

Ph. Echinodermata

“spiny-skin”



Cl. Crinoidea



Cl. Echinoidea



Cl. Ophiuroidea



Cl. Holothuroidea



Cl. Asteroidea



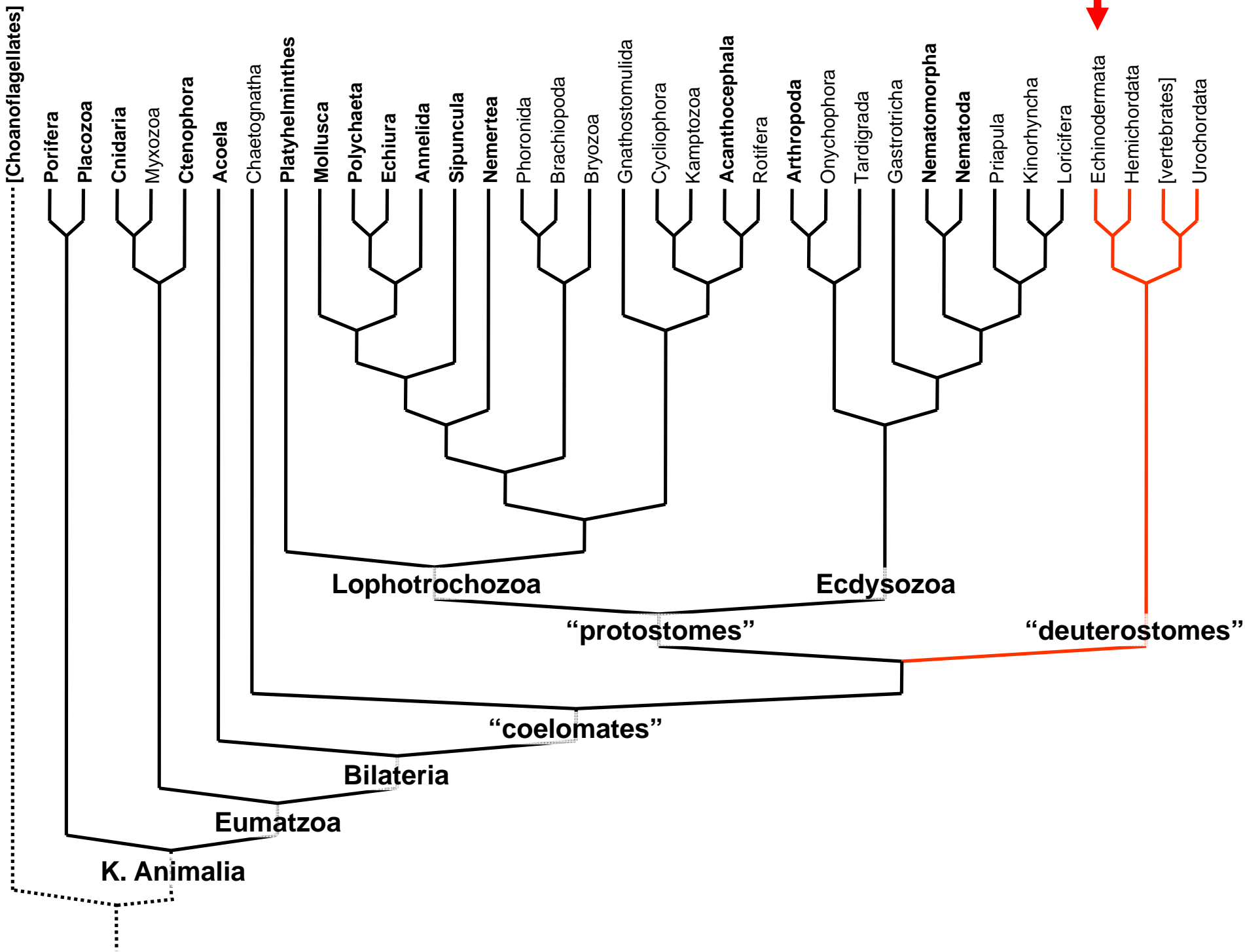
Concentricycloidea
Xyloplax turnarea

SubCl. ↑

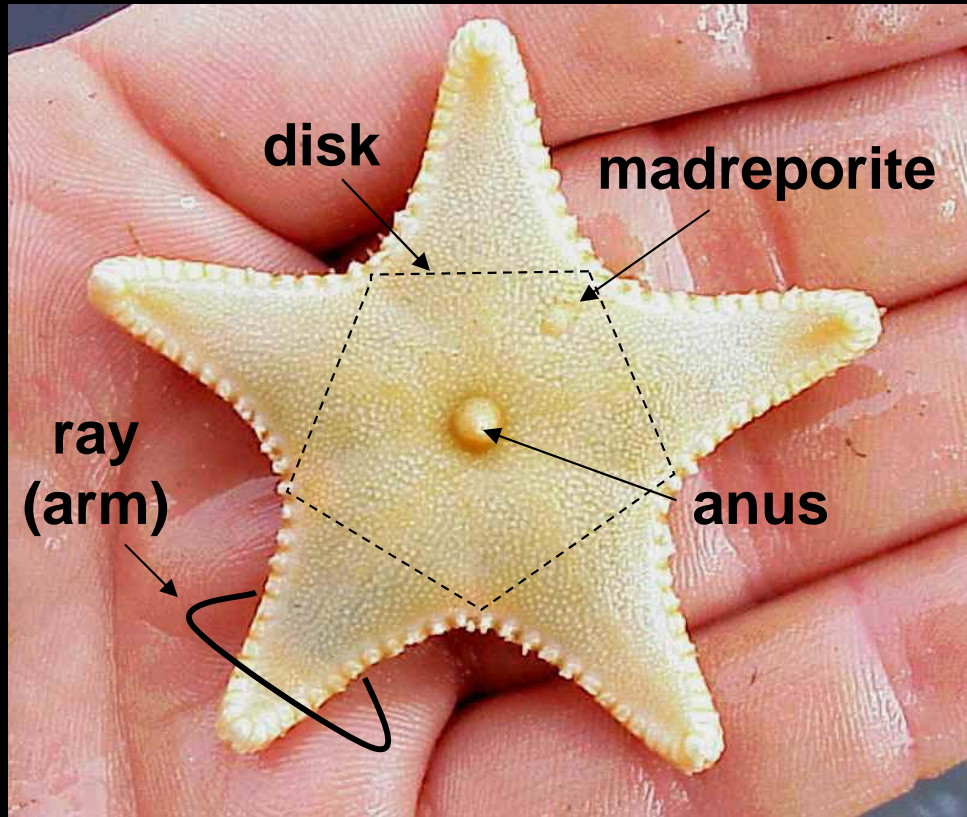
Pechenik:
“Cl. Stelleroidea”

SubCl. ↙

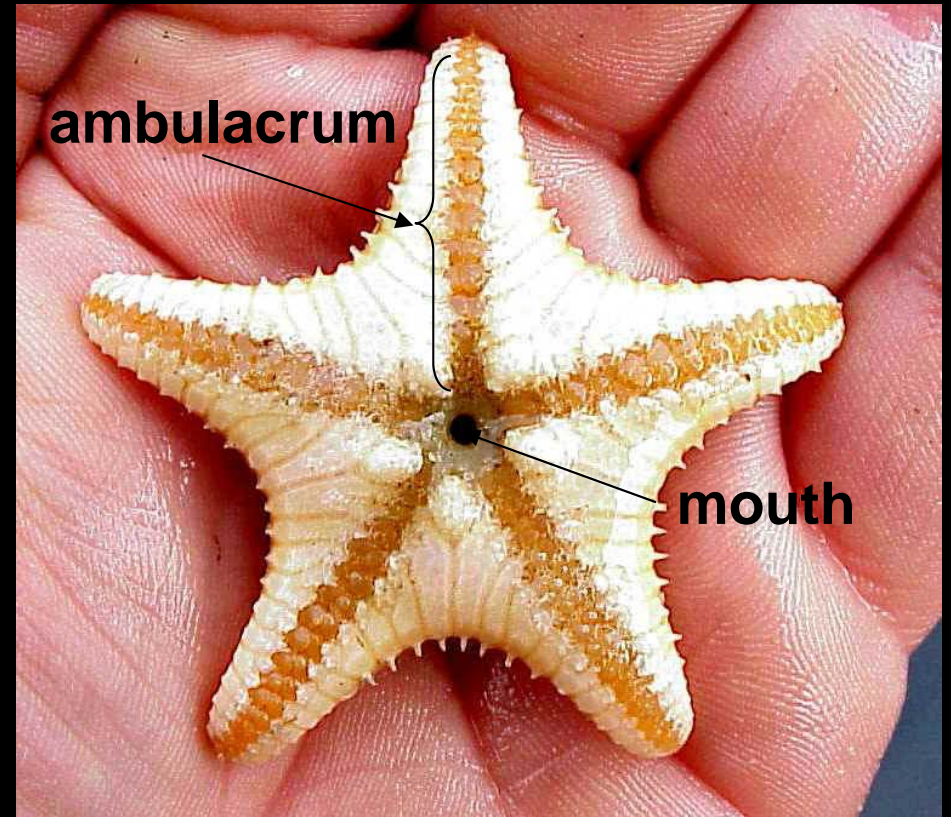
**Theme: radical
body design**



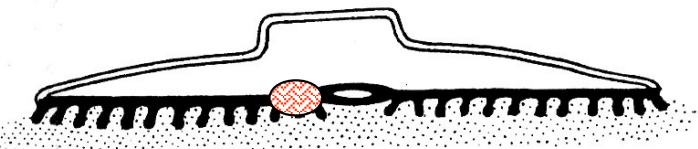
Pentamerous radial symmetry



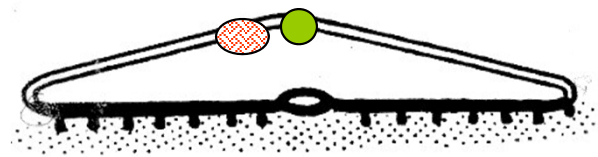
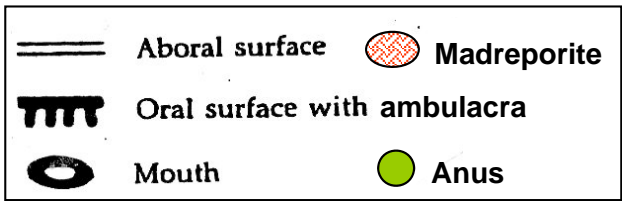
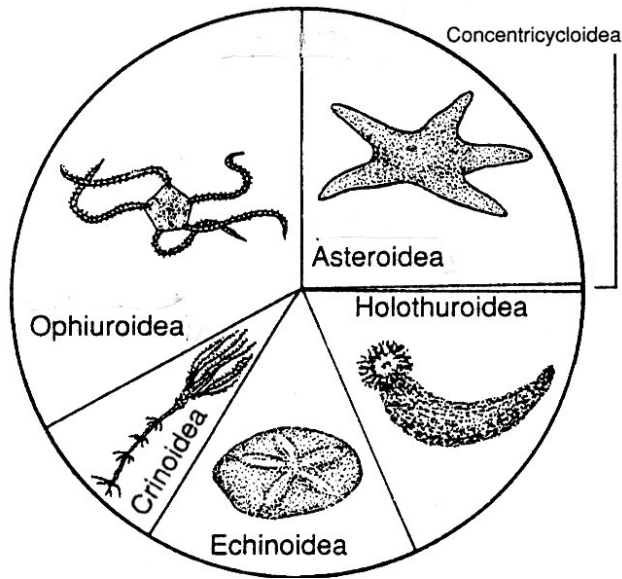
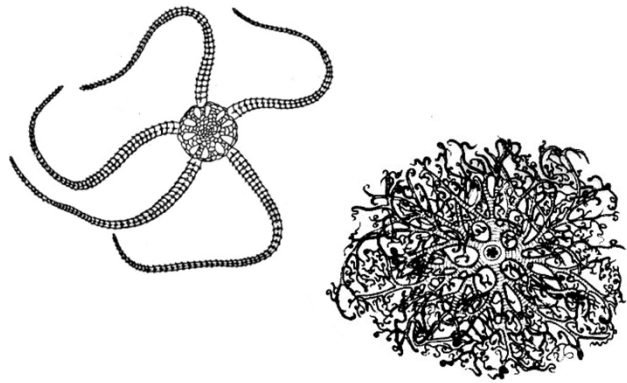
aboral (dorsal)



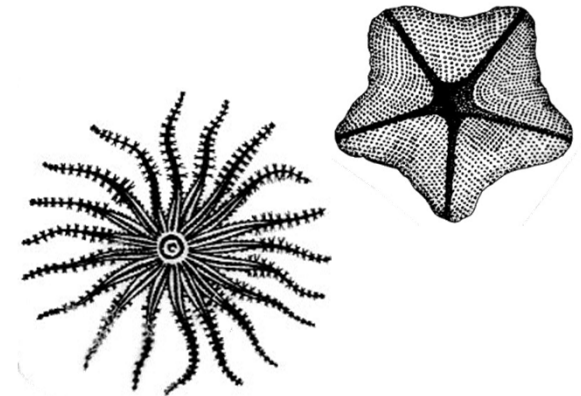
oral (ventral)



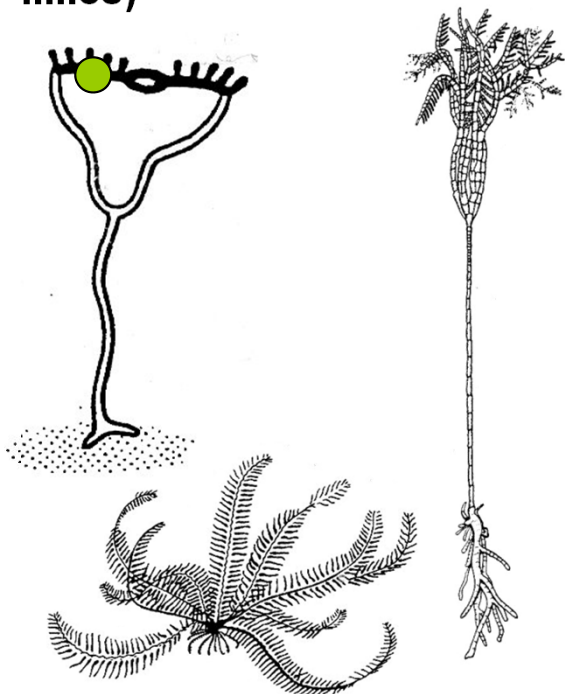
Ophiuroids (brittlestars)



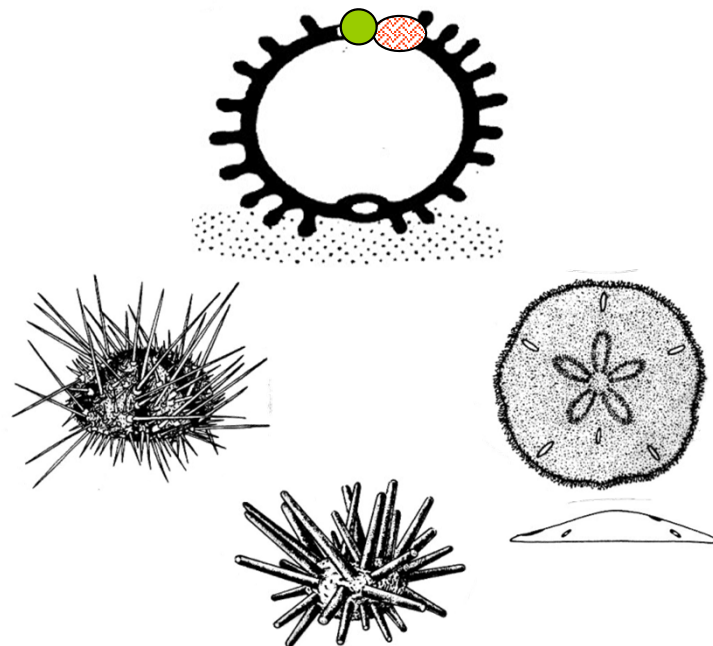
Asteroids (seastars)



