

# DEPARTMENT OF ZOOLOGY

## B.N. COLLEGE BHAGALPUR

T.M. BHAGALPUR UNIVERSITY,  
BHAGALPUR- 812007



*Dr. Rajesh Kumar*  
Assistant Professor

Phone- 7677189610 (w.app)

7004072016 (R)

Email id- raju.km1987@gmail.com

### B.Sc. Zoology Part- I

### CHARACTERS AND CLASSIFICATION OF ECHINODERMATA

#### DIFINITION

*“The echinoderms are enterocoelous coelomates with pentamerous radial symmetry, without distinct head or brain having a calcareous endoskeleton of separate plates or pieces and a peculiar water vascular system of coelomic origin with podia or tube-feet projecting out of the body.”*

#### GENERAL CHARACTERS

- The echinoderms are exclusively **marine** and are among the most common and widely distributed of marine animals.
- They occur in all seas from the intertidal zone to the great depths.
- Symmetry usually radial, nearly always pentamerous.
- Body is triploblastic, coelomate with distinct **oral** and **aboral** surfaces and without definite head and segmentation.
- They are of moderate to considerable size but none are microscopic.
- Body shape rounded to cylindrical or star-like with simple arms radiating from a central disc or branched feathery arms arise from a central body.
- Surface of the body is rarely smooth, typically it is covered by five symmetrically spaced radiating grooves called **ambulacra** with five alternating **inter-radii** or **inter-ambulacra**.
- Body wall consists of an outer epidermis, a middle dermis and an inner lining of peritoneum.
- Endoskeleton consists of closely fitted plates forming a shell usually called **theca** or **test** or may be composed of separate small ossicles.
- Coelom is spacious lined by peritoneum, occupied mainly by digestive and reproductive system and develops from embryonic archenteron, i.e., **enterocoel**.
- Presence of **water vascular** or **ambulacral system** is the most characteristic feature. It consists of tubes filled with a watery fluid.

- Alimentary tract is usually coiled tube extending from the mouth located on the oral surface to the anus on the aboral or oral surface.
- Circulatory or haemal or blood lacunar system is typically present.
- Respiration occurs through a variety of structures, i.e., papulae in starfishes, peristomial gills in sea urchins, genital bursae in brittle stars and cloacal respiratory trees in holothurians.
- Excretory system is wanting.
- Nervous system is primitive, consisting of networks concentrated into the radial ganglionated nerve cords.
- Sense organs are poorly developed.
- Sexes are usually separate (dioecious) with few exceptions. Gonads are simple with or without simple ducts.
- Reproduction is usually sexual, few reproduce asexually or by regeneration.
- Fertilization is external, while few echinoderms are viviparous.
- Development is indeterminate including characteristic larvae which undergo metamorphosis into the radially symmetrical adults.

## CLASSIFICATION

The classification is adopted from [Hyman, L.H. \(1995\)](#).

### SUBPHYLUM I: PELMATOZOA

(Gr; *pelmatos*= stalk + *zoon*= animal)

- Mostly extinct echinoderms.
- Body is attached by the aboral surface or by an aboral stalk.
- Mouth and anal aperture present on the oral surface facing upwards.
- Viscera is enclosed in a calcareous test.
- Tube feet or podia are primarily food catching and devoid of suckers.
- Main nervous system is aboral.
- Pelmatozoa has only one living class.

### CLASS 1: CRINOIDEA

(Gr; *crinon*= lily + *eidon*= form)

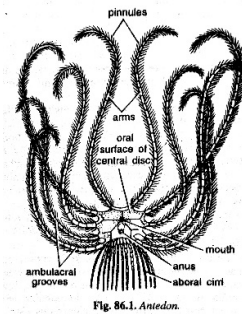
- Both extinct and living forms.
- Living members are without stalk and free moving but extinct forms attached by a stalk.
- Body consists of an aboral cup, the **calyx** and oral cover or roof, the **tegmen** and strongly pentamerous in structure.
- Oral surface is directed upwards.
- Mouth usually central anus usually eccentric are present on the oral surface.
- Arms movable, simple, mostly branched, usually five or ten in number with or without pinnules.
- Ambulacral grooves are open and extend along arms and pinnules to their tips.

