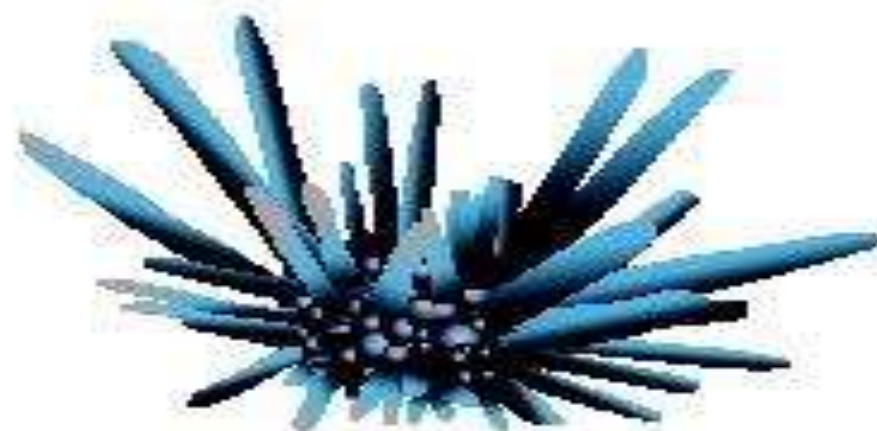
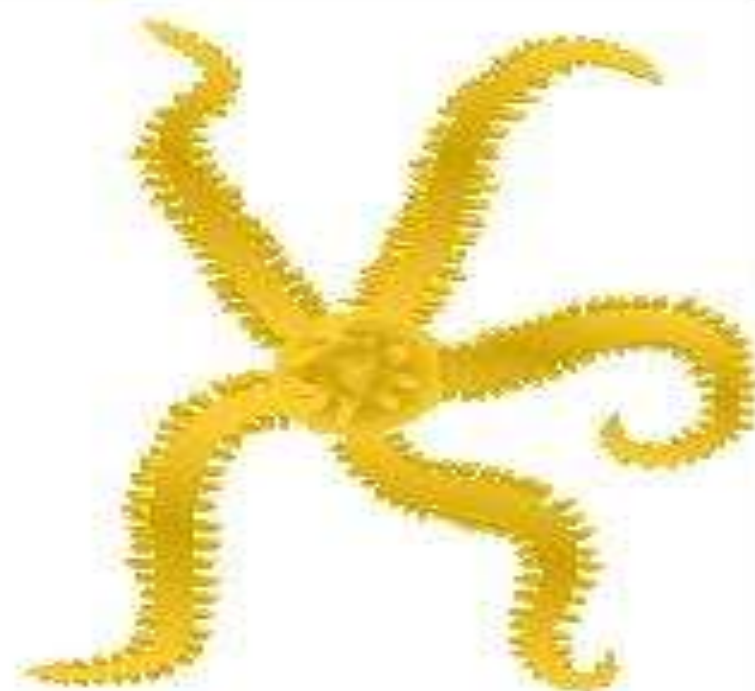
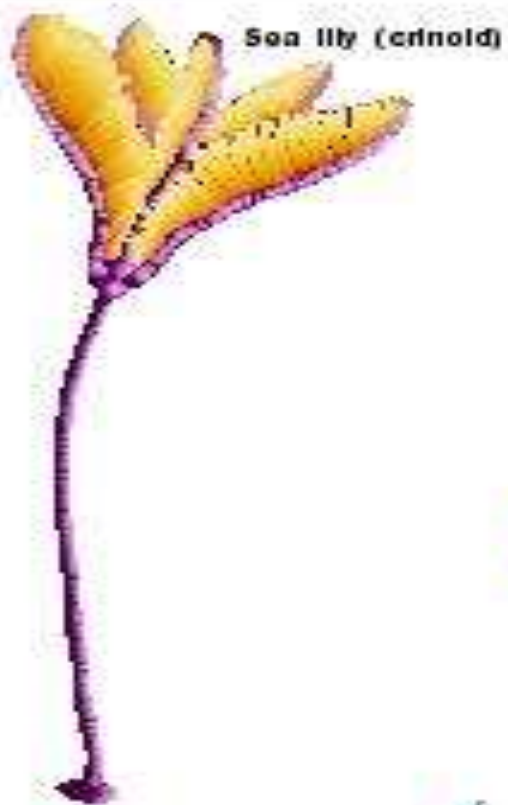


INTRODUCTION

- ▶ Jacob Klein (1734) coined this term by observing sea urchin
- ▶ For long term these were in “Radiata” along with Coelenterata
- ▶ Leuckert (1874) separated these from Radiata as they are more evolved
- ▶ Spiny skinned marine animals
- ▶ Have economic values like fertilizer (CaCO_3), food, As Scavengers and also can cause great loss to oyster beds. +

Echinoderms



Sea cucumber (holothuroid)

