PHYLUM - ARTHROPODA

- Arthropod is **the biggest phylum.** About 9,00,000 species are there.

- **Von Siebold** established phylum **Arthropods.**

- Arthropods are found in water, land, sea, in plant and anima. They are Colonia gregarious, shows parental care.

- Sometime **Parthenogenesis** Phenomenon also found i.e. Development of an unfertilised egg into an offspring.

- Phylum Includes Crabs, prawn, insets, spinder, scorpion, ticks, mite, centipedes, millipedes, Fossil arthropods are called **Trilobites.**

- Body is **Bilateral, Triplablastic** with **organ system level** of organisation

- Head is distinct [High degree of canalization], Consists of many fused segments bears well developed sense organ such as eyes, compound eyes, antennae.
  Compound eye consist of many similar unit **ommatidia** each having lense and capable of forming image.

- Arthropod have various shapes with externally segmented body. Segmentation is either
  (1) Two region with Head and trunk or Cephalothoras and abdomen
  (2) Three region with Head, thorax & addomen
  Some or all segments bear **<u>jointed appendages.</u>** Hence name arthro - joints, poda - foot
  No internal segmentation like Annelida
  <u>Body wall</u> consists of :-

- Cuticle composed or protein & polysaccharide chitin which is further strengthen by deposition of mineral (calcium phosphate & carbonate)

- Restricts growth and periodically change during growth known as **<u>moulitng or ecdysis.</u>**

- Flexible part of cuticle is called **<u>suture</u>.**

- Chitinous plates which form exoskeleton are known as sclerites.
  Epidermis

- Single layered epidermis without cilia & flagella.
  Muscle

- Muscle are arranged in bundles.

- Muscle are striped/strained - Voluntary (first time developed in arthropods)
- Due to presence of joints muscle are separate in them
  Body cavity around viscera contain blood and is called the **haemocoel.** True coelom is reduced to cavities in reproductive organs (gonads) & excretory organs. Coelom of gonads is called **gonocoel** and of nephrons is called **<u>nephrocoel</u>.**
  Digestive Tract is complete
  It has divided into three parts :
  (1) Stomedaeum (Anterior) (21) Mesenteron (Midde) (3) Proctodeum (Posterior)
  Striated muscles are found in digestive tract.
- **Mouth parts** adapted for -
  (1) **<u>Biting and chewing</u> -** Biting and chewing type - Grasshopper, Cockroach, Termits, Caterpillars.

(2) **Piercing - Sucking type -** Mosquitoes, Bugs, Fleas
(3) **Chewing Lapping type -** Bee
(4) **Sponging type -** Housefly, fruitfly.
(5) **Siphoning type -** Butterflies, moths

- **Respiration** is through **body surface** or special structure such as **gills** (e.g. Prawn), **Trachea** (e.g. Insects), **Book-lungs** (e.g. Scorpion), **Book-gills** (e.g. King crabs). Trachea carry oxygen direct to the cells

- **Circulatory system** is **Open** i.e. blood flows in hoemocoel instead of blood vessels.
  Blood - With white corpuscle, colourless - **Haemolymph.** (.e.g. Insect)
  - Copper containing pigment **haemocyanin** (e.g. Prawn)
  Heart - A dorsal, tubular pulsatile, one to many chambered tubular structure.

- **Excretory organs** are -
  (1) **Antennary** or **green glands** or **maxillary gland** (e.g. Crustaceans) opening directly to the exterior.
  (2) **Coxal gland** (e.g. Arachnids)
  (3) **Malpighian tubules** (e.g. Insects) opening into the gut.
  Excretory matter is **Ammoia** in aquatic animal are **Uric acid** is hand animal

