# VIVEKANANDA COLLEGE THAKURPUKUR

# KOLKATA-700063

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| **TOPIC** | **: ECHINODERMATA** |
| **COURSE TITLE** | **: NON-CHORDATE IDENTIFICATION** |
| **PAPER** | **: ZOOA-CC2-3-P** |
| **UNIT** | **: STUDY OF SPECIMEN [ECHINODERMATA]** |
| **SEMESTER** | **: 2ND SEMESTER** |
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# Non-Chordate Identification


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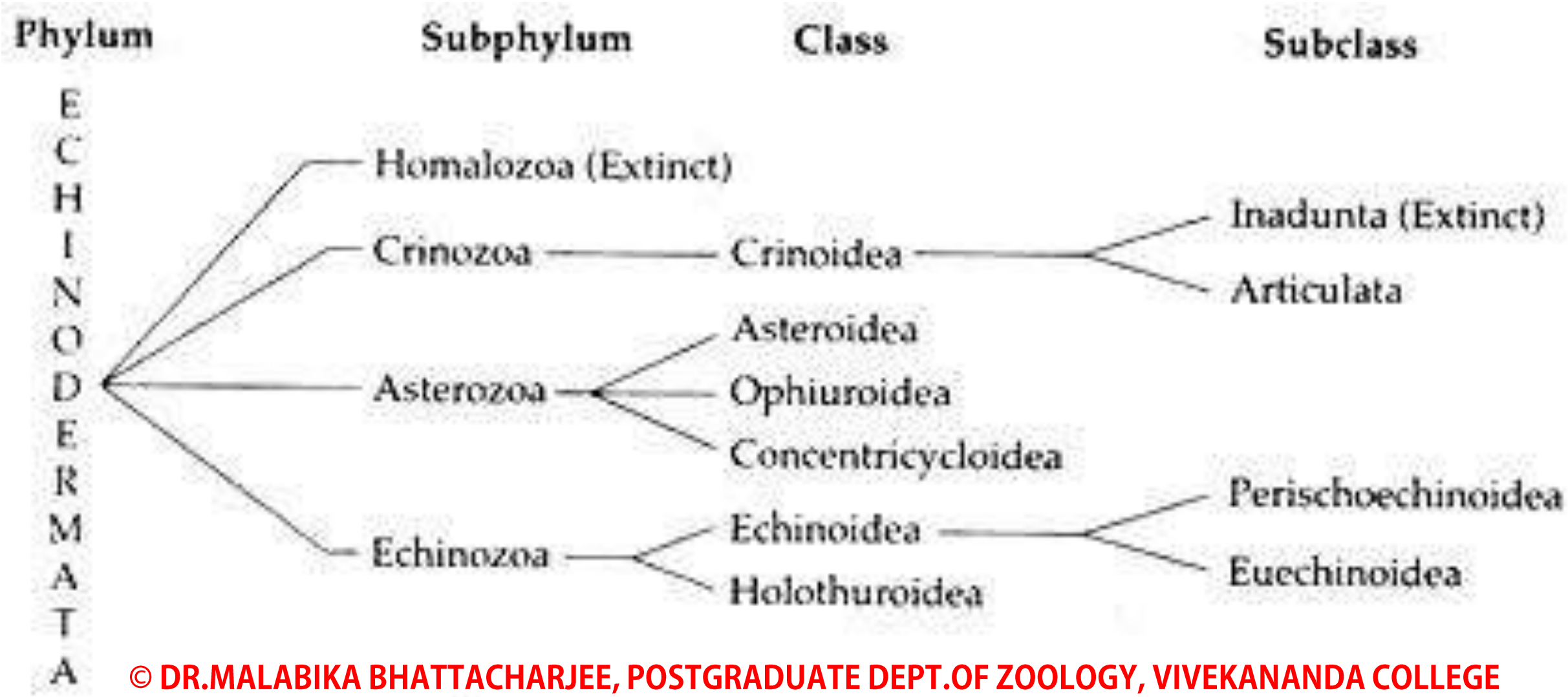
**REFERNCE:**


1. **Ruppert and Barnes, 1994.**
2. **Specimen Picture are taken from the specimens of the Museum of Zoology Department, Vivekananda College, Thakurpukur.**
3. **Practical Zoology-Ghosh Manna**
4. **Practical Zoology-Poddar**

# NON-CHORDATE ECHINODERM SYLLABUS

## *Asterias, Ophiura, Clypeaster, Echinus, Cucumaria and Antedon*

**The name Echinodermata was first coined by Jacob Klein in 1734. Later in 1801 Lamarck classified these group of animals. The scheme of classification presented here is based on the classificatory plan outlined by Ruppert and Barnes, 1994.**



**Etymology:**

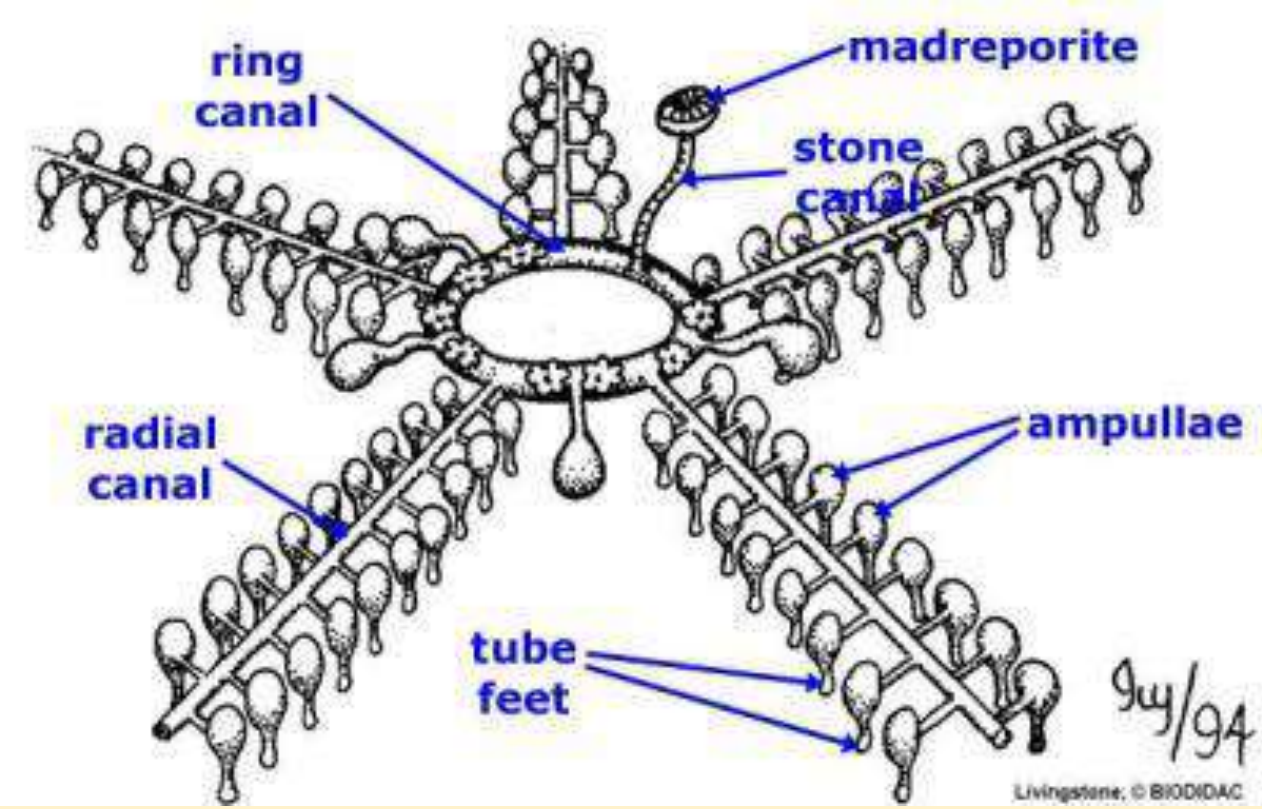
Greek: echinos, hedgehog; derma, skin.

