

Introduction

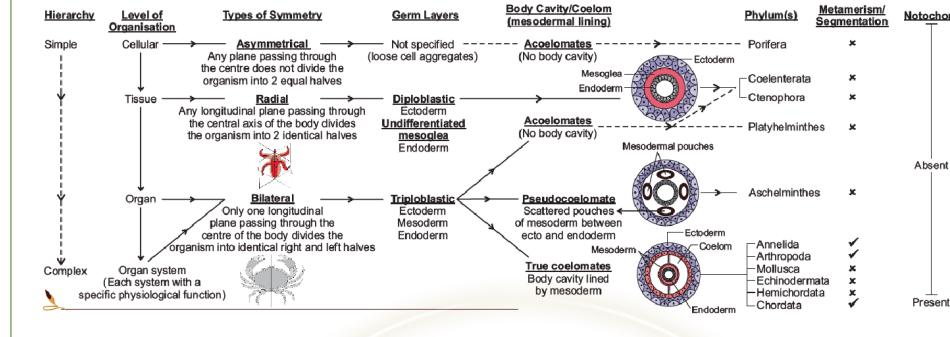
- What is the need to classify animals?
- Classification helps in assigning a systematic position to newly described species.
- Characteristics of members of kingdom Animalia
 - Eukaryotic organisms
 - Definite growth pattern
 - Capable of locomotion
 - Sensory and neuromotor mechanism
 - Multicellular and their cells lack cell wall
 - Heterotrophic with holozoic mode of nutrition

Animal Kingdom: Non-Chordates

Comparative account from porifera to aschelminthes

- There are fundamental features common to various individuals and have certain distinct characters which are specific to each phyla/class.

Broad Classification



- Metameric Segmentation** – Body is externally and internally divided into segments with a serial repetition of at least some organs
- Notochord** – Mesodermally derived rod like structure formed on the dorsal side during embryonic development in some animals
- Animals without notochord** – Non-chordates (Porifera to echinoderms)
- Animals with notochord** – Chordates
- About 2/3 of all species on earth are **Arthropods** (Most abundant are insects)

Some Conclusions From Classification:

- Poriferans are mostly asymmetrical organisms with cellular level of organisation.
- All diploblastic organisms have radial symmetry and are acoelomates.
- Bilateral symmetry is most advanced form of symmetry that arose with motile organisms.
- Platyhelminthes are first triploblastic, bilaterally symmetrical acoelomates.
- Echinoderms have radial symmetry at adult stage and bilateral in the larval stage.

Comparative account from annelida to hemichordata

- All have complete alimentary canal with extracellular digestion
- All can reproduce sexually and are usually oviparous

