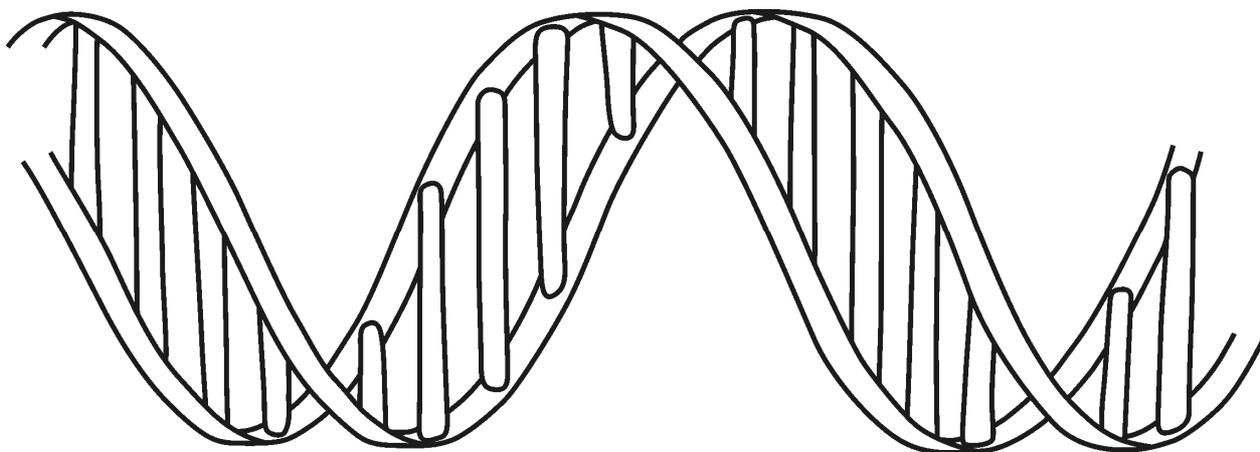


DO REVISSE

BIOLOGY (5090)

(for Zambian pupils G10-12)

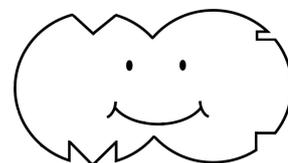


To do or not to do, this is the problem.

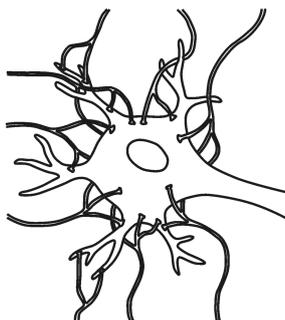
NAME _____

SCHOOL _____

My Friend



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Introduction

1. The purpose of this booklet is to understand **Biology** that follows the **BIOLOGY HIGH SCHOOL SYLLABUS GRADES 10-12** established by Zambia Curriculum Developing Centre (CDC).
2. The wish of the author is to spread this book to whole Zambia and what all pupils have this booklet to learn Biology.
3. The topics of this booklet are based on above syllabus with slight modification of arrangement. Therefore, **this booklet is essential for your knowledge**.
4. I wish you **to do EXTRA work**, and **to treasure regular classes**. If you do so, you must be happy at the end of grade 12.
5. This booklet is sold through JOCV (Japan Overseas Cooperation Volunteer) teacher's committee, however, other volunteers in Zambia (VSO, Peace Corps) also be able to sell this book if they cooperate with JOCV.
6. The price can be decided as **the lowest price** in only JOCV teacher's committee.
7. If other volunteers sell this booklet, the profit can not be requested, and a selling price can not exceed the price that JOCV teacher's committee decides.
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9. The digital data of this book can be used by only JOCV.
10. The author authorizes the chairperson of JOCV teacher's committee and the chief of JOCV teacher's committee pamphlet to sell this booklet.

Acknowledgement

I would like to say thanks to all of the scientists, authors and publishers, especially to D. G. Mackean, 'IGCSE Biology' and A. R. Sebastian, 'Biology KEY.POINTS', for giving me many useful ideas.

1st Edition: June 2008

Masashi ABE (19-2)

Japan Overseas Cooperation Volunteer

Luwingu High School

UNIT 00 Preface

Thank you for your great decision to use this booklet!

*** Why did I decide to make this Biology booklet.**

The main reason for making this booklet is the fact that almost all the pupils do NOT have any textbook, because the price of present textbooks is too expensive to buy for the pupils, so that, the regular biology lessons tend to do the COPYING activity. Huge amounts of copying spoil your teacher's marvelous lessons as well as decrease the time to revise the lesson. Fortunately, you have already taken this booklet. You can learn biology more effectively than before!

*** What is this booklet including.**

The arrangement of topics chosen in this textbook parallels, for the most part, **BIOLOGY HIGH SCHOOL SYLLABUS GRADE 10-12** by Zambia Curriculum Developing Centre (CDC). However, some changes and deletions have been introduced to improve the logical flow of materials and to reduce the PRICE of this booklet. MAKE SURE that this textbook is **NOT PERFECT** in topics. **NEED YOUR EXTRA EFFORT!**

*** What are the features of this booklet.**

This booklet is designed to be used as a revise for your regular lessons. 'Objectives' indicate the essential abilities expected in the unit. 'Activity' sets provide opportunities for

your revision and intercosta knowledge. It is very difficult to remember the unfamiliar scientific terms by just looking them. I'm sure that writing the terms again and again will support your memory. 'Creativity' sets are expected to use in the discussion in order to enhance your ability to problem solving. Let's create and describe your own idea! There is no answer.

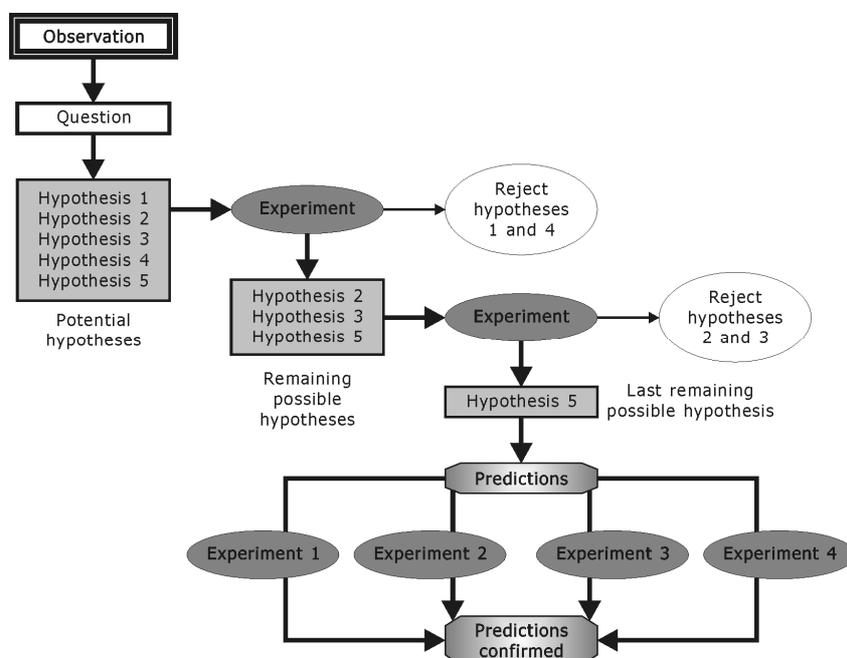
*** Messages from the author.**

How science is done

All sciences begin with an **observation**. A **hypothesis** is a suggested explanation that accounts for an observation.

An **experiment** is used to test a hypothesis, and/or eliminate one or more multiple hypotheses.

Predictions should be developed before the experiment is conducted in order to test the validity of the hypothesis.



How do I study Biology

Biology is the study of life... NOT copying activity.

1. Whenever I study biology, I try to keep 5W1H questions in my mind:

WHAT are raw materials for photosynthesis?

WHEN does cross-over between homologous chromosomes occur?

WHERE is adrenaline produced?

WHO introduced binomial nomenclature?

Why do animals need oxygen?

HOW do humans keep body temperature constant?

2. One principle of biology:

"The structure is suited for its function."

3. When I discuss functions, adaptations, advantages, and disadvantages of certain structure or a substance, I try to consider by following three ways:

If the structure is NOTHING, what will happen? (I name 'deletion')

If the structure is DIFFERENT feature, what will happen? (I name 'replacement')

If the substance is MUCH, what will happen? (I name 'addition')

These three ways of thinking can be applied in our daily life. Let's study biology and have fun!

Copyright problem

All pupils in senior secondary course anywhere in Zambia will find this booklet to be a valuable supplement to his/her regular notebook and use this booklet in much the same way UNTIL you buy more profitable textbooks. Some figures and tables are quoted and referred with a modification from following books:

A. R. Sebastian, GCE 'O' LEVEL Biology KEY.POINTS, 2004

D. G. Mackean, IGCSE Biology, 2002

Michael Roberts, GCSE Biology QuickCheck Study Guides, 1988

D. G. Mackean, INTRODUCTION TO BIOLOGY, 1973

School and College Press, Senior Secondary Course Biology 10 Pupil's Book

School and College Press, Senior Secondary Course Biology 11 Pupil's Book

School and College Press, Senior Secondary Course Biology 12 Pupil's Book

The copyright of these figures and tables are those reference books. This booklet is just summary. If you want to understand deeply and to know more detail information, I recommend you buy above excellent textbooks. I wish to reduce the number of selling those JOCV booklets and increase the number of abovementioned textbooks. I think this is one of the first steps of development of the nation.

My hope

I'm sure that this booklet will be a "spring board" for your career of future. And I hope you will be a good citizen in the world.

Your success depends on...

"WHAT YOU DID" and "WHAT YOU WILL DO"

Not 'Who you are' neither 'Books you have'

Apr 2008, Masashi ABE, JOCV (Japan Overseas Cooperation Volunteer) teacher

UNIT 01 Living Organism

Objectives

- 01-1 Describe a typical cell.
- 01-1 Distinguish between an animal and a plant cell.
- 01-2 Formulate a simple key for classification of animals and plants.
- 01-3 Explain the term: Diffusion, Osmosis and Active transport.
- 01-4 Describe properties of an enzyme.

→ Properties of life are **cellular organization, metabolism, homeostasis** and **reproduction**.

01-1 Cell structure

01-1-01 Process in living organisms.

→ Organisms are distinguished from non-living things by the processes they carry out. These processes are described below;

1. **Feeding** : An organism takes in materials from its environment for use in its body.
2. **Respiration** : From food, organisms obtain the energy they need to live.
3. **Growth** : This is a permanent increase in size of the organism which is accompanied by an increase in mass.
4. **Excretion** : Organisms remove harmful substances out of their bodies.
5. **Sensitivity** : This is the ability organisms have to detect and respond to changes in the environment.
6. **Movement** : This process is more obvious among animals as they move the whole body from one place to another.
7. **Reproduction** : This is the process of forming younger organisms from the older ones.

* Introduction of the cell (**The Cell Theory**)

→ A cell is **the basic unit** of structure and function in an organism.

→ All organisms are composed of one (unicellular organisms) or more cells (multicellular

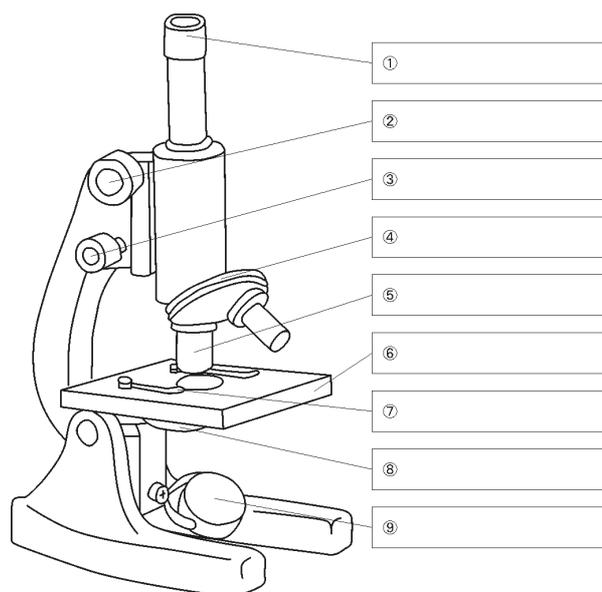
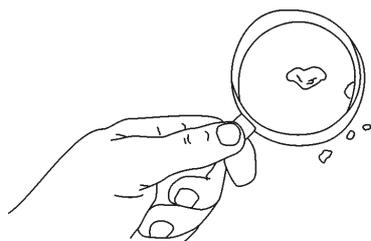
organisms).

→ Cells are produced only from existing cells.

01-1-02 Observation of a cell (hand lens and compound microscope).

→ There are several types of microscope. One type is a hand lens.

→ It is a simple microscope made up of a convex lens fixed in a frame with a handle.



* How to handle a microscope.

→ Another type of microscope is a compound microscope.

→ It consists of two sets of lens. The lenses are fitted at the opposite ends of a body tube.

→ The lenses closer to the eye are called the eyepiece and the ones nearer the object are called the objective lenses.

→ The objective lenses are fitted into a revolving nose piece in order of low power, medium power and high power.

Activity 01-1-02: Name the part ①-⑨ of a compound microscope.

01-1-03 Magnification.

→ Magnification is the number of times the images of the object is enlarged (magnified) as compared to the specimen.

→ For example, a magnification of a hundred (x100), means that the object is enlarged a

hundred times.

→ To obtain the total magnification of the specimen which you observe under a compound microscope, use the formula below;

$$\text{Magnification} = \text{Power of eyepiece lens} \times \text{Power of objective lens}$$

→ After drawing a specimen, calculate the magnification of your drawing by using the formula below;

$$\text{Magnification} = \frac{\text{①}}{\text{②}}$$

* Exercise

Actual size of a hand lens is 16 cm. Your drawing was 4 cm. Calculate the magnification of your drawing.

* Steps for answering

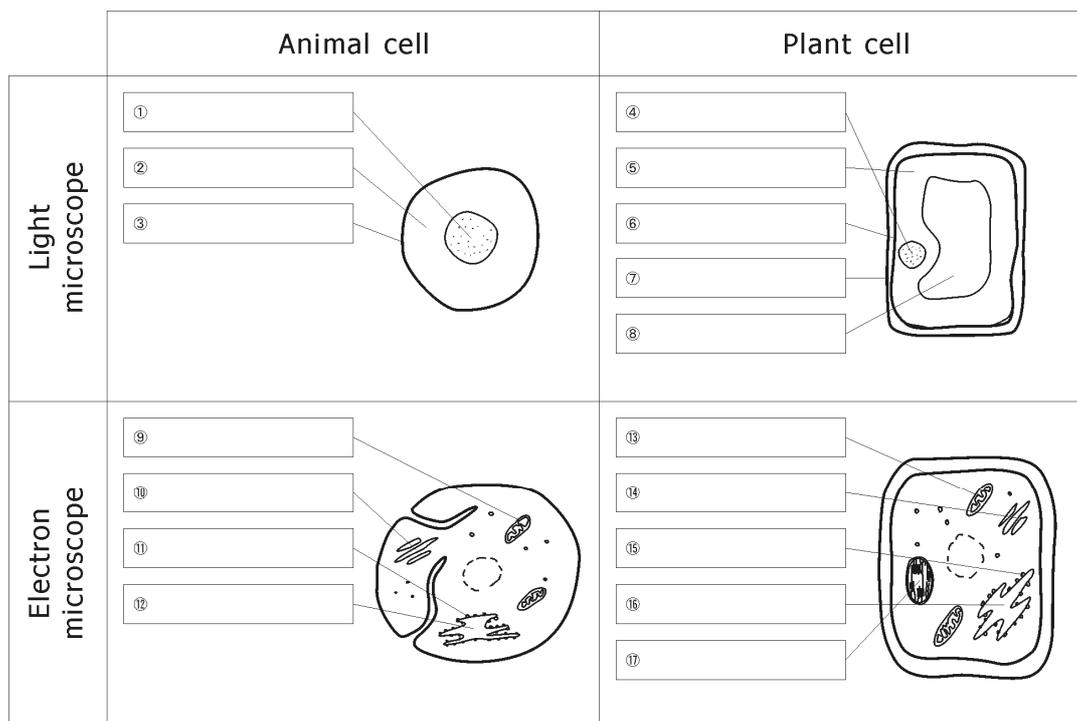
1. Write the magnification formula.
2. Put the numbers into the formula with units.
3. Convert the units (if the units differ). It is better that the larger unit converts to the smaller unit (eg 1 cm → 10 mm).
4. Calculate division.
5. Answer followed by the letter "X" (meaning the unit of magnification).

Activity 01-1-03: Fill in the blank ①②.

01-1-04 Basic structure of an animal and a plant cell.

→ Although cells differ in shape and size, they all have general characteristics.

→ Figure below is a generalized cell showing basic structures.



Activity 01-1-04: Identify the organelle ①-⑰.

01-1-05 Similarity and difference between animal and plant cells.

Three similarities;

Both animal and plant cells have...

1. ① _____
2. ② _____
3. ③ _____

regular in shape.

Five differences;

1. Only plant cells have ④ _____
2. Only plant cells have ⑤ _____
3. Plant cells have large sap vacuole.
4. Animal cells are irregular; plant cells are

5. Animal cells are smaller; plant cells are larger in size.

Activity 01-1-05: Write the organelle ①-⑤.

01-1-06 Detail structure of a cell.

→ Cell structures, nucleus and cytoplasm, together make **protoplasm**.

→ Apart from dissolved substances in the cytoplasm, there are suspended structures called **organelles**.

Structure	Description	Function
Nucleus	Usually spherical in shape Bound by two membranes forming nuclear envelope Contains chromatin	→ Control all cellular activities → Involve in ① _____ → House genetic materials (② _____)
Cell membrane	A thin, delicate mono-layer made of lipids and proteins Completely surrounds all living cells Separates one cell from another adjacent cell ③ _____ membrane	→ Control the transport of materials in and out of the cell → Allow certain small substances like water, oxygen, glucose to enter the cell → Prevent larger molecules like proteins and starch from leaving cell
Cytoplasm	Jelly-like substance Fills up the cell Suspension of various organelle	→ Where the metabolism takes place
Cell wall	Layer of ④ _____ surrounding plant cells	→ Strengthen and protect the cells
Mitochondria	Rod-shape Dual-membrane Sometimes referred to as 'power houses' of the cell	→ Generate energy for all the cellular activities → Site for ⑤ _____

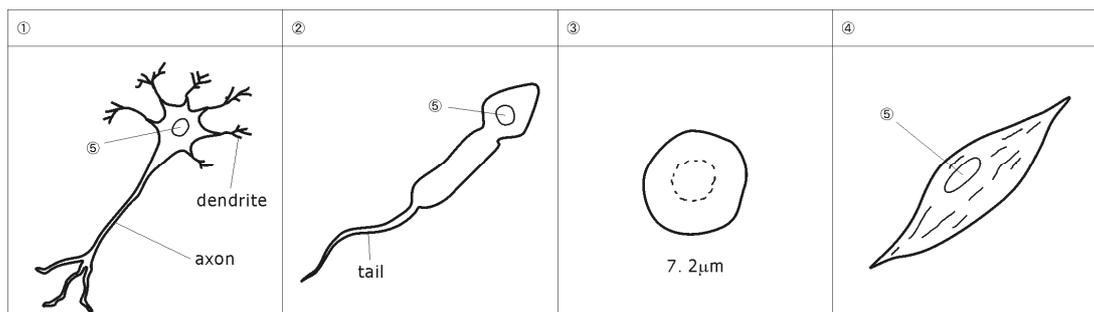
Vacuole	<p>Large compartments</p> <p>Fluid-filled cavity in the cytoplasm</p> <p>Sacs filled with cell sap, a watery solution of sugars, salts and pigments</p> <p>Membrane that surrounds the vacuole called a</p> <p>⑥ _____ in plant cells</p>	<p>→ Involve in osmoregulation</p> <p>→ Help to maintain the shape of the cell</p>
Chloroplasts	<p>Round-shape</p> <p>Dual-membrane</p> <p>Store chlorophyll</p>	<p>→ Absorb light</p> <p>→ Involve in ⑦ _____</p>
Endoplasmic reticulum (ER)	<p>Network of membrane-lined channels in the cytoplasm</p>	<p>→ Transport substances in and out of the cell and within the cell itself</p>
Golgi body	<p>Stacks of flattened vesicles which together make up the Golgi apparatus</p>	<p>→ Transport materials like enzymes from the ER to the sites of reactions</p>
Ribosome	<p>Tiny particles</p> <p>Some attach to the membranes of ER</p>	<p>→ Control ⑧ _____</p>

Activity 01-1-06: Write the process ①⑤⑦⑧. Fill in the blank ②③④⑥.

01-1-07 Example of specialized cells.

- Cells are specialized to carry out specific function hence they differ in structure.
- Within an organism there are various types of specialized cells.
- This **specialization** of cells is more prominent in complex organisms than in simple organisms.
- **Differentiation** is the process that allows cells to develop special structures and functions.

* Examples of animal cells;



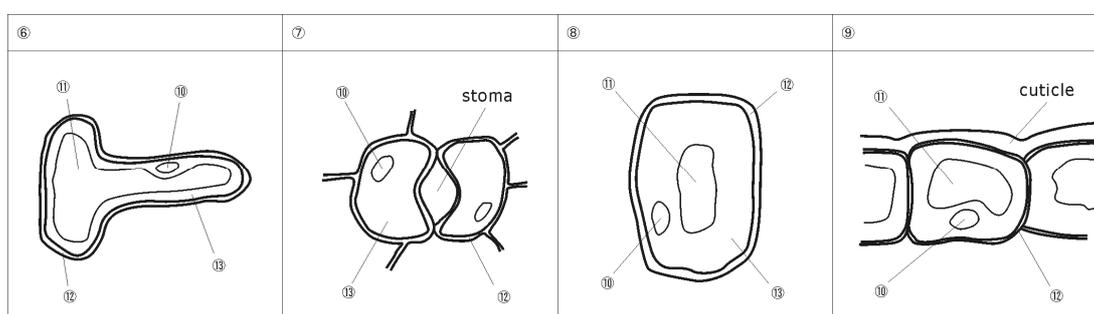
→ **Nerve cells** (nerve cells), which found in the brain, have dendrites and a long axon. They conduct electrical impulses.

→ **Sperms** (male cells), which found in the testes, have a long tail for movement (propulsion).

→ **Red blood cells** (erythrocytes) have no nucleus in human. They have **haemoglobin** for carrying oxygen and carbon dioxide.

→ **Muscle cells** are spindle shaped. They are capable of contracting and relaxing for movement.

* Examples of plant cells;



→ **Root hair cells** have elongated out growth to increase the surface area for efficient absorption of water and mineral salts.

→ **Guard cells**, which found in lower surface of leaves, contain chloroplasts for photosynthesis. They control size (opening and closing) of the stoma.

→ **Palisade cells**, which found in leaves, are oblong shaped. They have a lot of chloroplasts for efficient photosynthesis.

→ **Epidermal cells** protect inner tissues of roots, stems and leaves.

Activity 01-1-07: Name the specialized cell ①-④ and ⑥-⑨. Identify the organelle ⑤, ⑩ -⑬.

01-1-08 Cell intercostals.

- We have seen that cells of higher plants and animals differ in shape because of their specialization.
- These cells work together for the benefits of the organism.
- A **tissue** is a group of similar cells that together perform a particular function.
- An **organ** is made with two or more types of tissues, and is a distinct part of the body which carries out one or more specific functions.
- A **system** usually refers to a group of organs whose functions are closely related.
- Organisms can either be unicellular or multicellular. Unicellular organisms (eg amoeba) have one cell only. However the cell is capable of carrying out all cellular functions such as movement, respiration, excretion and reproduction.
- The following summarises stages in cell organization.

Organelle – ① _____ - ② _____ - ③ _____ - ④ _____

- Organism

* Main tissues in animals;

Name of tissue	Cells in the tissue	Main functions
⑤ _____ tissue	Layer of lining cells	Cover the external surface Serve as a protective lining
⑥ _____ tissue	Bone, Ligament Blood	Bind together other tissues and organs Store and transport materials
⑦ _____ tissue	Spindle-shaped muscle cells	Contract and relax for movement such as locomotion (voluntary) and breathing (involuntary).
⑧ _____	Nerve cells	Conduct and coordinate nerve impulses

tissue

throughout the body

* Main tissues in plants:

Name of tissue	Cells in the tissue	Main functions
⑨ _____ tissue	One layer of cells May be covered with a waxy cuticle	Cover surface of the plant Protect from physical damage and infection Reduce water loss
⑩ _____ tissue	Palisade cells, spongy cells Guard cells	Absorb light Photosynthesis
⑪ _____ tissue	Undifferentiated cells	Cell division for producing new cells
⑫ _____ tissue	Xylem cells Phloem cells	Transport water and mineral salts Transport food substances Provide support

* Main organs in animal and plant:

- The **eye**, which functions for sight, includes cornea, sclera, retina, nerve, blood, and so on.
- The **stomach**, which functions for digestion of food, includes smooth muscle, blood, mucus producing cell, and so on.
- The **lungs**, which function for breathing, include alveolus, muscle, blood, blood vessels, and so on.
- The **heart**, which functions for transport oxygen and carbon dioxide, includes cardiac muscle, pacemaker, valves, and so on.
- The **stem**, which functions for transport, has phloem, xylem, cambium, epidermis, and so on.

on.

→ The **leaf**, which functions for photosynthesis and transpiration, has epidermis, mesophyll, vascular bundle, and so on.

→ The **flower**, which functions for reproduction, has pistil, stamens, petal, sepal, and so on.

* Main systems in human;

Name of system	Main organs in the system	Main functions
⑬ _____ system	Stomach, liver, pancreas	Take in and break down food Absorb nutrients Undigested food is eliminated
⑭ _____ system	Nose, trachea, lungs	Take in oxygen Release carbon dioxide
⑮ _____ system	Heart, blood vessels	Regulate body temperature Transport food substances, wastes, and gases into and from cells
⑯ _____ system	Kidneys, bladder	Remove wastes from the body
Integumentary system	Skin	Waterproof barrier Regulate body temperature
Sensory system	Eyes, ears, nose	Detect stimuli
Nervous system	Brain, spinal cord	Control and coordinate body movements Transmit information from the

		brain
Musculo-skeletal system	Muscles, skeleton	Support and move the body Protect internal organs
Reproductive system	Testes, ovaries	Produce offsprings

Activity 01-1-08: Name the stage ①-④ of cell organization. Name the tissue ⑤-⑫.
Name the system ⑬-⑯.

01-2 Classification of living organisms

01-2-01 Scientific name – binomial system.

- The scientific name of any organism is in Latin and has two parts.
- This system was first introduced in 1753 by **Carl Linnaeus**, a Swedish naturalist, in a book called **Species Plantarum**.
- This system is referred to as **binomial system** of nomenclature, which is a standard system of naming things.

* Formula: The name of **genus** followed by the name of **species**

eg: (human) ① _____ (maize) ② _____

Activity 01-2-01: Write the binomial nomenclature ①②.

01-2-02 Sequence of classification.

- In addition to naming organisms, biologists also classify them into various groups.
- Scientists have developed a method of placing organisms in related groups.
- Placing organisms into groups is called **classification**.
- Most biologists use a system of classification which arranges organisms in groups of descending hierarchy as follow;

Kingdom – ① _____ - ② _____ - ③ _____
- ④ _____ - **Genus** – **Species**

- Species is the basic unit of biological classification.

- Today, most biologists use a system that intercosta five kingdoms: Animalia, Plantae, Fungi, Protista and Monera.
- Examples of divisions in **Animalia** are Arthropoda (eg insect) and Chordata (eg fish, bird, human), which has subdivision named Vertebrate.
- Examples of classes under division, Chordata, are Osteichthyes (fish), Amphibia (amphibians), Reptilia (reptile), Aves (bird) and Mammalia (human, cattle, lion).
- Example of divisions in **Plantae** is Tracheophyte (eg plants with vascular system).
- Example of classes under division, Tracheophyte, is Angiospermeae which includes two subclasses, Monocotyledoneae and Dicotyledoneae.
- **Fungi kingdom** is made up of eukaryotic, heterotrophic organisms. The organisms in this kingdom are generally saprophytes or parasites. They do not make their own food. Their cell wall is made of chitin.
- **Protista kingdom** contains organisms that are heterotrophic and autotrophic. Most organisms in this kingdom are unicellular and eukaryotic (ie chromosomes are covered with nuclear membranes).
- **Monera kingdom** contains prokaryotic organisms, which are organisms where cells have no nucleus and nuclear membranes. They are simple organisms which include both heterotrophs and autotrophs.

Activity 01-2-02: Write the stage of classification ①-④.

01-2-03 An example of classification using vertebrate key.

- The differeneeces that exist between organisms can be used to identify organisms especially those that are new.
- A key is a device for easy and quick identification of an unknown organism.

Key1	Key3
Poikilothermic ----- go to key2	Has no scale on body ----- ② _____
Homoiothermic ----- go to key4	Has scales ----- ③ _____
Key2	Key4

Has fins but no limbs ---- ① _____	Has feathers ----- ④ _____
Has 4 limbs ----- go to Key3	Has fur ----- ⑤ _____

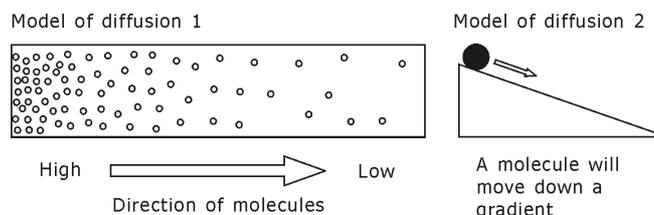
Activity 01-2-03: Name the group of animals ①-⑤.

01-3 Movement of molecules cross the cell membrane

- The human body is mostly made up of water which constitutes about 60 % of its mass. The human cell is made up of approximately 80 % water.
- Water is essential for keeping the tissue fluids at the correct concentration.
- Water is also the medium for biological reactions.
- Cell membranes are selectively permeable to solutes only and are completely permeable to water.
- Movement of molecules in and out of the cell is controlled by various methods.
- **Passive transport** (eg diffusion and osmosis) does not require energy for the movement of molecules, while **active transport** requires energy for movement of molecules.
- As a result of passive transport, the molecules will be equal concentration. While as a result of active transport, the molecules will be different concentration.

01-3-01 Description of diffusion.

→ **Diffusion** is defined that the movement of molecules from a region of higher concentration to a region of lower concentration down a concentration gradient.



* Importance of diffusion

1. **Gaseous exchange** during respiration and photosynthesis.
2. **Excretion** of waste products.

3. Absorption of digested food.

* Factors affecting rates of diffusion

Factor	
Temperature	(↑) temperature = (①) rate of diffusion
Size of particles	(↓) molecular size = (②) rate of diffusion
Thickness of the barrier (cell wall)	(↑) cell wall thickness = (③) rate of diffusion
Concentration gradient	(↑) gradient = (④) rate of diffusion
Total surface area of cell membrane	(↑) surface area = (⑤) rate of diffusion

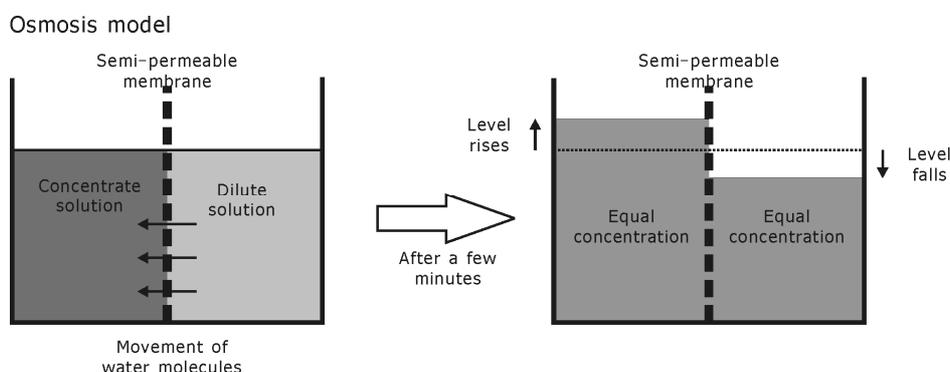
→ Diffusion will stop when the state of **equilibrium** (, which is the state the concentration gradient is zero) reached.

Activity 01-3-01: Write the arrow ①-⑤.

01-3-02 Description of osmosis.

→ If a dilute solution is separated from a concentrated solution by a partially permeable membrane, water diffuses across the membrane from the dilute to the concentrated solution.

This is known as osmosis.



→ **Osmosis** is defined that the movement of ① _____ across ② _____ membrane from a region of lower concentration to a region of higher concentration.

Activity 01-3-02: Fill in the blank ①-②.

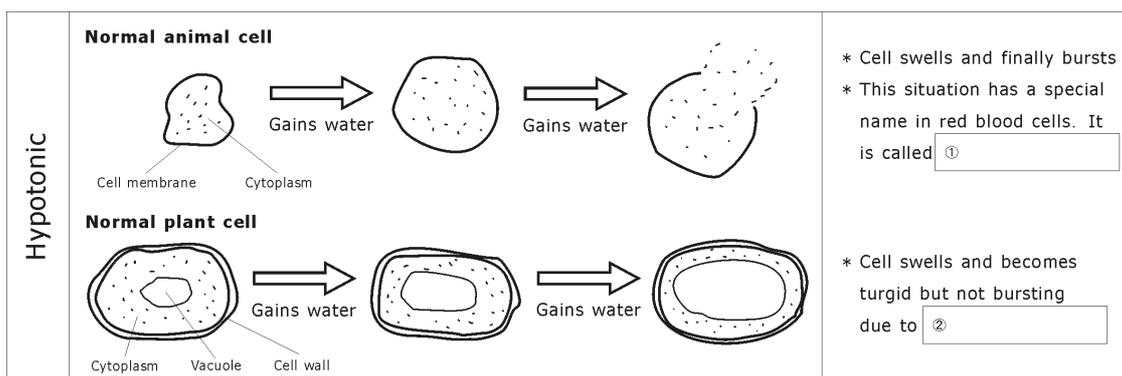
01-3-03 Water potential.

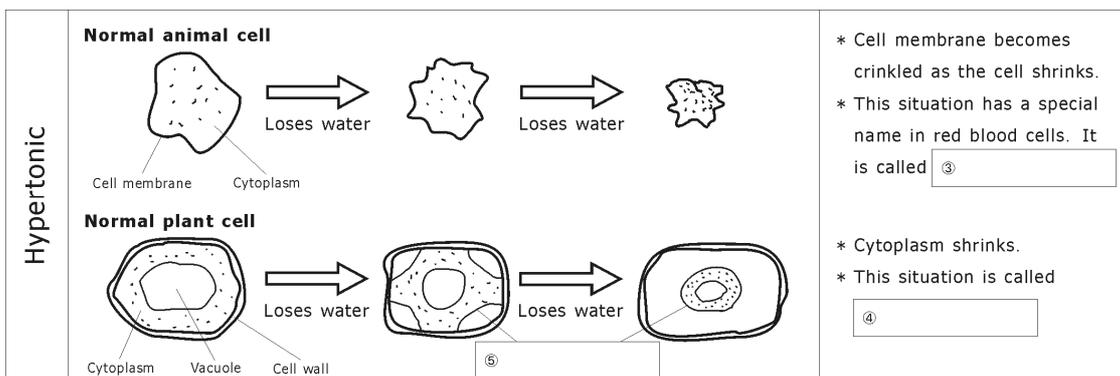
→ **Distilled water** has the highest possible water potential.

Types of solution	Concentration as compared to cell	Movement of water in the cell
Hypotonic	Low outside, high inside ① _____ water potential than cell	Water flows into the cell Cell becomes ② _____
Isotonic	Equal ③ _____ water potential	No net flow of water
Hypertonic	High outside, low inside ④ _____ water potential than cell	Water flows out of the cell Cell becomes ⑤ _____

Activity 01-3-03: Fill in the blank ①-⑤.

01-3-04 Osmosis in animal and plant cells.





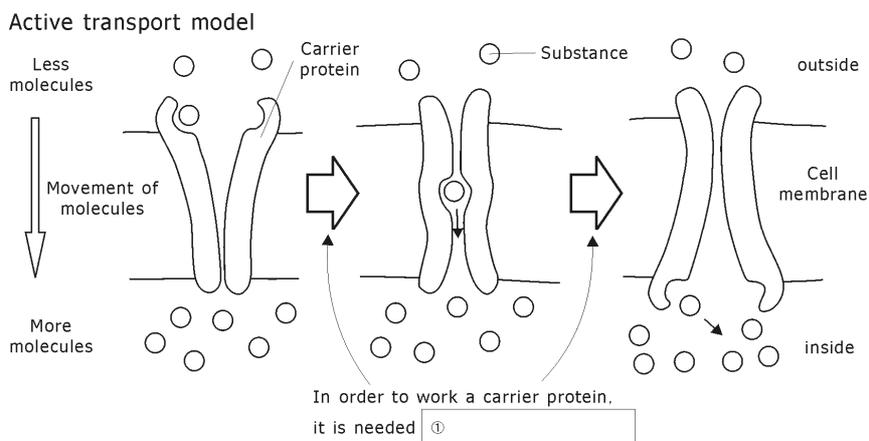
→ Animal cells only have the elastic cell membrane which encloses the internal solution.

→ Plant cells have a cell wall around the cell membrane. The cell wall is slightly elastic but mostly it is a rigid structure.

Activity 01-3-04: Write the condition of cell ①③④. Name the organelle ②⑤.

01-3-05 Description of active transport.

→ **Active transport** is defined that the movement of particles through a membrane from a region of low concentration to a region of high concentration by using energy.



→ For example, plants absorb mineral salts as charged ions present in soil. The concentration of ions in the soil is less than in the vacuole. Therefore uptake of ions is assisted by active transport across the root hair.

Activity 01-3-05: Fill in the blank ①.

01-4 Enzyme

→ In order to carry on with life processes, many chemical reactions are constantly taking place

in all living cells.

→ **Enzymes** are necessary in ALL chemical reactions which take place in organisms.

→ All chemical reactions that occur in a living cell are collectively known as metabolism.

→ **Metabolism** consists of anabolism and catabolism.

→ **Anabolism** is chemical reactions which involve the building up of small molecules into large complex molecules.

→ **Catabolism** is chemical reactions which involve the breakdown of complex compounds into simple molecules.

→ Both chemical reactions are catalysed by enzymes.

01-4-01 Characteristics of enzymes.

→ Enzymes have several physical and chemical properties as follows;

1. Made of proteins that function as **biological catalysts**.

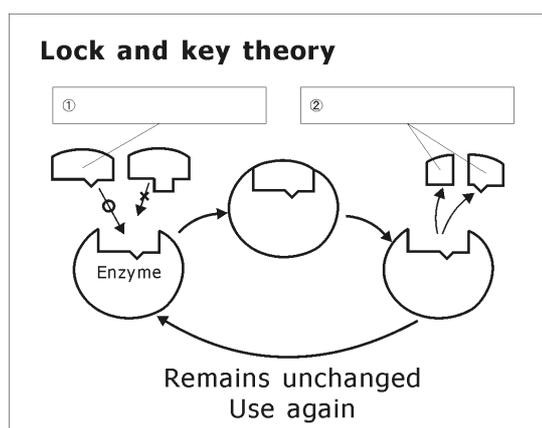
2. Specific in their action called "**Lock and key theory**".

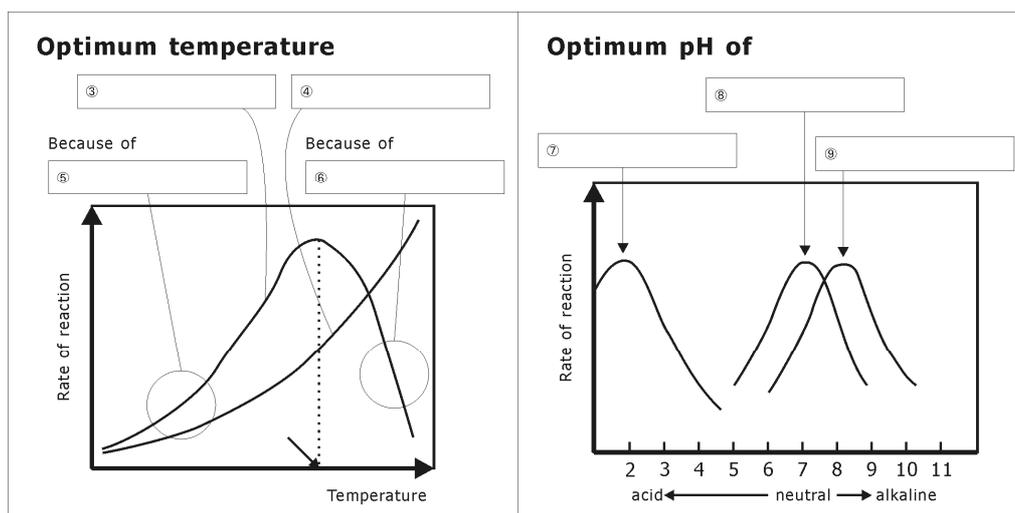
3. Can be used over and over again, as it remains unchanged at the end of the reaction.

4. Named by adding suffix '**ase**' to the name of its substrate.

5. Sensitive to heat and pH. Have **optimum** pH and temperature for their action.

6. Inactivated by poisons.





Activity 01-4-01: Write the word ①②. Identify enzyme or non-biological catalyst ③④. Name the process ⑤⑥. Name the enzyme ⑦-⑨.

01-4-02 Biological and non-biological catalyst

→ Enzymes and non-biological catalysts are similar in that they both increase rates of chemical reactions.

* Differences between enzyme and non-biological catalyst

Biological catalysts (Enzymes)	Non-biological catalysts
They are proteins.	They are mostly metals.
They are denatured at high temperature.	They work better at high temperature.
They are affected by pH.	They are not affected by pH.
They are specific. They can catalyse only particular substrates or class of substrates.	They are non-specific. They can be used in many reactions.
They are made from living tissues and therefore they are organic.	They are made from non-living materials and therefore they are inorganic.

01-4-03 Intra- and extra-cellular enzymes

→ Most reactions (eg respiration) in organisms occur within cells.

→ However some take place outside the cell membranes (eg digestion).

→ The enzymes which catalyse reactions within cells are called intra-cellular enzymes. And those that catalyse reactions outside cells are called extra-cellular enzymes.

→ Enzymes which are found in the alimentary canals are called digestive enzymes. All digestive enzymes are extra-cellular enzymes (eg lipase, protease).

01-4-04 Industrial applications of enzyme.

→ Research in enzymes from plant and animal tissues has led to the discovery of their uses in industry.

1. ① _____ : Contain proteases, lipases, amylases.
2. ② _____ : Breakdown sucrose to alcohol.
3. ③ _____ : Soften the animal skins into leather by tannic acid.
4. ④ _____ : The action of enzymes in the yeast.

Activity 01-4-04: List the example ①-④.

<Creativity> What is 'LIFE'?

[A living organism] – [the dead organism] = ??LIFE??

If the equation is true, what is 'LIFE'?

What is the differences between living organism and dead organism?

<Creativity> Clone animals

Nowadays, we can make clone mouse, sheep, cow, monkey and also human (but ethically we never make clone human).

Clone organs such as an ear, liver, cardiac muscles, and so on are more easy to make.

However, we cannot produce only one cell from inorganic substances chemically.

What are the differences between making clone animals and producing cells chemically?

Unit 01 Answers for the activities

<01-1-04> ①Nucleus ②Cytoplasm ③Cell membrane ④Nucleus ⑤Cytoplasm ⑥Cell membrane ⑦Cell wall ⑧Vacuole

⑨Mitochondrion ⑩Golgi body ⑪Ribosomes ⑫Endoplasmic reticulum ⑬Mitochondrion ⑭Golgi body ⑮Ribosomes

⑯Endoplasmic reticulum ⑰Chloroplast

<01-1-06> ①cell division ②chromosomes ③Semi-permeable (or selectively permeable or partially permeable) ④cellulose

⑤aerobic respiration ⑥tonoplast ⑦photosynthesis ⑧protein synthesis

<01-1-05> ①Nucleus ②Cell membrane ③Cytoplasm ④cell wall ⑤chloroplasts

<01-1-07> ①Nerve cell (neurone) ②Sperm ③Red blood cell ④Muscle cell ⑤nucleus ⑥Root hair cell ⑦Guard cells

⑧Palisade cell ⑨Epidermal cell ⑩nucleus ⑪vacuole ⑫cell wall ⑬cytoplasm

<01-1-03> ①Size of drawing ②Actual size of specimen ③x0.25 (or 0.25x)

<01-1-02> ①Eye piece ②Coarse adjustment ③Fine adjustment ④Revolving nose piece ⑤Objective lens ⑥Stage

⑦Stage clip ⑧Iris diaphragm ⑨Mirror

<01-1-08> ①Cell ②Tissue ③Organ ④System ⑤Epithelial ⑥Connective ⑦Muscular ⑧Nervous ⑨Epidermal

⑩Photosynthetic ⑪Meristematic ⑫Vascular ⑬Digestive ⑭Respiratory ⑮Circulatory ⑯Excretory

<01-2-01> ①*Homo sapiens* ②*Zea mays*

<01-2-02> ①Division (or phylum) ②Class ③Order ④Family

<01-2-03> ①Fish ②Amphibian ③Reptile ④Bird ⑤Mammal

<01-3-01> ①↑ ②↑ ③↓ ④↑ ⑤↑

<01-3-02> ①water molecules ②selectively permeable

<01-3-03> ①Higher ②turgid ③Zero ④Lower ⑤flaccid

<01-3-04> ①Haemolysis ②Cell wall ③Crenation ④Plasmolysis ⑤Cell membrane

<01-3-05> ①energy

<01-4-01> ①Substrate ②Product ③Enzyme ④Non-biological catalyst ⑤Inactivation ⑥

Denaturation ⑦Pepsin ⑧Amylase

⑨Trypsin

<01-4-04> ①Biological washing powder ②Brewing ③Tanning ④Baking

<Sample question>

1. A red blood cell and a plant root hair cell both have...

- A. Cell wall. B. A large surface area.
C. Haemoglobin. D. A nucleus.

2. The temperature of the environment of an enzyme is raised from 20°C to 30°C. Which of the statements below best describes the enzyme activity after the temperature rise?

- A. The enzyme would be denatured. B. The enzyme reaction rate would be higher.
C. The enzyme activity would be at optimum. D. The enzyme would now catalyze the reaction.

3. A mixture of food gives the following results on testing:

1. A purple colour in the biuret test.
2. A blue colour when heated with Benedict's solution.
3. A yellow colour with iodine.
4. A white emulsion with ethanol.

What does the mixture contain?

- A. Fat and protein. B. Protein and reducing sugar. C. Reducing sugar and starch.
D. Starch and fat.

<Answer> 1. B. 2. B. 3. A.

