BIOLOGY NOTES

CIE IGCSE

ALL YOU NEED, NOTHING MORE, NOTHING LESS

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The Main Characteristics of Living Organisms

The seven characteristics of living organisms, which are defined as:

• *nutrition* as taking in of nutrients which are organic substances and mineral ions, containing raw materials or energy for growth and tissue repair, absorbing and assimilating them
• *excretion* as removal from organisms of toxic materials, the waste products of metabolism (chemical reactions in cells including respiration) and substances in excess of requirements
• *respiration* as the chemical reactions that break down nutrient molecules in living cells to release energy
• *sensitivity* as the ability to detect or sense changes in the environment (stimuli) and to make responses
• *reproduction* as the processes that make more of the same kind of organism
• *growth* as a permanent increase in size and dry mass by an increase in cell number or cell size or both
• *movement* as an action by an organism or part of an organism causing a change of position or place

Classification and diversity of living organisms

Concept and use of a classificatory system

Define and describe the *binomial system* of naming species as a system in which the scientific name of an organism is made up of two parts showing the genus and species. The first part is the genus, and starts with a capital letter, while the second part is the species, and starts with a lower-case letter.

The classification system which is normally used is this one, based on the five kingdoms which contain groups/phylums which contain classes which contain orders which contain families which contain genuses which contain species. There are other types of classification systems like one based on DNA/RNA sequences, called cladistics.

Main features of:

Bony fish:

1. Have a gill cover (operculum)
2. Breathe through gills
3. Have a mouth in front of the head
4. Streamlined body

5. Are colored differently for camouflage
6. Covered with moist scales for protection
7. Have a lateral line for sensation
8. Adapted for life in water
9. Have a mouth and nostrils
10. Both fertilization and development is external
11. Poikilothermic
12. No parental care

Amphibians:

1. Have four limbs
2. Have moist skin with fine capillaries for gaseous exchange through skin (when submerged)
3. Have an external ear drum
4. Eyes stick out so it can be above water while the rest of the body is submerged
5. Nostrils are at the top of the head, for the same reason as the eyes sticking out
6. Lay soft eggs in a jelly-like coat to absorb shock
7. Poikilothermic
8. Their tadpoles are able to live under water because:
    a. They have external gills for breathing
    b. They have tails to swim in water
    c. They have a streamlined shape to decrease the resistance of water
9. No parental care
10. External fertilization and development

Reptiles:

1. Have dry scaly skin to reduce water loss, enabling them to live in dry places
2. Some of them spend a lot of time in water (eg. Crocodiles)
3. Lay eggs with water-proof shells
4. Have ear drums deep inside their heads
5. Mostly have four short weak limbs (excluding snakes)
6. Body is divided into head, neck, trunk, and tail
7. Internal fertilization, external development
8. No parental care
9. Poikilothermic

Birds:

1. Are covered in feathers which:
    a. Act as an insulating layer
    b. Decrease the bird's density to help it fly
    c. Covered in water proof oil so as not to absorb water
2. Have beaks which are modified depending on the food they eat
3. Have fore limbs in the form of wings
4. Have tails to control their direction during flying
5. Have eardrums deep inside heads
6. Females lay eggs with hard shells
7. Internal fertilization, external development
8. Homiothermic
9. Some parental care
10. Hollow bones and streamlined body for flight

Mammals:

1. Have hairy skin or fur
2. Have an external ear flap
3. Females have mammary glands which secrete milk
4. Have four limbs
5. Have teeth with different types
6. Internal fertilization and development
7. Homiothermic
8. Full parental care

Adaptations of organisms to their environment

The main features used in the classification of:

Flowering Plants:

1. Contain chlorophyll, make food using photosynthesis
2. Produce flowers for reproduction
3. Produce fruits which enclose seeds
4. Seeds germinate in favorable conditions to produce new plants

The main features used to classify them into further groups are:

Monocotyledons	Dicotyledons/Eudicotyledons
Have narrow leaves with parallel veins	Have broad leaves with branched veins
Seeds contain one Cotyledon	Seeds contain two Cotyledons
Have fibrous roots	Have one main tap root with lateral roots
The number of stomata is equally distributed in the upper and lower surfaces of leaves	Stomata are usually found in the lower surface of leaves
Floral parts are 3, 5, or their multiples	Floral parts are 2, 4, or their multiples

Arthropods:

1. They are invertebrates with segmented bodies
2. Have an exoskeleton made of chitin for protection and support
3. Have pairs of jointed legs for movement

Insects (eg. Ants)	Arachnids (eg. Spiders)	Crustaceans (eg. Crabs)	Myriapods (eg. Centipedes)
Body divided into three regions: Head, Thorax, and Abdomen	Body divided into two regions: Cephalothorax and Abdomen	Body divided into two regions: Thorax and Abdomen	Body divided into two regions: Thorax and Abdomen
One pair of antenna attached to the head	No antenna, but they have chelicerae/padipalps to hold/paralyze prey	Two pairs of antenna sensitive to touch and chemicals	One pair of antenna
Three pairs of jointed legs growing out of thorax	Four pairs of jointed legs growing out of cephalothorax	Four or more pairs of jointed legs, each pair grows out of a separate segment	Many pairs of jointed legs, each pair grows out of a separate segment
One pair of compound eyes	Several pairs of simple eyes	Stalked compound eyes	One pair of simple eyes
Have wings at at least some stage of their life	No wings	No wings	No wings

Annelids: (worms)

1. Elongated cylindrical bodies
2. Segmented bodies
3. Each segment has chaetae (bristles) for movement

Nematodes: (round worms)

1. Unsegmented round bodies
2. Pointed at both ends
3. Circular in cross section

Molluscs: (eg snails, octopuses, squids)

1. External or internal shell (mostly)
2. Have a muscular foot for movement, also produces mucus
3. Eyes usually at the end of stalks

Viruses	**Bacteria**
Smaller than bacteria	Larger than virus
Protein coat	Cell wall
Cell membrane absent	Cell membrane present
Cytoplasm absent	Cytoplasm present
No cell organelles	Few cell organelles
Only carries out reproduction	Carries out all functions of living organisms
Can only live as a parasite in other cells	Can live free or as a parasite

Exception is yeast, a single celled fungus

Bacteria	**Fungi**
Unicellular	Formed of thread like structures known individually as hypha
Cell wall made of proteins lipids and sugars	Cell wall made of chitin or chitin and cellulose
No distinct nucleus	Several nuclei in each hypha's cytoplasm
Some types carry out photosynthesis	No photosynthesis
Reproduce by binary fission	Reproduce by spores

Learn how to use simple dichotomous keys

Example of a Dichotomous Key for Animals

1a. This organism has an exoskeleton (go to question 2) 1b. This organism has an endoskeleton or no skeleton (go to question 3)

2a. This organism has thin black body and a red stripe on it's abdomen (go to question 4a.) 2b. This organism has a thick black body and large grey/brown abdomen (go to question 4b).

3a. Organism dwells on land (go to question 5) 3b. Organism dwells in the ocean (go to question 6)

4a. Organism is *Latrodectus hasselti* (black widow spider)

4b. Organism is *Atrax infensus* (funnel-web spider)

5a. Organism is totally covered in smooth scale-like skin (go to question 7) 5b. Organism has a textured coat or covering (go to question 8)

6a. Organism has 8 thick legs or tentacles (go to question 9a.) 6b. Has many string-like legs or tentacles (go to question 9b.)

7a. Scale-like skin is patterned in horizontal stripes over the body (go to question 10a.) 7b. Scale-like skin has one block color over most of it's body (go to question 10b.)

8a. Has fine fur-like covering (go to question 11) 8b. Has feather-like covering over most of it's body (go to question 12)

9a. Organism is *Hapalochlaena lunulata* (blue-ringed octopus) 9b. Organism is *Chironex flecken* (sea wasp)

10a. Organism is *Psuedonaja texilis* (tiger snake) 10b. Organism is *Pseudechis porphyricus* (red-bellied black snake)

11a. Has two opposing thumbs on the front paws (go to question 13a.) 11b. Has no opposing thumb on the front paws (go to question 13b.)

12a. Has large bone-like structure on a bald, blue-skinned head (go to question 14a.) 12b. Has feather-like covering over head with no bone-like structure (go to question 14b.)

13a. Organism is *Phascolatarctos cinerus* (koala) 13b. Organism is *Vombatus ursinus* (wombat)

14a. Organism is *Casuarius casuarius* (cassowary) 14b. Organism is *Dromaius novaebollandiae* (emu)

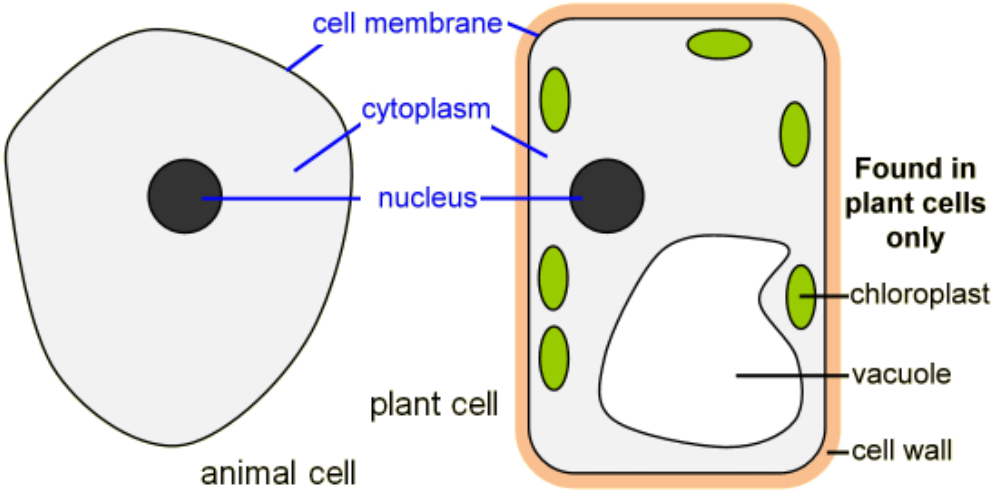
Example of Dichotomous Key for Plants

1. Needles in bundles/groups. (go to #2) 1. Needles single or flattened & scaly. (go to #6)
2. Needles in clusters. Tamarack 2. Needles 2-5 per bundle. (go to #3)
3. Five needles per bundle. White Pine 3. Needles in pairs. (go to #4)
4. Needles 3-4 inches long. Red or Norway Pine 4. Needles under 2 inches. (go to #5)
5. Bark dark gray. Jack Pine 5. Bark orange-brown. Scots Pine
6. Needles square, round or scaly. (go to #7) 6. Needles flat. (go to #9)
7. Needles scaly, flattened. Northern White Cedar 7. Needles square or round. (go to #8)
8. Needles 1/3-3/4 inch long, twigs hairless. White Spruce 8. Needles 1/4-3/4, new twigs with hair. Black Spruce
9. Shrub. Canada Yew 9. Tree. (go to #10)
10. Needles 1/2 inch long with short stem. Eastern Hemlock 10. Needles 3/4 –1 1/4 inches long, no stem. Balsam Fir

(no need to memorize anything, simply learn how to use them)

Living organisms are made of cells.

Animal Cell	Plant Cell
No cell wall	Has a cell wall made of cellulose
Has no or temporary small vacuoles	Has a large, permanent vacuole
No chloroplasts	Has chloroplasts (usually)
Usually contains stored glycogen	Usually contains stored starch



Structure	Functions
Cell wall	Supports, protects, and gives cells shape. Allows free movement of molecules.
Cell membrane	Envelopes the cell's contents. Controls molecule movement in and out of cells.
Nucleus	Controls cell activities. Carries inherited information.
Cytoplasm	Contains and supports cell organelles. May contain stored food.
Chloroplasts	Absorb light energy and convert it into chemical energy during photosynthesis.
Mitochondria	Release energy using aerobic respiration
Vacuole	Helps supporting the cell, regulates the absorption of water by osmosis, and serves as a storage facility.

Relate the structure of the following to their functions:
• ciliated cells – in respiratory tract, help mucus move along the trachea
• root hair cells – absorption of water and minerals from soil. Also helps root stick into soil.
• xylem vessels – conduction of dissolved substances from roots to leaves and support to the plant's structure.
• muscle cells – contract and relax in pairs, allowing movement.
• red blood cells – transport of oxygen to tissues.
Define (using examples covered later in notes):
• *tissue* as a group of cells with similar structures, working together to perform a shared function
• *organ* as a structure made up of a group of tissues, working together to perform specific functions
• *organ system* as a group of organs with related functions, working together to perform body functions

You should be able to calculate magnification and size of biological specimens using millimeters as units

Movement in and out of cells

Define *diffusion* as the net movement of molecules from a region of their higher concentration to a region of their lower concentration down a concentration gradient, as a result of their random movement.

The importance of diffusion in

Gases	Solutes (liquids)	Water as a solvent
Necessary for gaseous exchange in all living organisms	Dissolved salts diffuse through root hair cells	Dissolving oxygen in water is necessary for marine life
Necessary for obtaining carbon dioxide and release of oxygen during photosynthesis	Absorption of dissolved food materials in many organisms, like amoeba, bacteria and fungi, is done using diffusion	Excretory products cannot be excreted except if they are dissolved in water
---	Dissolved excretory materials diffuse from regions of their production to transport systems to be carried to excretory organs	Enzymes and hormones cannot be secreted except if they are dissolved in water
---	Some digested food materials in humans is absorbed by diffusion	Digested food cannot be absorbed except if it is dissolved in water
---	---	Plants cannot obtain minerals unless they are dissolved in water

Define *active transport* as movement of ions in or out of a cell through the cell membrane, from a region of their lower concentration to a region of their higher concentration against a concentration gradient, using energy released during respiration

The importance of active transport as an energy-consuming process by which substances are transported against a concentration gradient:
1. Ion/mineral uptake by root hair cells. The concentration of the ion/mineral in the cell is higher than the surroundings, therefore diffusion won't work, and active transport must be used.
2. Glucose uptake by epithelial cells of the villi. The concentration of glucose in the epithelial cell is higher than the food being digested, therefore diffusion won't work, and active transport must be used.

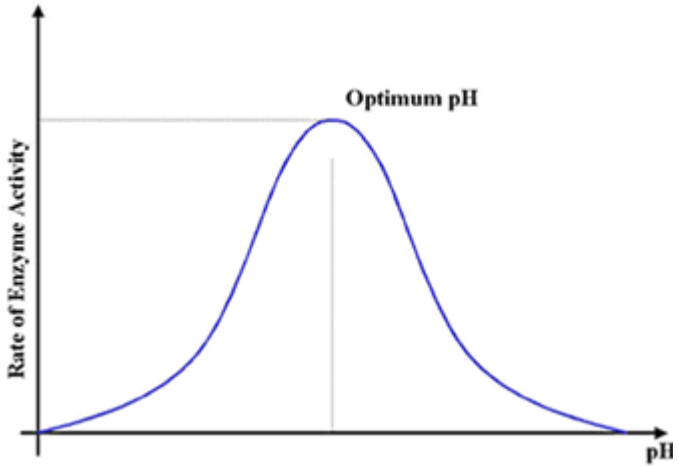
Define *osmosis* as the diffusion of water molecules from a region of higher water potential (dilute solution) to a region of their lower water potential (concentrated solution), through a partially permeable membrane

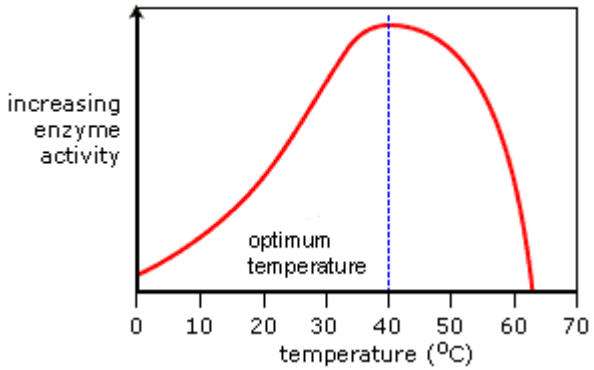
The importance of osmosis

Plants gain water through osmosis in their roots from the soil. Without a water potential gradient, roots will lose water, and the plant will be dehydrated. Plant cells contain vacuoles, which, if not full with water, will cause the cell to become flaccid. If all the cells in a leaf become flaccid, the whole leaf will become flaccid, and then wilt. Plant cells therefore need water to remain turgid and keep firm. In animal cells, if they are surrounded with a high water potential, osmosis will take place, and if the water is not expelled some way or the other, the cell will burst. If an animal cell is surrounded with low water potential, the water in the cytoplasm will diffuse outwards, causing the cell to shrink.

