

Integrated UG/PG Biotechnology (First Semester)
End Semester Examination, 2013
LBZS 103: Lower non chordates and parasitology

Model Answer (AS-2891)

Answer 1: Multiple Choice Questions

- (i) (a) Aschelminthes
- (ii) (b) Binomial nomenclature
- (iii) (c) Noctiluca
- (iv) (c) Mesenchyme
- (v) (b) Gametes
- (vi) (d) All
- (vii) (c) Blood
- (viii) (b) Sand fly
- (ix) (a) Digestive system
- (x) (d) *Fasciola hepatica*

Answer 2: Subjective questions

Answer (i):

Symmetry: Symmetry means arrangement of body parts into geometrical designs. It refers to the division of body into equal parts by lines or planes. Animals show different patterns of body symmetry. Some groups, such as the phylum Porifera, show no particular pattern of symmetry (asymmetry). That is, no line of bisection exists that could divide the organism into similar-looking halves. Other groups, including the Cnidaria and Echinodermata show **radial** symmetry where more than one hypothetical bisection can be visualized. A third pattern, seen in most phyla of animals, is **bilateral symmetry** where only one hypothetical bisection can be visualized. While these patterns can be seen readily, the implications of the different patterns of symmetry are important.

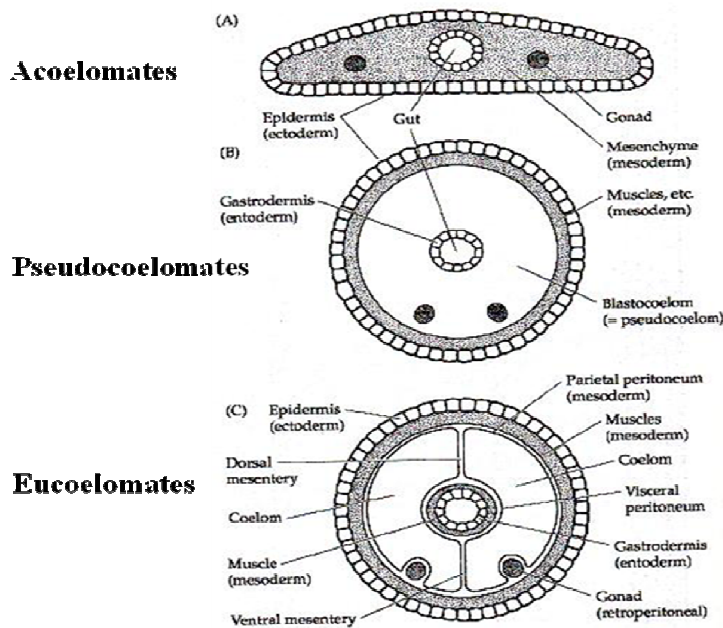
Asymmetry: The animal cannot be divided into mirror images. **Example:** Most sponges and *Amoeba*.

Spherical Symmetry: It is found in animals whose body has the shape of sphere. All planes that pass through the center will cut it into similar halves. **Example:** *Volvox*, *Radiolaria*.

Radial Symmetry: Body is in the form of flat or tall cylinder. Animals can be cut in half along many planes that allow for nearly identical halves. Body parts are arranged around central axis. **Examples:** Porifera, Coelenterata and Ctenophora.

Bilateral Symmetry: A single plane divides body into two mirror images. Body has right and left halves that are mirror images. Body has distinct anterior/posterior and dorsal/ventral divisions. **Example:** Platyhelminthes.

Body Cavities: Animals can be grouped on the basis of presence or absence of a coelom and pattern of their formation. A **coelom** (Greek: *coel* = hollow) is a fluid-filled cavity between the alimentary canal and the body wall. However, the type of coelom (or even its existence) differs among groups of animals- both in its structure (such as what types of tissues surround it) and its mode of development. There are three *structural* types of body plans related to the coelom.



