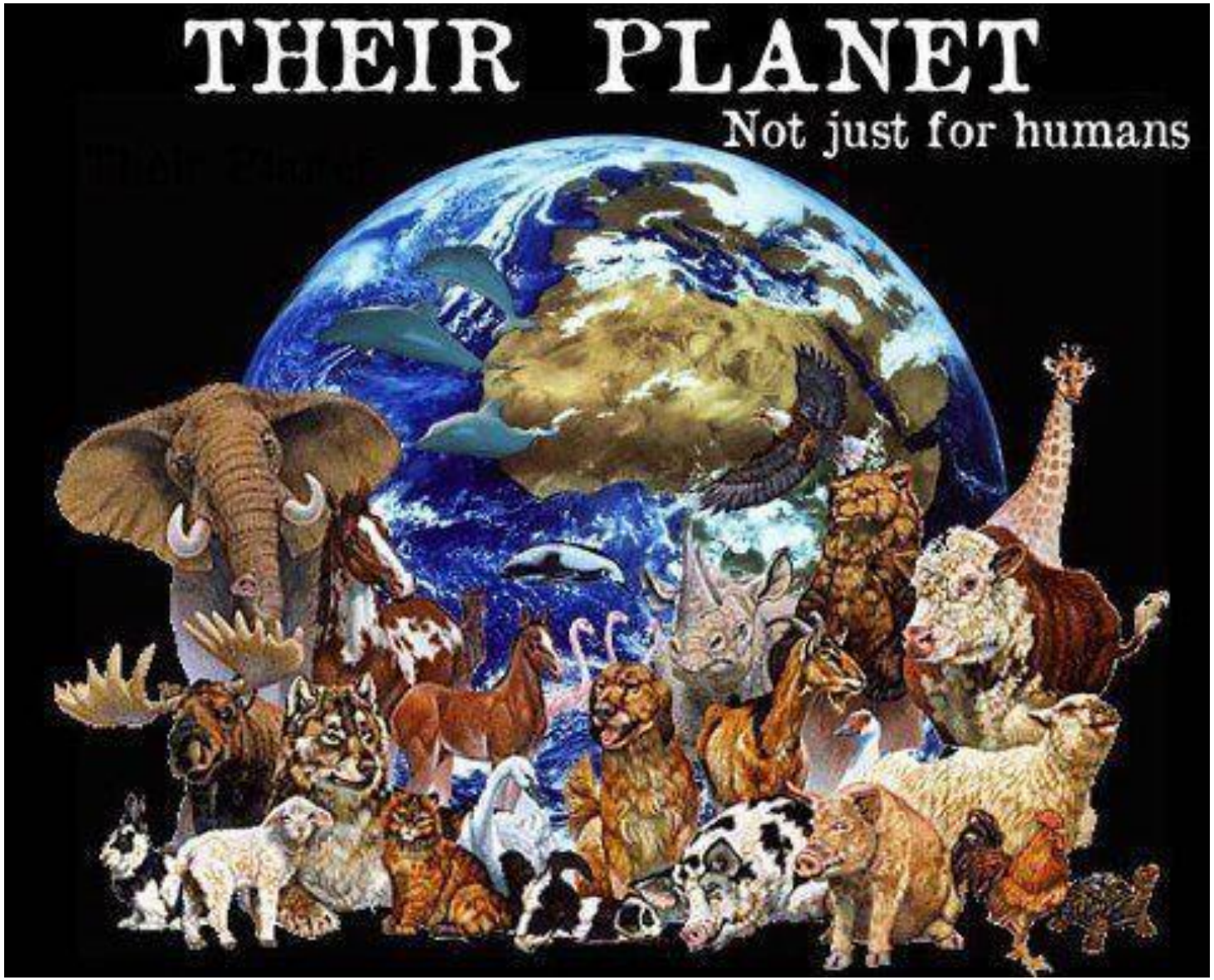
Animal diversity

DR SMITA RAI



Animal classification

The animal kingdom is divided into two groups:

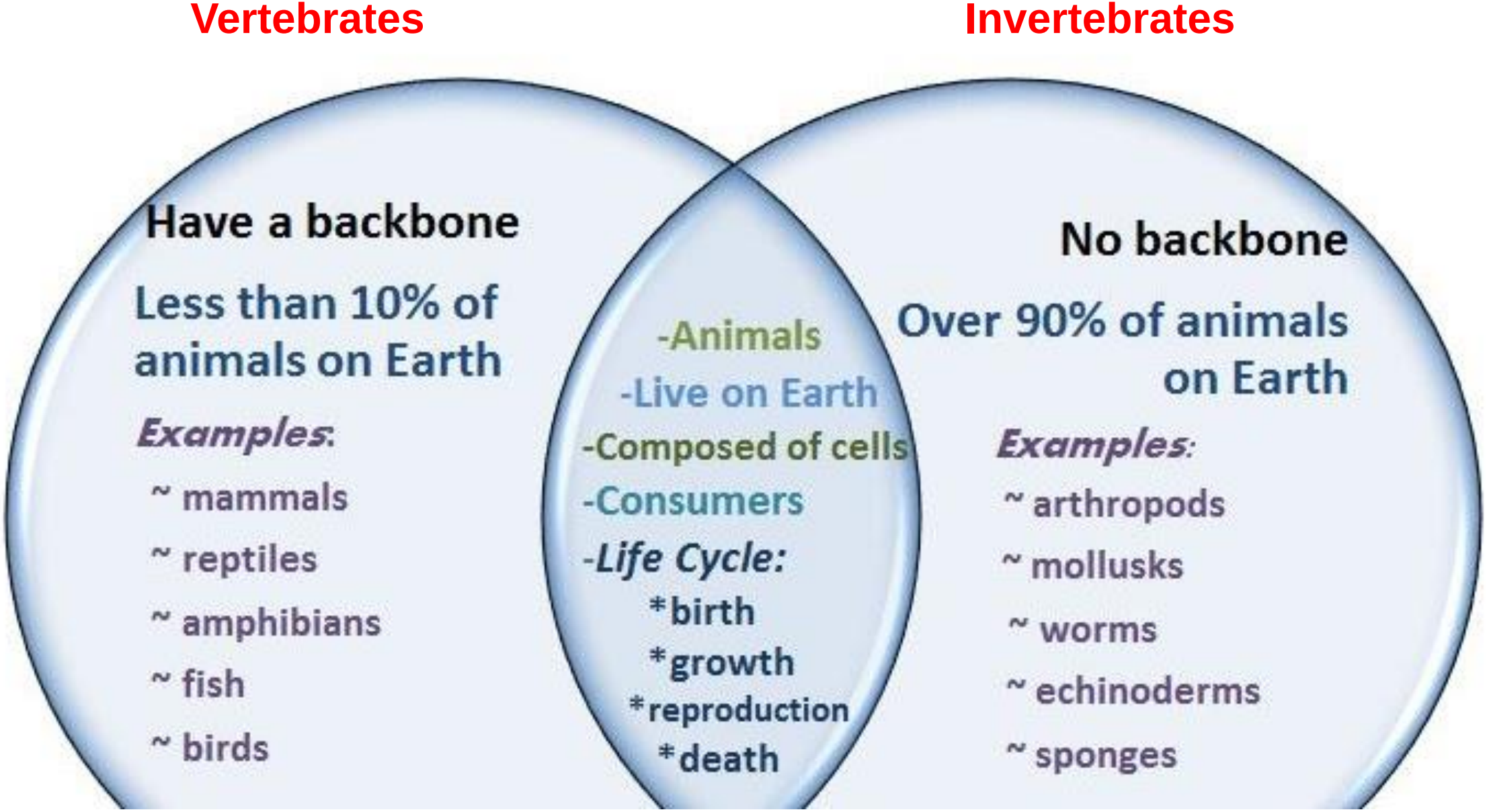
animals

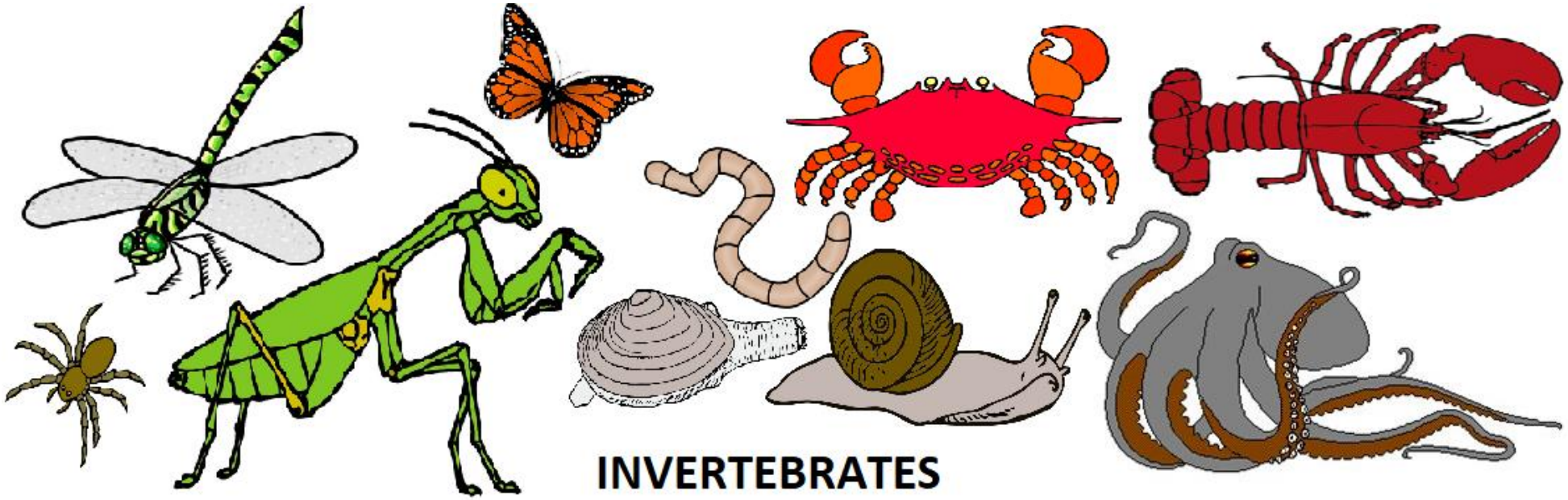
vertebrates

Vertebrates are animals that have a **backbone**. They have a firm body because of the muscles that connect to their skeleton.

invertebrates

Invertebrates are animals that do **not** have a backbone. They have soft inner bodies which are held in shape by a flexible covering of outer cells or by a hard covering called an exoskeleton.


Vertebrates
Invertebrates
Have a backbone
Less than 10% of animals on Earth
Examples:
~ mammals
~ reptiles
~ amphibians
~ fish
~ birds
-Animals
-Live on Earth
-Composed of cells
-Consumers
-Life Cycle:
*birth
*growth
*reproduction
*death
No backbone
Over 90% of animals on Earth
Examples:
~ arthropods
~ mollusks
~ worms
~ echinoderms
~ sponges



General characters of invertebrates:

1. **Habitat:** 80% terrestrial habitat, some fresh waters, others in sea
2. **Numerical strength:** 95% of all animals of the 1 million living species of animals
3. **Shape:** varied shapes like amoeba (irregular, ever changing), sponges are plant like, star fishes are star shaped

4.Size: great variation in size. Some are microscopic others are many meters long like the giant squid

5.Symmetry: All types of symmetries..bilateral or radial symmetry…or asymmetrical.

6.Grades of organisation: all grades of organisation

i. Protoplasmic grade = protozoa (plasmalemma)

ii. Cellular grade = cells exhibit division of labour eg sponges

iii. Cell tissue grade = eg coelentrates

iv. Tissue-organ grade = eg flatworms

v. Organ-system grade = higher invertebrates

7. **Presence or absence of germ layers:** germ layers absent in protozoa bcoz of unicellularity.

Diploblastic (sponges & coelenterates) or triploblastic

8. **Simple integument:** body covering is simple.

Protozoa (plasma membrane)

Pellicle

Some invertebrates possess outer protective epidermis or some have non cellular cuticle or chitinoid covering

9. **Multiple movement devices:** pseudopodia, flagella, cilia, contractile myonemes. Arthropods have jointed legs

10. **Presence or absence of segmentation**: segmentation or pseudosegmentation

In annelids or arthropods true segmentation is seen.

11. **Absence of living endoskeleton:** no rigid internal skeleton. Some have hard exoskeleton

12. **Types of coelom:** acoelomate (body is double layered sac with single cavity)

Pseudocoelom: a cavity is present b/w body wall and gut (mesoderm is not present).

True coelom: when coelom is lined by mesoderm it is true coelom.

13. **Dorsal gut:** alimentary canal is absent or partially formed or complete. If present, it lies dorsal to the nerve cord.

14. **Intra as well as extracellular digestion:**

15. **Open as well as closed circulatory system:** heart is dorsal to gut. Hepatic portal system is absent.

16**. Diversified respiratory system:** direct diffusion of gases from environment (protozoa, sponges).