X' indicates absence '+' indicates presence

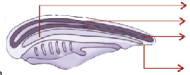
Parameters	Porifera (Sponges)	Coelenterata (Cnidaria)	Ctenophora (Sea walnuts)	Platyhelminthes (Flatworms)	Aschelminthes (Round worms)
Habitat/Habit	Mostly marine, some a freshwater (Spongilla)	Mostly marine, some are fresh water (Hydra), sessile or free swimming	Exclusively marine	Free living or parasitic	Aquatic, terrestrial, parasitic in plants and animals
Exoskeleton	X	Coral forms have skeleton of CaCO ₃	X	X	X
Endoskeleton	Spicules/spongin fibres	X	X	X	X
Digestive system/ Digestion	- Digestive system absent - Intracellular digestion	- Digestive system incomplete - Mouth on hypostome leading to body cavity - Gastro-vascular cavity - Intra and extracellular digestion	Extracellular and intracellular digestion	- Digestive system incomplete with single opening - Extracellular digestion - Some forms absorb food directly from body surface	- Complete alimentary canal with muscular pharynx - Extracellular digestion
Respiratory structure	Cell surface	Body wall		Free living-body surface	Free living-body surface
Circulatory system	Circulating fluid = water				
Excretory system/ Surface	Body surface			Flame cells (Protonephridia) for excretion and osmoregulation	Excretory tube opens out through excretory pore
Nervous system	X	Neurons appear	+	+	+
Asexual reproduction	Fragmentation, gemmule formation	Budding	X	High regeneration-Planarian capacity	X
Sexual reproduction	- Present - Hermaphrodites	Present	- Present - Hermaphrodites	- Present - Hermaphrodites	Distinctly dioecious
Fertilization	Internal	External	Internal	Internal	Internal
Development	Indirect, larva morphologically distinct from adult	Indirect/direct	Indirect	Indirect through many larval stages	Indirect/direct (young one resembles adult)
Unique features and examples	Water canal system Functions: Food gathering, Location, Size, Water flow, Removal of wastes Parameters: Number, Location, Size, Water flow Examples: Eupluma (Soft sponge), Spongilla (Fresh water sponge), Sycon (Scapha) Choanocytes /collar cells line the spongocoel (central cavity). Examples: Physalia (Portuguese man-of-war), Pennatulid (Sea-pen), Gorgonia (Sea-fan), Meandrina (Brain coral)	Name derived from cnidoblasts/cnidocytes containing nematocysts, present on body and tentacles. Functions: Anchorage, Defense, Capture of prey Obelia exhibits 2 basic forms: Polyp (sessile, cylindrical), Medusa (free swimming, umbrella like) Examples: Physalia (Portuguese man-of-war), Pennatulid (Sea-pen), Gorgonia (Sea-fan), Meandrina (Brain coral)	8 external rows of comb plates for locomotion, hence, called comb jellies Exhibit Bioluminescence i.e., property to emit light Examples: Ctenoplana, Pleurobrachia	Dorsoventrally flattened body Hooks and suckers present in parasitic forms 1 st ones with bilateral symmetry Examples: Taenia (Tapeworm), Fasciola (Liver fluke), Ascaris (Round worm), Male, Female	Circular in cross-section 1 st ones with complete alimentary canal Females longer than male Posterior end curved in males Examples: Wuchereria (Filaria worm), Angiostoma (Hookworm)

Parameters	Annelida (Segmented worms)	Arthropoda (Joint appendages) Largest Phylum	Mollusca/Soft bodied Second Largest Phylum	Echinodermata (Spiny skinned)	Hemichordata (Half chordates)
Habitat	Aquatic and Terrestrial	Aquatic and Terrestrial	Aquatic and Terrestrial	Exclusively marine	Exclusively marine
Body divisions/ appearance	Distinct segments/metameres/annuli	Head, thorax, abdomen	Head, muscular foot, visceral hump	Star like	Proboscis, collar, trunk (worm like)
Locomotory structure	- Longitudinal and circular muscles - Parapodia/lateral appendages in so	Joined appendages	Muscular foot	Water vascular system	X
Exoskeleton	X	Chitinous/Cuticle	Calcereous shells	Spines	X
Digestive system	+	+	Mouth with file like rasping organ, radula for feeding	Mouth-lower side/ventral Anus-upper side/dorsal	+
Respiratory system/surface	Body surface	Gills, book gills, tracheal system, book lungs	Feather like gills in mantle cavity	Water vascular system	Gills
Circulatory system	Closed	Open	Open	Open	Open
Excretory system	Nephridia	Malpighian tubules	Gills	X	Proboscis gland
Nervous system	Paired ganglia with double	ventral nerve cord	+	+	+
Sense organs	Eyes, Tentacles	Eyes (simple, compound), Antennae, Statocyst (balancing)	Tentacles	+	+
Mono/Dioecious	Monoecious – Earthworm, Leech Dioecious – Nereis (aquatic form)	Mostly dioecious	Usually dioecious	Dioecious	Dioecious
Fertilization	External/internal	Usually interna	External	Usually external	External
Development	Direct/Indirect	Indirect	Indirect	Indirect with free swimming larva	Indirect
Unique features and Examples	1 ones with metameric segmentation and true coelom Examples: Pheretima (Earthworm)	Examples: - Economically important insects- Apis (Honey bee), Bombyx (Silkworm), Laccifer (Lac insect) - Vectors - Anopheles, Culex, Aedes (Mosquitoes) - Living fossil- Limulus (King crab) - Gregarious pest- Locusta (Locust)	- Soft and spongy layer of skin forms a mantle over the visceral hump - Space between hump and mantle is mantle cavity. Examples: Sepia (Cuttlefish), Loligo (Squid), Pinctada (Pearl oyster), Chaetopleura (Chiton), Aplysia (Seahare)	- Water vascular system that helps in Locomotion/Capture and transport of food/Respiration - Presence of Calcareous ossicles Examples: Dentalium (Sea cucumber), Echinus (Sea cucumber), Antedon (Sea lily)	- Presence of rudimentary stomochord - Earlier considered as subphylum under phylum Chordata but now placed as separated phylum under non-chordata Examples: Saccoglossus