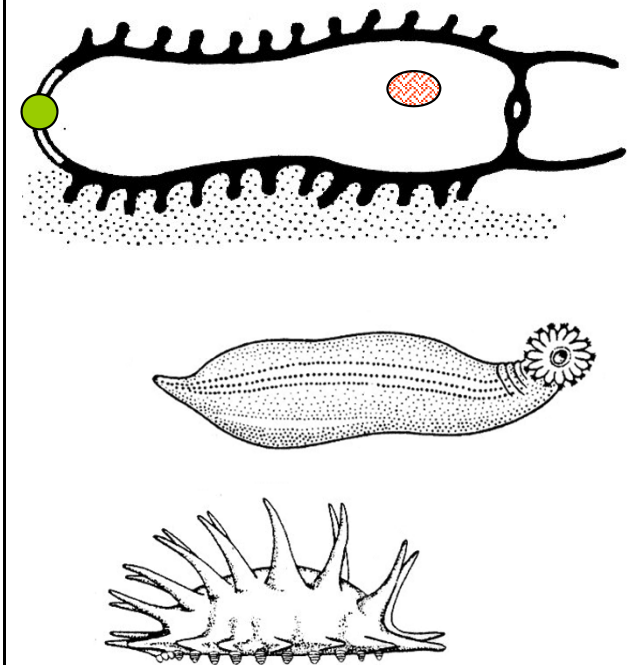
Crinoids (feather stars, sea lillies)



Echinoids (sea urchins, sand dollars)



Holothuroids (sea cucumbers)

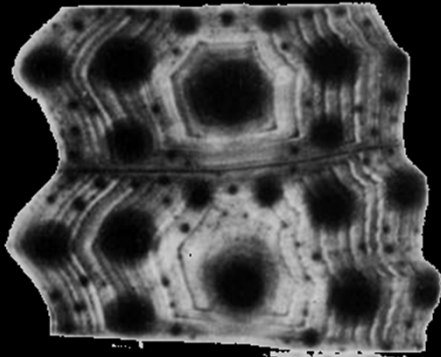


Body wall endoskelton { CaCO_3 ossicles (*stereom*)
connective tissue (*mutable collagen*)



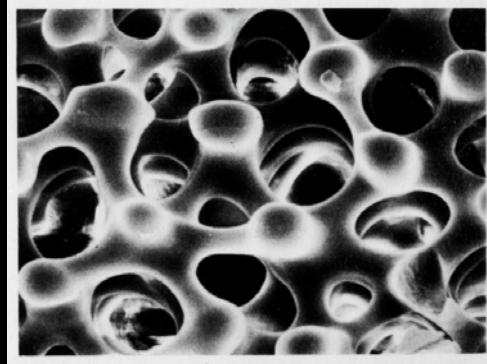
Stereom: a living meshwork of skeletal material

plates

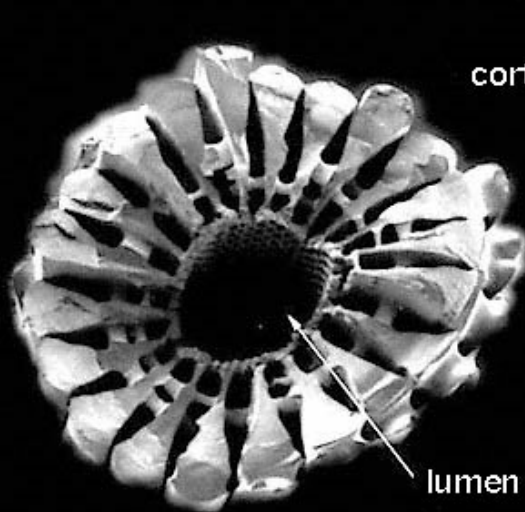
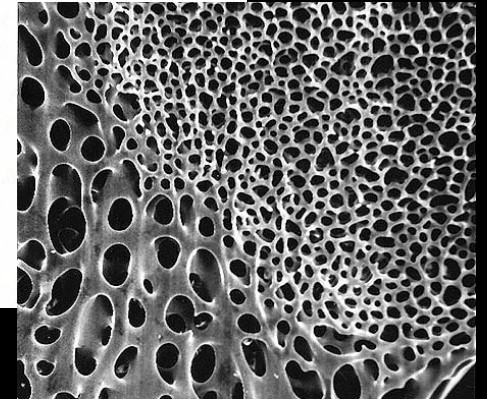
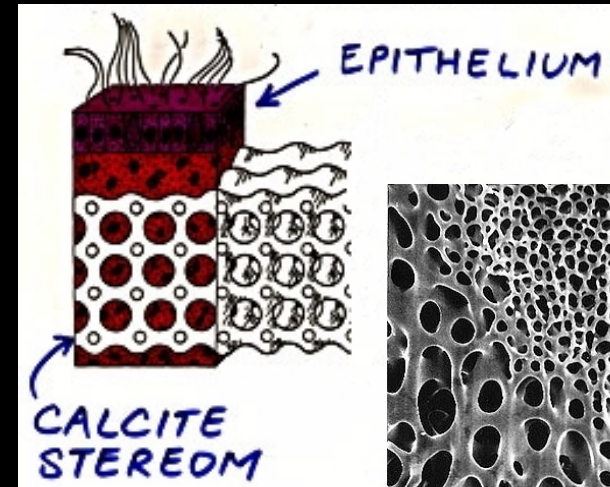


1 cm

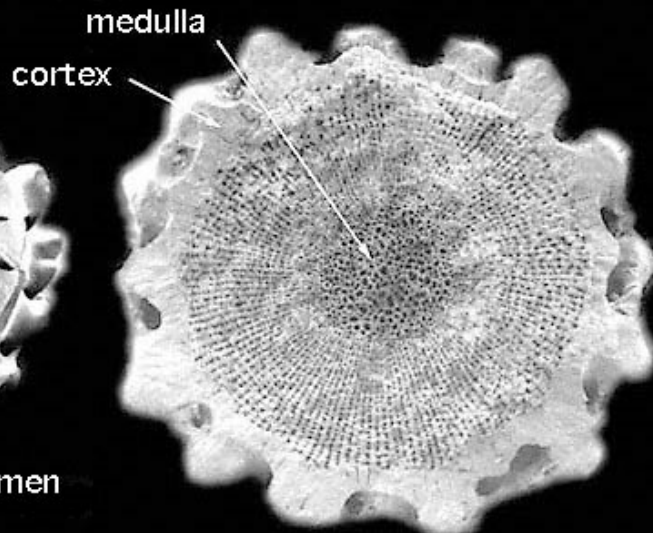
1000 x mag



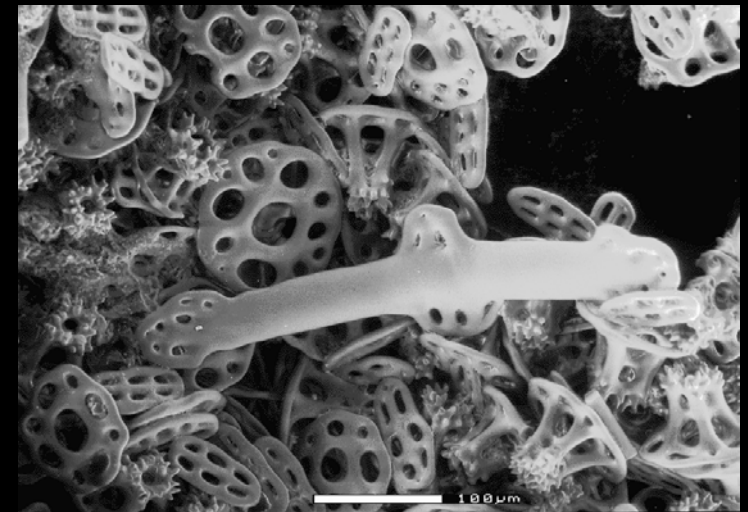
0.001 cm



diadematoid



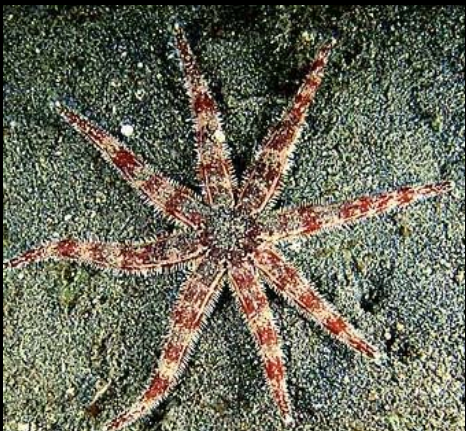
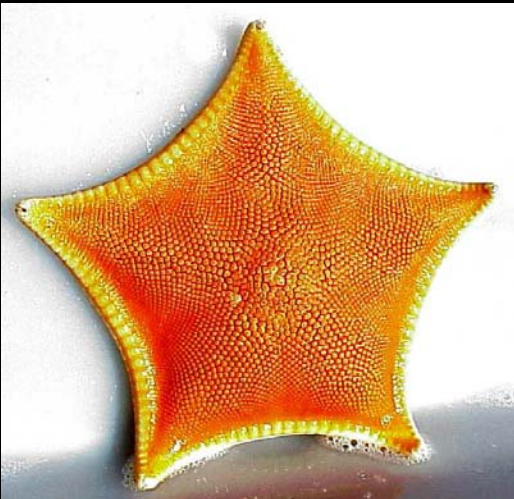
cidaroid



15kV ESD X200 D=6.8mm P=4.0T
holothuroid spicules 95.07.16 R2

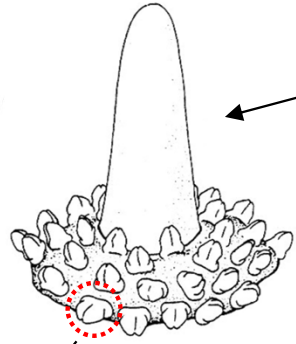
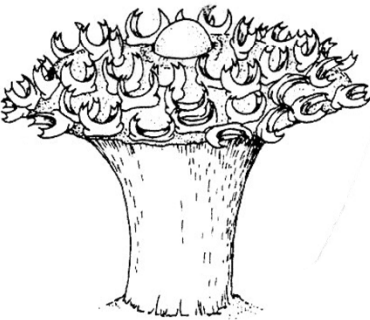
holothuroid ossicles
(tissue dissolved)

Cl. Asteroidea

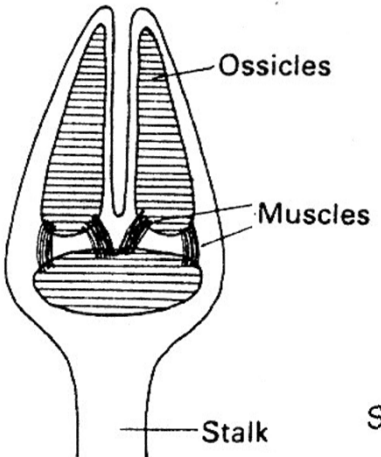


External features: asteroids

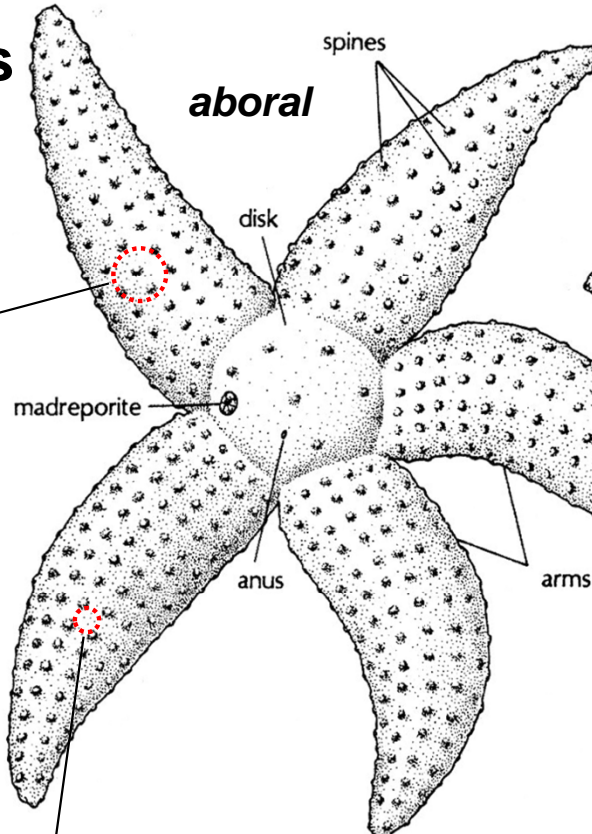
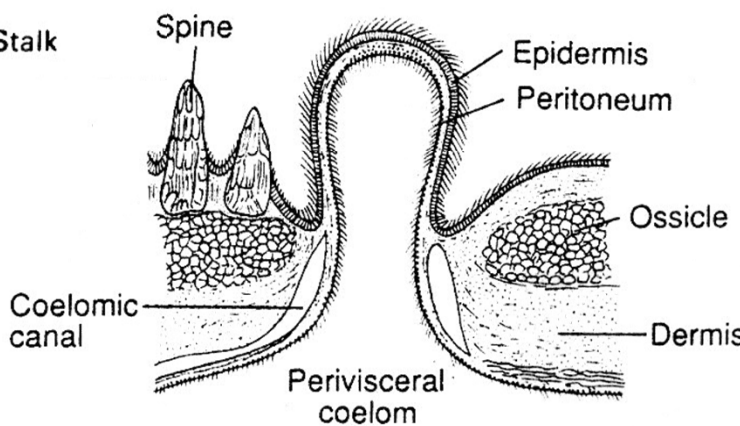
spines



