Phylum Echinodermata

by: Muhammad Arif Asadi

- Pentaradial symmetry
- no freshwater or terrestrial representatives
- Water vascular system: A complex series of fluid filled canals with numerous flexible feeding and locomotory
- well-known animals: starfish, sea urchins, sand dollars, and sea cucumbers, as well as the sea lilies
- 7000 living species

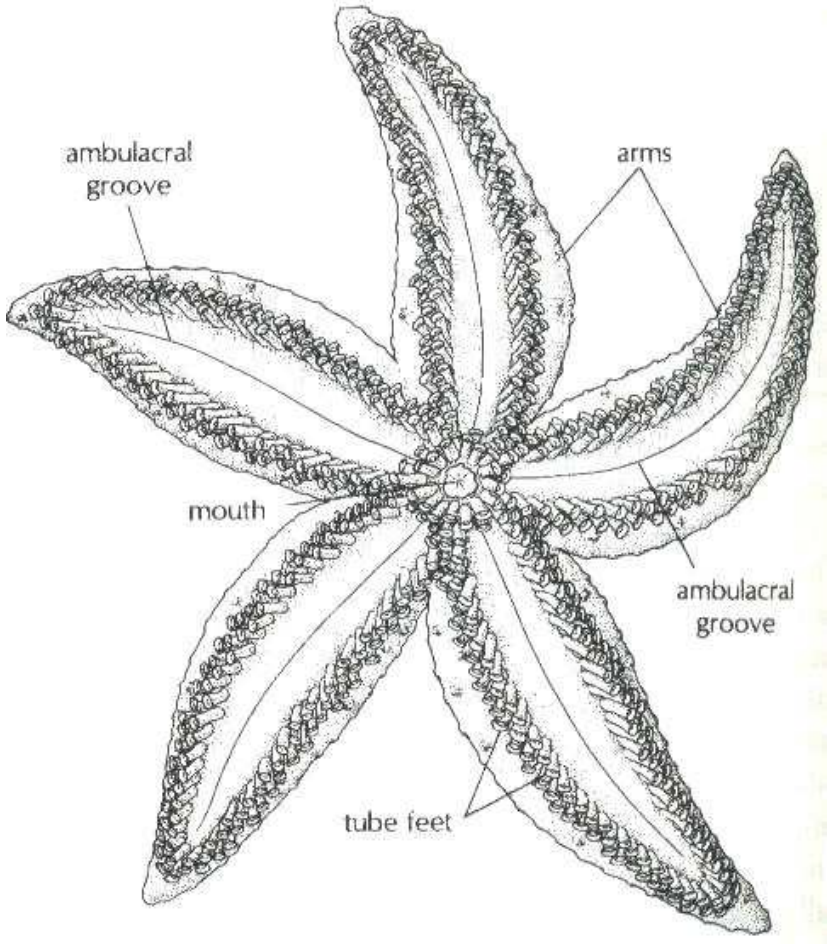




Echinoderms Skeleton

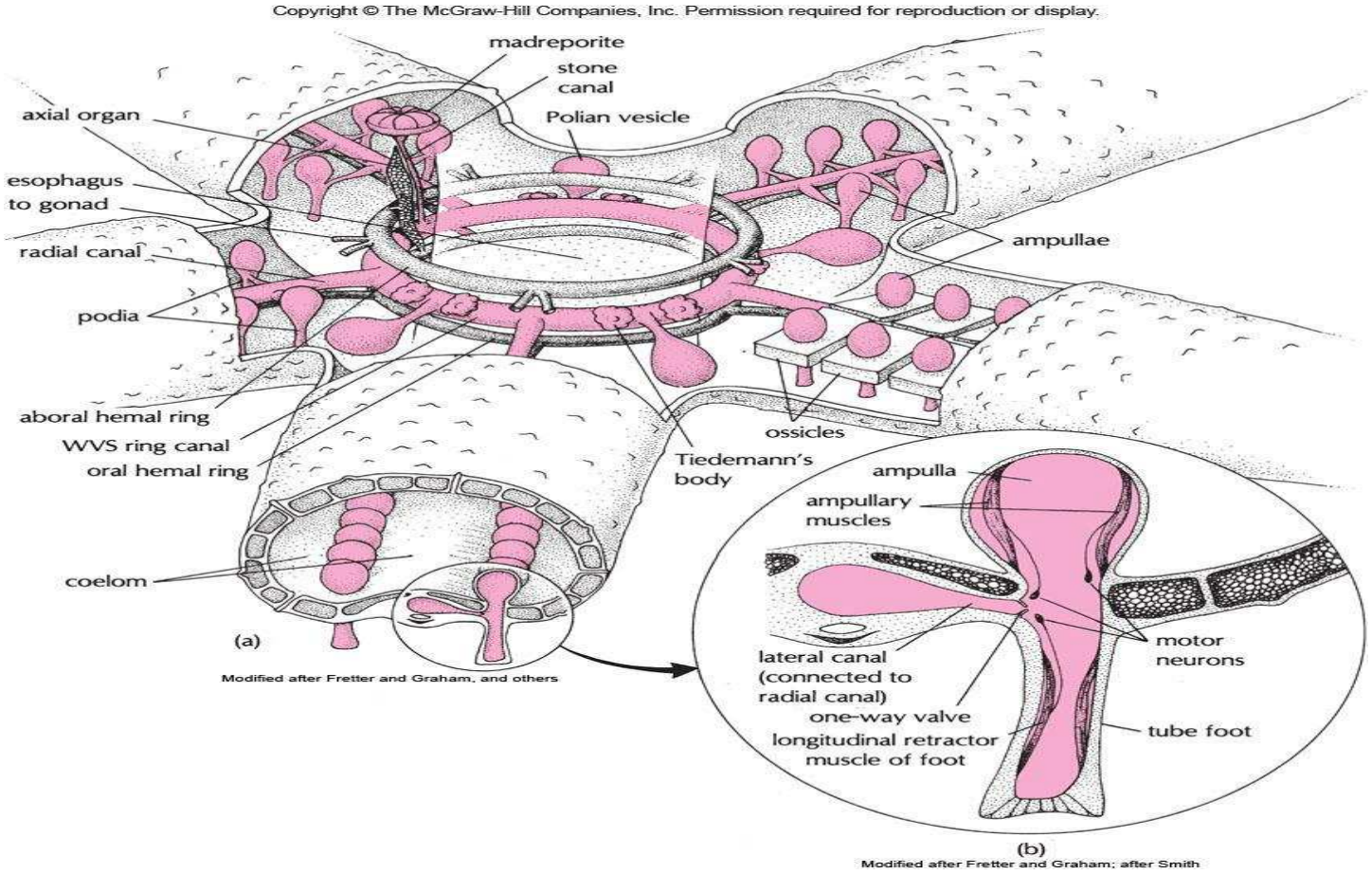
- **Have an internal skeleton (endoskeleton) of calcium carbonate**
- **Skeleton composed of skeletal plates & spines called *ossicles (Ossicles* = small bones)**
- **In sea cucumbers the plates are usually microscopic**

Water vascular system



- network of fluid-filled canals derived from the coelom
- A ring canal circles the mouth and gives off 5 radial canals
- The radial canal is exposed and runs along the ambulacral groove
- function in gas exchange, feeding, sensory reception and locomotion

