KUSOMA REVISION MATERIALS

# BIOLOGY FORM 3 NOTES

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1. **a) i) What is meant by the term binomial nomenclature?**

- scientific system of naming organisms using the generic(genus) and specific (species) names

**ii) State briefly the general principles of classification of living organisms**

- scientific names must be in Latin or should be latinised
- family names are formed by adding the suffix "idea" to the stem of the genus e.g. the genus Rana become Ranaidea
- generic names should be a single unique name

**b) State the main characteristics of the five kingdoms of organisms**

**i. Monera**

- e.g. bacteria
- unicellular (single celled)
- prokaryotic (genetic material not surrounded by membrane)
- cell wall without cellulose
- lack most organelles
- small in size (microscopic)

**ii. Protista(protoctista)**

- single celled(unicellular)
- eukaryotic (most cell organelles present)
- when cell walls are present have no cellulose
- e.g. protozoa and algae
- usually microscopic

**iii. Fungi**

- have hyphae (which form mycelia)
- absence of chlorophyll
- have rhizoids (lack roots, leaves, stem)
- have spore forming structures (sporangia)
- e.g. mucor, rhizopus

**iv. Plantae**

- most are green/contain chlorophyll
- autotrophic/feed by photosynthesis
- cells have cellulose cell walls
- respond slowly to stimuli (tropism)
- lack locomotion (are stationary)
- indefinite growth (at meristems)
- lack specialized excretory structures

**v. Animalia**

- cells do not have cell walls
- most carry out locomotion
- heterotrophic
- fast response to stimuli (tactic)
- have specialized excretory structures

**c) Describe the economic importance of:**

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**i. Fungi**

- some cause decay to our food
- some cause diseases to humans and animals e.g. ringworms
- may be used as food e.g. mushrooms, yeast
- some are used in production of antibiotics e.g. penicillin, chloromycin, streptomycin
- yeast is used in brewing industry, baking and source of vitamin B
- many cause diseases to our crops e.g. late blight
- important in recycling nutrients in soil since they cause decay of organic matter
- mycorrhizal association in forest development may help in water intake/absorption
- help in nitrogen fixation

**Bacteria**

- are useful in the manufacture of antibiotics
- silage formation,
- fermentation of cheese, butter, milk yoghurt
- curing of tea, tobacco and retting flax
- formation of vitamin B12 and K
- enzymes such as amylase and invertase
- hormones such as insulin
- vinegar, acetic acid, lactic acid, citric acid
- in septic tanks and modern sewage works make use of bacteria
- biogas production
- saprophytic bacteria are used in compost decomposition or cause decay
- symbiotic bacteria are used in compost decomposition or cause decay
- symbiotic bacteria in herbivores/ruminants help in digestion
- some diseases in animals/humans and plants are caused by bacteria
- many bacteria cause food spoilage/decay
- nitrifying and nitrogen fixing bacteria increase soil fertility/make nitrates available
- denitrifying bacteria reduce soil fertility/convert nitrates into nitrogen/reduce nitrates

**d) State the main characteristics of the following division of kingdom plantae**

**i. Bryophyte**

- e.g. mosses and liverworts
- presence of rhizoids
- lack of vascular tissues (lack phloem and xylem)
- body parts not differentiated into root, stem, leaves
- capsule or seta
- gametophyte generation dominant.

**ii. Pteridophyta**

- e.g. ferns
- has true roots, stems and leaves
- fond with sori on under-surface
- vascular tissues present
- sporophyte generation is dominant

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**iii. Spermatophyte**

- photosynthetic
- well differentiated into roots, stems and leaves
- well developed vascular system
- seed bearing plants

**e) Name sub-divisions of spermatophyte and state the characteristics of each class**

**i. Gymnospermae (cornifers)**

- naked seeds (exposed
- are all woody trees
- reproduce by means of cones
- show xerophytic characteristics
- xylem have tracheids but lack vessels
- phloem lacks companion cells
- single fertilization
- pollen lands directly on ovules

**ii. Angiospermae (flowering plants)**

- reproduce by flowers
- seeds enclosed (in fruits)
- flowers bisexual hence double fertilization
- herbaceous
- pollen grains land on stigma of pistil
- xylem contains vessels
- phloem contains companion cells
- ovules contained in ovary

**iii. Name the classes and state characteristics of angiospermae**

**Dicotyledonae**

- two seed leaves
- network venation of leaves
- regularly arranged vascular bundles
- tap root system
- broad leaves
- secondary growth occurs

**Monocotyledonae**

- one seed leaf
- parallel venation of leaves
- irregularly arranged vascular bundles
- fibrous root system

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- narrow leaves
- sheath like leaf stalk (petiole)
- no secondary growth

**iv) State the importance of plants**

- balancing carbon IV oxide and oxygen in the atmosphere during photosynthesis and respiration
- influence water cycle
- reduce soil erosion by bind soil particles together
- useful products e.g. food, medicine, timber, paper and clothing
- habitat ( e.g. forests and grassland) for animals which may also be tourist attraction
- earn money from sales of products
- aesthetic value/beauty e.g. flowers, shade/shelter, live fences, windbreaks
- Some are harmful e.g. poisons, weeds, injurious (stinging nettles, thorns), water hyacinth.

**f) i) Give the general characteristics of phylum arthropoda**

- jointed appendages
- presence of exoskeleton
- triploblastic and coelomate
- segmented body
- bilateral symmetry (similar halves)

**ii. State the characteristics of the following classes of arthropoda**

**Diplopoda**

- the millipedes
- two pairs of legs per segment
- many segments
- terrestrial habitat
- body cylindrical and long
- herbivorous
- one pair of antennae

**Chilopoda**

- the centipedes
- one pair of legs per segment
- many segments
- terrestrial habitat
- body long and ventro-dorsally flattened
- carnivorous
- last pair of legs pointing backwards with poison claws called maxillipedes
- one pair of antennae

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**Insecta**

- three body parts i.e. head thorax, abdomen
- six legs/three pairs of legs
- a pair of compound eyes
- presence of wings
- a pair of antennae

**Crustacean**

- two body parts
- segmented body
- have pincers (modified legs) to catch prey
- have hard exoskeleton
- a pair of compound eyes

**Arachnida**

- body divided into two parts( abdomen and cephalothorax)
- simple eyes
- eight legs (four pairs of legs)

**iii) State the economic importance of insects**

**Beneficial effects**

- food supply
- important in food chains
- pollinators
- biological control of pests and other organisms
- aesthetic value
- contribute to decomposition e.g. litter feeders like beetles

**Harmful effects**

- pests
- vectors
- dirt and disease carriers
- injurious e.g. stings and bites

**g) i) State the general characteristics of chordate**

- notochord
- dorsal slits (pharyngeal cleft during development)
- bilateral symmetry
- triploblastic (three layer body-ectoderm, mesoderm and endoderm)

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- clear cut head formation
- multilayered epidermis
- post anal tail
- closed circulatory system
- segmented muscle blocks(myotomes)
- single pair of gonads

**Give the characteristics of the following classes of chordate**

**Pisces**

- presence of fins for locomotion
- two chambered heart
- presence of overlapping scales
- presence of gills or operculum for gaseous exchange
- presence of lateral line for protection
- streamlined body
- poikilothermic (body temperature varies with that of environment)

**Amphibian**

- partially live in fresh water and partially on land
- poikilothermic
- pentadactylous with two pairs of limbs
- webbed feet for locomotion in water
- body streamlined
- heart is three chambered
- moist skin for gaseous exchange

**Reptilia**

- scales on body
- poikilothermic
- homodont teeth except tortoise and turtle
- all have limbs except snakes
- skin is dry
- oviparous (lay eggs)
- no pinna (external ear)
- three chambered heart 9crocodile has four chambers)

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- skin not glandular
- no mammary glands

**Aves**

- the birds
- homoeothermic (constant body temperature)
- four chambered heart
- streamlined body for locomotion in air
- skin dry and covered by feathers
- scales on legs
- hollow bones
- oviparous (lay eggs)
- mouths modified into beaks

**Mammalian**

- hair on the body
- homoeothermic
- viviparous (give birth to live young) except a few
- have mammary glands
- glandular skin e.g. sweat glands, sebaceous glands
- four chambered heart
- pinna (external ear)
- two pairs of pentadactyl limbs
- presence of diaphragm
- have salivary glands

**a) i) What is a dichotomous key?**

- A biological device (tool) which enables one to identify an organism by progressively opting between two alternative observable characteristics

**i. State the necessity of using a dichotomous key**

- used to identify organisms quickly and accurately
- by following the statements in the key we are able to identify each organism on the basis of a characteristic which is not to be found in other specimens

**ii. List the rules followed in constructing a dichotomous key**

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- use observable characteristics only
- start with major characteristics, placing organisms into two groups at each stage
- use a single characteristics at a time
- use contrasting characteristics at each stage e.g 1(a) short, 1(b) tall
- avoid repeating the same characteristics

**iv) Describe the procedure of using a dichotomous key. Make a list of major features of the characteristics to be identified**

- look at the features of similarities
- look at the features of differences between the organisms
- we can then be able to identify the organisms by distinguishing one from another
- the key uses a method of elimination by following statements that are correct only for the organism

**iv You are provided with a specimen kale leaf. Use the dichotomous key below to identify the taxonomic group to which the specimen belongs. Show the steps (number and letter) in the key that you followed to arrive at the identify of the specimen**

| | |
|---|---|
| 1 a) leaf broad | go to 2 |
| b) leaf narrow | Araicaria |
| 2 a) leaf parallel veined | Cynodon |
| b) leaf net-veined | go to 3 |
| 3 a) leaf with one lobe (simple) | go to 4 |
| b) leaf with many lobes (compound) | Grevellea |
| 4 a) leaf fleshy | Kalanchoa |
| b) leaf not fleshy | go to 5 |
| 5 a) leaf petiole modified to form sheath | go to 6 |

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b) leaf petiole not modified to form sheath Brassica

| | |
|---|---|
| 6 a) leaf purple | Tradescantia |
| b) leaf green | Commelina |

steps – 1a, 2b, 3a, 4b, 5b
Identify – Brassica

v) **You have been provided with four animals labeled K (mature adult housefly), L (mature adult grasshopper, M(maize flour beetle) and N(worker termite) use the dichotomous key below to identify the specimens. Write down in the correct order, the steps (number and letter) in the key that you followed to arrive at your answer.**

Dichotomous key

| | |
|---|---|
| 1 a) animal with wings | go to 2 |
| b) animal without wings | go to 7 |
| 2 a) with two pairs of wings | go to 3 |
| b) with one pair of wings | Diptera |
| 3 a) with membranous wings | go to 4 |
| b) hind pair of membranous wings | go to 6 |
| 4 a) with long abdomen | Odontata |
| b) medium sized abdomen | go to 5 |
| 5 a) wings with coloured scales | Lepidoptera |
| b) wings without scales | hymenoptera |
| 6 a) forewings hard and shell-like | coleopteran |
| b) forewings hard but not shell-like | Orthoptera |
| 7 a) body horizontally flattened | Isoptera |
| b) body laterally flattened | Symphonoptera |

**Identify the orders o the various specimens as per the table below**

| **Specimen** | **Order** | **Steps followed** |
|---|---|---|
| K-housefly | Diptera | 1a,2b |
| L- grasshopper | Orthoptera | 1a, 2a, 3b, 6b |
| M- beetle | Coleoptera | 1a, 2a, 3b, 6a |
| M-termite | Isoptera | 1b, 7a |

**2 a) Define the following ecological terms**

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**i. Ecology**

- study of the interrelationships between organisms and their environment

**ii. Environment**

- surrounding of the organism i.e. biotic or a biotic factors

**iii. Habitat**

- A specific locality (home) of a living organism with a set of factors (conditions) in which an organism lives.

**iv. Ecological niche**

- Role of an organism in its habitat e.g. feeding relationship

**v. Population**

- Number (group) of organisms of a species occupying a given habitat

**vi. Community**

- Refers to different species of (plants and animals) organisms in a given habitat (area) co-existing or interacting (living) with each other and the environment in which they live

**vii. Ecosystem**

- A community of organisms interacting with one another and the environment in which they live

**viii. Biosphere**

- The earth and its atmosphere where living organisms are found

**ix. Autecology**

- Study of a single (individual) species of plants or animals within a community, ecosystem, habitat or environment.

**x. Synecology**

- Study of natural communities (plants and animals) or populations interacting within an ecosystem.

**xi. Carrying capacity**

- maximum number of organisms an area can support without being depleted

**xii. Biome**

- geographical area with particular climatic conditions and flora and fauna
- it constitutes many ecosystems

**xiii. Biomass**

- dry weight (mass) of a living organism in a given area
- units of measurement are kg/m2/year

**b) i) What are abiotic factors?**

- non-living components of the ecosystem

**ii) Explain how abiotic factors affect living organisms**

**Wind**

- this influences rate of water evaporation from organisms
- therefore it affects distribution of organisms e.g. wind increases rate of transpiration and evaporation of water from the soil
- wind is an agent of soil erosion, may break and uproot trees
- may aid in the formation of sand dunes which can form habitats for some desert plants
- wind disperses fruits, seeds, spores
- wind forms waves in lakes and oceans which enhances aeration of water which replenishes oxygen concentration necessary for life
- wind is an agent of pollination

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**Temperature**

- influences rate of enzyme action in photosynthesis and other metabolic reactions in plants and animals
- organisms function within a narrow range of temperature
- it affects distribution of organisms
- changes in temperature affect rate of photosynthesis and biochemical reactions e.g. metabolism and enzyme reaction
- temperature increases rate of transpiration

**Light**

- needed by green plants and photosynthetic bacteria which are primary producers
- animals depend on plants directly or indirectly for food
- main source of light is the sun
- light is necessary for synthesis of vitamin D in certain animals
- some plants need light for flowering
- seeds like lettuce need light for germination

**Humidity**

- amount of water vapour held by the air
- affects the rate at which water is lost from organisms body by evaporation and stomatal transpiration
- when humidity is low the rate of transpiration increases
- humidity influences distribution of organisms

**PH**

- each plant requires a specific PH in which to grow (acidic, neutral or alkalinic)
- pH affects enzyme reaction in metabolism

**Salinity**

- some ions are needed for plant and animal nutrition
- osmoregulation implants and animals is affected by salinity

**Topography**

- altitude affects light, atmospheric pressure and light
- Slope influences surface runoff, wind erosion, etc.
- mountains affect distribution of organisms which differs in leeward side and windward side
- mountains affect distribution of organisms which differ on lowlands and on highlands
- mountains also form physical barriers to migration of organism and may cause isolation of species
- background may offer camouflage to some organisms hence protection from enemies

**Rainfall (water) or precipitation**

- amount and distribution of rainfall affect vegetation type
- this consequently affects distribution of animals e.g. polar region water frozen hence only well adapted organisms survive
- fewer organisms found in deserts where rainfall is less
- Water is required for seed germination, raw material for photosynthesis, solvent for mineral salts. Provides turgidity for plant support, medium for transport, disperses fruits, seeds and spores

**Pressure**

- the weight atmosphere exerts upon the earth

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- varies with altitude 9the higher the altitude the less the pressure
- this variation implies change in density which directly means less oxygen for respiration and less carbon iv oxide for photosynthesis and this affects distribution of organisms

**Mineral salts (trace elements)**

- these affect distribution of plants in the soil
- plants thrive best where elements are available
- Plants living in soil deficient in a particular element must have special methods of obtaining it.
- They harbor nitrogen fixing bacteria and others have carnivorous habit
- Plant distribution influences animal distribution

**c) i) What are biotic factors?**

- refers to living organisms in an area
- biotic environment of an organism constitutes all organisms around it, which it relates or interacts with in various ways

**ii) Give examples of biotic factors affecting ecosystems**

- feeding relationships
- predation
- competition
- diseases and pests
- human activities

**d) Discuss how the various biotic factors affect living organisms**

**i. Competition**

- organisms compete with one another for food, light, water, mates and shelter
- organisms must live together for competition for available resources
- those which cannot cope either structurally or behaviorally will migrate or die
- those remaining, due to better adaptations will increase in population
- competition between members of the same species is called intra-specific competition e.g. for mates
- Competition between members of different species is inter specific competition e.g. for food and space.

