ECHINODERMATA

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Derivation of Name

ECHINODERMATA

Greek. *echinos* = hedgehog	Greek. derma = skin

- Echinodermata literally means ‘spiny or prickly skinned’
- The Greeks applied the name “**echinos**” to the hedgehog as well as sea urchins (both have a prickly appearance.
- Possession of spines is not diagnostic of the phylum because only better known members (sea urchins, brittle stars and starfishes) have spines.

Fig: Sea urchin

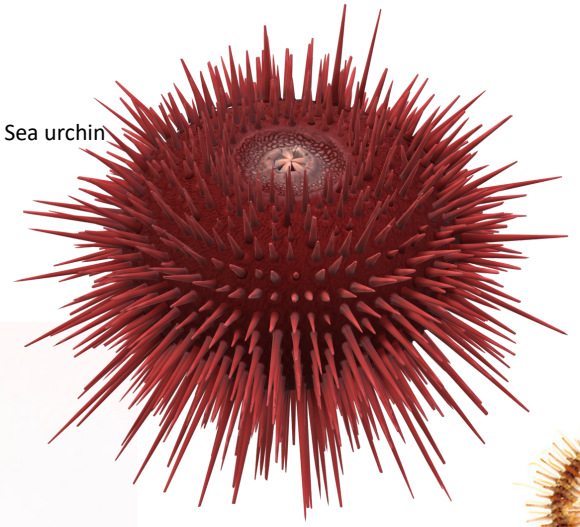


Fig: A hedgehog

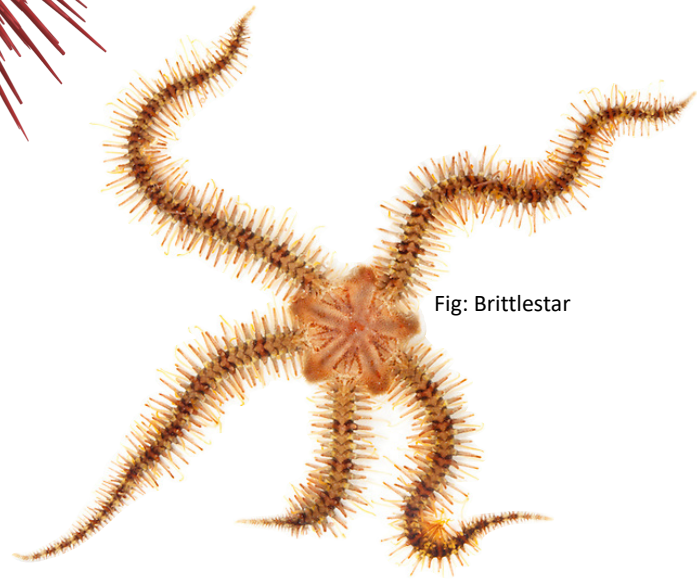


Fig: Brittlestar

Fig: Starfish

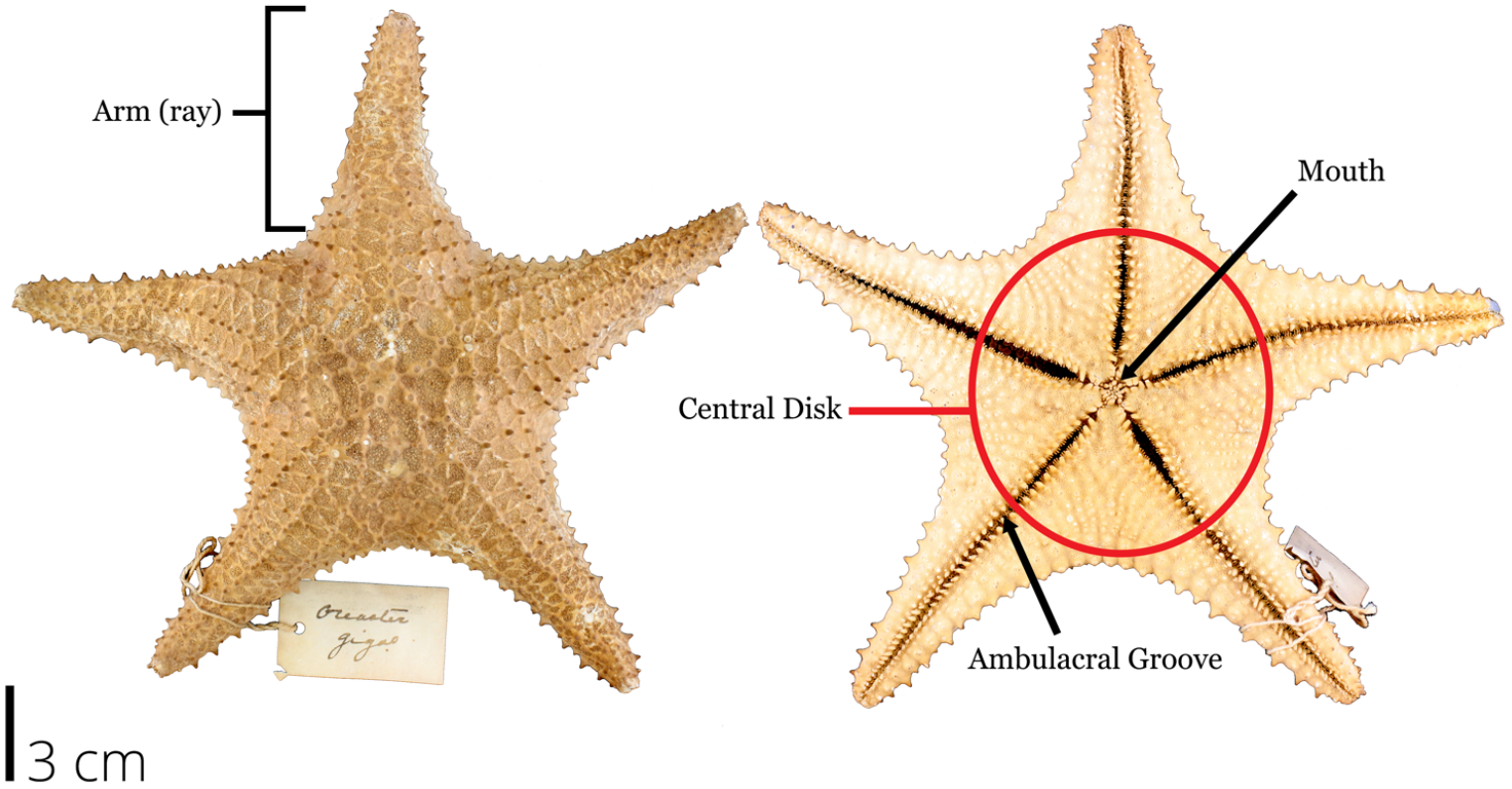
General Characters

1. Exclusively marine
2. Organ system grade of body organization.
3. Triploblastic[1], coelomate and radially symmetrical[2]; often pentamerous[3]
4. Body unsegmented with globular[4], star-like, spherical, discoidal or elongated shape.
5. Head absent; body surface is marked by five symmetrically radiating areas (ambulacra) and five alternating interradii (inter-ambulacra)
6. Endoskeleton of dermal calcareous ossicles[5] with spines, covered by the epidermis
7. Water vascular system of coelomic origin, including podia or tube feet for locomotion and usually with a madreporite
8. Coelom of enterocolous[6] type constitute the perivisceral cavity[7] and cavity of the water vascular system; coelomic fluid with coelomocytes[8]

[1]having three germ layers: ectoderm, mesoderm, endoderm
[2]body plan in which the organism can be divided into similar halves by passing a plane at any angle along a central axis
[3]body can be divided into five parts which point outward from the centre of the body
[4]having shape of a globe
[5]small calcareous elements embedded in the dermis of the body wall,provide rigidity and protection
[6]coelom forms from pouches "pinched" off of the digestive tract