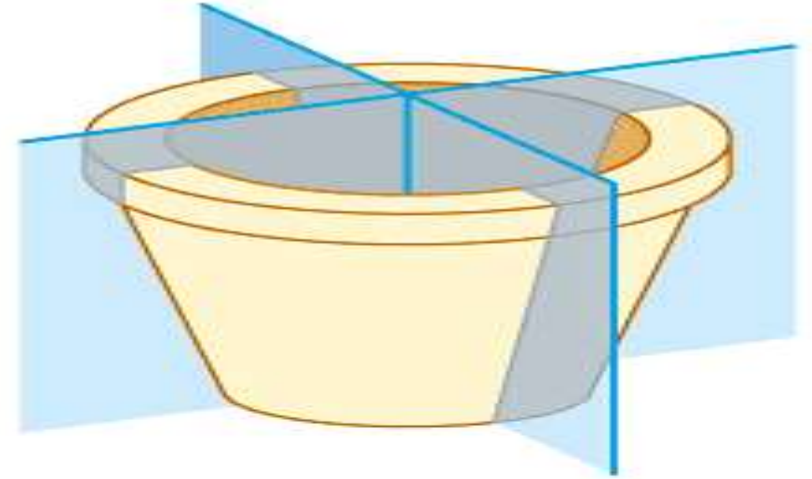
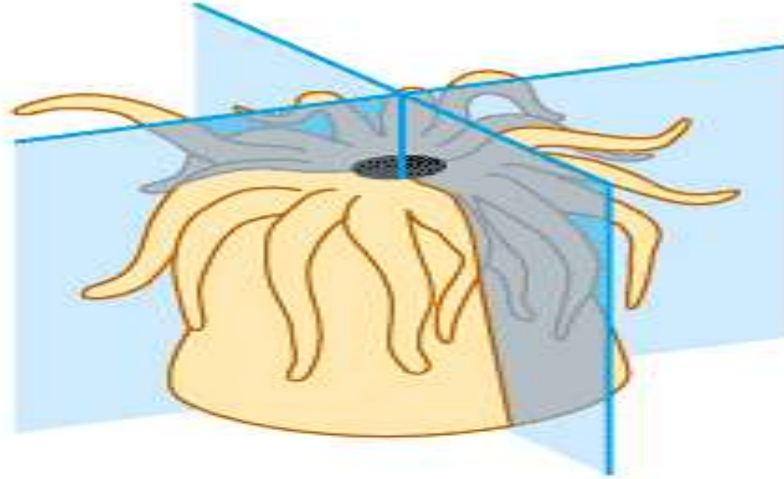
Sea urchin (echinoid)

Characteristics of Echinoderms

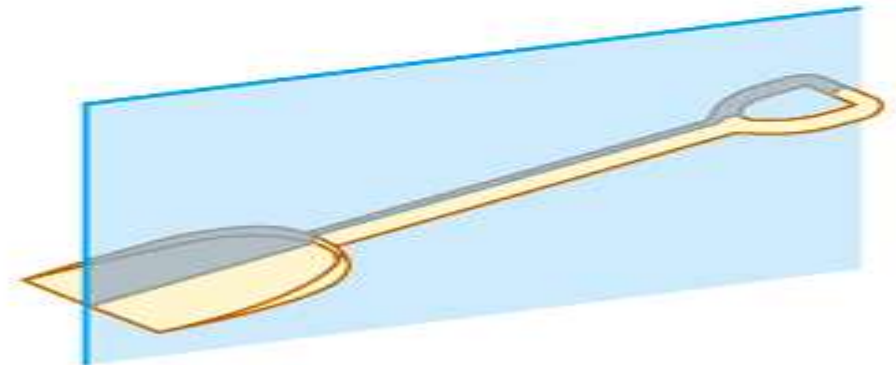
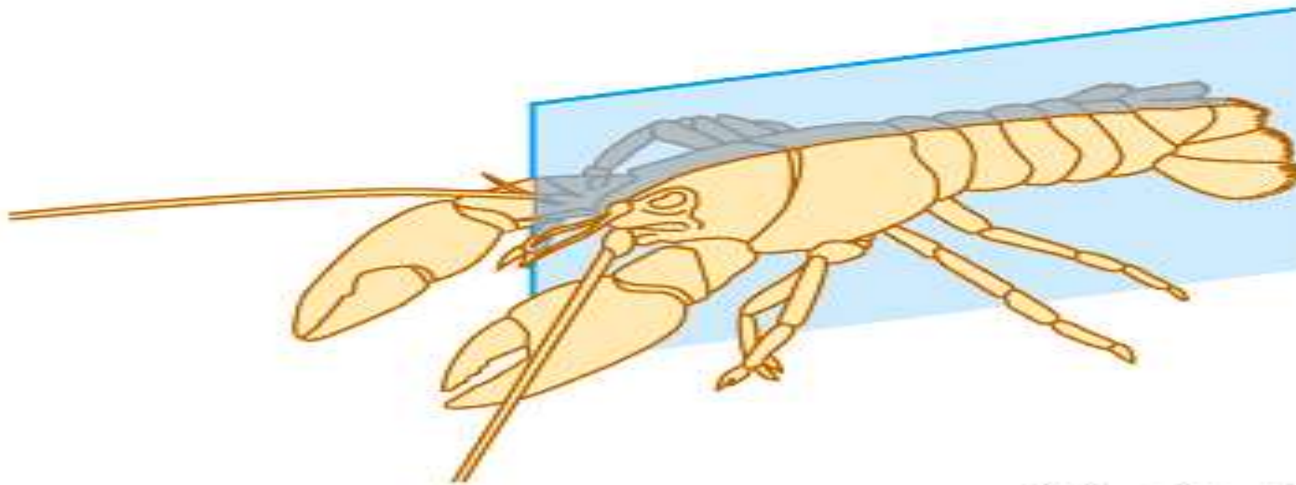
- One of the strangest and most unusual phylums in the animal kingdom.
- Echinoderms are deuterostomes, which they have in common with the chordates.
- All of the other invertebrates we learned about this semester have been protostomes.
- No cephalization or brain, very few specialized sensory organs.

