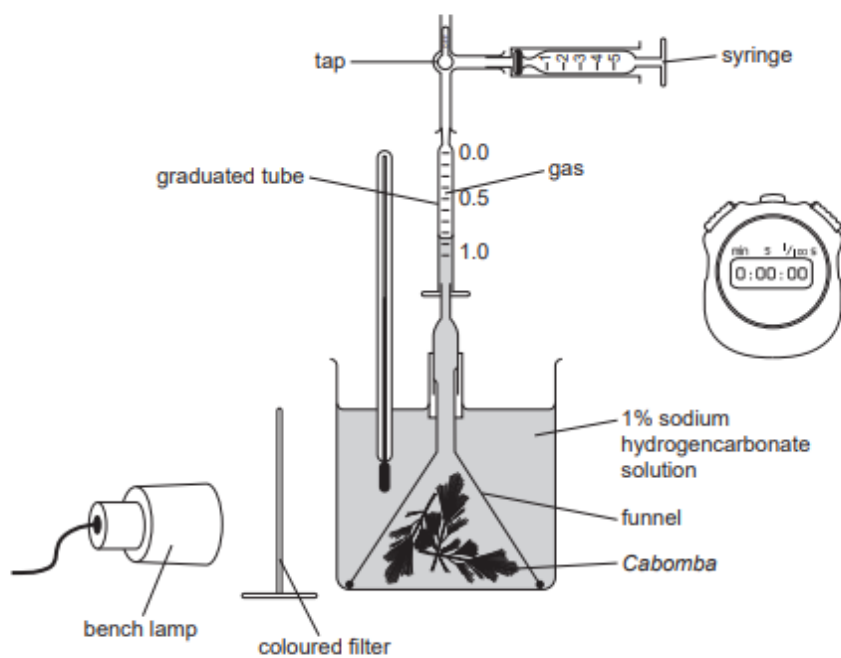


Fig. 6.1



- (b) The student collected the gas produced by the plant for five minutes. The results are shown in Table 6.1.

Table 6.1

colour of filter	wavelength of light / nm	volume of gas collected / cm ³
violet	400	0.80
blue	475	0.80
green	550	0.20
yellow	600	0.40
red	675	0.90

Describe the effect of wavelength of light on the rate of photosynthesis as shown in the student's results in Table 6.1.

You will gain credit if you use data from the table.

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[3]

- (c) State how the student would calculate the rates of photosynthesis from the results in Table 6.1.

.....

.....

[1]



1	(a)	$6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$;;	[2]	one mark for the correct chemical formulae one mark for balancing the equation correctly R word equation
	(b)	as <u>wavelength</u> increases, rate (of photosynthesis) decreases and increases ; high rates in, blue and violet and red/400–475 nm and 675 nm ; low(est) rate in, green and yellow/550–600 nm ; <i>either</i> maximum rate = 0.9 cm^3 , at 675 nm / red <i>or</i> minimum rate = 0.2 cm^3 , at 550 nm / green ;	[max 3]	units must be used once in the answer A volume of gas for rate
	(c)	divide the volumes by, five (minutes)/time ;	[1]	
	(d) (i)	to keep the <u>light intensity</u> the same ;	[1]	R temperature I 'fair test' A 'control light intensity' / 'light intensity is a control(led) variable'
	(ii)	to provide carbon dioxide / so carbon dioxide is not a limiting factor / so the only limiting factor is wavelength ;	[1]	
	(e)	for, respiration / energy ; converted to sucrose ; used to make, nectar / fruits ; used to make, cellulose / lignin ; used in cell walls ; used to make, starch / oils / fats ; storage ; used to make, amino acids ; used to make, chlorophyll ;	[max 3]	I protein synthesis / growth / active transport R produces energy I 'makes food', but A 'stores food' for 1 mark

Water is required for the process of photosynthesis.

(i)

Describe where **and** how water enters a plant.

[3]

(ii)

Describe **one** function of water in a plant other than for photosynthesis.

[1]

(iii)

State the name of the tissue in a plant that transports water.

[1]

(iv)

State the name of the part of a leaf through which most water vapour is lost from the plant

[1]



Answers

(i) Water enters the plant in the following way:

Any **three** from the following:

- Water enters the root (from the soil); [1 mark]
- Via the root hair cells; [1 mark]
- Water moves through the cell walls; [1 mark]
- Then it travels across a partially permeable (cell) membrane (into the cytoplasm); [1 mark]
- Water travels by osmosis; [1 mark]

(ii) One function of water in the plant could be:

Any **one** from the following:

- Support (of cells/stems/tissues); [1 mark]
- Transport of mineral ions/named mineral ions (around the plant); [1 mark]
- A solvent / to dissolve mineral ions/sugars/soluble substances into; [1 mark]
- A coolant **OR** to maintain optimum temperatures for plant growth; [1 mark]

Also accept the idea of water to be used to stimulate germination of seedlings

(a)(iii) Water is transported in the:

- Xylem; [1 mark]

(a)(iv) The name of the part of the leaf is... :

- The stoma/stomata ; [1 mark]



Chapter 7: Human Nutrition

7 Human nutrition

7.1 Diet

Core

- 1 Describe what is meant by a balanced diet
- 2 State the principal dietary sources and describe the importance of:
 - (a) carbohydrates
 - (b) fats and oils
 - (c) proteins
 - (d) vitamins, limited to C and D
 - (e) mineral ions, limited to calcium and iron
 - (f) fibre (roughage)
 - (g) water
- 3 State the causes of scurvy and rickets

Supplement

7.2 Digestive system

Core

- 1 Identify in diagrams and images the main organs of the digestive system, limited to:
 - (a) alimentary canal: mouth, oesophagus, stomach, small intestine (duodenum and ileum) and large intestine (colon, rectum, anus)
 - (b) associated organs: salivary glands, pancreas, liver and gall bladder
- 2 Describe the functions of the organs of the digestive system listed in 7.2.1, in relation to:
 - (a) ingestion – the taking of substances, e.g. food and drink, into the body
 - (b) digestion – the breakdown of food
 - (c) absorption – the movement of nutrients from the intestines into the blood
 - (d) assimilation – uptake and use of nutrients by cells
 - (e) egestion – the removal of undigested food from the body as faeces

Supplement



7.3 Physical digestion

Core

- 1 Describe physical digestion as the breakdown of food into smaller pieces without chemical change to the food molecules
- 2 State that physical digestion increases the surface area of food for the action of enzymes in chemical digestion
- 3 Identify in diagrams and images the types of human teeth: incisors, canines, premolars and molars
- 4 Describe the structure of human teeth, limited to: enamel, dentine, pulp, nerves, blood vessels and cement, and understand that teeth are embedded in bone and the gums
- 5 Describe the functions of the types of human teeth in physical digestion of food
- 6 Describe the function of the stomach in physical digestion

Supplement

- 7 Outline the role of bile in emulsifying fats and oils to increase the surface area for chemical digestion

7.4 Chemical digestion

Core

- 1 Describe chemical digestion as the break down of large insoluble molecules into small soluble molecules
- 2 State the role of chemical digestion in producing small soluble molecules that can be absorbed
- 3 Describe the functions of enzymes as follows:
 - (a) amylase breaks down starch to simple reducing sugars
 - (b) proteases break down protein to amino acids
 - (c) lipase breaks down fats and oils to fatty acids and glycerol
- 4 State where, in the digestive system, amylase, protease and lipase are secreted and where they act
- 5 Describe the functions of hydrochloric acid in gastric juice, limited to killing harmful microorganisms in food and providing an acidic pH for optimum enzyme activity

Supplement

- 6 Describe the digestion of starch in the digestive system:
 - (a) amylase breaks down starch to maltose
 - (b) maltase breaks down maltose to glucose on the membranes of the epithelium lining the small intestine
- 7 Describe the digestion of protein by proteases in the digestive system:
 - (a) pepsin breaks down protein in the acidic conditions of the stomach
 - (b) trypsin breaks down protein in the alkaline conditions of the small intestine
- 8 Explain that bile is an alkaline mixture that neutralises the acidic mixture of food and gastric juices entering the duodenum from the stomach, to provide a suitable pH for enzyme action



7.5 Absorption

Core

- 1 State that the small intestine is the region where nutrients are absorbed
- 2 State that most water is absorbed from the small intestine but that some is also absorbed from the colon

Supplement

- 3 Explain the significance of villi and microvilli in increasing the internal surface area of the small intestine
- 4 Describe the structure of a villus
- 5 Describe the roles of capillaries and lacteals in villi

Notes

Humans need many different nutrients. A balanced diet is one which includes specific quantities of all of these essential nutrients, for the function of the body.

Nutrient	Uses	Found in
Carbohydrates	Source of energy in respiration	Bread, cereals, pasta, rice
Fats and Oils	Source of energy, as energy storage material, insulation and protection of organs	Butter, dairy products, nuts
Proteins	Building materials, enzymes, structural material, hormones, antibodies, haemoglobin and energy source	Meats, eggs, fish
Vitamin C	collagen, repair of tissue	citrus fruits, some vegetables
Vitamin D	uptake of calcium, strong bones	dairy products, eggs, fish, exposure to sunlight

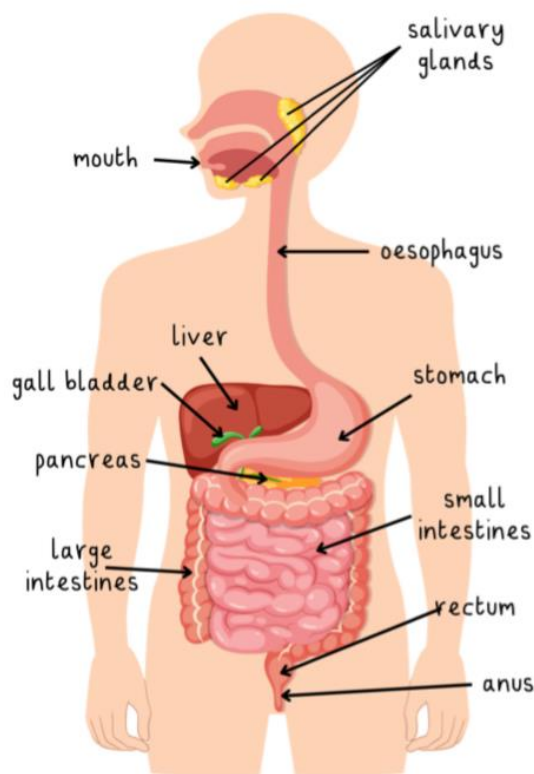


Calcium	healthy bones and teeth, blood clotting	dairy products, fish
Iron	Transport of oxygen around the body	red meat, dark green vegetables
Fibre	Helps in peristalsis	whole grains, fruit
Water	needed for chemical reactions to take place	water, juice, fruits, milk

A lack of Vitamin C causes scurvy which causes anaemia, gum bleeding, pain in joints and exhaustion.

A lack of Vitamin D causes rickets which causes bone pain, and soft weak bones. Adults need less nutrients than teenagers. Males need more energy than females. Pregnant females need more energy, as well as more calcium and iron.

The Digestive System





Once food is ingested, it undergoes both mechanical and chemical digestion. Mechanical/Physical digestion breaks food down into smaller parts without chemical altering it, thereby increasing the surface area and making chemical digestion easier. This is done by the mouth and alimentary canal/oesophagus. Chemical digestion involves breaking down large insoluble molecules to smaller, more soluble molecules, with the use of enzymes - so absorption can take place more efficiently.

Passage of food down the digestive tract:

Mouth and Salivary glands: contains teeth which mechanically digest food. Enzymes (amylase) start to work on starch, starting to chemically digest it

Oesophagus: food passes from mouth to stomach, contraction of muscles enables peristalsis which allows for more mechanical digestion

Stomach: hydrochloric acid is present which provides a condition of pH 2. The Protease enzyme pepsin works here in optimum pH, to produce amino acids. Acid kills bacteria by providing extremely acidic conditions.

Duodenum: first part of small intestine. Acidity from the stomach is neutralized. Fats are emulsified through bile and digested by pancreatic lipase to form fatty acids and glycerol. Pancreatic trypsin breaks down starch to simple carbohydrates such as maltose

Ileum: maltase breaks down maltose to glucose, absorption takes place here

Pancreas: produces amylase, trypsin, lipase

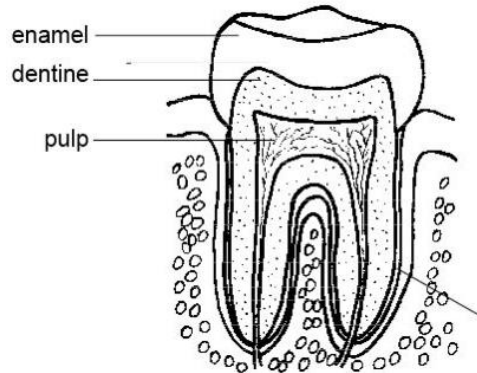
Liver: produces bile which neutralizes acidic fat molecules, helping in production of alkaline pH of trypsin. Bile is stored in gallbladder and secreted to duodenum through bile duct

Colon: first part of large intestine. Reabsorption of water. Indigestible food passes through

Rectum: second part of large intestine. Faeces are stored here and expelled through anus

Teeth:

Incisors	Canines	PreMolars	Molars
rectangular shape, for cutting and biting of food	sharp and pointed. Used for tearing and piercing food. Used by predators to kill prey	Chewing and grinding, blunt, have one ridge	Further chewing and grinding, have two ridges



Enamel is the hardest substance. Protects tissue inside. Can be digested by bacteria through neglect of brushing

Dentine is found underneath enamel, less hard than enamel and is digested easier than enamel if enamel layer is dissolved

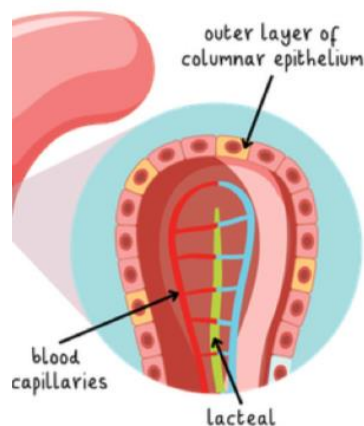
Pulp contains many blood vessels and is the central part of the tooth

Cement covers the root of the tooth and stabilises it overall

Absorption:

Digested food molecules are absorbed in the small intestine. The cells are adapted and have hair-like projections called villi and microvilli which increase the surface area of the small intestine. Each villus contains capillaries, which carry absorbed nutrients away. They also contain lacteal which absorbs fatty acids. Some water is also absorbed but most of it is absorbed in the colon.

Assimilation: uptake and use of nutrients by cells





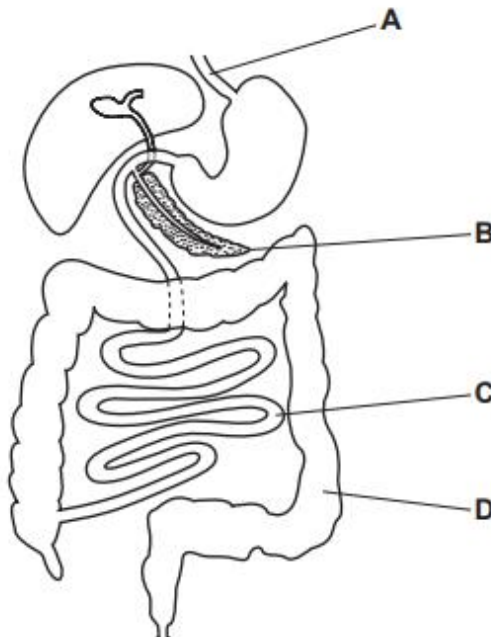
MCQS

1 Which type of food is **not** digested before being absorbed by the body?

- A carbohydrate
- B fat
- C protein
- D water

2 The diagram shows the human alimentary canal.

In which structure is most glucose absorbed into the blood?



3 Which dietary component is **unlikely** to be deficient in a meat-free diet?

- A fat
- B fibre
- C protein
- D vitamin D

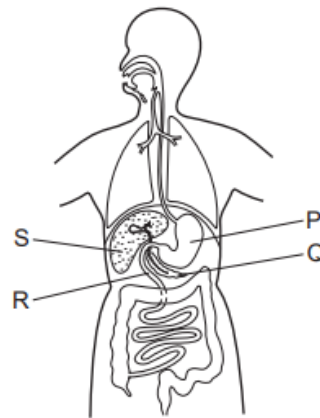


- 4 The bacterium *Salmonella enterica* can cause severe food poisoning and the lining of the alimentary canal may be damaged. In these cases absorption of digested food products cannot easily take place.

Which region of the alimentary canal is most affected?

- A colon
- B ileum
- C oesophagus
- D stomach

- 5 The diagram shows some of the organs of the human body.



In which organs does the digestion of proteins take place?

- A P and Q
 - B P and R
 - C Q and R
 - D Q and S
- 6 Which organ produces amylase?
- A gall bladder
 - B liver
 - C oesophagus
 - D pancreas





- | | |
|----|---|
| 1 | D |
| 2 | C |
| 3 | B |
| 4 | B |
| 5 | B |
| 6 | D |
| 7 | A |
| 8 | C |
| 9 | C |
| 10 | B |
| 11 | B |



Structured Questions

- 1 Fig. 6.1 shows the alimentary canals of two mammals, an insect-eating bat, which is a carnivore, and a rabbit, which is a herbivore.

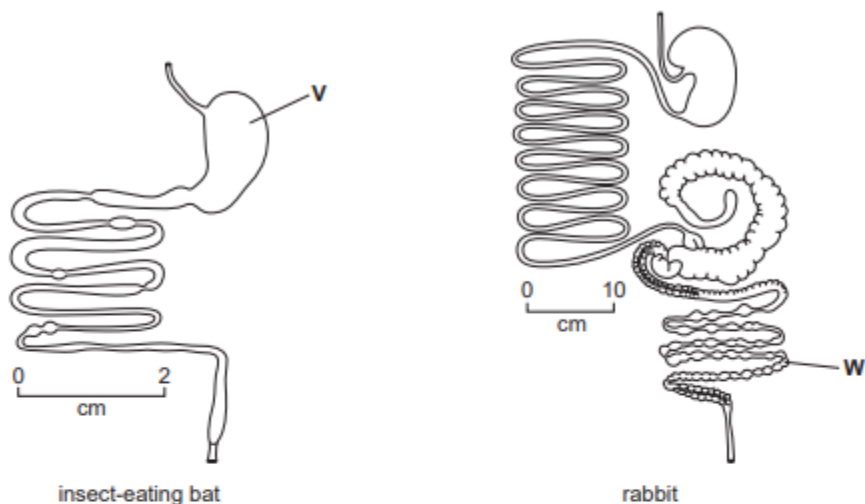


Fig. 6.1

- (a) Name the organs labelled **V** and **W**.

V

W

[2]

- (b) Explain the role of mechanical digestion.

.....
.....
.....
.....
.....
.....
.....

[3]



2 Fig. 3.1 shows part of the thoracic and abdominal cavities of a human.

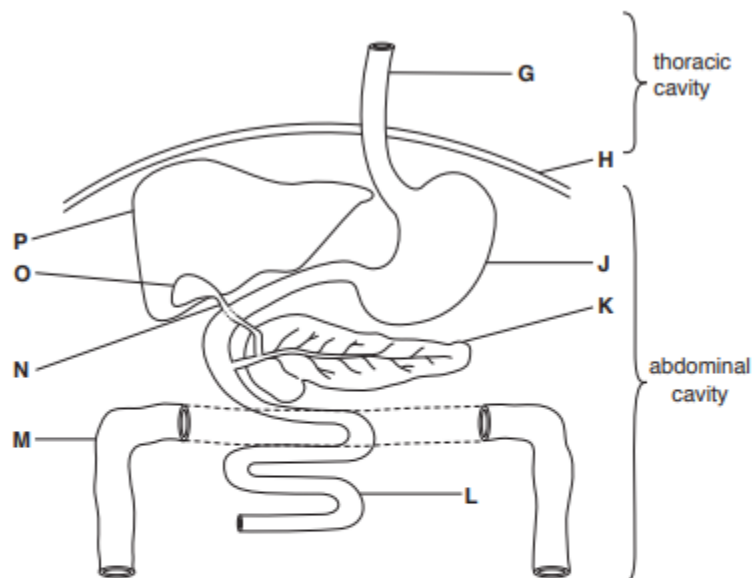


Fig. 3.1

(a) (i) Name the structures labelled G, H and M.

G

H

M

[3]



(ii) Table 3.1 shows five functions of organs in the abdominal cavity.

Complete the table by:

- naming the organ that carries out each function
- using the letters from Fig. 3.1 to identify the organ named.

One row has been completed for you.

Table 3.1

function	name	letter from Fig. 3.1
conversion of glucose to glycogen		
secretion of insulin and glucagon	pancreas	K
absorption of products of digestion		
storage of bile		
chemical digestion of protein in an acidic pH		

[4]

(b) Fat is particularly difficult to digest as it is not water soluble and forms spherical globules in the alimentary canal.

Fig. 3.2 is a diagram showing what happens to fat globules when mixed with bile.

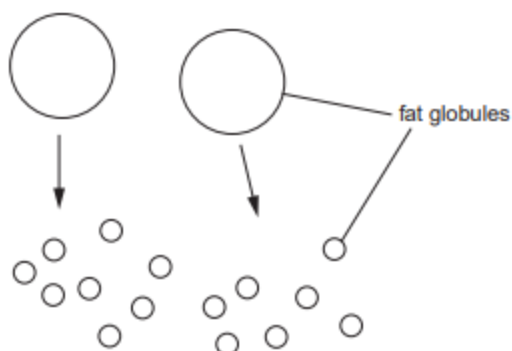


Fig. 3.2

(i) Name the process shown in Fig. 3.2.

.....[1]



(ii) Explain the advantage of the process shown in Fig. 3.2.

.....

.....

.....

.....

.....[2]

Answers

Question		Mark	Guidance
1 (a)	V stomach ; W large intestine / colon / rectum ;	[2]	I intestine unqualified
(b)	breaks up food into small(er) pieces ; without chemical change ; by teeth / muscles ; to mix (with digestive juice) ; increases surface area ; for enzyme action ; speeds up <u>chemical</u> digestion ; easier to swallow ;	[3]	R molecules A without enzymes A mastication / chewing / churning A easier / more effective

Question				Mark	Additional Guidance																		
2 (a) (i)	G oesophagus / esophagus / gullet ; H diaphragm ; M large intestine / large bowel / colon ;			[3]	R intestine unqualified / rectum																		
(ii)	<table><tr><td>function</td><td>name</td><td>letter from Fig. 3.1</td></tr><tr><td>conversion of glucose to glycogen</td><td>liver</td><td>P ;</td></tr><tr><td>secretion of insulin and glucagon</td><td>pancreas</td><td>K</td></tr><tr><td>absorption of products of digestion</td><td>ileum / small intestine</td><td>L ;</td></tr><tr><td>storage of bile</td><td>gall bladder</td><td>O ;</td></tr><tr><td>chemical digestion of protein in an acidic pH</td><td>stomach</td><td>J ;</td></tr></table>	function	name	letter from Fig. 3.1	conversion of glucose to glycogen	liver	P ;	secretion of insulin and glucagon	pancreas	K	absorption of products of digestion	ileum / small intestine	L ;	storage of bile	gall bladder	O ;	chemical digestion of protein in an acidic pH	stomach	J ;				ignore bile duct
function	name	letter from Fig. 3.1																					
conversion of glucose to glycogen	liver	P ;																					
secretion of insulin and glucagon	pancreas	K																					
absorption of products of digestion	ileum / small intestine	L ;																					
storage of bile	gall bladder	O ;																					
chemical digestion of protein in an acidic pH	stomach	J ;																					
				[4]																			



Question		Mark	Additional Guidance									
2 (b) (i)	emulsification/emulsifying (fat)/producing an emulsion ;	[1]	R 'emulsion' unqualified									
(ii)	increases surface area ; for action of, lipase/enzyme(s) ;	[2]	A speeds up, enzyme reaction/breakdown of fat/absorption of fat A makes it easier to absorb									
(c) (i)	<table><tr><td>hormone</td><td>uptake by liver cells</td><td>concentration of glucose in the blood</td></tr><tr><td>insulin</td><td>inc</td><td>decreases ;</td></tr><tr><td>glucagon</td><td>de</td><td>increases/stays the same ;</td></tr></table>	hormone	uptake by liver cells	concentration of glucose in the blood	insulin	inc	decreases ;	glucagon	de	increases/stays the same ;	[2]	one mark per correct row
hormone	uptake by liver cells	concentration of glucose in the blood										
insulin	inc	decreases ;										
glucagon	de	increases/stays the same ;										
(ii)	adrenaline ;	[1]	A epinephrine, cortisol, ACTH, growth hormone, somatostatin, thyroxine, GLP-1, GIP									
(d)	glucose concentration is kept, (near) constant/within narrow limits /AW ; any change (in concentration), is detected/acts as a stimulus ; correct ref to, glucose → glycogen/glycogen → glucose/increasing glucose concentration/decreasing glucose concentration ; <i>idea that it returns concentration to normal ;</i> <i>idea that release of correctly named hormone, stops/switches off ;</i> ref to <u>homeostasis</u> ;	max [3]	R hormones carrying out conversions directly									
		[Total: 16]										



Chapter 8: Transport In Plants

8 Transport in plants

8.1 Xylem and phloem

Core

- 1 State the functions of xylem and phloem:
 - (a) xylem – transport of water and mineral ions, and support
 - (b) phloem – transport of sucrose and amino acids
- 2 Identify in diagrams and images the position of xylem and phloem as seen in sections of roots, stems and leaves of non-woody dicotyledonous plants

Supplement

- 3 Relate the structure of xylem vessels to their function, limited to:
 - (a) thick walls with lignin (details of lignification are **not** required)
 - (b) no cell contents
 - (c) cells joined end to end with no cross walls to form a long continuous tube

8.2 Water uptake

Core

- 1 Identify in diagrams and images root hair cells and state their functions
- 2 State that the large surface area of root hairs increases the uptake of water and mineral ions
- 3 Outline the pathway taken by water through the root, stem and leaf as: root hair cells, root cortex cells, xylem, mesophyll cells
- 4 Investigate, using a suitable stain, the pathway of water through the above-ground parts of a plant

Supplement



8.3 Transpiration

Core

- 1 Describe transpiration as the loss of water vapour from leaves
- 2 State that water evaporates from the surfaces of the mesophyll cells into the air spaces and then diffuses out of the leaves through the stomata as water vapour
- 3 Investigate and describe the effects of variation of temperature and wind speed on transpiration rate

Supplement

- 4 Explain how water vapour loss is related to: the large internal surface area provided by the interconnecting air spaces between mesophyll cells and the size and number of stomata
- 5 Explain the mechanism by which water moves upwards in the xylem in terms of a transpiration pull that draws up a column of water molecules, held together by forces of attraction between water molecules
- 6 Explain the effects on the rate of transpiration of varying the following factors: temperature, wind speed and humidity
- 7 Explain how and why wilting occurs

8.4 Translocation

Core

Supplement

- 1 Describe translocation as the movement of sucrose and amino acids in phloem from sources to sinks
- 2 Describe:
 - (a) sources as the parts of plants that release sucrose or amino acids
 - (b) sinks as the parts of plants that use or store sucrose or amino acids
- 3 Explain why some parts of a plant may act as a source and a sink at different times



Notes

Plants take water and mineral ions from soil through roots. The water travels to leaves for photosynthesis through **xylem vessels**. Mineral ions also travel through xylem vessels

The sucrose and amino acids are transported to other parts of the plant by the leaves. These substances travel through **phloem tubes**.

Xylem

Xylem is made up of a lot of hollow dead cells joined end to end. The end walls of cells have also broken down making it a long continuous tube.

Xylem vessels do not contain nuclei or cytoplasm

This vessel runs from the root of plants right up the stem and then branches out into every leaf.

The walls of xylem vessels are made up of cellulose and lignin.

Lignin is a very strong substance so it gives support to plants keeping it upright.

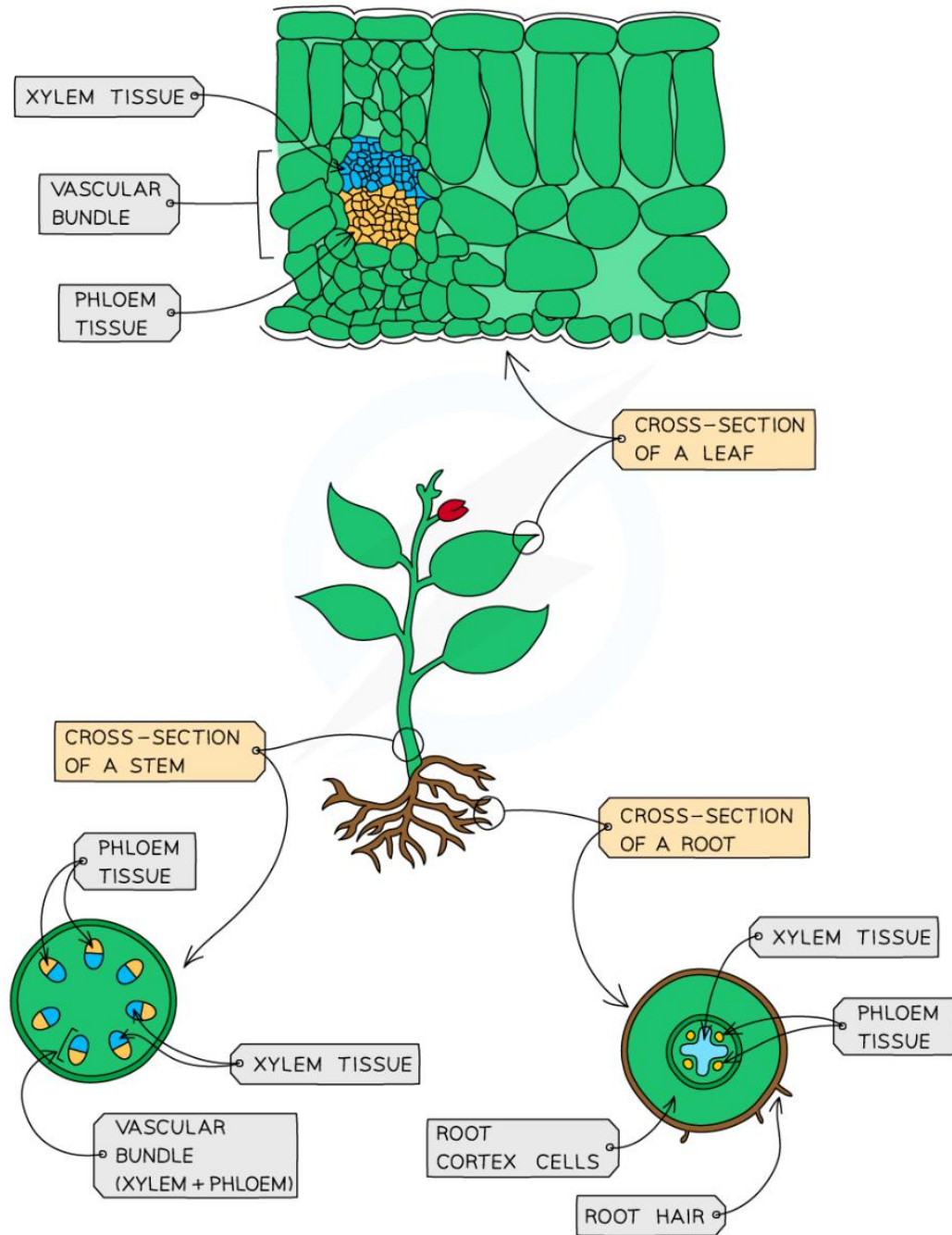
Wood is entirely lignified xylem vessels.

Vascular Bundles

A group of xylem vessels and phloem tubes is called a vascular bundle.



THE LOCATION OF TRANSPORT (VASCULAR) TISSUES IN NON-WOODY DICOTYLEDONOUS PLANTS





Pathway of water

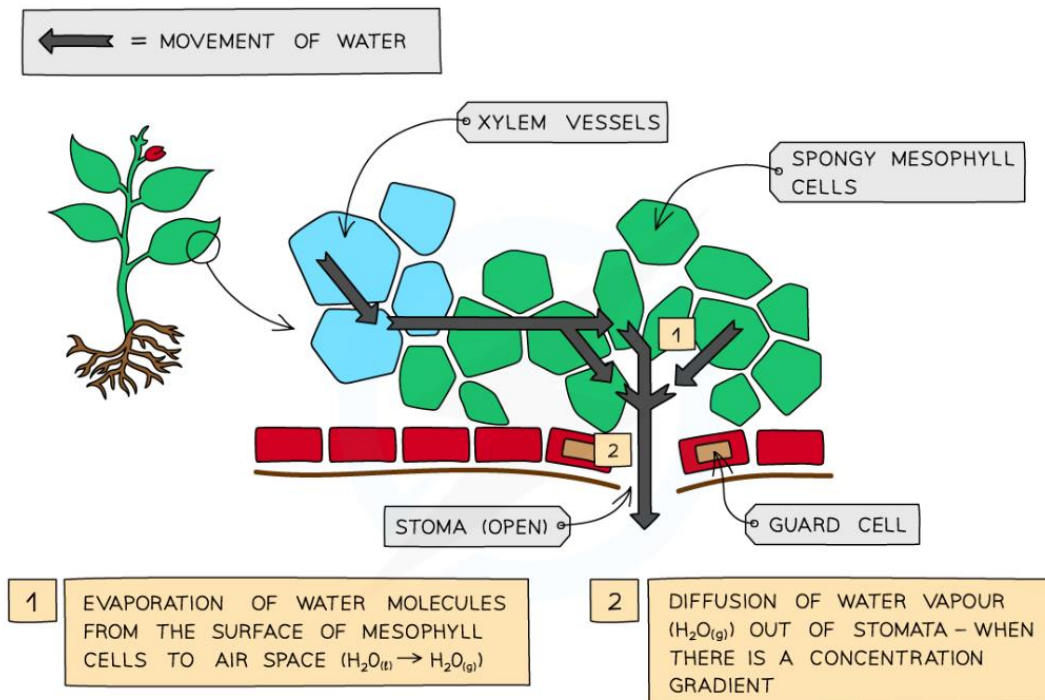
Water moves in plants through roots through osmosis.

Then the water travels through the cortex, through many root cells by osmosis. Eventually it reaches the middle of the root where xylem is present.

Root hair cell - Root cortex cell - leaf mesophyll cells

The water then travels up the xylem vessel due to the difference in pressure at the top.

Up in the leaves cells some of the water is used for photosynthesis and some of it evaporates from the leaf through stomata.



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Transpiration

It is the loss of water vapour from the plant

Mostly happens through stomata

As water vapour diffuses out of the leaf cells the water potential inside the cell decreases.



Through this way water from the top of the xylem vessel travels inside the leaf through osmosis.

Through this way water pressure at the top of the xylem decreases. It is now less than the pressure at the bottom of xylem vessels.

This pressure difference causes the water to flow upwards from area of high pressure to area of low pressure

This difference in pressure is known as transpiration pull

Transpiration pull is a force produced by the difference in pressure.

Water molecules are also attracted to each other by cohesion. Adhesive forces between water and cellulose also aids in transport up the stem.

This creates one transpiration stream up the xylem

Rate of transpiration can be measured through a potometer.

Conditions affecting transpiration rate

Transpiration happens faster when the the temperature is high

The higher the humidity, the lower the rate of transpiration.

The windy day, higher the rate of transpiration.

Translocation

The substances made in leaves are transported to other parts of the plant where they are required. This is known as **translocation**.

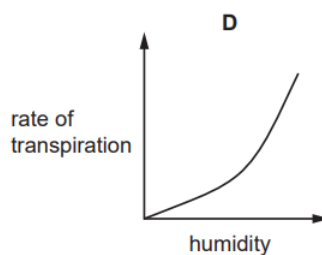
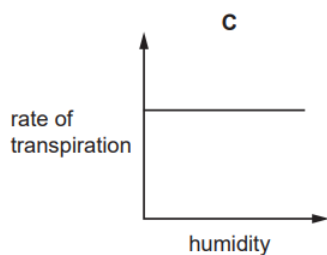
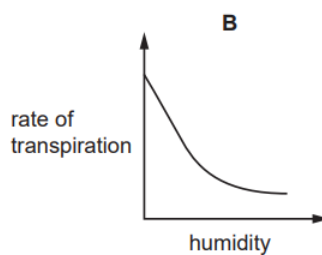
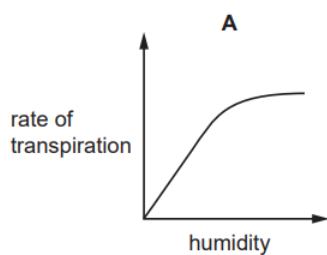
The part of the plant from which a substance is being translocated is known as the **source**.

The part of the plant where a substance is being translocated is known as **sink**.



MCQ Questions

Which graph shows most clearly what will happen to the rate of transpiration as humidity increases?



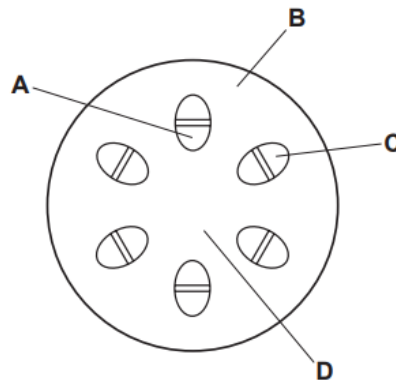
By which process is water lost from a leaf?

- A** active transport
- B** diffusion
- C** osmosis
- D** photosynthesis



The lower end of a plant stem is placed in water coloured with red dye. After three hours, the stem is cut as shown in the diagram.