1. PHYLUM-CHORDATA

General Features :

- Triploblastic organisms
- Bilaterally symmetrical
- Coelomates
- Organ-system level of organization
- Closed circulatory system



Salient features	Chordates	Non-chordates
Notochord	✓	✗
Central nervous system	Dorsal, hollow and single	Ventral, solid and double
Paired pharyngeal gill slits	✓	✗
Post anal tail	✓	✗
Position of heart	Ventral	Dorsal (if present)

4. CYCLOSTOMATA

Parameters	
Habitat	Marine
Habit	Ectoparasite on fishes
Temperature regulation	No (Poikilothermous)
Exoskeleton	Scales are absent
Endoskeleton	Cartilaginous cranium and vertebral column
Appendages	Unpaired fins
Digestive system	Circular and sucking mouth without jaws
Respiratory system	6-15 pairs of gill slits
Circular system	Closed type
Excretory system	Kidneys
Reproductive system	○ Migrate to fresh water for spawning ○ After spawning, the adult dies within few days
Development	○ Indirect ○ Larvae return to ocean after metamorphosis
Examples	<i>Myxine</i> (Hag fish), <i>Petromyzon</i> (Lamprey)



Petromyzon (Lamprey)

Animal Kingdom: Chordates

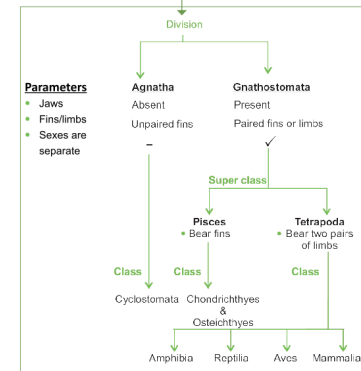
2. CLASSIFICATION OF CHORDATES

Parameters	Urochordata/ Tunicata	Cephalochordata	Vertebrata
Sub-phyta			
Habitat	Exclusively marine		Variety of habitats- Polar ice caps, deserts, mountains, forests grasslands and dark caves
Notochord	Only in larval tail	Extends from head to tail and persists throughout their life	Present in embryonic stage and is replaced by cartilaginous or bony vertebral column in the adult
Examples	<i>Salpa</i> , <i>Doliolum</i> , <i>Ascidia</i>	<i>Branchiostoma</i> (Amphioxus or Lancelet)	<i>Scotiodon</i> (Dog fish), <i>Rana</i> (Frog), <i>Crocodylus</i> (Crocodile), <i>Pavo</i> (Peacock), <i>Canis</i> (Dog)



All vertebrates are chordates but all chordates are not vertebrates.