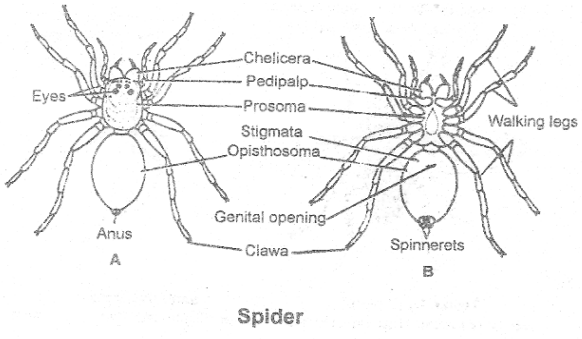
- **Nervous system** comprises of a circumenteric **ring** and a **double, solid midventral nerve cord** bearing a **pair of ganglia** per segment or less (Ganglia).
  Insects communicate by **Pheromonues** by releasing chemical into the environment. Also acts on a sex attraction. Sexes are separate. **Fertilization internal** but few aquatic has **external.** Gonads have ducts. Larva stage undergores degree of **Metamorphosis.** Sexual dimorphism may be present. Mostly **oviparous few viviparous.**

- Animals of **Arthropoda** are most **successful invaders of terrestrial** environment in invertebrates due to presence of (1) **Cuticle** (2) **Appendages** (3) **Wings**

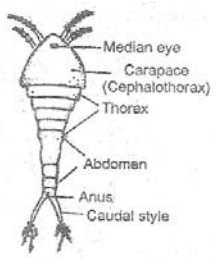
UNIQUE FEATURES

- Jointed appendages modified for a variety of functions.
- Tough, jointed exoskeleton of chitinous plates.
- Tracheae for respiration in majority of cases.
- Compound eyes.
- Malpighian tubules for excretion.
- Power of flight in most insects.
- Striped muscles arranged in bundles for moving particular parts.

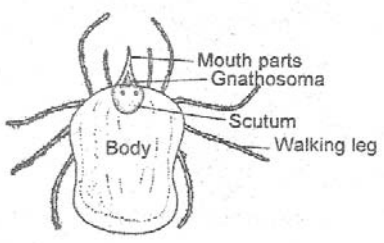
WITNESS FEW ARTHROPODS



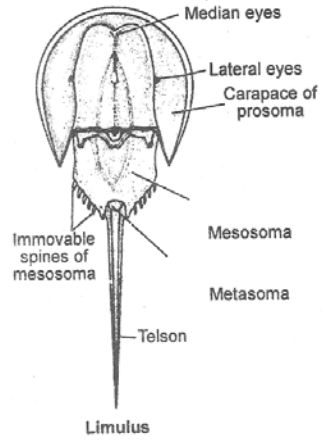
Spider



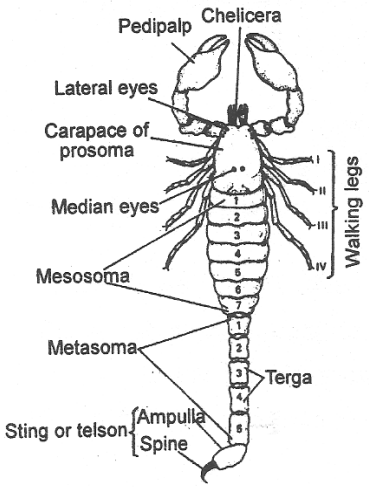
Cyclops



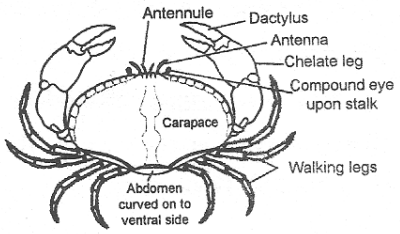
Boophilus (Cattle Tick)