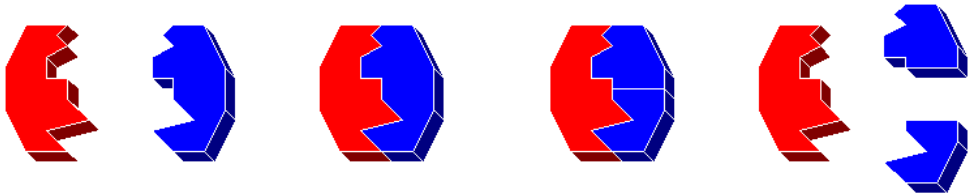
Enzymes

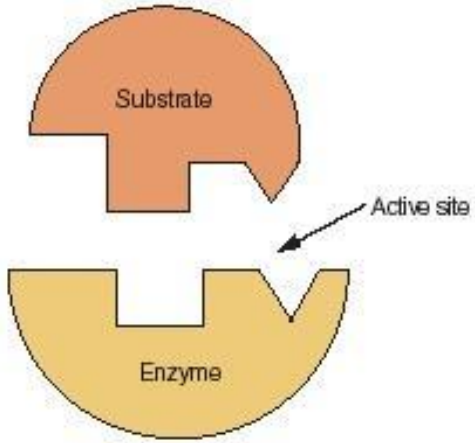
Define the term *catalyst* as a substance that speeds up a chemical reaction and is not changed by the reaction
Define *enzymes* as proteins that function as biological catalysts
Enzymes work best and fastest at their optimum pH. If the pH is too high or too low, the enzyme will stop working until appropriate conditions are restored. Some enzymes may actually get denatured if the pH is on an extreme.
Temperature also changes the activity of enzymes. As the temperature increases, so does enzyme activity. The enzymes and substrates move faster, meaning more successful collisions. It approximately doubles every 10°C higher you go. However, after it reaches approximately 37°C (body temperature) the rate of reaction falls dramatically due to the denaturing of enzymes, and cannot be restored.





Enzyme activity can be explained in terms of the lock and key model, as shown in the below diagram. This means only one type of enzyme works on each substrate, and that same enzyme will not be able speed up any other reaction. The area on the enzyme which the substrate fits into exactly is called the “active site”, and high temperatures change the shape of this active site, therefore the reaction cannot occur anymore.





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The role of enzymes in the germination of seeds

Seeds contain stored foods, in an insoluble form. During germination, the seed's embryo needs food to grow and carry out the different metabolic activities needed for germination, therefore there are enzymes in the seed, albeit in an inactive form as the seed is nearly free of water. When water enters the seed while it is under suitable conditions, these enzymes become active to catalyze the gradual breakdown of stored insoluble food in the seed to a soluble form that can be used by the embryo till it forms green leaves, which are then used to make food using photosynthesis.

The use of enzymes in biological washing powders

Some stains are insoluble in water, therefore it is difficult to be remove using only water. Eg blood and egg stains. Biological washing powders contain enzymes, which act as catalysts to remove the stains by breaking them down into smaller, soluble molecules, so they can be washed and removed by water. Examples include: Lipases, used to break down fat-based stains into fatty acids and glycerol. Proteases, used to break down protein based stains into soluble amino acids.

The use of enzymes in the food industry

Pectinase is an enzyme that breaks down pectin.

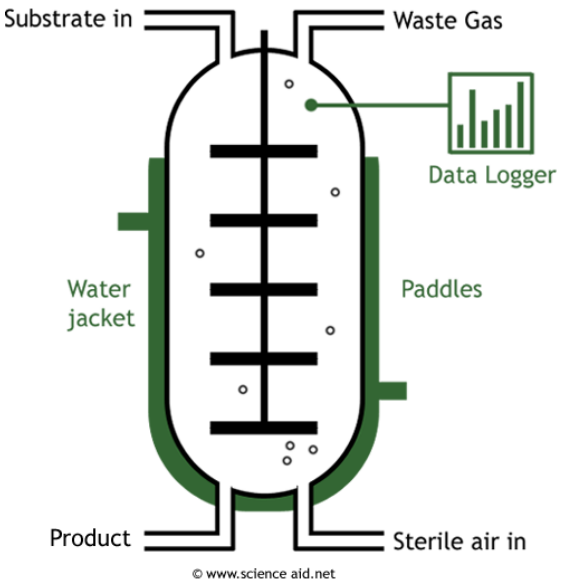
Pectinase helps to break down the cell walls. This

- increases the volume of juice obtained (increases the yield)
- lowers the viscosity of the juice (makes it more runny)
- reduces the cloudiness of the juice, cause by suspended pieces of cell wall

All of these effects improve the commercial quality of the juice.

The use of microorganisms and fermenters to manufacture the antibiotic penicillin and enzymes for use in biological washing powders

Fermenters are used in mass producing enzymes, as shown in the below diagram.



To increase production of an enzyme using a microorganism, this method is used. The method includes placing a microorganism that produces an enzyme into a medium that supports growth of the microorganism, and applying an electrical current to the medium to introduce electrons into the medium. The method produces a higher enzyme productivity rate. In other words, the amount of the enzyme produced b the microorganism in a time period using the method is greater than a second amount that would be produced by the microorganism in the same time period when no electrical current is applied to the medium.

The role of the fungus penicillium in the production of the antibiotic penicillin

Penicillin is released by Penicillium fungus when its growth is inhibited by stress. So Penicillium fungus is grown under strictly controlled conditions (of pH, oxygen nitrogen sources and lactose) to induce maximum stress, without killing the fungus, so that penicillin yields are maximized.

NUTRITION

Define *nutrition* as taking in of nutrients which are organic substances and mineral ions, containing raw materials or energy for growth and tissue repair, absorbing and assimilating them

The synthesis of large molecules from smaller basic units
• Simple sugars (glucose, Fructose) to starch and glycogen
• Amino acids to proteins
• Fatty acids and glycerol to fats and oils

The chemical elements that make up:
• Carbohydrates: Carbon, Hydrogen, and Oxygen
• Fats: Carbon, Hydrogen, and Oxygen (less oxygen than in carbohydrates)
• Proteins: Carbon, Hydrogen, Oxygen, Nitrogen, and sometimes Sulfur

FOOD TESTS:

Benedict's test - for simple (reducing) sugars:
- Make a solution of the substance to be tested in a boiling tube, and add Benedict's solution (blue).
- Alternatively, add Benedict's solution to a small chunk (of solid fruit, etc) in a tube.
- Heat the tube gently for about 2 minutes in the waterbath.

A colour change from blue, through murky green to yellow/orange/red shows the presence of a simple (reducing) sugar.
Actually an orange precipitate is formed so the (hopefully) initially clear solution not only changes colour but also becomes opaque.

Iodine test - for starch:
- Solid foods: Add a couple of drops of iodine solution (brown) directly to the substance to be tested, in a plastic dish.
- Liquids:
- Add 1-5 drops to test substance in a boiling tube or welled tile.
- THERE IS NO NEED TO HEAT.

The result is almost instantaneous, but the liquid needs to soak in to dry solids.
A colour change from orange to blue-black shows the presence of starch.

Biuret test - for Proteins:
- Add Biuret solution (sodium hydroxide + small amount of copper sulphate) - blue, like Benedict's - to the test substance.
- THERE IS NO NEED TO HEAT, but the result is not quite instantaneous.
A colour change from blue to mauve shows the presence of a protein.

Emulsion test - for Fats and Oils:
Add ethanol to a very small amount of the test substance. Shake or crush (and possibly heat gently using a water-bath - CAREFULLY - DO NOT USE A BURNER! - ethanol is flammable!) in order to dissolve. Filter or dilute if necessary to obtain fairly clear liquid (which is of course a solution of fat in ethanol).
Take another tube containing (tap) water, and pour the ethanolic solution (prepared above) into top.
A white (milk-like) emulsion indicates the presence of fats or oils.

The principal sources and importance of:

• **Carbohydrates**:

Sources: liver, potatoes, vegetables, milk, sugar cane, barley, grapes, fruits.

Importance:

1. The production of energy using respiration.
2. It is stored in cells as energy sources (in plants-starch, in animals-glycogen)
3. Cellulose (a carbohydrate) is needed to form cell walls in plants.

• **Fats**:

Sources: meat, milk, cheese, butter, eggs, maize, cotton seed oil, and palm oil.

Importance:

1. The release of energy using respiration
2. They form a part of the cell membrane
3. Stored in the body to:
    a. Act as a food reserve
    b. Protect and support certain organs
    c. To act as an insulating layer, reducing the rate of heat loss
4. Forms a water-proof layer on skin, fur and feathers.

• **Proteins**:

Sources: meat, milk fish, eggs, legumes (beans/lentils)

Importance:

1. Source of energy in case of starvation
2. Growth and tissue repair
3. Formation of enzymes and hormones
4. Protection against diseases, because white blood cells and antibodies are made of protein

• **Vitamins** (C and D only):

Sources: **C**; citrus fruits and fresh vegetables. **D**; Butter, eggs, cod liver oil, formed in the skin when exposed to the sun's rays.

Importance: **C**; Helps wounds heal, keeps blood vessels healthy, keeps teeth and gum healthy, helps body use iron, stimulates the immune system. **D**; Promotes the absorption of calcium and phosphorous, enables the body to use these enzymes in the formation of teeth and bones.

• **Mineral salts** (calcium and iron only):

Sources: **IRON**; liver, egg yolk, red meat, leafy vegetables. **CALCIUM**; Milk, dairy products, many fruits and vegetables

Importance: **IRON**; Necessary for formation of haemoglobin **CALCIUM**; Necessary for formation of teeth and bones and blood clotting

• **Fibre** (roughage):

Sources: all plant foods, cereal grains, barley, whole meal bread, brown rice.

Importance: Stimulates peristalsis, preventing constipation. Makes the stomach feel full, helping the diet.

• **Water**:

Importance:

1. It is the main component of cytoplasm
2. Main component of plasma in the blood
3. Metabolic reactions can only take place in the presence of water
4. Food cannot be transported without being dissolved in water
5. The gas exchange in lungs takes place more easily in the presence of water
6. To excrete, substances must be dissolved in water
7. Sweat is necessary for the regulation of body temperature
8. Enzymes and hormones are secreted after being dissolved in water

The deficiency symptoms for:

Vitamin C: Causes scurvy, whose symptoms are: pain in joints and muscles, bleeding gums, delayed healing of wounds

Vitamin D: Causes rickets in children, which makes bones soft and deformed. Slow dentition (growth and formation of teeth). Osteomalicia in adults.

Iron: Anaemia, a disease which causes breathlessness and tiredness from small exercises, due to the lack of haemoglobin.

Calcium: brittle bones, brittle teeth, slow dentition in children.

The use of microorganisms in the food industry

YOGHURT

Steps:

1. The milk is heated to about 87°C to kill off any microorganisms found in the milk
2. It is then left to cool to about 35-40°C
3. A small amount of pre-prepared yoghurt is added as source of the needed microorganism
4. The milk is then left in an incubator at a suitable temperature, and during this period the bacteria feeds on the milk sugar (lactose) producing lactic acid and energy
5. The lactic acid changes the pH of the milk, and it coagulates, forming curds
6. The yoghurt is then preserved in a refrigerator, so as to stop the action of the bacteria, otherwise the lactic acid content would be too high and this makes the yoghurt sour

SINGLE CELL PROTIEN

Since microorganisms reproduce rapidly, and their cells contain a high proportion of protein, they are sometimes used as food.

Steps:

1. The fermenter is first sterilized to avoid any negative effects brought about by other microorganisms
2. Any non-harmful bacteria/fungi/algae/plankton is brought to the fermenter
3. Sterilized nutritive materials are added, like air for aerobic respiration
4. The products are then taken to be used

Food additives:

Additive	Uses/Benefits
Coloring	They alter and improve food color, and can replace the foods natural color if it was lost while processing
Preservatives	It kills microorganisms which may rot food, allowing it to last longer
Antioxidants	They prevent changes in taste and color from oxidation
Emulsifiers	Help in the forming of an emulsion from fat and water
Stabilizers	Protects the food from its own enzymes
Flavorings	Provide the food with an artificial taste or smell

Health Hazards:

1. May cause hyperactivity in children
2. May cause allergic reactions
3. May develop sleeplessness and behavioral problems

Plant nutrition

Define *photosynthesis* as the fundamental process by which plants manufacture carbohydrates from raw materials using energy from light

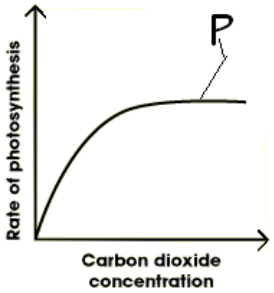
Equations:

$$\text{Carbon Dioxide + water} \xrightarrow[\text{Chlorophyll}]{\text{Light}} \text{Glucose + Oxygen}$$

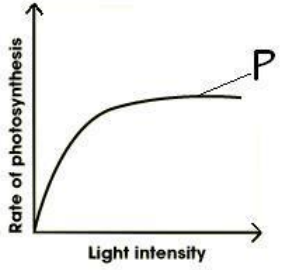
$$6CO_2 + 6H_2O \xrightarrow[\text{Chlorophyll}]{\text{Light}} C_6H_{12}O_6 + 6O_2$$

Plant must have chlorophyll in order to photosynthesise, as this is the substance which converts light energy into chemical energy. Chlorophyll traps light energy and converts it into chemical energy for the formation of carbohydrates and their subsequent storage. Therefore, it goes without saying, light is a necessity as well. Plants also need carbon dioxide and water, to convert into oxygen and glucose. All these should be plentiful, otherwise the plant's photosynthesis will slow down. Plants take in carbon dioxide from air through their stomata (on the leaves) using diffusion and they absorb water through their root hair cells using osmosis.

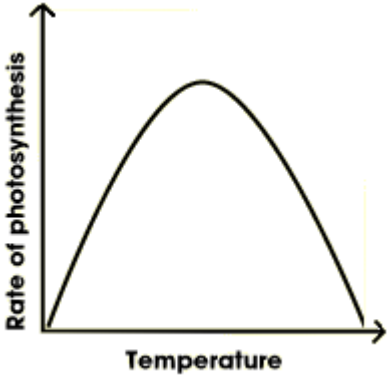
Define the term *limiting factor* as something present in the environment in such short supply that it restricts life processes
The three possible limiting factors of photosynthesis are carbon dioxide, temperature, and light intensity. When the carbon dioxide concentration is too low, the rate of reaction is low. The same happens with temperature and light intensity.



At point P, a factor other than light/CO2 conc. is now limiting the rate of photosynthesis.



If it gets too cold, the plant stops performing photosynthesis, the same, however, happens if it gets too hot.



In glasshouse systems, the air inside is enriched with carbon dioxide, and there is optimum light and temperature, so that the photosynthesis of plants is at its maximum rate.

Chloroplasts are distributed throughout the leaf to allow the absorption of sunlight and, in turn, the the process of photosynthesis to occur. They are concentrated the most at palisade cells, so that all the available sunlight is absorbed.
Stomata are the “holes” through which the gas diffusion occurs, allowing CO2 to enter. The oxygen produced in the mesophyll cells from photosynthesis is easily diffused outwards and out because of the large surface area (due to air spaces), this large surface area also allows the mesophyll cells to easily absorb CO2. These air spaces allow the gases to circulate. This is called gas exchange.
Vascular bundles (xylem and phloem): xylem supports the leaf and transports water and minerals, and phloem moves the produced foods to other parts of the plant.

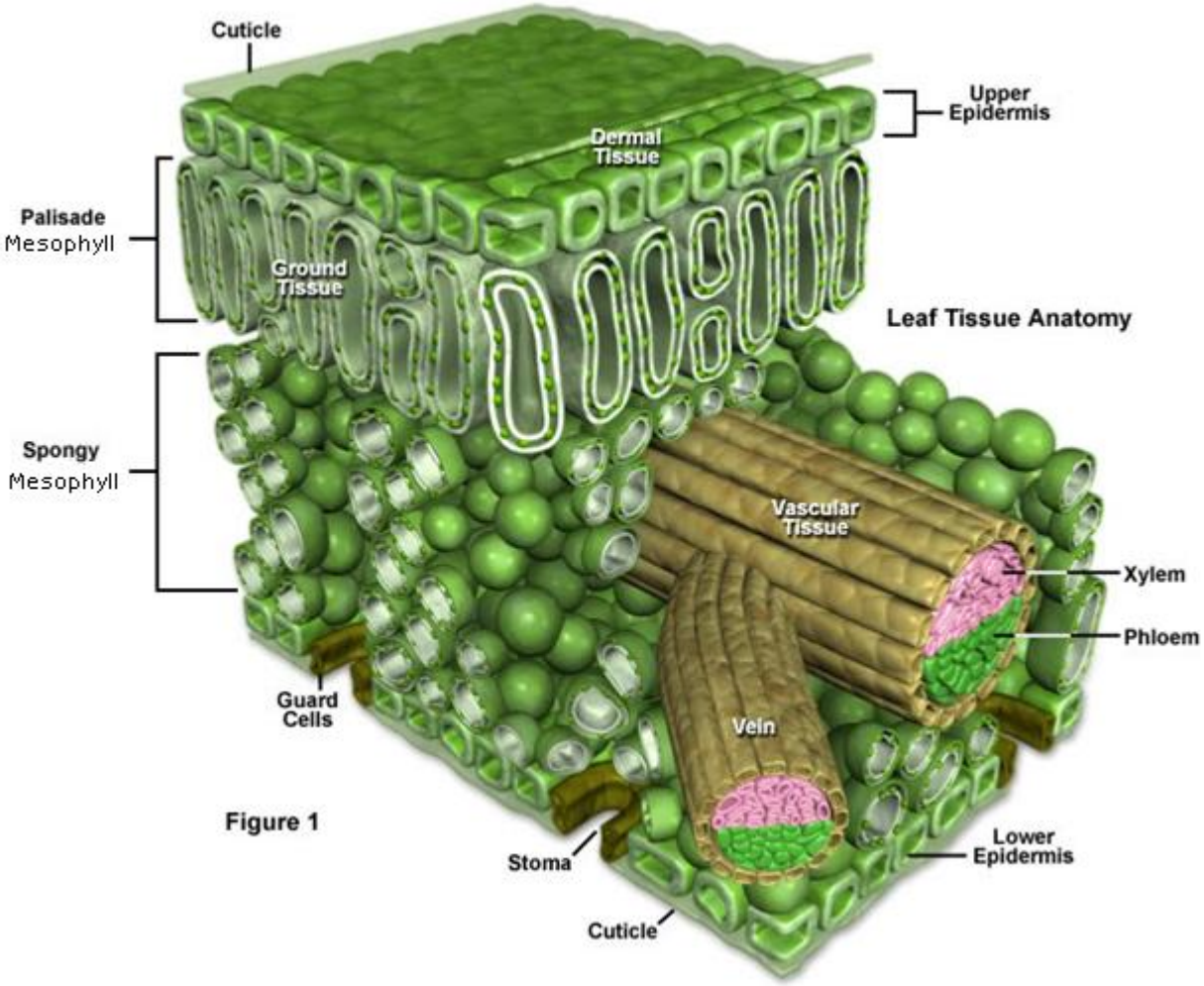
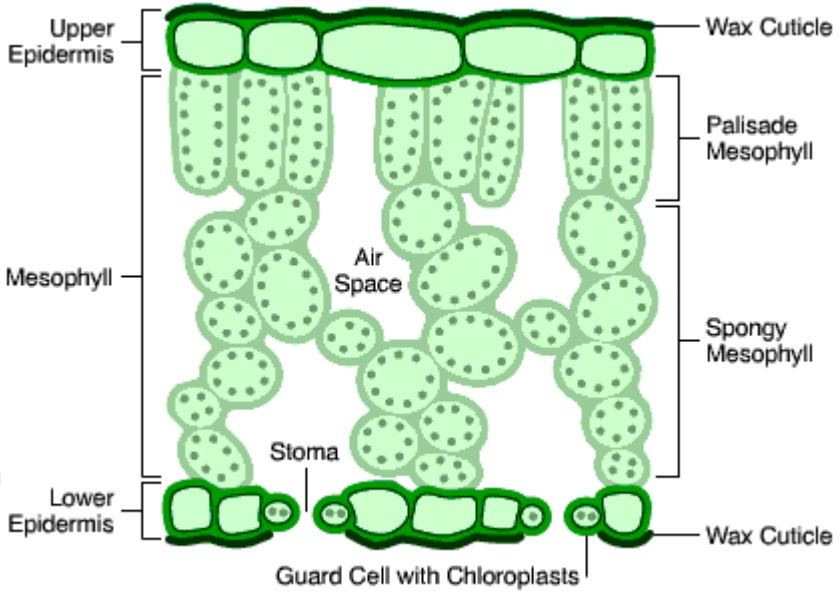


