TOPIC: EOLUTION OF METAZOA

LECTURE NO:05
B.SC PART 1
ZOOLOGY(HONS.)-PAPER I-GROUP A
CHAPTER 3
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Objectives

(1) Study of Germ layers.
(2)Study of diploblastic and triploblastic Organization.

Introduction

Metazoans are the multicellular organism which develops from embryo; they are heterotrophic and motile eukaryotes organisms. Their body is polarized along an anterior-posterior locomotory axis. Metazoans body is composed of functional specialized cells, each type of which is dedicate to one or a few functions.There is a great diversity in metazoans and according to the most widely accepted groupings there are 30 phyla of which only one, viz. the chordata, contains animals which are not invertebrates. The important features on the basis of which the metazoan hierarchy is decided are: symmetry, coelom and metamerism.

Lower and higher Metazoa:

We saw that animal phyla can be arranged in several different ways on the basis of their structural traits, as follows:

Asymmetrial (most Porifera), radially symmetrical (Coelentrata) and bilaterally symmetrical (all others).

Diploblastic (Porifera and Coelentrata) and triploblastic (all others).

Acoelomate (Porifera to Plathelminthes), Pseudocoelomate (Entoprocta, Acanthocephala, Aschminthes) and coeloate (all others).

Segmented (Annelid. Arthopoda, Tardigrada, Chordata) and coelomate (all others).

Chordates (Proto-chordata and Vertebrate) and non-chordates (all others).

Vertebrates (higher chordates) and invertebrates (all others).

Major Groups of Animals	Phyla	Number of species
Subkingdom I Protozoa.....	1. Protozoa	50,000
Branch 1. Mesozoa.....	+ 2. Mesozoa	50
Branch2. Parazoa.....	3. Porifera	5,000
Grade A. Radiata	4.Coelenterata	11,000
	+5. Ctenophora	90
(i) Subdivision Acoelomata	6. Platyhelminthes	15,000
	+7. Rhyncocoela (Nemertinea)	750
	+8. Acanthocephala	500
(ii)Subdivision Pseudocoelomata	+9.Entroprocta	60
	+10. Rotifera	1,500
	+11. Gastrotricha	175
	+12. Kinorhyncha	100
	13. Nematoda	12,000
	+ 14. Nematomorpha	100
(iii)Subdivision Lophophorate Coelomata	+15. Phoronida	
	+16. Ectoprocat (Bryozoa)	4,000
	+17. Brachiopoda	260
	+18. Priapulida	08
(iv)	+19. Spinunculida	275

	Subdivsion Schizocoelous Coelomata	9. 20. Mollusca +2 1. Echurida 22. Annelida +23. Tardigrada +2 4. Onychophora	80,000 60 8,700 180 73
Subkingdom II. Metazoa Branch3.Eumetazoa	**Subdivision Enterocoelous Coelomates**	25. Arthropoda 26. +Pentastomida 27. +Chaetognatha	900,000 70 50
Grade B. Bilateria Division 2. Deuterostomia		Echinodermaa +2 9. Pogonophora +30.Hemichordata *31. Chordata	6,000 80 80 49,000

Shows major phyla discussed in detail in this volume and + Shows Minor Phyla. * Treated in second volume on "Vertebrates".

1. **Lower Metazoa:**

Porifera, Colenterata, Platyhelminthes, Aschelminthes, Entoprocta and Acanthocephala are generally called Lower Metazoa.

They are unsegmented, radially or bilaterally symmetrical, diploblastic or triphloblastic and acoelomate.

Higher Metazoa:

- The remaining phyla namely Mollusca, Annelida, Arthopoda, Echinodermata and Chordata etc. are known as higher Metazoa.

  They are triploblastic and truly coelomate animals. Except chordata, all are non-chordates or invertebrates.

  However, the lower and higher metazoan phyla, based on structural traits or characters, must not be confused with the Minor and Major phyla which are based on different criteria, such as the number of species and individuals and their participation in ecological communities

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Germ layers:-

The primitive cell layers, or first tissues, which appear early in the development of animals and from which the embryo body and its auxiliary membranes, when present, are constructed. These are more or less distinct anatomically, but do not necessarily have sharp boundaries of demarcation.

Germ layers are almost universal among animal embryos and appear to establish discontinuities of architectural importance without complete loss of continuity.