Which labelled region is stained red?



What is transported in the phloem and what is the direction of transport?

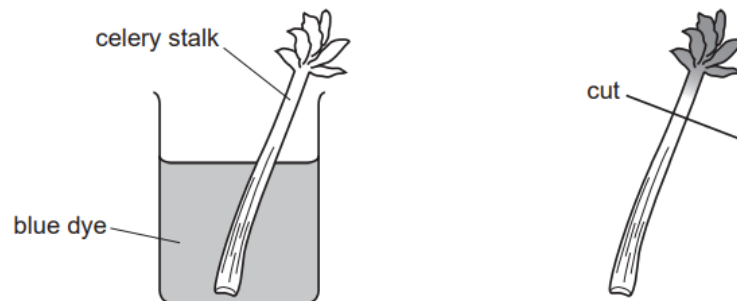
- A** starch, up and down
- B** starch, up only
- C** sucrose, down and up
- D** sucrose, down only



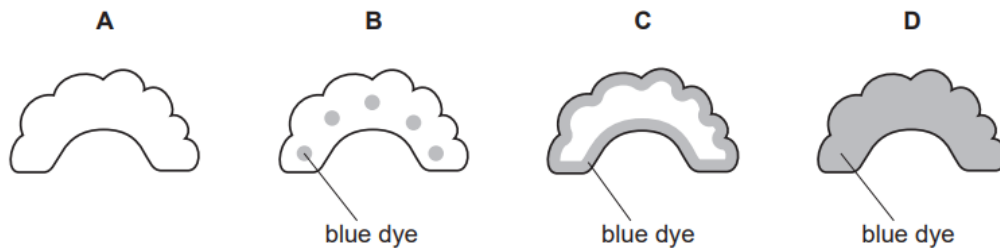
In which order does water pass through the cells of a plant, as the water travels from the roots to a leaf?

- A** mesophyll cells → root hair → root cortex → xylem
- B** root cortex → root hair → xylem → mesophyll cells
- C** root hair → mesophyll cells → root cortex → xylem
- D** root hair → root cortex → xylem → mesophyll cells

A celery stalk is placed in a beaker of blue dye. Once the dye reaches the leaves, the stalk is taken out and cut in half.



Which diagram shows the appearance of the cut end of the stalk?





Some liquid is collected from the xylem in the stem of a plant.

What is present in the liquid?

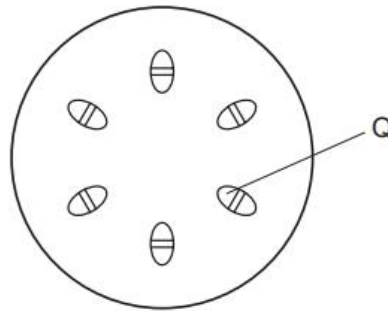
- A** cellulose
- B** inorganic ions
- C** starch
- D** sugar

Which statements about plant transpiration are correct?

	plants transpire most when	plants transpire least when
A	air is dry	temperature is high
B	light intensity is high	air is humid
C	light intensity is low	temperature is low
D	temperature is cold	light intensity is high



The diagram shows a cross-section through a plant stem.

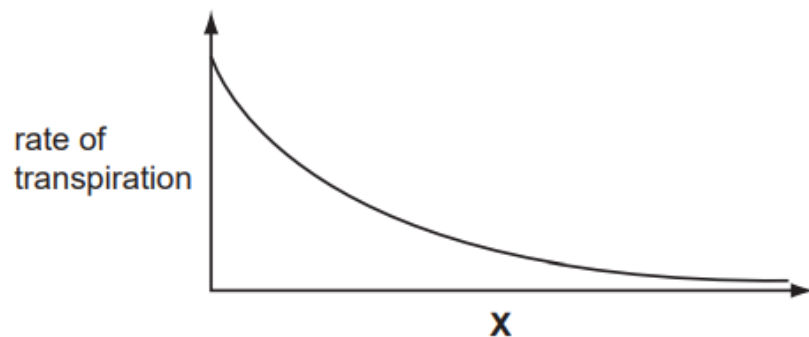


Q shows the part that is stained red when the stem is placed in water containing a red dye.

What is found at Q?

- A guard cells
- B palisade cells
- C phloem
- D xylem

The graph shows how the rate of transpiration is affected by **X**.



What is **X**?

- A humidity
- B light intensity
- C soil moisture
- D temperature



Answers

B
B
A
C
D
B
B
B
D
A

Aitchison College



Structured Questions

Explain how water moves from the soil into the root.

.....

.....

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.....

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.....

.....

.....[4]

In the Root hairs, water moves from high water potential to low water potential through osmosis,
Through a partially permeable membrane.

Describe the function of stomata.

.....

.....

.....

.....

.....[2]

It is designed to allow movement of gasses (carbon dioxide and oxygen) into and out of the leaf for photosynthesis and respiration.



Chapter 9:Transport in Animals

9 Transport in animals

9.1 Circulatory systems

Core

- 1 Describe the circulatory system as a system of blood vessels with a pump and valves to ensure one-way flow of blood

Supplement

- 2 Describe the single circulation of a fish
- 3 Describe the double circulation of a mammal
- 4 Explain the advantages of a double circulation

9.2 Heart

Core

- 1 Identify in diagrams and images the structures of the mammalian heart, limited to: muscular wall, septum, left and right ventricles, left and right atria, one-way valves and coronary arteries
- 2 State that blood is pumped away from the heart in arteries and returns to the heart in veins
- 3 State that the activity of the heart may be monitored by: ECG, pulse rate and listening to sounds of valves closing
- 4 Investigate and describe the effect of physical activity on the heart rate
- 5 Describe coronary heart disease in terms of the blockage of coronary arteries and state the possible risk factors including: diet, lack of exercise, stress, smoking, genetic predisposition, age and sex
- 6 Discuss the roles of diet and exercise in reducing the risk of coronary heart disease

Supplement

- 7 Identify in diagrams and images the atrioventricular and semilunar valves in the mammalian heart
- 8 Explain the relative thickness of:
 - (a) the muscle walls of the left and right ventricles
 - (b) the muscle walls of the atria compared to those of the ventricles
- 9 Explain the importance of the septum in separating oxygenated and deoxygenated blood
- 10 Describe the functioning of the heart in terms of the contraction of muscles of the atria and ventricles and the action of the valves
- 11 Explain the effect of physical activity on the heart rate



9.3 Blood vessels

Core

- 1 Describe the structure of arteries, veins and capillaries, limited to: relative thickness of wall, diameter of the lumen and the presence of valves in veins
- 2 State the functions of capillaries
- 3 Identify in diagrams and images the main blood vessels to and from the:
 - (a) heart, limited to: vena cava, aorta, pulmonary artery and pulmonary vein
 - (b) lungs, limited to: pulmonary artery and pulmonary vein
 - (c) kidney, limited to: renal artery and renal vein

Supplement

- 4 Explain how the structure of arteries and veins is related to the pressure of the blood that they transport
- 5 Explain how the structure of capillaries is related to their functions
- 6 Identify, in diagrams and images, the main blood vessels to and from the liver as: hepatic artery, hepatic veins and hepatic portal vein

9.4 Blood

Core

- 1 List the components of blood as: red blood cells, white blood cells, platelets and plasma
- 2 Identify red and white blood cells in photomicrographs and diagrams
- 3 State the functions of the following components of blood:
 - (a) red blood cells in transporting oxygen, including the role of haemoglobin
 - (b) white blood cells in phagocytosis and antibody production
 - (c) platelets in clotting (details are **not** required)
 - (d) plasma in the transport of blood cells, ions, nutrients, urea, hormones and carbon dioxide
- 4 State the roles of blood clotting as preventing blood loss and the entry of pathogens

Supplement

- 5 Identify lymphocytes and phagocytes in photomicrographs and diagrams
- 6 State the functions of:
 - (a) lymphocytes – antibody production
 - (b) phagocytes – engulfing pathogens by phagocytosis
- 7 Describe the process of clotting as the conversion of fibrinogen to fibrin to form a mesh



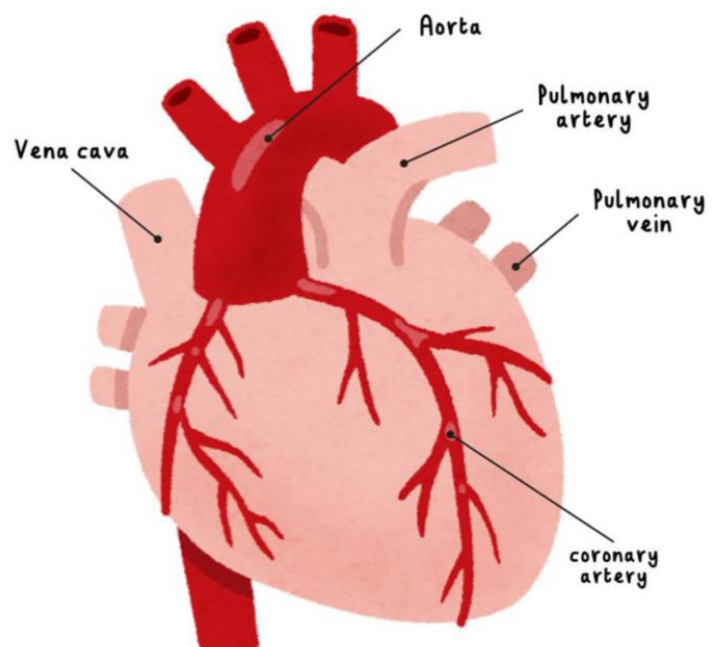
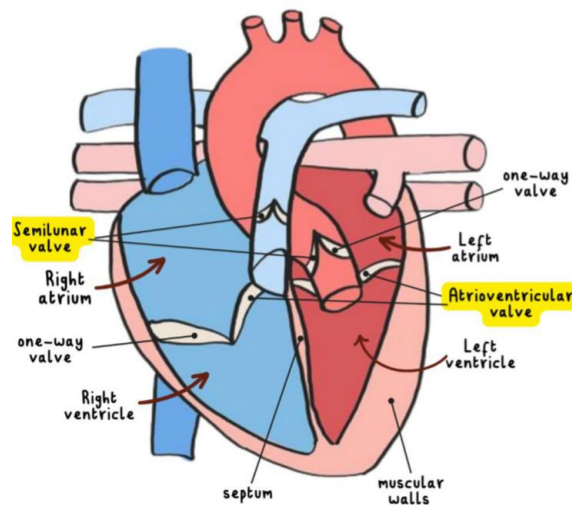
Notes

The circulatory system is composed of blood vessels such as arteries, veins and capillaries, also containing a pump - the heart.

Larger animals need specialised transport systems for efficient nutrient exchange which is fulfilled through a blood network system

Single circulatory system	Double circulatory system
fish	mammals
heart has two chambers and blood passes through heart once only in one complete circuit of the body	heart has four chambers and blood flows through the heart twice in one complete circuit of the body
less efficient at oxygen transport	more efficient at oxygen transport

The Heart:





Deoxygenated blood enters the heart through the vena cava into the right atrium
Right atrium contracts and blood moves downwards through the tricuspid valve
The right ventricle contracts and blood flows up into the pulmonary artery through the semilunar valve into the lungs
The oxygenated blood returns to the left atrium entering through the pulmonary vein through the semilunar valve
The left atrium contracts and blood moves into the left ventricle through the bicuspid valve
The ventricle contracts and the oxygenated blood flows through to the aorta through the semilunar valve
The left ventricle wall is much thicker so the blood flows out with much greater pressure than from the right ventricle as from the right atrium blood is transported only to lungs and with the aorta the whole body
The two sides of the heart are separated by the septum keeping oxygenated blood on the left side and deoxygenated on the right side
Bicuspid and tricuspid valves are called atrioventricular valves
Valves ensure blood moves in one direction and no backflow occurs
The pulmonary artery is the only artery which carries deoxygenated blood and the pulmonary vein is the only vein which carries oxygenated blood
The coronary arteries supply the heart with oxygen

Heart monitoring and CHD:

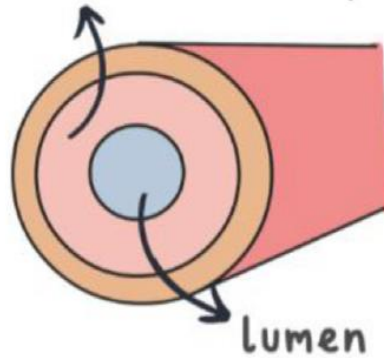
An electrocardiogram (ECG) is used to monitor the heart
Heart activity is also monitored through taking of a pulse
During physical activity the pulse rate gets higher so more oxygen is transported around the body and quicker hence the increased pulse rate
CHD is caused by a buildup of cholesterol in the coronary arteries which narrows the artery and restricts oxygen supply to the heart causing heart related problems and disease
CHD is often caused by smoking, bad eating habits, age and stress
Exercise reduces the risk of CHD a lot

Blood vessels:

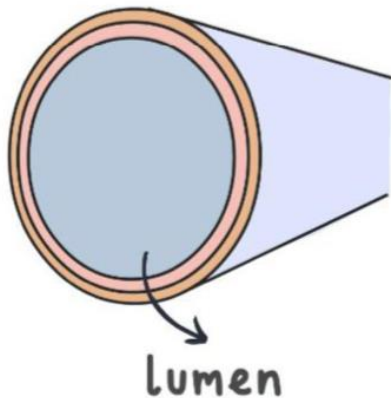
Arteries carry oxygenated blood from the heart to the body. They have a small lumen but thick wall composed of elastic fibres to maintain high blood pressure. Arteries then branch into arteries and then capillaries.



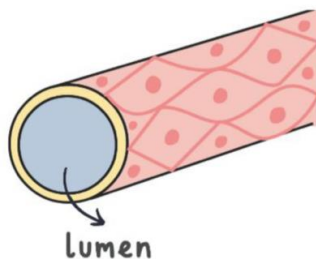
muscular and elastic fibres

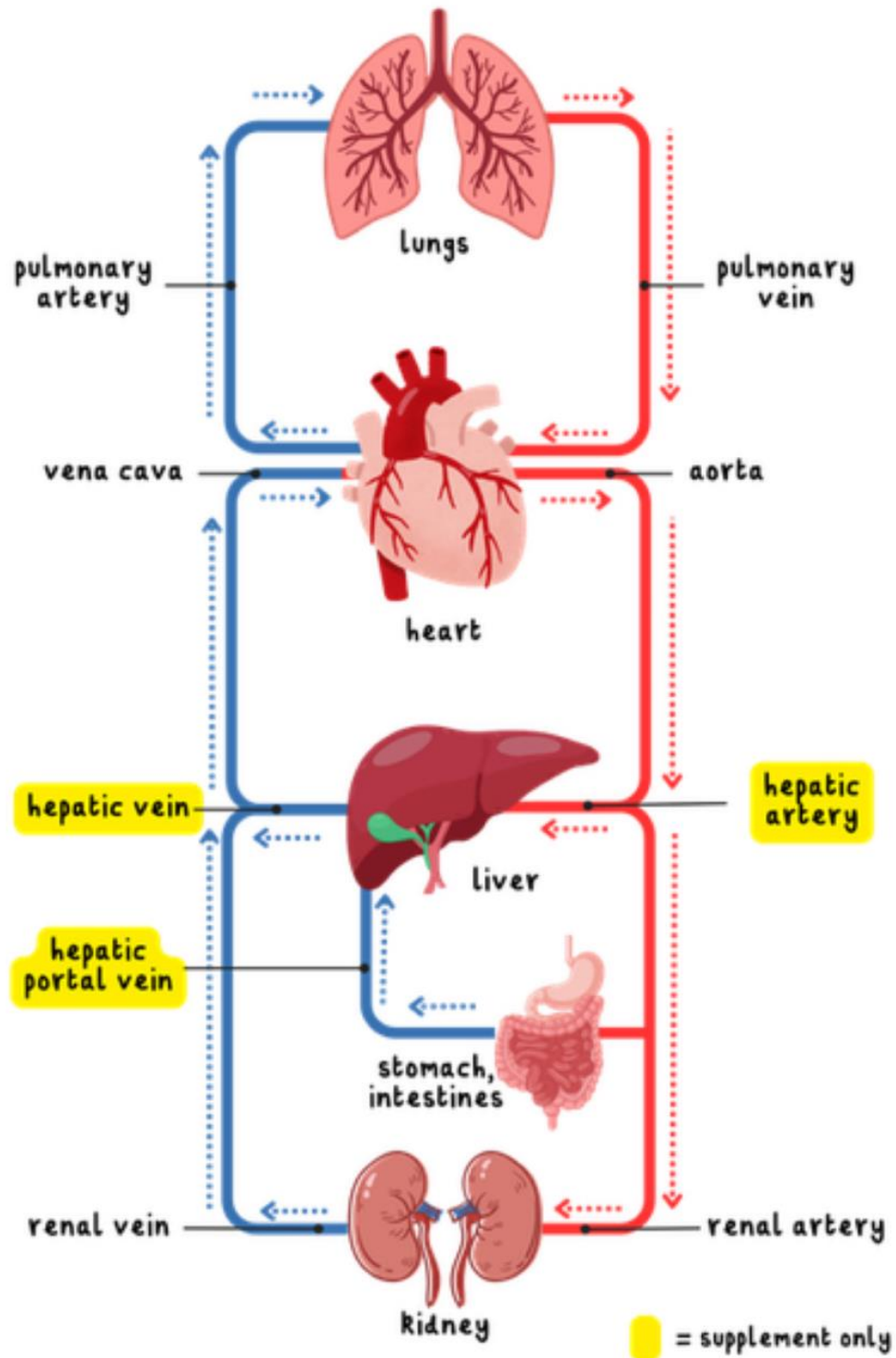


Veins carry deoxygenated blood from the body to the heart. They have a large lumen but thinner walls as the blood pressure isn't high enough for them to have thick elastic walls. They also contain valves as blood at lower pressure may backtrack and flow backwards. Capillaries branch into venules and then into veins.



Capillaries are very thin blood vessels, often only one Cell thick. They exchange substances with tissues and maintain oxygen carbon dioxide exchange with respiring cells. The thin walls enable them to have fast diffusion







Blood cells:

The blood contains red blood cells, white blood cells and platelets amongst many other substances.

Plasma is the liquid which contains soluble nutrients, the blood cells and urea etc. Red blood cells contain haemoglobin which binds to oxygen to become oxyhaemoglobin. They don't have a nucleus to enable more packing for haemoglobin. Haemoglobin releases the bonded oxygen to the cells in need. They are disc shaped and biconcave.



White blood cells are immunity related cells. They fight off pathogens. White blood cells are subdivided; one white blood cell type is lymphocytes. Lymphocytes produce antibodies. Antibodies are specific to specific antigens. Antibodies allow for fighting against the particular pathogen, often holding it in place for phagocytes to come and consume them.



Phagocytosis and platelets:

Phagocytes recognise and attach to the particular pathogen, engulfing it. The pathogen is trapped inside and the phagocyte releases enzymes to enable breakdown of the pathogen, killing it. This process is called phagocytosis.

Platelets are small fragments involved in blood clotting. Blood clotting occurs when a blood vessel is broken or damaged. Platelets stick to the broken blood vessel wall. This causes a protein known as fibrinogen to convert into fibrin which forms a mesh fibre around the breakage. More platelets come and attach themselves, trapping other cells around the site in the process. This creates a scab and prevents further bleeding, allowing the blood vessel to heal.



MCQS

Which chamber of the heart has the thickest muscle wall?

- A left atrium
- B left ventricle
- C right atrium
- D right ventricle

Which blood vessel has a high carbon dioxide concentration, a low oxygen concentration and a high blood pressure?

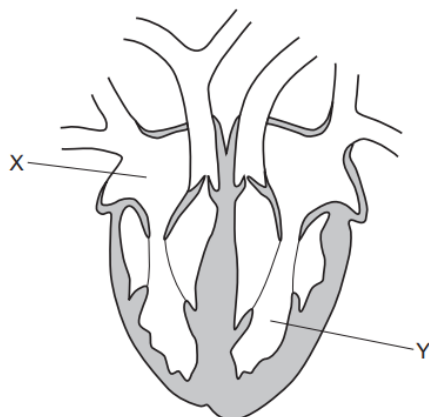
- A aorta
- B pulmonary artery
- C pulmonary vein
- D vena cava

Which statement is correct for **most** veins in the human body?

- A They carry blood at high pressure.
- B They have a pulse.
- C They have valves.
- D They take blood away from the heart.



The diagram shows a vertical section through a human heart.

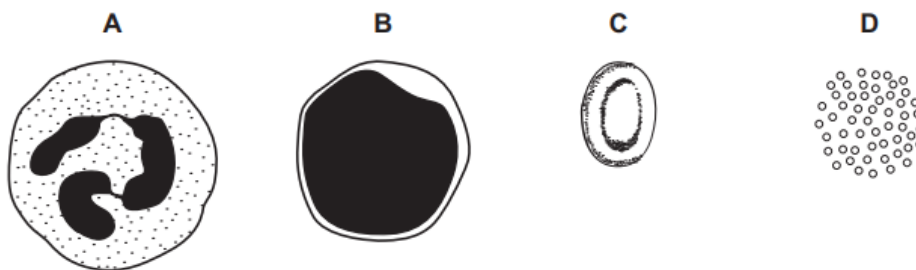


What are X and Y?

	X	Y
A	left atrium	right ventricle
B	left ventricle	right atrium
C	right atrium	left ventricle
D	right ventricle	left atrium

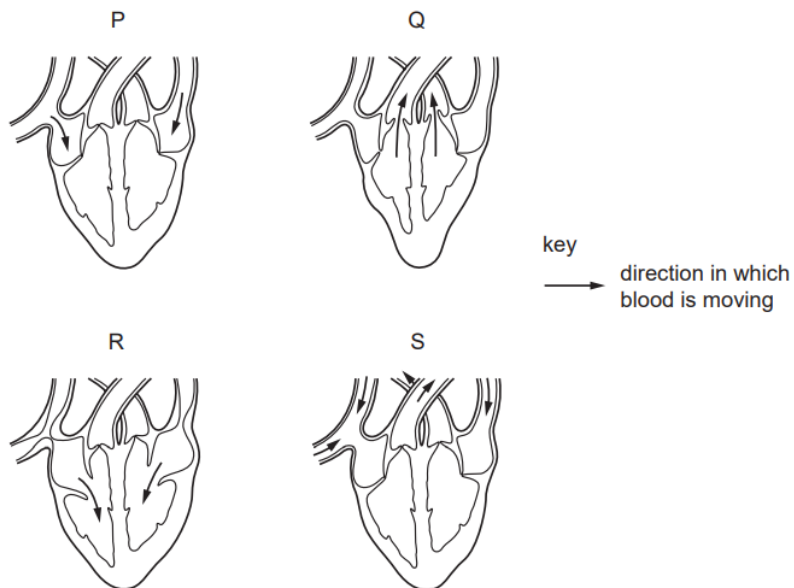
The diagrams show some components of the blood of a mammal.

Which component causes the blood to start clotting?





The diagrams show four different stages in **one** heart beat.



What is the correct order for the stages after stage P?

- A** Q → R → S
- B** R → Q → S
- C** R → S → Q
- D** S → R → Q

Where does haemoglobin become oxyhaemoglobin?

- A** heart
- B** kidneys
- C** liver
- D** lungs



What is the correct sequence for blood being pumped from the heart to the lungs?

- A** left atrium → left ventricle → pulmonary artery
- B** left atrium → left ventricle → pulmonary vein
- C** right atrium → right ventricle → pulmonary artery
- D** right atrium → right ventricle → pulmonary vein

Why is the circulatory system of mammals described as a double circulation?

- A** Blood flows firstly through arteries and then through veins.
- B** Blood flows through the heart twice on one complete circuit of the body.
- C** In the heart, blood flows firstly through atria and then through ventricles.
- D** The atria and the ventricles contract alternately.

Which substance is transported by haemoglobin?

- A** nitrogen
- B** oxygen
- C** urea
- D** water



Answers

B
B
C
C
D
B
D
C
B
B

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Theory Questions

Fig. 1.1 shows the human heart and the main blood vessels. The functions of the parts of the heart and some of the blood vessels are given in Table 1.1.

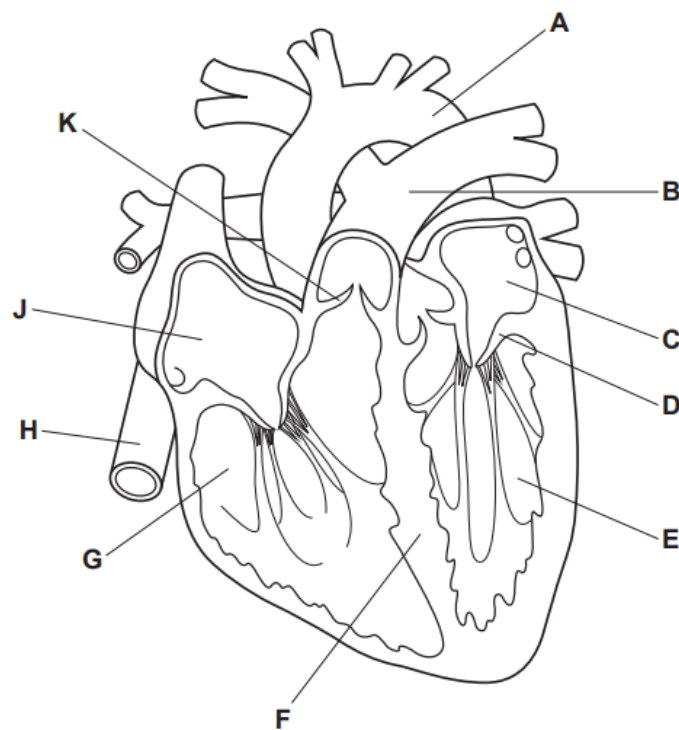


Fig. 1.1



Complete Table 1.1.

One row has been done for you.

Table 1.1

function	letter on Fig. 1.1	name
structure that separates oxygenated and deoxygenated blood		
structure that prevents backflow of blood from ventricle to atrium		
blood vessel that carries oxygenated blood	A	aorta
blood vessel that carries deoxygenated blood		
structure that prevents backflow of blood from pulmonary artery to right ventricle		
chamber of the heart that contains oxygenated blood		
chamber of the heart that contains deoxygenated blood		

[6]

- F Septum
- D Valve
- B Pulmonary Artery
- H Vena Cava
- K Semilunar Valve
- C Left Atrium
- E Left Ventricle
- J Right Atrium
- G Right Ventricle



2.

- (i) Describe what is meant by the term *double circulation*.

.....
.....
.....

[1]

- (ii) State **one** advantage of a double circulation.

.....
.....
.....

[1]

i)

Blood flows through heart twice to reach the same point, one loop goes to lungs and one to rest of the body.

ii)

It Allows animals to have high metabolic rates and facilitates transport of nutrients quicker



Chapter 10: Diseases And Immunity

10 Diseases and immunity

10.1 Diseases and immunity

Core

- 1 Describe a pathogen as a disease-causing organism
- 2 Describe a transmissible disease as a disease in which the pathogen can be passed from one host to another
- 3 State that a pathogen is transmitted:
 - (a) by direct contact, including through blood and other body fluids
 - (b) indirectly, including from contaminated surfaces, food, animals and air
- 4 Describe the body defences, limited to: skin, hairs in the nose, mucus, stomach acid and white blood cells
- 5 Explain the importance of the following in controlling the spread of disease:
 - (a) a clean water supply
 - (b) hygienic food preparation
 - (c) good personal hygiene
 - (d) waste disposal
 - (e) sewage treatment (details of the stages of sewage treatment are **not** required)

Supplement

- 6 Describe active immunity as defence against a pathogen by antibody production in the body
- 7 State that each pathogen has its own antigens, which have specific shapes
- 8 Describe antibodies as proteins that bind to antigens leading to direct destruction of pathogens or marking of pathogens for destruction by phagocytes
- 9 State that specific antibodies have complementary shapes which fit specific antigens
- 10 Explain that active immunity is gained after an infection by a pathogen or by vaccination
- 11 Outline the process of vaccination:
 - (a) weakened pathogens or their antigens are put into the body
 - (b) the antigens stimulate an immune response by lymphocytes which produce antibodies
 - (c) memory cells are produced that give long-term immunity
- 12 Explain the role of vaccination in controlling the spread of diseases
- 13 Explain that passive immunity is a short-term defence against a pathogen by antibodies acquired from another individual, including across the placenta and in breast milk
- 14 Explain the importance of breast-feeding for the development of passive immunity in infants
- 15 State that memory cells are not produced in passive immunity

continued



10.1 Diseases and immunity continued

Core

Supplement

- 16 Describe cholera as a disease caused by a bacterium which is transmitted in contaminated water
- 17 Explain that the cholera bacterium produces a toxin that causes secretion of chloride ions into the small intestine, causing osmotic movement of water into the gut, causing diarrhoea, dehydration and loss of ions from the blood

Notes

1. Pathogen: A pathogen is a disease-causing organism
2. Transmissible disease: A disease in which the pathogen can be passed from one host to another
3. Active immunity: It is the defence against a pathogen by antibody production in the body
4. Passive immunity: It is a short-term defence against a pathogen by antibodies acquired from another individual

- A pathogen is a disease-causing organism which can include bacteria, viruses, protozoa etc.
- A host is the organism whom the pathogen infects
- There are pathogens which can be passed on through hosts and thus the diseases which they cause are called transmissible diseases
- There are a number of ways through which pathogens can be transmitted and they are:
 - o Direct Contact: This can be through blood transfusions, exchange of other bodily fluids
 - o Indirect Contact: The pathogen is transferred through contaminated surfaces, air, water, food or animals



Body Defences

- The body have several defences to protect against pathogens:
 - o Mechanical Barriers:
 - Skin- Skin covers almost all of the external parts of the human body to protect pathogens from entering. When there is a cut in the skin, a scab immediately forms to prevent more pathogens from entering
 - Nasal hair-These hairs trap a lot of pathogens to prevent them from going further into the respiratory tract
 - o Chemical Barriers:
 - Mucus-It is made in several parts of the body especially in the trachea, which trap a lot of pathogens and gets swallowed or expelled from the body
 - Stomach acid- Contains hydrochloric acid having a low pH which kills pathogens

Controlling the spread of diseases

MEASURE TO PREVENT SPREAD	EXPLANATION
Hygienic food preparation	• Keep food cold while storing to prevent microbial growth • Washing hands, cleaning surfaces and utensils • Cook food well and long enough (high temperature) • Cover food to prevent insects from feeding
Personal hygiene	• Washing hands and body with soap to kill microbes • Use tissues to catch sneezes and coughs to prevent spreading of microbes
Waste disposal	• Dispose waste food in sealed containers to prevent flies which can be vectors for pathogens • Trash bins should be covered and cleared regularly • Store rubbish away from human habitation
Sanitation	• Proper plumbing and sanitation in homes to remove waste which contains pathogens • Raw sewage should be treated to remove solid waste and kill pathogens before being released into water bodies

Antibodies and Antigens

- In the blood, pathogens can be detected by white blood cells using antigens.



- Every cell including pathogens have proteins called **antigens** extending from their cell membranes
- Different cells have different antigens; thus lymphocytes (a type of white blood cells) can recognise foreign antigens and make **antibodies** which have a complementary shape to the antigen
- These antibodies attach to antigens and causes pathogens to agglutinate (clump together) and restrict their motion.
- Meanwhile phagocytes (another type of white blood cells) engulf and destroy the agglutinated pathogens and destroy them. They do this through the process of phagocytosis

Active Immunity

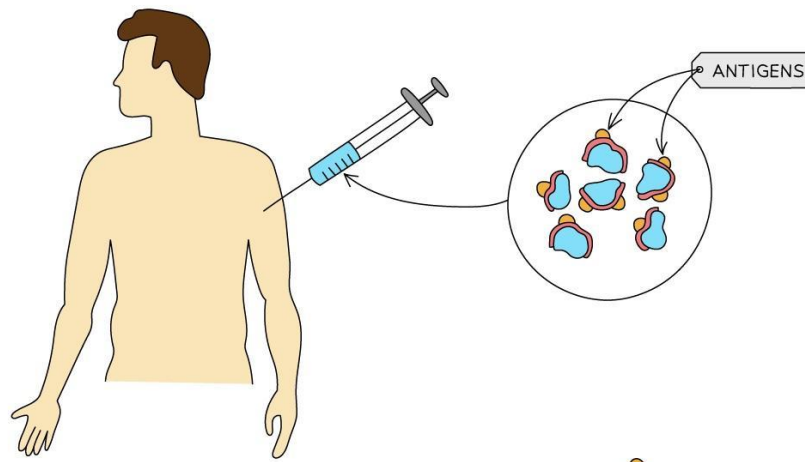
- Active immunity is the defence against a pathogen by antibody production in the body. This type of immunity can be achieved after an infection by a pathogen, or through vaccination. This type of immunity is long term yet slow acting.
- Infection:
 - o In the case of an infection, it might take the lymphocytes to take a few days to react and then form antibodies.
 - o After an infection, memory cells can be formed which retain the instructions for making the specific type of antibodies, so that if there is a re-infection, the body can quickly produce antibodies before the person can become sick
 - o This makes a person immune to the disease, unless the pathogen mutates
- Vaccination:
 - o Vaccinations can give protection against certain diseases without being directly exposed to harmful pathogen
 - o Vaccines are essentially dead or very weakened forms of specific pathogens, containing the specific antigens
 - o They are too weak to cause illness but an immune response does occur and as a result antibodies and eventually memory cells are produced.



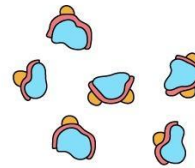
- o The memory cells produced will thus give long term immunity to the person against the particular disease
- o Vaccinations can also play a great part in the prevention of spread of diseases
- o Vaccination can be used to control the spread of disease by providing herd immunity. This is where a large amount of the population is vaccinated and are thus immune to the pathogen, so the disease cannot spread as there are only a few people left who can still become infected. The few that cannot be vaccinated, for example due to medical reasons, are therefore protected against the disease.



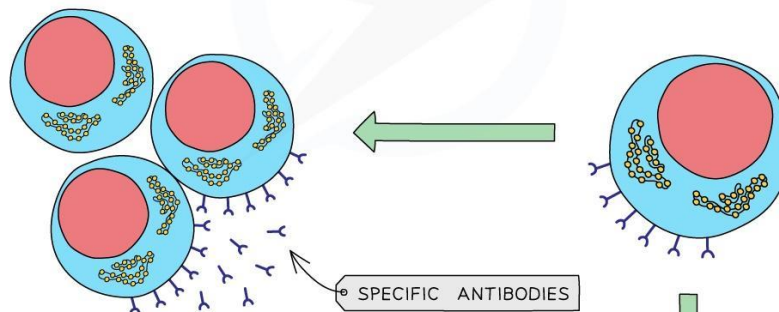
1 HARMLESS PATHOGEN INJECTED



2 ANTIGENS TRIGGER AN IMMUNE RESPONSE. IT CAN TAKE DAYS FOR A LYMPHOCYTE MAKING COMPLEMENTARY ANTIBODIES TO BE ACTIVATED.

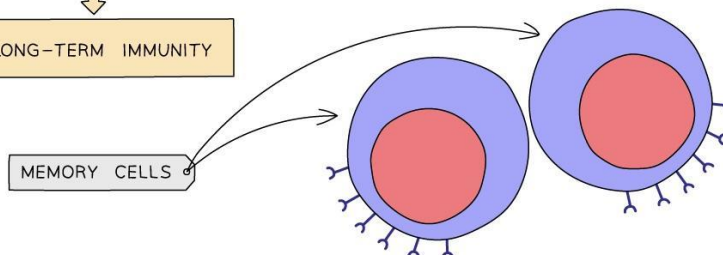


3 LYMPHOCYTE ABLE TO PRODUCE COMPLEMENTARY ANTIBODIES MULTIPLIES, ANTIBODIES RELEASED.



4 MEMORY CELLS (LASTING YEARS) ARE PRODUCED. IF ANTIGEN IS ENCOUNTERED AGAIN, ANTIBODIES ARE PRODUCED MUCH FASTER.

= LONG-TERM IMMUNITY





Passive Immunity

- Passive immunity is a short-term defence against a pathogen by antibodies acquired from another individual
- Examples of this include breastfeeding and through the placenta
- Passive immunity is fast acting yet short-term as the body does not make its own antibodies or memory cells
- In breastfeeding, antibodies pass from mother to infant through breast milk-this is important to fight off infections while their immune systems are still developing

Cholera

- Cholera is a disease caused by the bacteria *Vibrio Cholera*. This bacterium is transmitted through contaminated water or food
 - o When these bacteria enter the small intestine, it binds to the small intestine wall and then produces a toxin
 - o This toxin causes cells on the intestinal lining to secrete chloride ions into the lumen (hollow space) of the small intestine.
 - o These chloride ions decrease the water potential of the lumen as compared to the blood and thus water flows through osmosis from the cells into the lumen.
 - o This causes a large volume of water to be lost from the body as faeces and is called diarrhoea.
 - o This also leads to low concentration of Cl ions in the blood and causes dehydration.



Questions:

MCQ's:

What is the function of lymphocytes in the blood?

- A** antibody production
- B** blood clotting
- C** phagocytosis
- D** transport of hormones

Which part of a pathogen is recognised by the immune system?

- A** active site
- B** antibiotic
- C** antibody
- D** antigen

When a tissue from a man is grafted onto a woman it may be rejected by the woman's body.

What is the main cause of this rejection?