Thru moist skin in annelids

Gills in higher invertebrates

17. Ventral solid nervous system:

18. Diversified excretory mechanism: direct diffusion thru cell memb.

Flatworms –flame cells, annelids ---nephridia, insects ---malphigian tubes

19. **Simple sense organs:** in protozoa ---whole protoplasm acts as receptors, in flagellates ---stigma or eyespots acts as photorceptors. Tactile or chemoreceptors in arthropods

20. **Varied modes of reproduction:** simple binary fission to the more complicated sexual reproduction.

parthenogenesis (unfertilized egg develops into the individual)

Hermaphrodites or bisexual forms are found. Fertilization is internal or external

Development is direct or indirect (thru larvae and metamorphosis)

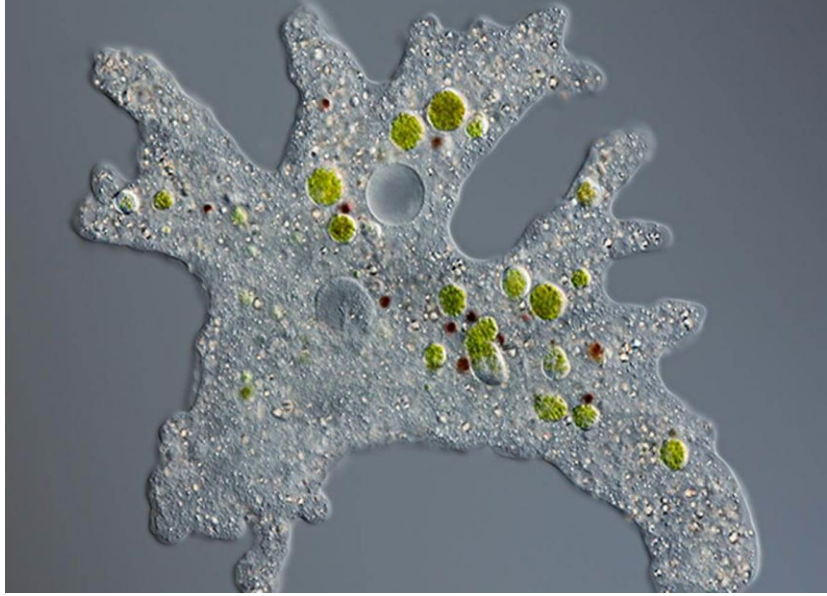
21. **Cold blooded animals**: body temp not constant at all the times.

Phylum Protozoa:

- Microscopic in size
- Found in freshwater, salt water and damp soil
- Some are parasitic, symbiotic and commensals
- Acellular or non-cellular (parts of bodies called organelles)
- Cytological differentiation..Protoplasmic level of organisation
- Protoplasm is differentiated into ectoplasm and endoplasm.
- Extreme diversity of structures and adaptations (spherical oval elongated and flattened)
- Solitary or colonial

- May have one or more nuclei: monomorphic or dimorphic
- Locomotory organs may be cilia, flagella, pseudopodia.
- Nutrition may be holozoic, holophytic, saprozoic , parasitic; digestion is intracellular(inside food vacuole)
- Respiration thru general body surface by diffusion.
- Excretion: thru general body surface
- Contractile vacuole performs osmoregulation
- Reproduction sexual or asexual
- Life cycle exhibits alternation of generation (sexual n asexual)
- Encystment in unfavourable conditions
- No physiological division of labour is there.

Subphylum: Sarcomastigophora (*Amoeba*)

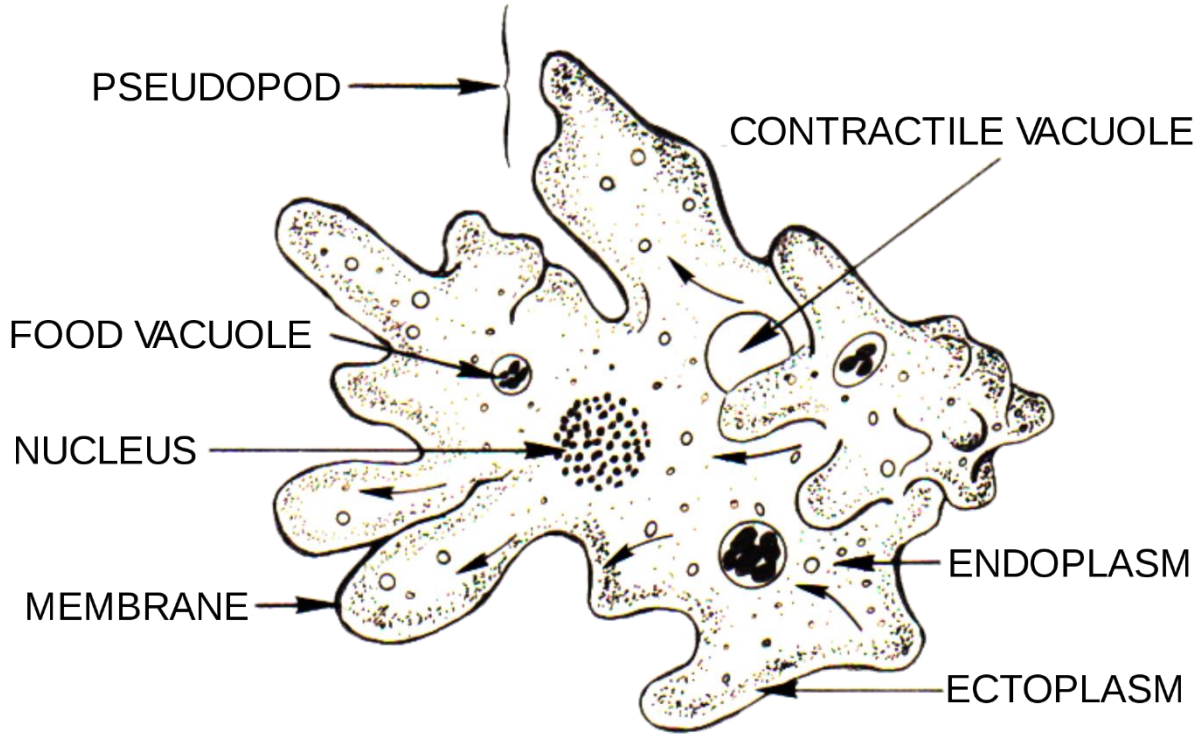


- Everchanging shape and simple structure.
- Body is a transparent asymmetrical speck of protoplasm having a nucleus but without permanent organelles.
- Habitat: bottom mud of freshwater pools, ponds, lakes & slow streams. Damp soil
- Structure: single celled, microscopic 0.25mm, transparent. Constantly changing shape and withdrawing finger like pseudopodia.

Thin outer memb called plasmalemma. Beneath it is the non granulated ectoplasm and granulated endoplasm.

Endoplasmic organelles:

1. Nucleus: covered by nuclear memb. It is massive and granular.
2. Contractile vacuole: clear round pulsating vacuole filled with fluid. Fills with fluid carries it to periphery and bursts it.
3. Food vacuole
4. Water globules: vacuoles filled with water



Locomotion: characteristic amoeboid movement by forming finger-like temporary process called pseudopodia. Also called lobopodia bcoz they are blunt.
Nutrition: solid organic particles are ingested, hence called zootrophic or holozoic. Food consists of bacteria, algal cells, filaments. No mouth but food is taken in from the anterior surface. Ingestion, digestion, assimilation, dissimilation and egestion.