**ii. Predation**

- this is predator-prey relationship
- predator feeds on prey hence both control the other's population
- Distribution of predator and prey is important as predator cannot survive without prey
- It there is no predator the prey will increase in population beyond carrying capacity hence die due to environment depletion

**iii. Parasitism**

- an association where an organism lives in or on another living organism obtaining food(and other benefits) from it, causing harm to it (without necessary killing it)
- parasites may kill host
- they deprive host of food
- make host weak by introducing diseases
- make reproductive ability of host low hence host becomes susceptible to predation

**iv. Diseases and parasites**

- make organisms weak and susceptible to predation
- kill organisms and reduce their population

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**v. Symbiotic**

- and association of organisms of different species where both benefit from the association i.e. there is mutual benefit

**vi. Human activities**

- these are human factors which have an influence on the biosphere
- examples are road construction, industrialization, deforestation, agriculture, pollution, poaching, fishing conservation, population control
- affect ecosystem and balance of nature

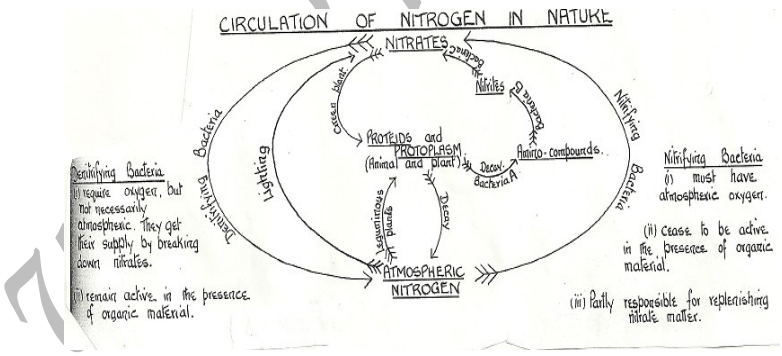
**Saprophytism**

- saprophytes are organisms which obtain organic matter in solution from dead and decaying tissues of plants and animals
- they include saprophytic bacteria and fungi
- they make available carbon, nitrogen and other elements form dead to living organisms
- they are useful in recycling nutrients in nature

**e)i) What is nitrogen cycle?**

- The process by which nitrogen in the air is made available plants and animals and eventually returns to the air.

**ii) Draw a simplified diagram representing the nitrogen cycle**




**iii) Describe the nitrogen cycle**

- during thunderstorms/lightning nitrogen gas combines with oxygen to form nitrogen oxides
- nitrogen oxides dissolve in water to form nitric acid
- acid is deposited in the soil by rain

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- nitric acid combines with chemical substances to form nitrates or nitric acid dissociates to form nitrates which are absorbed by plants
- symbiotic bacteria (Rhizobium) which are found in root nodules of leguminous plants fix free nitrogen to nitrates
- free living bacteria (clostridium and Azotobacter) fix nitrogen to nitrates
- nostoc algae (Anabaema chlorella) fix nitrogen to nitrates
- plants use nitrates to form plant proteins
- animals feed on plants and convert plant proteins into animal proteins
- plants and animals die and are decomposed by putrefying bacteria, fungi(saprophytes)
- decomposing plants, animals and nitrogenous wastes release ammonia which is converted to nitrites by Nitrosomonas and nitrococcus bacteria

- nitrites are converted to nitrates by nitrobacter bacteria
- nitrates in the soil can be converted to free nitrogen (denitrification) by some fungi, pseudomonas and theobaccilus bacteria generally called denitrifying bacteria

**iii. Nitrogen in the atmosphere cannot be directly utilized by plants. State two ways by which this nitrogen is made available for plant use**

- fixation by microorganisms (Rhixobium, Axotobacter)
- fixation by electrical discharge in atmosphere i.e. conversion by thunderstorm or lightning

**f) i) Describe how energy flows from the sun through the various trophic levels in an ecosystem**

- energy from the sun is trapped by green plants during photosynthesis, producing chemical energy9food or carbohydrates
- green plants are producers and occupy the first trophic level
- green plants are eaten by herbivores called primary producers as they occupy the second trophic level
- herbivores are eaten by carnivores, secondary consumers, which occupy the third trophic level
- when organisms 9plant and animals) die, fungi and bacteria which are saprophytic organisms feed on them thus causing them to decompose into simple substances e.g. mineral salts
- these organisms are called decomposers and detrivores
- decomposer feed on dead organic matter hence cause decomposition and decay which releases nutrients for plants, linking biotic and a biotic components
- at all levels energy is lost through respiration

**Give the reasons for loss of energy from one trophic level to another in a food chain**

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- insufficient utilization of food resources(wastage) e.g by defalcation
- through respiration
- through excretion e.g. urination and sweating

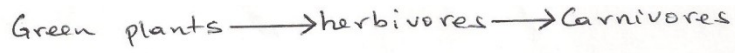
**Why are green plants referred to as primary producers in an ecosystem?**

- They utilize the energy from the sun to manufacture food for themselves and for subsequent trophic level (consumers) and other organisms

vi**. Explain the following terms giving suitable examples**

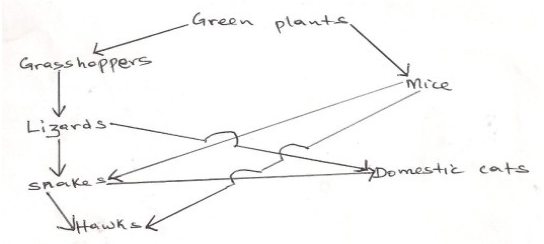
**Food chain**

- a nutritional sequence between producers and consumers through which energy flows in a straight line i.e. linear representation of feeding relationship between different organisms in an ecosystem
- if one consumer or the producer is removed the food chain is broken
- arrow points to the direction of energy flow e.g. green plant herbivore carnivore decomposer

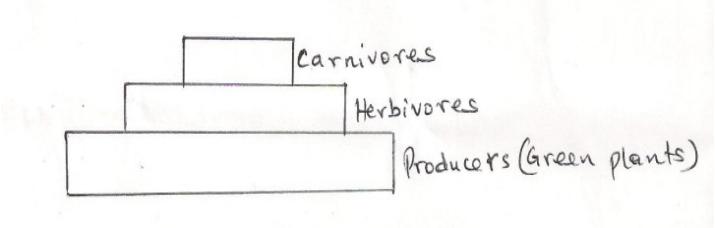



**Food web**

- complex feeding relationship where a consumer feeds on more than one type of food while several herbivores feed on one type of plant
- it is an interrelationship of many food chains
- consumers are usually fewer than producers to ensure survival of both



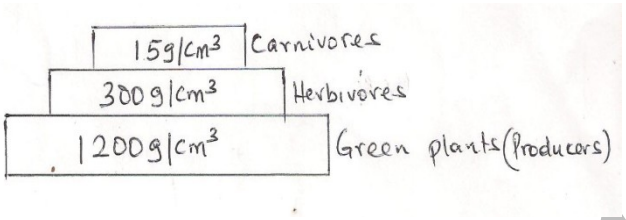

**Pyramid of numbers**




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- this is a diagrammatic representation of numbers of organisms at each trophic level in a food chain
- usually there are more producers than consumers
- hence producers herbivores carnivore
- the reason for the pyramid is because herbivores feed on many plants (producers) as carnivores feed on many herbivores
- sometimes this may not be true e.g. when many caterpillars feed on one tree or parasites on a herbivore
- this gives an inverted pyramid of numbers

**Pyramid of biomass**




- refers to diagrammatic representation total dry weight of organisms at different trophic levels in a food chain
- producers have greater biomass than any level of consumers progressively
- size of organisms in successive e trophic levels increases
- amount of individuals decreases in successive levels

**Account for the decrease of biomass in the successive trophic levels**

- fixed energy which supports living matter decreases at each successive trophic level since energy is lost by respiration and indigested (unconverted) materials hence less biomass supported at each level

**h) i) Describe the three characteristics of a population growth**

- increase in numbers
- decrease in numbers/growth rate
- change in numbers

**Dispersion**

- spread or distribution of organisms in a habitat

**Density**

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- the number of individuals per unit area

**ii) Explain how the following methods are used to estimate population of organisms**
**quadrat method**

- identify the study area
- throw or mark out the quadrat in the area of study at random
- identify or label the various species of plants in the quadrat
- count plants of each species
- record the numbers
- repeat the process
- work out the average per quadrat for each species
- calculate the total number of different species in the area or calculate the population for the total area of habitat

**Line transect**

- a string is stretched along an identified area
- all plants touching the string are counted

**Belt transect**

- preliminary study of the study area to estimate size or make a sketch map
- two parallel lines (strings or ropes) running for a determined distance and width
- count the number of organisms in the transect
- calculate the area covered by the transect
- calculate the number of organisms being investigated per unit area
- repeat this process at least three times in other parts of the study area
- find the mean number of organisms per unit area from all the belt transects
- from this figure calculate the total population of the desired organisms in the study area.

**Capture-recapture method**

- e.g. grasshoppers or fish
- capture the grasshoppers
- count and mark using permanent ink
- record
- release and allow time
- recapture and count the marked and unmarked
- total population is equal to the number of marked and unmarked grasshoppers in the second sample multiplied by the number of marked grasshoppers in the first sample divided by number of grasshoppers marked in the second sample that were recaptured

**2. a) Describe the adaptations of plants to various habitats**

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### i. Xerophytes

- grow in areas with scarcity of water
- roots grow deeply and extensively (widely spread) to ensure access to water
- thick succulent stems, roots and leaves for water storage
- photosynthetic stems take place of leaves which would lose a lot of water
- Leaves are needle-like (reduced to spines), scaly, have sunken stomata. Some have curled (rolled) leaves. Some have thick waxy cuticle, reduced number of stomata to reduce water loss by transpiration
- some shed leaves during dry season to reduce water loss
- presence of thorns for protection
- short life cycle to ensure survival
- reversed stomatal rhythm

### ii. Hyrophytes

- grow in places with plenty of water(waterlogged)
- aerenchyma a tissue (airspaces) and large intercellular spaces and long fibrous roots for buoyancy (floating in water)
- poorly developed support tissues (sclerenchyma) because water provides the necessary support
- upper epidermis of leaves have more stomata than lower epidermis for gaseous exchange or for increased rate of transpiration
- poorly developed conducting tissues (xylem and phloem) because plants obtain water by diffusion

### iii. Mesophytes

- grow in well watered soils (common plants)
- no special adaptations, but depending on particular habitat, may have some adaptations
- in forests they grow fast, tall to capture light. Have climbers while some are adapted to carry out photosynthesis in low light intensities (those that form undergrowth)
- in places with adequate water they form broad leaves, thin cuticle and many stomata on both leaf surfaces
- in direr regions they possess more stomata on the lower leaf surface and are deep rooted
- some are shallow rooted and develop buttress and prop roots for support
- some have waxy or glossy surface to reflect sun rays and drip off rain water

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### iv. Halophytes

- plants that grow in very salty soil where the salt concentration is higher than that in the plant
- have root cells which concentrate a lot of salts in them and enable then to take in water by osmosis
- succulent roots to store water

- have pneumatophores (breathing roots) to take in oxygen
- some have buttress roots for support
- secrete excess salt by use of salt glands
- have large airspaces in leaves and stems for buoyancy and to store air
- capable of photosynthesis at low light intensities
- e.g. mangrove

**b) i) What is pollution?**

- any process which leads to adverse or harmful changes in the environment

**ii) Explain the various human activities that have caused pollution**
**Causes and effects of air pollution**

- sulphur iv oxide, hydrogen sulphide, chlorine, oxides of nitrogen produced by industries, sewage, decomposing organic matter and fumes affect gaseous exchange, makes acid rain and damage plant leaves
- aerosols, herbicides, insecticides (agrochemicals), paint spays, acaricides and CFC's sprayed to control diseases, pests and weeds affect respiratory organs of animals. The chemicals are residual and persistent (not easily broken down) and bring depletion of the ozone layer
- smoke and fumes produced in areas with heavy industries, motor vehicles, fires which burn fuel, oil, wood and coal cause carbon ii oxide, poisoning affect respiratory systems and affect visibility
- particles in smoke and fumes settle on leaves and stop photosynthesis
- carbon iv oxide causes green house effect which causes temperature inversion as a result of heating the lower layers of atmosphere
- sound and noise produced incessantly by machines, aeroplanes and heavy vehicles affect hearing in animals
- dust from cement factories, quarries, dust roads settles on leaves limiting photosynthesis
- removal of vegetation interferes with carbon cycle
- radio-active emissions from nuclear reactors, mines and bombs cause cancer, mutations and death.

**Control of air pollution**

- use of lead free petrol in motor vehicles, air craft, aeroplanes and petroleum engines
- uses of smokeless fuels and electricity
- filtration, dissolution and use of chemicals to remove harmful gases
- factories should be erected far away from residential areas
- use of tall chimneys
- reduce volume or intensity of sound e.g. by use of ear muffs
- concords should fly at higher altitudes and aeroplanes to fly high up

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**State the causes, effects and methods of controlling and prop roots for support water pollution**

**Causes and effects**

- agrochemicals e.g. fertilizers cause eutrophication leading to increase in animal population
- Silting makes water surfaces shallow and silt clogs stomata and gills of fish reducing rates of photosynthesis and gaseous exchange. It also leads to reduction of algae which causes reduction of consumers i.e. animal population
- industrial and domestic wastes contain toxic materials which kill producers and other organism while oily substances in wastes may clog gills of fish and may change pH of water oxygen solubility is also reduced by oily surfaces
- Untreated sewage and effluents where decomposition or organic matter in sewage reduces oxygen supply and sewage provides food for bacteria increasing their population and demand for oxygen thus depriving fish of oxygen.
- Human feaces causes eutrophication, carbon IV oxide produced by decomposition of faecal matter changes pH of water interferes with photosynthesis and may clog fish gills or block light penetration which interferes with producers thereby decreasing productivity.
- Dumping of chemicals from industries with toxic pollutants which kill organisms
- Spillage of oil and chemicals block oxygen and kill organisms
- Discharge of water from industries into water body where high temperatures reduce amount of oxygen in the water causing organism to suffocate and die
- Untreated sewage may lead to outbreak of epidemics

**Control of water pollution**

-pollution caused by domestic effluents may be controlled by treating domestic waste, using biotechnology, banning the use of phosphate-based detergents, using plastic pipes instead of those made from lead, recycling gabbage, using biodegradable detergents.

Pollution caused by industrial waste may be controlled by treating/cooling industrial waste, carrying out environmental impact assessment before establishing industries

Oil spillage may be controlled by cleaning spilled oil biotechnology and penalizing the industry individual or companies which cause oil spills/water pollution

Pollution caused by agrochemicals may be controlled by using mechanical control of weeds, biological control of weeds and pests, biodegradable organic fertilizer herbicides, insecticides pesticides, organic farming educate farmers on the use of correct amount of agrochemicals

- silting may be controlled by appropriate farming practices, contour farming, reafforestation, building gabions and terracing

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**iv) State the causes /effects and control methods of soil pollution**
**Causes and effects**

- Air pollutants e.g. sulphur IV oxide fumes form sulphuric acid with rain water. The acid rain alters soil pH therefore affecting plants that cannot tolerate acidic soil
- most aerosols sprayed to control pests and diseases precipitate in the soil and are taken up by plants which make its concentration many times higher, increasing the toxicity in the plants which absorb them
- petroleum products due to spillage by oil tankers making it impossible for plant roots to obtain oxygen in oil saturated soils, therefore plants are killed
- agrochemicals and inorganic fertilizers contain heavy metals that are not used up by plants and eventually soil microorganisms cannot inhabit the soils
- organic matter slows down, life ceases and soil becomes exhausted
- community, household wastes and industrial wastes disposal is a major problem in big towns and cities. commodities packaged in metal tins, rubber, plastic containers, scrap metal, glass bottles, different types of paper are nuisance to the environment, rendering it useless for agricultural purposes

**Control of soil pollution**

- use of organic farming techniques
- biological control of pests, diseases, parasites
- recycling of non-degradable containers or burying them safely after use
- controlled burning of garbage
- treatment of human and industrial waste for safe disposal
- avoid spilling chemicals and oil when used

**v) Define biological control give suitable examples**

- using a living organism to regulate, control or reduce the population of another organism e.g beetles to feed on water hyacinth, fish to feed on mosquito larvae.