- A** antibody production
- B** phagocytosis
- C** the action of antibiotics
- D** the presence of a Y chromosome



The antibodies that give immunity to a disease can be acquired in the following different ways.

- 1 feeding on breast milk
- 2 infection by disease
- 3 vaccination

Which give active immunity?

- A** 1 and 2 only
- B** 1 and 3 only
- C** 2 and 3 only
- D** 1, 2 and 3

Which row describes the features of passive immunity?

	antibodies made	involves memory cells	effective period
A	no	no	short term
B	no	yes	short term
C	yes	no	long term
D	yes	yes	long term

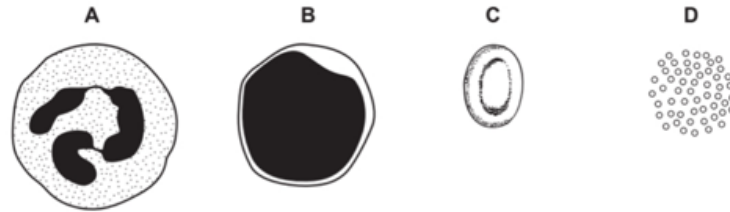
What happens when a child is vaccinated against tuberculosis?

	type of immunity	production of memory cells
A	active	no
B	active	yes
C	passive	no
D	passive	yes



The diagram shows some parts from the blood of a mammal.

Which part would contain the breakdown products of bacterial cells?



Which are both chemical barriers to the transmission of pathogens?

- A mucus and stomach acid
- B mucus and white blood cells
- C skin and hairs in the nose
- D skin and stomach acid

Which is a mechanical barrier to pathogens?

- A acid in the stomach
- B hairs in the nose
- C mucus in the trachea
- D phagocytosis in the blood

Which disease is caused by bacteria?

- A AIDS
- B cholera
- C obesity
- D scurvy



Answers:

1 A

2 A

3 A

4 C

5 A

6 B

7 A

8 A

9 B

10 B



- (c) State **two** other substances, apart from antibodies, transported by the blood.

.....
.....

(1)
(Total 5 marks)

- (a) Explain how the skin and mucous membranes prevent entry of pathogens into the body.

.....
.....
.....
.....
.....
.....

(3)

- (b) Explain why antibiotics are used to treat bacterial but not viral diseases.

.....
.....
.....
.....

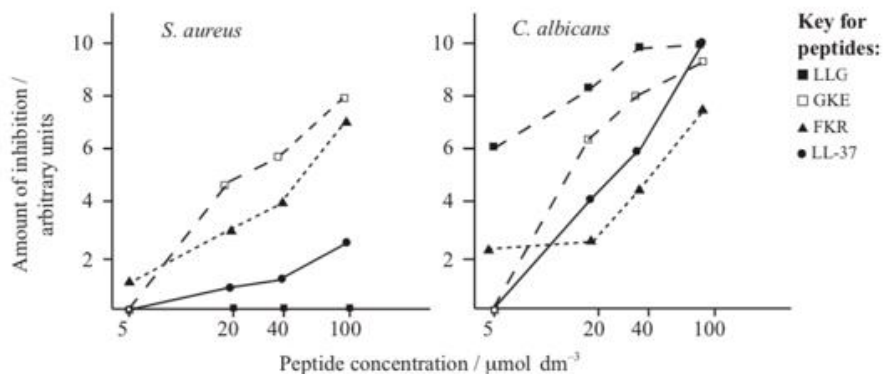
(2)
(Total 5 marks)





Antibiotic peptides occur naturally on the surface of human skin. One of these peptides, called LL-37, and three other similar synthetic peptides were investigated to assess both their antibiotic properties and effect on human cells.

The graphs show the antibiotic effect of the peptides against two microbes, *S. aureus* and *C. albicans*. The technique involves measuring the inhibition of growth of the microbes.



[Source: T Sigurdardottir, *et al.*, (2006), *Antimicrobial Agents and Chemotherapy*, **50** (9), pages 2983–2989]

- (a) Describe the effect of the FKR on *C. albicans*.

.....

.....

(2)

- (b) Compare the effects of the peptide LLG on *S. aureus* and *C. albicans*.

.....

.....

(2)



- (c) Evaluate the effectiveness of LL-37 against the two microbes.

.....

.....

.....

.....

(3)

Answers:

- (a) State the difference between an antigen and an antibody.

Antigen is a molecule that causes antibody production.
Antibody is a molecule that recognises an antigen

(1)

- (b) Explain antibody production.

Antigen causes an immune response. This.....
produces antibodies which are specific to that
antigen. Antibodies are produced in B
Lymphocytes and carried in blood

.....

.....

.....

.....

(3)



- (c) State **two** other substances, apart from antibodies, transported by the blood.

Urea and Oxygen.....

(1)

(Total 5 marks)

- (a) Explain how the skin and mucous membranes prevent entry of pathogens into the body.

Skin acts as physical barrier. Skin has
several layers of cells. The skin is dry and
discourages growth of pathogens. Enzyme
lysozyme present on skin which breaks
down pathogens

(3)

- (b) Explain why antibiotics are used to treat bacterial but not viral diseases.

Antibiotics inhibit cell wall growth. Viruses don't
possess cell walls and are unaffected

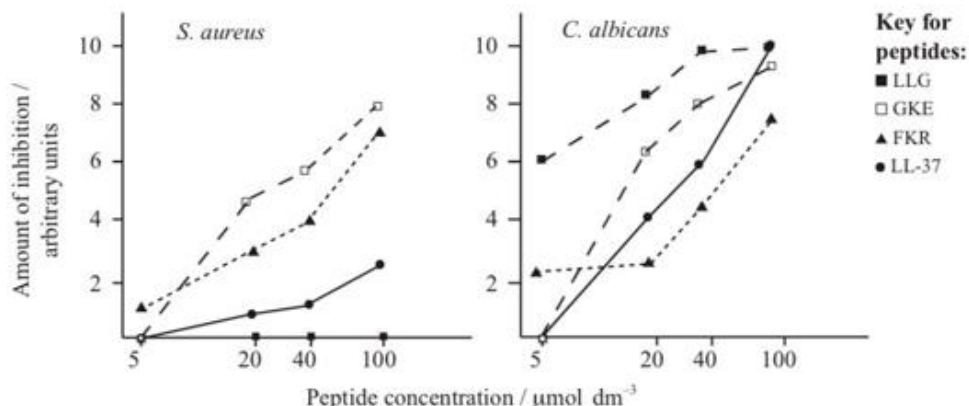
(2)

(Total 5 marks)



Antibiotic peptides occur naturally on the surface of human skin. One of these peptides, called LL-37, and three other similar synthetic peptides were investigated to assess both their antibiotic properties and effect on human cells.

The graphs show the antibiotic effect of the peptides against two microbes, *S. aureus* and *C. albicans*. The technique involves measuring the inhibition of growth of the microbes.



[Source: T Sigurdardottir, *et al.*, (2006), *Antimicrobial Agents and Chemotherapy*, **50** (9), pages 2983–2989]

- (a) Describe the effect of the FKR on *C. albicans*.

At lower concentrations, inhibition is low, from 20 $\mu\text{mol dm}^{-3}$ inhibition increases linearly

(2)

- (b) Compare the effects of the peptide LLG on *S. aureus* and *C. albicans*.

No effect on *S. aureus* and inhibition on *C. albicans*

(2)



- (c) Evaluate the effectiveness of LL-37 against the two microbes.

At lowest concentration, it doesn't have an effect on either one. As concentration increases, so does inhibition. There is a greater effect on *C. albicans*

(3)

- (a) State the difference between an antigen and an antibody.

.....

.....

(1)

- (b) Explain antibody production.

.....

.....

.....

.....

.....

.....

.....

.....

(3)



Chapter 11 &12: Gas Exchange and Respiration

11 Gas exchange in humans

11.1 Gas exchange in humans

Core

- 1 Describe the features of gas exchange surfaces in humans, limited to: large surface area, thin surface, good blood supply and good ventilation with air
- 2 Identify in diagrams and images the following parts of the breathing system: lungs, diaphragm, ribs, intercostal muscles, larynx, trachea, bronchi, bronchioles, alveoli and associated capillaries
- 3 Investigate the differences in composition between inspired and expired air using limewater as a test for carbon dioxide
- 4 Describe the differences in composition between inspired and expired air, limited to: oxygen, carbon dioxide and water vapour
- 5 Investigate and describe the effects of physical activity on the rate and depth of breathing

Supplement

- 6 Identify in diagrams and images the internal and external intercostal muscles
- 7 State the function of cartilage in the trachea
- 8 Explain the role of the ribs, the internal and external intercostal muscles and the diaphragm in producing volume and pressure changes in the thorax leading to the ventilation of the lungs
- 9 Explain the differences in composition between inspired and expired air
- 10 Explain the link between physical activity and the rate and depth of breathing in terms of: an increased carbon dioxide concentration in the blood, which is detected by the brain, leading to an increased rate and greater depth of breathing
- 11 Explain the role of goblet cells, mucus and ciliated cells in protecting the breathing system from pathogens and particles



12 Respiration

12.1 Respiration

Core

- 1 State the uses of energy in living organisms, including: muscle contraction, protein synthesis, cell division, active transport, growth, the passage of nerve impulses and the maintenance of a constant body temperature
- 2 Investigate and describe the effect of temperature on respiration in yeast

Supplement

12.2 Aerobic respiration

Core

- 1 Describe aerobic respiration as the chemical reactions in cells that use oxygen to break down nutrient molecules to release energy
- 2 State the word equation for aerobic respiration as:
glucose + oxygen $\rightarrow$ carbon dioxide + water

Supplement

- 3 State the balanced chemical equation for aerobic respiration as:
$$\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O}$$

12.3 Anaerobic respiration

Core

- 1 Describe anaerobic respiration as the chemical reactions in cells that break down nutrient molecules to release energy without using oxygen
- 2 State that anaerobic respiration releases much less energy per glucose molecule than aerobic respiration
- 3 State the word equation for anaerobic respiration in yeast as:
glucose $\rightarrow$ alcohol + carbon dioxide
- 4 State the word equation for anaerobic respiration in muscles during vigorous exercise as:
glucose $\rightarrow$ lactic acid

Supplement

- 5 State the balanced chemical equation for anaerobic respiration in yeast as:
$$\text{C}_6\text{H}_{12}\text{O}_6 \rightarrow 2\text{C}_2\text{H}_5\text{OH} + 2\text{CO}_2$$
- 6 State that lactic acid builds up in muscles and blood during vigorous exercise causing an oxygen debt

continued



12.3 Anaerobic respiration continued

Core

Supplement

- 7 Outline how the oxygen debt is removed after exercise, limited to:
- (a) continuation of fast heart rate to transport lactic acid in the blood from the muscles to the liver
 - (b) continuation of deeper and faster breathing to supply oxygen for aerobic respiration of lactic acid
 - (c) aerobic respiration of lactic acid in the liver

Notes

Respiration

Respiration is the process through which energy is released in our body

There are 2 types of respiration

Aerobic Respiration

It is a chemical reaction taking place in mitochondria that make use of oxygen to break down glucose and other nutrients to release energy

Anaerobic respiration

It is a chemical reaction in cells that break nutrients to release energy without use of oxygen.

Aerobic Respiration	Anaerobic Respiration
Involves chemical reaction in cells that break down glucose to release energy	Involves chemical reaction in cells that break down glucose to release energy
Uses oxygen	Does not use oxygen
No alcohol or lactic acid is made	alcohol(in yeast and plants) or lactic acid (in animals) is made
Large amount of energy released from each molecule of glucose	Much less amount of energy released from each molecule of glucose



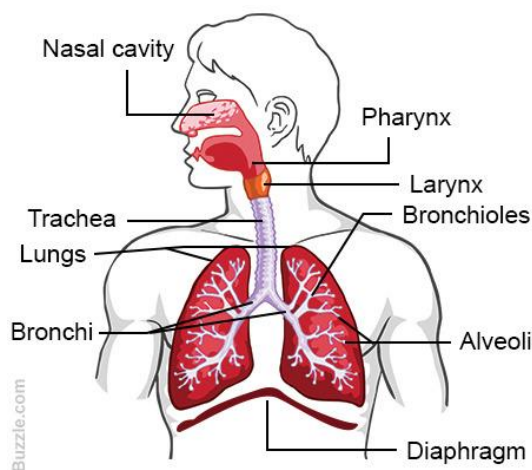
Carbon dioxide is made

Carbon dioxide is made by yeast and plants but not by animals

Gas Exchange and Gas exchange surface

Diffusion of oxygen and carbon dioxide into and out of an organism's body is known as **gas exchange**

A part of body where gas exchange between the body and the environment takes place is known as **gas exchange surface**



Features of Gas exchange Surface

Have to be thin so that gas diffusion takes place quickly

Close to efficient transport system to take gases to and fro from the exchange surface

Large surface area, increasing the amount of gas being diffused at a time

Have good supply of oxygen

Have to be permeable

Human Breathing System

Air enters the nose through either nose or mouth. Dust particles are trapped in nose due to hair. Some of the cells in the nose are known as goblet cells which make liquid



containing water and mucus. Cilia, tiny hair like projection in nose sweep the mucus (which has bacteria trapped in it) and sweep it back up so that the lungs are not blocked.

After the nose air passes to the trachea or windpipe. The trachea has a ring of cartilage around it which prevents it from collapsing at times when air pressure inside is lower than air pressure outside

Trachea goes into thorax (upper part of body from neck to the diaphragm). Trachea divides in 2 in thorax. The 2 branches are known as bronchi. One bronchus goes to the left lung and the other to the right lung.

Bronchus then divides further into bronchioles in the lungs

There are tiny air sacs at the end of each bronchiole which are known as Alveoli. This is a gas exchange surface.

Inhale and exhaled air comparison

Component	Percentage in inhaled air	Percentage in exhaled air
Oxygen	21	16
Carbon Dioxide	0.04	4
Water Vapour	variable	Usually very high

Breathing Movements

There are several muscles involved to help you breath in and out.

One of them is intercostal muscles

The other is diaphragm which is a large sheet of muscle and elastic tissue which stretches across your body underneath the lungs and heart.

Difference in the body while breathing in and out

Breathing in	Breathing Out
Diaphragm contracts	Diaphragm relaxes
Volume of thorax increases	Volume of thorax decreases



External intercostal muscles contracts	External intercostal muscles relax
Ribs cage is pulled upwards and outward	Ribs cage drop downwards to its normal position
Pressure inside falls below atmospheric pressure	

Questions:

MCQ's:

1.

A girl holds her breath for 30 seconds, breathes out, and then breathes in.

Compared with the air she breathes out, the air she breathes in contains less

- A carbon dioxide and water vapour.
- B nitrogen and water vapour.
- C oxygen and carbon dioxide.
- D oxygen and nitrogen.

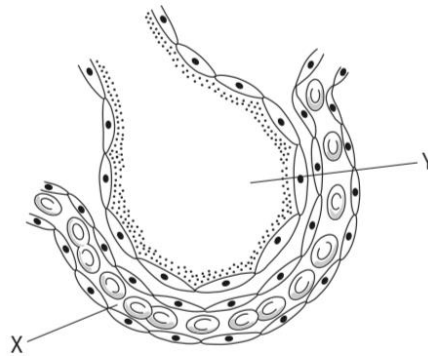
2.

What makes alveoli suitable as a gas exchange surface?

	large total surface area	well-supplied with blood vessels
A	✓	✓
B	✓	x
C	x	✓
D	x	x



The diagram shows a section through an alveolus and a capillary.

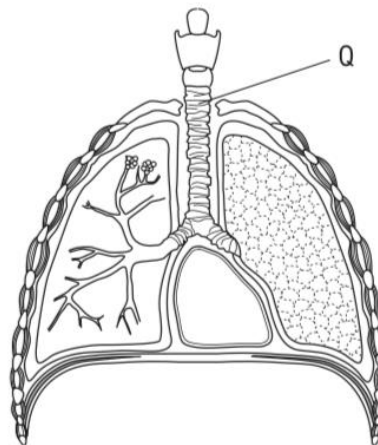


Why does carbon dioxide move from X to Y?

- A Air has a lower concentration of carbon dioxide than blood.
- B Carbon dioxide moves more freely in air than in blood.
- C Carbon dioxide must replace oxygen.
- D Diffusion of carbon dioxide can only be out of the blood.

4.

The diagram shows some structures in the human neck and thorax.



The lining of tube Q has cilia.

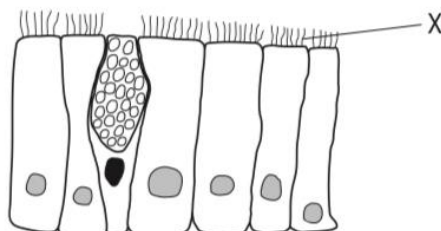
What is an important function of the cilia?

- A to help in the exchange of gases
- B to increase the internal surface area of tube Q
- C to moisten the air entering and leaving the lungs
- D to move mucus towards the throat

5.



The diagram shows some ciliated cells from the trachea.



What is the function of the parts labelled X?

- A detecting stimuli
- B exchanging gases
- C moving mucus
- D trapping bacteria

6.

What are the functions of the diaphragm and the cilia in the human gas exchange system?

	diaphragm	cilia
A	contracts to cause breathing in	carry mucus to the throat
B	contracts to cause breathing out	trap bacteria from the air
C	relaxes to cause breathing in	filter dust from the air
D	relaxes to cause breathing out	produce mucus

7.

The diagram shows someone blowing up a balloon.



What percentage of the gas in the balloon is carbon dioxide?

- A 0.04 %
- B 0.4 %
- C 4.0 %
- D 40 %

8.

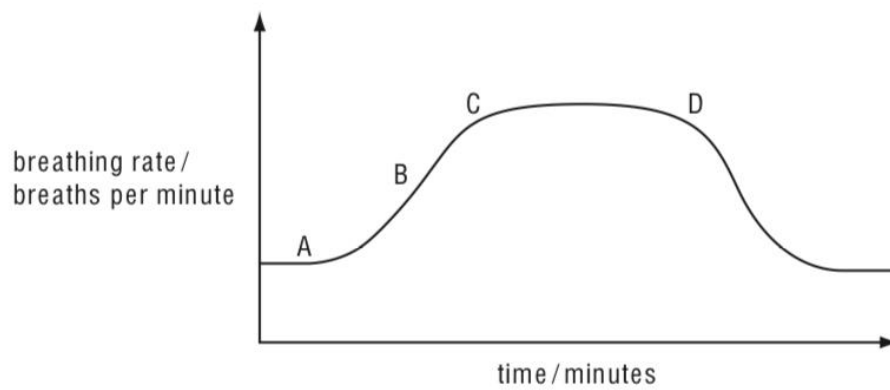


What increases the rate of diffusion of oxygen into red blood cells in the lungs?

- A Air leaving the lungs is saturated with water vapour.
- B Air leaving the lungs still contains 16 % oxygen.
- C Blood arriving in the lungs is saturated with oxygen.
- D Blood is taken away from the lungs as it circulates.

9.

From the graph, when did the person begin a period of vigorous exercise after resting?



10.

Which route is taken by air passing into the lungs of a human?

- A alveolus → trachea → bronchus
- B bronchus → trachea → alveolus
- C trachea → alveolus → bronchus
- D trachea → bronchus → alveolus



Answers:

1 A

2 A

3 A

4 D

5 C

6 A

7 C

8 D

9 B

10 D

Aitchison College



Structured Questions:

- 1 (a) Fig. 1.1 shows the human gas exchange system. The functions of the parts of the gas exchange system are given in Table 1.1.

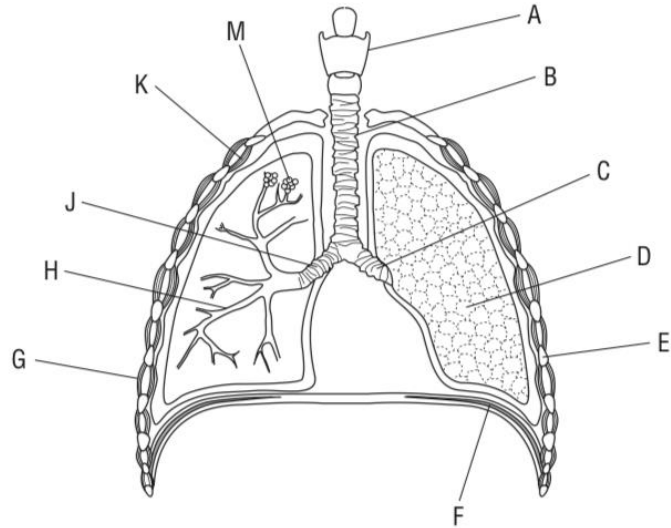


Fig. 1.1

Complete Table 1.1. One row has been done for you.

Table 1.1

function	letter on Fig. 1.1	name
structure that makes sounds	A	larynx
bone that provides protection for the lungs		
airway that allows passage of air only into the right lung		
airway that allows passage of air into both lungs		
contracts to increase volume of thorax		
muscle that contracts to lower the ribcage		
site of gas exchange		



- (b) The gas exchange system contains cartilage.

Describe the function of cartilage in the gas exchange system.

.....

.....

.....

.....

.....

[2]

- (c) Soon after starting physical activity the concentration of carbon dioxide in the blood increases.

- (i) Name the process inside cells that produces carbon dioxide.

.....

.....

[1]

- (ii) State the effect on breathing of an increase in carbon dioxide concentration in the blood.

.....

.....

.....

[1]



- 4 Fig. 6.1 shows the movement of the ribs and the diaphragm during breathing in.

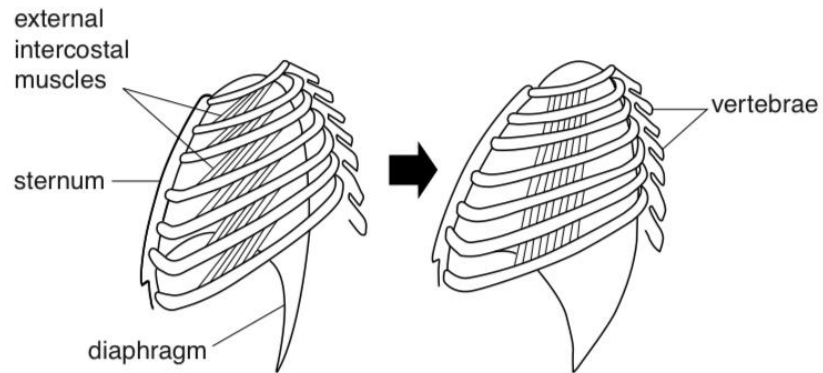


Fig. 6.1

- (a) State what happens to the following structures during breathing in.

diaphragm.....
.....
.....
ribcage.....
.....
.....
external intercostal muscles
.....
.....[3]



College

(b) Explain the effect of strenuous physical activity on the pH of the blood.

.....

.....

.....

.....

.....

.....

.....

.....[3]

[Total: 6]



Answers:

- 1 (a) Fig. 1.1 shows the human gas exchange system. The functions of the parts of the gas exchange system are given in Table 1.1.

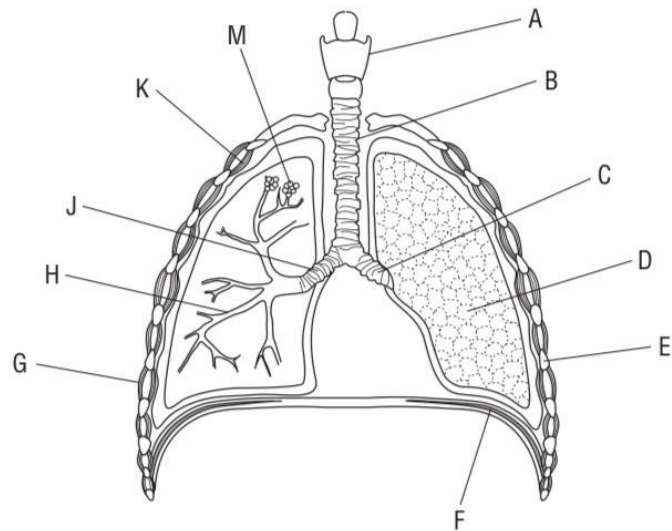


Fig. 1.1

Complete Table 1.1. One row has been done for you.

Table 1.1

function	letter on Fig. 1.1	name
structure that makes sounds	A	larynx
bone that provides protection for the lungs	E	Rib
airway that allows passage of air only into the right lung	J	Bronchus
airway that allows passage of air into both lungs	B	Trachea
contracts to increase volume of thorax	F	Diaphragm
muscle that contracts to lower the ribcage	K	Internal IC Muscles
site of gas exchange	M	Alveoli



- 4 Fig. 6.1 shows the movement of the ribs and the diaphragm during breathing in.

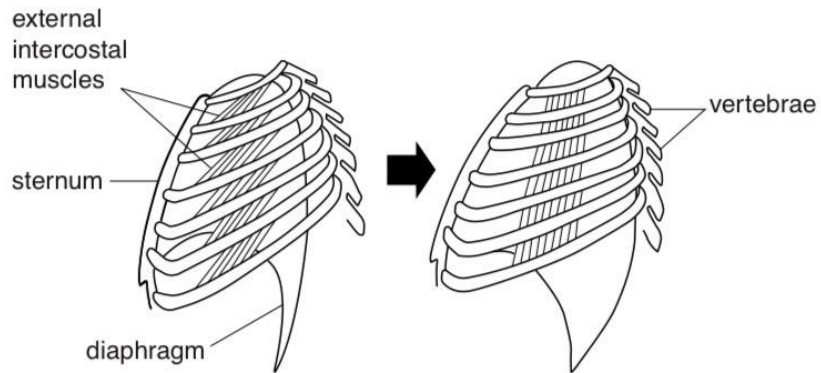


Fig. 6.1

- (a) State what happens to the following structures during breathing in.

diaphragm..... **Diaphragm contracts and flattens**

.....

ribcage..... **Rib cage rises**

.....

external intercostal muscles..... **External Inter coastal muscles contract**

.....[3]



College

- (b) Explain the effect of strenuous physical activity on the pH of the blood.

The pH decreases, there is an increased amount of aerobic respiration. There is more carbon dioxide in the blood which is acidic. Anaerobic respiration occurs which produces lactic acid.

[3]

[Total: 6]



Chapter 13: Excretion And Homeostasis

13 Excretion in humans

13.1 Excretion in humans

Core

- 1 State that carbon dioxide is excreted through the lungs
- 2 State that the kidneys excrete urea and excess water and ions
- 3 Identify in diagrams and images the kidneys, ureters, bladder and urethra

Supplement

- 4 Identify in diagrams and images the structure of the kidney, limited to the cortex and medulla
- 5 Outline the structure and function of a nephron and its associated blood vessels, limited to:
 - (a) the role of the glomerulus in the filtration from the blood of water, glucose, urea and ions
 - (b) the role of the nephron in the reabsorption of all of the glucose, some of the ions and most of the water back into the blood
 - (c) the formation of urine containing urea, excess water and excess ions(details of these processes are **not** required)
- 6 Describe the role of the liver in the assimilation of amino acids by converting them to proteins
- 7 State that urea is formed in the liver from excess amino acids
- 8 Describe deamination as the removal of the nitrogen-containing part of amino acids to form urea
- 9 Explain the importance of excretion, limited to toxicity of urea



14.4 Homeostasis

Core

- 1 Describe homeostasis as the maintenance of a constant internal environment
- 2 State that insulin decreases blood glucose concentration

Supplement

- 3 Explain the concept of homeostatic control by negative feedback with reference to a set point
- 4 Describe the control of blood glucose concentration by the liver and the roles of insulin and glucagon
- 5 Outline the treatment of Type 1 diabetes
- 6 Identify in diagrams and images of the skin: hairs, hair erector muscles, sweat glands, receptors, sensory neurones, blood vessels and fatty tissue
- 7 Describe the maintenance of a constant internal body temperature in mammals in terms of: insulation, sweating, shivering and the role of the brain
- 8 Describe the maintenance of a constant internal body temperature in mammals in terms of vasodilation and vasoconstriction of arterioles supplying skin surface capillaries

Notes

Excretion

Removal of waste products of metabolism from the body is known as **excretion**.

Carbon dioxide is also one of the waste products produced in the body that should be removed. If it isn't removed, it dissolves to form weak acid which could lower the pH of cells and blood.

Kidneys



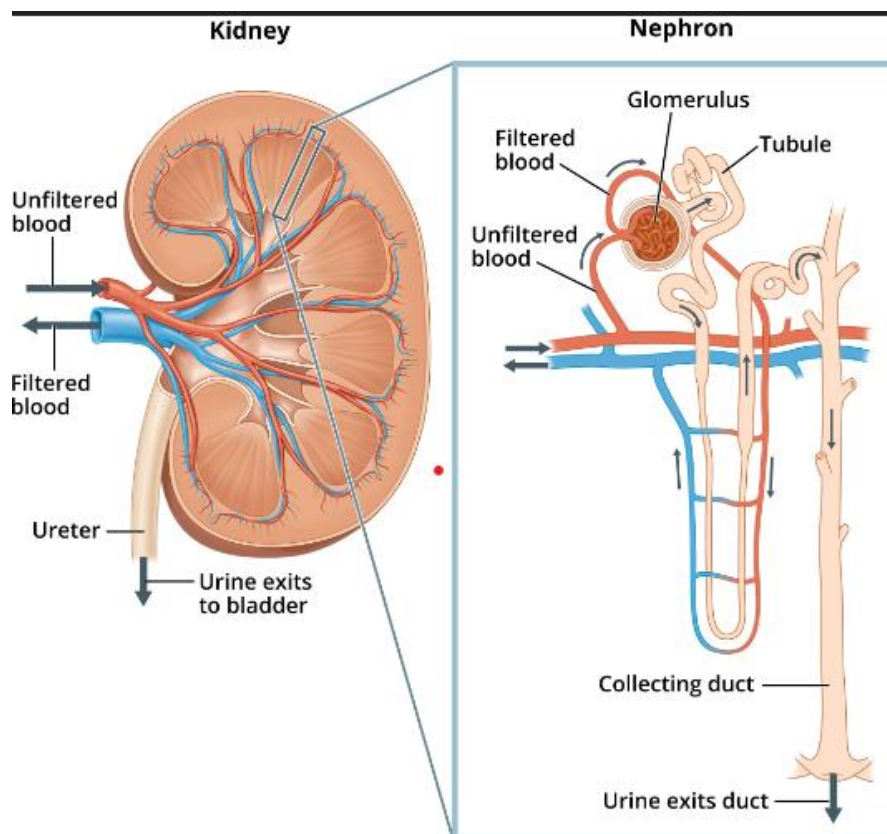
Has 2 main parts: the cortex and medulla

Kidney is made up of a lot of tiny tubules known as **nephrons**.

Each nephron starts in the cortex and loops to medulla, then back to cortex and then to medulla again.

Leading from each kidney is a tube called **ureter**

Ureter carries urine from kidneys to the **bladder**.



Urea

Urea is also one of the waste products produced in the **liver** of humans.

Urea is removed from the blood through the kidneys.

Urea is combined with excessive ions and water from body to form **urine**

Urine then travels through the ureter, into the bladder where it is stored. The sphincter muscles at the entrance of the urethra relax and the urine flows out of the urethra.

Formation of Urea

Produced in Liver



Urea is made from excess proteins and amino acids

Amino acids travel to the liver through the hepatic **portal vein**.

The required amino acids are allowed to travel throughout the body through blood.

The excessive amino acids are broken down into 2 parts with help of enzymes: one that contains energy and the nitrogen part

The energy part is stored for future use as carbohydrates.

The Nitrogen part is turned into urea. The removal of nitrogen from the amino acids to form urea is known as **deamination**.

Pathway of Urine in the kidney

Blood flows into the kidneys through the renal **artery**.

The renal artery is divided into small capillaries known as **glomeruli**.

Blood is filtered as it passes through glomeruli. Small molecules (the filtrate) such as urea, glucose, ions and water pass through it whereas large molecules don't.

As the filtrate move into the nephrons, some of it such as urea and excessive water and ions are needed to be lost from body

On the other hand glucose and some amount of water is needed for the body so they are taken back into blood. This process is known as **reabsorption**

At the end the final liquid coming out of nephron consists of urea, excessive water and excessive ions.

More concentrated urine the darker its color is so the color of urine is a good indication of how well the body is hydrated.

Homeostasis

Keeping the internal environment of the body constant is known as homeostasis.

Blood Glucose Concentration

It is controlled by hormones, secreted by **pancreas**

In the pancreas a group of cells called **islets** secrete these hormones.

The 2 hormones are **insulin** and **glucagon**

If the blood glucose concentration increases the islet cells detect this change. They secrete insulin which travels in blood to the liver. The liver, identifying the insulin, converts the glucose in the blood stream into a large complex known as **glycogen**.

On the other hand, if there is less concentration of glucose in the blood, glucagon is released. Now the liver breaks down its store of glycogen and balances the glucose in the blood.

Set point is the normal value or range of values for a particular parameter.



Negative feedback is a mechanism which detects a move away from the set point and brings about an action that takes the value back to the set point, which illustrates the mechanism adopted by the liver in response to insulin or glucagon.

Controlling Body temperature

Hypothalamus is the part of brain which is involved in controlling the body temperature

When the temperature around us **decreases** certain changes happen:

Muscles contract and relax quickly. They get the energy from respiration and due to respiration some of the energy is lost as heat energy which is used to warm the body. Metabolism may increase

The arterioles supplying blood contract. This is known as vasoconstriction.

Sweat glands reduce secretion. As sweat cools the body so its production is minimised.

Hair erector muscle contracts pulling the hair up and making them stand and trapping warmth around the body

When the temperature around **increases**, following changes occur:

Hair erector muscle relax causing the hair to lie flat so heat leaves the skin easily

The arterioles become dilated. This is known as vasodilation. As more blood flows in arterioles near the surface more heat is lost

Sweat production increases and more is released. This has a cooling effect on the body.

MCQ's:

1.

Which diet will cause the liver to produce the most urea?

- A** high carbohydrate, low fat
- B** high fat, high fibre
- C** high fat, low protein
- D** high protein, low carbohydrate

.

2.



3.

Where is urea formed?

- A** kidneys
- B** liver
- C** muscles
- D** small intestine

Where are hormones removed from the blood and broken down in the human body?

- A** gall bladder
- B** kidneys
- C** liver
- D** stomach

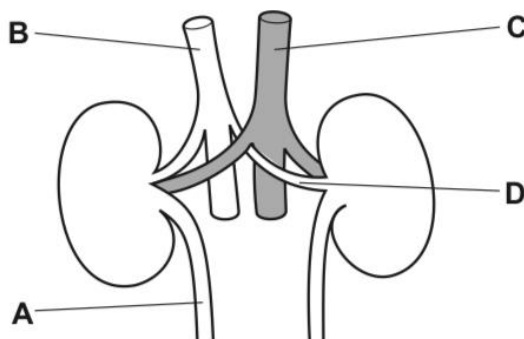


4.

The table shows the composition of a liquid found in the human body.

component	concentration / arbitrary units
amino acids	0.00
glucose	0.00
proteins	0.00
salts	1.50
urea	2.00

In a healthy person, which structure contains this liquid?



5.

Which two substances are both reabsorbed in the kidneys?

- A glucose and salts
- B glucose and starch
- C glycogen and salts
- D glycogen and starch



6.

How is urea removed from the body?

- A as insoluble waste
- B by being destroyed in the liver
- C in expired air
- D in solution

7.

The table shows the percentage composition of some chemicals found in blood entering the kidney of a healthy person.

chemical	composition in blood entering kidney / %
glucose	0.10
protein	8.00
urea	0.03

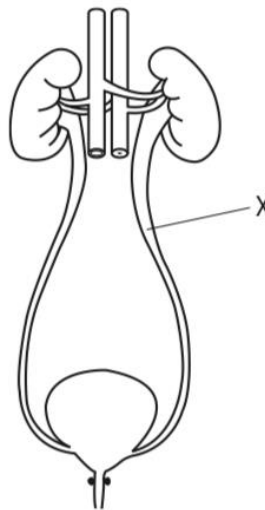
What is the percentage composition of the same chemicals in the urine of a healthy person?

	composition in urine / %		
	glucose	protein	urea
A	1.00	4.00	0.03
B	0.00	4.00	0.00
C	0.00	0.00	2.00
D	0.10	8.00	2.00



8.

The diagram shows the human urinary system.



What is the part labelled X?

- A renal artery
- B renal vein
- C ureter
- D urethra

9.



Which food type, when eaten in excess, will cause a rise in the urea content of urine?

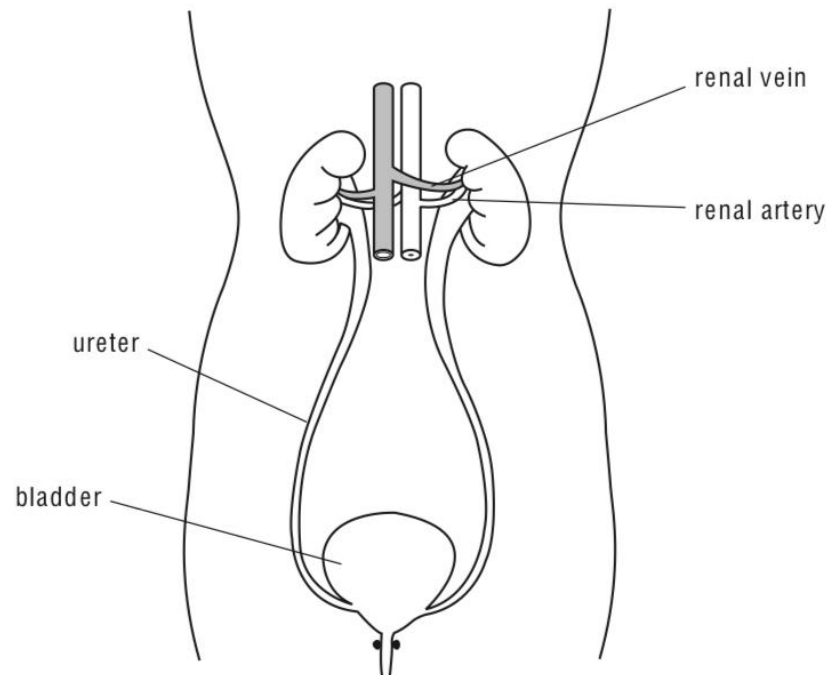
- A** carbohydrate
- B** fat
- C** mineral salts
- D** protein

3



10.

