B.Sc. (Semester V)
Session 2014-15
LZC-501: Functional anatomy and economic importance of non-chordates

SECTION-A

i. d)
ii. a)
iii. c)
iv. b)
v. a)
vi. b)
vii. b)
viii. c)
ix. d)
x. b)

SECTION (B)

Answers No. 2

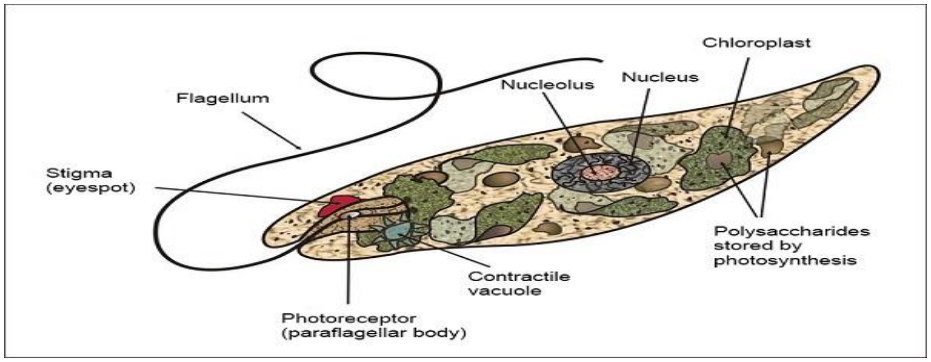
Euglena belong to the phylum Euglenozoa. Members of this phylum are unicellular organisms mostly found in freshwater, with a few found in saltwater. The all have a flagellum to use for movement and have chloroplasts but can also feed as heterotrophs. More specifically, they belong to class Euglenoida. All members of this class are found in freshwater and do photosynthesis or feed by diffusion of other organisms. They also have a tough outer coating known as a pellicle.

The Euglena are unicellular organisms with flagella. These flagella are long whip-like tails used for movement. Structurally, they do not have a cell wall. Instead, they have a thick outer covering known as a pellicle that is composed of protein and gives them both strength and flexibility. They are eukaryotes. This means that inside of them you can find all common cellular organelles, such as ribosomes to make proteins, mitochondria to produce energy, chloroplasts to produce energy, a nucleus to control activities, and vacuoles for storage.

There are three distinct methods of nutrition in *Euglena.*

Nutrition: Euglena are mixotrophs meaning that they are both autotrophs and heterotrophs. This is possible because of the animal and plant like characteristics Euglena has. The choloroplast in Euglena gives it the ability to provide nutrients for itself through the process of photosynthesis. Now if you were able to make yourself food why would you go bother hunting for food? Well even though Euglena is very efficient through photosynthesis the Sun is not always up and

therefore is not a constant supply of food for them. Euglena is usually around green algae which is their other food source. Whenever there is a lot of algae around Euglena will always be there to enjoy their constant source of nutrients. With the ability to surround and absorb other organisms for food the Euglena is never short on nutrients which is why it is such a successful organism. Euglena can always find a food source.



Structure of Euglena

Reproduction: *Euglena* has a simple and primal method of reproduction, known as Binary Fission. Reproduction by binary fission involves an organism merely splitting (fission) into two (binary) identical halves. Since another individual of the species is not involved, binary fission is an asexual form of reproduction. The following stages can be observed during binary fission.

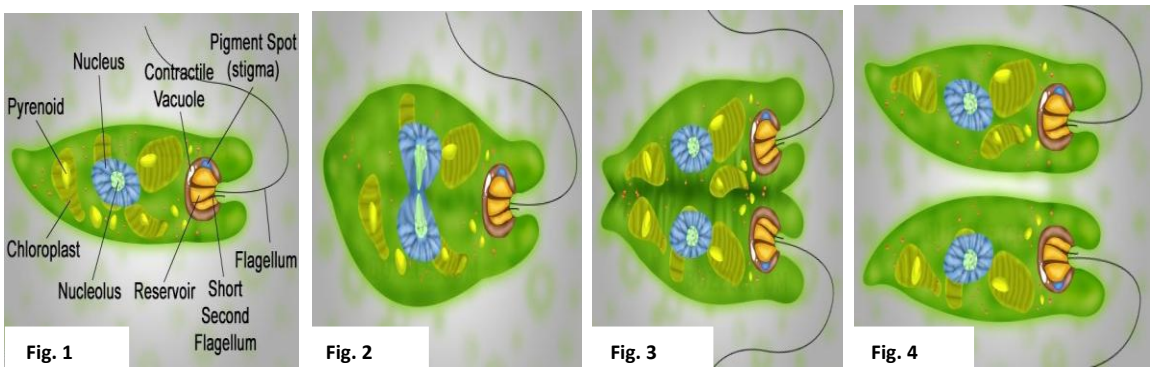
The most important part of binary fission is the division of the nucleus (genetic material), which occurs through a process calledmitosis. Mitosis consists of four stages. During the interphase, which takes up more than 90% of the cell's life cycle, the cell grows and stores nutrients, preparing itself for the eventual division. Interphase is not technically a part of mitosis, but is the time spent *preparing for* mitosis.