Figure 1



All notes written and produced by Ibrahim Hashme, hell yeah, I’ll be cheap about it to make sure y’all don’t take credit ;)

The importance of:
• Nitrate ions: for protein synthesis (making proteins)
• Magnesium ions: for chlorophyll synthesis (making chlorophyll)

The effects of nitrate ion deficiency: The plant has poor growth and yellowed leaves
The effects of magnesium ion deficiency: Plant leaves become yellow

The uses of nitrogen fertilizers

Since nitrogen fertilizers provide nitrogen ions, it allows plants to form more proteins, and therefore promotes the growth of plants and fruits.

The dangers of overuse of nitrogen fertilizers

Excess nitrogen can be dangerous to agriculture. Water may pass from the plants to the soil resulting in the wilting of the plant. In case of heavy rainfall, the fertilizer may be washed away in rivers and which may result in the rapid growth of water plants, thus decreasing the amount of oxygen in the water and causing an increase in the amount of bacteria as the plant and other creatures die. In short it also causes water pollution.

Define the term *balanced diet* as the daily intake of food containing the right amount of each nutrient to meet the body's requirements, which depends on age, sex, activity of an individual, and climate.
Malnutrition is not eating too little; it is eating the wrong amounts of some nutrients, too much or too little. (an unbalanced diet)

The effects of malnutrition in relation to:

Starvation: a massive lack of nutrition in all forms/not enough nutrition to survive, leads to famine.
Coronary heart disease: eating too many fats in the forms of fatty acids and cholesterol, may lead to heart attack.
Constipation: if there is a lack of fibre in the diet, the speed of food along the intestines slows down, causing the over-absorption of water, making the food drier than usual, leading to an uncomfortable egestion.
Obesity: too many fats and carbohydrates in the diet leads to their storage as fat, causing obesity.

Modern technology has resulted in increased food production because of:

1. Modern agricultural machinery, like tractors instead of the old plows. This increases the production rate of a farm.
2. Chemical fertilizers, this makes fruits and plants grow larger faster.
3. Herbicides, this kills off weeds which may compete with crops, and decrease production
4. Pesticides, this keeps pests (bugs/bacteria/fungi) which may harm plants away, by killing them.
5. Artificial selection, this is when farmers only allow the best of cattle/crops to breed with each other, making crops/cattle better/bigger over time.

The problems of world food supplies

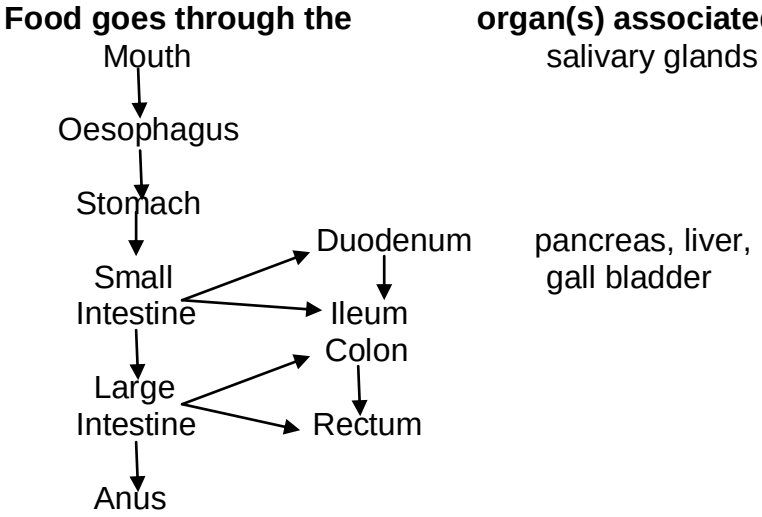
The supply of food is falling, while demand is rising. This causes a rise in prices and less affordability, causing famines.

The problems which contribute to famine

1. Increasing population, less food to feed more people.
2. Unequal distribution of food, some areas get more food than others.
3. Drought, there is no water for cattle/crops.
4. Floods, this kills off many crops and destroys property, reducing affordability.

Define *ingestion* as taking substances (e.g. food, drink) into the body through the mouth
Define *egestion* as passing out of food that has not been digested, as faeces, through the anus

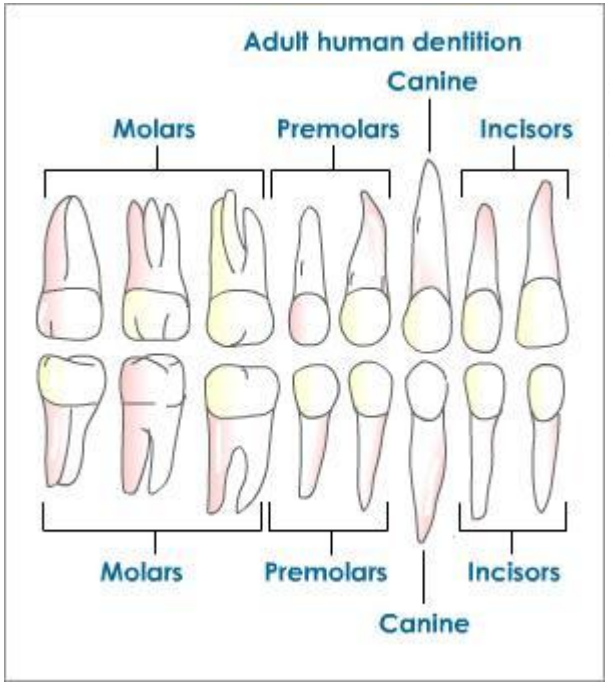
The alimentary canal:

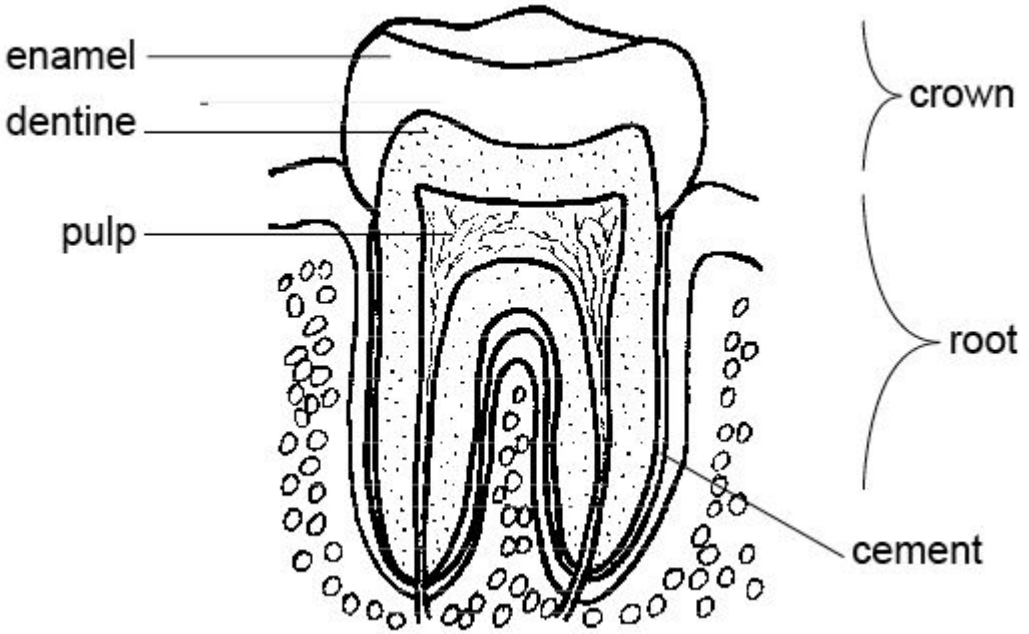


Roles of parts of alimentary canal:

Mouth: the food is ingested through here, and starch is broken down because saliva contains the enzyme amylase (chemical digestion). It also increases food surface area through mechanical digestion so it is easier to absorb food later on.
Oesophagus: transports food from the mouth to the stomach.
Stomach: digests food chemically and mechanically.
Small intestine: final chemical digestion takes place here, and nutrients from the food are absorbed here as well and transported throughout the body in the bloodstream.
Large intestine: water and vitamins from food is absorbed in the large intestine, and then the remaining food is egested through the anus as faeces

Define *digestion* as the break-down of large, insoluble food molecules into small, watersoluble molecules using mechanical and chemical processes.





Molars: broader and larger than pre-molars, used for crushing and grinding
Pre-molars: broad, for grinding and crushing
Canines: pointed to pierce and hold food, also tears food
Incisors: have sharp edges to bite and cut food

Causes of dental decay:

When certain bacteria feed on food left between/on teeth, they produce acids, which dissolve the enamel, and keep dissolving, as they get closer to the pulp, the tooth keeps getting more irritable. The bacteria feed mainly on sugars.

Proper care of teeth:

Brush teeth to remove any remaining food, with fluoride toothpaste. Also, drink fluoridated water and partake in less sugar. Food should contain enough calcium, phosphorous, and vitamin D which are necessary for the formation of enamel. Your food should also contain Vitamin C, as this keeps the cement of the tooth healthy.

How fluoride helps prevent tooth decay:

1. By speeding up the “fixing” process. The presence of fluoride attracts other minerals to a cavity, and these minerals reform the tooth
2. By making the tooth more resistant to decay, this is because the reformed part of a tooth is composed of more resistant material
3. By disrupting a bacteria’s ability to digest sugar. The less sugar digested, the less acid produced, meaning less cavities.

Arguments for and against the addition of fluoride to public water supplies

FOR:

1. It helps teeth resist decay
2. It helps in healing by formation of new enamel
3. It is very cheap
4. It is an easy solution to helping people resist decay

AGAINST:

1. It can mottle teeth in concentrations higher than 2ppm
2. People have no choice in the matter
3. There may be negative long term effects of fluoride

CHEWING:

The chewing muscles contract and relax to move the lower jaw up and down, this makes the food between teeth to be cut and crushed. The tongue helps by moving food between teeth.

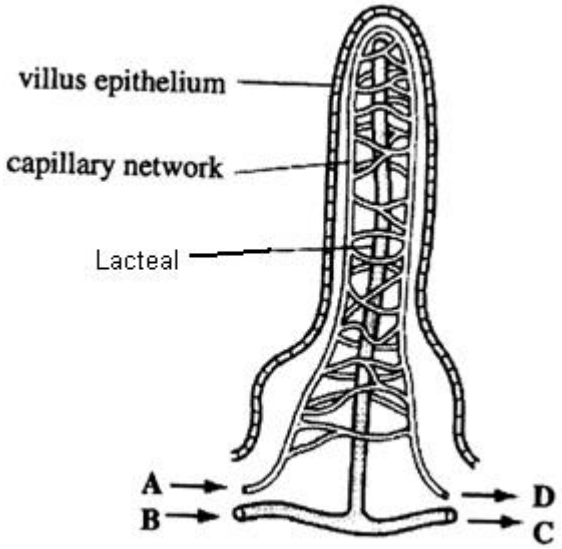
Peristalsis: this is the toothpaste tube-like motion of the alimentary canal to move food along. the process is: above the food the circular muscles contract while the longitudinal ones relax, and the opposite takes place around the piece of food. This moves the food along.

Bile emulsifies fats, meaning it make large fat droplets smaller, therefore increasing its surface area so enzymes can work faster.

Chemical Digestion: is important because it breaks down insoluble molecules to produce smaller, soluble ones which can be absorbed.

Enzyme	Substrate	End-products	Where it is secreted
Amylase	Starch	Maltose	Salivary glands (in saliva) and Pancreas
Lipase	Fats	Fatty Acids and Glycerol	Pancreas and Intestine
Protease	Protein	Amino Acids	Stomach, Pancreas and Intestine

Absorption: Define *absorption* as movement of digested food molecules through the wall of the intestine into the blood or lymph.



The small intestine is the region for the absorption of digested food. The small intestine's inside is covered in villi, which is extremely important, as it greatly increases the small intestine's surface area, allowing for a much higher rate of absorption. The lacteal is a lymph vessel (part of the lymphatic system) and the epithelium is the villus's epithelial tissue.

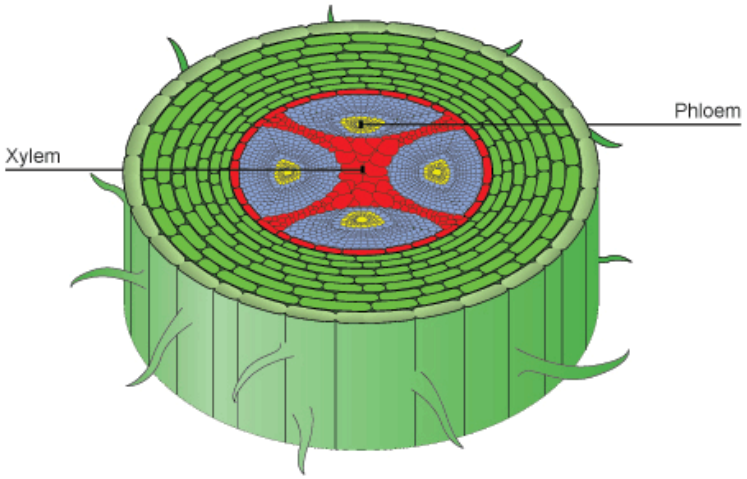
The vein at D joins up with other veins at other villi and forms the hepatic portal vein, which transports absorbed food to the liver, which is dissolved in the blood it contains. The small intestine absorbs water from food along with the first section of the large intestine (the colon). The small intestine absorbs 5-10dm^3 per day while the colon absorbs 0.3-0.5dm^3 per day.

Assimilation: Define *assimilation* as movement of digested food molecules into the cells of the body where they are used, becoming part of the cells
After food is transported to the liver it stores any excess glucose in the form of glycogen. The liver also converts amino acids to proteins and breaks any excesses of them. The fats that where absorbed are used as an energy storing substance.
Define *deamination* as removal of the nitrogen containing part of amino acids to form urea, followed by release of energy from the remainder of the amino acids
The liver is the site of breakdown of alcohol and other toxins.

