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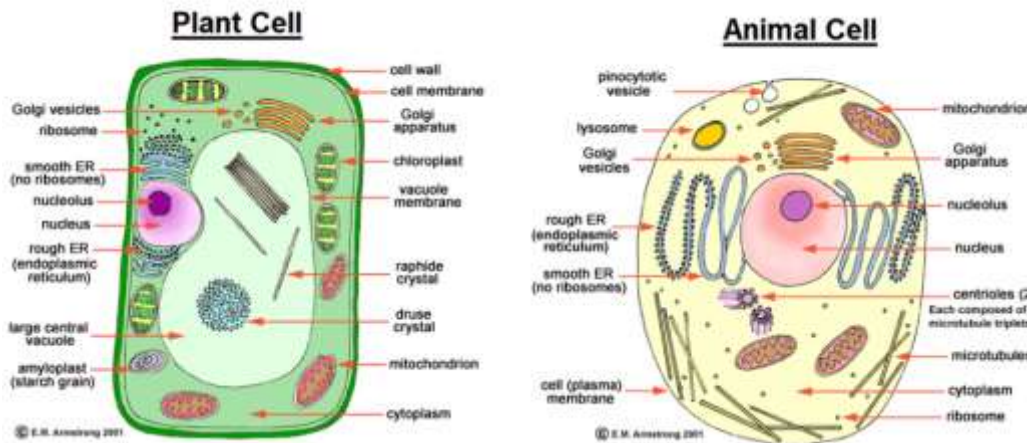
SCORE A+ IN SPM
BIOLOGY



All The Best

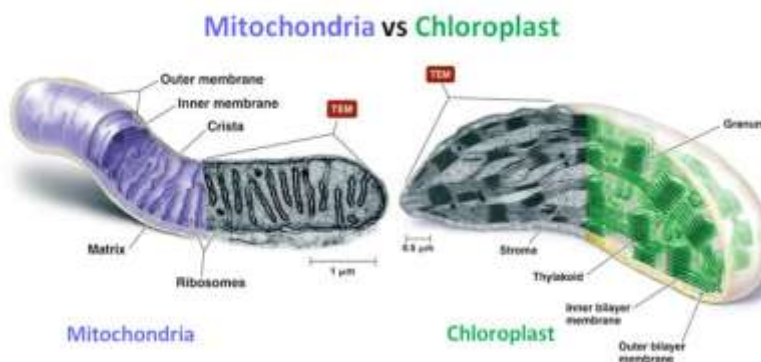
CHAPTER 2: CELL STRUCTURE AND CELL ORGANISATION

The comparison between structure of animal cells and plant cells



Characteristic	Animal cells	Plant cell
Shape	Does not have a fixed shape	Have a fixed shape
Cell walls	Does not have a cell walls	Have cell walls
Chloroplast	Does not have chloroplast	Have chloroplast
Vacuoles	Does not have vacuoles	Have large central vacuole
Food storage	Food stored the in form of glycogen	Food stored the in form of starch
Centrioles	Have centrioles	Does not have centrioles

Differences between mitochondria and chloroplast



Mitochondria	Chloroplast
They are colorless organelles	They are green organelles
Are found in plants and animals	Are found in some protists (Euglena) and in plants

They are generally cylindrical-shaped	They are generally disc-shaped
Their inner membrane is folded into cristae	Their inner membrane form flattened sacs called thylakoids
Cristae does not form grana	Thylakoids produces grana
Mitochondria does not take part in conversion of light energy into chemical energy	Chloroplast takes part in the conversion of light energy into chemical energy
They release ATP by breaking down organic food to produce carbon dioxide and water	They store energy by building up organic food like carbon dioxide and water as raw materials for photosynthesis
It used up oxygen	It produces oxygen
Undergoes respiration	Undergoes photosynthesis
Respiration occurs in all living things including green plants	Photosynthesis only occur in green plants only

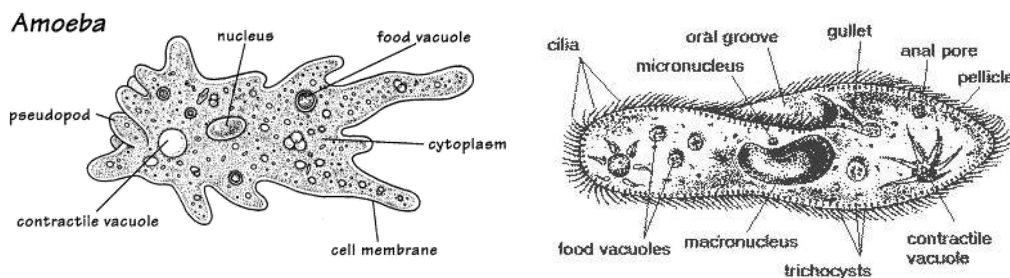
Phagocytosis

Amoeba sp. is a holozoic organism which feed on microscopic organism such as bacteria // Amoeba sp. engulfs food by phagocytosis // The presence of the presence of food causes the amoeba sp. to approach it by extending its pseudopodia // used for feeding // The pair of pseudopodia encloses the food which is then packaged in the food vacuole // The food vacuole fuses with the lysosomes // The food is digested by the hydrolytic enzymes called lysozyme // the nutrients are absorb into the cytoplasm.

Excretion of Paramecium sp.

Waste products like carbon dioxide are excreted by simple diffusion // contractile vacuoles one at the anterior end and posterior end aids in controlling the water balance in the cell called osmoregulation // The water from the hypotonic environment constantly enters the cell by osmosis making the contractile vacuole enlarges // the contractile vacuole then contracts and eliminates excess water to the surroundings // the contractile vacuoles will contract and expand periodically to maintain water balance.

Comparison of Amoeba sp. and Paramecium sp.



Living processes	Amoeba	Paramecium
Locomotion	Amoeboid by pseudopodia	Beating of cilia
Feeding	Engulfs food with the help of pseudopodia	Food drawn into mouth together with water
Reproduction	Binary fission	Binary fission and conjugation
Excretion	Waste products excreted through cell membrane	Waste products excreted through cell membrane

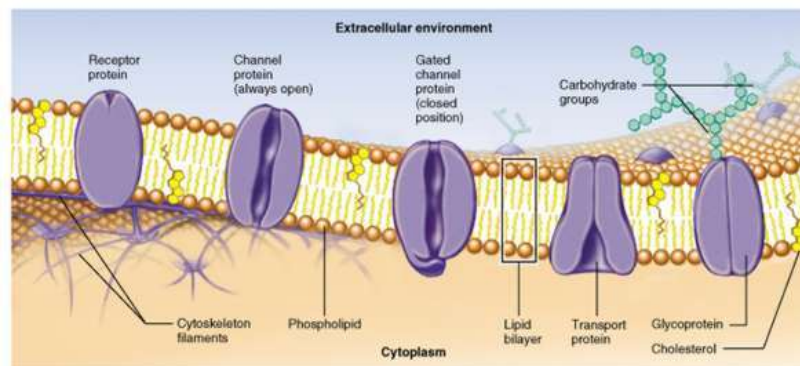
Response	Respond negatively to light, touch, heat and chemicals	Respond negatively to light, touch, heat and chemicals
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Cellular component and its functions

Cellular components	Functions
Plasma membrane	Separates the contents of a cell from its external environment // regulates movement in and out of the cell
Cell wall	Maintain shape of cell // prevents bursting due to excess osmosis
Vacuoles	Storage of chemicals (amino acid, waste products) // elongation and expansion of plant cell by absorbing water
Nucleus	Contains genetic information // controls all cellular activities
Golgi apparatus	Modifies proteins and transports to all cells // packages protein into secretory vesicles
Lysosomes	Digestion compartments in a cell // break down food into nutrients
Chloroplast	Traps light energy and convert them into chemical energy // gives plant its green color

CHAPTER 3: MOVEMENT OF SUBSTANCES ACROSS THE PLASMA MEMBRANE

Structure of the plasma membrane



The plasma membrane is semi-permeable // this means that certain substances can move across the plasma membrane freely while others cannot // the plasma membrane is to be semi-permeable because of its structure which consists mainly of a phospholipid bilayer and proteins // the hydrophobic tails of the phospholipid bilayer impede the transport ions but permits the movement of lipid-soluble molecules such as fatty acids, glycerol and vitamins A,D,E and K // small, unchanged molecules such as water and dissolved gases such as oxygen and carbon dioxide can also move across the plasma membrane freely through the phospholipid bilayer // the lipid bilayer is impermeable to larger molecules such as glucose and amino acids and small water-soluble ions such as sodium, potassium and calcium ions // the molecules or ions can only diffuse across the plasma membrane with the aid of transport proteins such as carrier proteins and pore protein

Simple diffusion

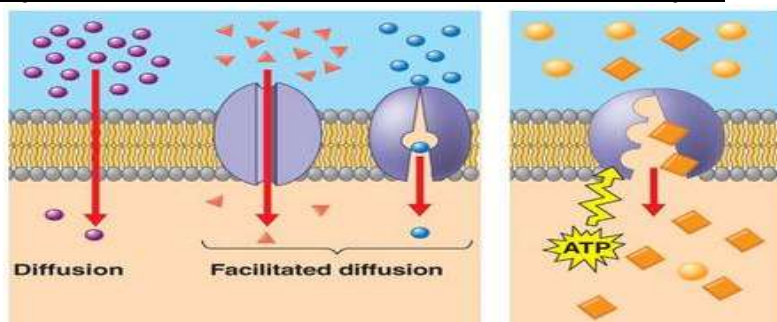
Net movement of molecules or ions from region of higher concentration to a region of lower concentration // Going down concentration gradient until an equilibrium is achieved // The particles are distributed equally throughout the system and is called dynamic equilibrium // The concentration gradient provides energy to move the molecules in and out of the cell.

Facilitated diffusion

Movement of hydrophilic molecules or ions across the plasma membrane with the aid of transport protein // Transport proteins move the molecules down their concentration gradient // Molecules such as glucose, proteins and amino acid move towards the binding site of specific carrier proteins and bind to it // The carrier protein changes its shape to allow the molecules to pass through the carrier protein // The carrier protein returns to its original shape and is free to allow other molecules to pass through the plasma membrane into the cell.

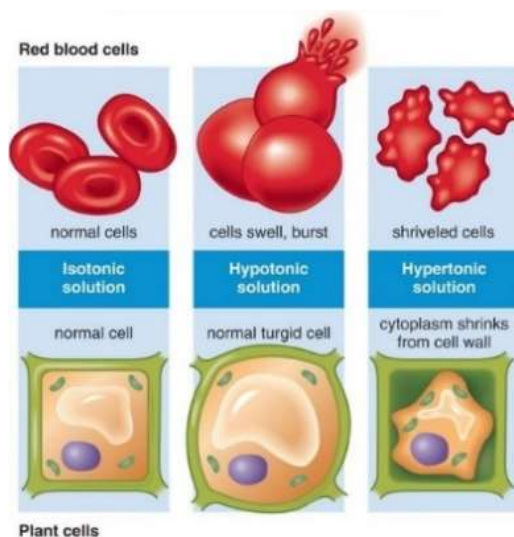
Active Transport

Movement of molecules or ions against the concentration gradient across the plasma membranes // It requires both carrier proteins and cellular energy // cellular energy from ATP (adenosine triphosphate) is generated during respiration in the mitochondria // the carrier proteins changes shape when the phosphate group from the ATP binds to it // the changing of the shape enable ion/molecules to bind to the carrier protein // the binding in turn changes the carrier protein thus transporting the ion/molecules to the other side of the plasma membrane the solutes then move across the plasma membrane

The comparison between facilitated diffusion and active transport

Facilitated diffusion	Active transport
Molecules move down the concentration gradient, from a region of higher concentration to a region of lower concentration of substances	Molecules move down the concentration gradient, from a region of lower concentration gradient to a region of higher concentration of substances
Molecules move through pore proteins or carrier proteins	Molecules move through carrier proteins only
Occurs until a dynamic equilibrium is achieved	Results in removal of substances from the cell
ATP is not needed	ATP is needed
Not affected by inhibitors	Affected by inhibitors
Not dependent on cellular respiration	Dependent on cellular respiration

The effects of hypotonic solutions on animal cells and plant cells



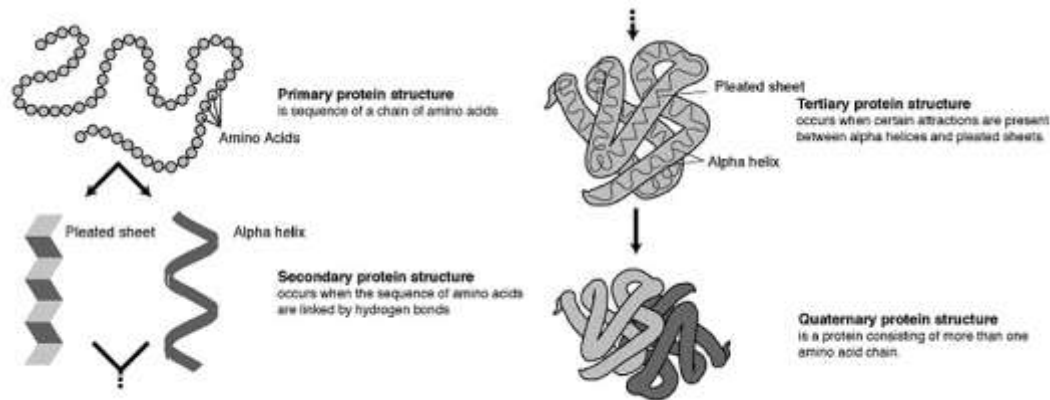
Animal cell	Plant Cell
When red blood cell is immersed in a hypotonic solution, the solution outside the cell is less concentrated than the inside // The water diffuses into the cell by osmosis and the cell starts to swell // the excess water will cause the plasma membrane to burst and the contents will be released // this condition is called hemolysis.	When plant cell is immersed in a hypotonic solution, the solution outside the cell is less concentrated than the inside // the water diffuses into the central vacuole by osmosis making it to swell up // the vacuole and cytoplasm press outwards against the plasma membrane which in turn presses hard on the cell wall making it to be turgid

The effects of hypertonic solutions on animal cells and plant cells

Animal cell	Plant cell
When red blood cell is immersed in a hypertonic solution, the solution outside the cell is more concentrated than the inside // water diffuses out of the cell by osmosis // the cell loses water to the external environment, shrinks and the plasma membrane crinkles up and undergo crenation	When plant cell is immersed in a hypertonic solution, the solution outside the cell is more concentrated than the inside // water osmosis out of the large central vacuole by osmosis // both vacuole and cytoplasm lose water to the surroundings and shrink making the cell membrane to pull away from the cell wall and undergo plasmolysis

CHAPTER 4: CHEMICAL COMPOSITION OF THE CELL

The structures of a protein



<ul style="list-style-type: none"> ○ Primary Structure The primary structure of proteins refers to the specific linear sequence of amino acids in a polypeptide chain Example: 	<ul style="list-style-type: none"> ○ Secondary structure The secondary structure of proteins refers to a polypeptide chain that is coiled to form an alpha-helix chain or folded beta-pleated sheets which are held together by hydrogen bonds
<ul style="list-style-type: none"> ○ Tertiary structure The tertiary structure refers to the way the alpha-helix chain or beta-pleated sheets are in a three-dimensional shape of a polypeptide chain Example: enzymes, hormones, antibodies 	<ul style="list-style-type: none"> ○ Quaternary structure The quaternary structure refers to more tertiary structure polypeptide chain are arranged to form a functional and complex protein molecules Example: haemoglobin

General Characteristics of enzymes

All enzymes are protein // enzymes reactions are reversible // only small amount of enzymes needed to do their job // enzymes are highly specific // each enzymes works best at 37°C but denatured at about 60°C // enzymes are sensitive to pH // enzyme reactions are slowed down by inhibitors like mercury and cyanides // some enzymes require cofactors to work like copper ion and vitamin B complex // enzymes are biological catalysts

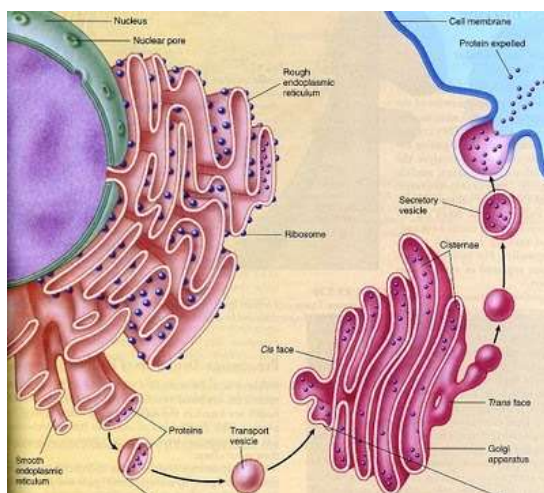
Comparison between unsaturated and saturated fat



Aspects	Saturated fat	Unsaturated fat
Types of chemical bond	A single carbon to carbon bond of covalent bond	A double carbon to carbon bond of covalent bond

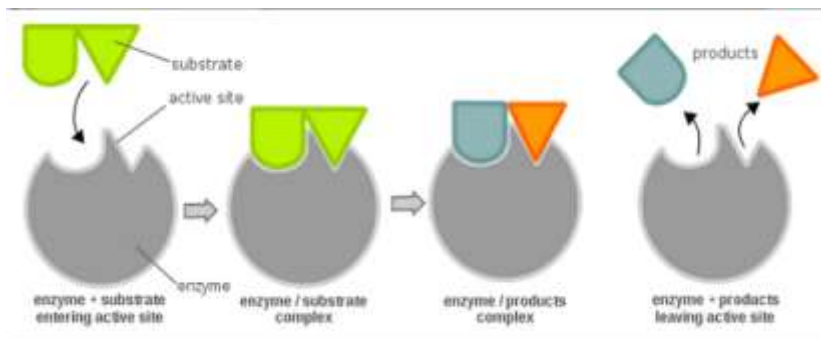
Reactivity	Less reactive	More reactive due to double bond
States of matter in room temperature	Solid (fats)	Liquid (oil)
Sources	Animal fats , butter , coconut oil , full cream milk , red meat	Vegetable oil , corn oil , olive oil , soybean oil
Effects on blood cholesterol level	Contains more cholesterol due to high LDL (bad cholesterol)	Contains less cholesterol due to high HDL (good cholesterol)

Production of extracellular enzymes



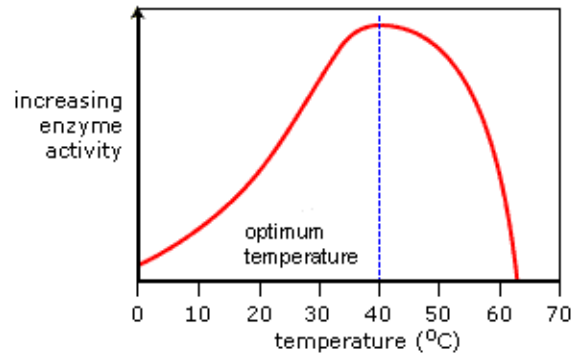
In the nucleus , the DNA double helix unwinds and become two messenger RNA strands // The mRNA leaves the nucleus and moves to the ribosome and attached itself to the ribosome // The ribosomes synthesized the mRNA and becomes protein // each amino acid around the cell will bond together with the protein and become a polypeptide chain // the protein is then transported to the space with the rough endoplasmic reticulum // Next , the protein departs from the RER wrapped in a transport vesicle that buds off from the membrane of the RER // The transport vesicle will fuse with the membrane of the Golgi apparatus and the proteins travel in it // Later , the protein is modified as they travel inside , for example carbohydrate is added and become glycoprotein // the secretory vesicle containing the modified protein buds off from the Golgi apparatus and travels to the plasma membrane // as they reach the protein are expelled as enzymes

'Lock' and 'key' hypothesis



The substrate molecule fits into the active site of the enzyme molecule // the substrate is the 'key' that fits into the enzyme 'lock' // Various types of bond such as hydrogen bond and ionic bond holds the substrate // this will form enzyme-substrate complex in the active side // once the complex is formed, the enzyme hydrolyzed the substrate to its product // later the product leaves the active site // the enzyme can be reuse for the next substrate

Effects of temperature on enzymatic activity



At low temperature, reaction takes place slowly // as the temperature increases, movement of substrate and enzyme molecules move more vigorously // this increases the chances of colliding of substrate at the active site of the enzyme and as result, the rate of reaction between the substrate and enzymes increases // for every 10°C rise in temperature, the rate of enzymatic reaction in a cell is doubled until it reaches optimum temperature // the optimum temperature of humans are at about 37°C // At optimum temperature, the reaction is at maximum rate // beyond the optimum temperature the chemical bonds that held the enzyme molecules begin to break // this alter the three dimension shape of the enzymes molecules and finally the active sites is destroyed // the substrate no longer fit into the active sites // the enzyme is denatured causing the rate of enzymatic activity to decrease drastically until it stops completely at about 60°C

CHAPTER 5: CELL DIVISION

Animal cell Mitosis

Nuclear division	Description
Prophase	During prophase , the chromosomes in the nucleus condenses and become tightly coiled // the chromosomes appeared shorter and thicker , which are visible under light microscope // Each chromosomes consist of a pair of sister chromatids joined together at the centromere // in the cytoplasm, the spindle fibers begin to form and extend between the centrioles // each pair of centrioles then migrates to lie at the opposite poles of the cell // the chromatids are attached to the spindle fibers at the centromere // at the end of prophase, the nucleolus and nuclear membrane disappear and disintegrates
Metaphase	Metaphase begins when the centromeres of all chromosomes are lined up on the metaphase plate , an imaginary plane // the spindle fibers are fully formed // the sister chromatids are still attached to each other at the centromere // metaphase ends when the centromere divides

Anaphase	The two sister chromatids of each chromosome separates at the centromere // the sister chromatids are pulled apart to opposite poles by the shortening of spindle fibers that connects the chromosomes to the poles // once separated , the chromatids are referred as daughter chromosomes // anaphase ends when the chromosomes reach the poles of the cell
Telophase	Telophase begins when both sets of chromosomes reach the opposite poles of the cell // the chromosomes starts to uncoil and return back to its original state // the spindle fibers disappear and a new nuclear membrane forms around each set of chromosomes // the nucleolus reforms in each nucleus // the process of mitosis is now complete

Meiosis

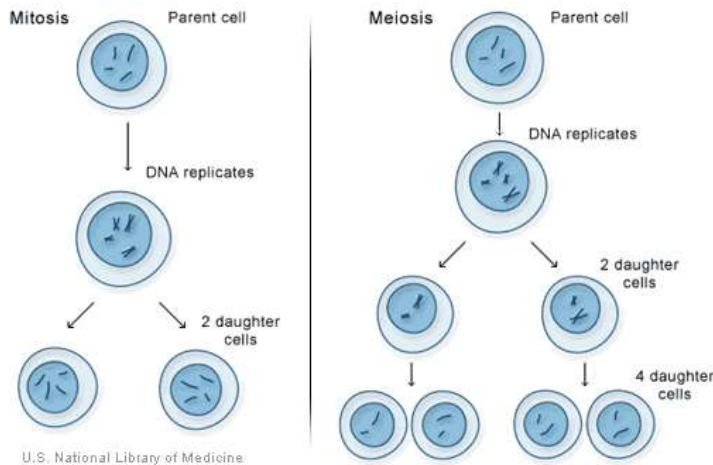
Nuclear division	Description
Prophase I	The chromosomes begin to condense as they become shorter , thicker and clearly visible // homologous chromosomes comes together to form pairs of bivalent through synapsis // each bivalent consist of a four part structure called tetrad , two homologous chromosomes which is made up of two sister chromatids each // non sister chromatids exchange segment of DNA , crossing over occur // At the end of prophase I the nucleolus and nuclear membrane disappear
Metaphase I	The spindle fibers pull the tetrads to the middle of the cell // pairs of homologous chromosomes align at the metaphase plate and lined up by the side as tetrads // the centromere does not divide
Anaphase I	The spindle fibers pull the homologous chromosomes apart from one another and pull them to the opposite pole of the cell // each chromosomes consist of two sister chromatids // each homologous chromosomes are attached by spindle fiber // at the end of Anaphase I , each poles has only two chromosomes each with two sister chromatids
Telophase I	The chromosomes arrived at the poles // each poles has haploid daughter cells as it only contains one set of chromosomes only // the spindle fibers disappear // the nuclear membrane and nucleolus reappear in each nucleus // cytokinesis takes place to form two daughter cell

- **The events that takes place in meiosis II are identical to those in mitosis**

Cytokinesis

It is a cytoplasmic division // begins before nuclear division is complete, towards the end of telophase in mitosis and meiosis // the arch filament forms contractile ring // when it contracts, it makes a ring at the plasma membrane which is then pulled inwards // groove at the cleavage furrow pinches at the equator between two nuclei // the cleavage furrow deepens progressively until the cell separates into two daughter cell.

