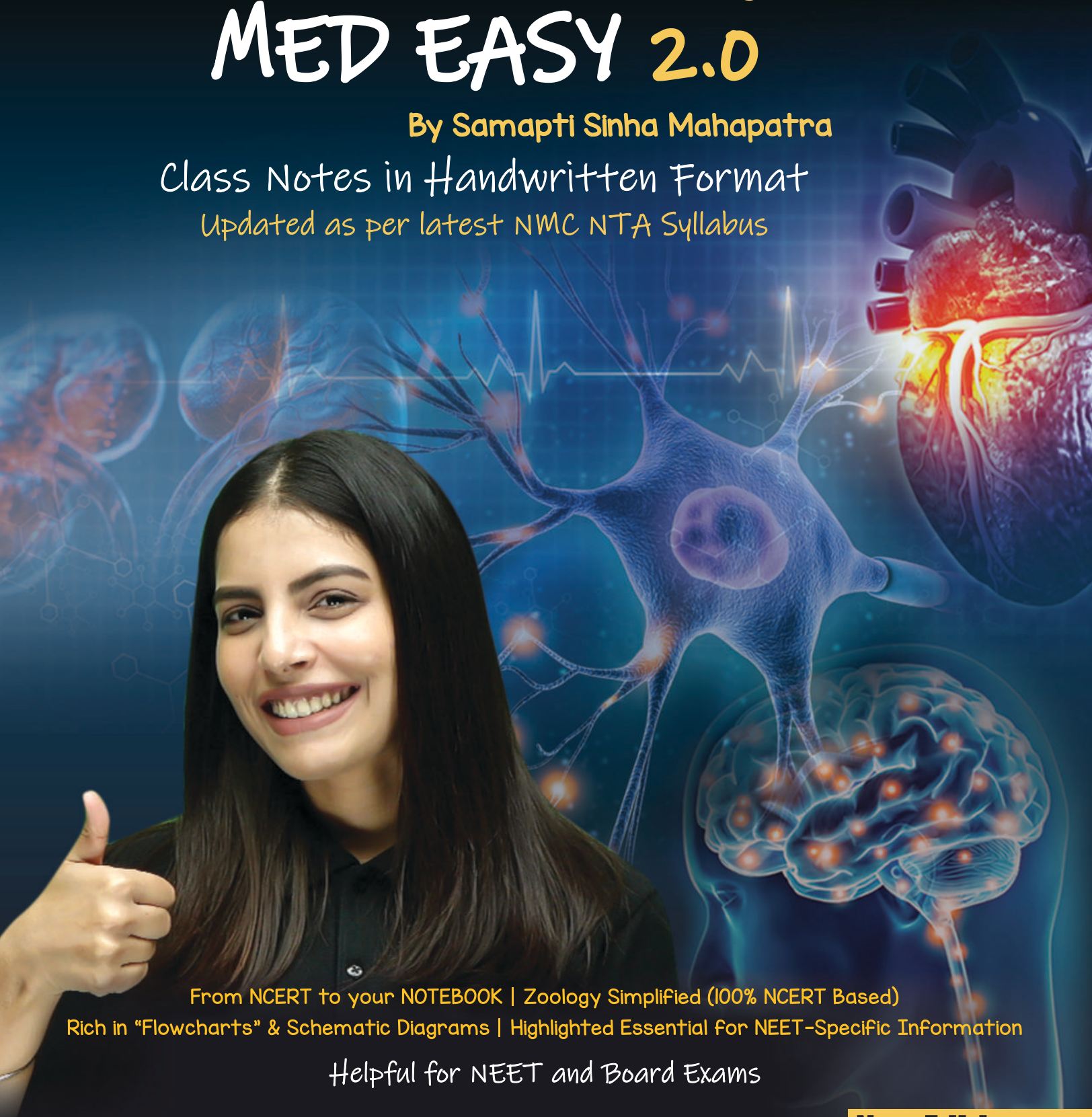
ZOOLOGY

MED EASY 2.0

By Samapti Sinha Mahapatra

Class Notes in Handwritten Format

Updated as per latest NMC NTA Syllabus



From NCERT to your NOTEBOOK | Zoology Simplified (100% NCERT Based)

Rich in "Flowcharts" & Schematic Diagrams | Highlighted Essential for NEET-Specific Information

Helpful for NEET and Board Exams

New Edition

Contents

Unit Overview

Diversity in the Living World

Biology: Study of life forms and living processes.

Living world shows huge diversity of organisms.

Early man:

- ♦ Knew difference between living and non-living.
- ♦ Worshipped elements like wind, fire, sea.
- ♦ All objects (living or non-living) created awe or fear.
- ❍ Study of living organisms began later in history.
- ❍ Societies with human-centered (anthropocentric) view made limited progress in biology.
- ❍ Detailed study led to identification, nomenclature, and classification systems.
- ❍ Helped recognize similarities among organisms:
- ♦ Horizontally (same time period)
- ♦ Vertically (through evolution)
- ❍ **Realization:** All organisms are related, past and present.
- ❍ Led to cultural movements for biodiversity conservation.
- ❍ **This unit:** Covers classification of plants and animals from a taxonomist's view.

Ernst Mayr – Key Facts

- ❍ **Born:** 5 July 1904, Kempten, Germany
- ❍ **Died:** 2004, at age 100
- ❍ Known as: "The Darwin of the 20th century"
- ❍ **Profession:** Evolutionary biologist, Harvard University
- ❍ Joined Harvard: 1953, Retired: 1975
- ❍ **Title:** Alexander Agassiz Professor of Zoology Emeritus

Fields of work:

- → Ornithology
- → Taxonomy
- → Zoogeography
- → Evolution
- → Systematics
- → Philosophy & history of biology

Major Contribution:

- ❍ Focused on species diversity in evolution
- ❍ Defined the biological species concept

Awards (Triple Crown of Biology):

- ❍ Balzan Prize (1983)
- ❍ International Prize for Biology (1994)
- ❍ Crafoord Prize (1999)

Structural Organisation in Plants and Animals

- ❍ Description of Life Forms
- ❍ Early study of life was by observation with naked eye, lenses, and microscopes.
- ❍ Focused on visible structures (external and internal).
- ❍ Recorded living phenomena that could be seen or felt.
- ❍ Before experimental biology or more specifically, physiology, biology was mostly natural history (descriptive).
- ❍ Although detailed descriptions may seem boring, they helped later in experimental biology.
- ❍ These descriptions guided research in physiology and evolutionary biology.
- ❍ Upcoming chapters will explain the structure of plants and animals and their link to functions and behaviors.
- ❍ Plant and animal descriptions are given separately for clarity.

1 Animal Kingdom

ANIMAL KINGDOM: (KINGDOM ANIMALIA /METAZOANS)

- Multicellular
- Heterotrophs: Dependent on others for food
- Holozoic mode of Nutrition
  - First ingestion, then Digestion

Metazoans/Kingdom Animalia

- Subkingdom Parazoa
  - Primitive Metazoans (old)
    - Phylum Porifera
- Subkingdom Eumetazoa (Advanced)
  - Coelenterata/Cnidaria
  - Ctenophora
  - Platyhelminthes
  - Aschelminthes/Nemathelminthes/Nematoda
  - Annelida
  - Arthropoda
  - Mollusca
  - Echinodermata
  - Hemichordata
  - Chordata

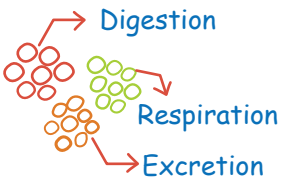
PHYLA — Advanced

Basis of Classification

In spite of differences in structure & form of different animals, there are fundamental features common to them that are used as the basis of animal classification.