UNIT 02 Nutrition

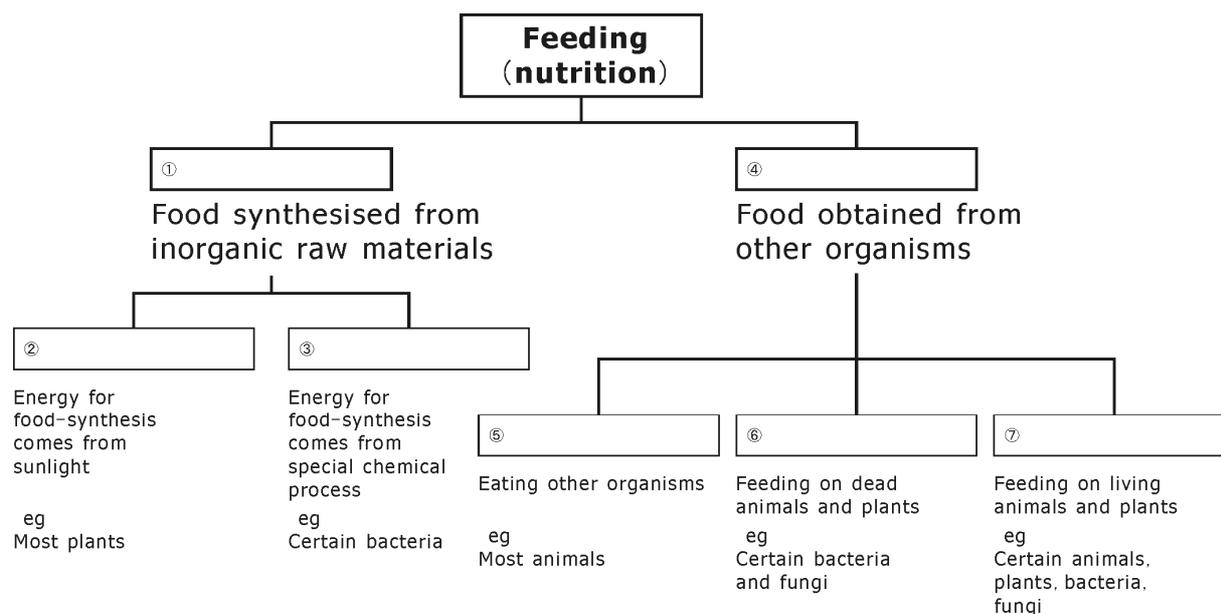
Objectives

- 02-1 Describe the importance of nutrients.
- 02-2 Explain the process of photosynthesis.
- 02-2 Demonstrate the conditions necessary for photosynthesis.
- 02-2 Explain how leaves are adapted to carry out photosynthesis.
- 02-3 Describe the dental formula.
- 02-3 Identify and illustrate the main regions of the alimentary canal.
- 02-3 State the main functions of the parts of the alimentary canal.

02-1 Classes of nutrients

02-1-01 Types of feeding.

→ There are two principle methods of obtaining food, called autotrophic and heterotrophic nutrition.



→ Autotrophic organisms (**autotrophs**) can build up all the organic molecules they need from simple inorganic substances.

→ Heterotrophic organisms (**heterotrophs**) use ready-made organic compounds as their food source.

→ The heterotrophs digest the organic compounds to simpler substances and absorb the products into their bodies.

→ **Saprotrophs** decompose dead organisms. Decomposition makes available nutrients.

→ Saprotrophic bacteria help in the recycling of carbon and nitrogen.

Activity 02-1-01: Name the type of nutrition ①-⑦.

02-1-02 Introduction about food.

→ **Source of energy** for the body.

→ Eaten in the right amounts and types, it leads to good health.

→ It serves to; **supply energy**, promote body **growth** and **repair** of tissues, **regulate** body functions.

→ **Carbohydrates**, **fats**, and **proteins** are nutrients that provide energy.

→ **Vitamins**, **mineral salts**, and **water** are not digested. They are used to regulate body function.

→ **Dietary fibre** is important in preventing constipation.

02-1-03 Carbohydrates.

→ Contain compounds of carbon, hydrogen, and oxygen in the ratio of **1:2:1**.

→ Provide **energy** during respiration (**glucose**, other sugars).

→ **Store** energy until using respiration (**starch**, **glycogen**).

→ Material of **cell wall** (**cellulose**).

Carbohydrate	Types	Sources	Function
① _____ (simple sugar)	Glucose	Fruits	Provide energy
	Fructose	Vegetables	Converted into glycogen for storage
	Galactose		
② _____ (complex sugar)	Sucrose	Sugar cane	Excess is stored as fats
	Maltose	Beetroot	
	Lactose	Milk	

③	Starch	Potatoes	Used in synthesis of DNA
	Cellulose	Cereal	Composed of cell wall
	Glycogen	Bread	

Activity 02-1-03: Name the type of carbohydrate ①-③.

02-1-04 Fats and lipids.

- Composed of carbon, hydrogen, and oxygen.
- Oils (fatty acids and glycerol) are liquid at room temperature, while waxes are solid at room temperature.
- Provide much energy. Keep water out on the surface of the body. Keep mammals and birds warm.
- There are saturated and unsaturated fats.
- Saturated fats increase the level of cholesterol in the blood. It may be deposited on the inner surface of the artery, causing an obstruction in the blood flow.

Fats	Sources	Function
Saturated	Butter	Provide energy
	Animal fats	Medium for intake of vitamin A,D,E,K
Unsaturated	Fish oil	Synthesis of cell membrane
	Vegetable oil	Insulation layer under skin
		Protect organs from physical injury

02-1-05 Proteins.

- Composed of carbon, hydrogen, oxygen, and **nitrogen**. May contain **sulphur** and **phosphorous**.
- Made up of large numbers of amino acids linked together by **peptide bonds**.
- Lack of proteins leads to **kwashiorkor**.

Sources	Function
Lean meat, Fish	Growth of new tissue

Eggs, Liver	Replacement of cell components
Milk, Cheese	Build up body structure like hair and nails
Soya beans	Function of muscles, tendons and ligaments
Cereals	Formation of enzymes, hormones and antibodies

02-1-06 Description of food test (it usually comes in Biology Paper3 Practical test).

1. Starch test

* Methods:

1. Put 3 cm³ of a solution in a test tube.
2. Add 3 drops of **iodine solution** to the test tube. Shake gently and observe.

* Two possible observations:

→ The colour changed as follows: from ① _____ - ② _____ - ③ _____ - ④ _____

→ The colour changed to **light brown**. (Note that light brown is natural colour of iodine solution.)

* Results of each observation:

- Starch is present in the solution.
- Starch is absent in the solution.

2. Reducing sugar test

→ The brick-red precipitate obtained is due to the fact that monosaccharide reduces the **copper (II) ions** in the Benedict's solution to **copper (I) ions**. Maltose also reacts in a similar way with Benedict's solution.

* Methods:

1. Put 2 cm³ of a solution in a test tube.
2. Add 2 cm³ of **Benedict's solution** to the test tube. Shake gently.
3. Boil the contents using a water bath. Observe.

* Two possible observations:

→ The colour changed as follows: from ⑤ _____ - ⑥ _____ - ⑦ _____ - ⑧ _____
- ⑨ _____

→ The colour changed to **blue**. (Note that blue is natural colour of Benedict's solution.)

* Results of each observation:

→ Reducing sugar is present in the solution.

→ Reducing sugar is absent in the solution.

3. Protein test

→ When a few drops of **sodium hydroxide solution** are added to a food substance which contains proteins, followed by the addition of **copper sulphate solution**, purple colour is obtained. This test is called biuret test for protein.

* Methods:

1. Put 2 cm³ of a solution in a test tube.

2. Add 5 drops of 5% sodium hydroxide solution to the test tube.

3. Add 2 drops of 1% copper sulphate solution drop by drop, shaking at each drop and observing.

Or in place of 2 and 3,

2'. Add 5 drops of biuret reagent to the test tube. Observe. (If the reagent has been prepared.)

* Two possible observations:

→ The colour changed from ⑩ _____ to ⑪ _____.

→ The colour changed to **blue**. (Note that blue is natural colour of biuret reagent.)

* Results of each observation:

→ Protein is present in the solution.

→ Protein is absent in the solution.

4. Lipid test

→ The presence of lipids can be determined in two ways: by emulsion test or by brown paper test.

* Methods:

1. Put 3 cm³ of a solution in a test tube.

2. Add some ethanol to the test tube. Shake thoroughly.

3. Add little distilled water to the test tube contained lipid-ethanol mixture. Observe.

* Two possible observations:

→ The mixture turned **cloudy**.

→ The mixture did not change.

* Results of each observation:

→ Lipid is present in the solution.

→ Lipid is absent in the solution.

5. Non-reducing sugar test

→ **After confirming** that reducing sugar is absent in the solution by conducting reducing sugar test, you will conduct non-reducing sugar test.

* Methods:

1. Put 2 cm³ of a solution in a test tube.

2. Add 2 cm³ of dilute hydrochloric acid (HCl) solution to the test tube.

3. Boil the mixture by using water bath, and then allow it cool.

4. Add some sodium hydrogen carbonate (NaHCO₃) solution to the test tube, and then allow it stop fizzing (bubbling).

5. 2 cm³ of **Benedict's solution** to the test tube. Shake gently.

6. Boil the contents using a water bath. Observe.

* Two possible observations:

→ The colour changed as follows: from ⑫ _____ - ⑬ _____ - ⑭ _____ - ⑮ _____
- ⑯ _____

→ The colour changed to **blue**.

* Results of each observation:

→ Non-reducing sugar is present in the solution.

→ Non-reducing sugar is absent in the solution.

* Meaning of solutions:

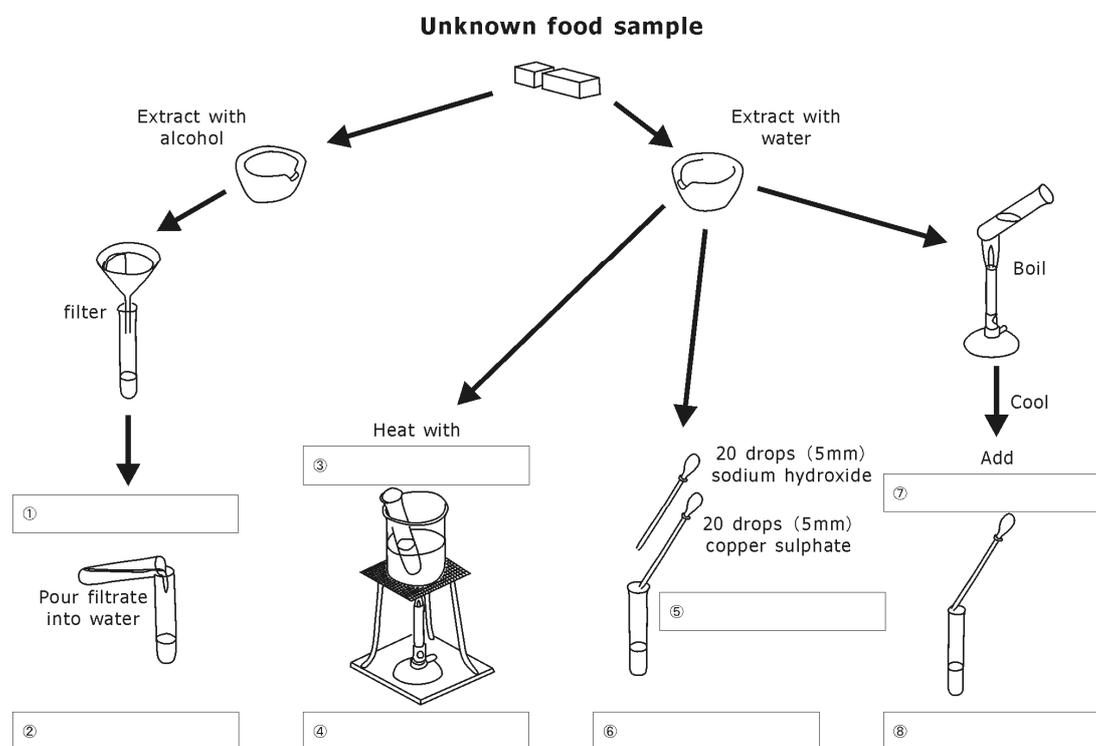
> HCl : hydrolysis of non-reducing sugar.

> NaHCO₃ : neutralization of solution.

Activity 02-1-06: Write the colour ①-⑩.

02-1-07 Food test series.

→ When you use **unknown food sample**, try to do the following ways.



Activity 02-1-07: Name the food substance or nutrients ①③⑤⑦. Name the food test ②④⑥⑧.

02-1-08 Minerals.

→ **Inorganic** chemical elements.

→ Regulate body processes. Not stored in the body. Quickly used or lost.

Minerals	Sources	Function	Deficiency
Calcium	Milk, Cheese	Harden of bones and teeth	Rickets (children)
	Fish	Muscle contraction	Soft bones
		① _____	
Iron	Liver, Kidney	Form haemoglobin in	② _____

		blood	
	Egg, Lean meat		Tiredness
Phosphorus	All foods	Form DNA and ATP Harden of bones and teeth	Weakness Soft bones
Iodine	Drinking water	Form thyroxine	③ _____
Fluorine	Drinking water	Prevent tooth decay	Bad teeth

Activity 02-1-08: Name the process ①. Name the deficiency ②③.

02-1-09 Vitamins.

→ **Organic** compounds. Required on small quantities.

→ There are **water soluble vitamin** (BC) and **fat soluble vitamin** (ADEK).

Vitamins	Sources	Function	Deficiency
A (Retinol)	Liver	Healthy growth	① _____
	Carrot	Maintenance of skin tissue Formation of pigments in eye	Poor skin
D (Calciferol)	Fish liver oil	Harden bones and teeth	Rickets in children
	Dairy products	Absorption of phosphorous and calcium	Soft bones
K	Cabbage	Blood clotting	Long clotting time
	Spinach		
B1 (Thiamin)	Cereals	Help enzymes in respiration	Wasting of muscle

	Yeast		②
B2 (Riboflavin)	Leafy vegetables	Help enzymes in respiration	Sore mouth
	Fish, Eggs		ulcers
B12 (Cyanocobalamin)	Meat, Fish	Formation of red blood cells	Anaemia
	Dairy products		
C (Ascorbic acid)	Citrus fruits	Formation of connective tissue	③
	Green		
	vegetables		

Activity 02-1-09: Name the deficiency ①-③.

02-1-10 Fibre (Roughage).

→ Consists of carbohydrates, mainly **cellulose** and **lignin**.

→ Not digested by the human body.

Sources	Function
Fruits, Vegetables	Stimulate peristalsis
Bread, Cereals	Prevent constipation

02-1-11 Water.

→ Lost urine, perspiration and breathing.

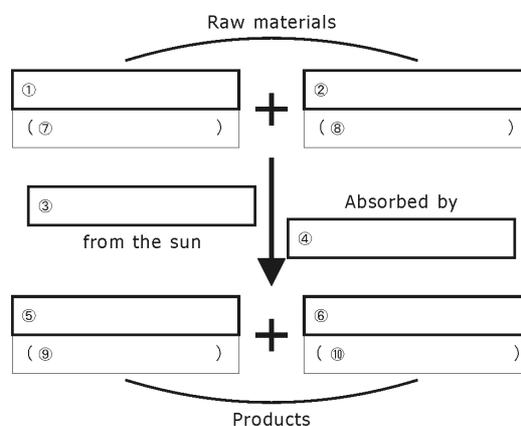
→ If not replaced, the body gets dehydrated.

Function	Mode of action
Transport	Main constituent of blood and fluids
	Medium for transport of nutrients, hormones
Reactions	Solvent for chemical reactions
	Hydrolytic reactions during digestion
Lubrication	Constituent of synovial fluids in joints and

mucus	
Homeostasis	Sweating cools the body (heat of vaporization)

02-2 Nutrition in plants

→ Green plants make their own food (meaning autotrophic) by using inorganic substances to build up (meaning anabolism) organic substances from sunlight.



02-2-01 Equation of photosynthesis.

→ **Photosynthesis** is the process by which green plants make glucose from carbon dioxide and water in the presence of light.

→ The light energy is trapped by a green pigment called chlorophyll which is found in small sacs called chloroplasts.

Activity 02-1-01: Name the chemical ①②⑤⑥. Write the material ③④. Write the molecular formula ⑦-⑩.

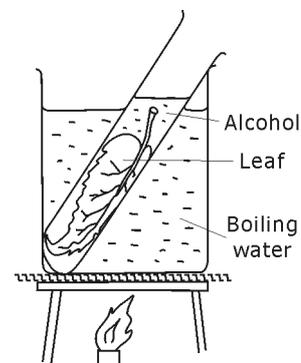
02-2-02 Experiments involved in photosynthesis.

02-2-02A Let's try EXP: Testing a leaf for starch.

* Suggested materials: a leaf / alcohol / water bath system / iodine solution

* Methods:

1. Detach a leaf from a plant that has been exposed to light.
2. Boil it in water (**to make it soft and to stop the chemical reactions**).
3. Boil the leaf in alcohol using a water bath (**to remove chlorophyll and decolourise**).



4. Wash the leaf in warm water (**to remove alcohol and to make it soft since alcohol makes the leaf brittle**).
5. Spread the bleached leaf on a white tile or Petri dish.
6. Add drops of iodine solution.

* Questions:

1. Explain why chlorophyll is removed before adding drops of iodine solution.
2. Why should the chemical reaction be stopped in this experiment?
3. Account for the use of the water bath in the experiment.

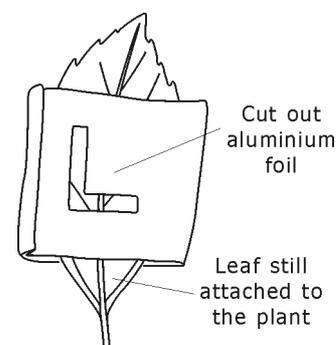
* Hints: The colour of chloroplasts.

02-2-02B Let's try EXP: To show whether light is necessary for photosynthesis.

* Suggested materials: potted Geranium plant / aluminium foil / razor blade / paper clips

* Methods:

1. The plant is destarched by leaving it in complete darkness for at least 24 hours. (**Destarching**)
2. Test one of the leaves for starch (**to ensure that it does not contain any starch**).
3. Arrange the experiment as shown in figure.
4. Leave the plant in light for 4 to 6 hours (**photosynthesis**).
5. Make a diagram of the leaf and label the covered and the uncovered parts.
6. Remove the cover and test the leaf for starch.



* Questions:

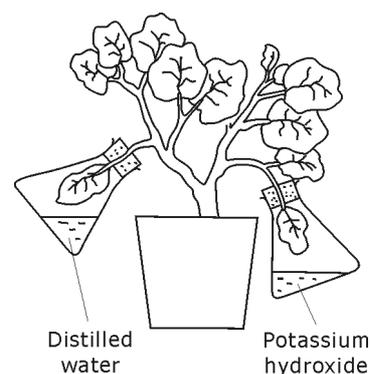
1. Which part of the leaf shows colour changes?
2. What conclusion can you make from the experiment?
3. What is the control for this experiment?

* Hints: Which parts of the leaf were lighting.

02-2-02C **Let's try** EXP: To see if carbon dioxide is necessary for photosynthesis.

* Suggested materials: potted Geranium plant / Vaseline / conical flasks / distilled water

rubber bungs / potassium hydroxide or sodium hydroxide (**soda lime**)



* Methods:

1. Destarch the leaves.
2. Arrange the apparatus as shown in figure.
3. Leave the plant in light for 4 to 6 hours.
4. Test each leaf in the flask for starch.

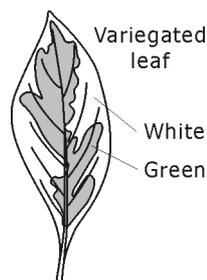
* Questions:

1. What is the purpose of using potassium hydroxide in this experiment?
2. What role is the flask with distilled water playing in this experiment?

* Hints: Soda lime would absorb carbon dioxide.

02-2-02D **Let's try** EXP: To show that chlorophyll is necessary for photosynthesis.

* Suggested materials: **plant with variegated**



leaves / pencil

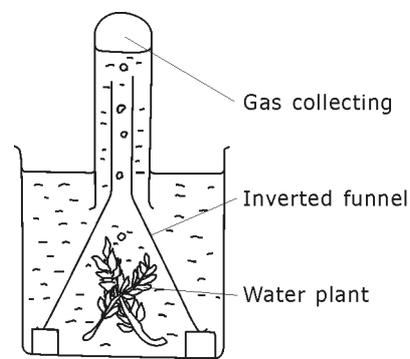
* Methods:

1. Destarch the plant with variegated (green and white) leaves.
2. Leave the plant in sunlight for 4 to 6 hours.
3. Draw a leaf and label the green and white parts.
4. Test the leaf for starch.

* Questions:

1. Which parts of the leaf show colour changes?
2. What was the control in this experiment?

02-2-02E **Let's try** EXP: To investigate if oxygen is



produced during the process of photosynthesis.

* Suggested materials: water plant / test-tube / beaker / funnel / water / glowing splint

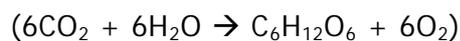
* Methods:

1. Using a water weed eg. Elodea or Hydrilla, arrange the apparatus as shown in figure.
2. Leave the apparatus in sunlight until enough gas has been collected.
3. Without allowing the gas escape, carefully remove the test-tube.
4. Put a glowing splint into a gas. **If it bursts into a flame, then the gas is oxygen.**

This method is usually used to check the presence of oxygen.

02-2-03 Process of photosynthesis.

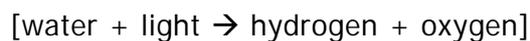
→ Whole equation summarises a series of chemical reactions which take place in **chloroplasts**.



→ In fact, carbondioxide and water do NOT combine directly.

→ The reaction occurs in two stages called light reaction and dark reaction.

Light reaction: Using light energy, water split into hydrogen and oxygen.

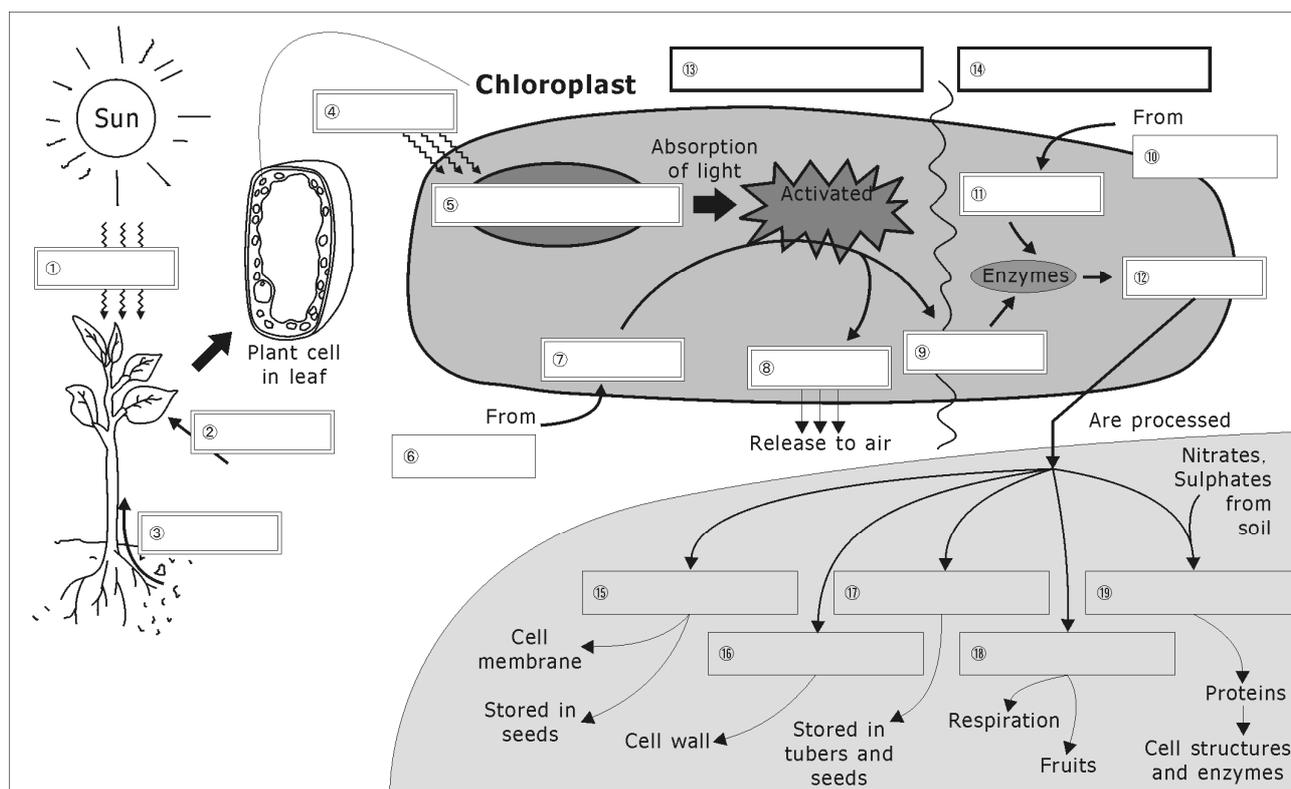


Dark reaction: Not use light. By several enzymatic reactions, hydrogen combines carbon dioxide to form glucose.



→ (Equation of light reaction) + (Equation of dark reaction) =

water + carbon dioxide + light → oxygen + glucose (note: it's same as the word equation of photosynthesis.)



→ Water: From the soil, through the roots, by osmosis.

→ Carbon dioxide: From the atmosphere, through stomata in leaves, by diffusion.

Activity 02-2-03: Write the material ①④⑤. Name the chemical ②③⑦⑧⑨⑪⑫. Name the place ⑥⑩.

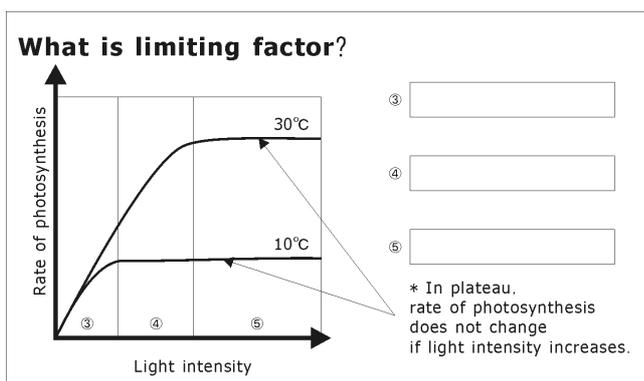
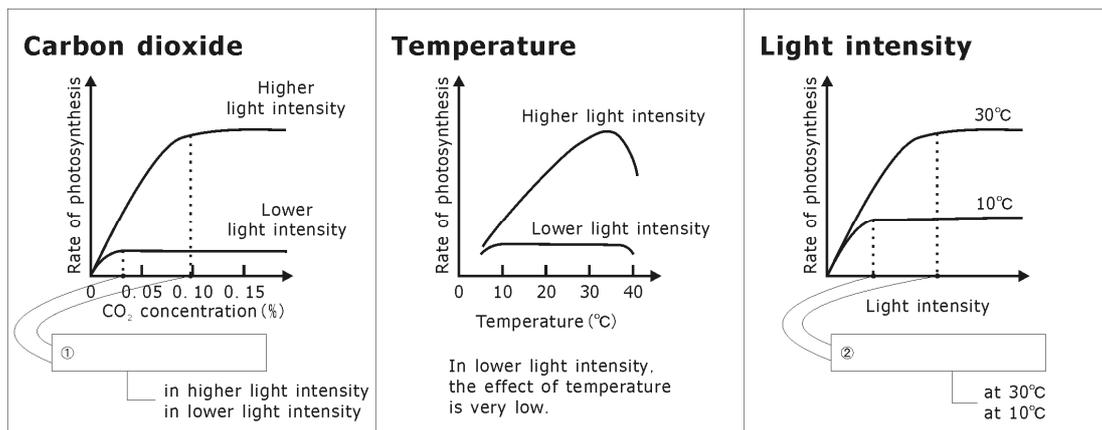
Name the reaction ⑬⑭. In terms of the fate of glucose, name the chemical ⑮-⑲.

02-2-04 Three factors affected for photosynthesis and the limiting factor.

→ The rate of the light reaction will depend on the **light intensity**.

→ The rate of the dark reaction will be affected by **temperature** and **carbon dioxide concentration**.

→ When light intensity is increased to certain brightness, the rate of photosynthesis does not increase further.



→ Any one of the external factors such as temperature, light intensity or carbon dioxide concentration, may limit the effects of the other two.

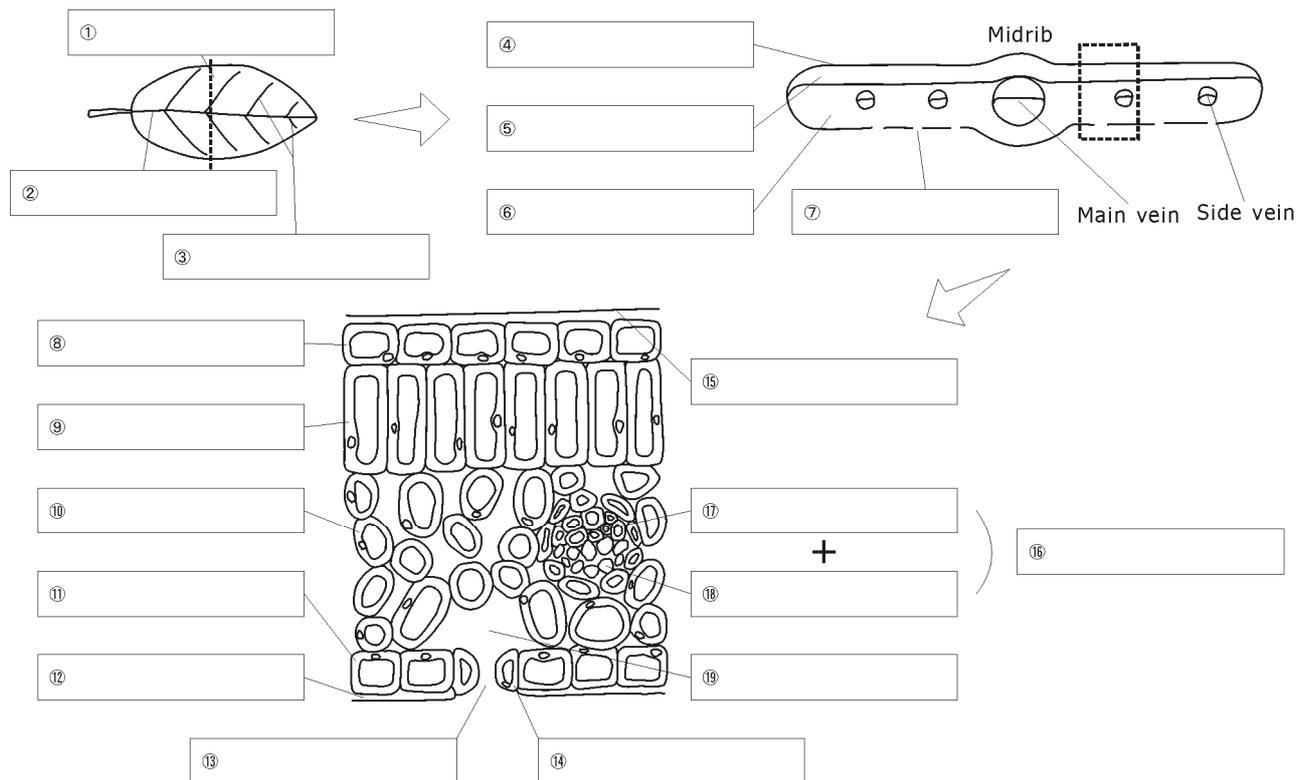
← In each range ③④⑤, limiting factors are different.

Activity 02-2-04: Name the point ①②. Write the limiting factor ③-⑤.

02-2-05 Structure of a leaf.

- The main organ of photosynthesis in green plants is the leaf.
- Chloroplasts are present in abundance in leaves. Water and carbon dioxide combine in the chloroplasts.
- The structure of the leaf enables light, carbon dioxide and water to reach the chloroplasts efficiently.
- Vein contains vascular bundles which are made up of xylem vessels and phloem tubes.

→ Although the leaf appears to be thin, it is made up of several layers of cells.



→ **Waxy cuticle:** Reduces the loss of water by evaporation.

→ Upper **epidermis:** Are transparent and do not contain chloroplasts.

→ Mesophyll layer, **Palisade cells:** Contain lots of chloroplast, and are closely packed. Main site for photosynthesis.

→ Mesophyll layer, **Spongy cells:** Contain chloroplasts, and are loosely arranged.

→ **Stoma:** The place where gaseous exchange takes place, and locates mainly lower epidermis.

→ **Guard cells:** Surrounds stoma, contains chloroplasts, and control the opening and closing of stomata.

Activity 02-2-05: Identify the part of a leaf ①-⑱.

02-2-06 Adaptation of a leaf for photosynthesis.

→ When biologists say that something is adapted, they mean that its structure is well suited to its function.

Structure	Adaptation	Results
-----------	------------	---------

Leaf	① _____	Trapping as much light and carbon dioxide as possible
Lamina	② _____	Efficient penetration of light and diffusion of gases
Stomata	③ _____	Taking in carbon dioxide
Palisade cells	④ _____	Trapping as much light as possible
Spongy layer	⑤ _____	Rapid diffusion of carbon dioxide
Vascular bundle	⑥ _____	Bringing water to the intercostal cells and taking away glucose

Activity 02-2-06: List the adaptation of each structure ①-⑥.

02-2-07 Importance of photosynthesis.

- The organic substances produced in photosynthesis are used later by animals and non-photosynthetic plants.
 - Thus, in all ecosystems, plants are the producers on which consumers depend for energy and nutrients.
 - Green plants help to **maintain** 0.03% of carbon dioxide in the air during photosynthesis.
 - **Provide** oxygen to organisms for respiration.
-

02-3 Animal nutrition

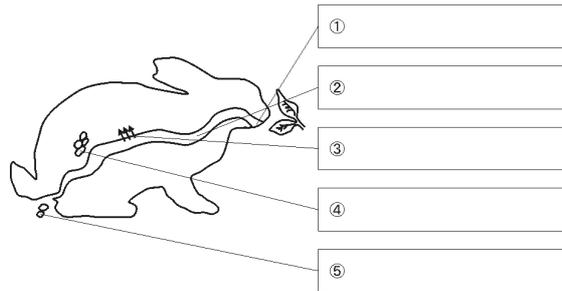
→ Unlike plants, animals take in large, complex food molecules. This type of nutrition is called holozoic nutrition.

02-3-01 Feeding processed for alimentary canal.

→ Holozoic type of nutrition in animals involves the following processes;

1. **Ingestion:** Food is taken into the alimentary canal through the mouth.

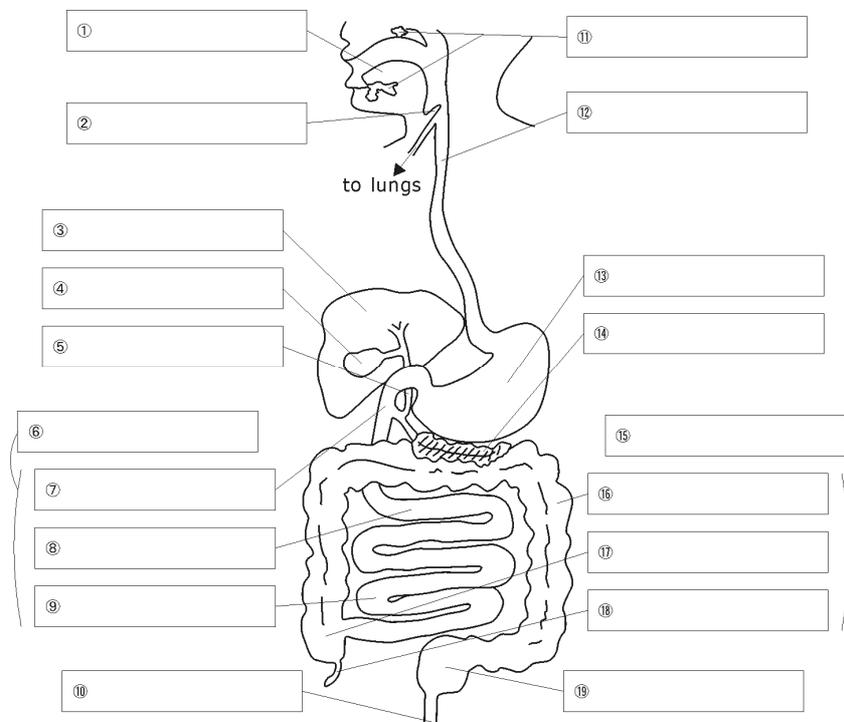
2. **Digestion:** The food is broken down into soluble substances.
3. **Absorption:** The soluble products of digestion are absorbed into the bloodstream and transported round the body.
4. **Assimilation:** The soluble products of digestion are taken into the cells.
5. **Egestion:** Components of the food which cannot be digested are got rid of through the anus.



Activity 02-3-01: Write the process ①-⑤.

02-3-02 Overview of alimentary canal in human.

- The alimentary canal is a tube running through the body.
- It runs from the mouth to the anus of any mammals.

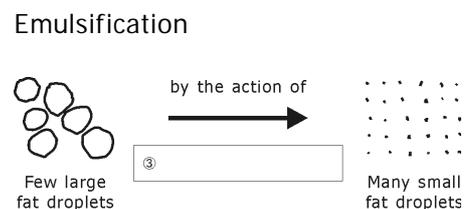
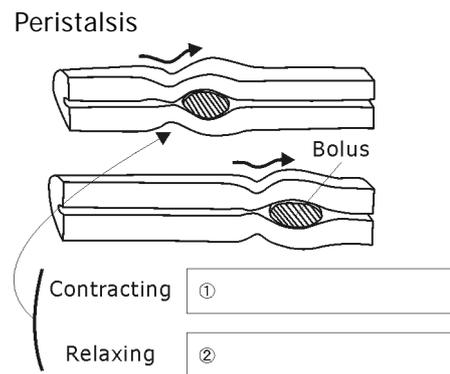


Activity 02-3-02: Identify the part of human digestive system ①-⑱.

02-3-03 Description of alimentary canal.

→ Different parts of the alimentary canal are adapted to carrying out these processes.

Structure	Function
Teeth	Physical digestion by mastication (cutting and grinding)
Salivary glands	Chemical digestion of starch
Oesophagus	Move food down to stomach by peristalsis (See right)
Stomach	Store food for 2-6 hours Secretion of hydrochloric acid to kill bacteria and provide acidic pH for functioning pepsin Chemical digestion of proteins Absorption of water, alcohol, drugs
Pancreas	Secretion of digestive enzymes for starch, protein, fat Secretion of insulin for stimulating glycogen synthesis
Liver	Production of bile , storing in gall bladder, for emulsification of fats (See right) Bile salts provide alkaline pH for functioning trypsin
Duodenum	Secretion of digestive enzymes for protein/peptide and starch/disaccharide
Ileum	Absorption of food substances
Colon	Absorption of water



	Form faeces
Rectum	Store faeces before defaecation

Activity 02-3-03: Name the muscle ①②. Name the chemical ③.

02-3-04 Digestion.

→ Digestion in mammals is divided into two ways;

1. ① _____ : Mastication by the teeth. Rolling action by tongue.

Peristalsis.

2. ② _____ : Action of **digestive enzymes** (See below). Hydrolysis.

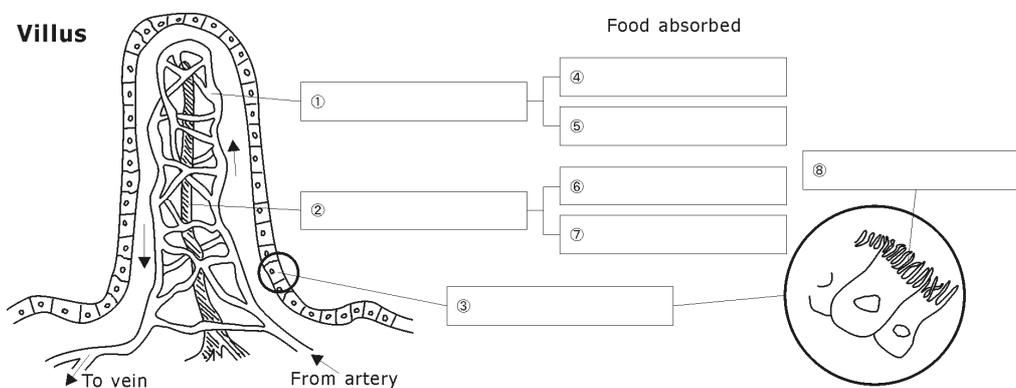
Juice	Source	Site of action	Enzymes	Substrate	Product
Saliva	Salivary glands	Mouth cavity	③ _____	Starch	Maltose
Gastric	Stomach wall	Stomach	④ _____	Protein	Polypeptides
Bile	Liver	Duodenum	Bile salts (not enzyme)	Fats	Fat droplets
Pancreatic	Pancreas	Duodenum	⑤ _____	Starch	Maltose
			⑥ _____	Protein	polypeptides
			⑦ _____	Fats	Fatty acids and glycerol
Intestinal	Wall of small intestine	Small intestine	⑧ _____	Maltose	Glucose
			⑨ _____	Sucrose	Glucose and Fructose
			⑩ _____	Lactose	Glucose and Galactose
			⑪ _____	Polypeptides	Amino acids

Activity 02-3-04: Name the process ①②. Name the enzyme ③-⑪.

02-3-05 Absorption in ileum.

→ Ileum is long (5m) and folded thereby presenting an enormous surface area for absorption.

→ Ileum has numerous projections on its surface called **villi** (singular = villus). These further increase the surface area.



→ Each villus is divided into tiny **microvilli** which also greatly increase the surface area for absorption.

→ Larger surface area gets more chance to absorb the food substances.

→ Each villus has a dense network of blood capillaries which monosaccharides and amino acids are absorbed into it.

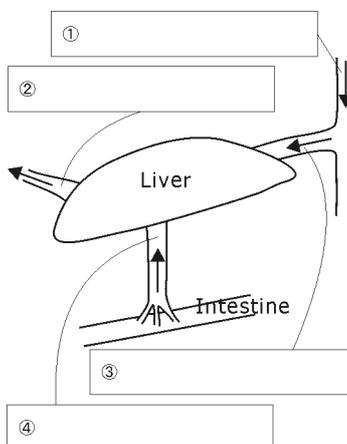
→ Each villus contains a lacteal which fatty acids and glycerol are absorbed into it.

→ Lacteal is the part of the lymphatic system.

Activity 02-3-05: Identify the structure ①③⑧. Name the food substance ④-⑦.

02-3-06 Associated vessels in the liver.

→ Food substances absorbed in the capillaries in villi move to the liver for assimilation.



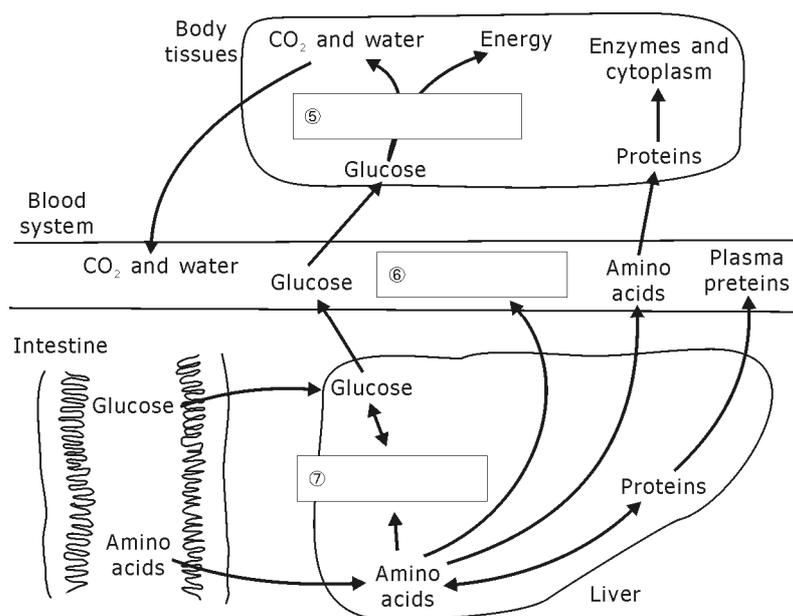
Activity 02-3-06: Name the blood vessel ①-④.

02-3-07 Function of the liver.

→ Liver plays an important role in metabolism, homeostasis and excretion.

→ The functions of the liver can be classified into five major groups;

1. Metabolic function.
2. Circulatory function.
3. Excretory function.
4. Protective function.
5. Haematologic function.

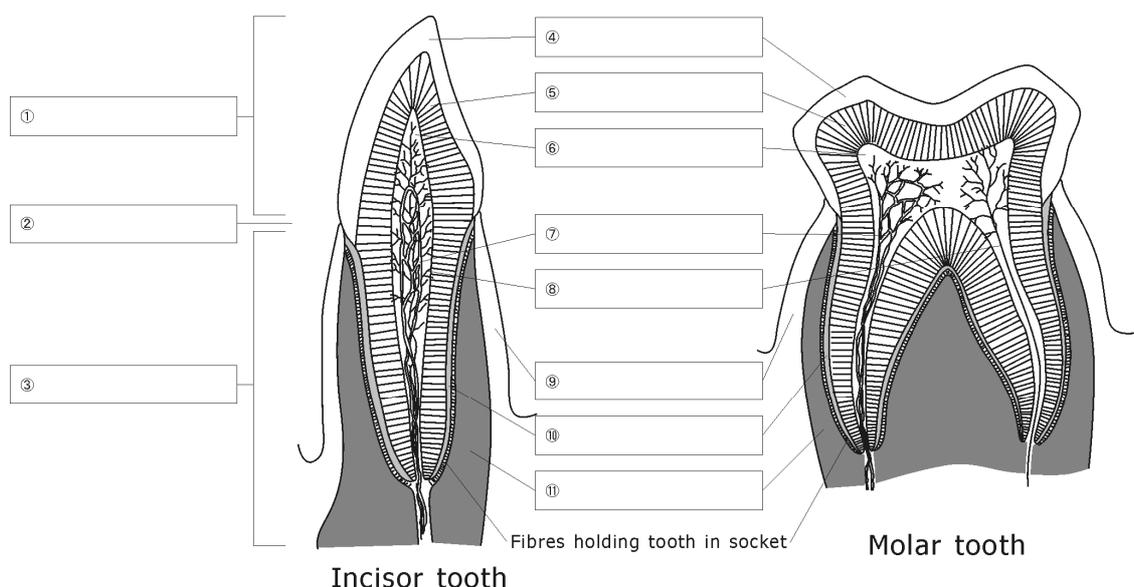


Function	Mode of action
Metabolism of glucose	Convert excess glucose to ⑧ _____ Maintain constant glucose level in the blood
Metabolism of amino acids	Deaminate excess amino acids and produces ⑨ _____ Convert excess amino acids to glycogen
Production of bile	Break down old red blood cells and makes bile
Synthesis of plasma protein	eg. prothrombin and fibrinogen; they are used for blood clotting.
Detoxification	Destroy poisons, alcohol and bacteria
Storage of minerals	eg. iron, copper, potassium
Storage of vitamins	eg. vitamin A and D
Production of heat	There are many chemical reactions in the liver that produce a lot of heat which is used in maintaining the body temperature

Activity 02-3-07: Name the process ⑤. Write the chemical ⑥-⑨.