Comparison between mitosis and meiosis



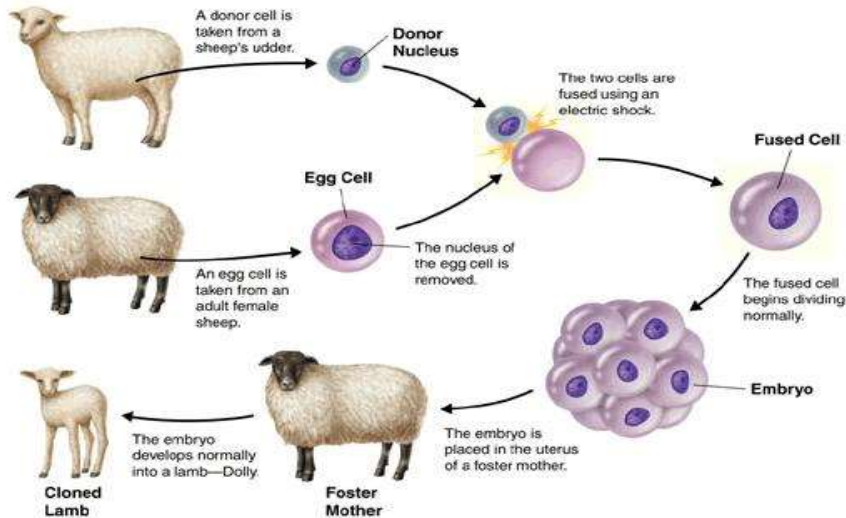
Both are process of cell division that occurs in all living cells // DNA replicates only once in both processes

Mitosis	Meiosis
Takes place in the somatic cell	Takes place in the reproductive cells only
Functions to produce new cells for growth repair and	Functions to produce gametes for sexual reproduction
Synapsis does not occur	Synapsis occur
Crossing over does not occur	Crossing over occur
One cell division	Two cell division
Produce two daughter cells	Produce four daughter cells
Maintains the number of chromosomes	Halved the number of chromosomes
Daughter cells are genetically identical to parent cell	Daughter cells are not genetically identical to parent cell
Will undergo interphase again	Continue its process from meiosis 1 to meiosis 2
Has no genetic variation	Has genetic variation

Uncontrolled mitosis

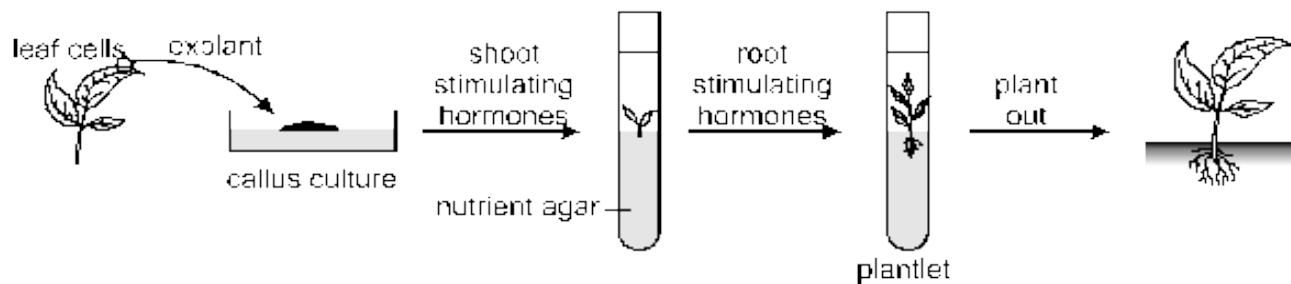
Cell divides through mitosis repeatedly without control which produces cancerous cells // cancer is a genetic diseases caused by uncontrolled mitosis // the cancerous cell divides freely and uncontrollably not according to the cell cycle // the cell competes with surrounding normal cells for energy and nutrients // this cancer cells formed tumour and this tumour will invade and destroy neighboring cells

Animal cloning



Somatic cells from the mammary gland cells are removed and grown in a low culture medium // the starved cells stop dividing and enter a non-dividing phase // an unfertilized egg is obtained // the nucleus is sucked out, leaving the cytoplasm and other organelles without any chromosomes // an electrical pulse stimulates the fusion between the somatic cell and egg cell without nucleus // the cell divides rapidly forming an embryo // the embryo is then implanted into a surrogate mother // the cloned animal of the somatic cell donor is born

Tissue culture

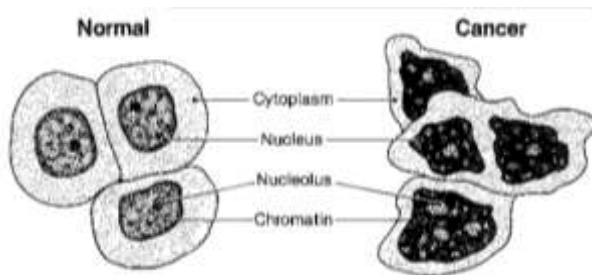


Choose a high quality breed of plant and high productivity // small pieces of plant tissues are cut and called explants // the explants must be from a meristematic cell because they undergo mitosis actively // the culture medium and the apparatus used must be in sterile condition and microorganism-free // the culture medium must contain growth hormones and nutrients // the explants grow into a callus, an aggregate of cells // the callus becomes a somatic embryo which then develops into a plantlet // all the plantlets grown have the same characteristics of their parents (genetically identical)

Cloning

Advantages	Disadvantages
Clones produced in a short time and large numbers	Long term side effects
Affordable and always available	Mutation of organism
Transgenic crops are resistant to herbicides	Does not show any genetic variation
Better quality products produced	Same level of resistance towards environment
Vegetative reproduction does not require pollination	Cloned organism has shorter lifespan

Differences between normal cells and cancer cells



Normal cells	Cancer cells
Controlled growth	Uncontrolled growth
Monolayer and organized	Multilayer and disorganized
Cells are differentiated to carry out specialized functions	Cells are undifferentiated and do not have specialized functions
Normal chromosomal number	Abnormal chromosomal number

Differences between meiosis 1 and meiosis 2

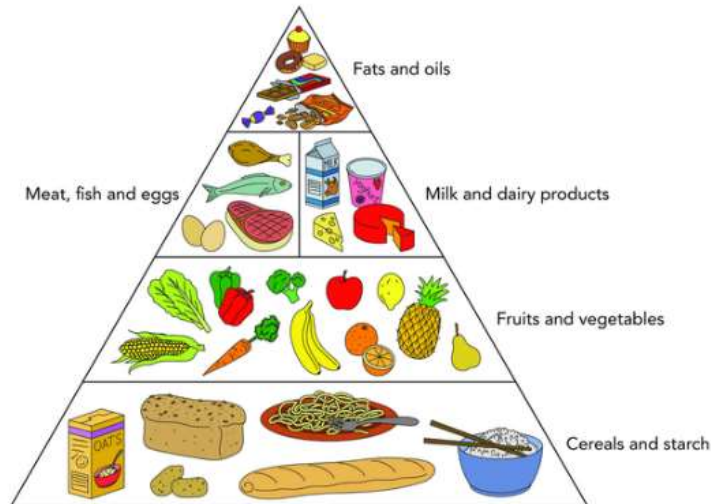
Nuclear division	Meiosis 1	Meiosis 2
Function	Reduce haploid chromosome to diploid	Divides the remaining sets of chromosomes like mitosis
Prophase	Chromosomes already replicated // homologous chromosomes synapse // chiasma forms and crossing over takes place	No replication // no synapse // no chiasma and crossing over
Metaphase	Paired homologous chromosomes align at the equator	Sister chromatids align at equator
Anaphase	Separation of homologous chromosomes to opposite poles	Separation of sister chromatids to opposite poles
Telophase	Single cytokinesis // two identical cell produced	Two cytokinesis // four identical cell produced

CHAPTER 6: NUTRITION

Test on food samples

Test for	Reagent	Observation	Conclusion
Starch	Iodine solution	Color changes from brownish yellow to blue-black	Food sample contains starch
Reducing sugar	Benedict's solution	Color changes from blue to brick red precipitate	Food sample contains reducing sugar
Non-reducing sugar	Dilute hydrochloric acid and benedict's solution	Color changes from blue to brick red precipitate	Food sample contains non-reducing sugar
Protein	Biuret's test	Color changes from blue to purple	Food sample contains protein
Lipid	Filter paper	Translucent mark	Food sample contains lipid
Lipid	Emulsion test	Oily mixture on the surface of water	Food sample contains lipid

The food pyramid



The food guide illustrates the relative amounts of different food groups that make up a balanced diet // level 1 consists of carbohydrates // carbohydrates provide a large amount of energy but excessive intake of carbohydrates will lead to diabetes mellitus and obesity // level 2 consists of vitamins, minerals and fibre // vitamins and minerals are important in maintaining good health but lack of fibre may cause constipation // excess lipid-soluble vitamins can cause kidney damage // fibre and water help in peristaltic movement and prevent constipation level 3 consists of proteins // proteins are important in building new cells and repairing old cells but lack of protein causes kwashiorkor and excess protein causes gout // level 4 consists of lipids // lipids provide a large amount of energy but lack of lipid leads to tiredness and excess lipid leads to cardiovascular diseases

Vitamins

Fat-soluble vitamins are vitamins A,D,E and K and they can be stored in body fat // water soluble vitamins include B and C and they cannot be stored in the body and have to be constantly supplied in daily diet

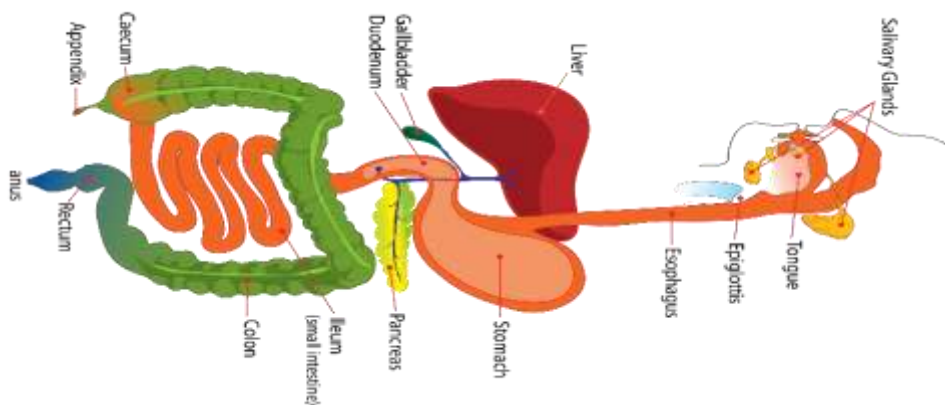
Vitamins	Sources	Functions	Symptoms of deficiency
A	Egg yolk, butter, fish oil, dairy products, green vegetables	Needed for the formation of light sensitive pigment in the retina // acts as an antioxidant by combining with free radicals to minimize their damaging effects // free radicals react with DNA leading to serious damage and cancer // maintenance of epithelial tissue // delays aging process	Night blindness // cornea becomes dry and opaque // scaly skin
D	Dairy products , egg yolk, cold liver	Aids in the absorption of calcium and phosphorus ions in the small intestine and usage of these ions for bones and teeth // promote bone growth	Rickets which is poor bone formation // deformities such as bowed legs // osteomalacia which is the softening of bones in adults
E	Wheat germ ,nuts, green vegetables, grains, olive oil, milk	Produce red blood cells // acts as an antioxidant as it combines easily with free radicals // protects unsaturated fatty acids with vitamin A and C // prevent damage to phospholipids in plasma membrane thus maintaining its structure	Muscle dystrophy // liver damage // infertility // anaemia
K	Egg yolk, cabbage, spinach	Important in blood clotting	Excessive bleeding // anaemia
Folic acid	Green vegetables, orange, nuts, whole grains	Acts as a coenzyme in nucleic acid and amino acid metabolism	Anaemia // diarrhea // muscle pain
C Ascorbic acid	Citrus fruits, tomatoes, green peppers	Required in the synthesis of collagen // maintenance of cartilage bones, dentin and healthy blood vessels // strong antioxidant // aids in detoxification // improve iron absorption	Poor collage formation // scaly skins // scurvy // degeneration of blood vessels, muscle and cartilage // impaired immunity // delayed wound healing
B12	Milk, meat, cheese	A coenzyme in nucleic acid metabolism // formation of blood cells	Neurological disorder // weight loss

Minerals

Macrominerals are required in large quantities such as calcium, magnesium, phosphorus and sodium // microminerals are in small quantities such as cobalt, fluorine, iodine, manganese and zinc

Mineral	Sources	Function	Symptoms of deficiency
Calcium	Milk, cheese, vegetables, anchovies, grains	Bone and tooth formation // aids in blood clotting // needed in muscle and nerve coordination // transmission of nerve impulses	Rickets // stunted growth // blood clotting // osteoporosis
Magnesium	Green leafy, vegetables, whole grains, meat	Activates most types of enzymes in protein synthesis // maintain normal functions of muscle and nerves // bone and tooth formation	Retarded function of muscles and nerves
Iron	Green leafy, vegetables, liver, egg yolk, meat	Component of haemoglobin needed for oxygen transport in the blood // component of enzymes involved in cellular respiration	Anaemia // less resistance to infection
Sodium	Table salt	An important component in blood plasma // maintains the acid-base balance and water balance // normal muscle and nerve function // involve in nerve impulse transmission	Muscle cramps // loss of appetite
Potassium	Meat, dairy products, fruits, vegetables and grains	Needed for the correct functioning of the heart // maintenance of acid-base balance and water balance // muscle and nerve function	Heart failure // muscle weakness // paralysis
Iodine	Seafood, seaweed, iodized salt	Component of the thyroxine hormone	Goitre which is enlarged thyroid gland
Phosphorus	Milk, cheese, egg, grains	Bone and teeth formation // nucleotide synthesis // involve in the transfer of energy in ATP	Rickets // demineralization of bones // loss of calcium and other minerals

Digestion in the mouth



Starts at the mouth as the chewing action breaks the food into smaller pieces and increase the surface area for digestive enzymes to react on // the presences of chewed food in the mouth triggers the secretion of saliva by three pairs of salivary glands // saliva contains the enzyme , salivary amylase which begins the hydrolysis of starch to maltose // the chewed food is rolled into a mass called bolus for swallowing // during swallowing, epiglottis temporally closes the airway to prevent food from entering the trachea // the bolus then enter oesophagus , a muscular tubed lined with the epithelium and mucous gland // the mucus lubricates the bolus and aids the movement along the oesophagus by peristalsis // when the cardiac sphincter, a ring of muscle that controls the opening of stomach , relaxes then the bolus will enter the stomach

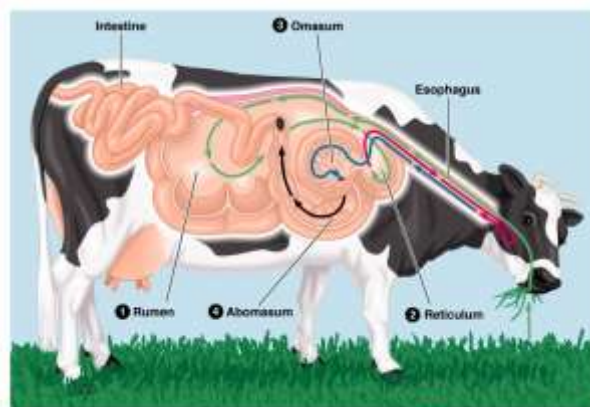
Digestion in the stomach

Stomach is a muscular sac with tightly folded inner wall situated below the diaphragm // the epithelial lining of the stomach contains gastric glands that secretes gastric juice // gastric juice contains hydrochloric acid that is used to create an acidic condition for the enzymes to work , to stop the salivary amylase enzyme action and helps to kill the bacteria in the food // it also contains pepsin to hydrolyse large protein molecules to polypeptides and contains rennin to coagulate milk by converting caseinogen into casein // mucus is secreted by the goblet cells of the gastric gland to protect the stomach wall from hydrochloric acid and digestive enzymes // eventually after the food is churned and mixed with the gastric juice , the contents of the stomach becomes a semi-fluid called chyme // relaxation and contraction of the pyloric sphincter allows the chyme to gradually enters the duodenum.

Digestion in the small intestine

Duodenum receives chyme from stomach and secretion from the gall bladder and pancreas // in the duodenum digestion of starch, proteins and lipids takes place // Bile which is produced by the liver and stored in the gall bladder enters the duodenum via the bile duct // bile creates an alkaline environment for enzymatic action in the duodenum to reduce the acidity of the chyme from the stomach and maintain a suitable pH for the enzyme // bile salts emulsify lipids, breaking them into tiny droplets to provide large TSA for digestion // pancreas secretes pancreatic juice which contains amylase, trypsin and lipase // pancreatic juice is secreted into the duodenum via the pancreatic duct // pancreatic amylase completes the digestion of starch to maltose // trypsin digest polypeptides into peptides // lipase complete the digestion of lipid into fatty and glycerol // glands in the ileum (small intestine) secrete intestinal juice which contain digestive enzymes needed to complete the digestion of peptides and disaccharides // peptides is digested by erepsin into amino acids // maltose is digested by maltase into glucose // disaccharides are digested by its own enzyme into monosaccharides and glucose // vitamins and minerals are not digested as it is a big molecule

Digestion of ruminants

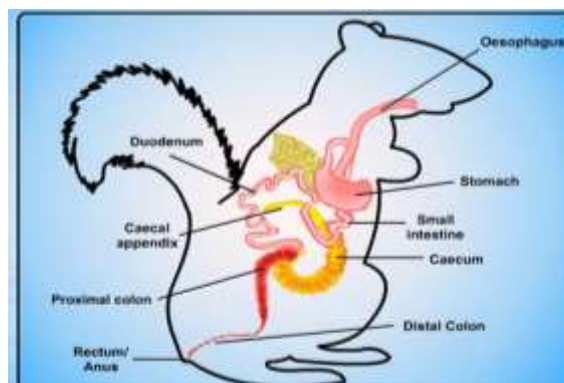


Partially chewed food is passed down to the rumen, the largest compartment of the stomach // cellulose is broken down by cellulase produced by the bacteria // Part of the breakdown products are absorbed by the bacteria and the rest by the host // Food enters the reticulum, called the cud is then regurgitated bit by bit into the mouth to be thoroughly chewed // This helps soften and breakdown of cellulose, making it more accessible for further microbial action // the cud is re-swallowed and moved to the omasum // Here large food particles are broken down into smaller pieces by peristalsis // Water is removed from the cud and then the food particles moved to the abomasum, the true stomach of the ruminant // Gastric juice completes the digestion of protein and other food substances // The food then passes through the small intestine to be digested and absorbed like the usual way .

Comparison of digested system of humans, ruminants and rodents

Aspects	Humans	Ruminants	Rodents
Number of stomach chambers	One	Four	One
Size of caecum	Not large	Not large	Large
Cellulase-providing bacteria	Absent	Present	Present
Regurgitation of food	Does not take place	Takes place	Does not take place
Place where cellulose is broken down	Absent	Stomach (rumen and reticulum)	Caecum
Number of times food passes through the alimentary canal	Once	Once	Twice
Place where gastric juice is produced	Stomach	Abomasum	Stomach
Presence of undigested cellulose	Yes	None	None
Ingesting partially digested food that is passed out of the body	Does not take place	Does not take place	Takes place

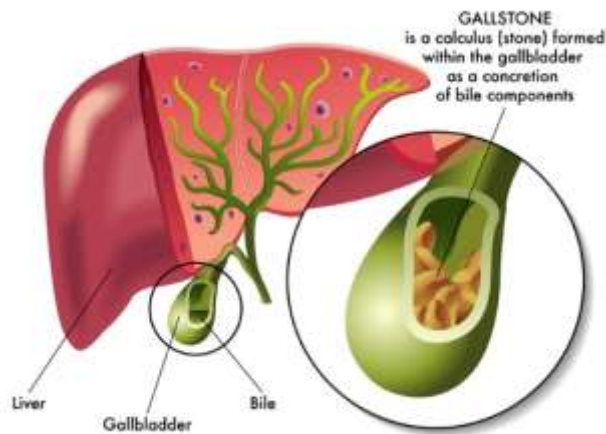
The digestive system of rodents and other herbivores



In rodents like rats, the caecum and appendix are enlarged to store the cellulase-producing bacteria // in herbivores like rabbits, the breakdown products pass through the alimentary canal twice // the faeces in the first batch are usually produced at night and are soft and watery //

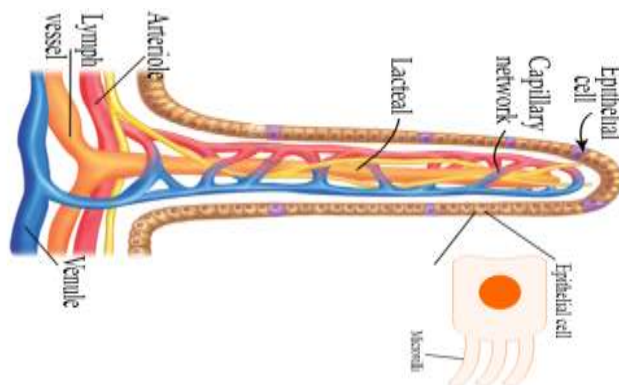
theses are eaten again to enable the animals to absorb the products of bacterial breakdown as they pass through the alimentary canal for the second time // the second batch of faeces become drier and harder // this helps the rabbit to recover nutrients initially lost with the faeces

Gallstone preventing the flow of bile



A person who often eats fatty food encourages the formation of gallstones in the bile duct and gall bladder // Gallstone are formed through the hardening of cholesterol and it is also caused by the excessive secretion of bilirubin and bile salts // the size of gallstones may be either small or big // when the gallstone block the bile duct, bile cannot be channeled out and as a result, lipids cannot be emulsified and difficult to be digest // formation of gallstones usually occurs in obese people

Absorption of digested food



End products	How?
Glucose and amino acid	Initially glucose and amino acid is diffuse into epithelial cell // the remaining glucose and amino acid actively transport into blood capillaries // all blood capillaries converge into hepatic portal vein which leads to the liver and transport to all parts of the body.
Water	Water moves from the lumen into the epithelial cells and then into the blood capillaries by osmosis
Water soluble vitamins	Vitamins B and C diffuses into the epithelial cells and then into the blood capillaries
Fatty acids and glycerol // fat soluble	Fatty acid and glycerol diffuse into the epithelial cell which lines the ileum and condenses to form lipid droplets // fat soluble vitamins and lipid droplets will move to the lacteal // the lacteal then converge into larger vessels of lymphatic system // the fluid in the

vitamins (ADEK) lymphatic system will flow into the right lymphatic duct and thoracic duct and then finally to the bloodstream via subclavian vein

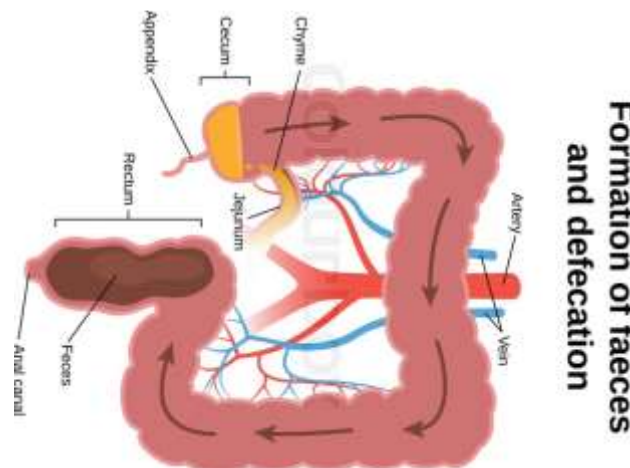
Assimilation of digested food in the liver

Amino acids	The liver synthesized plasma proteins from amino acid that passes through the liver before reaching blood circulatory system // When a short supply of glucose and glycogen occurs , the liver converts amino acid into glucose // excess amino acid cannot be stored in the body and are broken down in the liver through deamination // during deamination urea is produced and be transported to the kidney to be excreted
Glucose	Glucose in the liver is used for respiration and excess glucose will be converted into glycogen and stored in liver // when the blood sugar falls and the body needs energy, the stored glycogen is converted back into glucose // when the glycogen storage is full, the excess glycogen will be converted to lipids by the liver
Lipids	Lipids which enter the heart through the subclavian veins are transported in the bloodstream to body cells

Assimilation of digested food in body cells

Amino acids	Amino acids which enters the cells are used for synthesis of new protoplasm and repair of damaged tissues // are substances for synthesis of enzymes and hormones // amino acids are used in the synthesis of proteins of plasma membrane
Glucose	Glucose are oxidize to release energy during cellular respiration which is used for various chemical processes // excess glucose is stored as glycogen in the muscle // glycogen is a long chained molecule that is insoluble in water
Lipids	Lipids such as phospholipids and cholesterol form components of plasma membrane // excess fats are stored in the adipose tissue underneath the skin as the reserve energy and cushion for internal organ // when body lacks glucose, fats are oxidized to release energy

Formation of faeces



After the absorption of nutrients has taken place in the small intestine, the intestinal contents enter the colon // the intestinal content consist of water, dead cells from the intestinal lining, undigested materials and toxic substances enters the colon slowly and aided by peristalsis // the wall of the colon secretes mucus which helps to bind the contents and lubricates the movement of faeces along the colon // the colon reabsorbs almost 90% of water and minerals into the bloodstream // after more water is reabsorb, the contents hardens and form faeces // as the faeces accumulates, pressure in the rectum increases, causing the need to expel the faeces from the body // when the rectum is full, the muscles of the rectal wall contract to eject the faeces via the anus, the opening of the rectum // the elimination of faeces is known as defecation