Water vascular system

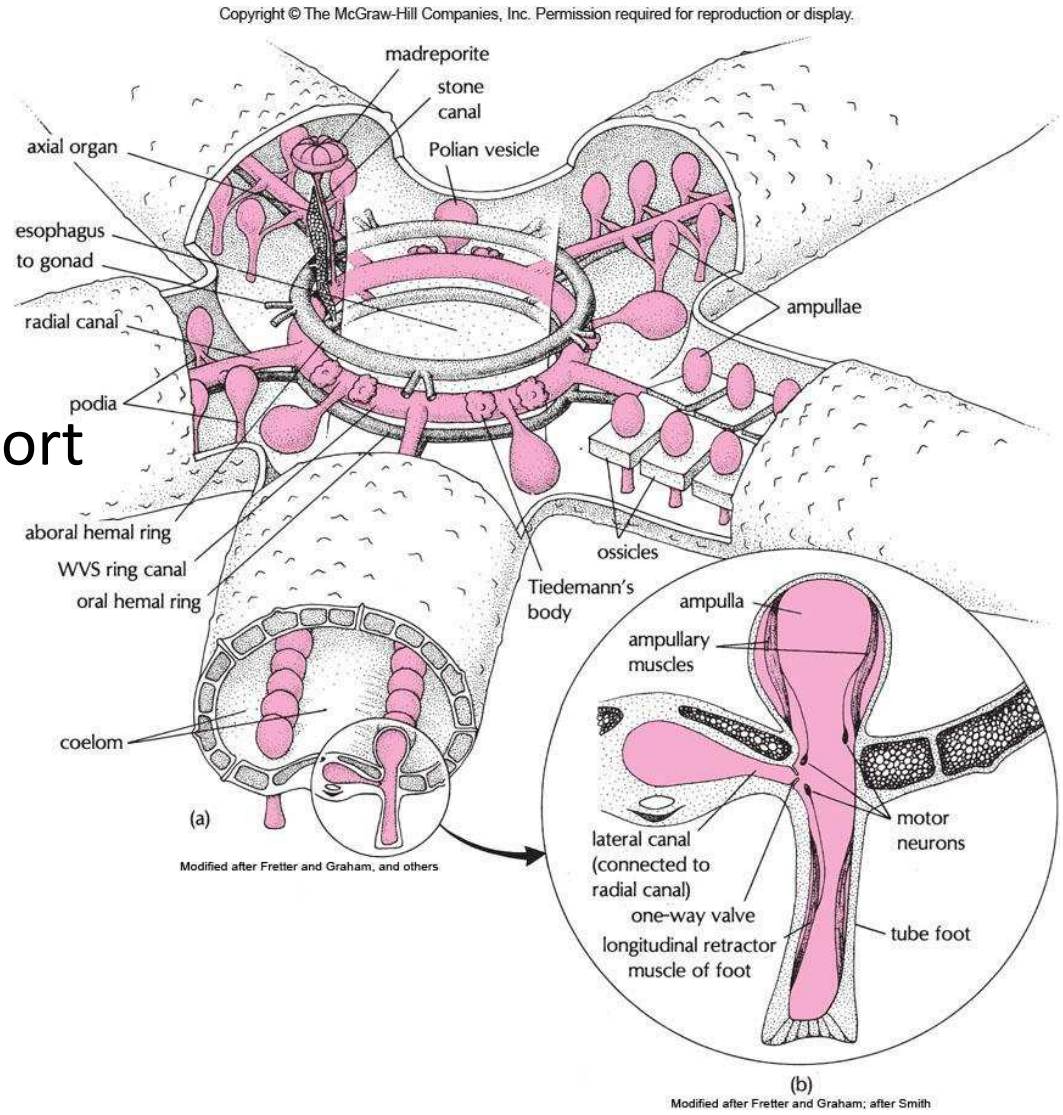


madreporite, stone canal, ring canal, radial canal, ampulla, tube feet

Water vascular system

Ambulacral ossicles support ampullae and tube feet

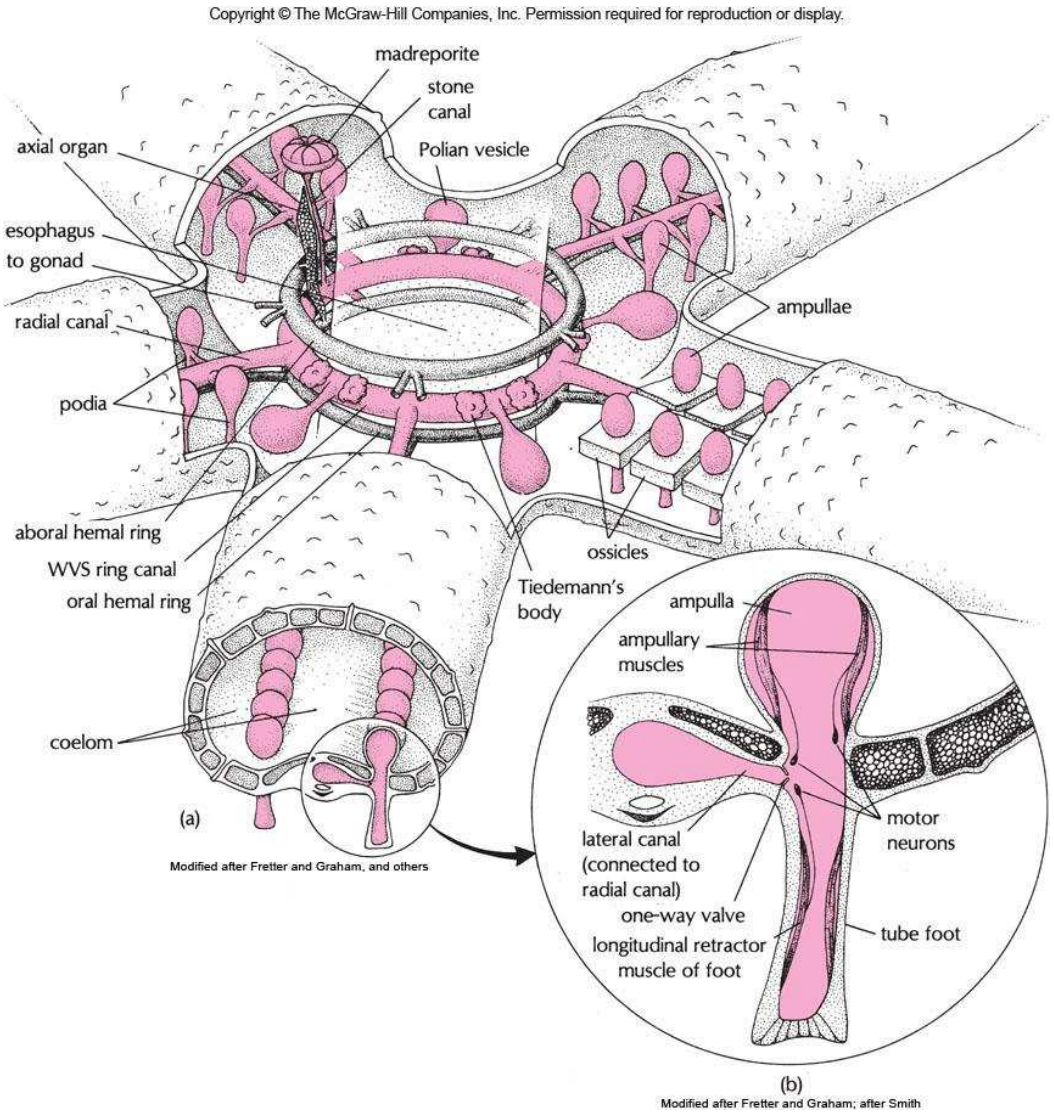
Contraction of ampulla moves fluid to tube feet



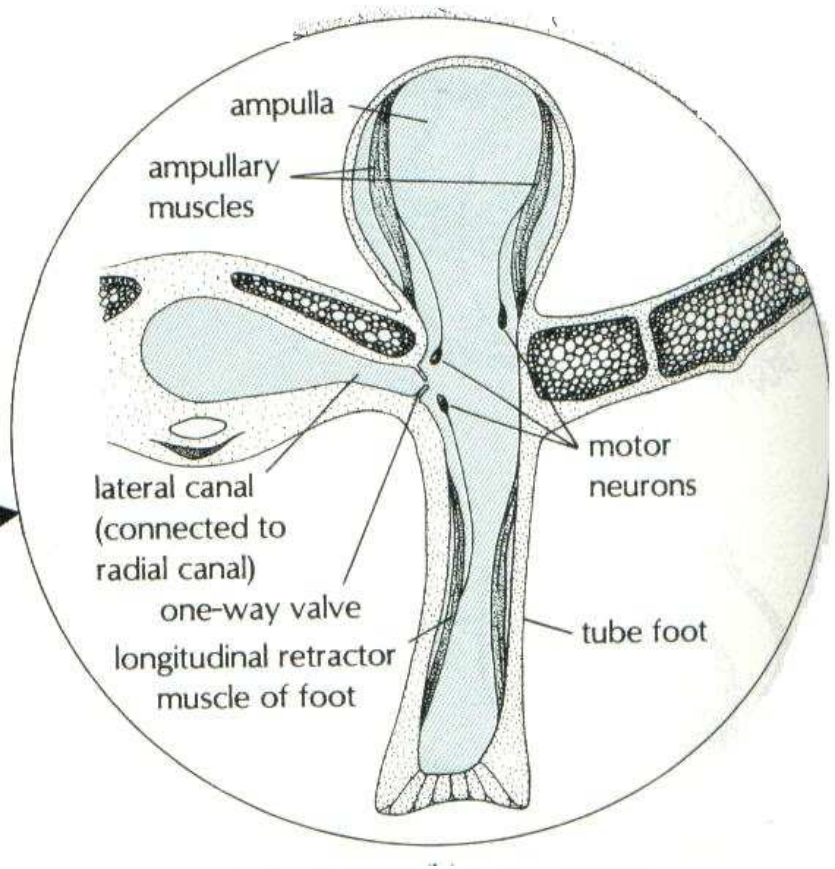
Water vascular system

- Tiedemann's body:

- Contains phagocytes; a defensive reaction against infection and invasion of the body by foreign substances



Tube Feet



- The ampullae is a small ball that sits above the tube foot
- Contraction and expansion of the ampulla accomplishes movement
- Tube feet function in locomotion, feeding and respiration

Unique Features

Echinoderms can REGENERATE
ex: sea cucumbers can eject a portion of gut in response to predators and regenerate when safe

Unique Features

Autonomy = The spontaneous self amputation of an appendage when the organism is injured or under attack. The autotomized part is usually regenerated.