02-3-08 Tooth structure.

- Mechanical digestion is carried out in the mouth by the action of the teeth and the tongue.
- Although teeth may differ in shape, they all have the same structure.



→ Each tooth has three parts, the **crown**, the **neck** and **root**. The crown is above the jaw bone. The root is embedded in the jaw bone and is held firmly by cement and fibres growing out of it.

→ A tooth is made up of **enamel**, **dentine** and **pulp cavity**.

→ **Enamel** is a non-living substance. It is the hardest substance made in animals and contains a lot of phosphate and calcium salts and it prevents wearing of the tooth. Enamel can be dissolved by acids.

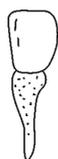
→ **Dentine** is similar to bone in structure. It is non-living but has strands of living cytoplasm penetrating it. The cells, from which these cytoplasmic strands extend, are able to add move dentine to the inside of a tooth.

→ In the middle of the dentine of a tooth, is a cavity known as the **pulp cavity**. This contains nerves and blood capillaries. The blood capillaries supply the nerves and cytoplasm in the dentine with food and oxygen. The nerves are sensitive to heat, cold and pressure.

Activity 02-3-08: Identify the part of teeth ①-⑪.

02-3-09 Types of teeth.

→ There are four different types of teeth in mammals. These are incisors, canines, premolars and molars. Each type of teeth is adapted for a specific function.



①



②



③



④

* Functions of the different types of teeth:

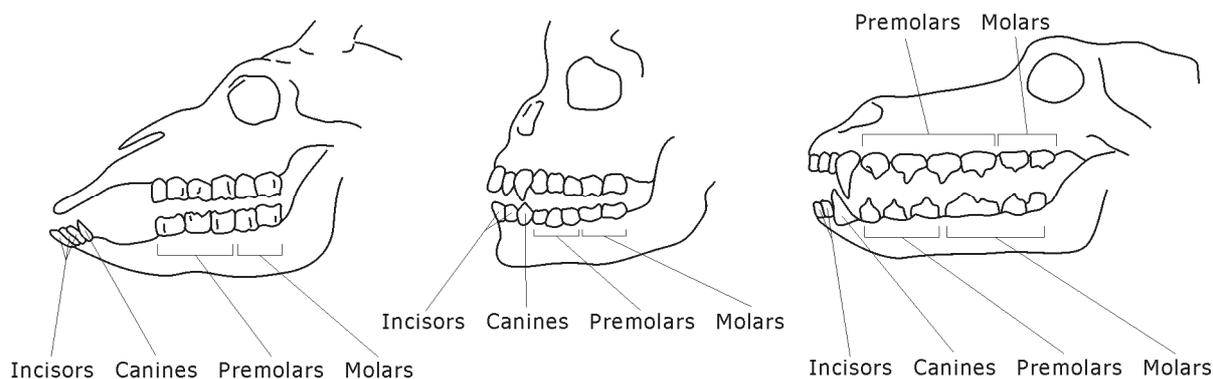
	Herbivore	Omnivore	Carnivore
Incisors	Chisel shaped and sharp edged. Quite large to cut grass and leaves	Chisel shaped and sharp edged. Not very large to cut off pieces of food.	Almost pointed and much smaller. Used for gripping food.
Canines	Usually absent. If present very small and vestigial.	Pointed and about the same size as incisors. To tear pieces of food.	Long and pointed. Prominent and used for killing prey and tearing flesh.
Premolars/ Molars	Broad with ridged top surface for grinding the leaves and grass.	Broad with two ridges on top of surface. Used for crushing and grinding the food.	Have sharp cutting edges. Used for chopping food into pieces.

Activity 02-3-09: Name the type of teeth ①-④.

02-3-10 Dentition.

→ Dentition refers to the type and arrangement of teeth in an animal.

→ Teeth arrangement in an animal is specially modified and adapted to the type of nutrition.



→ Dentition of a mammal can be represented conveniently by means of a **dental formula**.

This shows the type and number of teeth in one half of each jaw.

	Herbivore	Omnivore	Carnivore
mode of nutrition	plant	plant and animal	animal
example of dental formula	goat i:0/3 c:0/1 pm:3/3 m:3/3	human i:2/2 c:1/1 pm:2/2 m:3/3 rat i:1/1 c:0/0 pm:0/0 m:3/3	dog i:3/3 c:1/1 pm:4/3 m:2/3 cat i:3/3 c:1/1 pm:3/2 m:1/1
diastema	They have a diastema between incisors and premolars.		
Feeding action	Jaws move in circular and sideways motion.	Jaws move up and down. Grind food with lateral movements (side to side) of lower jaw	Jaws move up and down. Scissor-like action

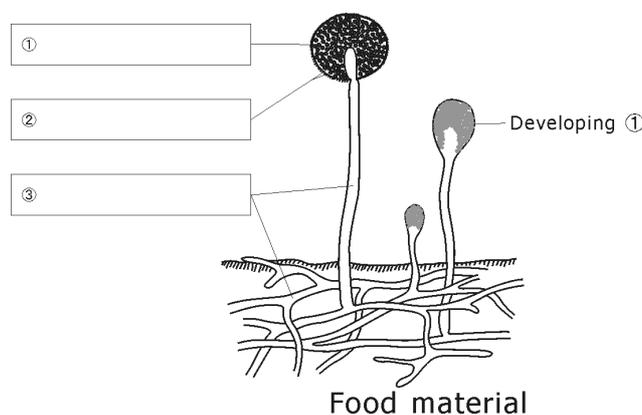
02-3-11 Saprophytic nutrition.

→ Some heterotrophs obtain their food from organic material of dead organisms. This mode of nutrition is called **saprophytic nutrition**. The organism that obtains food by this type of nutrition is called a **saprophyte**.

→ eg. Many bacteria and fungi, such as mushrooms, moulds, and yeasts.

→ **Rhizopus** is a mould that forms a network of small strands on its food. It grows on different kinds of food substances such as bread, fruits and nshima. The mould grows when these substances are left in warm, moist conditions for sometime.

→ **Hyphae** (stolons and rhizoids) secrete enzymes onto the substrate. Then the complex food substances are broken down (digested) to simple, soluble ones.



* Importance of saprophytic nutrition:

→ Saprophytic bacteria help in the recycling of carbon and nitrogen due to the action of decomposition of dead organisms.

→ Some moulds such as *Penicillium* are used in the production of antibiotics,

④ _____.

→ Saprophytes are also used in baking, production of dairy products like cheese and brewing of alcohol.

Activity 02-3-11: Identify the part of the organism ①-③. Name the antibiotic ④.

<Creativity> Possibility of artificial photosynthesis

When you mix water, carbon dioxide and chlorophyll in a beaker, and leave the beaker in light,

what will happen?

Does glucose make in the beaker?

If you can make chlorophyll on your body, is it possible to live without feeding?

<Creativity> Preventing oxidation in the cell.

In chemistry, oxygen is caused oxidation. For example, iron will oxidized to ferrous oxide or ferric oxide and the property will also change. They are completely different substance.

As the same way, living organisms and the cells are processed oxidation during aerobic respiration. It means that components of the cell will be oxidized, leading to change the structure of the cells.

However, cells seem to be able to keep their structure their structure longer than chemical oxidation. How do cells keep their structure? How do they prevent oxidation?

<Creativity> New gene

The genetic properties and natures are inherited through genes in all organisms.

But only in human, knowledges may be 'inherited' through languages and letters.

We can understand ancient histories from some old books.

Consider that languages and letters are 'genetic substances' or not.

Give your own idea.

<Calculation> How old are human beings? Let's compare to the earth history.

Earth: 5 billion-year-old

Human being: 4 million-year-old

Suppose that earth origin is 0:00 hours, present day is 24:00. What time do human beings appeared?

Unit 02 Answers for the activities

<02-1-01> ①Autotrophic nutrition ②Photosynthesis ③Chemosynthesis ④Heterotrophic nutrition ⑤Holozoic nutrition

⑥Saprotrophic nutrition ⑦Parasitic nutrition

<02-1-03> ①Monosaccharide ②Disaccharide ③Polysaccharide

<02-1-06> ①brown ②green ③blue ④bluish-black ⑤blue ⑥green ⑦yellow ⑧orange ⑨brick-red ⑩blue ⑪purple ⑫blue

⑬green ⑭yellow ⑮orange ⑯brick-red

<02-1-07> ①Fat ②Emulsion test ③Benedict's solution ④Reducing sugar test ⑤Protein ⑥Biuret test ⑦Iodine solution

⑧Starch test

<02-1-08> ①Blood clotting ②Anaemia ③Goitre

<02-1-09> ①Night blindness ②Beri-beri ③Scurvy

<02-2-01> ①Carbon dioxide ②Water ③Energy ④Chlorophyll ⑤Glucose ⑥Oxygen ⑦ 6CO_2 ⑧ $6\text{H}_2\text{O}$ ⑨ $\text{C}_6\text{H}_{12}\text{O}_6$ ⑩ 6O_2

<02-2-03> ①Light ② CO_2 ③ H_2O ④Light ⑤Chlorophyll ⑥Soil ⑦ H_2O ⑧ O_2 ⑨ H^+ (Proton) ⑩Air ⑪ CO_2 ⑫Glucose

⑬Light reaction ⑭Dark reaction ⑮Oil ⑯Cellulose ⑰Starch ⑱Sucrose ⑲Amino acids

<02-2-04> ① CO_2 saturation point ②Light saturation point ③Light intensity ④Temperature ⑤No factor, because of saturation

<02-2-05> ①Lamina ②Mid vein (Mid-rib) ③Lateral vein ④epidermis ⑤palisade mesophyll ⑥spongy mesophyll ⑦stoma

⑧Upper epidermis ⑨Palisade mesophyll ⑩Spongy mesophyll ⑪Lower epidermis ⑫Cuticle

⑬Stoma ⑭Guard cell ⑮Cuticle

⑯Vascular bundle ⑰Xylem ⑱Phloem ⑲Air space

<02-2-06> ①Large surface area ②Thin ③Numerous number ④Lots of chlorophyll ⑤Large air spaces ⑥Presence

<02-3-01> ①Ingestion ②Digestion ③Absorption ④Assimilation ⑤Egestion

<02-3-02> ①Tongue ②Epiglottis ③Liver ④Gall bladder ⑤Bile duct ⑥Small intestine ⑦ Duodenum ⑧Jejunum ⑨Ileum

⑩Anus ⑪Salivary glands ⑫Oesophagus ⑬Stomach ⑭Pancreas ⑮Large intestine ⑯Colon ⑰Caecum ⑱Appendix ⑲Rectum

<02-3-03> ①Circular muscle ②Longitudinal muscle ③Bile salts

<02-3-04> ①Physical digestion ②Chemical digestion ③Amylase ④Pepsin ⑤Amylase ⑥ Trypsin ⑦Lipase ⑧Maltase

⑨Sucrase ⑩Lactase ⑪Peptidases

<02-3-05> ①Capillary ②Lacteal (lymph vessel) ③Epithelium ④Amino acids ⑤Glucose ⑥ Fatty acids ⑦Glycerol ⑧Microvilli

<02-3-06> ①Aorta ②Hepatic vein ③Hepatic artery ④Hepatic portal vein

<02-3-07> ⑤Respiration ⑥Urea ⑦Glycogen ⑧glycogen ⑨urea

<02-3-08> ①Crown ②Neck ③Root ④Enamel ⑤Dentine ⑥Pulp cavity ⑦Blood capillary ⑧ Nerve fibre ⑨Gum ⑩Cement

⑪Jaw bone

<02-3-09> ①Incisor ②Canine ③Premolar ④Molar

<02-3-11> ①sporangium ②spores ③hyphae ④penicillin

UNIT 03 Transport

Objectives

- 03-1 Describe the transport of water, salts and food substances.
- 03-2 Describe the composition of blood.
- 03-2 Describe the structure of the heart.
- 03-2 Compare the structure and functions of arteries, veins and capillaries.

03-1 Transport in plants

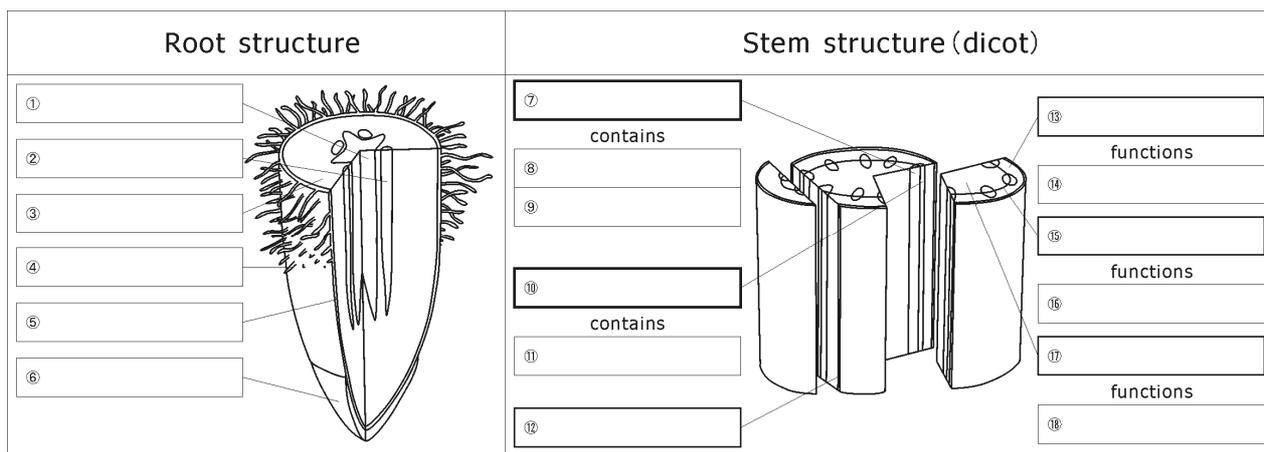
→ Plants transport and store various substances within their bodies. This transport is conducted by the vascular bundle consisting of xylem and phloem cells which are continuous with those found from the root to leaves.

03-1-01 Internal structure of roots and stems.

→ In the root, some of the cells in epidermis are specialized into root hair cells which are used to absorb water and mineral salts from the soil.

→ A dicotyledonous stem is made up of the **epidermis** on the outside and the **cortex** on the inside.

→ Present between phloem and xylem is an actively dividing layer of cells called **cambium**.



Activity 03-1-01: Identify the part of root and stem ①-⑦⑩⑫⑬⑮⑰. Write the structure ⑧⑨⑪.

Write the function ⑭⑯⑱.

03-1-02 Mode of transport in xylem and phloem.

Remember the arrangement of xylem and phloem in root, stem and leaf!

* Function of xylem and phloem:

Xylem: Transports ① _____ and ② _____ from the root.

Non-living parts. Thick lignified cellulose wall.

Mode of transport in xylem:

1. Root pressure (Osmosis draws water into the root system)
2. Capillary action (Strong cohesive forces between water molecules. Adhesion of water to xylem walls)
3. ③ _____ (A suction force resulting from transpiration)

Phloem: Transports ④ _____ dissolved in sap vacuole.

Consists of sieve elements which are placed end to end to form **sieve tubes**.

Companion cells (with nucleus) control activities of the sieve tubes by providing energy.

Mode of transport in phloem

1. ⑤ _____ (Require energy to transport substances)
2. Translocation (A process that substances in solution are carried to all parts of the plant. Mechanism is not fully understood. Affected by a lack of oxygen, temperature, poison.)

Activity 03-1-02: Write the chemical ①②④. Name the force ③. Name the process ⑤.

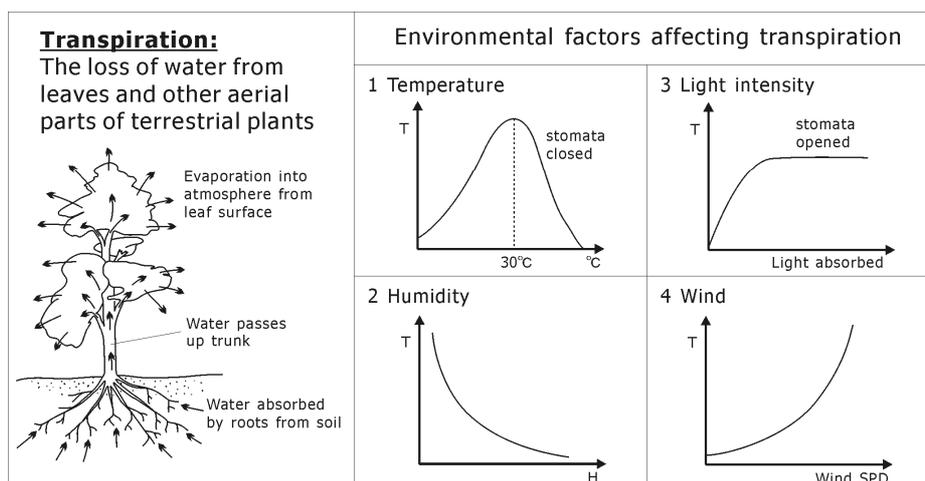
03-1-03 Transpiration.

→ Transpiration is a process by which water evaporates from a plant. Mostly occurs through stomata in leaves.

→ (See next diagram) Temperature and light intensity are related to the opening and closing stomata.

→ (See next diagram) On a humid day, especially after a rain, the concentration gradient reduces.

→ (See next diagram) On a windy day, the concentration gradient of water vapour increases because water vapour blows away at the surface of leaves.

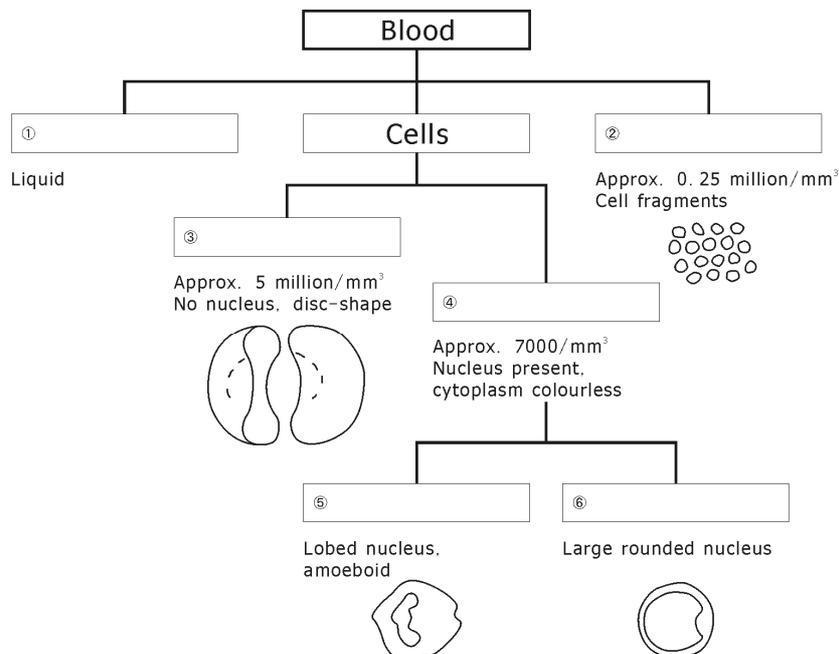


03-2 Transport in animals

- Large animals need a transport system that will carry substances to the regions where metabolism takes place.
- They also need to transport products of metabolism (eg respiration and digestion) to specific regions for metabolism or excretion.
- As a result of the increase in size and the need to move materials around large animals, they have developed a complex transport system known as the blood circulatory system.
- The system comprises blood, the heart and blood vessels.

03-2-01 Composition of blood.

- When a sample of blood is spun in a high speed centrifuge, blood separates into a fluid and a solid part.
- The fluid part is called plasma (55% of blood), and the solid part comprises blood cells and platelets (45% of blood).



Activity 03-2-01: Name the component of blood ①②. Name the blood cell ③-⑥.

03-2-02 Function of blood.

→ Blood is highly specialized tissue that performs many functions;

1. ① _____ : → Blood transports essential food nutrients, hormones, metabolic wastes and gases.

2. ② _____ : → White blood cells protect from invading bacteria by phagocytes and antibodies.

→ Excess loss of blood through bleeding is prevented by blood clotting.

3. ③ _____ : → Blood fulfils a homeostatic function, maintaining the constancy of the internal

environment (eg. osmorality and temperature)

→ Each component of blood is responsible for some special functions.

Structure	Contents	Function
Plasma	Water	Buffer in the blood Maintain osmotic pressure Medium of transport for soluble food substances,

		minerals, wastes, hormones, etc
	④ _____	Maintain normal blood pressure
	(Albumin)	Make blood viscous
	(Globulin)	Protein of which antibodies are made
	(Fibrinogen)	Clotting of blood
Cells	Red blood cells	Exchange of ⑤ _____ and ⑥ _____
	(haemoglobin)	Combine reversibly with oxygen
	White blood cells	
	(Phagocytes)	Kill germs by ingesting them (phagocytosis)
	(Lymphocytes)	Produce antibodies which kill germs
Platelets		⑦ _____

Activity 03-2-02: List the function ①-③. Name the chemical ④-⑥. Name the process ⑦.

03-2-03 Transfusion and blood groups

- If somebody loses a lot of blood as a result of an injury or surgical operation, he/she can be given a blood transfusion.
- A person who gives blood is a donor, while the one receiving is a recipient.
- For a transfusion to be successful, the blood type of the donor has to match the blood of the recipient.
- If the two blood types do not match, the donor's red blood cells are clumped together (agglutination) in the patient's blood vessels and cause serious harm.
- The factors which determine the blood types are inherited. eg ABO, Rhesus factor
- In ABO system, blood type O is universal donor, while blood group AB is universal recipient.
- Group O does not have antigens while group AB does not have antibodies.
- The absence of antigen in group O means that the recipient's blood antibodies have no antigen to react against. While in group AB, the antigens will be present in the donated blood and the recipient's blood has antibodies to attack the antigens, leading the

agglutination between two bloods.

* Antigens and antibodies

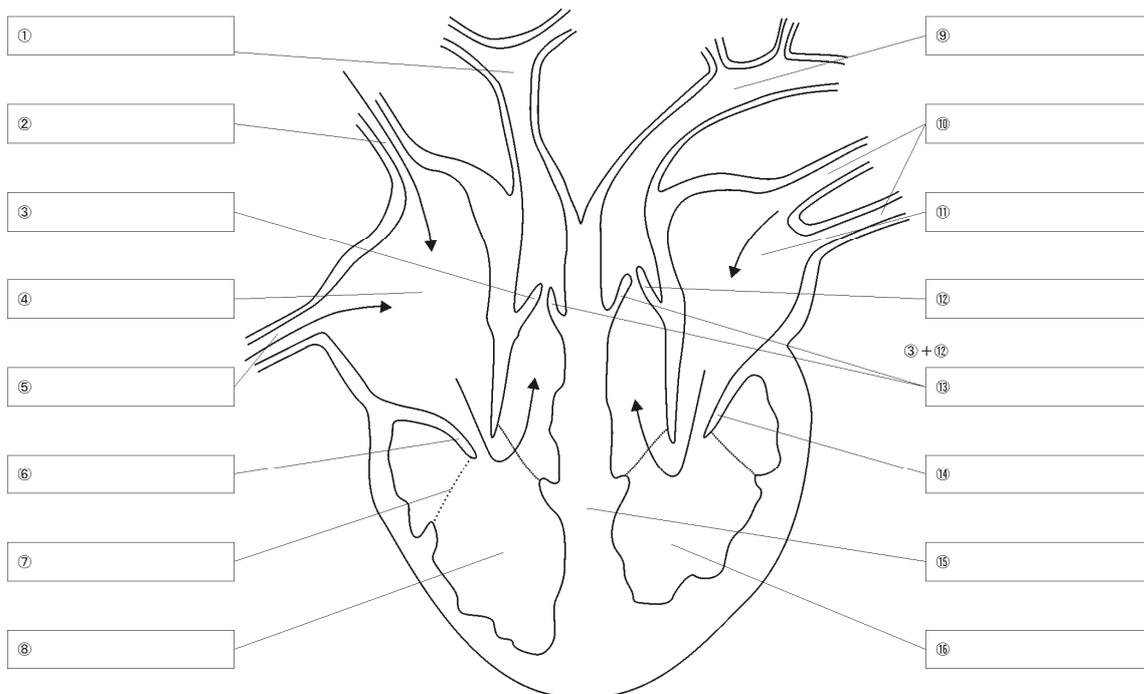
Group	Antigen on cells	Antibody in plasma
A	A	Anti-B
B	B	Anti-A
AB	A and B	Neither
O	Neither	Anti-A and anti-B

* Blood transfusion

Group	Can donate blood to	Can receive blood from
A	A and AB	A and O
B	B and AB	B and O
AB	AB	All groups
O	All groups	O

03-2-04 Structure of the heart.

- The heart is situated in the left side of the chest, behind the sternum and between the lungs.
- The walls of the heart are made of cardiac muscle.
- The heart contracts rhythmically because of the action of **pacemakers** found in right atrium.
- During rest, a healthy adult has a heart rate of 72 beats per minute.



Activity 03-2-04: Identify the part of the heart ①-⑱.

03-2-05 Function of the heart.

→ The heart pumps blood throughout the body.

→ Valves in the heart and blood vessels prevent backflow of blood. This ensures that blood travels in only one direction.

Structure	Function
Left atrium	Receive ① _____ blood from the lungs via ② _____
Left ventricle	Pump blood to all parts of the body except the lungs via aorta
Right atrium	Receive ③ _____ blood
Right ventricle	Pump blood to the lungs via ④ _____
Bicuspid valve	Prevent backflow of blood to ⑤ _____
Tricuspid valve	Prevent backflow of blood to ⑥ _____
Aorta	Carry ⑦ _____ blood to the body
Pulmonary	Carry ⑧ _____ blood to the lungs

artery	
Pulmonary vein	Return ⑨ _____ blood from the lungs to the heart
Vena cava	Return ⑩ _____ blood from the body

Activity 03-2-05: Write the state of blood ①③⑦⑩. Name the blood vessel ②④. Name the part of heart ⑤⑥.

03-2-06 Coronary heart diseases.

* Examples;

Coronary heart diseases	Causes
① _____	Sudden stopping of contractions of heart muscle Block of the coronary arteries
Hypertension	High blood pressure
Arteriosclerosis	Narrowing and hardening of arteries Fatty deposits (② _____) on the walls of the artery
Coronary thrombosis	Forming of blood clot (thrombus) in the artery Likely to occur in arrow arteries

* Prevention;

Prevention	Causes
③ _____ and	Unhealthy diet rich in cholesterol
④ _____	Lead to high blood cholesterol level
Stop or do not start	Increase heart rate and blood pressure
⑤ _____	Cause blood to clot more easily Tabacco has toxin which reduces the blood's ability

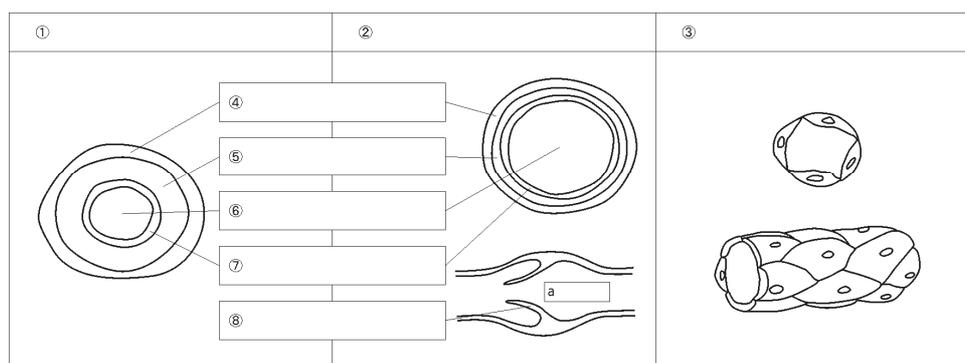
	to carry oxygen
Reduce ⑥ _____	Release adrenaline which increases heart rate and blood pressure

Activity 03-2-06: Name the disease ①. Name the chemical ②. Fill in the blank ③-⑥.

03-2-07 Three type of blood vessels.

- **Arteries** divide into smaller vessels called **arterioles**.
- The arterioles divide repeatedly to form a branching network of microscopic vessels passing between the cells of every living tissue. These final branches are called **capillaries**.
- The capillaries join up into larger vessels, called **venules**, which then combine to form **veins**.

Structure of blood vessel



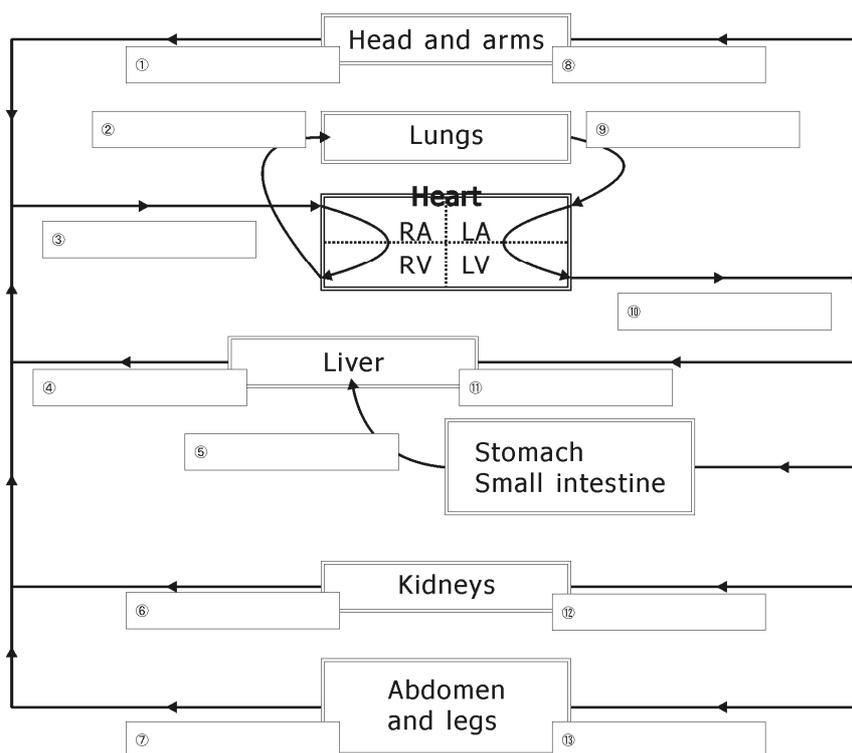
- Arteries are made of thick walled smooth elastic muscles.
- Arteries carry blood from the heart to the body. Arteries carry oxygenated blood except the pulmonary artery.
- Veins are made of smooth thin muscles. Valves are present in veins.
- Veins carry blood to the heart from the body. Veins carry deoxygenated blood except the pulmonary vein.
- Capillaries are thin walled minute blood vessels which run through the tissues.
- Capillaries have walls that are one cell thickness to allow substances to move in and out of them by diffusion.

Activity 03-2-07: Name type of blood vessel ①-③. Identify the part of blood vessels ④-⑧.

Write the direction of blood flowing in (a).

03-2-08 Circulatory system in human.

- Circulation divides into oxygenated blood and deoxygenated blood system.
- Further division based on **pulmonary circulation** and **systemic circulation**.
- In one complete circulation, blood passes through the heart twice (called **dual circulation**).

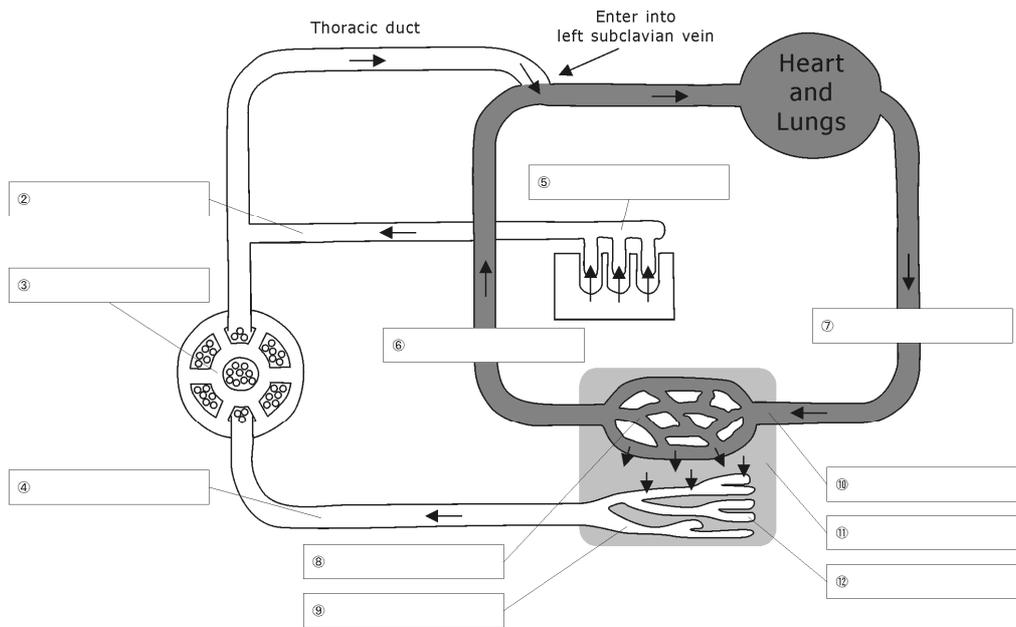


Activity 03-2-08: Name the blood vessel ①-⑬.

03-3 Lymphatic systems

03-3-01 The lymphatic system.

- Tissue fluid which diffuses into lymphatic vessel is called **lymph**. Lymph is straw-coloured and lacks red blood cells but it contains blood proteins hence it can clot.
- Lymphatic vessels have ① _____ which prevent the backflow of lymph.

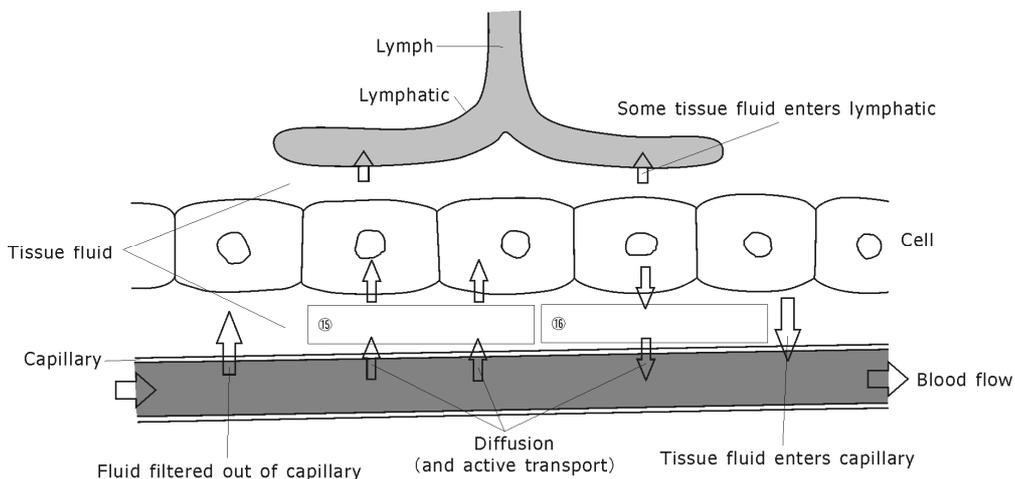


→ At a certain points in the lymphatic vessels there are swellings called **lymph nodes**.

→ **Lymphocytes** are stored in the lymph nodes and released into the lymph to reach, eventually, the blood system. There are also **phagocytes** in the lymph nodes. The lymph nodes thus form part of the body's defence system against infection.

→ The 13 _____ is the largest organ in the adult lymphatic system. It lies in the left side of the upper abdomen, between the lower ribs and the stomach. It contains lymphatics and blood vessels. Its main functions are to remove worn-out red cells, bacteria and cell fragments from the blood, and to produce lymphocytes and antibodies.

→ The 14 _____ lies at the top of the thorax, partly over the heart and lungs. It is an important lymphoid organ particularly in the newborn where it controls the development of the spleen and lymph nodes. The thymus produces lymphocytes and is the main centre for providing immunity against harmful micro-organisms.



* Importance of lymphatic system:

- It collects plasma and takes it back to the heart.
- It helps to remove harmful or waste products.
- It helps to distribute hormones and food nutrients.
- Lymph transports fats and oils from the small intestines to the liver.
- It produces macrophagocytes which helps to remove foreign particles and toxins which enter the body.

Activity 03-3-01: Fill in the blank ①. Identify the part of lymphatic system ②-④.

Name the organ ⑤⑬⑭.

Name the blood vessel ⑥⑦. Name the structure ⑧⑨. Name the liquid ⑩-⑫. Name the chemical ⑮⑯.

Unit 03 Answers for the activities

<03-1-01> ①Xylem ②Phloem ③Cortex ④Root hair ⑤Epidermis ⑥Root cap ⑦Xylem ⑧ vessels ⑨fibres ⑩Phloem

⑪sieve tubes ⑫Epidermis ⑬Cortex ⑭Protection of inside ⑮Cambium ⑯Cell division ⑰Pith ⑱Support of plant

<03-1-02> ①water ②mineral ions ③Transpiration pull ④sugar ⑤Active transport

<03-2-01> ①Plasma ②Platelets ③Red blood cells ④White blood cells ⑤Phagocytes ⑥ Lymphocytes

<03-2-02> ①Transport ②Protection ③Regulation ④Plasma protein ⑤oxygen ⑥carbon dioxide ⑦Clotting of blood

<03-2-04> ①Pulmonary artery ②Superior vena cava ③Pulmonary valve ④Right atrium ⑤ Inferior vena cava

⑥Tricuspid valve ⑦Chordae tendineae ⑧Right ventricle ⑨Aorta ⑩Pulmonary vein⑪Left atrium ⑫Aortic valve

⑬Semi-lunar valve ⑭Bicuspid valve ⑮Septum ⑯Left ventricle

<03-2-05> ①oxygenated ②pulmonary vein ③deoxygenated ④pulmonary artery ⑤left

atrium ⑥right atrium ⑦oxygenated

⑧deoxygenated ⑨oxygenated ⑩deoxygenated

<03-2-06> ①Heart attack ②cholesterol ③Healthy diet ④regular exercise ⑤smoking ⑥ stress

<03-2-07> ①Artery ②Vein ③Capillary ④Outer wall ⑤Muscle tissue ⑥Lumen ⑦Inner layer ⑧Valve (a)←

<03-2-08> ①Anterior vena cava ②Pulmonary artery ③Vena cava ④Hepatic vein ⑤Hepatic portal vein ⑥Renal vein

⑦Femoral vein ⑧Carotid artery ⑨Pulmonary vein ⑩Aorta ⑪Hepatic artery ⑫Renal artery ⑬Femoral artery

<03-3-01> ①valves ②Lymph vessel ③Lymph node ④Lymph vesse ⑤Small intestine ⑥ Vena cava ⑦Aorta ⑧Blood capillary ⑨Lymphatic ⑩Blood ⑪Tissue fluid ⑫Lymph ⑬spleen ⑭thymus gland ⑮Glucose, Oxygen ⑯Carbon dioxide

Supplement: Birth rate / Death rate

→ Birth rate (or crude birth rate) refers to the number of live births (babies) born to a population per one thousand people in the population.

→ Death rate (or mortality rate) refers to the number of deaths which occur per population of 1000 human beings.

* Formula:

$$\text{Crude Birth Rate} = \frac{\text{Number of births per year}}{\text{Total population}} \times \frac{1000}{1}$$

$$\text{Death Rate} = \frac{\text{Total number of deaths}}{\text{Total population}} \times \frac{1000}{1}$$

* Exercise:

- ① the mid-year population of Zambia in 1972 was 4.600.000 and the number of babies born in the same year was 227.500. Calculate the crude birth rate.
- ② Zambia's estimated population in 1992 was 8.6 million people and approximately 190.000 deaths occurred during the same period as at 1st July. Calculate the death rate.

* Answer:

$$\textcircled{1} \text{ Crude birth rate} = \frac{227500}{4600000} \times \frac{1000}{1} = 49.5$$

$$\textcircled{2} \text{ Death rate} = \frac{190000}{8600000} \times \frac{1000}{1} = 22.1$$

UNIT 04 Respiration**Objectives**

- 04-1 Define respiration.
- 04-1 Compare and contrast aerobic and anaerobic respiration.
- 04-2 List the tissues for gaseous exchange.
- 04-3 Explain the mechanism of breathing in human.
- 04-3 Describe the adverse effects of smoking on human health.

04-1 Respiration in a cell

- **Respiration** is the chemical process by which **energy** is produced from food.
- All cells in living organisms need energy for carrying out all the processes.
- There are two types of respiration: **aerobic respiration** and **anaerobic respiration**.

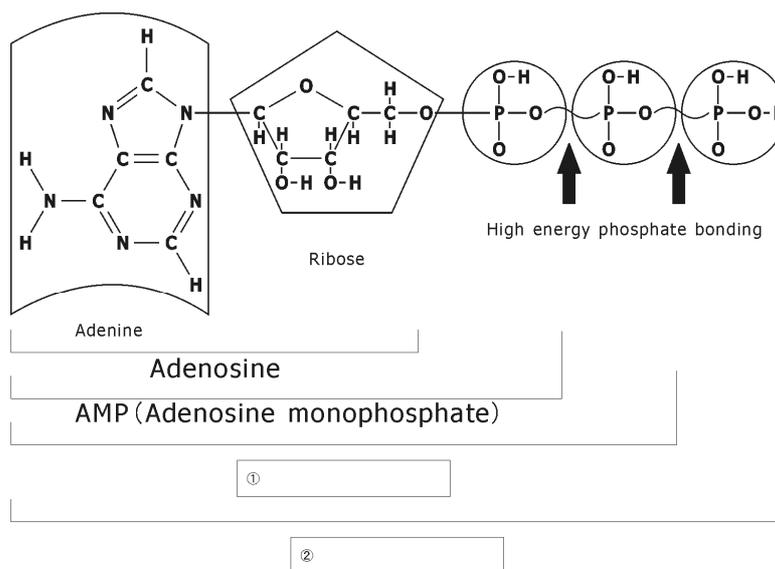
04-1-01 Difference between aerobic and anaerobic respiration.

	Aerobic respiration	Anaerobic respiration
Oxygen	① _____	② _____
Water	Produced by vapour	Not produced
Location	Begin in ③ _____ and continue into ④ _____	In ⑤ _____
Efficiency	Very good ⑥ _____ ATP from 1 glucose	Inefficient ⑦ _____ ATP from 1 glucose
Example of organisms	All organisms and some yeast	Yeast, bacteria, whales

Activity 04-1-01: Fill in the blank ①②. Name the organelle ③-⑤. Write the number number of molecules ⑥⑦.

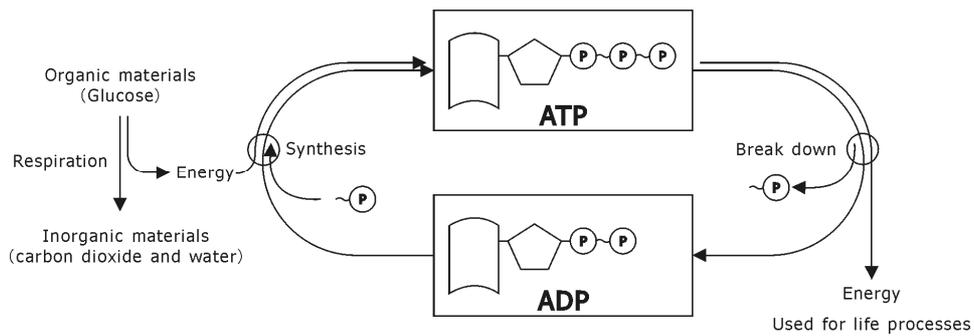
04-1-02 ATP as energy for cells.

- Energy from respiration is NOT directly used by the organism.
- It is temporarily stored in a chemical substance called adenosine triphosphate (**ATP**).
- ATP is sometimes called '**currency**' of energy for the cell.
- When there is need for energy, ATP is decomposed to ADP and a phosphate group in the presence of the enzyme, **ATPase**.



* Uses of ATP in human;

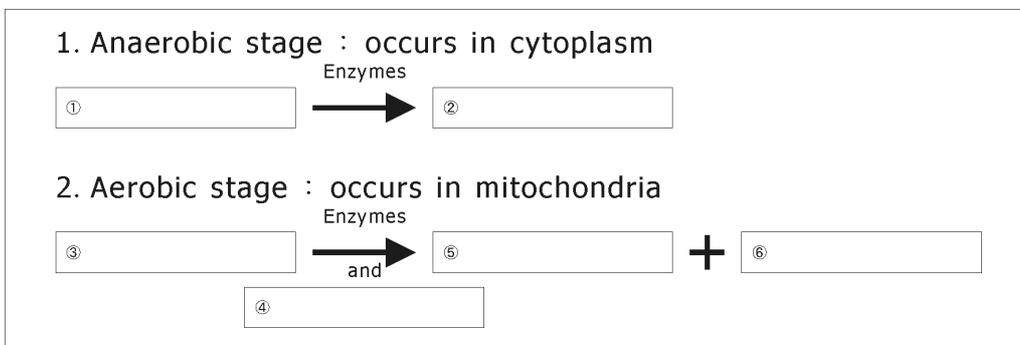
Usage	Mode of action
③ _____	Cardiac muscles and peristalsis
④ _____	Formation of peptide bonds
⑤ _____	Growth, synthesis of chromosome, cell membrane, etc.
⑥ _____	Conformational change of membrane proteins to transport
⑦ _____	Along the axon, for the transport of sodium ions out
Regulation of body temperature	Energy released to keep body warm



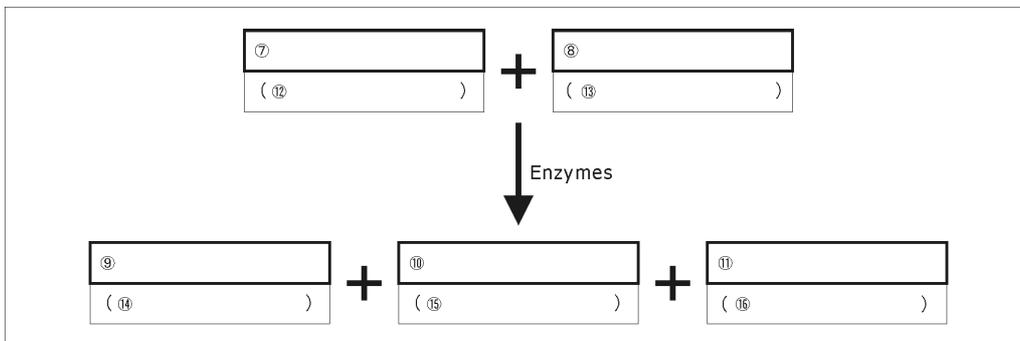
Activity 04-1-02: Name the chemical ①②. List the cellular process ③-⑦.

04-1-03 Cellular respiration.