**Diagnostic Features of Phylum Echinodermata:**

1. Exclusively marine forms.
2. Adults with radial and five-rayed symmetry [pentamerous radially symmetrical] while the larvae are bilaterally symmetrical.
3. Body distinguishable into oral and aboral surfaces and are without any differentiated head.
4. The surface of the body is covered by calcareous ossicles or plates, often bearing projecting tubercles or spines.
5. On the underside are five grooves called **ambulacra,** radiating from the mouth to the tip of the arms, with intervening inter-ambulacra.
6. Digestive canal is mostly a coiled tube with the anus placed on the aboral side.
7. A characteristic water vascular system of coelomic canals, which performs many functions.
8. Presence of tubular contractile tube feet or podia used as locomotory organ and/or feeding organ.
9. Haemal circulatory system poorly defined.
10. There are no definite respiratory and excretory systems.
11. Nervous system sub-epidermal, in the form of a circumoesophageal ring from which arises diffused nerve along each ambulacrum.
12. Usually gonochoristic. Reproduction is sexual. Gonads simple in nature. Fertilization external.
13. Eggs cleave radially.
14. Development deuterostomatous, characteristically indirect via ciliated, bilaterally symmetrical,' free swimming larval forms.

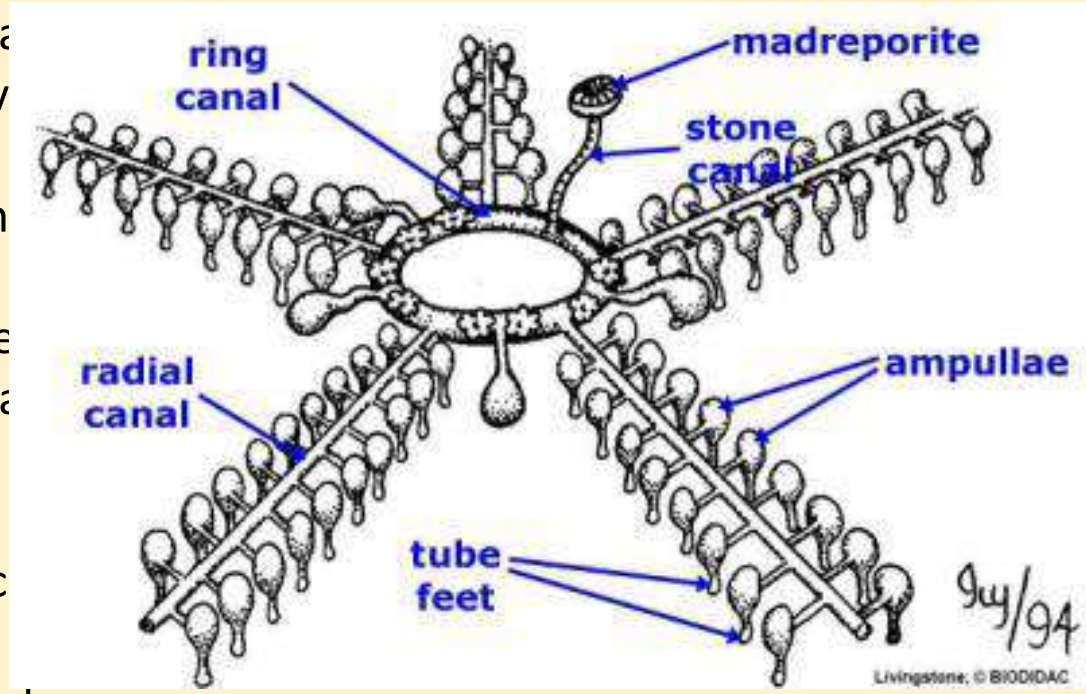
## Water Vascular System

1. The water vascular system of echinoderms is essentially a system of fluid-filled canals that extend along each of the body regions and have many external projections called tube feet.
2. There are several functions of the system, one of which is to use water pressure to mediate movement and assist in feeding.
3. It also carries out respiratory, excretory, and some circulatory functions within the animal.
4. The individual components of the water vascular system are the following:
    - •Madreporite.
    - •Stone canal.
    - •Circular ring canal.
    - •Radial canals.
    - •Lateral canals.
    - •Tube feet.



**Components of WVS**

1. The madreporite is a sieve-like, calcified plate that connects the system to the aquatic environment.
2. Water enters through the madreporite and flows through a tube, called the stone canal, that connects to the circular ring cana surrounding the mouth. From there, water can flow into fiv radial canals that branch off the circular ring.
3. The radial canals each extend into a different ray, or arm, of th organism along a groove called the **ambulacral groove.**
4. Numerous lateral canals, leading to rows of tube feet on eithe side of the ambulacral groove, branch from each side of the radia canals.