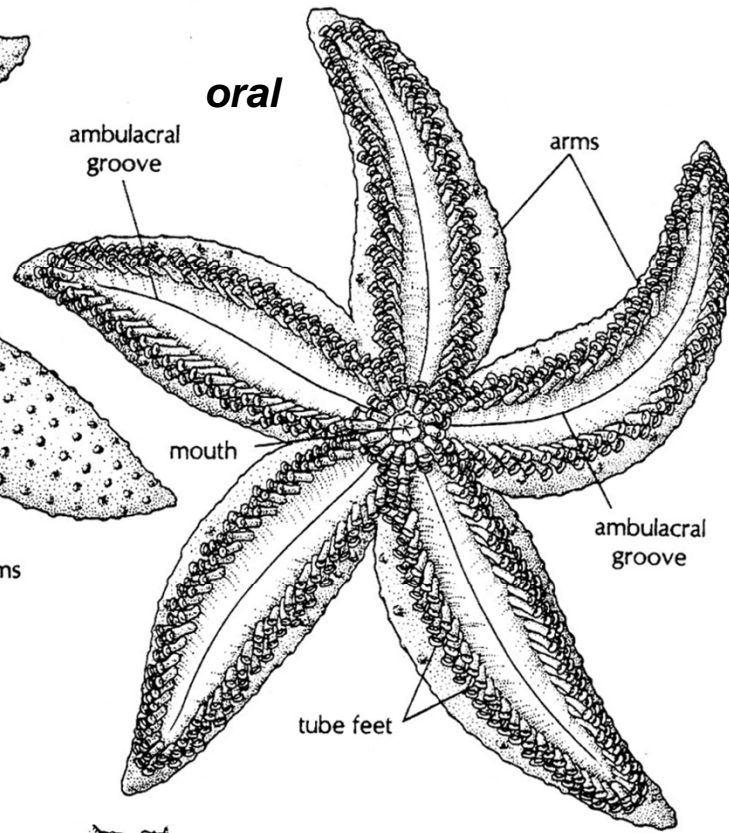
pedicellariae



papulae

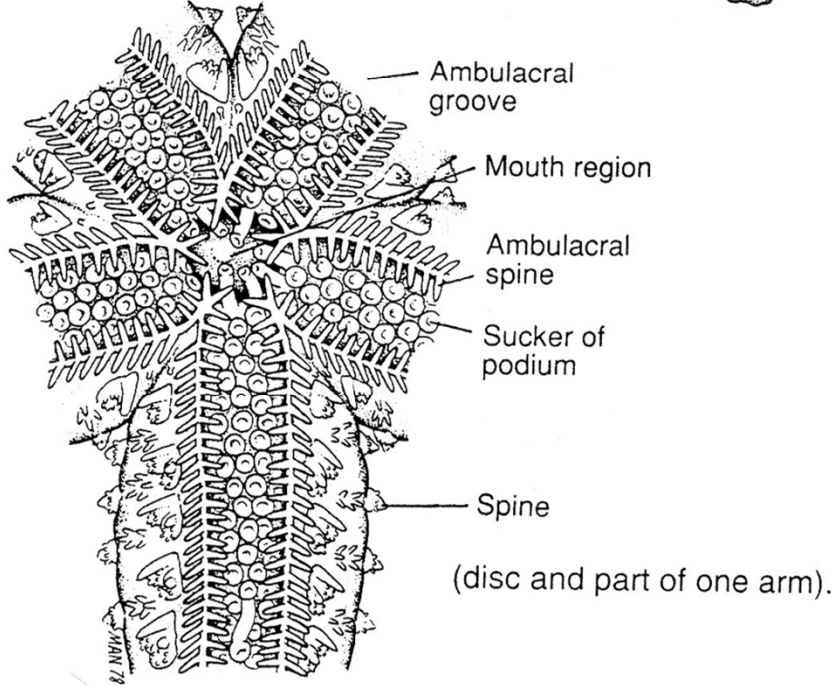


aboral



oral

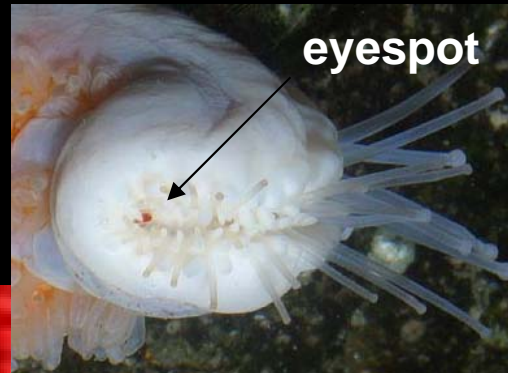
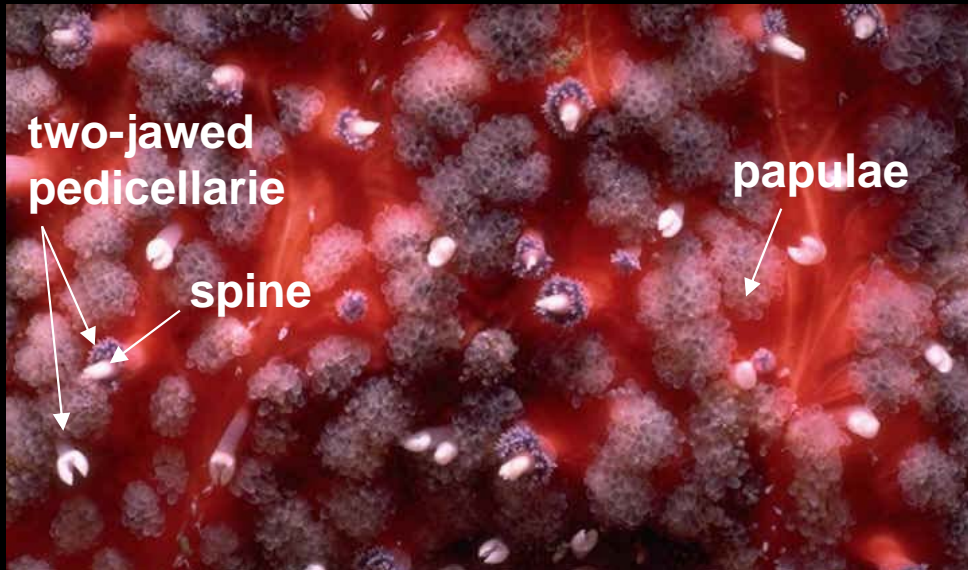
podia (tube feet)



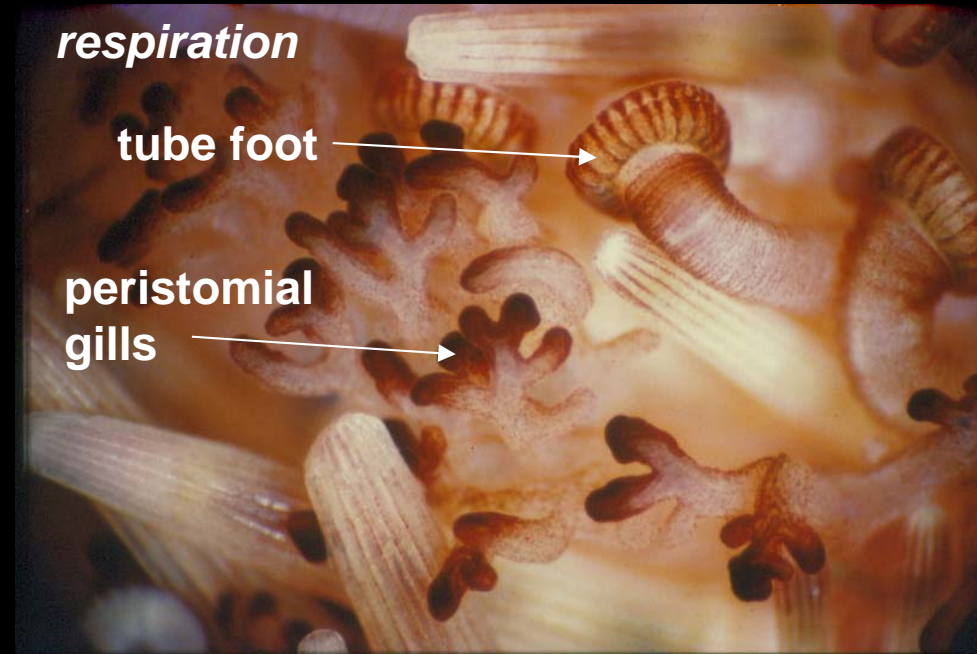
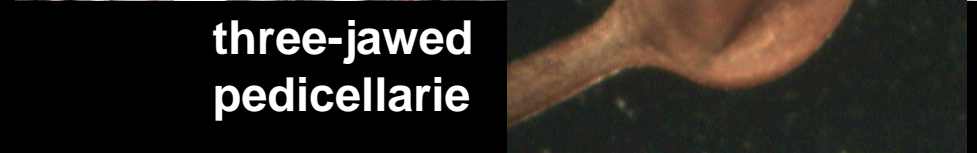
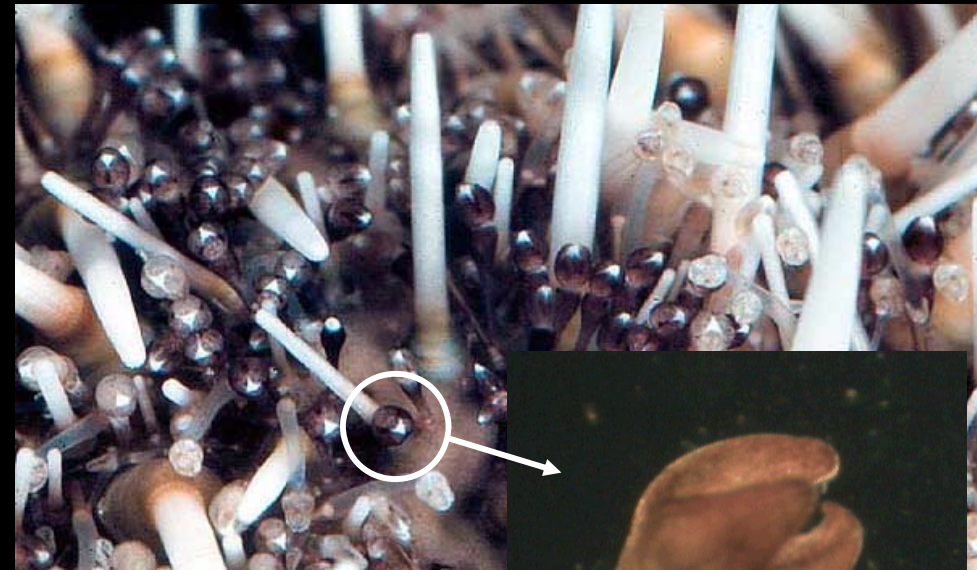
(disc and part of one arm).

Complex surface features

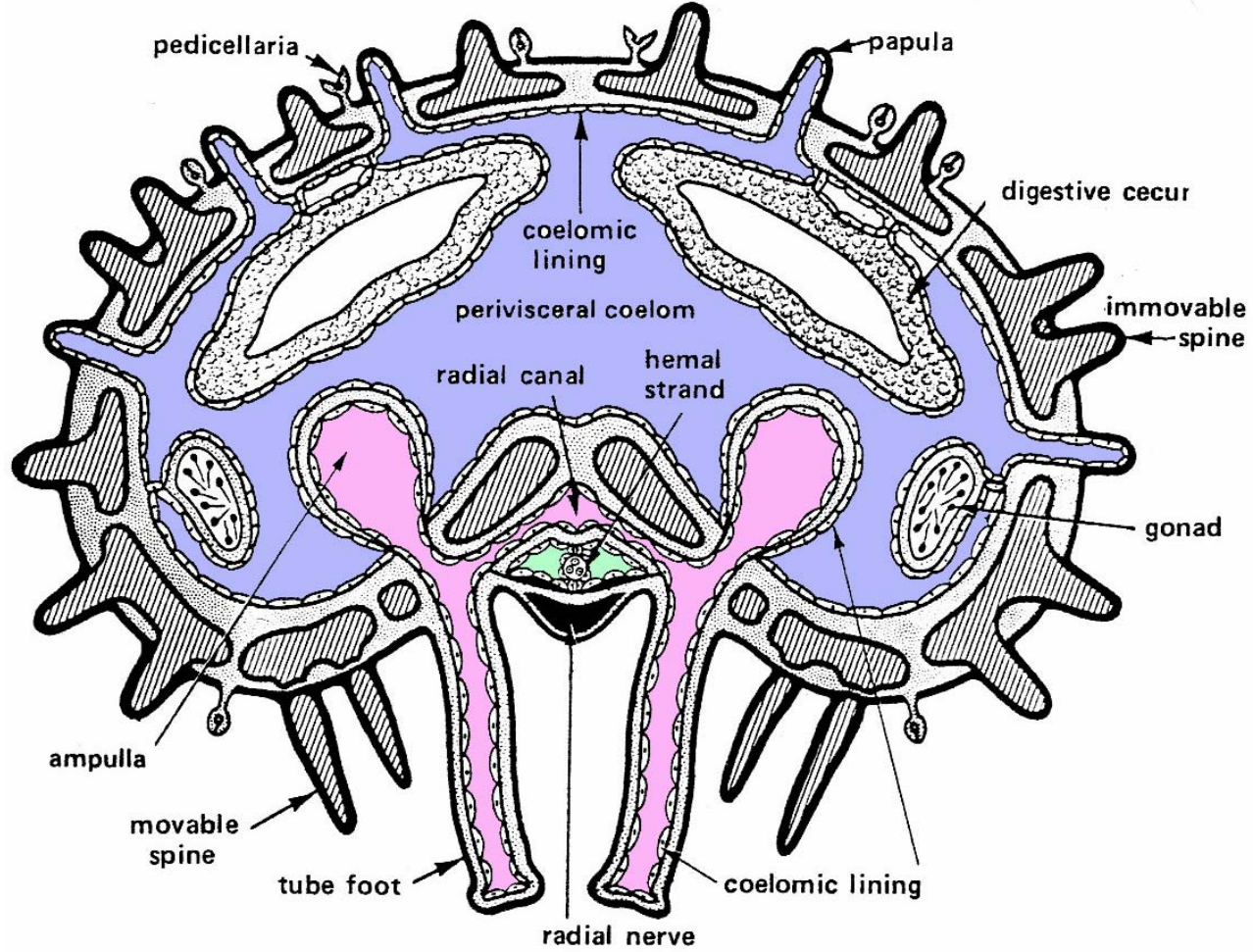
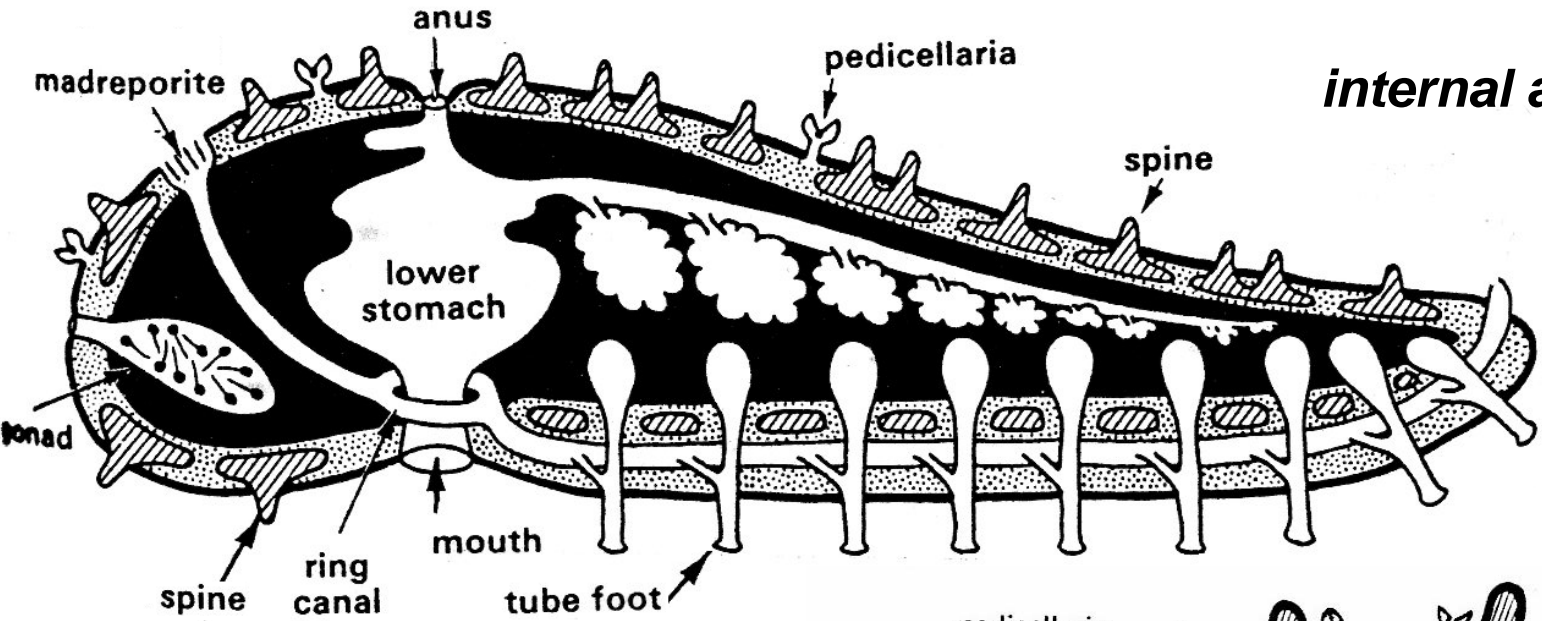
Sea star