1. **Acoelomate:** Animals in which no coelomic cavity exists. Embryonic mesoderm remains as a solid layer, space between gutwall and bodywall is filled with mesenchyme and muscle fibres. **Example:** Porifera, Coelenterata, Ctenophora and Platyhelminthes.

2. **Pseudocoelomate:** Animals in which a coelom exists, but it is lined by mesoderm only on the body wall, not around the gut. Thus Coelom is false type. **Example:** Acanthocephala, Ectoprocta, Aschelminthes.

3. **Coelomate (or Eucoelmate, or “True” Coelom),** in which the coelom is lined both on the inside of the body wall and around the gut by mesoderm. Animals with a true coelom also have **mesenteries**, which suspend the body organs within the coelom. **Example:** Annelida, Arthropoda, Mollusca etc.

There are two types of “true” coelomic cavities. These do not differ in structure, but they do develop in different ways. In most protostome animals with a true coelom, the body cavity originates as a split within a bud of mesodermal tissue at the time of gastrulation. This method of coelom formation is termed schizocoelous (Greek: schizo = split), and occurs in animals like segmented worms and molluscs. In most deuterostome animals the coelom originates from an outpocketing of the archenterons during gastrulation. This method of coelom formation is called enterocoelous. Example of enterocoel is Echinodermata, Hemichordata and Chordata.

Answer (ii):

General Accounts:

1. Small, usually microscopic animalcules.
2. Simplest and most primitive. Protoplasmic grade of body organization.
3. Body unicellular, containing one or more nuclei which are monomorphic and dimorphic.
4. Solitary or forming loose colonies in which individuals remain alike and independent.
5. Body symmetry none, bilateral, radial or spherical.
6. Body naked or bounded by pellicle and often provided with cytoskeleton.

7. The single cell body performs all the essential and vital activities, which characterize the animal body; hence only sub-cellular physiological division of labour.
8. Locomotor organelles are finger-like pseudopodia or whip-like flagella or hair-like cilia or absent
9. Nutrition holozoic, holophytic, saprozoic or parasitic. With or without definite oral and anal apertures. Digestion intracellular inside food vacuole.
10. Respiration and excretion through general surface or through contractile vacuoles, which serves mainly for osmoregulation.
11. Reproduction asexual by binary or multiple fission and budding, and sexual by conjugation of adults (hologamy) or by fusion of gametes (syngamy).
12. Encystment commonly occurs to resist unfavourable conditions of food, temperature and moisture.
13. Free living Protozoa mostly aquatic, inhabiting fresh and sea waters and damp places. Parasitic and commensal Protozoa live over or inside the bodies of animals or plants.

Classification: Phylum Protozoa has been divided into four main sub-phylum-

SUBPHYLUM 1: SARCOMASTIGOPHORA

Locomotor organelles are pseudopodia or flagella or both. Nuclei are of one kind (monomorphic).

Superclass A: Mastigophora (Flagellata)

1. Simple, primitive, with firm pellicle
2. Locomoter organelle flagella
3. Nutrition autotrophic or heterotrophic, or both

Class 1: Phytomastigophorea (Phytoflagellata)

1. Chlorophyll bearing chromatophores present
2. Nutrition mainly holophytic
3. Reserve food starch or paramylon
4. Flagella 1 or 2, sometimes more

Examples: *Euglena*, *Noctiluca*, *Chlamydomonas*, *Volvox*

Class 2: Zoomastigophorea (Zooflagellata)

1. Chlorophyll or chromatophores absent
2. Mostly parasitic
3. Nutrition holozoic or saprozoic
4. Reserve food glycogen
5. Flagella one to many

Examples: *Leishmania*, *Trypanosoma*, *Trichomonas*

Superclass B: Opalinata

1. Entire body covered by cilia like flagella
2. Nuclei 2 to many
3. Parasitic mainly in frogs or toads

Examples: *Opalina*, *Zelleriella*

Superclass C: Sarcodina (Rhizopoda)