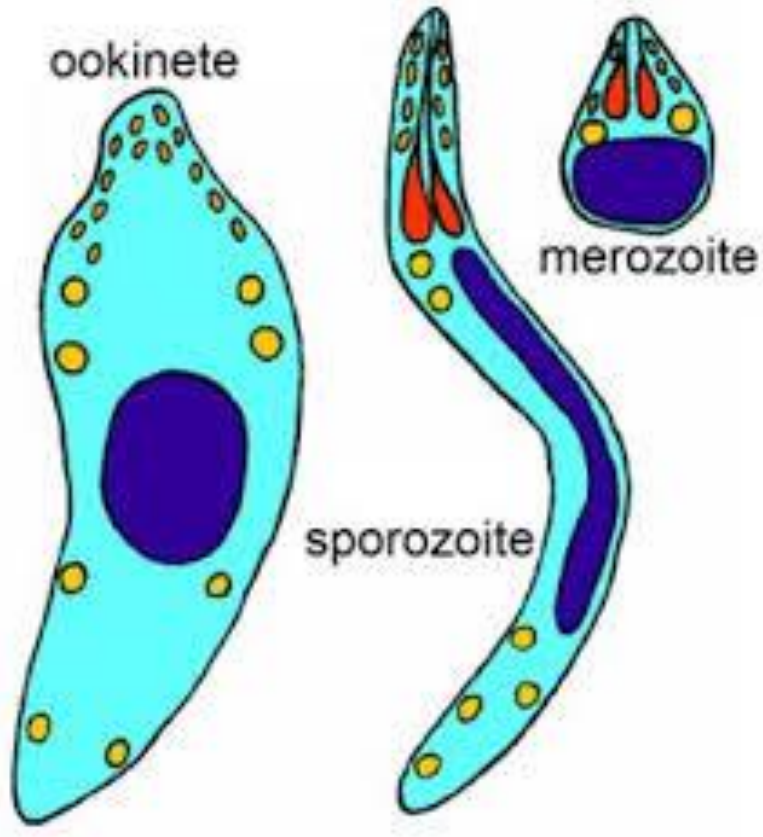
Respiration occurs by diffusion thru plasmalemma (Aerobic)
Excretion: diffusion or by contractile vacuole
Osmoregulation: by contractile vacuole
Response to stimuli: negative to touch positive to food (no special sense organs)
Reproduction: by binary fission (during favourable conditions), multiple fission (during unfavourable conditions of food and temp)or sporulation (unfavourable conditions)

Immortality of amoeba

Subphyllum Sporozoa

- The adults have no external organelles for locomotion
- They are all parasitic and incapable of active life outside host
- Cilia or flagella may be present in gametes
- Syngamy takes place after which many spores are formed
- The spores are simple and contain one or many sporozoites
- Sprorozoites are the infective stage.
- Nucleus is of a single type.

Eg *Plasmodium*



Subphyllum Cnidospora

- All are parasitic
- Spores have several cells having one or more polar filaments which are coiled threads and can be shot out
- One or more sarcoplasms or sporoplasms (analogous to sporozoites)
- Zygotes give rise to one or more trophozoites without sporogamy

Eg *Myxobolus*

Subphyllum Ciliophora

- All possess simple ciliary organelles for locomotion
- They have two nuclei, a trophic macronucleus and a reproductive micronucleus.
- Binary fission is perkinetal
- Conjugation takes place with fusion of nuclei, autogamy and syngamy also occur
- There are never any free gametes
- Nutrition is mixotrophic or heterotrophic
- They usually have a cytostome

Eg Paramecium

Paramecium:

Freshwater…
Morphology:

- Microscopic , visible to naked eye as minute elongated body
- Appears light grey or white. b/w 170 to 290 microns in length. Cylindrical with distinctly different ends.
- Anterior end is blunt ; posterior end is pointed.
- *P. claudatum* looks like the sole of a slipper or shoe; hence is known as slipper animalcule.
- Body is asymmetrical.