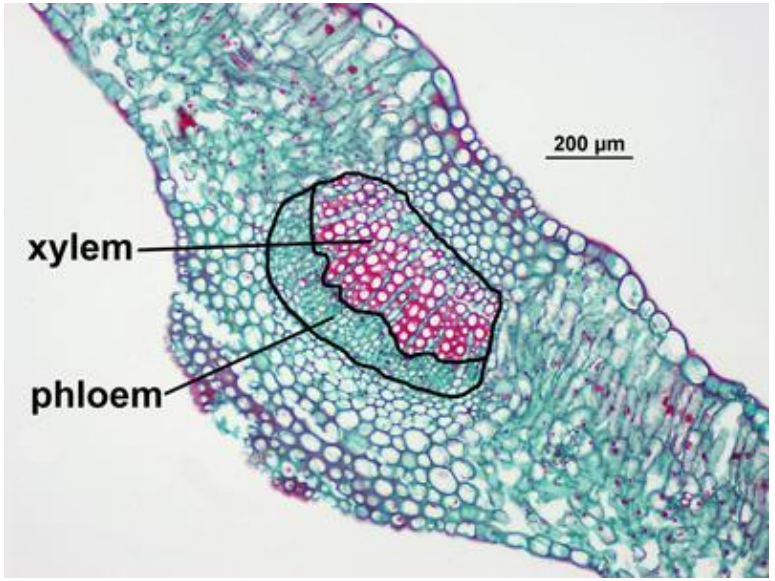
Transportation

The functions of:
Xylem: carries water and minerals throughout the plant and provides mechanical support to the plant.
Phloem: carries sugars and other nutrients from the leaves to cells for consumption or storage.
POSITIONS:

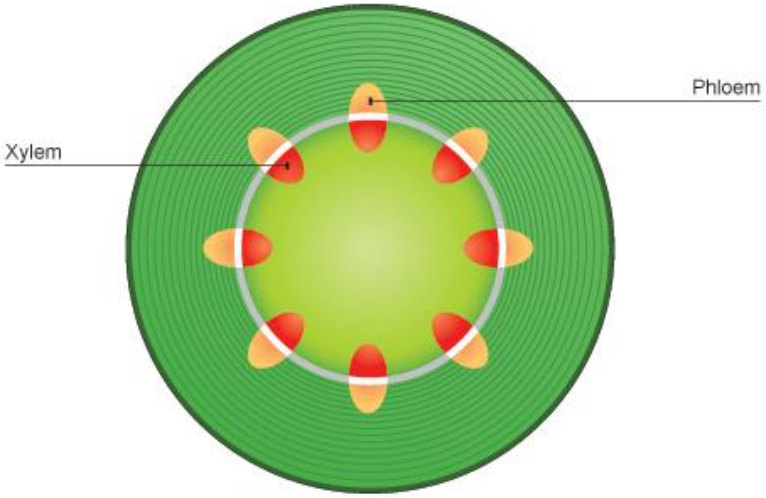
Root



Leaf



Stem



Root hair cells:

They are present in roots to absorb water and mineral ions, and, due to the “hair” they have a large surface area, allowing for faster absorption. Also, they help the roots to stick in the soil. Water is absorbed by a root hair, and then moves to the root cortex cells, then to the xylem, which then takes it to the mesophyll cells in the leaves.
(The water is taken straight up the stem to the leaves, where it travels through the stalk, then the midrib, then the veins. It then diffuses towards the mesophyll cells.)

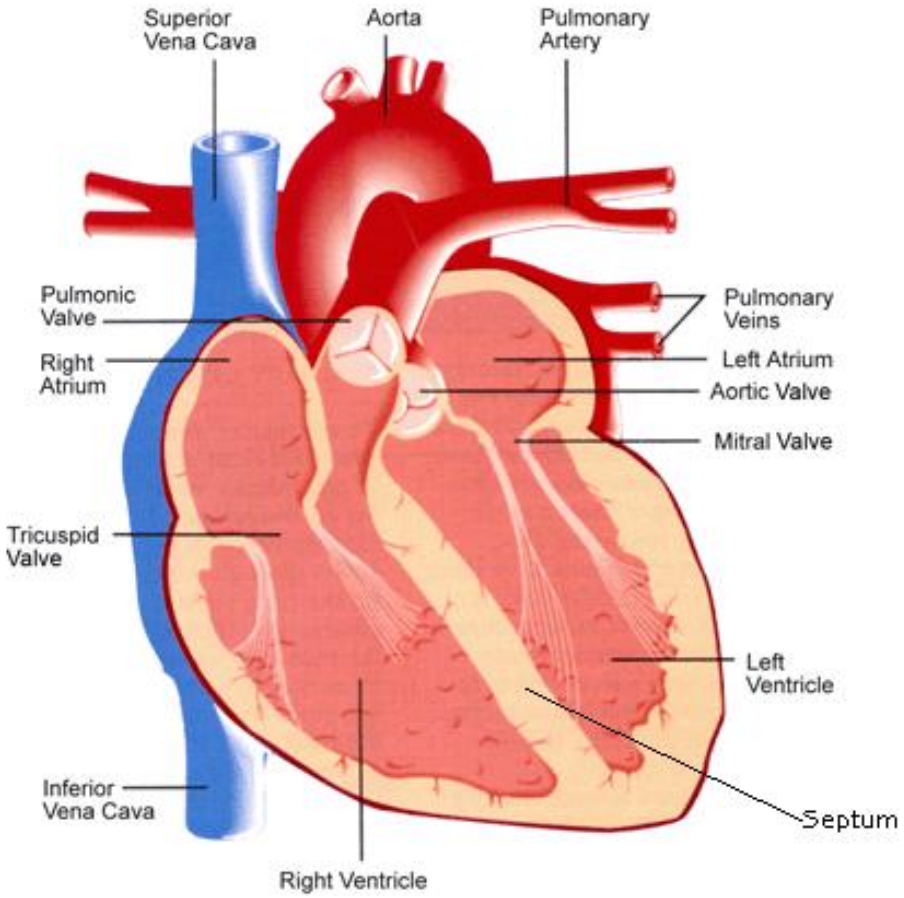
Tanspiration: Define *transpiration* as evaporation of water at the surfaces of the mesophyll cells followed by loss of water vapour from plant leaves, through the stomata
The water vapour, when lost, is lost through the surfaces of cells, and then it is present in the air between the leaf cells (the air spaces) and it then diffuses outwards through stomata. Therefore the water is lost. When the temperature is increased, the rate of transpiration also increases, because the water evaporates faster due to the increased kinetic energy it contains. The transpiration rate of a plant decreases if the air surrounding it is more humid, because diffusion is slower, there is a high water potential outside. An increase in light intensity would increase the transpiration rate because the stomata open more to obtain carbon dioxide from the air for photosynthesis.

Wilting: wilting occurs when the cells in a plant lose water to the extent that the cells in its leaves become flaccid. The main cause of wilting is when a plant has a higher rate of transpiration than water uptake.
Water uptake: is the process where transpiration produces a tension, or pull, from above, creating a water potential gradient in the xylem, and drawing water molecules up the plant.

Adapted to:	Desert	Pond	Garden
Leaf	Reduced to spines, less surface area means less water lost.	Little or no cuticle, there is no need to conserve water. Shaped like ribbons so as to not get pulled off by water currents. Contain air spaces to keep plant afloat and to allow for quicker gaseous exchange. Contain lots of chloroplasts because light intensity is usually low. No stomata.	Usually broad, flat.
Stem	Swollen, containing water-storage tissue. Photosynthesis occurs here. Stomata present here. Surface is shiny to reflect heat and light. Thick waxy cuticle to reduce water loss.	Little or no cuticle, there is no need to conserve water. Elastic so as not to get cut off by water currents, contain air spaces to float.	Normal
Root	Shallow, wide spread, to quickly collect water from rainfall or overnight condensation.	Very weak, or absent, because there is no need to absorb water/mineral ions. No root hairs present.	Normal

Translocation: Define *translocation* in terms of the movement of sucrose and amino acids in phloem;
• from regions of production
• to regions of storage OR to regions of utilisation in respiration or growth
Systematic pesticides are pesticides which the plants absorb, and then it gets transported throughout the plant in the phloem.

Transport in humans



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

Describe the double circulation in terms of a low pressure circulation to the lungs and a high pressure circulation to the body tissues

Blood flows to the lungs at a lower pressure because in the other circuit, the blood needs to be transported over longer distances, and through thinner vessels.

Starting in the right atrium, the blood flows through the tricuspid valve to the right ventricle. Here, it is pumped out of the pulmonary semilunar valve and travels through the pulmonary artery to the lungs. From there, blood flows back through the pulmonary vein to the left atrium. It then travels through the mitral valve to the left ventricle, from where it is pumped through the aortic semilunar valve to the aorta and to the rest of the body. The (relatively) deoxygenated blood finally returns to the heart through the inferior vena cava and superior vena cava, and enters the right atrium where the process began.

Valves ensure that the blood won't flow backwards. Though not visible here, there are also coronary arteries that encircle the heart (branched off the aorta) and supply it with the required food and oxygen.

Physical activity increases heart rate, because muscles need more energy to carry out respiration, and this means the blood has to supply them with more oxygen and food as well as take more waste products away.

Coronary heart disease occurs when some of the heart muscle is starved and dies due to the blockage of the coronary artery supplying that part. Its causes include the eating of too many fats, as they precipitate on the inner walls of the arteries. This results in blockage. Smoking helps this precipitation, and stress speeds it up because of an increase in blood pressure. Alcohol also causes this disease. It can be prevented by eating a healthy diet, exercising, quitting smoking, maintaining a healthy body weight, and laughing every once in a while to reduce stress.

Names of main blood vessels

To the lungs from the heart - pulmonary artery
from the lungs to the heart - pulmonary vein
to the liver - hepatic artery, from the liver hepatic vein another blood vessel goes to the liver from the intestines - it is the hepatic portal vein
to the kidney - renal artery, from the kidney - renal vein
Two main veins go to the heart - the vena cava and the pulmonary vein
Two main arteries come from the heart - aorta and pulmonary artery

Arteries

Blood in the arteries is under high pressure generated by the heart. The arteries have:

- thick outer walls
- thick layers of muscle and elastic fibres (because of high pressure)
- narrow lumens

They (normally) carry oxygen-rich blood to cells

Veins

The blood in veins is under lower pressure than the blood in arteries. The veins have:

- thin walls
- thin layers of muscle and elastic fibres
- relatively wide lumens
- valves to avoid backward flow

They (normally) carry oxygen-poor blood to cells

Capillaries

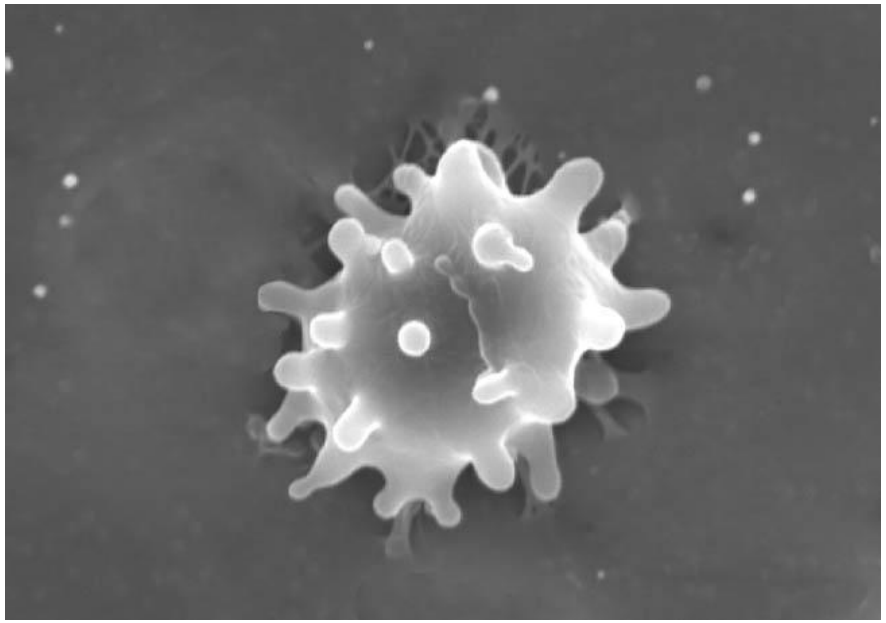
Capillaries have:

- very thin, one cell thick walls
- pores to allow white blood cells to squeeze through
- very narrow lumens, red blood cells travel single-file

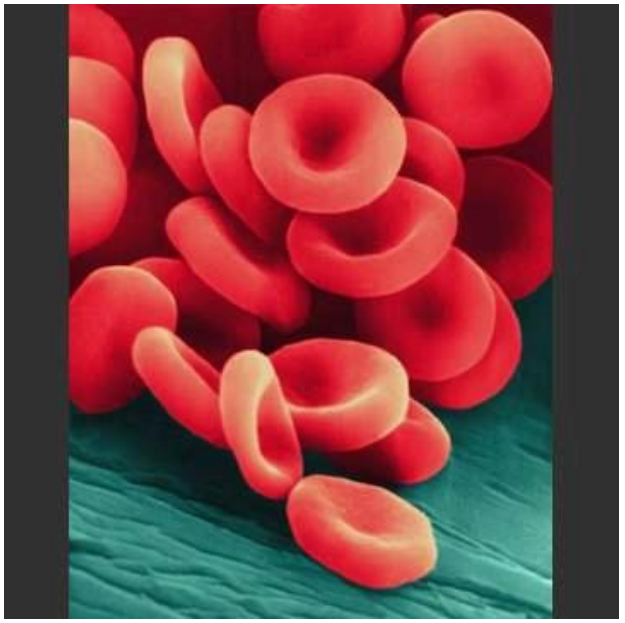
They supply the body's cells with oxygen-rich blood (reason for thin walls)

Capillaries release tissue fluid to bathe body cells; it contains food, hormones, minerals, antibodies, and water. It then takes the waste products.

White blood cell



Red blood cells



Components of blood: red blood cells, white blood cells, platelets and plasma

The functions of blood:
• Red blood cells – haemoglobin and oxygen transport
• White blood cells – phagocytosis (process in which phagocytes engulf and digest microorganisms and cellular debris; an important defense against infection) and antibody formation
• Platelets – causing clotting
• Plasma – transport of blood cells, ions, soluble nutrients, hormones, carbon dioxide, urea and plasma proteins

The immune system is the system responsible for body protection. It causes:

1. Phagocytosis: vasodilation takes place in the infected area, meaning more blood passes out of the vessels, and the white blood cells in the blood engulf and digest microbes.
2. Antibody production: the white blood cells enlarge and, increasing in number, and then beginning to produce antibodies, which remain fixed on their surface. They then migrate to the site of infection and release these antibodies to attack germs.
3. Tissue rejection: when an organ or something similar is transplanted into the body, it may reject it because the antigens it produces are recognized as foreign chemicals to the white blood cells in the body.

The lymphatic system is responsible for the circulation of body fluids, including tissue fluid and fatty acids + glycerol, throughout the body (it makes them enter the blood after collecting them). It is also responsible for developing lymphocytes, a type of white blood cell. The other type is phagocytes. Lymphocytes are responsible for antibody production and phagocytes for phagocytosis.

Blood clotting: fibrinogen is plasma protein present in the blood (synthesized in liver). When a blood vessel is cut the prothrombin comes in contact with collagen (in wall of blood vessel). This causes the conversion of prothrombin to thrombin. Thrombin is then in turn responsible for conversion of **fibrinogen** to **fibrin**. The fibrin molecules can then attach to one another to form big long strands which form the clots - blocking holes etc.

Respiration

Define *respiration* as the chemical reactions that break down nutrient molecules in living cells to release energy

The uses of energy in the body of humans:

1. muscle contraction
2. protein synthesis
3. cell division
4. active transport
5. growth
6. the passage of nerve impulses
7. the maintenance of a constant body temperature

Define *aerobic respiration* as the release of a relatively large amount of energy in cells by the breakdown of food substances in the presence of oxygen

Glucose + oxygen $\longrightarrow$ carbon dioxide + water $\quad C_6H_{12}O_6 + 6O_2 \longrightarrow 6CO_2 + 6H_2O$

Define *anaerobic respiration* as the release of a relatively small amount of energy by the breakdown of food substances in the absence of oxygen

In muscles during hard exercise:

glucose ⟶ lactic acid $C_6H_{12}O_6 \longrightarrow 2C_3H_6O_3$

in microorganism, yeast:

Glucose ⟶ alcohol + carbon dioxide $C_6H_{12}O_6 \longrightarrow 2C_2H_5OH + 2CO_2$

The anaerobic respiration of yeast is used to make carbon dioxide bubbles in dough, then, when baked, the carbon dioxide expands and the ethanol evaporates. Baking also kills the added yeast.

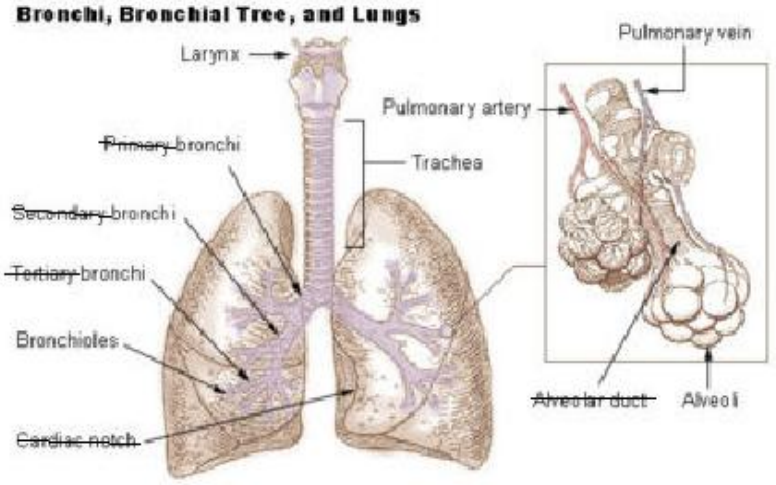
The anaerobic respiration of yeast is also used in brewing, where the alcohol produced makes the drink alcoholic, and the carbon dioxide produced makes it fizzy.