1. Level of organisation (LOO)

- Cellular: Only cells are present. eg: Porifera
- Tissue: Group of similar cells organised to Perform a specific function
  eg: Coelenterata, Ctenophora



- Organ: Tissues are organised to form an organ
  eg: Platyhelminthes
  ↓
  (ALSO ORGAN SYSTEM-TABLE 4.2 NCERT)
- Organ-system: Organs are organised to form organ system. eg: From Aschelminthes upto Chordata

2. Symmetry

i) Asymmetrical: Body can't be divided into equal halves passing through any plane that passes through centre
eg: Mostly Porifera (sponges)

ii) Radially Symmetrical: Body can be divided into equal halves passing through any plane that passes through centre
eg: Coelenterata, Ctenophora
* ECHINODERMS (ADULT)

iii) Bilaterally Symmetrical: Body can be divided into equal halves passing through only one plane through centre.
eg: Platyhelminthes upto Chordata
(*ECHINODERMATA LARVA)

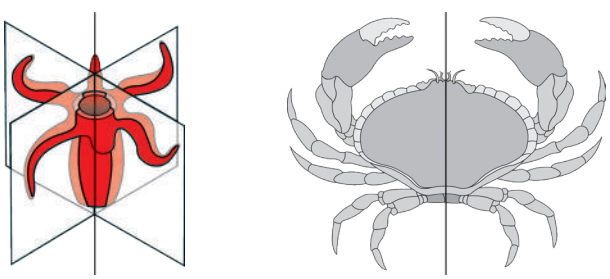


Figure: (a) Radial symmetry, (b) Bilateral symmetry

3. Body plan (Not in NCERT directly)

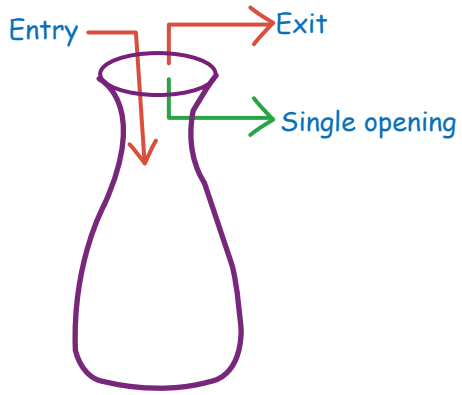
(अतिरिक्त Gyaan)

→ i) Cellular aggregation: Only cell are diffused in body.

eg: Porifera

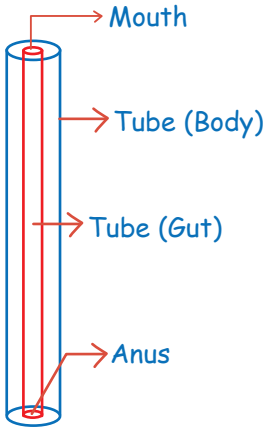
→ ii) Blind sac: Body has only one opening for entry or exit of substances

eg: Coelenterata, Ctenophora, Platyhelminthes



→ iii) Tube within tube: 2 separate openings are present, one acting as a mouth & another like a anus.

eg: Aschelminthes upto Chordata



4. Germ Layer

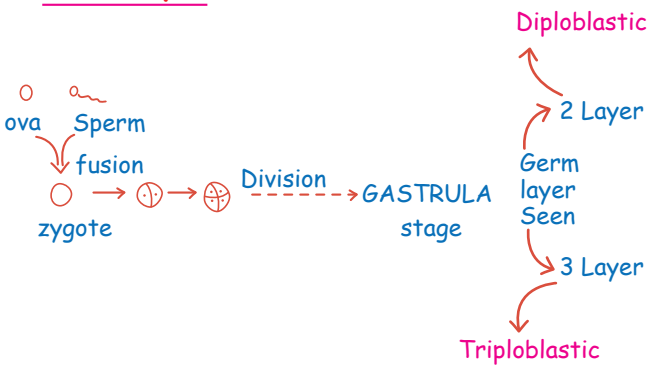
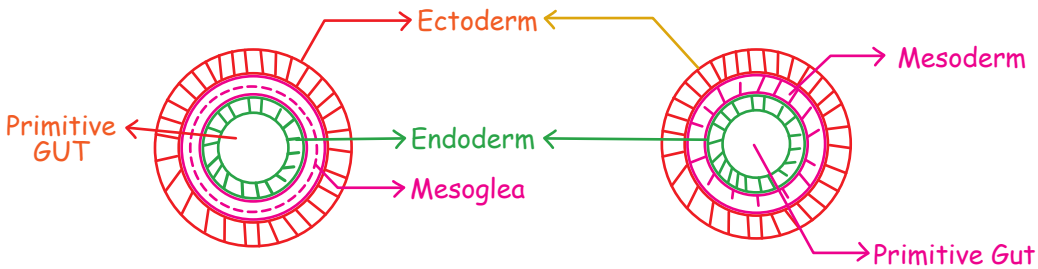


Figure: Embryonic development

- Animals in which only 2 germ layers: Ectoderm & Endoderm are found.
- A non-cellular MESOGLEA is present Between them.

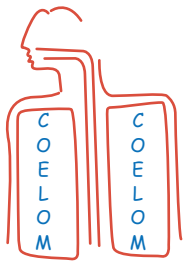
- Animals in which 3 germ layers are found ECTODERM, ENDODERM & MESODERM.



eg: Coelenterata, Ctenophora

eg: Platyhelminthes upto Chordata

5. Coelom



→ ① Acoelomate: Absence of Coelom eg: Porifera, Coelenterata, Ctenophora, Platyhelminthes
→ ② Pseudocoelomate: Aschelminthes
→ ③ Eucoelomate: Annelida upto Chordata

Acoelomate: (No coelom): Body cavity is absent.

In PLATYHELMINTHES, even though Mesoderm was present but it does not split & remains SOLID

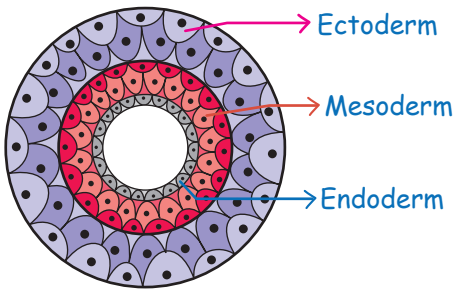
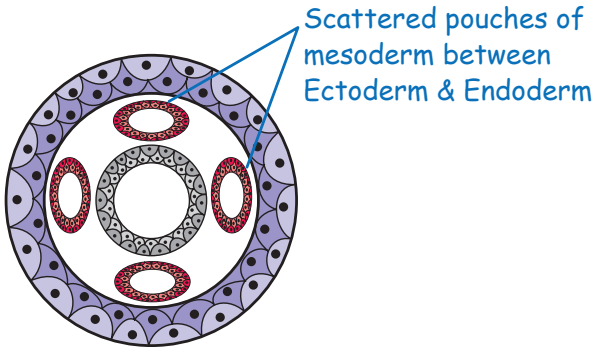
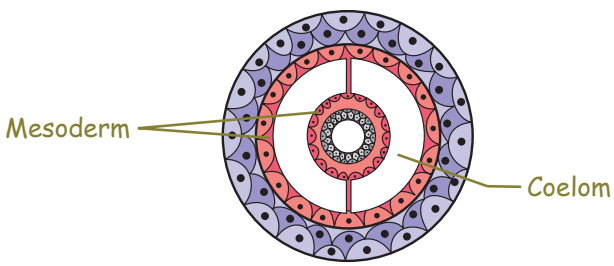


Figure: Solid Mesoderm in platyhelminthes

Pseudocoelomate (False coelom): Mesoderm is present as scattered pouches between ectoderm and endoderm



Eucoelomate (True Coelom): The body cavity which is lined by mesoderm on the both sides.