Problems related to defecation

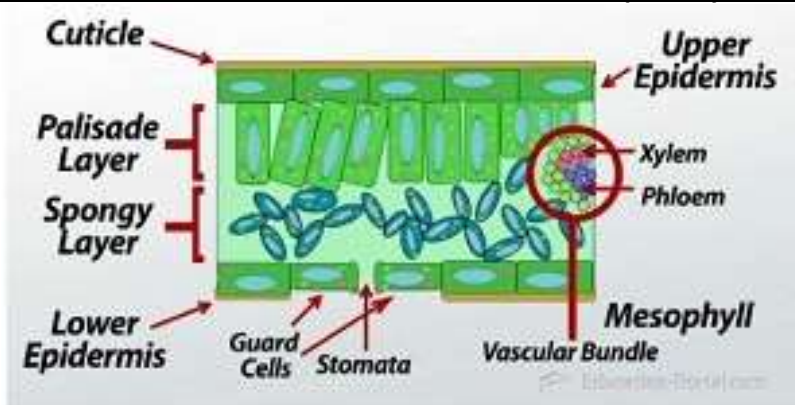
Constipation is caused by faeces moving too slow in the colon // as a result, a greater amount of water is reabsorbed in the colon making the faeces hard thus leads to painful defecation // constipation can be avoided by drinking a lot of water and taking sufficient amount of fibre which can help in the movement of undigested food substances along the colon // water that is absorbed will soften the faeces and increase its size making the muscle to push out the residue // chronic constipation will lead to haemorrhoids and colon cancer // haemorrhoids are abnormal swollen in the rectum and anus and it is caused because of too much pressure in the rectum so it forces the veins to stretch, swell and burst // when the swelling haemorrhoidal veins are irritated, they can cause the surrounding membranes to swell, burn, itch, painful and bleed // tumors of the colon and rectum are growth arising from the inner wall of the large intestine and the malignant tumor of the large intestine are called colon cancer // the breakdown of products from fat metabolism leads to the formation of carcinogens in the colon

Health problems related to eating habits

Problem	Explanation
Gastritis	Is the condition in which the epithelial lining of the stomach becomes inflamed // the stomach lining is usually covered with a layer of mucus which protects it from the hydrochloric acid and digestive enzymes // gastric juice is secreted into the lumen of the stomach when one feels hungry // if the food is absence in the stomach, it will result in the acidic gastric juice acting on the epithelial lining of the stomach wall // when the breach in the stomach lining develops into a hole a gastric ulcer occur // inflammation to the stomach lining can be caused by excessive alcohol assumption, stress and taking pain relievers regularly // tendency of getting ulcers is increased with the presence of helicobacter pylori because the infection by this bacteria weakens the mucosal and damages the mucus layer // this exposes the stomach lining to the action of acid and digestive enzymes // this can be prevented by taking antacids to neutralize the hydrochloric acid in the gastric juice
Anorexia nervosa	Is a psychological disorder characterized by self-depriving of food to achieved severe body weight loss // the weight of a person with anorexia nervosa is less than the normal body weight // people with it loses their appetite to eat or do not want to eat at all because they fear of gaining weight // they lose both fat and muscle and eventually leads to a disruption of the functions of the heart, endocrine system and reproductive system // this is a psychological disorder that occurs frequently among female teenagers and adults // early treatment through nutrition and gradual restoration of body mass can correct some physical symptom

Obesity	Obesity is defined as the condition where a person's body mass exceeds 20% of the normal weight according to the body mass index (BMI) // an obese person is prompt to have diseases like cardiovascular diseases, hypertension and diabetes mellitus // factors that leads to obesity are eating excessively, eating too much carbohydrates and fats and lack of exercise // obesity can be overcome by practicing a balance diet and eating the right amount the body wants
Bulimia	Bulimia has a normal body mass // Bulimia is a serious mental illness where people feel that they have lost control over their eating and evaluate themselves according to their body shape and weight // People with bulimia are caught in a cycle of eating large quantities of food (called 'bingeing'), and then vomiting, taking laxatives or diuretics (called purging), in order to prevent gaining weight // repeated purging results in serious injury to the digestive tract and can cause imbalance of mineral salts in the blood thus the victim will experience dehydration and irregular periods // symptom associated with bulimia include malnutrition, hormonal imbalance, kidney and cardiovascular problems and liver diseases

Adaptation of the structure of the leaves and cells of the leaf for photosynthesis



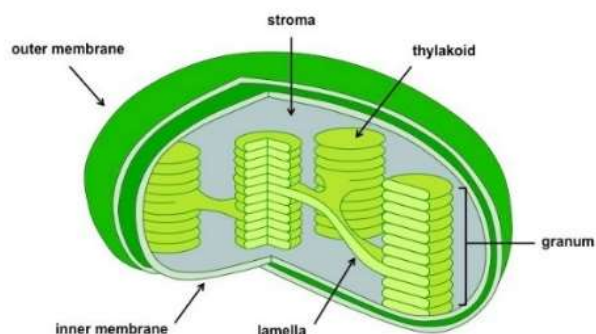
Structure / cell	Adaptation
Leaves	Broad and flattened shape of the lamina has a large surface area to trap sunlight // thin leaf to allow sunlight to penetrate to the other leaf and increase efficiency of the diffusion of gases involved in photosynthesis // the leaves are arranged in leaf mosaic to prevent minimal shade to each other
Cuticle	The waxy cuticle is waterproof to help prevent excessive water loss // transparent to allow light to penetrate
Upper epidermis	The upper epidermis of a leaf is single layered, thin and transparent to allow penetration of light and reach the light-trapping chloroplast // does not contain chloroplast
Lower epidermis	Does not contain chloroplast except for the guard cells and each stoma is flanked by two guard cells // guard cells enable the opening and closing of the stomata that functions to support photosynthesis by allowing the exchange of gases // carbon dioxide from the atmosphere diffuses into the leaf through stomata and oxygen diffuse out of the leaf through the same route

Vascular bundle	Xylem transport mineral ions and water to the leaf // phloem transports products of photosynthesis away from the leaf
Palisade mesophyll	Cylindrical shaped , tightly packed together in an upright position situated beneath the upper epidermis and this helps the cell to receive maximum amount of light // have high density of chloroplast to absorb sunlight // the cell walls of palisade mesophyll are coated with film of water so that carbon dioxide are able to dissolve in the water before diffusing into the cell
Spongy mesophyll	Irregular shaped to increase TSA for gaseous exchange // the cells are loosely arranged and bathes in air spaces that connects the mesophyll to the stomata, making it to contain less chloroplast // the large air spaces allow easy diffusion of water and carbon dioxide through the interior of the leaf to the palisade cells // has cells wall coated with film of water to allow gaseous exchange

Adaptation of plants from different habitats to carry out photosynthesis

Habitat	Distribution of stomata and chloroplast	Examples
Land plants	Large number of stomata at the lower epidermis for maximum carbon dioxide absorption // less number of stomata at the upper epidermis to prevent evaporation and water loss due to direct sunlight // most chloroplast are found in mesophyll to allow absorption of sunlight	Hibiscus
Floating plants	The stomata are mostly distributed on the upper epidermis of the leaves // the upper epidermis is covered with thick and waxy cuticle act as a waterproof layer and keep the stomata open // chloroplast are found at the upper epidermis to maximize absorption of sunlight	Water lilies (rooted) Duckweeds (floated)
Desert plants	The leaves contain less stomata to prevent excessive water loss through respiration // the stomata are located at the stem // some cacti open their stomata at night when its cooler than during the day when its hotter // they absorb and store carbon dioxide during the night // the stored carbon dioxide is used during the day when the stoma is forced to closed // some shrubs have sunken stomata to prevent water loss // stems perform most of the photosynthesis and the leaves are modified to become thorns ,that are green in color	Cacti
Aquatic plants	No waterproof cuticle because no water loss // the cells on the surface are able to absorb water, nutrients and dissolved gases from the surroundings // air filled sacs are in the plants providing the internal atmosphere where gaseous exchange take place // aquatic plants have feathery and highly divided leaves which creates high TSA for photosynthesis // the leaves and stems have chloroplast all over it to maximize absorption of sunlight because of low light intensity in the water	Hydrilla sp.

The mechanism of photosynthesis



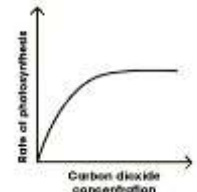

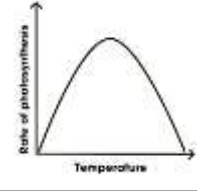
The formation of starch in plants is by the process of photosynthesis which occurs in the chloroplasts // the two stages in photosynthesis are light and dark reaction // the light reaction only occurs in the presence of light while the dark reaction occurs during day and night // light reaction takes place in the grana // during light reaction, chlorophyll captures light energy which excites the electrons of chlorophyll to a higher state of energy levels // in the excited state, the electrons leave the chlorophyll molecules // light energy is also used to split water molecules into hydrogen ions and hydroxyl ions and this process is called photolysis of water // the hydrogen ions then combine with the electrons released by chlorophyll to form hydrogen atoms // the energy from the excited electrons is used to form energy-rich molecules of adenosine triphosphate // hydroxyl ion loses an electron to form a hydroxyl group and this electron is then received by chlorophyll // the hydroxyl groups then combine to form water and gaseous oxygen // oxygen is released into the atmosphere and use for cellular respiration // dark reaction takes place during day and night and does not require light energy // the hydrogen atoms from the light reaction are used to fix carbon dioxide in a series of reactions catalyzed by photosynthetic enzymes // this causes the reduction of carbon dioxide into glucose // the glucose monomers then undergo condensation to form starch which is temporarily stored as starch grains in the chloroplast

The differences between light reaction and dark reaction

Aspects	Light reaction	Dark reaction
Type of reaction	A photolytic reaction	A biochemical reaction
Time of reaction	Day time	Day and night
Site of reaction	Grana	Stroma
Substances required for reaction	Water	Carbon dioxide
Products of reaction	Oxygen and water	Glucose and water
Photolysis of water	Occurs	Does not occur
Light energy	Required	Not required
ATP and hydrogen atoms	Forms ATP and hydrogen atoms	Uses ATP and hydrogen atoms

Factors affecting photosynthesis

Factors	Explanation
Concentration of carbon dioxide	Carbon dioxide is needed in dark reaction as a raw material used in synthesis of glucose // nearly 0.03% by volume of carbon dioxide is present in

 <p>A line graph with 'Rate of photosynthesis' on the y-axis and 'Carbon dioxide concentration' on the x-axis. The curve starts at the origin, rises steeply, and then levels off to a horizontal line, indicating that photosynthesis is limited by carbon dioxide concentration at high levels.</p>	<p>the atmosphere and at this low level it acts as a limiting factor //</p>
<p>Light intensity</p>  <p>A line graph with 'Rate of photosynthesis' on the y-axis and 'Light intensity' on the x-axis. The curve starts at the origin, rises steeply, and then levels off to a horizontal line, indicating that photosynthesis is limited by light intensity at high levels.</p>	<p>Light is essential during light reaction of photosynthesis which is the photolysis of water // when the concentration of carbon dioxide and temperature are controlled at constant level, the rate of photosynthesis is directly proportional to light intensity to a certain point // increasing the light intensity will boost the speed of photosynthesis.</p>
<p>Temperature</p>  <p>A line graph with 'Rate of photosynthesis' on the y-axis and 'Temperature' on the x-axis. The curve starts at the origin, rises to a peak, and then falls back to zero, indicating that photosynthesis is limited by temperature and has an optimum range.</p>	<p>The dark reaction of photosynthesis is catalyzed by photosynthetic enzymes and therefore changes in temperature will affect rate of photosynthesis // an increase of 10°C will double the rate of photosynthesis // the optimum temperature for most plants are between 25°C and 30°C // however when the temperature is too high, the photosynthetic enzymes denature and photosynthesis stops</p>
<p>Water</p>	<p>Water is required for photosynthesis but water is rarely the limiting factor in photosynthesis because the amount of water required is small // at the same time, if water is not supplied, wilting occurs and this cause the stomata to close thus preventing diffusion of carbon dioxide into the leaves // as a result the rate of photosynthesis decrease as the lower concentration of carbon dioxide becomes the limiting factor</p>

CHAPTER 7: RESPIRATION

Aerobic respiration

Aerobic respiration requires a continuous supply of oxygen from its surroundings // oxygen that is taken in is delivered by the blood circulatory system to all body cells // in the glucose molecules are oxidized by oxygen to release energy // carbon dioxide and water are produced as waste products // this process is followed by a sequence of complex biochemical reactions which are catalyzed by respiratory enzymes // only a small portion of the energy is lost in maintaining the body temperature but a larger portion of the energy is used to synthesis adenosine triphosphate from adenosine diphosphate and inorganic phosphate // ATP acts as instant energy source which supply for all living cells // each ATP molecules consist of three phosphate groups and this phosphate bonds can be easily broken down to release energy.

Anaerobic respiration in human muscle

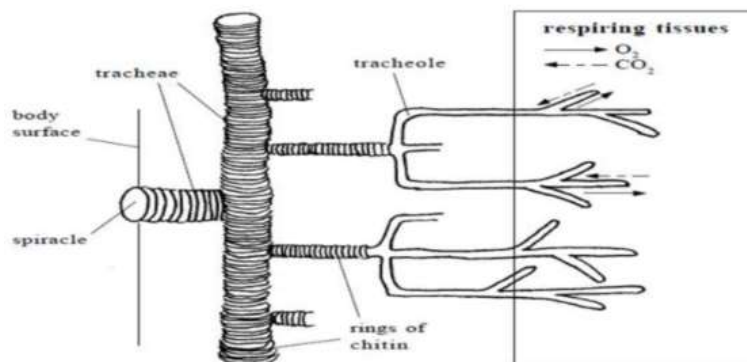
During vigorous activities, the cells are using ATP at a high rate // the lungs and circulatory system cannot deliver sufficient oxygen to the cells for cellular respiration and the blood cannot supply

oxygen fast enough to meet their requirements // the muscles are forced to do work without enough oxygen supply // the muscles are in a state of oxygen deficiency and oxygen debt occurred // during anaerobic respiration the glucose molecules are partially broken down into lactic acid, with only a limited amount of energy being produced instead of carbon dioxide and water // high accumulation of lactic acid can cause muscle cramp and fatigue // this contributes to the exhaustion of a person after a period of vigorous activities // the person then needs to breathe heavily and deeply in order to inhale more oxygen to oxidized the accumulated lactic acid to carbon dioxide, water and energy // the remaining lactic acid is converted into glycogen and stored in muscle cells // the oxygen debt is paid after an increased breathing rate and increase intake of oxygen in order to remove lactic acid from the muscle cells.

Differences respiration process of an athlete during and after vigorous activities

During vigorous activities	After vigorous activities
Intake of oxygen cannot meet the oxygen demand of the cells	There is sufficient amount of oxygen supply to the cells
Anaerobic respiration occurs	Aerobic respiration occurs
Glucose molecules are incompletely oxidized	Glucose molecules are completely oxidized
2 ATP molecules are produced	38 ATP molecules are produced
Concentration of lactic acid in the blood increases	Concentration of lactic acid in the blood decreases
Lactic acid accumulates in the body	Lactic acid is oxidized and eliminated from the body
Oxygen debt occurs	Oxygen debt is paid off
Process takes place in the cytoplasm	Process takes place in the mitochondria

Respiratory structure of insects

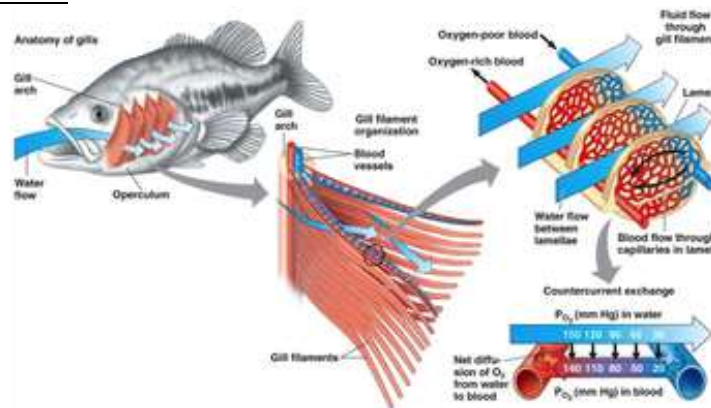


The respiratory system of insects is known as the tracheal system // the tracheal system consists of a network of air tubes called tracheae and it is lined with rings of chitin to prevent them from collapsing // air enters the tracheae through tiny openings called spiracles which is located along the sides of the thorax and abdomen of an insect // spiracles have valves which can open and close allowing the movement of air going in and out of the body // the tracheae branches into fine tube called tracheoles which are large in numbers that has a thin permeable wall and contains fluid to dissolve respiratory gases // some insects like grasshopper have air sacs to speed up gaseous exchange in their tracheal system

Breathing mechanism of insects

Insects inhale and exhale through the rhythmic contraction and expansion of their abdominal muscle // the body movements and the contractions of abdominal muscles speed up the rate of gas diffusion from the tracheae into the body cells // when insect inhales , the abdominal muscles relax and the spiracles open // air pressure inside the tracheae decreases and air is drawn in //when the insect exhales , the abdominal muscles contract // the increased air pressure forces air out through the spiracles // the tracheal system with its network of small tubes allows oxygen to be absorbed directly from the atmosphere into body cells, therefore there is no circulatory system in secret

Respiratory structure of a fish

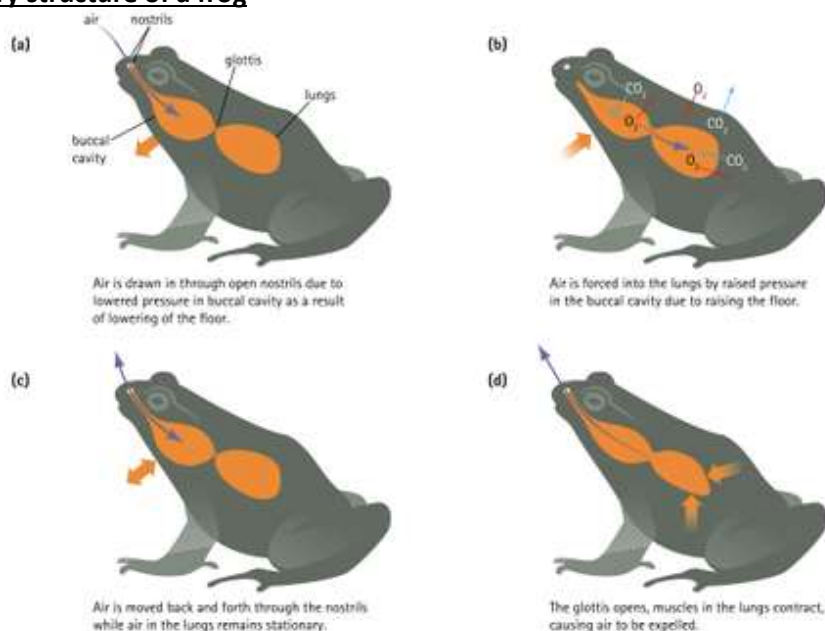


Gills which is supported by a gill arch and protected by the operculum that are specialized respiratory structure for gaseous exchange in water // bony fish have four pairs of gills on each side // each gills has two rows of thin filaments arranged in V-shape and these filaments consist of numerous thin walled lamellae that provides a large surface area for gaseous exchange // the membrane of the gill filaments are thin to allow absorption of respiratory gases into the blood capillaries // the filaments which are surrounded by water are supplied with blood capillaries for efficient transporting and dissolving of respiratory gases // the efficiency of the gaseous exchange is further enhance by the countercurrent exchange mechanism at the respiratory surface // this countercurrent flow maximizes the oxygen transfer because as water flows over the gills in one direction , the blood flows in the opposite direction through the blood capillaries in the lamellae // as deoxygenated blood enters the blood capillaries ,it meets with the water with a higher oxygen content and simple diffusion will occur

Breathing mechanism of fish

During inhalation, the floor of the buccal cavity lowers and at the same time the opercular cavity enlarges and the operculum closes // this lowers the pressure in the buccal cavity so water with dissolved oxygen is drawn into the mouth // during exhalation, when the mouth closes, the floor of the buccal cavity rises so water flows through the lamellae and gaseous exchange between the blood capillaries and water takes place // at the same time , the opercular cavity becomes smaller and the pressure in the buccal cavity is higher than the pressure outside // the higher water pressure forces the opercular to open and water to flow out through the operculum

Respiratory structure of a frog

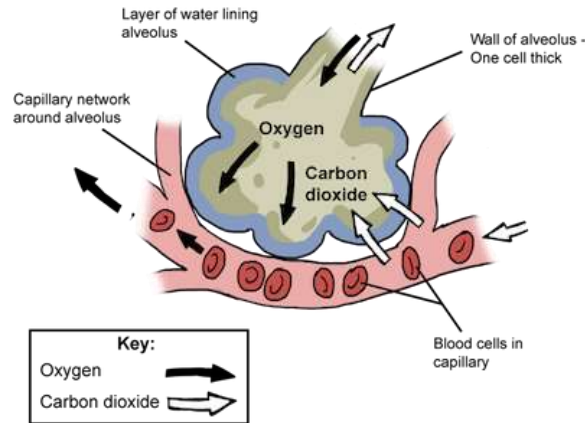


The gaseous exchange of a frog occurs mainly through the skin, when times of inactivity and the lungs // the skin is thin, permeable and constantly moist by mucus secreted by glands found on the surface of the body to enable rapid and efficient gaseous exchange // beneath the skin is a network of blood capillaries that transport respiratory gases to and from all parts of body cells // the lungs of a frog consist of a pair of thin walled sacs connected to the mouth through an opening called the glottis // the surface area in the lungs is increased by the presence of numerous inner partitions // the membranes of the lungs are thin and moist for efficient gaseous exchange // the lungs are supplied with rich network of blood capillaries to transport the respiratory gases to the body cells.

Breathing mechanism of frogs

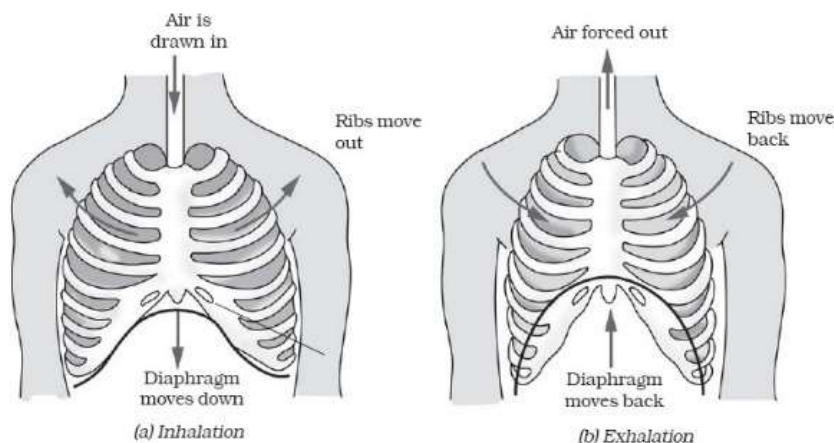
During inhalation, as frog breathes in through its nostrils, the bucco-pharyngeal floor lowers and the glottis closes // fresh air is drawn into the bucco-pharyngeal cavity while stale air still remains in the lungs // when the glottis open, the nostrils close and the bucco-pharyngeal floor rises making the increase air pressure forces air into the lungs // the lungs expand when air is pushed in from the bucco-pharyngeal cavity and the rapid movements of the bucco-pharyngeal floor in the frog accumulate fresh air for lung ventilation // during exhalation, when the lungs muscle contract , air is expelled from the lungs which is aided by the abdominal pressure and elasticity of the lungs // some air escapes through the nostrils while the rest of the air mixes with that in the bucco-pharyngeal cavity // the bucco-pharyngeal floor has strong muscular walls that is constantly moving upwards and downwards to enable breathing through the nostrils

Respiratory structure of human



Gaseous exchange takes place in the alveoli of the lungs // The inner surface of each alveolus is lined with a layer of moist epithelial cell which enables oxygen and carbon dioxide to dissolve in and diffuse into the alveoli // the alveoli are thin walled air sacs and one cell thick only which allows the diffusion of gases across the membranes to take place easily // the trachea, bronchi and bronchioles are complex network of air tubes that bring air in and out of the lungs // the epithelial cells of the trachea are lined with cilia and between the epithelial cells are goblet cells which secrete mucus // the mucus traps dust and microorganism present in the air while the cilia sweeps the mucus together with the trap substances towards the back of the mouth to be swallowed or coughed out // hence the air that enters the lungs is clean and warmed to body temperature and moistened // the entire outer surface of each alveolus is covered by a dense network of blood capillaries // this network of blood capillaries provide a large TSA/V ratio for rapid diffusion and transport of respiratory gases.