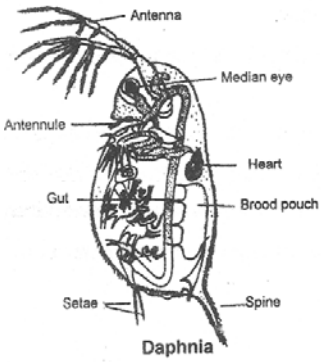
Limulus



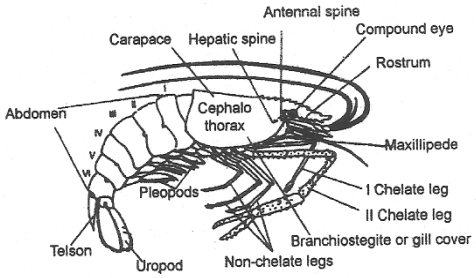
Palamnaeus



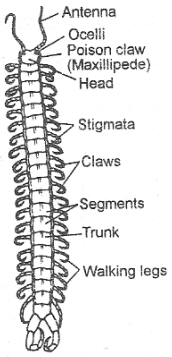
Crab (genus Cancer) - Dorsal view



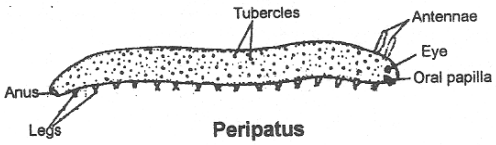
Daphnia



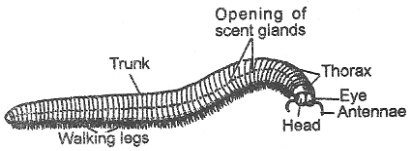
Palaemon



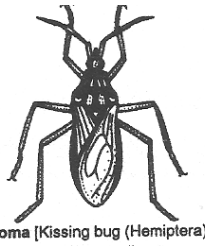
A Centipede (dorsal view)



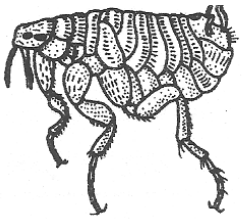
Peripatus



Millipede



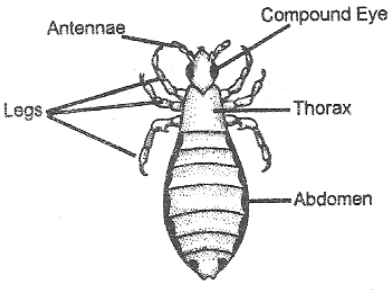
Triatoma [Kissing bug (Hemiptera)] vector of Chagas disease



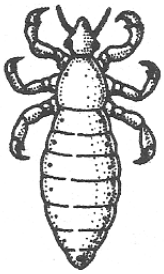
Oriental Rat flea (Siphonapter vector of bubonic plague



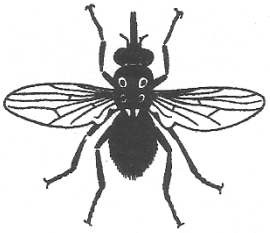
Deer fly (Diptera), vector of tularemia



Pediculus (Human head louse)



Bed bug, vector of typhus, relapsing fevers



Tsetse fly (Diptera), vector of African sleeping sickness



Sand fly, (Diptera) vector of kala-azar and oriental sore

PHYLUM - MOLLUSCA

- It is **second largest** Phylum.

- Mollusca (Soft bodied) are **marine.** some are also found in **fresh water** or on **land.**
  Jonhston coined the name **Mollusca.**

- Study of this phylum is known as **Malacology** & study of shell of molluscan is known as **Chancology.**

- Body is unsegmeneted with variety of shapes. ***Neopilina*** is exceptionally segmented.

- Molluscns are usually **bilateral.** Few are secondarily **asymmetrical** (snail) due to twisting (Torsion) during growth. These are **triploblastic** with **Organ system** level.

- **Body wall** includes one layered epidermis (usually ciliated) with unstriped muscles found in bundles.

- Body parts consist of
  (1) **Head** with sense organ. Head is absent in Pelecypod.
  (2) Dorsal **visceral mass** containing organs system
  (3) **Ventral foot** for locomotion.
  (4) Thin fleshy fold or outgrowth of dorsal body wall coveres the body. This fold is called **mantle or pallim.**
  It encoloses a space mantle or pallial cavity between itself and the body.
  The mantle usually secretes as external limy **shell**. Shell is made up of **Calcium carbonate and Choncheolin protein.**
  Shell may also be internal (Cattle fish), reduced and even absent **(Octopus)**

- **Coelom** is greatly **reduced.** It is presented by cavities in the **pericardium kidneys** and **gonads.** Space among the viscera contain blood and form **haemocoel.**

- **Digestive tract** is complete. Buccal cavity contain a rasping organ the **Radula.** with transverse row of teeth. Anus pens into the mantle cavity. Digestive glands are known as **hepatopancrease.**

- **Respiration** is usually by **bills.** i.e. **Ctenidia** are in the mantle cavity but respiration may takes pace by **body surface** also. **Dentalium** respire by **Mantle. Pila** respire by **polmonary sac** on land and by **gills** in water.