General characters

- ▶ Exclusively marine, intertidal zone
- ▶ All are free living and lives in groups, some creep like star fishes, some attach to rocks like sea lillies
- ▶ Triploblastic true, enterocoelomic, dueterostomes
- ▶ Echinoderms are radially symmetrical and adults show pentamerous symmetry while larvae are bilaterally symmetrical
- ▶ Different shapes, some flat(Star fishes), globular (Sea urchins) or elongated(Sea cucumbers)



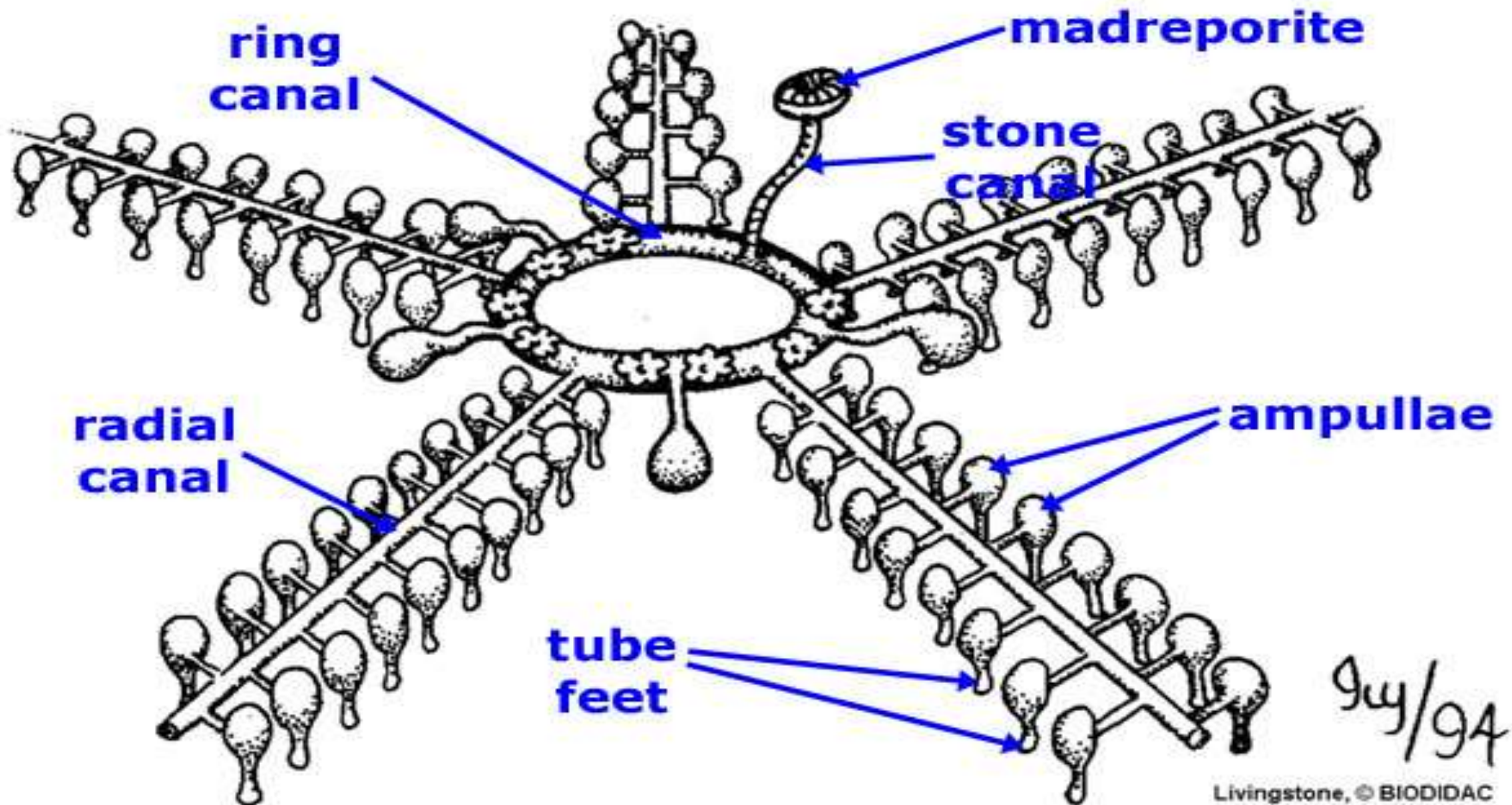
(a) Radial symmetry



(b) Bilateral symmetry

General characters

- ▶ Animals have oral (Mouth side) and aboral (Opposite side) surfaces.
- ▶ Body surface is marked by symmetrically radiating grooves or areas known as ambulacral areas and five inter radii/ Inter – ambulacral areas
- ▶ Body surface is generally covered by calcareous ossicles and spines hence the name
- ▶ Endoskeleton is mesodermal, hard and calcareous in the form of shell/ test/ ossicles
- ▶ Perivisceral coelom(Enterocoelic)- lined by perital and visceral peritoneum
- ▶ Presence of water vascular system/ ambulacral system- developed from larval coelom and consists of tube feet,lateral canals, radial canals, ring canal, stone canal and a madreporite(sieve plate)on aboral surface



General characters

- ▶ Feeds on small animals, plants and organic debris
- ▶ Digestive system- coiled tube, anus in aboral surface or absent in some
- ▶ Locomotion is by tube feet which also help in nutrition and respiration
- ▶ Respiration- papulae/ dermal branchiae (star fish), peristomial gills (sea urchins), genital bursae (brittle stars) and respiratory trees (holothurians)
- ▶ Haemal system-open type, not well developed, heart is absent, blood vessels don't have definite walls and are enclosed in coelomic canals
- ▶ Definite excretory organs are absent. Nitrogenous wastes are ammonia, urea, and creatine. Sent out by diffusion through tube feet and papulae