Aerobic respiration releases 36 ATP, which is much more than the 2 ATP released by anaerobic respiration.

During exercise, a lot of food and oxygen is needed to respire and produce energy for the contraction of muscles. Therefore, the rate and depth of breathing increases to obtain the necessary oxygen and get rid of the produced carbon dioxide. The heart also beats faster to supply the muscles with enough food and oxygen, contained in the blood. Ata a certain limit, the heart and lungs cannot supply materials any faster but the muscles still need more energy. This is why anaerobic respiration is carried out, which produces lactic acid, which gets deposited in the muscles, causing fatigue. After the exercise is over, you continue breathing hard because extra oxygen is needed to oxidize the lactic acid (ie to recover the oxygen debt)

The features of gas exchange surfaces in animals

1. large surface area
2. very thin
3. elastic
4. moist
5. supplied with a dense network of capillaries



Inspired air: 20-21% oxygen, 0.03-0.04% carbon dioxide, less water vapour

Expired air: 16% oxygen, 4% carbon dioxide, more water vapour

Lime water can be used as a test for carbon dioxide, when atmospheric air is pumped into it, little or no white precipitate is formed, however, when expired air is pumped into it, the limewater turns milky due to the white precipitate formed.

Breathing in: first, the external intercostal muscles contract, causing the internal ones to relax, which raises the rib cage upward and outward. The diaphragm also contracts and stretches tto a more flattened shape. The volume in the rib cage thus increases. This causes the pressure in the lungs to decrease, and therefore the air outside, which has a higher pressure, rushes into the lungs.
Breathing out: first, the internal intercostal muscles contract, causing the external ones to relax, which moves the rib cage downward and inward. The diaphragm relaxes and changes to a more dome-like shape. The volume in the rib cage thus decreases. This causes the pressure in the lungs to increase, and therefore the air inside, which has a higher pressure, rushes out into the atmosphere.
The trachea is lined with ciliated cells, whose cilia move mucus, which is secreted by goblet cells, along the windpipe. This mucus is sticky, and any pathogens and particles in inspired air should get trapped in it. The mucus is then moved to the stomach by the cilia's motion and digested.
Physical activity increases the rate and depth of breathing. This is because it increases the rate of respiration, and this means a higher carbon dioxide concentration in the circulating blood. This lowers the pH, and the brain ddetects this and orders the lungs to breath deeper and faster.

EXCRETION

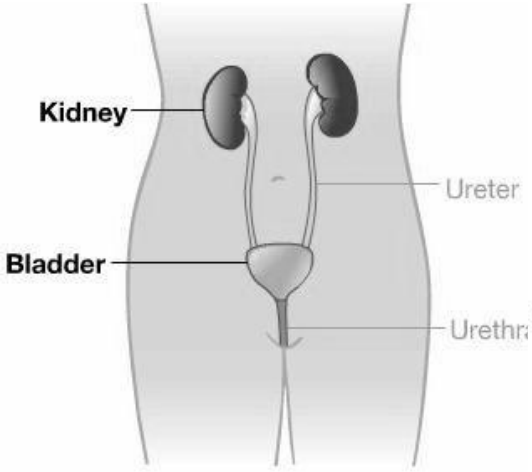
Define *excretion* as the removal from organisms of toxic materials, the waste products of metabolism (chemical reactions in cells including respiration) and substances in excess of requirements. Substances should include carbon dioxide, urea and salts.
The kidney functions to:

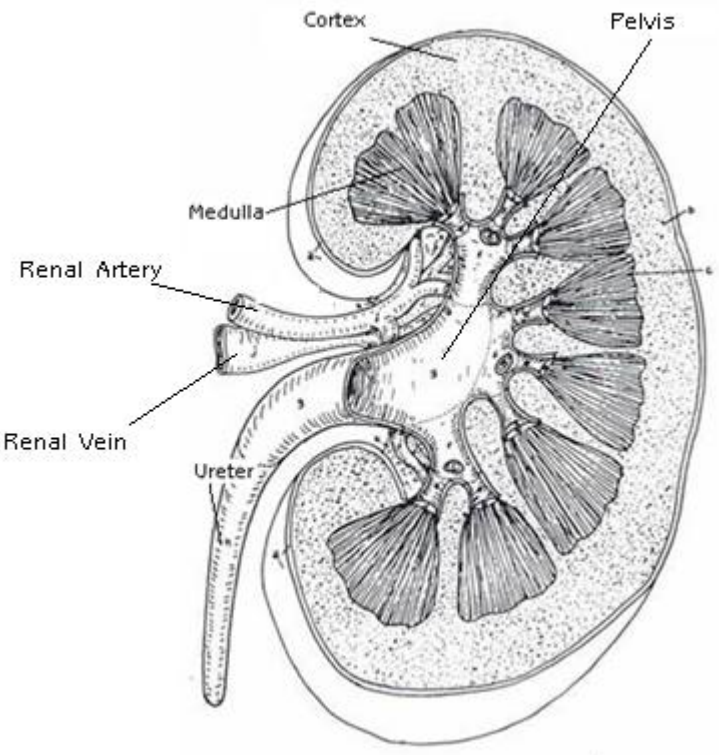
1. remove urea and excess water
2. reabsorb glucose and some salts

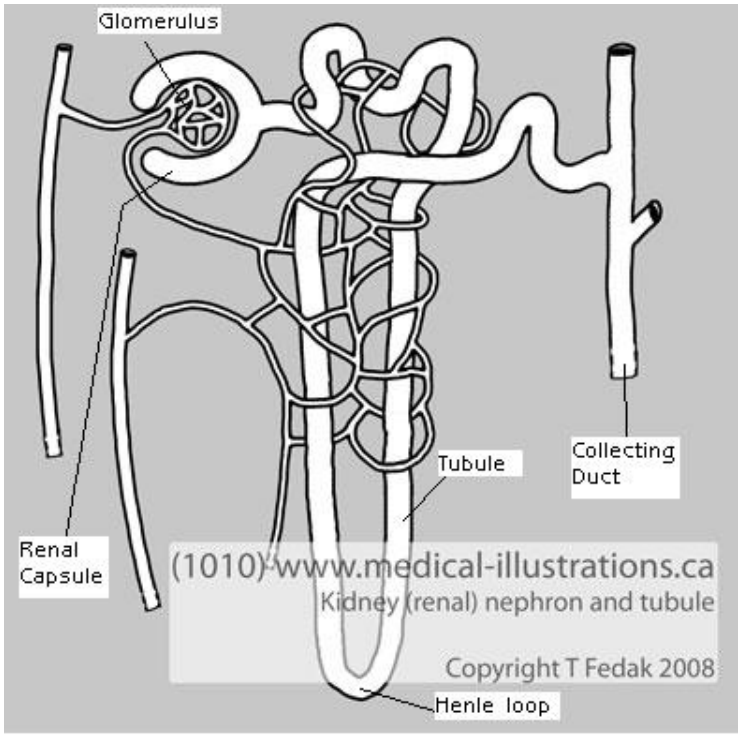
The liver changes excess amino acids into urea, which is then excreted as urine. Alcohol, drugs and hormones are also broken down in the liver.
In nephrons, the renal capsule does "ultra filtration", meaning it absorbs almost all the blood's contents, other than blood cells, proteins, and other large molecules.
Then, the tubule does "selective reabsrobtion" by reabsorbing glucose, most of the water and some salts back into the blood, leading to concentration of urea in the urine as well as loss of excess water and salts.

Dialysis is the separation of small molecules from large molecules in a solution by a semi-permeable membrane. Therefore it can be used to purify blood by keeping the glucose and protein concentration in blood maintained whilst diffusing the urea into the dialysis fluid. In a kidney machine, dialysis is used to clean blood, using dialysis fluid and a partially permeable tube through which the blood passes.

Dialysis	Transplant
There is a need for frequent treatment	Only need to visit physicians more frequently than usual
No surgery needed	Discomfort of surgery
No risk of tissue rejection (reliable)	Risk of tissue rejection
No such thing	Lifelong medications, which suppress immune system, making them prone to infections.
The clotting of blood may “mess up”	No such thing
Danger of steep drop in blood pressure	No such thing
Proven to live shorter than transplant patients	Proven to live longer than dialysis patients







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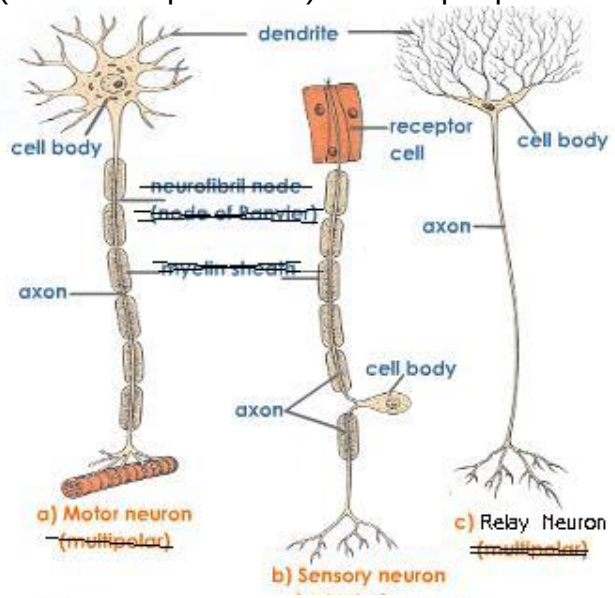
THE NERVOUS SYSTEM

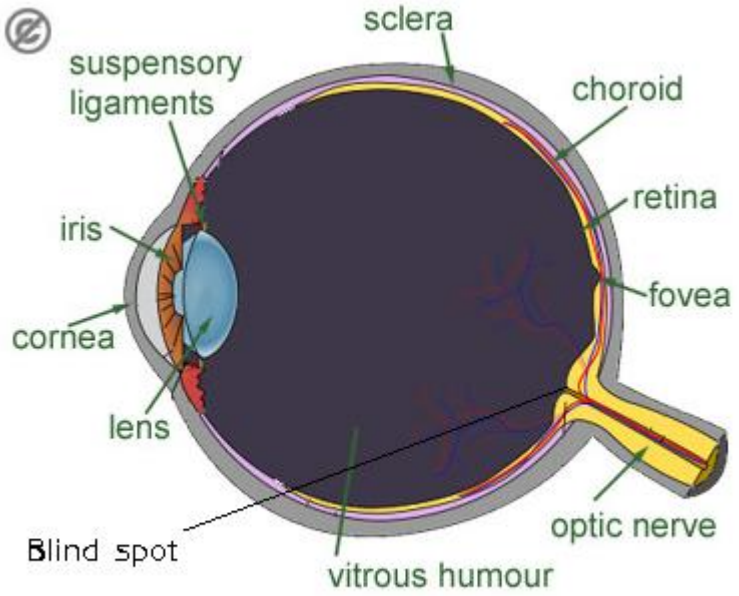
Describe the *nervous system* as a system consisting of the central nervous system (brain and spinal cord) and the peripheral nervous system, which together serve to regulate and coordinate body functions.

The reflex arc: sensory neuron to relay neuron to motor neuron to effectors
Reflex action: a means of automatically and rapidly integrating and coordinating stimuli with responses. Voluntary and involuntary actions are those done either on purpose or subconsciously.
Muscles and glands generally act as effectors.
Antagonistic muscle pairs are pairs of muscle like at the elbow, the biceps and triceps. As one contracts, the other relaxes. This causes movement.

Define *sense organs* as groups of receptor cells responding to specific stimuli: light, sound, touch, temperature and chemicals.



The eye: the pupil is the hole in the middle of the iris, through which the light goes. The retina is the light sensitive part of the eye which is covered in rods and cones. Rods are sensitive in dim light but only sense black and white, while rods sense colours but are not as effective in dim light. The pupil reflex is when the pupil changes size due to light intensity, allowing different amounts of light to enter the eye. In bright light the radial muscles relax and the circular ones contract, making the pupil smaller to allow less light in, while in dim light it gets larger (opposite muscle movement) to allow more light in.
Cones are most highly concentrated at the fovea, whereas their concentration elsewhere is low. Rods keep increasing in concentration as you get closer to the fovea, but as they get very close to the fovea their concentration falls, and is very low at the fovea itself.
There are no rods or cones present at the blind spot.
The lens also changes thickness if the eye is being focused on an object which is further away or closer. When the eye is being focused on a closer object, the ligaments slacken, making the lens thicker, and the pupil gets smaller. The opposite happens to focus on an object that is further away.



All notes written and produced by Ibrahim Hashme, hell yeah, I'll be cheap about it to make sure y'all

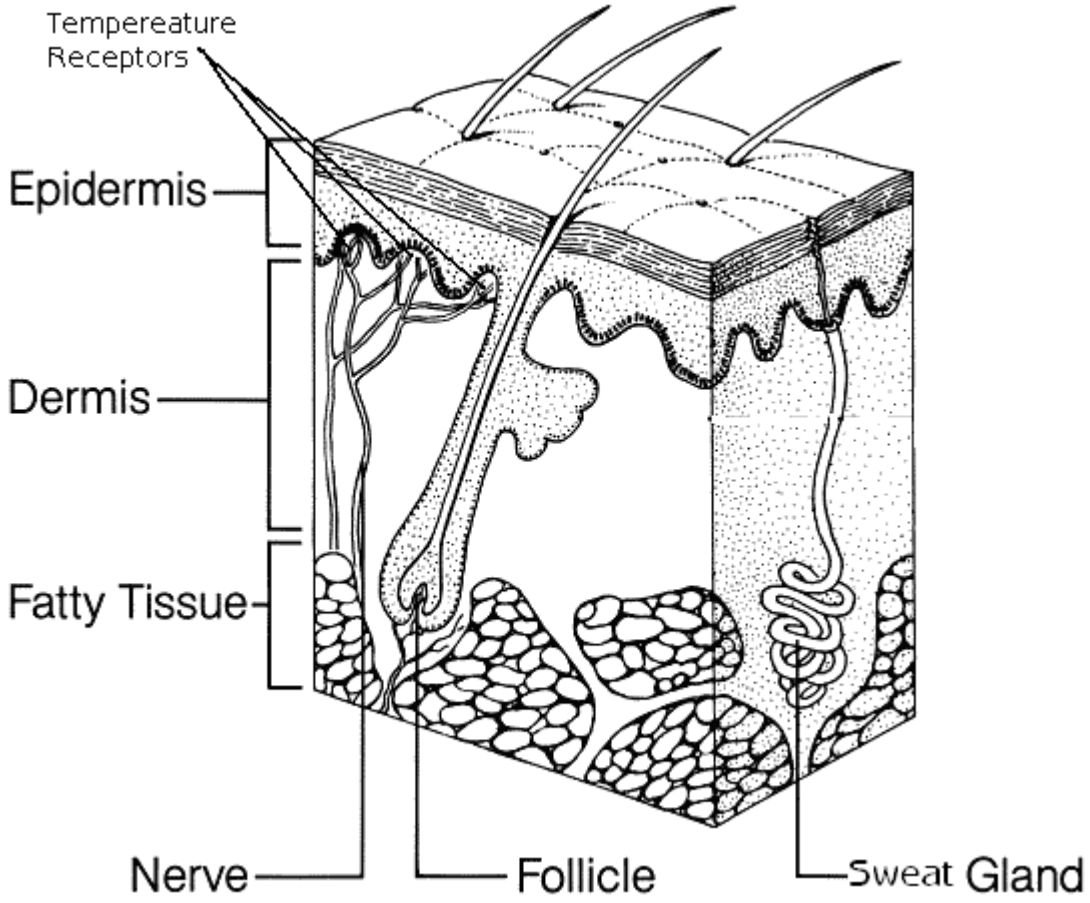
HORMONES

Define a *hormone* as a chemical substance, produced by a gland, carried by the blood, which alters the activity of one or more specific target organs and is then destroyed by the liver.
Adrenaline chemically controls metabolic activity, including an increase in blood glucose concentration and pulse rate. Adrenaline secretion increases in situations where the organism feels danger, a challenge, or fear, or something similar. Eg. Fights

Nervous control	Hormonal control
Involves electric impulses	Involves chemical substances
Impulses transmitted by neurons	Chemicals transported by blood
Quick response	Relatively slower response
May be voluntary or involuntary	Always involuntary
Sent to target organ	Dispersed throughout the body
Short term effect	Long term effect

The uses of hormones in food production:
Some hormones increase the rate of growth of cattle along with giving them a larger body mass, resulting in less feed and more meat. Hormones can also increase the yield of milk for a dairy manufacturer.

Define *geotropism* as a response in which a plant grows towards or away from gravity and *phototropism* as a response in which a plant grows towards or away from the direction from which light is coming.
Auxins are growth hormones in a plant. When they are distributed unequally, some parts of the plant grow faster than others, causing it to bend/change direction.
In positive phototropism auxins accumulate where the shoot is darkest, causing the dark side to grow rapidly, making the plant bend towards the light.
In negative phototropism the auxins also accumulate at the darker side, but this time they restrain growth there, making the shoot grow away from light.
In negative geotropism, auxins accumulate at the lower side of the shoot, therefore the lower side grows faster and then the shoot bends away from gravity.
In positive geotropism, auxins accumulate on the lower side of the root, but it restrains growth there, causing it to bemd toward gravity.
Synthetic plant hormones can be used to kill weeds, which have broad leaves. If another plant is nearby that is wanted has broad leaves, it will die too.
Define *homeostasis* as the maintenance of a constant internal environment.