Then come the actual four stages of mitosis, prophase, metaphase, anaphase, and telophase.

Via these stages, the nucleus is duplicated, and both nuclei are temporarily housed in the same cell.

Through cytokinesis, the rest of the cell is duplicated and separated, resulting in two identical (albeit a bit smaller than the mother cell) daughter euglinoids, containing the two nuclei and roughly the same percentage of other organelles ('organs' of a cell).

As the daughter cells grow, the optimum number of various organelles is achieved. Eventually the daughter cells go through the same process themselves, preparing for the division for 90% of their lives, and after the interphase, undergoing binary fission to produce their own daughter euglinoids.



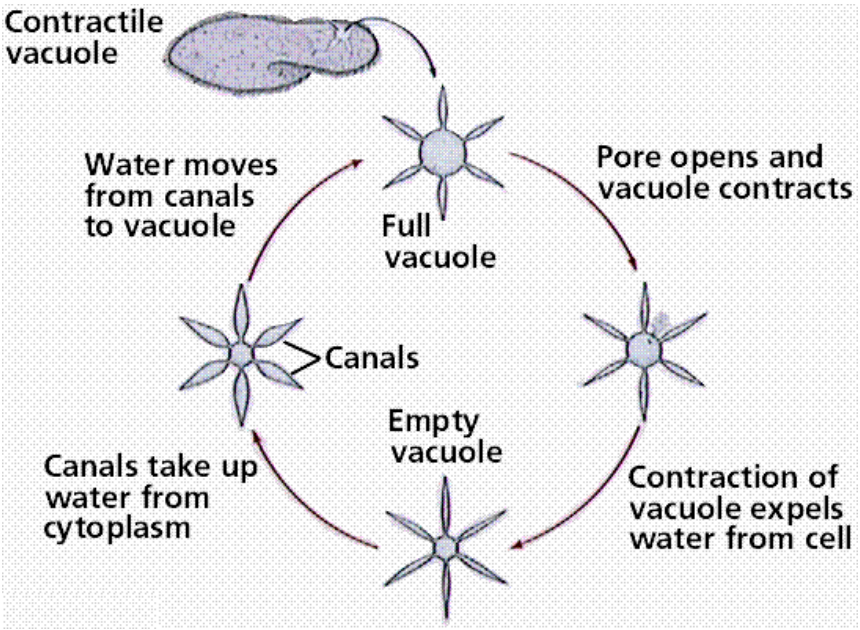
Different reproductive stages of Euglena

Answers No. 3

Contractile vacuoles absorb excess water and wastes from a microorganism's cell and excrete them into the environment by contracting.

Contractile Vacuoles in Microorganisms

A contractile vacuole (CV) is an organelle, or sub-cellular structure, that is involved in osmoregulation and waste removal . Previously, a CV was known as a pulsatile or pulsating vacuole. CVs should not be confused with vacuoles which store food or water. A CV is found predominantly in protists and in unicellular algae. In freshwater environments, the concentration of solutes inside the cell is higher than outside the cell. Under these conditions, water flows from the environment into the cell by osmosis. Thus, the CV acts as a protective mechanism against cellular expansion (and possibly explosion) from too much water; it expels excess water from the cell by contracting. However, not all species that possess a CV are freshwater organisms; some marine and soil microorganisms also have a CV. The CV is predominant in species that do not have a cell wall, but there are exceptions. Through the process of evolution, the CV was mostly eliminated in multicellular organisms; however it still exists in the unicellular stage of several multicellular fungi and in several types of cells in sponges, including amoebocytes, pinacocytes, and choanocytes.