General characters

- ▶ Nervous system is poorly developed. Brain is absent, a circum oral ring and radial nerves are present
- ▶ Sense organs are poorly developed and are represented by tentacles, eyes and statocysts
- ▶ Sexes are separate, sexual reproduction, sexual dimorphism is absent. Gonads are large and simple. Gonoducts may/ may not present. Fertilisation is external in sea water.
- ▶ Development is indirect with a free swimming larval stage.
- ▶ Few echinoderms are viviparous like *Asterina gibbosa*, *Chiriodata contorta*
- ▶ Exhibits high power of regeneration, Autotomy is seen

Classification

- ▶ Classified into four sub phyla.
- ▶ Namely
 - ▶ Echinozoa
 - ▶ Homalozoa
 - ▶ Crinozoa
 - ▶ Asterozoa

Sub phylum1: Echinozoa

- ▶ Includes sedentary animals like sea cucumbers and creeping animals like sea urchins
- ▶ Elongated bodies/ spherical bodies. Mouth is on oral and anus is on aboral sides
- ▶ Arms are absent . But ambulacral and inter ambulacral regions are present
- ▶ Ambulacral grooves are absent
- ▶ Bilaterally symmetrical larvae is present
 - ▶ It includes five classes. Of these only holothuroidea and Echinoidea are living. Remaining are extinct.they are Helioplacoidea, Adrio asteroidea and ophiosiaasteroidea

Class Echinoidea

(Sea Urchins and Sand Dollars)

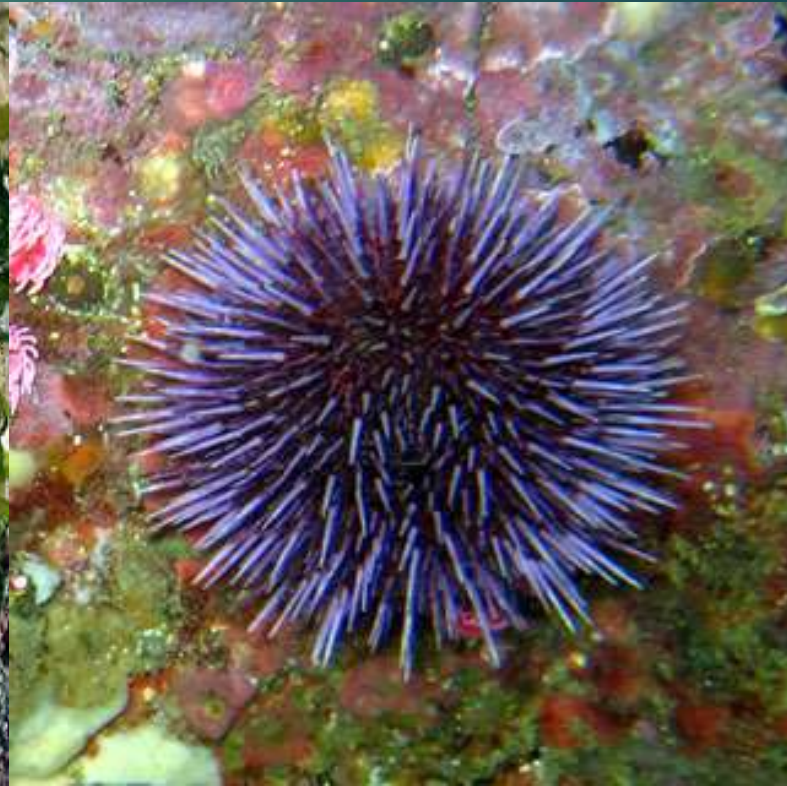
- Members of class Echinoidea have a compact body or shell called a **Test**.
- Echinoids lack arms, but their test is still divided into five parts like the sea star's and brittle star's.
- Inside a sea urchin's test is a coiled digestive system and a complex chewing mechanism called an **Aristotle's lantern**.
- The Aristotle's lantern is used for chewing food, and it has teeth that are controlled by both retractor muscles and protractor muscles.

Class Echinoidea (Sea Urchins and Sand Dollars)