3. CLASSIFICATION OF VERTEBRATES



5. COMPARATIVE ACCOUNT OF GYNOTHOMATATES

Characteristics	Chondrichthyes	Osteichthyes	Amphibia	Reptilia	Avics	Mammalia
Habitat	Marine	Both marine and fresh water	Both on land and in water	Mostly terrestrial		Terrestrial, aquatic
Habit	Predaceous		Dual life	Creeping and crawling	Most of them can fly except flightless birds	Limbs adapted to fly and live in water
Temperature Regulation	Poikilothermous (Cold blooded)			Homeothermous (Warm blooded)		
Exoskeleton	Placoid scales for tough skin	Cycloid and ctenoid scales	○ Scales are absent ○ Skin is moist	Epidermal scales or scutes with dry cornified skin	○ Scales on hindlimbs ○ Body covered by feathers and skin is dry	Skin may possess hair
Endoskeleton	Cartilaginous		Bony		Bony (Fully ossified)	Bony
Digestive System	○ Ventral mouth ○ Teeth are modified scales & backward directed ○ Powerful jaws	Terminal mouth	Cloaca present		○ Additional gizzard and crop ○ Beak present	Different types of teeth in the jaws
Respirator system	Gill slits without operculum	4 pair of gill slits with operculum	Gill, skins and lungs	Lungs	○ Lungs, ○ Air sacs supplement respiration	Lungs
Circulatory system	2 chambered heart with 1 auricle and 1 ventricle		3 chambered heart with 2 auricles and 1 ventricle	3 chambered heart with 2 auricles and 1 ventricle except crocodile (4 chambered heart)	4 chambered heart with 2 auricles and 2 ventricles	
Excretory system	Kidneys (Excretion and Osmoregulation)					
Sense organs ○ Eye ○ Ear	Eyes present			Eyes with Eyelids		
	Tympanum absent		Tympanum represents ear	Tympanum represents ear& many reptiles do not have external ear opening	Tympanum represents ear, many birds have external ear opening	External ear/pinna present
Fertilisation	Internal as pelvic fins Of males bear claspers	Usually external	External	Internal		
Oviparous/ Viviparous	Many are viviparous	Mostly oviparous		Oviparous		Viviparous except egg laying platypus
Development	Direct		Indirect	Direct		
Unique features	○ Streamlined body ○ Notochord persists throughout life ○ Absence of air bladder, hence, swim continuously to avoid sinking. Examples : <i>Carcharodon</i> (Great white shark), <i>Trygon</i> (Poisonous sting ray), <i>Torpedo</i> (Electric ray)  <i>Scoliodon</i> (Dog fish)  <i>Pristis</i> (Saw fish)	○ Streamlined body ○ They have air bladder/ swim bladder that regulated buoyancy Examples : Marine – <i>Exocoetus</i> (Flying fish), <i>Hippocampus</i> (Sea horse) Fresh water – <i>Labeo</i> (Rohu), <i>Clarias</i> (Magur) ; Aquarium – <i>Betta</i> (Fighting fish), <i>Pterophyllum</i> (Angel fish).  <i>Cata</i> (Katta),	○ Body divided into head and trunk, tail in some e.g. Salamander ○ Alimentary canal, urinary and reproductive tracts open into a common chamber called cloaca Examples : <i>Bufo</i> (Toad), <i>Hyla</i> (Tree frog), <i>Ichthyophis</i> (Limbless amphibia)  <i>Rana</i> (Frog)  <i>Salamandra</i> (Salamander)	Snakes and lizards shed their scales as skin cast Examples : <i>Chelone</i> (Turtle), <i>Testudo</i> (Tortoise), <i>Calotes</i> (Garden lizard), <i>Alligator</i> (Alligator), <i>Hemidactylus</i> (Wall lizard), Poisonous snakes – <i>Bangarus</i> (Krait), <i>Vipera</i> (Viper)  <i>Crocodylus</i> (Crocodile)  <i>Naja</i> (Cobra)	○ Forelimbs modified into wings ○ Hindlimbs of birds are modified for walkings, wimming or clapping the tree branches ○ Skin is dry without gland except oil gland at the base of tail Examples : Flying birds <i>Corvus</i> (Crow), <i>Columba</i> (Pigeon), Flightless birds <i>Aptenodytes</i> (Penguin)  <i>Struthin</i> (Ostrich)  <i>Psittacula</i> (Parrot)	○ Presence of mammary glands to nourish young ones Examples : Oviparous <i>Ornithorhynchus</i> (Platypus) Viviparous <i>Macropus</i> (Kangaroo), <i>Pteropus</i> (Flying fox), <i>Camelus</i> (Camel), <i>Macaca</i> (Monkey), <i>Rattus</i> (Rat), <i>Canis</i> (Dog), <i>Felis</i> (Cat), <i>Elephas</i> (Elephant), <i>Equus</i> (Horse), <i>Dolphinus</i> (Common dolphins), <i>Panthera tigris</i> (Tiger), <i>Panthera leo</i> (Lion).  <i>Balainoptera</i> (Blue whale)