**Tube feet**

1. The tube feet extend between the endoskeletal plates to reac outside of the organism.
2. They are basically thin-walled cylinders with muscular bulb-shaped structures called **ampullae** on the internal end and suckered structures called **podia** on the external ends.
3. The tubular canals that make up the water vascular system are lined with **cilia.**
4. Cilia are small hair-like, cellular projections that beat back and forth repeatedly to help maintain water flow through the canals.

| | Specimen | Systematic position |
|---|---|---|
| 1. | ***Antedon* sp.** | Phylum - Echinodermata<br>Subphylum- Crinozoa<br>Class- Crinoidea<br>Subclass-Articulata<br>Genus-*Antedon sp* |

**Phylum Echinodermata:**

1. Radially and pentamerically symmetrical body.
2. Body distinguishable into oral and aboral surfaces and are without any differentiated head.
3. The surface of the body is covered by calcareous ossicles or plates, often bearing projecting tubercles or spines.
4. On the underside are five grooves called **ambulacra,** radiating from the mouth to the tip of the arms, with intervening inter-ambulacra.
5. Water vascular system present.
6. Presence of tubular contractile tube feet or podia used as locomotory organ and/or feeding organ.
7. Development indirect and free swimming larval forms.

**Subphylum Crinozoa:**

1. Radially symmetrical, possessing a cup- shaped theca and 5-10 brachioles or arms.
2. Mostly attached, with oral surface directed upwards, which contains both mouth and anus.
3. **Madreporit**e absent.
4. The cup shaped aboral side is called calyx.

**Class Crinoidea (Greek: lily-like):**

1. Stalked and free moving forms, the oral side of the body directed upwards.
2. Arms branched (10 to 200 or more) and bearing pinnules.
3. The ambulacral grooves radiate from the mouth and extend to the tip of the pinnules.
4. Absence of **ampullae** to operate the podia.
5. Presence of a non-contractile aboral stalk, often bearing whorls of cirri, terminating in a disc for attachment.
6. The arms, body and stalk contain heavily calcified plates.

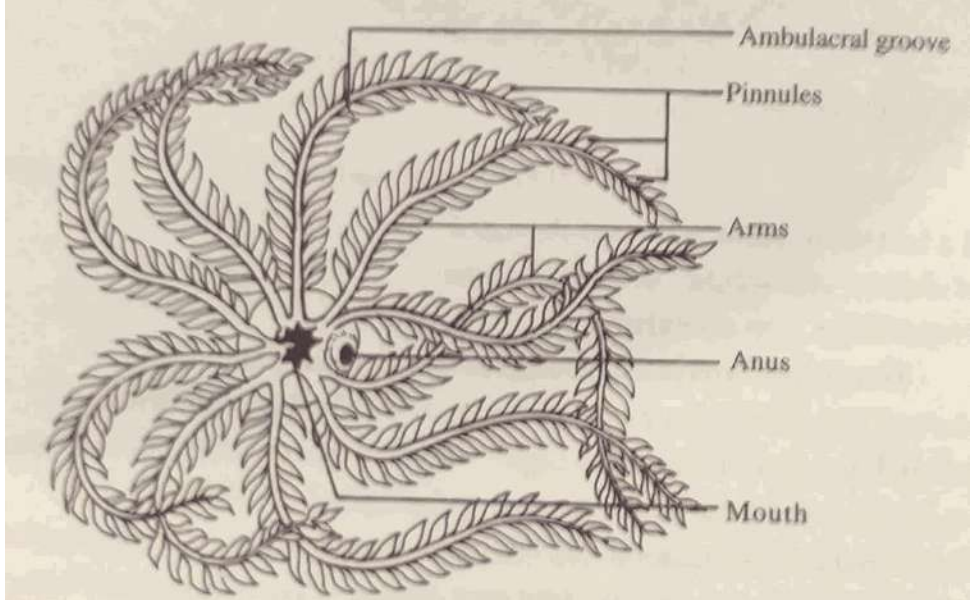



Fig. 1.73 : *Antedon* (Sea-lily)

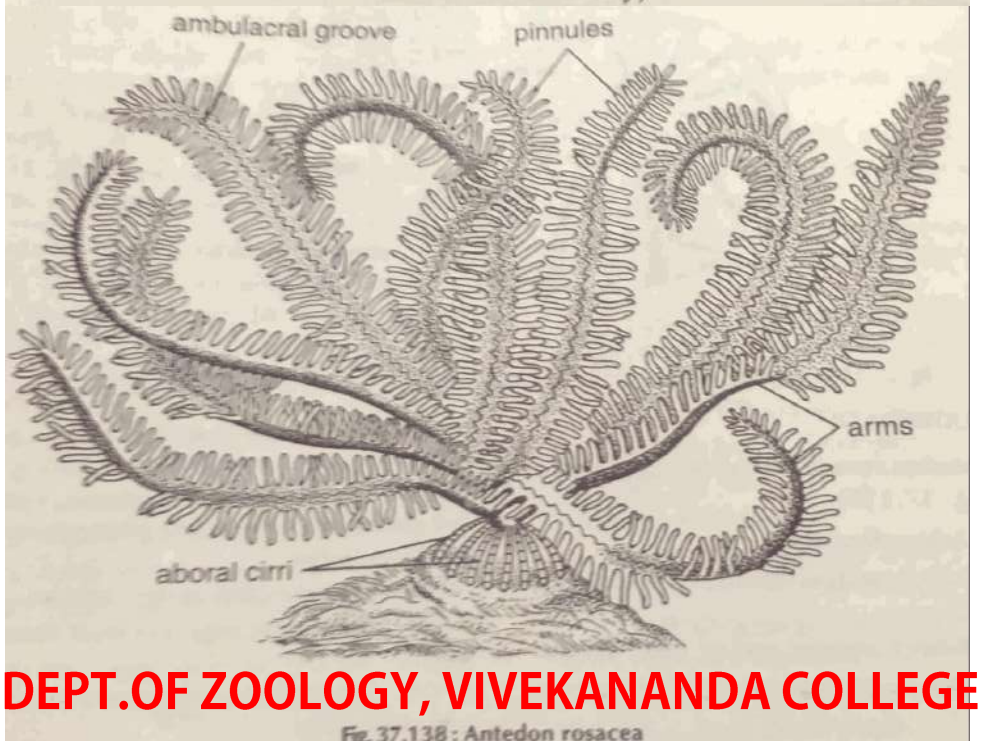



Fig. 37.138 : Antedon rosacea

## Subclass Inadunta (Extinct):

Stalked paleozoic crinoids with or without cirri and some without pinnules.