Nutrition: Holozoic. Food is bacteria & minute protozoa.
Hunts for activity

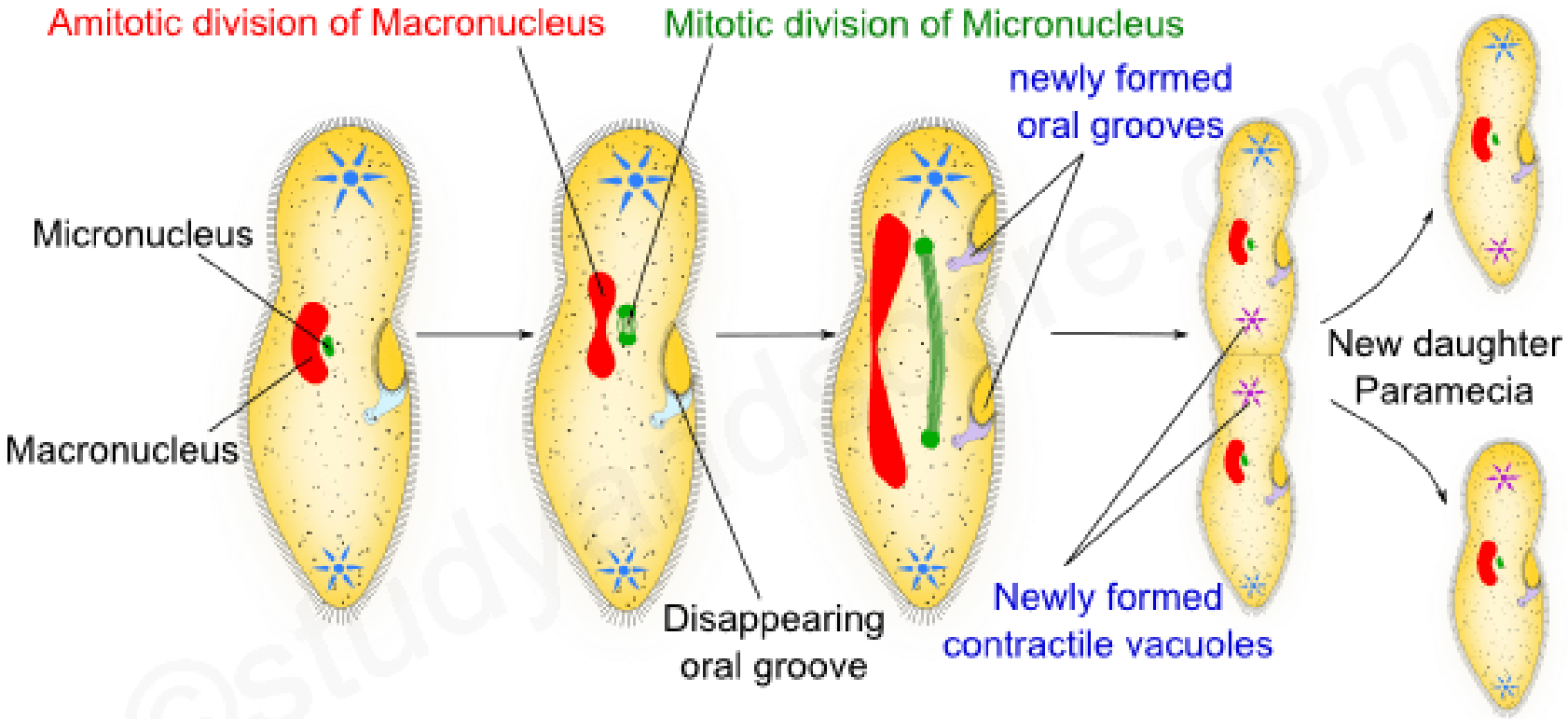
Reproduction

Transverse binary fission -- asexual

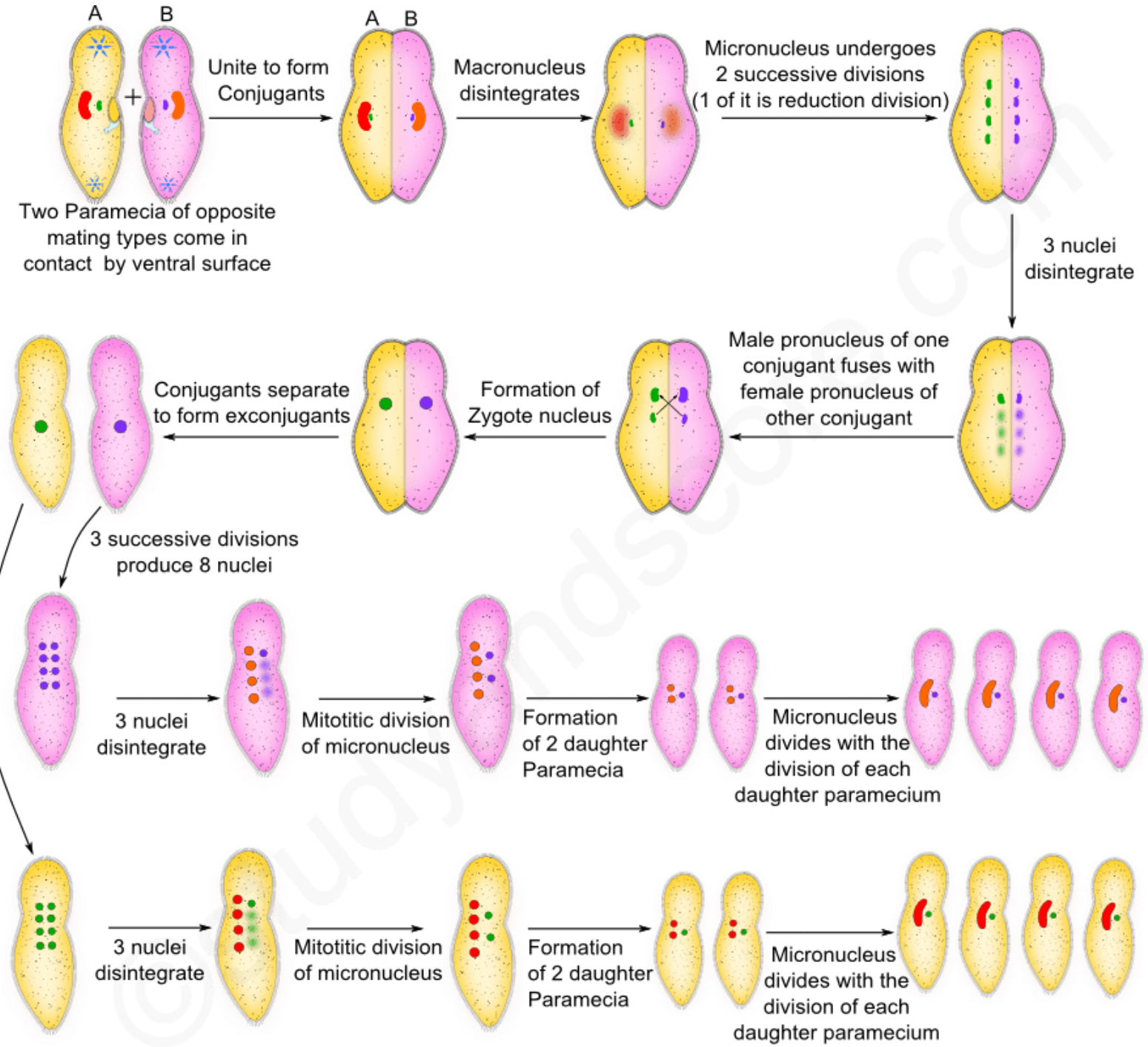
Conjugation -- sexual

Two nuclei

- Macronucleus for vegetative functions
- Micronucleus for reproduction



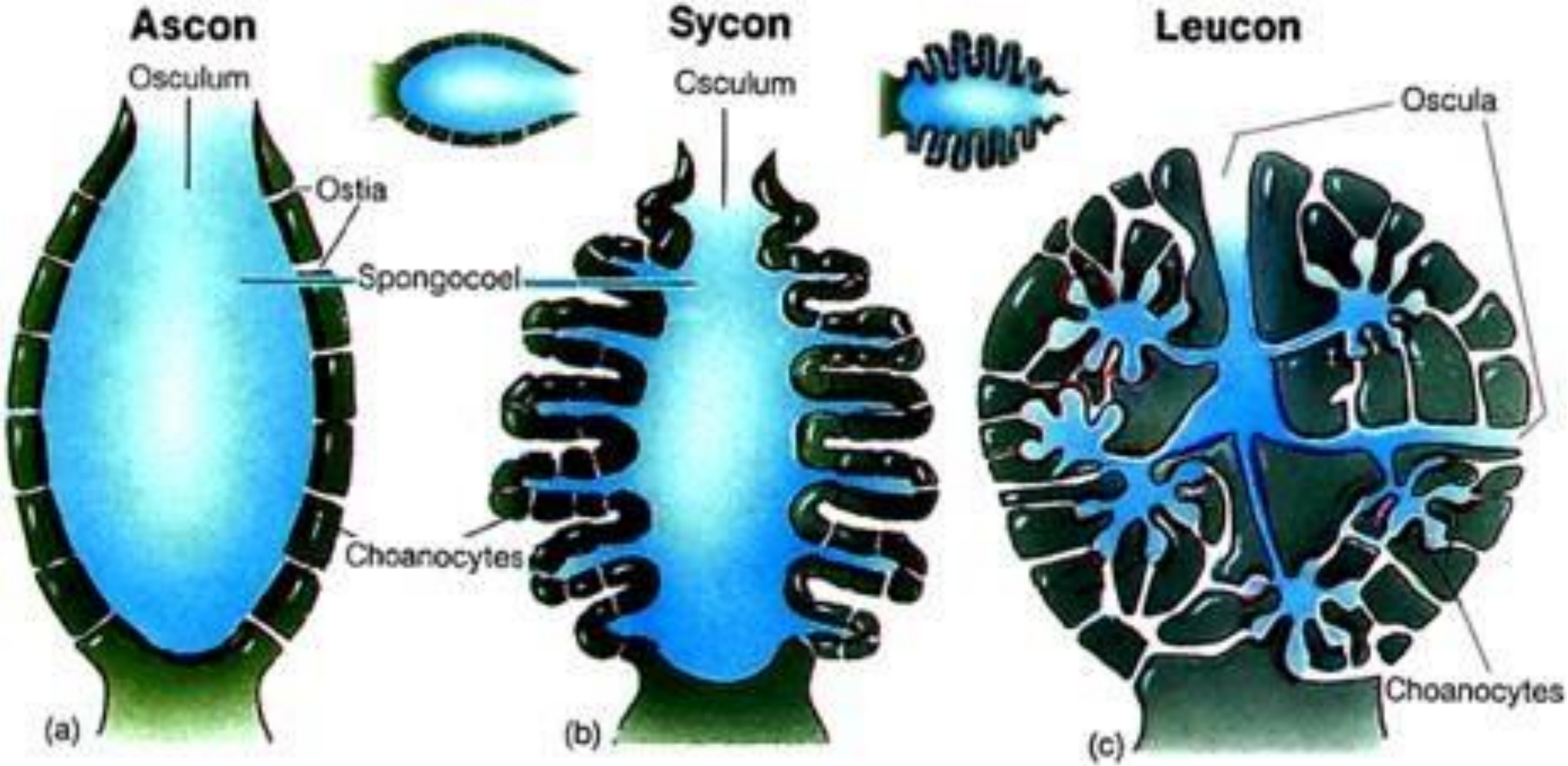
Conjugation



Phyllum porifera:

- All aquatic, mostly marine
- Sessile and sedentary & grow like plants.
- Body shape is vase or cylinder like, assymetrical or radial symmetry
- Body surface is perforated; ostia (water enters); oscula (water exits)
- Multicellular body,, outer ectoderm, inner endoderm, intermediate mesenchyme ; hence diploblastic. (Cellular grade of organisation)
- Interior space of body is hollow or permeated by canals lined by choanocytes, the interior space of sponge body is called spongocoel.

- Characteristic skeleton consists of either fine flexible spongin fibres, siliceous spicules or calcareous spicules .
- Mouth absent, digestion intracellular, excretory & respiratory organs are absent.
- Nervous n sensory cells are not differentiated
- Sponges are monoecious, both sexual n asexual methods present.
- Asexual reproduction occurs by buds and gemmules.
- Posses high power of regeneration
- Sexual reproduction by ova and sperm. Fertilization is internal (cross fertilization)
- Cleavage holoblastic; development indirect thru a free swimming ciliated larva called amphiblastula or parenchymula.
- Organisation of sponges is grouped in three main types: ascon type, sycon type and leuconoid type (based on simplicity / complexity).


Ascon
Osculum
Ostia
Spongocoel
Choanocytes
(a)
Sycon
Csculum
(b)
Leucon
Oscula
Choanocytes
(c)

Class 1 Calcarea or Calcispongiae (calx = line)

- Skeleton of calcareous spicules
- Solid or colonial; body shape vase like or cylindrical
- Asconoid, syconoid or leuconoid structure.
- Dull coloured sponges ….less than 15 cm in size
- They occur in shallow waters in all oceans
- Eg *Leucosolenia*

Order : Homocoela

Asconoid sponge.

Class 2 : Hexactinellida or Hyalospongiae (Hyalos = glassy)

- They are called glass sponges; skeleton is of siliceous spicules
- There is no epidermal epithelium.
- Choanocytes line finger shaped chambers.
- They are cylindrical or funnel shaped n found in deep tropical seas
- They grow upto 1 m
- Eg *Euplectella*

Class III: Demospongiae (dermos : frame , spongia : sponge)

- It contains the largest no. of sponge species. Large sized, solitary or colonial.