1. Body mostly amoeboid without definite pellicle
2. Locomotion by pseudopodia
3. Nutrition holozoic or saprozoic

Class 1: Rhizopodea

1. Pseudopodia as lobopodia, filopodia or reticulopodia, without axial filaments
Examples: *Amoeba*, *Entamoeba*, *Elphidium*

Class 2: Actinopodea

1. Pseudopodia mainly axopodia with axial filaments radiating from a spherical body
Examples: *Acanthometra*, *Actinosphaerium*, *Actinophrys*

Class 3: Piroplasmia

Small parasites in RBCs of vertebrates

Example: *Babesia*

SUBPHYLUM 1: SPOROZOA

Locomotor organelles are absent. Spores usually present and exclusively endoparasites.

Class 1: Telosporea

Spores are without polar capsules and filaments, naked or encysted.

Examples: *Monocystis*, *Isospora*

Class 2: Toxoplasmea

Spores are absent. Only asexual reproduction occurs.

Example: *Toxoplasma*

Class 3: Haplosporea

Spores cases present. Only asexual reproduction occurs.

Examples: *Ichthyosporidium*

SUBPHYLUM 1: SPOROZOA

Class 1: Myxosporidea

1. Spores large, developed from several nuclei
2. Spores with 2 or 3 valves
3. Parasites mostly in fishes

Examples: *Myxidium*, *Myxobolus*

Class 2: Microsporidea

1. Spores small, developed from one nucleus
2. Spores with univalved membrane
3. Intracellular parasites in Arthropods and fishes

Examples: *Nosema*

SUBPHYLUM 1: CILIOPHORA

Cilia as locomotor are present and feeding organelles can be observed at some stage in the life cycle. Nuclei are of two kinds (dimorphic).

Class 1: Ciliata

1. Locomotor organelles numerous hair-like cilia, present throughout life
2. Definite mouth and gullet present except in few parasitic forms
3. One or more contractile vacuoles present even in marine and parasitic types
4. Mostly two kinds of nuclei, large macronucleus and smaller micronucleus

Examples: *Balantidium*, *Paramecium*, *Vorticella*

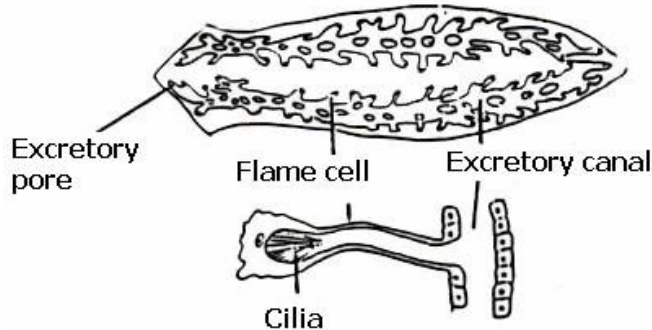
Answer (iii):

Morphology: Dugesia species have an elongated body with a slightly triangle-shaped head. Usually they have grey, brown or black colors on the dorsal body surface. These animals have a couple of eyes constituted by a multicellular pigmented cup with many retinal cells to detect the amount of light in the nearby environment. At the anterior part of the body, behind the eyes level, they have a couple of auricles that give the triangle look to the 'head' and that allow them to detect the intensity of water current. These auricles are free of pigment and rhabdites. Each

side of the anterior margin of the head have between 5 and 10 shallow sensory fossae, their number depends on the species or the individual. The sensory fossae and the auricle grooves are supplied with many nerve endings. Following points should be elaborated for external morphology-

1. Shape, size and color
2. Head end
3. Cilia
4. External aperture- Mouth, Genital aperture, Nephridiopores.

Excretory System of *Dugesia*:

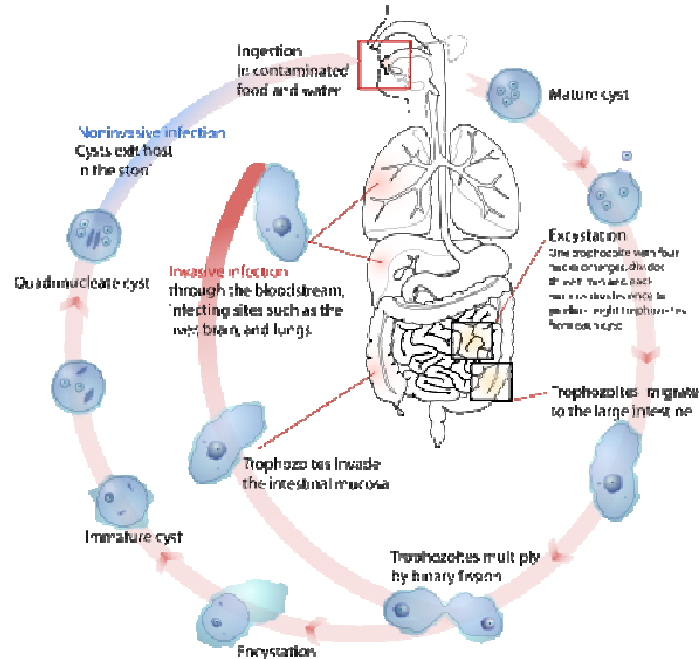


Excretory system of *Dugesia* consists of a large number of excretory cells, the flame cells and a system of longitudinal excretory tubules. Following points should be elaborated-

1. Flame Cells (structure and function)
2. Excretory tubules (longitudinal excretory duct or canal, transverse vessel and excretory pores)
3. Physiology of excretion

Answer (iv):

Entamoeba histolytica is a protozoan parasite responsible for a disease called amoebiasis. It occurs usually in the large intestine and causes internal inflammation as its name suggests (histo= tissue, lytic= destroying). 50 million people are infected worldwide, mostly in tropical countries in areas of poor sanitation. In industrialized countries most of the infected patients are immigrants, institutionalized people and those who have recently visited developing countries. Inside humans *Entamoeba histolytica* lives and multiplies as a trophozoite. Trophozoites are oblong and about 15-20 μm in length. In order to infect other humans they encyst and exit the body. The life cycle of *Entamoeba histolytica* does not require any intermediate host. Mature cysts (spherical, 12–15 μm in diameter) are passed in the feces of an infected human. Another human can get infected by ingesting them in fecally contaminated water, food or hands. If the cysts survive the acidic stomach, they transform back into trophozoites in the small intestine. Trophozoites migrate to the large intestine where they live and multiply by binary fission. Both cysts and trophozoites are sometimes present in the feces. Cysts are usually found in firm stool, whereas trophozoites are found in loose stool. Only cysts can survive longer periods (up to many weeks outside the host) and infect other humans. If trophozoites are ingested, they are killed by the gastric acid of the stomach. Occasionally trophozoites might be transmitted during sexual intercourse.



Most *Entamoeba histolytica* infections are asymptomatic and trophozoites remain in the intestinal lumen feeding on surrounding nutrients. About 10-20% of the infections develop into amoebiasis which causes 70,000 deaths each year.

Following points should be discussed in details-

1. Host
2. Binary fission
3. Encystation
4. Transmission and Infection
5. Excystation
6. Metacystic development

Disease: Following points should be there-

1. Symptoms and pathogenesis
2. Mode of transmission
3. Diagnosis
4. Prevention

Answer (v):

Following points should be explained -

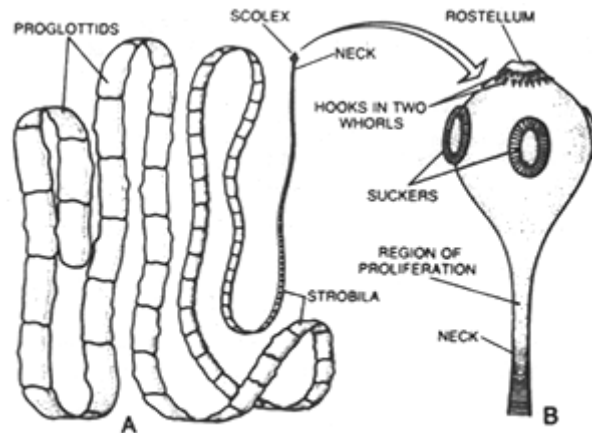
1. Shape, size and coloration
2. Segmentation
3. Scolex
4. Neck
5. Strobila (Immature proglottids, mature proglottids and ripe or gravid proglottids)