[7]The extensive body cavity (coelom) is modified to form several specialized regions. Two subdivisions of the coelom are the perivisceral coelom and the water-vascular system. The perivisceral coelom is large, fluid-filled cavity in which the major organs, particularly the digestive tube and sex organs, are suspended
[8]The coelomic fluid is similar, in some respects, to the blood. It fills the water vascular system and has many functions, such as hydraulic movement, transport of wastes and gases and storage of eggs and sperm during spawning. The coelomic fluid contains free cells called coelomocytes-immune effector cells

General Characters

9. Alimentary canal straight or coiled
10. Respiratory organs include dermal branchiae[1], tube feet, respiratory tree[2] and bursae[3]
11. Nervous system without a brain and with a circumoral ring and radial nerves
12. Poorly developed sense organs include tactile organs, chemoreceptors, terminal tentacles, photoreceptors and statocysts
13. No excretory organs
14. Usually dioecious, gonads large and single or multiple; fertilization external; development indirect through free-swimming larval forms
15. Regeneration of lost parts



[1]tubular projections in the skin, which allow gas exchange to occur by simple diffusion (in starfish)
[2]pair of tubular organs, used as respiratory, excretory and hydrostatic organs operated by pumping action of cloaca (present in sea cucumbers)
[3]cilia-lined sacs (in brittle stars)

CLASSIFICATION

SUBPHYLUM I
Eleutherozoa
(Gr.,eleutheros, free + zoios, animal)

CLASS 1 ASTEROIDEA
Aster, star+ eidos, form)

Eg. *Asterias Asterina Luidia*

CLASS 2 OPHIUROIDEA
Ophis, snake+ Oura, tail+ eidos, form)

Eg. *Ophiura, Ophioderma, Gorgonocephalus*

CLASS 3 ECHINOIDEA
Echinos, hedgehog+ eidos, form)

Eg. *Clypeaster, Echinoneus, Echinus, Spatangus*

CLASS 4 HOLOTHUROIDEA
Holothurian, sea cucumber+ Eidos, form

Eg. *Cucumaria, Holothuria, Caudina*

SUBPHYLUM II
Pelmatozoa
(Gr.,pelmatos, free + zoios, animal)

CLASS 5 CRINOIDEA
Crinon, lily+ Eidos, form

Eg. *Antedon, Neometra* (feather star)

Fig: *Asterias* (common starfish)

Fig: *Gorgonocephalus* (basket star)

Fig: *Spatangus* (Heart urchin)