NOTE

Eucoelom (अतिरिक्त Gyaan)

Schizocoelom	Enterocoelom
→ Body cavity formed by splitting (schizo: split) of solid mesoderm to line both side of Body cavity eventually.	→ Body cavity formed from outpocketing of gut to line both side of Body cavity eventually.

6. Metameric Segmentation

Body can be divided externally, internally with serial repetition of at least some organs is known as 'METAMERISM'

eg: Annelida, Arthropoda, Chordata

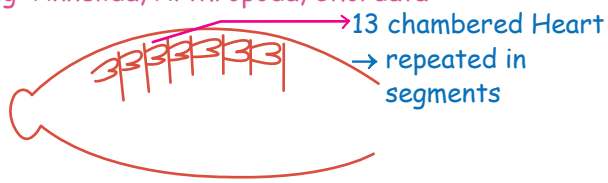


Figure: Cockroach

7. Notochord

A supporting mesodermally derived structure present Dorsally only in CHORDATES.

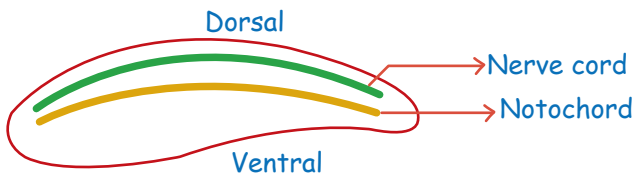


Figure: Chordata

8. Digestive system
- Complete → 2 opening present in alimentary canal. eg., Aschelminthes upto Chordate
- Incomplete → Only single opening present in alimentary canal. eg., Coelenterata upto Platyhelminthes

9. Respiratory system → It was properly seen for the first time in Arthropods

10. Circulatory system
- Open (Blood vessels not bounded by capillary) → eg., A N T H E
  - Non-cephalopod Mollusca
  - Hemichordata
  - Echinodermata
  - Arthropoda
  - Tunicata (Urochordate)

  eg., of open Circulatory system
- Closed (Blood vessels bounded by capillary) → eg., Chordata

PORIFERA (SPONGES)

'Pore' Bearers

General Characteristics

1. Habitat: All are aquatic, few fresh water But mostly marine
   - These are SESSILE animals → attached to the Substratum/ Ocean floor
2. Level of Organisation: Cellular
3. Symmetry: Mostly asymmetrical
4. Germ layer: Absent
5. Body plan: Cellular aggregation
6. Coelom: Absent
7. Metamerism: Absent
8. Notochord: Absent

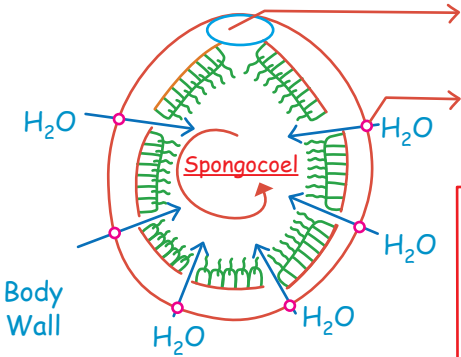


Figure: Water Canal System

flagella

Collar cells / Choanocytes

These are flagellated cells lining the spongocoel & helps in the movement of H_2O

WATER-CANAL-SYSTEM

Helps in
- OSTIA → SPONGOCOEL → OSCULUM
- Digestion, respiration, excretion, Reproduction (transfer of gamete)

NOTE The body is supported with SKELETON made of spongin fibers, SPICULES (Calcium or Silicon)

Physiology

1. Digestive system: Intracellular
2. Respiratory system: Absent
3. Circulatory system: Absent
4. Excretory system: Absent
5. Reproduction: Hermaphrodite, 'Sexual' & Asexual (By Fragmentation)
6. Fertilisation: Internal fertilisation
7. Development: Indirect (via larval Stages)

NOTE

UNISEXUAL /DIOECIOUS: Sexes are separate
BISEXUAL /MONOECIOUS / HERMAPHRODITE: Sexes are not separate, male & female reproductive organs are present within the same individual

eg: Euspongia (Common Bath Sponge)
Spongilla (Freshwater Sponge)
Sycon (Scypha)

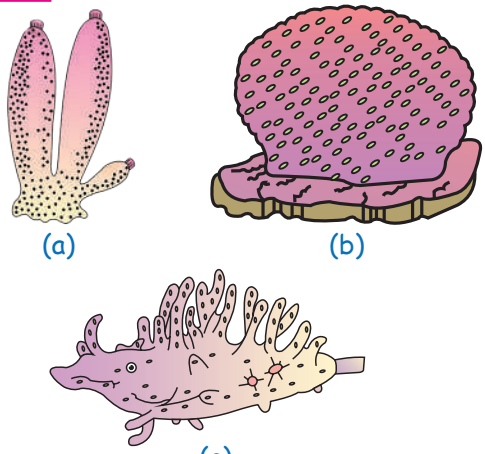


Figure: Examples of Porifera
(a) Sycon (b) Euspongia (c) Spongilla

COELENTERATA/CNIDARIA

↓
Because of the presence of Stinging cell known as Cnidocyte

General Characteristic

1. Habitat All are Aquatic, mostly marine, few fresh water, both Sessile or free-Swimming.
2. Level of Organisation: Tissue
3. Symmetry: Radially
4. Body Plan: Blind sac
5. Germ Layer: Diploblastic
6. Coelom: Acoelomate
7. Metamerism: Absent
8. Notochord: Absent

free-Swimming → move along with water current

Coelenterates have **2 body forms**

Polyp
- Cylindrical
- Sessile
- Asexual form

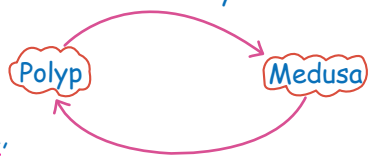
eg: Hydra, Adamsia

Medusa
- Umbrella like
- Free-swimming
- Sexual form

eg: Aurelia

- A few coelenterates exhibits alternation of generation also known as 'METAGENESIS'

i.e. from POLYP ⟹ MEDUSA
Asexually



Sexually

eg., Physalia, Obelia

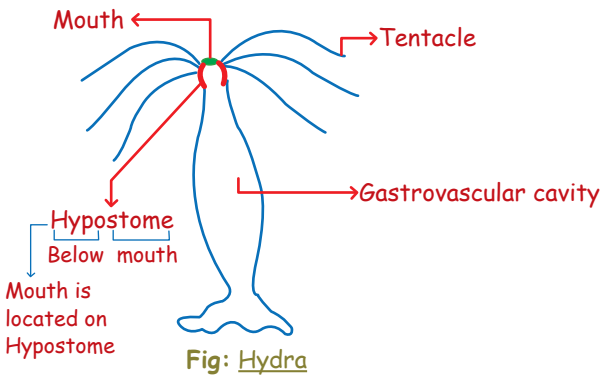


Fig: Hydra

- Corals have a skeleton composed of calcium carbonate

STINGING CELL (Cnidoblast or Cnidocyte)
- It has the STINGING CAPSULE: Nematocyst (CAPSULE)
- Present on tentacles & body