T. solium is a flattened ribbon like tapeworm that is white creamish white in color. The attachment organ, or scolex (measure 1.0 mm), has 4 large suckers and rostellum with 25-50 hooklets with a double row of hooks. *Taenia* measures about 2-4 m and has 700-1000 segments known as proglottides. As the tapeworm grows in the intestine, mature proglottis called gravid proglottis will be casted off out of the human body. Each gravid proglottids contains both male and female

reproductive organs and houses 30-40 thousand eggs. The short and slender neck is the budding zone containing germinative cells from which new segments grow up to form a long and segmented strobilus. Immature proglottids are transverse rectangle, located in the anterior part of the body and inner organs are developing. Mature proglottids are square in shape and located in the mid part of the body and have 150-200 testes, a centrally straight uterus, 3 lobes of ovary and a vitelline gland. The pregnant proglottids are longitudinal rectangle, located in the posterior part of the body and contain a branched uterus filled with eggs.

Scolex: At the anterior end of *T. solium*, known as the scolex, is used to attach the organism to the inside of a human's small intestine, and anchor it so it can feed on the nutrients in our digestive tract. The scolex of *T. solium* features four suckers and a double row of hooks to attach to the intestine.

Strobilla: The flat ribbon-like body that makes up the rest of the organism is the strobilla, which is comprised of proglottids, which contain both male and female reproductive organs. Basically, a tapeworm is comprised almost completely of gonads, which means that it is very efficient at reproduction. The tapeworm will shed proglottids to be excreted by the host in its feces, which is an integral step in the life cycle, because the proglottids are totipotent, and if ingested by an intermediate host, will form the larval stage to continue the cycle.



Taenia solium : A. whole; B. its scolex

Answer (vi):

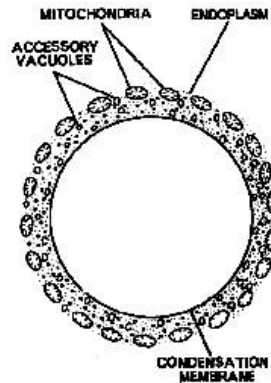
Osmoregulation in *Amoeba*: Osmoregulation is the active regulation of the osmotic pressure of an organism's fluids to maintain the homeostasis of the organism's water content. It keeps the organism's fluids from becoming too diluted or too concentrated. Osmotic pressure is a measure of the tendency of water to move into one solution from another by osmosis. The higher the osmotic pressure of a solution, the more water tends to move into it. Pressure must be exerted on the hypertonic side of a selectively permeable membrane to prevent diffusion of water by osmosis from the side containing pure water. The plasmalemma around amoeba is semipermeable and as the water of the pond in which this animal lives hypotonic to the cytoplasm of its body. According to the law of diffusion large amount of water enters the body. If all this water is allowed to remain in the body, the body will swell and ultimately burst. Hence, a special arrangement is required for the removal of this excess water in amoeba and this is done by the contractile vacuole. The vacuole bursts to the outside disappears and soon reappears. The

process goes on continuously. There are two states of contractile vacuole in osmoregulation. 1. Diastole. 2. Systole.

1. Diastole: During this state many small vacuoles appear.

2. Systole: The process of disappearance of contractile vacuoles after bursting is called systole.

Contractile vacuole, a membranous vesicle, is surrounded by accessory vacuoles and mitochondria to provide energy (ATPs) for osmoregulation.