Fig: *Cucumaria*

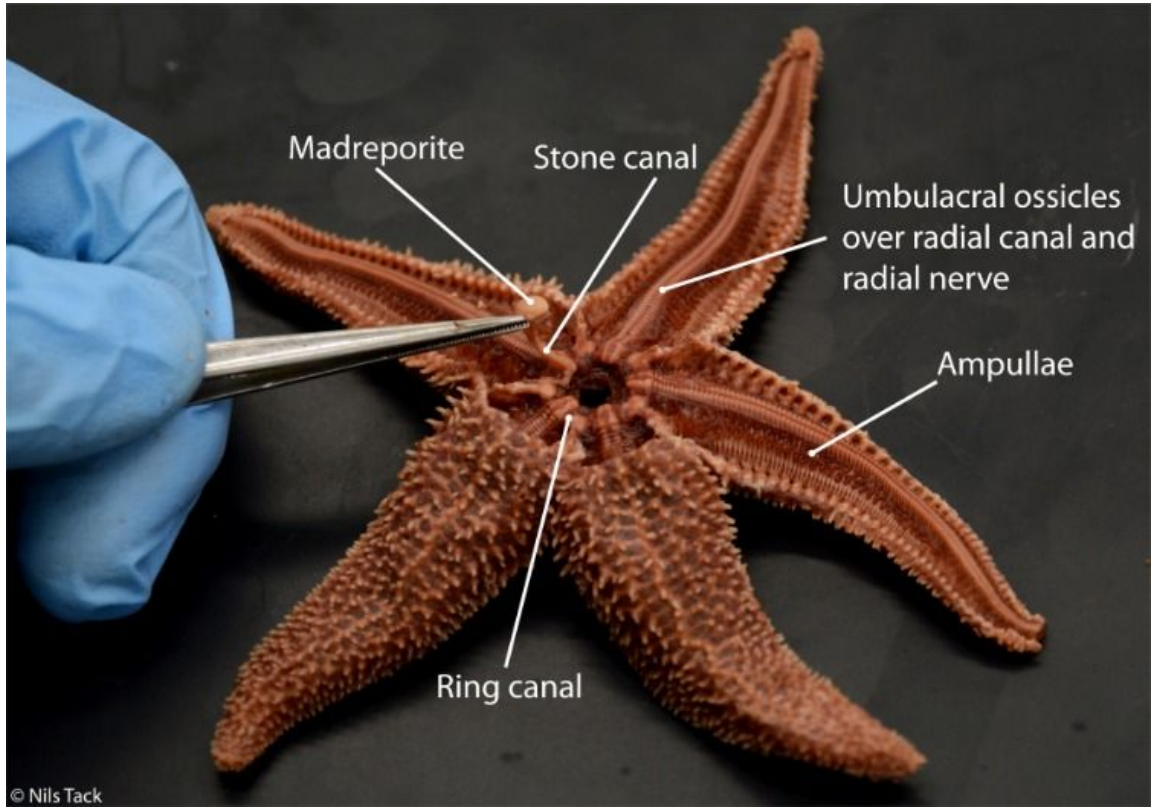
Fig: *Antedon* (sea lily)

Water Vascular System

The water vascular system is a hydraulic system used by echinoderms, such as sea stars and sea urchins, for locomotion, food and waste transportation, and respiration.

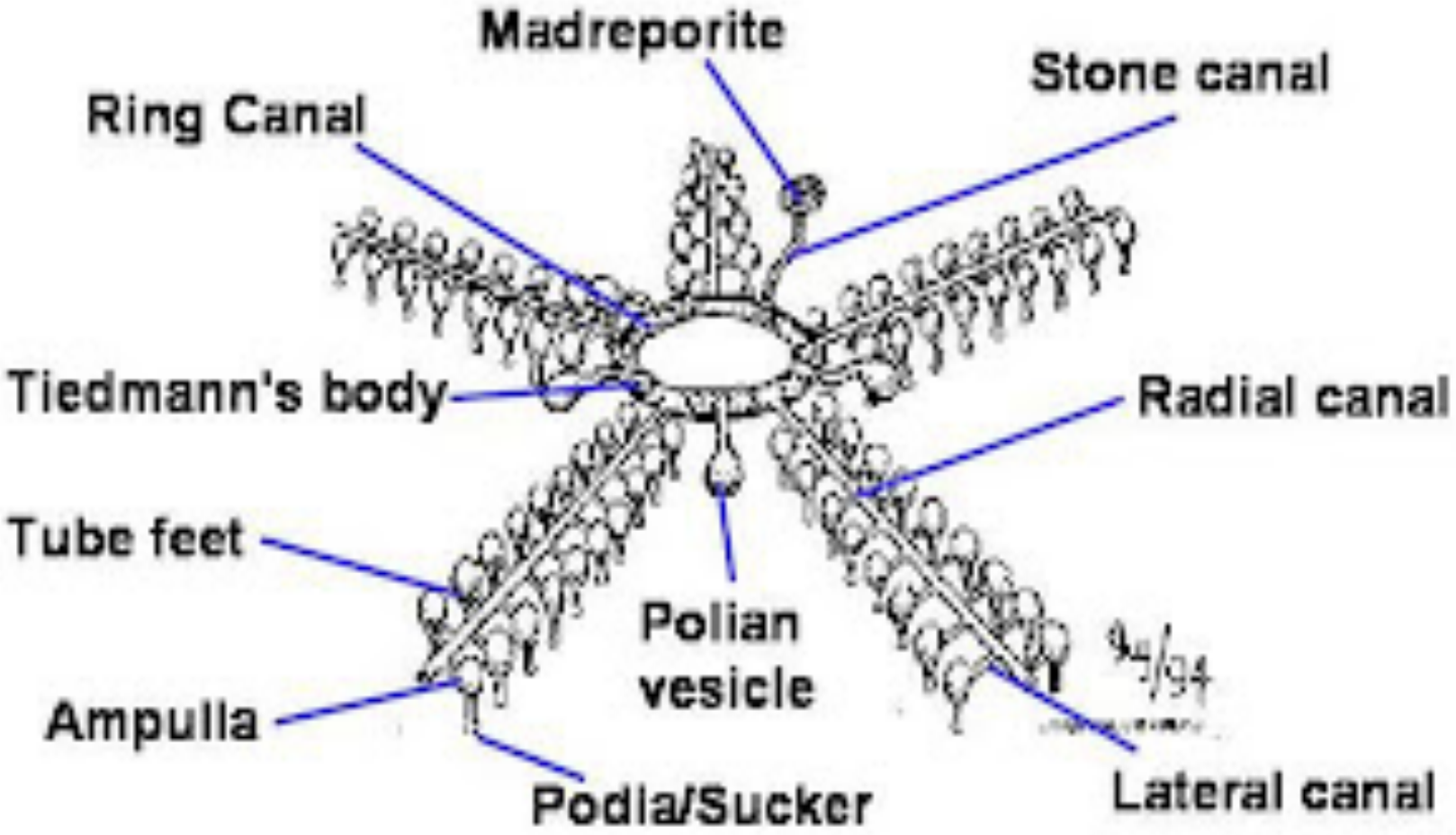
The system is composed of canals connecting numerous tube feet. Echinoderms move by alternately contracting muscles that force water into the tube feet, causing them to extend and push against the ground, then relaxing to allow the feet to retract.