- Madriporite, spines and pedicellariae are present.
- Sexes are separate. Larva doliolaria.
- Commonly called **sea lilies** or **feather stars**.

### Order 1: Articulata

- Extinct and living crinoids.
- Calyx pentamerous, flexible incorporating the lower arm ossicles.
- Tegmen leathery containing calcareous particles or small plates.
- Mouth and ambulacral grooves exposed.

**Example:-** *Antedon*, *Rhizocrinus*, *Metacrinus*.



### SUBPHYLUM II: ELEUTHEROZOA

(Gr; *eleutheros*= free + *zoon*= animal)

- Mostly living echinoderms.
- Stem or stalk absent, usually free living forms.
- Body structure usually pentamerous.
- Oral surface bearing the mouth is downward or lying on one side.
- Anus usually on the aboral surface.
- Ambulacral grooves usually not for food gathering and the tube feet with suckers are chiefly locomotory organs.
- Main nervous system is oral.

### CLASS 1: HOLOTHUROIDEA

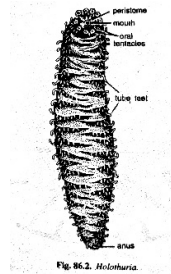
(Gr; *holothurion*= water polyp + *eidos*= form)

- Body bilaterally symmetrical, usually elongated in the oral-aboral axis having mouth at or near one end and anus at or near the other end.
- Body surface is coarse.
- Endoskeleton reduced to microscopic spicules or plates embedded in the body wall.
- Mouth surrounded by a set of tentacles attached to water vascular system.
- Podia or tube feet are usually present and locomotory.
- Alimentary canal is long and coiled and cloaca usually with respiratory trees.
- Sexes are separate and gonad single or paired tufts of tubules.
- Commonly called sea **cucumbers**.

### Order 1: Aspidochirota

- Podia or tube feet are numerous.
- Mouth is surrounded by 10-30 mostly 20 peltate or branched oral tentacles.
- Retractor muscles of pharynx are absent.
- A pair of well-developed respiratory trees is present.

**Example:-** *Holothuria*, *Stichopus*, *Mesothuria*.



### Order 2: Elaspipoda

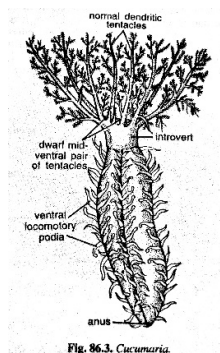
- Numerous podia or tube feet.
- Mouth is usually ventral and surrounded by 10-20 peltate or branched tentacles.
- Oral retractors absent.
- Respiratory tree is absent.

**Example:-** *Deima*, *Benthodytes*.

### Order 3: Dendrochirota

- Podia or tube feet are numerous.
- Oral tentacles are dendritic or branched or branched like tree branches.
- Oral retractors are absent.
- Respiratory trees are present.

**Example:-** *Thyone*, *Cucumaria*, *Phyllophorus*.



### Order 4: Molpadonia

- Podia or tube feet are absent except as anal papillae.
- Oral tentacles are digitate or finger-shaped.

- Oral retractors are present.
- Posterior region is generally tapering into a caudal portion.

**Example:-** *Molpadia*, *Paracaudina*.

### Order 5: Apoda

- Body vermiform having smooth or watery surface.
- Podia or tube feet are absent.
- Oral tentacles are 10-20, simple digitate or pinnate.
- Pharyngeal retractors are present in some forms.
- Water vascular system is greatly reduced.

**Example:-** *Synapta*, *Chiridoata*.

## CLASS 2: ECHINOIDEA

(Gr; *echinos*= hedgehog + *eidōs*= form)

- Body is spherical, disc-like, oval or heart shaped.
- Body is enclosed in an endoskeletal shell or test of closely fitted calcareous plates covered with movable spines.
- Outer calcareous plates are distinguished into five alternating ambulacral and five inter-ambulacral areas.
- Podia or tube feet come out from the pores of ambulacral plates and are locomotory in function.
- Mouth is centrally placed on the oral surface and surrounded by a membranous peristome. Anus is located at the aboral pole and surrounded by membranous **periproct**.
- Ambulacral grooves are absent.
- Pedicellariae are stalked and three jawed.
- Sexes are separate. Gonads are pentamerous.
- Development includes a free swimming **echinopluteus larva**.
- Commonly called **sea urchins** and **sand dollars**.