→ Cellular respiration is divided into **two stages** by the absence or presence of oxygen in the stage;

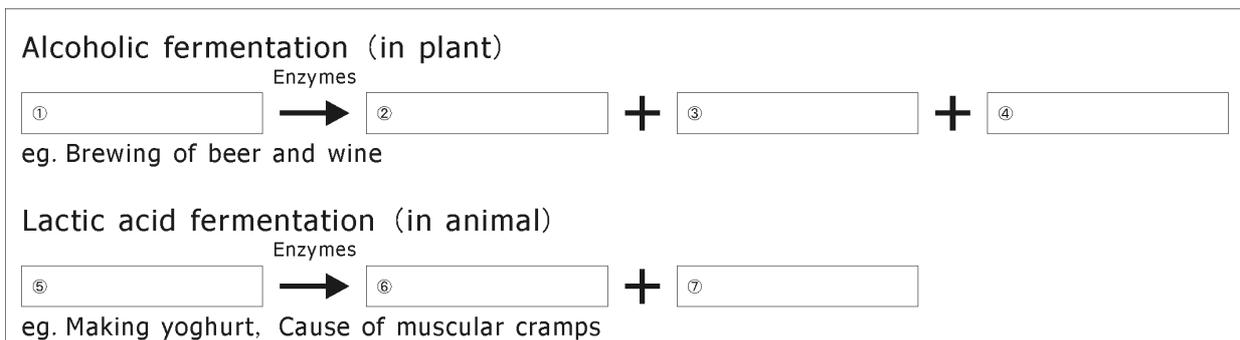


→ Total equation is shown below.



Activity 04-1-03: Name the chemical ①-⑪. Write molecular formula ⑫-⑯.

04-1-04 Examples of anaerobic respiration.



Activity 04-1-04: Name the chemical ①-⑦.

04-1-05 Experiments involved in respiration.

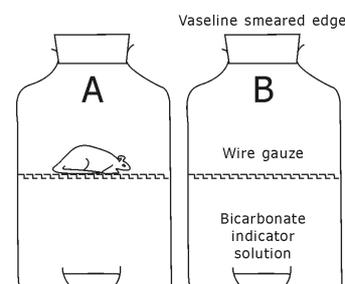
04-1-05A Let's try EXP: To investigate whether carbon dioxide is produced in aerobic respiration.

* The presence of carbon dioxide will be indicated by the colour change in the bicarbonate indicator solution. The solution changes from ①_____ to ②_____ in presence of carbon dioxide in the case of phenol red indicator.

* Suggested materials: bell jars / small animal like a mouse / Petri dishes / bicarbonate indicator solution

* Methods:

1. Arrange the apparatus as shown in figure.
2. Leave the experiment for at least six hours.
3. Observe the colour change of indicator solution in each bell



jar.

* Questions:

1. What colour changes occurred to the bicarbonate indicator solution?
2. How do you explain these changes?

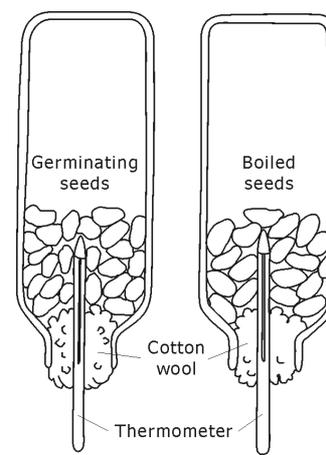
Activity 04-1-05A: Write the colour ①②.

04-1-05B Let's try EXP: To investigate whether heat is given out during respiration.

* Suggested materials: bean seeds / two thermos flasks / two thermometers / cotton wool / disinfectant such as formalin

* Methods:

1. Soak a sample of bean seeds until they begin to germinate.
2. Boil the same number of bean seeds for at least 15 minutes.
3. Rinse the two sets of seeds separately in the disinfectant.



4. Place each sample in a thermos flask.
5. Set up the apparatus as indicated in figure.
6. Record the initial and final temperatures in both thermometers.

* Questions:

1. In which flask did the thermometer show a higher temperature reading?
2. Why?
3. What is the reason for boiling the seeds?
4. What is the reason for rinsing the seeds in a disinfectant?
5. Apart from heat energy what else is produced in the reaction occurring in the flask with a high temperature reading?

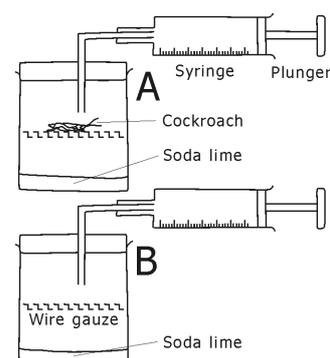
* Hints: Which set of seeds are alive or dead. Respiration is a process only for living organisms. Decay bacteria would release heat energy during the decaying process.

04-1-05C Let's try EXP: To investigate whether oxygen is taken up during respiration.

* Suggested materials: two flasks / small animals such as cockroaches / two syringes / soda lime / wire gauze

* Methods:

1. Arrange the apparatus as shown in figure.
2. Smear Vaseline between the stopper and the mouth of the vessel to make the vessel air-tight.
3. Pull back the plunger of syringe so as to leave the syringe at maximum volume.
4. Record the volume of the syringe at the start of the experiment.
5. After every 10 minutes read off the position of the plunger against the reading on the syringe.
6. Plot a graph of oxygen uptake against time.



* Questions:

1. What is the purpose of B in this investigation?

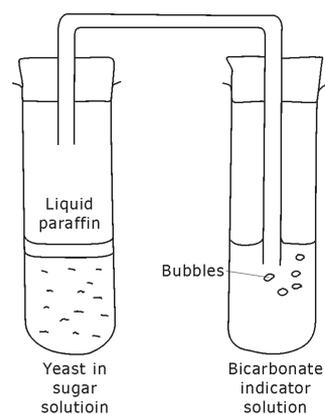
2. Explain the differences in observations made in A and B.
 3. What gaseous product in A would interfere with the results?
 4. How is the interference in question being avoided?
 5. From your graph, calculate the rate of oxygen uptake by the cockroaches.
- * Hints: Investigator has to show that no change can be seen naturally. As the equation of aerobic respiration, the volumes of gases which are taking in (oxygen) and releasing (carbon dioxide) are the same.

04-1-05D Let's try EXP: To investigate whether carbon dioxide is produced in anaerobic respiration.

* Suggested materials: glucose / yeast / test-tubes / pipette / liquid paraffin / bicarbonate indicator solution

* Methods:

1. Boil some water to remove dissolved air.
2. Add some glucose to about 5 cm³ hot water.
3. Allow the solution to cool.
4. Add some little yeast to the sugar solution and allow the yeast to dissolve.
5. Using a pipette, run down some liquid paraffin along the side of the test-tube containing yeast and sugar solution.
6. Leave the apparatus as in figure.
7. Using boiled yeast, set up a similar experiment.
8. Observe any colour changes in the indicator solution in both parts of the experiment.



* Questions:

1. Explain the purpose of the following in the experiment:
(a) cooling of sugar solution before yeast is added, and (b) liquid paraffin.
2. What colour changes occurred to the bicarbonate indicator solution?
3. Which other substance can be used in place of bicarbonate indicator?

* Hint: Yeast can conduct both aerobic and anaerobic respiration. Under the presence of oxygen, which is the best way to produce energy?

04-2 Gaseous exchange

- Gaseous exchange is the process of uptaking of oxygen and releasing of carbon dioxide.
- There is a continuous exchange of these gases between the organism and its environment.
- The movement of these gases into and out of the organism occurs by diffusion.
- Diffusion gradients are always maintained between the environment and the organism because the cells of the organism use up oxygen and produce carbon dioxide.

04-2-01 Tissues for gaseous exchange.

Organism	tissues
Plant	① _____ in leaf, ② _____ in stem
Amoeba	The entire cell membrane
Insect	Spiracles (openings to the atmosphere) Tracheae (fine tubes in the whole body) Tracheoles (very tiny tubes throughout the body)
Fish	Gills
Human	Alveoli in lungs

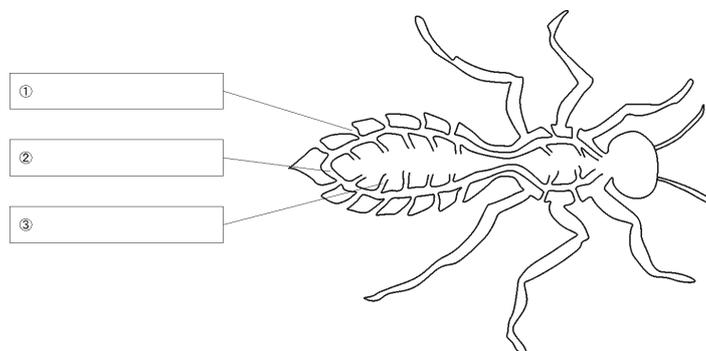
Activity 04-2-01: Name the tissue ①②.

04-2-02 Tracheal system in insects

- Many insects are terrestrial, that is they live on land.
- Like all other terrestrial animals, insects face a problem of water loss which can lead to dehydration.

→ To prevent dehydration, insects are covered by a waterproof waxy cuticle.

→ While offering protection against dehydration, the cuticle also acts as a barrier to gaseous exchange.



→ Openings to the atmosphere are found in the cuticle of the thorax and abdomen. These openings are called spiracles.

→ Spiracles allow air to pass into and out of the insect body. Spiracles are directly connected to a network of fine tubes transversing the whole insect body called tracheae.

→ Tracheae thus permeate throughout the insect body and end in the tissues as very tiny tubes called tracheoles. These tracheoles are the sites for gaseous exchange in insects.

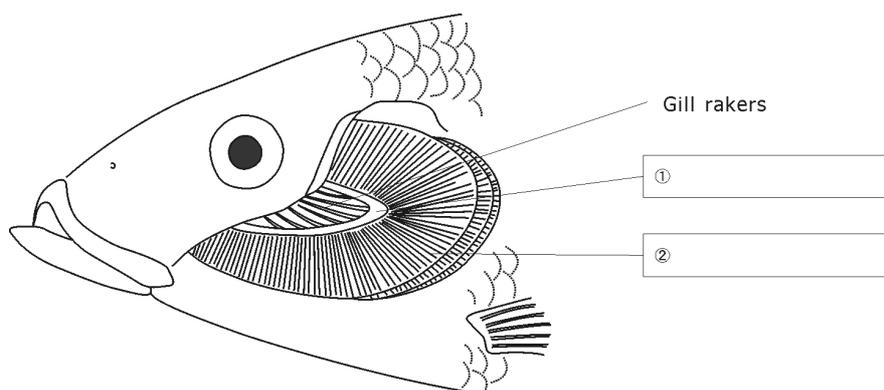
Activity 04-2-02: Identify the part for gaseous exchange in insect ①-③.

04-2-03 Gaseous exchange in fish

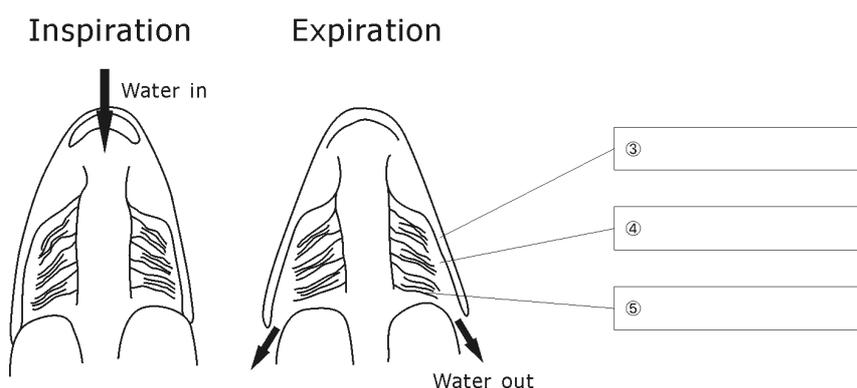
→ Fish obtain their oxygen from the air dissolved in water by using the gills located in the gill chamber or opercular cavity.

→ The gills are covered and hence protected by a semicircular flap called operculum or gill cover.

→ Each gill is made up of a curved bony bar called gill bar or gill arch to which are attached a large number of filamentous outgrowth called gill filaments. The gill filaments provide a large surface area for gaseous exchange.



* Events in gaseous exchange in fish:



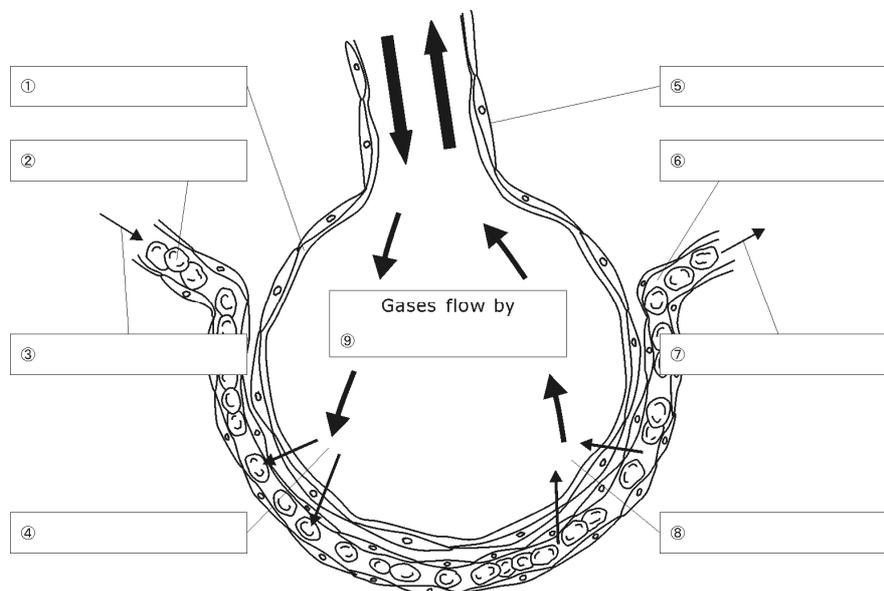
Order		Inspiration	Expiration
1	Mouth	open	close
2	Volume of mouth and pharynx	increase	decrease
3	Operculum	close	open
4	Pressure in gill chamber	decrease	increase
5	Water	enter	come out

Activity 04-2-03: Name the part for gaseous exchange in fish ①-⑤.

04-2-04 Gaseous exchange in alveolus.

- In the alveolus, gaseous exchange occurs by **diffusion**.
- There are many alveoli which greatly increase the surface area for gaseous exchange.
- Oxygen diffuses into the blood across the thin epithelium of the alveolus and blood capillaries.
- Carbon dioxide diffuses from the blood of the capillaries into the alveolus.

→ The surfaces are thin, moist and permeable to gases in order to permit and facilitate diffusion.



Activity 04-2-04: Name the part ①②⑤⑥. Name the chemical ④⑧. Write the state of blood ③⑦.

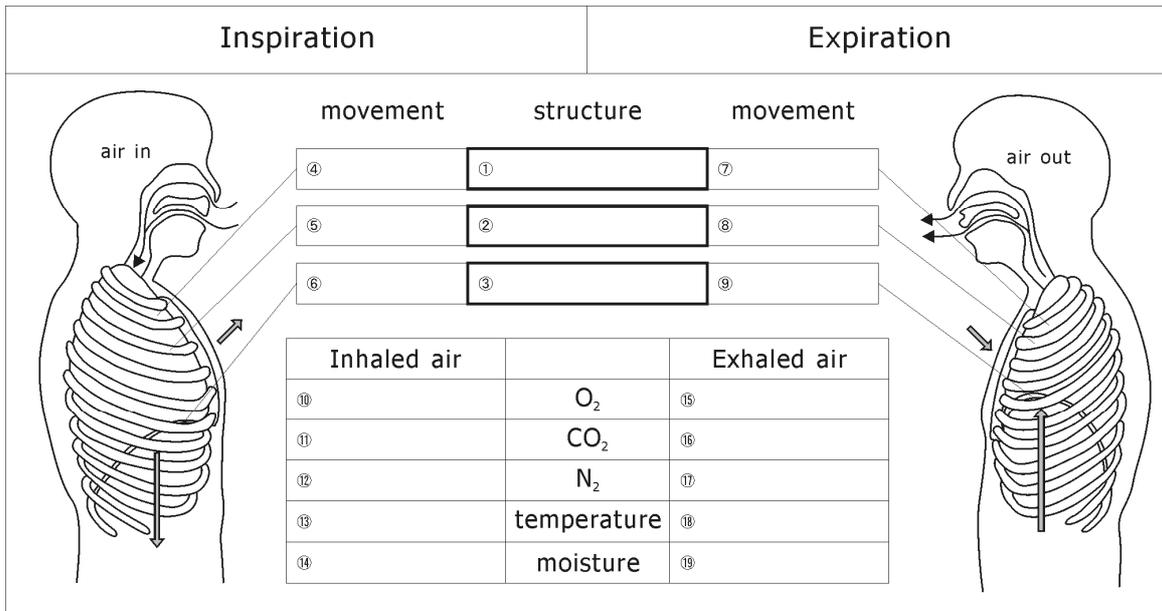
Name the movement of gases ⑨.

04-3 Breathing

→ The movement of air into and out of the lungs is brought about by changes in the volume of the thorax, or chest.

04-3-01 Breathing mechanism in human.

→ These changes are caused by the action of two muscles; the diaphragm and intercostals muscles.



→ Only 4% of oxygen is used. No change in the % of nitrogen.

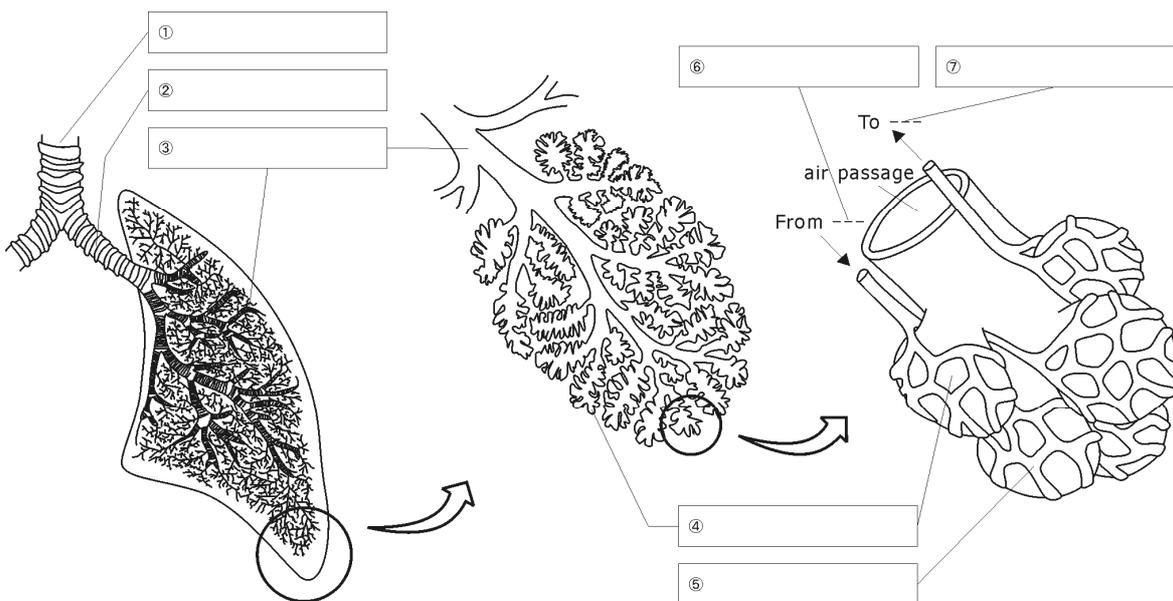
→ Differences in the composition between inhaled and exhaled air can be explained by cellular respiration.

Activity 04-3-01: Name the organ ①-③. Write the movement of each organ ④-⑨.

Write the % of each gas ⑩-⑫, ⑮-⑰. Fill in the blank ⑬⑭⑱.

04-3-02 Air passage in human.

→ The structures involved in the passage of air are shown below;



→ **Pharynx:** The part of throat that separate passage for food (oesophagus) and air (trachea).

→ **Trachea:** The tube with rings that takes air from the throat to lungs.

→ **Bronchus** (pl. Bronchi): The trachea branches into two narrow tubes called bronchi.

One bronchus goes into the left lung, the other goes into right lung.

→ **Bronchiole**: Each bronchus further subdivides into smaller tubes called bronchioles.

→ **Alveolus** (pl. Alveoli): Bronchioles end in structures called alveoli or air sacs.

A network of blood capillaries covers in alveoli.

*** Sequences of inhaled air:**

Mouth → Pharynx → Trachea → Bronchus → Bronchiole → Alveolus

*** Sequences of exhaled air:**

Alveolus → Bronchiole → Bronchus → Trachea → Pharynx → Mouth

Activity 04-3-02: Name the part ①-⑤. Name the blood vessel ⑥⑦.

04-3-03 Examples of respiratory diseases.

* Diseases of breathing system:

Name	Cause
Bronchitis	Inflammation of the bronchial tubes
Pleurisy	Inflammation of the pleural membranes
Pneumoconiosis	Inflammation of the lungs due to, eg. asbestos or silica dust
Pneumonia	Infection of the lungs by bacteria or viruses
Tuberculosis	Infection of the lungs by bacteria
Emphysema	Destruction of walls of the alveoli caused by, eg. smoking
Asthema	Allergic reaction to many substances inducing those in tobacco smoke
Influenza	Infection of the respiratory passages by viruses
Silicosis	Prolonged inhaling of dust
Lung cancer	Growths in walls of the bronchial tubes caused by,

eg. smoking

04-3-04 Smoking effect on the lungs.

→ Smoking causes many respiratory diseases.

→ Harmful substances in tobacco are **nicotine**, **tar**, **carbon monoxide**, etc (about 20 substances).

→ Affection is not only smokers but also the people in the same room. It is called "**Passive smoking**".

Timing	Symptoms / Reactions
Short term:	Speed up heart rate and increase blood pressure
① _____	Cause blood vessels to constrict
② _____	Coughs, trying to clear the vessel
③ _____	Damage lining of blood vessels while increasing fatty deposits on the walls
Long term:	Bronchitis, Asthema, Emphysema, Lung cancer, Heart disease
④ _____	Stain teeth and fingers Deposit in the lung, leading to growth of cancerous cells
⑤ _____	Make blood clot more easily Increase risk of coronary diseases
Chemical irritants	Cause narrowing of air passages
During pregnancy:	Smaller baby at birth Increase risk of miscarriage, stillbirth, and infant death

→ The cancer inducing chemicals are called **carcinogens**.

Activity 04-3-04: List the harmful substance in tobacco ①-⑤.

Unit 04 Answers for the activities

<04-1-01> ①Present ②Absent ③cytoplasm ④mitochondria ⑤cytoplasm ⑥36 ⑦2

<04-1-02> ①ADP(Adenosine diphosphate) ②ATP(Adenosine triphosphate) ③Muscle contraction ④Protein synthesis ⑤Cell division ⑥Active transport ⑦Transmission of nerve impulse

<04-1-03> ①Glucose ②Pyruvic acid ③Pyruvic acid ④Oxygen ⑤Carbon dioxide ⑥Water ⑦Glucose ⑧Oxygen

⑨Carbon dioxide ⑩Water ⑪Energy(2880kJ) ⑫ $C_6H_{12}O_6$ ⑬ $6O_2$ ⑭ $6CO_2$ ⑮ $6H_2O$ ⑯36ATP

<04-1-04> ①Glucose ②2 ethyl alcohol ③Carbon dioxide ④Energy (2ATP) ⑤Glucose ⑥2 lactic acid ⑦Energy (2ATP)

<04-1-05A> ①red ②yellow

<04-2-01> ①Stomata ②Lenticels

<04-2-02> ①Spiracle ②Trachea ③Tracheole

<04-2-03> ①Gill bar ②Gill filament ③Operculum ④Gill chamber ⑤Gill filament

<04-2-04> ①Moisture ②Red blood cell ③Deoxygenated blood ④Oxygen ⑤epithelium ⑥capillary ⑦Oxygenated blood

⑧Carbon dioxide ⑨Diffusion

<04-3-01> ①lungs ②ribs ③diaphragm ④expansion ⑤upwards,outwards ⑥

contract,flatten ⑦reduction

⑧downwards,inwards ⑨relax,elevate ⑩21% ⑪0.03% ⑫79% ⑬Room temperature ⑭

Variable ⑮17% ⑯4% ⑰79%

⑱ $36^{\circ}C$ ⑲100%

<04-3-02> ①Trachea ②Bronchus ③Bronchiole ④Alveolus ⑤capillary ⑥pulmonary artery ⑦pulmonary vein

<04-3-04> ①Nicotine ②Tar ③Carbon monoxide ④Tar ⑤Nicotine

<Sample question>

1. During the beating of the heart, in which region will the highest pressure develop?

- A. Left atrium. B. Left ventricle. C. Pulmonary artery. D. Right ventricle.

UNIT 05 Excretion**Objectives**

- 05-1 Define excretion.
- 05-2 Explain the mechanism of excretion in the kidney.

05-1 Excretion

- Excretion is the **removal** of toxic wastes of metabolism from the body.
- Metabolic wastes in animals include carbon dioxide, water, bile pigments, nitrogenous products (urea, ammonia and uric acid), etc.
- The accumulation of wastes in the body interferes with the proper functioning of cells.
- The term excretion should not usually be applied to the passing out of faeces (egestion), because most of the contents of the faeces, apart from the bile pigments, have not taken part in reactions in the cells of the body.

05-1-01 Excretory organ in mammals.

Excretory organ	Excretory products	Form of excretion
① _____	carbon dioxide	Exhaled air
② _____	water, mineral salts, urea, lactic acid	Sweat
③ _____	bile pigments	Faeces
④ _____	nitrogenous wastes, excess water, mineral salts, toxins, hormones, drugs	Urine

- Excess proteins and amino acids are **deaminated** by liver cells to produce ammonia. Ammonia is then converted to less toxic urea.

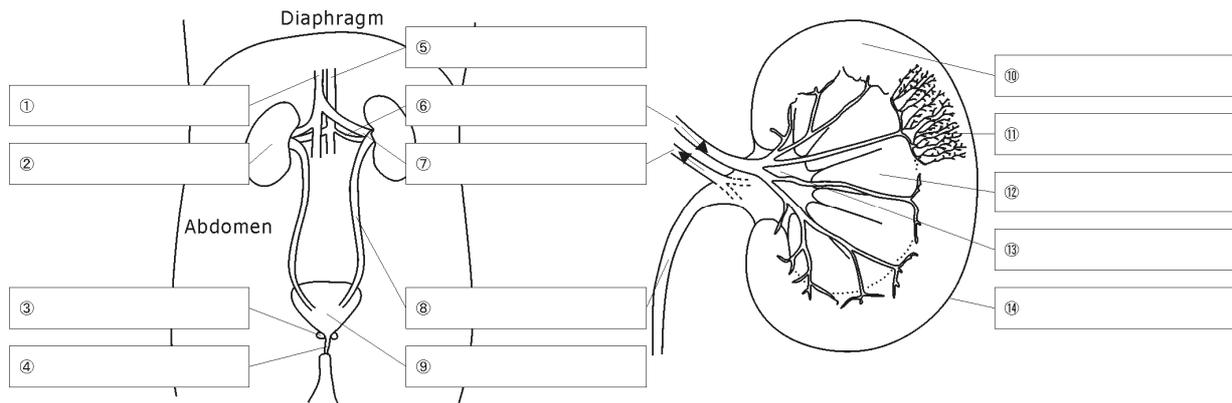
Activity 05-1-01: List the organ ①-④.

05-2 The kidneys

- The kidneys are the most important excretory organs in mammals.
- They are a pair of bean-shaped organs, and located toward the back of the abdominal cavity.

05-2-01 Structure of urinary system and the kidney in human.

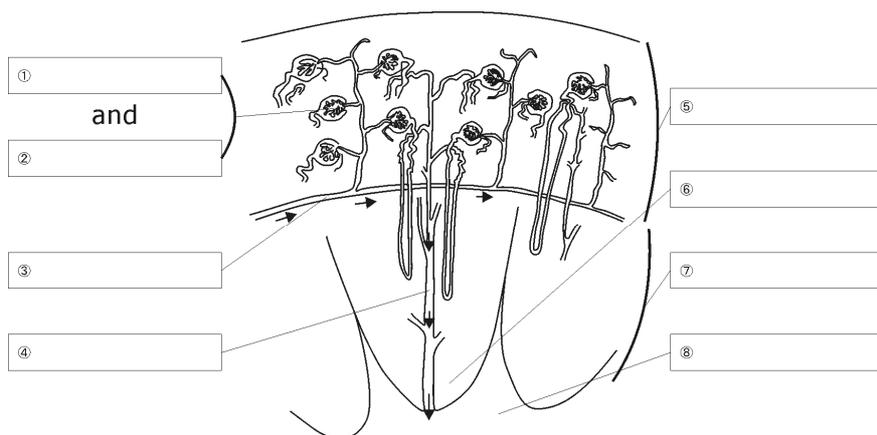
- Attached to the kidney are the ureter, renal artery and renal vein.



Activity 05-2-01: Name the blood vessel ①⑤⑥⑦. Name the organ ②③④⑧⑨. Name the part of the kidney ⑩-⑭.

05-2-02 Detail structure of the kidney.

- A kidney is a compact organ which has its tissues in distinct regions.



- These main regions of the kidney are the **cortex**, **medulla** and **pelvis**.
- The renal artery divides up into a great many arterioles and capillaries, mostly in the cortex.
- Each arteriole leads to a **glomerulus**.
- Each glomerulus is almost entirely surrounded by a cup-shaped organ called **Bowman's**

capsule, which leads to a coiled tubule.

→ After a number of loops and coils, the renal tubules join a common collecting duct, which passes through the medulla to open into the pelvis.

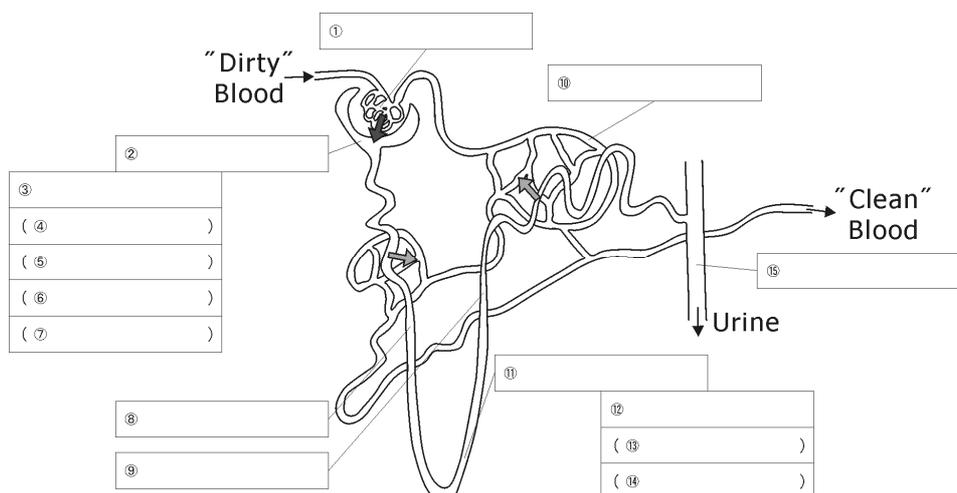
Activity 05-2-02: Name the organ ①-④. Name the region of the kidney ⑤-⑧.

05-2-03 Nephron.

→ A nephron is the unit of function of the kidney.

→ A nephron is a single glomerulus with its Bowman's capsule, renal tubule and blood capillaries.

→ In a nephron, **ultrafiltration** (from blood to capsule) and **selective reabsorption** (from tubule to blood) are processed.



Activity 05-2-03: Name the part ①②,⑧-⑪,⑮. Name the process ③⑫. Name the chemical ④-⑦,⑬⑭.

05-2-04 Artificial kidney.

→ Sometimes, a kidney may stop working properly due to infection or accident. This condition is known as **kidney failure**.

→ Kidney failure may be treated in two main ways: **kidney transplant** and **dialysis** (using artificial kidney machines).

→ Patient's blood from the artery is passed into the machines and returned to a vein in the same arm.

- C. Active transport and osmosis. D. Diffusion and osmosis.

2. Which process does not use energy released by respiration?

- A. Active transport of glucose into the villi. B. Diffusion of oxygen across the alveolar.
C. Maintenance of a constant body temperature. D. Passage of nerve impulses.

3. Which is the best equation to represent aerobic respiration?

- A. carbon dioxide + water + energy → oxygen + sugar
B. energy + oxygen → carbon dioxide + water + sugar
C. oxygen + sugar → carbon dioxide + water + energy
D. sugar + carbon dioxide → oxygen + water + energy

4. What are the products of aerobic and anaerobic respiration in muscle tissue?

	Aerobic respiration	Anaerobic respiration
A.	Cabon dioxide and water	Ethanol
B.	Cabon dioxide and water	Lactic acid
C.	Ethanol	Cabon dioxide and water
D.	Lactic acid	Cabon dioxide and water

5. What is the approximate oxygen content of expired air?

- A. 0%. B. 4%. C. 16%. D. 20%.

<Answer> 1. D. 2. B. 3. C. 4. B. 5. C.

UNIT 06 Homeostasis

Objectives

- 06-1 List the important organs in homeostasis.
- 06-1 Describe the negative feedback loop.

06-1 Homeostasis

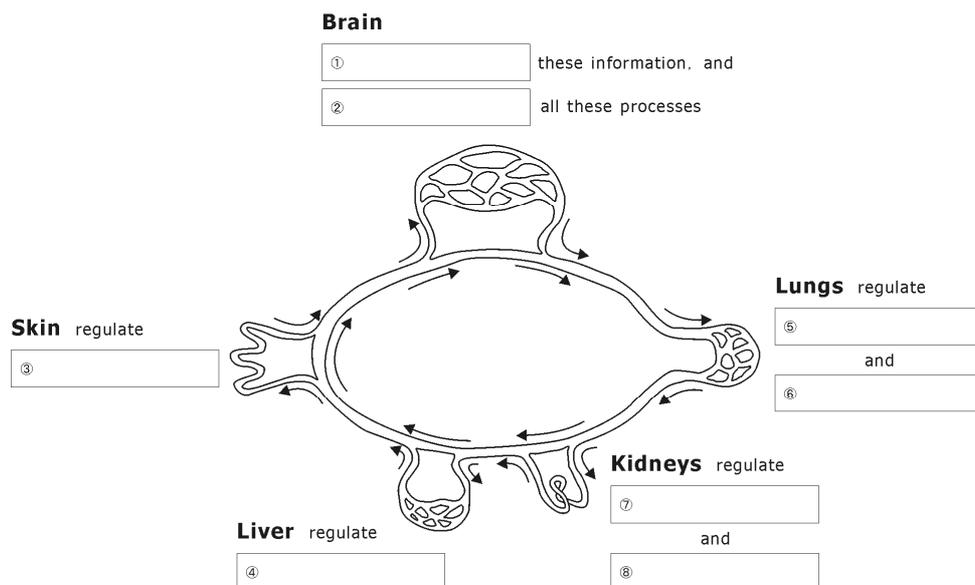
- Homeostasis is the maintenance of **a constant internal environment**.
- The internal environment of the human body is the blood and tissue fluid.
- The concentration, acidity and temperature of this fluid are being adjusted all the time to prevent any big changes.

* Importance:

- Organisms are alive because of the metabolic reactions going inside their cells.
- All the reactions are controlled by enzymes, and enzymes are extremely sensitive to changes in temperature and pH.

06-1-01 Organ involved in homeostasis.

- The **hypothalamus** in the brain plays an important role in homeostasis as a control centre.



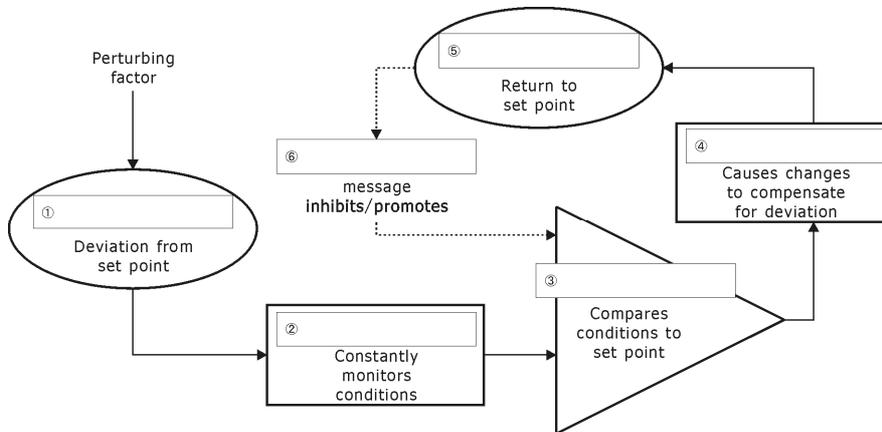
Activity 06-1-01: Fill in the blank ①-⑧.

06-1-02 Mechanism for homeostasis (feedback loop).

→ Feedback is needed to maintain homeostasis.

→ For example, when in a hot environment, thermoreceptors send information to the brain.

This is processed in the brain and information is sent to cooling systems in the body to be activated. When adjusted, another feedback is sent to inform the brain and loop continues.



Activity 06-1-02: Fill in the blank ①-⑥.

06-1-03 Thermoregulation. Means control of the body temperature.

Low temperature

Stimulus	Sensor	Integrator	Effector	Response	Feedback
Low temperature in outside	Cold spot in skin	Temperature controlling centre in the ① _____	② _____	Facilitate heart rate	Raised body temperature
			③ _____	Increase metabolic reaction	
	④ _____		Constrict		
	⑤ _____ in skin		Contract		
	⑥ _____ in skin		Not produce the sweat		

High temperature

Stimulus	Sensor	Integrator	Effector	Response	Feedback
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High temperature in outside	Warm spot in skin	Temperature controlling centre in the ① _____	② _____	Suppress heart rate	Lowered body temperature
			③ _____	Decrease metabolic reaction	
	④ _____		Dilate		
	⑤ _____ in skin		Relax		
	⑥ _____ in skin		Increase production of sweat		

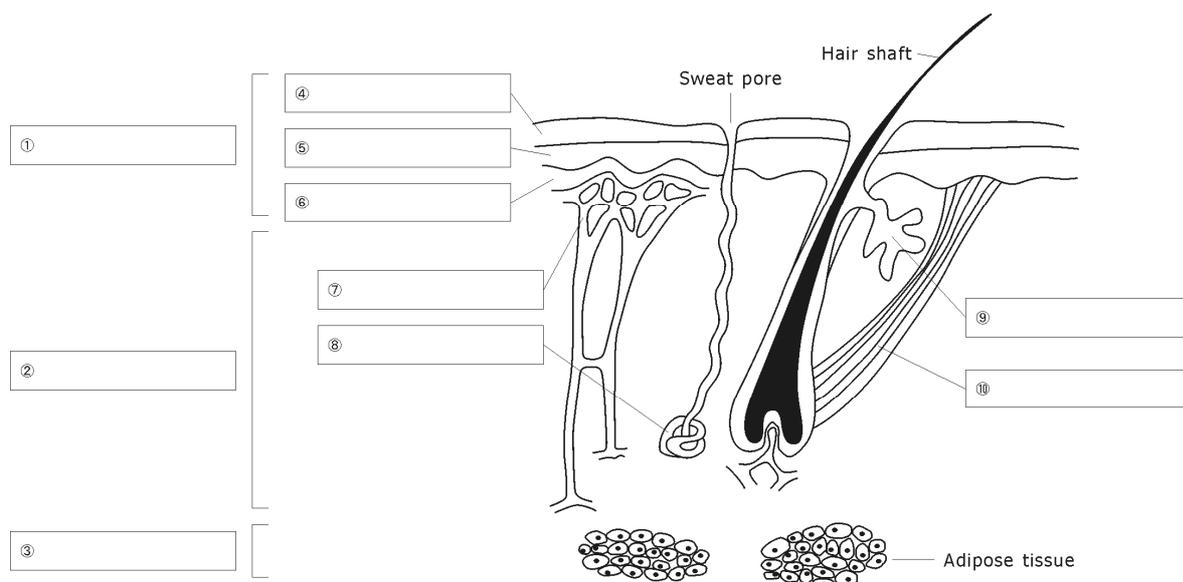
* Methods of heat gain/loss

Heat gain/loss	Mode of action
Radiation	Transfer of heat from hot object to cold through the air
Evaporation	Change of liquid to vapour accompanied by cooling
Conduction	Transfer of heat when in contact with each other
Convection	Movement of air in which the warmer air is replaced by cooler air

- Constriction of capillary prevents the heat from radiating.
- Contraction of muscle leads erection of the hair thus helps the air to be trapped.
- Less sweat production leads less evaporation.
- As a result of these responses, body temperature will raise.

Activity 06-1-03: Name the organ ①-⑥.

06-1-04 Skin structure.



- The skin (Cutaneous layer) consists of two layers, an **epidermis** and a **dermis**.
- The epidermis can be subdivided into three layers, an outer cornified layer, a middle granular layer and an inner Malpighian layer.
- Cornified layer contains **keratin**, an effective waterproof layer. Granular layer replaces dead cells from the cornified layer. Malpighian layer contains **melanin** to protect genetic material from UV radiation.
- The dermis consists of a thick layer of connective tissues. Within the dermis are **capillaries** and **nerve endings**.
- The nerve endings are sensitive to **touch, pain** and **temperature**.
- There are sweat glands, hair follicles and oil producing glands, called sebaceous glands, in the dermis.
- The capillaries are important in the control of the temperature of the body. The sweat glands act as excretory organs.

Activity 06-1-04: Name the part in the skin ①-⑩.

06-1-05 Osmoregulation. Means control of the water and salts balance.

Low osmolarity (dilute blood)

Stimulus	Sensor	Integrator	Effector	Response	Feedback
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Low osmolarity in blood	Osmolarity sensitive neurones in hypothalamus	Osmolarity controlling centre in the hypothalamus	① _____	Secret ② _____	Raised osmolarity
	Adrenal glands			to facilitate reabsorption of ③ _____ in Loop of Henle	

High osmolarity (concentrated blood)

Stimulus	Sensor	Integrator	Effector	Response	Feedback
High osmolarity in blood	Osmolarity sensitive neurones in hypothalamus	Osmolarity controlling centre in the hypothalamus	④ _____	Secret ⑤ _____ to facilitate reabsorption of ⑥ _____ in Loop of Henle	Lowered osmolarity

Activity 06-1-05: Name the organ ①④. Name chemical ②③⑤⑥.

06-1-06 Blood glucose level regulation.

Low glucose level

Stimulus	Sensor	Integrator	Effector	Response	Feedback
Low glucose level in blood	Glucose level sensitive neurones in hypothalamus	Glucose level controlling centre in the hypothalamus	① _____ in pancreas	Secret ② _____ to facilitate conversion into ③ _____ from	Raised glucose level in blood

				④ _____	
			⑤ _____	Secret ⑥ _____ to facilitate conversion into ③ _____ from ④ _____	

High glucose level

Stimulus	Sensor	Integrator	Effector	Response	Feedback
High glucose level in blood	Glucose level sensitive neurones in hypothalamus	Glucose level controlling centre in the hypothalamus	① _____ in pancreas	Secret ⑦ _____ to facilitate synthesis ⑧ _____ from ⑨ _____	Lowered glucose level in blood

Activity 06-1-06: Name the organ ①⑤. Name chemical ②-④,⑥-⑨.

Unit 06 Answers for the activities

<06-1-01> ①Receives ②Controls ③Temperature ④Glucose level ⑤Oxygen ⑥Carbon dioxide ⑦Water ⑧Salts

<06-1-02> ①Stimulus ②Sensor ③Integrator ④Effector ⑤Response ⑥Negative feedback

<06-1-03> ①hypothalamus ②Heart ③Liver ④Blood capillaries ⑤Hair erector muscles ⑥ Sweat glands

<06-1-04> ①Epidermis ②Dermis ③Sub-cutaneous layer ④Cornified layer ⑤Granular layer ⑥Malpighian layer

⑦Blood capillary ⑧Sweat gland ⑨Sebaceous gland ⑩Erector muscle

<06-1-05> ①Adrenal glands ②adrenocorticosteroid ③sodium ion ④Pituitary ⑤ADH, or vasopressin ⑥water

<06-1-06> ①Islet of Langerhans ②glucagon ③glucose ④glycogen ⑤Adrenal glands ⑥adrenaline ⑦insulin ⑧glycogen

⑨glucose

<Sample question>

1. Which substances in the dialysis fluid should be at a lower concentration than the blood?

- A. Amino acids and glucose. B. Glucose and salts. C. Glucose and urea. D. Salts and urea.

2. From which of the following is urea produced?

- A. Fats. B. Glycerol. C. Proteins. D. Starch.

3. Which of the following is NOT normally present in urine?

- A. Glucose. B. Water. C. Urea. D. Nephron.

4. Where are hormones destroyed?

- A. Adrenal glands. B. Kidneys. C. Liver. D. Pancreas.

5. What is the result of a rise in body temperature?

- A. A decrease in the production of sweat. B. An increase in blood flow to the skin.
C. Narrowing of blood vessels in the skin. D. Raising of hairs on the skin.

6. How does spraying of oil and insecticide on stagnant water help to reduce the spread of malaria?

- A. It suffocates the larvae and pupae. B. It kills the mosquito.

UNIT 07 Growth and Development

Objectives

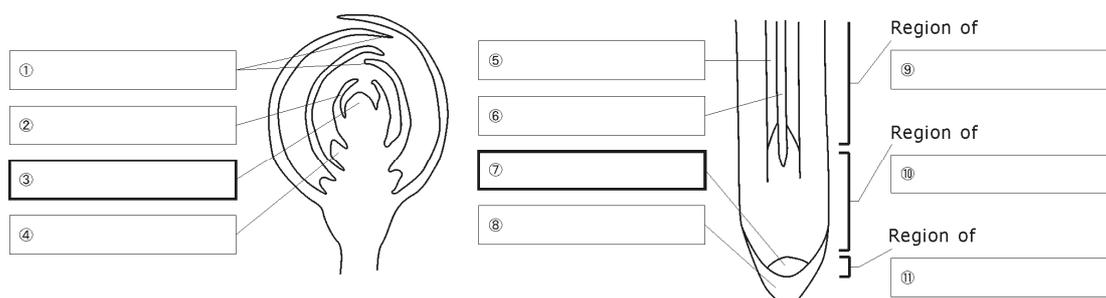
- 07-1 Identify the regions of cell division in stems and roots.
- 07-2 Describe the life history of a mosquito.
- 07-2 Explain the role of mosquitoes in the spread of malaria.

07-1 Growth in plants

- Most living organisms start their lives as a single cell (eg zygote), too small to be seen with the naked eye.
- This cell divides many times (by mitosis) to produce an organism made up of thousands or millions of cells.
- Also, all living things grow either by increasing the size of their individual cells or by multiplying and increasing in size at the same time.
- The increase in the size of the cells is the result of converting nutrients into living materials.
- As organisms grow, they develop special structures that enable them to cope with the demands of life. This process is called **differentiation** or **specialization**, resulting in the formation of tissues, organs and systems.

07-1-01 Meristematic region in root and stem.