"arms" → multiples of 5; some have more because of regeneration

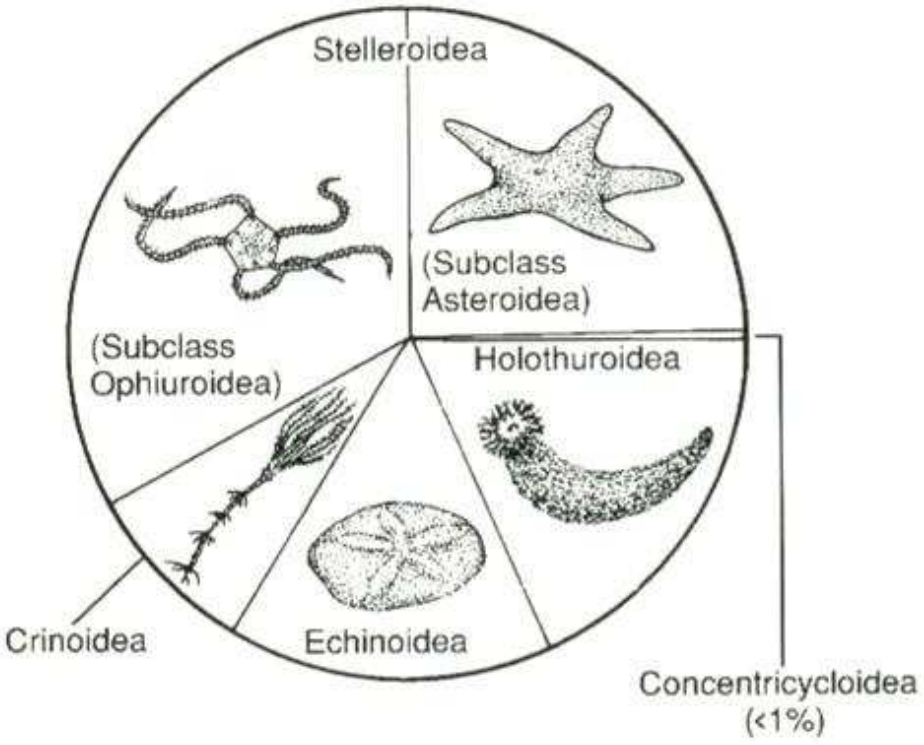
mutable collagenous tissue ~ connect ossicles; can maintain different positions without much effort

Nervous System

- Decentralized
- central nerve ring surrounds gut, connect radial nerves.
- Radial nerves run under each arm, coordinate movement, etc.
- Do not have “brains,” but some have ganglia along radial nerves

http://www.tolweb.org/Echinodermata

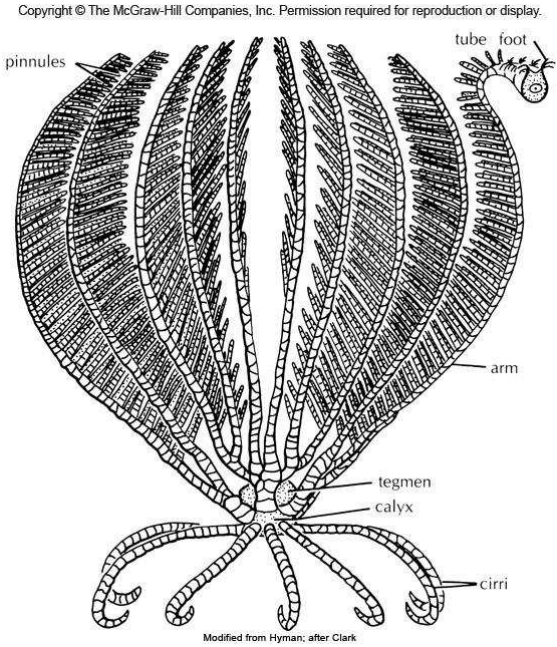
Taxonomic Summary



- Phylum Echinodermata
  - Class Crinoidea
  - Class Concentricycloidea
  - Class Stelleroidea
    - Subclass Asteroidea
    - Subclass Ophiuroidea
  - Class Echinoidea
  - Class Holothuroidea

Class Crinoidea

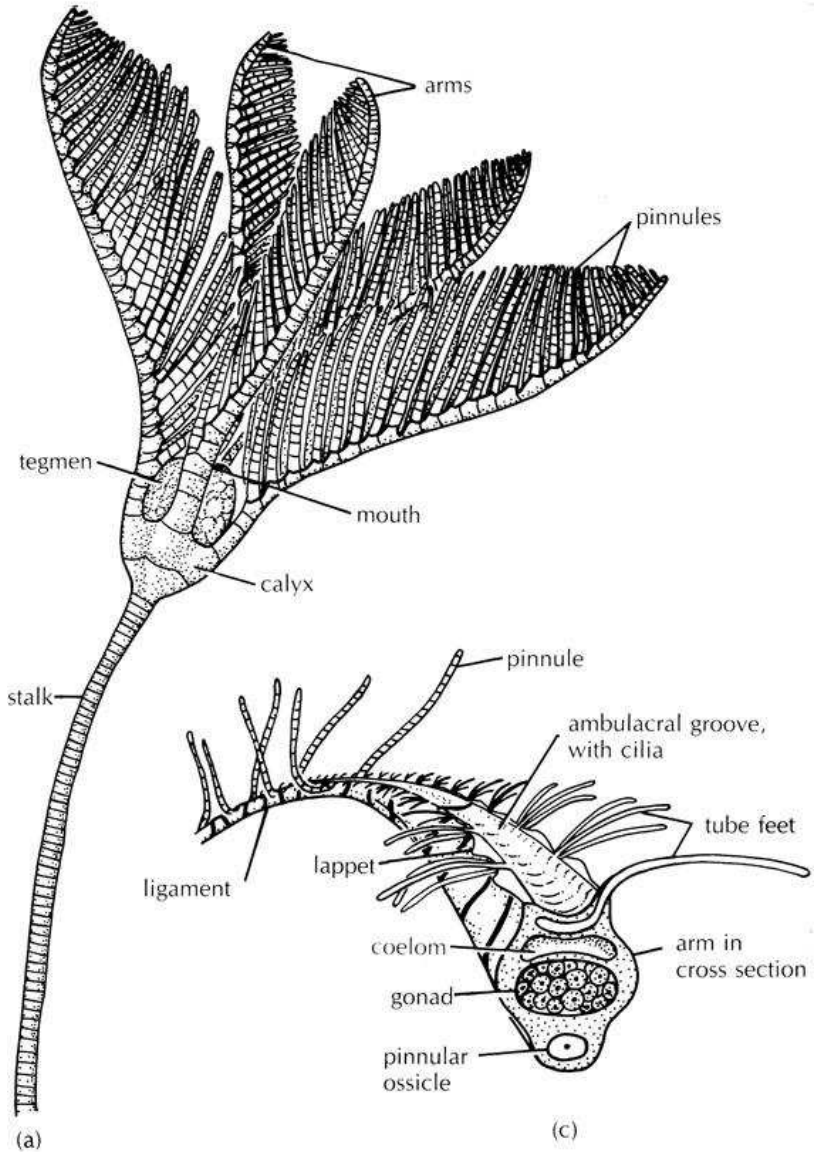
- Lily-like
- Feather stars and sea lilies
- Oldest of living echinoderms