**vi) What is eutrophication?**

- enrichment of water bodies with nutrients due to discharge of sewage leading to rapid growth of surface plants

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**i) What are the effects of eutrophication?**

- enrichment of water bodies with nutrients due to discharge of sewage leading to rapid growth of surface plants

**vii) What are the effects of eutrophication?**

- The plants block light from reaching plants underneath hence no photosynthesis
The plants die and decompose leading to lack of oxygen hence animals also die

**c) Describe the symptoms, mode of transmission and control of cholera, typhoid malaria and amoebic dysentery in humans**

| Disease | Causative agent | Transmission | Symptoms | Control |
|---|---|---|---|---|
| Cholera | Vibrio cholerae(bacterium) | Contaminated food or water<br>Spread by flies form faeces | Intestinal pain<br>Diarrhea<br>Vomiting<br>Dehydration | Proper hygiene e.g. boiling drinking water<br>Vaccination |
| Typhoid | Salmonella typhi (bacterium) | • contaminated food or water<br>• spread by flies from faeces | • fever<br>• rashes<br>• diarrhea + blood from bowels | • proper sanitation<br>• vaccination |
| Malaria | Plasmodium (protozoa) | - bite by infected female anopheles mosquito | - fever<br>Joint pains<br>Vomiting<br>Headache<br>Anaemia | • killing mosquito<br>• killing the mosquito larvae<br>• draining stagnant water<br>• clearing bushes<br>• treatment<br>• sleep under mosquito net |
| Amoebic dysentery | Entamoeba hystolytica | - contaminated food or water due to | - intestinal pain<br>Diarrhea | • sanitation<br>• personal |

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| | | | | |
|---|---|---|---|---|
| (amoebiasis) | (bacterium) | improper disposal of faeces | Vomiting<br>Dehydration | hygiene<br>• cook food well<br>• treatment using drugs |

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**d) Discuss Ascaris lumbricoides under the following sub-headings**

**i. Mode of transmission**
- through ingestion of contaminated food
- live in intestines

**ii. Effects of parasite on the host**
- inflammation of lungs
- pneumonia
- produce toxic substances
- intestinal obstruction

**iii. Adaptations**
- thick cuticle which protects it against digestion
- lays many eggs to ensure survival
- mouthparts for sucking partly digested food
- lack of elaborate alimentary canal
- tolerant to low oxygen concentration
- two hosts to ensure survival
- eggs have protective cover to ensure survival in adverse environments

**iv. Control and prevention**
- proper sanitation
- wash hand after defaecation and before eating

**e) Discuss schistosoma under the following sub-headings**

**i. Mode of transmission**

- through contaminated water in swamps, etc

**ii. Effects on host**

- bleeding in lungs
- blood stained urine
- unthriftiness

**iii. Adaptations**

- has two hosts to increase chances of survival
- eggs have a hook like structure which raptures the walls of intestine or bladder
- lay large number of eggs to ensure survival
- larvae have a sucker for attachment on human skin which it digests
- larva has a tail which it swims with in search of host in water
- prolonged association between male and female to ensure that fertilization takes place
- adults can tolerate low oxygen concentration (in the animal tissues)
- adult worm secretes chemicals against antibodies
- larvae and eggs (have glands that) secrete lytic enzymes to soften the tissues that ease penetration
- larvae are encysted so as to survive adverse conditions

**iv) Control and prevention**

- proper use of toilet facilities
- boiling water before use
- avoid bathing/washing in infected water
- Use of molluscicides (chemicals that kill snails/biological control/clearing water weeds on which snails feed.
- Drainage of stagnant water
- Wearing gum/rubber boots

**3. a) i) What is reproduction?**

- process by which living organisms give rise to new members of their own species which resemble the parents

**ii) Why is reproduction important?**

- for continuity of species/ to ensure survival of species
- maintaining life of species
- replace dead individuals

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**iii) Name the types of reproduction**

- sexual which involves fusion of male and female gametes
- asexual in which no gametes are involved but parts of a mature organism develops into new individuals

**b) i) What is cell division?**

- process by which cells are formed from pre-existing cells

**ii) What are chromosomes?**

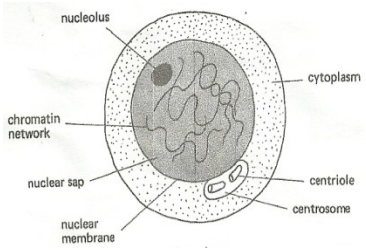
- Threadlike structures found in nucleus of a cell.
- The units called genes
- Genes are factors that cause inheritance or determine characteristics of offspring

**c) i) What is mitosis?**

- A type of cell division that occurs during growth leading to increase in number of cells
- all cells maintain the same chromosome constitution i.e. the diploid state

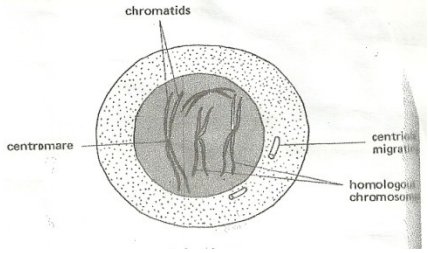
**ii) Describe the five stages of mitosis**

**Interphase**




- replication of organelles
- duplication of DNA
- production of energy (ATP) for cell division

**Prophase**

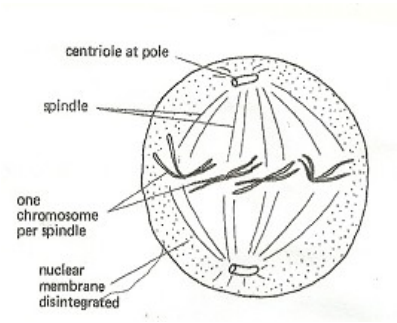



- stage of dehydration
- chromosomes shorten and thicken
- chromosome replicates into two chromatids
- chromatids joined at centromere
- formation of spindle fibers

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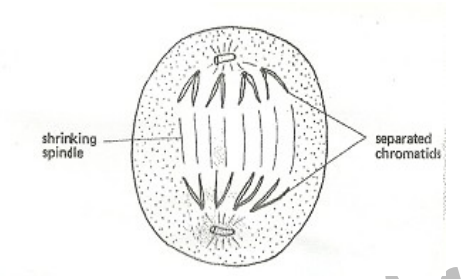
**Metaphase**

- chromosomes move to equator (early metaphase)
- chromosomes line up at the equator
- homologous chromosomes do not associate

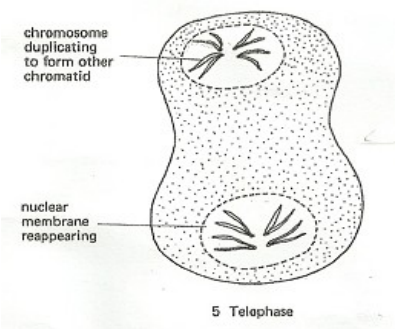



**Anaphase**

- chromatids separate
- move to opposite ends (poles) of the cell




Telophase




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- chromatids reach the poles
- formation of two daughter cells occurs i.e. cytoplasmic division

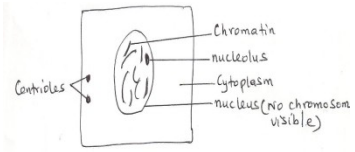
**ii) State the significance of mitosis**
- ensures each daughter cell has same number and kinds of chromosomes as daughter cells
- gives rise to new cells (responsible for growth)

**d) i) What is meiosis?**
- division of diploid cells to form gametes which are haploid

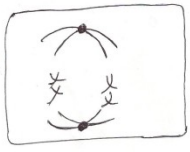
**ii) State the significance of meiosis**
- gives rise to gametes
- source of variation

**iii) Give a summary of the stages of meiosis**
**First meiotic division**

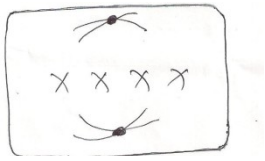
**Interphase**
- cell is in non-dividing condition
- chromosomes appear threadlike




**Prophase I**
- chromatic material shorten and thicken
- double stranded chromosomes appear (bivalent)
- double stranded chromosomes pair and twist round each other (synapsis)
- point of contact of chromosomes is called chiasma



**Metaphase I**
- paired homologous chromosomes line up at the equator



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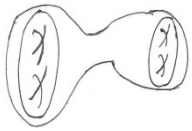
**Anaphase I**

- paired homologous chromosomes move to the poles



**Telophase I**

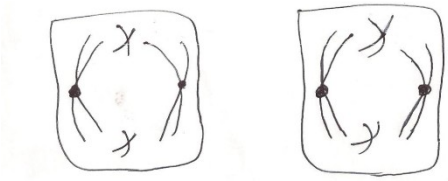
- paired homologous chromosomes reach the poles
- two new nuclei are formed



**Second meiotic division**

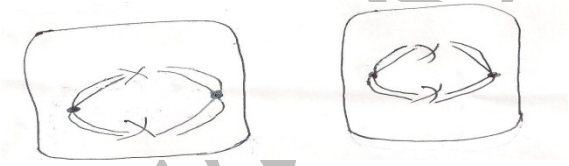
**Prophase II**

- chromosomes shorten, thicken and become visible,
- stage of dehydration



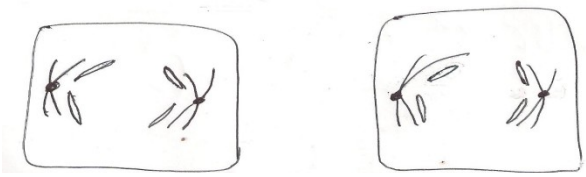
**Metaphase II**

- movement of chromosomes to equator



**Anaphase II**

-chromatids of each chromosome separate to the poles



**Telophase II**

- reach the poles
- four haploid daughter cells are formed



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**iv) Give the similarities between mitosis and meiosis**

- both take part in cells
- both involve division (cell multiplication)

**v) What are the differences between mitosis and meiosis?**

| Mitosis | Meiosis |
|---|---|
| • maintenance of chromosome number (diploid)<br>• takes place in somatic cells/growth<br>• no crossing over/no variations<br>• results into 2 daughter cells<br>• no pairing/no synapsis/no bivalent formed<br>• a one division process of four stages | • reduction/halving of chromosomes (haploid<br>• occurs in reproductive cells/gonads/produces gametes<br>• crossing over takes place/variation occurs<br>• results into 4 daughter cells<br>• there is paring/synapsis/bivalent<br>• a two division process of four stages each |

**d) i) What is asexual reproduction**

- formation of new individuals as a result of the fusion of two gametes
- fusion is called fertilization

**ii) What is the significance of sexual reproduction in living organisms?**

- leads to genetic variation e.g. cross breeding which gives rise to hybrids

**iii) State the advantages of sexual reproduction**

- genetic variation
- greater adaptability to environment by offspring
- few bad or good traits inherited/retained
- greater amount of dispersal is possible
- may result in stronger offspring

**iv) Give the disadvantages of sexual reproduction**

- less certainty in egg and sperm meeting
- low rate of survival
- sex-linked diseases easily transmitted

**e) i) What is asexual reproduction?**

- formation of new organisms without fusion of gametes
- occurs with only one parent
- parts of organism develop into new individual

**ii) State the advantages of asexual reproduction**

- retention of useful characteristics/genes/traits

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- offspring establish faster/shorter life cycle
- better chances of survival because of suitable environment

**iii) Give the disadvantages of asexual reproduction**

- lack of genetic variation
- lowered resistance to disease
- loss of hybrid vigor
- competition for resources due to overcrowding

**iv) Explain how reproduction occurs by the following methods of asexual reproduction**
**Sporulation**

- formation of spores
- spores are small haploid cells produced by plants
- spores give rise to new haploid organisms
- includes moulds, ferns, bryophytes, pteridophytes

**Budding**

- where an outgrowth arises from a parent and drops off to develop into a new organisms
- hereditary material in the daughter cell and parent are exactly the same
- occurs in organisms such as hydra, jelly fish, sea anemones, yeast and some fungi

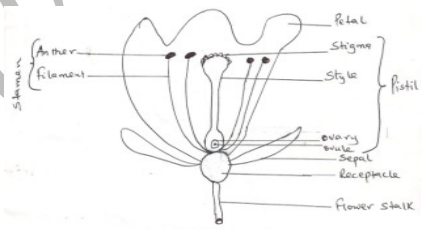
**Binary fission**

- a cell splits into two new cells of equal size
- each daughter cell grows into anew organism
- Occurs in organisms such as amoeba, euglena, paramecium, some fungi and bacteria.

**f) i) What is a flower?**

- this is the reproductive structure which bears the reproductive parts of a plant
- it produces seeds and fruits

**ii) Draw a longitudinal section of a labeled diagram of a flower**




**iii) Give the functions of the parts of a flower**

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**Receptacle**

- expanded end of stalk which bears floral parts

**Calyx**

- consists of sepals
- usually green
- protect flower in bud

**Corolla**

- consist of petals
- often colored or scented to attract insects

**Androecium**

- male part of flower
- consist of stamens
- each stamen consists of an anther containing pollen sacs
- anther produces pollen grains which contain male gametes

**Gynaecium**

- female part of flower
- consists of one or more carpels
- each carpel contains one or more ovules in an ovary
- style bearing a stigma extends from ovary
- ovary contains female gametes which when fertilized become seeds

**iv) What is inflorescence?**

- a group of flowers borne on the same branch (main stalk)

v**) Explain the meaning of the following terms which describe flowers**

**Hermaphrodite**

- one with both stamen and carpel
- most flowers are hermaphrodite/bisexual

**Unisexual**

- have only one of carpel or stamen i.e. either male or female

**Carpelate**

- also called pistilate
- contains only carpels hence a female flower

**Staminate**

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- also called male flower
- contains only stamens

**Dioecious plants**
- have pistilate and staminate flowers on different plants e.g. pawpaw

**Monoecius plants**
- have pistilate and staminate on one plant
- however, pistilate and staminate occur at different plants e.g. maize

**Complete flower**
- Has all four parts i.e. Calyx, corolla, androecium and gynoecium

**Incomplete flower**
- does not have all four parts
- at least one is missing

**vi) Explain the meaning of the following types of ovary**
**Superior**
- ovary occurs above other floral parts on the receptacle

**Inferior (epigynous)**
- other floral parts arise above ovary on the receptacle

**g) i) What is pollination?**
- transfer of pollen grains from anther of a stamen to stigma of a flower

**ii) Explain the types of pollination**
- self pollination takes place when mature pollen grains of a flower fall on the stigma of the same flower
- cross pollination takes place when pollen grains of a flower fall on the stigma of another flower of the same species

**iii) State the advantages of pollination**
- healthy offspring
- leads to variation
- greater chances of dispersal

**iv) List the agents of pollination**
- wind
- water
- insects

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**v) How are flowers adapted to wind and insect pollination?**

**Insect pollinated flowers (entomophilus)**

- are scented to attract insects
- have stick stigma for pollen grains to stick on
- are brightly coloured to attract insects
- presence of nectar to attract insects
- have nectar guides to guide insects to the nectarines
- have nectarines to secrete nectar
- stigma/ anthers located inside the flower/tubal/funnel shaped corolla to increase chances of contact by insects
- sticky/spiny/spiky pollen grains which stick on the body of insects and on stigma
- large/conspicuous flowers easily seen by/attract insects
- anthers firmly attached to the filament for insects to brush against them
- landing platform to ensure contact with anthers and stigma
- mimicry to attract (male) insects

**Wind pollinated flower (anemophilus)**

- anthers/stigma hang outside the flower to increase chances of pollination
- the style/filament is long to expose stigma/anthers
- stigma is hairy/feathery/branched to increase surface area over which pollen grains land/to trap pollen grains
- pollen grains are smooth/dry/light/small to be easily carried by wind
- large amount of pollen grains to increase chances of pollination
- anthers loosely attached to filaments to enable them to sway to release pollen grains
- pollen grains may have structures which contain air to increase buoyancy
- flowers have long stalks holding them out in the wind

**vi) State the ways in which plants prevent self-pollination**

- protandry(anthers/stamens mature first)
- protagyny (pistils mature first)
- monoecism (where male and female parts are on same plant but different parts)
- dioecism(where male and female parts are on different plants)
- incompatibility (self sterility)
- heterostyly (styles at different heights)

**vii) Give the characteristics that ensure cross pollination takes place in flowering plants**

- presence of special structures that attract agents of pollination
- protandry/dichogamy
- protagyny/dichogamy
- monoecism
- self sterility
- heterostyly

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**viii State the advantages of cross pollination**

- hybrid vigour
- less prone to diseases
- promotes genetic variation
- greater evolutionary potential