Also known as the ambulacral system, it is derived entirely from the coelom and the canals are linked by ciliated epithelium and filled with watery fluid (of albuminous nature-contains sea water and leucocytes).



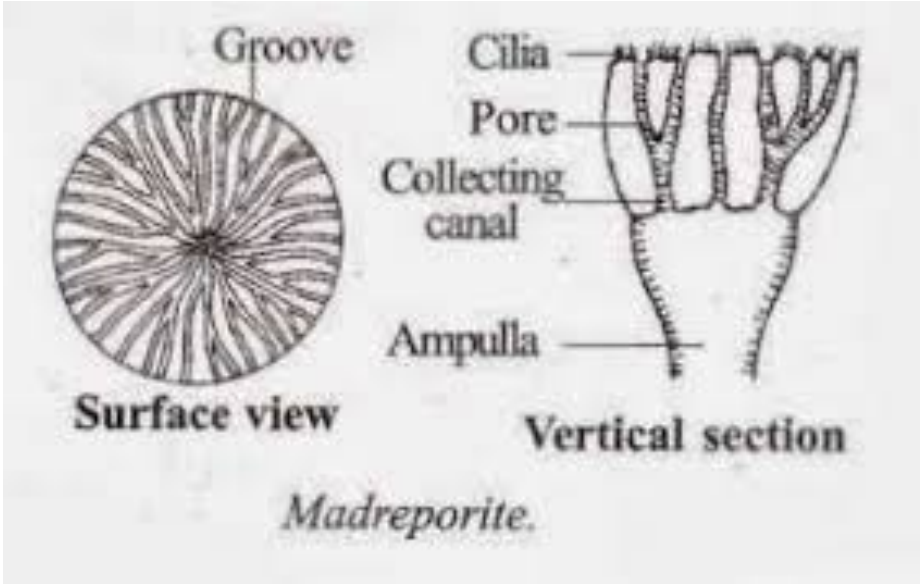
Parts of Water Vascular System:

1. Madreporite
2. Stone Canal
3. Ring Canal
4. Radial Canals
5. Tiedmann’s bodies
6. Polian Vesticles
7. Lateral Canals
8. Tube feet



1. MADREPORITE

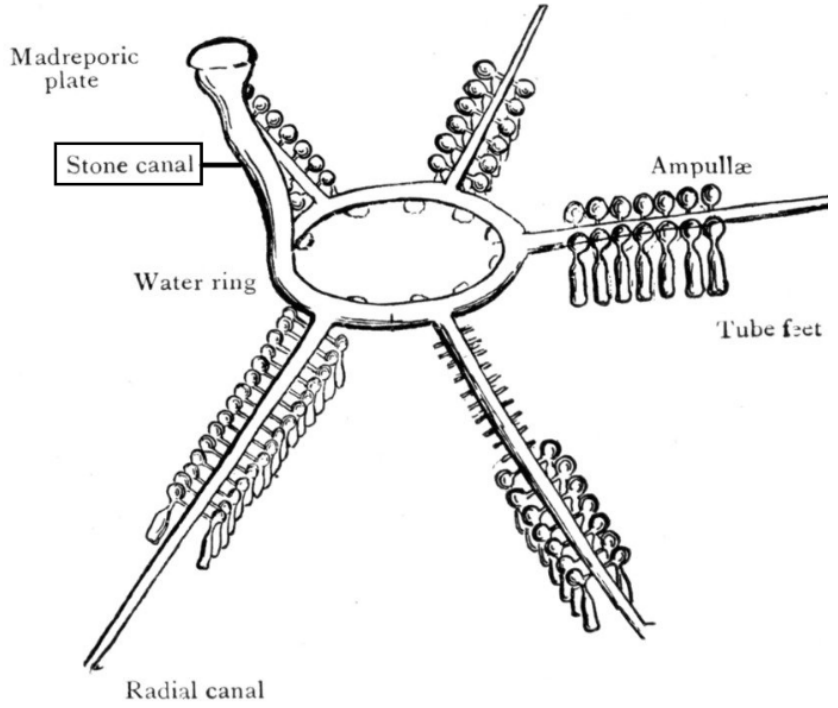
- It is a hard rounded and calcareous plate lying on the aboral surface.
- It is situated in the inter radial position.
- The surface of the madreporite is provided with a number of radiating grooves or furrows.
- The bottom of these furrows are perforated by minute pores , so that the whole plate looks like a sieve .
- Each pore leads into a pore canal and all the pore canals merge into collecting canals.
- The collecting canals converge into a small bag-like ampulla beneath the madreporite.
- The ampulla opens into a stone canal .



Madreporite.

2. STONE CANAL

- It is an S – shaped canal . The walls are strengthened by a series of calcareous rings and hence the name.
- Internally the stone canal is lined with cilia , the movement of which draws the sea water from outside into the canal .
- One end of the tube opens to the outside through the madreporite . The other ends opens into a ring canal .
- The lumen of the stone canal is occupied by a ridge with spirally coiled lamellae .