The diagram shows the human urinary system.



Which row shows substances that are present in each of these structures in a healthy person?

	renal artery	renal vein	ureter	bladder
A	glucose	glucose	salts	urea
B	protein	salts	water	protein
C	salts	water	protein	water
D	urea	glucose	protein	salts



Answers:

1 D

2 B

3 C

4 C

5 A

6 D

7 C

8 C

9 D

10 A

.



Structured Questions:

1 The lungs and the kidneys are excretory organs of the human body.

(a) (i) Define the term *excretion*.

.....

.....

.....

.....

.....

.....

.....[3]

(ii) State an excretory product that is passed out through the lungs.

.....[1]

(iii) Outline the role of the liver in excretion.

.....

.....

.....

.....

.....

.....

.....[3]



(b) Fig. 4.1 is a vertical section of the kidney.

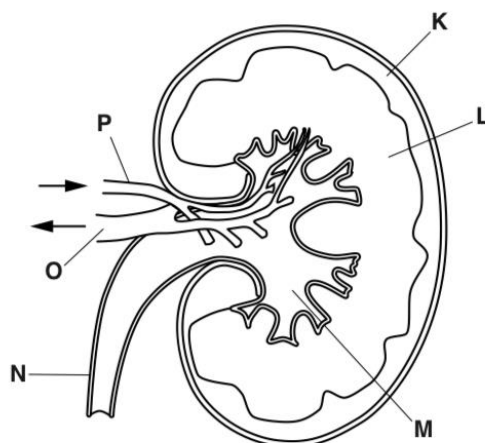


Fig. 4.1

Table 4.1 shows the functions of parts of the kidney.

Complete the table by:

- naming the part of the kidney that carries out each function
- using letters from Fig. 4.1 to identify the part of the kidney named.

One row has been completed for you.

Table 4.1

function	name of part	letter from Fig. 4.1
blood is filtered		
concentration of urine is determined	medulla	L
urine flows to the bladder		
blood is carried into the kidney		
blood flows out of the kidney		

[4]



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- (c) People with kidney disease are often treated in renal dialysis clinics. Their blood passes through tubes lined with a special membrane for about three hours.

- (i) State **two** waste substances that are removed from the blood by dialysis.

1

2

[2]

- (ii) Kidney patients may be given a kidney transplant. State **one** advantage and **one** disadvantage of kidney transplants compared with dialysis.

advantage

.....

.....

disadvantage

.....

.....

[2]

[Total: 15]



Answers:

(b) Fig. 4.1 is a vertical section of the kidney.



1 The lungs and the kidneys are excretory organs of the human body.

(a) (i) Define the term *excretion*.

Removal of harmful substances from the body, which are often in excess, is termed excretion. Urea is a substance removed

.....
.....
.....
.....[3]

(ii) State an excretory product that is passed out through the lungs.

Carbon Dioxide.....[1]

(iii) Outline the role of the liver in excretion.

It is involved in the deamination of amino acids, by removing the nitrogen part of the amino acid and producing urea. It is also involved in the breakdown of hormones and passing them out through the blood

.....
.....
.....[3]

4]



- (c) People with kidney disease are often treated in renal dialysis clinics. Their blood passes through tubes lined with a special membrane for about three hours.

(i) State **two** waste substances that are removed from the blood by dialysis.

- 1 Urea
 - 2 Ammonia
- [2]

(ii) Kidney patients may be given a kidney transplant. State **one** advantage and **one** disadvantage of kidney transplants compared with dialysis.

advantage Patients don't need to eat a restricted diet

.....

.....

disadvantage There is the risk of the rejection of the kidney

.....

[2]

[Total: 15]



Chapter 14 : Coordination and Response

14 Coordination and response

14.1 Coordination and response

Core

- 1 State that electrical impulses travel along neurones
- 2 Describe the mammalian nervous system in terms of:
 - (a) the central nervous system (CNS) consisting of the brain and the spinal cord
 - (b) the peripheral nervous system (PNS) consisting of the nerves outside of the brain and spinal cord
- 3 Describe the role of the nervous system as coordination and regulation of body functions
- 4 Identify in diagrams and images sensory, relay and motor neurones
- 5 Describe a simple reflex arc in terms of: receptor, sensory neurone, relay neurone, motor neurone and effector
- 6 Describe a reflex action as a means of automatically and rapidly integrating and coordinating stimuli with the responses of effectors (muscles and glands)
- 7 Describe a synapse as a junction between two neurones

Supplement

- 8 Describe the structure of a synapse, including the presence of vesicles containing neurotransmitter molecules, the synaptic gap and receptor proteins
- 9 Describe the events at a synapse as:
 - (a) an impulse stimulates the release of neurotransmitter molecules from vesicles into the synaptic gap
 - (b) the neurotransmitter molecules diffuse across the gap
 - (c) neurotransmitter molecules bind with receptor proteins on the next neurone
 - (d) an impulse is then stimulated in the next neurone
- 10 State that synapses ensure that impulses travel in one direction only



14.2 Sense organs

Core

- 1 Describe sense organs as groups of receptor cells responding to specific stimuli: light, sound, touch, temperature and chemicals
- 2 Identify in diagrams and images the structures of the eye, limited to: cornea, iris, pupil, lens, retina, optic nerve and blind spot
- 3 Describe the function of each part of the eye, limited to:
 - (a) cornea – refracts light
 - (b) iris – controls how much light enters the pupil
 - (c) lens – focuses light on to the retina
 - (d) retina – contains light receptors, some sensitive to light of different colours
 - (e) optic nerve – carries impulses to the brain
- 4 Explain the pupil reflex, limited to changes in light intensity and pupil diameter

Supplement

- 5 Explain the pupil reflex in terms of the antagonistic action of circular and radial muscles in the iris
- 6 Explain accommodation to view near and distant objects in terms of the contraction and relaxation of the ciliary muscles, tension in the suspensory ligaments, shape of the lens and refraction of light
- 7 Describe the distribution of rods and cones in the retina of a human
- 8 Outline the function of rods and cones, limited to:
 - (a) greater sensitivity of rods for night vision
 - (b) three different kinds of cones, absorbing light of different colours, for colour vision
- 9 Identify in diagrams and images the position of the fovea and state its function



College

14.3 Hormones

Core

- 1 Describe a hormone as a chemical substance, produced by a gland and carried by the blood, which alters the activity of one or more specific target organs
- 2 Identify in diagrams and images specific endocrine glands and state the hormones they secrete, limited to:
 - (a) adrenal glands and adrenaline
 - (b) pancreas and insulin
 - (c) testes and testosterone
 - (d) ovaries and oestrogen
- 3 Describe adrenaline as the hormone secreted in 'fight or flight' situations and its effects, limited to:
 - (a) increased breathing rate
 - (b) increased heart rate
 - (c) increased pupil diameter
- 4 Compare nervous and hormonal control, limited to speed of action and duration of effect

Supplement

- 5 State that glucagon is secreted by the pancreas
- 6 Describe the role of adrenaline in the control of metabolic activity, limited to:
 - (a) increasing the blood glucose concentration
 - (b) increasing heart rate



14.5 Tropic responses

Core

- 1 Describe gravitropism as a response in which parts of a plant grow towards or away from gravity
- 2 Describe phototropism as a response in which parts of a plant grow towards or away from the direction of the light source
- 3 Investigate and describe gravitropism and phototropism in shoots and roots

Supplement

- 4 Explain phototropism and gravitropism of a shoot as examples of the chemical control of plant growth
- 5 Explain the role of auxin in controlling shoot growth, limited to:
 - (a) auxin is made in the shoot tip
 - (b) auxin diffuses through the plant from the shoot tip
 - (c) auxin is unequally distributed in response to light and gravity
 - (d) auxin stimulates cell elongation

Notes

Human Nervous System

- Changes in an organism's environment are called stimuli.
- These are sensed by specialised cells called receptors.
- The organism responds to this using effectors.
- The way in which receptors sense stimuli and then send signals to effectors is called coordination.
- There are two ways of sending signals, one is through nerves and second is through hormones.

Neurones

- The human nervous system is made up of specialised cells called neurons.
- Neurons are adapted to carry out their function.



- They have thin fibres of cytoplasm stretching out from their body.
- The longest fibre is called axon.
- The shortest fibres are called dendrites.
- The dendrites pick up signals from other neurons lying nearby. These are called nerve impulses. These then pass through the axon which passes it on to other neurons.

The Central Nervous System

- All mammals have a central nervous system and a peripheral nervous system.
- The CNS is made up of the spinal cord and the brain.
- Its role is to coordinate the electrical impulses travelling through the nervous system.
- The PNS is made out of nerves that spread out of the CNS.
- Receptors in our sense organs are also included in the PNS.
- When a stimulus is detected the signals are sent from the receptor to the brain or spinal cord which then sends it to the effector for response.

Reflex Arcs

- In a reflex arc there are three types of neurons involved.
- When a receptor detects a stimulus it starts off an electrical impulse which travels to the spinal cord. This cell is called the sensory neuron.
- In the spinal cord the neuron passes the electrical impulse to many other neurons. These neurons are called relay neurons.
- The relay neurons pass the impulse to the brain and then onwards to the motor neuron which delivers it to the effector.
- The pathway along which the nerve impulses pass is called the reflex arc.
- All three neurons have different shapes.
- The reaction that happens after an impulse has sped around the reflex arc is called reflex action.

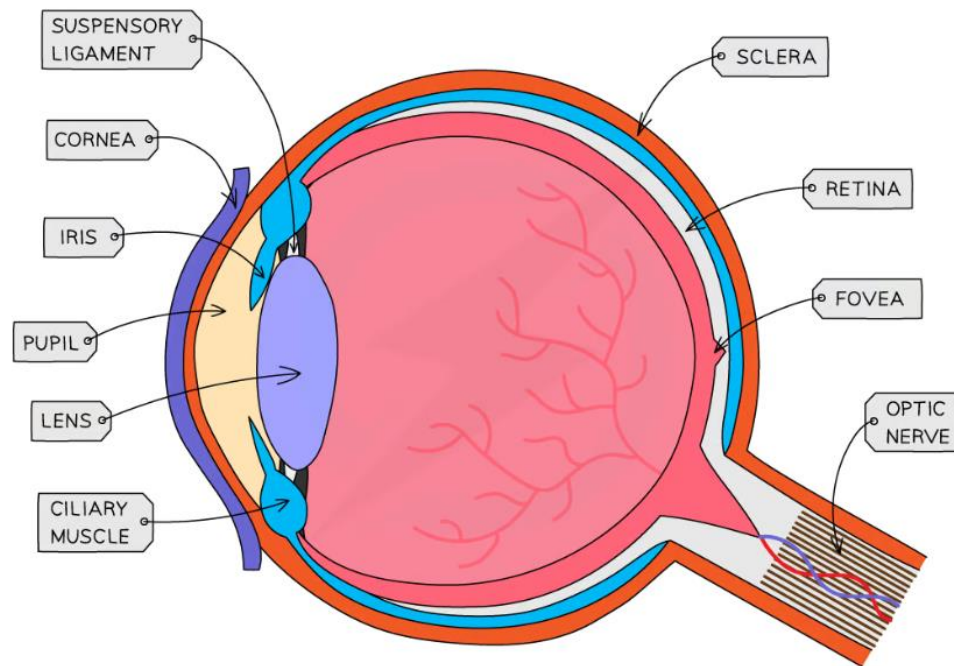


Synapses

- There are small gaps between neurons which are called synaptic gaps.
- The ends of the two neurons plus the gap is together known as a synapse.
- In one of the neuron ends there are small vesicles or tiny vacuoles. These contain huge numbers of molecules of a chemical called neurotransmitters.
- When an electrical impulse arrives along the axon of the neuron it causes these vesicles to move to the cell membrane. They fuse with the membrane and empty their contents in the gap.
- The neurotransmitters quickly diffuse to the other side and attach to the receptor proteins in the cell membrane of the other neuron end. The shape of the receptor proteins are complementary to the shape of the neurotransmitters.
- This binding triggers an electrical impulse in the other neuron.
- Synapses act as one way valves. Receptor proteins are found on only one of the neuron's ends. This makes sure electrical impulses move in one desired direction only.

Sense Organs

- Sense organs are the ones that have receptors which are specialised cells to detect stimuli.

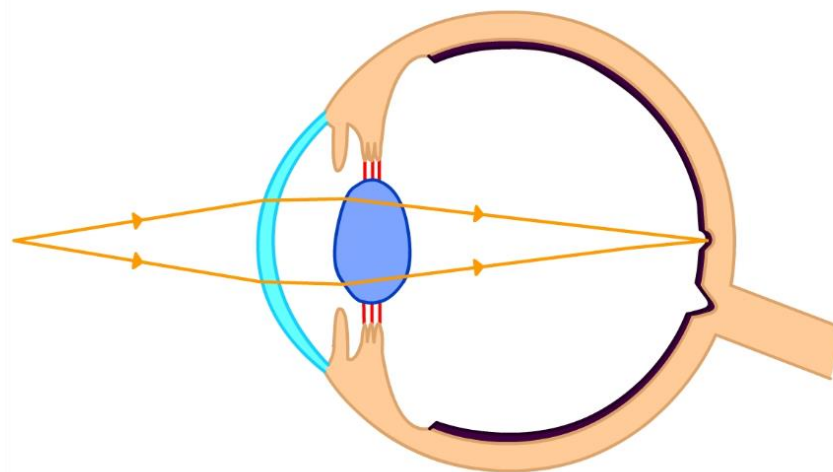


The Structure of the Eye

- Eye is found in the bony socket of the skull.
- The eye is filled with a fluid that helps it keep its shape.
- The surface of the eye is always kept moist by a fluid made in the tear glands. This fluid contains an enzyme called lysozyme which kills bacteria in the eye.
- The retina is at the back of the eye and it is the place where the receptor cells are present.
- When light falls on the receptor cells on the retina, the cell sends an electrical impulse through the optic nerve to the brain. The brain uses the impulses from each receptor cell to build an image.
- There are no receptor cells in the place where the optic nerve leaves the retina. This is called the blind spot.
- More closely packed the receptor cells, the clearer the image the brain can produce. The part of the retina where the receptor cells are packed closest together is called the fovea.



- There are two kinds of receptor cells in the retina. Rods are sensitive to quiet dim light but they do not respond to colour. Cones are able to distinguish between colours but they only function in bright light.
- The coloured part of the eye is the iris. In the middle of the iris is a small circular gap called the pupil.
- The size of the pupil influences the amount of light entering and reaching the retina.
- In low light intensities the iris pulls back and makes pupil larger but in high light intensities the iris closes in and makes pupil smaller.
- To adjust size of pupil iris contains two types of muscles. Circular muscles are arranged in circles around the pupil. Radial muscles run outwards from the edge of the pupil.
- When circular muscles contract they make pupil get smaller. When radial muscles contract they make pupil dilate or get larger. This is called the iris reflex or the pupil reflex.
- The circular muscles and radial muscles are antagonistic muscles meaning that when one contracts the other relaxes.



the lens becomes rounder (more convex)

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Focusing Light

- Bending light rays is called refraction.



- Most refraction of the light entering in the eye is done by the cornea. The lens makes fine adjustments.
- The light coming from long distance objects needs less bending as light rays are diverging slightly. However light from nearby objects needs a lot of bending as light rays are diverging sharply.
- The shape of the lens is changed to alter the amount of bending of the light. The thicker the lens the more the bending. Adjusting the shape of the lens according to the light is known as accommodation.
- The lens is held by suspensory ligaments. These ligaments are controlled by the ciliary muscles which alter the tension of the ligaments and change the shape of the lens.
- When this muscle contracts, the ligaments loosen and the lens gets thicker. When this muscle relaxes, the ligaments are tightened and the lens becomes Thinner.

Hormones

- Animals use chemicals to transmit information around the body. These chemicals are known as hormones.
- Hormones are made in specialised glands called endocrine glands.
- The hormones are carried around the body via blood plasma.
- Each hormone targets specific organs called target organs.
- Adrenal glands secrete adrenaline which prepares the body for vigorous action. These adrenal glands are found above each kidney. It makes your heart beat faster, increases the breathing rate and widens the pupils as well.
- Pancreas secrete insulin which reduces the concentration of glucose in blood. They also secrete glucagon which increases glucose concentration in blood.
- Testis secrete testosterone which causes the development of male secondary sexual characteristics.
- Ovary secretes oestrogen which causes the development of secondary



female sexual characteristics and helps control menstrual cycle.

- There are some differences between the nervous system and endocrine system. Nervous system is made up of nerves while the endocrine system is made up of glands. Nervous system transmits information in the form of electrical impulses but the endocrine system transmits information in the form of chemicals. Nervous system transmits impulses along neurons but in the endocrine system chemicals are carried via blood plasma. Nervous system acts fast while the endocrine system acts slow. Effect of the nervous system is short termed while the effect of the endocrine system is long termed.

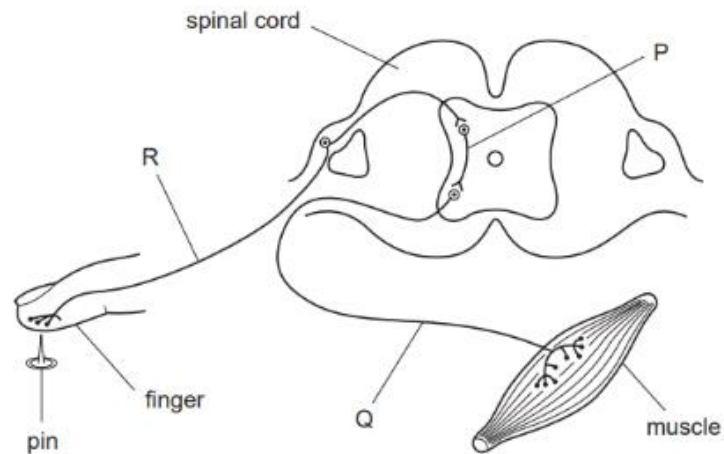
Coordination in Plants

- Plants also respond towards stimuli. They do this by changing their rate or direction of growth.
- Growth towards a stimulus is said to be a positive response but growth away from a stimulus is said to be a negative response. These growth responses are called tropisms.
- Growth responses to light are called phototropism.
- Growth responses to gravity are called gravitropism.
- Normally in a plant shoots grow towards light so they are positively phototropic. On the other hand, roots are negatively phototropic. Generally grow away from gravity so they are negatively gravitropic while roots are positively gravitropic.
- Plants also use chemicals for transporting information. These are known as plant hormones. One important one is auxin.
- Auxin is made at the tip of the shoot. Then it diffuses down to the rest of the shoot. Auxin makes the cells get longer. More the auxin, the faster they elongate. Without it they will not grow.
- When light shines on one side of the shoot, auxin diffuses to the shady side and causes the cells there to grow and elongate faster. This causes the shoot to grow towards the light source.
- Same with gravitropism, if a shoot is kept on its side the auxin accumulates at the bottom and causes cells there to grow and eventually makes the shoot grow



MCQS

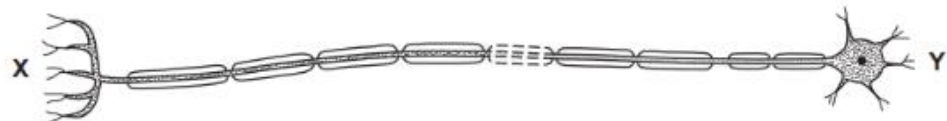
- 1 The diagram represents a simple reflex arc.



What is the sequence of nerve cells through which an impulse passes during a reflex action?

	first	→	last
A	P	Q	R
B	Q	R	P
C	Q	P	R
D	R	P	Q

- 2 The diagram shows a neurone.



Which structures could be found at X and Y?

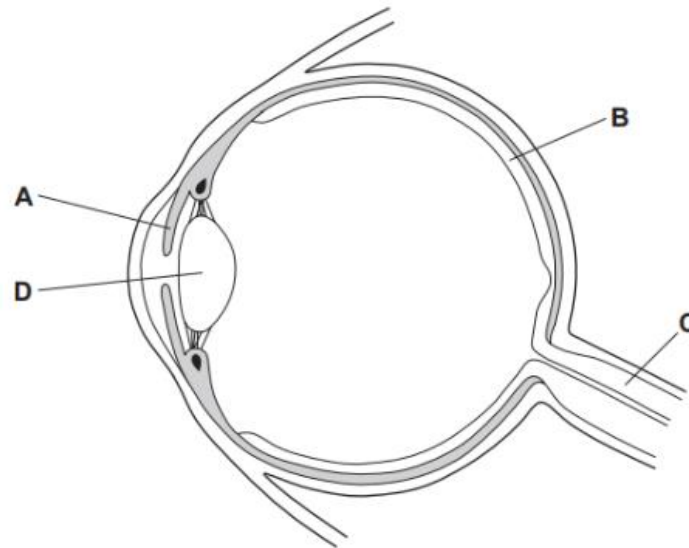
	X	Y
A	brain	intestine
B	brain	leg
C	eye	hand
D	gland	spinal cord



3.

The diagram shows a section through an eye.

Which structure controls how much light enters the pupil?



4. 5 What are the effects of adrenaline?

	breathing rate	pulse rate
A	decreased	decreased
B	increased	increased
C	increased	no effect
D	no effect	increased



What is an example of gravitropism?

- A** a chemical messenger produced by a plant
- B** a painful sensation in response to a stimulus
- C** the growth of a plant root towards the centre of the Earth
- D** the growth of a plant shoot towards light

6.

Which organ produces a hormone?

- A** heart
- B** lung
- C** ovary
- D** spinal cord

7.

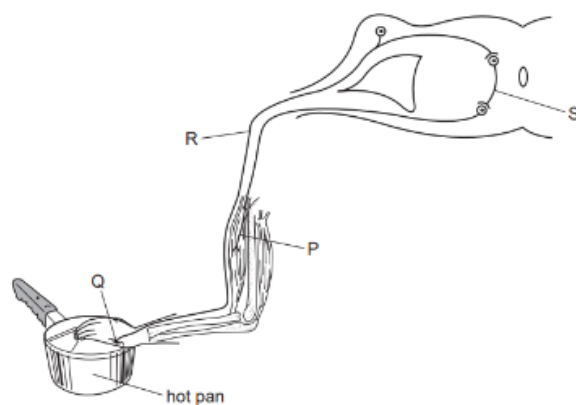
Which part of the human eye is sensitive to light?

- A** iris
- B** lens
- C** optic nerve
- D** retina



8.

The diagram shows the structures involved in a reflex action.

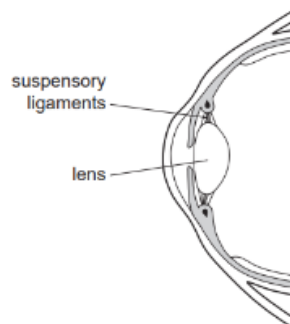


What is the sequence in which impulses pass through these structures?

- A $P \rightarrow S \rightarrow R \rightarrow Q$
- B $Q \rightarrow R \rightarrow S \rightarrow P$
- C $Q \rightarrow P \rightarrow R \rightarrow S$
- D $S \rightarrow P \rightarrow Q \rightarrow R$

9.

The diagram shows a section through part of the human eye.



When a person looks at an object which is far away from their eye, which of the following happens?

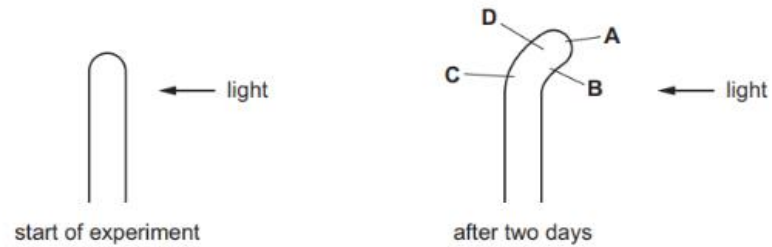
	suspensory ligaments	lens
A	slacken	becomes fatter
B	slacken	becomes thinner
C	tighten	becomes fatter
D	tighten	becomes thinner



10.

In an experiment to investigate phototropism, a plant shoot is grown with light coming from one side only.

After two days, in which region has the greatest rate of growth occurred?



Answers

1. D
2. D
3. A
4. B
5. C
6. C
7. D
8. B
9. D
10. C



Structured Questions

1.

(a) Fig. 2.1 shows a reflex action that involves the eye.

A shows an eye in dim light. **B** shows the same eye when a bright blue light is shone into it.

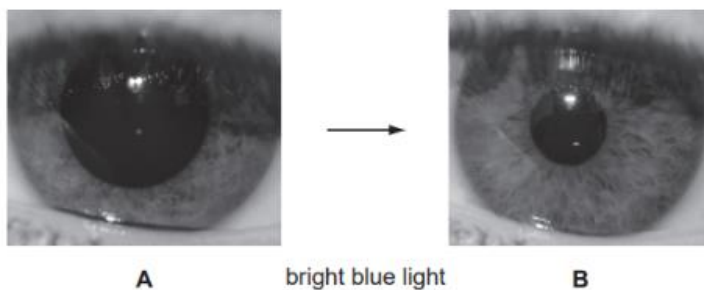


Fig. 2.1

(i) Identify the:

- stimulus to which the eye responds;
- receptor cells that detect the stimulus;
- effector;
- response that the eye makes.

Write your answers in Table 2.1.

Table 2.1

stimulus	
receptor cells	
effector	
response	



2.

Fig. 2.1 shows a section through the eye with a ray of light passing through it and four muscles labelled **A**, **B**, **C** and **D**.

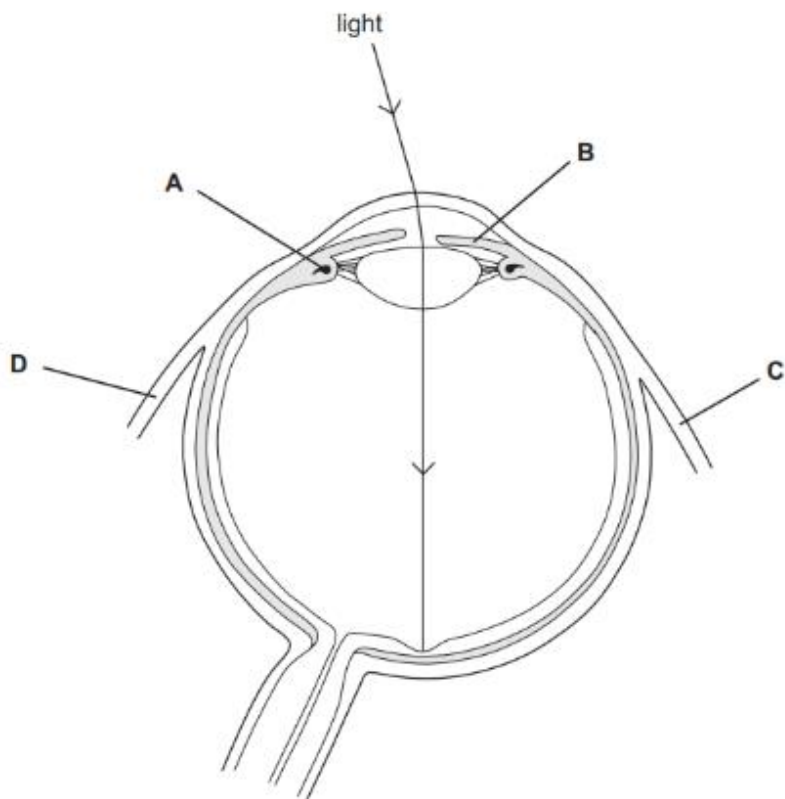


Fig. 2.1

(a) Complete the table.

part	name of muscle	effect of contraction
A		allows the lens to become fatter for focusing on close objects
B	iris circular muscle	

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3.

The nervous system coordinates the responses of animals to changes in their environment.

(a) Fig. 2.1 shows the arrangement of the nervous system in a mammal.

Complete Fig. 2.1 by writing the names of the missing parts of the mammalian nervous system in the boxes.

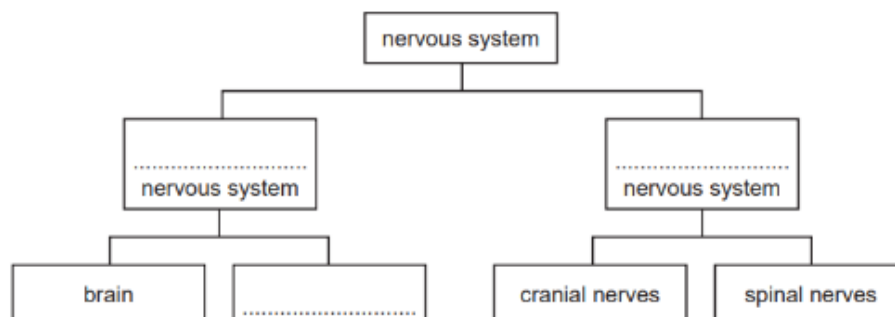


Fig. 2.1

[3]

(b) Fig. 2.2 is a flow chart that shows how an involuntary action is controlled.

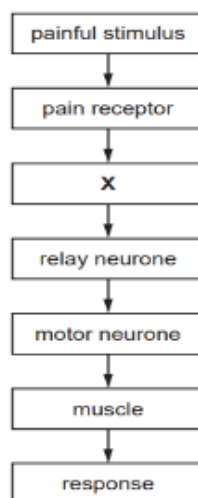


Fig. 2.2

What is X?



4.

Fig. 3.1 is a diagram that shows the control of blood glucose concentration.

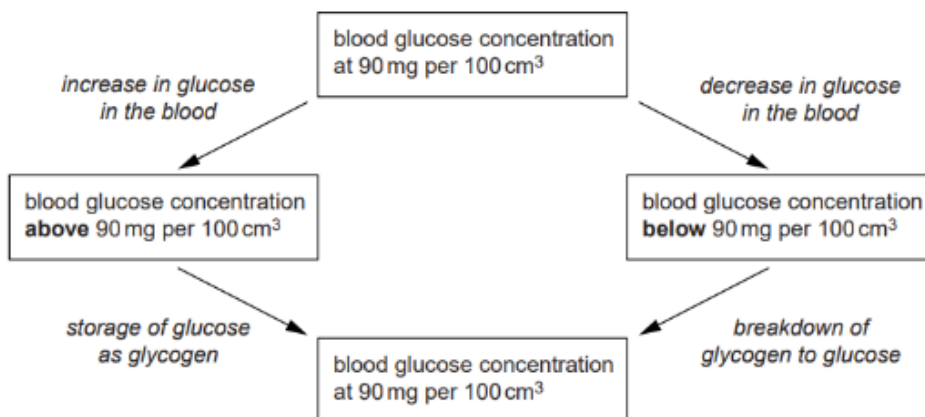


Fig. 3.1

(a) (i) State **one** reason why the concentration of glucose in the blood **increases**.

.....
.....[1]

(ii) State **one** reason why the concentration of glucose in the blood **decreases**.

.....
.....[1]

(iii) Name **two** places in the body where glycogen is stored.

1
2
[2]

Explain how an increase in glucose concentration is controlled in the body.

.....
.....
.....
.....
.....
.....[3]



5.

Describe how rods and cones function.

.....

.....

.....

.....

.....

.....

.....

..... [4]



Answers

(a) Fig. 2.1 shows a reflex action that involves the eye.

A shows an eye in dim light. **B** shows the same eye when a bright blue light is shone into it.

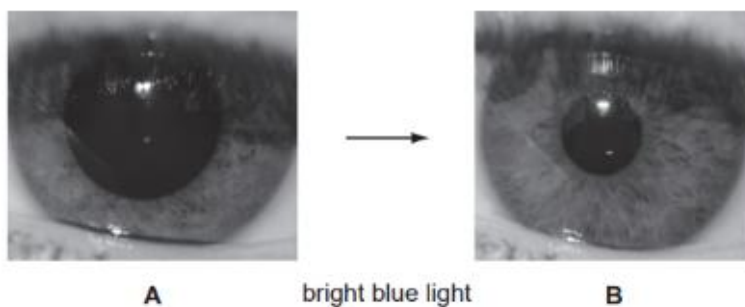


Fig. 2.1

(i) Identify the:

- stimulus to which the eye responds;
- receptor cells that detect the stimulus;
- effector;
- response that the eye makes.

Write your answers in Table 2.1.

Table 2.1

stimulus	Change in light intensity
receptor cells	Cones/Rods
effector	Iris
response	Pupil gets smaller



Fig. 2.1 shows a section through the eye with a ray of light passing through it and four muscles labelled A, B, C and D.

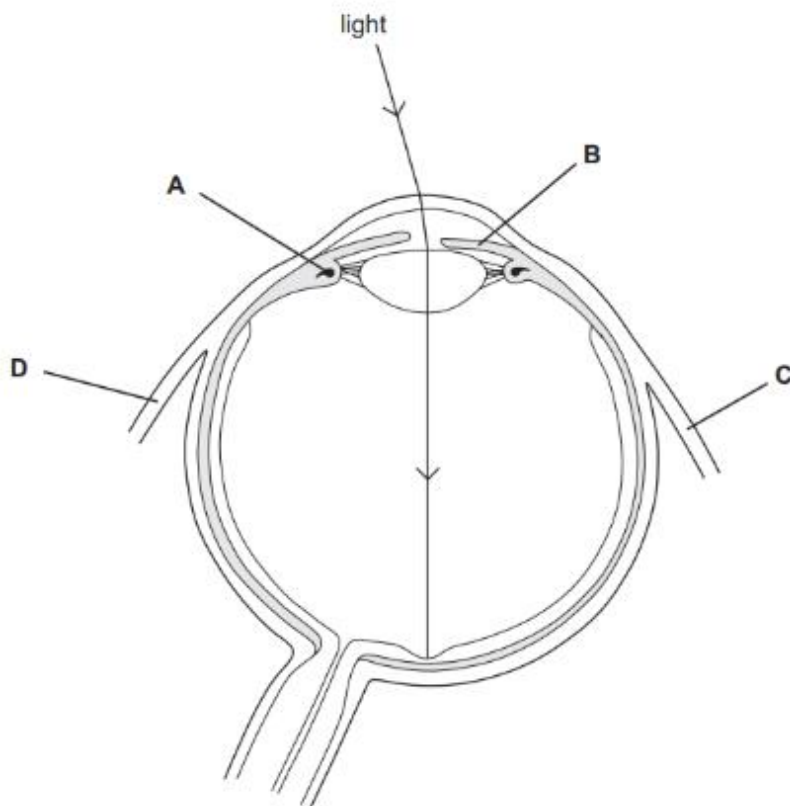


Fig. 2.1

(a) Complete the table.

part	name of muscle	effect of contraction
A	Ciliary muscle	allows the lens to become fatter for focusing on close objects
B	iris circular muscle	Allows pupil to become smaller and for less light to enter the eye.

[2]



The nervous system coordinates the responses of animals to changes in their environment.

(a) Fig. 2.1 shows the arrangement of the nervous system in a mammal.

Complete Fig. 2.1 by writing the names of the missing parts of the mammalian nervous system in the boxes.

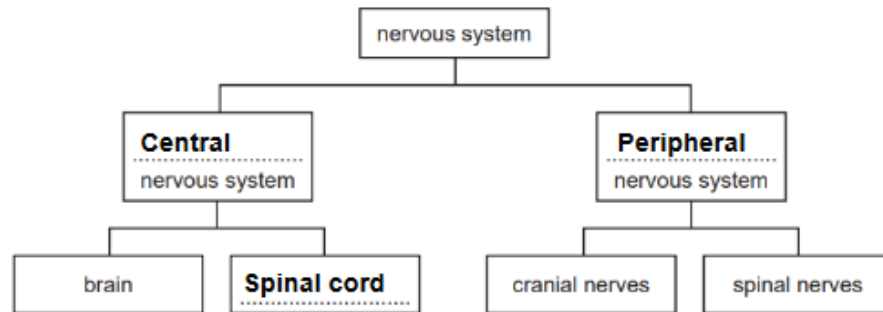


Fig. 2.1

[3]

(b) Fig. 2.2 is a flow chart that shows how an involuntary action is controlled.

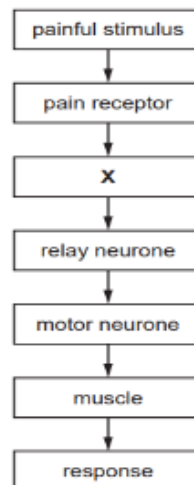


Fig. 2.2

Ans. X is a sensory neuron.



Fig. 3.1 is a diagram that shows the control of blood glucose concentration.