- **Circulatory system** is **open.** It includes dorsal pulsatile heart and a few arteries that open into sinuses.
  Cephalopoda has **closed** type of circulatory system
  Blood has a copper containing, blue respiratory pigment **Haemocyamin.** Blood is colourless with ameobocytes.

- **Excretory system** includes 1 or 2 pairs of sac like **kidneys,** which open into the mantle cavity. Kidney of molluscans are **Metanephridia** known as **Kaber's organs** or **Organ of Bojanus.** Excretory metter is **ammonia** or **uric acid.**

- **Nervous system** comprises three paired **ganglia**
  (1) **Cerebral** (above the mouth) (2) **Pedal** (in the foot) (3) **Visceral** (in visceral mass)
  These are inter connected by (1) **Commissure** (Joins similar ganglia)
  (2) **Connective** (Joins dissimilar ganglia)

  Senses organ included
  (1) **Eye -** Present over a stalk called **ommatophore** (Gastropoda).
  (2) **Statocyst/Lithocyst -** For equilibrium in foot
  (3) **Osphradia -** Chemoreceptor/Olfactory as well as for testing chemical & physical nature of water.

- **Sexes** usually **separate** (snail has ovotestis). Gonads have ducts. Fertilization may be **external** or **internal.**
  Cleavage is **spiral, determinate, unequal** and **holoblastic.**
  Development is - **Direct** or **indirect. Trochophore** is very common larva of Mollusca phylum. Larva **Glochidium** (Fresh water mussel) and **Veliger, (Pila)**