## Subclass Articulata:

1. Calyx dicylic.
2. Arm ossicles on the lower surface united with the calyx.
3. Ambulacra and mouth are open.
4. The arms bears pinnules and usually branched.
5. Stalked or stalk less.
6. With or without cirri.
7. It comprises of extinct as well as living crinoids;

**Examples:**

**Antedon (stalkless),** Metacrinus (with cirri), Rhizocrinus (without cirri).

1. Arms 10, elongated and slender, radiating form the central part of the body, the calyx.
2. Mouth and anus on the convex oral surface; arms and cirri inserted into the flat aboral surface.
3. Oral surface leathery with numerous calcareous plates.
4. Ambulacral grooves divide into 10 and lead into arms.
5. Ambulacral grooves send branches to each pinnule and contain tube feet.

-Hence the specimen is ***Antedon*** sp.

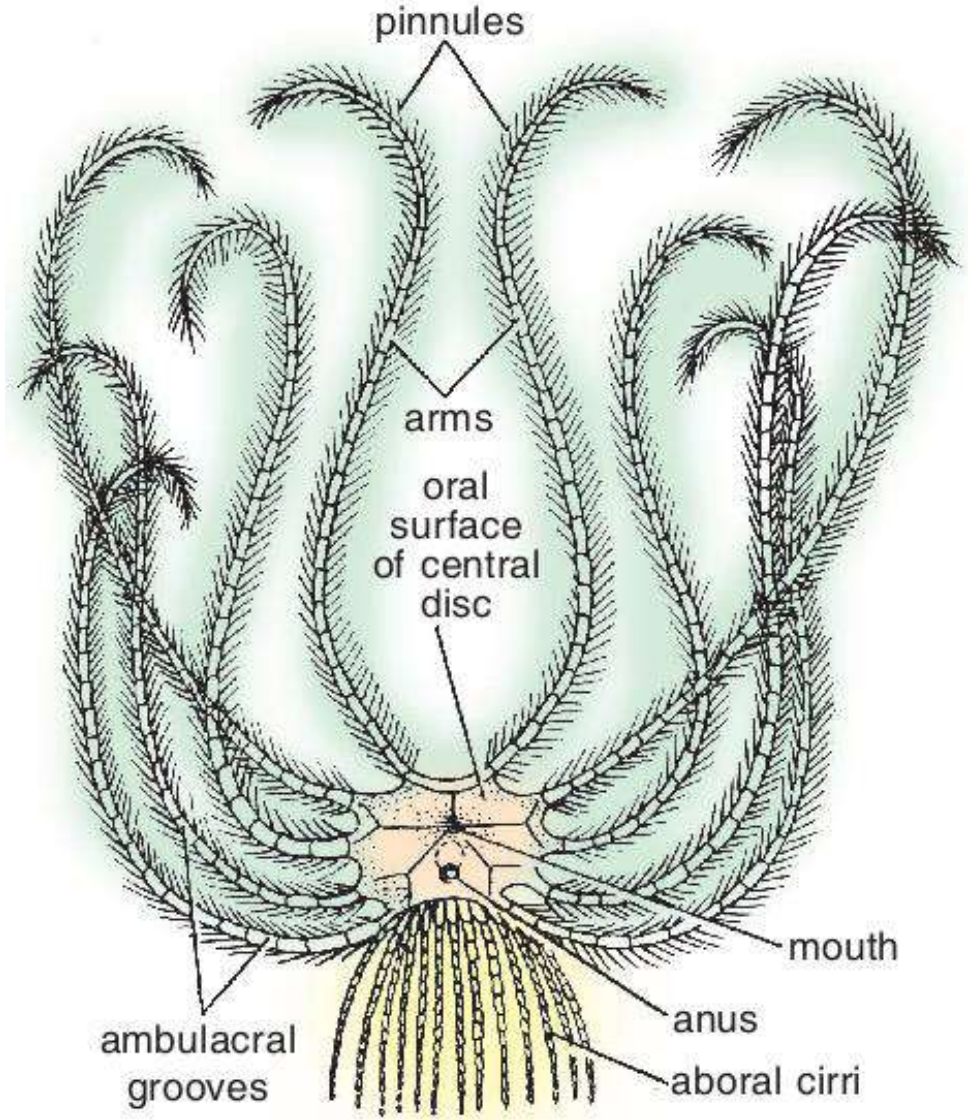



Fig. 86.1. *Antedon.*

| | Specimen | Systematic position |
|---|---|---|
| 2. | ***Asterias* sp.** | Phylum - Echinodermata<br>Subphylum- Asterozoa<br>Class- Asteroidea<br>Genus-*Asterias sp.* |
| 3. | ***Ophiura* sp.** | Phylum - Echinodermata<br>Subphylum- Asterozoa<br>Class- Ophiuroidea<br>Genus-*Ophiura sp.* |

**Subphylum Asterozoa:**

1. Radially symmetrical having a body composed of a flattened disc and radially arranged arms.
2. Body star shaped and remains unattached.
3. On the oral surface in the ambulacral groove, tube feet are present.

**Class Asteroidea (Greek: star-like):**

1. Arms not sharply set off from the central disc.
2. Ambulacral grooves are open and a large coelomic cavity is present in the arms.
3. Each ambulacral groove contains 2 or 4 rows of tube feet.
4. Tube feet with or without suckers.
5. Anus and madreporite are present on the aboral surface.