Sea urchin

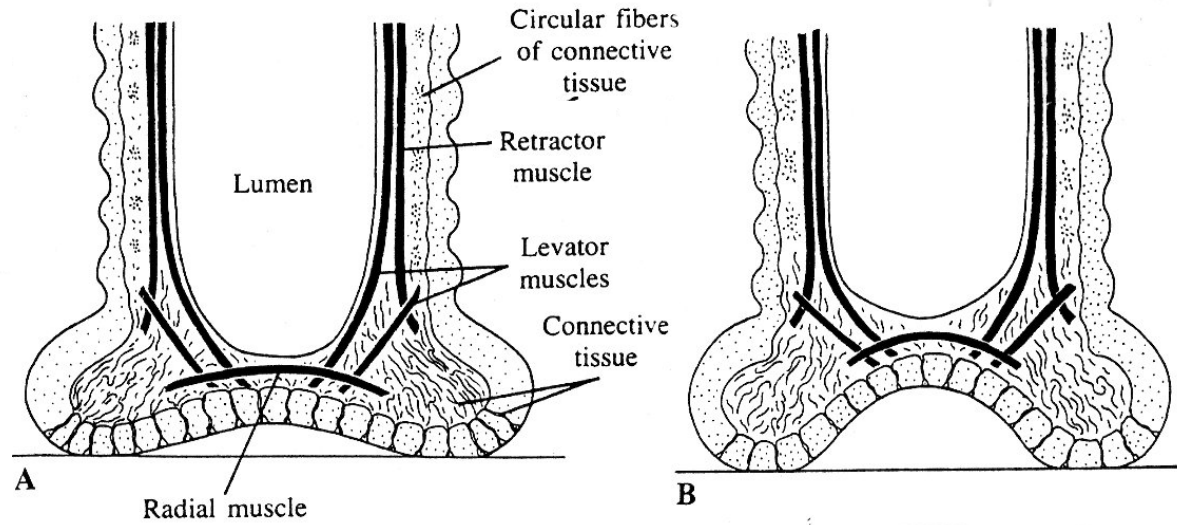
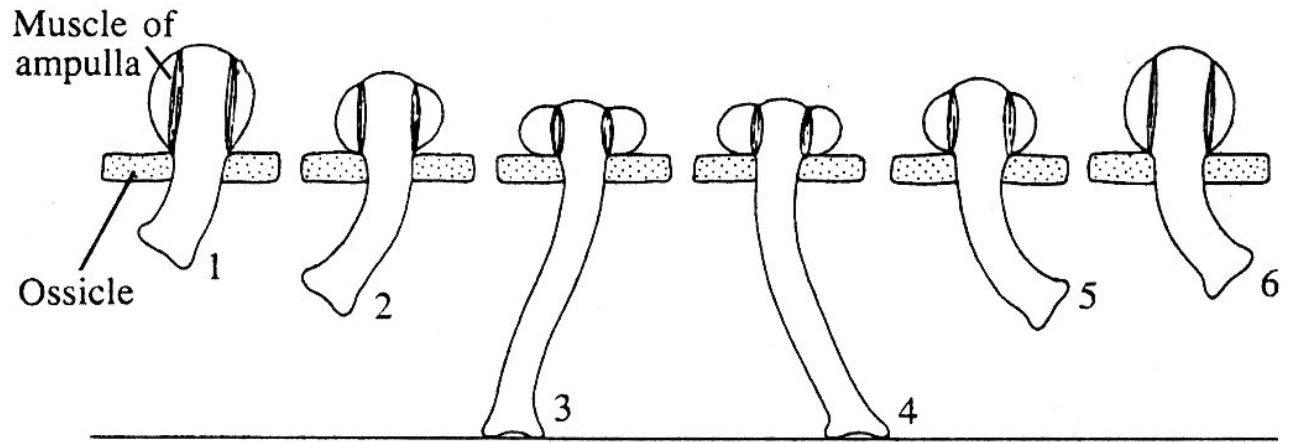
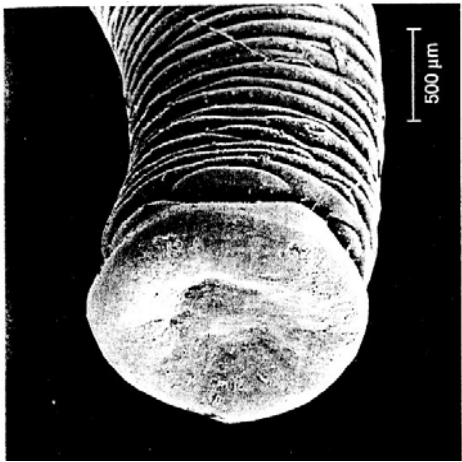


internal anatomy: asteroids

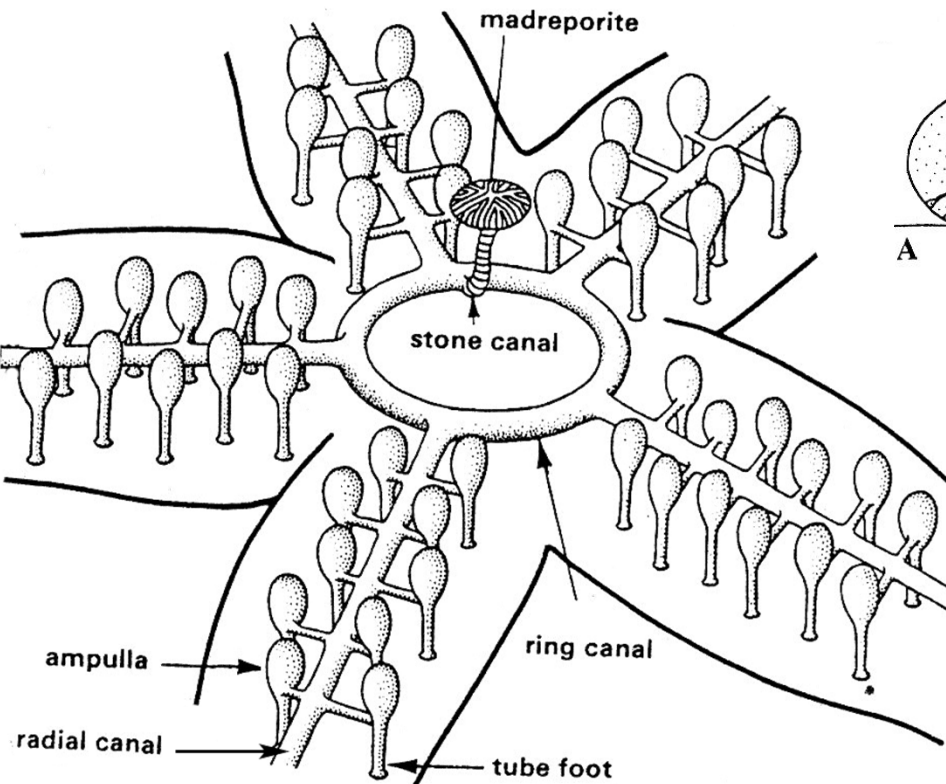


seastar feeding

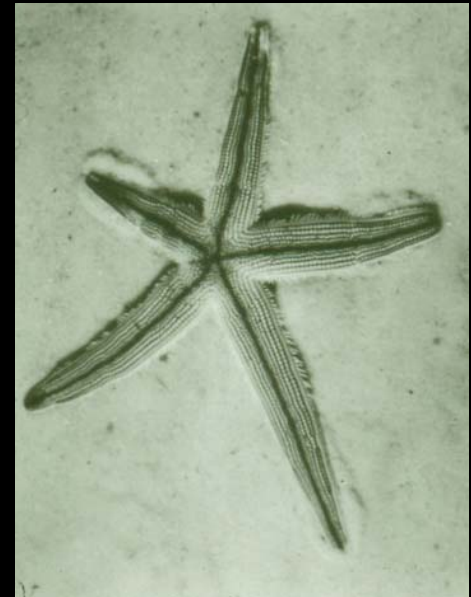
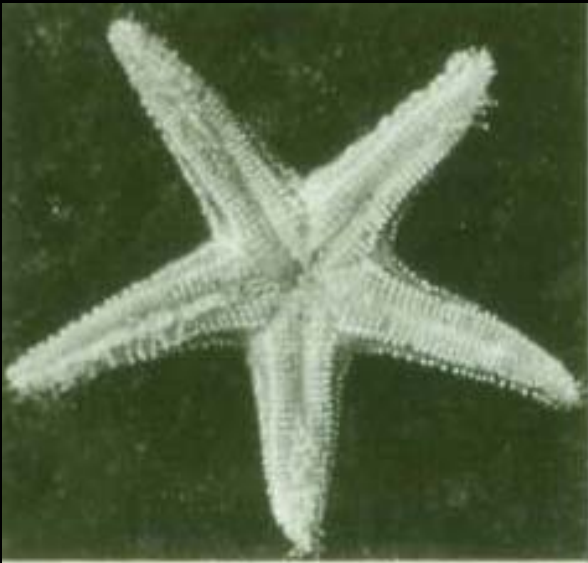
locomotion: asteroids



locomotion: ophiuroids



Variation in tube foot design and function



righting

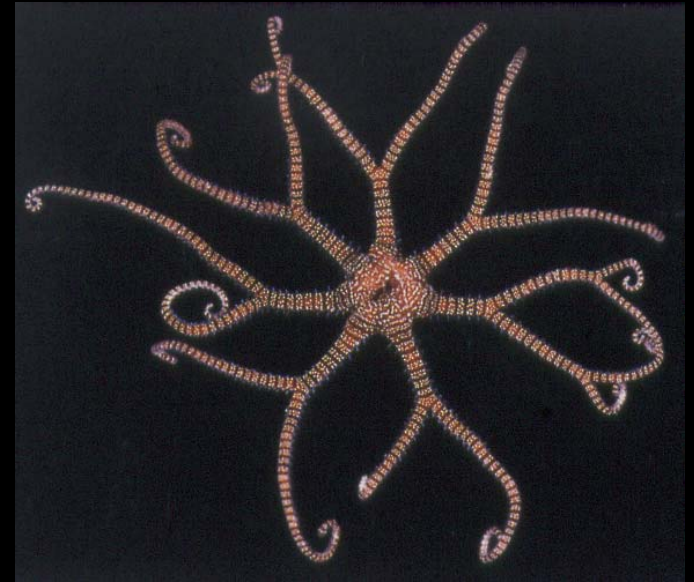
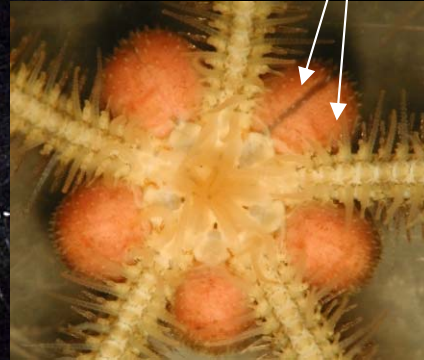
burying

Cl. Ophiuroidea

brittle star



two ovaries
per disk
section

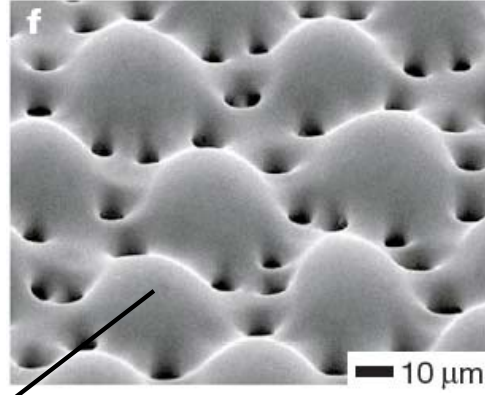
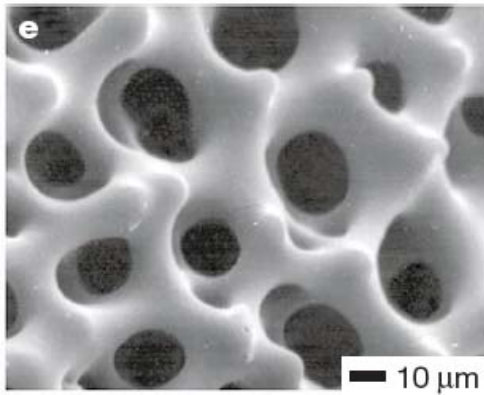