Please note that blood vessels (capillaries) are also present and they co-mingle with the sweat glands.

The human body needs to retain its heat. Therefore there are methods to lose heat or to reduce the loss of heat.
When it gets too hot:

1. Sweating takes place, which has a cooling effect due to evaporation.
2. Vasodilation takes place, the blood vessels near the skin dilate, allowing more heat from the blood to be lost through the skin.

When it gets too cold:

1. Shivering takes place, and the muscles that shiver require energy to move, and the respiration for that energy produces heat (exothermic).
2. Vasoconstriction takes place, the blood vessels near the skin constrict, allowing less heat from the blood to be lost through the skin.

Temperature is sensed by the temperature sensors, which send signals to the brain to act.

Negative feedback is a mechanism where an organism does the opposite of a change to bring the organism's conditions back to normal.
Blood glucose level is controlled by two hormones secreted by the pancreas, insulin and glucagon.

Insulin:

1. Stimulates cells to use glucose
2. Stimulates muscle and liver cells to store glucose in the form of glycogen
3. Slows down the conversion of proteins to carbohydrates and stimulates the conversion of carbohydrates to fats
4. Suppresses glucagon

Glucagon:

1. stimulates the liver and muscle cells to release stored glycogen
2. suppresses insulin
3. stimulates the conversion of fats and proteins to carbohydrates

Define a *drug* as any substance taken into the body that modifies or affects chemical reactions in the body.
Antibiotics work by stopping a metabolic practice performed by the bacteria you are trying to get rid of, but not performed by human cells. Antibiotics don't work on viruses because they are not really living and they make the host cell perform the tasks for them. Therefore antibiotics are used to treat bacterial infection, by stopping their ability to respire or reproduce or something similar.
Heroin can be abused, having effects like:

1. Addiction, reduced tolerance
2. Severe withdrawal symptoms (vomiting, restlessness, muscle/bone pain)
3. Respiratory depression, can lead to death
4. Not eating well, losing weight
5. People may share needles to inject heroin, causing the transfer of diseases transmitted through blood, like HIV/AIDS/hepatitis etc.
6. Addicts may turn to crime to earn the money for it

The effects of excessive consumption of alcohol:

1. Reduced self control
2. Depression
3. Large doses can cause coma and death
4. Damages liver
5. Makes people more aggressive and violent
6. Reaction times are slowed dramatically, it takes drunk people time to respond to their surroundings, leading to car accidents, etc.

Smoking affects the respiratory system by burning the cilia in your trachea, causing mucus to stop moving. It also causes the production of more mucus. This results in coughing and the damage of the bronchiole lining and alveoli, making smokers more prone to disease and giving them less efficient gas exchange systems (lower surface area). The carbon monoxide in smoke makes the smoker breathless, as less oxygen is getting into his blood, because the blood carries carbon monoxide instead.
Components of tobacco smoke:

1. tar
2. nicotine
3. carbon monoxide
4. smoke particles

REPRODUCTION

Define *asexual reproduction* as the process resulting in the production of genetically identical offspring from one parent.

Advantages	Disadvantages
Often rapid, no need to find a partner	Harmful if disease causing organisms use this, as it is rapid
Produces identical strains, therefore it is useful if parent is good strain	No variety in offspring, therefore a change in the environment may kill them due to lack of adaptation
	Harmful genes in parents will be given to offspring
	Overcrowding may cause competition for food

Bacteria:

1. the nuclear material replicates
2. the nuclear material then becomes constricted in the middle and divides into two
3. the cytoplasm also becomes constricted
4. a cell wall forms in the middle, separating the replication and the original
5. the new cells then divide

Fungi

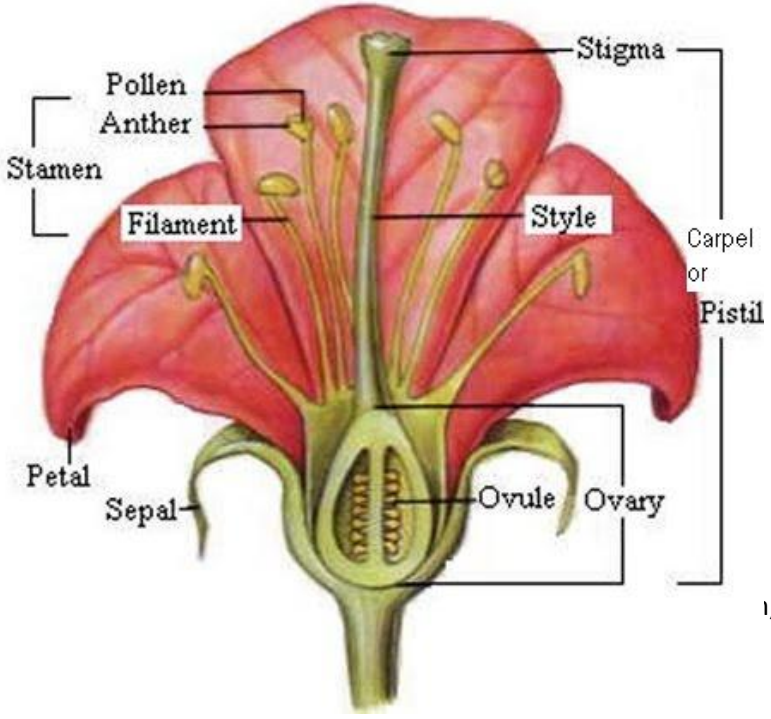
1. under favorable conditions the tip becomes filled with cytoplasm, nuclei, and nutritive substances
2. the tip swells up, forming a sporangium
3. the sporangium forms a large number of cells called spores
4. when the sporangium becomes mature, it ruptures, releasing the spores into the air (usually carried by wind)
5. if the spores land on a suitable medium, the germinate and produce new hyphae that grow to form a new fungus
6. if they do not fall on a suitable medium, they remain dormant until the conditions become suitable

Potatoes (tuber formation):

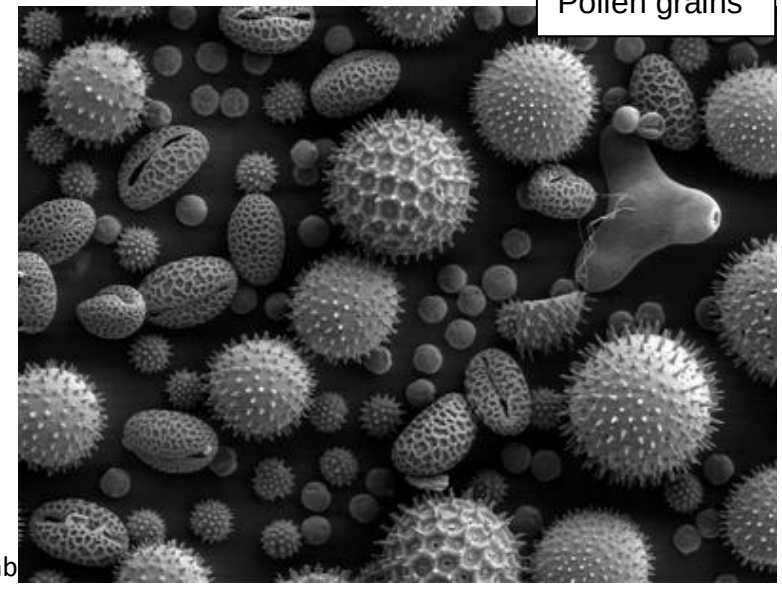
1. the potato has grooves called eyes
2. in favorable conditions the grow to form a shoot and root using the food stored in the potato tuber
3. the roots grow downwards and the shoots form leaves
4. underground side stems grow from the base of the main stem
5. food is stored in these underground stems forming tubers
6. the leaves and stems of the old tuber die, and the new tuber remains dormant, waiting for suitable conditions

Define *sexual reproduction* as the process involving the fusion of haploid nuclei to form a diploid zygote and the production of genetically dissimilar offspring.

Advantages	Disadvantages
Produces variety, therefore adaptations are more likely	Excellent individuals cannot give identical offspring
Allows for evolution	It is a very slow process and leads to the production of a few offspring
Harmful genes in the parent won't always be passed on	
Slower, meaning less overcrowding happens	



Pollen grains



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Functions of:
Sepals: protect the flower while it is closed
Petals: attract insects with scent; some have guide lines to guide insects to nectary gland. Used to allow for insects to land, while surrounding and protecting the reproductive organs of the flower
Anther: produces pollen grains (male gamete)
Stigma: receives pollen grains, and produces nutritive materials for the germination of the pollen
Ovary: produces ovules (which contain female gametes)

Define *pollination* as the transfer of pollen grains from the male part of the plant (anther of stamen) to the female part of the plant (stigma)

Self pollinated flowers	Cross pollinated flowers
They all carry sex organs from both sexes	Some are unisexual, others are bisexual
Male and female organs mature at the same time	They mature at different times
Stamens are longer than carpels	Stamens are shorter than carpels
Male and female organs ripen before the flower opens	They ripen after the flower opens
No such thing	The stigma secretes chemicals that kill any pollen grains of the same flower

Implications of self pollination and cross pollination:

Self pollination	Cross pollination
Less variation, meaning less probability of adaptation to a change in environment. This also means that a good strain will probably produce more good strains.	More variation, meaning more probability of adaptation to a change in the environment. This also means that a good strain most probably will worsen over generations.

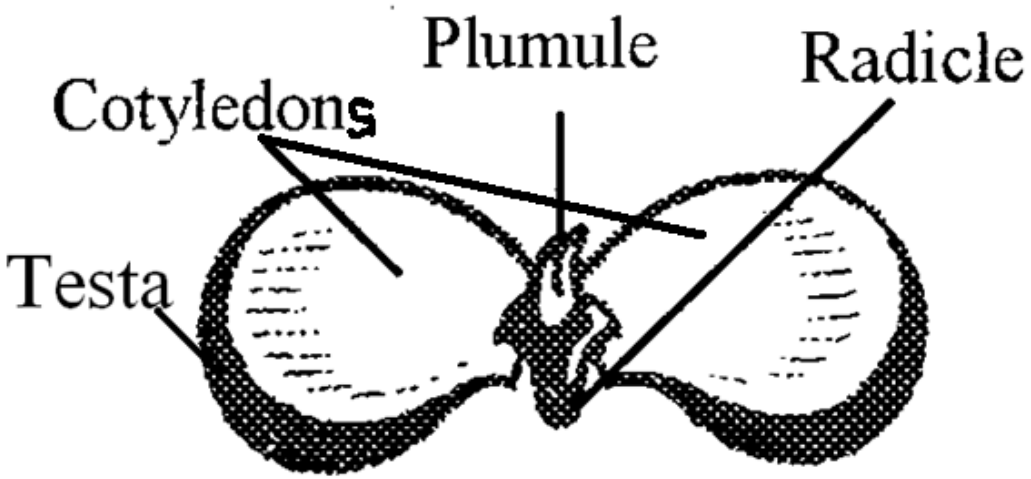
Agents of pollination:
1. wind
2. insects
3. animals
4. water
5. humans

Structural adaptations of wind/insect pollinated flowers:

Insect pollinated	Wind pollinated
Usually large	Usually small
Flowers blossom in warmer times	Flowers blossom in colder times
Scented to attract insects	Not scented
Have nectary glands to secrete nectar	No nectar
Reproductive organs enclosed in flower	Reproductive organs stick out of flower
Stigma is not feathery	Feathery stigma
Pollen grains are: 1. sticky to stick on insects 2. smaller in number 3. larger than wind carried ones	Pollen grains are: 1. small, light, and dry 2. larger in number, as most are lost

Steps of fertilization:

1. pollen grain falls on stigma, and stigma produces a sticky, nutritious substance
2. the pollen grain absorbs the fluid, and makes a pollen tube, and the nucleus of the pollen goes down the tube
3. pollen tube grows toward the ovule until it reaches the micropyle



4. the tip of the pollen tube then ruptures, and the nucleus of the pollen fuses with the egg nucleus, producing a zygote (fertilization)

Seed Structure:

The plumule, radical, and cotyledons form the embryo.

1. Testa: non-permeable, softens and ruptures during germination (soaked in water)
2. Cotyledon: stores food
3. Radicle: grows into root
4. Plumule: grows into shoot

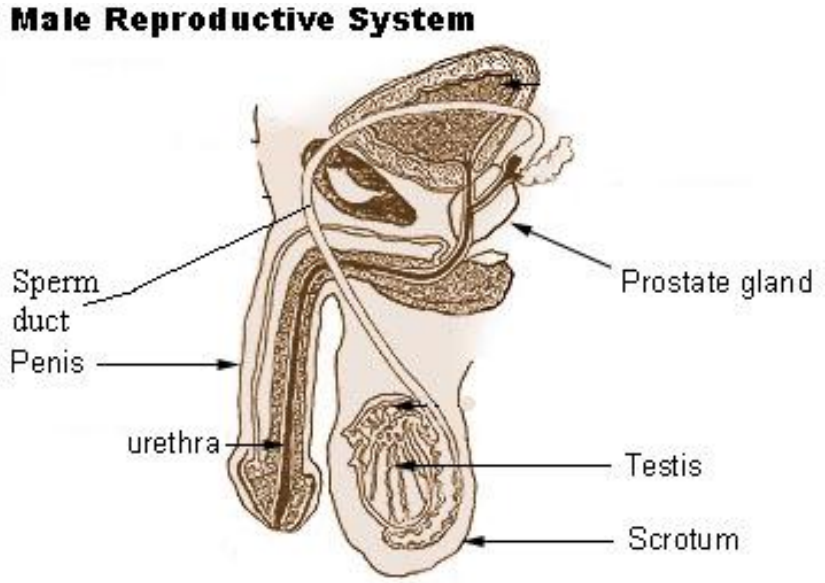
This is then covered in the fruit for protection.

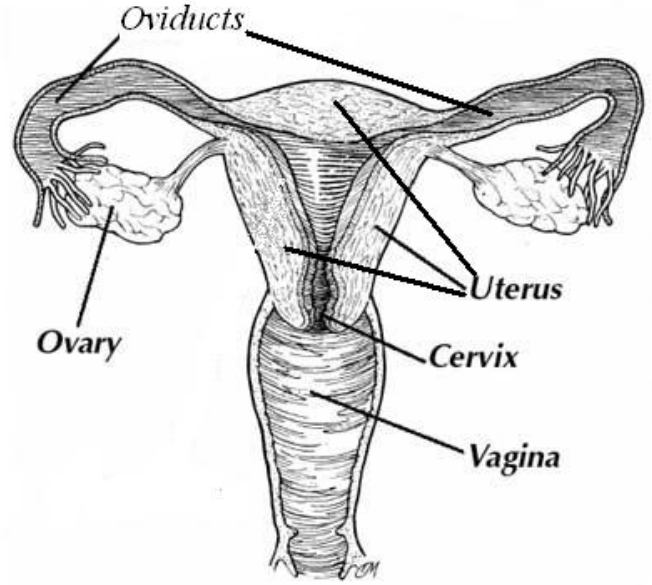
After fertilization:

1. The sepals, petals, stamen, stigma and style dry up and fall
2. The ovule develops into a seed
3. The ovary wall enlarges and becomes the fruit

After fertilization has occurred, the zygote divides many times by mitosis and forms an embryo, which is like a miniature plant. This embryo has a radicle, plumule, and two special leaves called cotyledons. The cotyledons then constantly receive food via phloem from the parent. They eventually grow so large that they enclose the rest of the embryo. The outer wall of the cotyledons then become harder and thicker, to form the testa.
Seed and fruit dispersal by wind and by animals provides a means of colonising new areas.
Seed/fruit dispersal by animals: some plants, like the burdock, have hooks to cling to the fur of animals or the feathers of birds, to be carried from one place to another. Other plants, like the strawberry, have idegestible so that the animal that eats it will remove it in his stool in another area, where it can germinate.
Seed/fruit dispersal by wind: some plants, like the sycamore, have small fruits with wing-like structures)elongation of ovary wall) to allow it to be carried by wind across large distances. Other plants, like the poppy, have the remains of their stigmas still on them, to enable them to glide, while scattering seeds through pores. Other plants, like the dandelion, have hair that provides a large enough surface area to glide in air.

In Humans: (do NOT get pervy)





A front view of the female reproductive organs.

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Functions:

Female:

1. **Ovaries**: Produce ova and female hormones (oestrogen), every 28 days an ovum is released by one of the ovaries
2. **Oviducts**: the funnel at the front receives the ovum, and it contains cilia to push this ovum into the uterus, fertilization occurs in the oviduct.
3. **Uterus**: This is where the embryo is developed (if fertilization occurs), contracts during birth to push out fetus
4. **Cervix**: secretes mucus to help sperm swim
5. **Vagina**: the organ where copulation takes place, and it is folded to allow expansion during birth. It secretes mucus to allow movement of the male organ during copulation. It secretes acid to kill bacteria and other microorganisms.

Male:

1. **Testis**: Produce sperms, and the male sex hormone (testosterone)
2. **Scrotum**: it is used to hold the testes outside the body, for a lower temperature, because higher temperatures affect sperm production
3. **Sperm duct**: transports sperm from the production site to the urethra, contracts in a process like peristalsis to help in ejaculation
4. **Urethra**: allows the passage of urine and semen, also contacts to help in ejaculation.
5. **Prostate gland**: secretes seminal fluid, which mixes with sperms to make semen, the seminal fluid consists of mucus (to help swimming), sugars (to provide energy for sperms), alkaline materials (to neutralize the acidic conditions of the urethra (due to remains of urine))
6. **Penis**: this is the organ of copulation. It contains erectile tissue, which contains blood cavities, which get filled up due to stimulation, making the penis erect for copulation.