**Examples:**

**Asterias**, Astropecten, Heliaster, Platyasterias, Asterina

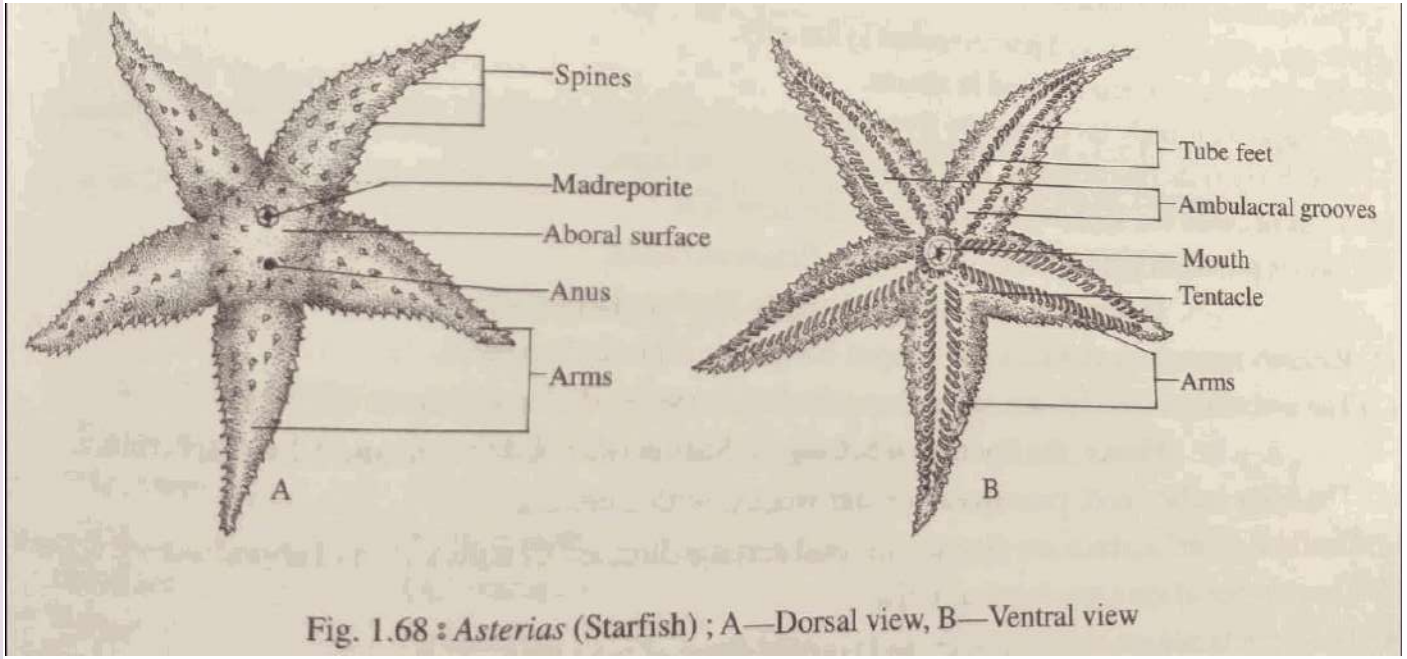



Fig. 1.68 : *Asterias* (Starfish) ; A—Dorsal view, B—Ventral view

1. Body consists of central disc and 5 radiating arms.
2. The oral and the aboral surfaces are distinct.
3. Aboral surface bears spines, asymmetrical and inter-radial madreporite, anus, branchiae and pedicellariae
4. Flat oral surface possess a central mouth, 5 ambulacral grooves, one in each arm.
5. Tube feet arranged in two rows, present in the ambulacral grooves.

-Hence the specimen is ***Asterias*** sp.

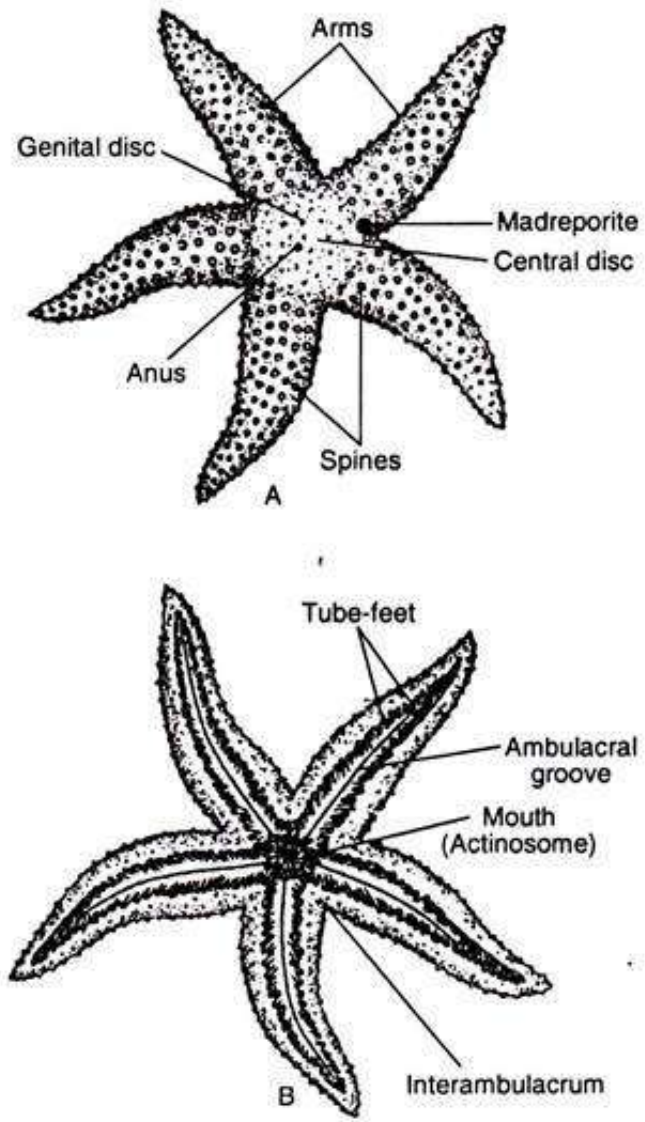



Fig. 21.2: External features of *Asterias*. A. Aboral view. B. Oral view.

**Subphylum Asterozoa:**

1. Radially symmetrical having a body composed of a flattened disc and radially arranged arms.
2. Body star shaped and remains unattached.
3. On the oral surface in the ambulacral groove, tube feet are present.

**Class Ophiuroidea (Greek: snake-like):**

1. Arms sharply set off from the central disc.
2. Absence of ambulacral groove and the arms are filled by vertebral ossicles.
3. Mouth and madreporite are situated on the oral surface of the body.
4. Anus lacking.

**Examples:**

**Ophiura**, Ophiothrix, Ophioderma, Ophionereis, Asteronyx.

1. The flat disc is covered by scales and radial shields.
2. Arms short to moderate with regular plates.
3. Arm combs continue to the oral side to merge into the genital papillae.