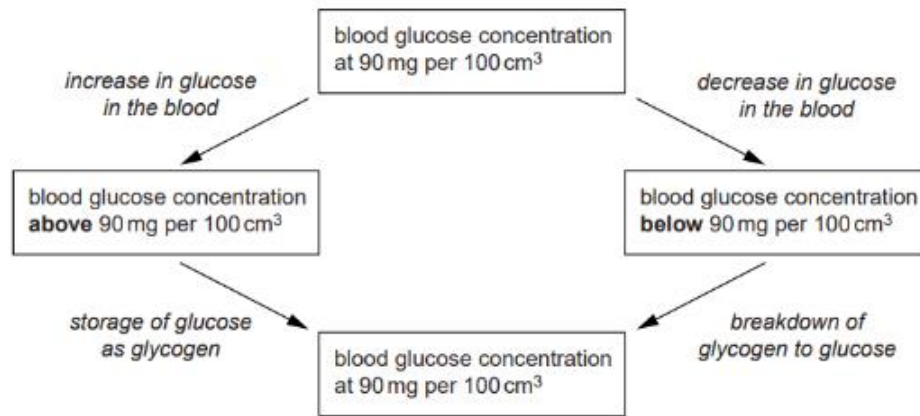


Fig. 3.1

- (a) (i) State **one** reason why the concentration of glucose in the blood **increases**.

Eaten a meal recently.

[1]

- (ii) State **one** reason why the concentration of glucose in the blood **decreases**.

Exercise and physical activity.

[1]

- (iii) Name **two** places in the body where glycogen is stored.

1 **Liver**

Muscle

2

[2]

Explain how an increase in glucose concentration is controlled in the body.

Pancreas detect increase in glucose concentration. They secrete insulin which is carried by blood plasma. Liver and muscle cells convert glucose to glycogen. This is called homeostasis.

[3]



lege

Describe how rods and cones function.

Rods detect low light but do not detect colour. They enable us to have night

vision. Cones detect high light and enable us to see colour.

[4]

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Chapter 15: Drugs

15 Drugs

15.1 Drugs

Core

- 1 Describe a drug as any substance taken into the body that modifies or affects chemical reactions in the body
- 2 Describe the use of antibiotics for the treatment of bacterial infections
- 3 State that some bacteria are resistant to antibiotics which reduces the effectiveness of antibiotics
- 4 State that antibiotics kill bacteria but do not affect viruses

Supplement

- 5 Explain how using antibiotics only when essential can limit the development of resistant bacteria such as MRSA



Notes:

A drug is any substance which when taken into the body, affects chemical reactions in the body

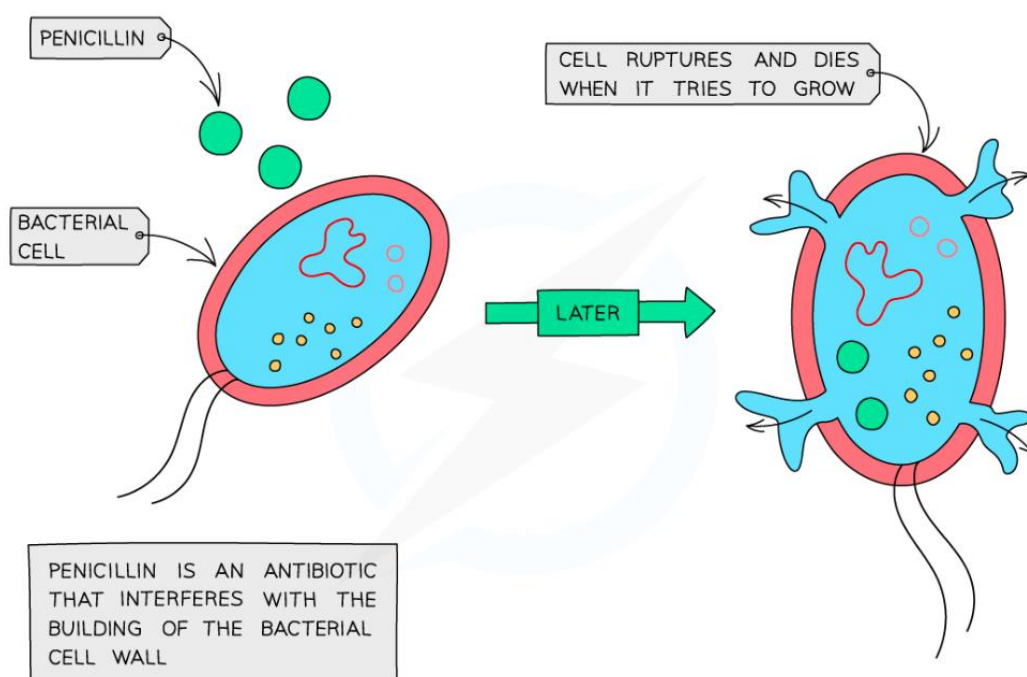
Antibiotics are the most widely known drug and are used to treat disease owing to bacteria

They work by disrupting bacterial structure and function

Antibiotics aren't effective against viruses or fungal disease

They target specific bacterial functions

The example of penicillin is given below:



Antibiotics are becoming less effective due to:

Overuse and being prescribed when not necessary

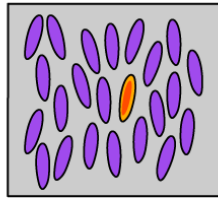
Patients not completing their antibiotic course

Large scale use of antibiotics in farming for production

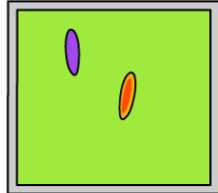
Use of antibiotics against viral diseases

The resistant bacteria are commonly referred as MRSA

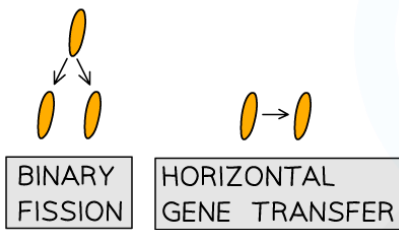
The mechanism through which antibiotic resistance develops is outlined below:



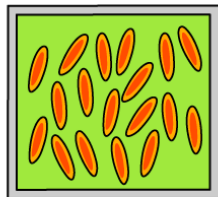
ANTIBIOTIC RESISTANCE ARISES IN AN INDIVIDUAL BY RANDOM MUTATION



A BACTERIAL INFECTION IS TREATED WITH AN ANTIBIOTIC, KILLING MOST OF THE NON-RESISTANT INDIVIDUALS



THE RESISTANT SURVIVE, PASSING ON THE MUTATION FOR ANTIBIOTIC RESISTANCE



ANTIBIOTIC RESISTANCE INCREASES IN FREQUENCY IN THE POPULATION

KEY:

● = NORMAL BACTERIUM

● = RESISTANT BACTERIUM



Chapter 16: Reproduction



16 Reproduction

16.1 Asexual reproduction

Core

- 1 Describe asexual reproduction as a process resulting in the production of genetically identical offspring from one parent
- 2 Identify examples of asexual reproduction in diagrams, images and information provided

Supplement

- 3 Discuss the advantages and disadvantages of asexual reproduction:
 - (a) to a population of a species in the wild
 - (b) to crop production

Aitchison



16.2 Sexual reproduction

Core

- 1 Describe sexual reproduction as a process involving the fusion of the nuclei of two gametes to form a zygote and the production of offspring that are genetically different from each other
- 2 Describe fertilisation as the fusion of the nuclei of gametes

Supplement

- 3 State that nuclei of gametes are haploid and that the nucleus of a zygote is diploid
- 4 Discuss the advantages and disadvantages of sexual reproduction:
 - (a) to a population of a species in the wild
 - (b) to crop production

16.3 Sexual reproduction in plants

Core

- 1 Identify in diagrams and images and draw the following parts of an insect-pollinated flower: sepals, petals, stamens, filaments, anthers, carpels, style, stigma, ovary and ovules
- 2 State the functions of the structures listed in 16.3.1
- 3 Identify in diagrams and images and describe the anthers and stigmas of a wind-pollinated flower
- 4 Distinguish between the pollen grains of insect-pollinated and wind-pollinated flowers
- 5 Describe pollination as the transfer of pollen grains from an anther to a stigma

Supplement

- 9 Describe self-pollination as the transfer of pollen grains from the anther of a flower to the stigma of the same flower or a different flower on the same plant
- 10 Describe cross-pollination as the transfer of pollen grains from the anther of a flower to the stigma of a flower on a different plant of the same species
- 11 Discuss the potential effects of self-pollination and cross-pollination on a population, in terms of variation, capacity to respond to changes in the environment and reliance on pollinators

continued



16.3 Sexual reproduction in plants continued

Core

- 6 State that fertilisation occurs when a pollen nucleus fuses with a nucleus in an ovule
- 7 Describe the structural adaptations of insect-pollinated and wind-pollinated flowers
- 8 Investigate and describe the environmental conditions that affect germination of seeds, limited to the requirement for: water, oxygen and a suitable temperature

Supplement

- 12 Describe the growth of the pollen tube and its entry into the ovule followed by fertilisation (details of production of endosperm and development are **not** required)

16.4 Sexual reproduction in humans

Core

- 1 Identify on diagrams and state the functions of the following parts of the male reproductive system: testes, scrotum, sperm ducts, prostate gland, urethra and penis
- 2 Identify on diagrams and state the functions of the following parts of the female reproductive system: ovaries, oviducts, uterus, cervix and vagina
- 3 Describe fertilisation as the fusion of the nuclei from a male gamete (sperm) and a female gamete (egg cell)
- 4 Explain the adaptive features of sperm, limited to: flagellum, mitochondria and enzymes in the acrosome
- 5 Explain the adaptive features of egg cells, limited to: energy stores and the jelly coat that changes at fertilisation
- 6 Compare male and female gametes in terms of: size, structure, motility and numbers
- 7 State that in early development, the zygote forms an embryo which is a ball of cells that implants into the lining of the uterus
- 8 Identify on diagrams and state the functions of the following in the development of the fetus: umbilical cord, placenta, amniotic sac and amniotic fluid

Supplement

- 9 Describe the function of the placenta and umbilical cord in relation to the exchange of dissolved nutrients, gases and excretory products between the blood of the mother and the blood of the fetus
- 10 State that some pathogens and toxins can pass across the placenta and affect the fetus



16.5 Sexual hormones in humans

Core

- 1 Describe the roles of testosterone and oestrogen in the development and regulation of secondary sexual characteristics during puberty
- 2 Describe the menstrual cycle in terms of changes in the ovaries and in the lining of the uterus

Supplement

- 3 Describe the sites of production of oestrogen and progesterone in the menstrual cycle and in pregnancy
- 4 Explain the role of hormones in controlling the menstrual cycle and pregnancy, limited to FSH, LH, progesterone and oestrogen

16.6 Sexually transmitted infections

Core

- 1 Describe a sexually transmitted infection (STI) as an infection that is transmitted through sexual contact
- 2 State that human immunodeficiency virus (HIV) is a pathogen that causes an STI
- 3 State that HIV infection may lead to AIDS
- 4 Describe the methods of transmission of HIV
- 5 Explain how the spread of STIs is controlled

Supplement



Notes

- There are two types of reproduction.

Sexual reproduction

Asexual reproduction.

- In reproduction each new organism obtains a set of chromosomes from its parents or parents.
- Chromosomes are long threads of DNA found in the nucleus of a cell.
- They contain a set of instructions known as genes.

Asexual Reproduction

- Asexual reproduction involves just one parent. Some of the parent cells divide to produce new cells that contain exactly the same genes as the parent cell.

Hence the new organism is said to be genetically identical to its parent.

- Both plants and some animals can produce asexually.

Sexual Reproduction

- In this kind of reproduction parent organisms produce sex cells called Gametes.
- Eggs and sperms are examples of sex cells.
- Two of these gametes join and their nuclei fuse together in a process known as fertilization.
- The new cell formed after fertilization is called a zygote. The zygote divides again and again and forms into a new organism.
- The zygote contains chromosomes from both its parents and can have a combination of genes. Therefore the offspring is said to be genetically different from each other and their parents.

Gametes

- Gametes contain only half as many chromosomes as a normal cell. This is so when two of them fuse together the zygote formed contains the right number of chromosomes.
- Female gametes tend to be relatively larger and they do not move. In plants the female gamete is a nucleus inside an ovule. In animals it is called an egg.
- Male gametes are usually much smaller and they can move. In plants they are found inside pollen grains. In animals they are called sperms.



- In a human cell there are two sets of chromosomes. One from the father and one from the mother. Each set contains 23 chromosomes so in total there are 46 chromosomes in a human cell. A cell that has two sets of chromosomes is called a diploid.
- A cell containing only one set of chromosomes is called a haploid. Examples of haploid are gametes.
- Gametes are made when cells inside reproductive organs divide.
- Normally when a cell divides it divides by a process called mitosis in which new cells contain exactly the same number and type of chromosomes and genes as the parent cell.
- However when gametes need to be formed with only one set of chromosomes then cells divide by a process called meiosis. It produces haploid cells from diploid parent cells.
- Normally one organism can produce only one type of gamete. So they are either male or female. Some organisms can produce both types of gametes and these organisms are said to be hermaphrodite.

Flowers

- The function of a flower is to make gametes and to make sure that fertilization will take place.
- Most flowers are hermaphrodites.
- On the outside of the flower are the sepals. They protect the flower when it is a bud and they are usually green.
- Inside the sepals are the petals. These are often brightly coloured. They attract insects to the flowers.
- The female part of the flower is in the centre. It consists of one or more carpels. A carpel contains an ovary. Inside the ovary are many ovules. These contain the female gametes.
- At the top of the ovary is the style with a stigma at the tip. The function of the stigma is to catch the pollen grains.
- The male gametes are inside the pollen grains which are made in the anthers.



- The anthers have pollen sacs in them. Cells around the pollen sacs divide to form the pollen grains.
- Pollen grains look like fine powder and are often yellow. Pollen grains from different kinds of flowers have different shapes and can be spiky or smooth. Each grain has an outer hard coating which protects it in difficult conditions.

Pollination

- For fertilization to take place the male gametes must travel to the female gametes. The first stage of this journey is for pollen to be taken from the anther where it was made to a stigma. This is called pollination.
- There are two types of pollination.
- First is insect pollination. Insects come to flowers attracted by their color and a strong sweet scent. The bee follows the guidelines to the nectaries, brushing past the anthers as it goes. Some of the pollen sticks to its body. The bee then goes to another flower in search of nectar. Some of the pollen then sticks onto the stigma of the second flower when the bee brushes past it. If the second flower is of the same species pollination has occurred.
- In some plants wind pollination occurs. Wind pollinated flowers usually produce much more pollen than insect pollinated flowers as a lot of the pollen does not land on flowers and is wasted. Wind pollinated flowers usually do not have petals as there is no need to attract insects. Their anthers and stigmas dangle outside the flower to catch the wind.



-

Insect pollinated flower	Wind pollinated flower
Large, conspicuous petals often with guidelines.	Small, inconspicuous petals or no petals at all.
Often strongly scented.	No scent.
Often have nectaries at the base of petals.	No nectaries.
Anthers inside flowers, where insects have to brush past them to reach nectar.	Anthers dangle outside flowers, where they catch the wind.
Stigma inside flower, where insect has to brush past it to reach the nectar.	Stigmas large and feathery and dangle outside the flower, where pollen in the air may land on it.
Sticky or spiky pollen grains which stick to insects.	Smooth, light pollen which can be blown in wind.
Quite large quantities of pollen made.	Very large quantities of pollen made.

- Sometimes pollen is carried to the stigma of the same flower or to another flower on the same plant. This is called self pollination.
- If pollen is taken to a flower on a different plant of the same species. Then it is called cross pollination.

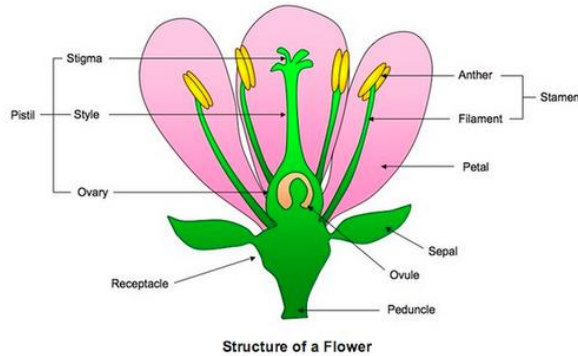
Fertilisation

- After pollination the male gamete inside the pollen grain is on the stigma.
- Now it has to find its way inside the flower in the ovary in the ovule to the female gamete.
- The pollen grain begins to grow in a tube. It grows through the style and ovary towards the ovule.
- It secretes an enzyme to digest a pathway through the style.
- The ovule is surrounded by several protective layers of cells called integuments. At one end there is a small hole called the micropyle into the



ovule.

- The pollen nucleus travels all the way through the tube into the ovule. It fuses with the ovule nucleus. Fertilisation has now taken place.



Seeds

- After fertilisation many parts of the flower are useless now. They wither and fall off.
- In the ovary the ovule starts to grow. Each ovule now contains a zygote.
- The zygote divides by mitosis to form an embryo plant. The ovule is now a seed.
- The seed contains very little water. Without water almost no metabolic reactions take place inside the seed and it is said to be in a dormant state. This helps it survive harsh conditions.
- For germination to occur the seed must have water, oxygen and a warm temperature.

Differences in asexual and sexual reproduction

- Sexual reproduction produces offspring which are genetically different from each other but asexual reproduction produces offspring which are genetically same.
- Sexual reproduction leads to variation but asexual reproduction does not.
- Less variation in terms of asexual reproduction is useful if a plant is well adapted to certain conditions and its offspring having its same characteristics would be useful.
- Sexual reproduction is useful in an area where there is a lot of crowding and competition. In this case asexual reproduction would make new organisms in the same area increasing competition and making things even more crowded.



It is better that new plants are dispersed a little further away.

- Another advantage of asexual reproduction is that they do not need to waste time and energy to find a mate. It is particularly important for lonely plants with no similar species plant nearby.
- However sexual reproduction is useful in fighting against diseases. Plants that reproduce asexually are prone to new diseases and very vulnerable due to their lack of variation and coping.

Differences in cross pollination and self pollination

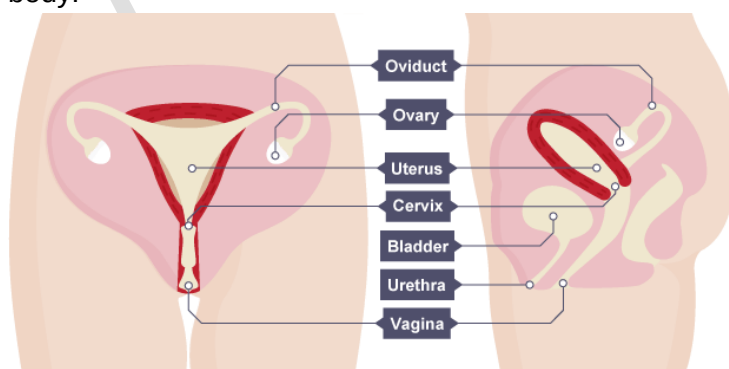
- Despite the fact that cross pollination and self pollination are both examples of sexual reproduction, their differences in advantages are the same as sexual and asexual reproduction. Cross pollination has the same advantages as sexual reproduction and self pollination has the same advantages as asexual reproduction.

Human Reproductive System

- Humans produce sexually.

The Female Reproductive System

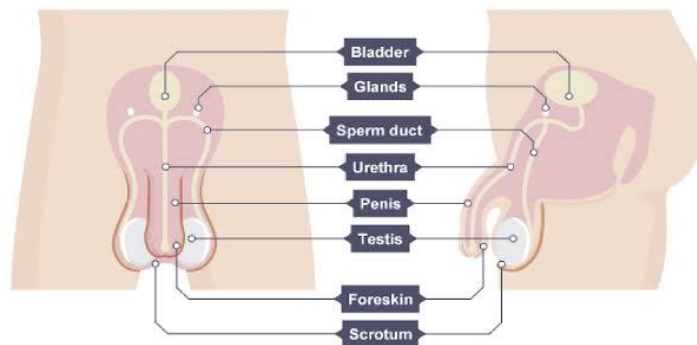
- The female gametes called egg cells are made in the two ovaries.
- Leading away from the ovaries are the oviducts or Fallopian Tubes.
- The tubes do not connect directly to the ovaries but have a funnel shaped opening just a short distance away.
- The two oviducts lead to the womb or uterus.
- At the base of the uterus is a narrow opening called the cervix.
- This opening connects to the vagina which then leads to the outside of the body.





Male Reproductive System

- The male gametes called sperms are made in the two testes.
- These are outside the body in two sacs of skin called scrotum.
- The sperm are carried away from each testis through a tube called the sperm duct.
- The sperm ducts from the testes join up with the urethra just below the bladder.
- The urethra continues downwards and opens at the tip of the penis.
- The urethra can carry sperm and urine at different times.
- Where the urethra joins the sperm ducts, there is a gland called the prostate gland. This makes a fluid called semen which the sperm swim in.



Human Gametes

- At birth a girl already has thousands of partly developed eggs inside her ovaries.
- When she reaches puberty some of the eggs begin to mature.
- An egg is a single cell.
- When it is fully developed, it bursts out of the ovary and into the funnel at the



end of the oviduct. This is called ovulation.

- Sperm after being made by the testes are stored in the epididymis.
- Sperm production is very heat sensitive. This is why testes are found outside the body where they are cooler than they would be inside.
- Eggs and sperms are both haploid cells and are made by meiosis.
- The egg cell has a jelly coat surrounding it.
- The sperm has an acrosome in its head. It is a vesicle containing enzymes to dissolve a way through the jelly surrounding the egg cell.
- It also has a flagellum or tail to help it swim and move.

Fertilisation

- After ovulation the egg is caught in the funnel of the oviduct. Very slowly the egg travels towards the uterus. Cilia lining the oviduct help it move around. Muscles in the walls also help it move by producing gentle rippling movements.
- If a sperm does not fertilise the egg within 8 to 24 hours the egg cell dies.
- For sperm to reach the egg easily the penis is placed inside the vagina.
- Then the sperm is squeezed out of the penis due to rhythmic contractions.
- The semen containing the sperm is deposited at the top of the vagina near the cervix. The sperms still have a long way to go.
- To help them swim they use their flagella and the energy from the mitochondria inside them. They move through the cervix, through the uterus and into the oviduct.
- When a sperm cell comes into contact with the jelly coat surrounding the egg the cell its acrosome becomes activated. It releases enzymes and they digest the jelly coat.
- This allows for the head of the sperm to move inside and get into the cytoplasm of the cell. The nucleus in the sperm then fuses with the nucleus of the egg. This is fertilisation.
- As soon as the successful sperm enters the egg cell, its jelly coat becomes impenetrable and all other sperm are left outside to die.



Implantation

- After fertilisation a zygote forms.
- It slowly continues to move down the oviduct.
- As it goes down it divides repeatedly and ultimately forms a ball of cells called an embryo.
- The embryo contains nutrients from the yolk of the egg.
- It takes several hours for the embryo to reach the uterus. The uterus has a thick and spongy lining and the embryo sinks into it. This is called Implantation.

Placenta

- The embryo continues to divide. As the embryo grows a placenta also grows which connects it to the walls of the uterus.
- The placenta is soft, dark red and has finger-like projections called villi.
- The placenta is the place where substances are exchanged between the mother's blood and the embryo's blood.
- After 11 weeks, the embryo has grown most of its organs and is called a fetus.
- The placenta is joined to the fetus by the umbilical cord.
- Inside the cord are two arteries and a vein. The arteries take blood from the fetus into the placenta and the vein returns the blood to the fetus.
- The placenta contains capillaries filled with fetus blood. The lining of the the uterus contains large spaces filled with the mother's blood. The fetus's and mother's blood does not mix. They are separated by the walls of the placenta.
- Oxygen and dissolved nutrients in the mother's blood diffuse across the placenta into the fetus's blood and are then carried along the umbilical cord to the fetus.
- Carbon dioxide and other excretory products diffuse in the other direction and are carried away in the mother's blood.



- Some unwanted substances can also cross the placenta. These include toxins such as alcohol, carbon monoxide and pathogens.

Amniotic Sac

- The fetus is surrounded by a strong membrane called the amniotic sac.
- This makes a fluid called the amniotic fluid.
- Amniotic fluid helps to support the embryo and protect it from mechanical injury. The embryo floats in the fluid and is able to move its arms and legs which helps the muscles and bones to develop correctly.
- After nine months, when the fetus is ready to be born, contractions of muscles in the uterus wall often cause the amniotic sac to break, releasing the amniotic sac so that it flows into the vagina. This is often the first sign that the a woman is about to give birth.

Testosterone and Oestrogen

- The main reproductive hormone produced in men is testosterone. While in women oestrogen and progesterone are secreted.
- The time when a person approaches sexual maturity is called adolescence.
- The point at which sexual maturity is reached is called puberty.
- In men during puberty, the hormones cause growth of facial hair and pubic hair, broadening of shoulders, general muscular development and a deepening voice.
- In women during puberty, the hormones cause the breasts to grow larger, pubic hair to grow and hips to become wider.

The Menstrual Cycle

- Eggs develop in small structures called follicles.
- After a girl reaches puberty, one egg is usually released from a follicle into the oviduct every month. Before the egg is released the lining of the uterus becomes thick and spongy so that it is ready to receive a zygote. It is full of tiny blood vessels which will supply the embryo with nutrients and oxygen if it should arrive.



- However if the egg is not fertilised the spongy lining is not needed. It gradually breaks down and is slowly lost through the vagina. This is called menstruation.
- It usually lasts for about five days.
- The recurring events of the menstrual cycle are controlled by four hormones. These include oestrogen, progesterone, FSH and LH.
- Oestrogen and progesterone are secreted by the ovaries. FSH and LH are secreted by a small gland attached to the base of the brain called the pituitary gland.
- During the first part of the cycle, following menstruation, both FSH and LH are produced. FSH causes a follicle to develop in the ovary with a developing female gamete inside it.
- The developing follicle secretes oestrogen in increasing amounts. Oestrogen causes the lining of the uterus to become thicker and better supplied with blood.
- When the follicle is fully developed there is a surge in production of LH. This causes ovulation. This causes the oestrogen levels to fall.
- The follicle from which the egg was released develops into a structure called a corpus luteum. This secretes progesterone so its concentration increases.
- It keeps the lining of the uterus thick and spongy, ready to receive a fertilized egg.
- The increase in progesterone inhibits the pituitary gland which causes FSH and LH production to decrease.
- If the egg is not fertilized the corpus luteum breaks down so the concentration progesterone drops and menstruation occurs. Because progesterone is now not inhibiting the secretion of FSH and LH, their levels start to increase and the whole cycle runs again.
- However if the egg is fertilized progesterone levels stay high. This happens because the corpus luteum remains in the ovary and continues to secrete



progesterone.

- It helps to maintain the thick uterus lining so that the embryo can implant into it. Once the placenta develops, it takes over the role of secreting progesterone which it does throughout pregnancy.
- The high levels of progesterone inhibit the secretion of FSH so no more follicles develop in the ovary.

Sexually Transmitted Infections

- Sexually transmitted infections or STIs for short are infections caused by bacteria or viruses that can be passed from one person to the other during sexual contact.
- One of the most important infections is HIV/AIDS.
- HIV stands for Human Immunodeficiency Virus.
- HIV affects white blood cells and in particular a type called T cells.
- Over a long period of time HIV destroys T cells. Their number drops so low that they become unable to fight against pathogens.
- After several years of infection, a person is likely to develop symptoms of AIDS.
- They become very vulnerable to infections. They may develop cancer as well. Brain cells can also be damaged. Normally a person suffering with HIV dies from a collection of illnesses.
- However there are drugs to control HIV called antiretrovirals. They stop the virus from multiplying.

Preventing HIV Transmission

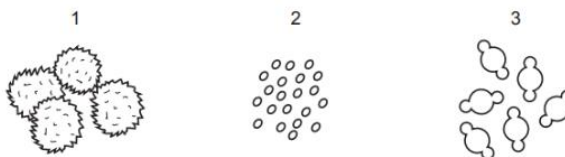
- A person can catch HIV through a number of ways.
- One way is through sexual contact. During sexual intercourse fluids from one partners come in contact with the fluids of the other.
- The best way to avoid it is to have only one sexual partner. Using a condom is another way.



- It's very important for a person infected with HIV to know that they are infected so they do not transmit it to any other person.
- Another way of spreading is through blood contact.
- The virus can pass from the mother to her child during childbirth.
- The virus can also be passed if people share hypodermic needles.
- People who deal with accidents where there is blood around need to wear protection to protect themselves from potential HIV threats.
- Another way of spreading is through breast feeding

MCQS

The diagrams show pollen grains from three different species of plant as they appear under the microscope. The diagrams are all to the same scale.



Which pollen grains are involved in insect-pollination?

- A** 1 and 2 **B** 1 only **C** 2 and 3 **D** 3 only

2.

What are the characteristics of asexual reproduction?

	fusion of gamete nuclei	genetic variety in the offspring
A	✓	✓
B	✓	x
C	x	✓
D	x	x



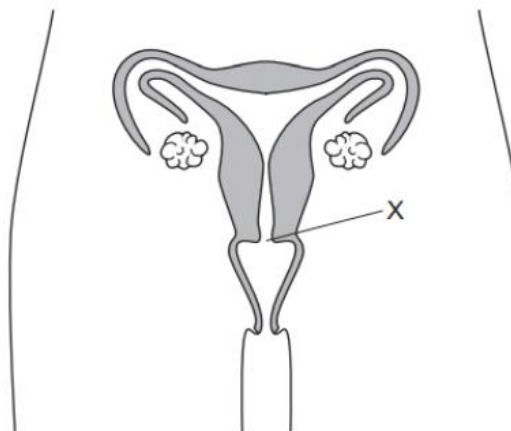
The table shows the conditions provided for four sets of seeds.

Which of the seeds germinate?

	oxygen	water	carbon dioxide
A	✓	✓	✓
B	✓	x	x
C	x	✓	✓
D	x	x	x

4.

The diagram shows a human female's reproductive organs.



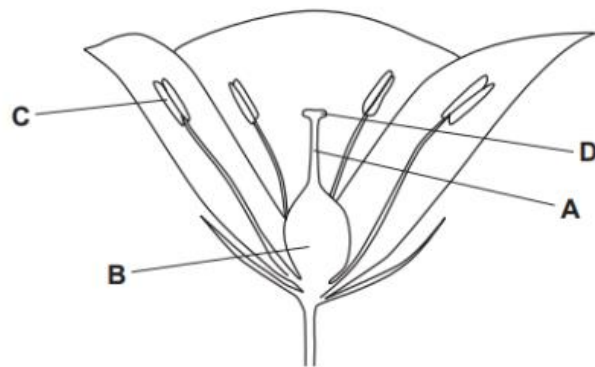
What is the name of structure X?

- A** cervix
- B** ovary
- C** oviduct
- D** ovule



The diagram shows a flower.

In which structure do seeds develop?



6.

The following statements are about some hormones in the human body.

V causes changes in the ovaries during the menstrual cycle

W promotes the development of stronger muscles

X causes the voice to deepen at puberty

Y produced by the pancreas

Which statements are correct for testosterone?

A V and W

B V and Y

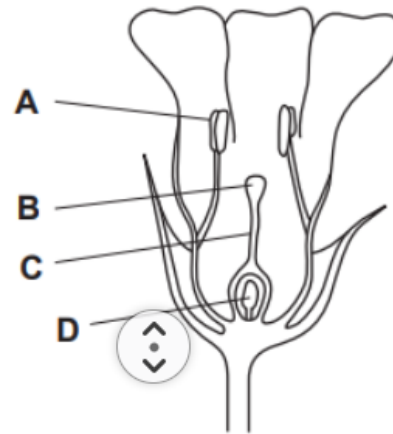
C W and X

D X and Y



The diagram shows half a flower.

On which structure would pollen be deposited in pollination?



8.

In which region does diffusion of materials take place between mother and fetus?

- A amniotic sac
- B ovary
- C placenta
- D umbilical cord

9.

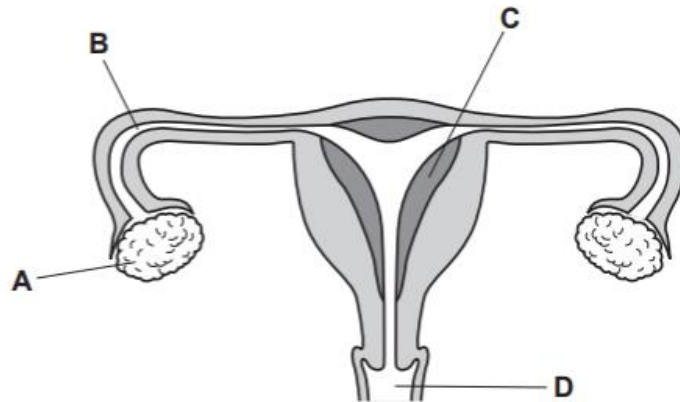
Which row shows how one type of gamete is transported so that fertilisation can occur in a flowering plant?

	type of gamete	how transported
A	female	in a pollen grain
B	female	in a seed
C	male	in a pollen grain
D	male	in a seed



The diagram shows the female reproductive system.

Where does implantation normally occur?



Answers

1. B
 2. D
 3. A
 4. A
 5. B
 6. C
 7. B
 8. C
 9. C
 10. C
-



Structured Questions

1.

Hormones are secreted by glands or made artificially by drug companies.

- (a) (i) Name the gland that secretes testosterone.

..... [1]

- (ii) State why testosterone can improve sporting performance.

.....
.....
..... [1]

- (iii) Describe the role of progesterone in the menstrual cycle.

.....
.....
..... [1]

Hormones are secreted by glands or made artificially by drug companies.

- (a) (i) Name the gland that secretes testosterone.

Testes.
..... [1]

- (ii) State why testosterone can improve sporting performance.

It increases muscle mass.
.....
..... [1]

- (iii) Describe the role of progesterone in the menstrual cycle.

It maintains uterus lining.
.....
..... [1]



Explain how a sperm cell is adapted for its functions.

.....

.....

.....

.....

.....

.....

.....

.....

.....[3]

Explain how a sperm cell is adapted for its functions.

It has a flagellum to move and swim. It has a small streamlined shaped for
.....

better movement. It is also packed with mitochondria to provide efficient
.....

energy.
.....

.....

.....

.....

.....

.....[3]



3.

Explain the advantages of sexual reproduction to an animal species.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [5]

Explain the advantages of sexual reproduction to an animal species.

.....

It allows variation. It allows to maintain/increase population. Allows adaptation

.....

of new/changed environments. Allows new species to form and for evolution

.....

It is caused by meiosis.

.....

.....

.....

.....

.....

.....

..... [5]



4.

Describe the effects of HIV on the immune system.

.....

.....

.....

.....

.....

.....

.....

.....[3]

Describe the effects of HIV on the immune system.

It weakens the immune system and the body's ability to fight pathogens.

.....

Lymphocytes are destroyed and damaged.

.....

The body becomes vulnerable to infections and diseases. Phagocytes are unable to engulf pathogens and lymphocytes are unable to kill them.

.....

.....[3]



5.

State the meanings of the terms *pollination* and *fertilisation*.

pollination

.....

.....
.....

fertilisation

.....

.....
..... [2]

State the meanings of the terms *pollination* and *fertilisation*.

State the meanings of the terms *pollination* and *fertilisation*.

pollination

The process of transferring pollen from anther to stigma.

.....

.....
.....

fertilisation

The process that occurs when the nucleus of the female and

.....

male gametes fuse together.

.....
..... [2]

Aitch



Chapter 17: Inheritance

17 Inheritance

17.1 Chromosomes, genes and proteins

Core

- 1 State that chromosomes are made of DNA, which contains genetic information in the form of genes
- 2 Define a gene as a length of DNA that codes for a protein
- 3 Define an allele as an alternative form of a gene
- 4 Describe the inheritance of sex in humans with reference to X and Y chromosomes

Supplement

- 5 State that the sequence of bases in a gene determines the sequence of amino acids used to make a specific protein (knowledge of the details of nucleotide structure is **not** required)
- 6 Explain that different sequences of amino acids give different shapes to protein molecules

continued

Aitchison



17.1 Chromosomes, genes and proteins continued

Core

Supplement

- 7 Explain that DNA controls cell function by controlling the production of proteins, including enzymes, membrane carriers and receptors for neurotransmitters
- 8 Explain how a protein is made, limited to:
 - the gene coding for the protein remains in the nucleus
 - messenger RNA (mRNA) is a copy of a gene
 - mRNA molecules are made in the nucleus and move to the cytoplasm
 - the mRNA passes through ribosomes
 - the ribosome assembles amino acids into protein molecules
 - the specific sequence of amino acids is determined by the sequence of bases in the mRNA(knowledge of the details of transcription or translation is **not** required)
- 9 Explain that most body cells in an organism contain the same genes, but many genes in a particular cell are not expressed because the cell only makes the specific proteins it needs
- 10 Describe a haploid nucleus as a nucleus containing a single set of chromosomes
- 11 Describe a diploid nucleus as a nucleus containing two sets of chromosomes
- 12 State that in a diploid cell, there is a pair of each type of chromosome and in a human diploid cell there are 23 pairs

17.2 Mitosis

Core

Supplement

- 1 Describe mitosis as nuclear division giving rise to genetically identical cells (details of the stages of mitosis are **not** required)
- 2 State the role of mitosis in growth, repair of damaged tissues, replacement of cells and asexual reproduction
- 3 State that the exact replication of chromosomes occurs before mitosis
- 4 State that during mitosis, the copies of chromosomes separate, maintaining the chromosome number in each daughter cell
- 5 Describe stem cells as unspecialised cells that divide by mitosis to produce daughter cells that can become specialised for specific functions



17.3 Meiosis

Core

Supplement

- 1 State that meiosis is involved in the production of gametes
- 2 Describe meiosis as a reduction division in which the chromosome number is halved from diploid to haploid resulting in genetically different cells (details of the stages of meiosis are **not** required)

17.4 Monohybrid inheritance

Core

Supplement

- 1 Describe inheritance as the transmission of genetic information from generation to generation
- 2 Describe genotype as the genetic make-up of an organism and in terms of the alleles present
- 3 Describe phenotype as the observable features of an organism
- 4 Describe homozygous as having two identical alleles of a particular gene
- 5 State that two identical homozygous individuals that breed together will be pure-breeding
- 6 Describe heterozygous as having two different alleles of a particular gene
- 7 State that a heterozygous individual will not be pure-breeding
- 8 Describe a dominant allele as an allele that is expressed if it is present in the genotype
- 9 Describe a recessive allele as an allele that is only expressed when there is no dominant allele of the gene present in the genotype
- 10 Interpret pedigree diagrams for the inheritance of a given characteristic
- 11 Use genetic diagrams to predict the results of monohybrid crosses and calculate phenotypic ratios, limited to 1:1 and 3:1 ratios
- 12 Use Punnett squares in crosses which result in more than one genotype to work out and show the possible different genotypes
- 13 Explain how to use a test cross to identify an unknown genotype

continued



17.4 Monohybrid inheritance continued

Core

Supplement

- 14 Describe codominance as a situation in which both alleles in heterozygous organisms contribute to the phenotype
- 15 Explain the inheritance of ABO blood groups: phenotypes are A, B, AB and O blood groups and alleles are I^A , I^B and I^O
- 16 Describe a sex-linked characteristic as a feature in which the gene responsible is located on a sex chromosome and that this makes the characteristic more common in one sex than in the other
- 17 Describe red-green colour blindness as an example of sex linkage
- 18 Use genetic diagrams to predict the results of monohybrid crosses involving codominance or sex linkage and calculate phenotypic ratios

Notes

Inheritance is the passing down of genetic information from parents to offsprings.