FUNCTIONS:
- Offense & defense
- Capturing prey
- Anchorage

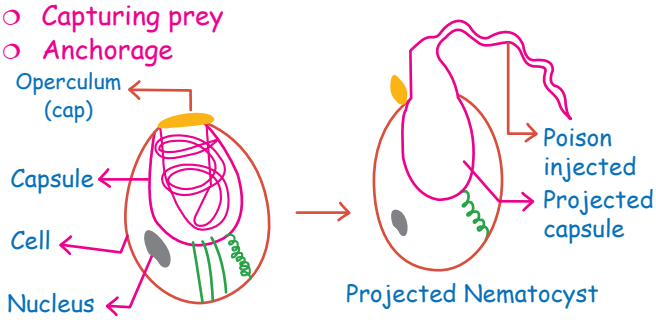


Figure: Cnidoblast

PHYSIOLOGY

1. Digestive system: Incomplete digestive system, Both intracellular & extracellular
2. Respiratory system: Absent
3. Circulatory system: Absent
4. Excretory system: Absent

Eg.
Hydra (Freshwater Polyp)
Adamsia (Sea-anemone)
Aurelia (Jellyfish)

Obelia (Sea fur)
Physalia (Portuguese man of war)
Pennatula (Sea Pen)
Gorgonia (Sea fan)
Meandrina (Brain coral)

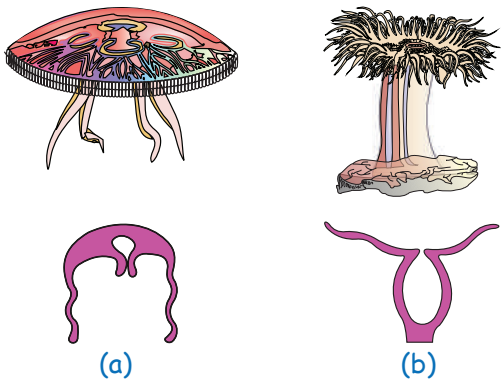


Figure: Examples of Coelenterata indicating outline of their body form
(a) Aurelia (Medusa) (b) Adamsia (Polyp)

CTENOPHORA

→ Commonly known as 'Sea- WALNUTS' or 'COMB-JELLIES', Sea Gooseberry

- They have 8 external rows of Ciliated Comb Plates

↓

USED FOR LOCOMOTION

- They show a property of Bioluminescence → Emission of light

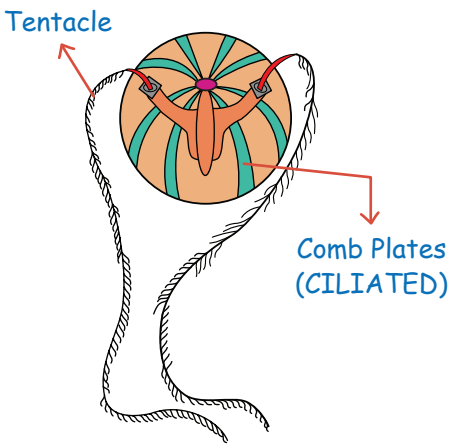


Figure: Example of Ctenophora (Pleurobrachia)

General Characters

1. Habitat*: Exclusively Marine **(V. Imp.)**
2. Level of Organisation: Tissue
3. Body Plan: Blind Sac
4. Symmetry: Radially
5. Germ Layer: Diploblastic
6. Coelom: Acoelomate
7. Metamerism: Absent
8. Notochord: Absent

Physiology

1. Digestive System: Incomplete, both extracellular & intracellular
2. Respiratory System: Absent
3. Circulatory System: Absent
4. Excretory System: Absent
5. Reproduction: Sexual, Bisexual
6. Fertilisation: External
7. Development: Indirect

eg. Pleurobrachia, Ctenoplana

PLATYHELMINTHES

Flat Worms

1. Habitat: Aquatic or terrestrial, free living or Endoparasite (within host)

↓

Mostly in Animals

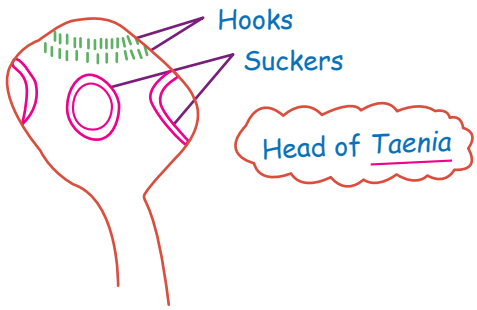
↓

Act as host including humans

2. Level of Organisation: Organ or organ system
3. Body Plan: Blind Sac
4. Germ Layer: Triploblastic
5. COELOM: Acoelomate
6. Symmetry: Bilaterally
7. Metamerism: Absent
8. Notochord: Absent

Parasitic Adaptations

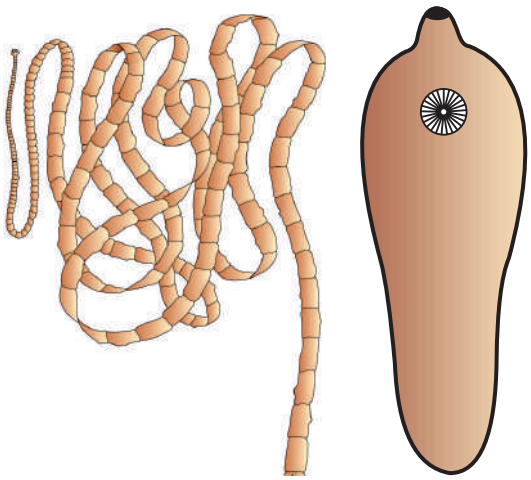
1. Thick Tegument (prevent action of any Digestive enzymes)
2. Some parasites may develop 'HOOK' for attachment to the host body.
3. Some may also have 'SUCKERS' for absorbing nutrients from the host.
4. Some have the capability to directly absorb nutrients from their body surface.



Physiology

1. Digestive System: Incomplete
2. Respiratory System: Absent, Simple diffusion, general body surface
3. Circulatory System: Absent
4. Excretory System: 'Flame-cells' for Excretion & Osmoregulation
5. Reproduction: Bisexual
6. Fertilisation: → Internal
   eg: *Taenia* (tapeworm), *Fasciola* (liver Fluke) → Parasitic
7. Development: → Indirect

NOTE: Free living *Planaria* → High regeneration capacity



(a) (b)

Figure: Examples of Platyhelminthes
(a) Tapeworm (b) Liver fluke

ASCHELMINTHES/ NEMATHELMINTHES/ NEMATODA

→ Commonly known as 'Roundworms'

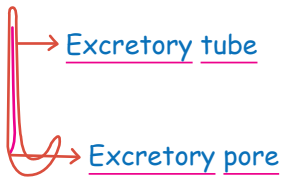
Cross section: Appears Circular

General Characteristics

1. Habitat: Aquatic or terrestrial, free living or Parasitic *(they can be parasitic for Plants as well as Animals).
2. Level of Organisation: Organ System
3. Body Plan: Tube within Tube
4. Germ Layer: Triploblastic
5. Coelom: Pseudocoelom
6. Symmetry: Bilateral
7. Metamerism: Absent
8. Notochord: Absent