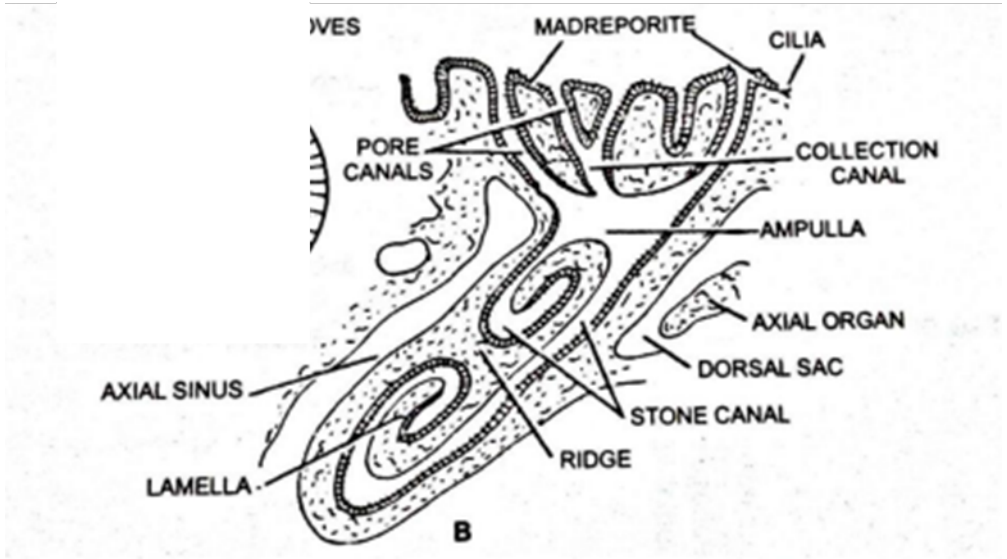
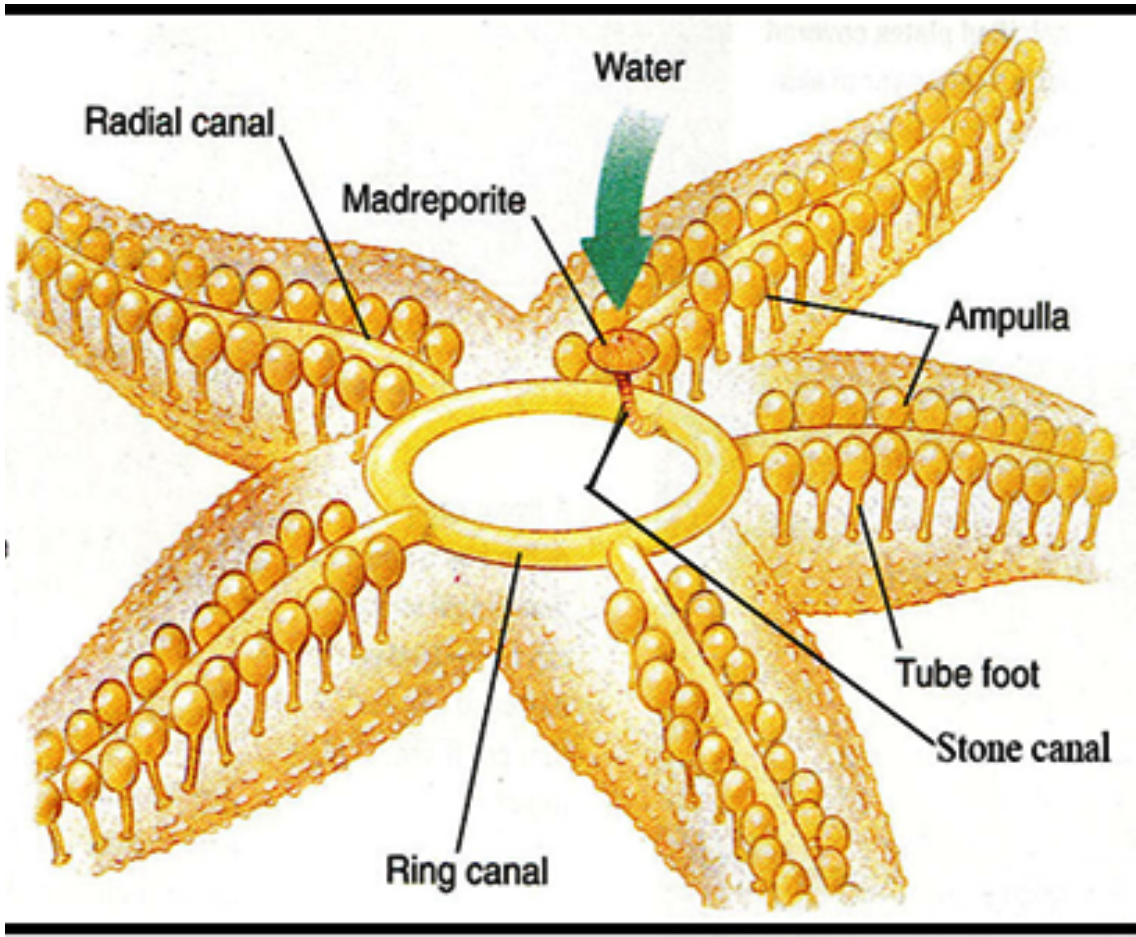