Physiology of contractile vacuole

The CV's phases of collecting water (expansion) and expelling water (contraction) are periodical. One cycle takes several seconds, depending on the species and the environment's osmolarity. The stage in which water flows into the CV is called diastole. The contraction of the CV and the expulsion of water from the cell is called systole. Water always flows from outside the cell into the cytoplasm; and only then from the cytoplasm into the CV. Species that possess a CV always use it, even in very hypertonic (high concentration of solutes) environments, since the cell tends to adjust its cytoplasm to become even more hyperosmotic (hypertonic) than the environment. The amount of water expelled from the cell and the rate of contraction are related to the osmolarity of the environment. In hyperosmotic environments, less water will be expelled and the contraction cycle will be longer.

The number of CVs per cell varies, depending on the species. Amoeba have one; Dictyostelium discoideum, Paramecium aurelia, and Chlamydomonas reinhardtii have two; and giant amoeba, such as Chaos carolinensis, have many. In some unicellular eukaryotic organisms (e.g., amoeba), cellular wastes, such as ammonia and excess water, are excreted by exocytosis as the contractile vacuoles merge with the cell membrane, expelling wastes into the environment. In Paramecium, which, presumably, has the most-complex and highly-evolved CV, the vacuole is surrounded by several canals, which absorb water by osmosis from the cytoplasm. After the canals fill with water, it is pumped into the vacuole. When the vacuole is full, it expels the water through a pore in the cytoplasm that can be opened and closed.

Function: Contractile vacuoles protect a cell from absorbing too much water and potentially exploding by excreting excess water.

Wastes, such as ammonia, are soluble in water; they are excreted from the cell along with excess water by the contractile vacuoles.

Contractile vacuoles function in a periodic cycle by expanding while collecting water and contracting to release the water.

Answers No. 4

The gross enlargement of the arms, legs or genitals to elephantoid size is known as Elephantiasis. Elephantiasis or Lymphatic Filariasis, is a rare disorder of the lymphatic system. It is caused by thread-like parasitic worms such as *Wuchereria bancrofti, Brugia malayi* and *B. timori,* all of which are transmitted by mosquitoes. Inflammation of the lymphatic vessels causes extreme enlargement of the affected area, most commonly a limb, parts of the head and genitals.

***Wuchereria bancrofti* in blood**

It occurs most commonly in tropical regions. Elephantiasis puts at risk more than a billion people in more than 80 countries. Over 120 million have already been affected by it, over 40 million of them are seriously incapacitated and disfigured by the disease. One-third of the people infected with the disease live in India, one third are in Africa and most of the remainder are in South Asia.

There are 9 known filarial nematodes which use humans as the definitive host. They are divided into 3 groups according to the niche within the body that they occupy:

i. Lymphatic Filariasis
ii. Subcutaneous Filariasis
iii. Serous Cavity Filariasis

Microfilarial periodicity

Periodic form: Microfilaria in small numbers in circulating blood during the day and peak density at night (10 pm to 2 to 4 am).

Subperiodic form: Microfilaria peak between noon and 8 pm

Periodic form mosquitoes feed at night; subperiodic form mosquitoes feed during the day.