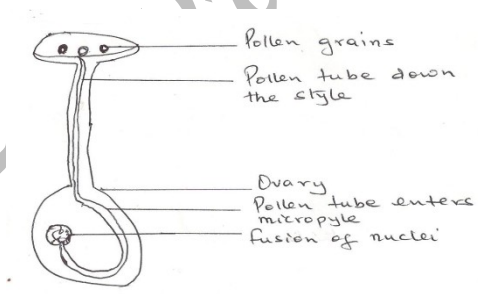
**h) i) What is fertilization?**

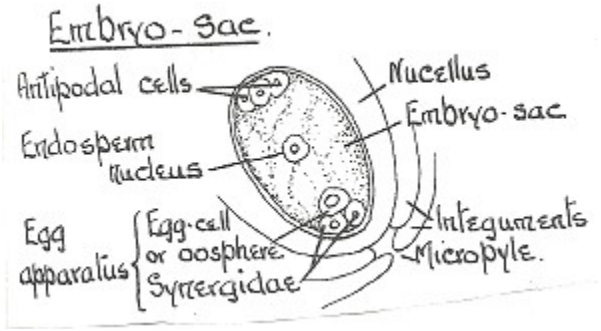
- Fusion of male and female gametes to form a zygote

**ii) Describe how fertilization takes place in a flower**

- this follows pollination
- pollen grain is deposited on the stigma
- pollen grain sticks to the surface of the stigma
- the surface of the stigma produces a chemical substance which stimulates the pollen grain to produce a pollen tube/to germinate
- the pollen tube grows through the style tissues on which it feeds until it enters the ovary
- the generative nucleus divides into two giving two male nuclei
- embryo sac contains eight nuclei i.e. two synergids, egg cell, two polar nuclei and three antipodal cells
- the pollen tube enters the embryo sac through the micropyle and one of the male nucleus fuses with the egg cell/ovum to form a zygote

- the other male nucleus fuses with the two polar nuclei to form the triploid nuclei/endosperm)food storage used by developing embryo)
- the pollen tube nucleus in the pollen tube disintergrates soon afterwards
- this process is referred to as double fertilization
- zygote grows into an embryo containing plumule, radicle and cotyledons




**iii) What is double fertilization?**

- there are two male nuclei entering embryo sac
- one fuses with the ovum to form a zygote, while the other fuses with the polar nuclei to form a triploid primary endosperm nucleus

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- therefore there are two fusions at fertilization

**iv) Name the changes that Occur in a flower after fertilization**

- petals, stamen, calyx and style wither
- ovary wall changes into pericarp
- intergument changes into seed coat/testa
- zygote changes into embryo (by mitosis)
- primary endosperm nucleus changes into endosperm
- whole ovule changes into seed
- ovary develops and grows into fruit(under the influence of gibberrellic hormone)

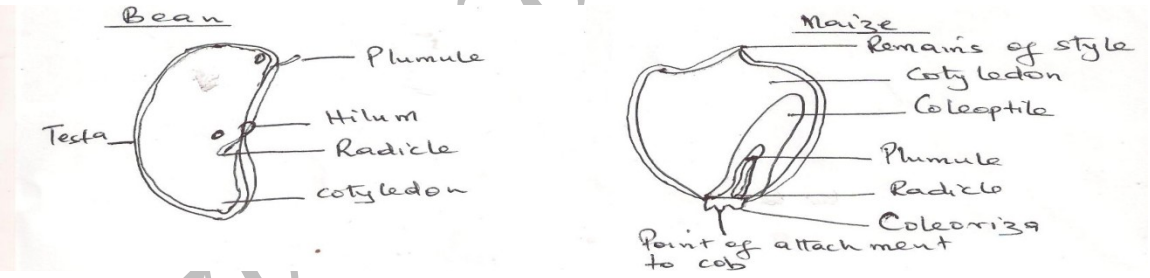
**b) i) Distinguish between a fruit and a seed**

- a fruit is a fertilized ovary and has two scars
- a seed is a fertilized ovule and has one scar

**ii) How is a seed formed?**

- after fertilization, zygote grows into an embryo, primary endosperm nucleus developed into endosperm, interguments harden to form testa, hence the whole ovule becomes the seed
- the seed loses water to become drier
- the seed has plumule, radicle, seed leaves called cotyledons, a microphyle and a scar

**iii) Draw a labeled diagram of a seed**




**iv) Describe the main parts of a seed**

**Testa**

- also called seed coat
- a tough outer covering which protects the seed from insects, bacteria etc
- segment is the membrane inside the testa

**Hilum**

- a scar
- spot where the seed was attached to the fruit or pod

**Micropyle**

- small hole through which water and air enter the seed

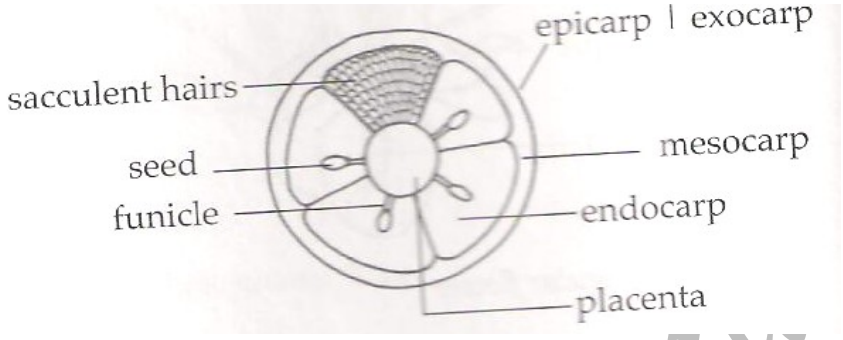
**Radicle**

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- embryonic root
- grows into the shoot system

**Cotyledons**
- embryonic leaves
- store food for the germinating seed i.e. for plumule and radicle
- when plumule and radicle grow, they use food stored in the cotyledon
- in some seeds food is stored in the endosperm

**v) Draw a labeled diagram of a fruit**




**vi) How is a fruit formed?**
- one of the organs that remains on the plant after pollination and fertilization is the ovary
- within the ovary, the developing embryo produces special chemical substances that stimulate the young ovary
- these substances also signal the start of the formation of the fruit, which is a mature ovary
- the fruit may contain one or more seeds
- during fruit formation the ovary increases in size while ripening or maturing
- a true fruit is formed from the ovary of a flower after fertilization
- it has two scars(style scar and stalk scar) and contains seeds
- some seeds are not formed from the ovary of a flower
- some other parts of a flower develop to form a fruit
- such fruits are called false fruits

**vii) Explain the importance of fruits in the survival of plants**
- protect the seed against dessication, predators and adverse conditions
- aid in seed dispersal by attracting agents of dispersal
- stores food for the plant

**vii. Distinguish between parthenogenesis and** parthenocarpy
- parthenogenesis is development of new animals from unfertilized eggs
- parthenocarpy is development of a fruit without fertilization

**iv) State the differences between a seed** and fruit

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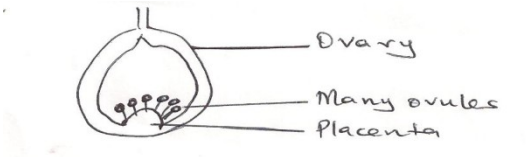
| Seed | Fruit |
|---|---|
| • fertilized ovule<br>• attached to placenta through funicle<br>• one scar called hilum<br>• has seed coat/testa<br>• seed wall undifferentiated | • fertilized ovary<br>• attached to branch through a stalk<br>• two scars (style scar and stalk scar)<br>• has fruit wall/pericarp<br>• fruit wall is differentiated |

**j. i) What is placentation?**

- arrangement of ovules within the plant ovary

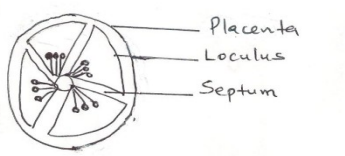
**ii) Explain the following types of placentation**

**Marginal**



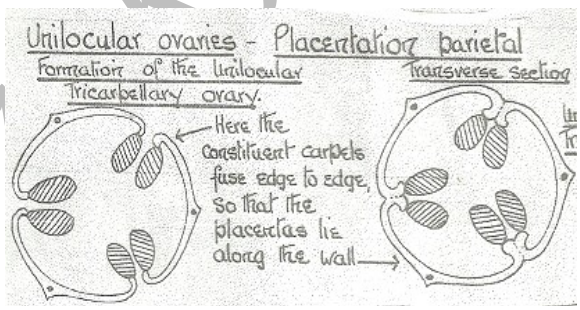

- placenta appears as one ridge on ovary wall
- ovules are attached to placenta in rows e.g. peas in a pod

**Basal**




- placenta formed at the base of the ovary with numerous ovules attached to it

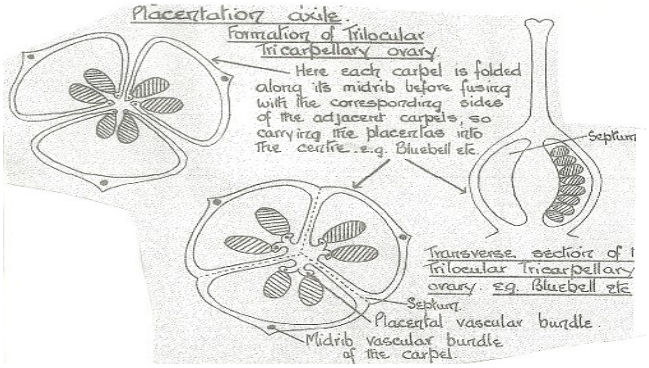
**Parietal**




- edges of carpels fuse together
- dividing walls disappear, leaving one loculus
- have numerous seeds e.g. passion fruit
- placenta of each carpel appears as ridges on ovary wall

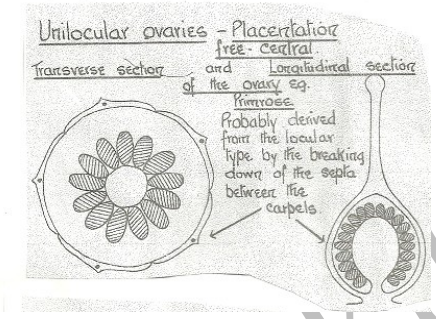
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**Axile**




- edges of carpels fuse together to form a single central placenta
- numerous ovules arranged on placenta
- ovary divided into a number of loculi by walls of the carpel e.g.

**Free central placentation**




- edges of carpels fuse together
- dividing was disappears leaving one loculus
- placenta appears at base of ovary
- has numerous ovules

**c) i) How are fruits grouped?**

**Simple fruits**

- formed from a single flower or one ovary e.g. mango

**Aggregate fruits**

- consists a group of ovaries that appear on a common receptacle e.g. strawberry

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**Multiple (compound) fruits**

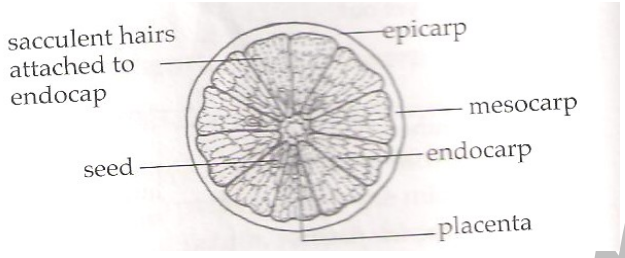
- formed from several flowers whose ovaries fuse together after fertilization
- form a bunch e.g. pineapple, figs
- are always false fruits

**ii) What are succulent fruits?**

- also called fleshy fruits
- all or part of pericarp (fruit wall) becomes juicy

**iii) Give types of juicy fruits**

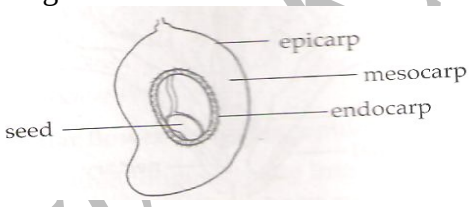
**-Berry**




- has many seeds
- whole pericarp is succulent e.g. orange, tomato, pawpaw

**Drupe**

- only one seed
- pericarp divided into three layers i.e. epicarp, mesocarp(juicy) and endocarp(hard)
- e.g. mango and coconut




**Pome**

- juicy part is swollen receptacle
- is usually a false fruit
- example is a pear

**iv) What are dry fruits?**

- have a pericarp that is dry, hard and woody
- either dehiscent or indehiscent
- called dry because they are not succulent

**v) What are dehiscent fruits?**

- split open when ripe to release seeds
- contain many seeds

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**vi) Give types of dehiscent fruits**

**Legumes**

- split along two edges
- are usually pods e.g. beans, peas, crotolaria

**Follicle**

- split on one side only e.g. Sodom apple

**Capsule**

- has several lines of weakness/sutures
- open in many places e.g. castor oil, cotton

**vii) What are indehiscent fruits?**

- non-splitting fruits
- usually one seeded only

**ii) Give main types of indehiscent fruits**

**Nut**

- pericarp woody, hard and thick e.g. cashew

**Achene**

- has thin, tough pericarp e.g. sunflower

**d) i) What is seed and fruit dispersal?**

- spreading of seeds and fruits away from parents so as to settle where conditions are suitable for their germination

**ii) Why is dispersal of seeds and fruits necessary?**

- prevent overcrowding
- reduces competition for space, nutrients and light
- colonization of new areas is made possible
- to increase chances of survival
- to prevent inbreeding
- to avoid extinction due to over competition for the necessities

**iii) Explain how seeds and fruits are adapted to various methods of dispersal**

**Adaptations for wind dispersal**

- they have wings, feathers or hair-like structures to increase surface area for wind to carry them easily/buoyancy
- seeds/fruits are loosely attached on the stalks so that they can easily be released and carried away by wing
- seeds/fruits are generally light and small sized to be easily carried by wind

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- some seeds/fruits have parachute-like structures to be easily carried b wind
- some have censor mechanism where seeds and fruits are borne on long stalks that are loosely attached which allows swaying so that movements of capsule by wind releases the seeds

**Water dispersal seeds**

- seed/ mesocarp has air spaces thus light/buoyant to float hence carried by water
- they have waterproof cover and tough pericarp protects seeds from getting soaked
- fibrous and spongy mesocarp to easily float

**Animal dispersal seeds**

- presence of hooks for attachment to animals thus carried to other parts
- fruits are brightly coloured, succulent and scented to attract animals
- seed coats are hard and resistant to digestive enzymes hence seeds are dropped away from mother plant
- large in size or borne on clusters to be easily seen

**Self dispersal/explosive**

- self opening seeds
- they have lines of weakness called sutures for violent opening thus scattering seeds away from parent plant

**5. a) i) Distinguish between external and internal fertilization in animals**

- in external fertilization fusion of the male and female gametes takes place outside the body of the female e.g. amphibians and fish
- in internal fertilization union of gametes occurs inside the body of the female

**ii) State the advantages and disadvantages of external fertilization**

**Advantages**

- large numbers produced therefore many offspring per breeding season
- female does not suffer gestation stress
- mother does not need to care for the young except in a few species
- the surviving individuals are highly selected for better survival

**Disadvantages**

- many predators surround the eggs before and after fertilization
- fewer chances of fertilization/a lot of gametes wasted
- embryo development at mercy of environment
- large numbers of female gametes are required therefore female gets much exhausted

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**iii) State the advantages and disadvantages of internal fertilization**

**Disadvantages**

- number of gametes fewer hence less number of offspring
- less adapted for sudden change of environment after birth
- in mammals females suffer gestation stress

**Advantages**

- more chances of fertilization
- fewer predators of oval/fertilized egg protected in females body
- stable internal environment
- fewer gametes required

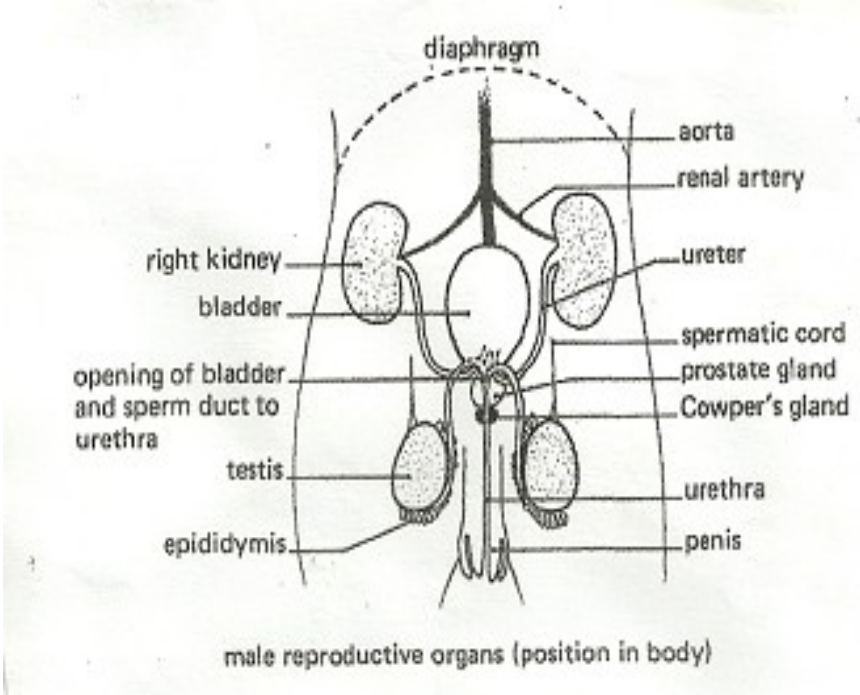
**iii) Give a reason why it is necessary for frogs to lay many eggs**