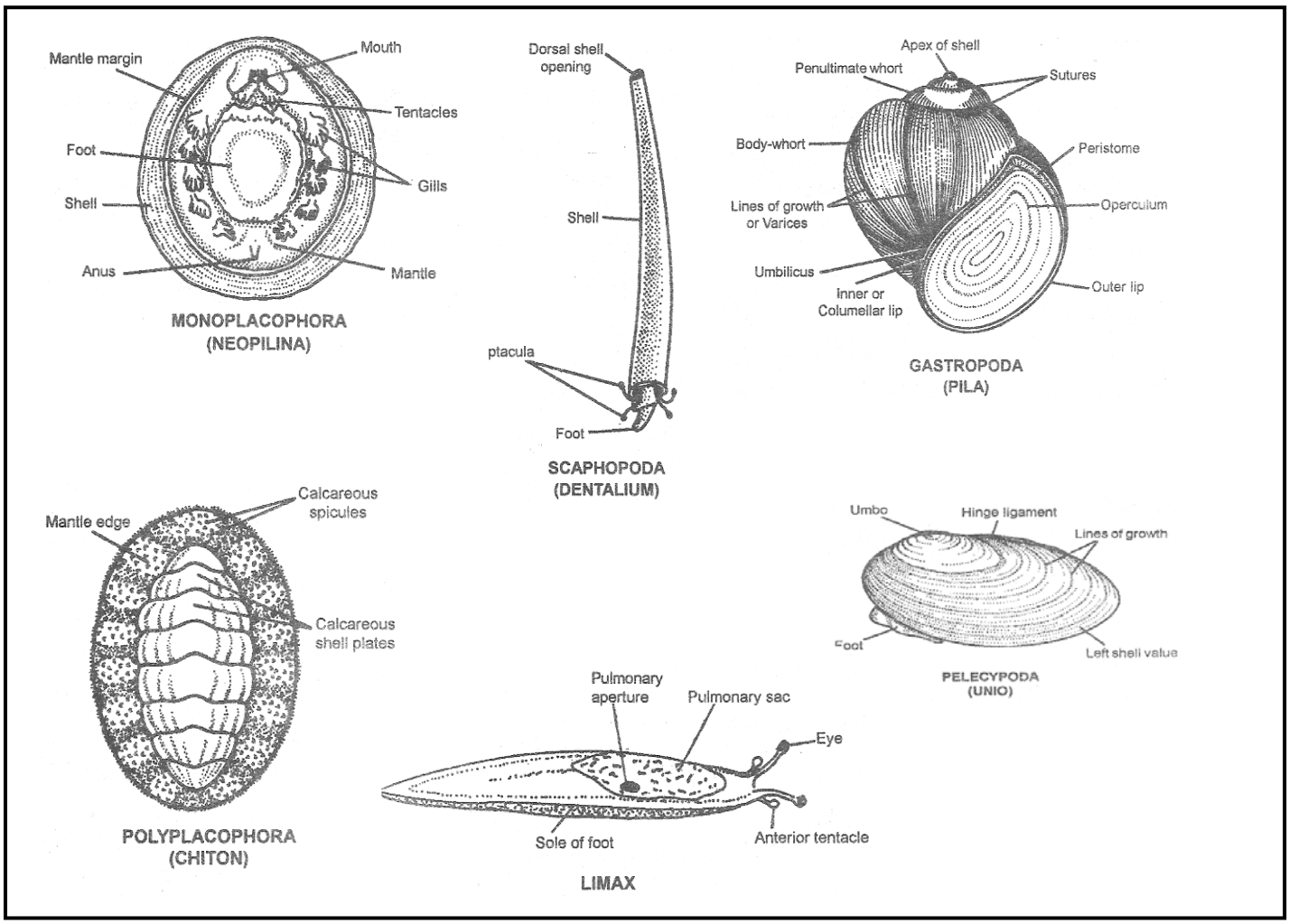
UNIQUE FEATURES

Precious pearl of the size of tennis - balls is made by a mollusc - **Tridekna**
"Nacre layer" is called **"Mother of Pearl":** This layer is made up of $CaCO_3$ and choncheolin protein.
Father of pearl industry - **Kokichi Mikimoto**
Molluscs are classified on the basis of shell, Foot, Nervous system and Gills into seven classes.

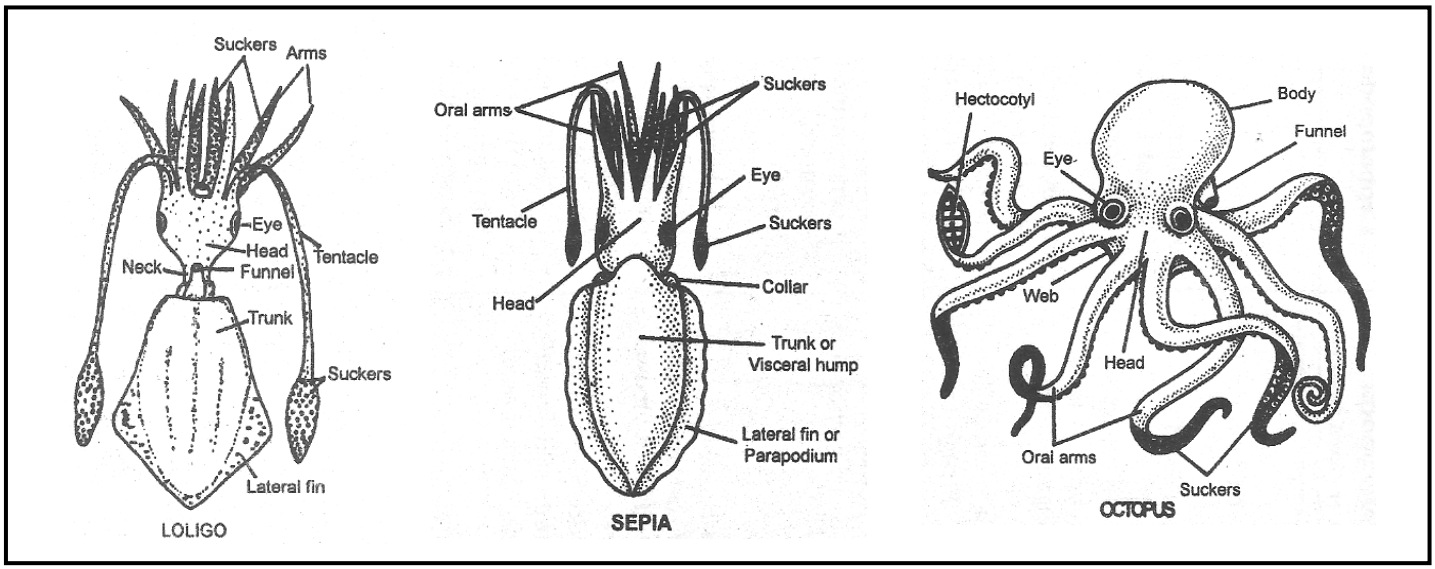
UNIQUE FEATURES

- Three body regions : head, visceral mass and foot
- A glandular fold, the mantle, over the body.
- Mantle cavity with anal, excretory and genital apertures in it.
- Calcareous shell around the body in most cases.
- A rasping organ, the radula, in the buccal cavity.
- Much better sense organs, such as eyes, statocytsts, osphradia, etc.