- In plants, growth is mainly confined to the tips of roots and stems.
- It is at these tips where the specialized cells that actively divide are situated.
- These cells form **meristematic tissues**.
- The stem apical meristem is protected by overlapping scales.
- The root apical meristem is covered and protected by the root cap.

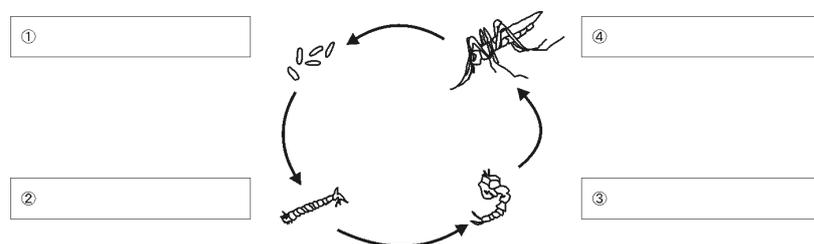


Activity 07-1-01: Identify the part of stem and root ①-⑧. Name the process ⑨-⑪.

07-2 Growth in insects

07-2-01 Life cycle of mosquito.

- The female mosquito lays its eggs in stagnant water after mating.
- The eggs hatch into larvae after a few days.
- The larvae of the mosquito are very active. They swim in the water and feed on tiny aquatic plants and animals.
- The mosquito pupa has a different shape from that of the larva.
- The larvae tissues dissolve and new tissues develop within the pupa.
- After some days, the young adult mosquito breaks out of the skin, and then flies out of the water.



Activity 07-2-01: Name the stage of life cycle ①-④.

07-2-02 Metamorphosis

- In many insects, when the insect develops from larva to adult, it undergoes distinct structural changes.
- Because of this, the larva, pupa and adult look very different from each other.
- These changes in form as the insect develops are called **metamorphosis**.
- Insects such as mosquitoes and houseflies show **complete metamorphosis**. In this case, the structural and morphological appearance between the larva, pupa and adult are quite different.
- Insects such as cockroach and grasshopper show **incomplete metamorphosis**. In this

case, the significant differences between the young developing insect and the adult are that the young insect is smaller than the adult.

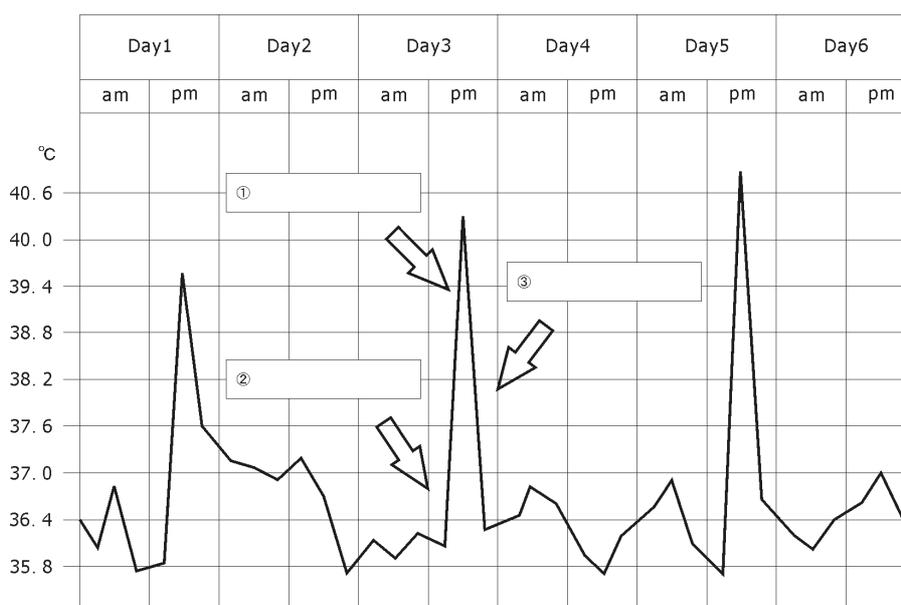
- Insects that show incomplete metamorphosis do not have the pupa stage in their life cycle. The larva in this case is called nymph.
 - During metamorphosis, the larva or nymph has to shed off its skin, or exoskeleton, in order to allow for increase in size. This is so because the skeleton of insects covers the body. Since it is a rigid structure, it restricts expansion of the body.
-

07-2-03 Malaria.

- Houseflies and mosquitoes are important to human beings because they transmit diseases. They are called **vectors** of disease. One of these diseases is **malaria**.
- The malarial parasite is a protozoan called ①_____.
- ① is found in the salivary glands of the female *Anopheles* mosquito (insect vector).
- ① is spread from person to person by mosquitoes of the genus **Anopheles**.
- When an *Anopheles* mosquito bites a human to obtain blood, it injects saliva mixed with a substance that prevents the blood from clotting.
- If the mosquito is infected with ①, it will also inject about 1000 elongated cells of this protist into the bloodstream of its victim.
- There are three stages in the ① life cycle.
- The stage of ① while it lives in mosquitoes and is injected into humans is called the **sporozoite**.
- Sporozoites make their way through the bloodstream to the human ②_____ in about three minutes.
- In the ②, they rapidly divide and produce millions of cells of the second stage of life cycle, called the **merozoite**.
- Merozoites reenter the host's bloodstream, invade ③_____ and divide rapidly.
- In about 48 hours, ③ rupture, releasing merozoites and toxic substances throughout the

host body, initiating a **cycle of fever and chills** that characterizes malaria (see next figure).

- The cycle repeats itself regularly every 48 hours as new waves of blood cells are infected.
- Some of the merozoites in the human bloodstream undergo a sexual phase and develop into third stage of ① life cycle, called the **gametocyte**.
- In the human bloodstream, gametocytes are incapable of undergoing meiosis to form haploid gametes. However, if they are extracted from an infected person by a mosquito, they form sperm and egg cells within the gut of the mosquito.
- Gametes fuse to form a zygote, which develops in the wall of the mosquito's gut and produces large numbers of sporozoites.
- Sporozoites migrate to the salivary glands of the mosquito, where they may be infected by the mosquito into the bloodstream of a human, completing the life cycle.



Activity 07-2-03: Name the organism ① in text. Name the organ and cell ②③ in text.

Name the stage ①-③ in figure.

* Treatments: Chloroquine. Quinine. Anti-malarial drugs.

* Symptoms: Headaches. Muscle aches. Anaemia (damage to red blood cells).

Alternates with cold shivering spells and hot sweating with shaking.

07-2-04 Prevention of malaria.

Prevention	Mode of action
Population control	Fogging to kill adult mosquitoes Spraying ① _____ The use of ② _____
Preventing bites	Mosquito creams and fumes Screening windows and doors, using ③ _____ over beds Wear suitable garments, long sleeved shirts and long pants
Removing breeding sites	Draining places with stagnant water Introducing fish etc. into ponds Spraying oil onto standing containers Emptying receptacles that collect water
Drugs	Anti-malarial drugs
Biological control	Releasing sterile male Anopheles Releasing predators and parasites of mosquitoes

Activity 07-2-04: Name the method ①-③.

07-3 Growth in vertebrates

07-3-01 Life cycle in a toad.

→ Toads spend most of their developing stage in water and the adult life on land.

→ The stages in the life cycles of a toad consist of egg, larva and adult, so that they show complete metamorphosis.

Stage	Features	Functions
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Egg	Yolk	Source of nutrients
	Albumen	Holding eggs together for protection
Larva (tadpole)	External and internal gills	For breathing in water For swimming
	Tail	For feeding
	Mouth	
Adult	Lungs	For breathing on land
	Hind legs	For jumping
	Webbed feet	For swimming
	Forelegs	Landing and balance
	Poison glands	Protection

07-3-02 Life cycle in human beings.

- Growth in human beings can be divided into stages. These are the prenatal, infant, early childhood, juvenile, adolescent and postadolescent stages.
- As the human being grows from one stage to another, there are very distinct proportional differences in the various structures of the body. That is, the head grows relatively little compared with the limbs.

Unit 07 Answers for the activities

<07-1-01> ①Over-lapping scales ②Developing leaf ③Apical meristem ④Developing axillary bud ⑤Phloem ⑥Xylem

⑦Apical meristem ⑧Root cap ⑨Cell differentiation ⑩Cell elongation ⑪Cell division

<07-2-01> ①Eggs ②Larva ③Pupa ④Adult (Imago)

<07-2-03> (text) ①Plasmodium ②liver ③red blood cells (figure) ①Hot stage ②Cold stage ③Sweating stage

<07-2-04> ①insecticides ②mosquito coils ③mosquito nets

UNIT 08 Responses

Objectives

- 08-1 Demonstrate responses exhibited by plants.
- 08-1 State functions of auxins.
- 08-2 Name the hormones and the glands which produced the hormones.
- 08-2 Explain the function of adrenaline.
- 08-3 Describe the nervous system in human.
- 08-3 Outline the pathway through a spinal reflex arc.
- 08-3 Describe the effects of abuse of drugs.
- 08-4 Describe the structure and function of the eye.
- 08-4 Describe accommodation of the eye.

08-1 Response in plants

08-1-01 Tropic response in plant (Tropism).

→ Tropisms are growth movements related to directional stimuli.

1. Geotropism (positively - root, negatively - shoot; see figure):

The plant response to ① _____

2. Phototropism (positively - shoot, negatively - root):

The plant response to ② _____

3. Hydrotropism (positively - root, pollen tube):

The plant response to ③ _____

4. Chemotropism (positively - root, pollen tube):

The plant response to ④ _____

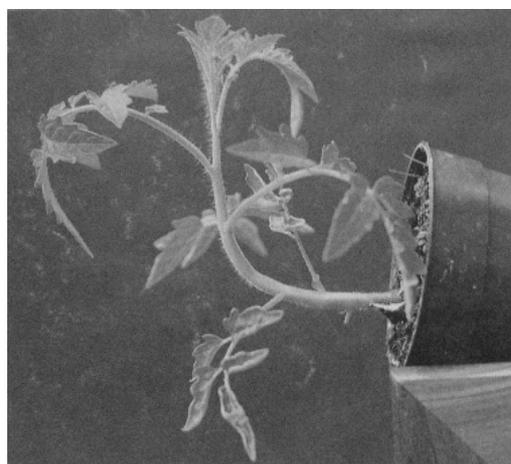
5. Thigmotropism (positively - tendril):

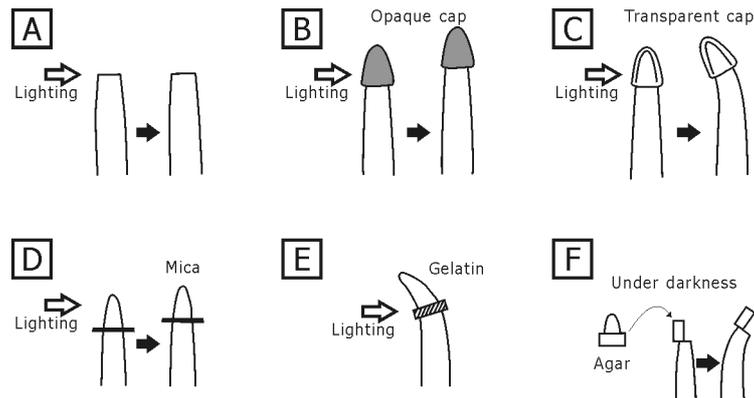
The plant response to ⑤ _____

Activity 08-1-01: List the stimulus ①-⑤.

08-1-02 Auxin.

→ Plants grow towards light when exposed to unidirectional light because of chemical substances, **auxins** in the plants.





- In the activity (A), the coleoptile tips were cut off and the coleoptiles allowed to grow. The coleoptiles stopped growing after a few days. From this, it was concluded that the coleoptiles stopped growing due to desiccation.
- When the coleoptile tips were covered with foil caps (B) or transparent caps (C) and then illuminated from one side, the shoots with transparent caps moved toward light. This showed that the tips were the one sensitive to one-sided light. It was also concluded that light reduces the auxins in the tip.
- In another activity, the tips were cut off and pieces of mica (D) or gelatin (E) placed between the tips and the rest of the shoots. It was observed that only coleoptiles with gelatin bent. They concluded that the mica prevented chemicals from reaching the shoot. And the chemical passed through the gelatin to the shoots causing them to grow.
- In the activity (F), the exercised cut tip was placed on agar blocks and left for several hours. The agar blocks were then placed on the tips in such a way that only a part of the tip was covered. The tips grew towards the direction without the agar block. This proved that the chemical in the tip diffused into the block. The part with the block received more of the growth-promoting chemical and thus causing it to grow towards the other part without extra growth-promoting chemical.
- On the other hand, in the case of roots, it has been suggested that the higher concentration of auxins reduces growth. This causes the roots to grow downwards towards the force of gravity. The above activities were used to explain tropisms.

08-1-03 Plant hormones.

→ Nowadays, some plant hormones are identified and the functions of them are examined.

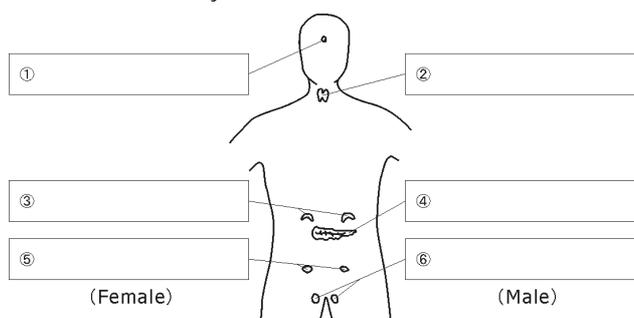
	growth	budding	aging	dropping of leaves	maturing of fruit	differentiation
promotion	auxins gibberellins cytokinins	gibberellins	abscisic acid ethelene	abscisic acid ethelene	auxins gibberellins ethelene	auxins (root) cytokinins (shoot)
inhibition	abscisic acid ethelene	abscisic acid	auxins cytokinins	auxins		

08-2 Endocrine system

- The endocrine system consists of ductless glands which produce hormones.
- **Hormones** are chemicals secreted by the endocrine glands which are ductless.
- Hormones are related into the bloodstream and transported to different parts of the body where they affect the target organ. That is hormones act as '**messengers**'.
- Hormones are usually produced in **minute concentrations**.
- Some hormones are **target-specific** while others are more generalised in their action.

08-2-01 Endocrine glands in human.

- The main glands that makeup the endocrine system are the pituitary, thyroid, parathyroid, islets of Langerhans in the pancreas, adrenal, testes and ovaries.



Activity 08-2-01: Name the organ ①-⑥.

08-2-02 Examples of hormones.

→ Hormones are important because they are particularly concerned with metabolic processes in the body cells.

→ Hormones can coordinate long-term changes such as growth and maturation of the organisms.

Endocrine gland	Hormone	Target organ	Function
Pituitary	① _____	Body cells	Growth
	② _____	Thyroid gland	Stimulate to secrete thyroxine
	③ _____	Testes, ovaries	Stimulate to secrete sex steroid hormones
	④ _____	Kidney	Promote reabsorption of water
Thyroid	⑤ _____	Tissue cells	Control metabolic rate Regulate growth and development
Adrenals	⑥ _____	Liver, heart, skin, lungs, alimentary canal	Prepare body for fight or flight response
Pancreas	⑦ _____	Tissue cells and liver	Regulate conversion of glucose to glycogen

	⑧ _____	Tissue cells and liver	Regulate conversion of glycogen to glucose
Testes	⑨ _____	Body cells and testes	Development of primary and secondary characteristics in males
Ovaries	⑩ _____	Uterus, ovary	Control growth of uterus walls
	⑪ _____	Body cells	Secondary characteristics in females

- The formation of **thyroxine** requires the element **iodine**.
- The islets of Langerhans are made up of two types of cells, called **alpha cells** which secrete **glucagons** and **beta cells** which secrete **insulin**.
- If anything goes wrong with the producing or function of insulin, the person will show the symptoms of **diabetes**.
- The adrenal cortex produces **cortisol**, which is responsible for the conversion of fats and proteins to glucose, and **aldosterone**, which promotes the reabsorption of sodium ions into the blood from the glomerular filtrate.
- The adrenal medulla produces **adrenalin** and **noradrenalin**.

Activity 08-2-02: Name the hormone ①-⑪.

08-2-03 Function of adrenaline (nicknamed ① _____ hormone)

* Three main effects

- Make ② _____ more quickly.
- Increase ③ _____, ie. the rate at which the cells release energy.
- Constrict arteries to the less important organs and dilates those to the more important ones (eg. muscles) so that blood is diverted to where it is most needed.

Target organ	Effect	Advantage
④ _____	Increase heart beat and blood pressure	Send more glucose and oxygen to the muscles

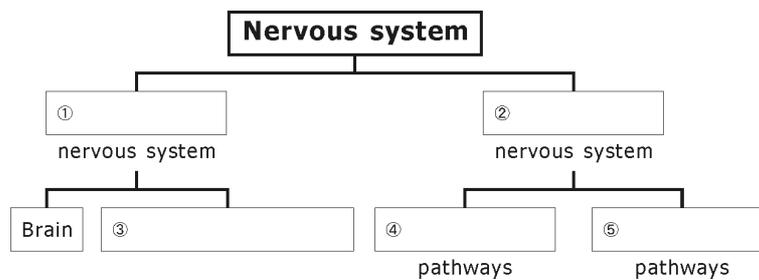
⑤ _____	Convert glycogen to glucose	For energy production
⑥ _____	Increase rate of gaseous exchange	Increase oxygen concentration in blood
⑦ _____	Increase sweating	Help to cool active muscle
⑧ _____	Arterioles contract	Less blood going to the skin means more is available to the muscle
⑨ _____	Smooth muscles relax	Peristalsis slow down means more energy available for action
Fatty deposit	Convert fats to fatty acids	Source of energy
Muscles	Takes up more glucose and oxygen	Ready for immediate action

Activity 08-2-03: Fill in the blank ①-③. Name the organ ④-⑨.

08-3 Nervous system

08-3-01 Description of nervous system.

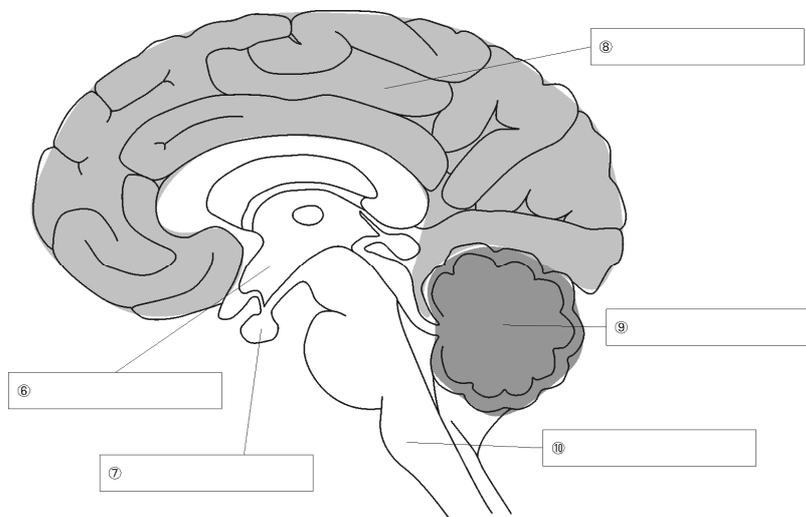
- The nervous system transmits messages throughout the body via nerves.
- The nervous system can be separated into the central nervous system (CNS) and the peripheral nervous system.
- The peripheral nervous system consist two pathways: **sensory pathways** in which sensory neurones transmit messages to CNS, and **motor pathways** in which motor neurones transmit messages to effector such as muscles.



Activity 08-3-01: Fill in the blank ①-⑤.

08-3-02 Structure of the brain in human.

→ The brain can divide into several parts based on their structures and functions.



Activity 08-3-02: Identify the part of the brain ⑥-⑩.

08-3-03 Function of the central nervous system.

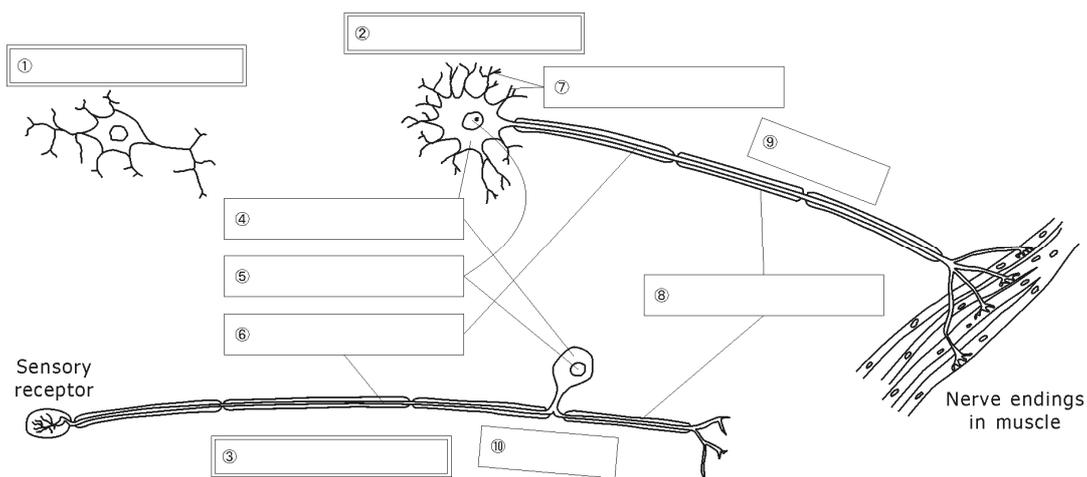
Structure	Function
Cerebrum	Regulate ① _____, ② _____, sense interpretation, reasoning, and other voluntary activities All ③ _____, including conditioned behaviour (habit)
Cerebellum	Responsible for ④ _____ Responsible for helping the body to remain in ⑤ _____ relative to its surroundings
Medulla oblongata	Regulate the ⑥ _____, ⑦ _____ processes of the body (involuntary)

	eg. regulation of ⑧ _____, ⑨ _____, ⑩ _____
	Control ⑪ _____, ⑫ _____,
Hypothalamus	⑬ _____, ⑭ _____
Spinal cord	Connect the brain to the peripheral nerves Coordinate the ⑮ _____

Activity 08-3-03: Fill in the blank ①-⑮.

08-3-04 Cells in nervous system.

- The nervous system is made up of nerve cells, called neurones.
- Messages are transmitted in form of electrical **impulses**.
- Multipolar neurons (or relay neurones or intermediate neurones) are neither sensory nor motor but make connections to other neurones inside the CNS.
- Nervous impulses travel in one direction only. It starts at the dendrites and travels towards the axon.
- The regions where impulses are able to cross from one neurone to the next are called **synapses**.



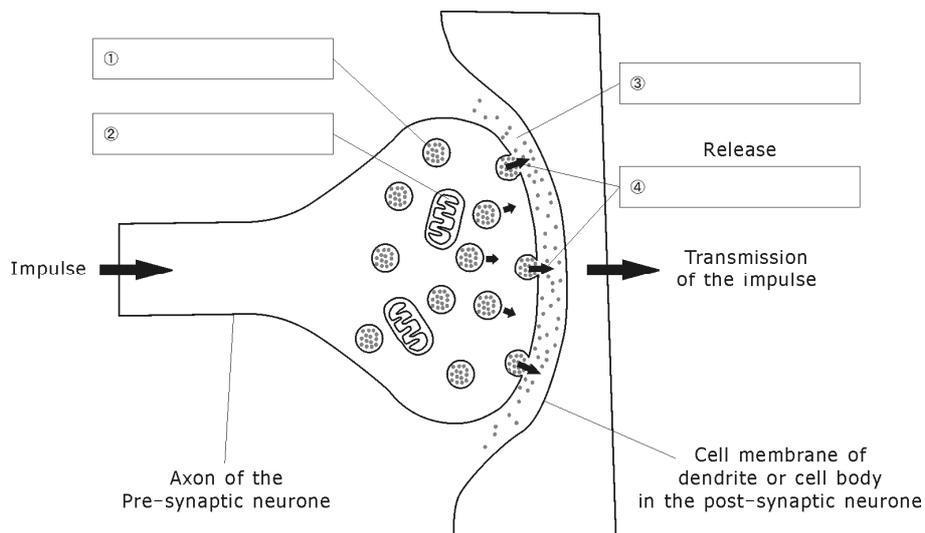
Activity 08-3-04: Name the cell ①-③. Identify the part of neurones ④-⑧. Write the direction of impulse in ⑨⑩.

08-3-05 Synapse.

- When an impulse arrives at the synapse, it releases a tiny amount of a chemical substance

(a **neurotransmitter**) which sets off an impulse in the next neurone.

→ The nerve fibres do not carry sensations like pain or cold. These sensations are felt only when a nerve impulse reaches the brain. The impulse itself is a series of electrical pulses which travel down the fibre. All nerve impulses are similar; there is no difference between nerve impulses from the eyes, ears or hands.



Activity 08-3-05: Name the structure ①-③. Fill in the blank ④.

08-3-06 Difference between endocrine and nervous system.

	Nervous system	Endocrine system
Control	Voluntary and involuntary	Involuntary
Message	① _____ (nerve impulse)	② _____ (hormone)
Conductor	③ _____	④ _____
Effector	Muscles, glands	All over the body except for effector-specific hormones
Speed	⑤ _____	⑥ _____
Duration	⑦ _____	⑧ _____
Extent	⑨ _____	⑩ _____

→ Coordination is the way all the organs and systems of the body are made to work efficiently together.

→ It achieves by the nervous system and the endocrine system.

Activity 08-3-06: Contrast two systems ①-⑩.

08-3-07 Two examples of spinal reflex.

→ A **reflex action** is an automatic response to a stimulus.

→ The nervous pathway for such reflexes is called a **reflex arc**.

→ One of the simplest situations where impulses cross synapses to produce action is in the spinal reflex arc.

→ The brain, theoretically, is not needed for a **spinal reflex** to happen.

→ Sensory fibres enter the **dorsal** (means the back) root, while motor fibres exit through the **ventral** (means the front) root.

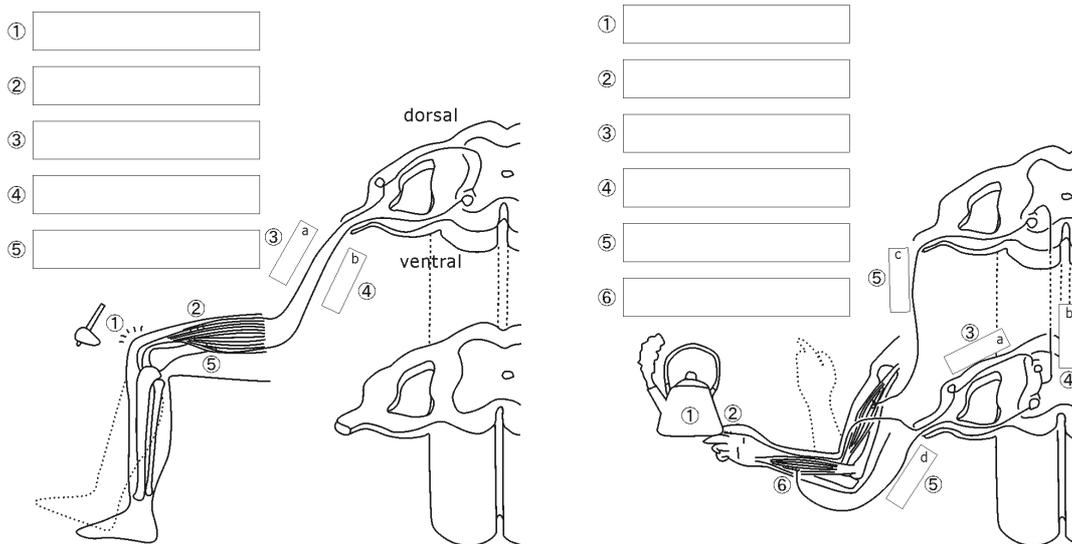
Knee jerk (patellar reflex);

When you tap tendon in the knee.

Flexor reflex;

When you touch a hot

object.



Activity 08-3-07: (left figure) Name the structure of the pathway ①-⑤. Write the direction of impulse at (a) (b).

Activity 08-3-07: (right figure) Name the structure of the pathway ①-⑥. Write the direction of impulse at (a) to (d).

08-3-08 Abuse of drugs.

- Drugs are externally administered substances. They modify or affect chemical reactions in the body.
- Drugs can be taken into the body in various ways; eg. orally, by injection, applied as a cream or inhaled.
- Drugs are supposed to be medicinal, but taken incorrectly leads to abuse.
- Abuse of drugs may impair judgment and make you clumsy and inaccurate, eg. Alcohol.
- You may become addicted to the drugs. If you stop taking such a drug, you may suffer from withdrawal symptoms, eg. nicotine, alcohol, heroin.

Type of drugs	Mode of action	Examples
Stimulants	Speed up transmission of nerve impulses	① _____
	Increase heart rate, breathing and blood pressure	② _____
		③ _____

Depressants	Slow down transmission of nerve impulses	④ _____
	Slow down body's processes	Tranquilliser
Painkillers	Block transmission of pain signals to the brain	Aspirin
Narcotics	Strong painkillers that cause sleepness	⑤ _____
	Very addictive	⑥ _____
		⑦ _____
Hallucinogens	Mind-altering drug	⑧ _____
	Abusers lose sense of time and space	
Antibiotics	Treatment of bacterial infections	Penicillin

Activity 08-3-08: Name the drug ①-⑧.

08-3-09 Alcohol.

- Ethanol helps to reduce tension and inhibitions in a person.
- It dilates small blood vessels near the skin. This causes the person to flush and feel warm as well.
- Drinking alcohol during driving leads to road accidents because alcohol consumption slows reflex time and blurs the vision of the driver. This would lead to an overall poor judgement in the driver.

Timing	Symptoms/reactions
Short-term	Depressant: slow down nerve actions in the brain and spinal cord
Motor centre	Poor ① _____, poor ② _____ Reflexes are sluggish
Cerebrum	Change in behaviour, loss of ③ _____ Slurring of speech
Medulla	Large amounts of alcohol can lead to coma or death (acute

oblongata	alcoholism)
Long-term	
Body	Malnutrition, damage to heart muscles Stomach disorders like ulcers and gastritis
Cirrhosis of liver	Not able to detoxify blood or process nutrients
Other drugs	Most medicines cannot be taken with alcohol as it interacts negatively
Life	Lead to ④ _____
During pregnancy	Lead to ⑤ _____ (reduced physical/mental development) Retardation, birth defects, miscarriage

Activity 08-3-09: Fill in the blank ①-⑤.

08-3-10 Heroin.

- Heroin is made from morphine. It gives the abuser a sense of euphoria.
- The physical addiction to heroin develops very quickly.
- When the abuser increases his heroin dosage to avoid withdrawal symptoms, a psychological dependence develops as well.

Effect	Withdrawal symptoms
Hallucination, reduced alertness	Nervousness, chills
Nausea, vomiting	Sweating, hot/cold flushes
Impotence	Stomach cramps, diarrhoea
Unconsciousness, death	

Problem	Results in
---------	------------

Crime	<p>Turn to crime to feed their habit</p> <p>Not capable of holding down a job for long</p> <p>Willing to steal and lie for money to buy more drugs</p>
Infection	<p>Addicts that share needles that are used to inject drugs into their system</p> <p>Without sterile needles and syringes, they are prone to diseases transmitted by blood, like AIDS</p>
Social	<p>Family life suffers</p> <p>Main purpose everyday is to obtain and use drugs</p> <p>Do not contribute to the family or the country</p> <p>May be more prone to violent tendencies</p>
Cure	<p>The only cure is their own determination to stop the abuse</p> <p>There are rehabilitation centers and help groups available</p>

08-4 Sense organs

→ Living organisms detect changes in their environment using special organs called sense organs.

08-4-01 Sense organ and receptor.

→ A **stimulus** (pl. stimuli) is a change in light, temperature, pressure, etc., which produces a reaction in a living organism.

→ Structures which detect stimuli are called **receptors**. Receptors are consisted of **sensory cells**.

→ The special property of sensory cells and sense organs is that they are able to **convert** one form of energy to another.

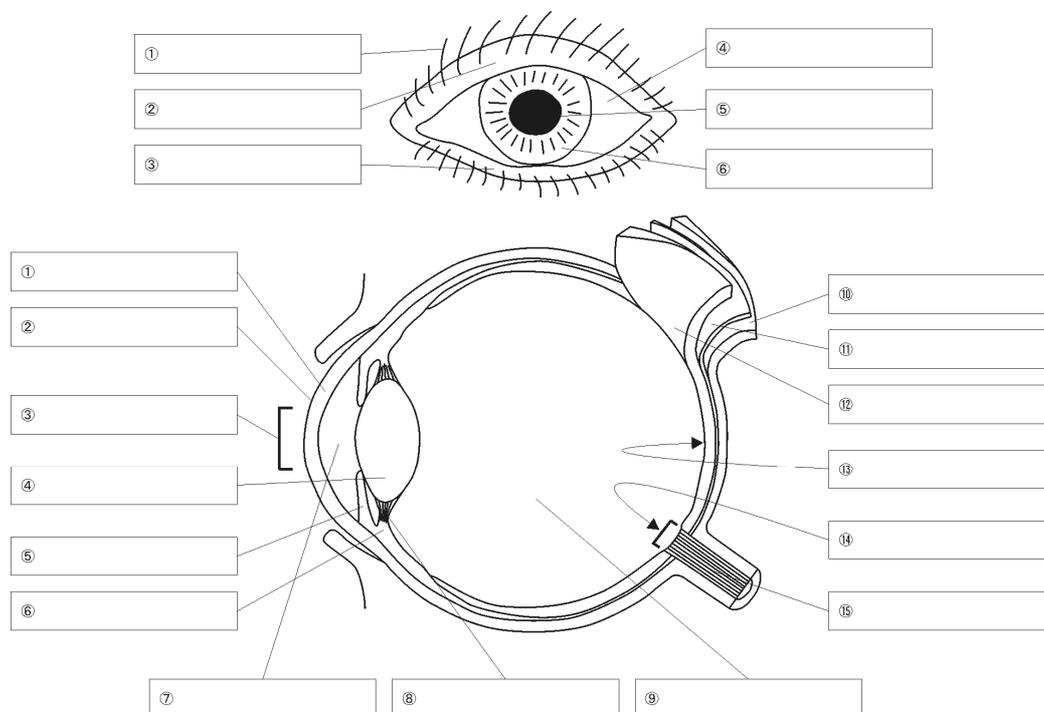
→ For example, the eye can convert light energy into the electrical energy of a nerve impulse.

* Types of stimuli and their received organ

1. ① _____ : the eye
2. ② _____ : the ear
3. ③ _____ : touch receptor in the skin
4. ④ _____ : temperature receptor in the skin
5. ⑤ _____ : taste buds in the tongue, nose

Activity 08-4-01: List the stimulus ①-⑤.

08-4-02 Structure of the eye. (external and internal)



→ Horizontal section through the right eye

Activity 08-4-02: identify the part of the eye ①-⑥ (external), ①-⑮ (internal).

08-4-03 Function of the parts of the eye.

Structure	Notes
① _____	Transparent, bends (refracts) light rays
② _____	Aperture ('hole') through which light rays pass into eye
③ _____	Surrounds pupil, can constrict or dilate thereby regulating amount of light entering eye

④ _____	Transparent, bends (refracts) light rays and brings them to a focus on retina
⑤ _____	Ring or circular muscle surrounding lens, attached to lens by suspensory ligament
⑥ _____	Runny fluid, nourishes cornea and maintains correct pressure in front part of eye
⑦ _____	Jelly-like fluid, maintains spherical shape of eyeball
⑧ _____	Layer of light-sensitive cells (rods and cones) lining back and sides of eyeball
⑨ _____	Layer of pigmented cells and blood vessels behind retina, absorbs light (preventing it being reflected within eye) and nourishes retina
⑩ _____	Thick wall of eyeball (the 'white' of the eye), protective
⑪ _____	Most central part of retina, responsible for 'precision vision'
⑫ _____	Carry nerve impulses from retina to brain
⑬ _____	Part of the retina where optic nerve is attached to eye, no light sensitive cells are present here

→ Light sensitive cells are two types: **rods**, which detect light intensity, and **cones**, which detect wavelength of light for colour vision.

Activity 08-4-03: Name the structure of eye ①-⑬.

08-4-03A Let's try EXP: To investigate what happens when light falls on the blind spot.

* Methods:

1. Make a plus sign (+) and a dot (●) about 10 cm apart on a piece of paper.
2. Hold the piece of paper about 50 cm away in front of your eyes.
3. Close the left eye and concentrate on both the cross and dot using the right eye.
4. Bring the paper slowly towards your eye.

* Questions:

1. What happens to the images as the paper is brought closer to the eye?

2. What could be the cause for this?

+

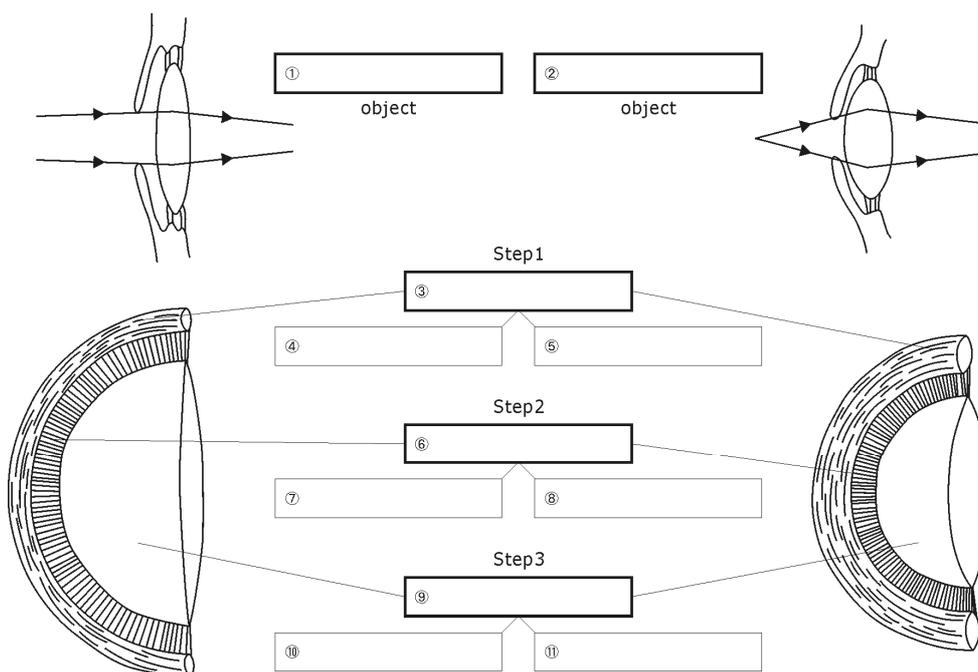
●

* Forming an image

- A clear image can be seen when an object is focused on the retina.
- Light from the object is refracted by the eye to form an inverted image on the **retina**.
- The image is interpreted by the brain and is then cognized the right way up.

08-4-04 Accommodation of the eye.

- Images are focused onto the retina by the adjustments made in the eye.
- Accomodation makes the **lens** thicker or thinner by the action of the **ciliary muscles**.
- The action of the ciliary muscles affects the tension of the **suspensory ligaments**, and follows the change in the thickness of the lens.



Activity 08-4-04: Fill in the blank ①②. Name the structure ③⑥⑨.

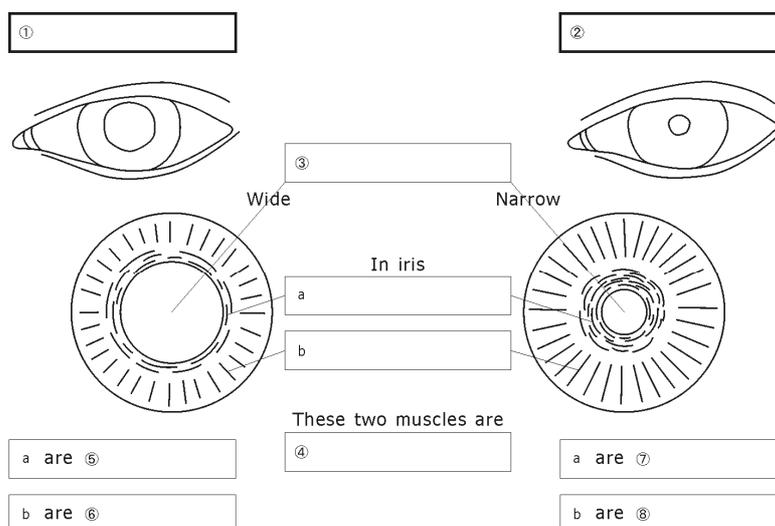
State the movement of each structure ④⑤⑦⑧⑩⑪.

08-4-05 Light response of the eye.

- The amount of light entering the eye is controlled by altering the size of the **pupil**.
- Two types of muscles are involved in the light response: **circular muscles** and **radial**

muscles.

→ The change in size of the pupil is caused by an automatic reflex action.



Activity 08-4-05: Name the muscle (a) (b). Write the direction of light ①②. Fill in the blank ③④.

State the movement of muscle ⑤-⑧.

08-4-06 Defect of the eye.

→ Like all other sense organs, sometimes the eyes may not function properly.

→ In addition to the defects, there are many curable and incurable diseases that affect the eye.

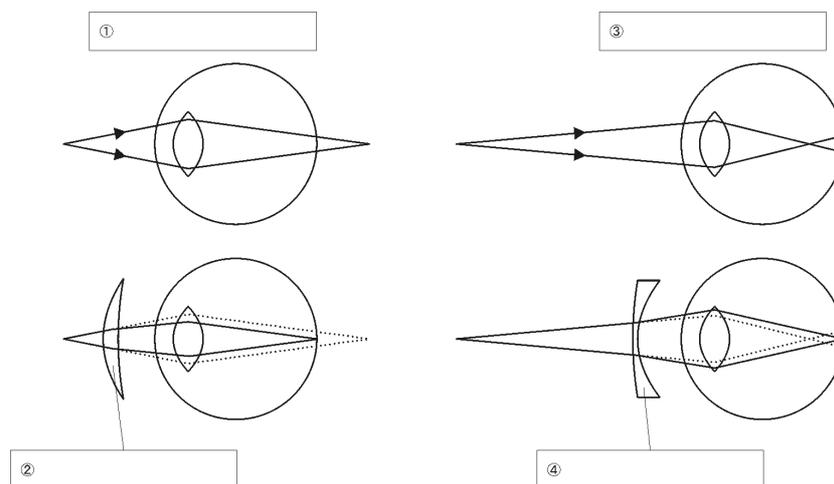
1. ① _____ : the person can focus near objects but not far objects (see right figure).

2. ② _____ : the person can focus far objects but not near objects (see left figure).

3. ③ _____ : inability to distinguish colour, particularly red and green (genetic disease).

4. ④ _____ : lens becomes opaque and will not let light through (innate, aging, diabetic, or injury).

→ ① and ② are corrected by wearing glasses.

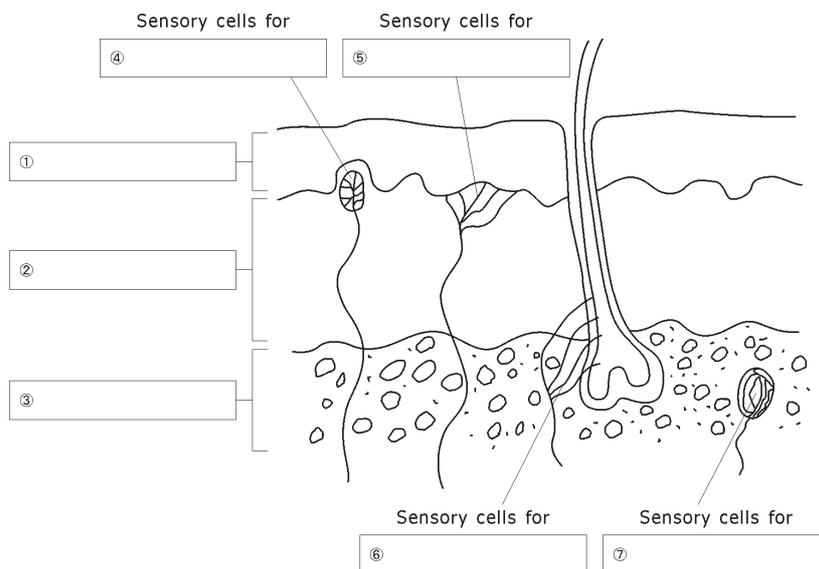


Activity 08-4-06: Name the eye defect ①-④ in text. Name the condition of eye defect ①③. Name the lens ②④.

08-4-07 Skin as a sense organ.

→ The skin contains sensory cells which can be stimulated by changes in temperature and pressure. Some are sensitive to touch and pain.

→ When stimulated the sensory cells send nerve impulses to the brain. The brain will then give a response either in the form of a reflex action or record an impression by which the animal is aware of the nature of the stimulus.

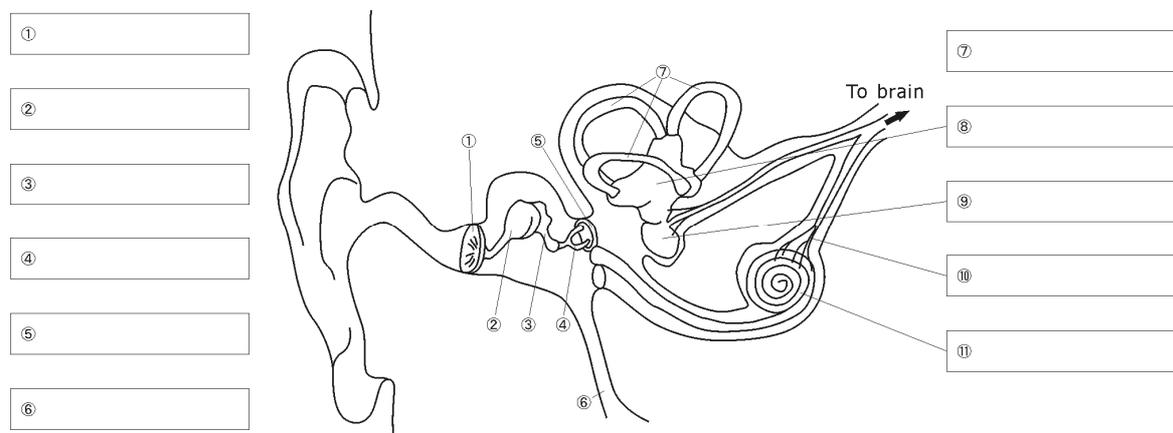


Activity 08-4-07: Name the layer ①-③. Name the stimulus ④-⑦.

08-4-08 Structure of the ear.

→ The mammalian ear is the sense organ that detects sound so that hearing is made possible.

→ The mammalian ear consists of three main parts. These are the outer ear, middle ear and inner ear.



→ The outer ear consists of a tube which runs from the side of the head, to **the eardrum**. This tube is called the external auditory meatus. The outer ear contains wax and hairs that traps dirty and pathogens. The eardrum, or tympanum, is a thin membrane stretched tightly across the inner end of the ear tube in the skull.