Class Crinoidea

- Feeding, repro structures at top of stalk

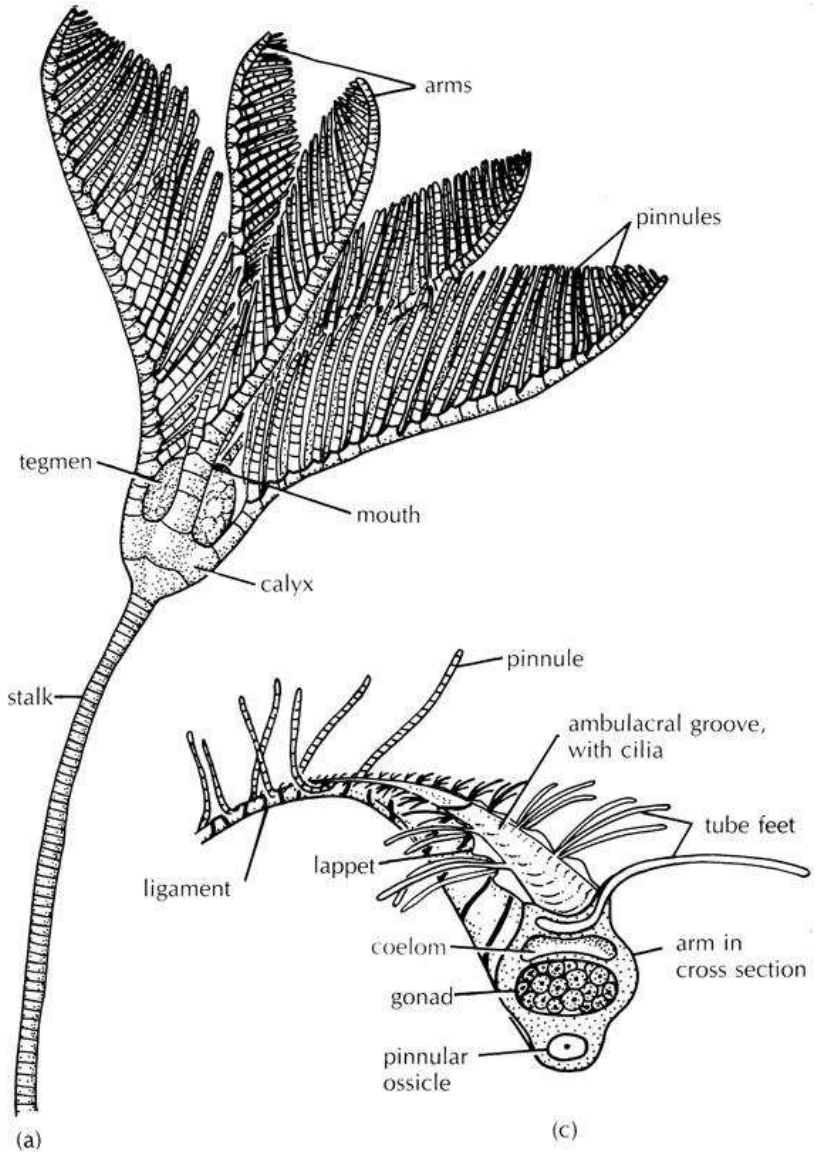
- Complete digestive system in calyx: mouth – intestine, anus



Class Crinoidea

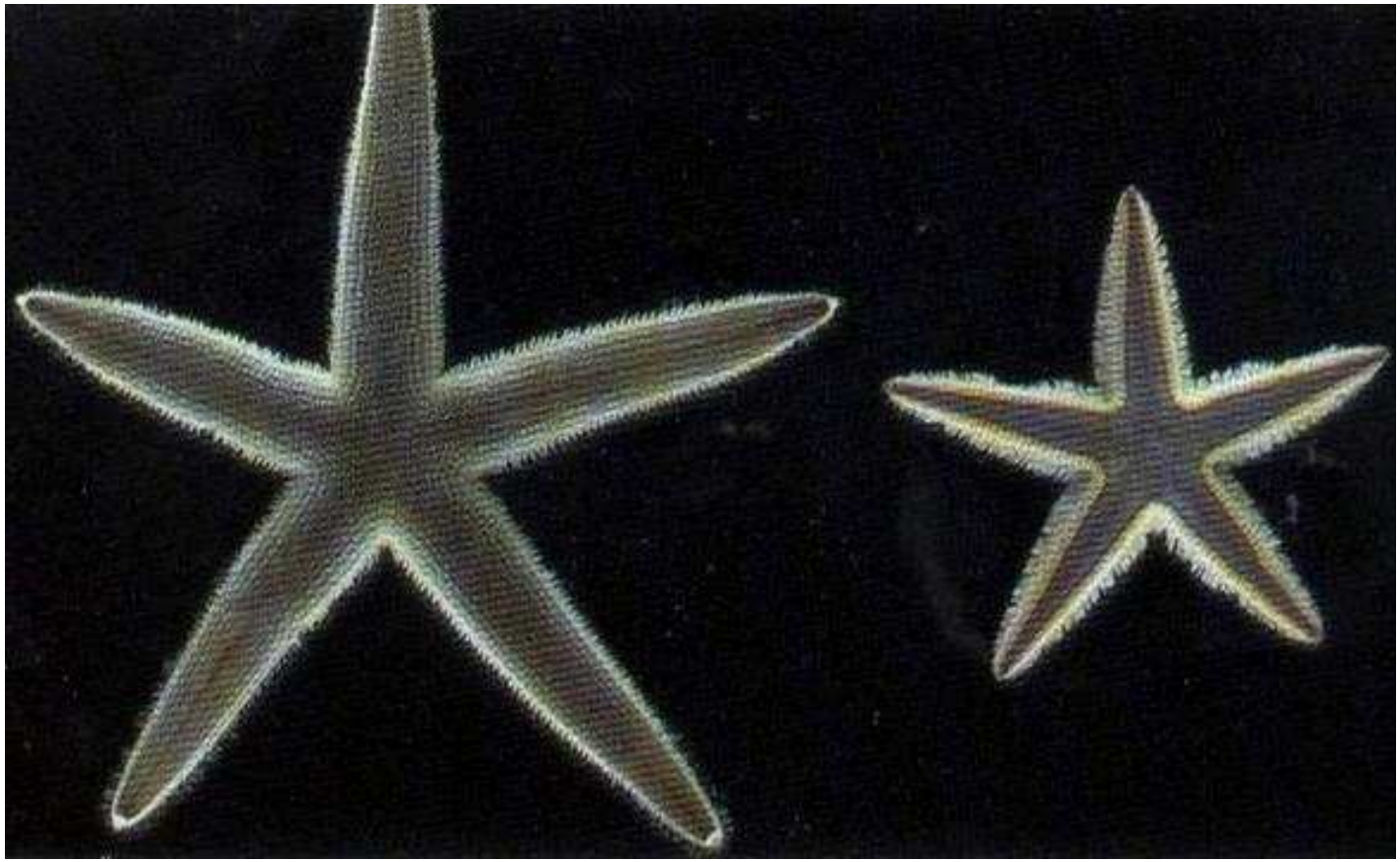
- Arms have ambulacral groove with mucus-secreting glands adjacent.