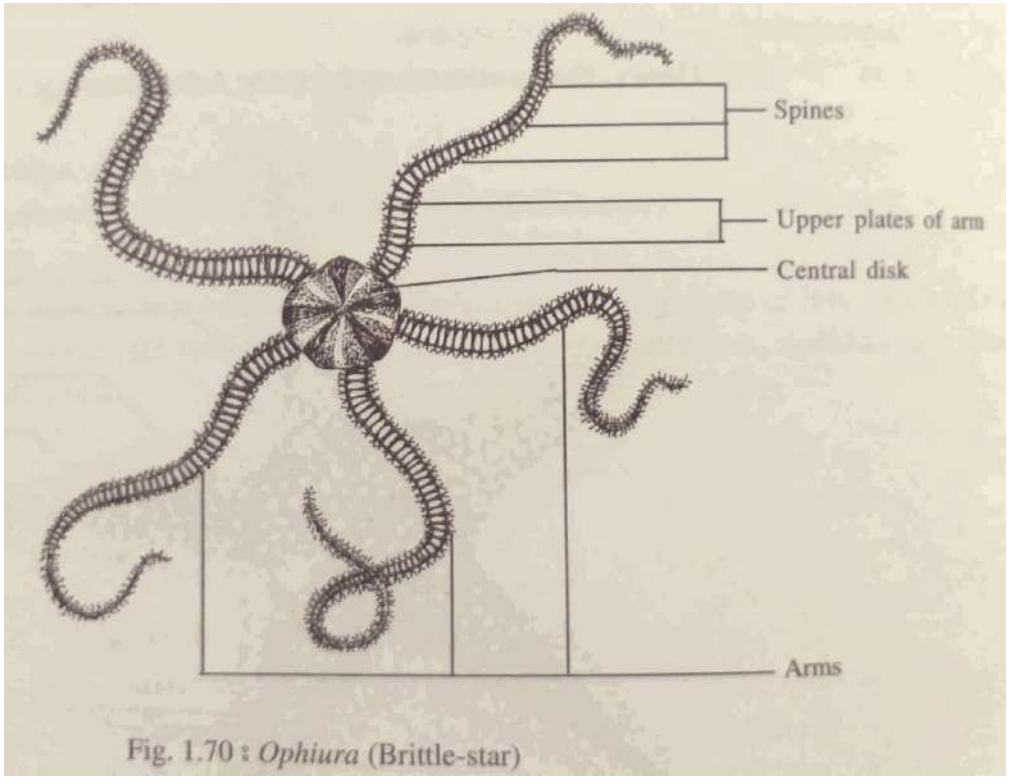


Fig. 1.70 : *Ophiura* (Brittle-star)

-Hence the specimen is ***Ophiura*** sp.

## Class Concentricycloidea (Latin: concentric ring):

1. Minute, with disc shaped body.
2. Body covered aborally with plate like ossicles.
3. Marginal spines are located around the periphery.
4. Water vascular system has two ring canals with the tube feet arising from the outer one.
5. Absence of arms but the passage of tube feet between ossicles ‘are like those of stelleroidea.

## Examples:

Xyloplax medusiformis , Xyloplax turnerae.

| | Specimen | Systematic position |
|---|---|---|
| 4. | *Clypeaster* sp. | Phylum - Echinodermata<br>Subphylum- Echinozoa<br>Class- Echinoidea<br>Subclass-Euechinoidea<br>Genus-*Clypeaster sp* |
| 5. | *Echinus sp.* | Phylum - Echinodermata<br>Subphylum- Echinozoa<br>Class- Echinoidea<br>Subclass-Euechinoidea<br>Genus-*Echinus sp* |

**Subphylum Echinozoa:**

1. Radially symmetrical, globoid or discoid, without arms or brachioles.
2. Remains unattached.
3. Madreporite and anus remain on the aboral side.
4. Mouth present on the oral surface.

**Class Echinoidea (Greek: spiny):**

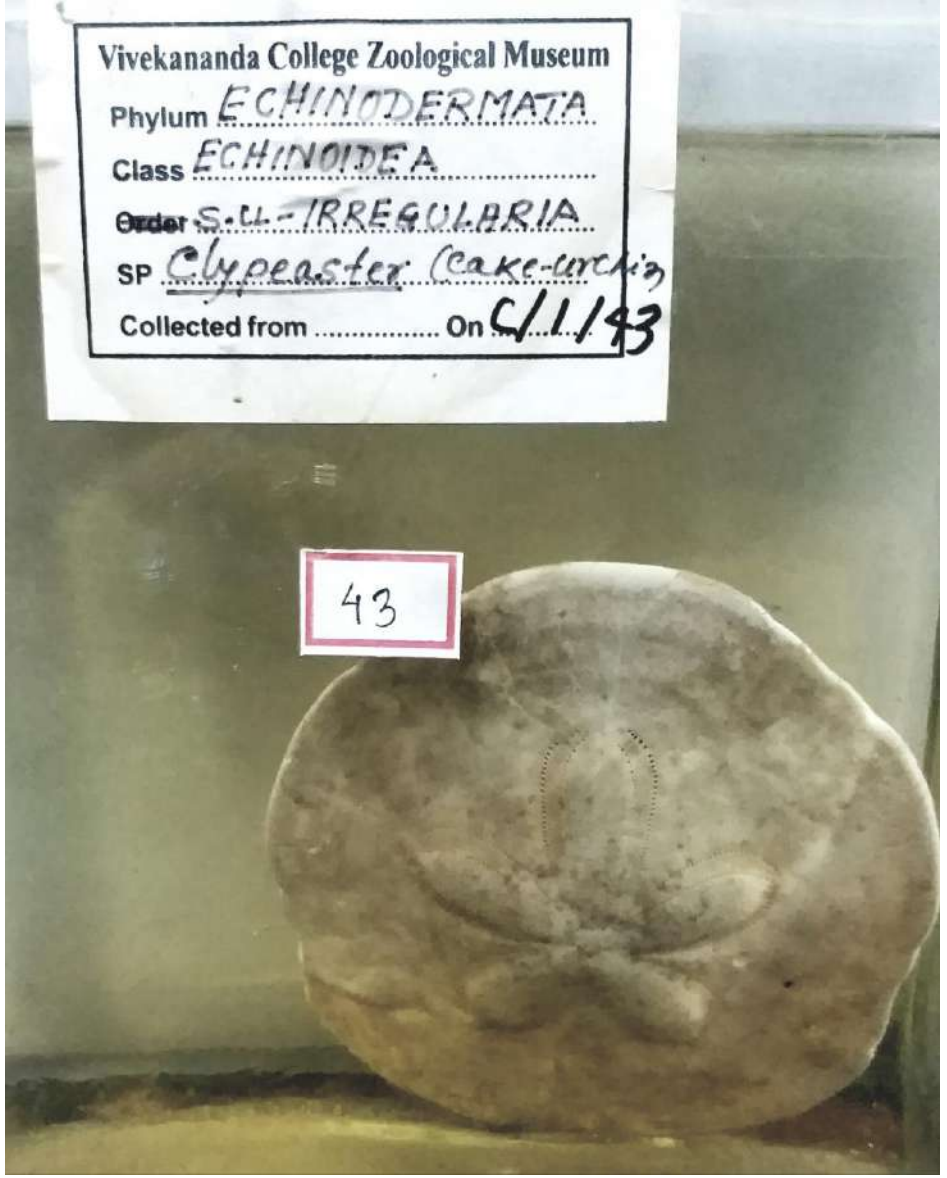
1. Body more or less spherical, flattened orally/aborally.
2. Ossicles fused to form an internal test on which moveable spines are mounted.
3. Although the ambulacral grooves are absent, the body surface is divided into alternate ambulacral and inter-ambulacral areas.
4. The ambulacral areas extend from the oral to the aboral sides of the body.
5. Ambulacral plates have pores for the passage of the tube feet.
6. The tube feet possess suckers.