basket star

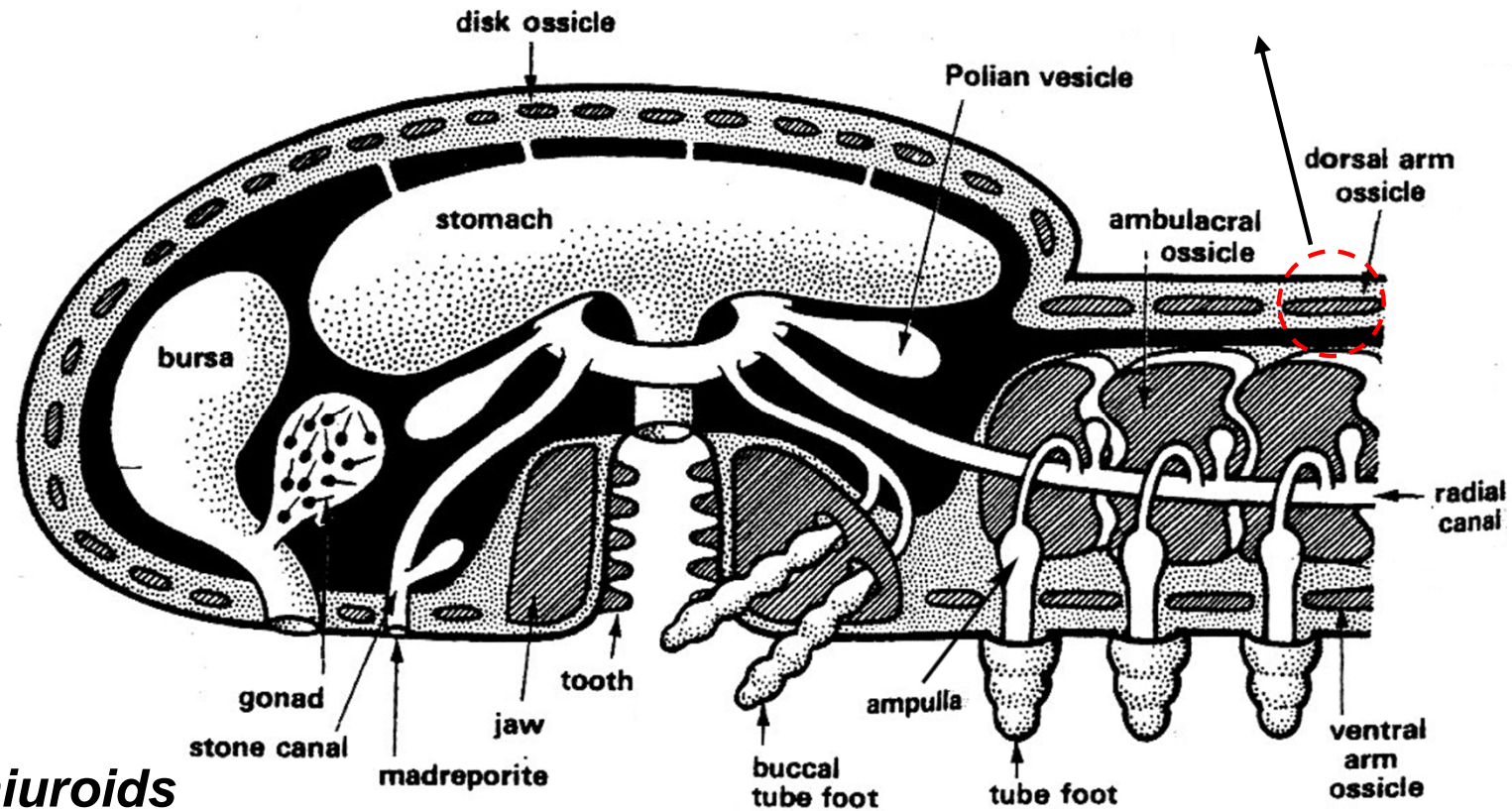
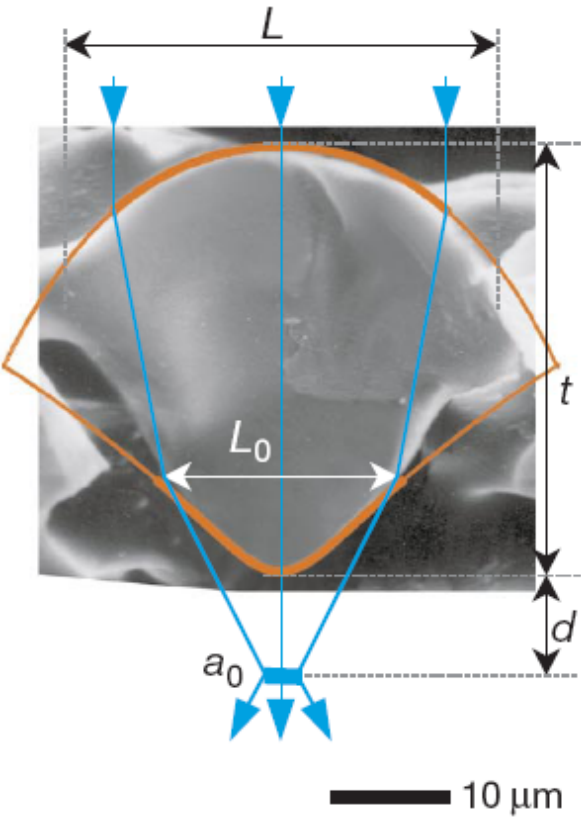
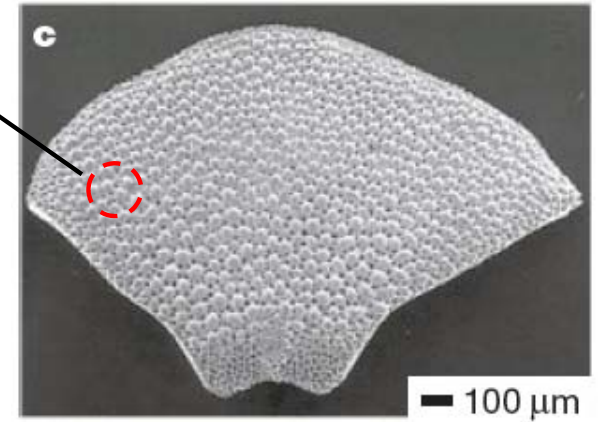




typical
stereom

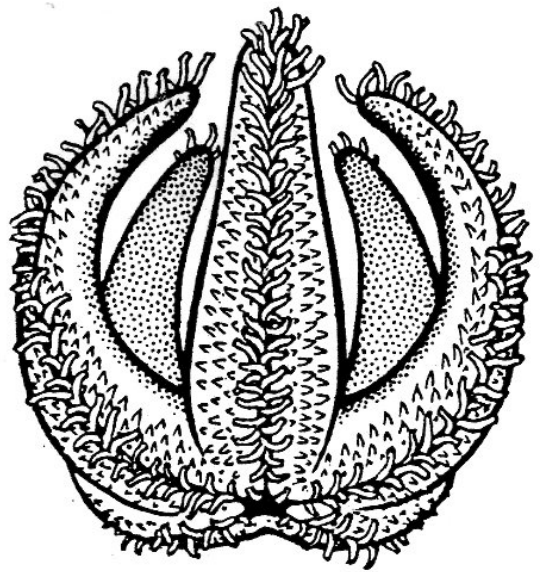
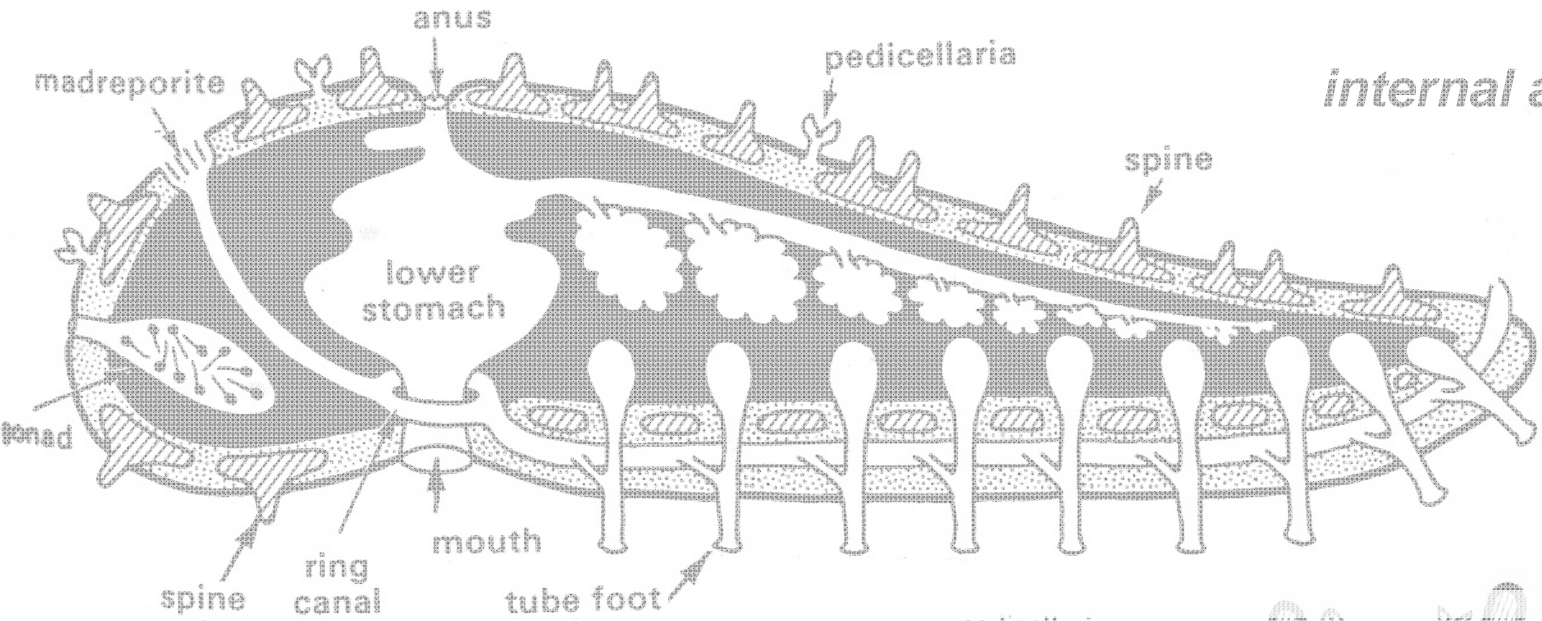


Arm ossicle of light-
sensitive brittlestar

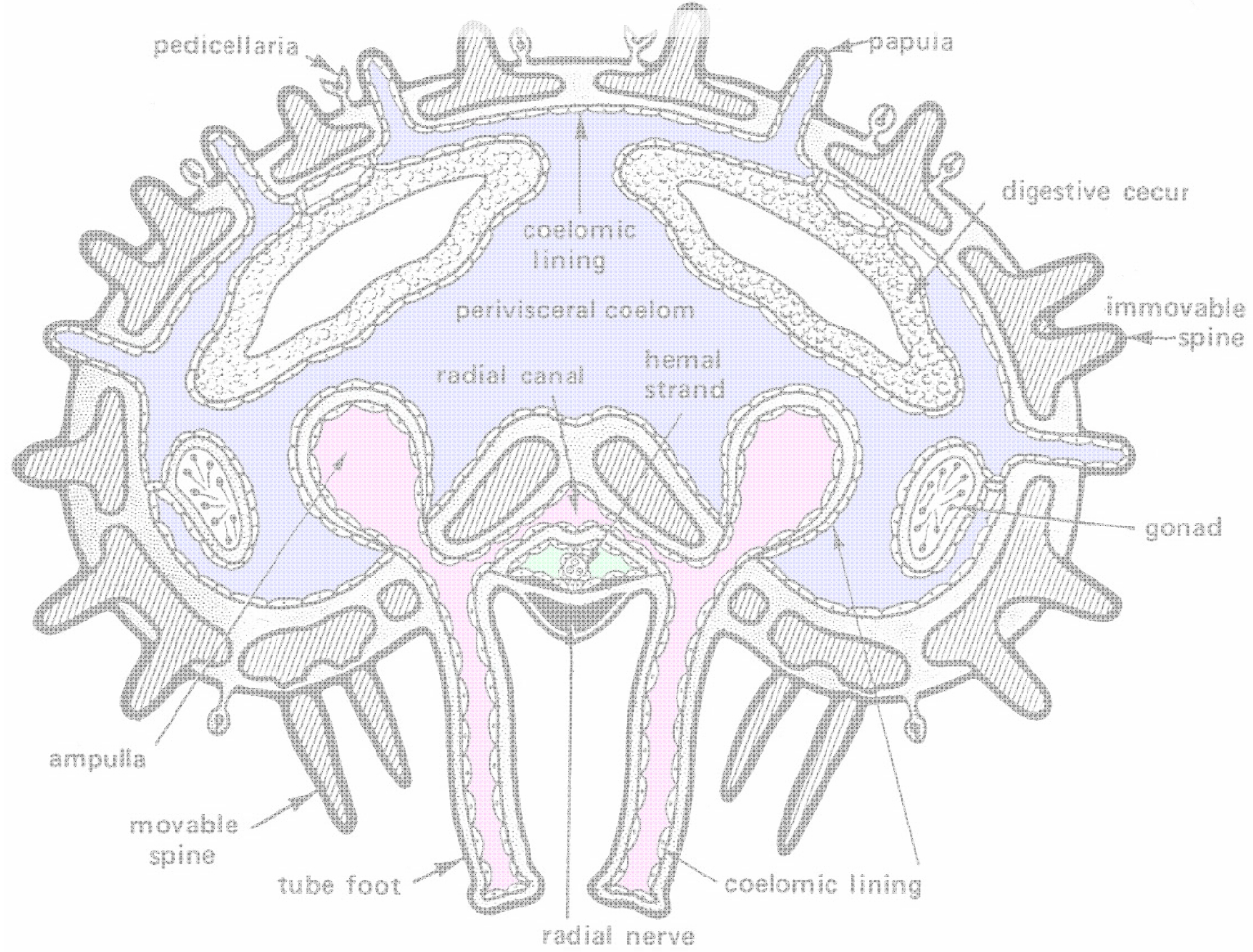


internal anatomy: ophiuroids

internal anatomy: asteroids

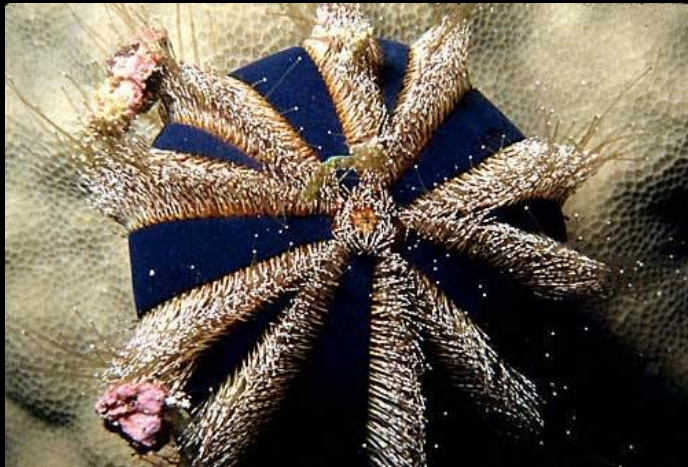


If we imagine the arms of a sea star, with the upper surface skinned off, bending upward to meet at their tips, and if we fill the angles between them with hard plates, we can see how the globular sea urchin is similar to a 5-armed sea star.