Breathing mechanism of humans



During inhalation the external intercostal muscles contract while the internal intercostal muscles relax making the rib cage to move upwards and outwards // at the same time the diaphragm muscles contract, then lowers and flattens // these actions cause the volume of the thoracic cavity to increase and the pressure of the thoracic cavity decreases so the higher atmospheric pressure outside forces the air into the lungs // during exhalation, the external intercostal muscle relax while the internal intercostal muscle contracts making the rib cage to move downwards and inwards // at the same time, the diaphragm muscles relax then curves upwards into a dome-shaped // these action causes the volume of the thoracic cavity to decrease and the pressure of

the thoracic cavity increases so the higher atmospheric pressure inside the lungs forces the air out of the lungs

Partial pressure of oxygen and carbon dioxide

Gas	Partial pressure in the alveoli	Partial pressure in the blood capillaries	Partial pressure in tissue capillaries	Partial pressure in body cells
Oxygen	High	Low	High	Low
Carbon dioxide	Low	High	Low	High
Effects	Oxygen diffuses from the alveoli into the blood capillaries	Carbon dioxide diffuses from the blood capillaries into the alveoli	Oxygen diffuses from the tissue capillaries into the body cells	Carbon dioxide diffuses from the body cells into the tissue capillaries

Transport of oxygen and carbon dioxide in humans

After gaseous exchange has taken place, the oxygen in the blood that leaves the alveoli is transported to the body cells for cellular respiration // the transport of oxygen is carried out by the blood circulatory system // oxygen combines with the respiratory pigment called haemoglobin in the red blood cells to form oxyhaemoglobin // each haemoglobin molecule can carry four molecules of oxygen // oxygen is then carried in the form of oxyhaemoglobin to every part of the body // when the blood passes through tissue with low partial pressure of oxygen, the oxyhaemoglobin dissociates itself to release oxygen molecules // carbon dioxide is released by respiring cells can be transported in three ways // firstly as dissolved carbon dioxide in the blood plasma // secondly the carbon dioxide binds itself to the haemoglobin and is transported as carbaminohaemoglobin // the carbon dioxide is transported in the blood in the form of bicarbonate ions // carbon dioxide is expelled with water vapour from the lungs

Breathing mechanism of human at high altitude

At high altitudes, the atmospheric pressure is low and may lead to difficulty in breathing // Carbon dioxide is constantly produced by the body and the lungs remove it by allowing it to diffuse into the fresh air in the lungs // Increasing the flow of fresh air through the lungs, by hyperventilating, increases the rate at which CO₂ is lost // Because CO₂ is an acid gas, losing more of it from the blood leaves the blood relatively alkaline // At altitudes up to about 6000m, the kidneys correct the alkalinity of the blood over a few days by removing alkali in the form of bicarbonate ions, HCO₃⁻ from the blood // above 10 000 feet, the decreased partial pressure of oxygen causes a drop in oxygen level of blood // initially, a person will experience headaches, nausea and dizziness // however after a few days, the body will adjust to the condition as the tendency of haemoglobin to combine with oxygen is reduced and more oxygen is released to the body tissues

Contents of oxygen, carbon dioxide, water and heat in inhaled water and exhaled air.

Content	Inhaled air	Exhaled air
Oxygen	21.09 %	16.4 %
Carbon dioxide	0.03 %	4.1 %

Nitrogen	79.0 %	79.0 %
Water vapour	Varies and never saturated	Saturated
Temperature	Room temperature	Body temperature

Effects of smoking



Smoking is the act of inhaling smoke from burning tobacco // the heat and dryness will cause irritation in the lungs and can lead to laryngitis // laryngitis makes speaking difficult and painful // the two main components of cigarette smoke are tar and nicotine // the tar in tobacco can cause lung cancer and deposit on the bronchioles // nicotine in the tobacco smoke is a chemical which is absorbed into the bloodstream and transported to the body // nicotine is also a stimulant which makes the heart beats faster thus constricting the blood vessels making the heart pump harder and rises blood pressure // nicotine restrict the movement of cilia, making it harder for the lungs to get rid of tar and causes addiction to the smoker // carbon monoxide is a compound in the cigarette smoke that competes to bind with the haemoglobin and forms carboxyhaemoglobin // since carboxyhaemoglobin is a stable compound, it reduces the supply of oxygen to the cells thus reducing the aerobic respiration // nitrogen dioxide from cigarette smoke can dissolve in the mucus to form an acidic medium which erodes lung tissues

Comparison of the respiratory system between humans and other organism

Large TSA/V for efficient gaseous exchange // cells lining the respiratory structures are thin allowing gas diffusion is efficient // surface for gaseous exchange is constantly moist for the respiratory gases to dissolve in them

Characteristic	Protozoa	Insects	Fish	Amphibians	Humans
Respiratory system	None	Tracheal system	Gills	Skin and pulmonary system	Human respiratory system
Respiratory organs	None	Tracheae	Gills	Skins and lungs	Lungs
Respiratory structure	Plasma membrane	Tracheoles	Filaments and lamellae	Lungs and skin	Alveoli
Respiratory openings	None	Spiracles	Mouth and operculum	Nostrils	Nostrils
Network of blood capillaries	None	None	Filaments are rich in blood capillaries	Skins and lungs are rich in blood capillaries	The alveoli are rich in blood capillaries

Air passages	None	Spiracles – tracheae – tracheoles – body cells	Mouth – opercular cavity – gills and lamellae – operculum	Nostrils – bucco pharyngeal cavity – lungs	Nostrils – trachea – bronchi – bronchioles – alveoli
Structure that helps external respiration	None	Thorax abdomen	Operculum and muscular walls of the floor of the buccal cavity	The strong muscular walls of the bucco pharyngeal floor	Diaphragm ,rib cage and intercostal muscle

The pathway of gaseous exchange in a leaf during respiration

When the stomata open, they connect the air spaces within the atmosphere // oxygen from the atmosphere diffuses into the air spaces and then dissolves in the film of water around the mesophyll cells // oxygen is then used in the aerobic respiration // the concentration of oxygen in the cells becomes lower than the concentration of oxygen in the air spaces // the difference in the concentration gradient allows oxygen to diffuse continuously from the air spaces into the cells // during the day, the carbon dioxide which is produced during aerobic respiration is used in photosynthesis // the excess carbon dioxide diffuses into the air spaces and then through the stomata into the atmosphere //

Comparison between respiration and photosynthesis

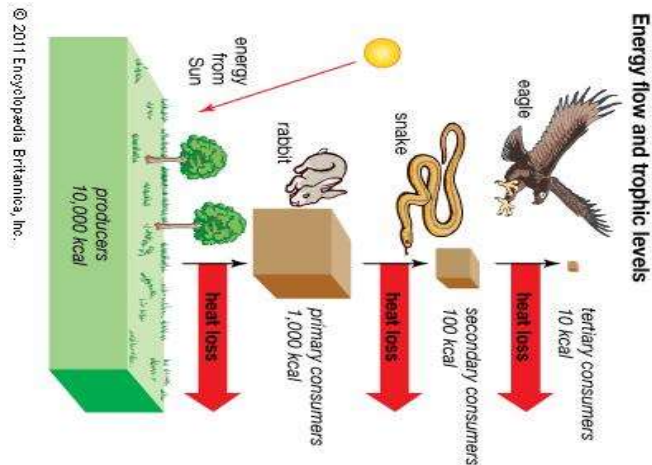
Process	Photosynthesis	Respiration
Occurrence	Occurs in all green plants	Occurs in all living organism
Purpose	Stores energy	Releases energy
Raw materials	Water and carbon dioxide	Glucose and oxygen
Products	Glucose and oxygen	Energy water and carbon dioxide
Energy requirement	Light energy	No light energy needed
Takes place in	Chloroplast	Mitochondria
Presence of chlorophyll	Required	Not required

Differences in gaseous exchange in a flowering plant and a human

Flowering plants	Humans
The organ involve is the leaf	The organ involve are the lungs
Respiratory gas enters the leaf through the process of diffusion	Respiratory gas enters the lungs through the process of inhalation
Numerous palisade mesophyll, spongy mesophyll and air spaces provides a large surface area for gaseous exchange	Numerous alveoli provide a large surface area for gaseous exchange
The surface of palisade mesophyll and spongy mesophyll are moist to allow oxygen to diffuse into the cell	Alveoli are covered by a thin film of moisture to allow oxygen to diffuse through the wall into the blood capillaries

CHAPTER 8: DYNAMIC ECOSYSTEM

Energy flow and how it is lost to the environment



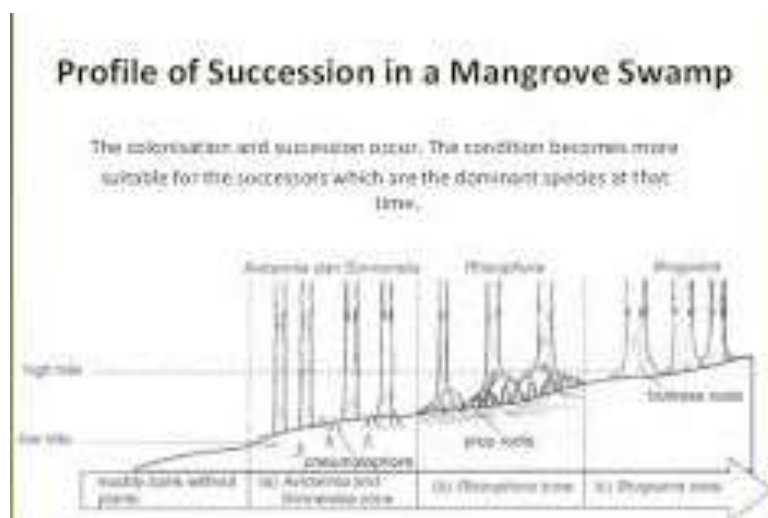
As one organism eats one another, energy is transferred from one trophic level to the next // in a food web the producer absorb solar energy and convert it during photosynthesis into chemical energy that is used for cell division, growth and reproduction // when the producer dies, this energy is made available to the decomposer // when a primary consumers(herbivore) eat the producers, part of the energy stored in the plants is transferred to the primary consumers // about 10% of a producer available energy is passed on to the primary consumers which eat it, the 90% of the energy is lost when it is transferred from one trophic level to the next // the consumers release the obtained energy through cellular respiration and this energy is used for growth , movement and maintaining body temperature // through excretion and defaecation some of the energy of the herbivores becomes available for the decomposer // when the secondary consumer (carnivore) eats a primary consumer , the primary consumer's available energy is transferred to the secondary consumer // the secondary consumer also loses energy through defecation, respiration and excretion // the carnivore is then eaten up by tertiary consumer (carnivore) and this feeding relationship is an energy flow through a food web in an ecosystem // since about 10% of the energy is available to each subsequent consumer , the energy level becomes too low to be sufficient enough to sustain the consumer at the end of the food chain // hence food chains rarely have more than four trophic levels between producer and the final consumer

The adaptation of mangrove plants

Problem faced by mangrove swamps	Adaptations
Soft muddy soil and strong coastal winds pose support problems	For support, mangrove trees have long branched underground cable roots (Avicennia sp.) // another mangrove species have prop roots (Rhizophora sp.) // aerial roots anchor the plants from muddy soil
High concentration of water in the soil reduce the amount of oxygen	The Avicennia sp. has breathing roots called pneumatophores which grows vertically upwards and each pneumatophores has numerous that allow gaseous exchange to occur during low tides // the bark of the

available and this lead to anaerobic respiration	mangrove trees has pores called lenticels to allow gaseous exchange
Direct sunlight leads to increased rate of transpiration	The leaves of mangrove trees are covered by a thick layer of cuticle which reduces transpiration during hot days and able to store water
High salt concentration of the sea water makes the surrounding water in the soil hypertonic compared to the root cell sap	The cell sap in root cells of the mangrove tree has a higher osmotic pressure than the soil water that surrounds them // this ensures that the water is not loss through osmosis but the excess salt that enters the roots is then excreted as crystalline salt from the hydathodes, the pores on the lower epidermis of leaves
Seeds fall then die after being submerged in the soft and waterlogged soil	Mangrove seeds are able to germinate while still attached to the mother plant and this phenomenon is called viviparity // viviparity increases the survival chances as the seedlings can horizontally float on the water and subsequently get washed up on the sad where they establish a new population

Colonization and succession in a mangrove swamp

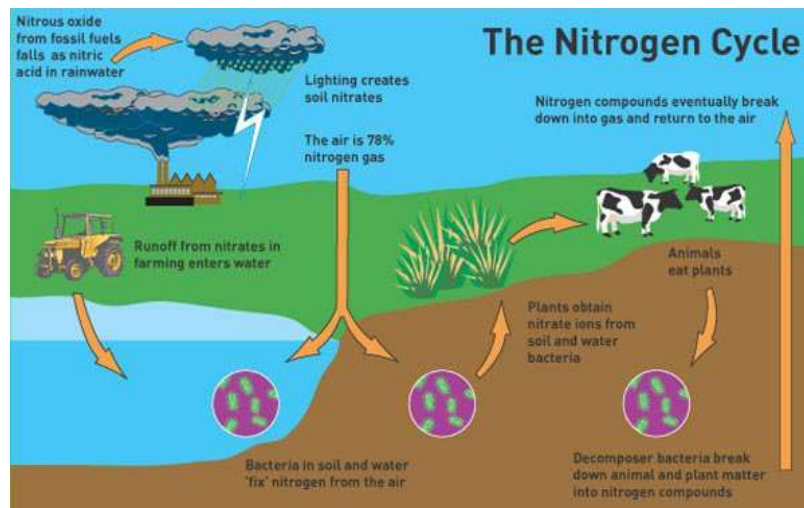


Mangrove swamps have muddy soft soil that are hostile environment for normal plants because the soil has low levels of oxygen and high concentration of salts // the pioneer species of mangrove swamps are the Sonneratia sp. and Avicennia sp. // the presence of these species gradually changes the physical environment of the habitat // the extensive root systems of these plants trap and collect sediments, including organic matter from decaying plants // as time passes, the soil becomes more compact and firm thus making condition favors the growth of Rhizophora sp. // gradually the Rhizophora sp. replaces the pioneer species and the prop root system of the Rhizophora sp. traps silts and muds, creating a firmer soil structure over time // the ground becomes higher and as a result the soil is drier because it is less submerged by sea water // the condition now becomes more suitable for another mangrove species, the Bruguiera sp., which replaces the Rhizophora sp. // the buttress root system of the Bruguier sp. forms loops which extend from the soil to trap more slit and mud // as more sediments are deposited, the shore extends further to the sea and the old shore is now further away from the sea thus it is like terrestrial ground // over time, terrestrial plants like the Nipah palm and Pandanus sp. begin to replace Bruguier sp.

Colonization and succession in a pond

Succession in a disused pond begins with growth of pioneer species such as phytoplankton, algae and submerged plants like the Hydrilla sp., Cabomba sp. and Elodea sp. // these plants have special adaptive features which enable them to colonize the pond and their fibrous roots penetrate deep into the soil to absorb nutrients and bind sand particles together // plenty of sunlight penetrates through the clear water allow photosynthesis to take place // when the pioneer species die and decompose, more organic nutrients are released into the pond and these organic matter is converted into humus at the pond base // the humus and soil which erode from the sides of the pond are deposited on the base of the pond, making the pond shallower // this condition becomes unfavorable for submerged plants but more suitable for floating such as duckweeds, water hyacinths and lotus plants // these plants float freely on the surface of the water and receive sunlight directly thus making them reproduce rapidly by vegetative propagation // as the floating plants spread to cover the surface of the water, it prevents sunlight from reaching the submerged plants thus making it die because they cannot photosynthesis // the decomposed remains of the submerged plants add more organic matter on the base of the pond and sediments being deposited on the base of the pond

Nitrogen cycle



In the atmosphere, there is 79% nitrogen gas and the lightning will supply oxygen and nitrogen to form nitrogen oxide and also water vapour // plants can only use nitrogen in the form of ammonium, nitrite or nitrate ions which is absorbed from the soil because the water and nitrogen combined together in the cloud to give out rain which contain nitric acid thus will go down to the soil // plant will absorb the nitrogen for 3R1G purposes and the extra nitrogen will be kept to be converted into plant proteins // when the animals eat the plant, the organic nitrogen is transferred into the body of the animal and become animal protein and have amino acid // waste materials, dead plants and animals are decomposed by decaying bacteria and fungi into ammonium compound // ammonium compounds are converted into nitrites and nitrates by nitrifying bacteria which are the Nitrosomonas sp and Nitrobacter sp. through a process called nitrification // the cycle is balanced by a continuous return of nitrogen to the atmosphere by denitrifying bacteria through denitrification // these bacteria break down nitrates into gaseous nitrogen and oxygen // the oxygen is used by the bacteria while the nitrogen returns to the atmosphere

The importance of maintaining the biodiversity in a pond

Biodiversity is a source of food like fish or other aquatic animals that has high nutritional content // biodiversity is a source of oxygen supply // aquatic green plants undergo photosynthesis and it

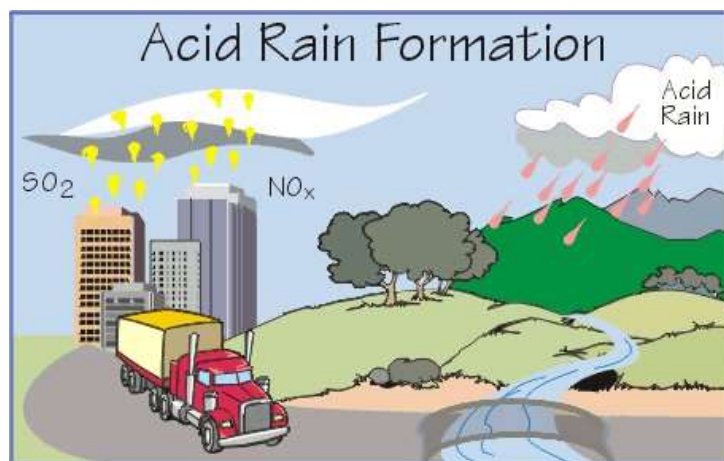
releases oxygen as a product // biodiversity is a source of carbon dioxide because aquatic organism undergo respiration that releases carbon dioxide // biodiversity is a clean water supply for domestic usage // interaction between plants and animals are important in an ecosystem // biodiversity sustains the food chains in the ecosystem

CHAPTER 9: ENDANGERED ECOSYSTEM

Deforestation

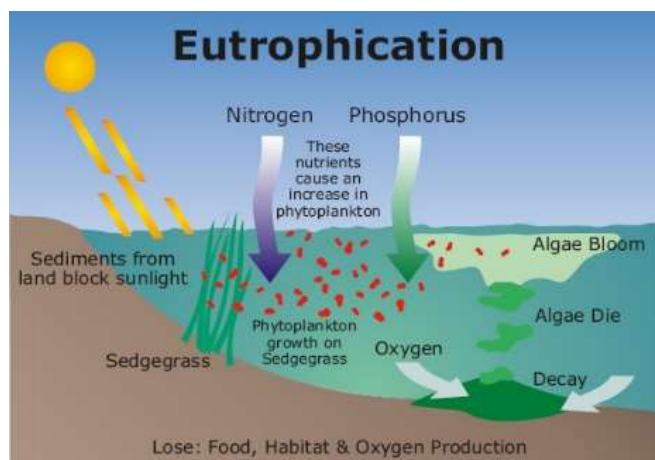
The rapid destruction of woodlands or removal of trees from forests is known as deforestation // vast areas are cleared for agriculture and development yearly // tropical rainforest are the habitat for most of the flora and fauna of earth // rainforests contains unique species that provide food, medicine and other biological products // rainforest also regulate climate by influencing wind, rainfall, humidity, temperature patterns and absorb carbon dioxide from the atmosphere plus releasing oxygen to the atmosphere // the effects of deforestation are loss of habitat can lead to species extinction // it also has negative consequences for medicinal research and local populations who rely on the animals and plants in the forests for hunting and medicine // Tree roots anchor the soil and without trees, the soil is free to wash or blow away, which can lead to vegetation growth problems //

Acid rain



The combustion of fossil fuels in vehicles' engines and power stations produce huge amounts of sulphur dioxide and oxides of nitrogen in the atmosphere // these gases react with water vapour to form sulphuric acid and nitric acid // they fall to earth as acid rain // the effects of acid rain are the increased acidity of the aquatic ecosystems kills plankton and other organisms which then disrupts the food chain // acid rain releases the ions of heavy metals like lead which can contaminate the supply of drinking water and able to corrodes metals and stoneworks // acid rain makes the soil becomes acidic making it unsuitable for farming and leaching of minerals like calcium from the soil makes the soil infertile // the solutions to acid rains are using scrubbers to clean up emissions from power stations // then acid rain can be reduced by using catalytic converters to clean up exhaust emissions by reacting pollutants with each other to form less harmful substances.

Eutrophication

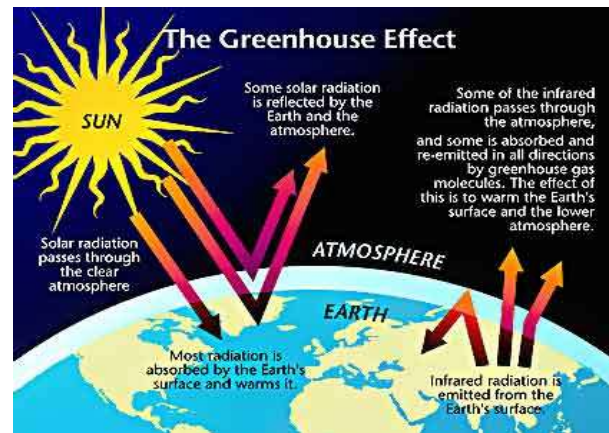


Eutrophication is the adding of high nutrient content into water bodies // the causes of eutrophication are the high nutrient contents from untreated sewage , leaching of fertilizers which are mainly nitrates and phosphate and the liquid manures washed out of farmyards // the effects of eutrophication are the low amount of oxygen in the water causes death of fish and other aquatic organisms // the high amount of nitrates in water may be dangerous to human babies // the process of eutrophication are as follows // the excess nitrate and phosphate that cannot be absorbed by the plants would flow into ponds or rivers // high content of nitrates and phosphate in the pond water increases the fast growth of algae on the surface of the water // the growth of algae can rapidly cover the whole water surface // sunlight is blocked by the algae from passing through the water making the aquatic plants difficult to carry out photosynthesis // this situation is caused by the lack of oxygen in the water // the aquatic animals eventually die and the decomposition of their body adds toxic substances to the water // lastly the pond ecosystem is unstable and begins to collapse

Thermal pollution

Thermal pollution is the production and release of excessive heat into the environment // the cause of thermal pollution are the hot water from power stations and factories is released into nearby ponds and rivers // The excess heat liberated into the lakes and rivers raises from the water temperature by 5-10°C and the reflection of heat from glass buildings contributes to thermal pollution // The effects of thermal pollution is the rise in temperature will lower the oxygen content of water because oxygen is less soluble in water with high temperature // a sudden increase of temperature can kill aquatic life because some species can only survive with certain range of temperature and this leads to faster growth of algae thus result in a higher BOD in the water // Ways to prevent thermal pollution are controlling the amount of hot water discharged from industrial plants and water stations into surroundings lakes and rivers.