- Food particles stick in mucus, flicked to the ambulacral groove, then mouth



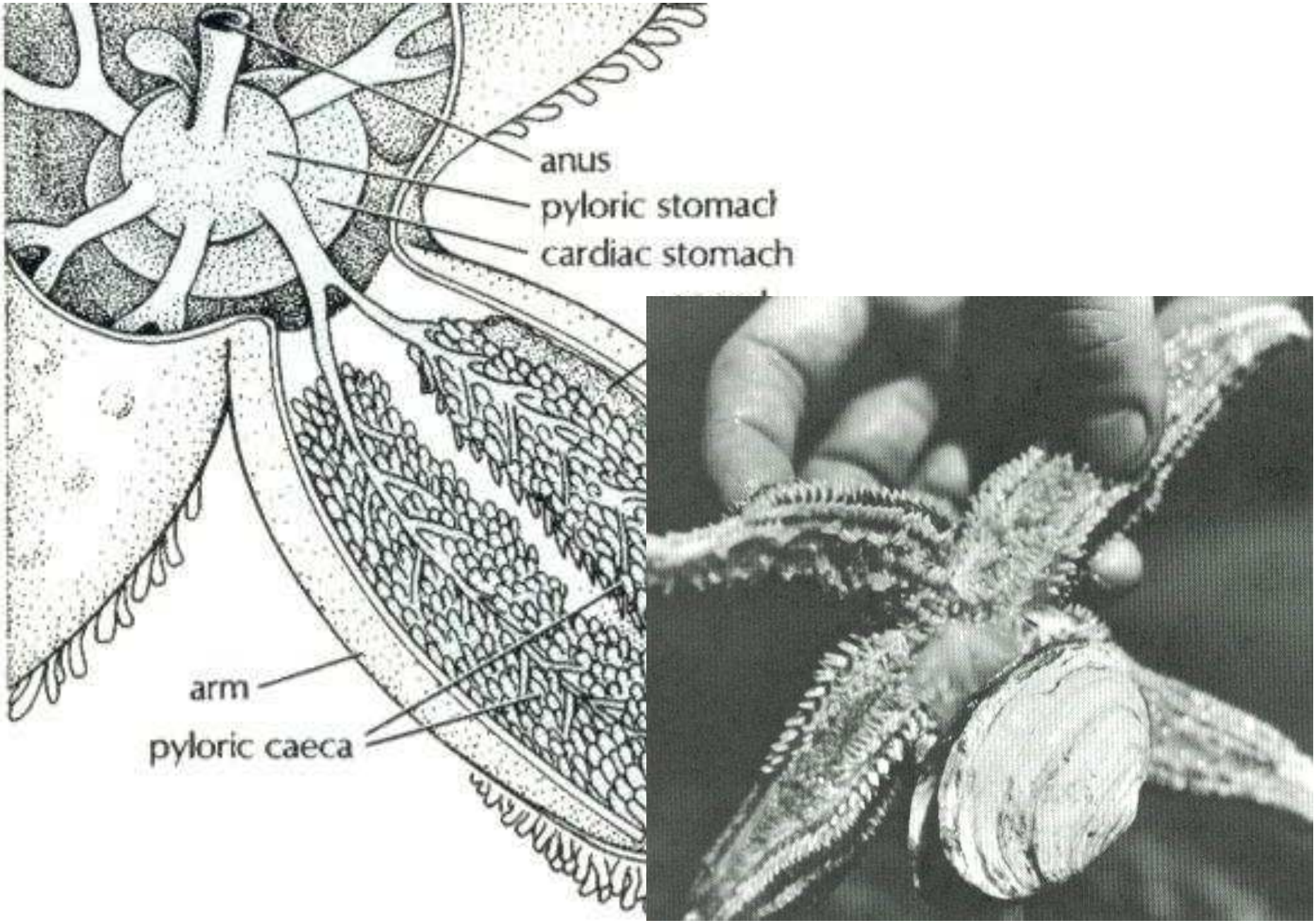

Flying
Crinoid

Subclass Asteroidea



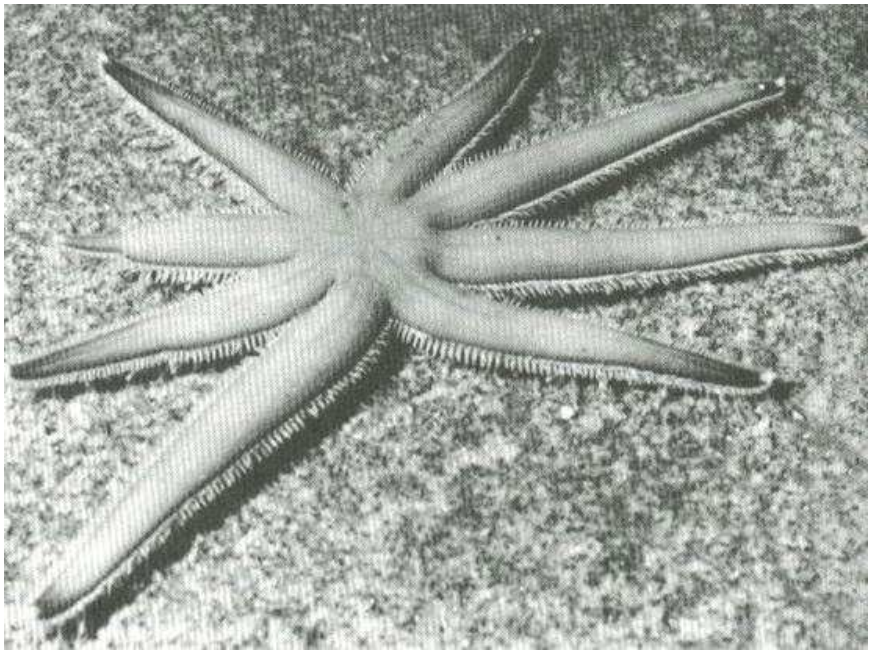
Sea Stars

- The oral surface of each arm has a single ambulacral groove
- Have a large coelom where all the main organs occur


anus
pyloric stomach
cardiac stomach
arm
pyloric caeca

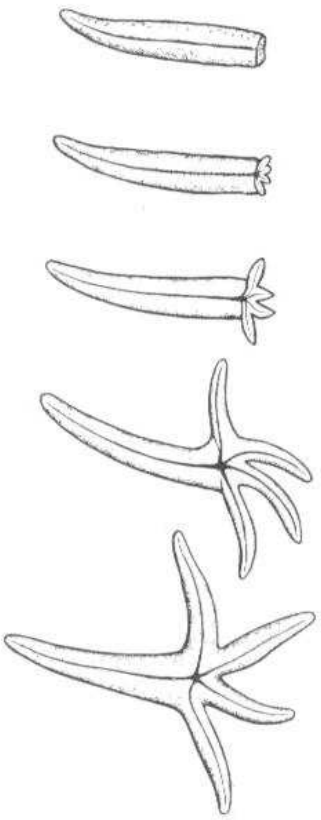
Reproduction

- Can reproduce asexually by disk division
- Sexual Reproduction
  - Dioecious with sperm or eggs produced in 2 or more gonads in each arm