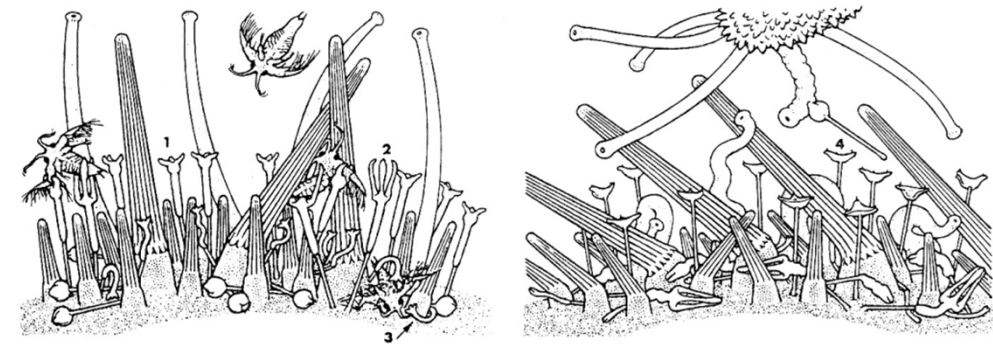
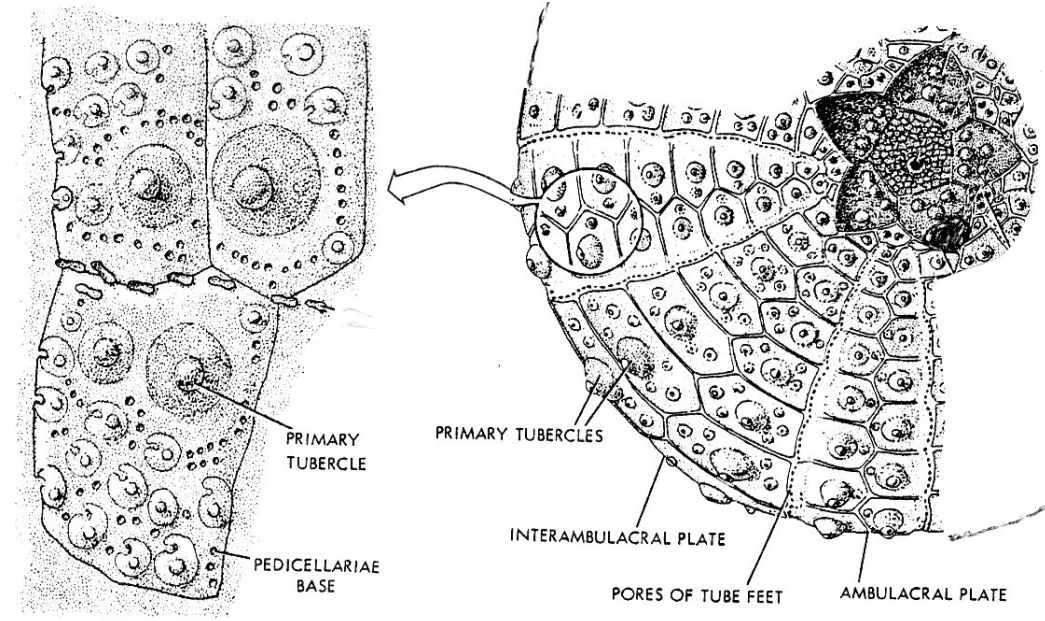
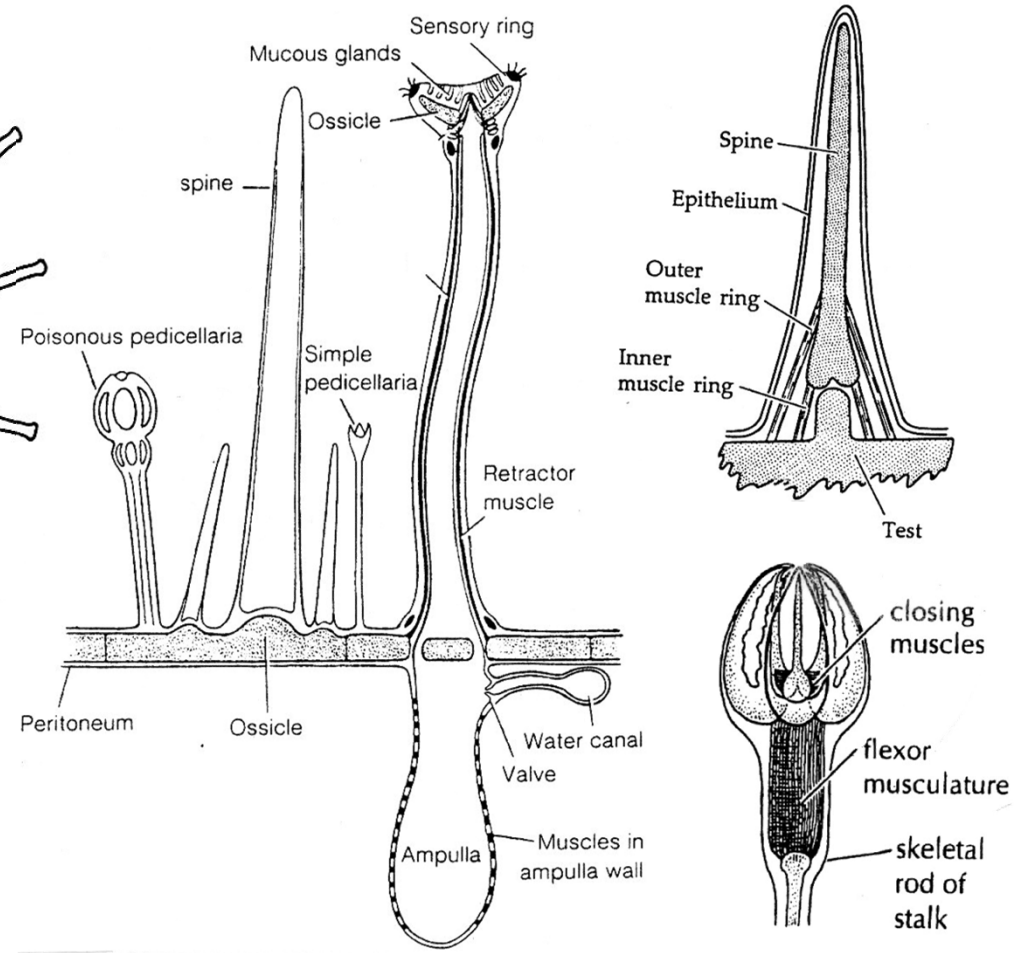
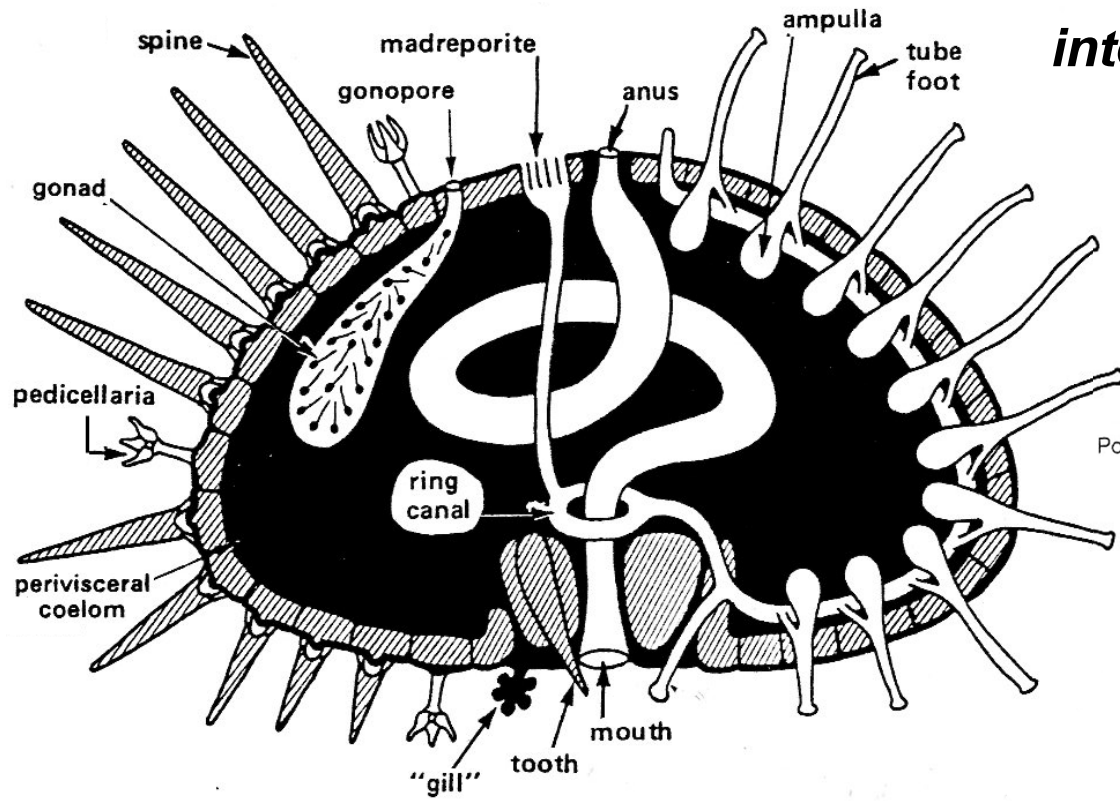


Cl. Echinoidea

“regular” > sea urchins



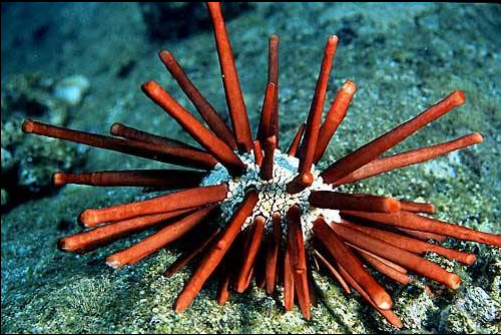
internal & external anatomy: echinoids



Swimming plankters (*Artemia*). Two kinds of large pedicellariae, and also spines, catch and crush nauplii. Tiny pedicellariae seize ones that fall to the surface.

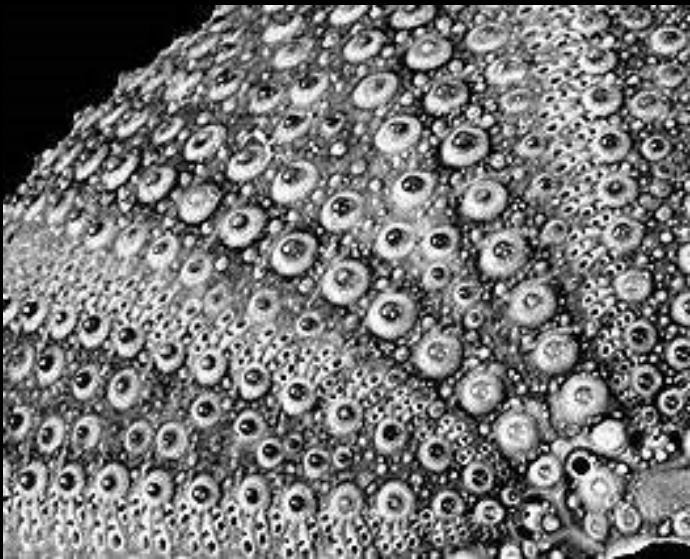
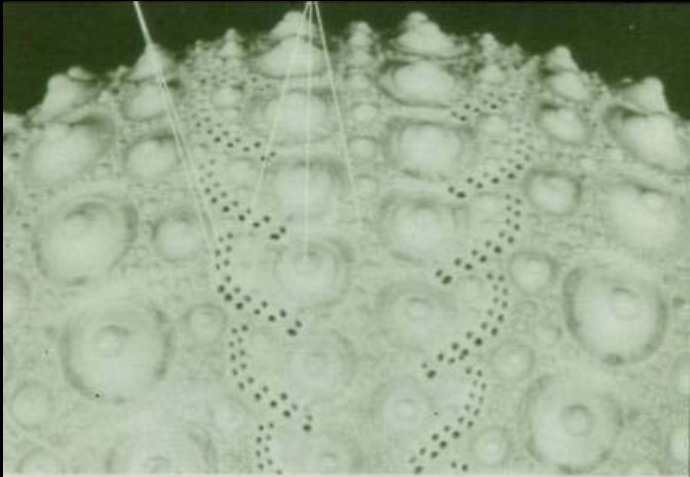
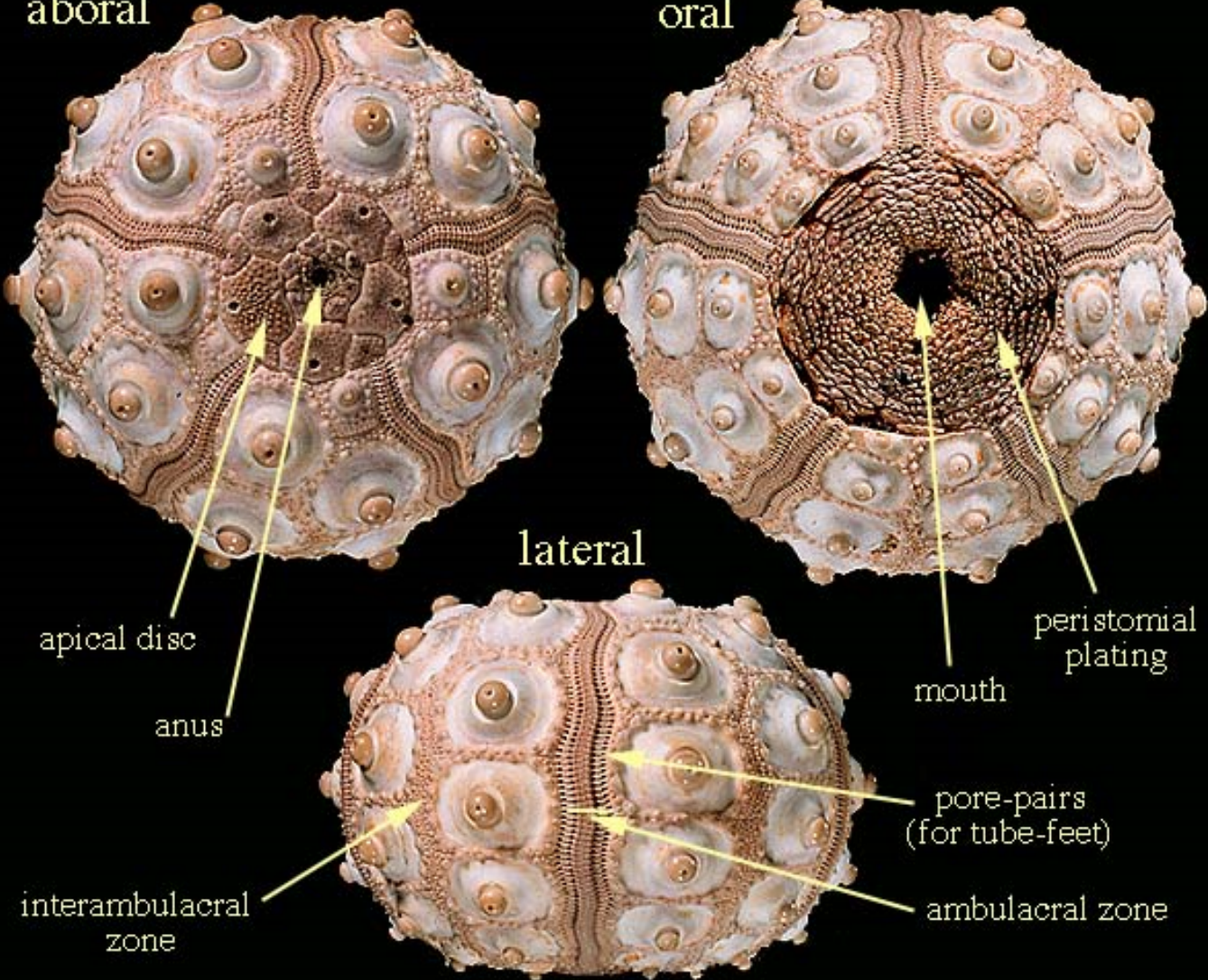
Predator, a sea star (*Marthasterias*). Tube feet of urchin contract, spines bend away. Toxic, toothed pedicellariae open wide and bite at star's tube feet. The star retreats.