CHROMOSOMES

Chromosomes are long strands of DNA that hold genetic information encoded in genes.

In the human body there are a total of 46 chromosomes(23 pairs).

Out of 23 pairs of chromosomes, 1 pair is sex chromosome. Other 22 pairs chromosomes are called **autosomes**.

A cell containing a single set of chromosomes is said to be **haploid**. Eg Gametes

A cell containing 2 sets of chromosomes is said to be **diploid**.

Sex related chromosomes.

As the name suggests sex related chromosomes determine your sex.

Sex chromosomes are of two types

- i. X Chromosome - Long one
- ii. Y Chromosome - Short one

Of a female the sex chromosome is XX

Of a male sex chromosome is XY

It can be said that Father chromosomes determine the sex of the child as he is the only one that passes the Y chromosome.

Sex- Linked genes are genes that are only found on one of the chromosomes (usually X) so they are more common in one sex than the other. Eg different type of cone cells in retina



Genetic diagram of inheriting sex chromosome

Gametes	X	Y
X	XX	XY
Y	XY	YY

GENES

Segments of DNA ,on which genetic information is stored are called **genes**. These genes determine your traits as they contain code for production of specific proteins which allow only specific traits to develop.

Alleles are different types of version of the same gene.

If the alleles of a particular gene are identical in chromosome then it is known as **homologous chromosome**

If the alleles of a particular gene are not identical in chromosome then it is known as **heterozygous chromosome**.

Genotype is the genetic makeup of the organism in terms of allele.

Phenotype is the physical appearance of an organism.

Alleles

Alleles are different types of version of the same gene.

Allele can be of 2 types:

1.Dominant Allele:

Allele that gives an expression when it is present.Often shown by capital alphabet e.g “G”

2.Recessive allele:

Allele that only gives an expression when no dominant allele is present or both the alleles present are recessive.Often shown by small alphabet e.g “g”.

Example Question

Q. In a species of animal, the allele for brown eyes is dominant and the allele for green eyes is recessive.

Write down the suitable symbols for these 2 alleles

ANS.) Brown eyes= B



Green eyes= b

Using your symbols, write the 3 possible genotypes and the phenotypes that each genotype produces. Tell which genotype is homozygous and which is heterozygous?

ANS.

GENOTYPE	PHENOTYPE
BB (Homozygous)	Brown Eyes
Bb (Heterozygous)	Brown Eyes
bb (Homozygous)	Green Eyes

<u>GENOTYPE</u>	<u>PHENOTYPE</u>
$I^A I^A$	Blood Group A
$I^A I^B$	Blood group AB
$I^A I^O$	Blood Group A
$I^B I^B$	Blood Group B
$I^B I^O$	Blood Group B
$I^O I^O$	Blood Group O

Codominance:

Alleles that are both expressed in the phenotype when they both are present. **E.g** Blood groups are examples of Codominance.

From the table below we can deduce that Alleles I^A and I^B are codominant but are dominant to I^O

Protein Synthesis

DNA is a protein molecule found in the nucleus of cell made up of 2 long strands of molecules called nucleotides

There are 4 different nucleotides each containing a different base-A,C,T,G.



Protein molecules are made up of smaller molecules chained up together known as **amino acids**.

The sequence of amino acids determines the shape of the protein molecule.

Code for which protein to make is present in DNA.

Protein synthesis takes place in **ribosomes**.

To carry information from the DNA (in the nucleus) to ribosomes, **messenger RNA (mRNA)** is used.

mRNA copies the base sequence from the gene and travels towards the ribosome.

Accordingly the ribosomes link amino acids together as it was written on mRNA.

Through this way a protein molecule is formed.

Mitosis:

Is a division of the nucleus of a cell resulting in formation of 2 new nuclei containing the same number of and type of chromosomes.

The parent cell and daughter cells are genetically identical.

Used in growth repair of damaged tissues and asexual reproduction.

Meiosis:

Diploid cells divide to produce haploid cells.

Is a reduction division.

They are genetically different from their parents.

Used in the production of gametes

Stem cells:

Unspecialised cells that are able to divide by mitosis to produce different types of specialized cells.

E.g Zygote. When zygote is forming all of our cells are unspecialised at that time, but as it grows specialized cell are formed

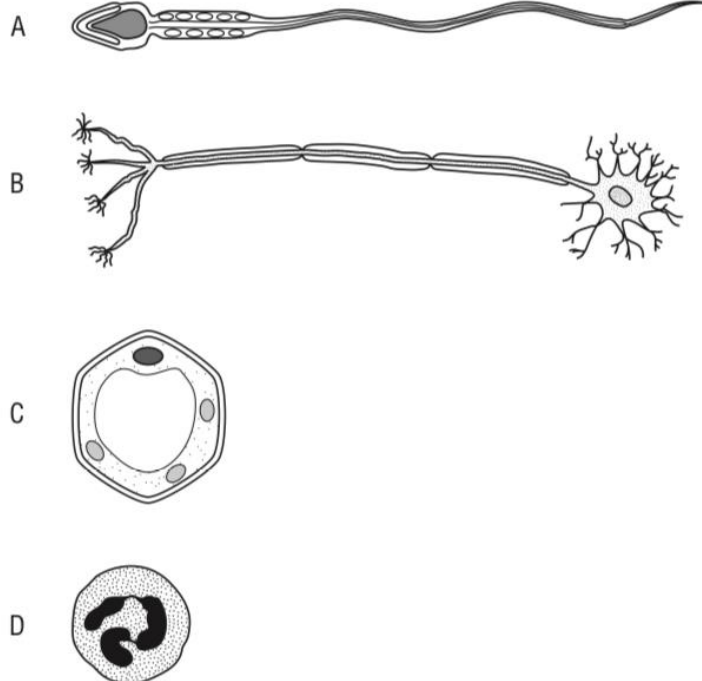


MCQ's:

1.

1 Cells are formed by the division of existing cells. Four different cells are shown.

Which cell is produced by meiosis?



2.

Albinism is an inherited condition in which pigment does not develop in the skin, hair and eyes.

The allele for albinism is recessive.

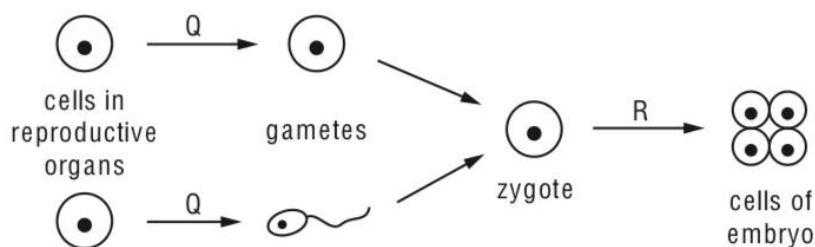
What are the chances of albino parents having an albino child?

- A** 0% **B** 25% **C** 75% **D** 100%



3.

The diagram represents processes in sexual reproduction.



Which processes are represented by stages Q and R?

	Q	R
A	meiosis	meiosis
B	meiosis	mitosis
C	mitosis	meiosis
D	mitosis	mitosis

4.

Which name is given to the observable features of an organism?

- A** alleles
- B** genes
- C** genotype
- D** phenotype

5.



Which structure will be found in the nucleus of a body cell in a woman?

- A X allele
 - B X chromosome
 - C Y allele
 - D Y chromosome
-

6.

Owners of successful race horses hope that the horses' offspring will be like their parents.

How does a young race horse inherit its characteristics?

- A equally from its mother and father
 - B mainly from its father
 - C mainly from its mother
 - D passed across the placenta
-

7.

In pea plants the allele for tall, T, is dominant to the allele for dwarf, t.

Which cross would produce plants in the proportion of 1 tall : 1 dwarf?

- A $TT \times Tt$
 - B $Tt \times Tt$
 - C $Tt \times tt$
 - D $tt \times tt$
-

8.

What are alleles?

- A a pair of chromosomes
 - B different versions of the same gene
 - C the total number of genes on one chromosome
 - D two genes side by side on the same chromosome
-

9.



A pure-breeding plant with smooth stems was crossed with a heterozygous plant with hairy stems.

What will be the ratio of hairy : smooth stems in the resulting plants?

- A 1 hairy : 1 smooth
 - B 1 hairy : 3 smooth
 - C 3 hairy : 1 smooth
 - D all hairy
-

10.

Which statement about the human sex chromosomes is correct?

- A All boys have two Y chromosomes.
 - B Everybody has at least one X chromosome.
 - C Girls have a Y chromosome and an X chromosome.
 - D Nobody has two X chromosomes.
-



Answers:

- 1 A
- 2 D
- 3 B
- 4 D
- 5 B
- 6 A
- 7 C
- 8 B
- 9 A
- 10 B

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Structured Questions

Sex in cats is determined in the same way as in humans.

Complete the diagram below to show how sex is determined in cats.

male cat × female cat

		female cat (XX)	
		gametes	
male cat (.....)			
			

offspring ratio..... [3]

X XX XX
Y XY XY

1:1



Define the terms *gene* and *gene mutation*.

gene.....

.....

gene mutation.....

.....

A gene is a length of DNA that codes for a protein

A change in base sequence of DNA is termed as a gene mutation.



Chapter 18: Variation and Selection

18 Variation and selection

18.1 Variation

Core

- 1 Describe variation as differences between individuals of the same species
- 2 State that continuous variation results in a range of phenotypes between two extremes; examples include body length and body mass
- 3 State that discontinuous variation results in a limited number of phenotypes with no intermediates; examples include ABO blood groups, seed shape in peas and seed colour in peas
- 4 State that discontinuous variation is usually caused by genes only and continuous variation is caused by both genes and the environment
- 5 Investigate and describe examples of continuous and discontinuous variation
- 6 Describe mutation as genetic change
- 7 State that mutation is the way in which new alleles are formed
- 8 State that ionising radiation and some chemicals increase the rate of mutation
- 2 Describe selective breeding with reference to:
 - (a) selection by humans of individuals with desirable features
 - (b) crossing these individuals to produce the next generation
 - (c) selection of offspring showing the desirable features
- 3 Outline how selective breeding by artificial selection is carried out over many generations to improve crop plants and domesticated animals and apply this to given contexts

Supplement

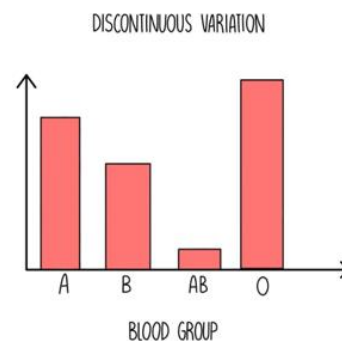
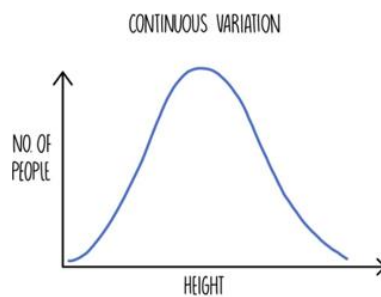
- 9 Describe gene mutation as a random change in the base sequence of DNA
- 10 State that mutation, meiosis, random mating and random fertilisation are sources of genetic variation in populations
- 6 Outline the differences between natural and artificial selection



Notes

What is variation?

- The difference between two individuals belonging to the same species is known as variation.
- There are two types of variation: continuous and discontinuous variation.
- Continuous variation is when an infinite range of phenotypes can be produced within a certain range. Two examples are height and weight.
- For example, the height of zebras ranges from about 1.1 to 1.5m, which means that the zebra height of any ordinary zebra would be anywhere between that range. It could be 1.23m, 1.255m, 1.38913m and so on.
- There are a limitless number of values in that specific range in which the zebra's height could lie. That is continuous variation.
- Discontinuous variation results in a limited number of phenotypes with no intermediates (nothing is between them). Examples include blood group and seed shape in peas.
- There are only four blood groups: A, B, AB, and O and nothing between them so the number is not limitless.





Causes of variation

- Discontinuous variation is usually caused by genes only, like blood groups are decided by genes only.
- Continuous variation is often dependent on both genes and environment such as height, which depends on both genes and the diet and habits of a person.
- A mutation, put simply, is a random change in a gene.
- Mutations are how new alleles are formed.
- A gene mutation occurs when there is a random change in the base sequence of DNA.
- It is unpredictable and can happen for no apparent reason but it can be accelerated by ionizing radiation or by heavy metals such as lead and mercury.

Why variation occurs

- Genetic variation can occur for a number of reasons. This includes mutations, meiosis, random mating and random fertilization.
 - Mutations cause variation because they lead to change in an allele.
 - Meiosis causes variation because the pairs of homologous chromosomes exchange genes and so the gametes formed can have many different combinations of alleles.
 - In a population, any male can mate with any female and at fertilization, any two gametes can fuse together so there are a huge number of combinations of alleles that can be produced in the zygote.

What is an adaptive feature?

- An adaptive feature is an inherited feature that helps an organism to survive and reproduce in its environment.



- Some examples include gills for fish, streamlined bodies and different types of enzymes.
- Some plants contain adaptive features to help them survive in an environment where water is scarce. These are known as xerophytes.
- Other plants contain adaptive features to help them survive in a water-dense environment. These are called hydrophytes.

Adaptive features of xerophytes

- Xerophytes often have closed stomata. This is because plants lose most water as water vapor through the stomata. If they close the stomata, transpiration of water almost completely stops.
- The leaves of xerophyte plants are covered with a thick waxy cuticle which makes them waterproof.
- Xerophytes contain hairs on their leaves. These trap a layer of moist air next to the leaf. The moist air reduces the diffusion gradient for water vapor from the leaf into the air so less water vapor diffuses out of the leaf.
- Most xerophytes have sunken stomata on the undersides of leaves. The lower surface is cooler than the upper one due to less contact with sunlight so less water will evaporate.
- The xerophytes usually contain few stomata and they are often sunk into deep pits in the leaves. When water wafer diffuses out through the stomata it collects in the air trapped in the pits. This reduces the diffusion gradient so less water vapor diffuses out of the leaf.
- Xerophytes have very small and barely visible leaves, often in the form of spines. The spines are sharp and prevent hungry and thirsty animals eating the plant and the small surface area of the leaves allows less diffusion of water outside.
- Usually desert plants also have deep or spreading roots so that they can seek out water deep down in the soil or over a wide area.



- Although many plants may show some of these adaptive features, xerophytes show them to a greater extent.

Adaptive features of hydrophytes

- Plants that live in very wet places, or in water, are called hydrophytes. Their adaptive features help them to survive in water.
- The roots of hydrophytes do not attach to the bottom of the water but rather float freely in the river or pond where they grow.
- The stems and leaf stalks have hollowed spaces filled in them, filled with air to help them float on top of the water and get light for photosynthesis.
- They have stomata on the upper surfaces as well as lower surfaces. This is because the upper surface receives light from the Sun so photosynthesis can take place. It also has no need to conserve water so stomata don't need to be hidden away from the light.
- Some hydrophytes may also have thin, feathery leaves that can spread out easily and absorb sunlight.

Natural Selection

- The process in which individuals with advantageous features survive and pass on genes to the next generation, is called natural selection.
-
- Natural selection can be summarized in five points:
 1. **Variation:** There is genetic variation within a population of organisms which affects their adaptive features.
 2. **Overproduction:** Within a wild population, many more wild offspring are produced than will survive to become adults and reproduce.



3. **Struggle for survival:** Within the population, the individuals will compete with one another for resources.
4. **Survival of the fittest:** Only the individuals that have the best adaptive features will have the best chance of surviving and reproducing.
5. **Reproduction:** Useful alleles are likely to be passed on since the better adapted individuals survive for longer and will likely pass on their alleles to the next generation.

Development of Antibiotic-resistant bacteria

- Adaptation is the process resulting from natural selection in which populations become better suited to their environment over many generations.
- Antibiotics were used to kill bacterial cells without harming human cells but over time bacteria have become resistant to antibiotics due to natural selection.
- Within a bacterial population, there will be several million bacteria. Out of these one or two are likely to be resistant to a specific antibiotic. These bacteria reproduce rapidly while others die and so they spawn a new population of bacteria that is completely resistant to that antibiotic.
- Staphylococcus aureus bacteria are one bacteria species that have been rapidly evolving and adapting to antibiotics.
- To stop bacteria from becoming resistant to antibiotics, we can restrict use of antibiotics, complete the full medication provided to us, only use antibiotics for bacteria and only when necessary.

Selective breeding vs Natural selection

- Selective breeding/Artificial Selection is when humans breed organisms for their own benefits.
- Firstly, they select individual organisms with features they consider desirable. Second, they cross these individuals to produce



the next generation. Lastly, they pick out the offspring showing the desirable features. This process can be repeated many times.

- For example, disease-resistant crops or cows that produce more milk can be bred this way and improve the quality or quantity of the goods humans desire.

Natural Selection	Artificial Selection
It's long and slow	It's faster
There's more variation in the population hence, if the environment changes/ there is a disease, survival chances for the offspring are higher	There's not much variation in the population hence, survival chances for the offspring are lower
Reproducing individuals have characteristics that suit their environment	Reproducing individuals have characteristics that are desirable by humans
There's less likely to be inbreeding so offspring are healthier	There's more likely to be inbreeding which reduces variation and increases the chances of getting genetic disorders
It occurs naturally in the wild to all organisms	It only occurs in the organisms chosen by humans



MCQS

1.

37 Which statement about variation is correct?

- A ABO blood groups show continuous variation.
- B Body mass shows discontinuous variation.
- C Seed colour in peas shows continuous variation.
- D Seed shape in peas shows discontinuous variation.

2.

36 The photograph shows a species of fish called a leafy sea-dragon.

Leafy sea-dragons live in areas of the sea where seaweed is present.



Which statements explain how natural selection caused the leafy sea-dragon species to develop?

- 1 Leafy sea-dragons that looked like seaweed were better adapted to their environment.
- 2 Leafy sea-dragons that survived passed on the allele for their appearance to their offspring.
- 3 Humans selected leafy sea-dragons that looked like seaweed.

A 1, 2 and 3 B 1 and 2 only C 1 and 3 only D 2 and 3 only



- 33** Which feature is found in a hydrophytic plant?
- A** Leaves are curled with stomata on the inside.
 - B** Leaves are reduced to spines.
 - C** Stomata are sunk in pits in the epidermis.
 - D** There is no waxy cuticle.

4.

- 34** Which statements are correct during both natural selection and artificial selection?
- 1 Only certain individuals reproduce.
 - 2 Alleles are passed on to the offspring.
 - 3 Organisms do **not** compete with each other for survival.
- A** 1 and 2 **B** 1 and 3 **C** 2 only **D** 2 and 3

Aitchis



5.

35 Which row shows features of xerophytes that reduce water loss?

	green colour from chlorophyll	leaves reduced to spines	presence of stomata	thick cuticle
A	✓	x	✓	x
B	✓	✓	x	x
C	x	✓	x	✓
D	x	x	✓	✓

key

✓ = reduces water loss

x = does **not** reduce water loss

6.

34 Which statement about selective breeding is correct?

- A It does not involve humans.
- B It involves a struggle for survival.
- C It always involves only one parent.
- D It involves parents that possess desirable features.

Ans



7.

33 Which statement is correct?

- A** Discontinuous variation is mainly caused by environmental factors.
- B** Ionising radiation and some chemicals decrease the rate of mutation.
- C** A gene mutation is a change in the base sequence of a DNA molecule.
- D** Small variations in height within a human population are an example of discontinuous variation.

8.

34 Which adaptation may be present in a xerophyte?

- A** leaves with small surface area and large numbers of stomata
- B** little or no xylem tissue and leaves with large surface area
- C** stomatal hairs and rolled leaves
- D** thin or no cuticle and deep roots

Aitchison



Answers:

1. **D:** The answer is D because blood groups and seed color are both examples of discontinuous variation while body mass is an example of continuous variation. So, D is the only right answer.
2. **B:** We know that humans have nothing to do with natural selection, so option 3 is incorrect. So the only correct answer can be B.
3. **D:** Here, option D is correct as a wavy cuticle is a feature of a xerophyte and thus hydrophytes do not contain them whereas options A,B and C are all adaptive features that increase conservation of water and are thus wrong.
4. **A:** The first two options here are correct as in both natural and artificial selection specific individuals reproduce and then give alleles to their offspring but in artificial selection, organisms do not compete with each other as humans select and breed them. So option 3 is incorrect and the answer is A.
5. **C:** C is the correct answer because a thick waxy cuticle and leaves shrunk to spines are both adaptive features of xerophytes reducing water loss, while stomata and green color of chlorophyll causing increased photosynthesis cause increased water loss and are thus not part if their adaptive features.
6. **D:** Here, D is the correct answer because selective breeding is done between two desirable parents and involves no competition and human involvement.
7. **C:** Option C is the only correct answer because discontinuous variation is caused mainly by genetic factors, radiation increases the rate of mutation and variation in height is an example of continuous variation.
8. **C:** Xerophytes contain stomatal hair to trap moisture and reduce water loss by diffusion, and rolled leaves to reduce surface area for water loss by photosynthesis so option C is correct.



A study was carried out in Sweden into the effects of natural selection on wing length in reed warblers.

The wings of young reed warblers reach their maximum length a few days after leaving the nest.

At this age the wing length in millimetres of each bird was recorded. Each bird was identified by putting a small ring around one of its legs.

When the birds were caught in net traps as adults, the information on the rings was used to identify specific birds and their ages.

Aitchison



The length of time between ringing and trapping was recorded for each bird that was identified before it was released.

The mean age at trapping was calculated for birds with each wing length.

The results are shown in Table 5.1.

Table 5.1

wing length at ringing / mm	number of birds trapped	mean age at trapping / days
63 or less	24	253
64	72	256
65	1	297
66	1	346
67	1	349
68	1	270
69	66	237
70 or more	23	199
	total = 771	

- (b) (i) Explain why wing length is an example of continuous variation.

.....
.....
.....
..... [2]

- (ii) Suggest a feature of reed warblers, **other than wing length**, that shows continuous variation.

..... [1]



- (c) The researchers concluded that reed warblers with a wing length of 66-67 mm had the best chance of survival.

(i) Describe the evidence from Table 5.1 that supports this conclusion.

.....

.....

.....

.....

.....

.....

.....

..... [4]

(ii) The researchers also suggested that more evidence was needed to make this conclusion.

Suggest what other evidence would show that birds with wings 66-67 mm in length have the best chance of survival.

.....

.....

.....

.....

.....

..... [3]

Y



- (d) Scientists have discovered that genes are responsible for wing length in reed warblers. The most common length of wing has been 66-67 mm for many generations of these birds.

Explain how natural selection may be responsible for maintaining the mean wing length of reed warblers at 66-67 mm.

.....

.....

.....

.....

.....

.....

.....

.....

..... [4]

[Total: 17]

Aitchison



Answers

The length of time between ringing and trapping was recorded for each bird that was identified before it was released.

The mean age at trapping was calculated for birds with each wing length.

The results are shown in Table 5.1.

Table 5.1

wing length at ringing / mm	number of birds trapped	mean age at trapping / days
63 or less	24	253
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68	1	270
69	66	237
70 or more	23	199
	total = 771	

- (b) (i) Explain why wing length is an example of continuous variation.

It is a quantitative feature. The characteristic is influenced by the environment and genotype. Wing length is a quantity found between two extremes. [2]

- (ii) Suggest a feature of reed warblers, **other than wing length**, that shows continuous variation.

Body mass [1]



- (c) The researchers concluded that reed warblers with a wing length of 66-67 mm had the best chance of survival.

- (i) Describe the evidence from Table 5.1 that supports this conclusion.

Largest number of birds trapped were.....
from this wingspan. These birds had the.....
highest mean age (346-349 being the.....
mean age which is much higher than.....
other wingspans).
.....
.....
.....

[4]

- (ii) The researchers also suggested that more evidence was needed to make this conclusion.

Suggest what other evidence would show that birds with wings 66-67 mm in length have the best chance of survival.

Knowing the wing length of birds that died.....
Knowing the wing lengths of birds that.....
breed. Knowing the number of times each.....
bird is trapped.
.....
.....
.....

[3]



- (d) Scientists have discovered that genes are responsible for wing length in reed warblers. The most common length of wing has been 66-67 mm for many generations of these birds.

Explain how natural selection may be responsible for maintaining the mean wing length of reed warblers at 66-67 mm.

Birds with wing length of 66-67 mm survive longer. The birds breed and have offspring. The allele for wing length is passed on. Birds with smaller and larger wing lengths die and their alleles aren't carried forward

[4]

[Total: 17]



Fig. 4.2 shows a cactus plant.

Both plants live in very dry conditions.

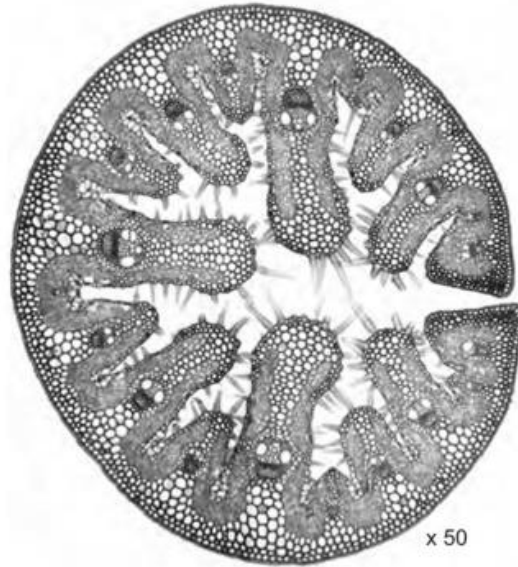


Fig. 4.1

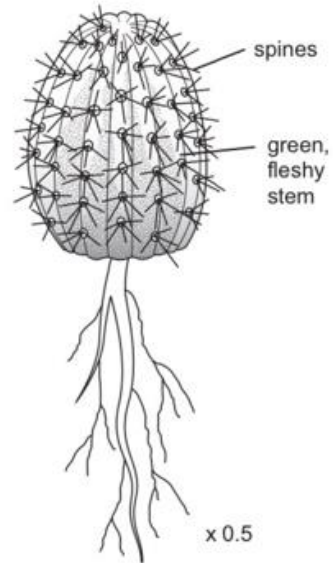


Fig. 4.2

(a) Suggest how each of the following adaptations would enable the named plant to survive in very dry conditions.

(i) *Ammophila*

1. rolled leaves with stomata on the inside of the leaf

This reduces air movement and wind effect. Transpired water vapour remains trapped inside. Humidity increases inside [2]

2. thick waxy cuticle on the outside of the leaf

It prevents evaporation of water from leaf

[1]



Chapter 19: Organisms And Their Environment

19 Organisms and their environment

19.1 Energy flow

Core

- 1 State that the Sun is the principal source of energy input to biological systems
- 2 Describe the flow of energy through living organisms, including light energy from the Sun and chemical energy in organisms, and its eventual transfer to the environment

Supplement

19.2 Food chains and food webs

Core

- 1 Describe a food chain as showing the transfer of energy from one organism to the next, beginning with a producer
- 2 Construct and interpret simple food chains
- 3 Describe a food web as a network of interconnected food chains and interpret food webs
- 4 Describe a producer as an organism that makes its own organic nutrients, usually using energy from sunlight, through photosynthesis
- 5 Describe a consumer as an organism that gets its energy by feeding on other organisms
- 6 State that consumers may be classed as primary, secondary, tertiary and quaternary according to their position in a food chain
- 7 Describe a herbivore as an animal that gets its energy by eating plants
- 8 Describe a carnivore as an animal that gets its energy by eating other animals
- 9 Describe a decomposer as an organism that gets its energy from dead or waste organic material
- 10 Use food chains and food webs to describe the impact humans have through overharvesting of food species and through introducing foreign species to a habitat
- 11 Draw, describe and interpret pyramids of numbers and pyramids of biomass
- 12 Discuss the advantages of using a pyramid of biomass rather than a pyramid of numbers to represent a food chain
- 13 Describe a trophic level as the position of an organism in a food chain, food web or ecological pyramid

Supplement

- 15 Draw, describe and interpret pyramids of energy
- 16 Discuss the advantages of using a pyramid of energy rather than pyramids of numbers or biomass to represent a food chain

continued



19.2 Food chains and food webs continued

Core

- 14 Identify the following as the trophic levels in food webs, food chains and ecological pyramids: producers, primary consumers, secondary consumers, tertiary consumers and quaternary consumers

Supplement

- 17 Explain why the transfer of energy from one trophic level to another is often not efficient
- 18 Explain, in terms of energy loss, why food chains usually have fewer than five trophic levels
- 19 Explain why it is more energy efficient for humans to eat crop plants than to eat livestock that have been fed on crop plants

19.3 Nutrient cycles

Core

- 1 Describe the carbon cycle, limited to: photosynthesis, respiration, feeding, decomposition, formation of fossil fuels and combustion

Supplement

- 2 Describe the nitrogen cycle with reference to:
- decomposition of plant and animal protein to ammonium ions
 - nitrification
 - nitrogen fixation by lightning and bacteria
 - absorption of nitrate ions by plants
 - production of amino acids and proteins
 - feeding and digestion of proteins
 - deamination
 - denitrification
- 3 State the roles of microorganisms in the nitrogen cycle, limited to: decomposition, nitrification, nitrogen fixation and denitrification (generic names of individual bacteria, e.g. *Rhizobium*, are **not** required)



College

19.4 Populations

Core

- 1 Describe a population as a group of organisms of one species, living in the same area, at the same time
- 2 Describe a community as all of the populations of different species in an ecosystem
- 3 Describe an ecosystem as a unit containing the community of organisms and their environment, interacting together
- 4 Identify and state the factors affecting the rate of population growth for a population of an organism, limited to food supply, competition, predation and disease
- 5 Identify the lag, exponential (log), stationary and death phases in the sigmoid curve of population growth for a population growing in an environment with limited resources
- 6 Interpret graphs and diagrams of population growth

Supplement

- 7 Explain the factors that lead to each phase in the sigmoid curve of population growth, making reference, where appropriate, to the role of limiting factors



Notes

Energy flow

- The Sun is the main source of energy input to all biological systems.
- The energy from the Sun is captured as light energy in plants, which are then eaten by animals who store energy in the form of chemical energy. These animals are eaten by other animals and then eventually these other animals also die and are decomposed by bacteria after which their energy is released to the environment.
- The transfer of energy in this way from one organism to another, is known as a food chain and it always begins with a producer (an organism that can produce food).
- Multiple food chains together are called a food web.

Food Chains

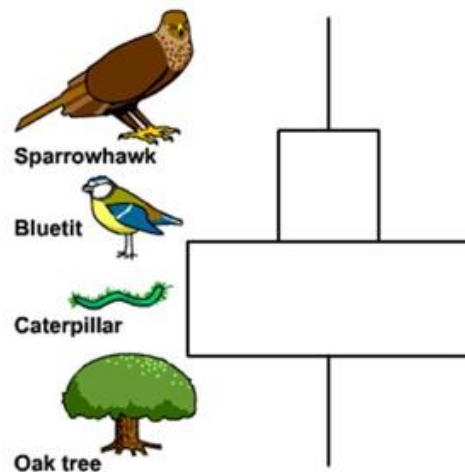
- A producer is an organism that makes its own organic nutrients (usually using energy from sunlight) through photosynthesis.
- A consumer is an organism that gets its energy by feeding on other organisms.
- Consumers can be called primary, secondary, tertiary or quaternary based on their position in the food chain.
- Primary consumers are the ones that eat plants such as the deer above; secondary consumers then eat primary consumers; tertiary consumers then eat secondary consumers; quaternary consumers then eat tertiary consumers.
- A herbivore is an animal that gets its energy by eating plants.
- A carnivore is an animal that gets its energy by eating other animals.
- A decomposer is an organism that gets its energy from dead or waste organic material.
- All herbivores are primary consumers and most decomposers are bacteria.
- We can use food chains/webs to see the impacts of overharvesting, which reduces the number of producers in the food chain or of adding a new species to a habitat, which reduces the food for other species already in the habitat.

Pyramid of numbers and biomass

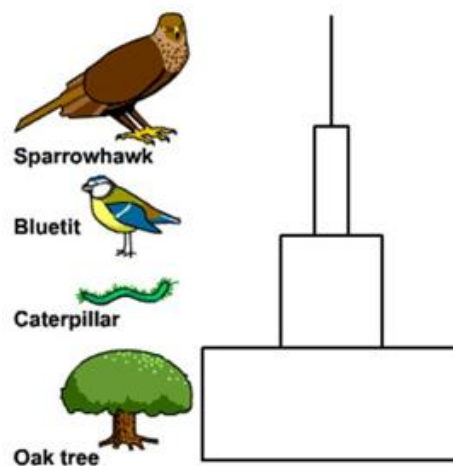


- A pyramid of numbers shows the numbers of organisms in a habitat, starting from the producers at the bottom to the primary consumers above them and so on until the end of the food chain is reached.
- A pyramid of biomass (total mass of living material) does the exact same thing but with biomass instead of numbers.
- Imagine the food chain Oak Tree → Caterpillar → Bluetit → Sparrowhawk. The pyramid of numbers and of biomass are shown below for this food chain.

Pyramid of number



Pyramid of biomass



- The pyramid of numbers may not always be shaped like a regular pyramid but the pyramid of biomass will always be since the total mass of organisms will continuously decrease from bottom to top.

Pyramid of Energy

- A trophic level is the position of an organism in a food chain, food web or ecological pyramid.
- The trophic levels are producer, primary consumer, secondary consumer, tertiary consumer and quaternary consumer.

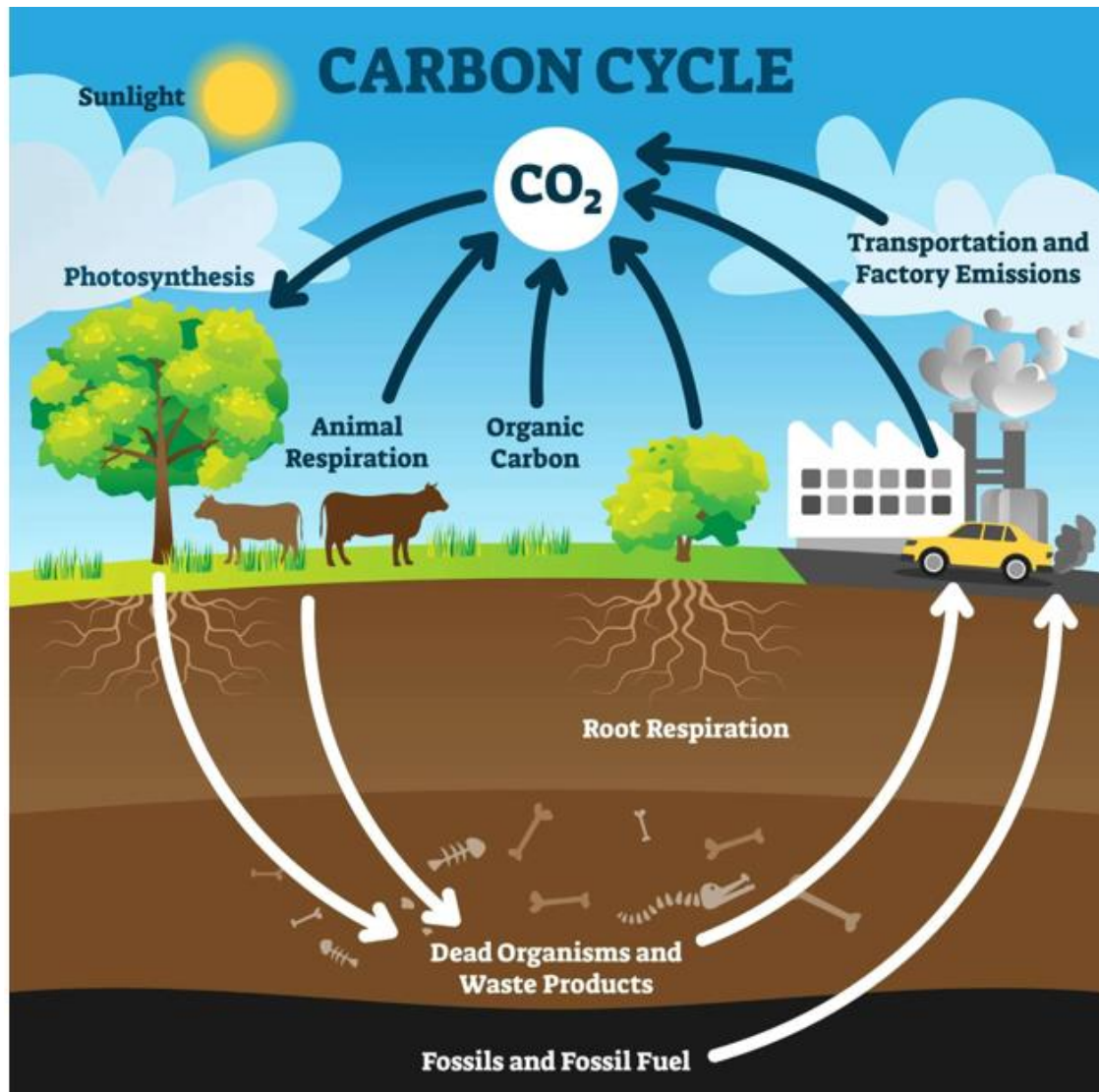


- The pyramid of energy has a number of advantages compared to the pyramid of numbers and biomass.