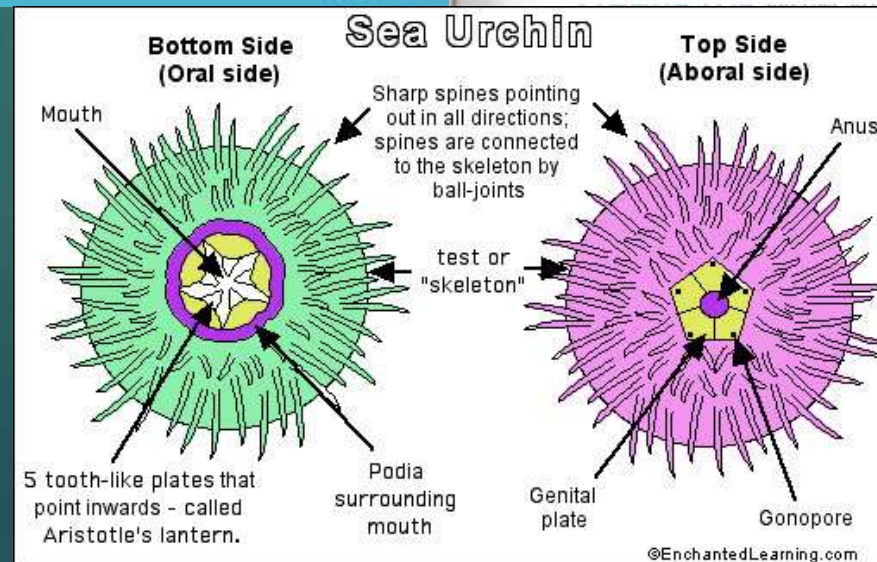
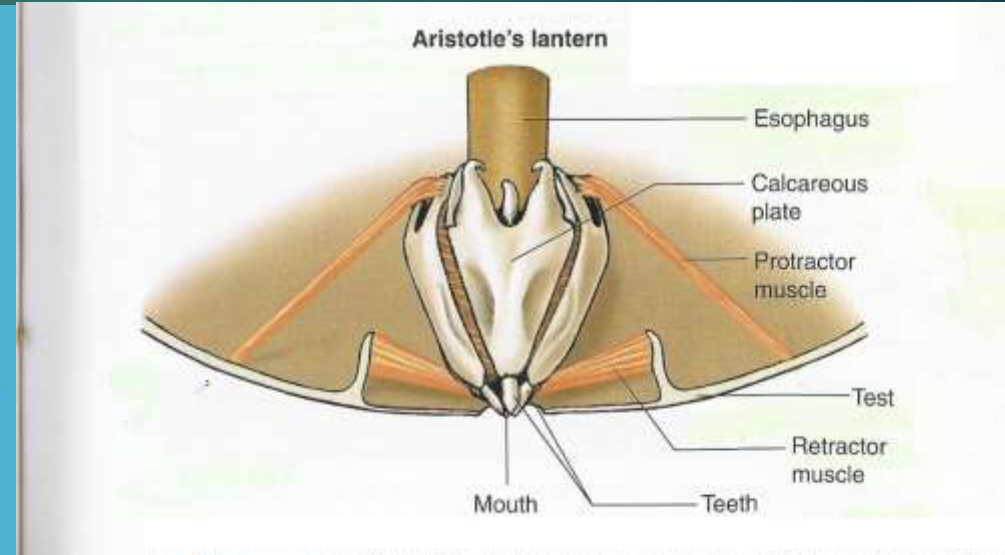
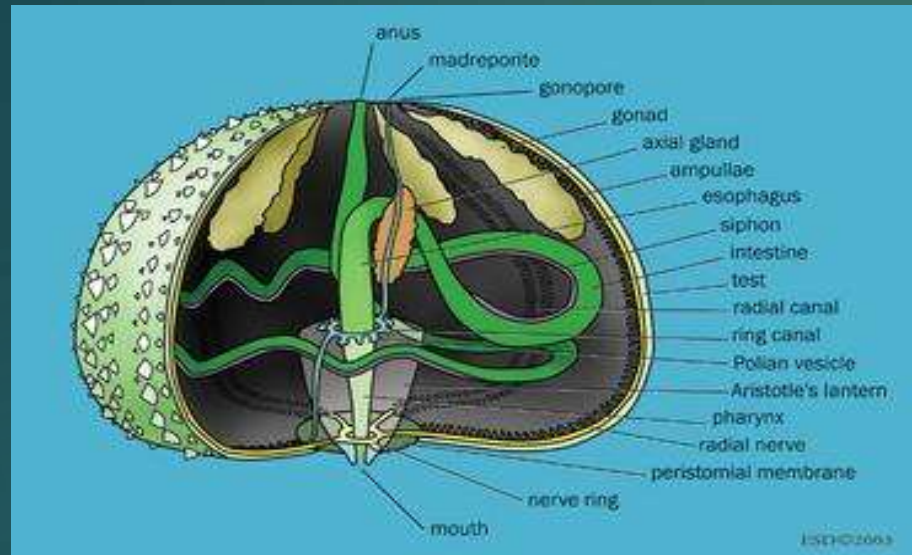
- Sand Dollar



Sea Urchin



Sea Urchin Anatomy



Class Holothuroidea (Sea Cucumbers)

- Sea cucumbers are elongate and have 10-30 oral tentacles (modified tube feet) around the mouth.
- Strangely, although there appears to be an anterior end, cephalization and a brain are absent.
- Respiration occurs in a network of tubes and branches called the respiratory tree.
- When threatened, sea cucumbers can discharge long sticky toxic substances called Cuvierian tubules.