Three kinds of germ layers are recognized:

The ectoderm or outer layer

The endoderm or inner layer

The mesoderm or middle layer

The layers have been named in accordance with their positions in the spherical type of gastrula such as that of the sea urchin or amphibian. The terms epiblast, mesoblast, and hypoblast are sometimes used as synonyms for ectoderm, mesoderm, and endoderm, respectively. The majority of organisms have all three primary germ layers: the exterior, or ectoderm; the interior, or endoderm; and the middle, or mesoderm. Exceptions are the sponges and coelenterates, in which only two germ layers are formed, the exterior and the interior and a distinct mesodermal layer are absent.

Derivatives of the ectoderm:

Perform integumental, sensory, and motor functions:
In the course of embryonic development they give rise to the nervous system;
The skin integument and the skin glands that are formed from it;
The hair, plumage, scales, nails, and so forth;
The epithelium of the anterior and posterior sections of the digestive system;
The connective-tissue foundation of the skin; the pigment cells; and the visceral skeleton.

Derivatives of the endoderm:

The endoderm forms the lining of the intestinal cavity
Provides nutrition for the embryo;

From it originate the mucous membrane of the digestive system, the digestive glands.
Forms the organs of respiration.

Derivatives of the Mesoderm:

The mesoderm effects communication between the parts of the embryo
Performs supportive and tropic functions;
From it are formed the organs of excretion, the sex organs,
Forms the circulatory system, and
Forms the serous membranes that line the secondary body cavity (coelom) and clothe the internal organs and muscles;
In vertebrates the skeleton is also formed from the mesoderm.

Analogous germ layers in different groups of organisms may have, in addition to common traits, substantial differences in their manner of formation and their structures, because of the adaptation of the embryos to different conditions of development.

Metazoan Organization

Animals show various patterns in their morphology. Relationships between animals or groups of animals are best explained by their cooperative morphology and embryology. The gross external morphology of animals falls under a limited number of patterns (criteria).

These include form of animals (symmetry), arrangement of body parts in segments (metamerism), formation of a head (cephalization), and Progressive sequence of specialization of structure (levels or grades of organization).

Similary, the criteria of internal morphology are differences in formation of body cavity (coelom) and reproduction (embryology), etc.

Symmetry and its significance:

Symmetry means an arrangement of body parts into geometrical designs. It refers to the division of body into equal parts by lines or planes.

An animal is called symmetrical when a plane passing through its centre will divide into similar halves.

When an animal cannot be divided into like parts by a plane, it is called asymmetrical e.g. sponge, some Protozoa (Amoeba) and few others.

Certain terms are often used when explaining symmetry.

An axis is an imaginary line passing through the center of body, such as longitudinal axis and oral-aboral axis. Either end of an axis is termed a pole. Thus, each axis has two poles.

A plane of symmetry is a straight line that divides into corresponding halves.

Metazoa commonly display two types of symmetry, radial and bilateral. Two other types of symmetry are also recognized, spherical and biradial.

Protozoa are not only asymmetrical but display all four types of symmetry in their diverse body forms.

Spherical symmetry:

It is found in animals whose body has the shape of a sphere.

All planes that pass through the center will cut it into similar halves.

Some protozoans (e.g.Volvox, Helozoa, Radiolaria) have sepherical symmetry, and it is adapted for free-floting or rolling movments (Fig.1)

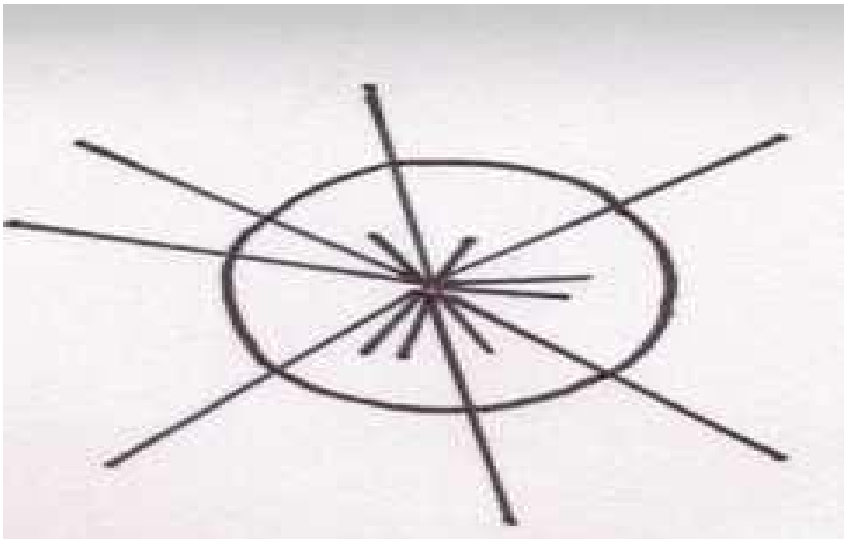

Fig 1.Spherical Symmetry

Radial symmetry:

Many similar body parts, called antimeres, are arranged around one main, central or longitudinal axis in a circular or radiating manner like the spokes of a wheel.

All the lines passing through this longitudinal axis, in any plane, will divide the body into equal halves or antimeres.

The surface having mouth is the oral surface, and the opposite surface is the aboral surface. Examples are echinoderms and most colelentrates (e.g. Hydra).

The body is in the form of a flat or tall cylinder.

Radial symmetry is best suited for a sessile existence.

Most of them attached by the aboral surface.

Some are free-swimming but remain at the mercy of water current.

Due to similarity of antimeres, their sensory receptors are equally distributed all around the periphery.

This enables them to receive stimuli and to meet the challenges of the environment equally from all direction.

They can obtain food or repel enemies from all sides (Fig.2).

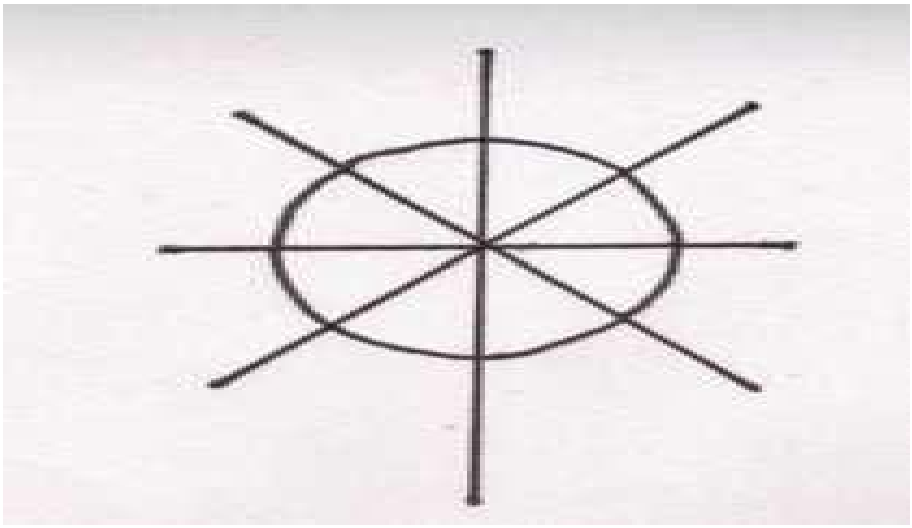

Fig 2. Radial Symmetry

In the animal kingdom, radially symmetrical phyla and porifera, Coelenterata, Ctenophora and Echinodermata. Out of these, only Coelenterata and ctenophore display a

fundamental radial symmetry. Both the phyla were groupe together by Haatschek (1888-

under the division Radita. Adult porifera are mostly asymmetrical larva. On the other hand, larval stage of Echinodermata has bilateral symmetry, but the adults become radilly or pentaradially symmetrical.

Biradial symmetry:

It is a variant from of radial symmetry found in Ctenophora and most Arthozoa (e.g.anemones), and is best fitted for a floating life.

There are only 2 planes of symmetry, one through the longitudinal and sagittal axis and the other through the longitudinal and transverse axis, which will divide the animal into equal halves (Fig.3)