Endoskeleton: the echinoid test

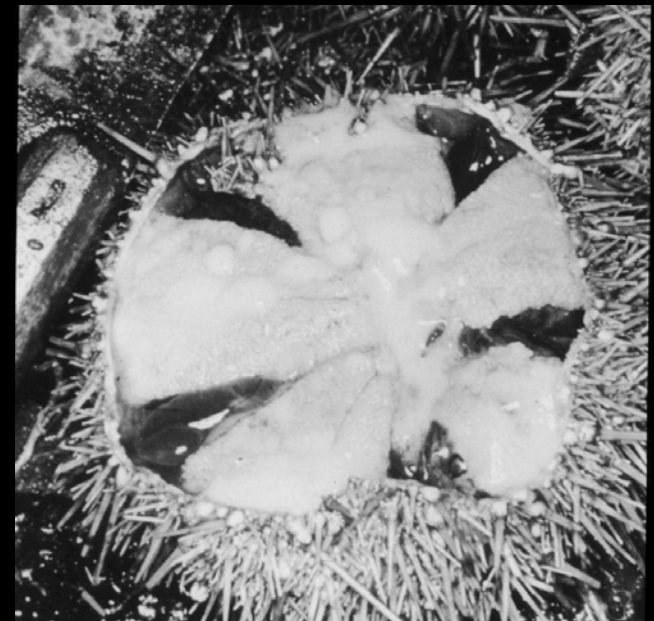
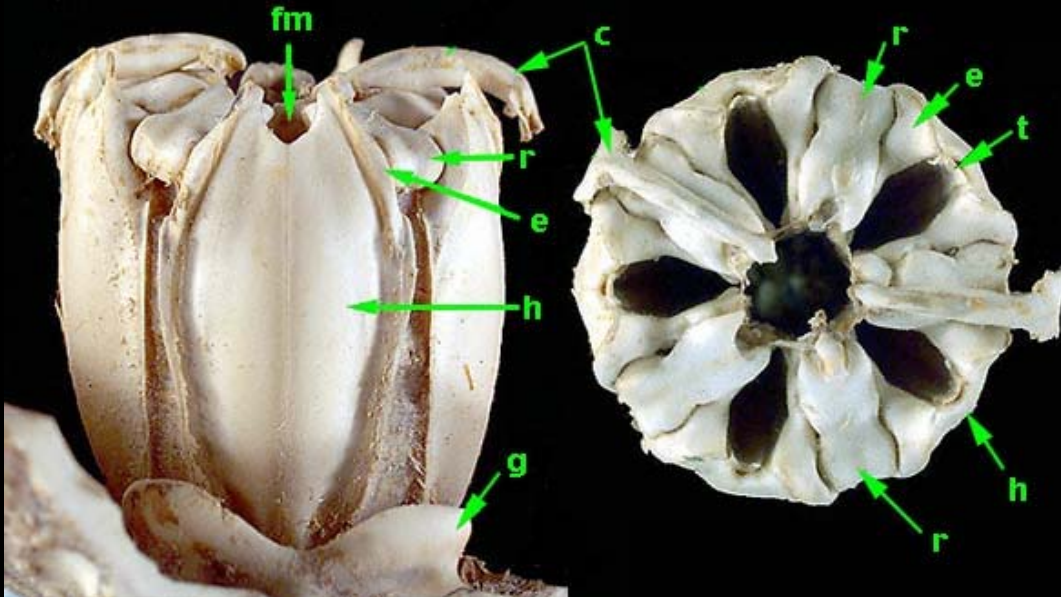
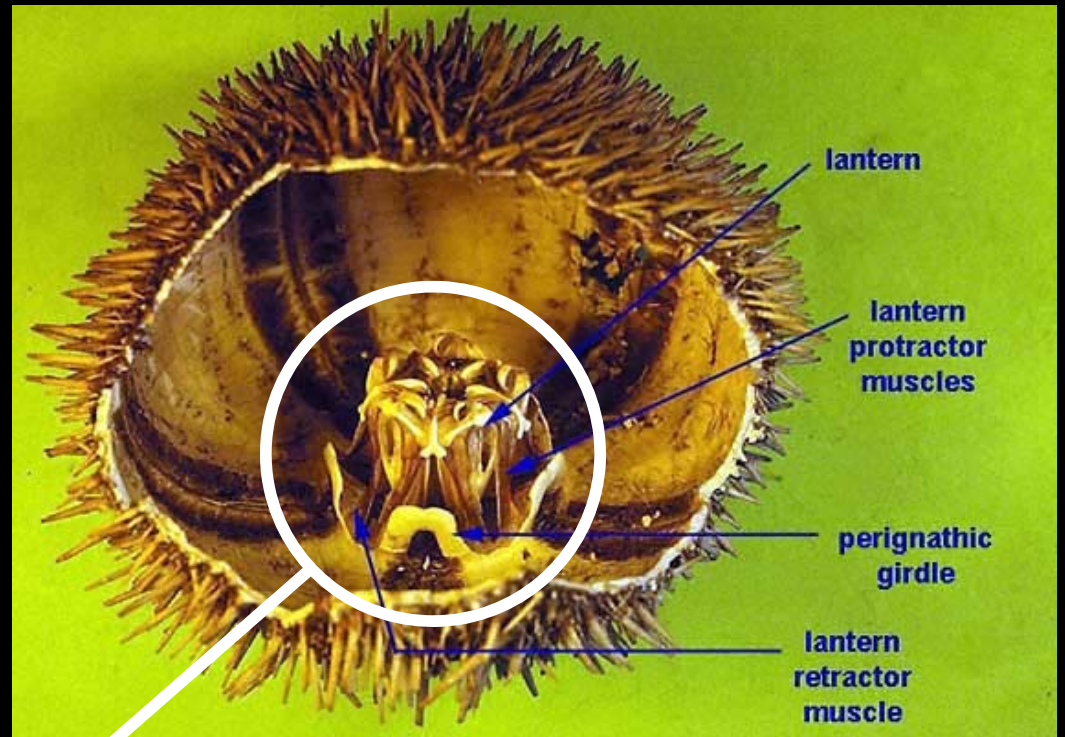


aboral

oral

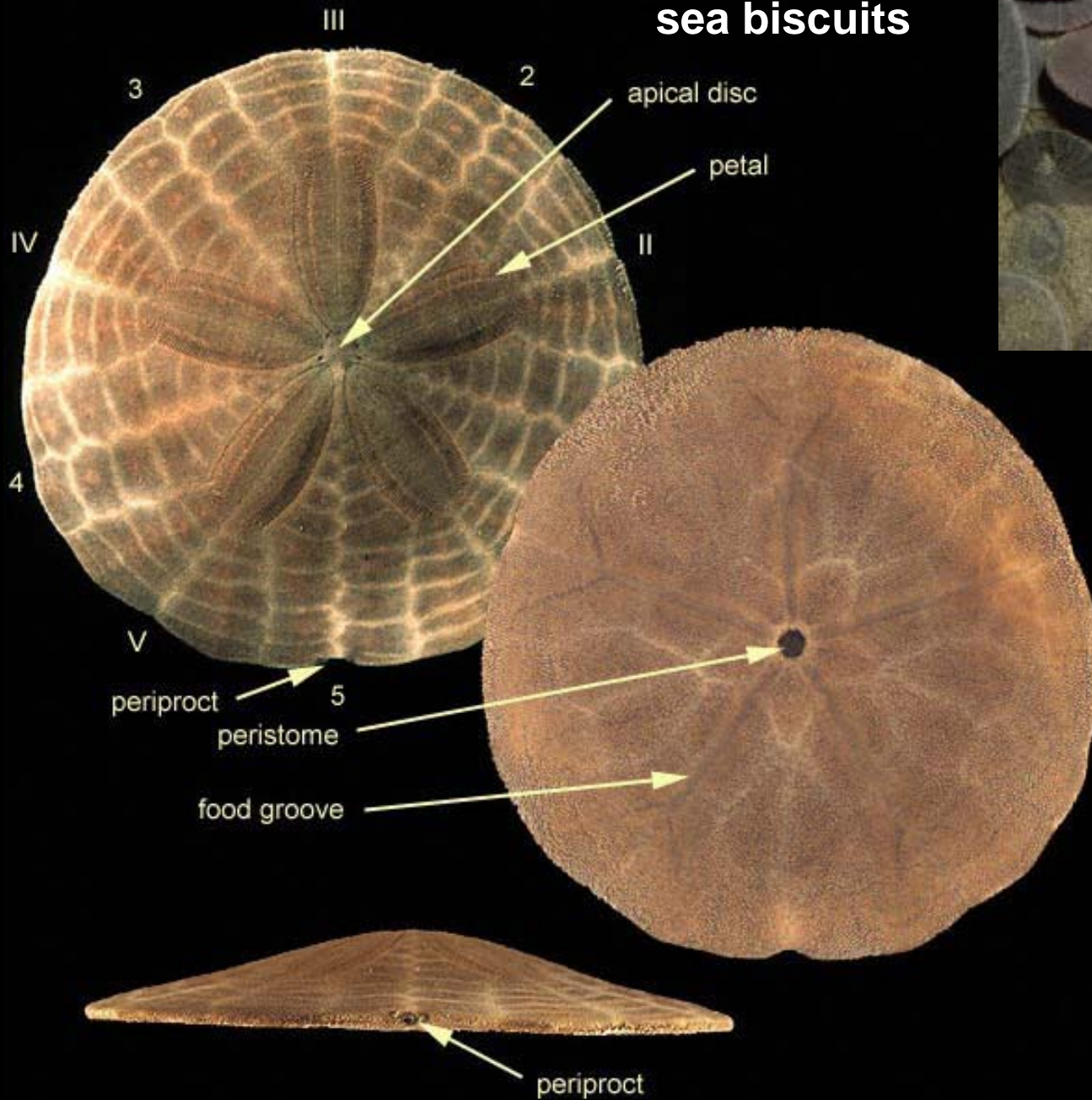


Echinoid internal feeding structure: Aristotle's lantern



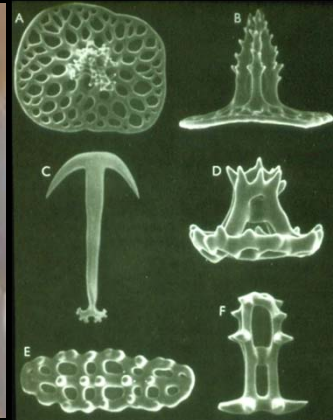
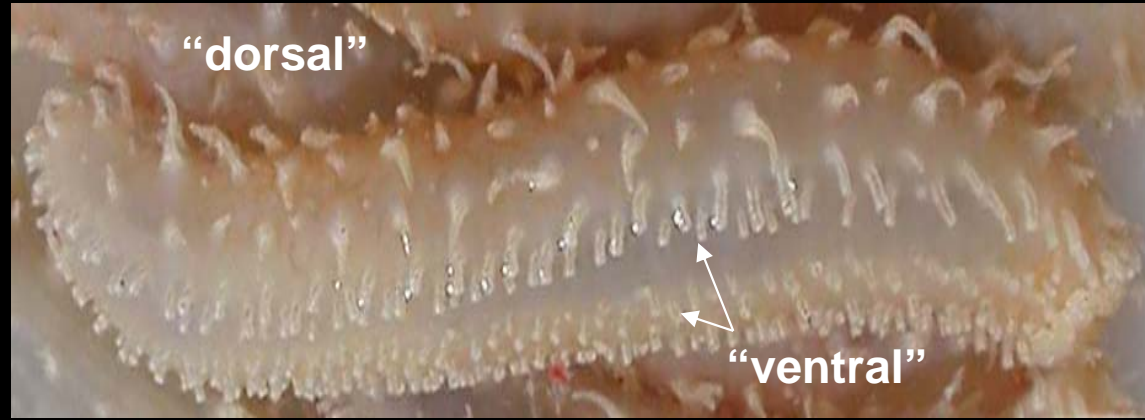
Cl. Echinoidea

“irregular” > sand dollars, heart urchins, sea biscuits



Cl. Holothuroidea

("sea cucumbers")