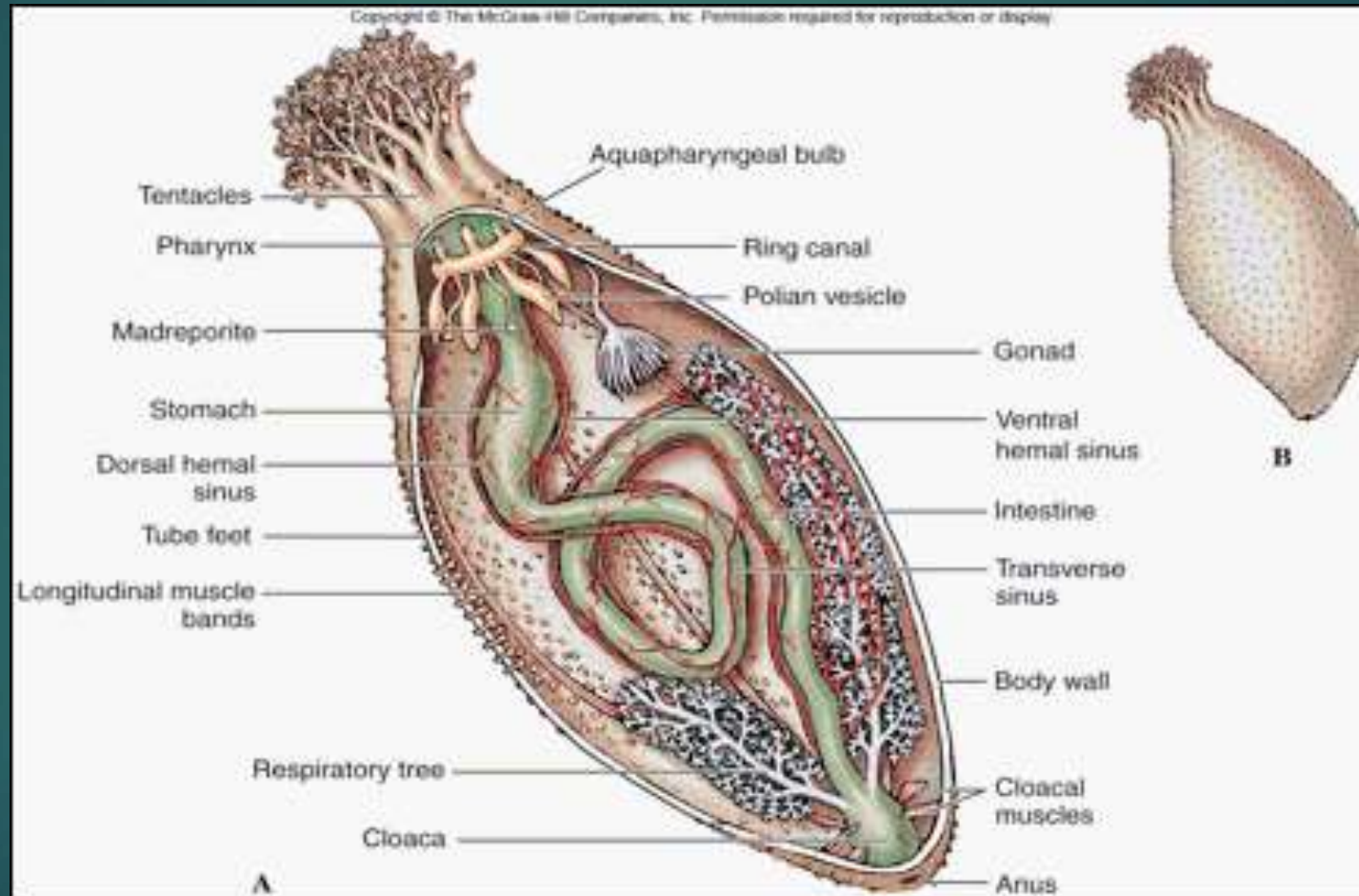
Sea Cucumbers



Cuvierian Tubules



Sea Cucumber Anatomy



Sub- phylum: Homalozoa

- ▶ Belongs to cambrian and devonian periods
- ▶ Radial symmetry is absent, some are bilaterally symmetrical and others are asymmetrical
- ▶ Body is dorso-ventrally compressed. Dorsal plates form carapace and ventral plates form plastron
- ▶ Only one order, Carpoidea is included
- ▶ Example : Enopleura

Sub-phylum3: Crinozoa

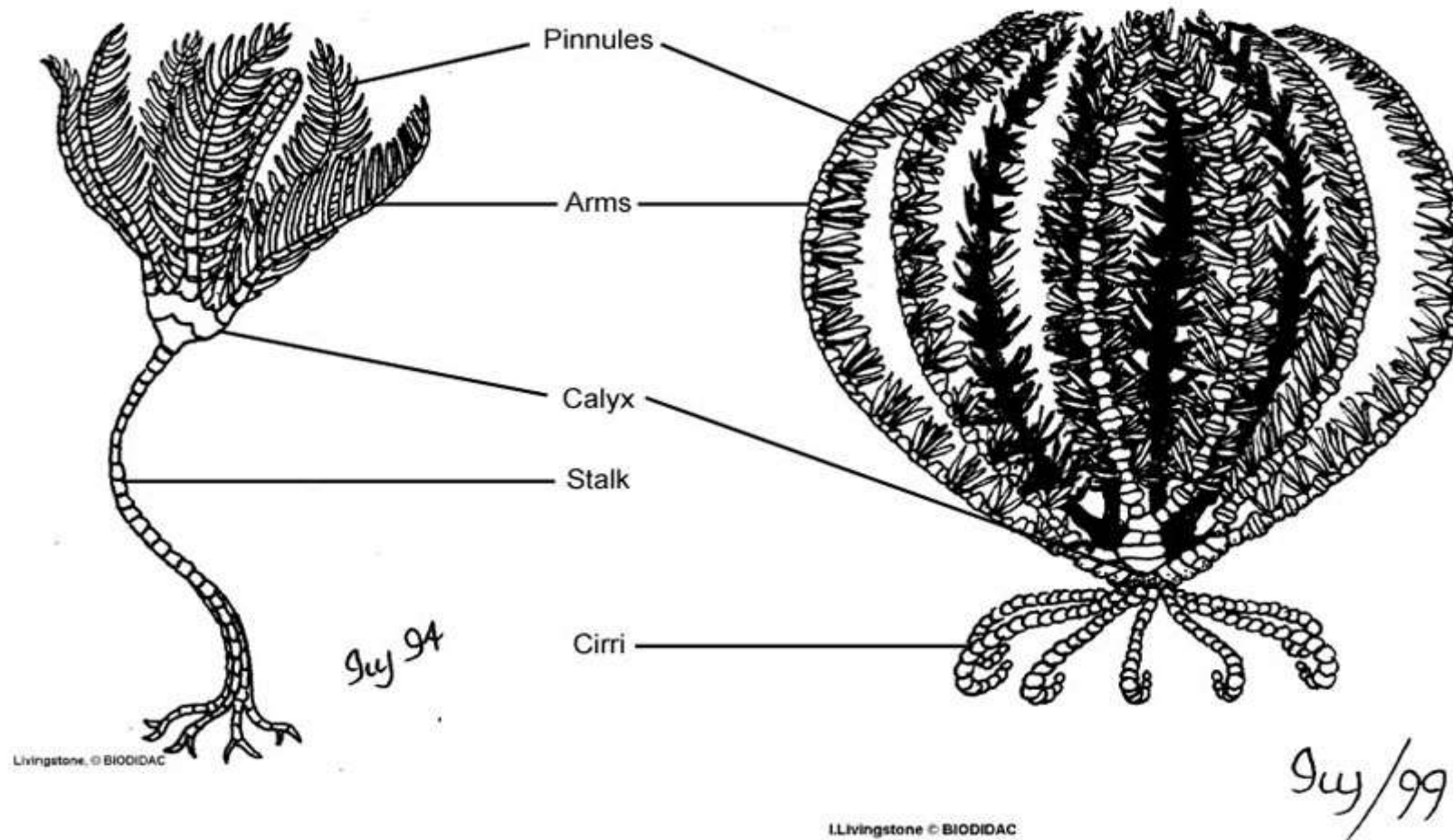
- ▶ Primarily spherical individuals with plates
- ▶ Partial, semi- radial symmetry
- ▶ Mouth and anus are on oral side. And alimentary canal is “U” shaped
- ▶ Attach to substratum by aboral side and lead sedentary life
- ▶ Arms present, surrounds mouth, show branching nature
 - ▶ Divided into five classes namely
 - ▶ Cystoidea
 - ▶ Blastoidea
 - ▶ Heterostalia
 - ▶ Eocrinoidea
 - ▶ Paracrinoidea
 - ▶ but only Eocrinoidea are living all others are extinct