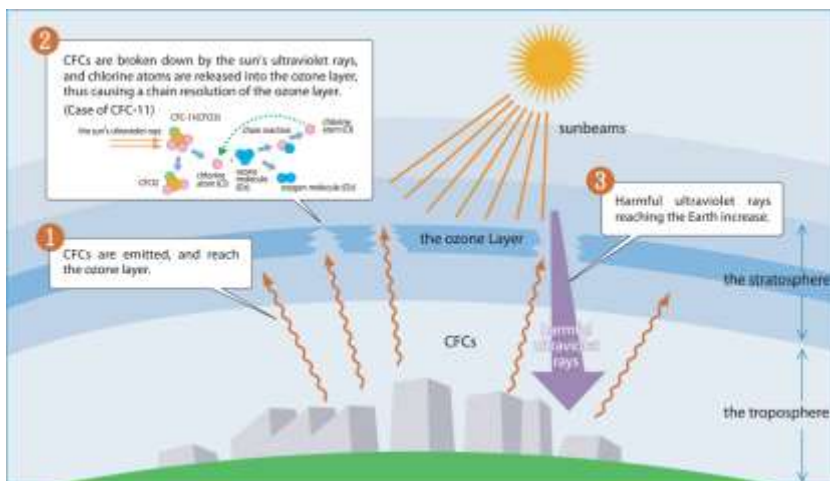
Global warming



The high levels of carbon dioxide traps heat in the atmosphere // the layer of carbon dioxide and other greenhouse gases prevent heat from being reflected back to outer space // this causes a rise in temperature which leads to greenhouse effect // global warming results in melting of glaciers in the north and south poles that causes sea level rises and this causes flooding in low-lying areas // global warming cause climate changes such as prolonged drought and this high temperature will reduce the rate of photosynthesis // land becomes infertile and dry which leads to lower crop yields // Changes in weather will effect distribution of rainfall and extinction of certain species

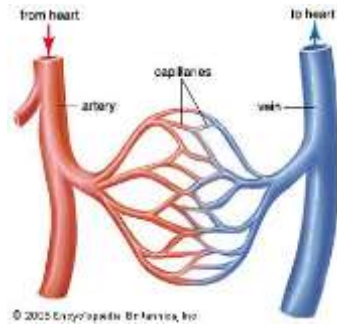
Ozone Depletion

The ozone layer contains high concentration of ozone molecules that absorbs ultraviolet radiation and shield organism from its damaging effect // the causes of ozone depletion are the increasing level of chlorofluorocarbon (CFCs) in the atmosphere // CFCs are very active chemicals that contains chlorine, carbon and fluorine which are mainly used as coolants in air conditioners and refrigerator, propellants in aerosol cans and foaming agents in the making of styrofoam packaging // CFCs are extremely stable and can remain stable for more than 75 years and once there are in the stratosphere, CFCs are broken down by ultraviolet rays // highly reactive chlorine radicals are released and it breaks down the ozone molecules in a chain reaction // the effects of ozone depletion are skin cancer, mutations, cataracts and sunburns // ultraviolet radiation weakens the immune system and the ability of the body to resist infectious diseases // leaf cells and chlorophyll are damaged by the UV rays thus lowering rate of photosynthesis // it rises the temperature on earth and certain level of UV radiation can damage eggs of certain amphibians



CHAPTER 1: TRANSPORT

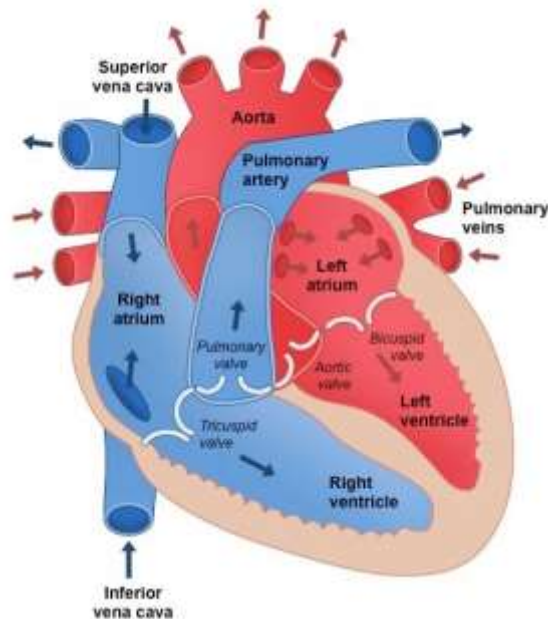
The differences between arteries, capillaries and veins



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Characteristics	Arteries	Capillaries	Veins
Wall	Thick, muscular and elastic	One cell thick, no muscles or elastic tissue	Thin, less muscular, less elastic
Lumen	Small	Very small	Large
Valve	No valve	No valve	Have valves
Blood pressure	High	Low	Very low
Blood flow	From the heart to the organs	From arteries to veins	From all parts of the body to the heart
Blood content	Oxygenated blood except pulmonary artery	Oxygenated blood at the arteriole end and deoxygenated at the venule end	Deoxygenated blood except for pulmonary veins
Functions	To transport blood rapidly from the heart to the body tissues	Allow rapid gaseous exchange between blood and body cells	Allow blood from the tissues to return to the heart

The pumping of the heart



The heart is made up of cardiac muscles which are interconnected // this arrangement allow electrical signals to be conducted rapidly through the heart and stimulates the cardiac muscles to contract in a coordinated way // cardiac muscles are myogenic, which means they can contract and relax without receiving impulses from the nervous system // the contraction of the heart is initiated and coordinated by a pacemaker, a clustered of specialized muscles // the pacemaker is situated in the wall of the right atrium // it generates electrical impulses which spread rapidly over the walls of atria, causing the atria to contract antagonistically // from the SA node, the impulse reach the AV node // from the AV node, specialized muscle fibres called his bundle , bundle branches and purkinje fibres send the signals to the apex of the heart and throughout the walls of the ventricles, causing the ventricles to contract // this push the blood out to the lungs and body

The regulation of blood pressure

When blood pressure increases for example during physical exercises, the baroreceptors in the arch of the aorta and carotid arteries are stimulated // the increased rate of nerve impulses is sent to the cardiovascular center in the medulla oblongata at the brain // the cardiovascular center sends nerve impulses to the effectors // the effectors will make the cardiac muscles contraction weaker, smooth muscles of arteries will relax and the decrease blood flow in the blood vessels // the widening of blood vessels is known as vasodilation // the weaker cardiac muscle contraction and lower rate of resistance of blood flow which decreases the blood pressure and brings it back to normal

Circulatory system of insects

One or more hearts pump the haemolymph through the vessels and into the haemocoel // the haemocoel contains soft internal organs and is filled with the haemolymph // here a chemical exchange between the haemolymph and the body cells takes place // the haemolymph flows from the heart into the haemocoel when the hearts contract // when the heart relax, the haemolymph is drawn through the pores called ostia, back into the heart // the ostia are equipped with valves that closes when the hearts contract

Circulatory system of fish

A fish has a heart with two main chambers, one atrium and one ventricle // blood leaving the ventricle goes first to the gill capillaries where gaseous exchange takes place // the gill capillaries converge into a vessel that carries the oxygenated blood to the body capillaries or systemic capillaries // in the systemic capillaries, oxygen diffuses into the tissues while carbon dioxide diffuses out of the tissues and into the capillaries // the oxygenated blood then returns to the atrium of the heart through the veins // since the circulatory system of a fish has only one circuit, blood goes to the gill capillaries and then the systemic capillaries // hence it is called a single closed circulatory system

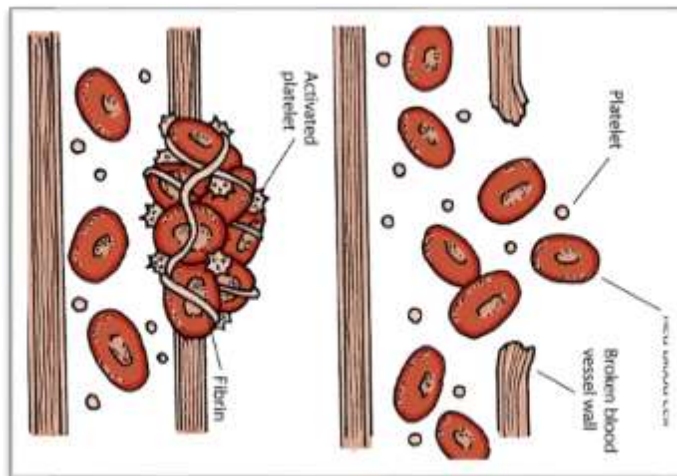
Circulatory system of humans

Humans have four-chambered heart, two atria and two completely separated ventricles which prevents deoxygenated blood and oxygenated blood to mix // the four chambers ensure efficient and rapid movement of highly oxygenated blood to the organs of the body // in the pulmonary circulation, the oxygenated blood is pumped into the pulmonary arteries and these arteries carry the blood to the lungs where it passes through the blood capillaries // this enables the release of carbon dioxide and the uptake of oxygen from the air // in the systemic circulation, blood is carried from the heart to all parts of the body except the lungs // the oxygenated blood from the lungs returns to the left atrium and flows into the left ventricle and the blood is then pumped to the body tissues through the aorta .

The differences between the circulatory systems of fish, amphibians, insects and humans

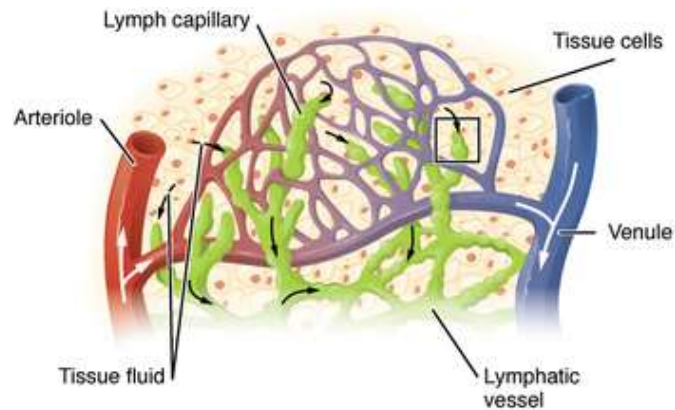
Organism	Fish	Amphibians	Humans	insects
Type of circulatory system	Single closed circulatory system	Double closed circulatory system	Double closed circulatory system	Open circulatory system
Number of atrium	One	Two	Two	None
Number of ventricle	One	One	Two	None
Presence of septum	Does not have	Does not have	Present	Does not have
Separation of oxygenated and deoxygenated blood	Mixed	Mixed	Separated	-
Gaseous exchange takes place in	Gills	Moist skin	Lungs	Haemocoel

The mechanism of blood clotting



When a vessel in the body is damaged, the connective tissue in the vessel wall is exposed to the blood plasma // platelets stick rapidly to the connective tissue and release chemicals called clotting factors that make the surrounding platelets sticky // the aggregation of platelets forms a plug called platelet plug which stops blood loss completely if the damage area is small // the clumped platelets, damaged cells and clotting factors in the plasma form activators called thromboplastins // these activators, together with calcium and vitamin K will convert prothrombin, an inactive plasma protein to thrombin, an active plasma protein // thrombin will catalyze the conversion of fibrinogen in the plasma membrane to insoluble fibrin // fibrin is a fibrous protein which forms mesh over the wound, trapping red blood cell and sealing the wound // the resulting clots hardens as it exposed to the air and forms scab .

The lymphatic system



when blood flows from arteries into capillaries, there is a higher hydrostatic pressure at the arterial end of the capillaries // the high pressure causes some of the blood plasma to pass through capillary walls then into the intercellular spaces // the interstitial fluid fills the spaces between cells and constantly bathes the cells // 90% of interstitial fluid diffuses back into blood capillaries and 10% of the interstitial fluid goes into the lymph capillaries // the fluid inside the capillaries is known as lymph, a transparent yellowish fluid // lymph capillaries converge together forming a larger lymphatic vessels // located at the intervals along the lymphatic vessels are the lymph nodes and its functions to produce and store lymphocytes, and protect the body against infection // the lymphatic vessels channels to the thoracic duct and right lymphatic duct // the thoracic duct empties its lymph into the left subclavian vein and right lymphatic duct // hence the lymph is drained back into the blood

Differences between blood and lymph

Lymph	Blood
It is a colorless fluid that does not contain RBCs	It is a red-colored fluid that contains RBCs
It contains plasma and less number of WBCs and platelets	It contains abundant RBCs, WBCs and platelets
It helps in body defence system and a part of the immune system	It is associated with the circulation of oxygen and carbon dioxide
Its plasma lacks protein	Its plasma has proteins, calcium and phosphorus
It transport nutrients from the tissue cells to the blood, through lymphatic vessels	It transport nutrients and oxygen from one organ to another
The flow of lymph is slow	The flow of blood is faster in blood vessels
Contains more lymphocytes because as lymph flows through the lymphatic nodes, lymphocytes are produced	Contains less lymphocytes

Phagocytosis in second line of defense

The phagocyte is attracted by the chemicals released by the bacteria of damaged cells // the phagocyte extends its pseudopodia towards the bacterium to engulf it // ingestion of the bacterium forms phagosome // the phagosome combines with a lysosome which releases lysozyme into the phagosome // the bacterium inside the phagosome is killed by the lysozyme // the phagocyte releases the digested products from the cell



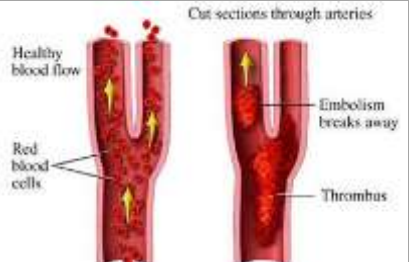
Natural killer cells

Helper T cell gain information from the dead pathogen which is killed by the killer T cell // the helper T cell will send information to the memory cell to produce antibody with the correct codes to kill the other pathogen // when the antibody is ready, the suppressor will stop the killer T cell to kill and allow the antibody to do its work

Inflammation

Inflammation is triggered by antigens // when some of the bacteria or pathogen escaped into the wounds and enters the body, inflammation will occur // the lumen of the blood vessels will expand to allow more blood flow in a faster rate // as this happen it will increase the temperature of the blood to kill the foreign cells

Cardiovascular diseases

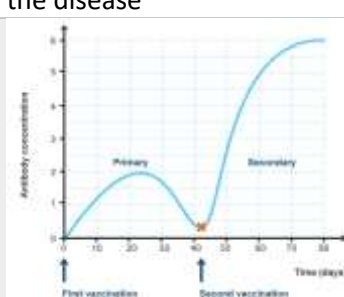
Diseases	Description
Atherosclerosis 	Formation and deposition of plaques on the inner wall of arteries // plaque consists of cholesterol, fats, fibrous, connective tissues and clumps of platelets // the plaques clog the lumen of blood vessels and narrows the lumen // this is the early stage of arteriosclerosis
Arteriosclerosis	Formation and deposition of plaques on the inner walls of arteries // plaque consists of calcium, cholesterol, fats, fibrous connective tissues, dead muscle tissues and clump of platelets // the hard plaques clog the lumen of blood vessels and narrows the blood lumen // the hard plaques also cause the hardening of arteries and decreased elasticity of the arteries
Thrombosis 	A clot forms inside the lumen of an artery // the clog or thrombus is formed when blood flows too slowly or when there is a defect in blood vessels // as a result, clotting factors accumulate and stimulate the formation of clot // the clot slows down or prevents blood flow in blood vessels
Embolism 	When a clot or thrombus moves in the blood vessel, it is called embolus // the embolus inside the lumen of the blood vessel will move until it is lodged in a narrow artery // when this happens, the blood vessels is blocked and blood flow is obstructed

Hypertension

Blood pressure is the force exerted by the blood against the walls of the blood vessels // Medical guidelines define hypertension as a blood pressure higher than 140 over 90 millimeters of mercury (mmHg) // Hypertension is more common in people aged over 60 years. With age, blood pressure can increase steadily as the arteries become stiffer and narrower due to plaque build-up // Long-term hypertension can cause complications through atherosclerosis, where the formation of plaque results in the narrowing of blood vessels. This makes hypertension worse, as the heart must pump harder to deliver blood to the body

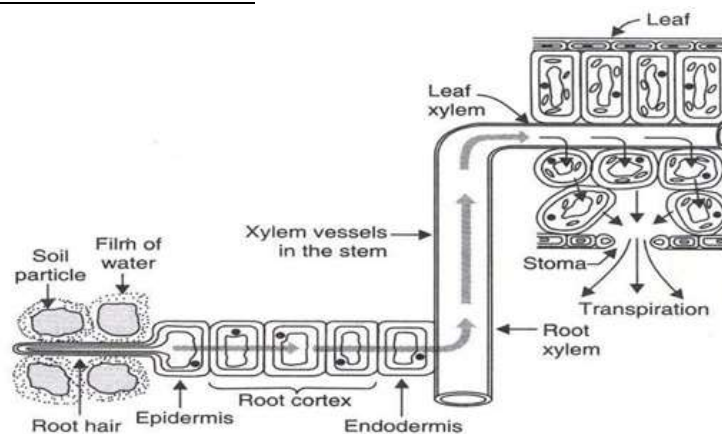
The differences between active immunity and passive immunity

Active immunity	Passive immunity
Obtained by injection of vaccine (artificially acquired)	Obtained by injection or serum (artificially acquired)
Needs time to make own antibody	Immediate immunity
Long lasting	Temporary
Given before the person is infected with the disease	Given when the person is infected or has a high risk getting the diseases



The graph shows antibody concentration on the y-axis (0 to 6) and time in days on the x-axis (0 to 60). The primary response starts at day 0, peaks at day 20 with a concentration of 2, and then declines. The secondary response starts at day 40, peaks at day 50 with a concentration of 6, and then declines. Arrows indicate 'First vaccination or infection' at day 0 and 'Second vaccination or infection' at day 40.

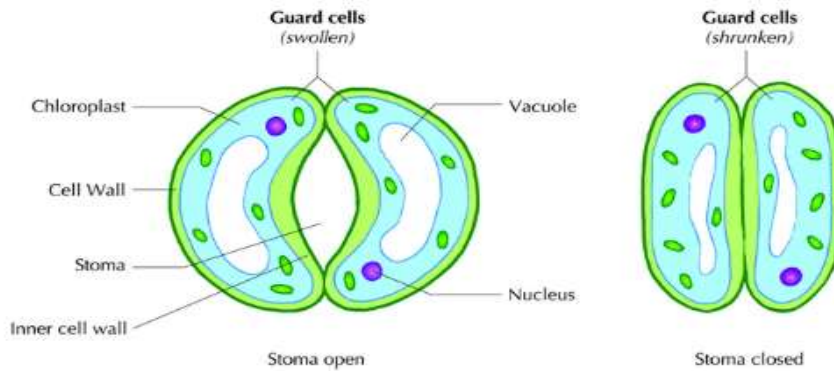
The movement of water from soil to leaves



The root hair are surrounded by soil particles and a thin film of water // root hair cells have a higher concentration of solutes than in the surrounding soil and water enters the root hair via osmosis // root hair cell is hypotonic to the adjacent cells and water diffuses into the adjacent cells // water moves inwards from cell to cell until it reaches the cortex and then the endodermis // the water starts to moves through cytoplasm and vacuole due to the presence of casparian

strips, until it reaches the xylem // the root pressure in the root pushes water up with the aid of cohesive forces between the water molecules to draw up the water in the xylem vessels // the capillary action which draws up the water in the xylem vessels is aided by the adhesive forces between the water molecules and the wall of the xylem // transpirational pull helps to pull the water to the leaves // water evaporates from the surface of mesophyll cells into the surrounding and the empty spaces are replaced by the water in the xylem

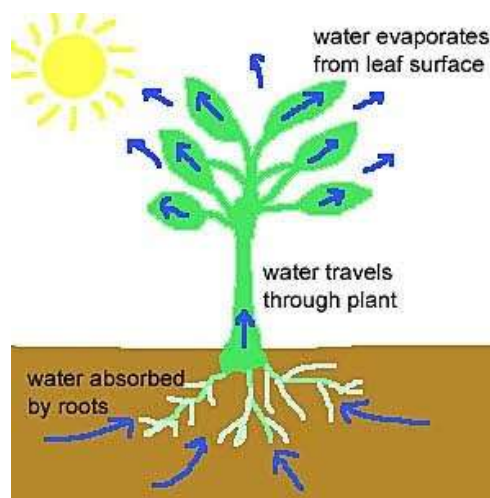
The mechanism of the opening of a stomata



During the day, light stimulates photosynthesis in the guard cells // they start synthesizing glucose and generate the energy required for active transport // the guard cells accumulate potassium ions from the adjacent cells through active transport // the guard cells become hypertonic and water from the adjacent cells enters the guard cell by osmosis // as a result, the guard cells swell up and become turgid // since the inner cell walls of the guard cells are thicker than the outer walls, the guard cells bend outward and the stoma opens // this is because the thinner outer wall stretches more than the thicker wall.

Condition of guard cells during the day	Condition of guard cells during the night
Turgid	Flaccid
Shape of the guard cell is more curved and bent outwards	Shape of the guard cells curved inwards
Stomata opened	Stomata closed

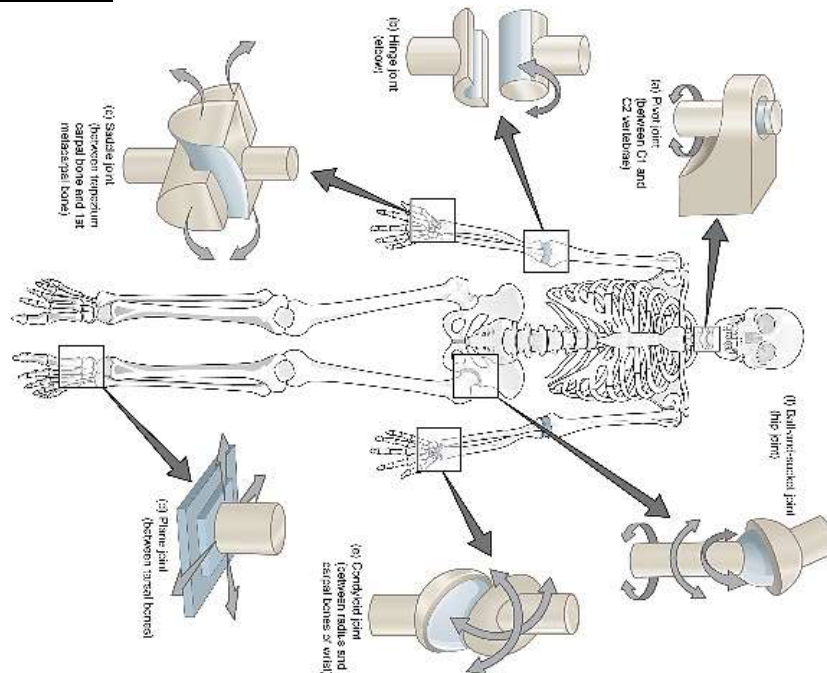
Differences between guttation and transpiration



Guttation	Transpiration
Occurs usually during the night	Occurs usually during the day
Water is lost from the leaves in the form of liquid droplets	Water is lost from the leaves in the form of water vapour
Occurs through the vein endings of a leaf	It occurs through the stomata
It is an uncontrolled process	It is a controlled process

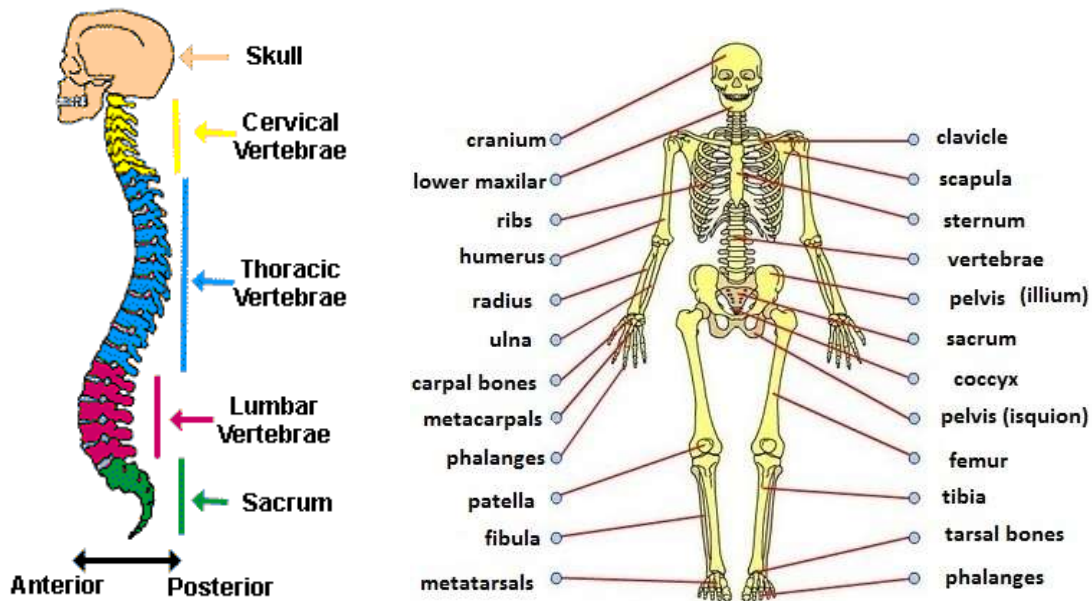
CHAPTER 2: LOCOMOTION AND SUPPORT

Types of joints in humans

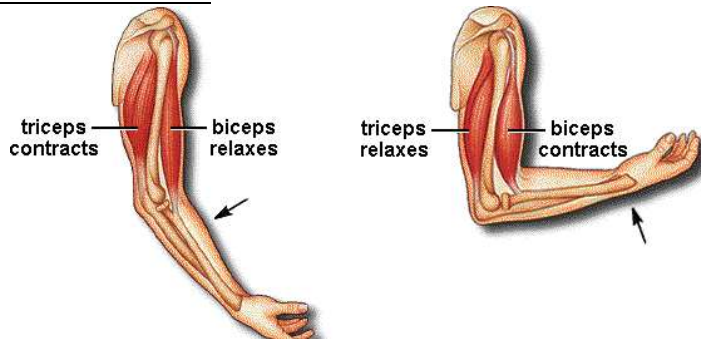


Gliding joints, such as the ones between the carpals of the wrist, are found where bones meet as flat surfaces and allow for the bones to glide past one another in any direction // hinge joints, such as the elbow and knee, limit movement in only one direction so that the angle between bones can increase or decrease at the joint // the limited motion at hinge joints provides for more strength and reinforcement from the bones, muscles, and ligaments that make up the joint // saddle joints, such as the one between the first metacarpal and trapezium bone, permit 360 degree motion by allowing the bones to pivot along two axes // the shoulder and hip joints form the only ball and socket joints in the body // these joints have the freest range of motion of any joint in the body – they are the only joints that can move in a full circle and rotate around their axis

Bones



Movement of the forearm





The muscles involve are the biceps and triceps // these sets of muscle will move antagonistically // when the biceps (flexor) contracts, the tendons transmit the pulling force produced by the contraction to the forearm // at the same time, the triceps relaxes // as a result, the elbow joint bends and the forearms moves upwards // when the triceps(extensor) contracts, the forearm is straightened and at the same time the biceps relaxes.