→ The middle ear is found just after the eardrum. It comprises an air filled cavity and three small bones. The cavity is linked to the back of the mouth cavity through a narrow tube called the **eustachian tube**. The function of the eustachian tube is to equalise pressure between the outer and middle ear.

→ In the middle ear are also found three small bones called **ear ossicles**. These are the **malleus, incus** and **stapes**. They are responsible for transmitting sound vibrations from the eardrum to the **oval window** of the inner ear.

→ The inner ear is housed in several passage ways formed by the bones of the skull. It comprises a labyrinth of tubular structures one of which the **cochlea** is directly involved in the hearing process. The cochlea is a coiled tube which gives the appearance of the snail.

→ The other tubular structures of the inner ear are the **utricle, saccule** and the three **semicircular canals**. The functions of these are balancing the body during motion.

Activity 08-4-08: Identify the part ①-⑪.

<Creativity> Brain vs Computer

What are similarities and differences between a computer and a human brain?

<Creativity> Heat sensitive neurone

Heat is a kind of physical signal. Impulse of neurone is an electrical signal.

How do the heat sensitive neurones transduce (change) these signals? Consider the possible mechanism of transducing.

Not only heat sensitive neurones, but also other sensory neurones transduce physical signal to electrical signal.

How do they achieve their function?

Unit 08 Answers for the activities

<08-1-01> ①gravity ②light ③water ④gradient of chemical concentration ⑤touch

<08-2-01> ①Pituitary ②Thyroid ③Adrenal ④Pancreas ⑤Ovary ⑥Testis

<08-2-02> ①Growth hormone ②Thyroid stimulating hormone ③Gonadotropic hormone ④

Anti-diuretic hormone

⑤Thyroxine ⑥Adrenaline ⑦Insulin ⑧Glucagon ⑨Testosterone ⑩Oestrogen ⑪

Progesterone

<08-2-03> ①fight or flight ②heart beat ③metabolic rate ④Heart ⑤Liver ⑥Lungs ⑦

Sweat glands ⑧Skin

⑨Digestive system

<08-3-01> ①Central ②Peripheral ③Spinal cord ④Sensory ⑤Motor

<08-3-02> ⑥Hypothalamus ⑦Pituitary ⑧Cerebrum ⑨Cerebellum ⑩Medulla oblongata

<08-3-03> ①conscious thought ②memory ③learned behaviour ④coordinating muscular activities ⑤physical balance

⑥automatic ⑦rhythmic ⑧heartbeat ⑨breathing rate ⑩peristaltic activity ⑪blood pressure

⑫body temperature

⑬appetite ⑭sleeping ⑮reflex response

<08-3-04> ①Multi-polar neurone ②Motor neurone ③Sensory neurone ④Cell body ⑤ Nucleus ⑥Axon ⑦Dendrites

⑧Sheath ⑨→ ⑩→

<08-3-05> ①Synaptic vesicle ②Mitochondrion ③Synaptic cleft ④Neurotransmitter

<08-3-06> ①Electrical ②Chemical ③Neurons ④Blood stream ⑤Rapid ⑥Slow ⑦ short-term ⑧long-lasting ⑨Localised

⑩Generalised

<08-3-07> (left) ①Stimulus ②Muscle spindle ③Sensory neurone ④Motor neurone ⑤ Muscle (a) ↑ (b) ↓ (right)

①Stimulus ②Thermoreceptor ③Sensory neurone ④Interneurone ⑤Motor neurone ⑥

Muscle (a)→ (b) ↑ (c) ↓ (d) ↓

<08-3-08> ①Caffeine ②Nicotine ③Cocaine ④alcohol ⑤Heroin ⑥Morphine ⑦Marijuana ⑧LSD (d-lysergic acid diethylamide)

<08-3-09> ①coordination ②balance ③memory ④social and personal problems ⑤foetal abnormalities

<08-4-01> ①Light ②Sound ③Touch ④Temperature ⑤Chemicals

<08-4-02> (external) ①Eyelashes ②Upper eyelid ③Lower eyelid ④Sclera ⑤Pupil ⑥Iris (internal) ①Cornea

②Conjunctiva ③Pupil ④Lens ⑤Iris ⑥Ciliary body ⑦Aqueous humour ⑧Suspensory ligament ⑨Vitreous humour ⑩Sclera

⑪Choroid ⑫Retina ⑬Yellow spot (Fovea) ⑭Blind spot ⑮Optic nerve

<08-4-03> ①Cornea ②Pupil ③Iris ④Lens ⑤Ciliary body ⑥Aqueous humour ⑦Vitreous humour ⑧Retina ⑨Choroid

⑩Sclera (sclerotic) ⑪Yellow spot (fovea) ⑫Optic nerve ⑬Blind spot

<08-4-04> ①Distant ②Near ③Ciliary muscles ④Relaxed ⑤Contract ⑥Suspensory ligament ⑦Taut ⑧Slackens ⑨Lens

⑩Pulled thin ⑪Allowed to shrink and thicken

<08-4-05> (a)Circular muscles (b)Radial muscles ①Dark ②Bright ③Pupil ④Antagonistic

UNIT 09 Skeleton and movement

Objectives

- 09-1 Identify the bones of the axial and appendicular skeletons.
- 09-3 Compare the ball and socket joint and the hinge joint.
- 09-4 Explain the action of antagonistic muscles.

09-1 The skeleton

→ Animals such as mammals and other vertebrates possess antigravity supports in the form of the skeletal system.

→ The skeleton supports the vertebrate body and is used in locomotion.

09-1-01 Functions of the skeleton.

1. ① _____ : The skeleton provides support for the soft tissues of the body.
2. ② _____ : Vital and delicate organs such as the brain, lungs and heart are protected by the skeleton.
3. **Movement** : The skeleton provides suitable points of attachment for the end of muscles.
4. ③ _____ : Blood cells are produced by the bone marrow found in the various bones of the skeleton.
5. ④ _____ : The bone is a living tissue consisting of living cells, strong fibres made from a protein called **collagen**, and crystals of calcium phosphate (and other minerals) which give bone its hardness.
6. **Transmission of sound** : The vibrations of three ear bones cause sound to be amplified and thus enhance hearing.
7. ⑤ _____ : The change of position of the whole body.

Activity 09-1-01: List the function ①-⑤.

09-1-02 Vertebrate skeleton.

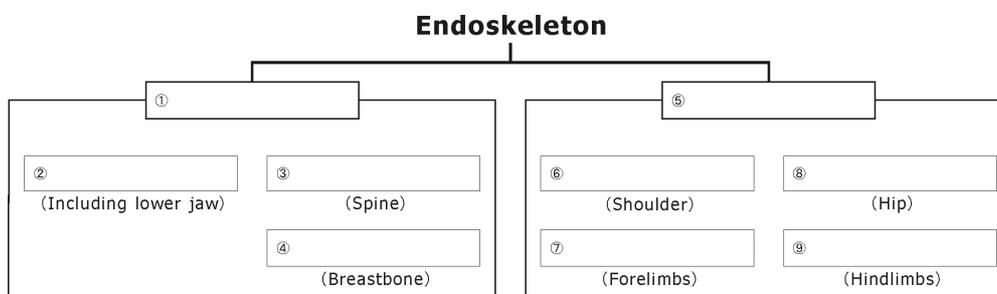
→ **Exoskeleton** is the type that the skeletons occur outside the body, eg. insects.

→ **Endoskeleton** is the type that has internal skeletons, eg. vertebrates, mammals

→ The bone of the mammalian skeleton can be grouped into the **axial skeleton** and the **appendicular skeleton**.

→ The axial skeleton forms the axis of the body.

→ The appendicular skeleton forms the appendages that are attached to the body axis.



→ The **skull** is made up of many bone plates joined together. The base of the skull makes a joint with the top vertebra of the vertebral column. This joint allows the head to make nodding and rotational movement.

→ The upper arm bone is the **humerus**. It is attached by a hinge joint to the lower arm bones, the radius and ulna.

→ The thighbone or **femur** is attached at the hip to the pelvic girdle by a ball and socket joint and at the knee it makes a hinge joint with the tibia. The fibula runs parallel to the tibia but does not form of the knee joint.

Activity 09-1-02: Name the group of skeletons ①⑤. Name the group of bones ②-④,⑥-⑨.

09-1-03 Types of connective tissue.

→ ① _____ : Very hard because it contains minerals, particularly calcium.

→ ② _____ : soft, serves as a shock-absorber between bones.

→ ③ _____ : Connect bones to bones. They are elastic and can be stretched. They hold the skeleton together while allowing muscles to move the individual bones. They consist of tough collagen fibres.

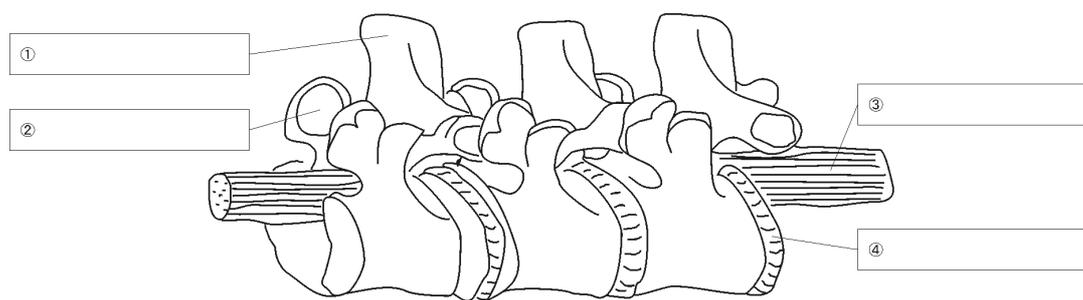
→ ④ _____ : Connect muscles to bone. They have little elasticity and so are virtually unstretchable. They also consist of tough collagen fibres.

Activity 09-1-03: Fill in the blank ①-④.

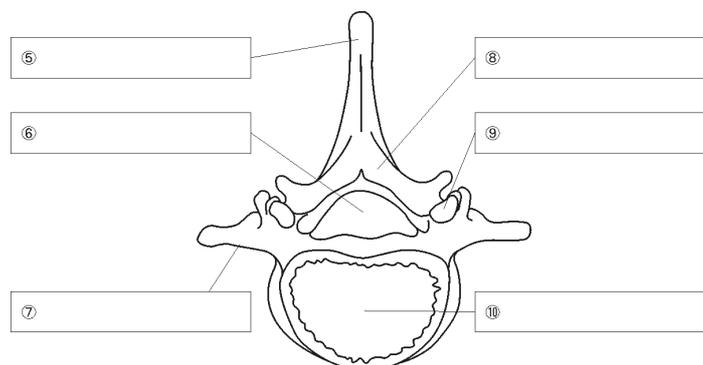
09-2 Bones

09-2-01 Structure of the vertebral column.

→ The backbone is known as the vertebral column. It is made up of 33 bones and each bone is known as a vertebra. Each vertebra is separated from the one above and the one below by a compressible pad of cartilage, **intervertebral disc**.



* Basic Structure of vertebra:



→ A vertebra has a **neural canal** through which the spinal cord passes. The neural canal is surrounded by the **neural arch**. The neural arch extends into a **neural spine** which projects upwards. The neural spine is used for muscle attachment.

→ The lower end of the vertebra is a solid bone known as **centrum**.

→ On either side of the vertebra are **transverse process** which are also used for muscle attachment.

→ Other bone projections called **facets** or **zygapophysis** are present at the back and front of each vertebra. These facets are used for articulation.

Activity 09-2-01: Identify the part ①-⑩.

09-2-02 Types of the vertebral column.

→ The bones in the vertebral column can be grouped into five different types. These are the **cervical** (neck region), **thoracic** (chest region), **lumbar** (abdominal region), **sacral** (pelvic region) and **caudal** (tail region) vertebrae.

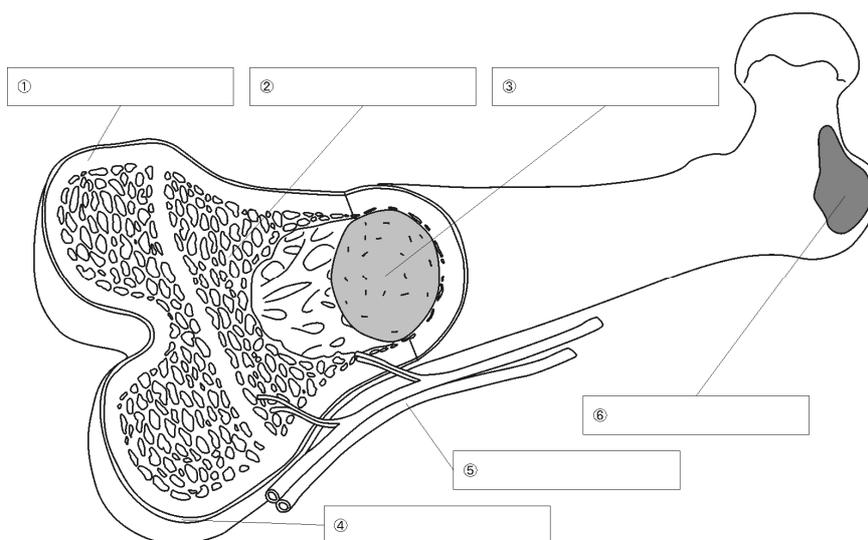
→ All vertebrae in the vertebral column have the same basic structure, but they show variations due to the different regions of the vertebral column where they are found and the different functions they perform.

	number of bones	neural canal	centrum	neural spine	transverse process	features
The cervical vertebrae	One	large in atlas	absent in atlas	small in atlas	absent in atlas	Present a pair of canals known as vertebral arterial canals (passage for the blood vessels). The first cervical vertebra is called atlas and the second is called axis.
	One	large in axis	large projection (odontoid process) in axis	large in axis	absent in axis	
	Five	large in others	large in others	small in others	small in others	They allow free rotation movement of the head.
The thoracic vertebrae	Twelve	large	large	long	short	The neural spine projects upwards and backwards.
The lumbar vertebrae	Five	present	large and thick	long	long	The neural spine projects upwards and forward.

						The largest and strongest bones of the vertebral column.
The sacral vertebrae	Five	narrow	large	reduced	present	They are fused form known as sacrum.
The caudal vertebrae	Four	absent	present	absent	absent	They are fused form known as coccyx.

09-2-03 Internal structure of bones.

→ Bone tissues can be classified as **compact** or **spongy**.

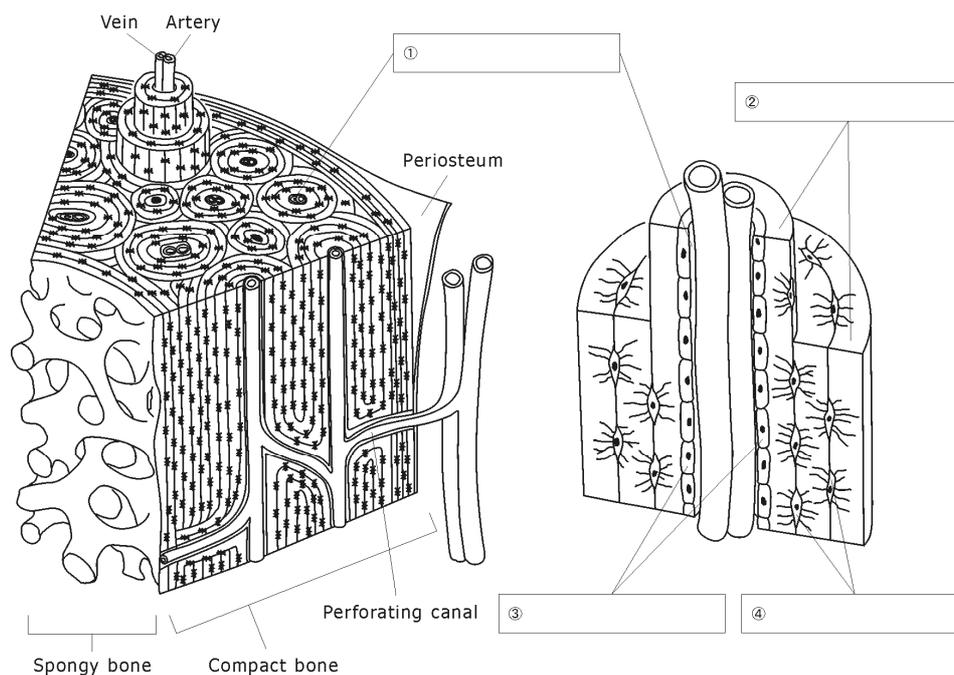


→ Compact bones are made up of tightly packed concentric rings of bone known as **Haversian system**, which gives bones a porous appearance in the shaft area. Within the porous spaces of the Haversian system are the bone cells and blood vessels.

→ Spongy bone is less tightly packed and it is made of thin plates of bone. There is no Haversian system but in between the plates there is **red marrow**. The red marrow found at the ends is richly supplied with blood vessels. Red blood cells are manufactured in the red marrow. The marrow cavity also contains **yellow marrow** for fat storage.

Activity 09-2-03: Identify the part ①-⑥.

09-2-04 Structure of the Haversian system;



Activity 09-2-04: Identify the part ①②. Name the cell ③④.

09-3 Joints

→ Where two bones meet, they form a joint.

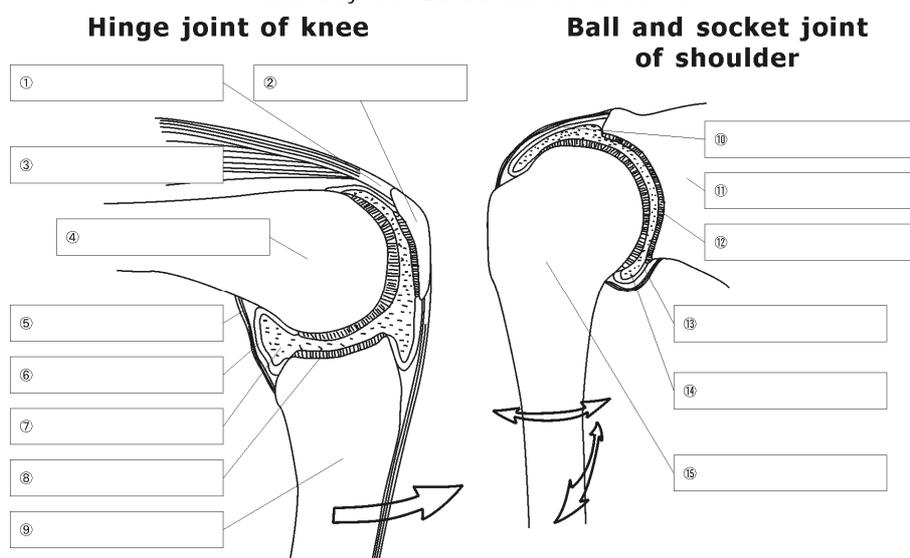
→ It may be a **fixed joint** as in the junction of the hip girdle (fibrous joints) and the vertebrate column (cartilaginous joints) or a **movable joint** (in other words a **synovial joint**) as in the knee.

09-3-01 Two types of joint.

→ Two important types of the movable joint are the **hinge joint** and the **ball and socket joint**.

1. **Hinge joint:** allows movement **in only one plane**, eg. knee, elbow

2. **Ball and socket joint:** allows movement **in any plane**, eg. hip, shoulder



* Important properties of joints

→ Joints allow the bones to move easily without friction, which is achieved by synovial fluid.

Movable joint are sometimes called the synovial joint.

→ Joints prevent the bones coming apart, which is achieved by the capsule surrounding the joint, and by ligaments which connect the bones together on either side of the joint.

Activity 09-3-01: Name the tissue ①③,⑤-⑧,⑩,⑫-⑭. Name the bone ②④⑨⑪⑮.

09-4 Muscles

→ There are three main types of muscles: **skeletal muscles** (or voluntary muscle), **smooth muscles** (or involuntary muscle) and **cardiac muscles**.

→ Skeletal muscle is made up of long fibres. Each fibre is found from many cells, but the cells have fused together.

→ Skeletal muscles are composed of the proteins, actin and myosin. These are responsible for the contractions of the muscles.

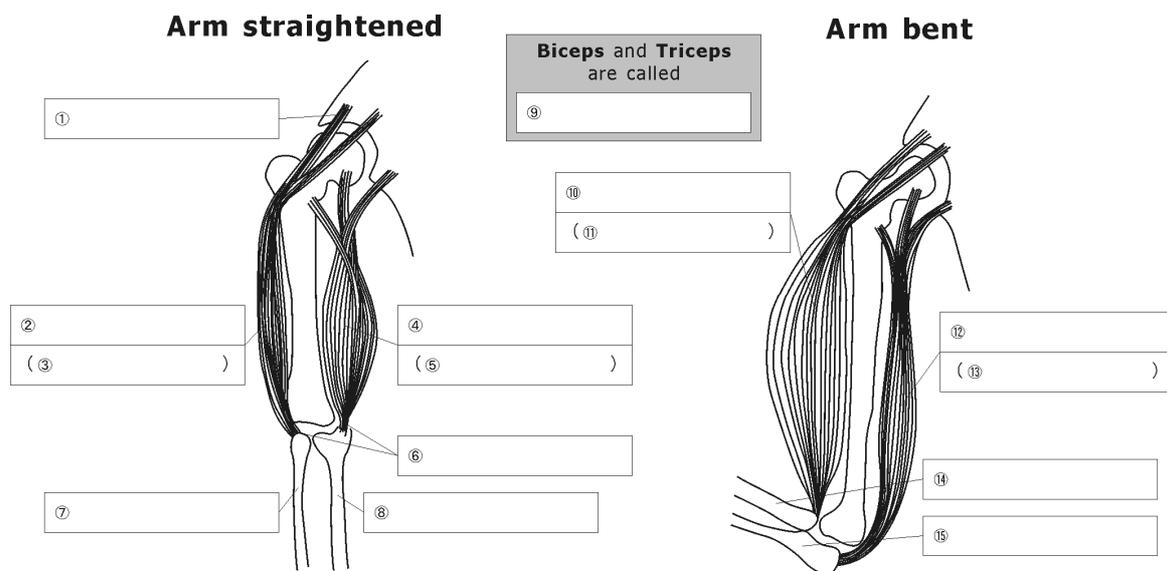
→ Smooth (or visceral or striated) muscle cells are found in organs which are not controlled by the voluntary part of the brain.

→ They line the walls of the alimentary canal, the uterus and the blood vessels.

→ Each smooth muscle fibre is made of a single cell with a single nucleus and numerous fibrils.

- Cardiac muscles are special muscle found only in the heart.
- Cardiac muscles possess rhythmic contractions and relaxations originate in the cardiac muscles themselves without being fatigued.
- The fibres of skeletal muscle and the cells of smooth muscle have the special property of being able to contract, i.e. shorten, when stimulated by nerve impulses.
- However, the fibres and cells cannot elongate; they can only contract and relax.

09-4-01 Muscle attachment and movement of an arm in human.

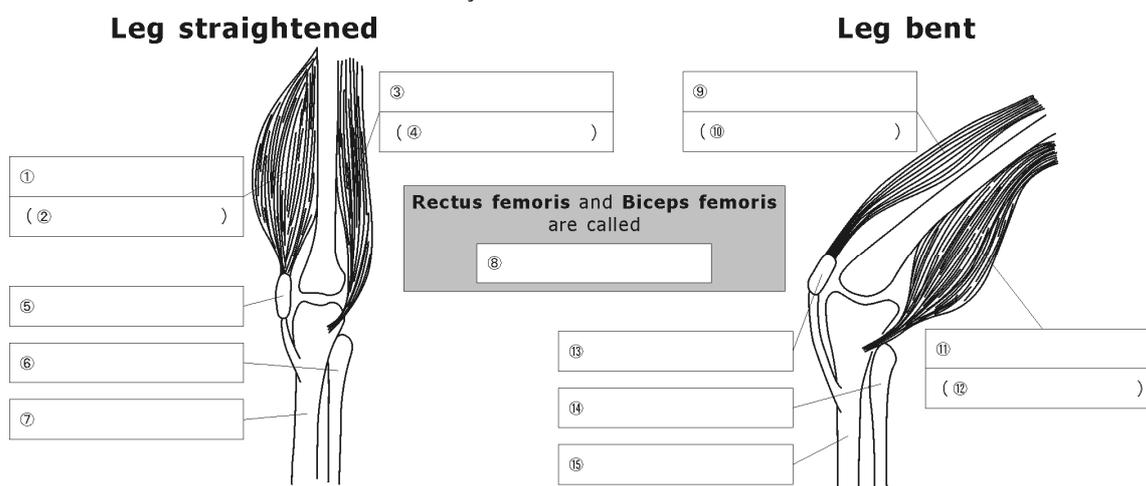


→ The point of muscle attachment on a non-movable part is called the **origin** and that on the movable part is called the **insertion**.

Activity 09-4-01: Name the point of muscle attachment ①⑥. Name the muscle ②④⑩⑫.

Write the action of the muscle ③⑤⑪⑬. Name the bone ⑦⑧⑭⑮. Fill in the blank ⑨.

09-4-02 Muscle attachment and movement of a leg in human.



Activity 09-4-02: Name the muscle ①③⑨⑪. Write the action of the muscle ②④⑩⑫.

Name the bone ⑤-⑦,⑬-⑮.

Fill in the blank ⑧.

Unit 09 Answers for the activities

<09-1-01> ①Support ②Protection ③Blood cells production ④Calcium storage ⑤

Locomotion

<09-1-02> ①Axial skeleton ②Skull ③Vertebral column ④Ribs and sternum ⑤Appendicular skeleton ⑥Pectoral girdle

⑦Arms ⑧Pelvic girdle ⑨Legs

<09-1-03> ①Bone ②Cartilage (gristle) ③Ligaments ④Tendons

<09-2-01> ①Neural spine ②Facets ③Spinal cord ④Intervertebral disc ⑤Neural spine ⑥ Neural canal ⑦Transverse process

⑧Neural arch ⑨Zygapophysis ⑩Centrum

<09-2-03> ①Compact bone ②Spongy bone ③Yellow marrow ④Periosteum ⑤Blood vessels ⑥Red marrow

<09-2-04> ①Haversian canals ②Bone layers ③Osteoblasts ④Osteocytes

<09-3-01> ①Tendon ②Patella ③Muscle ④Femur ⑤Ligament ⑥Synovial membrane ⑦ Synovial fluid ⑧Cartilage ⑨Tibia

⑩Ligament ⑪Scapula (Shoulder blade) ⑫Cartilage ⑬Synovial membrane ⑭Synovial fluid ⑮Humerus

<09-4-01> ①Origin ②Biceps ③Relax ④Triceps ⑤Contract ⑥Insertion ⑦Radius ⑧Ulna
⑨Antagonistic muscle ⑩Biceps

⑪Contract ⑫Triceps ⑬Relax ⑭Radius ⑮Ulna

<09-4-02> ①Rectus femoris ②Contract ③Biceps femoris ④Relax ⑤Patella ⑥Fibula ⑦
Tibia ⑧Antagonistic muscle

⑨Rectus femoris ⑩Relax ⑪Biceps femoris ⑫Contract ⑬Patella ⑭Fibula ⑮Tibia

UNIT 10 Reproduction

Objectives

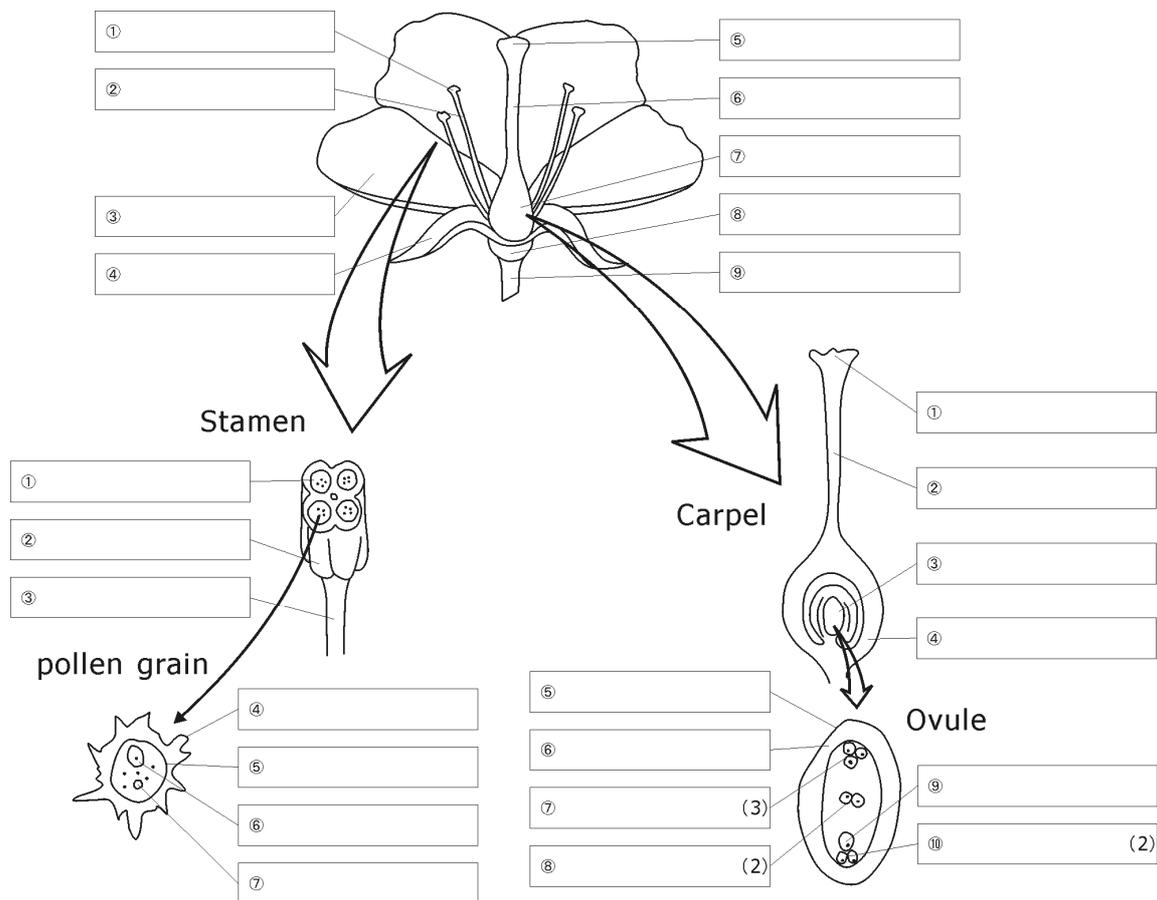
- 10-1 Describe the structure of a typical flower.
- 10-1 Distinguish between wind and insect pollination.
- 10-1 Outline the process during and after fertilisation.
- 10-1 Describe the structure of a dicotyledon and monocotyledon seed.
- 10-1 Demonstrate the experiments of conditions necessary for germination.
- 10-2 Describe the structure of reproductive systems in human.
- 10-2 Outline the process of fertilisation in human.
- 10-2 Describe the function of placenta.
- 10-3 Compare and contrast sexual and asexual reproduction.

10-1 Sexual reproduction in plants

- In flowering plants, the **reproductive organs** are the flowers.
- Some plants bear **both male and female flowers on the same plant**. eg. maize.
- In the papaya, **male and female flowers** are borne **on different plants**.

10-1-01 Structure of a typical flower.

- Although flowers are of indifferent shapes, forms and sizes, they have the same basic parts.



→ **Petals** are usually coloured because of some pigments. This helps to direct insects towards the nectary.

→ The part next to the petals is the **stamens** which form the male parts of the flower.

→ The **carpels** constitute the female reproductive parts of the flower.

→ A carpel consists of an elongated structure called **style**.

→ At the top end of the style, there is the knob-like structure called **stigma** which collects pollen grains.

→ At the bottom end of the style, there is a swollen portion called **ovary** in which the female gametes are enclosed.

Activity 10-1-01: Identify the part of flower ①-⑨ (top). Identify the part of stamen ①-⑦ (lower-left).

Identify the part of carpel ①-⑩ (lower-right).

10-1-02 Self and cross pollination.

→ Pollination is the transfer of pollen grains from the anthers to the stigma.

- Flowers have various **adaptations to facilitate pollination**.
- Plants rely on wind or animals **to transfer pollen** to the stigma, to enable fertilisation.
- If the transfer of pollen is from a plant to another of a different genetic makeup, the process is called cross-pollination.
- If the transfer occurs within the same plant, it is called self-pollination.
- The **design** of the flower is **suited for** its **specific type** of pollination. (Cross- or Self-) (Wind- or Insect-)

* Features:

Cross-pollinated flower	Self-pollinated flower
Stamens are ① _____	Stamens are ② _____
Some produce chemicals (③ _____) which hinder self-pollination	Do not produce such chemicals
Anthers and stigma usually mature at ④ _____ times	Anthers and stigma may mature at ⑤ _____ time
Most flowers face ⑥ _____	Most flowers face ⑦ _____
Pollen grains are inhibited from growing through the stigma and style	Pollen grains are not inhibited from growing through the stigma and style

* Disadvantage:

Cross-pollinated flower	Self-pollinated flower
Has difficulty to maintain a ⑧ _____	May transmit ⑨ _____ characteristics
Few chance of pollen falling on the stigma if separated by ⑩ _____	May sometimes produce ⑪ _____ seeds
	Loss of ⑫ _____ to pathogenic and deficiency diseases

Activity 10-1-02: Contrast cross-pollination and self-pollination ①-⑫.

10-1-03 Wind and insect pollination.

Wind-pollinated flower	Insect-pollinated flower
① _____ coloured petals	② _____ coloured petals
③ _____ petals	④ _____ petals
No scent	Fragrant flowers
No nectar	Nectar produced in nectary
Stigmas are feathery and borne on long styles	Stigmas lie within the petals
Filaments are ⑤ _____	Filaments are ⑥ _____
Anthers supported outside the flower	Anthers lie inside with flower
Light, minute pollen; may have ⑦ _____ eg little wings to aid wind transport	Large pollen grains; may have ⑧ _____ or a sticky surface to aid adhering to insects
⑨ _____ number of pollen formed	⑩ _____ number of pollen formed
Flowers may be in bunches or inflorescent	Flowers are solitary or as inflorescence
Plants tend to be ⑪ _____ with an excessive number of male flowers	Plants carry ⑫ _____ flowers

Activity 10-1-03: Contrast wind-pollination and insect-pollination ①-⑫.

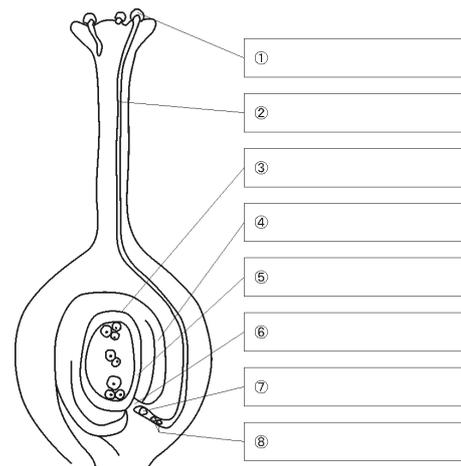
10-1-04 Process during fertilisation. (See figure on the next page)

1. A pollen tube grows out of the pollen grain.
2. The pollen tube grows into the stigma and down the style to the ovary.
3. The pollen tube grows into the ovule (usually through the micropyle) and releases two male nucleus into the embryo sac, and tube nucleus degenerates.
4. ⑨ _____ occurs:

[1 male nucleus + egg cell = zygote] and

[1 male nucleus + 2 definitive nuclei = endospermic nucleus]

Activity 10-1-04: Identify the part in the carpel during fertilization ①-⑧ (figure at the right). Name the process ⑨ (text).



10-1-05 Process after fertilisation (formation of fruits and seeds).

→ The ① _____ develops into an ② _____.

→ The ② _____ becomes surrounded by ③ _____ which nourishes it.

→ The ovule develops into the ④ _____, the wall of the ovule becomes the ⑤ _____.

→ The ovary develops into the ⑥ _____.

→ The seed dries out, becoming dormant.

→ The sepals, petals and stamens wither away and/or drop off.

Activity 10-1-05: Fill in the blank ①-⑥.

10-1-06 Dispersal.

→ Seeds are dispersed as far away from the parent plant as possible.

→ This helps to prevent competition for ① _____, ② _____ and ③ _____.

→ Seeds are carried to new habitats where conditions may be more favourable for growth.

* Five ways of dispersal

1. ④ _____ dispersal
2. ⑤ _____ dispersal
3. ⑥ _____ dispersal
4. ⑦ _____ dispersal
5. ⑧ _____ dispersal

* Importance of dispersal

1. can **change** the living environment.
2. can **exchange** the genetic factors.
3. can **reduce** competition for nutrients.

Activity 10-1-06: Fill in the blank ①-③. List the method of dispersal ④-⑧.

10-1-07 Adaptation of dispersal in seeds and fruits.

Dispersal method	Feature	Mode of action
Animal	①_____ fruits Succulent, brightly coloured, scented	Caught on fur of passing animal Eaten by animals Undigested seeds are passed out
Wind	②_____ -like projections Out-Growths that look like ③__	Small size Carried in the wind For flight
Water	Has water resistant layer Spongy layer inside fruit	Floats on water
Self (or explosive)	Pericarp dries in sun Shrinks	Fruit splits horizontally into two halves, seeds ejected

Activity 10-1-07: Fill in the blank ①-③.

10-1-08 Germination.

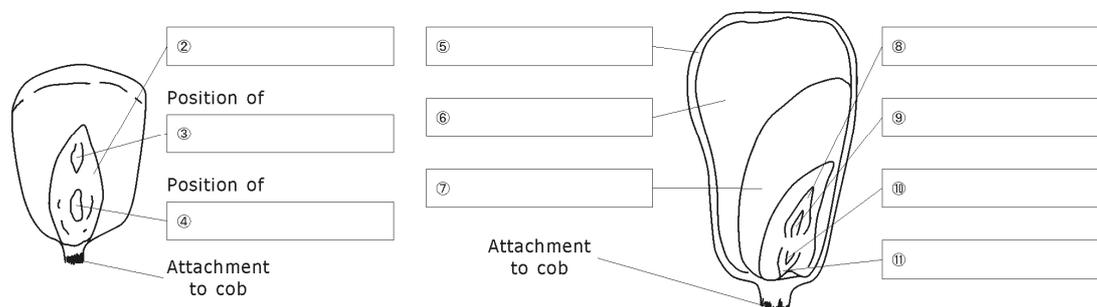
- Many flowering plants grow from seeds.
- The process by which a seed starts to grow into a young plant is called **germination**.
- In dicotyledonous embryo, two cotyledons are formed. However, there is only one in the monocotyledonous plants.
- Viable seeds are able to remain alive for long periods without germinating.

10-1-09 Structure of two types of seed.

→ The embryo has an embryonic root called **radicle**.

→ There is also a **plumule** or embryonic shoot which grows into the shoot system.

Maize is an example of



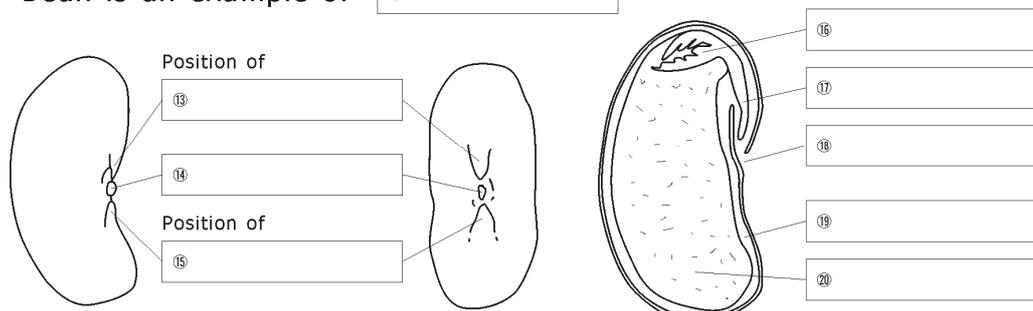
→ The **testa** protects the inner parts of the seed from damage and dessication.

→ The **endosperm** stores the food nutrients needed by the embryo during germination.

→ The **plumule** is covered by a sheath called coleoptile which protects it from damage by soil particles during germination.

→ The **radicle** is protected by a sheath called coleorrhiza.

Bean is an example of



→ When a bean seed is split open, it separates into two halves. These are cotyledons.

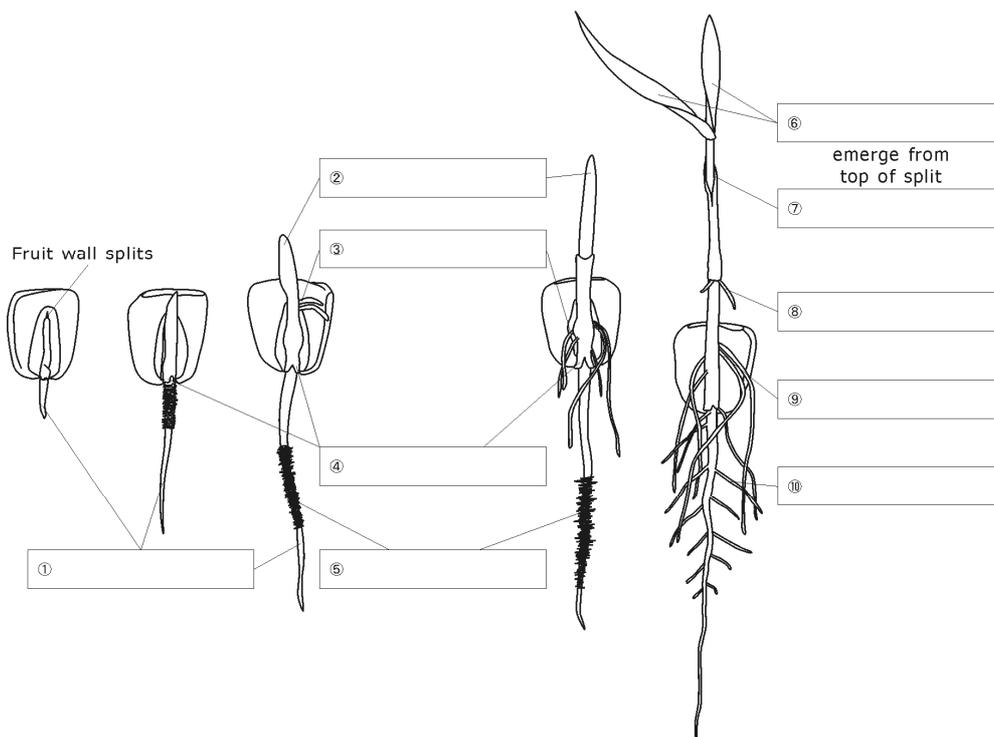
→ The **cotyledons** store nutrients which the embryo uses during germination.

→ The part between the cotyledons is the **embryo**. The embryo has a radicle and a plumule.

Activity 10-1-09: Name the group of plant . Identify the part of seeds -, -.

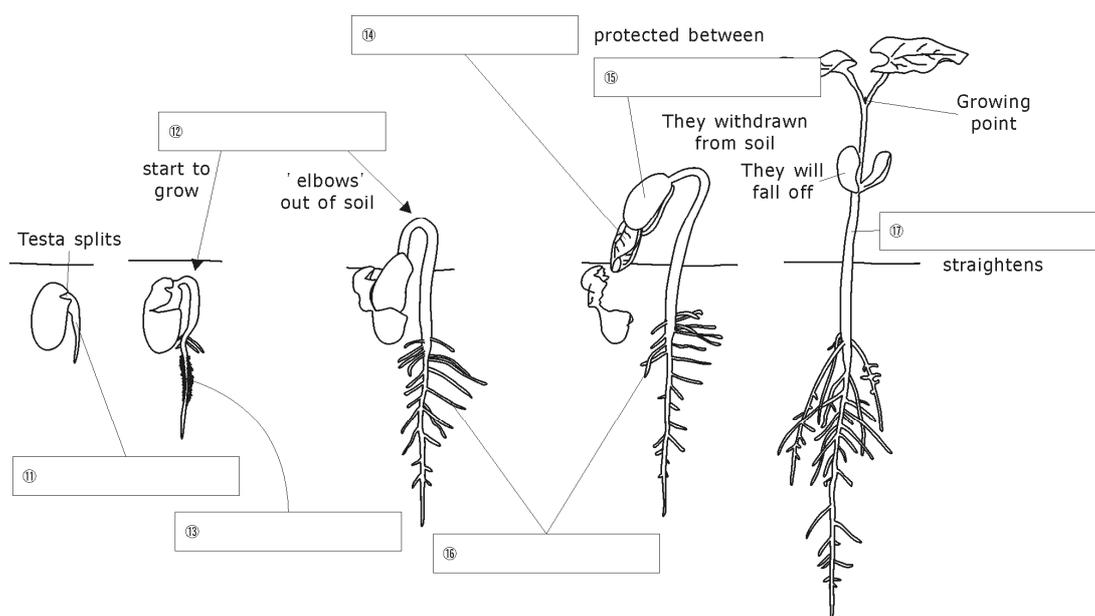
10-1-10 Process of two types of germination.

* Germination of maize;



- Germination begins when the embryo in the seeds starts to develop into a seedling.
- As the seed absorbs water, the testa becomes soft and bursts.
- The radicle emerges and grows downwards. The radicle develops root hairs which absorb water and mineral nutrients.
- As the radicle grows down, the plumule breaks through the testa and grows upwards.
- The coleoptile breaks open and the plumule releases the first seed leaf or cotyledon.

* Germination of bean:



- As the radicle grows down, the hypocotyl elongates pushing with it the cotyledons upwards

through the soil.

→ The plumule remains protected between the two cotyledons.

Activity 10-1-10: Identify the part of plants ①-⑰.

10-1-11 Conditions needed for germination.

→ Conditions for germination vary; some are internal factors while others are external factors.

→ Internal conditions are enzymes, seed viability and supply of energy.

→ External conditions are shown below:

1. ① _____ : swelling and bursting of the seed, movement of food reserves, activation of enzymes, and for growth of the shoot and root.
2. ② _____ : respiration (energy release) by the growing seedling.
3. ③ _____ : efficient functioning of enzymes in the embryo.
4. ④ _____ : **not normally needed for germination**, but it is needed for the formation of chlorophyll and for photosynthesis by the seedling.

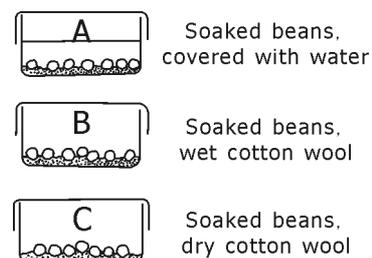
Activity 10-1-11: List the condition ①-④.

10-1-12A Let's try EXP: To show that water is necessary for germination.

* Suggested materials: soaked maize seeds / dry maize seeds / cotton wool / three Petri dishes

* Methods:

1. Label Petri dishes A, B, C.
2. Put cotton wool in each of the dishes, to cover bottom of the dishes.
3. Put six soaked seeds in A and another six in B.
4. Put six unsoaked seeds in C.
5. Cover the seeds in A completely with water.
6. Sprinkle some water on the cotton wool to make it moist.
7. Keep the cotton wool in B moist all the time.
8. Leave the seeds for at least seven days.