Physiology

1. Digestive System: A well developed muscular pharynx is associated with its Digestive system which helps in sucking of food with complete Digestive system
2. Respiratory System: Absent
3. Circulatory System: Absent
4. Excretory System: There is an excretory tube which eliminates the N_2 waste via an excretory pore that opens outside



5. Reproduction: Unisexual
6. Fertilisation: Internal
7. Development: Direct & Indirect

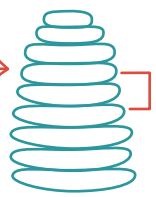
eg: ❍ Wuchereria (Filarial worm) —Causes→ Elephantiasis
❍ Ancylostoma (Hookworm)
❍ Ascaris (Common roundworm) —Causes→ Ascariasis

♂ Ascaris	♀ Ascaris
❍ Shorter	❍ Longer
❍ Posterior tail curved	❍ Posterior tail straight

Figure: Aschelminthes: Roundworm

ANNELIDA

ANNELIDA → 'ANNULI' - LITTLE RING



Metameres → Segments

General Characteristics

1. Habitat: Aquatic or terrestrial, Free Living or Parasitic.
2. Level of Organisation: Organ System
3. Body Plan: Tube within Tube
4. Germ Layer: Triploblastic
5. Symmetry: Bilaterally
6. Coelom: Eucoelom
7. Metamerism: Metameric segmentation is present
8. Notochord: Absent

Physiology

1. Digestive System: Complete Digestive System.
2. Respiratory System: ABSENT, Earthworm respires *via* moist Cuticle
3. Circulatory System: Closed Circulatory system
4. Excretory System: Nephridia are the excretory and Osmoregulatory structure
5. Nervous System: Paired ganglia connected by lateral nerves to Double Ventral Solid Nerve Cord
6. Reproduction: Sexual

Nereis → Unisexual

Leech, Earthworm → Bisexual

7. Locomotion: They may use some circular & Longitudinal muscles for locomotion.

- Some aquatic forms also have structures known as Parapodia which helps in swimming.

Eg. Nereis (Sandworm)
Pheretima (Earthworm)
Hirudinaria (Blood sucking leech)

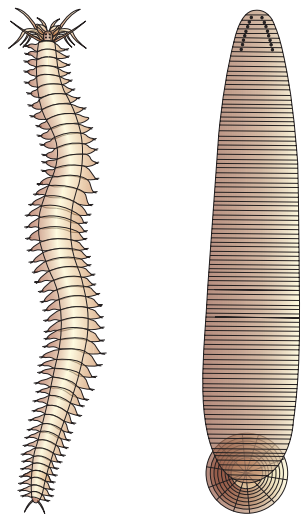


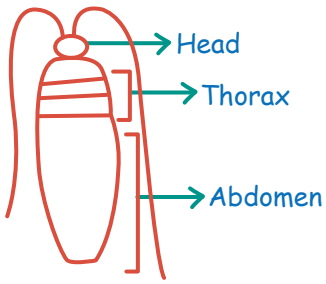
Figure: Examples of Annelida:
(a) Nereis (b) Hirudinaria

ARTHROPODA

- Largest Phylum of the Animal kingdom, over 2/3 named species on earth are arthropods.

Arthropoda → Jointed appendage : jointed appendages

- Their Body is covered with hard Chitinous Exoskeleton
- Body is divisible into 3 parts: Head, Thorax, Abdomen



General Characters

1. Habitat: Aquatic or terrestrial, free living or Parasitic.
2. Level of Organisation: Organ System
3. Symmetry: Bilaterally
4. Body plan: Tube within Tube
5. Germ Layer: Triploblastic
6. Coelom: Eucoelomate
7. Metamerism: Metamerism is present
8. Notochord: Absent

Physiology

1. Digestive System: Complete
2. Respiratory System: → Gills, Book gills, Book Lungs, Tracheal system → Insect
3. Circulatory System: Open Circulatory System
   (Color less Blood) → Known as: Hemolymph
4. Excretory System: Malpighian tubules, green gland/antennary gland, which helps in Excretion, Osmoregulation.
5. Nervous System: Ganglions with Double Ventral Solid Nerve Cord.

6. Reproduction: Mostly unisexual.
7. Fertilisation: Usually Internal,
   Mostly Oviparous → egg laying animals
8. Development: Both direct and indirect.
9. Sensory structures: Eyes (Simple or compound), Antennae, Balancing structure "Statocyst"

Eg. **Economically Important Insects**
- → Apis (Honey bee)
- → Bombyx (Silkworm)
- → Laccifer (Lac insect)

Insects as Vector
- ♀ Anopheles mosquito (Malaria)
- ♀ Aedes mosquito (Dengue, Chikungunya)
- ♀ Culex mosquito (Elephantiasis)

Gregarious pest → attack in groups
→ Locusta (Locust)

Other eg: Limulus (King Crab)
→ Living Fossil

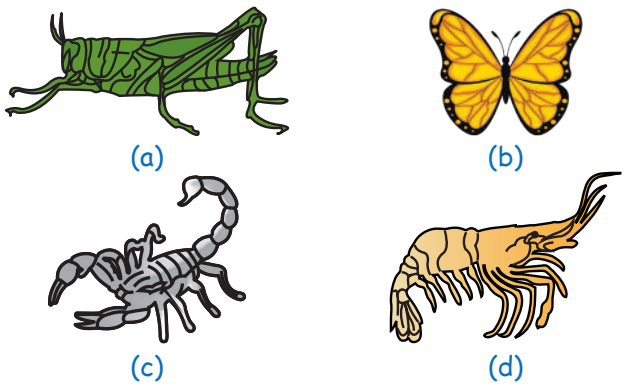


Figure: Examples of Arthropods:
(a) Locust (b) Butterfly
(c) Scorpion (d) Prawn

MOLLUSCA: Second Largest Phylum of Animal Kingdom
Mollis → **Soft Bodied Animals**

Body
- ① Head
- ② Visceral hump/mass
- ③ muscular foot

Tentacles

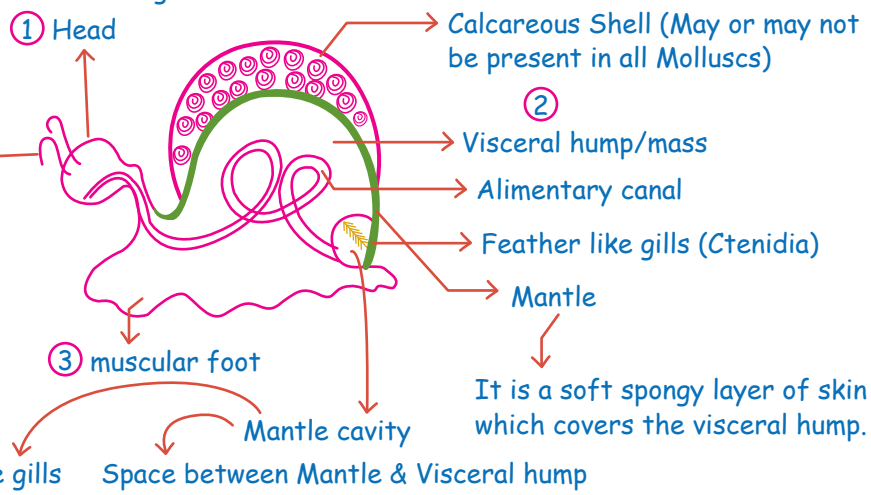


Figure: Body parts of Molluscs

General Characters

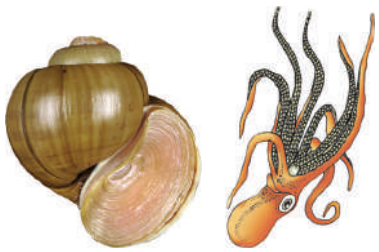
1. Habitat: Aquatic (Both freshwater and marine) as well as Terrestrial
2. Level of Organisation: Organ System
3. Body Plan: Tube within Tube
4. Symmetry: Bilaterally
5. Germ Layer: Triploblastic
6. Coelom: Eucoelomate
7. Metamerism: Absent
8. Notochord: Absent

Physiology

1. Digestive System: Complete Digestive System, Mouth is provide with file-like rasping organ known as Radula
2. Respiratory System: Feather like gills
3. Circulatory System: Both Open & Closed
4. Excretory System: Feather like gills
5. Reproduction: Usually unisexual, oviparous
6. Development: Indirect development.
7. Sensory Structure: Head with sensory tentacles.