Fig: L.S. of Madreporite and Stone canal

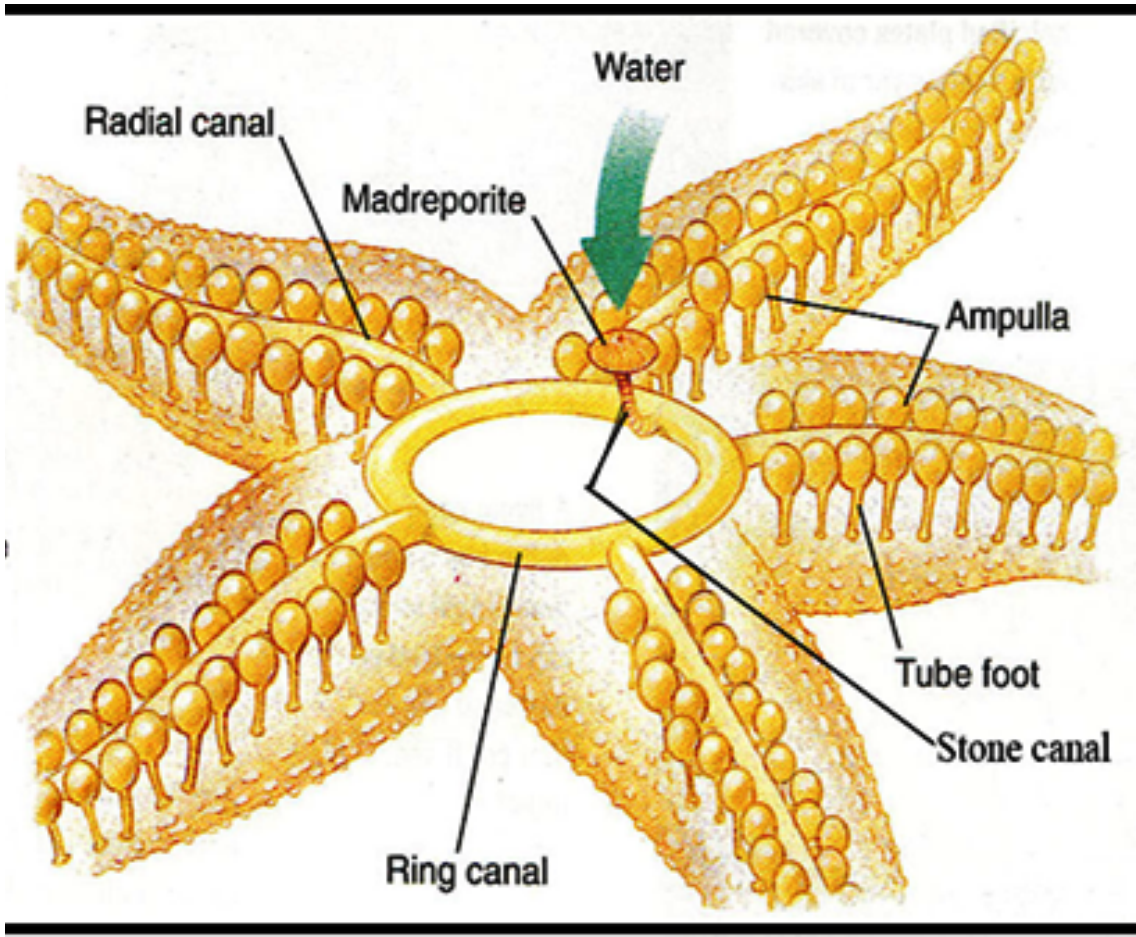
3. RING CANAL

- The stone canal opens below into a considerably wide pentagonal ring-like canal situated around the mouth.



4. RADIAL CANALS

- From its outer surface the ring canal gives off five radial canals , one entering each arm .
- The radial canal runs up to the tip of the arm and ends in the terminal tentacles .
- Involved in water-flow through the system



5. TIEDEMANN'S BODIES

- The ring canal gives off inter radially from its inner surface 10 small yellowish rounded glandular bodies called Tiedmann's bodies .
- In *Asterias* only 9 Tiedmann's bodies occur , the position of the 10th being occupied by the stone canal .
- They produce phagocytes . They remove foreign matter such as bacteria from incoming seawater.

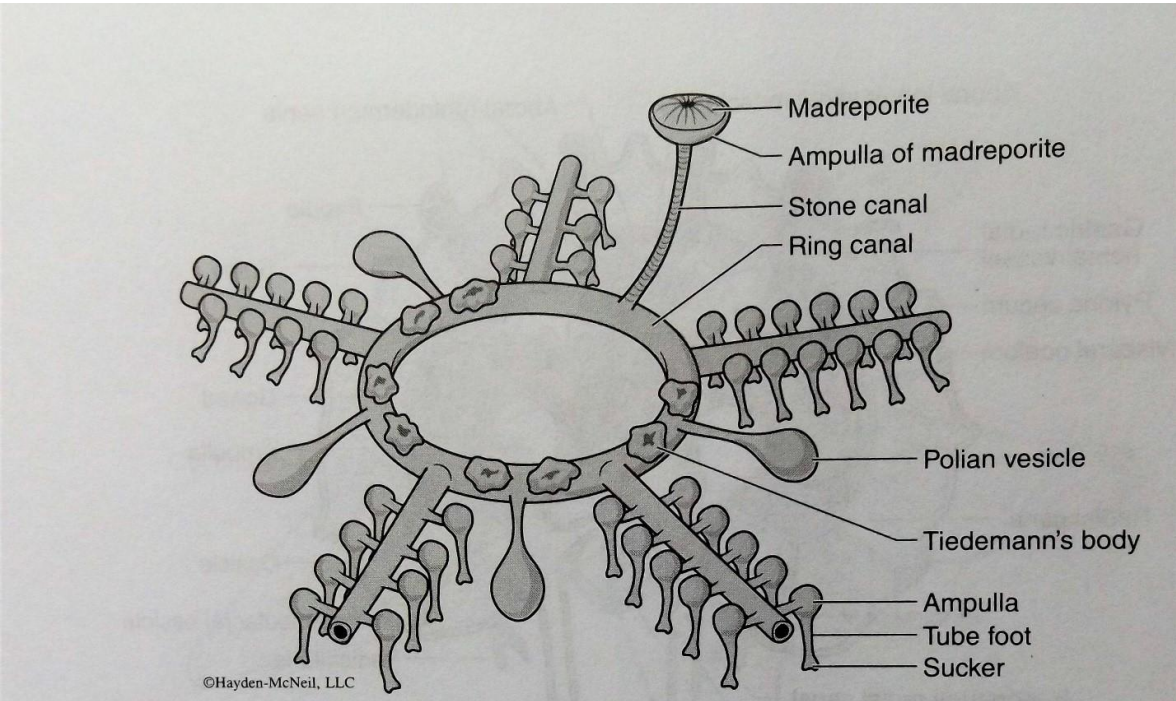


FIGURE 22-11. Water vascular system of the sea star.