Class Crinoidea

(Sea Lilies and Feather Stars)

- Their bodies are attached to the ocean floor for at least part of their life.
- The **calyx** (body) of a sea lily is attached to a **stalk** on the aboral side.
- The **stalk** attaches to the ground surface.
- Five flexible arms branch to form more arms, each with many lateral branching **pinnules** arranged like barbs on a feather.
- Feather stars resemble sea lilies without a stalk.

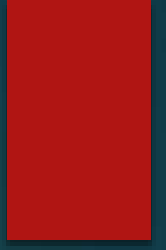
Sea Lily Anatomy



Sea Lilies and Feather Stars



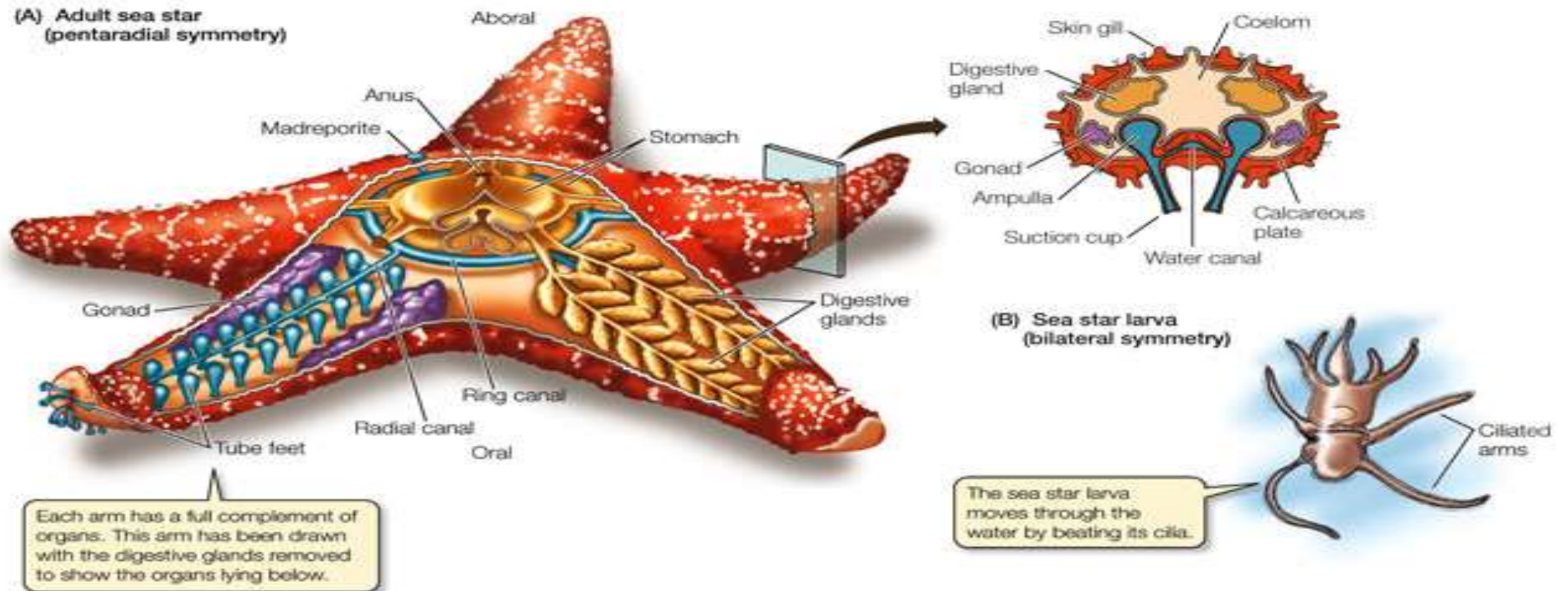
Sub- phylum4: Asterozoa



Class Asteroidea (Sea Stars)

- Sea stars or starfish typically have five arms which is called pentaradial symmetry
- Mouth is on the oral side. The side that is opposite of the mouth is the aboral side.
- Ambulacral grooves radiate out along the arms from the mouth located on the oral side.
- Tube feet (also called podia) stick out from the ambulacral grooves.
- Radial nerves run the length of the grooves.