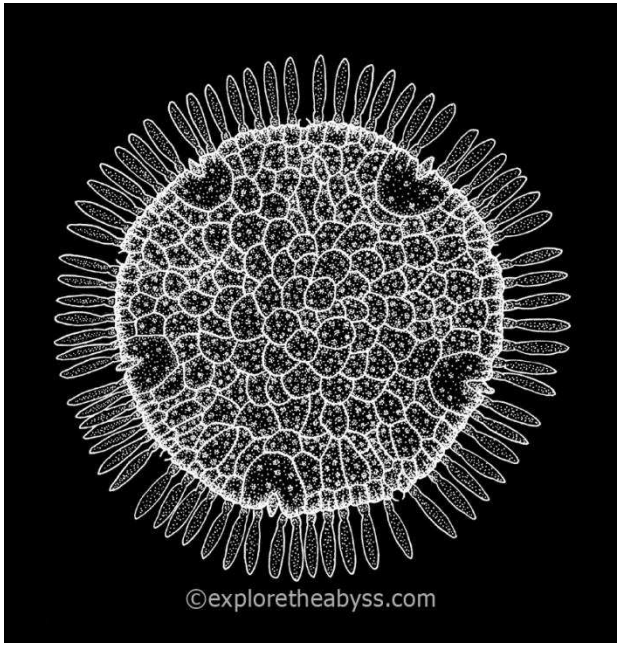
Regeneration

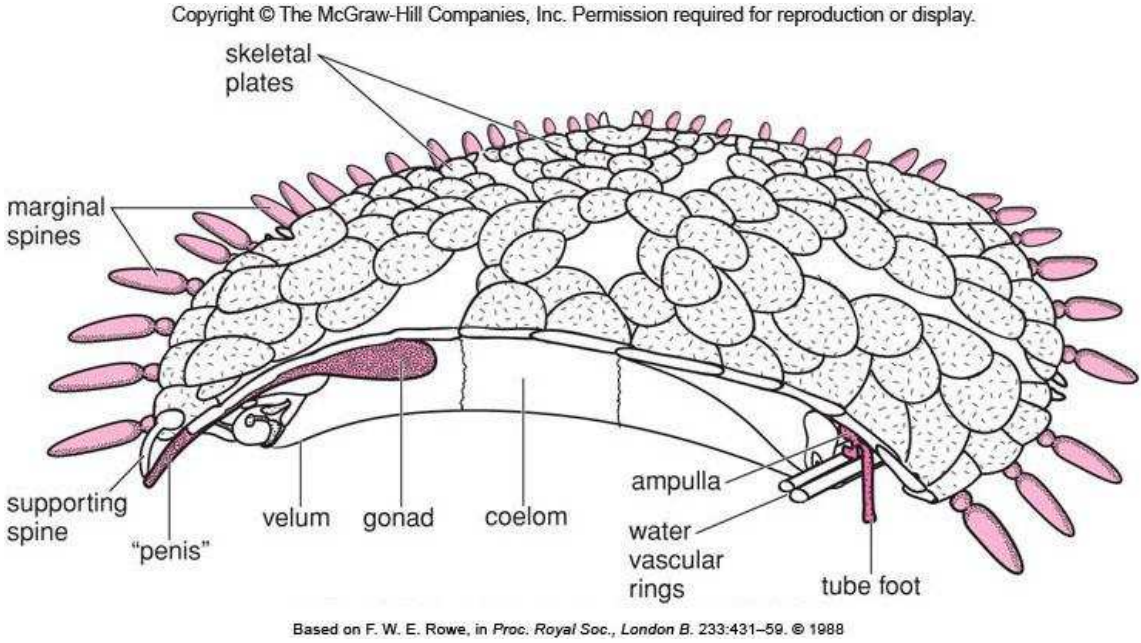
- Many species autotomize, leaving predators with a nutritious souvenir while they escape
- Most spp. can regenerate from fragments that include the disk



Concentricycloids – sea daisies

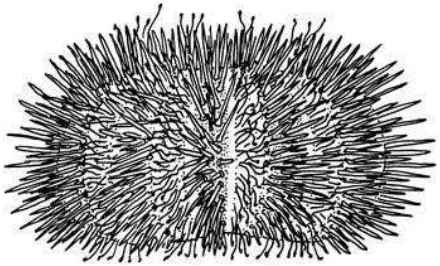
- Recently (1986) discovered echinoderms
- > 1000 m New Zealand, Bahamas
  - Tube feet arrangement different



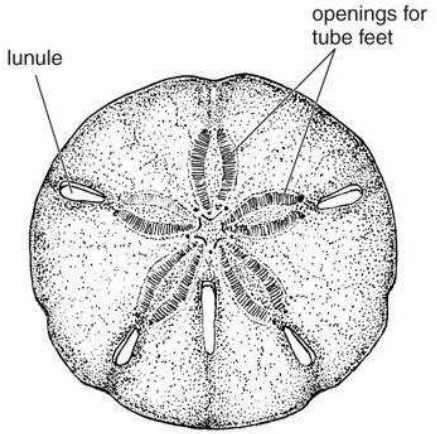


Class Echinoidea: spine-like

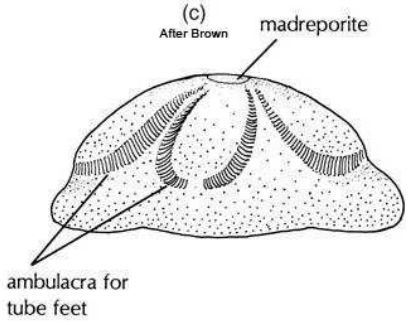
- Sea urchins, sand dollars
- < 1000 species