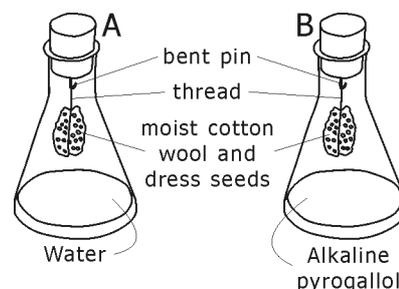
* Questions:

1. In which dish did the seeds germinate?
2. In which dish did the seeds not germinate?
3. Why did some of the seeds not germinate?
4. What can be concluded from this experiment?

* Hints: The seeds in water are difficult to process aerobic respiration.

10-1-12B Let's try EXP: To show that oxygen is necessary for germination.

* Suggested materials: soaked maize seeds / cotton wool / two flasks / alkaline pyrogallol / stoppers



* Methods:

1. Mark the flasks A and B.
2. Put some 10 cm³ water in flask A and 10 cm³ of alkaline pyrogallol in flask B.
3. Wrap two sets of five maize seeds in moist cotton wool.
4. Hang one set in flask A and the other set in flask B as shown in figure.
5. Leave the seeds for at least seven days.

* Questions:

1. In which flask did the seeds germinate?
2. In which flask did the seeds fail to germinate?
3. What is the purpose of using alkaline pyrogallic acid in this experiment?

10-1-13C Let's try EXP: To show that suitable temperature is necessary for germination.

* Suggested materials: soaked seeds / cotton wool / Pyrex beakers

* Methods:

1. Label the beakers A, B, C.
2. Wrap five seeds in moist cotton wool in three sets.
3. Place one set in beaker A, one in B and the other in beaker C.
4. Put beaker A in a refrigerator at a temperature 0°C, beaker B at room temperature 25°C,

and beaker C in a place at a temperature of 50°C.

5. Leave the set up for at least seven days while ensuring that the cotton wool remains moist.

* Questions:

1. Which seeds germinated?
2. Which seeds did not germinate?
3. Give reasons why some seeds germinated while others did not.
4. What can be concluded from this experiment?

* Hints: Temperature affects the activity of enzymes.

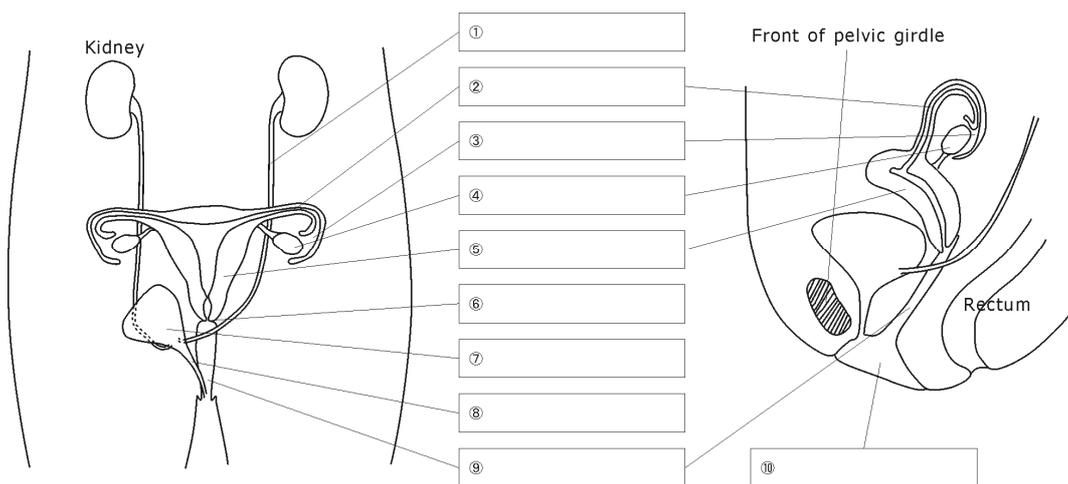
10-2 Reproduction in human

→ Fertilization and development of embryo of human beings take place inside the body of the female like other mammals.

→ In order to be able to reproduce, the human should reach sexual maturity. Secondary sexual characteristics of male and female human begin at puberty.

→ At puberty, the pituitary secretes gonad-stimulating hormone which stimulates testes to produce **testosterone**. The same hormone in women stimulates the ovaries to produce **oestrogen**. These lead to the development of sexual characteristics in human. The age when this happens may vary from person to person.

10-2-01 Structure of human reproductive organs in female.

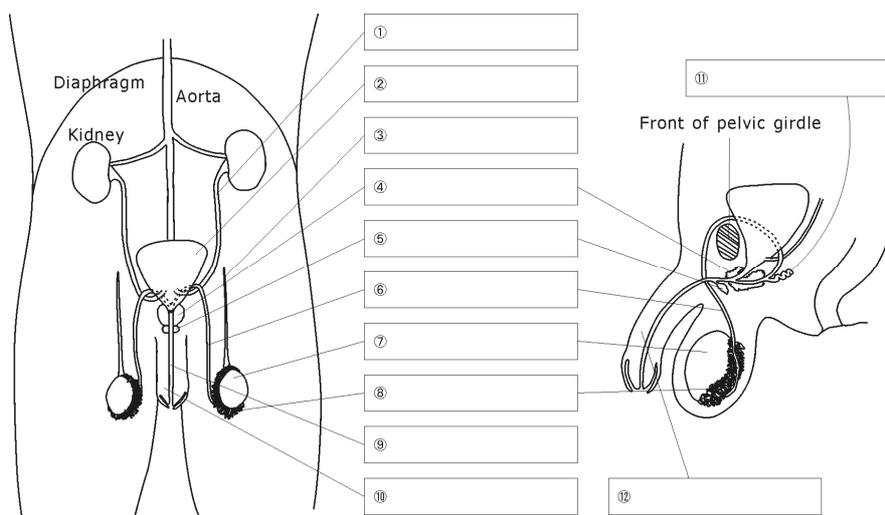


Structure	Function
Ovary	Paired, attached to dorsal wall of abdomen Consists of ova (ovum) Produces ① _____ and ② _____
Oviduct	Transfers ova from ovary into uterus Site of ③ _____
Uterus	Receives, nourishes and protects foetus during pregnancy
Cervix	Produces watery mucus which serves as lubricant for penis
Vagina	Receives penis during intercourse Birth canal

Activity 10-2-01: Identify the part ①-⑩ (figure). Name the hormone ①② (table).

Name the process ③ (table).

10-2-02 Structure of human reproductive organs in male.



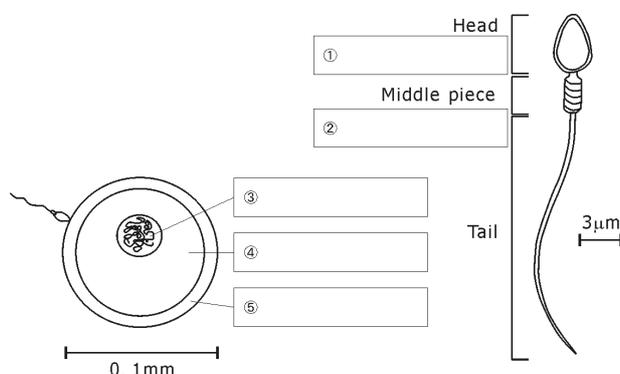
Structure	Function
Testes	Paired, hundreds of minute seminiferous tubules Produce sperm Produce ① _____
Epididymis	Coiled tube, temporary storage of sperm
Sperm duct (vas deferens)	Transports sperm from epididymis to penis
Prostate gland, Cowper's gland, seminal vesicle	Secrets seminal fluid Contains enzymes and nutrients to nourish sperm Combines with sperm to form semen
Erectile tissue	Spongy tissue filled with blood vessels Brings about erection

Activity 10-2-02: Identify the part ①-⑫ (figure). Name the hormone ① (table).

10-2-03 Gametes of human.

→ The two sexes, male and female, each produces special types of reproductive cells called **gametes**.

→ The male gametes are the sperms and the female gametes are the **ova** (singular = ovum) or egg cells.



Characteristics	Ovum	Sperm
Chromosome number	⑥ _____	⑦ _____
Size	Larger (0.1mm)	Smaller (3µm)
Shape	Spherical Inner plasma membrane Outer protein coat	Head with nucleus Mitochondria in the middle Tail at the end
Nucleus	Large	Small
Cytoplasm	Abundant	Little
Movement	None	By tail

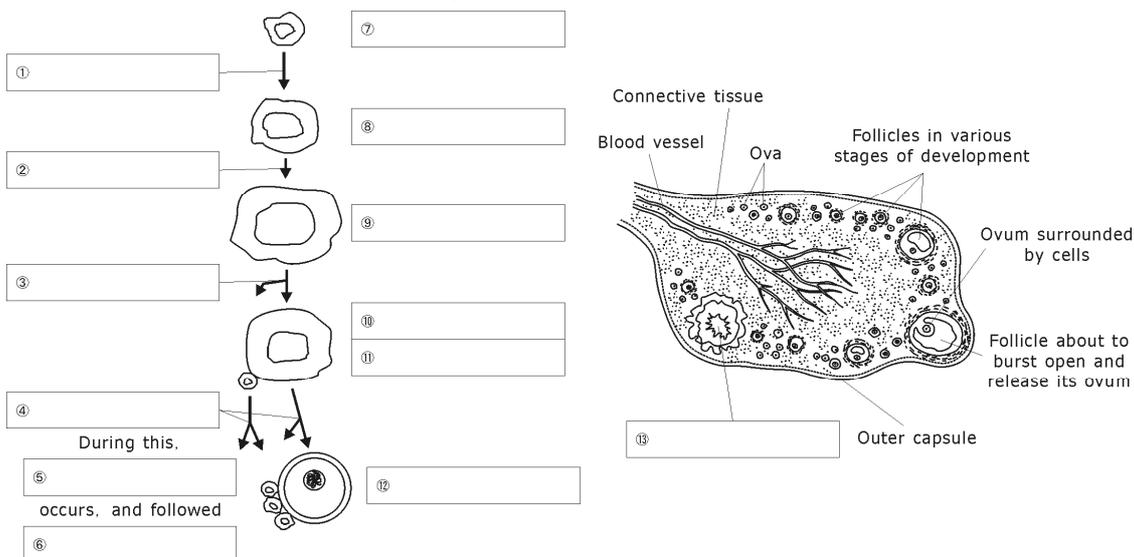
Activity 10-2-03: Identify the part ①-⑤ (figure). Write the number ⑥⑦ (table).

10-2-04 Oogenesis - Production of an egg cell.

→ The egg cells (ova) are present in the ovary from the time of birth.

→ No more are formed during the lifetime

→ Between the ages of 10 and 14, some of the egg cells start to mature and are released one at a time about every 4 weeks from alternate ovaries.

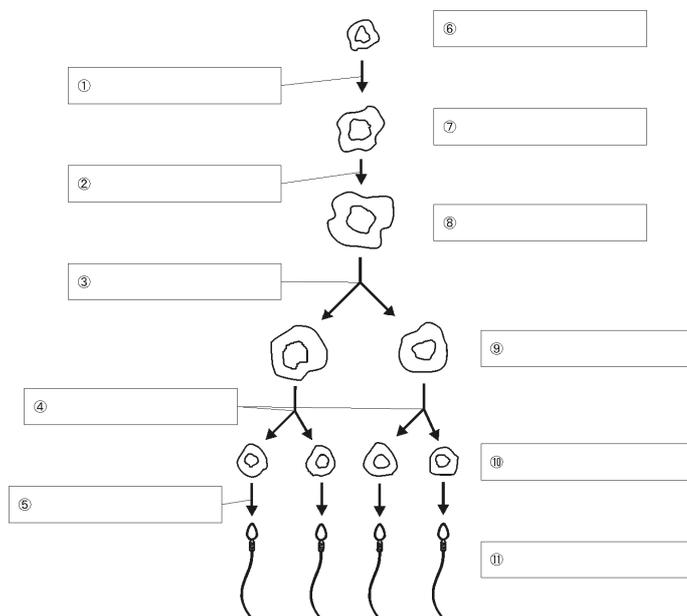


Activity 10-2-04: Name the process ①-⑥. Identify the cell ⑦-⑫. Name the tissue ⑬.

10-2-05 Spermatogenesis. - Production of sperms

→ The lining of the sperm producing tubules in the testis consists of rapidly dividing cells.

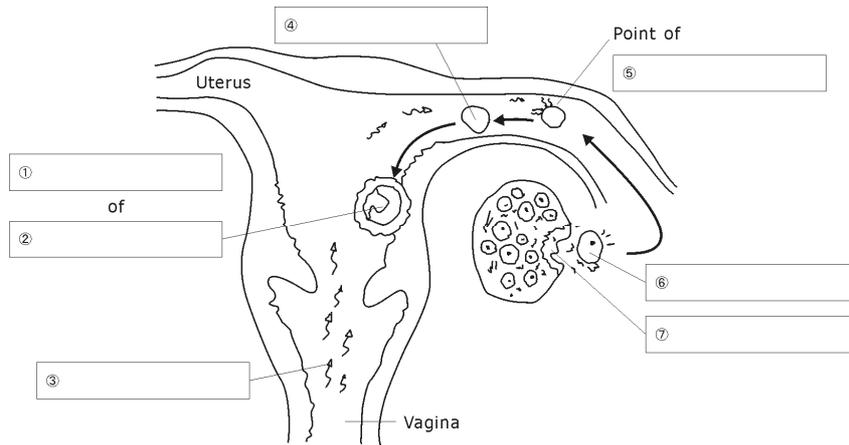
→ After a series of cell division, the cells grow long tails and become sperms which pass into the epididymis.



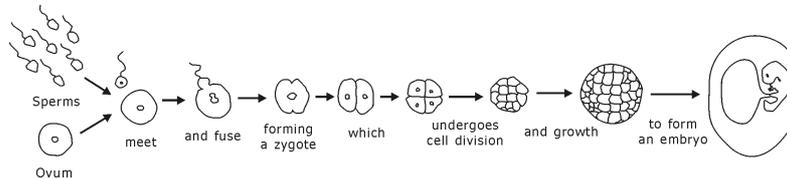
Activity 10-2-05: Name the process ①-⑤. Identify the cell ⑥-⑪.

10-2-06 Process of fertilisation in human.

→ In humans, fertilization takes place inside the body of the female just like in other mammals.

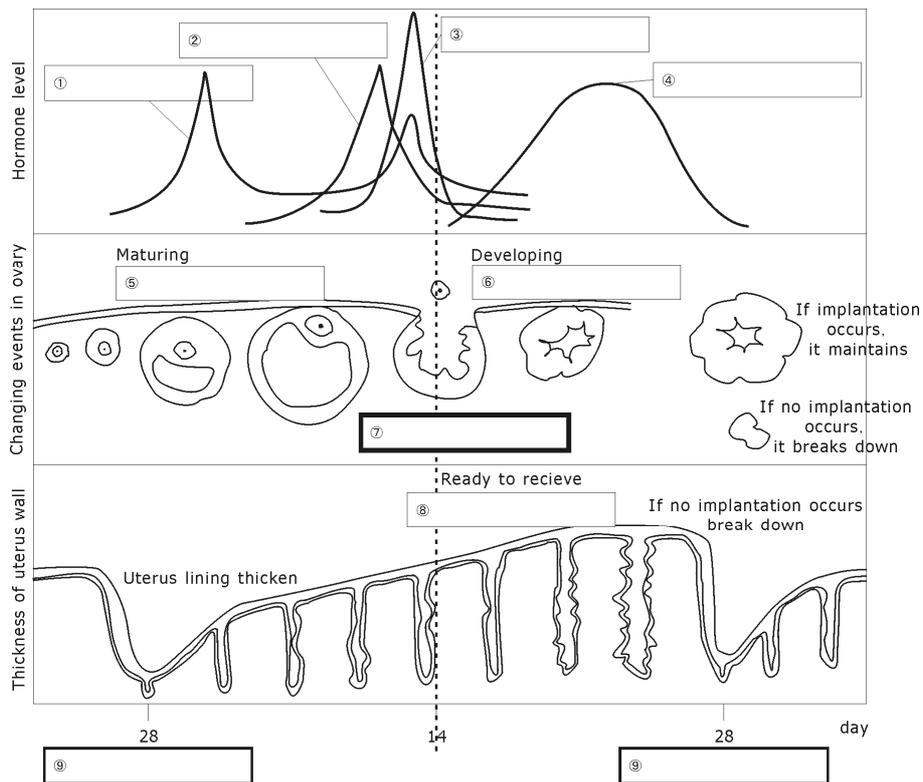


1. The sperms swim by lashing their tails from side to side.
2. They bump into the egg in oviduct.
3. A sperm penetrates the egg membrane which thickens to prevent other sperms entering.
4. The head of sperm is drawn towards the egg nucleus.
5. The tail is discarded. All other sperm dies.
6. The **sperm nucleus** combines with the **egg nucleus** to form ⑧_____.
7. The zygote moves to ⑨_____ in 4-7 days with mitotic division.
8. The zygote is **implanted in the uterus wall**.



Activity 10-2-06: Name the process ①⑤. Label the structure ②③④⑥⑦. Fill in the blank ⑧⑨.

10-2-07 Menstrual cycle in human.



- The ovaries release an ovum about every 4 weeks. This process is regulated by ① _____ secreted by the anterior lobe of the pituitary gland (gonadotropin or gonad-stimulating hormone) and ovaries (see above).
- ② _____ occurs ③ _____ days after onset of ④ _____.
- As each follicle develops by the effect of **follicle-stimulating hormone** (FSH) which is produced in the pituitary, the amounts of oestrogen are produced by the ovary increases.
- The **oestrogen** acts on the uterus and cause its lining (or the uterus wall) to become thicker and develop more blood vessels for helping an early embryo to implant. And the oestrogen also acts on the pituitary to produce **luteinizing hormone** (LH).
- The transient secretion of LH and FSH leads the **ovulation**.
- Once the ovum has been released, the follicle which produced it develops into a solid body called the **corpus luteum**.
- This produces a hormone, **progesterone**, which affects the uterus lining making it grow thicker and produce more blood vessels.
- If the ovum is fertilized, the corpus luteum continues to release progesterone, keeping the uterus in a state suitable for implantation.

→ If the ovum is not fertilized, the corpus luteum stops producing progesterone. As a result, the thickened lining of the uterus breaks down and loses blood which escapes through the cervix and vagina. This discharge lasts for about 3-5 days.

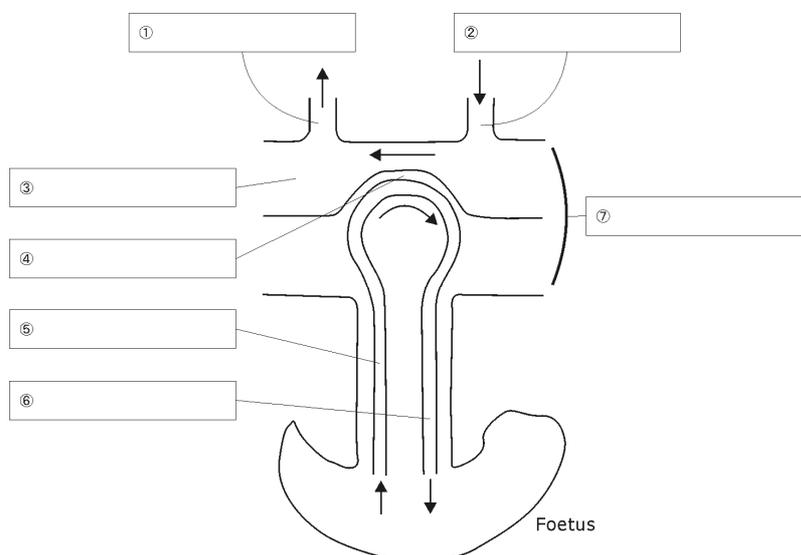
→ This is known as a menstrual cycle. These cycles occur after puberty till **menopause**.

Activity 10-2-07: Name the hormone ①-④. Name the structure ⑤⑥⑧. Name the process ⑦⑨ (figure).

Fill in the blank ①-④ (text).

10-2-08 Function of placenta.

* Structure of placenta;



* Why must the foetal and maternal bloodstreams not mix?

→ The ① _____ of the mother would burst the foetal blood vessels.

→ If the two bloods belonged to different blood groups, ② _____ would occur.

* What substances pass across the placenta?

→ **From mother to foetus:** ③ _____, ④ _____, ⑤ _____,

⑥ _____, ⑦ _____

→ **From foetus to mother:** ⑧ _____, ⑨ _____

Activity 10-2-08: Name the blood vessel ①②⑤⑥. Name the part ③④⑦ (figure).

Fill in the blank ①②. List the chemical ③-⑨ (text).

10-2-09 Birth control (Contraception).

→ All human communities practice some form of birth control to space out births and limit the size of the family.

Types	Examples	Mode of action	Function	Reliability
Natural	① _____	Intercourse restricted to 'safe time'	Avoid fertilisation	Poor
Chemical	② _____	Applied in vagina before intercourse	Kills sperm	Better
Mechanical	③ _____	Rubber sheath placed over penis before intercourse	Catch semen during ejaculation	Good if used properly
	Cap (diaphragm)	Flexible rubber cup placed over cervix before intercourse	Prevent sperms entering uterus	Good
	IUD (Intra-uterine device)	Plastic or metal device places in uterus by doctor	Stop embryo implanting	Good
Hormonal	④ _____	Pills taken daily	Stop ovulation	Very good if taken properly
	Injectable contraceptive	Injected into the blood by doctor	Stop ovulation	Very good but side-effects
Surgical	⑤ _____	Oviducts clipped or tied	Stop sperms reaching ovum	Excellent but irreversible
	⑥ _____	Sperm ducts cut or tied	Stop sperms getting into	Excellent but irreversible

semen

Activity 10-2-09: List the method ①-⑥.

10-2-10 Sexually transmitted diseases (STDs).

- STDs are diseases that are spread from one person to another through a **sexual act**.
- There are over 20 different types of identified STDs, eg. syphilis, gonorrhoea, genital herpes, AIDS.
- Most can be controlled or cured. But **all can be prevented**.
- The best way to safeguard against these diseases is to **use physical barrier during sex (condom)**, refrain from sex with an infected person and by keeping to only one sex partner.

* Examples of STDs:

Disease	Causative agent	Main symptoms	Treatment
① _____	Bacterium	Painless sore (chancere) for 2 weeks Rush and fever for 1-2 months Insanity Fatal in untreated	Antibiotics
② _____	Bacterium	Discharge from genital opening Painful joints	Antibiotics
③ _____	Virus	Reduced resistance to disease Fatal in untreated	No cure Drugs help
Non-specific urethritis	Virus	Imflamed urethra	Drugs

Genital herpes

Virus

Painful blisters

Drugs

Activity 10-2-10: List the disease ①-③.

10-2-11 HIV / AIDS

- Fatal disease of **the immune system**, caused by **HIV**.
- Most of the time, the patient dies from complications of the virus, not by the virus itself.
- For example, 50% of AIDS patients die of ①_____.
- AIDS can be controlled, but so far, it cannot be cured.
- ** **Transmission:** Anybody can be at risk. - It's not who you are, it's what you do. -
- HIV infection happens because of particular behaviours.
- HIV transmitted: from person to person via exchange of ②_____ - semen, blood, pre-ejaculate and vaginal fluids - during anal, vaginal, and possibly oral sex, or when sharing needles during intravenous drug use.
- HIV also transmitted: **from mother to child** during pregnancy, the birth process, and through breastfeeding.
- HIV can not be transmitted through saliva, sweat, tears or urine.
- ** **Prevention** is YOU CAN DO IT.
- **Practice** ③_____ : use male or female condoms everytime you have sex.
The risk of infection is higher for vaginal and anal sex, but there is also a risk of infection through oral sex.
- **Drugs and alcohol can affect your judgment ability.** It is sometimes harder to make good decisions about safer sex when you are under the influence, so it might be better not to have sex if you have been drinking alcohol or using drugs.
- **Do not share needles** or injecting equipment with others when injecting drugs.
- ** **Caution: for young people - no age is too young for HIV -**
- Information from friends, magazines, the internet, etc. is not always correct.
- Be yourself! It's sometimes hard to make decisions about sex with so many pressures, but remember, you don't have to do something you don't feel comfortable with.

→ It's nothing to be ashamed of getting condoms.

Activity 10-2-11: Fill in the blank ①-③.

10-3 Asexual reproduction

→ Asexual reproduction is a type of reproduction in which living organisms produce new individuals without using gametes or sex cells.

→ Examples of asexual reproduction include **binary fission** (eg amoeba, bacteria), **spore formation** (eg fungi, bacteria), **budding** (eg hydra, yeast), **fragmentation** (eg flatworm, starfish) and **vegetative propagation** (eg many flowering plants).

10-3-01 Comparison of sexual and asexual reproduction.

Sexual	Asexual
Two parents	One parent
Male and female sex cells (haploid gametes)	No sex cell
Fertilization forms a diploid zygote	No zygote
Offspring genetically different from both parents	Offspring genetically identical to parent
Reproduction takes a long time	Reproduction occurs rapidly under favourable environments
Population increases slowly	Population increases rapidly
Plants and more complex organisms	Plants and simple organisms

→ Asexual reproduction produces clones. It is common among the simplest organisms. It produces offsprings without the need of gametes or searching for a mate.

10-3-02 Vegetative propagation.

→ This involves the production of new plants from a part of the old parent plant.

- It involves storage organs such as **bulbs, corms, tubers** and **rhizomes**.
- They enable plants to grow year after year (perennating organs).
- They also serve as a food source for animals.

* Examples of underground storage organs:

Storage organ	Examples / food
Tuber (underground stem)	Potato / starch, vitamin C, water
Rhizome (underground stem)	Ginger / starch
Bulb (underground shoot)	Onion / glucose, water (in leaves)
Corm (underground shoot)	Water chestnut / glucose, water (in stems)

* Advantages and disadvantages of vegetative propagation:

Advantages	Disadvantages
→ enables the plant population to grow faster and increase yield	→ identical daughter lack in genetic variation, resulting in all susceptible to the same disease
→ can be selected for desirable characteristics	→ all susceptible to the environmental change
→ new plants can be produced even when seed production fails	→ usually overcrowded and compete for space and nutrients
→ not dependent on pollinators for reproduction	→ not widely dispersed as such they do not colonise new areas

Unit 10 Answers for the activities

<10-1-01> (Top) ①Anther ②Filament ③Petal ④Sepal ⑤Stigma ⑥Style ⑦Ovary ⑧

Receptable ⑨Stalk (Lower-Left)

①Pollen sac ②Anther ③Filament ④Exine ⑤Intine ⑥Generative nucleus ⑦Pollen tube nucleus (Lower-Right) ①Stigma

②Style ③Ovary ④Ovary wall ⑤Nucellus ⑥Embryo sac ⑦Antipodal cells ⑧Definitive nucleus ⑨Egg cell ⑩Synergids

<10-1-02> ①long ②short ③inhibitors ④different ⑤the same ⑥downwards ⑦upwards ⑧ pure breed ⑨undesirable

⑩geographical barriers ⑪sterile ⑫resistance

<10-1-03> ①Dull ②Brightly ③Small ④Large ⑤long and slender ⑥strong ⑦extensions ⑧ projections ⑨Large ⑩Small

⑪unisexual ⑫bisexual

<10-1-04> ①Pollen grain ②Pollen tube ③Ovule ④Integument ⑤Embryo sac ⑥Micropyle ⑦Tube nucleus

⑧two male gametes ⑨Double fertilisation

<10-1-05> ①zygote ②embryo ③endosperm tissue ④seed ⑤seed coat ⑥fruit

<10-1-06> ①space ②food ③sunlight ④Animal ⑤Wind ⑥Water ⑦Self ⑧Chance

<10-1-07> ①Hooked or hairy ②Parachute ③wings

<10-1-09> ①Monocotyledon ②Scutellum ③Plumule ④Radicle ⑤Testa ⑥Endosperm ⑦ Cotyledon (Scutellum)

⑧Coleoptile (Plumule Sheath) ⑨Plumule ⑩Radicle ⑪Coleorrhiza (Radicle sheath) ⑫

Dicotyledon ⑬Radicle ⑭Micropyle

⑮Plumule ⑯Plumule ⑰Radicle ⑱Micropyle ⑲Testa ⑳Cotyledon

<10-1-10> ①Radicle ②Coleoptile ③Adventitious root ④Coleorrhiza ⑤Root hairs ⑥First leaves ⑦Coleoptile ⑧Prop root

⑨Adventitious root ⑩Lateral root ⑪Radicle ⑫Hypocotyl ⑬Root hairs ⑭Plumule ⑮ Cotyledons ⑯Lateral roots

⑰Hypocotyl

<10-1-11> ①Water ②Oxygen ③Suitable temperature ④Light

<10-2-01> (figure) ①Ureter ②Oviduct (or Fallopian tube) ③Funnel of oviduct ④Ovary ⑤ Uterus ⑥Cervix ⑦Bladder

⑧Urethra ⑨Vagina ⑩Vulva (table) ①oestrogen ②progesterone ③fertilisation

<10-2-02> (figure) ①Ureter ②Bladder ③Spermatic cord ④Prostate gland ⑤Cowper's gland ⑥Sperm duct (or vas deferens)

⑦Testis ⑧Epididymis ⑨Urethra ⑩Penis ⑪Seminal vesicle ⑫Erectile tissue (table) ① testosterone

<10-2-03> (figure) ①Nucleus ②Mitochondria ③Nucleus ④Cytoplasm ⑤Jelly coat (table) ⑥23 ⑦23

<10-2-04> ①Mitosis ②Growth ③First meiotic division ④Second meiotic division ⑤ Ovulation ⑥Fertilisation

⑦Oogonium ⑧Oogonium ⑨Primary oocyte ⑩Secondary oocyte ⑪Polar body ⑫Mature ovum ⑬Corpus luteum

<10-2-05> ①Mitosis ②Growth ③First meiotic division ④Second meiotic division ⑤ Differentiation ⑥Spermatogonium

⑦spermatogonium ⑧Primary spermatocyte ⑨Secondary spermatocyte ⑩Spermatids ⑪ Sperm

<10-2-06> ①Implantation ②Embryo ③Sperm ④Zygote ⑤Fertilisation ⑥Ovum ⑦Ovarian follicle ⑧zygote ⑨uterus

<10-2-07> (figure) ①Follicle-stimulating hormone ②Oestrogen ③Luteinizing hormone ④ Progesterone ⑤Follicle

⑥Corpus luteum ⑦Ovulation ⑧Embryo ⑨Menstruation (text) ①hormones ②Ovulation ③ 14 ④menstruation

<10-2-08> (text) ①high blood pressure ②agglutination ③oxygen ④nutrients ⑤antibodies ⑥Drugs ⑦poisons

⑧carbon dioxide ⑨excretory waste (eg urea) (figure) ①Uterine vein ②Uterine artery ③ Maternal blood ④Placental barrier

⑤Umbilical artery ⑥Umbilical vein ⑦Placenta

<10-2-09> ①Rhythm method ②Spermicide ③Condom ④Oral contraceptive pills ⑤Tubal ligation ⑥Vasectomy

<10-2-10> ①Syphilis ②Gonorrhoea ③AIDS

<10-2-11> ①pneumonia ②body fluids ③safer sex

<Sample question>

1. Sexually reproduction is a process during which...

- A. All types of organisms reproduce. B. Many cells of one type fuse with a single cell of another type.
- C. Nuclei of two specialized cells fuse together. D. Parents produce genetically identical offspring.

2. Most wind-pollinated flowers have...

- A. A strong smell. B. Brightly coloured petals. C. Large nectaries. D. Long projecting stigma.

3. In some females, the uterus can be removed due to illness.

Which of the following best explains why such females cannot become pregnant?

- A. Ovulation stops. B. Menstrual cycles stop.
- C. Zygote cannot get implanted. D. Ovum cannot mature.

4. Which of the following contraception methods best reduces the transmission of syphilis?

- A. The cup. B. The loop (IUD)
- C. The sheath (condom) D. the spermicide

5. When is the sex of a baby determined?

- A. Before ovulation. B. Between ovulation and fertilisation.
- C. At the moment of fertilisation. D. After the first division of the zygote.

<Answer> 1. C. 2. D. 3. C. 4. C. 5. C.

UNIT 11 Health

Objectives

- 11-1 Define disease.
- 11-1 Describe the transmission of diseases.
- 11-1 Explain causative agents in some diseases.
- 11-2 Describe the defence system.

11-1 Diseases

→ The term disease means a condition which changes the normal functioning of a living organism.

→ Disease may also be a disorderly state of tissues, organs or systems where they are not function normally.

11-1-01 Introduction of diseases.

** Cause of diseases:

1. ① _____ diseases: lack of certain nutrients in the diet, eg scurvy.
2. ② _____ diseases: faults in our genes, eg cystic fibrosis.
3. ③ _____ diseases: stress
4. ④ _____ diseases: harmful micro-organisms, mostly transmissible --- see below.

** Causative agents (called pathogens) of diseases:

→ The organisms that cause various diseases belong to various groups of living things and as such they differ in many ways.

→ In addition to size, these organisms differ in body form, reproduction and mode of transmission from one host to another.

→ Most of these diseases may often be fatal if not treated on time.

→ There are four types of causative agents.

1. ⑤ _____
2. ⑥ _____
3. ⑦ _____
4. ⑧ _____

** Spread of diseases:

1. ⑨ _____ from coughs and sneezes (common cold, influenza).
2. ⑩ _____ (diphtheria, scarlet fever). 3. ⑪ _____ (impetigo, athlete's foot).
4. ⑫ _____ (typhoid, cholera). 5. ⑬ _____ such as flies and mosquitoes (plague, malaria).
6. ⑭ _____ (viral hepatitis, AIDS). 7. ⑮ _____ (syphilis, AIDS).

** Protection from infectious diseases:

1. ⑯ _____ : heat treatment. 2. Destroying animal vector: kill flies and mosquitoes.
3. Isolating infectious individuals. 4. Keeping the skin clean (personal hygiene). 5. Active immunisation (⑰ _____).
6. Passive immunization. 7. Antibiotics: destroy bacteria (penicillin). 8. Drugs

Activity 11-1-01: List the cause of diseases ①-④. List the causative agent ⑤-⑧. List the way of spread ⑨-⑮.

List the way of protection ⑯⑰.

11-1-02 Bacterial diseases.

- Bacteria are very small organisms visible only under a high-power microscope.
- The rod-shaped bacteria are called bacillus, the spherical ones coccus, the comma-shaped ones vibrio and the spiral forms spirillum.
- Most bacteria reproduce by binary fission.
- Bacterial poisons are called toxins. Toxins damage the cells in which the bacteria are growing.

Disease	Causative agent	Transmittion	Signs/Symptoms	Prevention	Treatment
Cholera	Vibro cholerae	Comtaminated water and foods.	Severe diarrhea Vomit	① _____ Hand washing	Replacement of water lost

Typhoid	Salmonella typhi	Contaminated water and foods.	High temperature for 5 days Increasing headache, drowsiness and aching Vomiting ② _____ on the upper abdomen ③ _____ on the back	Inoculation	Chloramphenicol
Tuberculosis (TB)	Mycobacterium tuberculosis	Inhaling of contaminated air	④ _____ ⑤ _____ Loose weight excessively	BCG vaccine Radiography diagnosis	Streptomycin
Gonorrhoea	Gonococcus neisseria	Sexual intercourse	Purulent yellow discharge	Condoms Safer sex	Penicillin Ampicillin Oxytetracycline
Syphilis	Treponema pallidum	Sexual intercourse	2-4 weeks primary chancre or '⑥ _____' 6-8 weeks headache, fever and rash.	Condoms Safer sex	Penicillin

Leprosy	Mycobacterium leprae	Droplets from sneezes	Small but persistent area of impaired sensation or numbness	Dapsone
			Muscular paralysis	Thiacetazone
			Dry skin	
			Gross tissue destruction	

Activity 11-1-02: Write the method of prevention ①. Write the sign ②-⑥.

11-1-03 Viral diseases.

- Viruses are even smaller than bacteria and can only be seen under the electron microscope.
- Their size ranges between 10 and 300 nm in diameter.
- They do **not** have a **nucleus**, **cytoplasm** and **cell membrane** which are characteristic of the cells of living organisms.
- Viruses consist of nucleic acid (DNA or RNA) surrounded by a protein coat.
- Viruses can reproduce only inside other cells, and so all viruses are parasitic.
- Most viral diseases have no cure and the infected person entirely depends on the body immune system for recovery.

Disease	Causative agent	Transmission	Signs/Symptoms	Prevention	Treatment
Acquired Immune Deficiency Syndrome (AIDS)	① _____	Close sexual intercourse	Fever	No vaccine	No specific treatment
	_____	_____	Loss of weight by	Avoiding	

		unsterilise d needles	diarrhea	unsafe sex.	
			Swelling of lymph nodes		
② _____	Rubella virus	Droplets	Sneezing, Cough, Dark red rash Redness of the conjunctiva Swelling of the eyelids Watering of the eyes Hoarseness of the voice Koplik's spots on the mouth	Immunisat ion	
Hepatitis	One or other of the hepatitis viruses	Human faeces	Jaundice Chills, headache, nausea, vomit and diarrhea ③ _____ urine ④ _____ colour to sclera	Good hygiene Light diet Immunisat ion	Vitamin B
Influenza	Influenza virus	Droplets	Raised temperature, Headache, Dry cough, Mild sore throat, "Rotten"	Wash hands	No specific drug
Common	Rhinovirus	Droplets	Dry throat, Sneezing,	Wash	No cure

cold	hands
Watering of the eyes	

→ Antibiotics are ineffective against viruses, but they may be prescribed if an acute or persistent secondary bacterial infection appears.

Activity 11-1-03: Fill in the blank ①②. Write the sign ③④.

11-1-04 Protozoal diseases.

→ Protozoa are very small single-celled organisms which are likely to be found in fresh water and moist soil.

→ Protozoa are visible under a high-power microscope.

→ Most of them reproduce asexually.

Disease	Causative agent	Transmission	Signs/Symptoms	Prevention	Treatment
Malaria	① _____	Biting and injecting salivary of female anopheline mosquito.	② _____ stage (40 degree fever, vomiting, headache) ③ _____ stage (feels burning hot) ④ _____ stage (profuse perspiration)	Draining still water ⑤ _____ Drugs	Drugs
Amoebic dysentery	Entamoeba histolytica	Faeces	Grumbling pain in the abdomen Diarrhea	Hand washing Boiling	Metronidazole Tinidazole
Sleeping	⑥ _____	Biting of a	Irregular bouts		Pentamidi

sickness	genus	blood sucking	of fever,	ne.
(Trypanosomi asis)		⑦ _____	Headache	
			Enlargement of lymph nodes	
			Changed behaviour	
			Sleeplessness during the day	
			Mental confusion	

Activity 11-1-04: Fill in the blank ①⑥⑦. Write the sign ②③④. Write the method of prevention ⑤.

11-1-05 Fungal diseases.

→ Fungi form spores which are dispersed to new hosts.

→ Their structure ranges in size from microscopic forms to large ones which are easily seen with the unaided eye.

Disease	Causative agent	Transmittion	Signs/Symptoms	Prevention	Treatment
Athletes foot	Chronic fungal infection of the deep soft tissue and bones	Spores	Discomfort	Washing Regular changing of clean socks	

11-2 Immune system

11-2-01 Defence against infection.

→ There are several types of defence mechanisms in organisms.

1. **Protection** by the skin.
2. **Disinfection** by the saliva, tears and secretion of the alimentary canal.
3. **Clearance** of foreign matter by sneeze, cough and cilia in the trachea.
4. **Clotting of blood.**
5. Action of the **white cells.**
6. Action of the **antibodies.**

11-2-02 Blood clotting.

→ When tissues are damaged and blood vessels cut, **platelets** clump together and block the smaller capillaries. The platelets and damaged cells at the wound also produce a substance, **thromboplastin** which can act on the plasma protein called **prothrombin** together with **calcium ion**, and eventually the prothrombin is changed into the enzyme **thrombin**. The thrombin can react on another plasma protein, **fibrinogen**, to change into **fibrin**, which forms a network of fibres across the wound. Red cells become trapped in this network and so form a blood clot. The clot not only stops further loss of blood, but also prevents the entry of harmful bacteria into the wound.

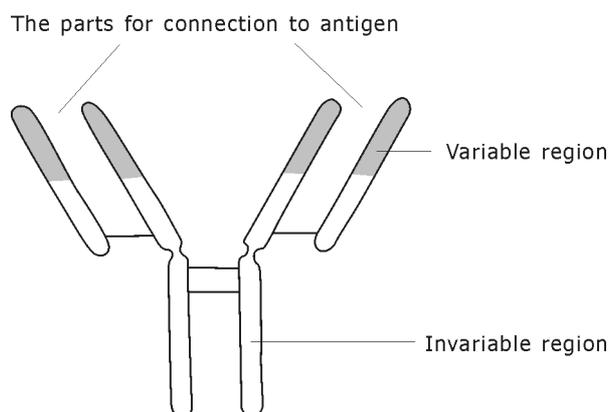
11-2-03 Cells involved in immune system.

cell	feature
T cells	Differentiate and mature in the ①_____.
	②_____ facilitate the antibody production of B cells and the function of ④.
	③_____ inhibit the effect of ②.

	④ _____ attack the cells infected by viruses.
B cells	Differentiate and mature in the ⑤ _____. Produce ⑥ _____ (see below).
Macrophage	Trap antigens (denatured cells, infected cells, cancer cells, etc) by ⑦ _____. Transmit information about antigens to T cells.

→ The lymphocytes, or B cells, produce antibodies against foreign proteins called antigens. Each antibody is very specific. This means that an antibody which attacks a typhoid bacterium will not affect a pneumonia bacterium. Some of the lymphocytes which produced the specific antibodies remain in the lymph nodes for some time and divide rapidly and make antibodies if the same antigen gets into the body again. This means that the body has become immune to the disease caused by the antigen.

* Structure of an antibody (immunoglobulin):



Activity 11-2-03: Name the organ ①⑤. Name the cell ②-④. Write the chemical ⑥. Name the process ⑦.

Unit 11 Answers for the activities

<11-1-01> ①Deficiency ②Inherited ③Mental ④Pathogenic ⑤Bacteria ⑥Viruses ⑦ Protozoa ⑧Fungi ⑨droplets ⑩dust
⑪touch ⑫faeces ⑬animals ⑭blood mixing ⑮sexual intercourse ⑯Sterilisation ⑰ vaccination

<11-1-02> ①Boiling ②Rash ③Red spot ④Vigorous coughs ⑤Sputum ⑥pimple

<11-1-03> ①Human Immunodeficiency Virus (HIV) ②Measles ③Dark ④Yellow

<11-1-04> ①Plasmodium ②Cold ③Hot ④Sweating ⑤Insecticides ⑥Trypanosoma ⑦
tsetse fly

<11-2-03> ①thymus ②Helper T cells ③Suppressor T cells ④Killer T cells ⑤bone marrow
⑥antibodies ⑦phagocytosis

<Sample question>

1. Which diseases can usually be cured by antibiotics?

A. AIDS and malaria. B. AIDS and syphilis. C. Gonorrhoea and malaria. D.
Gonorrhoea and syphilis.

2. Which of the following exists only as parasites?

A. Bacteria. B. Fungi. C. Insects. D. Viruses.

3. Which organisms have cells containing nuclear material without a nuclear membrane?

A. Animals. B. Bacteria. C. Fungi. D. Plants.

<Answer> 1. D. 2. D. 3. B.

UNIT 12 Genetics**Objectives**

- 12-1 Describe the stage of mitosis.
- 12-1 Describe the stage of meiosis.
- 12-2 Describe a chromosome and a gene.
- 12-2 Explain a monohybrid cross.
- 12-2 Explain a determination of sex in human.
- 12-2 Explain the mechanism of ABO inheritance.
- 12-3 State causes of mutation.

12-1 Mitosis and meiosis

→ Cells in organisms undergo cell division for growth and reproduction.

→ There are two types of cell division; **mitosis** and **meiosis**.

12-1-01 Difference between mitosis and meiosis.

	Mitosis	Meiosis
Associated with:	Asexual reproduction	Sexual reproduction
Purpose	①_____ and ②_____	Production of ③_____
Parent cell	Diploid (2n)	Diploid (2n)
Daughter cells	④_____	⑤_____
Genetic variation	No (parent and daughters are '⑥_____')	⑦_____ of chromosomes
Location	All other cells	Sexual reproductive cells

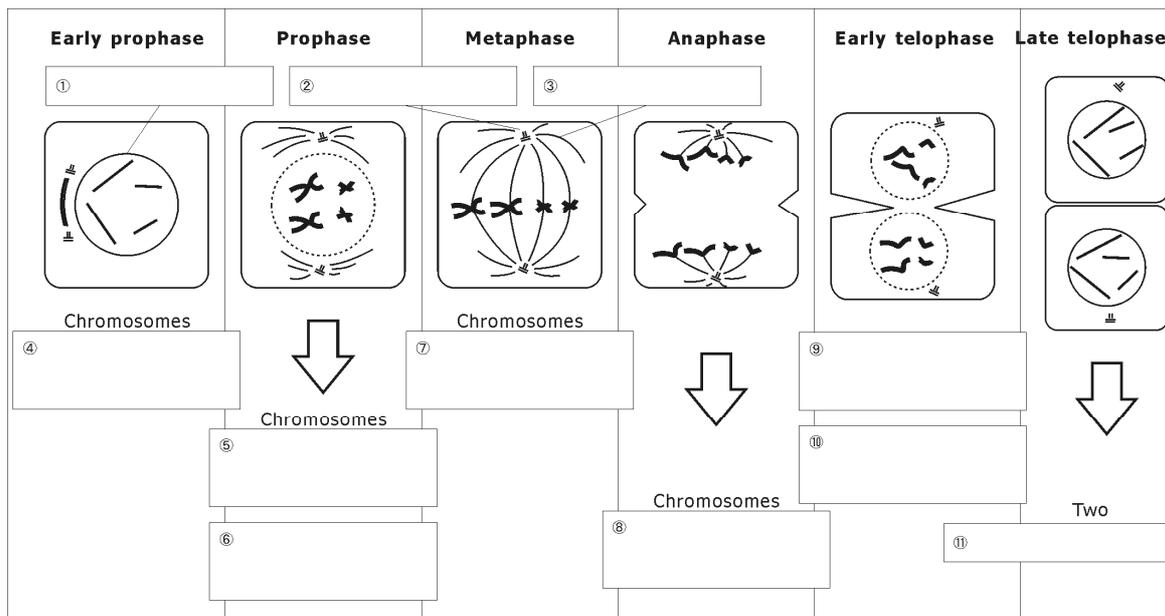
Activity 12-1-01: Write the process ①②. Fill in the blank ③⑥⑦. Write the number of daughter cells ④⑤.

12-1-02 Process of mitosis.

→ Mitosis occurs in the ordinary cells of the body (autosomal cells).

→ Mitosis is important because it leads to the increase in size and number of cells without

alteration in the genetic constitution of the cells.