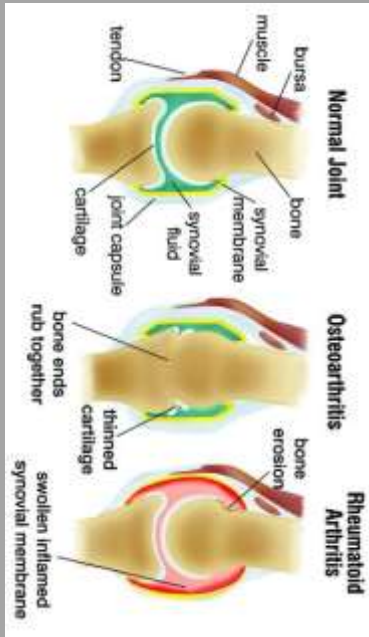
Movement of the leg

The muscles involve are hamstring(bicep femoris) and the quadriceps // these sets of muscle will move antagonistically // the calf muscles contract and raises the heel ball and the leg will be shifted forward // the hamstring muscles contract to pull back to the femur and bends the knee making the leg raised // at the same time the quadriceps relaxes // the weight of the body is supported by the other leg // then the quadriceps contracts and the leg is straightened // at the same time the hamstring relaxes // then the heel touches the ground and the weight is supported to the another leg // the whole sequence is repeated

Consequences of impaired musculoskeletal system on support and locomotion

Disease	Description
<p>Muscle cramp</p>	<p>Muscle cramp is a spontaneous contraction of muscle which is painful and unable to use the affected muscle // a muscle cramp is forcibly unable to contract for about few minutes or longer // when the cramps begin, the spinal cord stimulates the muscle to keep contracting // muscle cramp are common to athletes and older people who perform tough physical exercise // the group of muscle that often affected are the calf, hamstring and the quadriceps // usually poor stretching and muscle fatigue lead to abnormalities in the muscle contraction mechanism</p>
<p>Muscle dystrophy</p>  <p>The diagram is titled "Muscular Dystrophy" and shows two illustrations of a human arm. The left illustration is labeled "Normal biceps" and shows a healthy, thick bicep muscle. The right illustration is labeled "Biceps with MD" and shows a significantly thinner and atrophied bicep muscle.</p>	<p>Muscle dystrophy is caused by the progressive degeneration and weakening of the skeletal muscle // the body muscle gradually become weak as they are replaced by fibrous tissue // this disease is caused by mutated gene in the X chromosome and mainly affects boys</p>
<p>Osteoporosis</p>  <p>The diagram is titled "Osteoporosis" and illustrates the progression of the disease. At the top, it compares a "Healthy bone" (dense and solid) with "Osteoporosis" (porous and brittle). Below this, it shows three human figures representing the progression of bone mass loss over time: "40 years" (normal bone mass), "60 years" (reduced bone mass), and "70 years" (osteoporosis bone mass). At the bottom, three circular cross-sections of bone are shown, labeled "Normal bone mass", "Reduced bone mass", and "Osteoporosis bone mass", showing a clear decrease in bone density and increased porosity from left to right.</p>	<p>Osteoporosis causes the bone to become thinner, more brittle and more porous and the loss of bone mass normally begins after the age of 30 years and accelerates after the age of 45 // this is a common disease in elderly women because it particularly affects women after menopause, when changes in the hormone level like the oestrogen level reduces bone strength // the body needs phosphate and calcium to build bones as we aged // if the intake and insufficient absorption of these minerals, the bone production and bone tissue is affected, resulting in brittle and fragile bones // there are no early signs of osteoporosis but it takes years to be identified // symptoms like fractures of the vertebrae, wrist or hips, reduction in height and a stooped posture // osteoporosis can be prevented by taking sufficient amount of calcium, phosphorus and vitamin D</p>

Arthritis



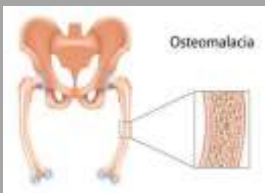
A group of muscle disorders that involves inflammation of the joint // the joints become swollen, stiff and painful // osteoarthritis, a form of arthritis is part of the ageing process caused by the wear and tear of the cartilage between the bones inside certain joints // the ageing process decreases the production of synovial fluid in the joints // it is painful and restrict the movement of the patient // a surgeon may replace the damaged joints with artificial ones

Gout



Gout is a kind of arthritis. It can cause an attack of sudden burning pain, stiffness, and swelling in a joint, usually a big toe // Gout is caused by too much uric acid in the blood // But when uric acid levels in your blood are too high, the uric acid may form hard crystals in your joints // Your chances of getting gout are higher if you are overweight, drink too much alcohol, or eat too much meat and fish // The most common sign of gout is a nighttime attack of swelling, tenderness, redness, and sharp pain in your big toe // You can also get gout attacks in your foot, ankle, or knees, or other joints // The attacks can last a few days or many weeks before the pain goes away. Another attack may not happen for months or years

Osteomalacia



Most likely to break bones, particularly those in your ribs, spine and legs // Your body uses the minerals calcium and phosphate to help build strong bones // You might develop osteomalacia if you do not get enough of these minerals in your diet or if your body does not absorb them properly // usually occurs in pregnant female

Locomotion of earthworm

The muscles involve are longitudinal and circular // these sets of muscles will move antagonistically // earthworm has chaetae which is acts as an anchor to the ground // when the circular muscles contracts the earthworm become thinner and longer then it will anchor to the ground // at the same time the longitudinal muscle relaxes // when the longitudinal muscles contract the earthworm becomes shorter and thicker, the earthworm will release its anchor and the body will be pull forwards // at the same time the circular muscles relaxes // this sequence is repeated by the next part of the earthworm's segment // the continuation of contracting and relaxing of muscle will produce peristaltic waves that makes the earthworm's segment forward.

Locomotion of grasshopper

The hind legs and fore legs are involve // the extensor is the muscle for hind legs and flexor is for the fore legs // these sets of muscles will move antagonistically // the flexor will contract making the hind legs to pull towards the fore legs to make a z-shape which stores a force that creates a jumping mechanism // at the same time the extensor relaxes // when the extensor will contract the hind legs will straightened // this will create a propelling force and the grasshopper jump upwards to the air.

Locomotion of frogs

The muscles involve are hamstring(flexor) and the quadriceps (extensor) // these sets of muscles will move antagonistically // the flexor contracts to create a z shape as it is folded // at the same time the extensor relaxes // then the extensor contracts and the tibia will be pulled backward which straightened the tibia to the direction of the femur // at the same time the flexor relaxes // the frog will launch itself forward-this sequences is repeated.

Locomotion of birds

The muscles involve are the pectoralis major which connects to the upper part of the bone and pectoralis minor which connects to the lower part of the bone of the wing // these sets of muscles will move antagonistically // as the pectoralis minor contracts, it will pull the upper part of the bone that makes an upstroke force // at the same time the pectoralis major relaxes // when the pectoralis major contracts it will pull the bone downward that makes a down stroke force // at the same time the pectoralis minor relaxes // the upward and downward force will generate the forward thrust and an uplift force for the bird to fly // the aero foil wings generates lift for the flying bird

Locomotion of fish

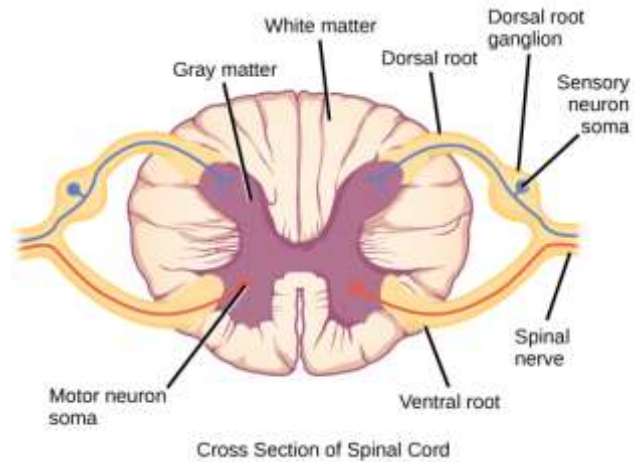
Myotome muscles carry out opposite actions in a fish // when one side of the muscle contracts the other side will relax // these muscles move antagonistically // when the left muscles contracts the myotome is shortened thus the body will bend to the left while the right muscles relaxes // the alternating waves of contractions and relaxation of left and right will be passed down to the myotomes on either side of the tail // this helps the fish to push the water backwards and sideways // to help the fish to move forward.

How support is achieved in submerged and floating plants

Submerged plants	Floating plants
Possesses air sacs within the leaves and the stem to help the plant to stay upright in water and obtain maximum sunlight	Aerenchyma tissue helps to stay afloat in water that have plenty of air sacs
Water buoyancy provides support because of the absent of woody tissue in the stem	Do not have woody tissues and natural water buoyancy helps the plants to stay afloat
Have thin, narrow and flexible leaves to provide less resistance to water flow	Have broad leaves that are firm but flexible to resist being torn by wave action
Ex. Hydrilla sp. and seaweed	Ex. Water hyacinth and water lily

CHAPTER 3:COORDINATION AND RESPONSE

The spinal cord

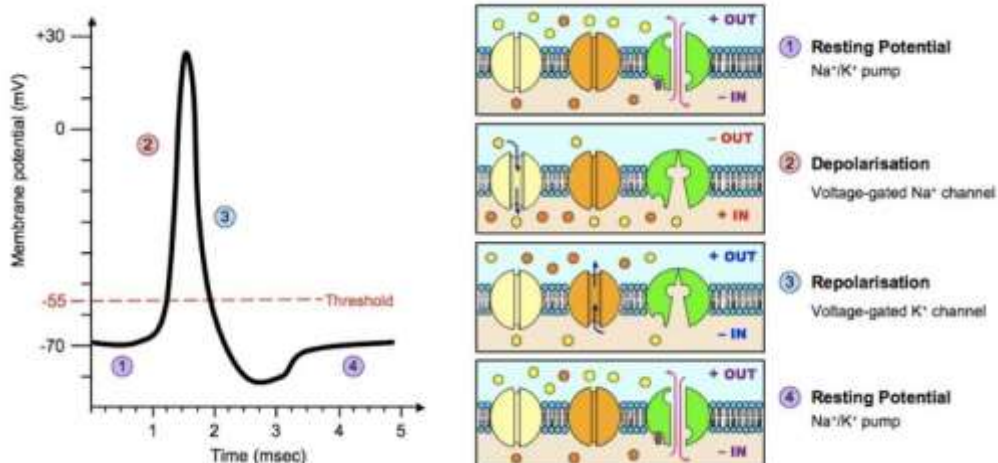


When the response to stimuli are involuntary, they are called reflex actions which are rapid and automatic // A reflex arc is the pathway by which nerve impulse travel from the receptor to the effector in a reflex action // when a finger touches something hot or sharp , this triggers the sensory receptors in the skin to generate nerve impulses // the nerve impulses are transmitted along an afferent neuron towards the spinal cord // in the spinal cord ,the nerve impulse are transmitted from the afferent neuron to an interneuron // from the interneuron, the nerve impulses are transmitted to an efferent neuron // the efferent neuron carries the nerve impulses from the spinal cord to the effector which is the muscle tissue so that the finger will be pull away from the danger immediately.

The differences between voluntary and involuntary actions

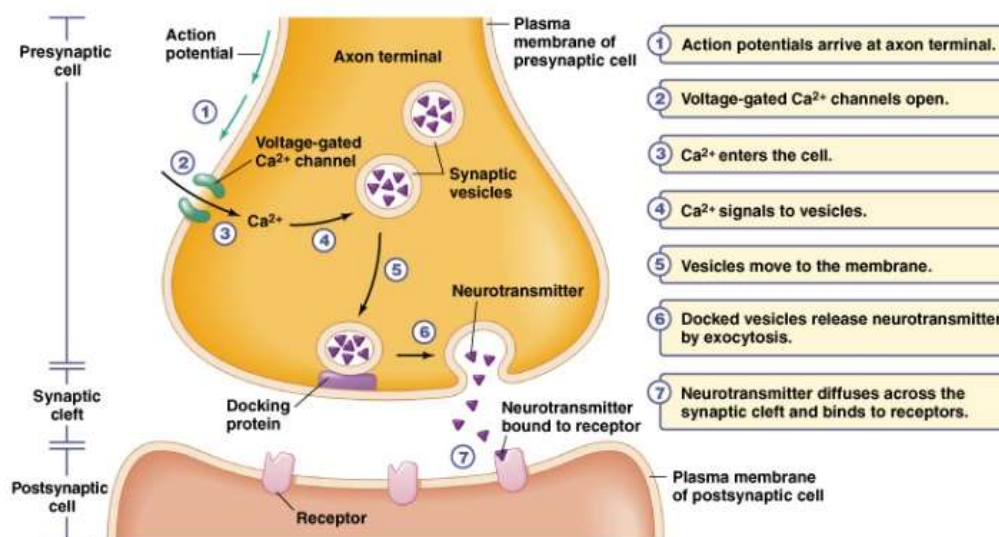
Voluntary Action	Involuntary Action
Aware ,can be controlled	Unaware ,cannot be controlled
Responds are due to environment change	Responds to danger
Controlled by cerebral cortex by effectors and receptors	Controlled by spinal cord by hormones and muscles
Slow responds	Instant responds and automatic
Nerve impulses travel along a longer pathway	Impulses travel along a shorter pathway, the reflex arc

Action Potential



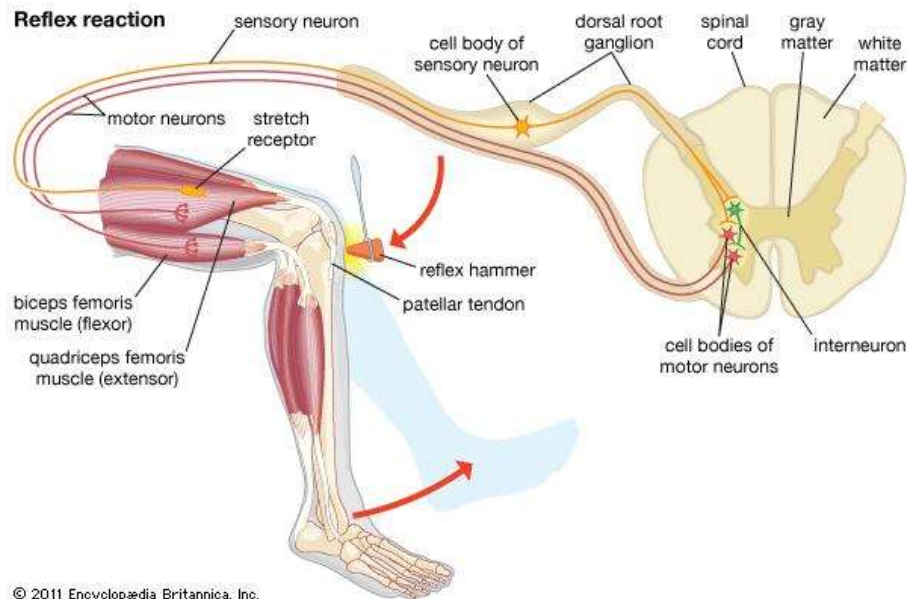
The transmission of a nerve impulse is an electrical phenomenon // when the neuron is at rest there is a higher concentration of sodium ions outside the cell compared to the concentration inside the cell and it is also the same for potassium (vice versa) // due to the concentration gradient and active transport is needed to maintain the potassium sodium pump // this uses energy in the form of ATP to move ions against their diffusion gradient // this gives a resting potential (axon is not carrying an impulse) in the neuron of about -70mV // thus the inner membrane of the axon is said to be polarized // when the neuron is stimulated, it causes rapid depolarization of the membrane of the axon and then rapid repolarization again // if the amount of depolarization reaches a threshold it causes voltage dependent sodium channels in the axon membrane to open allowing sodium ions to diffuse along the concentration gradient into the cell causing the inside of the neuron to become positive compared to the outside // this stage is represented in the uphill part of the action potential trace // then the sodium channel is now closed and the potassium channel will allow potassium ions to diffuse out of the cell making the inside of the cell more negative than the outside making the depolarization reach around 40mV before the potassium channels open // after the potassium channels are closed and the potassium ions diffuse out this will cause repolarization as the inside is negative again // gradually the ion concentrations go back to resting levels and the cells return to -70mV .

The transmission of information across a synapse



The synapse is the site where two neurons or a neuron or an effector cell communicate // a synaptic cleft is the space between the presynaptic membrane and the postsynaptic membrane // a chemical is used by a neuron to transmit an impulse across the synaptic cleft // the chemical is called neurotransmitter, which are stored in synaptic vesicles situated at the tip of a synaptic terminal // the transmission of information across a synapse involves the conversion of electrical signals into chemical signals in the form of neurotransmitter // the synaptic terminal consists of abundant mitochondria to generate energy for the transmission of nerve impulse across a synapse because it is an active transport that requires energy // when an electrical impulse reaches the presynaptic membrane, it triggers the synaptic vesicles to release neurotransmitter into the synaptic cleft // the neurotransmitters diffuse across the synaptic cleft and bind to specific receptors which are attached to the postsynaptic membrane // the binding of the neurotransmitters to the receptors leads to the generation of a new electrical signal and the old one is rapidly broken down by enzymes // the old one will bounce back across the synaptic cleft and into the presynaptic cleft to be recycled // the new nerve impulse will be carrying same info to another axon.

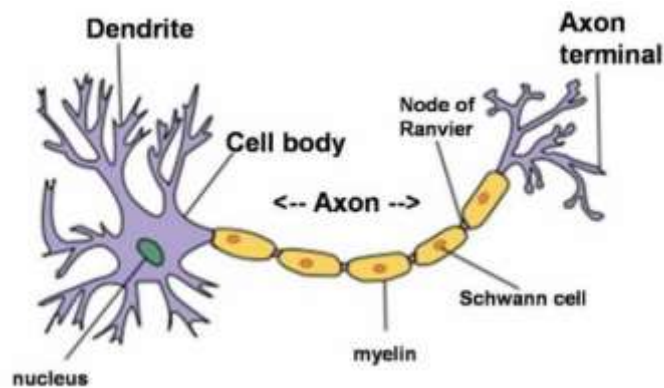
The knee jerk



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The knee jerk action involves the afferent neuron and the efferent neuron // when a hammer hits a tendon that connects the quadriceps muscles in the thigh to a bone in the lower leg // as the hammer strikes the knee, the force stretches the quadriceps muscles and stimulates the stretch receptors in the muscles triggering nerve impulses // the efferent neurons transmit the information to the efferent neurons in the spinal cord // the efferent neurons transmit this information to the quadriceps muscle and the muscles contract, jerking the lower leg forward // if the patient is able to jerk his leg forward, it indicates that the patient's nervous system is still functioning // if there is no response, it shows that the patient's nervous system fails to function properly.

Transmission of nerve impulse from the receptors to the muscle fibre



The receptor is stimulated by a stimulus and nerve impulses are generated // impulse is transmitted along the dendrites to the cell body // the impulse is then transmitted along the axon of afferent neurone to the central nervous system // the nerve impulse is transmitted to the interneurone // from the interneurone, the nerve impulses are transmitted to the efferent neurone // finally the impulses are sent to the muscle fibres and the muscle fibres contract

Differences between afferent neurone and efferent neurone

Afferent neurone	Efferent neurone
Afferent neurons are responsible for receiving and transmitting messages to the central nervous system from all parts of the body	Efferent neurons are responsible for receiving and transmitting the messages from the central nervous system to all parts of the body.
Are called sensory neurons	Are called motor neurons
Afferent neurons make up sensory nerves	Efferent neurons make up motor nerves
Afferent neurons have a single long dendrite and a short axon	Efferent neurons have a single long axon and several dendrites.
afferent neurons are located just outside the central nervous system	Efferent neurons are located inside the central nervous system.

The differences between the endocrine system and nervous system

The nervous system	The endocrine system
consists of network of nerve cells	consists of numerous glands
controls voluntary and involuntary actions	controls involuntary actions
conveys electrical signals (nerve impulse)	conveys chemical signals (hormones)
messages are conveyed via neurons	messages are conveyed via bloodstream
messages are conveyed rapidly	messages are conveyed slowly
messages are carried to specific locations	messages are carried to various location
the responses are temporary and reversible	the responses are long-lasting and irreversible

Flight and fight situation

The eyes detect the danger coming danger // the eyes send nerve impulse to the hypothalamus // the hypothalamus send new nerve impulse via sympathetic nerves to the adrenal medulla // the adrenal medulla then secretes adrenaline hormone // the heartbeat and blood pressure will increase to send more oxygen to all over the body to generate more energy // the breathing rate increases to take in more oxygen from the air to generate more energy // glucagon converts into glucose to supply glucose to the body and provide energy // vasoconstriction occurs in the skin of the blood vessels to channel more blood to the muscles and brain // vasodilation occurs in muscles and brain blood vessels to supply more oxygen and glucose rich blood to muscle and brain for quick thinking and acting // the skeletal muscles become more energized and enables the person to fight off an attacker or flee immediately // the nervous and endocrine systems both work together to bring about rapid responses for the situation.

Formation of urine

To produce urine, the basic processes are ultrafiltration, reabsorption, secretion // Blood is under high pressure when it reaches the nephron because the afferent arteriole has larger diameter than the efferent arteriole // as blood enters the glomerulus, ultrafiltration takes place and the high blood pressure in the glomerulus forces fluid through the filtration membrane into the Bowman's capsule // the fluid that enters the Bowman's capsule is called glomerular filtrate which contains water, glucose, amino acids, mineral salts and other small molecules // the glomerular filtrate will flow into proximal convoluted tubule where selective reabsorption takes place by active transport, passive transport and osmosis // glomerular filtrate then flow into loop of Henle and distal convoluted tubule // at the distal convoluted tubule, the watery filtrate is now low in salt but high in wastes like urea thus more minerals and ions are reabsorbed // the

collecting duct contains less salt so 99% of water is reabsorbed into the bloodstream and 1% of the water in the filtrate actually leaves the body as urine // secretion is a process in which waste and excess substances from the blood are secreted into renal tubule // urea is being secreted by passive diffusion and active transport from blood capillary into distal convoluted tubule // from the collecting ducts, the urine flows down the ureter, the bladder and urethra and is finally excreted

Homeostasis (when we drink too much water)

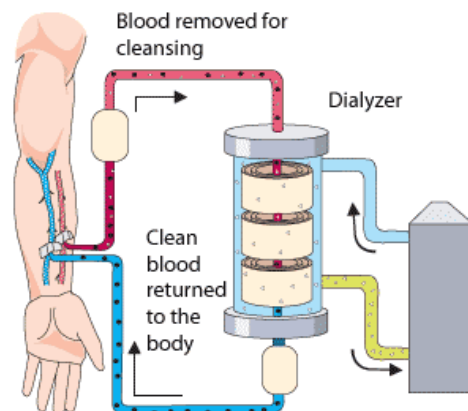
When we drink too much water, the blood osmotic pressure decreases // this will be detected by the osmoreceptor at the hypothalamus // hypothalamus send message to the adrenal cortex to release aldosterone // at the same time less ADH will be release from the pituitary gland // the membrane of the distal convoluted tubule and collecting duct become more permeable to mineral salts // thus more minerals will be reabsorbs back into the blood and less water will be reabsorb back into the blood because the distal convoluted tubule is less permeable to water // the urine produced contains more water and less concentration of mineral which makes the urine lighter in color // blood pressure will return back to normal which creates a negative feedback in the hypothalamus so that aldosterone is not release anymore.

Homeostasis (when we drink less water)

When we drink too little water, the blood osmotic pressure increases // this will be detected by the osmoreceptor at the hypothalamus // hypothalamus send messages to the posterior pituitary gland to released ADH while less aldosterone will be release from the adrenal cortex // the membrane of the distal convoluted tubule and collecting duct become more permeable to water // thus more water will reabsorbs back into the blood and less minerals will be reabsorbs back into the blood because the distal convoluted tubule and collecting duct is less permeable to minerals // the urine produced contains more minerals and less concentration of water which makes the urine darker in color // blood pressure will return back to normal which creates a negative feedback in the hypothalamus so that less ADH is not released anymore.

Hemodialysis

Hemodialysis is the process of filtering blood using artificial means that replaces a failed kidney // during hemodialysis ,blood is from the patient's artery is passed through a machine which contains a dialyzer an artificial kidney // the dialyzer has two spaces separated by a semi permeable membrane // blood passes on one side of the membrane and dialysis solution passes on the other // excess salts and urea can diffuse through the membrane from the blood and into the dialysis solution following the concentration gradient // while the plasma proteins and white blood cells remains inside the blood // glucose and other required substances that diffuse out of the blood may be restored by the dialysis solution // blood will then return to the patient's body



The regulation of body temperature on a hot day.

When the external temperature changes, there is an initial change in the internal body temperature // the thermoreceptors in the hypothalamus monitors the temperature of the blood as it passes through the brain while the thermoreceptors in the skin monitors the external temperature // these thermoreceptors send impulses to the thermoregulatory centre in the hypothalamus then it send impulses to the effectors // when the internal temperature rises above the set point, vasodilation occurs whereby the smooth muscles around the efferent arterioles relaxes // this increases more blood flowing through the skin , thus increasing the amount of heat radiated and lost through the skin via the blood // The sweat glands secretes sweat onto the surface of the skin, where it evaporates and heat is lost to the surroundings // erector muscles in the skin relax, lowering the skin hairs so that warm air is not trapped against the skin and is free to escape // the skeletal muscles are not stimulated and shivering does not occur // the adrenal and thyroid glands are less stimulated to secrete adrenaline and thyroxine , thus the metabolic rate is low and no excess heat is generated

The regulation of body temperature on a cold day.