**Subclass Euechinoidea:**

1. Test present which may be rigid or flexible, flattened or round to oval.
2. Spines may be hollow or solid.
3. Aristotle's lantern, a highly developed scraping apparatus used in feeding, is mostly present.
4. Gills usually present.

**Examples:**

**Echinus, Arbacia, Clypeaster,** Diadema



1. They are irregular sea urchins with a bilateral symmetry (Bilateria) and flattened body
2. They have a rounded pentagonal outline.
3. The anus is observed on the oral side, on the lower surface.
4. The mouth is observed in the center of the base.

-Hence the specimen is ***Clypaester*** sp.

Extra information

During day they live partially or completely buried in sand in shallow waters and emerge at night to feed on the sediment.

**Subphylum Echinozoa:**

1. Radially symmetrical, globoid or discoid, without arms or brachioles.
2. Remains unattached.
3. Madreporite and anus remain on the aboral side.
4. Mouth present on the oral surface.

**Class Echinoidea (Greek: spiny):**

1. Body more or less spherical, flattened orally/aborally.
2. Ossicles fused to form an internal test on which moveable spines are mounted.
3. Although the ambulacral grooves are absent, the body surface is divided into alternate ambulacral and inter-ambulacral areas.
4. The ambulacral areas extend from the oral to the aboral sides of the body.
5. Ambulacral plates have pores for the passage of the tube feet.
6. The tube feet possess suckers.

**Subclass Euechinoidea:**

1. Test present which may be rigid or flexible, flattened or round to oval.
2. Spines may be hollow or solid.
3. Aristotle's lantern, a highly developed scraping apparatus used in feeding, is mostly present.
4. Gills usually present.

**Examples:**

**Echinus**, Arbacia, Clypeaster, Diadema

1. Body nearly spherical with flat oral and nearly a domed aboral surface.
2. Test rigid; ambulacral and interambulacral zones clearly distinguished.
3. Whole surface of the test except peristome and periproct covered by movable spines articulated to it.
4. Aristotle's lantern protrudes internally from the mouth at the centre of the oral surface.
5. Tube feet arranged in rows in the ambulacral.
6. Presence of external gills.

-Hence the specimen is ***Echinus*** sp.

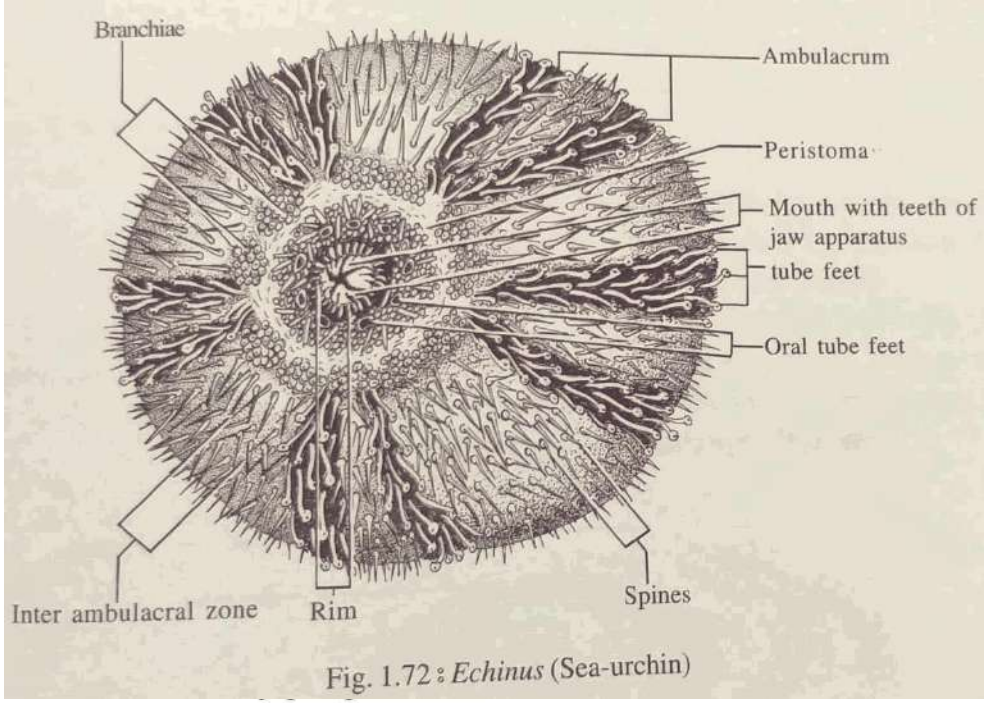
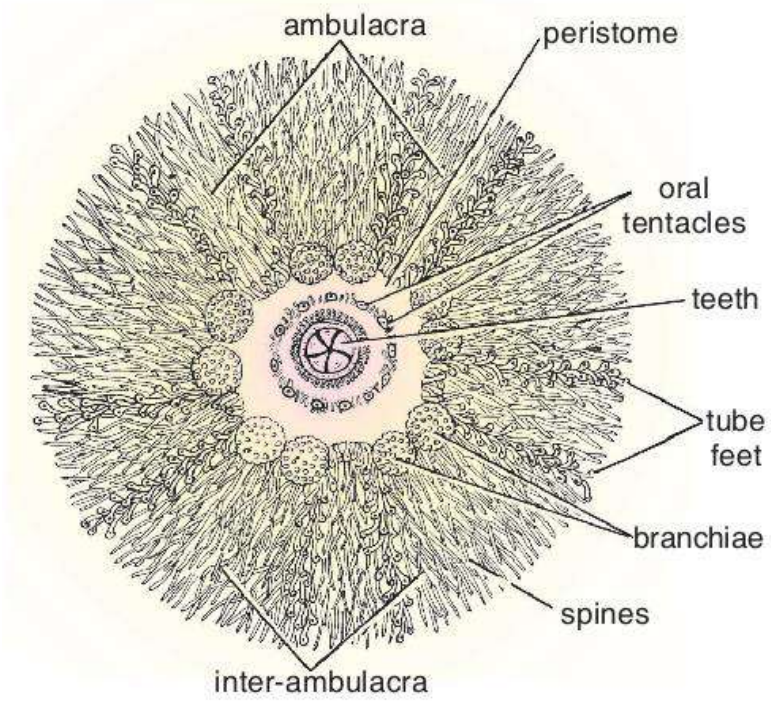