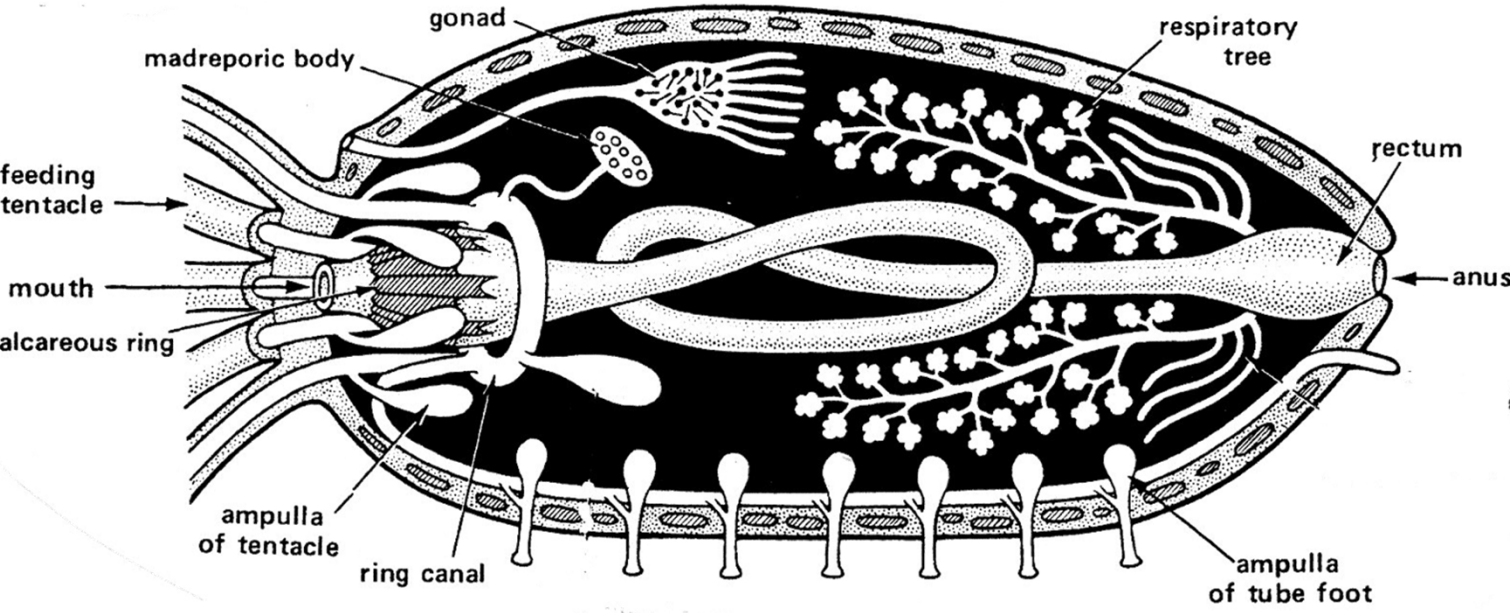
deposit feeders



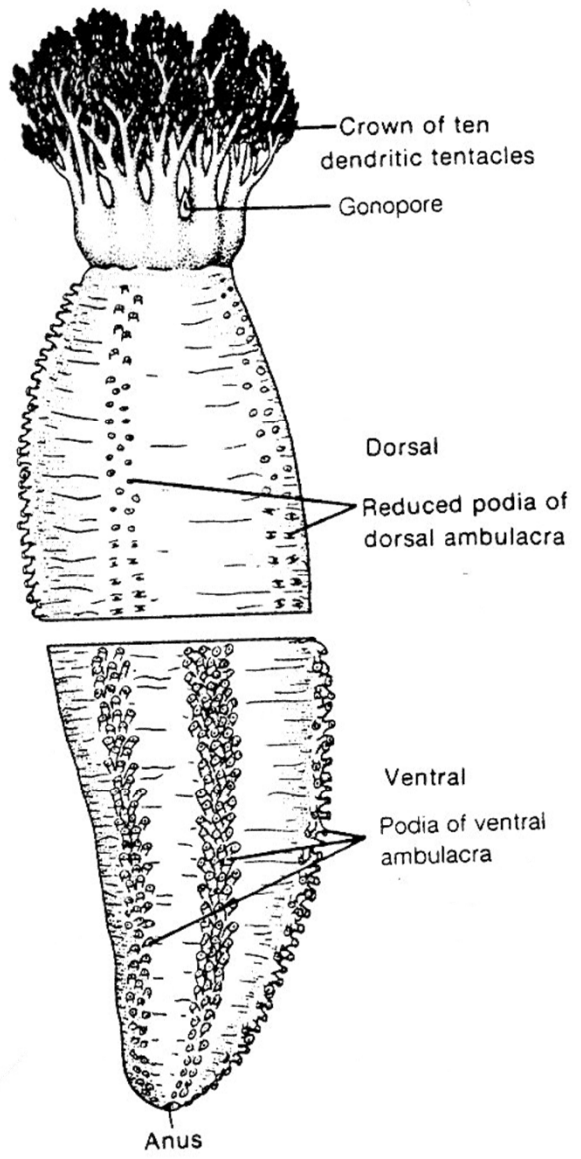
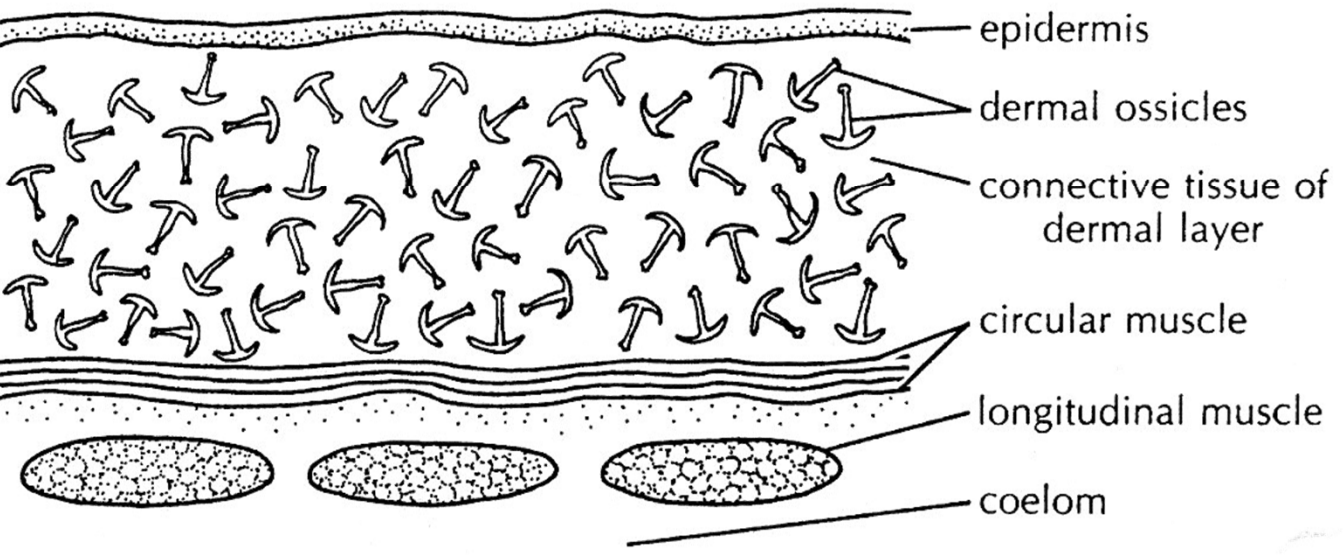
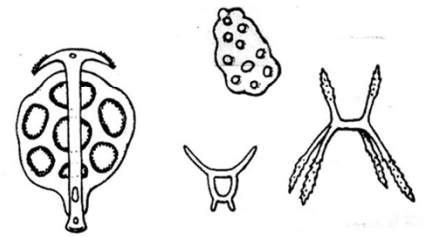
suspension feeders



anatomy: holothuroids

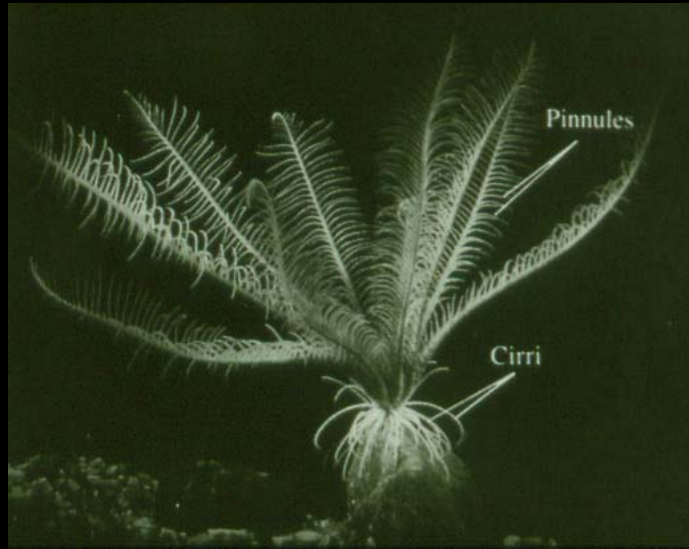


Microscopic ossicles of sea cucumbers.



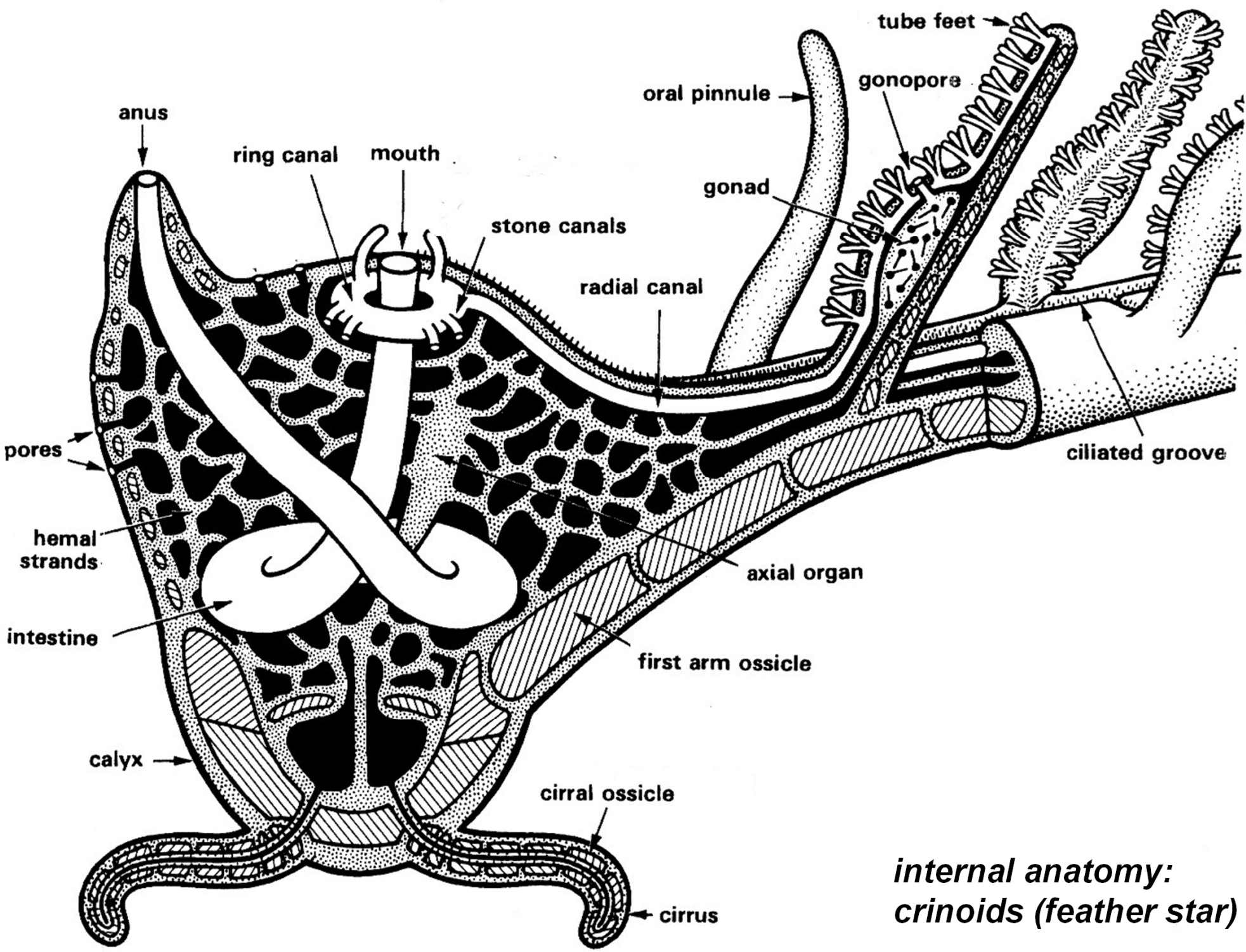
Cl. Crinoidea

“feather stars”
non-stalked crinoids



“sea lilies”
stalked crinoids

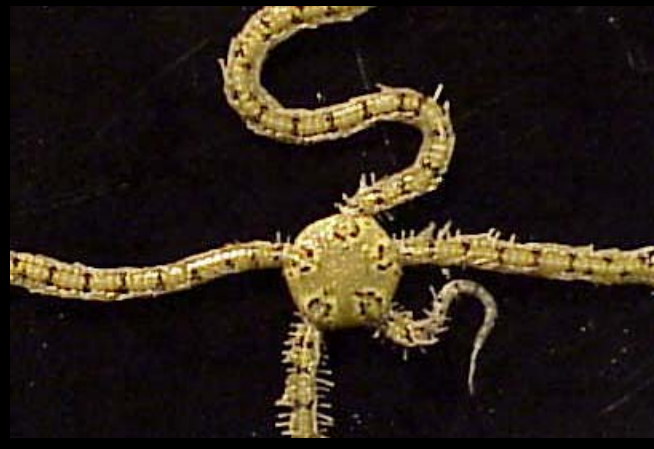
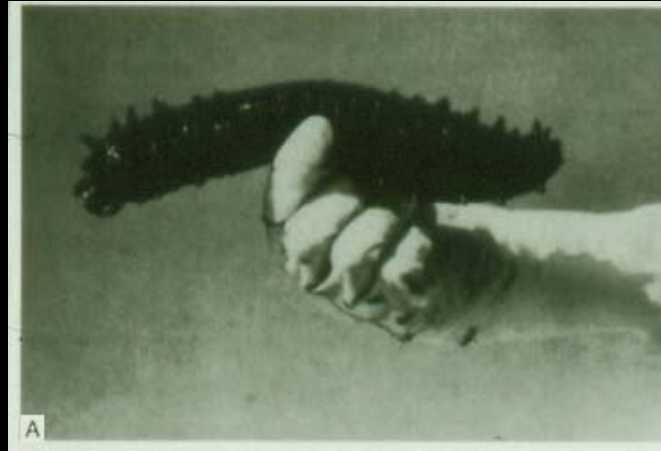
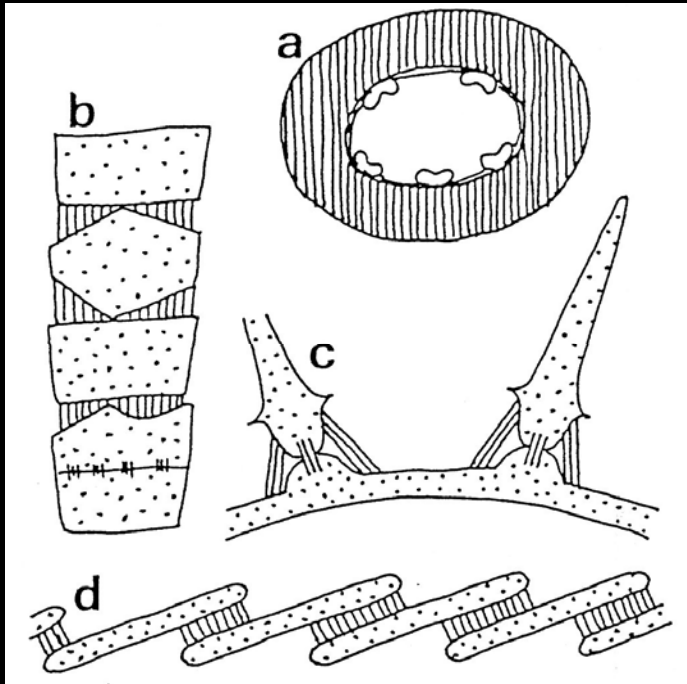




*internal anatomy:
crinoids (feather star)*



mutable (“catch”) connective tissue

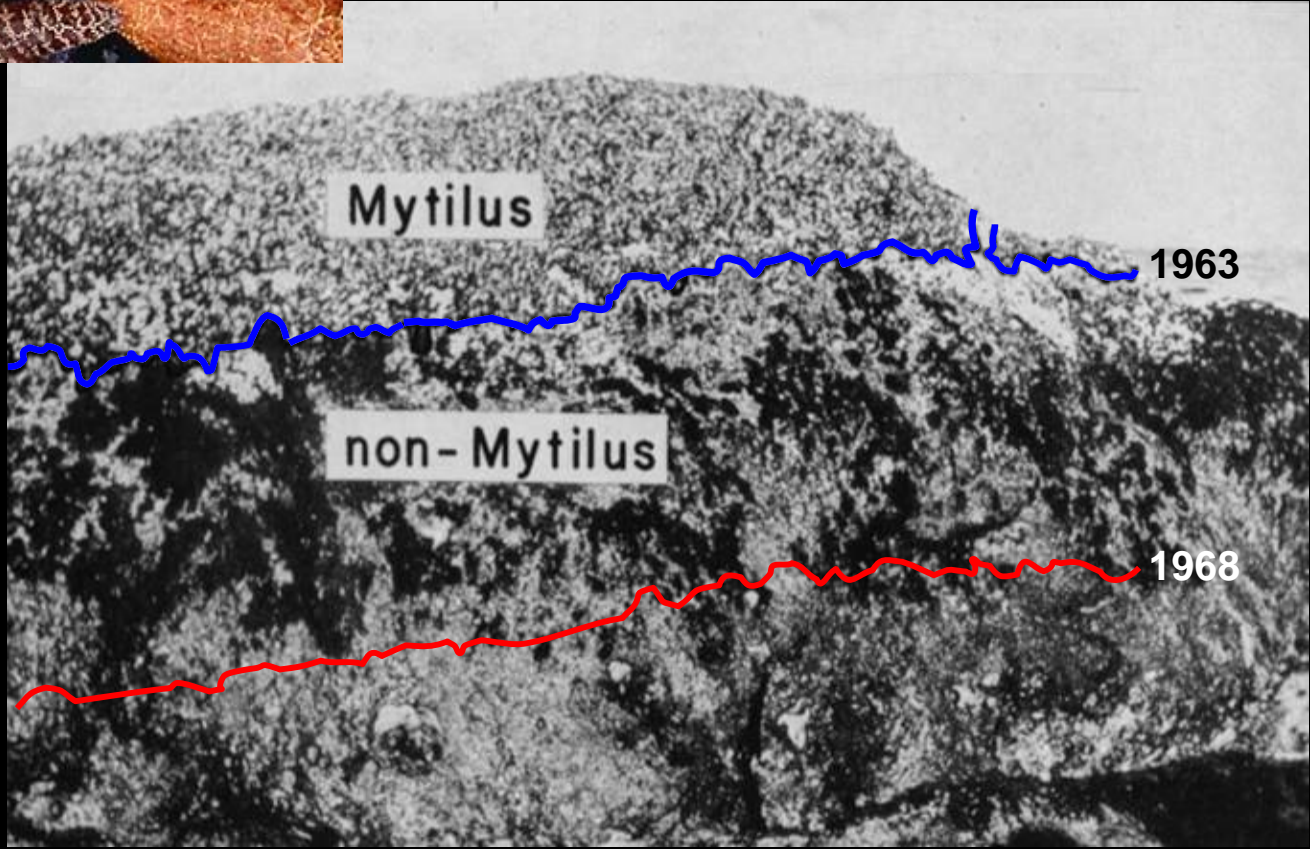


Examples of echinoderm ecology
(time permitting)



Experimental removal of predatory sea stars

(Paine 1974)



Diadema antillarum



Mass mortality of sea urchins in the Caribbean (Carpenter 1990)



Effects of sea otter recovery on algal diversity

(Duggins 1990)



Strongylocentrotus purpuratus



S. droebachiensis



S. franciscanus



Damage to coral reefs by crown-of-thorns seastars

Acanthaster planci