WITNESS FEW MOLLUSCS



Monoplacophora	**Aplacophora**	**Polylocophora/Amphineura**	**Scaphopoda**	**Gastropoda**	**Pelecypoda Bialvia or Lamellibranchia**	**Cephalopoda**
- Marin, common Character of Annelida and Arthropoda Body – Bilaterally symmetrical and segmented. Head - Indistinct Shell - Dome - shaped with mantle Radula - Present Foot - Flat muscular Larva-Trochopore e.g. - **Neopilina** Living fossils Connecting link of Annelida and Molluca and onlysegmented mollusc with nephridia.	- Marine, Worm like Body - Small covered by thick mantle Head - Small without eyes & tenticles Shell- Absent. Radula- Present Foot- Reduce / Absent Larva-Trochophore e.g. - **Neomenia**	- Marine Body - Bilateral Head - reduced without eyes and tentacels Shell - Present or absent. 8 dorsal plates present (Multivalved) Radual - Present Foot - Reduce/absent. Larva - Trochophore e.g. **Chiton** - The coat of small shell (Sea-mica) **Chaetopleura** *Name **Amphineura** was given by **Vonlhering**	-Marine Bod -Bilateral Head- absent Shell-ubular, open at both end. Radula- Present Foot- Conical and use for digging. Larva-Trochophore e.g. **Dentalium** - Tusk shell (Respire by mantle)	- Marine/fresh waster/moist soil Body- Symmetrical embryo grows into an asymmetrical adult due to twisting/torsion of visceral mass during development, mouth & anus lies on same side Head-With yes & tentacles. Shell - Spirally coiled Radula - present Root - Large & flat -Larva- Trochophore or Veliger e.g. **Pila** - Apple-snail (Shell used in buttons) **Cypraea** - Old currency **Limex** - Slug (shell less) **helix** **Turbinella** - Shankh **Turbo** - Bat's eye **Doris** - Sea lemon **Aplysia** - Sea hare **Planorbis** - Land snail **Lymnea** - Land snail **Actatina** - Land snail **Achatina** - Land snail **Xancus** - Holy chank **Potella** - Limpet **Fissurella** - Keyhole limpet	-Marine / fresh water Body - Bilateral and flat Head - Absent Shell - Consist of two valves movably hinged dorsally Radula - Absent Foot Plough or Wedge shaped for burrowing Redula-absent Larva-lochidium Trochophore e.g. **Unio -** Mussel (fresh water) **Mytilus-**Mussel (marine) **Lamellidens** – (mussel) **Ostrea** **Tered-** Ship worm **Pinctada –** Pearl oysters **Pteria -** Indian Preal oyster **Spondilus –** Edible oyster **Tridekna -** Highest economic value **Pecten-**Scallop **Cardium-** Jumping ivalvia **Soeln -** Blade fish	-Marine Body - Bilateral head & foot combined cephalopoda Shell - Internal and reduced it may be external (Nautilus) or absent (Octopus) Redula- Present Foot - Modified into a funnel and partly into 8 or 10 sucker bearing arms that surround the mouth. Exhalant siphon -Closed blood circulation -Discharge Ink gland for defence -Hectocotyle for sperm transfer -Lava absent e.g. **Sepia** - Cuttle fish 10 arms having Chromatophires **Tethys -** Sea fly **Loligo** - Squid (redula absent) **Architeuthis** - Giant squid (Largest invertebrate) **Octopus –** Devil fish 8 arms **Nautilus**