Examples

- Pila (Apple snail)
- Dentalium (Elephant tusk shell)
- Chaetopleura (Chiton)
- Octopus (Devil fish)
- Loligo (Squid)
- Sepia (Cuttlefish)
- Aplysia (Sea hare)
- Pinctada (Pearl oyster)



(a) (b)

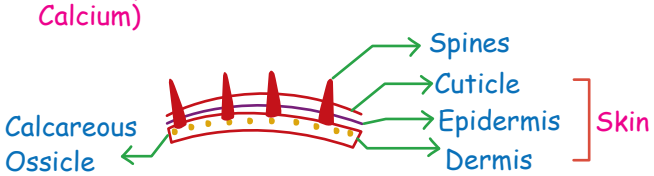
Figure: Examples of Mollusca:
(a) Pila (b) Octopus

ECHINODERMATA → Spiny skinned Animals
Spiny Skin

General Characters

1. Habitat: Exclusively marine
2. Level of Organisation: Organ System
3. Body Plan: Tube within Tube
4. Symmetry: Adults: Radial, Larva: bilateral
4. Germ Layer: Triploblastic
6. Coelom: Eucoelom
7. Metamerism: Absent
8. Notochord: Absent

- SPINY SKINNED & body has an endoskeleton made up of CALCAREOUS OSSICLE (made of Calcium)



Physiology

1. Digestive System: Complete, Mouth is on Ventral side (Lower), whereas Anus on the Dorsal (ABOVE)
2. Respiratory System: Present
3. Circulatory System: Open
4. Excretory System: Absent
5. Reproduction: Sexual, Unisexual
6. Fertilisation: Usually External
7. Development: Indirect

Examples

- *Asterias* (Starfish)
- *Ophiura* (Brittle star)
- *Antedon* (Sea lily)
- *Echinus* (Sea Urchin)
- *Cucumaria* (Sea Cucumber)

NOTE

The most distinctive feature of Echinoderm is the presence of **Water Vascular System**

- Capturing & Transport of food
- Respiration
- Locomotion
- Excretion

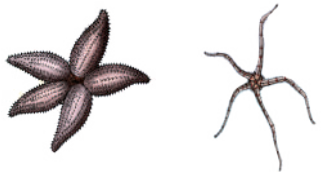


Figure: Examples of Echinodermata
(a) Asterias (b) Ophiura

HEMICHORDATA

- Earlier it was placed under Phylum chordata due to a structure similar to Notochord known as, 'Stomochord' but later it was found to have a different origin (Ectodermal) than Notochord (Mesodermal) hence placed under a separate phylum.

Body is Divisible into
- Proboscis
- Collar
- Trunk

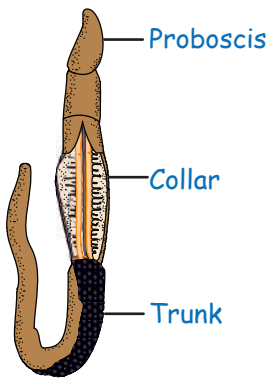


Figure: Balanoglossus

General Characters

1. Habitat: Exclusively Marine
2. Level of Organisation: Organ System
3. Body Plan: Tube within Tube
4. Symmetry: Bilaterally
5. Germ Layer: Triploblastic
6. Coelom: Eucoelomate
7. Metamerism: Absent
8. Notochord: Absent

Physiology

1. Digestive System: Complete Digestive System
2. Respiratory System: Gills
3. Circulatory System: Open
4. Excretory System: Proboscis gland
5. Reproduction: Unisexual, Sexual
6. Fertilisation: External
7. Development: Indirect

eg: Balanoglossus, Saccoglossus] Tongue worms

Table: Salient features of non-chordates. (ONLY those mentioned in NCERT) ['—' Means NOT in NCERT]

PHYLUM	Digestive System	Respiratory system	Circulatory system	Excretory system	Nervous system	Locomotion	Sensory structure	Reproduction	Fertilization	Develop-ment
Porifera	Absent Intracellular	Absent	Absent	Absent	—	—	—	Both Sexual and Asexual, Bisexual	Internal	Indirect
Coelenterata	Incomplete, Both intra & extra	Absent	Absent	Absent	—	—	—	—	—	—
Ctenophora	"	Absent	Absent	Absent	—	Comb Plates	—	Sexual, Bisexual	External	Indirect
Platyhelminthes	Incomplete	Absent	Absent	Flame cells	—	—	—	Bisexual	Internal	Indirect
Aschelminthes	Complete	Absent	Absent	Excretory tube	—	—	—	Unisexual, Sexual	Internal	Both
Annelida	"	Absent	Closed	Nephridia	Double ventral solid nerve cord	Parapodia, Muscles	—	Sexual both Unsexual and Bisexual	—	—
Arthropod	"	Gill, Book Gills, Book Lungs, Tracheal system	Open	Malpighian tubule	Double ventral solid nerve cord	—	Eyes, statocyst, antennae	Mostly Unisexual	Usually internal	Direct or Indirect
Mollusca	"	Feather like gills	Both	Feather like gills	—	—	—	Mostly Unisexual	—	Indirect
Echinoderm	"	Water vascular system	Open	Absent	—	Water Vascular System	—	Sexual Unisexual	External	Indirect
Hemichordata	"	Gills	Open	Proboscis gland	—	—	—	"	"	"

PHYLUM CHORDATA

- Presence of dorsal notochord at any stage of life.
- Presence of dorsal nerve cord " " "
- Presence of Paired pharyngeal gill slits

- Presence of Post anal tail

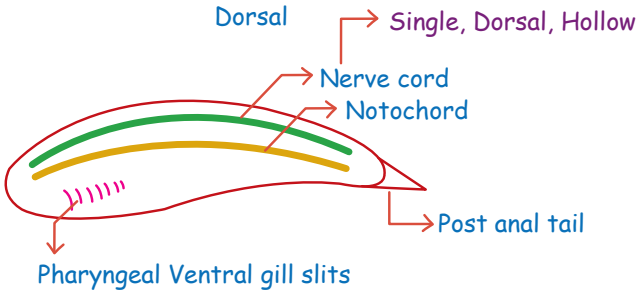


Figure: Chordata

- Heart is usually ventral

NOTE Notochord & Nerve cord both are dorsal structure but Nerve cord is most Dorsal.

Table: Chordates vs non-chordates.

S.No.	Chordates	Non-chordates
1.	Notochord present.	Notochord absent.
2.	Central nervous system is dorsal hollow and single.	Central nervous system is ventral solid and double
3.	Pharynx perforated by gill slits	Gill slits are absent.
4.	Heart is ventral	Heart is dorsal (if present)
5.	A post-anal part (tail) is present	Post-anal tail is absent.