- Skeleton may be spongin fibres or spongin fibres with siliceous spicules or there may be no skeleton.
- Body shape is irregular. Leucon type
- generally marine ..few are freshwater
- eg *Euspongia* (bath sponge)

Reproduction in sponges: pg320-322

Asexual reproduction:
- Regeneration
- Formation of reduction bodies
- budding
  - Exogenous budding (external buds form vegetatively)
  - endogenous budding (gemmules)

Under unfavourable conditions reduction bodies are formed.

Sexual reproduction : no sex organs. Amoebocytes form sex cells in mesenchyma. Eggs and sperms are produced. Sponges are protogynous: in which cross fertilization takes place. The sperm enters thru choanocytes n fuses egg of diff sponge, a covering is formed on zygote called brood capsule. Holoblastic n unequal cleavage. The embryo attaches itself to solid object n develops into a sponge.

Phylum coelenterata:

- They are metazoan or multicellular organisms with tissue grade of organization
- They are aquatic, mostly marine
- Sedentary or free swimming; solitary or colonial.
- Individuals are radially symmetrical with central gatrovascular cavity; mouth present
- diploblastic : ectoderm endoderm n in between is mesoglea (non cellular n gelatinous)
- Acoelomate
- tentacles around mouth
- tentacles have nematocysts…. Used for food capture n injection
- polymorphism (polyps amd medusa)
- Polyp is sessile n asexual: medusa is free swimming n sexual

- Skeleton is exoskeleton or endoskeleton
- Carnivorous ; digestion is extracellular as well as intracellular
- Nervous system consists of one or more networks or nerve cells and neurites located in the ectoderm and endoderm.
- Reproduction by sexual n asexual methods
- asexual reproduction by budding n sexual reproduction by formation of gametes
- A ciliated planula larva is present in life history
- The life history exhibits phenomenon of alternation of generation or metagenesis in which asexual polyploid sessile generation alternates with sexual medusoid, free swimming generations

Class Hydrozoa:

- Solitary and freshwater or mostly colonial and marine; sessile and free swimming forms
- They exhibit radial symmetry
- Body wall consists of outer ectoderm n inner endoderm separated by non cellular mesoglea
- Gastrovascular cavity without stomodaeum, septa or nematocyst bearing gastric filaments
- skeleton is horny perisarc while coenosarc secretes a skeleton of calcium carbonate forming coral.
- They exhibit polymorphism: polyp and medusa.

- Sex cells are ectodermal in origin and discharged externally.
- Cleavage is holoblastic,
- eg Hydra

Class scyphozoa (skyphos cup)