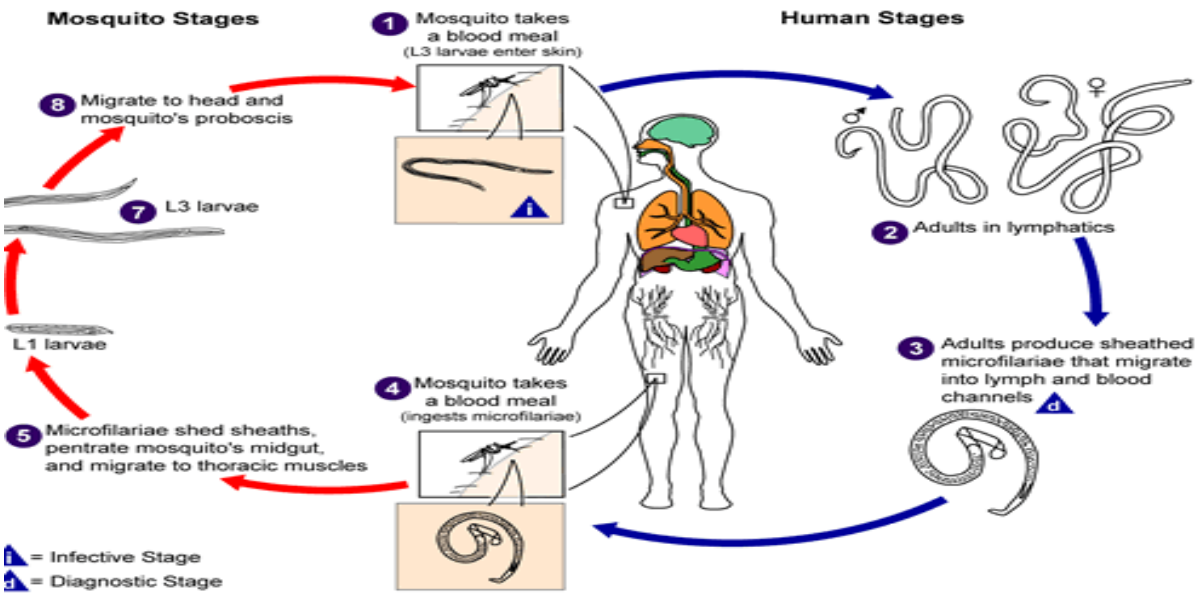
Life Cycle of *W. bancrofti*

W. bancrofti acquired via the bite of culex mosquitoes. When mosquitoes bite humans, they deposit third-stage infective larvae into the skin. These larvae travel through the dermis and enter local lymphatic vessels. Over a period of approximately nine months, these larvae undergo a series of molts and develop into mature adult worms, which range from 2 to 5cm in length.

These adults reside in the lymphatics, generally several centimeters from lymph nodes. They survive for approximately five years (occasionally up to 12 to 15 years), during which time male and females worms mate and produce microfilariae. Female parasites can release more than 10,000 microfilariae per day into the bloodstream. These microfilariae are also known as embryonic or first-stage larvae, and measure approximately 200 to 300 μm by 10 μm.

Mosquitoes, which bite infected individuals, can take up these circulating microfilariae. Within the mosquito, these embryonic larvae develop into second then third stage larvae over a period of 10 to 14 days. The mosquito is then ready to bite and infect a new human host, thereby completing the life cycle.

The interval between acquisition of infective larvae from a mosquito bite and detection of microfilariae in the blood is known as the prepatent period. This interval is usually approximately 12 months in duration.



Life cycle of *Wuchereria bancrofti*

Signs and Symptoms

Many people never acquire outward clinical manifestations of their infections and there may be no clinical symptoms. However, studies have shown that victims, outwardly healthy, may have:

i. Hidden lymphatic pathology

ii. Kidney damage

iii. 10-50% of men suffer from genital damage including elephantiasis of penis and scrotum

iv. 10% women suffer from elephantitis of the breasts.

Diagnosis

The symptoms are graded by severity of the swelling known as a lymphœdema. These swellings usually occur in the legs and breast tissue. symptoms are as follows:

i. Swelling not reversible overnight
ii. Shallow skin folds at the ankle
iii. Alteration of skin texture and formation of knobs
iv. Presentation of deep skin folds
v. Presentation of mossy lesion
vi. Inability of patient to perform daily work
vii. Legs look like elephant leg

Treatment

i. Anti-parasite treatment can result in improvement of patients' elephantiasis.
ii. Rigorous hygiene to the affected limbs, with accompanying adjunctive measures to minimize infection and promote lymph flow which results both in a dramatic reduction in frequency of acute episodes of inflammation.
iii. Surgery can be performed to reduce elephantiasis by removing excess fatty and fibrous tissue, draining the swelled area, and removing the dead worms. With DEC treatment, the prognosis is good for early and mild cases of lymphatic filariasis.