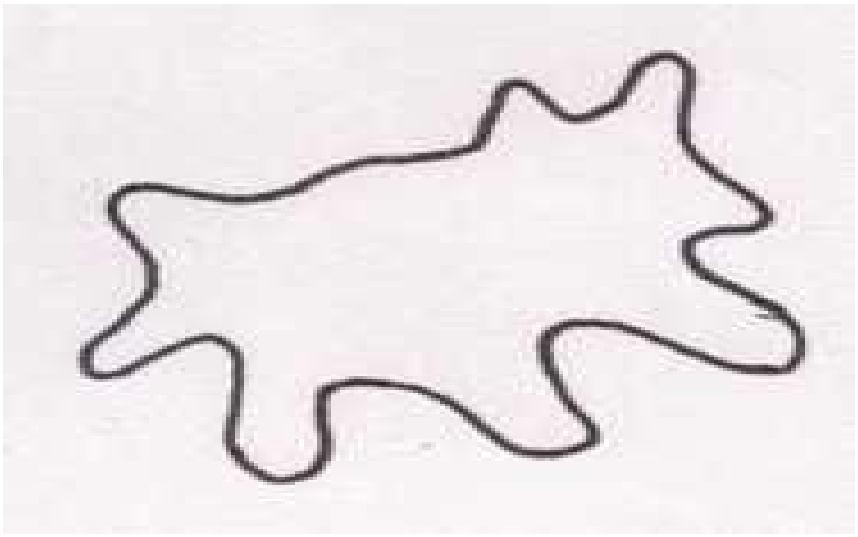

Fig 3. Asymmetry

Bilateral symmetry:

In higher animals, the longitudinal axis of body runs from the anterior end (head) to the posterior end (tail).

There is a single plane, the median longitudinal or sagittal plane, through which the body can be divided

into two similar rights and left halves. This is called bilateral symmetry.

Besides right and left sides, an upper or dorsal surface and a lower or ventral surface are also recognizable, which are unlike because they are exposed to different condition.

Bilateral symmetry is characteristic of the most successful and higher animals, including the remaining invertebrates and all vertebrates. In most of them, the anterior end is differentiated into a head (Fig.4).

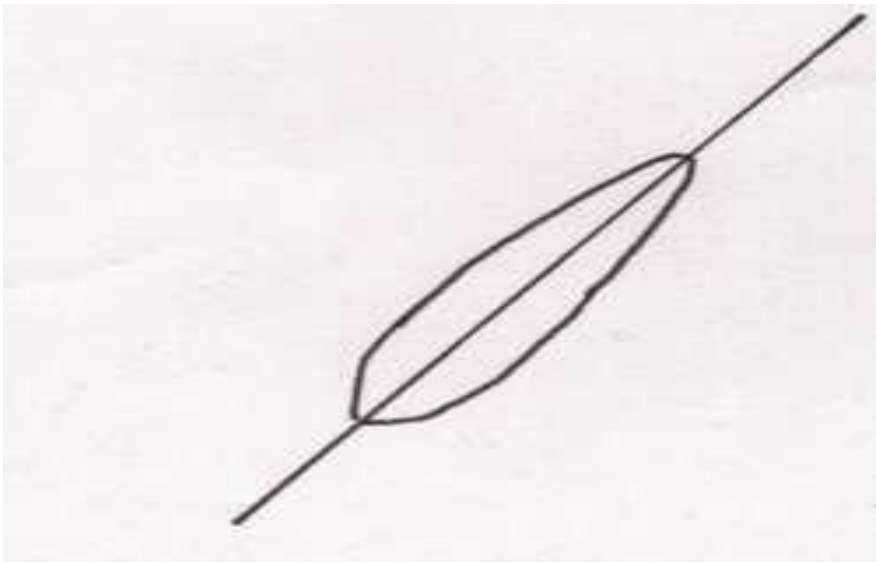

Fig 4. Bilateral Symmetry

First phylum of animal kingdom to exhibit bilateral symmetry is the phylum Platyhelminthes.

All bilateral symmetrical metazoans were grouped together by Hatschek (1988-91) under the division bilateria. As already mentioned earlier, some bilateria, such as echinoderms, display a radial symmetry which has been secondarily derived from bilateral ancestors due to assumption of an attached mode of life by adults.

Cephalization and Polarity; Bilateral symmetry is correlated with the locomoter movements brought about by these animal. One end of their body, usually containing the mouth, always moves forward in a particular direction.

It is the first to come in contact with the environment, so that there is great concentration of nervous tissue and sense organs at this anterior end called head. The posterior or rear end is usually equipped with some locomotory organ. This modification of anterior or oral end of the animal into a definite head is called cephalization which is characteristic of most bilateral animals.

Cephalization is always accompanies by a differentiation along an antero-posterior or oral aboral axis. This condition is known as polarity, and it usually involves gradients hitch refers to ascending or descending activates between anterior and posterior ends.