Sperms are mobile, ejaculated in large groups, and much smaller than eggs. Eggs are immobile, released once every 28 days, and much larger than sperms.

Menstrual Cycle:

First, the uterus lining builds up (due to oestrogen), this oestrogen also stimulates FSH production, which prevents further ova being produced. LH is then produced, causing the ova to be popped into the oviduct. It also causes the forming of a “yellow body”. This yellow body secretes progesterone, which thickens the lining of the uterus and maintains it. Two weeks after ovulation, the uterus lining breaks down and menstruation occurs. The cycle is then repeated.

Intercourse: first, the penis becomes erect due to stimulation. This erect penis is then inserted into the vagina, and is moved, getting stimulated, and semen is ejaculated. The sperms then swim using their tails towards the ovum. Many sperms reach the egg, and start producing enzymes to digest its way into the egg. The sperm leaves its tail outside, and has its nucleus fuse with that of the egg. This is called the zygote, which further divides, without increasing in total size, forming a ball of cells which gets implanted in the wall of the uterus.

Fetus formation: after the ball of cells is implanted in the uterus lining, it starts to grow in size as well as multiply. This embryo keeps growing, and, after about 8 weeks, when all its organs are formed, it is called a fetus. As the embryo is developing, the uterus enlarges to accommodate it. The embryo becomes enclosed in the amnion sac (which contains amniotic fluid), which protects it from damage and prevents unequal pressures on the embryo. The embryo and uterus both grow villi, and where these villi are close together is known as the placenta.

The placenta prevents high pressure blood from reaching the fetus, and prevents bacteria (not viruses) from passing through. If the blood groups of the mother and fetus are different, it prevents their mixing and coagulation. It also allows the exchange of gases between the fetus and mother (O_2 from mother's blood goes in; CO_2 from fetus's blood goes out). it also allows nutrition to reach the fetus (glucose and amino acids) and removes waste from the fetal blood, like urea. The umbilical cord connects the placenta and fetus, and the umbilical arteries carry CO_2 to the placenta, and the umbilical veins carry O_2 to the fetus.

Ante-natal care must be taken, including:

1. A healthy diet, with sufficient proteins, carbohydrates, fats and minerals
2. Drugs, smoking and alcohol must be avoided
3. Gentle exercise must be done

Breast milk	Bottle feeding
Free from bacteria	May be contaminated
Creates a bond between the parent and baby	No such bond is created
Suitable temperature	Not perfect temperature
Free of cost	Costs money
Ready at all times	Needs to be prepared
Only mother/foster mother can feed the baby	Anyone can feed the baby

Labor/Birth first, the uterus contracts. The cervix then becomes soft and dilates. The amniotic sac then ruptures. The uterine contractions eventually push the baby's head out, and the rest of the body slides out. The umbilical cord is then tied and cut. The placenta is then expelled by the uterine contractions. Cold air stimulates the baby's lungs, causing the baby to breath.

At puberty, the oestrogen in a female's body starts to cause the secondary sex characteristics. These are the increased growth of the breasts, widening of the hips, growth of hair in the armpits and pubic region, and an increase in the size of the uterus and vagina. Oestrogen is produced in the ovaries.
At puberty, the testosterone in a male's body starts to cause the secondary sex characteristics. These are the enlargement of the testes and penis, deepening of the voice, growth of hair in the pubic region, armpits, chest, and later on, face. Testosterone is produced in the testes.
Once an ovum is released, the follicle which produced it develops into a solid body and secretes progesterone. (the body is known as the corpus luteum ("yellow body")).

During pregnancy, the progesterone is needed in the following ways, (mostly in conjunction with oestrogen):

- Makes the uterus lining develop and secrete fluids after being primed by oestrogen
- Maintains the functions of the placenta and fights off unwanted cells near the womb that could cause damage to the placenta or fetus.
- Keeps the uterus lining in a thickened condition
- Stops the uterus making spontaneous movements
- Stimulates the growth of breast tissue
- Prevents lactation until after the birth (with oestrogen)
- Strengthens the mucus plug covering the cervix to prevent infection.
- Strengthens the pelvic walls in preparation for labour.
- Stops the uterus from contracting (thus keeping the baby where it is)

Methods of birth control:
Natural: 1. Abstinence, not having intercourse at all
2. Rhythm method, avoiding intercourse when the ovum is in the oviduct. You can tell because there will be a slight rise in temperature, and vaginal mucus becomes more viscous.
Chemical: 1. Contraceptive pills, these contain oestrogen and progesterone, which prevent ovulation by the negative feedback effect. It is taken daily for three weeks, and then stopped for a week to allow mensuration.
2. Spermicides, a creamy substance that kills sperm, applied to the vagina before intercourse.
Mechanical: 1. Condoms, sheath of rubber placed on penis during intercourse to prevent sperms reaching the vagina.
2. Diaphragms, a dome shaped piece of rubber placed over the cervix at the top of the vagina before intercourse.
3. Femidom, it is like a condom, put for females, and placed inside the vagina during intercourse.
4. IUD (Intra Uterine Device), prevents implantation as it is put on the uterus lining.
Surgical: 1. Vasectomy, the sperm ducts are cut and tied in a surgical procedure.
2. Female sterilization, the oviducts are cut and tied, this prevent the sperm from reaching the ova.

Artificial insemination: this is when fertilization takes place outside the female's body. First, a ripe ova is taken from the female, and placed in the sperms of the male in certain apparatus. The sperm fertilize to ova, forming a zygote. The zygote(s) are then left to divide to form a young embryo (a ball of cells). This embryo is then implanted into the female's uterus.
Fertility drugs: they contain female hormones which stimulate the production of ova by the ovaries, or, in other cases, the development of the uterus lining. This depends on the hormone contained in the drug.
Social implications of fertility drugs: it implies that parents are interested in having offspring that are genetically related to them. It also tends to cause multiple fertilizations; meaning more than one child is to be born at once.
Gonorrhea:
Symptoms/signs: a burning sensation when urinating. The reproductive organ becomes sore, and discharges a greenish yellow fluid. In anal infection, the anus becomes itchy, sore, and bleeds. The symptoms are not always shown for gonorrhea, and are much more visible in males.
Long term effects: may lead to pelvic inflammatory disease. It may also lead to arthritis. When a woman is pregnant, the virus tends to infect the baby's eyes. It can also lead to blindness, inflammation of the heart, and sterility due to inflammation and blocking of the urethra and sperm ducts.
Treatment: it can be treated when in early stages using antibiotics. To avoid gonorrhea one must use condoms and wash the genitals after intercourse. Also, avoid intercourse with several partners if possible.
HIV (Human Immunodeficiency Virus) is transferred through the movement of white blood cells from one person to another. Therefore it can be transferred by:

1. Intercourse
2. Blood transfusion from an infected person
3. Organ transplant from an infected person
4. Sharing needles with infected people

To avoid/prevent it from spreading one should:

1. Avoid intercourse with many partners, and, if infected, avoid intercourse completely
2. Use a condom
3. Never inject drugs with used needles
4. Never share razors or toothbrushes

The HIV virus attacks certain types of lymphocytes, and this weakens the immune system, causing the infected person to be more vulnerable to disease.

Define *growth* in terms of a permanent increase in size and dry mass by an increase in cell number or cell size or both
Define *development* in terms of increase in complexity, including the specialization of cells
The conditions needed for the germination of seeds are:

1. Water, needed to activate the seed's enzymes. expands the vacuoles of cells so that roots and shoots grow. Transports food from the cotyledons to growing regions.
2. Oxygen, used in aerobic respiration to supply the embryo with required energy.
3. Suitable temperature, around 35-40°C, as this is when enzymes are most active.

Define *inheritance* as the transmission of genetic information from generation to generation
• Define the terms:
• *chromosome* as a thread of DNA, made up of a string of genes
• *gene* as a length of DNA that is the unit of heredity and codes for a specific protein. A gene may be copied and passed on to the next generation
• *allele* as any of two or more alternative forms of a gene
• *haploid nucleus* as a nucleus containing a single set of unpaired chromosomes (e.g. sperm and egg)
• *diploid nucleus* as a nucleus containing two sets of chromosomes (e.g. in body cells)

Determining the gender of a human are the last pair of chromosomes, the sex chromosomes. Since the last pair for females contains the chromosomes X and X, all eggs produced will contain one of the X's. This means that males, with the XY pair, determine the gender of the baby. When meiosis occurs, some sperm have X and some Y. the one that joins up with the egg in the end will decide the gender, if it is a Y, the baby will be male, with XY, and if it is an X, the baby will be female with XX.
Define *mitosis* as nuclear division giving rise to genetically identical cells in which the chromosome number is maintained by the exact duplication of chromosomes
Mitosis is used in growth, the repair of damaged tissues, the replacement of worn out cells and asexual reproduction.
Define *meiosis* as reduction division in which the chromosome number is halved from diploid to haploid.
Gametes are a result of meiosis. Meiosis results in genetic variation, meaning not all cells produced are genetically identical.
Define the terms:
• *genotype* as genetic makeup of an organism in terms of the alleles present (e.g. Tt or GG)
• *phenotype* as the physical or other features of an organism due to both its genotype and its environment (e.g. tall plant or green seed)

• *homozygous* as having two identical alleles of a particular gene (e.g. TT or gg). Two identical homozygous individuals that breed together will be pure-breeding
• *heterozygous* as having two different alleles of a particular gene (e.g. Tt or Gg), not pure-breeding
• *dominant* as an allele that is expressed if it is present (e.g. T or G)
• *recessive* as an allele that is only expressed when there is no dominant allele of the gene present (e.g. t or g)

Monohybrid Crosses:
Suppose there are two genes for tongue rolling, the allele for tongue rolling is R and the allele which stops it is r
Example where the two mating plants have the genes Rr and Rr

	R	**r**
R	RR	Rr
r	Rr	rr

This shows the ratio 3:1, three of the offspring will be able to tongue roll while one won't

Example where the two mating plants have the genes RR and rr

	R	**r**
r	Rr	rr
r	Rr	rr

This shows the ratio 2:2, or 1:1 where half of the offspring can tongue roll

Co-dominance is shown when two dominant alleles are present in the same person. Both of them will affect this individual. It can be shown in blood groups. There are four blood groups, O, A, B, and AB. The ones that are dominant are A and B, while O is recessive. The allele for A is shown by I^A and for B by I^B and so on.
This means someone with blood group A can have the genotype I^OI^A or I^AI^A and to have a blood group of O one must have the genotype I^OI^O. When the two dominant alleles I^A and I^B appear, it forms the group AB, as both traits show. This is co-dominance. It is represented by the genotype I^AI^B.

Continuous variation is influenced by genes and environment, resulting in a range of phenotypes between two extremes, e.g. height in humans.
Discontinuous variation is caused by genes alone and results in a limited number of distinct phenotypes with no intermediates e.g. A, B, AB and O blood groups in humans
Define *mutation* as a change in a gene or chromosome.
Mutation can cause variation, like Down's syndrome does.

Ionizing radiation and some chemicals are known to speed up and increase the rate of mutation.

Sickle cell anaemia is a gene mutation, a disease caused in humans, in which there is a disorder in the sequence of amino acids in the haemoglobin molecule. It results in red blood cells being shaped like sickles. Malaria is caused by a parasite which lives in red blood cells. Therefore, if red blood cells are sickle shaped, the person is immune to malaria. This is why sickle cell anaemia is more common in tropical regions where malaria is common. People with sickle cell anaemia, however, die at a much earlier age.

Artificial selection helps produce varieties of animals and plants with increased economic importance.
Define *natural selection* as the greater chance of passing on of genes by the best adapted organisms.
After organisms vary, they compete with each other, and only the most capable ones reach the age of reproduction, producing more capable offspring who are best fitted to the environment.
Natural selection can be a means for organisms to evolve, because, since only those that are most adapted will live long enough to reproduce, the offspring are always getting better adapted to the environment, and they evolve into more adapted organisms over time, as all negative traits die off.
An example of natural selection could be when bacteria survive an antibiotic. Suppose a new antibiotic is made to kill off the strain of bacteria, Q. most of the bacteria, Q, die off, but there are some that are able to survive, and since these are the only ones left to reproduce, the entire next generation would have developed immunity against the antibiotic.

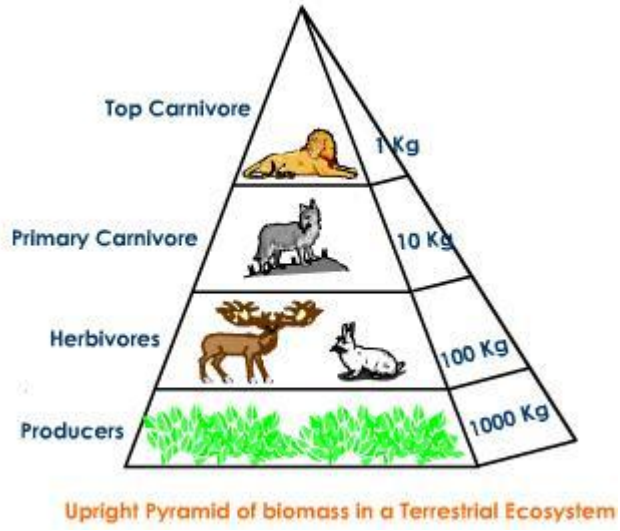
Define *genetic engineering* as taking a gene from one species and putting it into another species.
Genetic engineering was used to put the human insulin genes inside bacteria so that they produce insulin which can be taken, purified, and used to cure diabetes. How: all bacteria have plasmids, circular pieces of DNA, inside them. These are extracted and cut using an enzyme. At the same time, a section of human DNA is cut using an enzyme as well. The plastids then take up this human DNA to complete them, and now contain the insulin gene. This causes them to produce insulin. This bacterium is then cloned.

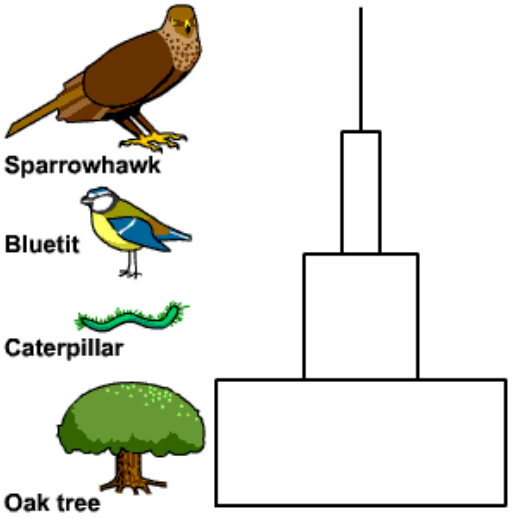
The Sun is the principal source of energy input to biological systems.
Energy flow is non-cyclical, meaning it does not repeat itself, as the energy is consumed and used.

Define the terms:
• *food chain* as a chart showing the flow of energy (food) from one organism to the next beginning with a producer (e.g. mahogany tree → caterpillar → song bird → hawk)
• *food web* as a network of interconnected food chains showing the energy flow through part of an ecosystem
• *producer* as an organism that makes its own organic nutrients, usually using energy from sunlight, through photosynthesis
• *consumer* as an organism that gets its energy by feeding on other organisms
• *herbivore* as an animal that gets its energy by eating plants
• *carnivore* as an animal that gets its energy by eating other animals
• *decomposer* as an organism that gets its energy from dead or waste organic matter
• *ecosystem* as a unit containing all of the organisms and their environment, interacting together, in a given area e.g. decomposing log or a lake
• *trophic level* as the position of an organism in a food chain, food web or pyramid of biomass, numbers or energy

Food chains usually have less than 5 trophic levels because each trophic level consumes some of the energy, leaving less for the next level.
If plants are fed to animals, and the animals are then eaten, it is less efficient than directly eating the plants, because the animal hasn't used up some of the plants energy, allowing plants to feed more people.
Energy is lost between trophic levels, as each level uses up some of this energy for the processes of life.

Biomass pyramid examples:





As you go higher, there is less energy available, and so less organisms higher up on the pyramids. (Lower biomass)

You should be able to interpret, draw, and describe these.

Pyramids of number: represent the number of each type of organism.
Pyramids of biomass: represent the biomass of the type of organism

Carbon Cycle:

1. Carbon is absorbed by plants in the form of CO_2 to form glucose.
2. This glucose is then converted into proteins, fats, and simple carbohydrates (saccharides)
3. The carbon then flows from plants to other organisms in the form of food
4. These organisms break down the food during respiration, producing CO_2, or they die, and, when decomposed, CO_2 is released.
5. Dead organisms also fossilize, and form fossil fuels.
6. These fossil fuels are burnt to produce CO_2.