General Anatomy of an Echinoderm



Feeding and Digestive System

- Sea stars typically have two stomachs.
- A larger and lower **cardiac stomach** and the smaller upper pyloric stomach.
- Sea stars are opportunistic carnivores.
- They feed upon molluscs, crustaceans, polychaetes, fish, and other echinoderms.
- They hunt by grabbing their prey with their tube feet. Then they evert their stomach (turn it inside out) and secrete digestive enzymes.

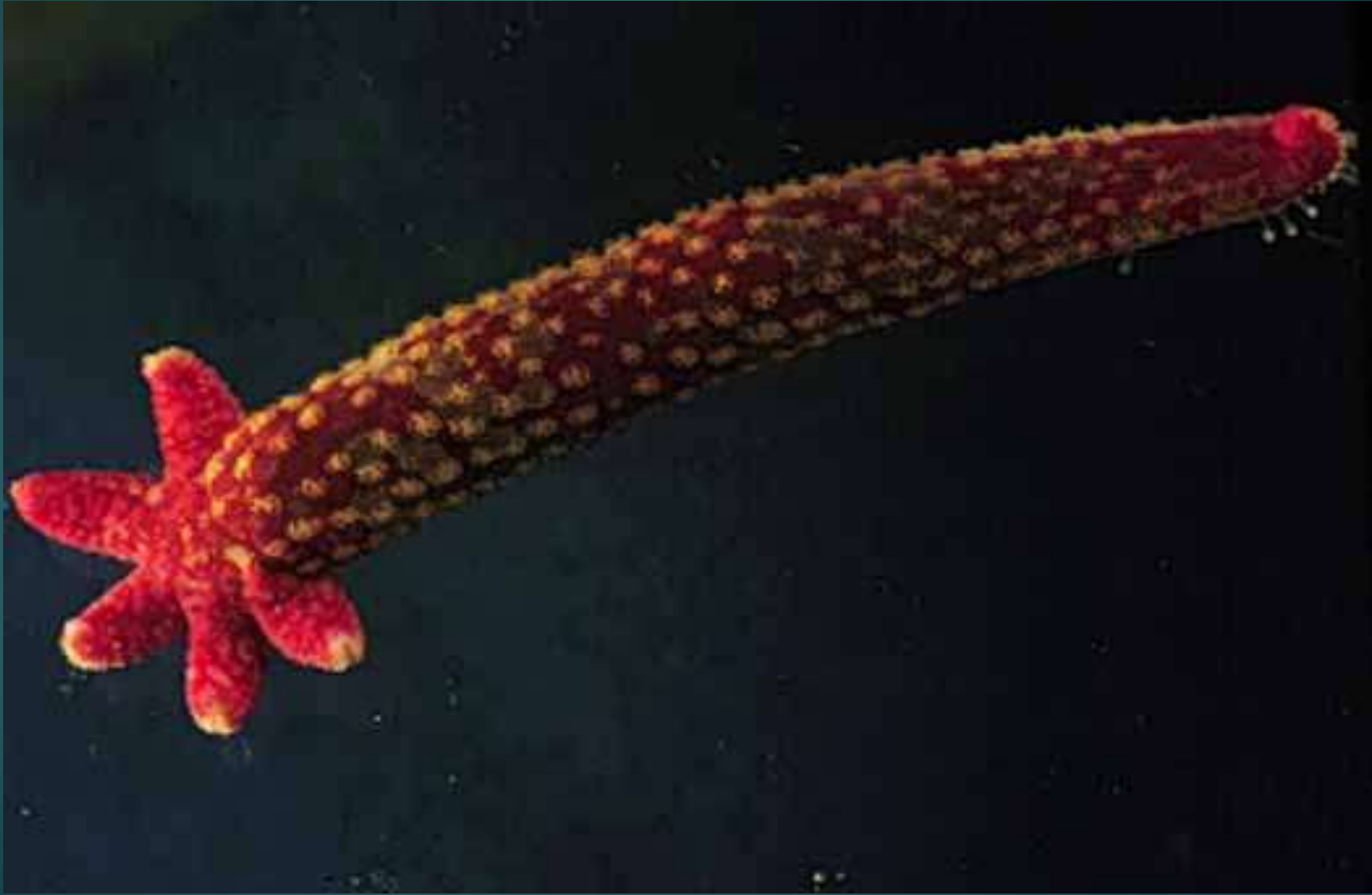
Sea Star eating an Anchovy



Sea Star Reproduction

- Sexes are separate in most species.
- Echinoderms can regenerate lost parts.
- Sea stars can also deliberately detach part of their own bodies and cast off an arm near its base. A feature referred to as **autotomy**.
- If a detached arm retains at least one fifth of the central disc (main body), the arm can regenerate an entirely new sea star.

Sea Star Regeneration



Class Ophiuroidea (Brittle Stars)

- Arms of brittle stars are more slender than species in class Asteroidea (sea stars and starfish).
- Tube feet are used for feeding, but not locomotion like the sea stars. Locomotion is by movement of their arms.
- The madreporite is located on the oral surface, unlike the sea star's madreporite, which is located on the aboral surface.
- Five movable plates on the oral surface that serve as jaws. They have no anus, so waste is expelled out the mouth.

Brittle Stars



Class Ophiuroidea (Brittle Stars)

- Because the arms are so slender, all of the major organs are in the central disc (body).
- The water-vascular system, nervous system, and reproduction is very similar to the members of class Asteroidea.
- Sexes are usually separate, and brittle stars can undergo regeneration and autotomy just like the sea stars.

Brittle Stars