Answers No. 5

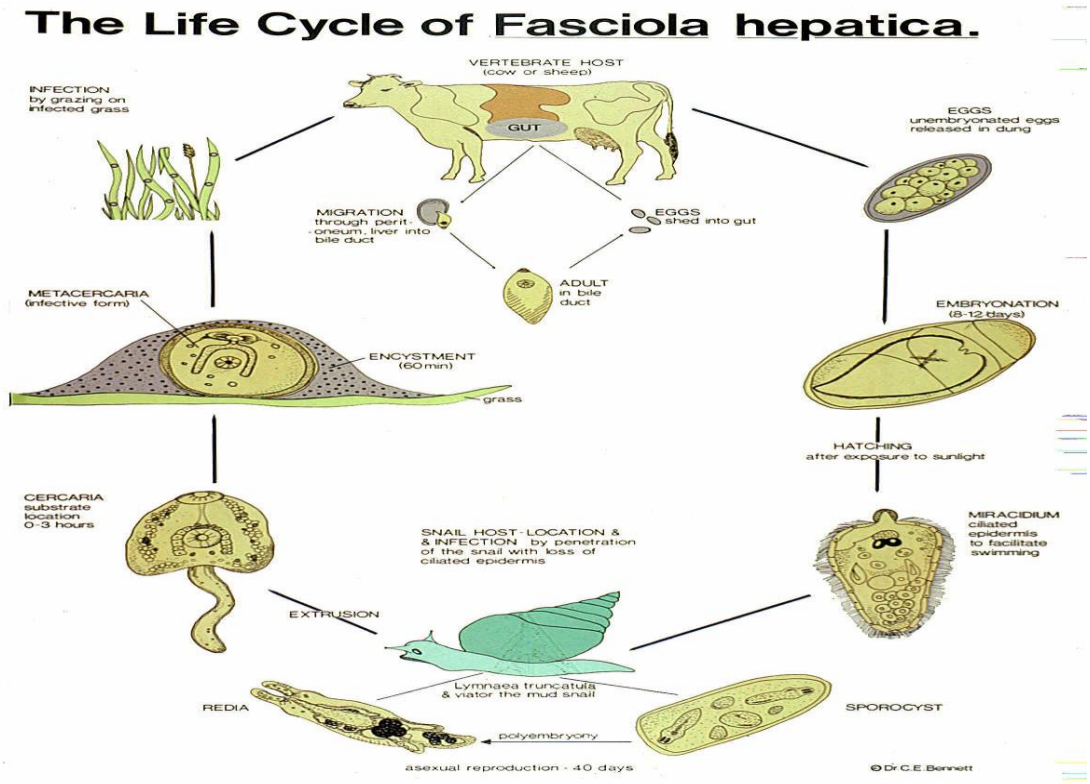
Fasciola hepatica, also known as the common liver fluke or sheep liver fluke, is a parasitic flatworm of the class Trematoda, phylum Platyhelminthes that infects the livers of various mammals, including humans. The disease caused by the fluke is called fascioliasis (also known as fasciolosis). Infection begins when metacercaria, infected aquatic vegetation is eaten or when water containing metacercariae is drunk. Humans are often infected by eating watercress. Human infections occur in parts of Europe, northern Africa, Cuba, South America, and other locales.

To complete its life cycle, *F. hepatica* requires a freshwater snail as an intermediate host, such as *snail* in which the parasite can reproduce asexually.

Adult hepatica lives in small passages of the liver of many kinds of mammals, especially ruminants. Humans are occasionally infected. In fact, fascioliasis is one of the major causes of hypereosinophilia in France. The flukes feed on the lining of biliary ducts. Their eggs are passed out of the liver with bile and into the intestine to be voided with feces. If they fall into water, eggs will complete their development into miracidia and hatch in 9 to 10 days during warm weather. Colder water retards their development. On hatching, miracidia have 24 hours in which they have to find a suitable snail host. Mother sporocysts produce first-generation rediae, which in turn produce daughter rediae that develop in the snail's digestive gland. From the snail, minute cercariae emerge and swim through pools of water in pasture, and encyst as metacercariae on near-by vegetation. From here, the metacercariae are ingested by the ruminant or, in some cases, by humans eating uncooked foods such as watercress. Contact with low pH in the stomach causes the early immature juvenile to begin the process of excystment. In

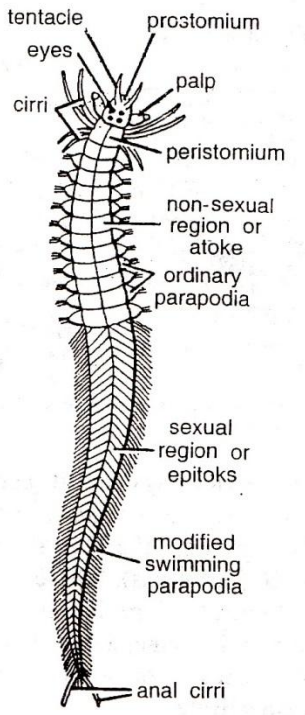
the duodenum, the parasite breaks free of the metacercariae and burrows through the intestinal lining into the peritoneal cavity. The newly excysted juvenile does not feed at this stage, but, once it finds the liver parenchyma after a period of days, feeding will start. This immature stage in the liver tissue is the pathogenic stage, causing anaemia and clinical signs sometimes observed in infected animals. The parasite browses on liver tissue for a period of up to six weeks, and eventually finds its way to the bile duct, where it matures into an adult and begins to produce eggs. Up to 25,000 eggs per day per fluke can be produced, and, in a light infection, up to 500,000 eggs per day can be deposited onto pasture by a single sheep.