- It shows the energy transfer between trophic levels and the role of primary producers in capturing energy.
- The pyramid of energy considers all energy sources, including solar energy and energy from decomposers.
- It takes into account the rate of production over a given period of time.
- There are no inverted pyramids like the pyramid of numbers may have.

Nutrient Cycles

- There are two nutrient cycles in the IGCSE Biology syllabus: the carbon cycle and the nitrogen cycle.



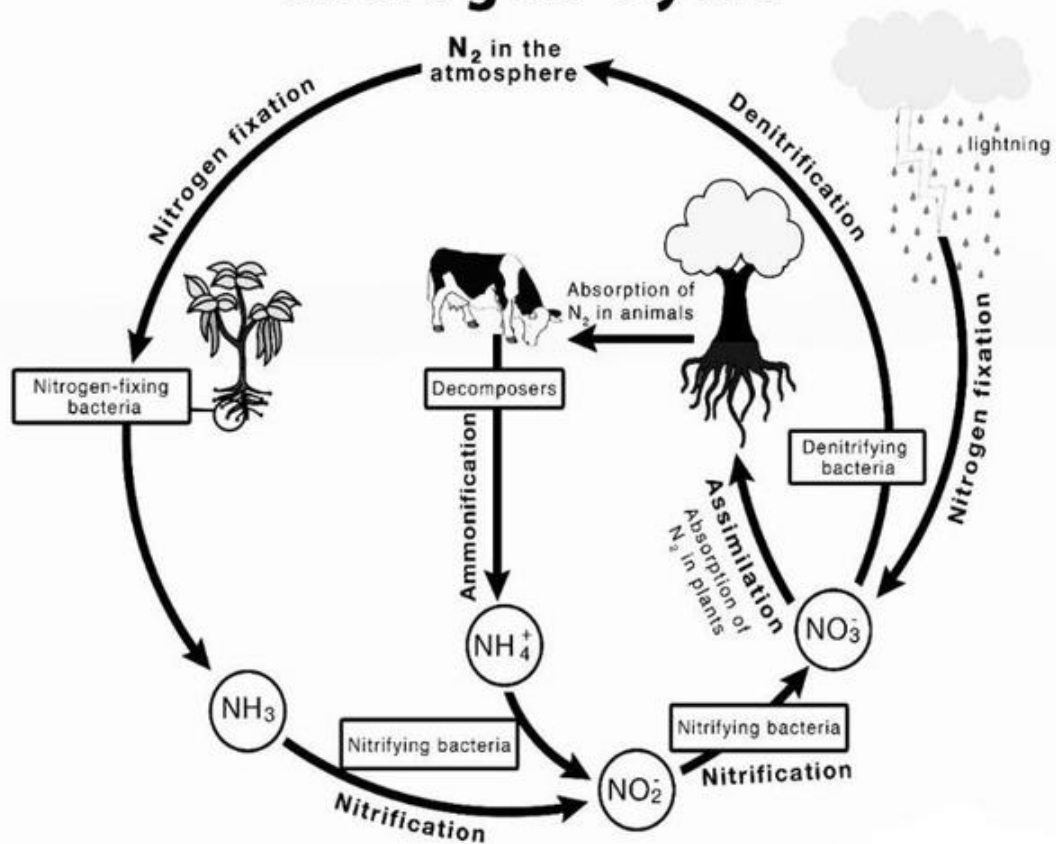


Carbon Cycle

- Carbon is a very important part of living things. It is used to make proteins, fats and carbohydrates.
- About 0.04% of the air is CO₂. When plants photosynthesize some carbon dioxide is used up and carbon atoms from CO₂ become part of glucose and starch molecules.
- Some glucose is broken down by plants in respiration. The carbon molecules used in photosynthesis again become part of atmospheric CO₂.
- Some carbon-containing compounds are eaten by animals, who then also respire.
- Decomposers also feed on waste materials and use carbon nutrients from them. They respire and release some in the air as CO₂.
- Decomposers may not break up all dead animals. Instead, these become buried in layers. Over very long periods of time they become fossil fuels in the form of coal, oil and natural gas.
- These fossil fuels are burnt in air and undergo combustion. A word can also come by. They form carbon dioxide, which is released to the air again.



Nitrogen Cycle





Nitrogen Cycle

- To make proteins, living organisms also need nitrogen. The air is 78% N_2 so there is plenty of Nitrogen around.
- However, they are very inert so they do not normally react and are unable to be used.
- First, nitrogen needs to be changed to a reactive form such as NH_3 or NO_3^- . This process is known as nitrogen fixation and this can happen in several ways.
- Lightning makes some nitrogen gas in the air combine with oxygen, forming nitrogen oxides. They dissolve in rain and are washed into the soil forming nitrates.
- Artificial fertilizers can be made, such as ammonia. Nitrogen and hydrogen can be used to make ammonia in the Haber's process, which may then be used to make nitrates.
- Nitrogen fixing bacteria in soil or root nodules use nitrogen gas from the air spaces in soil and combine it with other substances to make ammonium ions and other compounds.
- Once the nitrogen has been fixed, plants use it to make proteins. Animals eat plants, so they eat proteins from them.
- When an animal or plant dies, decomposers decompose the body. The proteins are converted to ammonium ions and released.
- A group of bacteria, called nitrifying bacteria, turns these ions into nitrates in a process called nitrification. Nitrogen is also returned when animals excrete nitrogenous waste material like urea, which they have produced after the deamination of excess amino acids. This is also converted to nitrates by nitrifying bacteria.
- A third group of bacteria, called denitrifying bacteria, undo the work done by nitrifying bacteria. They turn nitrates and ammonia in the soil to nitrogen gas in a process called denitrification, thus completing the nitrogen cycle.

Populations

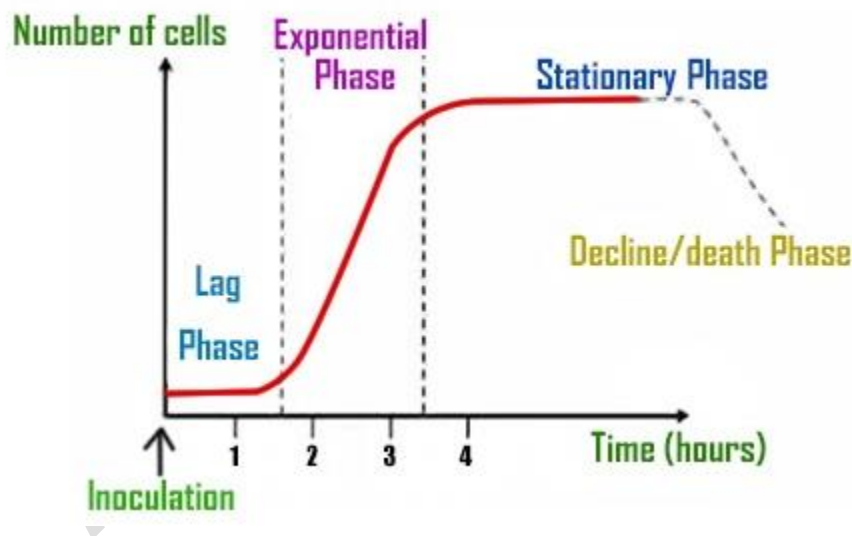
- A population is a group of organisms of one species living together in the same area at the same time.
- A community is all of the populations of different species in an ecosystem living together.



- An ecosystem is a unit containing the community of organisms and their environment, interacting together.
- Most populations remain the same size over a period of time. They may fluctuate but the average population is unlikely to change.
- The population growth rate depends on a number of factors including food supply, competition, predation and disease. These in turn influence death rate and birth rate, which will decide whether the population grows or decreases.

Sigmoid curve of population growth

- To understand our own population better we can put in organisms such as bacteria and yeast with a container of nutrient broth and count the number every few hours.
- The normal graph that forms when a small amount of organisms is provided with a fixed amount of food, to show population growth, is called a sigmoid growth curve.



- There are four phases of this graph.
 1. **Lag Phase:** In the first hour(or multiple hours depending on the population) the population needs time to adjust to the new conditions and there are not many cells to reproduce so the rate of population growth is very slow or lagged.
 2. **Log(Exponential) Phase:** In the next hour the cells reproduce rapidly and make more of themselves because they have adapted to their surroundings and have sufficient food supplies.



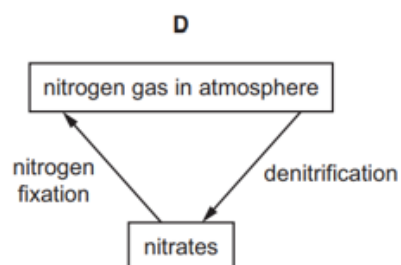
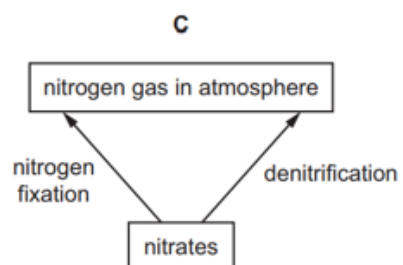
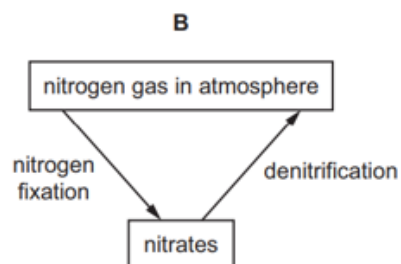
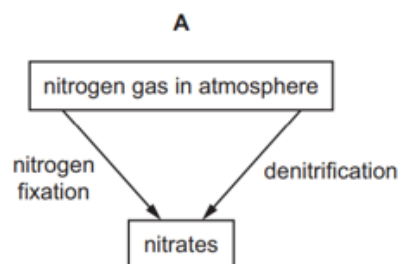
3. **Stationary phase:** The next phase is called the stationary phase. There may not be enough food for the bacteria and they may not be able to reproduce fast enough. Competition for food and increased ethanol production will kill yeast cells as fast as they produce.
4. **Death phase:** the last phase is called the death phase. The death rate overtakes the birth rate and the population starts decreasing because food may be running out or the population may be too large to be sustained.



MCQs

1.

37 Which diagram shows part of the nitrogen cycle?





2.

36 The diagram shows a food chain.

tree → insect → blue tit → hawk

Which statement about a pyramid based on this food chain is correct?

- A Drawn as a pyramid of biomass, the hawk would have the largest bar size.
- B Drawn as a pyramid of energy, the tree would have the largest bar size.
- C Drawn as a pyramid of energy, the tree would have the smallest bar size.
- D Drawn as a pyramid of numbers, the hawk would have the largest bar size.

3.

36 A herd of red deer live in a forest that contains snakes and a large variety of birds.

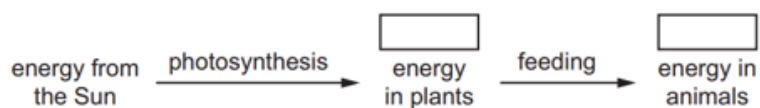
Which group of organisms is an example of a population?

- A all the animals in the forest
- B all the red deer in the forest
- C all the organisms in the forest
- D all the plants in the forest

4.

13

35 The diagram shows the flow of energy through living organisms.



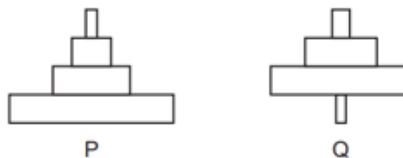
Which term should be placed in both boxes to complete the diagram?

- A chemical
- B heat
- C kinetic
- D light



5.

36 The diagram shows two pyramids based on food chains in which the producer is a large tree.



What do the two pyramids represent?

	P	Q
A	biomass	biomass
B	biomass	numbers
C	numbers	biomass
D	numbers	numbers

6.

38 Which organisms remove nitrate ions from soil?

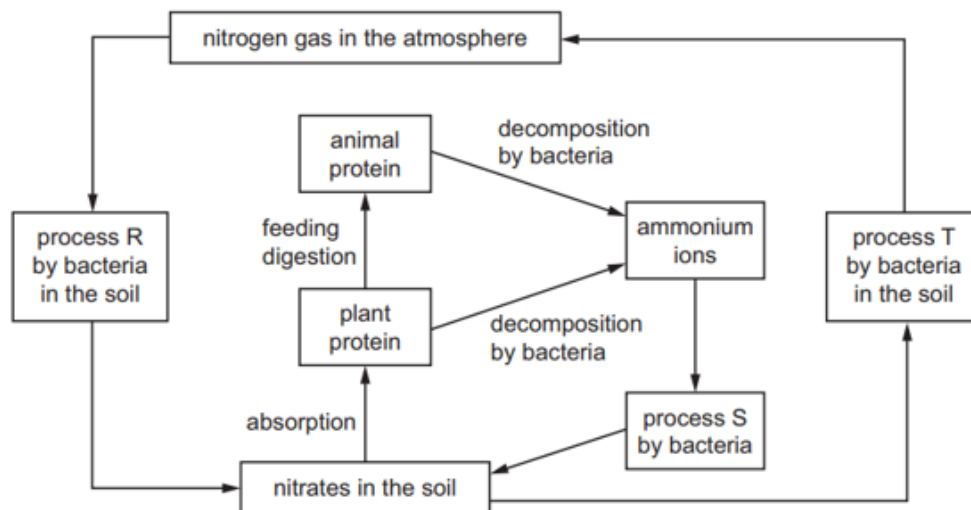
- A denitrifying bacteria and nitrogen-fixing bacteria in root nodules
- B denitrifying bacteria and plants
- C nitrifying bacteria and plants
- D nitrogen-fixing bacteria in root nodules



7.

19

37 The diagram shows part of the nitrogen cycle.



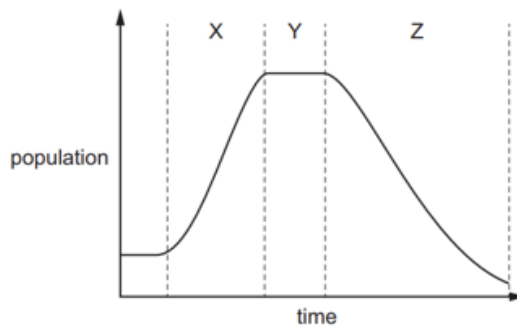
Which row shows the correct processes for R, S and T?

	denitrification	nitrogen fixation	nitrification
A	R	S	T
B	T	S	R
C	T	R	S
D	S	R	T



8.

37 The graph shows the change in population of an organism over time in an ecosystem.



Which row correctly identifies each phase of the population graph?

	X	Y	Z
A	lag	exponential (log)	stationary
B	lag	stationary	death
C	exponential (log)	death	stationary
D	exponential (log)	stationary	death

Answers:

1. B
2. B
3. B
4. A
5. B
6. B
7. C
8. D



Structured Questions

- 2 The human population is growing rapidly. This is increasing the pressure on the world food supply.

(a) Name the rapid growth phase of any population of organisms.

[1]

In Canada farmers are breeding fish in large nets because the wild stocks of fish are decreasing. Fig. 6.1 is a diagram of a salmon fish farm in the ocean. The salmon only eat the food provided by the worker.

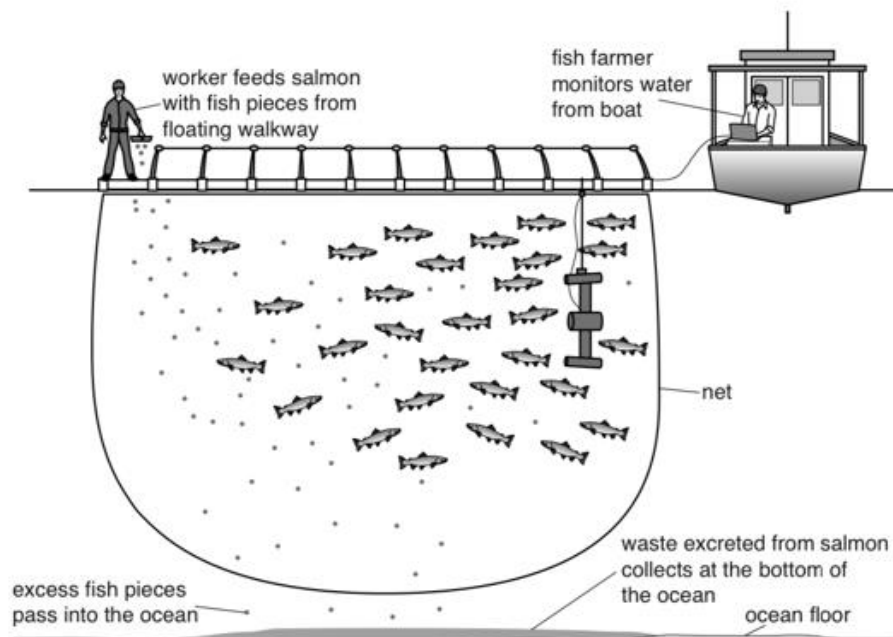


Fig. 6.1



- (b) Explain the effects of the excess fish pieces and waste excreted from the salmon on the environment.

.....

.....

.....

.....

.....

.....

..... [3]

- (c) State the lowest possible trophic level of the salmon shown in Fig. 6.1.

..... [1]

- (d) Other farmers grow seaweed. Salmon farming is a less energy efficient way of producing food for humans than seaweed farming.

Explain why.

.....

.....

.....

.....

.....

.....

..... [3]

[Total: 8]





- 4 Fig. 1.1 shows the change in the biomass of the fungus *Penicillium* when grown in a fermenter to produce the antibiotic penicillin.

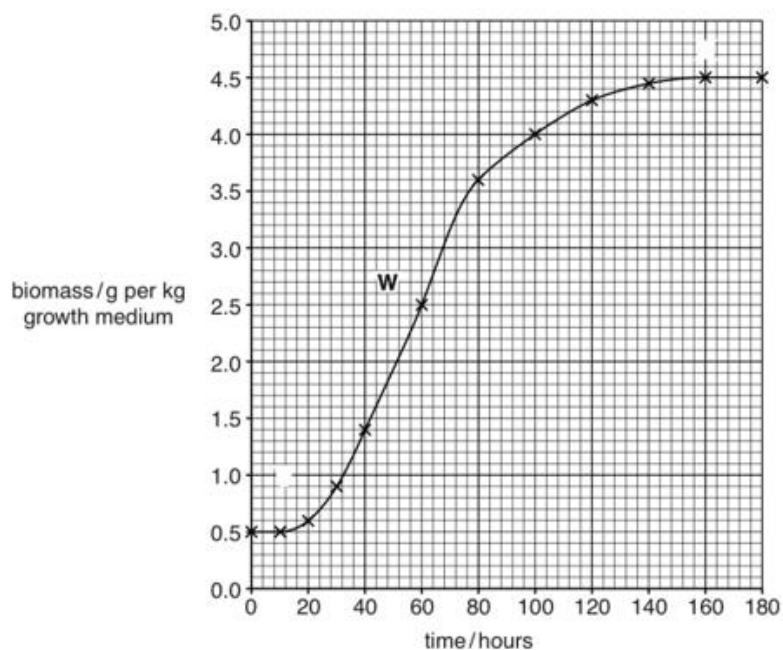


Fig. 1.1

- (a) Name the stages in the growth of *Penicillium* indicated by V, W and X.

V

W

X [3]

- (b) State **two** factors that are kept constant when *Penicillium* is grown in a fermenter.

1

2 [2]

- (c) Suggest why the growth of *Penicillium* is measured in biomass rather than numbers of cells.

.....

..... [1]

[Total: 6]



- 4 Marine conservationists are concerned that fish stocks in the sea are decreasing. Drastic measures will have to be taken to stop the extinction of many fish species.

Fig. 5.1 shows a marine food web. Tuna are large carnivorous fish that are an important human food. Dolphins may be caught in fishermen's nets and die.

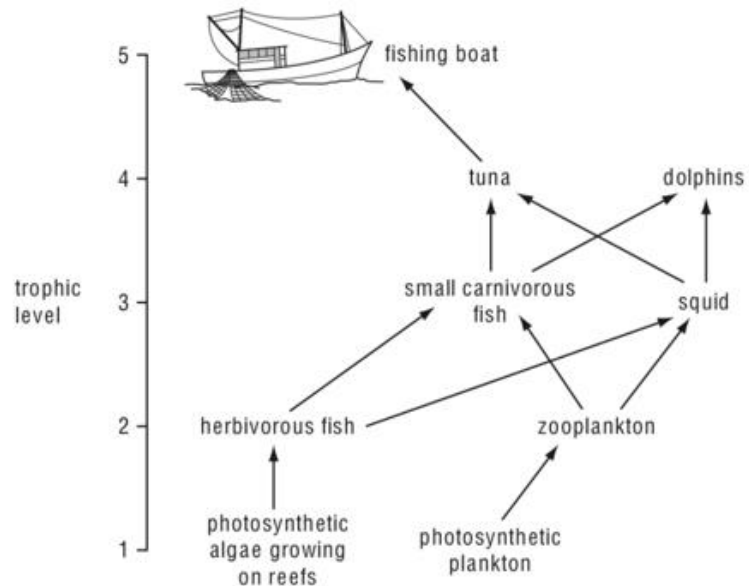


Fig. 5.1

- (a) State the names given to trophic levels 1 and 3.

1
3 [2]



Answers

- 2 The human population is growing rapidly. This is increasing the pressure on the world food supply.
- (a) Name the rapid growth phase of any population of organisms.

Exponential phase..... [1]

In Canada farmers are breeding fish in large nets because the wild stocks of fish are decreasing. Fig. 6.1 is a diagram of a salmon fish farm in the ocean. The salmon only eat the food provided by the worker.

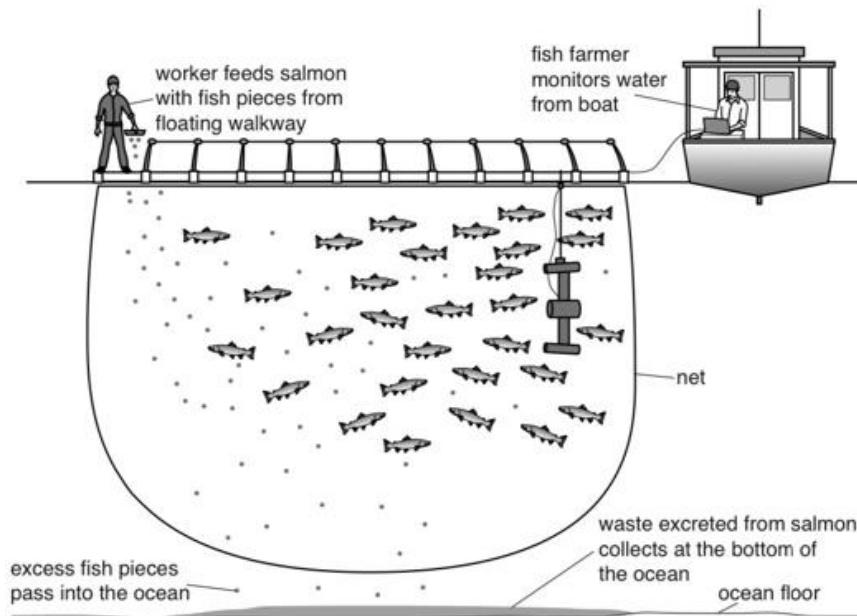


Fig. 6.1



- (b) Explain the effects of the excess fish pieces and waste excreted from the salmon on the environment.

The decomposition of waste by
microorganisms reduces oxygen available.
This contributes to an algae bloom, resulting
in the death of aquatic plants and animals

[3]

- (c) State the lowest possible trophic level of the salmon shown in Fig. 6.1.

Secondary consumer [1]

- (d) Other farmers grow seaweed. Salmon farming is a less energy efficient way of producing food for humans than seaweed farming.

Explain why.

Seaweed is at a lower trophic level than
salmon. Energy is lost in between trophic
levels. Energy is lost in movement and
muscle contraction. This altogether makes
salmon farming a less efficient method

[3]

[Total: 8]



- 4 Fig. 1.1 shows the change in the biomass of the fungus *Penicillium* when grown in a fermenter to produce the antibiotic penicillin.

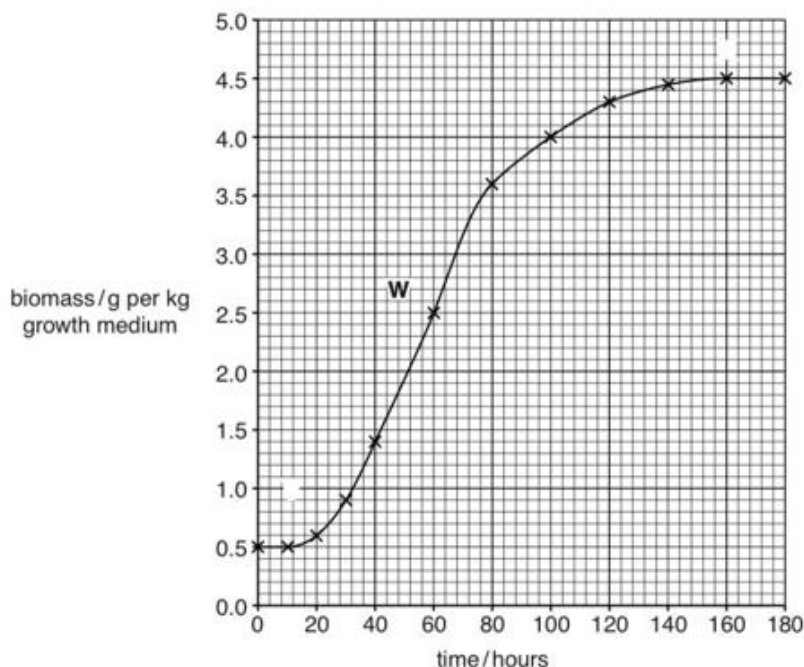


Fig. 1.1

- (a) Name the stages in the growth of *Penicillium* indicated by V, W and X.

v Lag phase

w Log phase

x Stationary phase

[3]

- (b) State **two** factors that are kept constant when *Penicillium* is grown in a fermenter.

1 Temperature

2 pH

[2]

- (c) Suggest why the growth of *Penicillium* is measured in biomass rather than numbers of cells.

Measuring mass is a more accurate method

[1]

[Total: 6]



- 4 Marine conservationists are concerned that fish stocks in the sea are decreasing. Drastic measures will have to be taken to stop the extinction of many fish species.

Fig. 5.1 shows a marine food web. Tuna are large carnivorous fish that are an important human food. Dolphins may be caught in fishermen's nets and die.

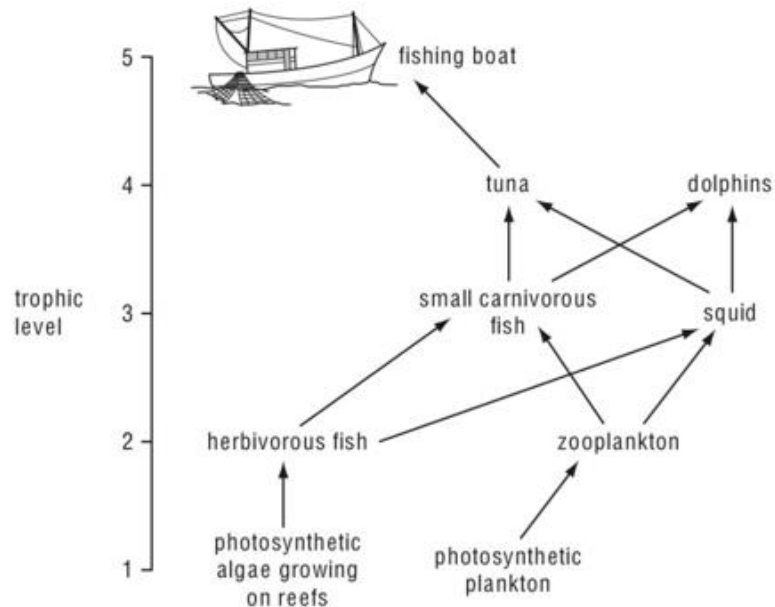


Fig. 5.1

- (a) State the names given to trophic levels 1 and 3.

- 1 Producer
3 Secondary level consumer [2]



Chapter 20: Human influences on ecosystems

20 Human influences on ecosystems

20.1 Food supply

Core

- 1 Describe how humans have increased food production, limited to:
 - (a) agricultural machinery to use larger areas of land and improve efficiency
 - (b) chemical fertilisers to improve yields
 - (c) insecticides to improve quality and yield
 - (d) herbicides to reduce competition with weeds
 - (e) selective breeding to improve production by crop plants and livestock
- 2 Describe the advantages and disadvantages of large-scale monocultures of crop plants
- 3 Describe the advantages and disadvantages of intensive livestock production

Supplement



20.2 Habitat destruction

Core

- 1 Describe biodiversity as the number of different species that live in an area
- 2 Describe the reasons for habitat destruction, including:
 - (a) increased area for housing, crop plant production and livestock production
 - (b) extraction of natural resources
 - (c) freshwater and marine pollution
- 3 State that through altering food webs and food chains, humans can have a negative impact on habitats
- 4 Explain the undesirable effects of deforestation as an example of habitat destruction, to include: reducing biodiversity, extinction, loss of soil, flooding and increase of carbon dioxide in the atmosphere

Supplement

20.3 Pollution

Core

- 1 Describe the effects of untreated sewage and excess fertiliser on aquatic ecosystems
- 2 Describe the effects of non-biodegradable plastics, in both aquatic and terrestrial ecosystems
- 3 Describe the sources and effects of pollution of the air by methane and carbon dioxide, limited to: the enhanced greenhouse effect and climate change

Supplement

- 4 Explain the process of eutrophication of water, limited to:
 - increased availability of nitrate and other ions
 - increased growth of producers
 - increased decomposition after death of producers
 - increased aerobic respiration by decomposers
 - reduction in dissolved oxygen
 - death of organisms requiring dissolved oxygen in water



20.4 Conservation

Core

- 1 Describe a sustainable resource as one which is produced as rapidly as it is removed from the environment so that it does not run out
- 2 State that some resources can be conserved and managed sustainably, limited to forests and fish stocks
- 3 Explain why organisms become endangered or extinct, including: climate change, habitat destruction, hunting, overharvesting, pollution and introduced species
- 4 Describe how endangered species can be conserved, limited to:
 - (a) monitoring and protecting species and habitats
 - (b) education
 - (c) captive breeding programmes
 - (d) seed banks

Supplement

- 5 Explain how forests can be conserved using: education, protected areas, quotas and replanting
- 6 Explain how fish stocks can be conserved using: education, closed seasons, protected areas, controlled net types and mesh size, quotas and monitoring
- 7 Describe the reasons for conservation programmes, limited to:
 - (a) maintaining or increasing biodiversity
 - (b) reducing extinction
 - (c) protecting vulnerable ecosystems
 - (d) maintaining ecosystem functions, limited to nutrient cycling and resource provision, including food, drugs, fuel and genes
- 8 Describe the use of artificial insemination (AI) and *in vitro* fertilisation (IVF) in captive breeding programmes
- 9 Explain the risks to a species if its population size decreases, reducing genetic variation (knowledge of genetic drift is **not** required)



Notes

Food Supply:

Increases in human food supply are due to:

Use of machinery: more efficient use of time, larger land employed and overall efficiency

Chemical fertilisers: increase amount of nutrients in soil, plants can grow faster and better and increased food yield

Insecticides and Herbicides: kill off insects and weeds respectively

Selective breeding: animals and crops which produce a large yield are selectively bred to produce a large number of organisms with high yield

Monoculture:

- Only one species of crop is grown in a selective area continuously.
- This can lead to lower food prices, increased yield and reduced labour costs.
- However, the crop will be more prone to devastation by natural disaster, pest attack and increased chance of resistance of pests to the crop. Also reduces biodiversity

Intensive Farming:

- Intensive crop farming involves use of monocultures. Intensive livestock farming is employed for animals by keeping them in high density and restricting their movement. High antibiotic doses are given to prevent disease
- It isn't sustainable. It can cause welfare issues for livestock. If disease does break out, it spreads quickly and animal waste can contribute significantly to pollution.

Habitat Destruction:

Biodiversity: number of different species that live in an area

Due to human activities (economic, pollution), biodiversity is decreasing in many areas

Causes of habitat destruction:

Clearing of land for farming and housing, demands are ever increasing and more land is needed

Extraction of natural resources

Marine pollution

Deforestation:



Cutting down trees in large amounts to gather resources.

Deforestation has several negative effects:

Extinction and reduced biodiversity, species go extinct with less shelter and food

Soil erosion, without roots to hold soil, is carried away by wind and rain causing decreased soil fertility.

Flooding, trees slow down water flow. Without trees, water moves swifter and thereby also increases erosion

Increased carbon dioxide, with fewer trees less carbon dioxide is absorbed and more is present in the atmosphere. Contributing to global warming

Pollution:

- Land, water and air pollution are all caused by human activity
- Raw sewage can be passed onto water bodies, chemicals can spread through the water, endangering aquatic life and drastically reducing water quality

Pollution due to pesticides:

- Insecticides can kill other useful insects such as bees and pollinators.
- Herbicides are harmful to animals which eat the plants on which they are sprayed.

Herbicides can get washed into streams and kill aquatic organisms

Non-biodegradable plastics:

- Choke animals such as birds and fish
- Fill up animal stomachs, leaving little space for actual food

Eutrophication:

- Fertilisers are washed from fields into streams, thus increased nutrients in waterways
- Plants grow rapidly and algae bloom caused
- Algae covers the surface of water, preventing sunlight from passing through and decreased photosynthesis, thus killing them off
- Less oxygen released into water, dead plants broken down by decomposes which use up a lot of the oxygen present in the water
- The lack of oxygen in the water kills fish and other animals

Air pollution:

- Main pollutants are methane and carbon dioxide
- Mostly due to fossil fuel burning



- Increased amounts of these greenhouse gasses cause global warming and overall temperature increase

Conservation:

Sustainable resources: resources which can be produced as quickly as they are diminished and don't run out.

Forestry:

- Education
- Demarcation of protected areas
- Replanting of trees in deforested areas
- Implementation of laws on logging companies and amount of forest cut

Fishing:

- Education
- Closed season during breeding
- Protected areas
- Controlled net size and mesh size
- Quotas implementation

Fossil fuels are a nonrenewable resource and thus their use must be regulated to prevent them from running out entirely

Species extinction prevention:

- Monitoring of the animals left
- Education on why an animal is going extinct and how it can be prevented
- Captive breeding, animals held in captivity and bred to increase their numbers and later reintroduced to the wild once population is stable
- Seed banks used, seeds from endangered plant species are preserved for future Generations

Artificial insemination:

- Sperm collected and inserted into female reproductive system
- Sperm is placed at the appropriate time when fertilisation is most likely and around the time of ovulation, thus increased chance of conception

In Vitro fertilisation:

- Fertilisation of egg outside the female body



- Eggs are collected from female body and fused with sperm in a lab
- The fertilised embryo is then transferred into the female uterus

Reasons for conservation:

- Increasing biodiversity
- Reduced extinction risk
- Protection of vulnerable ecosystems
- Maintenance of human demand which is exploited through the environment

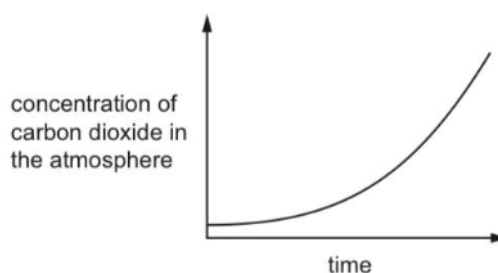
MCQ's:

1.

Three human activities are listed.

- 1 burning fossil fuels
- 2 deforestation
- 3 overusing fertilisers

Which activities can cause the change shown in the graph?



- A** 1, 2 and 3 **B** 1 and 2 only **C** 1 only **D** 2 and 3 only

2.

What is a reason for conserving plant species?

- A to absorb oxygen from the air
- B to decrease rainfall
- C to obtain drugs for medicinal use
- D to release carbon dioxide into the air

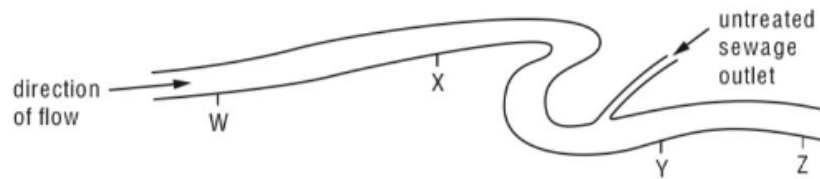


What is **reduced** after deforestation?