- to increase chances of survival/fertilization

**iv) Compare external and internal fertilization**

| External | Internal |
|---|---|
| • occurs in water outside the bodies of animals<br>• many eggs are laid<br>• usually less contact between male and female<br>• both fertilized eggs exposed to danger | • occurs inside the body of the female animal<br>• fewer eggs released from ovary<br>• very close contact in form of copulation between male and female<br>• Fertilized eggs are enclosed hence highly protected inside females' body. |

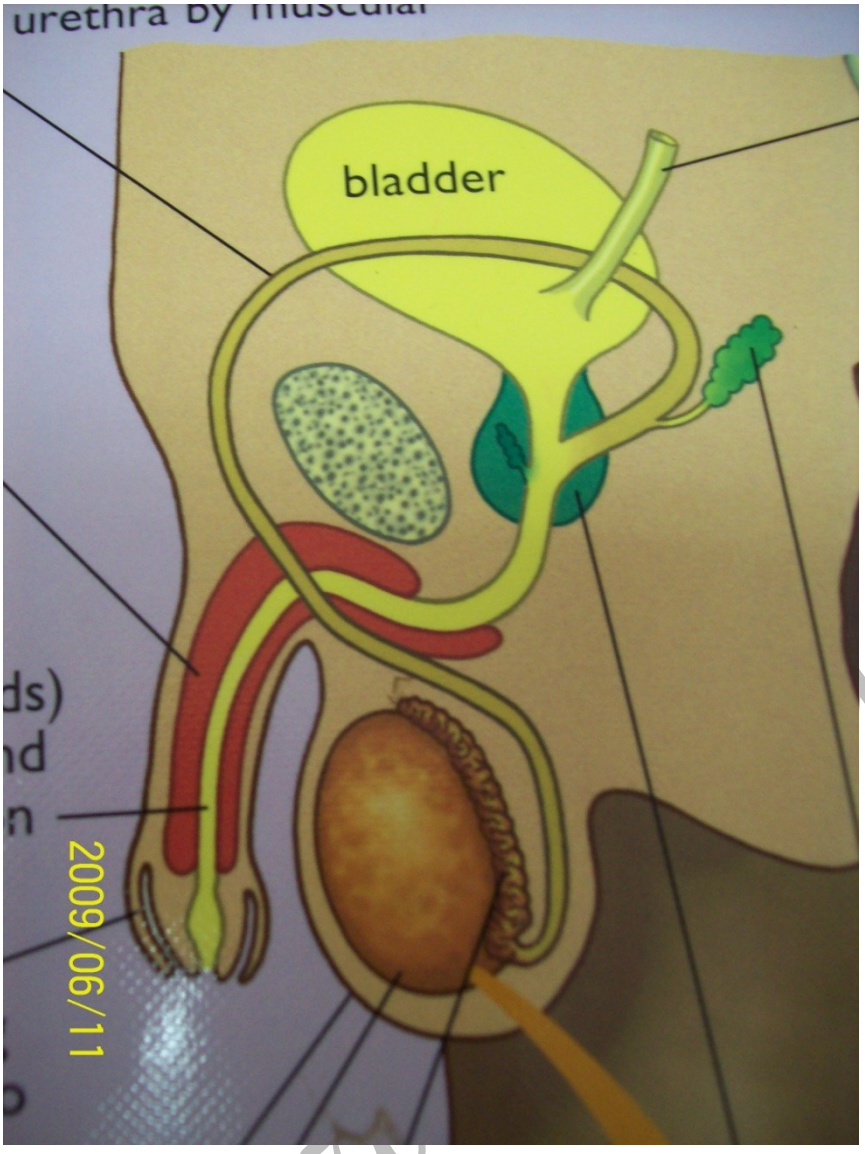
**b) i) Draw and label the human male reproductive system**



male reproductive organs (position in body)

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urethra by muscular
bladder
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**ii) Describe how the mammalian male reproductive system is adapted to perform its functions**

**Penis**

- is highly vascularised/spongy
- has a sensitive glands
- becomes erect to allow entry into the vagina

**Scrotum**

- contains the testes outside the body on whose walls the process of spermatogenesis takes place
- the process is favored by lower temperature
- it contains sertoli cells which nourish sperms until they are mature

**Epididymis**

- long and coiled for the purpose of sperm storage

**Vas deferens**

- muscular
- upon contraction pushes sperms out and allows ejaculation

**Gametes**

- produced in large numbers to increase chances of fertilization
- the sperms have a tail for swimming/large number of mitochondria to provide energy/allow swimming to reach the egg

**Accessory glands**

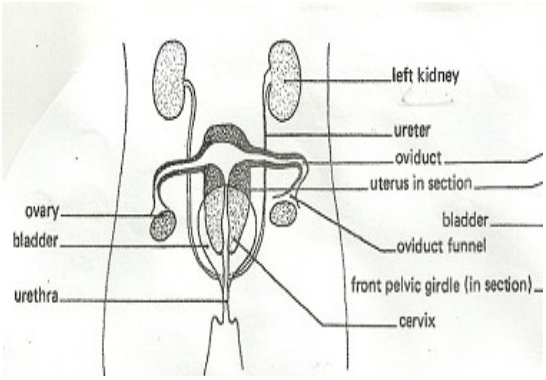
- are seminal vesicle, Cowper's gland and prostate gland
- they produce seminal fluid to provide a medium/ nutrients for sperms to swim

**iii) How is the sperm adapted to perform its function?**

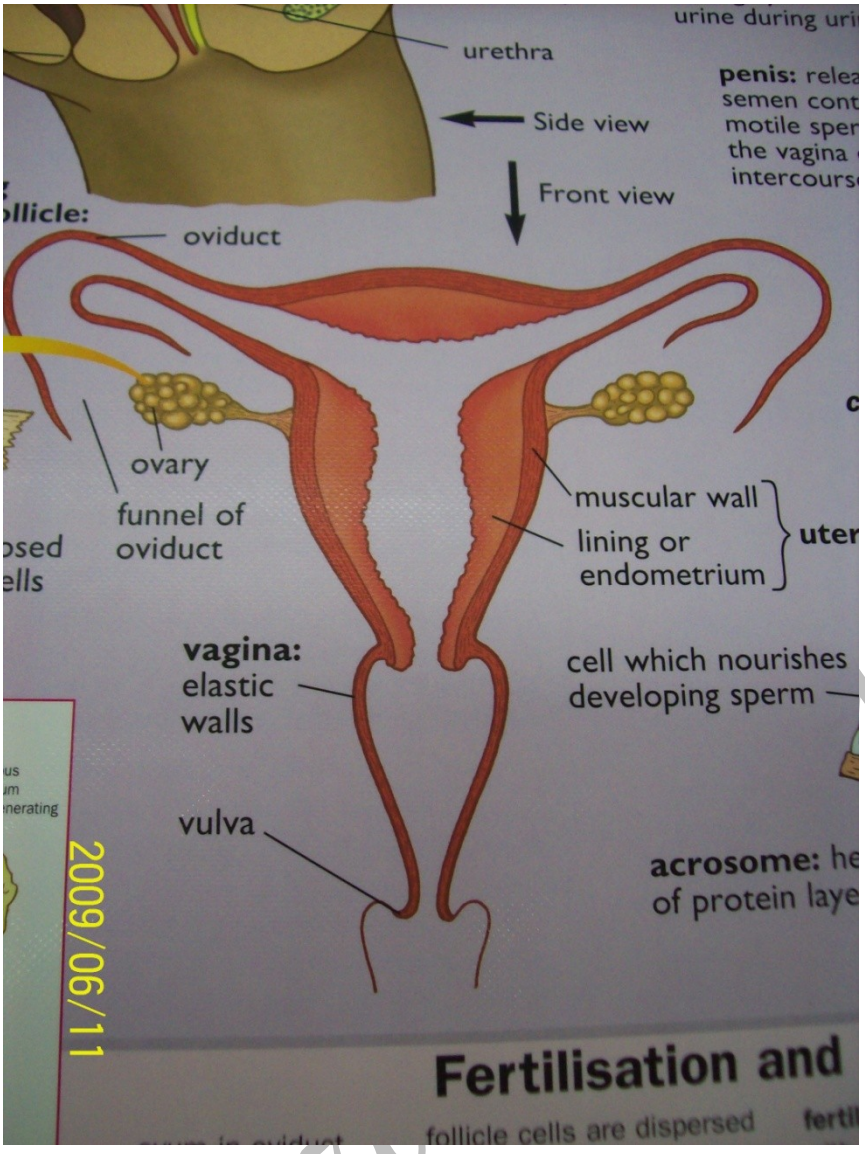
- acrosomes contain enzymes to digest egg membrane
- nucleus contains genetic material
- mitochondria produce energy to move the tail back and forth
- the lashing movement of the tail enables the sperm to move/propulsion in fluid medium towards the egg
- it is streamlined for faster/easier movement/swimming to meet the egg

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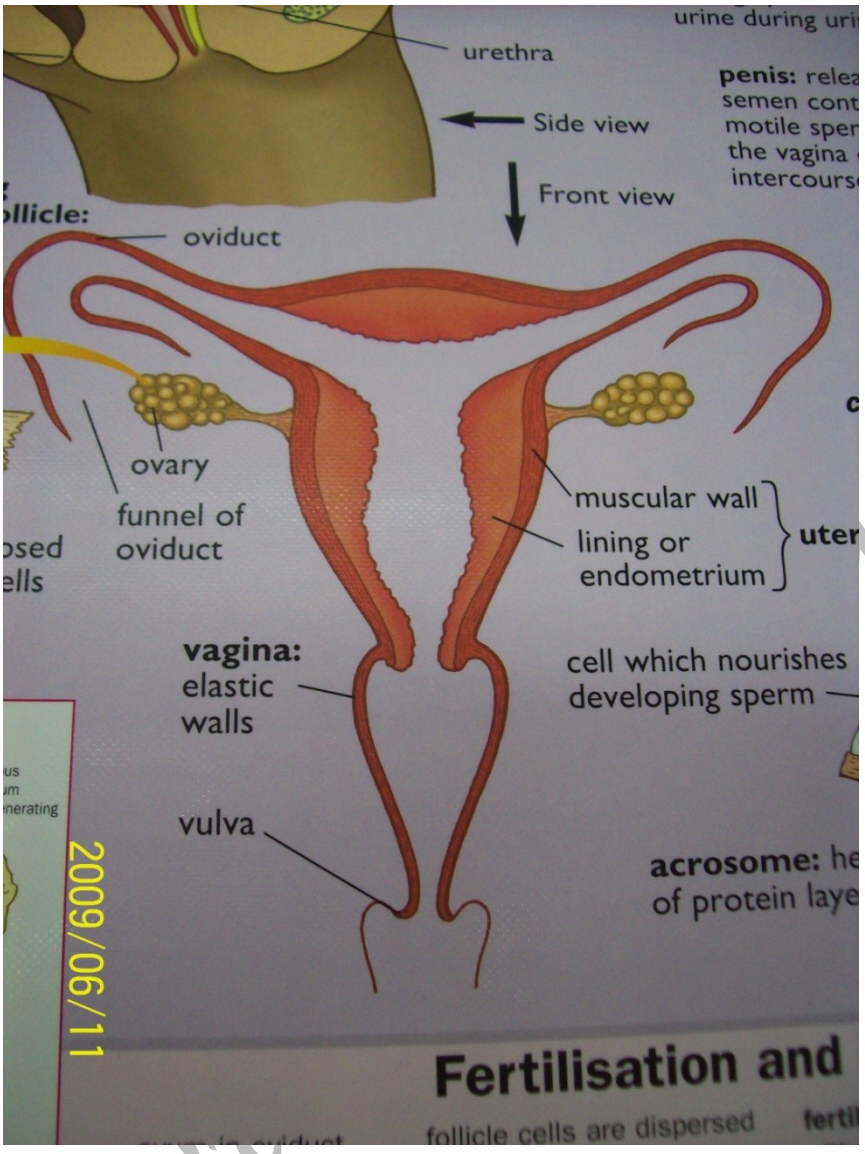
**c) i) Draw and label the human female reproductive system**

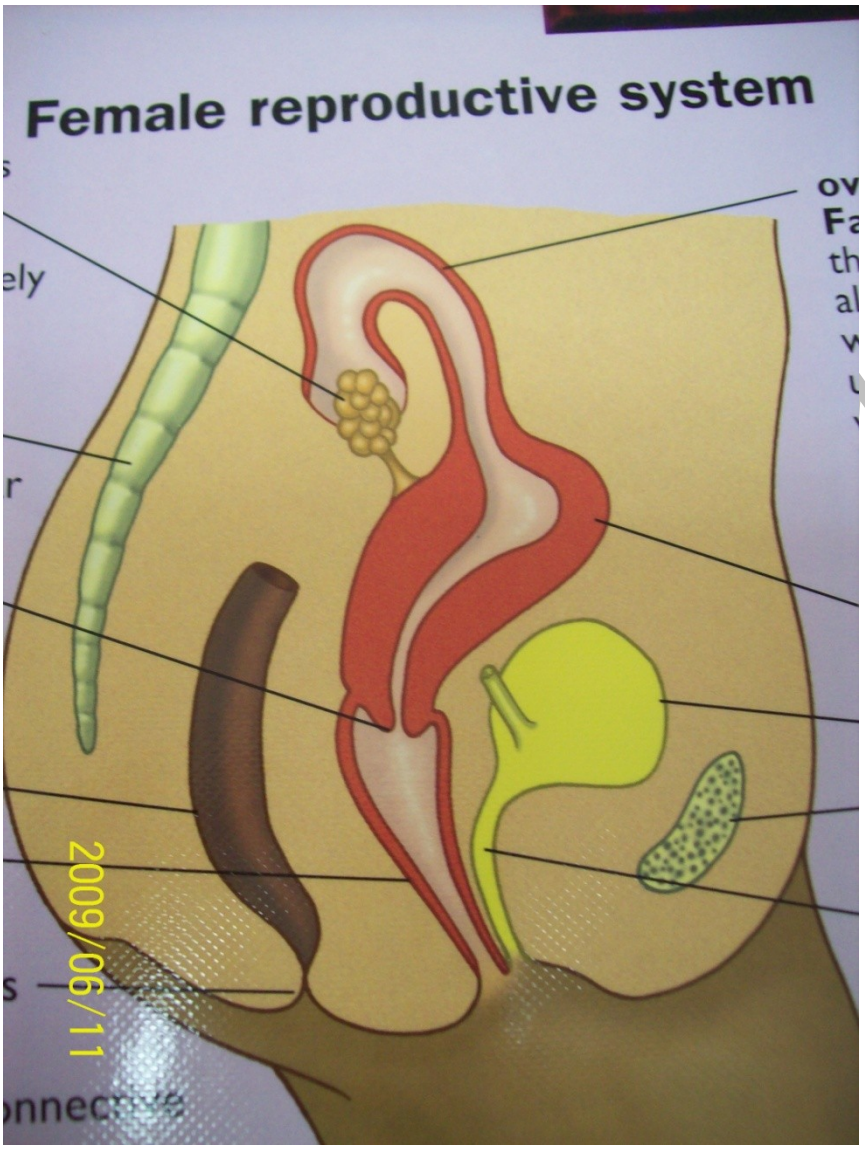



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urethra
Side view
Front view
oviduct
ovary
funnel of oviduct
muscular wall
lining or endometrium
vagina: elastic walls
cell which nourishes developing sperm
vulva
2009/06/11
Fertilisation and

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penis: relea
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Fertilisation and
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**ii) Describe how the various structures of the human female reproductive system are adapted to their function**

**Ovaries**

- have several graafian follicles that develop and burst open to release/produce mature ova