(a)
After Brown



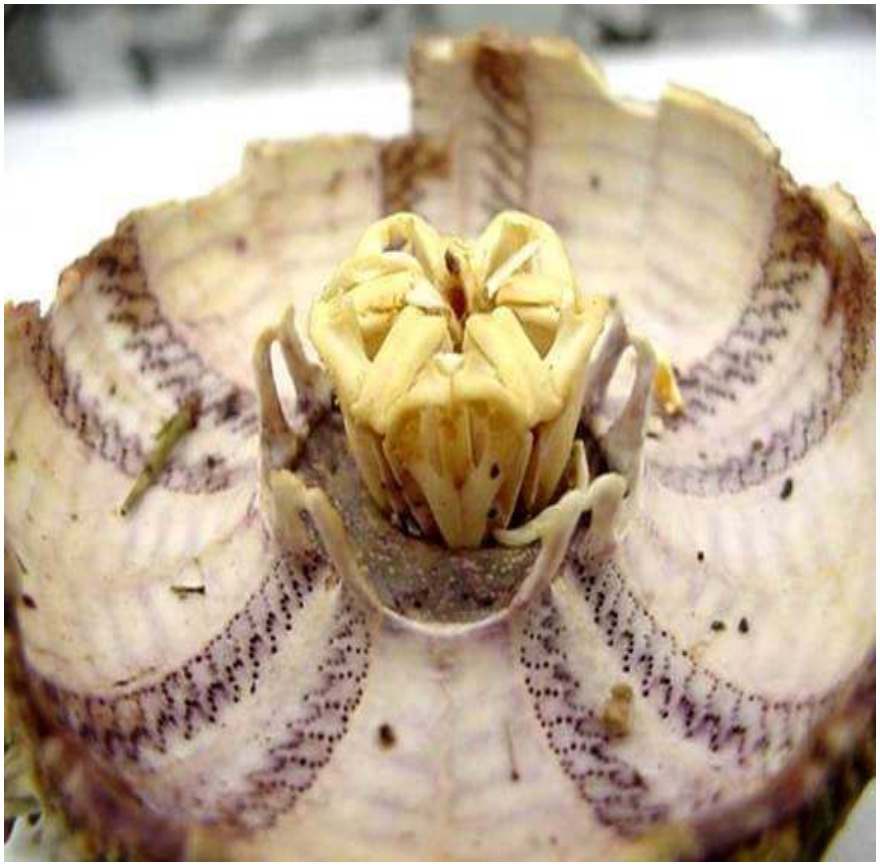
(c)
After Brown



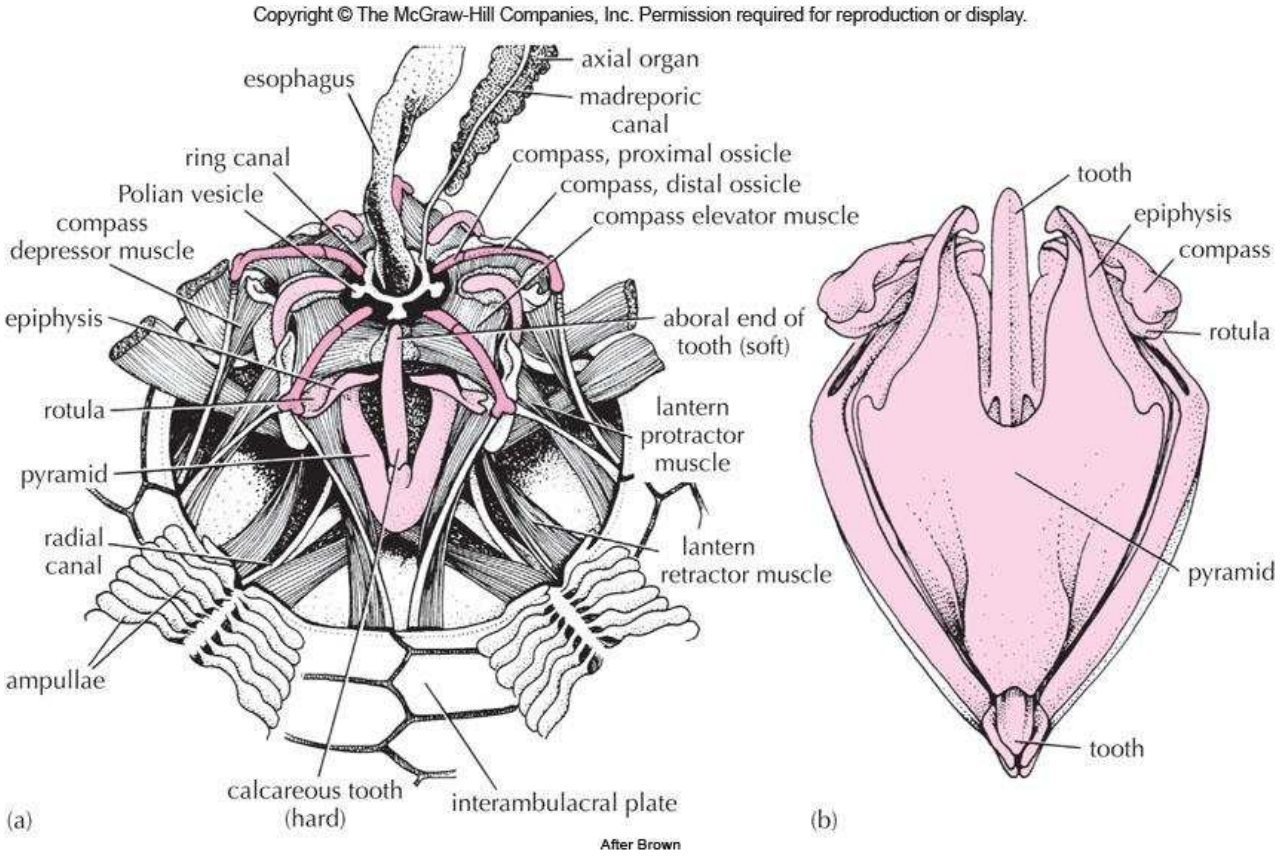
(d)
After Brown

Class Echinoidea: spine-like

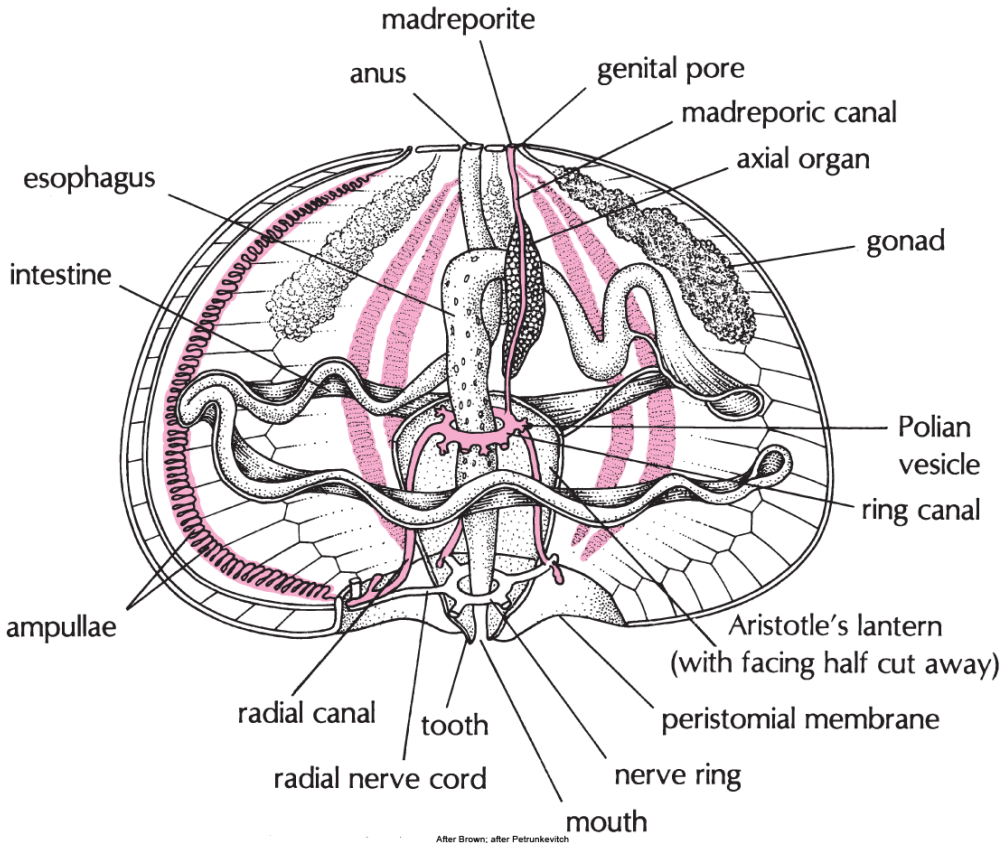
- the mouth is equipped with five teeth operated by a complex system of plates and muscles called Aristotle's lantern



- Feeding and digestion:
- Aristotle's lantern
- Teeth protruded to scrape algae or consume food
- Species w/o lantern usually detritivores