6. POLIAN VESSICLES

- The ring canal bears on it's outer side five pear – shaped structures called polian vesicle .
- They are inter – radially arranged .
- These are thin walled bladders with long narrow necks .
- The polian vesicles serve as store houses for the fluid in the water vascular system.
- The usual number of polian vesicles is ten, two in each inter-radius. But the numbers vary in different starfishes.

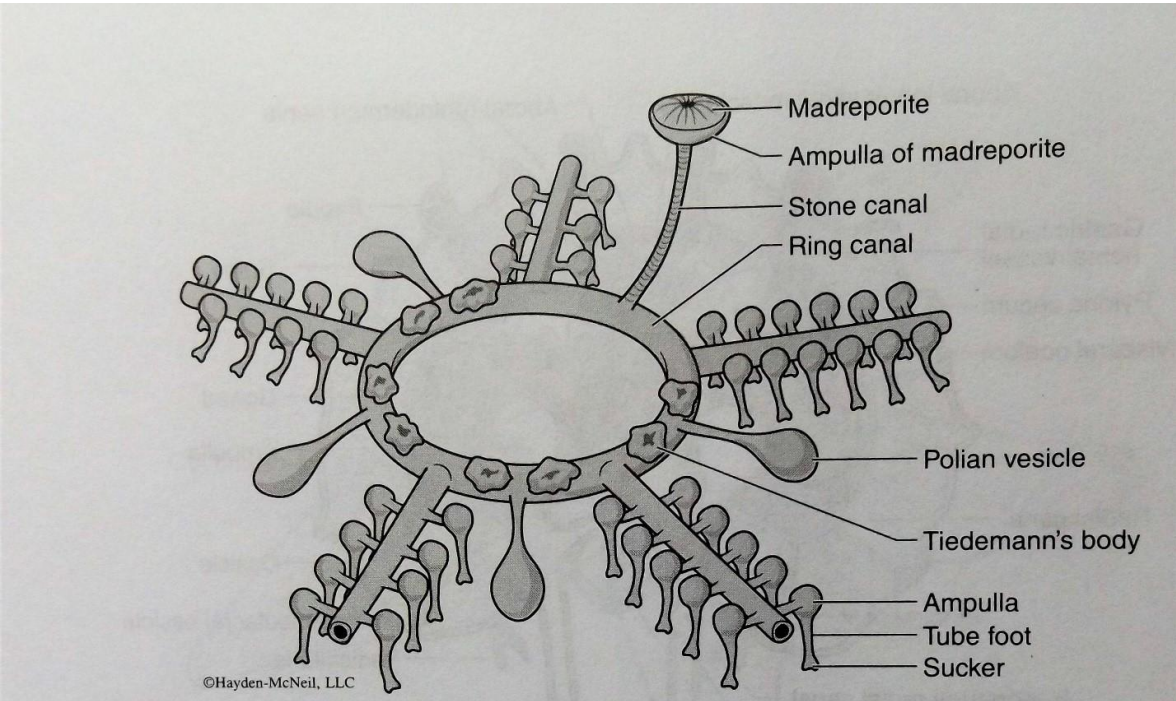
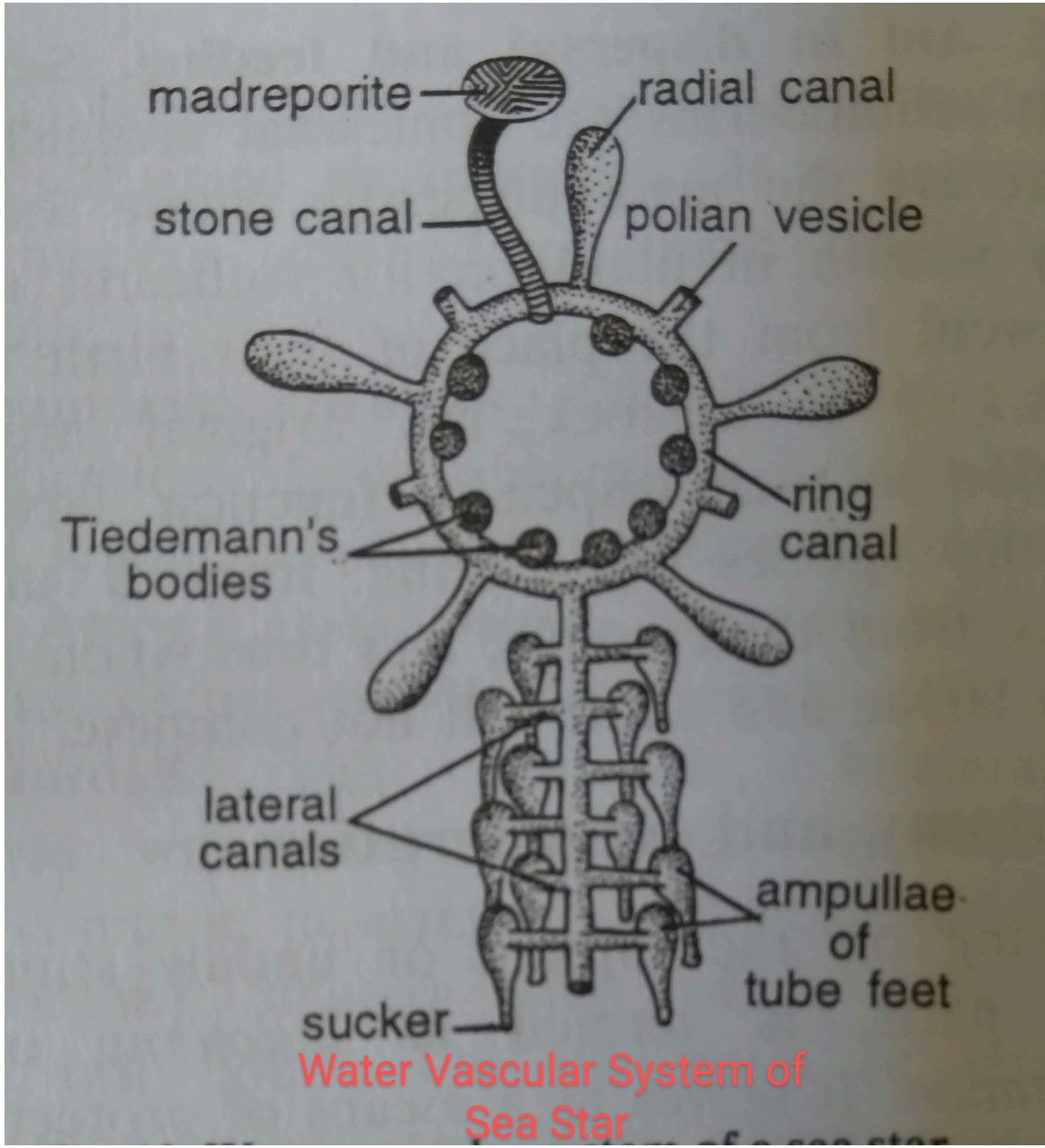