- secretes sex hormones)oestrogen) which initiate/control development of secondary sexual characteristics
- produce hormones oestrogen and progesterone which prepare the uterus for implantation and subsequent nourishment of the embryo

**Oviducts (fallopian tube)**

- are thin narrow and tubular to increase flowing speed of semen containing sperms
- are funnel shaped on the end next to ovary which enables them to receive the ovum
- their lining contains cilia which propel the ovum towards the uterus
- has peristaltic muscles that enable movement of zygote/ovum to the uterus for implantation
- is fairly long to increase surface area for fertilization

**Uterus**

- is muscular for protection of developing embryo
- has elastic wall that allows growth and development of foetus/embryo
- has a highly vascularised endometrium that provides nutrients/gaseous exchange to developing embryo

**Cervix**

- has valves that close the lower end of the uterus to ensure continued pregnancy during gestation period
- is capable of dilating
- has narrow entrance/neck-like entrance to uterus that enables quick swimming of sperms to uterus
- has suction mechanism that draws up/pulls sperms into uterus
- has a "W" shape that fits well with the glands of the penis to ensure sperms are deposited at the right point

**Vagina**

- is elastic and muscular to enable good accommodation or penetration of the penis thus proper deposition of sperms and for easy parturition
- allows menstrual flow
- has sensitive labial walls which secrete/produce lubricating substances that ensure/enable/facilitate good coition
- capable of considerable enlargement, due to elastic muscles, to accommodate baby during parturition

**Clitoris**

- has sensitive cells for orgasm

**iii) Explain how the ovum is adapted to its function**

- nucleus contains genetic material
- ventelline membrane encloses  plasma membrane which encloses yolky cytoplasm
- yolky cytoplasm provides nourishment

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- jelly coat protects ovum against dehydration

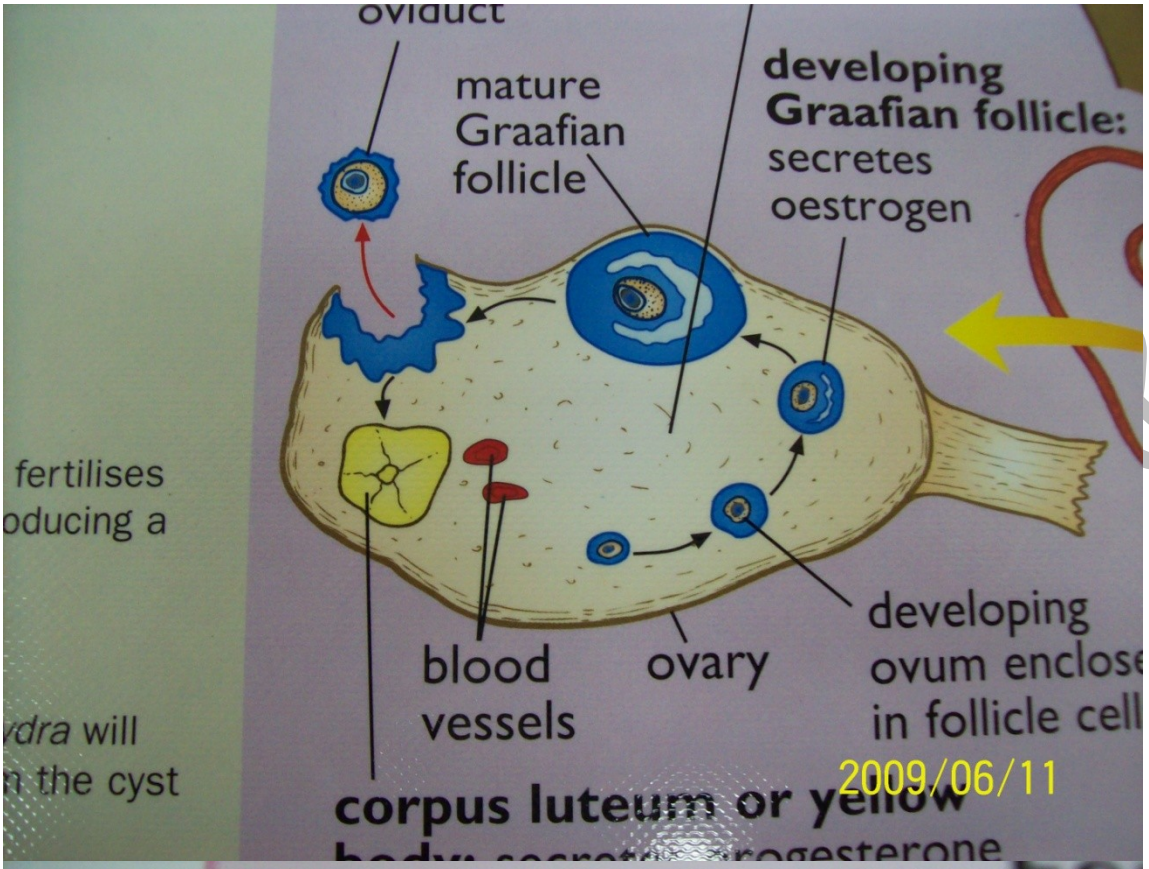
**iv) Explain the differences between sperm and ovum**

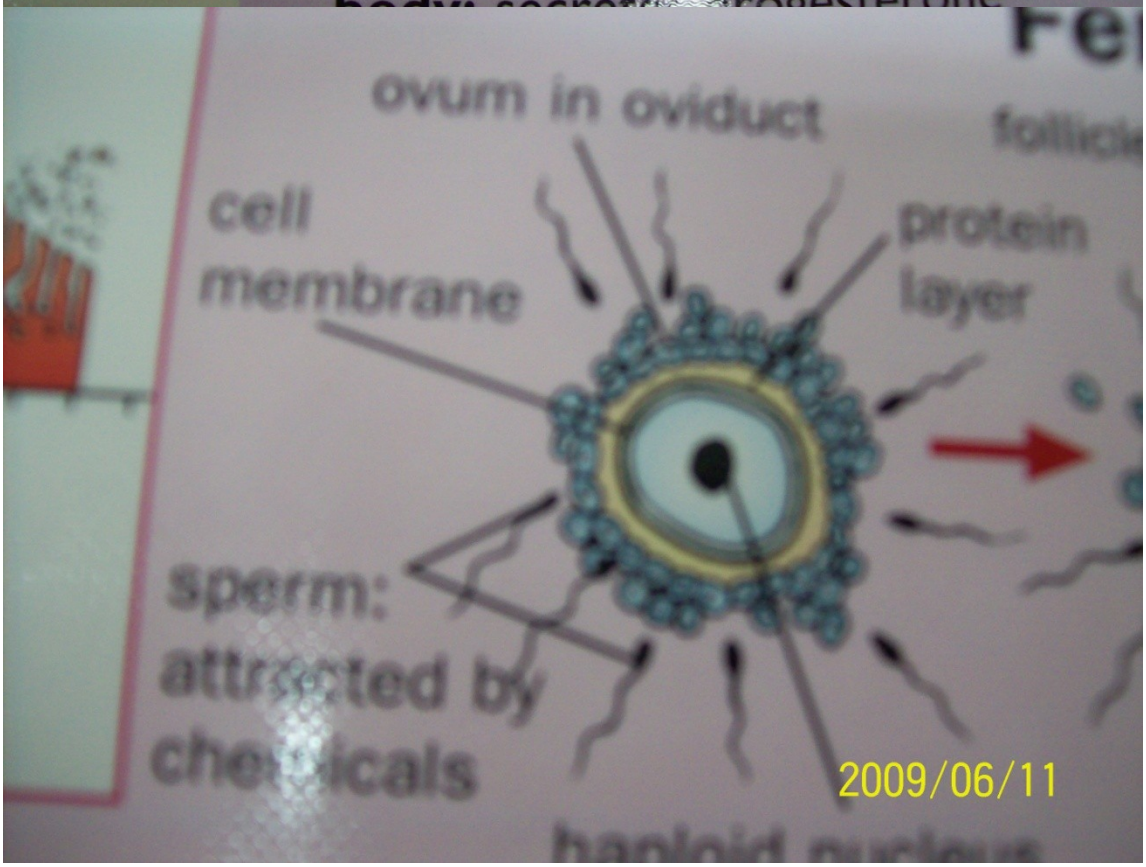
| **Sperm** | **Ovum** |
|---|---|
| • long with a tail and head<br>• small<br>• locomotory<br>• stores little food<br>• has acrosome (tip with lytic enzymes)<br>• nucleus prominent but cytoplasm negligible | • spherical<br>• large<br>• stationary<br>• a lot of food stored in yolky cytoplasm<br>• lacks acrosome<br>• a lot of cytoplasm |

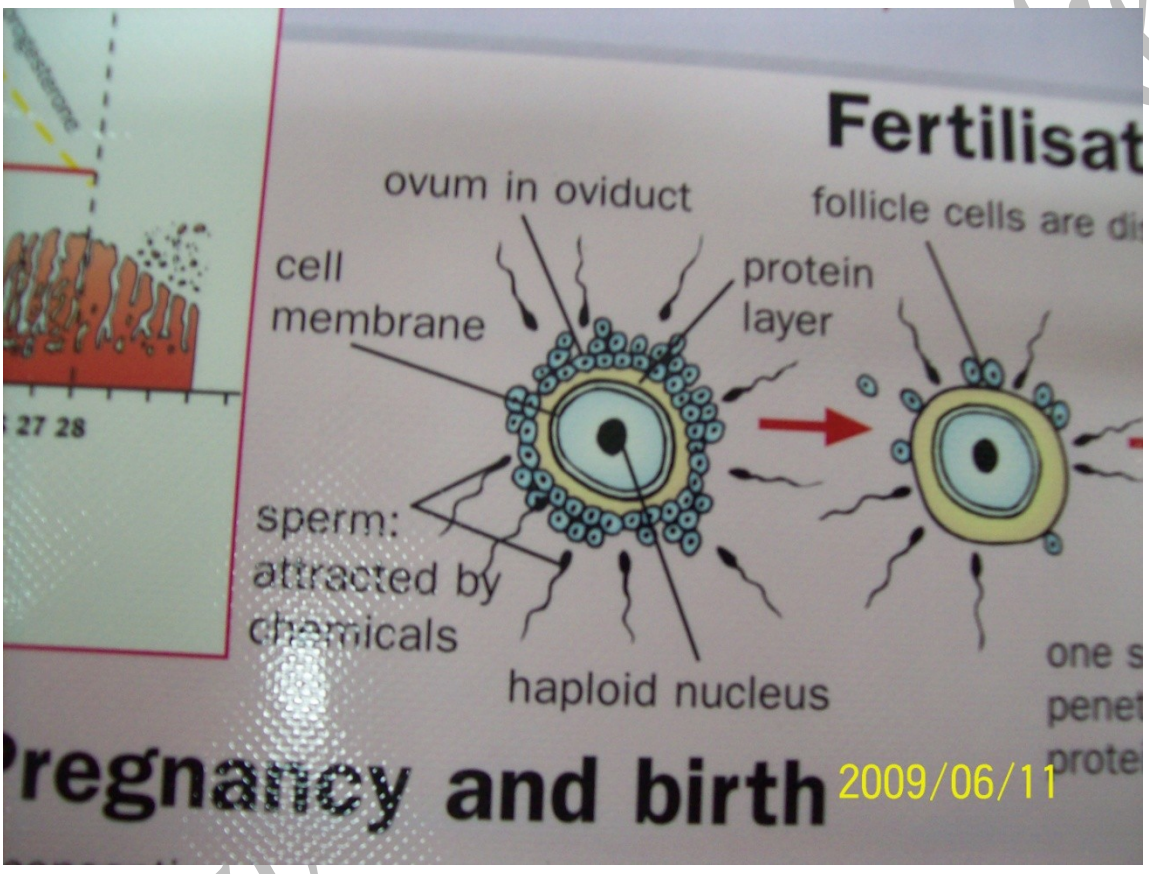
**d) i) Explain the process of fertilization**

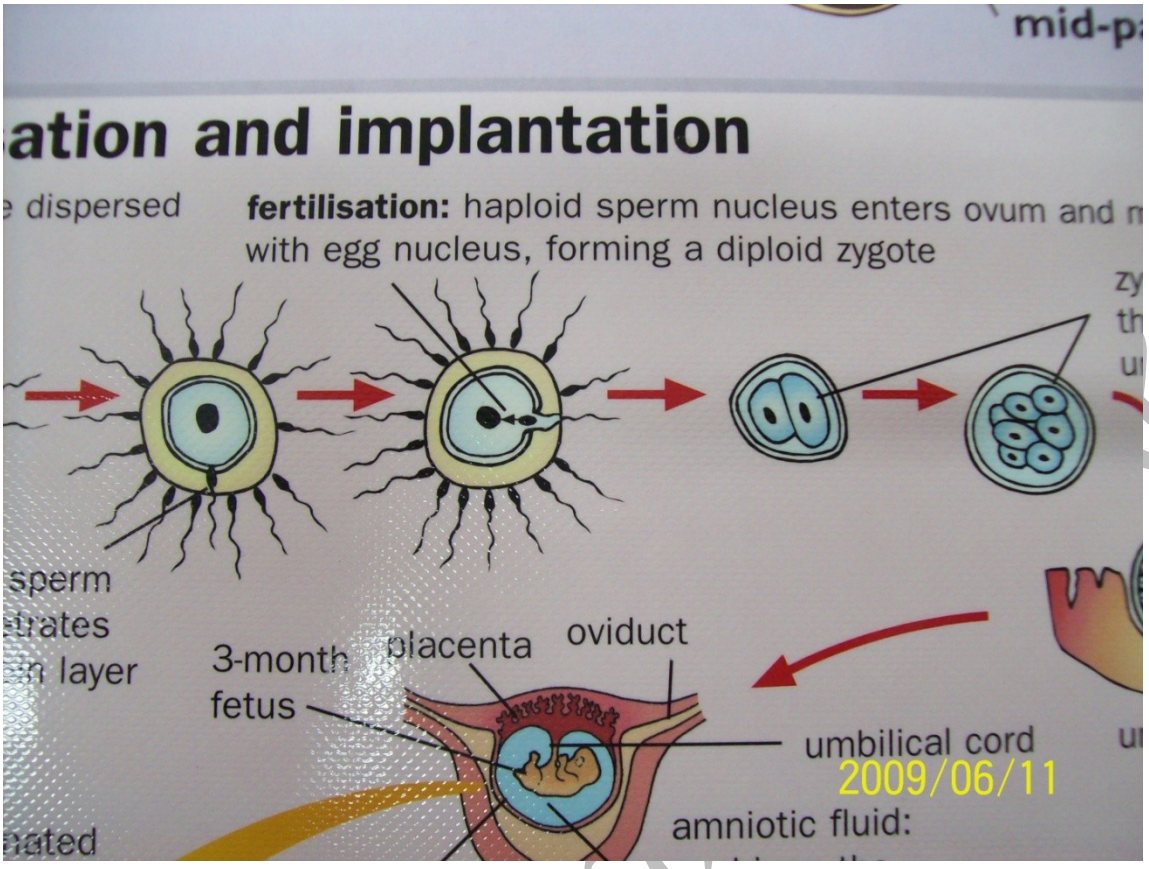
- a process whereby the egg and sperm are brought together and fuse to form a zygote
- occurs in the fallopian tube after copulation
- sperm head penetrates the outer coat of the ovum while the tail remains outside
- penetration is due to reaction of acrosome
- acrosome digests the vitelline membrane
- thereafter a zygote is formed
- zygote which is diploid undergoes rapid cell division to form a mass of cells called blastocyst
- after fertilization a membrane forms around the ovum to prevent further entry of sperms
- blastocyst eventually develops into an embryo

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oviduct
mature Graafian follicle
developing Graafian follicle: secretes oestrogen
fertilises
oducing a
developing ovum enclose in follicle cell
blood vessels
ovary
corpus luteum or yellow
2009/06/11