Fig. 1.72 : *Echinus* (Sea-urchin)



| | Specimen | Systematic position |
|---|---|---|
| 6. | *Cucumaria* sp. | Phylum - Echinodermata<br>Subphylum- Echinozoa<br>Class- Holothuroidea<br>Genus-*Cucumaria sp* |

**Class Holothuroidea (Greek: violent expulsion)**

1. Body elongated along the oral/aboral axis.
2. The surface of the body may exhibit five ambulacral areas.
3. Mouth and anus present at opposite extremities of the body.
4. Oral podia modified as tentacles which may be simple or dendritic and may or may not be provided with ampullae.
5. Skeleton reduced to microscopic ossicles.

**Examples:**

Holothuria, **Cucumaria**, Thyone, Molpadia

1. Shape cylindrical and blunty pointed posteriorly.
2. Body covered with hard leathery skin.
3. Oral end bears a whorl of 10 bushy pinnately branched tentacle around the mouth.
4. 5 ambulacral and 5 interambulacral zones are distinguishable in the body.
5. Mouth and anus terminal

-Hence the specimen is ***Cucumeria*** sp.

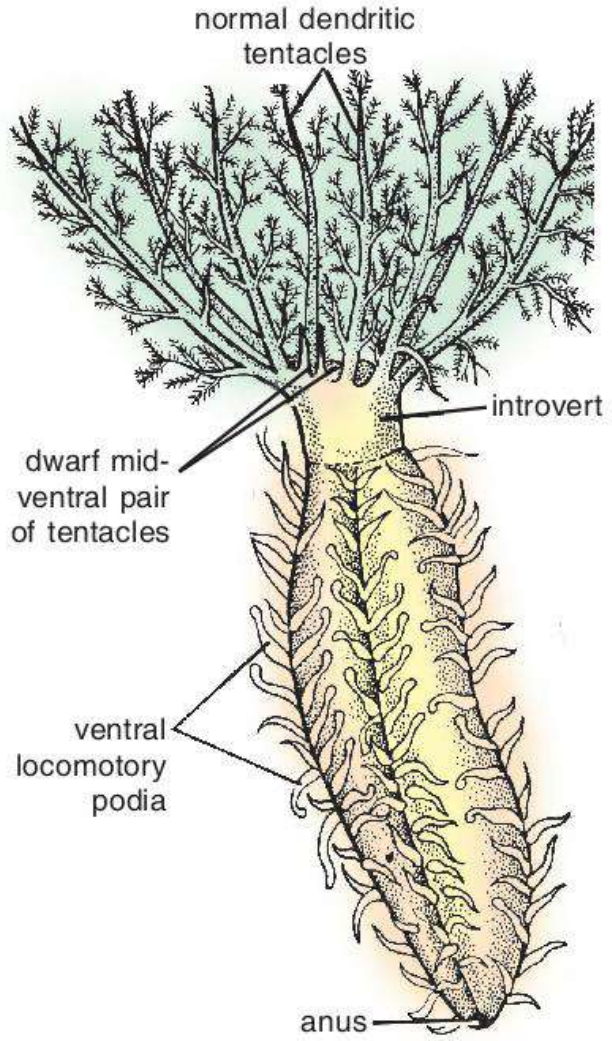



Fig. 86.3. *Cucumaria.*

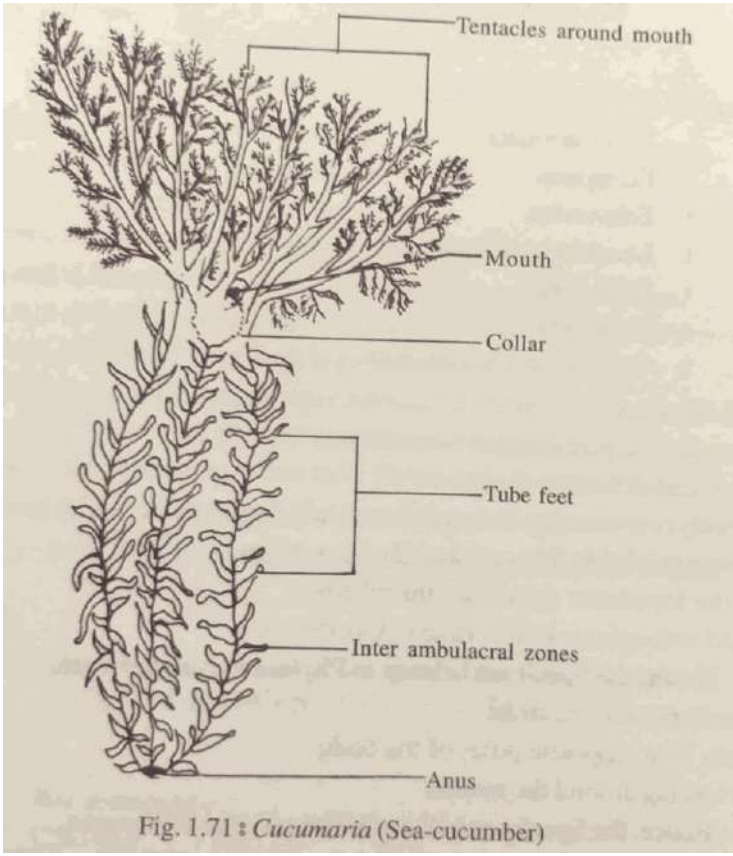



Fig. 1.71 : *Cucumaria* (Sea-cucumber)

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