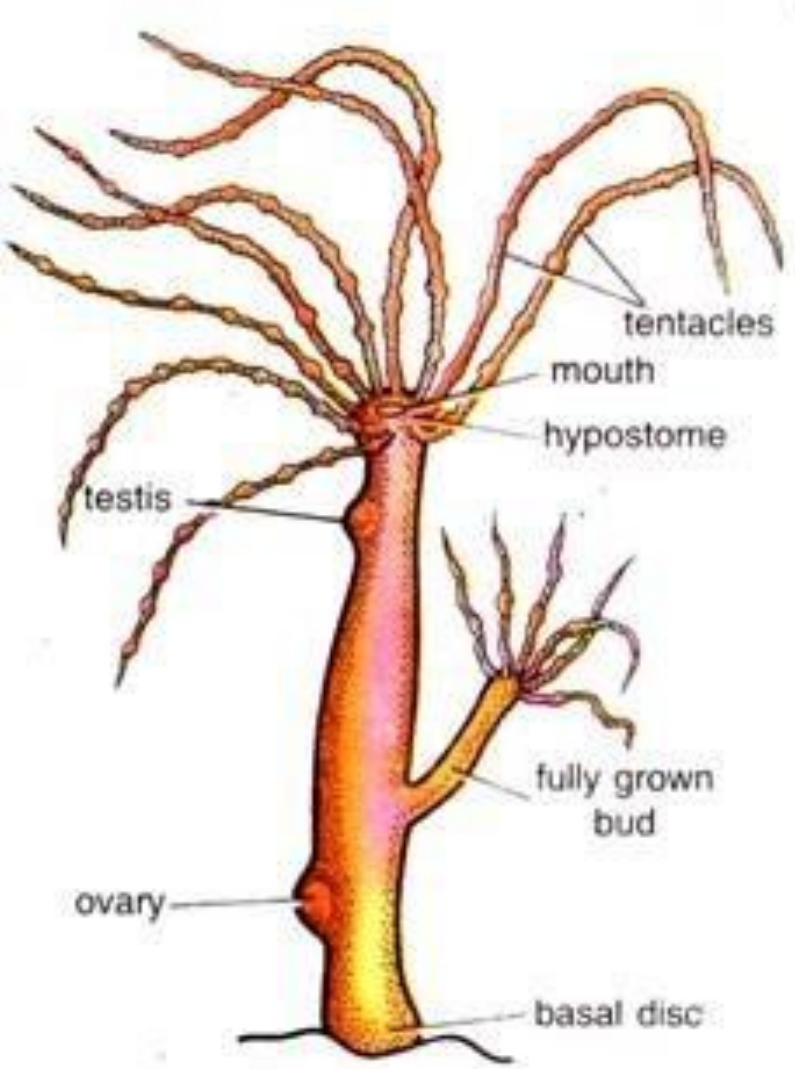
- Large jelly fishes or true medusa are exclusively marine.
- medusa are large, bell, or umbrella –shaped; free swimming
- marginal sense organs are tentaculocysts having endodermal statoliths.
- Polyploid generation absent or represented by small polyp, the scyphistoma which gives rise to medusa by transverse fission
- Gastrovascular system without stomodaeum
- Gonads are endodermal and sex cells are discharged
- Eg Aurelia

Class Anthozoa

- Solitary or colonial ; exclusively marine.
- Exclusively polyploidy
- Medusoid stage absent
- Body cylindrical
- Tentacles surrounding mouth
- Gastrovascular cavity is divide into compartments by complete or incomplete septa
- Skeleton either internal or external
- Nervous system in form of nerve net
- Gonads are endodermal n sexual endproducts are discharged into coelenteron
- Fertilization is external.. Eg Fungia

Hydra: polyploid coelenterate with cylindrical body.

- Visible by naked eye . 2 to 20 mm in length.
- Carnivorous; Food is small crustaceans and insect larva
- Reproduction : sexual n asexual
- Asexual reproduction : Budding
- Sexual : starts with development of temporary structures called gonads.
- During unfavourable conditions
- Hydra are dioceious ; some are monoecious
- Cross fertilization.



Phylum Platyhelminthes

- Bilaterally symmetrical, triploblastic worms
- Flatworms are microscopic to extremely elongated (upto 10-15 mt)
- White or colorless; free living forms may be brown, grey, black or colored
- Anterior end differentiated called head
- Organs of attachment or adhesion (hooks or suckers)
- Acoelomate
- Digestive system absent in acoela. Some may have mouth, pharynx and small intestine.
- Respiratory n circulatory systems absent.
- Excretory system consists of single or paired protonephridia.

- Primitive nervous system.
- Hermaphrodites. Reproductive system is highly evolved and complex
- Cross fertilization in trematodes ; self fertilization in cestodes. Fertilization is internal
- Life cycle involves one or more hosts
- Parthenogenesis and polyembryony is seen in trematodes
- Free living, ecto or endo commensals or parasites.

- fybiotech18@gmail.com

Class 1. Turbellaria

- Mostly free living flatworms, some may be commensals or parasitic
- Body unsegmented; covered with cellular or synctial epidermis
- Adhesive organs present
- Digestive system …mouth, pharynx and intestine, anus absent
- Excretory system ; protonephridia or flame cells
- Sense organs consist of tangoreceptors and chemoreceptors.
- Hermaphrodite.
- Reproduction sexual, asexual and by regeneration
- Eg *Planaria*

Class II : Trematoda

- Parasites; called flukes
- Body shape leaf like
- Body wall without epidermis or cilia
- Body undivided n covered with cuticle.
- Well developed suckers
- Digestive tract incomplete consisting of mouth, pharynx, branched intestine, anus absent.
- Protonephridial excretory system consisting of flame cells
- Hermaphrodites
- Ovary single; testis many eg *Liverfluke*

Class Cestoda

- Endoparasites in the intestine of vertebrates.
- Commonly called tapeworms
- Body without epidermis or cilia but covered with cuticle
- Body divided into few or many segments(proglottids)
- Anterior end is scolex; is provided with adhesive structure(hooks or suckers)
- Mouth n digestive tract totally absent
- Excretory system : protonephridia with typical terminal **flame bulbs**
- Nervous system is pair of ganglia and two lateral longitudinal nerve cords.
- Each segment (proglottid) contains one or two sets of complete hermaphrodite reproductive system.
- Life cycle complicated usually involving one or more hosts. Eg: Tapeworm

Phylum Aschelhelminthes:

- Bilateral symmetry; unsegmented worms
- Triploblastic, psuedocoelomate; organ system grade of organization
- Body cylindrical or flattened
- Cuticle present
- Alimentary canal straight and complete
- Respiratory n circulatory system absent
- Sexes separate i.e., dioecious
- Asexual reproduction does nor occur.
- Aquatic as well as terrestrial ; many are parasitic

Class: Nematoda

- Aquatic or terrestrial; free living or parasitic, elongated roundworms
- No circulatory or respiratory system
- Digestive system complete with muscular pharynx and glands
- Dioecious ; male smaller than female
- Fertilization internal

Eg *Ascaris*

Phylum Mollusca

- Sluggish, creeping slowly, over hard surfaces in shallow water
- Flattened bady, bilateral symmetry
- No segmentation; anterior mouth, posterior anus
- Head with tentacles and eyes
- Visceral mass covered in mantle or pallium
- Respiration was performed by gills
- Microphagus and herbivore
- Heart is three chambered
- Body cavity is haemocoel
- Nephridia or kidney for excretion
- Sexes separate; fertilization external.