PHYLUM - ENCHINODERMATA

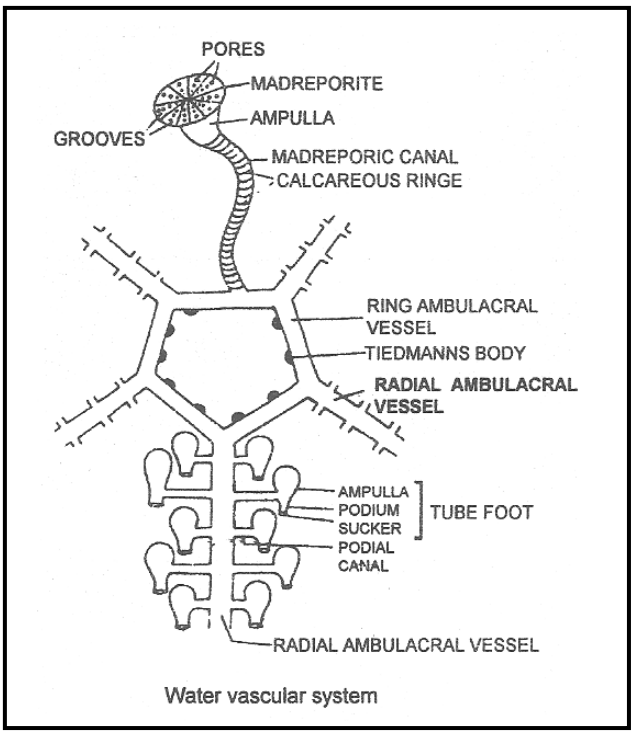
- Name **Echnodermata** was given by **Jabab Klein**
  All are **Marine** except Synapta similis.
  Generally live at **bottom** and show moving.
- Body shape is **star like, cylindrical like, melon-like disc-lime flower like.**
  Body unsegmented with **bilateral symmetry** is larva and **radial pentamerous** (arranged in five or multiple) in adult.
  Echinoderms are **triploblastic** with **organ - system level** of organisation
- Echinoderms do not have **head.**
  Tube feet (podia) with comes out through radial area i.e. **Ambulacral** used for locomotion. They are and retracted by variation in **hydraulic pressure** of fluid in them and by contraction of their muscles.
- **Body wall** of echinoderms consists of

(1) **Epidermis :** Single layered & ciliated.

(2) **Dermis -** Below the epidermis thick dermis having **mesodermal endo skeleton** of calcareous plate (Ossicles). In has spines

(3) **Muscles -** Smooth and lie below dermis.
Minute pincerlike structure **pedicellariae** comes out through skin. They keep body surface clear of debris by opening & closing.

- Echinoderms have true **Coelom** lined by **ciliated mesothe lium. Enterocoeleus** contains fluids with free amoeboid cells called **coelomocytes.**
- Coelom is divided into many tubes and sinuses , which together form **3 systems.**



Water vascular system

(1) A unique water filled **ambulacral** or **water vascular system** with tube feet to help in locomotion. A
perforated plate **madreporite** permits entry pf water into ambulacra system which also helps in food
and gas transport system. Structures like Pollian vesicle, Tiedemann body or recompose, stone canal
are also found in water vascular system.

(2) **Haemsal system.**

(3) **Perihaemal system.**

- **Respiration** takes place by **gills** called **dermal branchiae** or populae in most Echinoderms like Starfish. By **genital bursea** in Brittle star, By **cloacal respiratory trees** Sea Cucumber, by **Peristomial gills -** Sea urchin
  By tube feet in few echinoderms

- **Digestive tract** is **complete,** (incompletel - brittle star).
  Circulation system is reduced and **open type** called **haemal system** Perihaemal system. No heart or pumping vessel.

- There is not **excretory organ system.** Nitrogenous waste (ammonia) diffuses out via **gills bursea, reparatory trees and tube feet.** A amoeboid cells in coelomic fluid also perform excretory function by absorbing excretory mater.

- **Nervous system** is simple and premitive type includes a Nerve ring and radial nerve cord with simple sense organ. (No brain)

- Echinoderms resemble **chordates** in early embryonic development.

- Echinoderms have separate sexes.

- **Fertilization** is **external** (no copulation). Life history included ciliated, bilaterally symmetrical larva that undergoes metamorphosis and change into a adult (Deuterostome).