### SUBCLASS I: BOTHRIOCIDAROIDA

- Each inter-ambulacral is with single row of plates.
- Madreporite radially placed.
- Typical lantern absent.
- Includes a single **extinct** Ordovician genus.

**Example:-** *Bothriocidaris*.

### SUBCLASS II: REGULARIA

- Body is globular, mostly circular and sometimes oval in shape.
- Symmetry is pentamerous with two rows of inter-ambulacral plates.
- Mouth is centrally located at the oral surface and surrounded by peristome.

- Anus is centrally placed at the aboral pole surrounded by periproct.
- Aristotle lantern is well developed.
- Madreporite is ambulacral.

### Order 1: Lepidocentroida

- Test flexible with overlapping or separated plates.
- Ambulacral plates continue up to mouth lip.

**Example:-** *Phormosoma*, *Sperosoma*.

### Order 2: Cidaroidea

- Test is rigid and globular.
- Two rows of long narrow ambulacral plates and two rows of inter-ambulacral plates are present.
- Ambulacral and inter-ambulacral plates continue up to mouth lip.
- Gills and sphaeridia are absent.
- Five bushy **Stewart's organs** are present appended to the lantern.

**Example:-** *Cidaris*, *Notocidaris*.

### Order 3: Autodonta

- Test is symmetrical and globular.
- Test composed of two rows each in a ambulacral and inter-ambulacral plates.
- Ambulacral and inter-ambulacral plates reach up to the margin of peristome.
- Gills and sphaeridia are present.
- Teeth of Aristotle's lantern are devoid of keel

**Example:-** *Diodema*, *Astropyga*.

### Order 4: Camarodonta

- Test is rigid and rarely oval.
- Epiphyses of lantern are enlarged and meeting above the pyramids.
- Teeth are keeled.
- All the four types of pedicellariae are present.

**Example:-** *Echinus*, *Strongylocentrotus*.

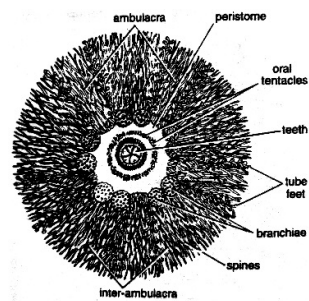


Fig. 86.5. *Echinus*. A—Oral view

### SUBCLASS III: IRREGULARIA

- Test is mostly flattened oval to circular.
- Symmetry is bilateral.
- Mouth centrally placed on the oral surface.
- Anus is displaced posteriorly generally marginal at oral aboral surface and lies outside the apical system of plates.
- Podia or tube feet are not locomotory.

#### Order 1: Clypeastroida

- Test is flattened, oval or rounded in shape covered with small spines.
- Mouth and apical system are usually central and oral in position.
- Aboral ambulacral areas petaloid.
- Aristotle's lantern present
- Gills are absent.

**Example:-** *Clypeaster*, *Laganum*.

#### Order 2: Spatangoida

- Test is oval or heart-shaped.
- Four aboral ambulacral areas petaloid, fifth not petaloid.
- Aristotle's lantern absent.

**Example:-** *Spatangus*, *Lovenia*, *Echinocardium*.

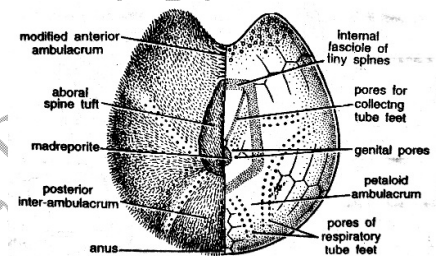


Fig. 86.7. *Echinocardium*.

### CLASS 3: ASTEROIDEA

(Gr; *aster*= star + *eidos*= form)

- Body is flattened, pentagonal or star shaped.
- Oral and aboral surfaces are distinct, the oral surface directed downwards and aboral surface upwards.
- Five to fifty long or short rays or arms radiating symmetrically from a central disc.
- Mouth is centrally placed at the oral surface surrounded by a membranous peristome.
- Anus is small and inconspicuous located more or less eccentrically on the aboral surface.