Pathology: Little damage is done by juveniles penetrating the intestinal wall and the capsule surrounding the liver but much necrosis results from migration of flukes through the liver parenchyma. During this time, they feed on liver cells and blood. Anemia sometimes results from heavy infections. Worms in bile ducts cause inflammation and edema, which in turn stimulate production of fibrous tissue in the walls of these ducts. Thus thickened, the ducts can handle less bile and are less responsive to needs of the liver. Back pressure causes atrophy of liver parenchyma, with concomitant cirrhosis and possibly jaundice. In heavy infections, the gallbladder is damaged, and walls of the bile ducts are eroded completely.



Answers No. 6

Hetronereis is reproductive form of nereis. At sexual maturity, most of the posterior segment, filled with gametes, exhibits morphological and anatomical differentiation. These constitute the sexual region or epitoke of worm. Few anterior segments which do not take part in gamete formation, constitute the asexual region or atoke. Sexually mature worm with these two regions is known as hetronereis and the phenomenon involving transformation of non-sexual individual into sexual individual is referred to as epitoky.



Hetronereis

Reproductive system: Nereis is dioecious, i.e. sexes are separate. The gonads (testes in male and ovaries in female) are neither permanent nor distinct; they are seasonal and develop only during the breeding season. The gonads are formed by the proliferation of the cells of coelomic epithelium and can be seen as groups of masses of germ cells. These groups of germ cells are found particularly on the ventral side in the coelomic space of nearly all segments except a few anterior segments of the body.

In nereis testes extend in many segments. In the female the ovaries lie in many segments around blood vessels. Gonads have no gonoducts. The germ cells in male, separate in the coelomic fluid as sperm mother cells, they keep floating in the coelomic fluid, divide rapidly and undergo maturation division to form sperms. A mature sperm has a rod-shaped head and a long vibrating tail. Ova are also formed in the same way in female. An ovum contains yolk granules and is rounded in shape surrounded by a vitelline membrane.

The body of a sexually mature Neanthes is, thus, packed with gametes. Since gonoducts are absent in Neanthes gametes are discharged out either by the rupture of body wall or by the nephridia. Such nephridia, acting both as excretory and genital ducts, are called mixonephridia.

A pair of dorsal ciliated organs is found in each segment situated close to the dorsal longitudinal muscles. Each ciliated organ is a small, ciliated tract of coelomic epithelium and much folded funnel-shaped structure; it opens into the coelom by a wide opening but it has no external opening. These are believed to be the coelomoducts of other polychaetes and open temporarily to the exterior during breeding season performing the function of gonoducts.

Generally a sexually mature Neanthes resembles more or less with non-sexual Neanthes from the morphological point of view. But in some species certain variations or structural modifications have been recorded in the body of sexually mature Neanthes which are completely lacking in immature forms. Such species exhibits two distinct phases in life cycle; a non-sexual or Neanthes phase and sexual or Heteronereis phase. This phenomenon is called epitoky.

Earthworms have been called ‘ecosystem engineers’. Much like human engineers, earthworms change the structure of their environments. Different types of earthworms can make both horizontal and vertical burrows, some of which can be very deep in soils.

These burrows create pores through which oxygen and water can enter and carbon dioxidecan leave the soil.Earthworm casts (their faeces) are also very important in soils and are responsible for some of the fine crumb structure of soils.

Decomposition and organic matter of soil

Earthworms play an important role in breaking down dead organic matter in a process known as decomposition. This is what the earthworms living in your compost bin are doing and earthworms living in soils also decompose organic matter. Decomposition releases nutrients locked up in dead plants and animals and makes them available for use by living plants.

Earthworms do this by eating organic matter and breaking it down into smaller pieces allowing bacteria and fungi to feed on it and release the nutrients.

Earthworms are also responsible for mixing soil layers and incorporating organic matter into the soil. Charles Darwin referred to earthworms as 'nature's ploughs' because of this mixing of soil and organic matter. This mixing improves thefertility of the soil by allowing the organic matter to be dispersed through the soil and the nutrients held in it to become available to bacteria, fungi and plants.