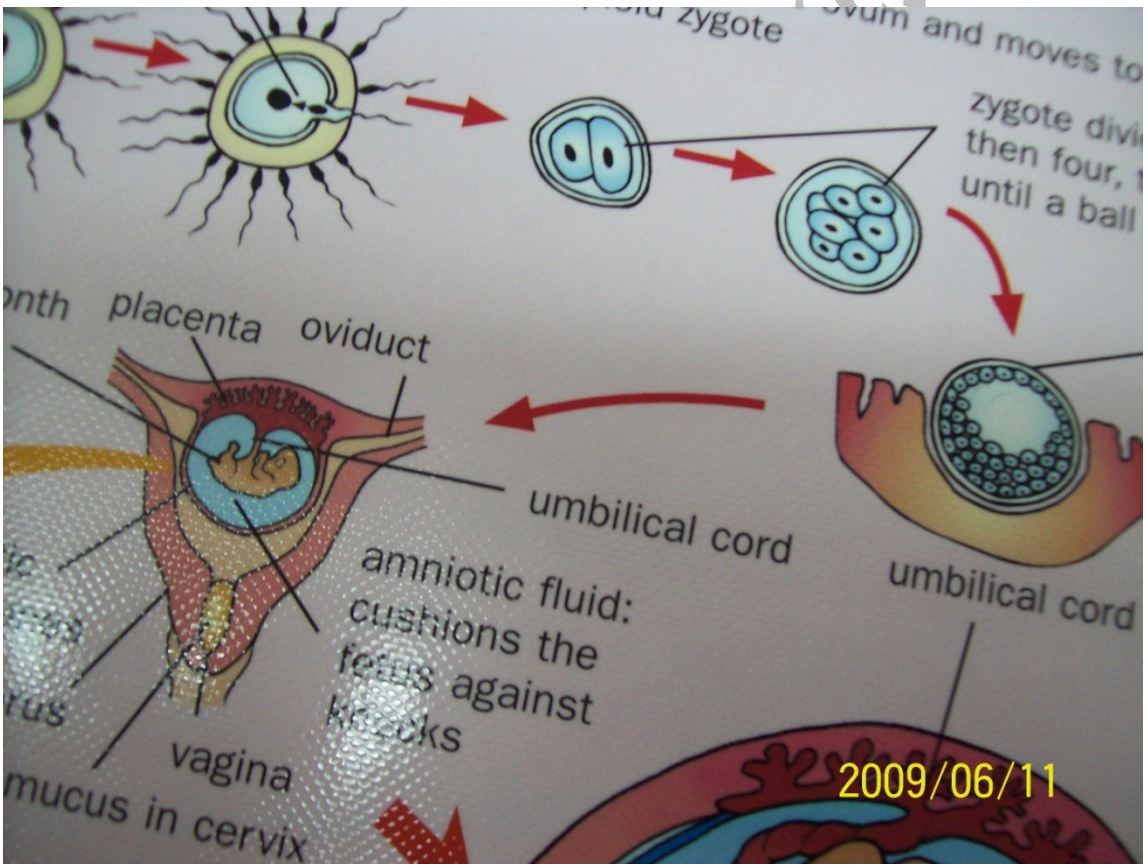

ovum in oviduct
cell membrane
protein layer
sperm:
attracted by
chemicals
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Fertilisat
ovum in oviduct
follicle cells are di
cell membrane
protein layer
sperm: attracted by chemicals
haploid nucleus
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Pregnancy and birth
2009/06/11

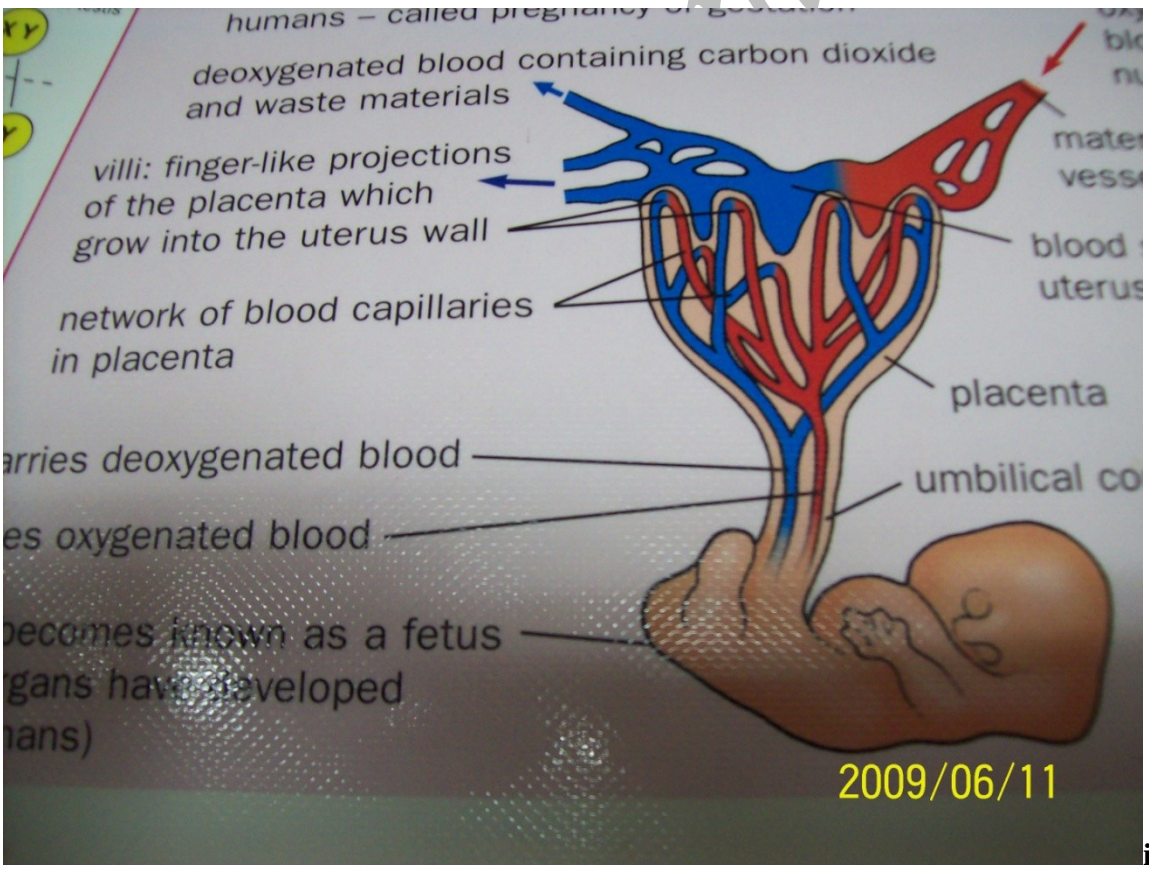



**i) Explain the process of implantation**

- this is the embedding and attaching of the embryo in the uterine wall/endometrium
- implantation marks the beginning of pregnancy
- sometimes implantation occurs in the oviduct wall which is abnormal and results in ectopic pregnancy which is fatal
- the outer wall of the blastocyst develops fingerlike projections which project into the uterine wall for attachment
- the projections are called villi
- the villi and endometrium develop into an organ that is called the placenta
- the embryo is attached to the placenta through a cord called the umbilical cord

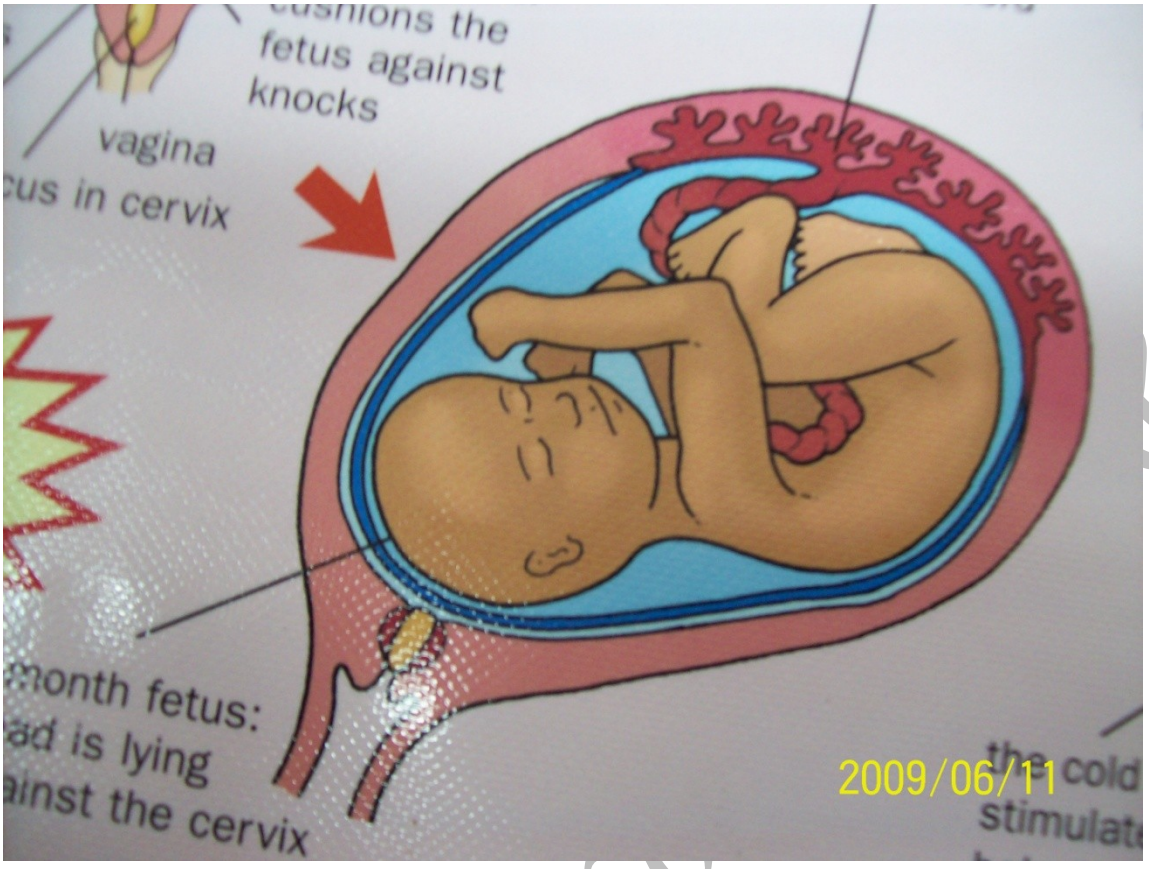

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zygote divi
then four,
until a ball
placenta
oviduct
umbilical cord
amniotic fluid:
cushions the
against
vagina
mucus in cervix
umbilical cord
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humans – called pregnancy or gestation
deoxygenated blood containing carbon dioxide and waste materials
villi: finger-like projections of the placenta which grow into the uterus wall
network of blood capillaries in placenta
placenta
arries deoxygenated blood
es oxygenated blood
becomes known as a fetus
gans have developed
ans)
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iii)

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**State the functions of umbilical cord**

- it contains blood vessels umbilical artery, iliac arteries and umbilical veins)
- it joins the placenta to the embryo
- passage for nutrients from the mother
- passage of excretory substances from foetus to mother for final discharge
- gaseous exchange
- passage of antibodies from mother to foetus, for protection of foetus against diseases

**iv) State the role of placenta**

- exchange of gases between mother and foetus
- exchange of nutrients and nitrogenous wastes
- anchorage/attachment of foetus
- produces hormones (oestrogen and progesterone)

**e) i) What is gestation period?**

- time taken from fertilization to birth/pregnancy

**ii) Explain the functions of the membranes associated with placenta**

**Chorion**

- surrounds the embryo
- has fingerlike projections that attach embryo to the uterus

**Amnion**

- contains amniotic fluid
- fluid surrounds embryo
- protects embryo from mechanical injury by acting as shock absorbers
- fluid also protects embryo from dehydration
- distributes pressure equally over embryo

**Yolk sac**

- surround the yolk
- produces blood cells for embryo until its own liver is able to perform the task

**Allantois**

- present only for a short time
- removes and store waste material
- it eventually becomes the umbilical cord

**iii) Explain the events that take place to facilitate parturition**

- near birth the placenta produces less progesterone
- oxytocin hormone is produced by posterior lobe of pituitary gland
- because progesterone level has decreased the uterus becomes sensitive to oxytocin
- oxytocin causes the contraction of the uterus (myometrium)
- these contractions are called labour pains
- just before parturition the head turns downwards
- the contractions eventually push the baby through the vagina
- amnion breaks and amniotic fluid is released
- oxytocin dilates the cervix
- foetus is expelled through cervix with head coming out first
- finally the whole infant comes out
- the umbilical cord is cut and the placenta is expelled as afterbirth

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**iv) State the reasons why later in pregnancy the ovary will b e removed without disturbing the pregnancy**

- corpus luteum in the ovary secretes progesterone which maintains pregnancy and development of foetus after conception

- after four months pregnancy is maintained by progesterone from the placenta

**f) i) What are secondary sexual characteristics**

- Characteristics (physiological and anatomical) that start developing at puberty due to the influence of male and female hormones

**ii) State the main secondary changes in**

**Boys**

- deepening of the voice
- growth of hair on face, pubic part, chest, legs
- penis and testes become bigger
- muscular development
- sperm production begins at puberty and may continue throughout life

**Girls**

- growth of hair on pubic part and armpits
- widening/enlargement of hips
- development of breasts
- menstrual cycle starts as ovaries mature
- body acquires extra fat

**iii) Describe the role of hormones in secondary sexual characteristics in**

**Boys**

**Follicle stimulation hormone (FSH)**

- from pituitary
- stimulates production of androgens(male hormones) mainly testosterone by testis

**Testosterone**

- secondary sexual characteristics

**Girls**

**FHS**

- from pituitary
- development of follicles
- stimulates oestrogen production by ovary

**LH**

- from pituitary
- ovulation
- stimulates release of progesterone by ovary

**Oestrogen**

- stimulates release of LH
- secondary sexual characteristics

**Progesterone**

- also from placenta
- sustains pregnancy as it inhibits prolactin and oxytocin during pregnancy

**Prolactin**

- milk formation

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**Oxytocin**

- parturition
- milk ejection

**g) i) What is menstruation?**

- vaginal discharge due to disintegration of endometrium

**ii) Describe the role of hormones in the human menstrual cycle**

- it is controlled by sex hormones which are responsible for the onset of secondary sexual characteristics and also control of the menstrual cycle
- the onset is signaled by discharge of blood/menses 14 days following the start of menstruation
- anterior lobe of pituitary gland secretes follicle stimulating hormone(FSH)
- Follicle stimulating hormone causes graafian follicle to develop in the ovary. It also stimulates tissues of the ovary/wall (theca) to secrete oestrogen
- oestrogen causes repair/healing of uterine wall
- oestrogen stimulates anterior lobe of pituitary to produce luteinising hormonge (LH)
- LH causes ovulation. It also causes graafian follicle to change into corpus luteum. LH stimulates corpus luteum to secrete progesterone
- Progesterone causes proliferation/thickening of uterine wall
- Oesterogen/progesterone inhibits the production of FSH by anterior lobe of pituitary, thus no more follicles develop and oestrogen production reduces
- In the next two weeks progesterone level rises and inhibits production of LH from anterior lobe of pituitary
- The corpus lutetium stops secreting progesterone and menstruation occurs when the level of progesterone drops
- Anterior lobe of pituitary starts secreting FSH again.

**iii) What is menopause?**

- end of ovulation in women
- occurs after age of 45 years
- does not occur in males

**h) Explain the symptoms, methods of transmitting and prevention (control) of the following sexually transmitted diseases**

**i) Gonorrhea**

- caused by a bacterium called neisseria gonorrhea
- transmitted through sexual intercourse,
- infects urethra and vaginal tract (epithelia)
- Symptoms include pain, discharge of mucus and bad smell (females)
- Effects include sterility, heart diseases, blindness of foetus and arthritis
- Treatment by antibiotics
- Control and prevention by proper sexual conduct

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**ii) Herpes**

- notably Herpes simplex and H. genitalis
- caused by virus which attacks genitalia
- symptoms are painful sores in genitalia, skin lesions
- transmitted in saliva, sexual intercourse and injection by drug addicts
- no treatment

**iii) Syphilis**

- caused by bacterium called Treponema palladium
- symptoms are painless wounds in genitalia
- attack genitalia, nervous system, lips
- treated by antibiotics

**iv) Trichomoniasis**

- caused by plasmodium called trichomonas
- attacks reproductive tract
- symptoms are itching and discharge of pus from the genitals
- treated by antibiotics

**v) Hepatitis**

- Viral disease
Affects the liver
Transmitted through sexual intercourse
No known treatment

**vi) Candidiasis**

- caused by fungus called candida albicans
- transmitted through sexual intercourse
- symptoms include itching urethra, and vaginal discharge (odourless)
- controlled by personal hygiene, early treatment and responsible sexual behavior

**vii) HIV/AIDS**

- caused by HIV virus
- transmitted by sexual intercourse, blood transfusion, sharing piercing instruments from infected mother to foetus, infant and baby
- symptoms include fever, swollen lymph nodes, night sweating, cough, weight loss, fatigue, loss of appetite, diarrhea, headache, a opportunistic infections and tumors
- Control by responsible sexual behaviour, education, screening blood for transfusion and using sterile piercing instruments.