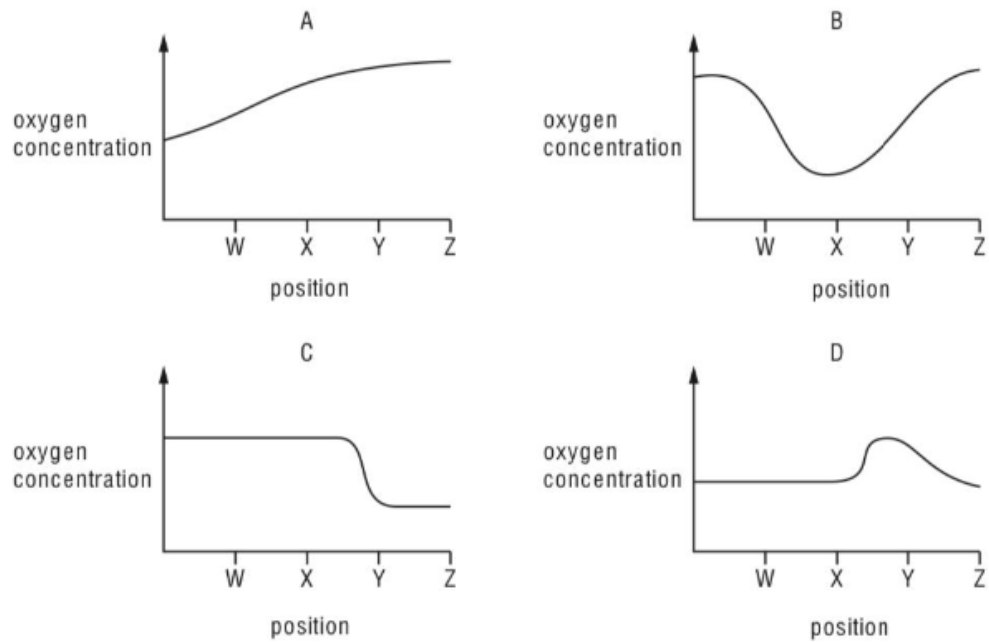
- A force of rain hitting the ground
- B rainwater run-off
- C soil erosion
- D soil fertility

4.

The diagram shows four positions on a river where water samples were taken.



Which graph shows oxygen concentrations in the river?





Over-use of fertilisers on farmland causes the chemicals in the fertilisers to be washed into ponds and lakes.

This causes eutrophication resulting in the following events.

- 1 algae grow
- 2 fish die
- 3 bacteria grow
- 4 oxygen decreases

What is the correct sequence of these events?

- A** 1 → 3 → 4 → 2
B 1 → 4 → 3 → 2
C 3 → 4 → 2 → 1
D 4 → 1 → 2 → 3

6.

What is reduced when untreated sewage is released into rivers?

- A** the amount of nitrate
B the concentration of carbon dioxide
C the concentration of oxygen
D the number of bacteria

7.

Which pollutants of water can lead to eutrophication?

	fertilisers	herbicides	insecticides	sewage
A	✓	✓	x	x
B	✓	x	x	✓
C	x	✓	✓	x
D	x	x	✓	✓



What are the possible effects of deforestation?

	loss of soil	flooding	decrease in atmospheric carbon dioxide
A	✓	✓	✗
B	✓	✗	✓
C	✗	✓	✗
D	✗	✗	✓

9.

Which agricultural activity can cause the most pollution?

- A** adding artificial fertilisers
- B** cutting down trees
- C** digging plant material into the soil
- D** growing high-yielding crops

10.

Untreated sewage can cause pollution of streams and rivers. Some changes in streams and rivers after sewage is added are shown.

- 1 fish die
- 2 the dissolved oxygen in the water decreases
- 3 the number of anaerobic organisms increases
- 4 the number of bacteria increases

What gives the order in which these events occur?

- A** 1 → 2 → 4 → 3
- B** 1 → 4 → 3 → 2
- C** 2 → 1 → 4 → 3
- D** 4 → 2 → 1 → 3



Answers:

1 B

2 C

3 D

4 C

5 A

6 C



7 B

8 A

9 A

10 D

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Structured Questions

Fig. 5.1 shows the total mass of wild fish caught worldwide between 1950 and 2012 and the mass of farmed fish produced worldwide over the same period.

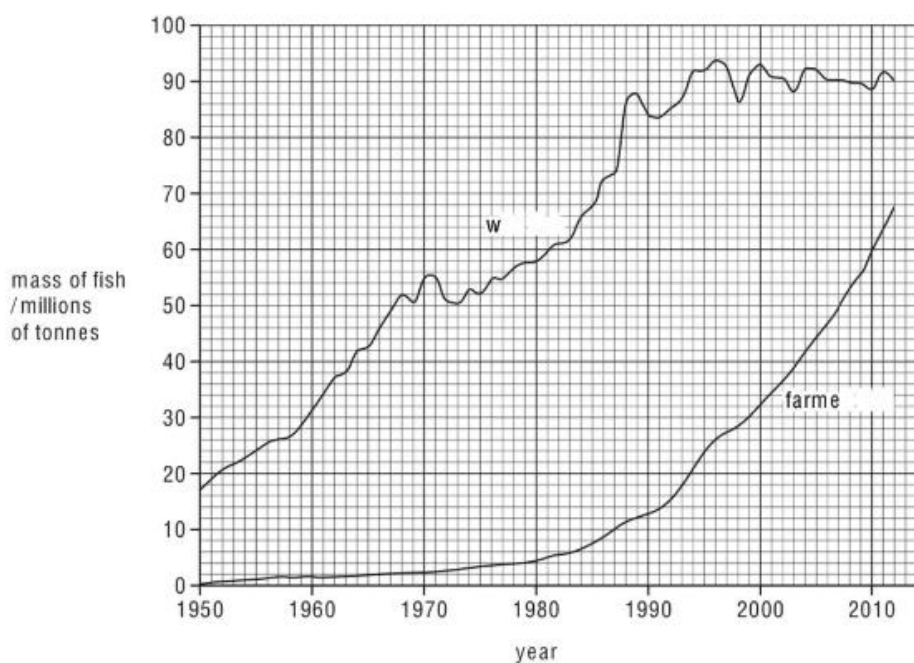


Fig. 5.1

(b) Describe the changes in the mass of **wild fish** caught between 1950 and 2012.

You will gain credit if you use data from Fig. 5.1.

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[3]



- (c) It is predicted that wild fish stocks will decrease and become depleted because of overfishing.

Suggest ways in which governments can try to maintain the stocks of wild fish.

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[6]

- (d) Like fish stocks, forests can be a sustainable resource.

Discuss what is meant by the term *sustainable resource*, using forests as an example.

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[3]



- 2 Fig. 5.1 shows an area of forest where some of the trees have been cut down.

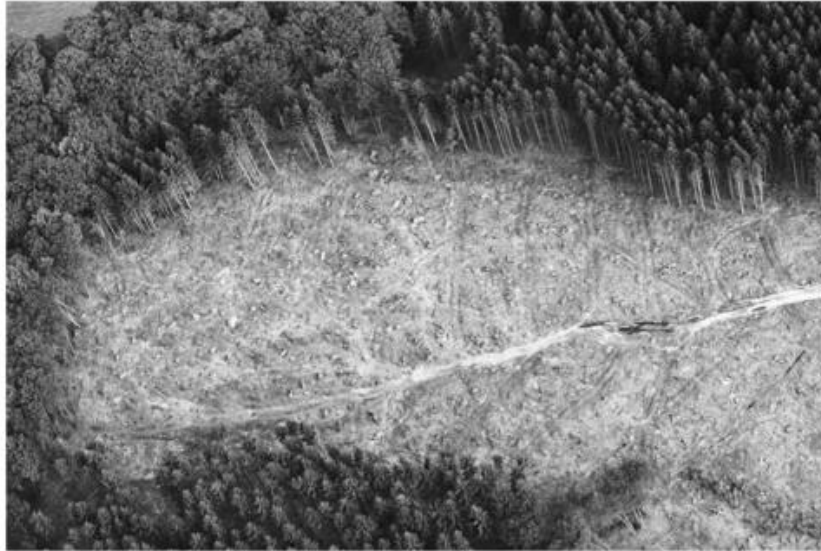


Fig. 5.1

- (a) Explain the reasons why forests may be cut down as shown in Fig. 5.1.

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[3]



- (b) The loss of forests from parts of the world is assessed by satellite imagery. Table 5.1 shows data on the forests in Indonesia and Malaysia, two countries in South-East Asia which have large areas of forest.

Table 5.1

country	type of forest	area / thousands of hectares			
		1990	2000	2005	2010
Indonesia	natural forest	118 545	95 737	94 158	90 883
Malaysia	natural forest	20 420	19 932	19 317	18 649

- (i) Calculate the percentage loss of natural forest in Indonesia between 1990 and 2010. Show your working and express your answer to the nearest whole number.

..... % [3]

- (ii) Use the data in Table 5.1 to compare the loss of natural forest in Indonesia with the loss of natural forest in Malaysia.

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[3]



- (iii) Many hectares of natural forest have been cleared in countries such as Malaysia and Indonesia for oil palm plantations. Both countries have also replanted forests to grow timber and other forest products.

Suggest why replanted forests and plantations are **less** useful for conservation than natural forest.

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[3]

- (c) Discuss the effects of deforestation on areas of land.

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[6]

[Total: 18]



Answers

- (c) It is predicted that wild fish stocks will decrease and become depleted because of overfishing.

Suggest ways in which governments can try to maintain the stocks of wild fish.

Use of quotas and international agreements

Restricted fish catching times

Education and monitoring of fish populations

Encouragement of fish farming

Heavy fines for illegal and overfishing

[6]

- (d) Like fish stocks, forests can be a sustainable resource.

Discuss what is meant by the term *sustainable resource*, using forests as an example.

Resource that is produced as fast as it depletes

Resource doesn't run out

For forests, replanting and coppicing should be done

[3]



- 2 Fig. 5.1 shows an area of forest where some of the trees have been cut down.

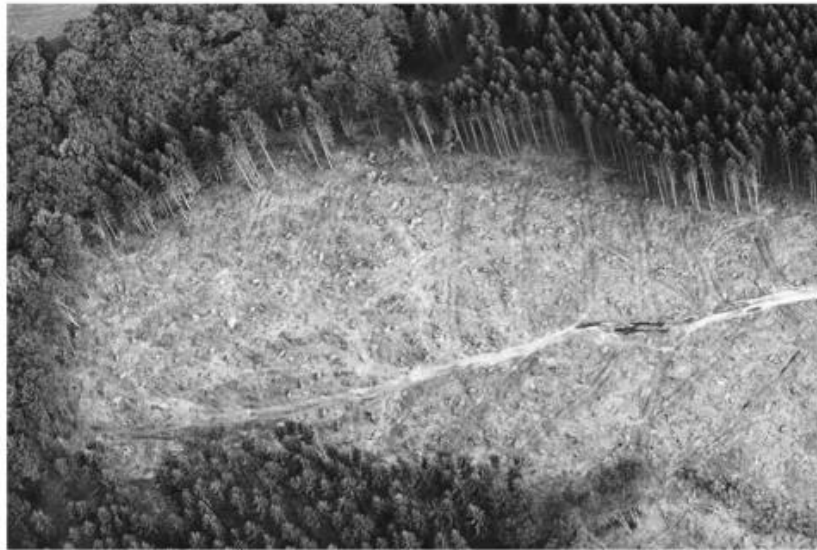


Fig. 5.1

- (a) Explain the reasons why forests may be cut down as shown in Fig. 5.1.

For paper and firewood
Urbanisation, agriculture and
extraction of natural resources are
other reasons

[3]



- (b) The loss of forests from parts of the world is assessed by satellite imagery. Table 5.1 shows data on the forests in Indonesia and Malaysia, two countries in South-East Asia which have large areas of forest.

Table 5.1

country	type of forest	area / thousands of hectares			
		1990	2000	2005	2010
Indonesia	natural forest	118 545	95 737	94 158	90 883
Malaysia	natural forest	20 420	19 932	19 317	18 649

- (i) Calculate the percentage loss of natural forest in Indonesia between 1990 and 2010. Show your working and express your answer to the nearest whole number.

$$118545 - 90883 = 27662$$

$$27662/118545 * 100 = 23.3\%$$

23 % [3]

- (ii) Use the data in Table 5.1 to compare the loss of natural forest in Indonesia with the loss of natural forest in Malaysia.

Indonesia has lost the most forest
23% in Indonesia vs 9% in Malaysia

Indonesian forest continues to be lost.
Malaysian forest loss has slowed btw
2005 and 2010.

[3]



- (iii) Many hectares of natural forest have been cleared in countries such as Malaysia and Indonesia for oil palm plantations. Both countries have also replanted forests to grow timber and other forest products.

Suggest why replanted forests and plantations are **less** useful for conservation than natural forest.

Planted forest has monoculture and
loss of biodiversity

Planted forest more prone to disease
and soil becomes infertile

[3]

- (c) Discuss the effects of deforestation on areas of land.

Roots die, so no binding of soil

Soil erosion

Increased risk of flooding

Loss of habitat

Silting of rivers

Loss of habitat and extinction of species

[6]

[Total: 18]



Chapter 21: Biotechnology and genetic modification



21 Biotechnology and genetic modification

21.1 Biotechnology and genetic modification

Core

- 1 State that bacteria are useful in biotechnology and genetic modification due to their rapid reproduction rate and their ability to make complex molecules

Supplement

- 2 Discuss why bacteria are useful in biotechnology and genetic modification, limited to:
 - (a) few ethical concerns over their manipulation and growth
 - (b) the presence of plasmids



21.2 Biotechnology

Core

- 1 Describe the role of anaerobic respiration in yeast during the production of ethanol for biofuels
- 2 Describe the role of anaerobic respiration in yeast during bread-making
- 3 Describe the use of pectinase in fruit juice production
- 4 Investigate and describe the use of biological washing powders that contain enzymes

Supplement

- 5 Explain the use of lactase to produce lactose-free milk
- 6 Describe how fermenters can be used for the large-scale production of useful products by bacteria and fungi, including insulin, penicillin and mycoprotein
- 7 Describe and explain the conditions that need to be controlled in a fermenter, including: temperature, pH, oxygen, nutrient supply and waste products

21.3 Genetic modification

Core

- 1 Describe genetic modification as changing the genetic material of an organism by removing, changing or inserting individual genes

Supplement

- 3 Outline the process of genetic modification using bacterial production of a human protein as an example, limited to:
 - (a) isolation of the DNA making up a human gene using restriction enzymes, forming sticky ends
 - (b) cutting of bacterial plasmid DNA with the same restriction enzymes, forming complementary sticky ends
 - (c) insertion of human DNA into bacterial plasmid DNA using DNA ligase to form a recombinant plasmid
 - (d) insertion of recombinant plasmids into bacteria (specific details are **not** required)
 - (e) multiplication of bacteria containing recombinant plasmids
 - (f) expression in bacteria of the human gene to make the human protein

continued



21.3 Genetic modification continued

Core

- 2 Outline examples of genetic modification:
 - (a) the insertion of human genes into bacteria to produce human proteins
 - (b) the insertion of genes into crop plants to confer resistance to herbicides
 - (c) the insertion of genes into crop plants to confer resistance to insect pests
 - (d) the insertion of genes into crop plants to improve nutritional qualities

Supplement

- 4 Discuss the advantages and disadvantages of genetically modifying crops, including soya, maize and rice

Notes

Usefulness of Bacteria:

- Bacteria are the most used microorganisms in biotechnology
- Bacteria reproduce very quickly and thus the amount of product they can produce can increase exponentially in a small amount of time
- There are very few ethical considerations involved in using bacteria
- They have plasmids which are ideal for transferring DNA from one cell to another

Biotechnology:

Artificially altering genes in a cell, for the cell to perform a desired function is the process of biotechnology.

Biotechnology involves several different microorganism:

Yeast can respire anaerobically, producing carbon dioxide. Yeast are involved in bread making, as carbon dioxide is formed, bubbles rise up the dough and make it stretch. Ethanol is also produced in the reaction and can be used as a biofuel. Plants are usually used as the substrate, sometimes as crops especially as fuel and sometimes as waste matter. There is a concern that crops that could have been used for food are used as fuel

2. Pectinase is another enzyme which breaks down pectin found in cell walls. Thus the yield of fruit juice is greatly increased. Furthermore, the juice gets more clear as



the pectin makes the juice cloudy and once it gets broken down, the juice becomes clear

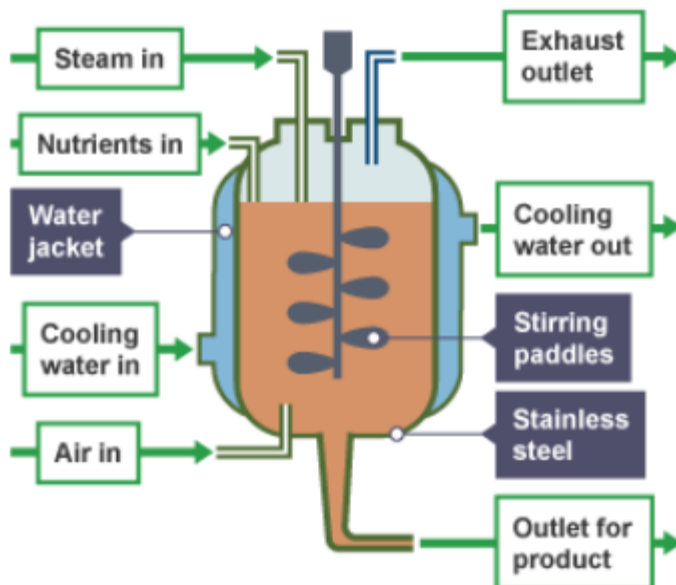
3. Enzymes used in biological washing powders break down different food molecules. The enzymes break large insoluble molecules into smaller soluble molecules which dissolve easily in water, thereby removing stains. The enzymes are useful at lower temperatures, less money is needed and the water doesn't need to be at a very high

Temperature

4. Lactase is an enzyme added to milk to break lactose down to glucose and galactose, thus making the milk drinkable for lactose intolerant people

Fermentation:

- Large scale production of useful products
- Microorganisms are placed in the fermenter, keeping them at optimum temperature and pH. Temperature in fermenters is usually 25-30 degrees Celsius. PH is adjusted according to microorganisms
- Air inlet present to enable aerobic respiration, oxygen is distributed inside
- All other microorganisms killed through steam to limit contamination
- Nutrients are provided to microorganisms, allowing them to reproduce and survive
- Paddles used to ensure temperature, PH and nutrients are distributed evenly in fermenter



Microorganism	Type	Method	Products
Pencillum	Fungus	Cultured in liquid medium, penicillin secreted and then isolated and purified	Penicillin
E.Coli	Bacteria	Genetically produced to make insulin	Insulin
Fusarium	Fungus	Placed in fermenter with glucose, producing mycoprotein	Mycoprotein

Genetic Modification:

- Bacteria used to produce human proteins by altering their genes
- The gene which is required to code for the protein is identified and isolated using restriction enzymes, the gene has sticky ends
- The plasmid from the cell is cut with the same restriction enzymes, leaving complementary sticky ends to the isolated gene
- Gene is inserted into plasmid



- Complementary sticky ends joined using enzyme DNA ligase, forming recombinant plasmid
- Plasmid is inserted back into bacterium and the gene is expressed, producing the desired protein
- The bacterium can be placed into a fermenter for exponential growth and product

Examples of Genetic Engineering:

- Insulin can be produced through genetic modification in high quantities
- Genes can be inserted into plants and crops, making them resistant to insects and herbicides
- Vitamin rich plants can be produced, plants can be genetically altered to contain more nutrients. Golden rice is an example, it produces beta carotene which can be synthesized to produce Vitamin A

Advantages and Disadvantages of Genetic Engineering:

- Reduce nutritional deficiencies in some areas and children
- Improve crop yield and production
- Genetically modified crops are more resistant to pest and disease and resistance to harsh environmental conditions
- However, they cause a loss in biodiversity
- Superweeds may come to reality which are resistant to the modified crops
- The modified crops are more expensive and are less researched.



MCQ's:

A gene for insulin is taken from a human cell and placed in a bacterium.

The bacterium can then make human insulin.

What is this process called?

- A artificial selection
- B genetic engineering
- C heterozygous inheritance
- D natural selection

1.

2.

Why is yeast used in bread-making?

- A to provide carbon dioxide
- B to provide ethanol
- C to provide lactic acid
- D to provide oxygen

3.

What has **not** increased the world's food production in the last 100 years?

- A artificial selection
- B herbicides
- C natural selection
- D pesticides





What term is used for the transference of a gene from one organism to another?

- A** artificial selection
- B** genetic engineering
- C** mutation
- D** natural selection

5.

What is the role of anaerobic respiration in bread-making?

- A** to produce alcohol to flavour the bread
- B** to produce gas to make the bread rise
- C** to release enough energy to bake the bread
- D** to release enough lactic acid to kill the yeast

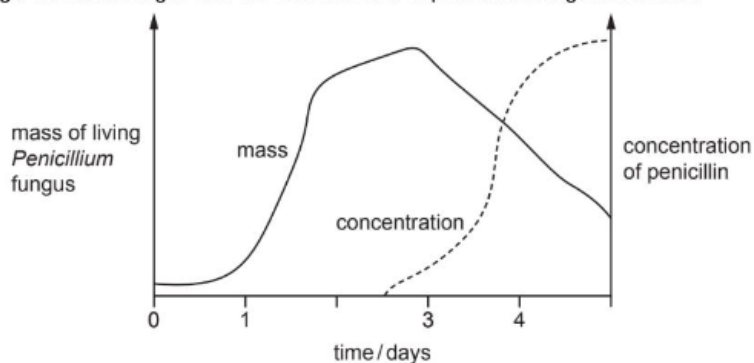
6.

Which products of anaerobic respiration are important for making beer and bread?

	beer	bread
A	carbon dioxide	simple sugar
B	ethanol	carbon dioxide
C	lactic acid	ethanol
D	simple sugar	lactic acid



Penicillin is produced in a fermenter by growing the fungus *Penicillium*. The graph shows how the mass of living *Penicillium* fungus and the concentration of penicillin changed over time.

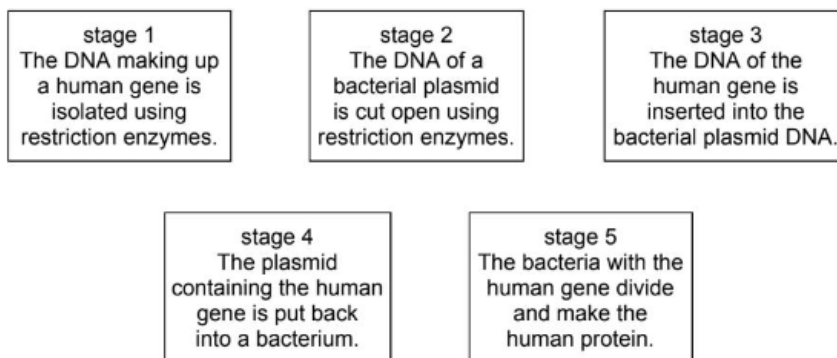


When is the best time to collect the penicillin?

- A at 1.5 days
- B at 3 days
- C at 3.5 days
- D at 5 days

8.

he diagram shows five stages in genetic engineering.

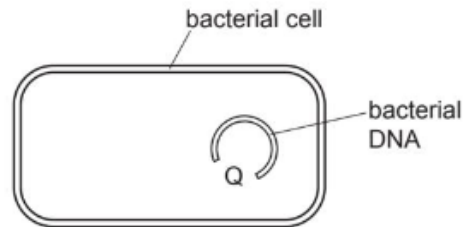


Which stages involve the formation of sticky ends?

- A 1, 2 and 3
- B 1 and 2 only
- C 1 and 3 only
- D 2 and 3 only



The diagram shows a bacterial cell that will be used to produce human insulin.



What is inserted into gap Q?

- A a gene from a healthy human
- B cells from a human pancreas
- C DNA from another bacterium
- D molecules of human insulin

10.

A crop plant has been genetically modified to make it resistant to herbicides.

Which is a possible disadvantage of introducing this new crop plant?

- A Loss of weeds reduces competition.
- B Some weeds might become resistant to the herbicide.
- C The crop plant is unharmed and produces a higher yield.
- D The new gene will appear in new generations of the crop.



Answers:

1 B

2 A

3 C

4 B

5 B

6 B

7 C

8 B

9 A

10 B

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Structured Answers

- 1 (a) Define the term *genetic engineering*.

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.....[2]

- (b) Fig. 6.1 is a flow diagram that shows how insulin can be produced using genetic engineering.

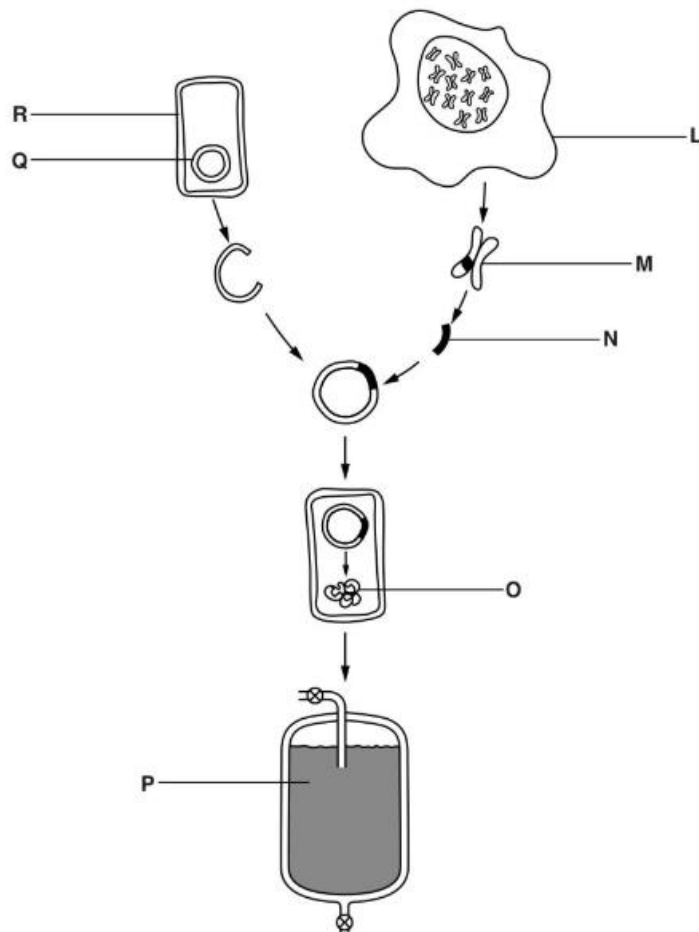


Fig. 6.1



Table 6.1 shows stages in the production of insulin by genetic engineering.
Complete Table 6.1. The first row has been done for you.

Table 6.1

letter from Fig. 6.1	name	description
M	chromosomes	threads of DNA found in the nucleus
		section of DNA removed from human cell
	plasmid	
		type of cell that is genetically engineered
		specific chain of amino acids coded by the section of DNA removed from the human cell
	fermenter	

[5]

(c) The genetically engineered cells in Fig. 6.1 reproduce asexually.

Explain the advantages of asexual reproduction for insulin production by genetic engineering.

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.....[3]

[Total: 10]



2 Antibiotics are used to treat human diseases.

Many bacteria have become resistant to antibiotics. Some antibiotics can no longer be used to treat certain diseases.

Samples of bacteria were taken from a person who had an infectious disease. They were spread onto four Petri dishes of agar (agar plates). Three of these agar plates contained the antibiotics **1**, **2** or **3**.

The results are shown in Fig. 2.1.

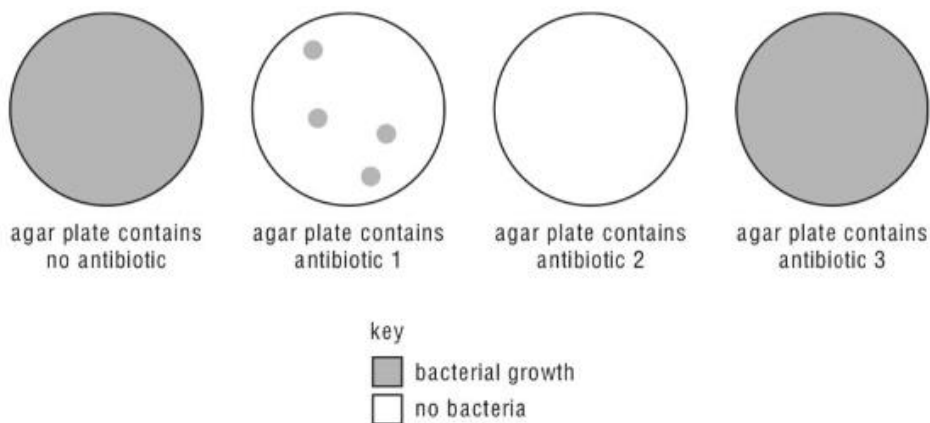


Fig. 2.1

(a) Explain why:

(i) no bacteria grew in the agar plate with antibiotic **2**;

.....
.....
..... [1]

(ii) bacteria grew in the agar plate with antibiotic **3**;

.....
.....
..... [1]



(iii) only a small number of bacteria grew with antibiotic 1.

.....

.....

.....

.....

..... [2]

(b) Explain why it is important to carry out a test similar to that shown in Fig. 2.1 before giving an antibiotic to a person infected with a bacterial disease.

.....

.....

.....

.....

..... [2]

(c) Antibiotic resistance has become a major problem worldwide.

Suggest how the problem of antibiotic resistance can be limited.

.....

.....

.....

.....

.....

.....

.....

.....

..... [4]



- (d) Hormones are used to treat a variety of conditions.

The most common hormonal treatment is the use of insulin to treat diabetes. Most of the insulin is produced using cells that are grown in large fermenters. These cells have been genetically engineered to produce human insulin.

Fig. 2.2 shows the stages involved in transferring the gene for insulin from human cells to bacterial cells.

P	gene from human cell removed from chromosome 11
Q	bacterium produces human insulin
R	plasmid vector enters bacterium
S	gene for human insulin found to be on chromosome 11
T	bacterium divides by binary fission
V	gene for human insulin inserted into a plasmid vector

Fig. 2.2

- (i) Put the stages into the correct sequence. Two have been done for you.

S					Q
----------	--	--	--	--	----------

[1]

- (ii) Diabetes is often treated with human insulin that has been produced by genetically modified cells. In most countries this type of insulin has replaced the insulin that was prepared from animals.

Suggest the advantages of providing human insulin to people with diabetes rather than insulin obtained from animals.

.....

.....

.....

.....

.....

.....

.....

.....

[3]

[Total: 14]



Answers

- 1 (a) Define the term *genetic engineering*.

Taking up a gene from one species and inserting it into another organism is termed as genetic engineering.

[2]

- (b) Fig. 6.1 is a flow diagram that shows how insulin can be produced using genetic engineering.

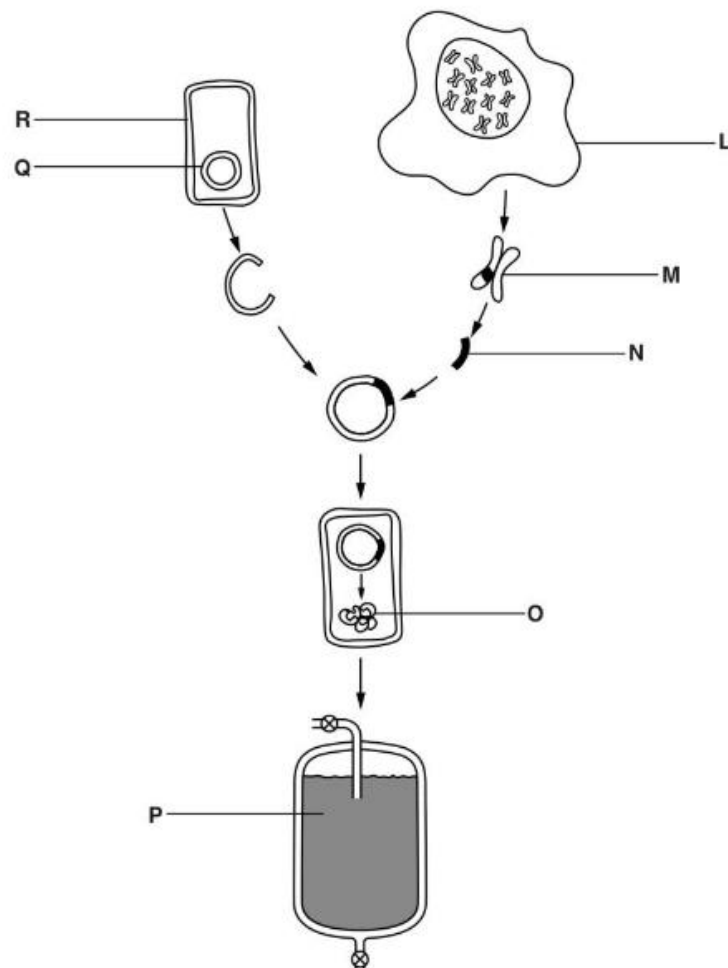


Fig. 6.1



Table 6.1 shows stages in the production of insulin by genetic engineering.

Complete Table 6.1. The first row has been done for you.

Table 6.1

letter from Fig. 6.1	name	description
M	chromosomes	threads of DNA found in the nucleus
N	gene	section of DNA removed from human cell
Q	plasmid	loop of separate DNA
R	bacterial cell	type of cell that is genetically engineered
O	insulin	specific chain of amino acids coded by the section of DNA removed from the human cell
P	fermenter	container where bacteria grow

[5]

- (c) The genetically engineered cells in Fig. 6.1 reproduce asexually.

Explain the advantages of asexual reproduction for insulin production by genetic engineering.

Rapid reproduction and less energy is needed.....
as only one parent is needed.....
Large quantities of insulin produced.....
Same insulin produced as all bacteria have.....
same insulin gene.....

[3]

[Total: 10]



2 Antibiotics are used to treat human diseases.

Many bacteria have become resistant to antibiotics. Some antibiotics can no longer be used to treat certain diseases.

Samples of bacteria were taken from a person who had an infectious disease. They were spread onto four Petri dishes of agar (agar plates). Three of these agar plates contained the antibiotics 1, 2 or 3.

The results are shown in Fig. 2.1.

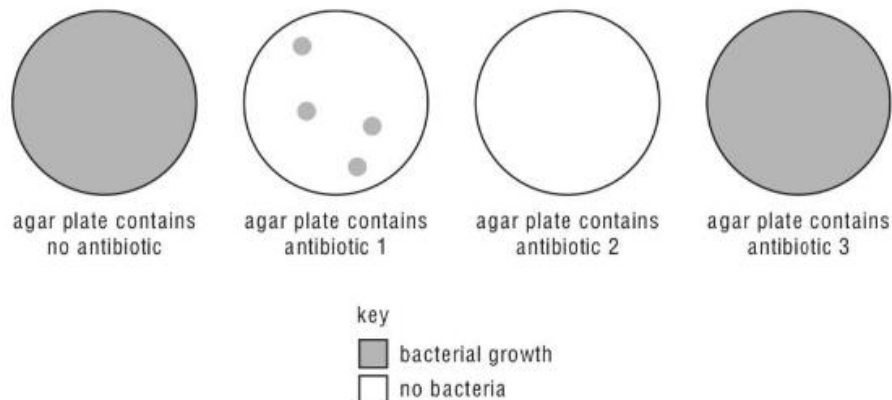


Fig. 2.1

(a) Explain why:

(i) no bacteria grew in the agar plate with antibiotic 2;

All bacteria aren't resistant to antibiotic 2

[1]

(ii) bacteria grew in the agar plate with antibiotic 3;

All the bacteria present are resistant to antibiotic 3

[1]



- (iii) only a small number of bacteria grew with antibiotic 1.

A few number of bacteria are resistant to the antibiotic due to mutations. These bacteria grew and reproduced.

[2]

- (b) Explain why it is important to carry out a test similar to that shown in Fig. 2.1 before giving an antibiotic to a person infected with a bacterial disease.

Person infected might be carrying bacteria that are resistant to some antibiotics. Tests should be done to find the most suitable antibiotic that kills all the bacteria in the person and provides antibiotic resistance.

[2]

- (c) Antibiotic resistance has become a major problem worldwide.

Suggest how the problem of antibiotic resistance can be limited.

Prescribe antibiotics only when necessary.
Don't prescribe antibiotics for fungal or viral infections
Make sure people complete the course of the antibiotics prescribed.
Use a combination of antibiotics to fight the infection.
Develop new antibiotics.

[4]



- (d) Hormones are used to treat a variety of conditions.

The most common hormonal treatment is the use of insulin to treat diabetes. Most of the insulin is produced using cells that are grown in large fermenters. These cells have been genetically engineered to produce human insulin.

Fig. 2.2 shows the stages involved in transferring the gene for insulin from human cells to bacterial cells.

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Fig. 2.2

- (i) Put the stages into the correct sequence. Two have been done for you.

s	P	V	R	T	q
---	---	---	---	---	---

[1]

- (ii) Diabetes is often treated with human insulin that has been produced by genetically modified cells. In most countries this type of insulin has replaced the insulin that was prepared from animals.

Suggest the advantages of providing human insulin to people with diabetes rather than insulin obtained from animals.

It will be a more cost effective approach.
Less risk of allergies developing and
human insulin is more effective than
animal insulin.
No risk of disease transmission from
animals and less ethical pressure if
animal insulin isn't used.

[3]