When the external temperature changes, there is an initial change in the internal body temperature // the thermoreceptors in the hypothalamus monitors the temperature of the blood as it passes through the brain while the thermoreceptors in the skin monitors the external temperature // these thermoreceptors send impulses to the thermoregulatory centre in the hypothalamus then it send impulses to the effectors // when internal temperature drops below the set point, vasoconstriction occurs whereby the smooth muscle around the efferent arterioles contracts // this decreases the amount of blood flowing through the skin thus reducing the amount of heat radiated and lost through the skin via the blood // the sweat glands does not secrete sweat so sweating does not occur and body heat is conserved // erector muscles In the skin contract, raising skin hairs and trapping an insulating layer of still , warm air next to the skin // The skeletal muscles are stimulated, shivering occurs and heat is generated // The adrenal and thyroid glands are stimulated to secrete more adrenaline and thyroxine thereby increasing the metabolic rate in targeted tissues , thus heat is generated for the body

Regulation of carbon dioxide in the blood during a vigorous exercise

When the concentration of carbon dioxide increases due to active cellular respiration during vigorous exercise , the carbon dioxide reacts with water to form carbonic acid // this causes the pH value of the blood to decrease // the decrease in pH value is detected by the central chemoreceptors in the medulla oblongata and the peripheral chemoreceptor // the central and peripheral chemoreceptors send nerve impulses to the respiratory centre in the medulla oblongata // the respiratory system, in return , send nerve impulses to the diaphragm and the intercostal muscles ,causing the respiratory muscles to contract and relax faster // as a result, breathing and ventilation rate is faster // as excess carbon dioxide is eliminated from the body, the carbon dioxide concentration and the pH level of the body returns to normal

Ethylene

Ethylene or ethene is a plant hormone which is synthesized during ripening of fruits // the synthesis of ethylene is confined to fruits only but also occurs in leaves and stems // ethylene speeds up the ripening of fruits by stimulating the production of cellulase // cellulase hydrolyses cellulose in plant cell walls thus making the fruit soft // ethylene promotes the breakdown of complex carbohydrates into simple sugar, which is the reason why ripe fruit taste sweeter than an unripe fruit // as ethylene is a gas , it moves freely through the air , making unripe bananas to be ripe when put together with ripe mangoes in a basket

Types of drugs and effects on their body

Types of drugs	Effects on the body
Stimulants	Increase the activity of central nervous system // cocaine can block the removal of pleasure-inducing neurotransmitters // excessive use can cause a temporary ecstasy that is soon to be followed up by depression once the level of neurotransmitter falls to its normal or below normal levels
Depressants	Often slows down the activity of the central nervous system // depressants such as tranquilizers slows down the transmission of nerve impulses // alcohol is a strong depressants that affects coordination and judgment // alcohol inhibits the release of ADH from the posterior pituitary gland and this causes the alcoholic often passes large volume of urine which leads to dehydration
Hallucinogens	LSD (D-lysergic acid diethylamide) causes user to see, hear and perceive things that do not exist and often hallucinate
Narcotics	Heroin and morphine are drugs which mimic neurotransmitter by binding to their receptor sites // this will induce feeling of ecstasy, block pain signals and slow down brain functions

CHAPTER 4 : REPRODUCTION AND GROWTH

Differences between sexual reproduction and asexual reproduction

Sexual reproduction	Asexual reproduction
The production of new individuals involving sex cells or gametes	The production of new individuals without involving sex cells
Gametes are formed by meiotic division	Relies entirely on mitotic division
Involves two individuals parents	Involves only one individual single parent
Occurs in humans, other mammals, birds , reptile, amphibians, fish and flowering plants	Occurs in simple organism like the amoeba sp. , paramecium sp. and hydra sp.
Produce offspring that are genetically different from their parents	Produces offspring that are genetically identical to parent
Ensure the survival of the species if the environment conditions undergo changes constantly	Ensures that the adaptation of the parent for survival are passed down remains unchanged to the offspring

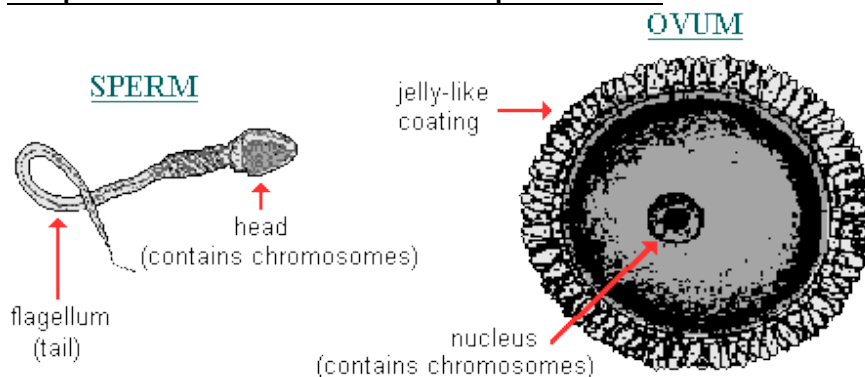
Sperm formation in humans

Spermatogenesis will occur when a male reached puberty // the spermatogenesis takes place in the seminiferous tubules in the epididymis // germinal epithelial cells of a seminiferous tubule divides by mitosis to produce diploid spermatogonia // the spermatogonia grow into primary spermatocytes which are large diploid cells // Each primary spermatocytes undergoes meiosis I to form two haploid secondary spermatocytes // Then each secondary spermatocytes divides again during meiosis II to produce two spermatids // Four spermatids are formed for every primary spermatocyte // the spermatids obtain nourishment from the sertoli cells, develops tails and mature into sperm through cell differentiation

Ovum formation in humans

Oogenesis starts in the ovaries of the foetus before birth // the germinal epithelial cells near the surface of the ovary divide repeatedly by mitosis until many diploid Oogonia are formed // the Oogonia grow to form primary oocytes // these primary oocytes are surrounded by a layer of layer of primary follicles // when a baby is born, the two ovaries with about two million primary follicles in each, remains dormant until puberty // from baby to puberty, meiosis I occurs at the primary oocytes but stops at prophase I // Each month, one primary oocytes will complete meiosis I to produce haploid secondary oocytes and a first haploid polar body // then secondary oocyte undergoes meiosis II but stops at metaphase II // the secondary oocytes are lined by layers of follicle cells called secondary follicles // this follicle increases in size into Graafian follicles // at intervals of approximately 28 days, the Graafian follicle merges with the wall of the ovary // the ovarian wall and the Graafian follicle then break, releasing the secondary oocyte or egg into fallopian tube // the release of secondary oocyte is known as ovulation and ovulation occurs in one of the ovaries every 28 days // if sperm penetrates the secondary oocyte during fertilization, meiosis II will be completed and two haploid cells of different sizes are formed // the larger cell is ovum and the other one is second polar body // the nuclei of the sperm cell and the ovum then fuse to form diploid zygote

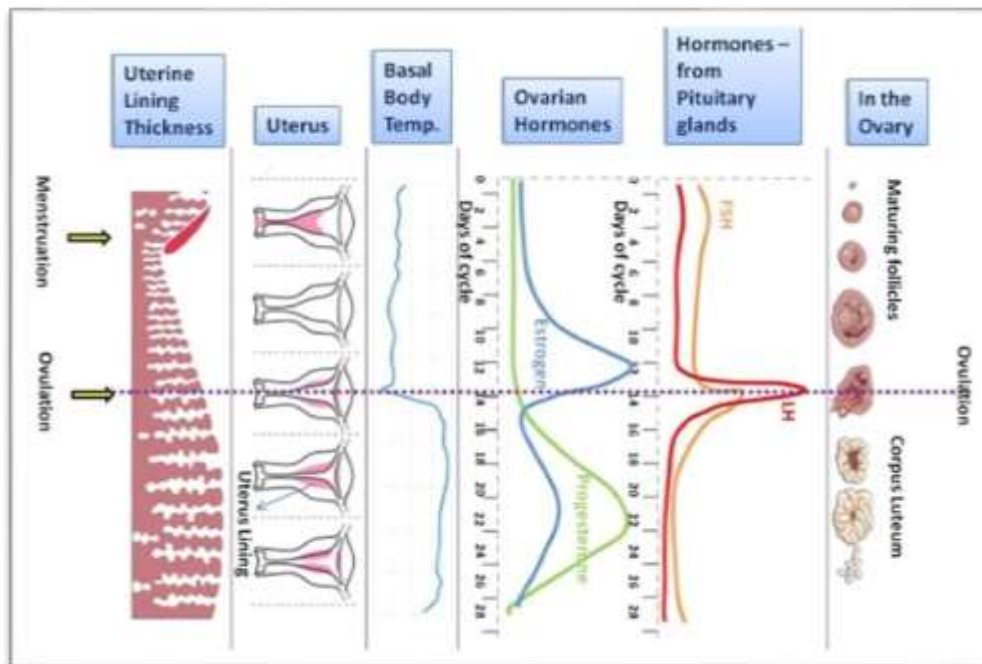
Comparison between the formation of sperm and ova



Spermatogenesis	Oogenesis
Occurs in the testes	Occurs in the ovaries
Produce sperms	Produce ova
Spermatids undergo differentiation to become sperms	Ovum does not undergo cell differentiation
All sperms are active and does not degenerate	Only one ovum survives and three polar bodies degenerate
Sperms are smaller in size	Ovums are bigger in size
A sperm has a tail which enables it to swim	An ovum does not a tail but its movement is aided by the cilla of oviducts
A lifelong process	The process stops at menopause
Begins when the males reaches puberty	Begins during foetal stage
Meiosis occur completely and without interruptions	Meiosis II is only complete when a sperm fertilize an ovum
The germinal epithelial cell divides to produce spermatogonia	Germinal epithelial cell divides to produce oogonia
After meiosis I, two secondary spermatocytes are formed	After meiosis I, one secondary oocyte and one polar body is formed

The formation of sperms occur all the time	The formation of ovum occurs during every menstrual cycle
Equal division of cytoplasm in cytokinesis	Unequal division of cytoplasm in cytokinesis

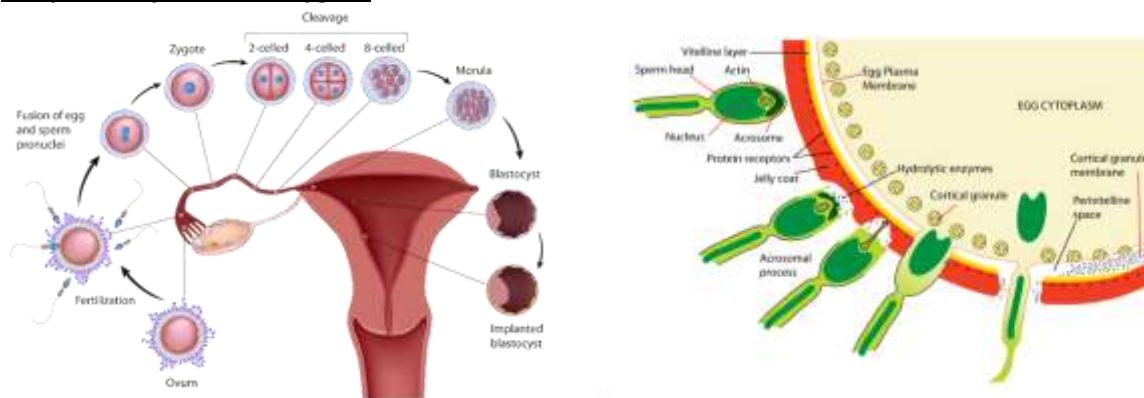
Menstrual cycle



DAYS	Hormonal control of the menstrual cycle
0 to 7	One day before menstruation begins, gonadotrophin releasing hormone (GnRH), produced by the hypothalamus, stimulates the anterior lobe of the pituitary gland to secrete follicle stimulating hormone (FSH) and luteinizing hormone (LH) into the bloodstream // FSH stimulates the development of follicles // the developing follicle cells secretes oestrogen // oestrogen stimulates the repair of the uterine lining and promotes the continuation development of follicle // at the beginning of the development, the follicle is small hence produce small amount of oestrogen // the low oestrogen level exerts negative feedback on the pituitary gland and this keeps FSH and LH levels low during the development of follicle // as the maturing follicle gets bigger, it produces more oestrogen
8 to 14	The oestrogen levels rise steeply and peak on the 12 th day // the high level of oestrogen level exerts positive feedback on the hypothalamus, resulting in increased GnRH secretion // High level of GnRH levels causes FSH and LH secretion to rise hence the peak in the oestrogen level is followed almost immediately by a peak in both FSH and LH level on the 13 th day of the cycle // LH stimulates the completion of meiosis I by changing the primary oocyte into secondary oocyte, ovulation on the 14 th day of the cycle and stimulates the remaining follicle tissue into corpus luteum // the level of progesterone is still low
15 to 21	The corpus luteum produces bigger quantity of progesterone but smaller quantity of oestrogen // the combination of progesterone and oestrogen exerts negative feedback on the hypothalamus and pituitary gland and halts

	the secretion of FSH and LH // this prevent the development of more follicles and ovulation // both oestrogen and progesterone stimulates the endometrium to become thicker , folded and enriched with blood vessels // the endometrium is now ready for implantation of the embryo
22-38	If no fertilization occurs , the corpus luteum begins to degenerate // the progesterone and oestrogen level drops and the endometrium breaks down // the shedding of blood and tissues as well as the lining of the uterus are discharged through the vagina // this result in menstruation at about the 28 th cycle // the hypothalamus once again releases GnRH to stimulate the production of FSH and LH and start a new cycle // if fertilization occurs, the corpus luteum will not degenerate // both progesterone and oestrogen levels continue to rise // the developing embryo gets implanted in the endometrium // the corpus luteum continues to produce both sex hormones for 2-3 months after fertilization // after this period, the corpus luteum degenerates and the placenta takes over the production of progesterone and oestrogen until the baby is born // menstruation and ovulation stops during pregnancy because progesterone inhibits the production of FSH and LH

Early development of a zygote



Fertilization is the union of sperm nucleus and an egg nucleus // only one sperm fuses with the secondary oocyte to form a diploid zygote in the fallopian tube // as soon as the sperm penetrates the secondary oocyte, meiosis II completed to form an ovum // the vitelline membrane of the ovum thickens and forms fertilization membrane to prevent entry of other sperms into the ovum // approximately 36 hours after fertilization, the resultant zygote begins to divide repeatedly by mitosis as it travels along the Fallopian tube towards the uterus // the first division forms a two-celled embryo // further divisions in 3-4 days leads to the formation of a solid mass called a morula // about the 5th day, the morula is a ball of 100 cells formed that arrange themselves in a fluid filled bag called blastocyst // the developing embryo has reached the uterus with the help of the cilla in the fallopian tube // 7 days after fertilization, the blastocyst attached itself to the endometrium // this process is known as implantation and the blastocyst with its inner cell mass becomes firmly embedded in the endometrium // the fertilized egg is known as embryo during the first 8 weeks of its development // from the third month of development until birth , it is called a foetus // the foetus is enclosed in a membrane called amnion and the fluid in the amnion is called amniotic fluid that protects the foetus by absorbing shocks and act as cushion from any physical damage

Formation of twins

Identical twins	Fraternal twins	Siamese twins
Formed when the balls of cells from a fertilized ovum splits into 2 embryos // these 2 embryos develops into 2 foetuses // each foetus has its own umbilical cords but share the same placenta // involves only 1 sperm and 1 ovum // they possesses similar genetic constitution and physical characteristics // they are always the same sex	Formed when 2 ova are released at the same time, one from each ovary // each ovum is fertilized by sperm // 2 zygotes are formed which develops into 2 separate embryos // both embryos develops into 2 foetuses which have separate placentae and umbilical cords // they have different genetic constitution and physical characteristics // they can be either same sex or different sex	Siamese twins are identical twins which were incompletely separated during embryonic development // they share some organs like head, chest and limbs // they can be surgically separated and can survive if they do not share major organs such as brains , hearts and lungs // they are genetically identical as they develop from the same single zygote

Differences between identical twins and Siamese twins

Both are the product of one sperm and one ovum // both share the same placenta // Both has the same gender

Siamese Twins	Identical Twins
Foetus are contained in one embryo sac	Foetus are contained in two embryo sac
Foetus are joined at one point of their body	Foetus are separated completely
Movement limited	Movement not limited

Comparison between identical twins and fraternal twins

Embryos formed are the product of fertilization between a sperm and a ovum // both embryos has its own umbilical cord // both grow by mitosis

Identical twins	Fraternal twins
One ovum is released during a menstrual cycle	Two ova are released during a menstrual cycle
One ovum is fertilized by one sperm to form a zygote	Each ovum is fertilized by a sperm
The zygote then splits into two separate embryos	Two zygotes are formed and develops into two embryos
Both twins have the same genetic constitution	Both twins do not share the same genetic constitution
The identical twins share one placenta	Each embryos has its own placenta
Both are the same sex either male or female	The twins may be of different or same sex
Both twins share the same physical characteristic	Both twins do not share the same physical characteristic

Contraceptive Method

Contraception methods



Technique	Description
Natural	<ul style="list-style-type: none"> Rhythm method <p>Prevent having sexual intercourse during the female's fertile period which is the ovulation period // The ovum may be present in the fallopian tube, ready to be fertilize</p>
Male	<ul style="list-style-type: none"> Condom <p>A thin rubber sheath that is fitted over an erect penis before sexual intercourse // this will minimize the chances of sperm from entering the vagina during ejaculation and protects against sexually transmitted diseases</p> <ul style="list-style-type: none"> Withdrawal method <p>The penis is withdrawn from the vagina before the release of sperm during ejaculation // this will minimize the chances of sperm entering the vagina during ejaculation but small possibility that sperms may leak out of the penis</p> <ul style="list-style-type: none"> Vasectomy <p>Sperm duct are tied and cut in a surgical operation // since sperms are absent in the semen , fertilization will not occur but this is an irreversible method</p>
Female	<ul style="list-style-type: none"> Diaphragm <p>A dome-shaped rubber cap with a springy outer ring is inserted in the vagina to cover the cervix // this will prevent sperm from entering the uterus</p> <ul style="list-style-type: none"> Femidom (female condom) <p>A thin sheath that lines the vagina // to prevent the entry of sperm and sexually transmitted diseases</p> <ul style="list-style-type: none"> Intrauterine device (IUD) <p>A plastic coated copper coil that is fitted into the uterus by a doctor and left inside the uterus for approximately two years but can be removed by a string attached to the lower end via the vagina // irritates the uterine line thus preventing implantation of zygote in the endometrium</p>

- Spermicide

Chemical cream that is applied to the vaginal walls before sexual intercourse and used together with diaphragm // the spermicide will kill the sperms ejaculated into the vagina but sperms may enter the uterus

- Contraceptive pills

Pills with a combination of oestrogen and synthetic progesterone // prevents ovulation by inhibiting the secretion of FSH and LH so that follicle development does not occur

- Tubal ligation

Both fallopian tubes are cut and tied in a surgical operation // a released ovum cannot reach through the cut part of the fallopian tube towards the sperm, so fertilization will not occur

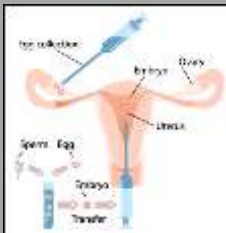
- Depo-Provera injection

An injection of synthetic progesterone given every three months // this causes changes in the uterine lining that interfere with the implantation of zygote

Infertility

Infertility means the failure of couple to have babies // the common cause of infertility are blocked fallopian tube, failure of an embryo to implant itself on the endometrium // inability to produce ovum // blocked sperm duct and low sperm counts // there are modern ways to help couples to overcome this problem

Way	Description
Artificial insemination (AI)	The sperm of men with low sperm counts are collected over a period of time so that the sperms will be enough for fertilization // the wife can be inseminated with the husband's sperms or sperms from sperm bank // the sperms are directly inserted into the fallopian tube
Sperm bank	A sperm bank is a special laboratory that stores donor sperms in liquid nitrogen at a temperature of -196°C // sperms from donors are collected, frozen and kept in a sperm bank
Surrogate motherhood	Another woman can be used as a surrogate mother // the sperm and ova are contributed by the parents but the sperms can also be obtained from a sperm bank and ova from the surrogate mother // either the sperms or an embryo is transferred to the uterus of the surrogate mother // the surrogate mother then becomes pregnant and the foetus develops in her uterus until birth
In vitro fertilization	A method of fertilization that occurs in a laboratory outside the human body // this method is used when the fallopian tubes are blocked, thus preventing fertilization by the sperms // a fine laparoscope is used to remove mature ova from the ovary then the ova is placed in glassware with culture solution to mature // after that the sperms from the father are added // the ova and sperms fuse and develop into embryos // after two to four days, when the embryos reach the eight-cell stage, a few embryos are selected and inserted into the uterus through the cervix for implantation on the uterine wall // if the procedure is successful, the implanted embryos will develop into healthy baby or healthy babies // ova can also be obtained from donors



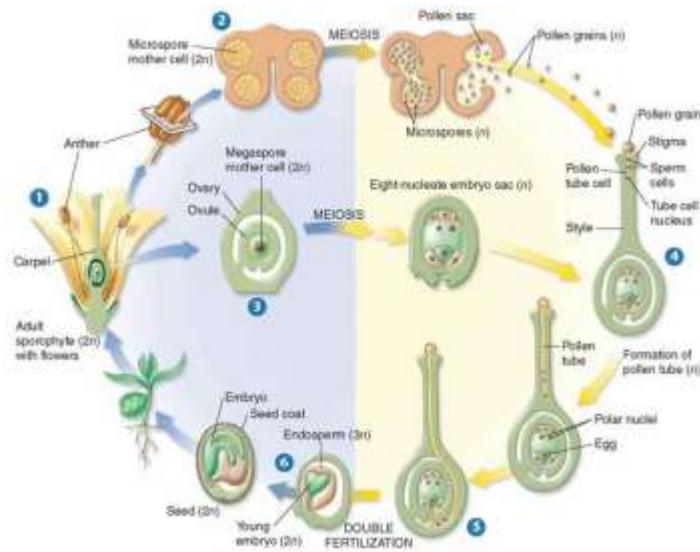
The formation of pollen grains in the anther

Pollen grains are formed in the anther // an anther has four pollen sacs // each pollen sac contains hundreds of cells called pollen mother cells ($2n$) // each pollen mother cell undergoes complete meiosis to produce four haploid microspores // the nucleus of each microspore then divides by mitosis to form a tube nucleus and a generative nucleus // the microspores develop into haploid pollen grains

Formation of the embryo sac in the ovule

The ovule develops from the ovarian tissue // each ovule consists of protective outer layer of cells called integuments that has a diploid embryo sac mother cell ($2n$) // the diploid embryo sac mother cell undergoes meiosis to form a row of four haploid cells called haploid megaspores // three of the four megaspores degenerate, leaving one in the ovule // the megaspore continues to grow and enlarges, filling up most of the ovule // the nucleus of the megaspore then undergoes mitosis thrice to form eight haploid nuclei // three of the eight nuclei migrate to one end of the cell to form antipodal cells // another two nuclei, called the polar nuclei will move to the center // one of the last three nuclei that is nearest to the opening of the ovule will develop into an egg cell bounded by two synergid cells // the whole arrangement of structure is called embryo sac where the embryo will be developed // the ovule which eventually becomes a seed is now consist of embryo sac and the surrounding integuments

Formation of the pollen tube, zygote and triploid nucleus (double fertilization)

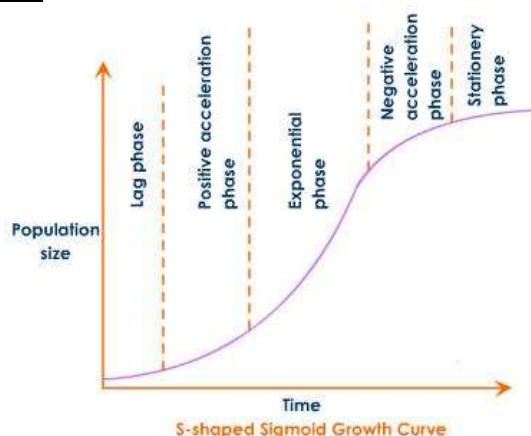


Pollination is the process in which ripe pollen from an anther are transferred to a stigma // the landing of a pollen grain on a stigma starts the fertilization process // sugars in the stigma stimulates the pollen grain to germinate and form a tube called pollen tube // the pollen tube grows into the style towards the ovule // at the same time, the generative nucleus divides by mitosis into two male gamete nuclei // the male nuclei move down the pollen tube via tube nucleus // when the pollen tube reaches the ovary, it penetrates the ovule through micropyle // the tube nucleus disintegrates leaving a clear passage for the male nuclei to enter the embryo sac // one of the male nuclei fuses with the egg cell to form a diploid zygote // the other male nucleus moves further in to fuse with the two polar nuclei forming a triploid nucleus // the triploid nucleus then divides to form a special nutritive tissue called endosperm // the zygote itself divides and grows into an embryo // the outer layer of the ovule loses moisture and develops into a hard seed coat that protects the embryo and endosperm

Growth

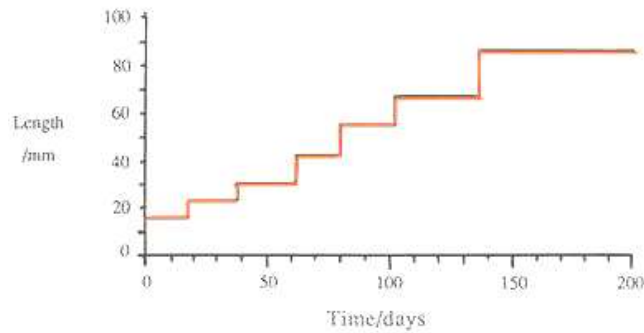
Growth involves changes that take place in an organism from zygote to adulthood, which is a feature of all living organism // growth is an irreversible increase in body size, mass and the number of cells in an organism // growth also involves quantitative changes to the cells which are changes in shape, function and complexity associated with specialization // the process of growth can be divided into three stages – firstly the cell division stage where the number of cells in an organism increases by repeated mitosis // one cell reproduces and give rise to $2 \rightarrow 4 \rightarrow 8 \rightarrow 16$ cells and so on // secondly the cell enlargement stage which involves an increase in size and volume of cells through the intake of water and other necessary substances from their surroundings // cell enlargement in plants involves vacuolation where the vacuole increase in size and cytoplasm and nucleus are pushed towards the cell margin // thirdly the cell differentiation stage where unspecialized cells becomes specialized, permanent cells with specific functions // the developmental stages in the process of growth can be observed distinctively at the shoot tip and root tip of a plant