PHYLUM CHORDATA

- **Group Protochordates/Acraniata**
  - Sub-Phylum
    - Urochordata
    - Cephalochordata
- **Group Euchordate/Craniata**
  - Sub-Phylum
    - VERTEBRATA
      - Division Agnatha
        - CLASS Cyclostomata
      - Division Gnathostomata
        - Superclass Pisces
          - Class Chondrichthyes
          - Class Osteichthyes
        - Superclass Tetrapoda
          - CLASS
            - Amphibia
            - Reptilia
            - Aves
            - Mammals

Protochordate/Acraniata: Primitive, Absence, cranium

- Primitive chordates, cranium Absent, all are marine

Sub-Phylum: Urochordata

tail

- Notochord is present only in the larval tail
- They are known as Tunicates as their body is covered with Tunicin which is made up of cellulose like substance.

  eg: Ascidia, Salpa, Doliolum

Figure: Ascidia

Sub-Phylum: Cephalochordata

Head

- Notochord is present from head to tail.
  eg: Branchiostoma (Amphioxus/ lancelet)
- Euchordata / Craniata : True Chordates, Brain Box is Present.

Sub-Phylum: VERTEBRATA

- Notochord is replaced by a vertebral column.
- Heart can be 2 / 3 / 4 chambered.
- Respiration through gills /Lungs.
- Paired appendages: Fins/Limbs may be present.
- Kidney for Excretion and Osmoregulation.
- Gonads present.

NOTE

All VERTEBRATES are CHORDATES But all CHORDATES are not VERTEBRATES

→ Division Agnathostome
(Jaw Absent, Mouth)

- Jawless Vertebrates

→ Division Gnathostomata

- Jawed Vertebrate

Division Agnathostome

CLASS CYCLOSTOME:

- All are Aquatic
- They have Circular, Suctorial mouth without any jaws.
- All living members are Ectoparasites on Some Fishes.
- They have 6-15 pairs of gill slits for respiration.
- Scales & paired fins are absent.
- Cranium & vertebral column are Cartilaginous.
- They are Marine water animals but for spawning they migrate to freshwater.
- After spawning, the adults die & the larva develops into adult & migrates back to the marine water.

NOTE

Spawning: It means to lay egg & sperm

eg: Petromyzon (Lamprey), Myxine (Hagfish)

Figure: Jawless vertebrate- Petromyzon

Division Gnathostome

SUPERCLASS PISCES

→ True Fish

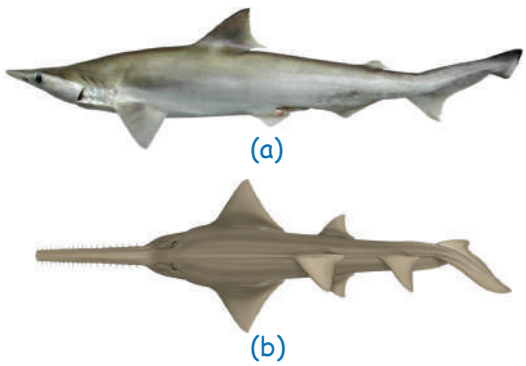
General Characters:

- Aquatic
- RESPIRATION: GILLS
- Heart 2 chambered, Single circulation
- Scales & fins present
- Nictitating membrane on eye for protection under water.
- Cold Blooded / Poikilothermal.
  → They do not have a constant body temperature, instead it changes with the change in outer temperature.

Table: Salient features of chondrichthyes and osteichthyes.

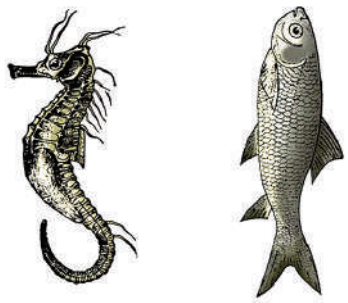
	Chondrichthyes	Osteichthyes
1.	They have CARTILAGINOUS endoskeleton known as Cartilaginous Fish.	Endoskeleton is Bony known as Bony fishes.
2.	MARINE water only.	Fresh & marine water
3.	Mouth is VENTRAL 	Mouth is terminal 
4.	Notochord is persistent throughout life. (incomplete replacement of vertebral column)	Notochord completely replaced by vertebral column.
5.	Swim bladder/air Bladder is absent, hence have to constantly swim to avoid sinking.	Air Bladder is present to provide them with Buoyancy.

	Chondrichthyes	Osteichthyes
6.	Operculum is Absent → GILL COVERING	4 pairs of gill slits present & covered with operculum
7. 8.	Scales: Placoid scales Their scales are modified to form backwardly directed teeth.	Scales: Cycloid & Ctenoid
9.	Internal fertilisation	Direct Development External fertilisation
10.	Viviparous: Directly giving Birth to young ones.	Oviparous
	Examples **Pristis** (Sawfish) **Scoliodon** (Dogfish) **Carcharodon** (Great white shark) **Trygon** (Sting ray) **Torpedo** (Electric ray)	Examples Marine water → Parental care → Male has BROOD POUCH to Care of egg before they hatch **Hippocampus** (Sea horse) **Exocoetus** (flying fish) **Fresh water** Labeo (Rohu) Catla (Katla) Clarias (Magur) **Aquarium** Betta (Fighting fish) Pterophyllum (Angel fish)



(a) (b)

Figure: Examples of Cartilaginous fishes
(a) Scoliodon (b) Pristis



(a) (b)

Figure: Examples of Bony fishes:
(a) Hippocampus (b) Catla

NOTE

In chondrichthyes:

- Male bear Claspers on their Pelvic fin to help in Copulation
- Usually Predatory in nature: Electric organ (Torpedo), Poisonous Sting (Trygon).

SUPERCLASS TETRAPODA

→ Four legged vertebrates

Table: Comparative Anatomy & Morphology of Classes of Tetrapods

Characteristics	AMPHIBIA	REPTILE	AVES	MAMMAL
1) Exoskeleton	Skin is Moist glandular without any Scales	Skin is Dry with Epidermal Scales /Scutes which often shed called as ecdysis/moulting	Body is covered with Feathers & scales on Hindlegs	Skin with Hair, Nails.
2) Skull	Dicondylic → 2 occipital condyles	Monocondylic → 1 occipital condyle	Monocondylic	Dicondylic
3) Respiration	Skin, Lungs, Buccopharynx, Gills	Lungs	Lungs	Lungs
4) Circulation	3 Chambered Heart, Mixed Circulation	3 Chambered Heart, Mixed Circulation (except Crocodile, Alligator	4 chambered Heart, Double Circulation	4 chambered Heart, Double Circulation
5) Excretion	Kidney Aquatic - NH_3 Terrestrial-UREA	Kidney URIC-ACID	Kidney URIC-ACID	Kidney UREA
6) Fertilisation	External	Internal	Internal	Internal
7) Development	Indirect	Direct	Direct	Direct
8) Oviparous/ Viviparous	Oviparous	Oviparous	Oviparous	Mostly viviparous
9) Body temperature	Cold-blooded/ Poikilotherm	Cold-blooded/ Poikilotherm	Warm blooded /Homeotherm	Warm blooded /Homeotherm

NOTE **Homeotherm:** Animals having fixed body temperature.