FIGURE 22-11. Water vascular system of the sea star.

7. LATERAL/PODIAL CANALS

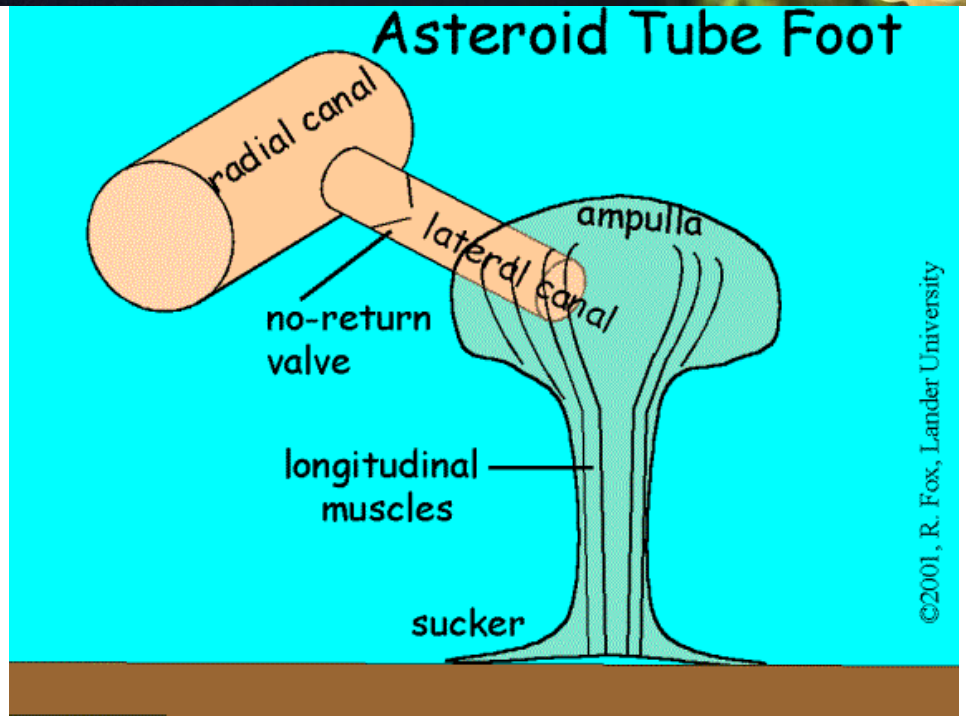
- Each radial canal gives off many paired lateral canals on both the sides , which lead to a tube foot or podium .
- Each canal is provided with a valve to prevent backward flow of fluid into the radial canal .
- The valve controls the flow of fluid from lateral canal to ampulla and podium (tube-foot).



Water Vascular System of Sea Star

8. TUBE FEET (podia)

- The tube-foot is a hollow elastic thin walled closed cylinder .
- It consists of an upper sac – like ampulla , a middle tubular podium and a terminal disc – like sucker .
- Muscle fibres are present in the walls of the ampulla and the podium .
- The tube feet are capable of greater extension and when extended they come out through the ambulacral grooves



FUNCTIONS OF WATER VASCULAR SYSTEM

1. **LOCOMOTION**: The main function of water vascular system locomotion. During locomotion the system serves like a hydraulic system.
   - Ampulla contracts, the valve in the lateral canals closes, and water is formed into the podium, which elongates.
   - Elongated podia come in contact with the substratum, the suckers adhere. After adhesion, the longitudinal muscles of the podium contract shortening the podium and forcing the fluid back into the ampulla, ultimately moving the animal forward.
   - Other parts of water vascular system function in maintaining the proper water pressure, necessary for the working of podia and ampullae.
   - Water passes in the following direction : madreporite → stone canal → ring canal → polian vesicles radial canal → Tube-feet
   - During locomotion the podium swings forward, grips the substratum, and then moves backward by contraction. In a particular section of an arm, most of the tube-feet perform the same step, and the animal moves forward. During progression one or two arms acts as leading arms, and the podia in all the arms move in the same direction.

2. RESPIRATION: Thin walls of tube-feet may help in the respiratory exchange of gases in those echinoderm who have non-suctorial tube-feet. e.g. Ophiuroidea.

3. FOOD COLLECTION: Tube-feet also help in capturing and handling the food particles

4. SENSORY FUNCTION: In echinoderms, where tube-feet are branch-like and bear terminal tentacles act as olfactory organs and thus sensory in functions

5. EXCRETORY FUNCTION: Podia in Ophiuroidea are found to serve excretory function.

6. ATTACHMENT: The star fish can be attached to the rocks by tube feet.