Class Aplacophora

- Body worm like, bilateral symmetry
- Head, mantle, foot, shell, nephridia are absent.
- Body covered with cuticle.
- Mouth and anus at opposite ends.
- Sexes united ; hermaphrodite or separate , dioecious
- Eg *Chaetoderma*

Class Polyplacophora

- Mostly bilateral symmetry, dorsoventrally flattened mollusc,
- Head without eyes and tentacles
- Shell composed of eight calcareous pieces
- Intestine coiled with a terminal anus
- Sexes are separate dioecious.
- Eg *Chiton*

Class Monoplacophora:

- Body bilaterally symmetrical and segmented
- Shell is single piece
- Head without eyes and tentacles
- Foot flat and ventral
- Mantle encircles body as a circular fold of body wall
- Gills external
- Five pairs of nephridia
- Sexes separate (dioecious)

Eg *Neopilina*

Class Gastropoda

- Marine, fresh water, terrestrial; few parasites on echinoderms.
- Body unsegmented; asymmetrical
- Head distinct bearing tentacles, eyes and mouth.
- Mantle is collar like fold of body wall
- Buccal cavity contains odontophores
- Digestive system contains a muscular pharynx, long oesophagus, stomach, long coiled intestine
- Respiration by gills
- Circulatory system is open; heart is enclosed in pericardium.
- Excretory organs are metanephridia
- Nervous system comprise of various ganglia; cerebral, pleural, buccal, pedal,

- Dioecious eg *Pila*

Class Scaphopoda

- Exclusively marine. Bilateral symmetry
- Eyes, tentacles and gills absent,
- Mantle encloses the body
- Mouth surrounded by lobular process.
- Heart rudimentary
- Sexes separate., dioecious
- Eg. *Dentalium*

Class Pelecypoda

- Aquatic, mostly marine,
- Bilateral symmetry
- Head is not distinct, tentacles absent
- Mantle is bilobed,
- Paired gills
- Coelom is reduced to pericardium
- Alimentary canal is coiled with large paired digestive glands
- Heart inside pericardium
- Excretory organs are paired nephridia
- Nervous system : four pairs of ganglia

- Sense organs are present: statocysts
- Sexes are separate or united
- Development is accompanied by metamorphosis
- Eg: *Mytilus*

Class Cephalopoda

- Exclusively marine
- Bilateral symmetry
- Head bears large eyes and mouth
- Trunk consists of symmetrical and uncoiled visceral mass.
- Suckers and tentacles present

- Mouth bears jaws.
- Gills present
- Circulatory system closed, heart with two or four auricles
- Excretory system two or four pairs of nephridia
- Nervous system is highly developed
- Eg *Sepia*

Phylum Annelida

- Mostly aquatic, free living, commensals or parasites
- Triploblastic, bilateral symmetry
- Body segmented by groves n septa. Each segment is called metamere

- Organ system grade of body organization
- Outer covering of body is cuticle
- Unjointed appendages
- Locomotry organs segmentally arranged, setae or chaetae.
- Alimentary canal is tube like from mouth to anus
- Respiration thru body surface or gills
- Circulatory system is closed; blood is red due to presence of haemoglobin, or erythrocruorin dissolved in plasma
- Nervous system : a pair of cerebral ganglia and brain
- Receptor organs like photoreceptors, eyes, taste buds
- Usually monoecious

Class Polychaeta

- Marine and carnivorous
- Body elongated n segmented
- Head bears eyes n tentacles
- Ceolom divided by septa
- Setae are numerous known as parapodia
- Excretory organs are segmented paired nephidia
- Sexes separate
- Eg: *Nereis*

Class Oligochaeta

- Terrestrial or fresh water
- Body with external or internal segmentation
- Distinct head eyes or tentacles are absent
- Parapodia are absent
- Setae are arranged segmentally
- Pharynx without jaws
- Hermaphrodites
- Eg Earthworm

Class Hirudinea

- Mostly ectoparasitic,
- Body elongated, has definite number of segments; each segment breaks into 2 to 4 rings or annuli
- Parapodia or setae absent
- Anterior and posterior sucker on body
- Hernaphrodite
- Eggs laid in cocoons
- Development direct
- Eg Leech

Phylum Arthropoda

- Triploblastic, bilateral symmetry, metamerically segmented
- Cuticle exoskeleton present
- Body segments bears paired appendages
- Striped muscles are present.
- Body cavity is haemocoel
- Digestive tract complete with mouth and anus
- Circulatory system is open with heart and arteries
- Respiration: gills, trachea or book lungs
- True nephridia absent
- Sexes separate and sexual dimorphism is exhibited

- Fertilization internal, development indirect thru larva

Class Crustacea

- Mostly aquatic
- Head n thorax fused to form cephalothorax, has compound eyes, five pairs of appendages
- Respiration thru gills or general body surface
- Coelom greatly reduced (haemocoel)
- Circulatory system has a heart
- Excretory system : maxillary glands or antennary or green glands
- Sexes separate, development thru metamorphosis
- Eg Crab

Class Insecta

- Air breathing ; terrestrial
- Body: head thorax and abdomen
- Head consists of six fused segments, bears compound eyes, mouthparts for chewing, biting, piercing, sucking n sponging type
- Thorax : three segments each bearing pair of legs, 2 pair of wings on 2^{nd} n 3^{rd} segment
- Abdomen : 7- 11 segments
- Liver absent , salivary glands are present
- Eight chambered heart
- Respiration by trachea
- Excretion by malphigian tubes, sexes separate Eg Beetle

Class Myriapoda:

- Simple eyes
- Mandibles inside the mouth
- Respiration thru trachea
- Long tubular heart
- Excretion thru malphigian tubes
- Nervous system has ganglia in each segment
- Sexes separate
- Eg Centipede.

Class Arachnida

- Carnivorous
- Have eight legs.
- Appendages help in feeding, defence and sensory perception
- Do not have wings
- Body divided into cephalothorax and abdomen
- Respiration thru trachea or book lungs
- Dioecious
- Eg Spider

Phylum Echinodermata

- Exclusively marine
- Radial symmetry, triploblastic
- Body round, cylindrical or star like
- Presence of water vascular or ambulacral system is the most characteristic feature.
- Alimentary canal is coiled tube
- Respiration thru papulae, gills, or cloacal trees
- Nervous system is primitive
- Sensory system poorly developed
- Dioecious

Class Chrinoidia

- Extinct as well as living forms
- Body consists of calyx and tegmen
- Arms simple branched 5 to 10 in number.
- Sexes separate larva dioliolaria
- Commonly called sea lilies or feather stars
- Eg Feather star

Class Holothuroidia

- Bilateral symmetry,
- Mouth surrounded by tentacles attached to water vascular system
- Podia or tube feet for locomotion
- Alimentary canal is long and coiled.

- Sexes separate
- Commonly called sea cucumbers
- Eg Sea cucumber

Class Echinoidea

- Body spherical or disc like, oval or heart shaped
- Body is enclosed in an endoskeleton shell
- Podia or tube feet for locomotion
- Sexes separate
- Development thru a free swimming echinopluteus larva
- Commonly called sea urchins and sand dollars

Eg Sea urchin

Class Asteroidea

- Body is flattened or star shaped
- Oral and aboral surfaces are distinct
- Five to fifty short rays or arms radiating from central disc
- Endoskeleton is flexible made of ossicles
- Respiration by papulae
- Sexes separate
- Development includes bipinnaria or brachiolaria larva
- Commonly called star fishes or sea stars
- Eg Star fish

Class Ophiuroidea

- Body is flattened with pentamerous or rounded central disc
- Oral and aboral surfaces are distinct
- Arms usually five; long slender, smooth or spiny
- Anus and intestine are absent
- Sexes are separate. Development thru free swimming pluteus larva
- Eg Brittle star