AMPHIBIANS — dual (dual) + Bio (Bio) → dual Life → Water / Terrestrial

- Body divisible into → Head, Trunk (Tail may be present in some)
- Nictitating membrane covering the eye.
- *CLOACA is present (Common chamber for alimentary, reproductive & excretory canal opening)
- Tympanum represents the external ear
- Eyelids are present

eg: **Rana** (Frog)

Bufo (Toad)

Hyla (Tree frog)

Ichthyophis (Limbless Amphibian)

Salamandra (Salamander)

(a) (b)

Figure: Examples of Amphibia (a) Salamandra (b) Rana

REPTILES

↳ Creeping & crawling animals

- First true land Vertebrates
- Tympanum represents external ear
- Cloaca is present
- Snakes & Lizard shed their skin as skin cast

eg: **Alligator** (Alligator)

Crocodilus (Crocodile)

Testudo (Tortoise)

Chelone (Turtle)

Chameleon (Tree lizard)

Calotes (Garden lizard)

Hemidactylus (Wall Lizard)

Poisonous Snakes

Naja (Cobra), Vipera (Viper)

Bangarus (Krait)

Non-poisonous

↳ **Python**

(a) (b) (c) (d)

Figure: Reptiles: (a) Chameleon, (b) Crocodilus, (c) Chelone, (d) Naja

AVES

- Forelimbs are modified into wings, hindlimb with CLAWS: walk, hold.
- No glands except at the base of tail: Uropygeal gland/oil gland.
- Beak is present.
- *Alimentary canal with additional chambers ┌ Crop └ Gizzard
- Lungs provided with 'AIR-SACS' additionally to supplement Respiration.
- Bones are fully ossified (Bony) & Pneumatic (long Bones are Hollow).
- Cloaca is present
- The waste/excretory product: Paste/Pellet

eg: **Pavo** (Peacock)

Psittacula (Parrot)

Neophron (Vulture)

↱ Largest flightless bird

Struthio (Ostrich)

Corvus (Crow)

Aptenodytes (Penguin)

Columba (Pigeon)

(a) (b)

(c) (d)

Figure: Some birds: (a) Neophron (b) Struthio (c) Psittacula (d) Pavo

MAMMALS

→ Unique mammalian feature ┌→ Ear pinna →Hair └→ Mammary glands

→ Heterodont Dentition (Different types of Teeth)

→ Skin possess Various types of gland.

→ Forelimbs modified for ┌→ Walking →Swimming └→ Flying etc.

eg: **Rattus** (Rat)

Camelus (Camel)

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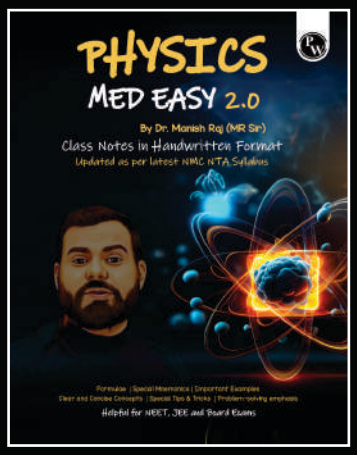

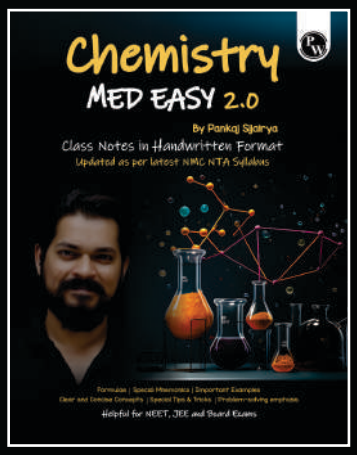

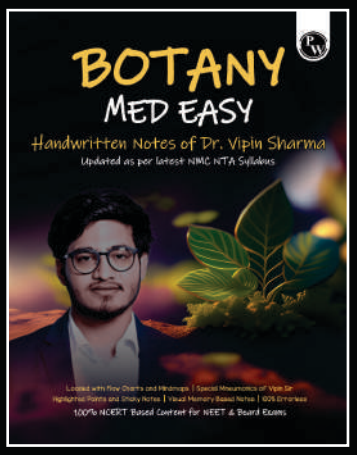

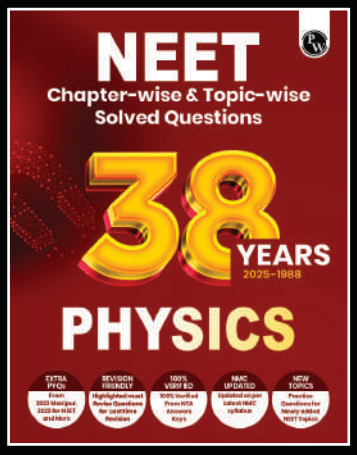

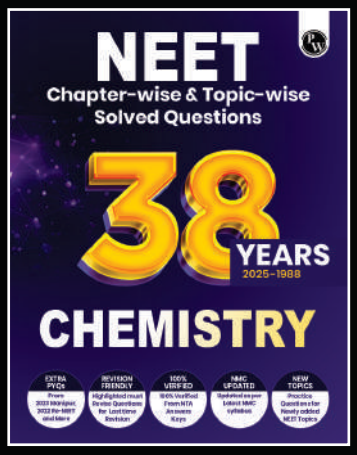

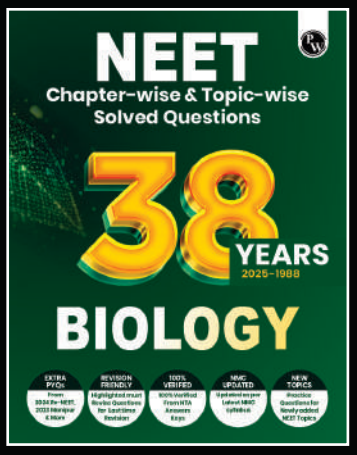

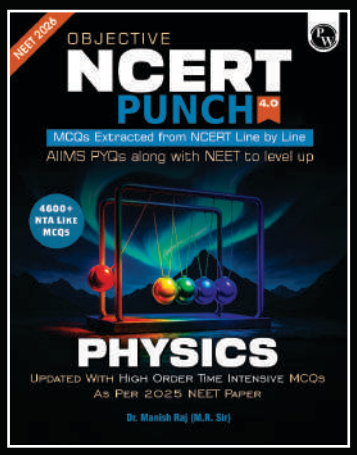

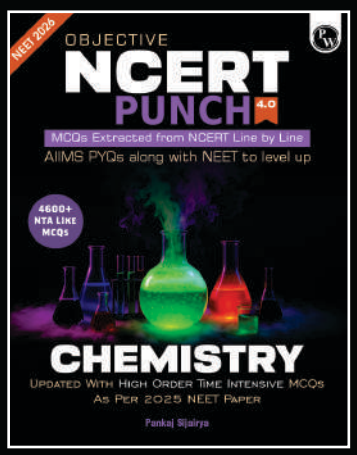

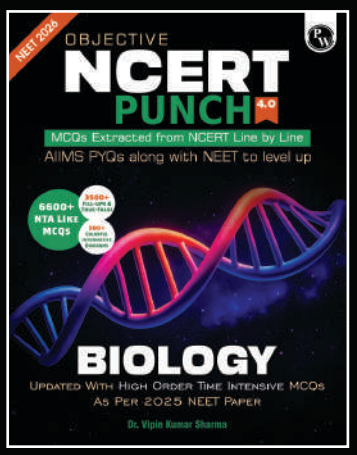

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