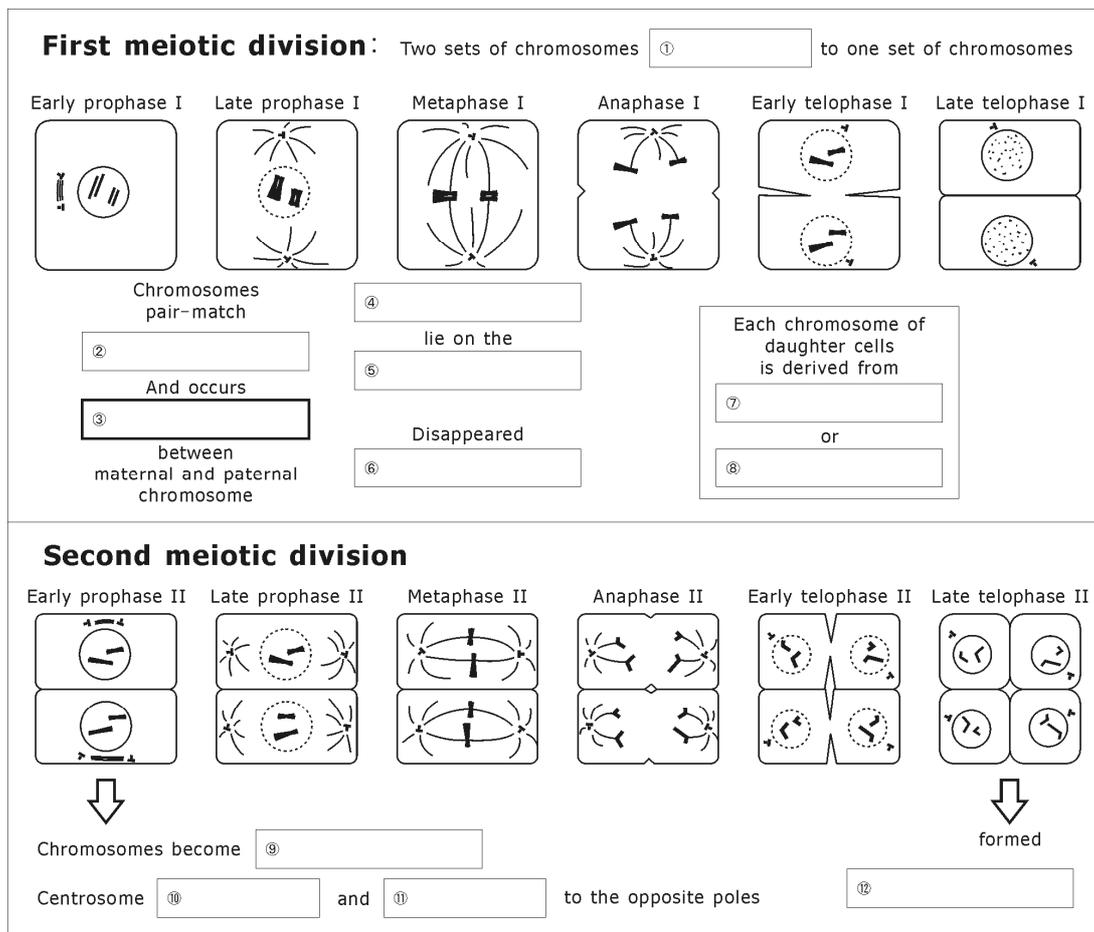
Activity 12-1-02: Name the structure ①-③. State the feature of each stage ④-⑩. Fill in the blank ⑪.

12-1-03 Process of meiosis.

→ Meiosis is the cell division that takes place in reproductive organs to produce reproductive cells (gametes).

→ It leads to the reduction in the number of chromosomes, thus it is called **reduction division**.

→ Half the number of the chromosomes in sex cells helps to keep the chromosome number constant.



Activity 12-1-03: Fill in the blank ①②⑦⑧⑫. Name the process ③. State the feature of the stage ④-⑥,⑨-⑪.

12-2 Inheritance

- Genetics is the study of the inheritance of genetic material from generation to generation.
- Genes are the basic units of inheritance.

12-2-01 Terms about inheritance.

** The principles of heredity (discovered by **Gregor Mendel** 1822-1884)

1. Characteristics are passed (ie. transmitted) from parents to offspring via ① _____ which are located in ② _____ in the ③ _____ of cells.
2. The ① controlling a particular characteristic can exist in two forms called

- ④ _____ . One of the ④ may be ⑤ _____ , the other ⑥ _____ .
3. ④ occur in pairs which are located in the same relative position (⑦ _____) on ⑧ _____ chromosomes.
4. An individual may possess two identical ④ for a given characteristic. Such an individual is called ⑨ _____ . If both alleles are ⑤, the individual is ⑩ _____ . If they are ⑥, the individual is ⑪ _____ .
5. An individual may possess two non-identical ④, one ⑤ and the other ⑥, for a given characteristic. Such an individual is ⑫ _____ .
6. The ④ which an individual possesses for a given characteristic (ie. its genetic constitution) is called the ⑬ _____ . The ⑬ is shown by letters: a capital letter for the ⑭ _____ , and the corresponding small letter for the ⑮ _____ .
7. The observable characteristics of an individual (ie. the way the alleles express themselves) is called the ⑯ _____ .
8. When a dominant and recessive allele are present together (ie. in a heterozygous individual), only the dominant allele produces an effect (ie. expresses itself) in the phenotype.
9. A recessive allele will only express itself when it is in the homozygous state, ie. when the dominant allele is absent.
10. In a gamete only one of a pair of alleles is present. This is because gametes are formed by meiosis in which homologous chromosomes become separated.

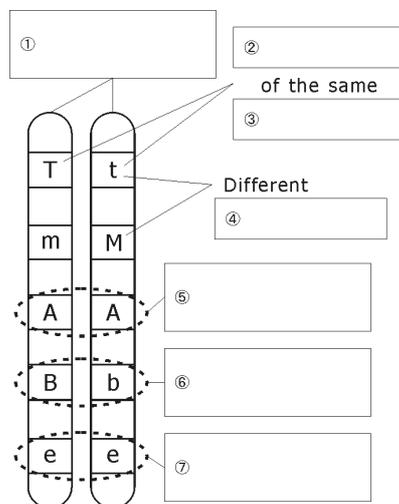
Activity 12-2-01: Fill in the blank ①-⑯.

12-2-02 Chromosome and gene.

→ The chromosomes exist in pairs such that each member of the pair has a characteristic length and shape similar to its partner. This pair is called homologous chromosomes.

→ A gene is a pair of DNA molecule which specifies the type of proteins to be produced and determines characteristics.

→ It is responsible for certain characteristics like eye colour, sex and texture of hair.



Activity 12-2-02: Fill in the blank ①-⑦.

12-2-03 Fine structure of chromosome.

→ Chromosomes are thread-like structures found in the nucleus of a cell.

→ Chromosomes consist of proteins called **histones** and the nucleic acid, **deoxyribonucleic acid (DNA)**.

→ The DNA molecule is a **double helix** formed by chains of sugar and phosphates attached to nitrogenous bases.

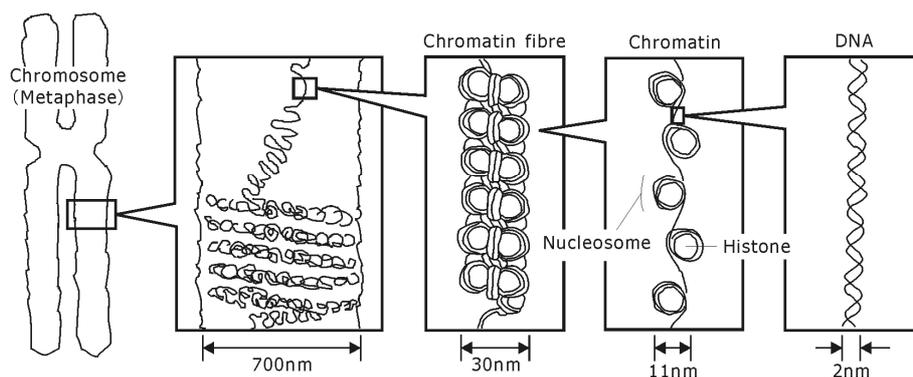
→ The sugar which makes the chain is a pentose sugar called **deoxyribose**.

→ The two helices in the DNA strands are linked together by nitrogenous bases.

→ There are four bases and these are **adenine (A)**, **thymine (T)**, **guanine (G)** and **cytosine (C)**.

→ The DNA strands are complementary that is adenine is always bonded to thymine (by two hydrogen bondings) and cytosine to guanine (by three hydrogen bondings).

Fine structure of chromosome



* Supplement: From genes to proteins

- How is the information in DNA used to determine an organism's characteristics?
- An organism's traits are determined by proteins that are built according to the plans specified in its DNA.
- How does DNA determine the nature of a protein?
- If you want to know the answer, you should study by yourself. There is no royal road to learning.

12-2-04 Mendel's law.

** What did Mendel discover?

- **Gregor Mendel** experimented on ① _____ to study one characteristic at a time.
- He usually started with ② _____ for his parent generation by carrying out self-pollination. These would then be crossed to form hybrids.
- His study shows that the first generation or **the first filial generation** (F_1 generation) shows dominant traits.
- Crosses within the first generation, which means self-pollination, in order to form the second generation or **the second filial generation** (F_2 generation) show more variation.
- From the ratio of phenotypes shown in offsprings, it might be possible to deduce the possible genotypes of the parent.
- An offspring that is all tall could have either homozygous dominant parents (TT x TT) or one homozygous dominant and one heterozygous parent (TT x Tt).

→ Offspring that are all short have to be from parents that are both homozygous recessive (tt x tt).

** **Mendel's law:** The condition for completing ③ _____ (Mendel-type heredity)

1. The principle of ④ _____: Alleles exist as pairs in genes, each on separate members on a pair of homologous chromosomes. During ⑤ _____, the chromosomes separate; alleles separate into different gametes.

2. Law of ⑥ _____: The inheritance of one gene is not affected by another gene. The segregation of alleles of a gene is not influenced by allele of another gene.

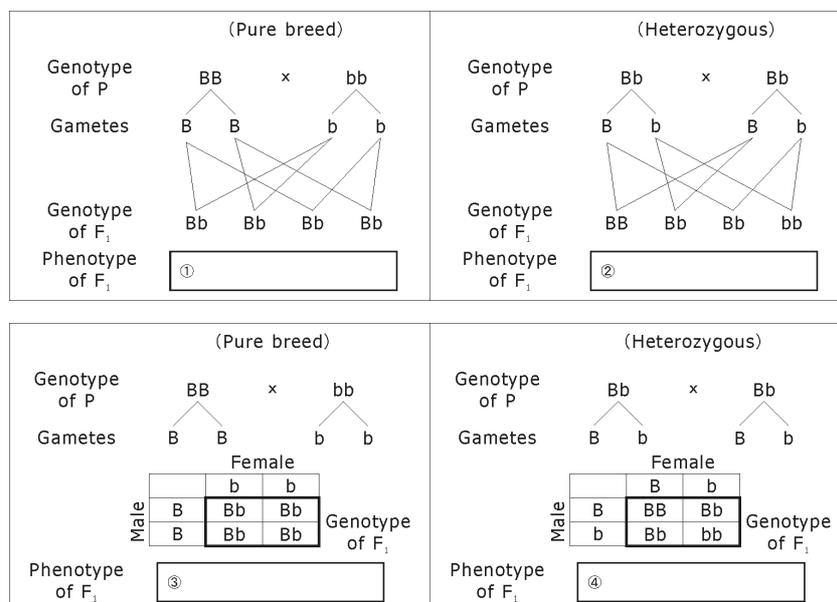
Activity 12-2-04: Fill in the blank ①-⑥.

12-2-05 Two ways of illustration of monohybrid cross.

→ A monohybrid cross is a cross that involves two contrasting alleles in determining a trait.

→ A trait is a characteristic such as eye colour, texture of hair and colour of flowers.

→ The alleles and the traits they bring about can be determined in the offspring as shown in below.



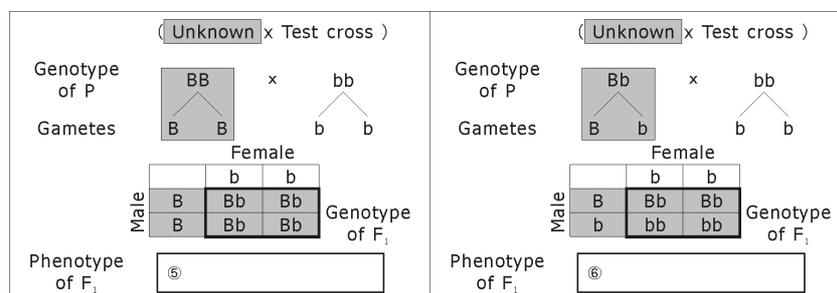
Activity 12-2-05: Describe the phenotype ①-④.

12-2-06 Cross test.

→ Sometimes, there is need to know whether the offsprings are homozygous or heterozygous.

→ This is done by carrying out a test cross.

→ A test cross is done by crossing the unknown organism with a homozygous recessive organism.



Activity 12-2-06: Describe the phenotype ⑤-⑥.

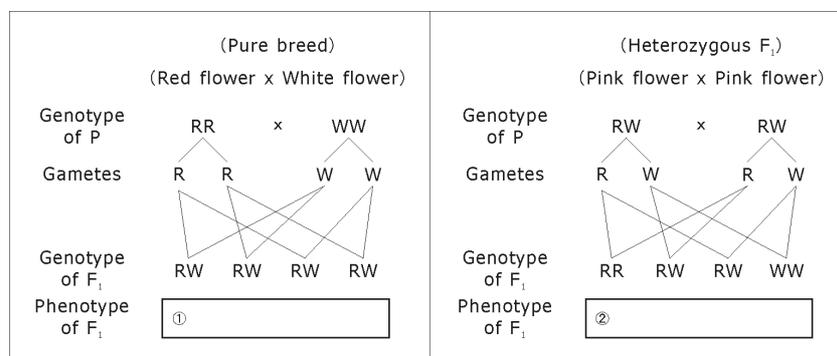
12-2-07 Co-dominance: Not apply Mendel's law.

→ If a characteristic is the result of two alleles which are **equally dominant**.

→ These types of alleles are termed **co-dominant**.

→ In human, the I^A and I^B alleles are co-dominant in the AB blood group.

* Example of colour of flower:



Activity 12-2-07: Describe the phenotype ①-②.

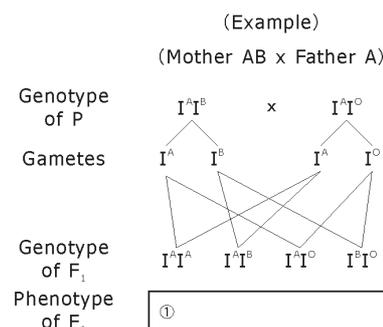
12-2-08 Multiple allele - ABO blood type in human

→ The gene that controls the **ABO blood group** in humans has three different alleles.

→ They are I^A , I^B , and I^O .

→ I^A and I^B are co-dominant, while I^O is recessive to both I^A and I^B .

→ For the blood group, there can only be 2 alleles in one



genotype.

Blood groups (phenotypes)	Alleles (genotypes)
A	$I^A I^A$ or $I^A I^O$
B	$I^B I^B$ or $I^B I^O$
AB	$I^A I^B$
O	$I^O I^O$

Activity 12-2-08: Describe the phenotype ①.

12-2-09 Sex determination in human.

→ **Sex chromosomes** (the 23rd pair) determine the sex of a person.

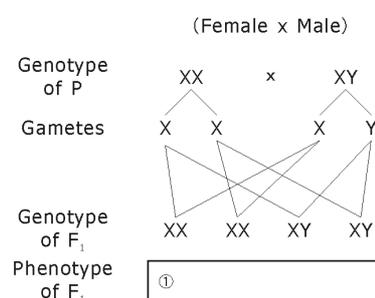
→ In female, the sex chromosomes are made of a homologous pair of X-chromosomes.

→ In male, this pair is made of a long X chromosome and a short Y chromosome.

→ The female gametes contain an X chromosome.

→ The male sperm contains either an X or a Y chromosome.

→ The X sperm or Y sperm determines if the child is female or male.



Activity 12-2-09: Describe the phenotype ①.

12-2-10 Human genetic disorder.

→ Most of the characteristics we think of as important are controlled by more than one pair of alleles, and can be influenced by our environment.

→ The harmful effects produced by mutated genes are called genetic disorders.

→ Some of human genetic disorders are controlled by single factor characteristics.

Recessive traits	Phenotypes
① _____	Lack of melanin pigmentation
Red-green ② _____	Inability to distinguish red or green wavelengths of light

③ _____	Inability to form blood clots
④ _____	Defective haemoglobin that causes ⑤ _____ cells to curve and stick together

Dominant traits	Phenotypes
Brachydactyly	Short fingers
⑥ _____ disease	Degeneration of nervous system, starting in middle age
Camptodactyly	Inability to straighten the little finger
Hypercholesterolemia	Elevated levels of blood cholesterol and risk of heart attack
⑦ _____	Extra fingers and toes

Activity 12-2-10: Name the disorder ①-④,⑥⑦. Name the cell ⑤.

12-3 Mutation

12-3-01 Mutation.

→ Mutations involve **spontaneous changes** to a ① _____ or a

② _____.

→ This change causes the gene to be coded differently from what it was supposed to be.

→ Any change in a gene or chromosome usually has a harmful effect on the cell in which it occurs.

→ Mutations in bacteria often produce resistance to drugs by mutation.

→ ③ _____ (environmental or chemical) can increase the rate of mutation in cells.

* Two types of mutation;

1. Gene mutations

Occur when the ④ _____ of the bases in the DNA molecule is changed.

There are different ways of gene mutations; ⑤ _____, ⑥ _____, ⑦ _____.

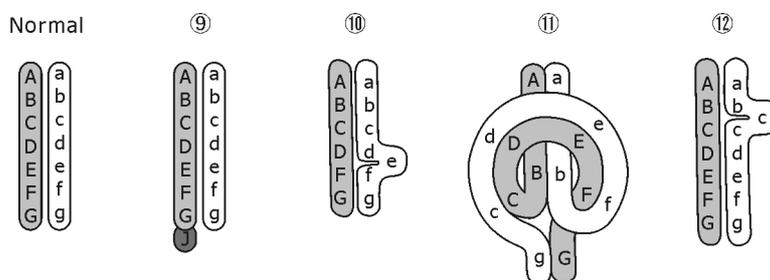
If the genetic code is changed, the type of ⑧ _____ synthesised will also changed.

eg. sickle cell anaemia, haemophilia

2. Chromosome mutations

During meiosis, some chromosomes may break and fragments may undergo the following changes;

⑨ _____, ⑩ _____, ⑪ _____, ⑫ _____.



During meiosis, the homologous chromosomes may fail to separate, so that the number of chromosome in gametes may be more or less than the normal number. It is known as polysomics.

eg. ⑬ _____ (21st chromosomes are triple)

* Causes of mutation (called **mutagen**);

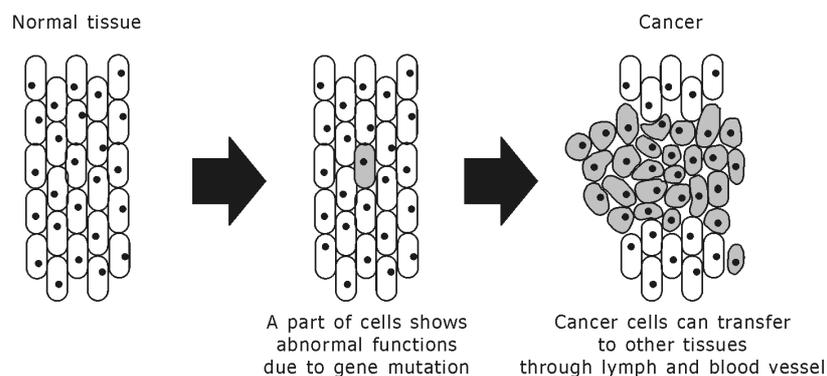
→ Excessively high temperature.

→ Exposure to chemicals such as formaldehyde, mustard gas, drugs.

→ High energy radiation such as ⑭ _____, ⑮ _____, beta-ray, alpha-ray, neutrons.

Activity 12-3-01: Fill in the blank ①-④, ⑧, ⑬-⑮. Name the way of mutation ⑤-⑦, ⑨-⑫.

12-3-02 Cancer.



→ A serious disease in which cells and tissues are the following condition:

- (1) Unlimited cell division,
- (2) Invasion of adjoining tissues (inhibition of normal function)
- (3) Metastasis (transference to the other tissues).

Unit 12 Answers for the activities

<12-1-01> ①Growth ②repair ③sex cells ④two diploid (2n) ⑤four haploid (n) ⑥clone ⑦

Recombination

<12-1-02> ①Nucleus ②Centrosome ③Spindle fibre ④become visible ⑤Shorten and thicken

⑥Nuclear membrane, Disintegrate ⑦Aligned at the equatorial region ⑧Moving to opposite poles

⑨Nuclear membrane, Form ⑩Cytoplasmic division ⑪Daughter cells

<12-1-03> ①reduce ②Homologous chromosomes ③Crossing over ④Homologous chromosomes ⑤Equatorial region

⑥Nuclear membrane ⑦Maternal ⑧Paternal ⑨visible ⑩divides ⑪moves ⑫Four daughter cells

<12-2-01> ①genes ②chromosomes ③nucleus ④alleles ⑤dominant ⑥recessive ⑦locus ⑧homologous ⑨homozygous

⑩homozygous dominant ⑪homozygous recessive ⑫heterozygous ⑬genotype ⑭dominant allele ⑮recessive allele

⑯phenotype

<12-2-02> ①Homologous chromosomes ②Alleles ③gene ④genes ⑤Homozygous dominant ⑥Heterozygous

⑦Homozygous recessive

<12-2-04> ①pea plants ②pure lines ③monohybrid cross ④segregation ⑤meiosis ⑥ independent assortment

<12-2-05> ①All black ②3 black : 1 brown ③All black ④3 black : 1 brown

<12-2-06> ⑤All black ⑥1 black : 1 brown

<12-2-07> ①All Pink flower ②1 red : 2 pink : 1 white

<12-2-08> ①2 A : 1 B : 1 AB

<12-2-09> ①1 Female : 1 Male

<12-2-10> ①Albinism ②color blindness ③Hemophilia ④Sickle cell anaemia ⑤red blood cells ⑥Huntington ⑦Polydactyly

<12-3-01> ①a gene ②a chromosome ③Mutagens ④arrangement ⑤deletion ⑥transition ⑦insertion ⑧protein

⑨translocation ⑩deletion ⑪inversion ⑫duplication ⑬Down's syndrome ⑭x-ray ⑮ultra violet light

<Sample question>

1. A families A and B the first five children of each family were all boys. If a boy from family A marries a girl from family B, what are the chances of their first born child being a boy?

- A. 25% B. 50% C. 75% D. 100%

2. An adopted child of blood type O has located the biological father and discovered that he has blood type B. Which blood type could NOT be a possible blood type of the mother?

- A. type A B. type B C. type AB D. type O

3. Which of the following is a result of gene mutation?

- A. Down's syndrome B. Sickle cell anaemia
C. ABO blood groups D. Sex determination

4. A particular characteristic is controlled by a dominant allele, A and recessive allele, a.

Which cross would give a 1:1 ratio of the two phenotypes among the offsprings?

- A. aa x aa B. Aa x AA C. Aa x Aa D. Aa x aa

5. In peas, the allele S, for smooth seeds, is dominant over s for wrinkled seeds. 200 heterozygous plants were self-pollinated and 1500 smooth seeds were collected. How many wrinkled seeds were collected?

- A. 6000 B. 2000 C. 1500 D. 500

<Answer> 1. B 2. C 3. B 4. D 5. D

UNIT 13 Ecology

Objectives

- 13-1 Explain the term: Food chain, Food web.
- 13-1 Explain pyramids of energy and biomass.
- 13-1 Describe how carbon and nitrogen are cycled within an ecosystem.
- 13-2 Explain the importance of living organisms in soil.
- 13-2 Describe the undesirable effects of water, air and land pollution.

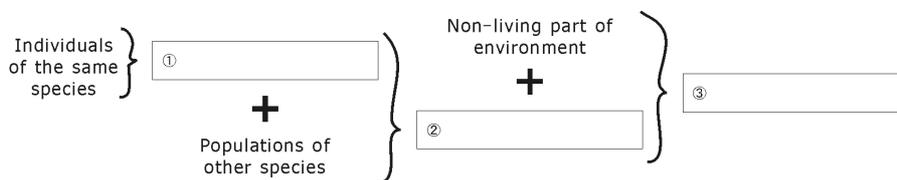
13-1 Ecosystem

→ Our environment is made up of many different living organisms.

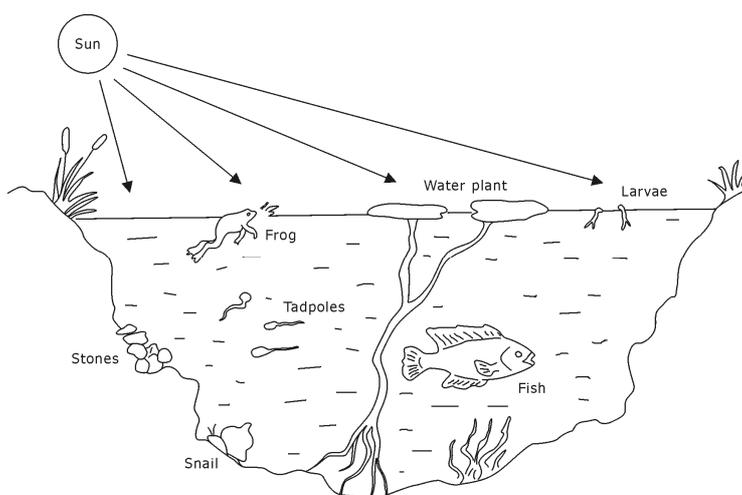
→ The survival of these organisms depends on how they interact with their environment and with each other.

13-1-01 Terms of ecosystem.

→ The **ecosystem** is an ecological unit in which living organisms in a community interact with each other and with the non-living.



* Example of ecosystem in the pond:



Activity 13-1-01: Fill in the blank ①-③.

13-1-02 Food chain.

→ **Producers** and **consumers** play different roles in the community.

→ These roles are termed as ①_____.

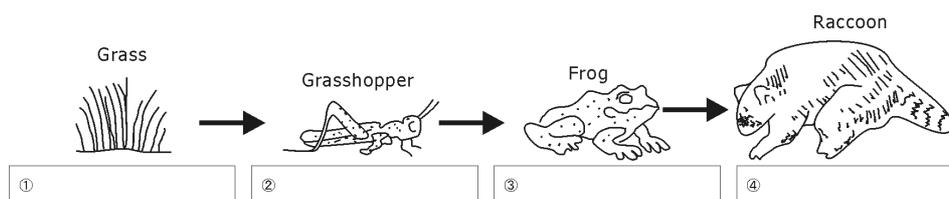
→ The different ① can be classified in various ways in the community.

→ When a herbivore eats a plant, and is then eaten by a carnivore, a chain of events form:

based on ②_____ habits.

→ This forms the food chain.

* Example of food chain;



* Levels of food chain;

Food chain	Named	Consumer level	Trophic level
Photo-plankton	Producer	Producer	1 st trophic level
Mussels	Herbivore	1 st order consumer	2 nd trophic level
Crab	Small carnivore	2 nd order consumer	3 rd trophic level
Man	Larger carnivore	3 rd order consumer	4 th trophic level
Bacteria	Decomposer	4 th order consumer	5 th trophic level

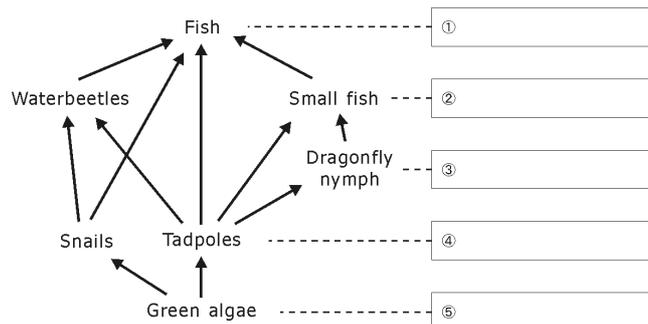
Activity 13-1-02: Fill in the blank ①-② (text). Name the level of food chain ①-④ (figure).

13-1-03 Food web.

→ In reality, the feeding relationship of organisms is not so simple as described above that predators feed on more than one type of prey.

→ When several different food chains can be strung together, it forms a food web.

→ A food web **interconnects** several food chains within an ecosystem.



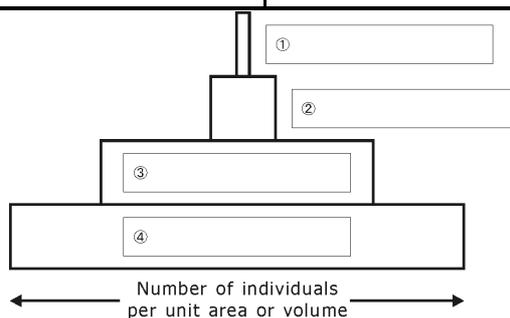
Activity 13-1-03: Name the level of food web ①-⑤.

13-1-04 Ecological pyramid.

→ With the progression of the food chain, the number of organisms of successive levels reduces.

→ The food chain therefore attains the shape of pyramid.

Pyramid of ① _____	Pyramid of ② _____
The base has the larger number of organisms	Represents the dry mass of all the organisms at that trophic level
The number of organisms reduce as you reach the higher tiers of the pyramid	The length of the bars estimates the relative biomass
May be upright or inverted	May be upright or inverted



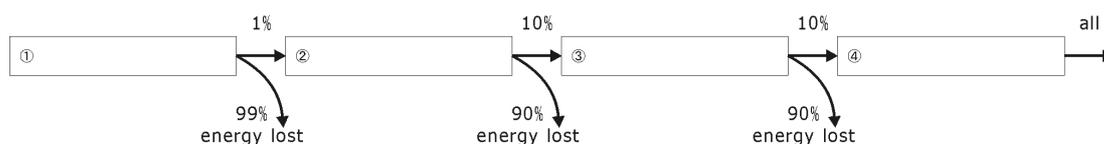
Activity 13-1-04: Name the pyramid ①② (table). Name the level of pyramid ①-④ (figure).

13-1-05 Energy transfer along the food chain.

→ All ecosystems require a constant input of energy.

→ The main energy sources on the earth in the ① _____.

- Solar energy can be trapped by ②_____ to make food.
- Energy flows in ③_____ direction along the food chain.
- Green plants capture only ④_____ % of solar energy.
- ⑤_____ % of energy at every trophic level is converted into biomass.
- At the next level, energy is lost (by heat energy because of respiration). Therefore energy supplied from level to level decreases.
- Finally, all energy will be released out of ecosystem.



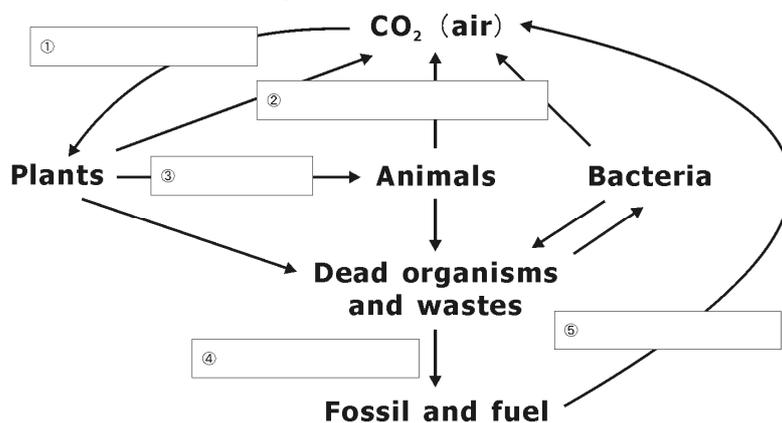
Activity 13-1-05: Fill in the blank ①-⑤ (text). Name the level of food chain ①-④ (figure).

Nutrient cycle

- In an ecosystem, materials are cycled so that they are used over and over again.
- Nutrients like carbon and nitrogen are not always in a readily available form to living organisms.
- They must be changed to forms that are usable to living organisms.

13-1-06 Carbon cycle.

- The cycling of carbon in the biosphere is called carbon cycle.
- Carbon dioxide is removed from the atmosphere through the process of **photosynthesis**.
- During **respiration**, carbohydrates are broken down to carbon dioxide and water, releasing back carbon to the atmosphere.
- During **decay**, bacteria give back carbon dioxide to the atmosphere.
- During **human activities**, fossil and fuel are used, releasing much carbon dioxide to the atmosphere.

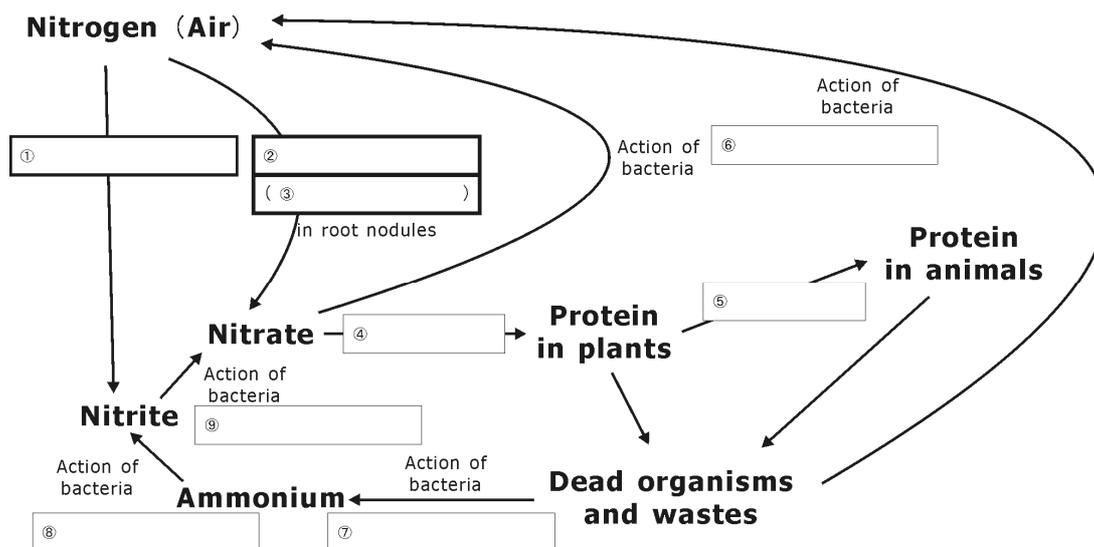


Activity 13-1-06: Name the process ①-⑤.

13-1-07 Nitrogen cycle.

→ Nitrogen is found in plants and animals in form of proteins, in soil as nitrates, and in the atmosphere as nitrogen gas.

→ The cycling of nitrogen in biosphere is called the nitrogen cycle.



→ **Nitrogen fixation** is the process which certain bacteria absorb nitrogen gas and combine it with other substances to make nitrogenous compounds.

→ Some nitrogen fixing bacteria can be found in root nodules of leguminous plants like beans, peas and groundnuts.

→ The nitrogen fixing bacteria in root nodules and leguminous plants provide an example of symbiosis (or mutualism in this case which implies that both organisms derive some benefit from the association).

→ That is, the leguminous plant benefits from the extra nitrates that the bacteria provide,

while the bacteria are protected in the plant's cells and can also use the sugars made by the plant's photosynthesis.

Activity 13-1-07: Name the process ①②④⑤. Name the organism ③,⑥-⑨.

13-2 Human impact on ecosystem

→ Human beings have caused much harm to their environment.

→ The environment that takes a long time to be established has been destroyed within the last few decades because of rapid increasing of the human population.

13-2-01 Human impact on ecosystem.

1. ① _____ : process which leads to increase in a harmful agent in the environment.
2. ② _____ : it alters the balance of nature.
3. ③ _____ : particularly monoculture, can destroy wildlife.
4. ④ _____ : alters the environment and destroys wildlife.

Activity 13-2-01: List the human impact ①-④.

13-2-02 Pest control.

→ In agriculture, monocultures, with their dense populations of single species, are usually applied.

→ Monoculture is very susceptible to attack by insects or the spread of fungus diseases.

→ To combat these threats, we used two types of pest control methods together.

1. ① _____ control -- pesticides

* Advantage: ② _____ and ③ _____.

* Disadvantage: Get into food chain and harm humans (④ _____).

Kill usefull predator. Become resistant to the pesticide.

Types of pesticide	Kills	Examples
Herbicide	Plants (dandelions)	Paraquat Hormone weedkiller
Insecticide	Insects (houseflies, mosquitoes)	⑤ _____
Fungicide	Fungi (potato blight, mildew)	Copper sulphate

2. ⑥ _____ control

* Advantage: ⑦ _____ in human body.

* Disadvantage: May disturb ⑧ _____ of nature (eg food web).

Pest	Harm done by the pest	How controlled
Greenfly (aphid)	Sucks plant juices, Transmits plant virus disease	Install ⑨ _____ (Ladybird beetle) to eat greenflies
Mosquito	Transmits malaria	Install ⑨ (certain species of fish) to eat mosquito larvae
Rabbit	Eats crop plants	Install ⑩ _____ to cause myxomatosis
Water hyacinth	Clogs up rivers and reservoirs in tropics	Install ⑨ (tilapia) to eat water hyacinth

Activity 13-2-02: Fill in the blank ①-⑩.

13-2-03 Organisms in soil.

→ Some organisms in soil play important roles especially in agriculture.

Organisms	Importance
Helpful	

Grass	Roots help to hold soil particles together; destruction of plants by eg over-grazing may result in erosion
① _____	Turn over, drain, aerate, fertilise and refine the soil
Moles	Drain the soil and eat pests (but also eat earthworm)
Bacteria and fungi	② _____ bring about decay; nitrifying and nitrogen-fixing bacteria raise ③ _____ content of soil
Harmful	
Wireworms (larvae of type of beetle)	Eat plant roots
Leather jackets (larvae of daddy longlegs)	Eat plant roots
Millipedes	Some species eat plant roots
④ _____	Some species attack plant roots and live inside them as parasites
Bacteria	De-nitrifying bacteria lower ③ content of soil

Activity 13-2-03: Fill in the blank ①-④.

13-2-04 Mineral salts needed for plants.

→ **Macronutrients:** chemical elements needed in rather amounts.

eg. nitrogen, phosphorous, sulphur, magnesium, potassium and calcium

→ **Micronutrients:** trace elements needed in tiny amounts.

eg. manganese, boron, cobalt, zinc, copper and molybdenum

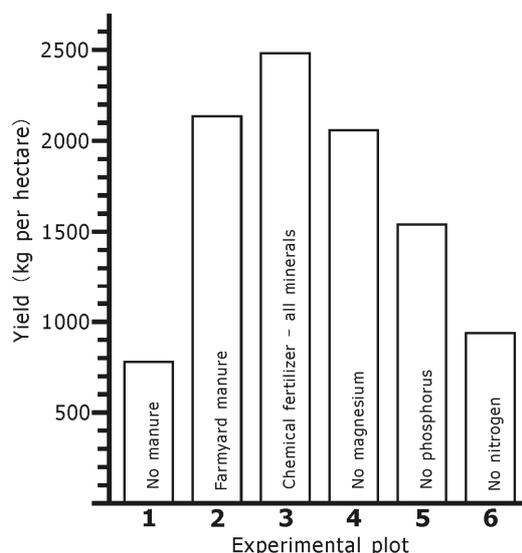
→ With the exception of legumes, plants are generally dependent on nitrogen in the form of nitrate ions or ammonium ions.

Element	Function	Deficiency
Nitrogen	Component of ①_____	Poor growth Yellow leaves
Phosphorous	Component of ②_____	Poor growth Dull green leaves Leaves with curly brown edges
Sulphur	Component of ③_____	Yellow leaves
Magnesium	Component of ④_____	Yellow leaves
⑤_____	Increase hardiness	Yellow edge to leaves Die early
Calcium	⑥_____ at root and shoot tips	Poor buds Stunted growth
Iron	Need for chlorophyll formation	Yellow leaves
Copper	Help certain enzymes	Shoots die back
Zinc	Help certain enzymes	Malformed leaves

Activity 13-2-04: Name the chemical ①-⑤. Name the process ⑥.

13-2-05 Effect of fertilizer.

→ Compared **manure** to **chemical fertilizer**, the effect on the yield is almost equal.



- The animal manure replaces the nitrates and other minerals removed by the crop.
- The animal manure is biodegradable, so that it helps to maintain the ecosystem in the soil.
- When animal manure is not available in large enough quantities, artificial fertilizers are used.
- These are mineral salts made on an industrial scale.
- Examples are ammonium sulphate (for nitrogen and sulphur), ammonium nitrate (for nitrogen) and compound NPK fertilizer for nitrogen, phosphorus and potassium.
- Remains of these chemical eventually make the soil acidic. Some organisms may not tolerate acidic conditions and as such they die. This in turn will affect the process of decomposition and replenish soil with nutrients.

13-2-06 Pollution.

- Pollution involves the addition of harmful substances (chemicals) in the earth's environment.
- When released into the environment, they are harmful. They are called

① _____.

→ Pollution is not confined to the air, land or water by itself. **It affects the entire ecosystem.**

Pollutant	Main components	Why it is harmful
Air pollutants		
Smoke from	② _____	Causes ③ _____

<p>industrial plants</p>	<p>Sulphur dioxide</p> <p>Carbon particles</p> <p>Oxides of nitrogen (NO_x)</p>	<p>leading to</p> <p>④ _____</p> <p>Reduces visibility</p> <p>Dirty buildings, harms plants</p> <p>Causes ⑤ _____</p> <p>⑥ _____</p> <p>(Smoke plus fog)</p>
<p>⑦ _____</p>	<p>Sulphuric acid, formed by sulphur dioxide gas reacting with atmospheric water and oxygen</p>	<p>Erodes buildings</p> <p>Harms plants</p>
<p>Motor vehicle exhaust</p>	<p>⑧ _____</p> <p>⑩ _____</p> <p>(Action of bright sunlight on exhaust makes photochemical smog)</p>	<p>Causes faintness</p> <p>Combines readily with ⑨ _____</p> <p>Harms brain</p> <p>Photochemical smog causes eye-irritation and headaches</p>
<p>Refrigerants</p> <p>Hair spray</p>	<p>CFCs (chlorofluorocarbons)</p>	<p>Destroy ozone layer, leading skin cancer</p>
<p>Green house effect gases</p>	<p>CO₂, methane, NO_x, CFCs</p>	<p>Global warming</p>
<p>Water pollutants</p>		
<p>⑪ _____</p>	<p>Liquid which floats on water</p>	<p>Ruins beaches</p> <p>Kills fish and sea birds</p>
<p>⑫ _____ and ⑬ _____ run-off</p>	<p>Nitrogenous substances</p>	<p>High nitrogen content makes ⑭ _____ multiply quickly;</p> <p>⑭ then die, causing</p>

		decomposers to multiply and use up oxygen so that fish suffocate
⑮ _____ (insecticide)	Complex chemical substance containing chlorine	Damages animal tissues Gets into food chain, becoming more concentrated at each step
Inorganic wastes	⑯ _____, Zinc	Marine life can be affected by even small quantities of these metals Settles in the mudbed; anaerobic bacteria converts it into neurotoxins Causes numbness, convulsions and blindness in people
Land pollutant		
Mine tips	Lead, Cadmium	Harmful to animals and certain plants
Litter	Natural materials (eg apple cores) Human-made materials (eg ⑰ _____)	Unsightly, may attract flies and rats Natural materials can decay (biodegradable), human-made materials often cannot decay (non-biodegradable).
Noise	Loud sounds	Discomfort Pain Damage to ears
Radioactivity from	Waves given out from radioactive substances	Damages genes (⑱ _____) causing

nuclear tests,
etc

deformities and/or cancer

Activity 13-2-06: Fill in the blank ①-⑱.

Unit 13 Answers for the activities

<13-1-01> ①Population ②Community ③Ecosystem

<13-1-02> (text) ①niches ②feeding (figure) ①Producer ②1st order consumer ③2nd order consumer ④3rd order consumer

<13-1-03> ①4th consumer ②3rd consumer ③2nd consumer ④1st consumer ⑤Producer

<13-1-04> (text) ①numbers ②biomass (figure) ①3rd consumer ②2nd consumer ③1st consumer ④Producer

<13-1-05> (text) ①Sun ②plants ③one ④1 ⑤10 (figure) ①Sun ②Producer ③Consumer ④Decomposer

<13-1-06> ①Photosynthesis ②Respiration ③Eaten ④Fossilisation ⑤Combustion

<13-1-07> ①Lightening ②Nitrogen fixation ③Rhizobium ④Absorption ⑤Eaten ⑥ Denitrifying bacteria

⑦Decomposition bacteria ⑧Nitrifying bacteria ⑨Nitrifying bacteria

<13-2-01> ①Pollution ②Pest control ③Modern farming ④Urban development

<13-2-02> ①Chemical ②quick ③efficient ④Biological accumulation ⑤DDT

(Dichlorodiphenyltrichloroethane)

⑥Biological ⑦Harmless ⑧balance ⑨predator ⑩certain type of virus

<13-2-03> ①Earthworms ②Decomposers ③nitrate ④Roundworms (nematodes)

<13-2-04> ①proteins ②ATP ③proteins ④chlorophyll ⑤Potassium ⑥Cell formation

<13-2-06> ①pollutants ②Carbon dioxide ③Greenhouse effect ④global warming ⑤ bronchitis ⑥Photochemical smog

⑦Acid rain ⑧Carbon monoxide ⑨haemoglobin ⑩Lead ⑪Oil ⑫Sewage ⑬fertiliser ⑭algae

⑮DDT ⑯Mercury ⑰plastic

⑱mutation

<Sample question>

1. Which statements about virus and bacteria are **not** correct?

	Virus	Bacteria
A.	Have a nucleus.	Have a nucleus.
B.	Not used in food production.	Used in food production.
C.	Caused disease.	Caused disease.
D.	Have DNA.	Have DNA.

2. The following samples were taken from a human patient. Which sample will be examined to find out whether the patient is infected with the malaria parasite?

- A. Red blood cells. B. Urine. C. Saliva. D. White blood cells

3. Which of the following statements explains why some living organisms in water die if raw sewage is allowed into the water?

- A. Sewage makes water dirty.
 B. Sewage ensures that it uses up all the oxygen in water.
 C. Sewage nourishes water microorganism which deplete the oxygen.
 D. Sewage is poisonous to aquatic organisms.

4. Which of the following is a direct effect of introducing raw sewage into a river?

- A. Oxygen levels would reduce. B. Number of fish would increase.
 C. Plant growth would reduce. D. Bacterial growth would increase.

5. A lake has been polluted by sewage. Compared with unpolluted water, the water in this lake will have...

- A. Fewer bacteria B. More fish C. More nitrogen compounds D.

more oxygen

6. For each 1000kJ of energy that a goat takes in a food, it uses 70kJ for growth, loses 410kJ as a heat and 520kJ in faeces. What percentage is used by the goat?

- A. 7% B. 41% C. 48% D. 52%

<Answer> 1. A 2. A 3. C 4. D 5. C 6. C