- Ambulacra form prominent grooves provided with podia or the feet.
- Ambulacra are restricted to oral surface extending from the peristome to the tips of the arms.
- Endoskeleton is flexible, made of separate ossicles.
- Pedicellariae are small, movable spine-like always present.
- Respiration by papulae.
- Sexes separate, gonad radially arranged
- Development includes **bipinnaria** or **brachiolaria** larva.
- Commonly called **star fishes** or **sea stars**.

### Order 1: Phanerozonia

- Arms are provided with two rows of conspicuous marginal plates.
- Oral plates are inframarginal and aboral plates are supra-marginal.
- Pedicellariae are alveolar or sessile type.
- Podia or tube feet are arranged in two rows.
- Mouth frame is well developed and adambulacral type.

**Example:-** *Luidia*, *Astropecten*, *Archaster*, *Pentaceros*.

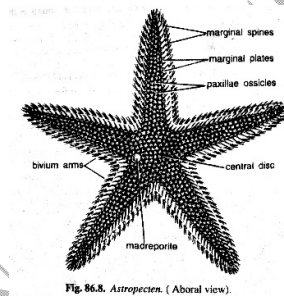


Fig. 86.8. *Astropecten*. (Aboral view).

### Order 2: Spinulosa

- Arms are generally without conspicuous marginal plates.
- Aboral skeleton is imbricated or reticulated with single or group of spines.
- Pedicellariae are rarely present.
- Podia or tube feet are in two rows provided with suckers.
- Mouth is adambulacral type.
- Ampullae single or bifurcated.

**Example:-** *Aesterina*, *Echinaster*, *Hymenaster*, *Solaster*.

### Order 3: Forcipulata

- Marginal plates are inconspicuous or absent.
- Aboral skeleton is mostly reticulate with conspicuous spines.
- Pedicellariae are pedunculated type with a basal piece.
- Podia or tube feet are arranged in four rows and provided with suckers.
- Papulae are on both surface.
- Mouth frame is of ambulacral type.



**Example:-** *Brisingaster, Heliaster, Zoraster, Asterias.*

#### CLASS 4: OPHIUROIDEA

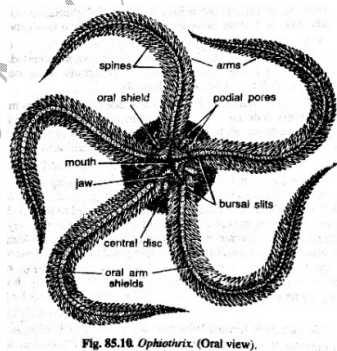
(Gr; *ophis*= serpent + *oura*= tail + *eidos*= form)

- Body is flattened with a pentamerous or rounded central disc.
- Oral and aboral surfaces are distinct.
- Arms usually five rarely six or seven are long, slender, smooth or spiny.
- Ambulacral grooves are absent.
- Anus and intestine are absent.
- Madreporite on the oral surface.
- Sexes are separate, gonads pentamerous.
- Development includes a free swimming pluteus larva.
- Commonly called **brittle stars**.

#### Order 1: Ophiuræ

- Arms are simple, mostly five in number, moving chiefly in transverse plane.
- Arm ossicles articulated by pits and projections.
- Disc and arms are usually covered with distinct shields or scales.
- Spines on arms are borne laterally and are directed outward or toward the arm tip, not downwards.
- Single madreporite.

**Example:-** *Ophioderma, Ophioscolex, Ophiothrix, Ophiopleie.*



#### Order 2: Euryolæ

- Arms are simple or branched, long and flexible, capable of coiling around objects and of rolling up in vertical plane.
- Ossicles of arms are articulated in streptospondylus manner.
- Disc and arms are without or poorly developed scales or shields.
- Spines are directed downwards often forming hooks or spiny clubs.
- One madreporite in each inter-radius.

**Examples:-** *Ateronyx, Astrophyton, Astoporpa.*

\*\*\*