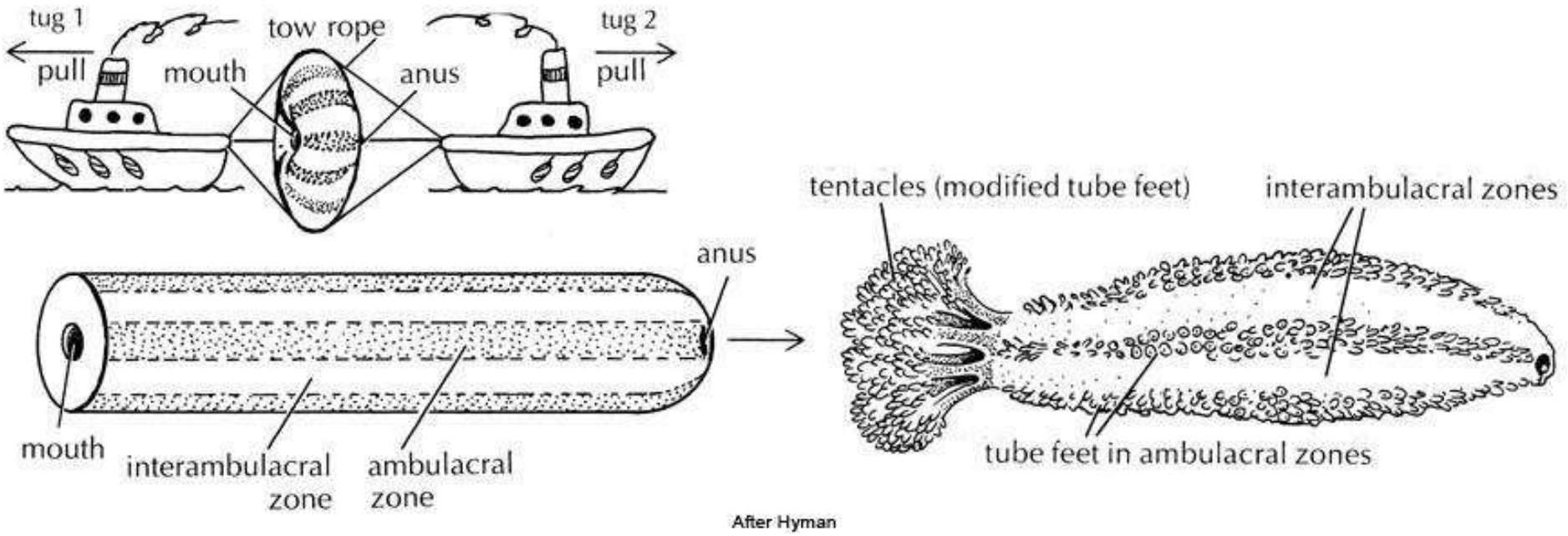


- Mouth – esophagus – intestine – anus



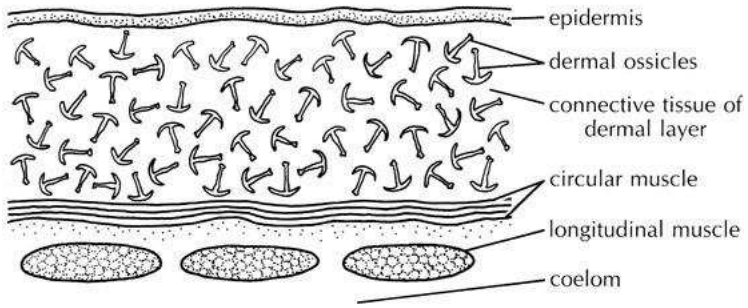

BBC

- **Class Holothuroidea: sea cucumbers**
- ~ 1200 species

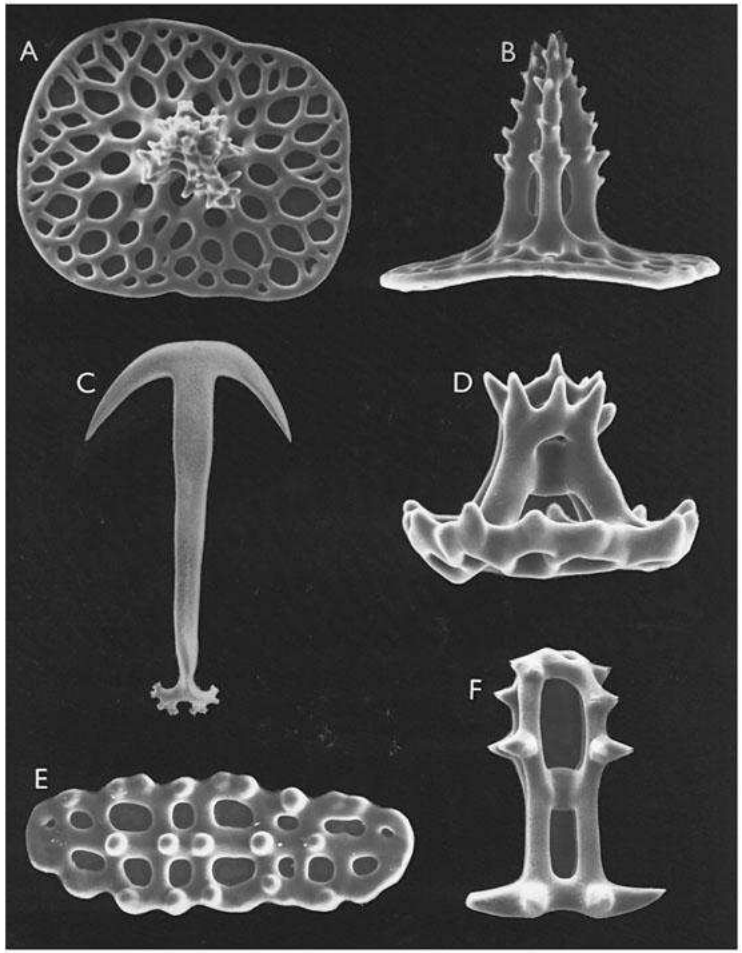


After Hyman

- Ossicles microscopic
- Multiple shapes



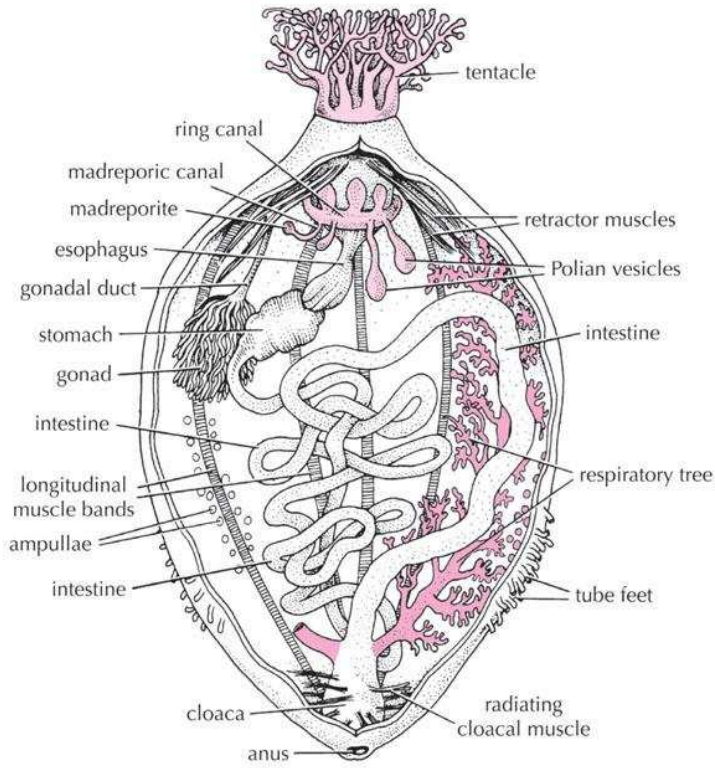
(a)



Courtesy of Harbor Branch Oceanographic Institution, Inc. Fort Pierce, Florida

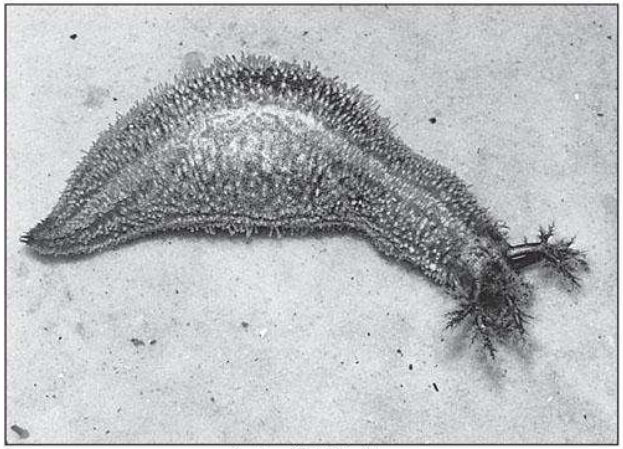
(b)

- Tube feet modified into tentacles around mouth
- Mostly deposit-feeders, few filter-feeders



(a)

After Hyman; After Coe



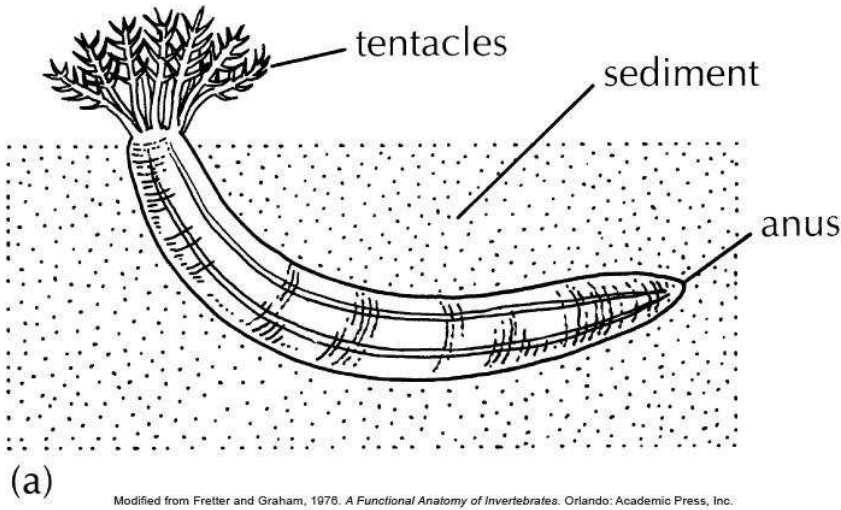
Courtesy of Ralph Buschbaum

(b)

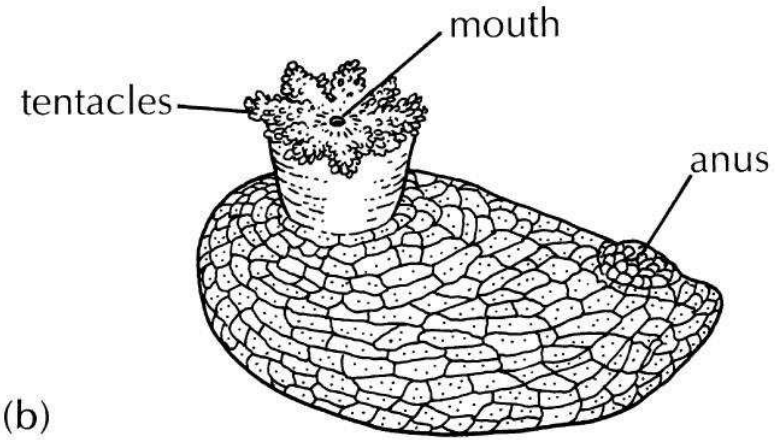
- Echinoderm repro + development:

- Some are asexual
- Most are dioecious

- Multiple gonads, gametes into seawater = external fert



Modified from Fretter and Graham, 1976. *A Functional Anatomy of Invertebrates.* Orlando: Academic Press, Inc.



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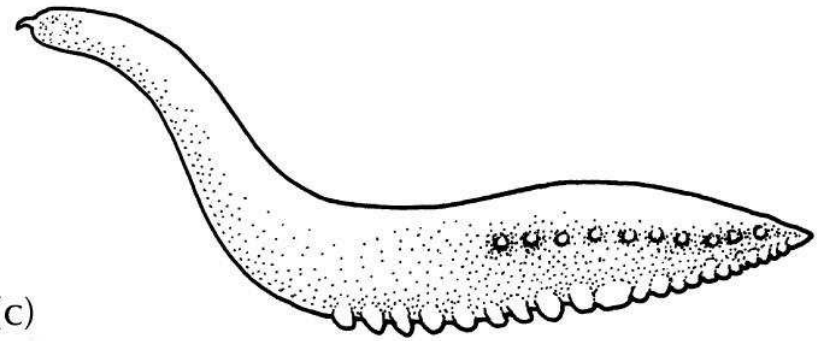

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- Distinctive ciliated larval form in each class
- Free-swimming, planktonic
- Metamorphosis into adult