The contractile vacuole slowly fills with water from the cytoplasm (diastole), and, while fusing with the cell membrane, it quickly contracts releasing water to the outside (systole) by exocytosis. This process regulates the amount of water present in the cytoplasm of the amoeba. It is known as osmoregulation. Immediately after the contractile vacuole expels water, its membrane crumples, and soon afterwards, many small vacuoles or vesicles appear surrounding the membrane of the contractile vacuole. It is suggested that these vesicles split from the contractile vacuole membrane itself. The small vesicles gradually increase in size as they take in water and then they fuse with the contractile vacuole, which grows in size as it fills with water. Therefore, the function of these numerous small vesicles is to collect excess cytoplasmic water and channel it to the central contractile vacuole. The contractile vacuole swells for a number of minutes and then contracts to expel the water outside. The cycle is then repeated again. The membranes of the small vesicles as well as the membrane of the contractile vacuole have aquaporin proteins embedded in them.

Behavior in Amoeba:

Although there are no special sense organs in Amoeba yet it exhibits generalized sensitivity against various stimuli. A taxis may be either positive (in which organism moves towards stimulus) or negative (in which organism moves away from stimulus). Amoeba shows both types of taxes, positive as well as negative, specifically to different stimuli. With respect to kinds of stimuli, taxes are classified as follows-

1. **Thermotaxis (response to heat):** Amoeba responds negatively to both low and high temperatures. Optimum temperature lies between 20⁰C and 25⁰C. It ceases all activities at temperature above 35⁰C.
2. **Phototaxis (response to light):** Negative to bright light (direct sunlight) and positive to weaklight.
3. **Thigmotaxis (response to touch):** A floating Amoeba responds positively to those objects upon which it glides or rests. It will back away from contact with a foreign object or or a probe while crawling or resting.

4. **Chemotaxis (response to chemicals):** Amoeba is negatively chemotactic to strong solutions of alkalis, salts and sugars. It also avoids sand particles or some other obstacles in the way. It responds positively to food organisms.
5. **Rheotaxis (response to current of water and air):** Amoeba prefers to be drifted along the floating water.
6. **Galvanotaxis (response to electric field):** In strong electric field, Amoeba stops moving and retract pseudopodia. However, in weak electric field, Amoeba moves towards cathode (-ve pole) and avoid anode (+ve pole).
7. **Geotaxis (response to gravity):** Amoeba shows positive response towards gravity.

Answer (vii):

Similarities between polyp and medusa:

1. Body is radially symmetrical.
2. Both are diploblastic, derived from two germ layer, ectoderm and endoderm.
3. Ex-umbrellar surface of medusa corresponds with the base of polyp, providing attachment with the parental stem.
4. Mouth is homologous in both cases, being situated on similar process, called manubrium. Anus is absent in both.
5. Stomach, radial canals and circular canal of medusa correspond with the gastrovascular cavity of polyp, lined by gastrodermis in both cases and serving for digestion of food.
6. Both are carnivorous capturing and ingesting food with help of tentacles. Digestion is extracellular as well as intracellular and digested food diffuses throughout body without a circulatory system.

Similarities between polyp and medusa:

S. No.	Polyp	Medusa
1.	Fixed, Rarely free.	Free swimming.
2.	Body cylindrically elongated.	Body saucer shaped or umbrella shaped.
3.	Base attached below so that manubrium is directed upward.	Base above so that manubrium hangs downward.
4.	Tentacles usually 24.	16 tentacles in young medusa and numerous in adult.
5.	Mesogloea poorly developed.	Mesogloea enormously developed.
6.	Body structure simple. Muscles and nervous system simple.	Body structure complicated. Muscles and nervous system are more developed.
7.	Vellum absent.	Vellum present around the margin of umbrella.
8.	Mouth circular without oral lobes.	Mouth rectangular with oral lobes.
9.	Gastrovascular cavity simple without radial and circular canals.	Gastrovascular cavity represented by stomach. Four radial canal and one circular canal.
10.	Sense organ absent.	Bases of 8 adradial tentacle possess marginal sense organ, called statocysts.
11.	Without gonads.	With four gonads on radial canals.
12.	Reproduces asexually by budding.	Reproduces sexually by gametes.