Earthworms have a positive effect on bacteria and fungi in soils. Where earthworms are present there are more bacteria and fungi and they are more active. This is important as bacteria and fungi are key in releasing nutrients from organic matter and making them available to plants. They are also an important source of food in their own right for many other animals that live in soils. Earthworms are familiar to the fisherman and poultry producer as bait or animal feed and it also has various medicinal compounds.

Answers No. 7

Characteristic features of Phylum Mollusca :Consists of triploblastic, coelomate, unsegmented (except in Monoplacophora) and bilaterally symmetrical animals.

Body divisible into head, mantle, foot and visceral mass.

Shell, when present, usually univalve or bivalve, constituting an exoskeleton, Some mollusks have an internal shell

Coelom is reduced and represented mainly by pericardial cavity, gonadial cavity and kidney.

Digestive system is complete with a digestive gland or liver (hepatopancreas); a rasping organ, the radula, usually present.

Circulatory system is mainly of closed type, but sinuses are present; heart with one or two auricles and one ventricle; blood with amoebocytes and haemocyanin.

Respiration is direct or by gills or lungs or both. Cutaneous respiration through vascularized mantle also occurs.

Excretion by paired metanephridia (kidneys).

Nervous system consists of paired ganglia, connectives and nerves. Ganglia usually form a circumenteric ring.

Sense organs include eyes, statocysts and receptors for touch, smell and taste.

Dioecious or monoecious; one or two gonads with gonoducts, opening into renal ducts or to exterior.

Fertilization may be external or internal; development may be direct without involving larval forms or through free larval forms.

Organisms may be terrestrial or aquatic; if aquatic, fresh water or marine.

Economically importance of Molluscs

Molluscs are economically important. The pearl oysters produce pearls that are used for making ornaments. Pearls are small white globular shining secretions found inside the shell of oysters. Shellfishes are in demand as they are relished as a delicacy in most parts of the world. The molluscan shells are rich in calcium carbonate and are a source of lime.

Molluscs are indirectly harmful to man but most of them are beneficial. Molluscs are of great important in various ways. There are some benefits of molluscs:

i. 1.The harmful molluscs ate slugs and shipworms. Slugs are injurious in gardens and cultivations. They not only eat leaves but also destroy plants by cutting up their roots and stems. Teredo, a shipworm damages wooden parts of ship.
ii. 2.Many mollusks are great source of food for man in many parts of world. Large quantity of calms, oysters and mussels are eaten in Fareast, Europe and America. Oysters are regarded as delicacy.
iii. 3.Shell of fresh water mussels is used in button industry.
iv. 4.The shell of oyster are mixed with tar for making roads in America.
v. 5.Shells in certain parts of world are also used for making ornaments.
vi. 6.Some oysters also make valuable pearls e.g. The pearl oyster.
vii. 7.Some pearls are used for making jewellery.
viii. 8.Some animals including in this phyla are use to eat in some countries.

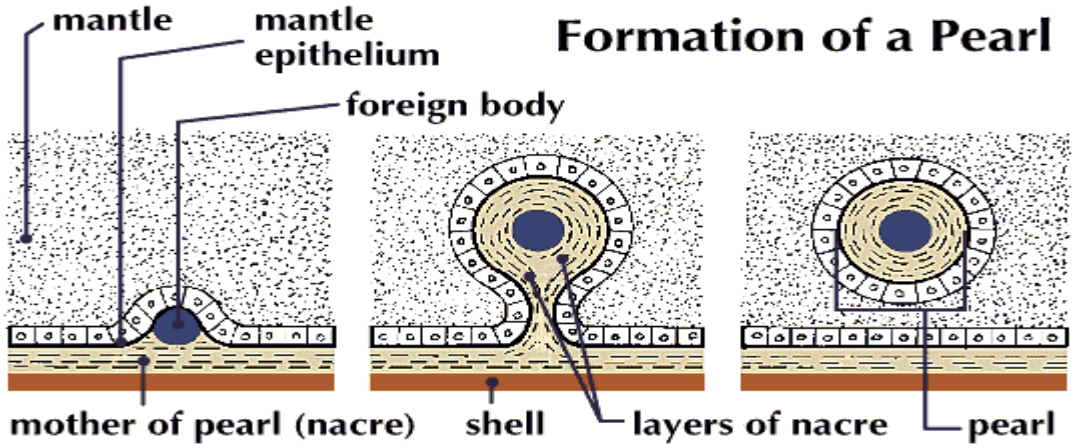
Answers No. 8

Pearls are produced by many different types of marine mollusks and freshwater mussels in China. Keshi pearls are actually a mistake in the cultured pearl seeding process. In seeding the

cultured pearl, a piece of mantle muscle from a sacrificed oyster is placed with a bead of mother of pearl within the oyster.