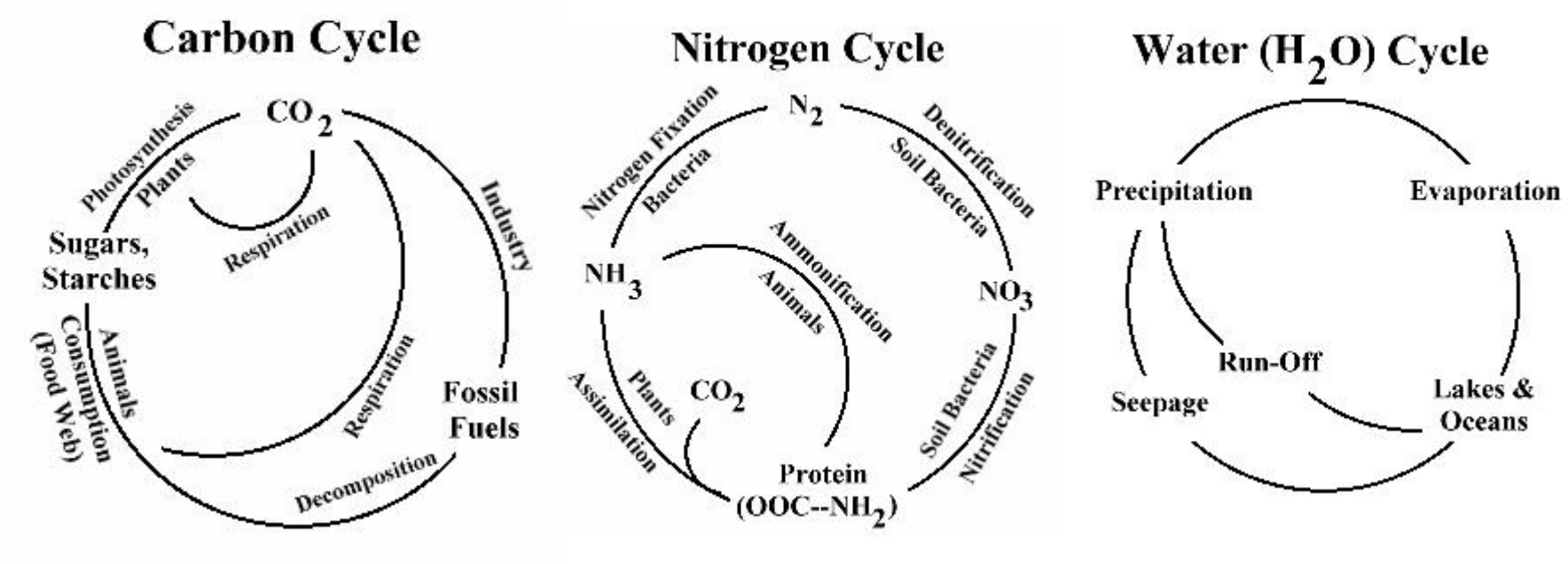
Water Cycle:

1. Some of the water contained in seas, lakes and oceans evaporates.
2. This vapour rises and forms clouds. The particles in these clouds may condense to form rain, or precipitate to form snow.
3. Some water is taken in by plants, and lost by transpiration. All remaining water is lost after death and decay.
4. Some water is taken by humans/animals and returns by respiration, excretion, defecation, and the remainder is returned after death and decay.
5. This water then forms underground water and streams, which are returned to lakes/seas/oceans and the cycle repeats.

Nitrogen Cycle:

1. Microorganisms provide usable nitrogen containing substances by decomposition and nitrogen fixation in roots.
2. Plants absorb these substances and convert them into proteins.
3. The plants are then eaten, and the proteins are passed through the food chain. If not, the plant will die and the protein is returned by death and decay. The organisms which ate other organisms who had nitrogen will also eventually die.
4. Some bacteria can “nitrify”, or convert nitrogen into nitrates, which is then absorbed by plants.
5. Other bacteria can “denitrify”, converting nitrates into nitrogen which is released into the atmosphere.

Diagrams: (only need to be able to describe, diagram not needed)

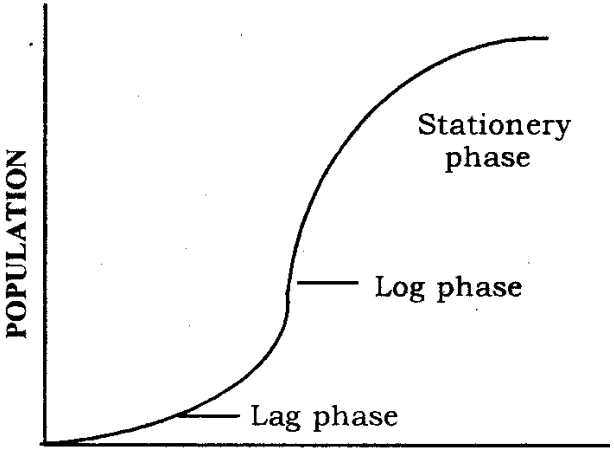


The combustion of fossil fuels increases Carbon Dioxide concentrations in the air, while decreasing the Oxygen concentration. So does the cutting down of forests, because trees use up carbon dioxide for photosynthesis, while releasing oxygen.

Define *population* as a group of organisms of one species, living in the same area at the same time.
Factors affecting rate of population growth:

1. Food supply: the more food there is the more organisms that are able to live.
2. Predation: the presence of predators suppresses the amount of prey
3. Diseases: when they are spread, population decreases due to death

Sigmoid population growth curve:



After the stationary phase there is a phase called the "Death Phase"

1. The lag phase is where the birth rate is slightly higher than the death rate. It is only slightly higher because the organism is adapting to the environment.
2. The log (exponential) phase is when the birth rate is higher than the death rate, and the population increase is high.
3. The stationary phase is when the birth rate and death rate are equal. This is because the death rate is higher, due to the lack of food and pollution by wastes, etc.
4. Death Phase, this is when the organism dies off because the factors above increase to a level where the death rate is more than the birth rate.

The population size of the human race has been increasing recently because there is more medicine, food, and hygienic education, which teaches people to avoid disease.
These decrease the death rate.
The social implications of the current rate of human population increase are:

1. Congestion, everything slows down
2. More unemployment
3. More poverty
4. More scarcity of resources
5. Education is harder to achieve

6. Lower standards of health

You should be able to interpret simple graphs and diagrams of human population growth.

Humans are currently throwing ecosystems out of balance. They do this by cutting down forests for commercial purposes like making paper and using it as fuel. This means many tropical rainforests are being destroyed, and many animals losing their habitats. Also, when humans start forest fires, the same thing happens. In oceans, humans do things like whaling and throw food chains and ecosystems out of balance. Humans dump wastes in rivers, which alters the pH of the water, or alters something else, making living conditions unsuitable for fish, making them all die.

Negative effects of deforestation:

1. Extinction of species of organisms. This is because their shelters and feeding areas are removed.
2. Loss of soil (erosion), because trees decrease the effect of wind and water currents.
3. Flooding, because trees normally make gaps in the soil, allowing water to seep into these gaps. When there are no trees, however, the soil gets compacted, and the water stays on top of it.
4. Carbon Dioxide build up, because trees use this carbon dioxide in photosynthesis.

Negative effects of overusing fertilizers:

1. Eutophication, this occurs in lakes and rivers, where plants and algae increase in population near the water's surface, blocking out light. This blockage of light kills the organisms living inside the water that need it. These deaths feed bacteria, which keep growing in number. The bacteria are constantly using up the water's oxygen, lowering its oxygen content. This kills fish and other aquatic creatures.

Describe the undesirable effects of pollution to include:

• Water pollution by sewage and chemical waste. The sewage consists of human urine and bacteria, which may be contaminated with viruses and bacteria, which could lead to widespread infections and diseases. The chemical waste has several negative effects, depending on the chemical.

• Air pollution by sulfur dioxide. It could cause acid rain. It could dissolve in the mucus of the respiratory system, causing numerous problems, such as asthma, bronchitis and irritation.

• Air pollution by greenhouse gases (carbon dioxide and methane) contributing to global warming.

• Pollution due to pesticides and herbicides. They may pass along the food chain, becoming more and more concentrated as they go along. This causes harm. They may kill both harmful and useful organisms.

• Pollution due to nuclear fall-out. it can damage genes. It affects cell division. It can cause cancer. It increases the amount of mutated sex cells, meaning more deformed babies.

The effects of non-biodegradable plastics in the environment:

1. They pollute the environment because they cannot be degraded and broken down by bacteria
2. They may kill animals and birds who attempt to eat them
3. They release toxic, harmful fumes when burnt

Acid Rain:

Causes: production of SO_2 and the production of nitrogen oxides during lightning strikes and in factories and car exhausts. These dissolve in rainwater making it acidic (either sulphuric acid or nitric acid)

Effects: buildings made of limestone are corroded. Plant growth is reduced, while their leaves are damaged. Makes lakes acidic, harming marine life.

Preventive measures: remove as much sulphur compound as possible from fuels before their combustion. Filter SO_2 out from factory exhausts/chimneys. Fit catalytic converters into exhaust systems of vehicles.

Increases in greenhouse gases, such as carbon dioxide and methane, are thought to cause global warming because they form a layer in the earth's atmosphere which allows the sun's rays to enter, but then keeps most of them in by reflecting them back at earth when they attempt to leave. This increases the world's temperature overall.

The need for conservation of:

• Species and their habitats. If a species goes extinct, anything it used to eat (be it plants or animals) now has one less predator and their numbers will increase. If they increase too much unchecked by their predators they may use too many resources and cause their own starvation. Another animal may start eating them, though -- since now they don't have to compete with the old species anymore.

Also, any animal which was a predator to the now-extinct species has lost a food source. They may have to find something else to eat or starve themselves into extinction, too.

If a habitat is destroyed, the species that live there will die off, causing the above problems.

• Natural resources.

Water: it is economical for families to save water. Also, all living organisms depend on water to live, and with a scarce water supply, they would die off.

Fossil Fuels: because they are non-renewable and are needed in our day to day lives.

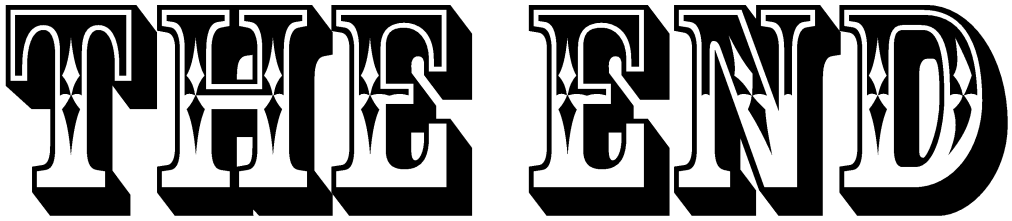
Limited/non-renewable resources can always be recycled!

Paper:

1. The waste paper is collected and washed by water currents to remove dust and ink.
2. It is then placed into containers with hot water and caustic soda, turning it into paste.
3. It may be bleached, if the result should be white.
4. The paste is passed through two hot cylinders, the distance between them determining the paper's thickness.

Sewage treatment:

1. The water is passed through screens to separate large objects.
2. This liquid is then left for a while in settlement tanks, where any insoluble particles drift to the bottom.
3. The water is then passed through filter beds.
4. Microorganisms are then allowed to digest the organic wastes left behind.
5. Chlorine is then added to the water to eliminate any microorganisms that may be harmful.



Needed definitions, mentioned in previous notes, brought together for your convenience:

1. *nutrition* as taking in of nutrients which are organic substances and mineral ions, containing raw materials or energy for growth and tissue repair, absorbing and assimilating them
2. *excretion* as removal from organisms of toxic materials, the waste products of metabolism (chemical reactions in cells including respiration) and substances in excess of requirements
3. *respiration* as the chemical reactions that break down nutrient molecules in living cells to release energy
4. *sensitivity* as the ability to detect or sense changes in the environment (stimuli) and to make responses
5. *reproduction* as the processes that make more of the same kind of organism
6. *growth* as a permanent increase in size and dry mass by an increase in cell number or cell size or both
7. *movement* as an action by an organism or part of an organism causing a change of position or place
8. Define and describe the *binomial system* of naming species as a system in which the scientific name of an organism is made up of two parts showing the genus and species.
9. *tissue* as a group of cells with similar structures, working together to perform a shared function
10. *organ* as a structure made up of a group of tissues, working together to perform specific functions
11. *organ system* as a group of organs with related functions, working together to perform body functions
12. Define *diffusion* as the net movement of molecules from a region of their higher concentration to a region of their lower concentration down a concentration gradient, as a result of their random movement.
13. Define *active transport* as movement of ions in or out of a cell through the cell membrane, from a region of their lower concentration to a region of their higher concentration against a concentration gradient, using energy released during respiration
14. Define *osmosis* as the diffusion of water molecules from a region of higher water potential (dilute solution) to a region of their lower water potential (concentrated solution), through a partially permeable membrane
15. Define the term *catalyst* as a substance that speeds up a chemical reaction and is not changed by the reaction
16. Define *enzymes* as proteins that function as biological catalysts
17. Define *photosynthesis* as the fundamental process by which plants manufacture carbohydrates from raw materials using energy from light
18. Define the term *limiting factor* as something present in the environment in such short supply that it restricts life processes
19. Define the term *balanced diet* as the daily intake of food containing the right amount of each nutrient to meet the body's requirements, which depends on age, sex, activity of an individual, and climate.
20. Define *ingestion* as taking substances (e.g. food, drink) into the body through the mouth
21. Define *egestion* as passing out of food that has not been digested, as faeces, through the anus

22. Define *digestion* as the break-down of large, insoluble food molecules into small, watersoluble molecules using mechanical and chemical processes.
23. Define *absorption* as movement of digested food molecules through the wall of the intestine into the blood or lymph.
24. Define *assimilation* as movement of digested food molecules into the cells of the body where they are used, becoming part of the cells
25. Define *deamination* as removal of the nitrogen containing part of amino acids to form urea, followed by release of energy from the remainder of the amino acids
26. Define *transpiration* as evaporation of water at the surfaces of the mesophyll cells followed by loss of water vapour from plant leaves, through the stomata
27. Define *translocation* in terms of the movement of sucrose and amino acids in phloem from regions of production to regions of storage OR to regions of utilisation in respiration or growth
28. Describe the circulatory system as a system of tubes with a pump and valves to ensure one-way flow of blood
29. Describe the double circulation in terms of a low pressure circulation to the lungs and a high pressure circulation to the body tissues
30. Define *respiration* as the chemical reactions that break down nutrient molecules in living cells to release energy
31. Define *aerobic respiration* as the release of a relatively large amount of energy in cells by the breakdown of food substances in the presence of oxygen
32. Define *anaerobic respiration* as the release of a relatively small amount of energy by the breakdown of food substances in the absence of oxygen
33. Define *excretion* as the removal from organisms of toxic materials, the waste products of metabolism (chemical reactions in cells including respiration) and substances in excess of requirements. Substances should include carbon dioxide, urea and salts.
34. Describe the *nervous system* as a system consisting of the central nervous system (brain and spinal cord) and the peripheral nervous system, which together serve to regulate and coordinate body functions.
35. Define *sense organs* as groups of receptor cells responding to specific stimuli: light, sound, touch, temperature and chemicals.
36. Define a *hormone* as a chemical substance, produced by a gland, carried by the blood, which alters the activity of one or more specific target organs and is then destroyed by the liver.
37. Define *geotropism* as a response in which a plant grows towards or away from gravity and *phototropism* as a response in which a plant grows towards or away from the direction from which light is coming.
38. Define *homeostasis* as the maintenance of a constant internal environment.
39. Define a *drug* as any substance taken into the body that modifies or affects chemical reactions in the body.

40. Define *sexual reproduction* as the process involving the fusion of haploid nuclei to form a diploid zygote and the production of genetically dissimilar offspring.
41. Define *asexual reproduction* as the process resulting in the production of genetically identical offspring from one parent.
42. Define *pollination* as the transfer of pollen grains from the male part of the plant (anther of stamen) to the female part of the plant (stigma)
43. Define *growth* in terms of a permanent increase in size and dry mass by an increase in cell number or cell size or both
44. Define *development* in terms of increase in complexity, including the specialization of cells
45. Define *inheritance* as the transmission of genetic information from generation to generation
46. *chromosome* as a thread of DNA, made up of a string of genes
47. *gene* as a length of DNA that is the unit of heredity and codes for a specific protein. A gene may be copied and passed on to the next generation
48. *allele* as any of two or more alternative forms of a gene
49. *haploid nucleus* as a nucleus containing a single set of unpaired chromosomes (e.g. sperm and egg)
50. *diploid nucleus* as a nucleus containing two sets of chromosomes (e.g. in body cells)
51. Define *mitosis* as nuclear division giving rise to genetically identical cells in which the chromosome number is maintained by the exact duplication of chromosomes
52. Define *meiosis* as reduction division in which the chromosome number is halved from diploid to haploid.
53. *genotype* as genetic makeup of an organism in terms of the alleles present (e.g. Tt or GG)
54. *phenotype* as the physical or other features of an organism due to both its genotype and its environment (e.g. tall plant or green seed)
55. *homozygous* as having two identical alleles of a particular gene (e.g. TT or gg). Two identical homozygous individuals that breed together will be pure-breeding
56. *heterozygous* as having two different alleles of a particular gene (e.g. Tt or Gg), not pure-breeding
57. *dominant* as an allele that is expressed if it is present (e.g. T or G)
58. *recessive* as an allele that is only expressed when there is no dominant allele of the gene present (e.g. t or g)
59. Define *mutation* as a change in a gene or chromosome.
60. Define *natural selection* as the greater chance of passing on of genes by the best adapted organisms.
61. Define *genetic engineering* as taking a gene from one species and putting it into another species.
62. *food chain* as a chart showing the flow of energy (food) from one organism to the next beginning with a producer (e.g. mahogany tree → caterpillar → song bird → hawk)
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71. Define *population* as a group of organisms of one species, living in the same area at the same time.