LARVA

Star fish	→	**Bipinnaria,**	→	**Brittle star**	→	**Ophioplutes**
Sear urchin	→	**Echonopluteus**	→	**Sea cucumber**	→	**Auricularia**
Father star	→	**Doliolaria**				

- Few echinoderms (star fish) have great power of **regeneration.** They brack of their arms for defence purpose. This phenomenon is known as **Autonomy.**

- Echinoderms in angry or frightened state vomits out viscera (internal organ). This phenomenon is known as
  Evisceration.

Heart urchin has lophophore (Ciliary structure)

Echinodermata has been Classified into -

(1)	Sub phylum - Enchinozoa	-	Class - Holothuroidea, Enchinoidea
(2)	Sub Phylum - Crinozoa	-	Class - Crinoidea.
(3)	Sub phylum - Asterozoa	-	Class - Asteroidea, Ophiuroidea.

UNIQUE FEATURES

- Bilateral symmetry in the larva and radial symmetry in the adult.

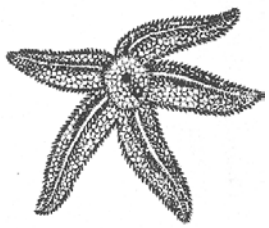
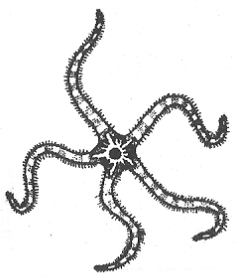
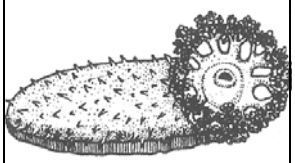
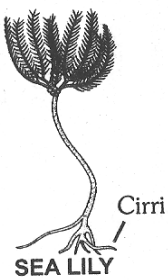
- Mesodermial endoskeleton of calcareous plates, usually with spines.

- Modification of a part of the coelom into a water vascular system for aid in locomotion.

- Characteristic tube feet for locomotion.

- Peculiar pedicellariae for cleaning the body surface.

Divided into Five classes.

Asteroidea	Ophiuroidea	Echinoidea	Holothuroidea	Crinoidea
Body form - Flat & star like. Arms - Five or multiple of five not sharply marked with the central disc Spines - Present Pedicellariae - Present Abmulacral groove - Situated at oral surface. Madreporite - at Aboral surface Anus - At aboral end. Viscera - Extend upto arms Respiration - Dermal branchiae or papulae Sucker-Present Larva - Bipinnaria or Brachiolaria **e.g.** **Asterias -** starfish **Solaster -** Sea star **Pentaceros -** Sea pentagon  STAR FISH	Body form - Flat & star like. Arms - Five or multiple of five Sharply marked with the central disc Spines - Present Pedicellariae - Absent Ambulacral groove - Not visible Madreporite - Oral Anus - Absent Viscera - No Viscera into arms. Respiraion - Genital bursea Suckers - Absent Larva - Ophiopluteus **e.g.** **Ophiothrix** (Brittle star) **Ophiura** **Gorgonocephalus** Basket  BRITTLE STAR	Body form- Globular/disc like. Arms - Absent Spenis - Present Pedicellariae - Present Ambulacral groove - Absent Madreporite - Aboral Anus - Aboral Viscera - No Viscera into arms. Repiration - Peristomium gills Suckers - Present Larva - Pluteus Mouth - with biting & chewing tooth apparatus **Aristotle's lantern** (Masticating apparatus with 5 teeth) **e.g.** **Echinus** sea urchin **Clypeaster -** Cake urchin **Echinarachinus -** sand dollar **Enchinocaradium -** heart urchin **Salmacis**  SEA URCHIN	Body form - Long & cylindrical Arms - Absent Spines - Absent Pedicellariae - Absent Ambulacral groove - Absent Madeportie - Internal Anus - Aboral Viscrera - No Viscera into arms. Respiration - Cloacal tree Suckers- Present Larva - Auticularia **e.g.** **Cucumaria -** Sea cucumber **Holothuria** **Synapta**  SEA CUCUMBER	Body form - Plant like fixed with cirri. Arms - Highly branched Spines - Absent Pedicellariae - Absent Ambulacral groove - Oral and ciliated Madreporite - Absent Anus - Oral Viscera - Extend upto arms Respiration -Tube feet Suckers - Absent Larva - Doliolaria **e.g. Antedon -** Sea lilly (most primitive) **Holopus** **Neometra -** Feather star  SEA LILY