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**6. a) Define the terms**

**i) Growth**

- an irreversible change in size of a cell, organ or whole organism
- growth is due to synthesis of protoplasm or extracellular substances

**ii) Development**

- refers to a series of changes which an organism goes through in its lie cycle
- during development both qualitative and quantitative changes take place(involves differentiation)

**iii) Differentiation**

- refers to changes in which the cells of the body undergo and become specialised to perform specific functions

**b) i) Differentiate growth in plants and animals**

| **Plants** | **Animals** |
|---|---|
| • confined to shoots/root tips (apical)<br>• have definite growth regions(meristems)<br>• often indefinite/continuous<br>• growth results in branching<br>• affected by light, auxins, hormones and temperature | • occurs all over the body(intercalary)<br>• different parts grow at different rates(allometric)<br>• maximum growth on maturity(definite)<br>• no branching<br>• affected by nutrients |

**ii) List the processes involved in growth**

- assimilation
- cell enlargement
- cell division(by mitosis)

**iv) List the parameters used to measure growth**

- height/length
- dry weight
- number of individuals
- volume
- leaf area of plant

**iv) Name the patterns of growth in organisms**

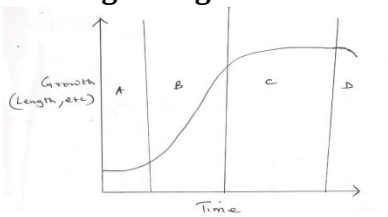
- allometric and isometric
- limited and unlimited
- discontinuous growth

**c) i) Name the different types of growth curves**

- sigmoid curve(normal growth curve)
- intermittent growth curve

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**ii) Draw a sigmoid growth curve and explain its different phases/stages**




**A-lag phase**

- Slow growth rate at first

Organism adapting to the environment

**B-exponential phase**

- organisms already adapted
- first growth due to birth rate that is higher than death rate

**C- Stationery phase (plateau)**

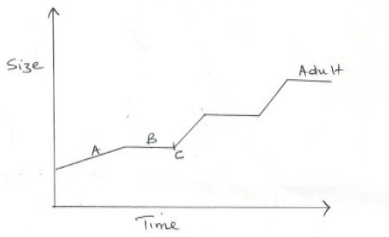
- Birth rate equals death rate (equilibrium)

Lack of nutrients, accumulation of toxic waste products

**D-phase of decline**

- due to depletion of nutrients, accumulation of toxic wastes, lack of space
- some individuals old hence not reproducing
- death rate higher than birth rate

**iii) Draw an intermittent curve and explain the various stages**




A-growth

B-no growth

C- moulting/ecdysis

- seen in arthropods
- growth in  in arthropods is intermittent(takes place during some time only because their hard cuticles (exoskeleton) does not expand to cause growth
- the cuticle must be shed off first to allow further growth
- the shedding is called ecdysis or moulting
- when moulting has taken place animal grows but growth stops when the exoskeleton hardens again

**d) i) What is seed dormancy?**

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- A state where a viable seed is incapable of germinating when all conditions are favourable.

**ii) State the biological importance of seed dormancy**

- gives embryo time to reach maturity
- gives time for dispersal
- allows plant to survive adverse conditions

**iii) State the factors which cause seed dormancy**

**Internal factors**

- presence of abscisic acid/ABA/ presence of germination inhibitors
- embryo not fully developed
- absence of hormones/enzymes/inactivity of hormones/enzymes/gibberellins/cytokinins
- impermeability of seed coat

**External factors**

- unsuitable temperature
- absence of light
- lack of oxygen
- lack of oxygen
- lack of water

**iv) Give the conditions necessary to break seed dormancy**

- scarification/scratching to make seed coat impermeable
- vernalisation/cold treatment in some seeds like wheat
- burning/nicking/expose to heat e.g. wattle seeds
- destruction of germination inhibitors

**e) i) What is seed germination?**

- process by which a seed develops in a seedling

**ii) What is viability**

- ability of a seed to germinate

**iii) Discuss the various conditions necessary for the germination of seeds**

**Water**

- medium for enzymatic activity
- hydrolysis of food into simpler substances
- medium of transport
- softens the seed
- acts as a solvent

**Air**

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- in form of oxygen
- oxygen is used for respiration/oxidation of food to release energy

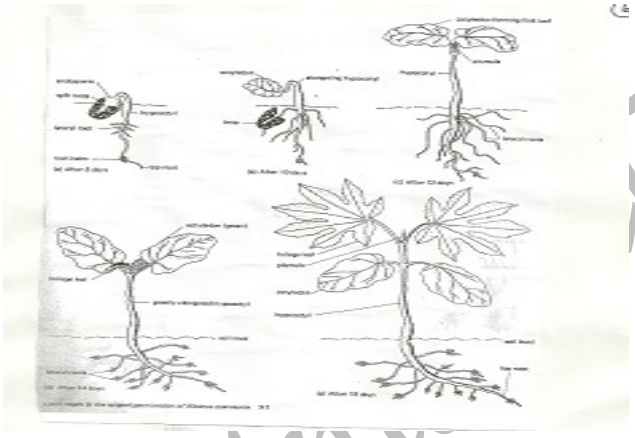
**Suitable (optimum) temperature**
- activates enzymes involved in mobilization of food reserves

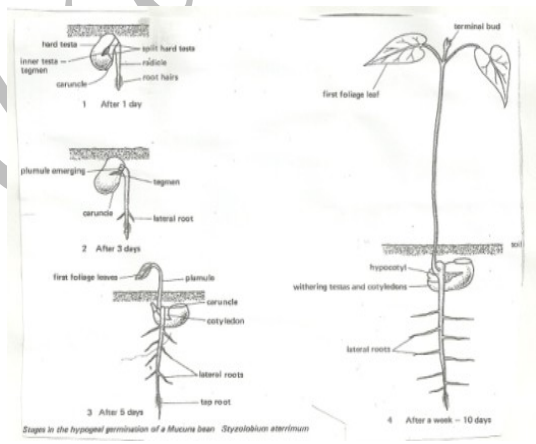
**Enzymes**
- breakdown and subsequent oxidation of food
- conservation of hydrolyzed food products into new plant tissues

**Viability**
- only viable seed are able to germinate and grow

**iv) Name and describe the types of germination**

**Epigeal**






Stages in the hypogeal germination of a Mucuna bean (Stizolobium aterrimum)

cotyledons are brought above the ground level during germination due to elongation of hypocotyls

**Hypogeal**

- the cotyledons remain below the surface during germination due to elongation of epicotyl e.g. maize

**v) Name the part of the bean seed that elongates to bring about epigeal germination**

hypocotyl

**vi) Account for the loss in dry weight of cotyledons in a germinating bean seed**
- food stored is mobilized/used up for respiration and growth

**vii) Describe the physiological changes that occur in a seed during germination**

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- in presence of oxygen, optimum temperature and water, food reserves in the seed are hydrolysed or broken down into soluble diffusible form by enzymes
- soluble food diffuses to the growing embryo
- oils and carbohydrates provide energy
- simple sugars converted to cellulose to form cell wall
- amino acids make protoplasm
- seed develops plumule and radicle hence germinates

**viii) Explain the biological significance of cotyledons being brought above the ground in epigeal germination**

- cotyledons have inadequate food
- they are brought above the ground to acquire chloroplasts to carry out photosynthesis before the formation of foliage leaves to supplement food supply required for growth during germination

**f) i) Distinguish between primary and secondary growth**

**Primary growth**

- occurs at the apical (shoot and tip) apices regions where meristematic cells occur
- causes plant elongation since cells divide by mitosis

**Secondary growth**

-occurs at the cambium meristems
Increases width (girth) of the stem

**ii) What are meristems**

- dividing cells
- meristem means they are dividing

**iii) State the characteristics of meristematic cells**

- dense cytoplasm
- thin cell walls
- absence of vacuoles/cell sap

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**iv) State the location and function of the following meristematic tissues**

**Apical meristem**

- located at tips of roots and shoots
- increase length of stem and roots/primary growth

**Intercalary meristem**

- found at bases of internodes

- responsible for elongation of internodes and increase in leaf sheath in grasses

**Lateral meristems**

- found near the periphery of stem and root
- responsible for secondary growth/growth in girth of stem and root/lateral growth
- called cambium and constitute vascular and cork cambium

**v) Describe primary growth**

- occurs at tips of shoots and roots in the meristematic tissues of apical meristem
- at the apex there is a zone of cell division/mitosis
- cells elongate at elongation zone
- the elongated cells differentiate at the region of differentiation resulting in increase in size
- in the stems meristems give rise to leaf premodia which envelop the apex to form a bud
- the bud protects the delicate inner cells
- in roots the meristem is protected by root cap
- after cells differentiate the form permanent tissues

**vi) Describe secondary growth in plants**

- also called secondary thickening
- only occurs in dicotyledonous plants that have cambium
- monocotyledonous plants do not undergo secondary growth because they lack intervascular cambium
- cambium cells divide to produce more cells on either side of the cambium
- cells produced to the inside become secondary cambium
- cells produced to the outside become secondary phloem
- division of cambium cells occurs yearly producing new rings of secondary phloem and secondary xylem each year
- intervascular cambium(cambium between vascular bundles) divide to form secondary parenchyma, thereby increasing growth of medullary rays
- much more xylem is formed than phloem, thus pushing phloem and cambium ring outward
- the rate of secondary growth is depended on seasons(rains) resulting in annual rings
- cork cambium is located beneath epidermis ad is responsible for secondary thickening of the bark of perennial plants
- cork cambium divides to form new cork(bark) tissues to accommodate increased growth on outside and secondary cortex on the inside
- Cork cells (cells of the bark) are loosely parked at some points to form lenticels for gaseous exchange.

**vii) State the significance of secondary growth**

- increase girth or circumference of trees
- annual rings which show seasonal growth can be used to tell the age of trees

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**g) i) Describe one method which can be used to measure the average growth rate of a single leaf of a plant**

**EITHER**

- chose/identify a young leaf(just unfolded)
- use the same leaf throughout
- measure (total) length of (whole) leaf
- record
- repeat at regular intervals until no more change occurs/constant length
- average rate of growth is equal to total increase in length divided by the period taken to achieve full length

$$\text{Average rate of growth} = \frac{\text{total increase in length}}{\text{period taken to achieve full length}}$$

**OR**

- choose/identify a young leaf(just unfolded)
- use the same leaf throughout
- trace the outline on a graph paper and work out the area
- record
- repeat at regular intervals until regular area
- average rate of growth equals to total increase in area divided by the period of time taken to achieve full area

$$\text{Average rate of growth} = \frac{\text{total increase in area}}{\text{period of time taken to achieve final area}}$$

**i**

**i) Describe how the growth of a root can be determined**

**Materials**

- fine thread, marking ink, germinating bean seedlings, blotting paper, ruler marked in millimeters, pins, cork, a boiling tube and moist cotton wool

**Procedure**

- dry seedlings using blotting paper
- place inside against the ruler marked in mm
- dip the fine thread in waterproof ink
- mark the radicle at equal intervals
- pin the seedling to the cork
- suspend the seedling into the boiling tube containing moist cotton wool
- allow the seedling to grow for two days/some

time observe the intervals with the marks

- record your observations the widest intervals are found in the region just behind the tip indicating/showing region of greatest growth

**iii) A boy hammered a nail in the bark of a tree at a height of 1.5metres above the ground.**

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**Four years later, the nail was found at the same height although the tree had grown 3 meters taller. Explain the above observation**
The nail was hammered at a point where vertical growth had stopped/further growth was confined to increase in width/diameter.
Vertical growth is confined to tips/apex/vertical apical meristem

**h) i) Describe the role of hormones in growth and development of plants**
indole acetic acid/IAA/ auxins
Cell division/increase in cell division
Tropic responses
Cell elongation/increases in ell elongation
Development of abscision layer
Growth of ovaries into fruits/parthenocarpy/initiates flowers
Inhibits growth of lateral buds/produces apical dominance
Stimulates adventitious/lateral roots
Gibberellins (Gibberellic acid/GA3

Promote cell elongation/rapid cell division/increase in length of the internodes
Promote fruit formation without fertilization/parthenocarpy
Reduces root growth
Breaks seed dormancy/promotes germination

**Cytokinnins (Kinnins/Kinnetin/Zeatin)**
- breaks dormancy
- promotes flowering
- promotes cell division
- stabilizes protein and chlorophyll
- promotes root formation on a shoot
- low concentration encourages leaf senses
- normal concentration increases cell enlargement in leaves
- stimulates lateral bud development

**Ethylene (ethynel$C_2H_4$)**
- accelerates ripening in fruits
- encourages fruit fall/leaf fall
- induces thickening in stern/inhibits stem elongation
- promotes flowering (in pineapples)
- promotes germination in certain seeds

**Abscisic acid (ABA) abscisin hormone/dormin)**
- causes bud dormancy
- encourages fruit/leaf fall
- high concentration causes closing of stomata

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- causes seed dormancy
- inhibits cell elongation

**Traumatin**
- heals wounds by callous formation

**Florigen**
- promotes flowering

**ii) State the applications of plant hormones in agriculture**
- induce root growth in stem cuttings
- selective weed killers
- encourage sprouting of lateral buds
- breaking seed dormancy
- induce parthenocarpy
- accelerate ripening of fruits
- promote flowering
- cause dormancy

**iii) Explain apical dominance**
- a phenomenon whereby production of auxins by a growing apical bud of a shoot inhibits growth of lateral buds
- this inhibition is due to high concentration of auxins (indoleacetic acid/IAA) in apical bud
- removal of terminal/apical bud causes development and sprouting of several buds which later develop into branches
- applied in pruning coffee, tea and hedges
- this leads to more yield

**iv) Describe the role of hormones in the growth and development of animal**
**somatotrophin (growth hormones)**
- from anterior pituitary
- promotes cell division
- overproduction causes gigantism
- underproduction causes dwarfism

**Thyroxine**
- promotes growth and metamorphosis
- underproduction leads to a child becoming a cretin (mentally retarted)

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**Androgens**
- in males
- growth of male reproductive organs

**Oestrogen**
- in females
- growth of female reproductive organs

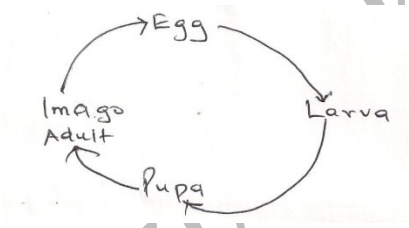
**Ecdysone**
- in arthropods
- moulting (ecdysis)

**t) i) What is metamorphosis?**
- change in form during which there are changes in structure and function in body of organism
- prepares organism for life in a different habitat

**ii) Explain complete metamorphosis**

radical changes in the body during the life cycle of an organism
called holometabolous development

example is egg larva pupa adult (imago)
occurs in animals such as butterfly and bee




**iii) What is the significance of each of the four stages in complete metamorphosis?**

**Larval stage**
- feeding takes place
- larva is quite different from adult
- larva sheds its cuticle (exoskeleton) several times to emerge as pupa
- dispersal stage avoids overcrowding

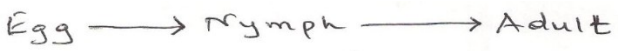
**Pupa**
- enclosed in a case called puparium (cocoon)
- no feeding

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- organ formation takes place

**Adult**
- emerges from puparium
- reproductive stage of the life cycle

**iv) Describe incomplete metamorphosis**
- called hemimetabolous development
- changes are gradual
- eggs develop into nymphs which develop into adults
- nymph resembles adult but are sexually immature
- a nymph moults several times as some parts develop before it becomes an adult
- stage of development between one moult and another is called instar
- occurs in insects such as locust and cockroach




**v) Name the hormones that control metamorphosis in insects**
- brain hormone responsible for moulting because it simulates production of ecdyson (moulting hormone)
- ecdysone(moulting hormone) causes moulting
- juvenile hormone causes moulting in larvae

**vi) State the advantages of metamorphosis in the life of insects**
- the adult and larvae exploit different niches
- do not compete for food
- pupa cam survive adverse pupa can survive adverse conditions  eg-feeding stage
- dispersal prevents overcrowding

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