The sigmoid curve of an organism



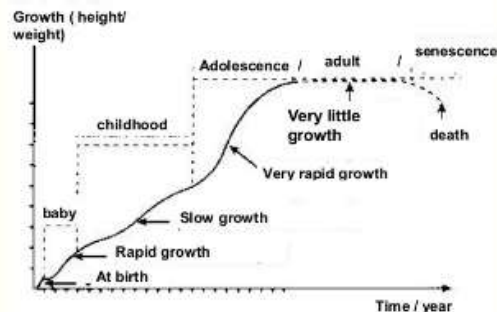
The first part of the sigmoid curve represents a period of slow growth, known as lag phase // this due to the small number of cells initially found in organism // even when the cells of the organism are dividing rapidly, the actual increase in size is small // at the rapid growth (exponential) phase the growth rate is the fastest as the number of the cells multiplies, the size of organism increase more rapidly because more cells are undergoing division // at the slow growth phase, the phase of rapid growth becomes limited by internal factors or external factors like shortage of nutrients or growth factors after a period of time // at the stationary phase, as the organism reaches maturity, the growth rate decreases until it stops completely and then the size of the organism remains unchanged although the cells divide, they divide to replace dead cells // at the death phase, it represents a period which the organism's cells undergo the process of ageing and death // this may be caused by lack of nutrients and growth factors required for cell repair and replacement

The growth curve of insects



The graph shows intermittent growth like a series of steps // the insects has a hard exoskeleton which is made from chitin that limits the increase in its body length // during the nymph stage, the insect stops growing // the insect undergoes a series of ecdysis before reaching adulthood // ecdysis occurs when ecdysis releasing hormone is release and it happens to an aging insect with old skeleton // a new skeleton forms below the old skeleton below the old skeleton // the old skeleton softens and its essential resources are digested and reabsorbed into the new exoskeleton // before the new exoskeleton hardens, the insects enlarges its body volume by swallowing air or liquid until the new exoskeleton hardens // this forces the old skeleton to split open and discard hence the insect emerges with a new skeleton // ecdysis is repeated multiple times before the insect reaches maximum length and becomes an adult // the growth of an insect only occur during ecdysis

Growth curve of a human



At infant phase, the growth rate is slow // at childhood phase the gradient of the graph is the highest showing rapid growth rate // the cells divides actively by mitosis // at adolescence stage the gradient of the graph is smaller showing a slower growth rate // most of the cells reached their maximum sizes //growth is limited by internal and external factors such as surroundings or hormone // at the adult phase the gradient of the graph is zero showing constant body height and the growth rate is zero // the last phase is the aging phase because the graph is showing negative growth // the body size decreases and this is because the muscles and bones begins to degenerate

KBAT QUESTION

1. Why do plant parasites such as aphids feed from the phloem rather than the xylem?
 - Xylem only contains water and mineral salts // phloem contains dissolved nutrients like sugars and amino acids // insect suck the phloem sap to obtain nutrients for their growth and metabolic needs
2. How a farmer can increase the yield of his produce grown in greenhouse?
 - Increase the level of carbon dioxide by 0.1% for plants to grow faster and bigger and usage of carbon dioxide pumps can be used to pump carbon dioxide into the greenhouse // increase light intensity using artificial lighting if the light intensity is low // maintaining the temperature at optimum level at 25°C to 30°C for maximum enzyme activity by using heater or air vents // supply sufficient water at all times through the water sprinkling system which waters the vegetables automatically
3. Describe the homeostatic mechanism that prevents the presence of glucose in the urine
 - The pancreas will secrete insulin // insulin stimulates liver cells, muscle cells and adipose tissue to use glucose for respiration // insulin also stimulates liver cells and muscle cells to convert excess glucose to glycogen // insulin stimulates adipose tissues to use glucose to form fat // all these mechanism lowers the blood glucose level // since all the glucose is absorbed in the proximal convoluted tubule, this prevents the presence of glucose in the urine
4. Why an athlete chooses to train at high altitudes before competing in a race?
 - High altitudes has lower partial pressure of oxygen // the body produces more haemoglobin to transport more oxygen to muscle tissues // the additional haemoglobin remains for some time when the athlete return to sea level // this allows aerobic respiration to continue longer when the athlete competes, delays oxygen debt and reduces the production of lactic acid in the body
5. Why there is a difference in thickness of the muscular walls of the right and left ventricles?
 - The left ventricle has a thicker muscular wall because stronger contractions are needed for the left ventricle to pump the blood to all parts of the body except the lungs // the right ventricle only needs to pump blood to the lungs
6. A baby is born with a “hole in the heart”. What condition may affect the baby?
 - If there is a hole in the heart, the pressure in both ventricles will be the same // since the left ventricle should have a higher pressure to force blood throughout the body, the blood leaving the aorta will have a lower pressure // the oxygenated and deoxygenated blood will mix and this means less oxygen is transported to the rest of the body // the body cell will have a shortage of oxygen and the baby will “turn blue”
7. During floods, plants are submerged in water for a few days, what are the effects of respiration of the plant?
 - No exchange of gases can happen // the plants undergo anaerobic respiration because of the low respiration rate // plants will eventually die

8. A man whom has stomach cancer had to have his stomach surgically removed. What would be the effects of his lifestyle and digestive function?

- Protein digestion would be less efficient as the stomach contains pepsin which digests proteins to polypeptides, hence the man needs to decrease his protein intake // without the stomach, peristalsis to break food into smaller pieces cannot occur, hence the man needs to consume soft or semi-fluid food like porridge to aid the digestion of the small intestine // without stomach, food cannot be stored before it is slowly released into the duodenum for further digestion, hence the man needs to take frequent small meals // with the absence of a stomach, there is no hydrochloric acid which kills bacteria in the food, hence the man must ensure that the food he eats is clean and hygienic

9. What are the advantages and disadvantages of having kidney transplant than dialysis?

Advantages	Disadvantages
No build-up of toxins // do not require diet or restricted fluid intake // does not need to undergo dialysis which is time consuming and expensive	Difficult to find a suitable donor // the body may reject the kidney // the kidney may not function well

10. What are the uses of yeast in bread-making?

- Flour contains starch, maltase and amylase is mixed with water to form dough // yeast is added to the dough // amylase is activated by water and hydrolyses starch into maltose // maltose is hydrolyzed by maltase into glucose // a lack of oxygen causes the yeast to respire anaerobically, converting glucose to ethanol, carbon dioxide and energy // carbon dioxide gas increases during baking, causing the dough to rise // the ethanol is then evaporated during baking.

11. How does the structure of mitochondria, folded structure affects its function?

- By having more folds in the inner membrane, more proteins can be packed // hence more energy can be produced

12. A student puts a drop of blood into a drop of distilled water, he observed that the red blood cell swells and burst. Why?

- When the red blood cell are placed into a hypotonic solution, water diffuses into the red blood cell and haemolysis occurs // the distilled water is a hypotonic solution // the cell burst because it cannot withstand the osmotic pressure as the water is keep entering the cell due to its absence of cell wall .

13. When an antiserum is injected into a person, what happens to the graph?

- From the first injection, the concentration of antibodies are enough to provide immunity temporarily // after the second injection, the concentration of antibodies should reach a maximum immediately // the temporary immunity provides a short-term protection while the body is producing its own antibodies to fight the diseases

14. Why termites can digest wood?

- After eating the wood, the wood is broken down into cellulose // in the stomach symbiotic microorganism is present in the termites to digest the food

15. When Kamil eats more rice than his body needs, his pancreas will secrete hormone **P** and when he fast, his pancreas secrete **Q**. what are hormone P and Q ?

- Eating more rice than the body needs results in increasing blood glucose level // pancreas will secrete insulin to lower the blood glucose level // when fasting, it will cause the blood glucose level to decrease so the pancreas will secrete glucagon to raise the blood glucose level back to normal

16. Why do athlete do warm up before doing any physical activities ?

- To increase the temperature of the body and muscle which will expand blood vessels, hence increase blood circulation // the blood will carry more oxygen to all body parts so that the oxygen being supplied is enough for cellular respiration // muscles will stretch and able to contract more efficiently // injuries are also minimized

17. Why does the athlete put ice on a muscle cramp area ?

- To decrease the rate of cellular respiration, hence the production of lactic acid decreases // to repair and gain back oxygen while converting lactic acid back to oxygen // this will lessen the pain for the athlete

18. Why does red blood cell does not have nucleus when matured ?

- Allow the red blood cell to contain more haemoglobin, therefore it can carry more oxygen inside the cell // it makes the shape of the red blood cell a biconcave shape which aids diffusion of oxygen

19. A gardener adds too much fertilizer to his plant . What are the effects to the plant?

- The plant will wilt because the presence of fertilizers will increase the concentration of soil water // the concentration of soil water is higher than the concentration of the cell sap making it more hypertonic // the water will osmosis out, hence the cytoplasm and vacuole to lose water to its surrounding and shrink // the cell becomes flaccid because the plasma membrane is pull away from the cell wall // the root hairs is plasmolyzed // eventually the plant will die

20. Why chloroplasts is not present in the onion scale leaf ?

- The onion bulb contains stored food for the growth of the onion leaf // therefore light energy is not absorb and photosynthesized does not occur

21. How does the addition of mercury affects the rate of an enzyme-catalyzed reaction ?

- During an enzyme-catalyzed reaction, substrate molecule bind to the enzymes at the active sites // mercury ions are inhibitors which also binds to the active sites of the enzymes // this prevents the substrate molecules from binding to the active sites // as the results, the rate of reaction decreases

22. A boy consume a set of nasi lemak daily for breakfast for days. What are the good and bad effects of this diet to his health ?

- Nasi lemak contains a big amount of carbohydrates, fats and cholesterol // carbohydrates provides energy but excess carbohydrates leads to obesity and diabetes because the excess energy is stored as fat in the body // proteins are needed to build new cells and repair old or damaged cells but excess protein causes an increase in uric acid level in the blood, which can lead to gout // fats provide more energy compared to carbohydrate and insulation but excess fats causes cardiovascular diseases // vitamins and minerals are needed to maintain good health but excess lipid-soluble vitamins can cause kidney damage // fibre and water helps in peristaltic movement, prevent constipation and water is a medium for biochemical reaction.

23. When the heart beats non-stop, why there are no accumulation of lactic acid or getting tired?
- The heart has its own circulation provided by the coronary arteries and veins // the coronary arteries start as a branch from the aorta, the main artery leaving the left side of the heart // therefore, the heart has sufficient supply of oxygen rich blood (oxyhaemoglobin) // the cardiac muscle contains more mitochondria which produces ATP than the skeletal muscle
24. How oedema happens ?
- Oedema is a condition where there is excessive accumulation of interstitial fluid in the interstitial space // the interstitial fluid is unable to diffuse into the lymphatic capillary // the body tissue become swollen because of too much fluid // it can be cause by blockage of the lymphatic vessels // oedema can happen when a person spend too much time sitting or lying in bed or someone who is unable to move // this is because the movement of fluid in the lymphatic system requires contraction of the surrounding skeletal muscle
25. Why does the top seven pairs of ribs are called 'true ribs' while the last two pairs of ribs are called 'floating ribs' ?
- The true ribs are connected from the spine directly to the sternum while the floating ribs are attached to the spine but not connected to the sternum .
26. State the problem that might occur when bone mass decreases after a certain age. Why the bone mass decreases drastically more in females ?
- The person who shows decrease in bone mass will suffer osteoporosis // the disease causes bones to become more thinner, more brittle and more porous // the female has higher chances to get the disease because after menopause, the hormone level changes // the changes in oestrogen level reduces absorption of calcium and reduce bone strength
27. Why is the blood salty?
- Sodium is another name for salt // about 85% of the sodium in your body is found in blood and lymphatic fluid // Sodium helps regulate fluid balance in your body and assist in the function of nerves and muscles.
28. Why does your right hand feels cold when its your left hand being dunk into a bucket of ice water?
- The fingertips are well equipped with sensory nerves to collect sensory information from the environment surrounding them // they contain a large number of receptors that produces electrical signals that is triggered by specific stimulus // thermoreceptor detect temperature changes and is send to the brain // So if the hand is dunked into a bucket of ice water, the cold receptor is activated thus signals are sent to the brain and the brain interprets the surrounding is cold
29. What happens to the yeast cells if there is too much ethanol produced?
- Too much ethanol produced causes an unsuitable condition for the yeast to reproduce // the high concentration of ethanol can penetrate through the cell wall and denature the protein and enzymes inside // the yeast cell will eventually die
30. How does shortening the small intestine during surgery can help an obese person to reduce body mass?
- The small intestine is the major organ of absorption of digested food // after the person went for surgery, the rate of hydrolyzing food to simplest food becomes slower // the small intestine has intestinal gland that produces intestinal juice containing digestive

enzymes // shorter small intestine has lesser surface area for absorption of food // so the rate of diffusion of digested food is slower // less digested food is absorbed into the blood capillaries from the villi // hence body tissues receive less glucose to undergo cellular respiration // lack of glucose will cause the adipose tissue to be oxidized to produce energy // the amount of stored fat decreases and the body mass reduces also

31. What do paddy plants contribute to the environment?

- More carbon dioxide in the atmosphere and rising temperatures cause rice agriculture to release more of the greenhouse gas methane (CH₄) for each kilogram of rice it produces // as more carbon dioxide is released into the atmosphere, resulting in greenhouse effect // eventually leads to global warming that will cause climate change

32. How does mutation lead to tumor formation?

- Mutation is the change in the structure of DNA and these changes will damage the genetic code information for controlling mitosis process // the damaged genetic code will cause uncontrolled mitosis // the uncontrolled mitosis may reproduce groups of many daughter cells which are known as tumour // there are two types of tumor which are the benign tumor and malignant tumor // benign tumor is not dangerous because benign tumor cells are fixed at the infected area // benign tumor does not spread to other parts of the body but benign tumor can become an early stage of cancer if it is not treated // malignant tumor is cancerous because cancer cells from malignant tumor can spread to the whole body via blood vessels and lymphatic vessels

33. How does Elephantiasis occur?

- Elephantiasis refers to a parasitic infection that causes extreme swelling in the arms and legs // the filarial worms block the lymphatic vessels that cause the interstitial fluid unable to be returned to the blood circulatory system // the disease is caused by the filarial worm, which is transmitted from human to human via the female mosquito when it takes a meal // the parasite grows into an adult worm that lives in the lymphatic system of humans // The condition is also called lymphatic filariasis

34. Why do some adults find it difficult to digest milk sugar compared to a baby or child?

- Lactose is the main sugar found in milk and other dairy products // Those who have lactose intolerance find it hard to digest the sugar, usually because their small intestine does not make enough lactase, the enzyme which digests lactose // In normal humans, the lactase stops being produced when the person is between two and five years old // The undigested sugars end up in the colon, where they begin to ferment, producing gas that can cause cramping, bloating, nausea, flatulence and diarrhea // this is a genetic disorder

35. Why is the pituitary gland ductless and known as the master gland?

- The pituitary gland is known as a ductless gland because it secretes hormones directly into the bloodstream // it is a master gland because the secreted hormones are able to stimulate other endocrine glands in the body // the glands which are controlled by the pituitary gland are thyroid gland, adrenal gland, testis and ovary // the hormones which are able to stimulate other endocrine glands are thyroid stimulating hormone (TSH), follicle stimulating hormone (FSH) and oxytocin.

36. How does the thickness of endometrium is maintained throughout pregnancy?

- Progesterone is continuously produced by corpus luteum after fertilization // once the placenta is formed, the placenta continue to secrete progesterone along with oestrogen to maintain the thickness of the wall

37. Why people suffering from diabetes are advised to eat their carbohydrates in the form of starch rather than sugars?

- A diabetic person does not produce sufficient insulin // starch is a polysaccharide that requires a much longer time to be hydrolysed into glucose molecules compared to sugar // however sugar is absorbed easily by the small intestine // therefore by taking starch, blood glucose level will not fluctuate drastically after a meal

38. What makes the cheetah the fastest runner in the world?

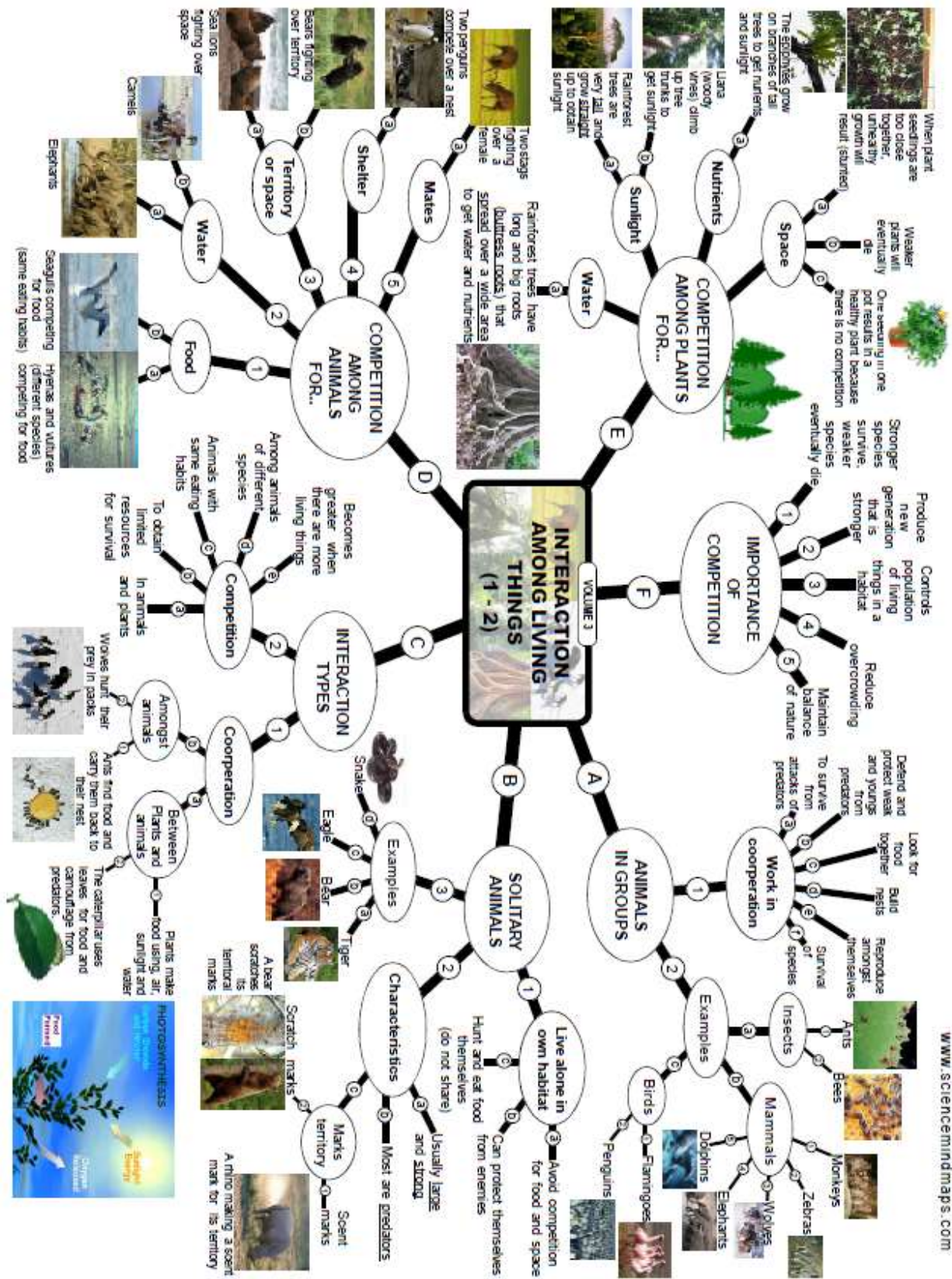
- It has a small head which is very light // it has a deep chest that makes it able to expand its lung therefore can take in more oxygen during a chase // it has a streamlined body which reduces the air resistance// Has a long tail that works as a balance check when the cheetah is at top speed // Has a flexible vertebral column allowing it to have a longer stride when running as it can space its legs much further apart and also enable it to straighten its back and stretch fore limb and hind limbs to a full spread // Has small paws which are light and easily controlled // it has small mouth which provides more space ,more oxygen to enter the mouth quickly // cheetah has very strong muscles at the hind limb for contraction and relaxation for the forward thrust // lastly it has an oversized, powerful heart Able to pump huge amounts of blood // it has extra long eyes for wide-angle view of its surroundings even at top speed

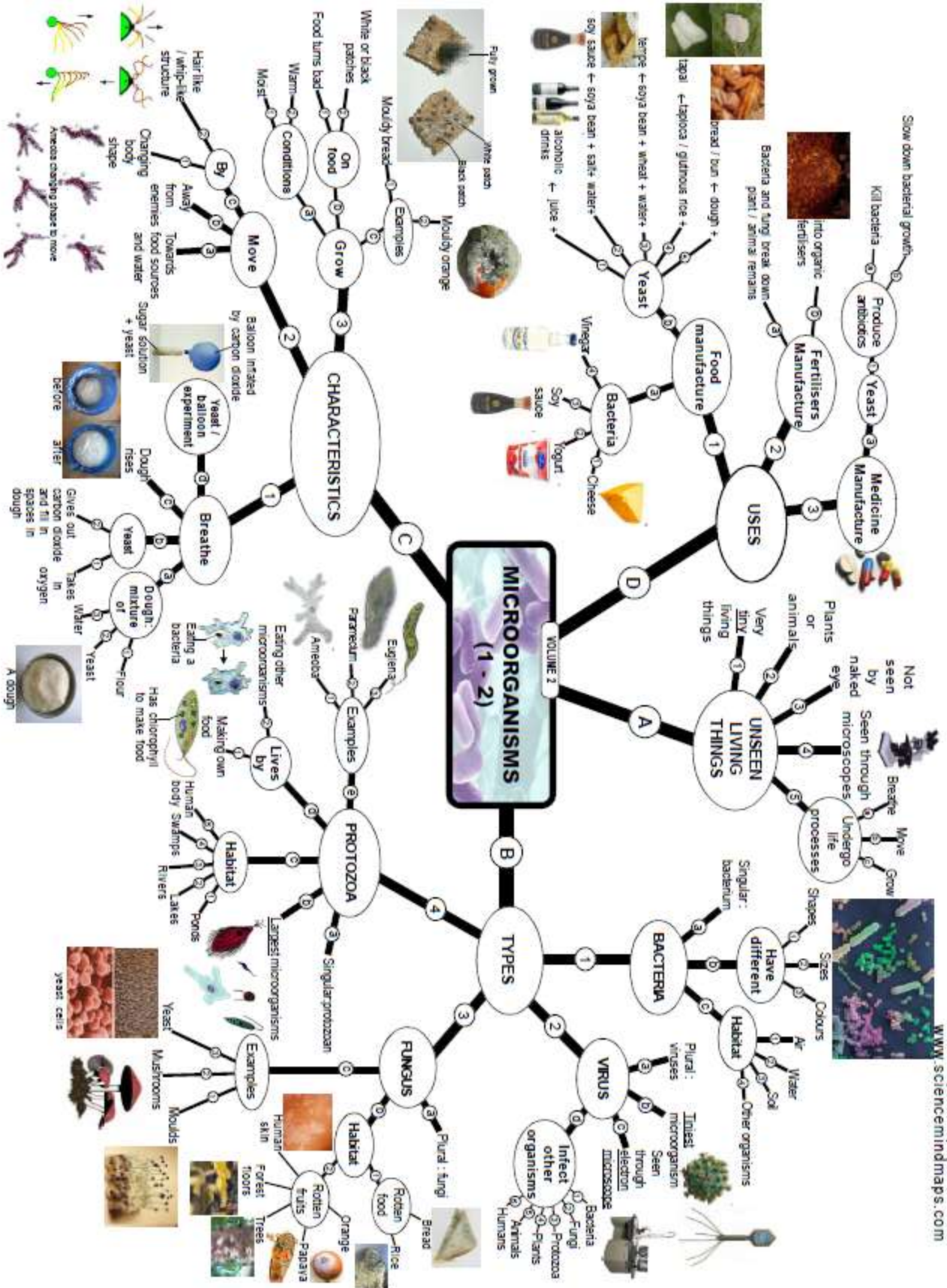
39. What happens to the ecosystem if all the decaying bacteria and fungi die?

- Decomposition of dead animals, plants and the waste products does not occur and this increases the amount of organic wastes on Earth // natural cycle such as carbon cycle and nitrogen cycle are disrupted so carbon and nitrogen remains on earth // the soil become infertile and photosynthesis will not occur

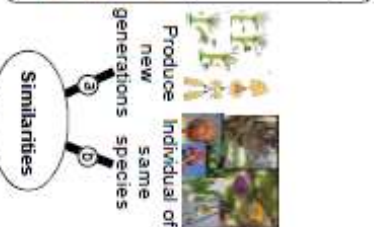
40. What are the advantages drinking breast milk over bottle milk?

- Breast milk has the right concentration of nutrients and daily requirement // breast milk is inexpensive and readily available // breast milk has antibodies and the correct temperature which is the body temperature // breast milk is sterile and microorganism-free

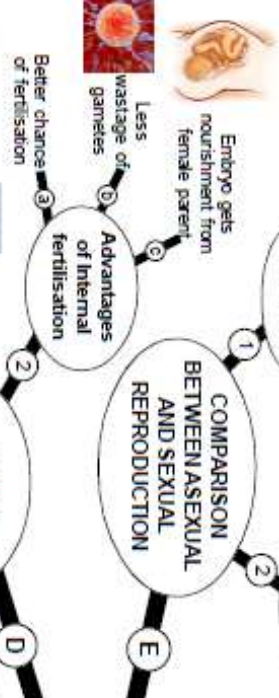




	Asexual	Sexual
Number of parents	One	Usually two
Gametes involved	No	2 types, male & female gametes
Genetic of offspring	Identical with parent	Different from parents, show genetic variation
Number of offspring	Large numbers	Small numbers
Reproduction speed	Rapid	Less rapid



COMPARISON BETWEEN ASEQUAL AND SEXUAL REPRODUCTION



REPRODUCTION (1 - 7)