Pearl is a natural gem and is produced by a mollusc. While the demand of pearls in India and elsewhere is increasing, their supplies from nature have reduced due to over exploitation and pollution. India is importing a large amount of cultured pearls every year from international market to meet the domestic demand. The Central Institute of Freshwater Aquaculture, Bhubaneswar has developed the technology of Freshwater Pearl Culture from common freshwater mussels, which are widely distributed in freshwater habitats throughout the country. In nature, a pearl is formed when a foreign particle *viz*., piece of sand, insects, etc. by chance enters into the body of mussel and the mussel can not reject that out and instead makes a shiny coating on the particle layer by layer. This simple phenomenon is being exploited in pearl culture practices.

The pearl is similar to the inner shining layer of shell called 'mother of pearl layer' or nacre, constituted by calcium carbonate, organic matrix and water. The pearls available in the could be artificial, natural or cultured. Artificial or imitation pearls are not pearls but pearl-like materials that simply contain a rigid, round core or base and an outer pearly coating. In natural pearls the core or nucleus is minute with thick pearl nacre. Generally, a natural pearl is small in size and irregular in shape. A cultured pearl is also a natural pearl, the only difference being the human intervention in surgical implantation of a live mantle graft and nucleus for hastening pearl formation to the desired size, shape, colour and lusture. In India, three species of commonly available freshwater mussels *viz*.,*Lamellidens marginalis*, *L. corrianus* and *Parreysia corrugata* found to produce good quality pearls.



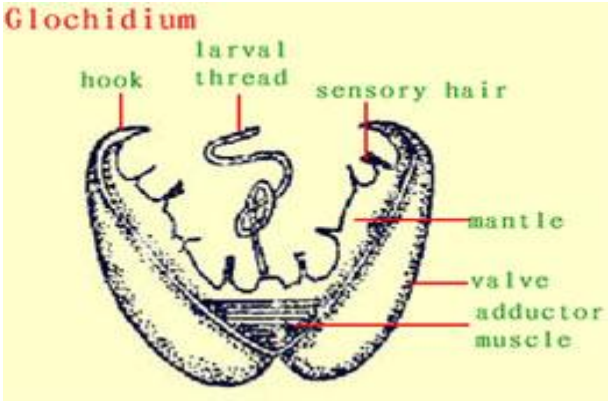
Gluchidium larva

In the freshwater Unionidae the released larva, called a glochidium, often has sharp spines projecting inward from each valve. The larva attaches to either the gills or fins of passing fish and becomes a temporary parasite. Eventually, it leaves the fish, falls to the lake floor, and metamorphoses into an adult.

This larva form has hooks, which enable it to attach itself to fish (for example to the gills of a fish host species) for a period before it detaches and falls to the substrate and takes on the typical form of a juvenile mussel. Since a fish is active and free-swimming, this process helps distribute the mussel species to potential areas of habitat that it could not reach any other way.

Before the origin of this larval form was understood, it used to be described as "parasitic worms" on the fish host, although under normal circumstances, glochidia do not harm fish. Overexposure or heavy infections of glochidia may however greatly decrease the host's ability to respire. This is because the tissue which is heavily covered in glochidia will eventually convert to scar tissue and lose functionality.

Some mussels in the Unionidae, such as *Ptychobranchus fasciolaris* and *P. greenii*, release their glochidia in mucilaginous packets called conglutinates. The conglutinate has a sticky filament that allows it to adhere to the substrate so it is not washed away. There is also an evenmore specialized way of dispersal known as a super-conglutinate. The super-conglutinate resembles an aquatic fly larva or a fish egg, complete with a dark area that looks like an eyespot, and it is appetizing to fish. When a fish consumes it, it breaks up, releasing the glochidia. Mussels that produce conglutinates and super-conglutinates are often gill parasites, the glochidia attaching to the fish gills to continue their development into juveniles.



Structure of Gluchidium larva