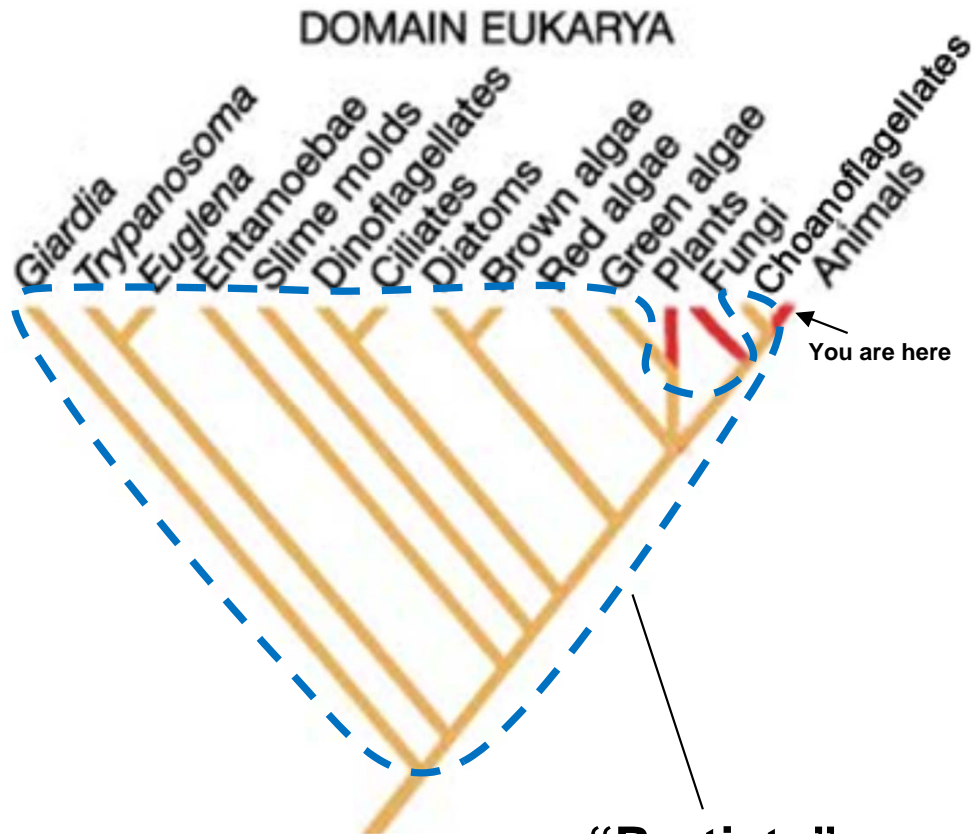
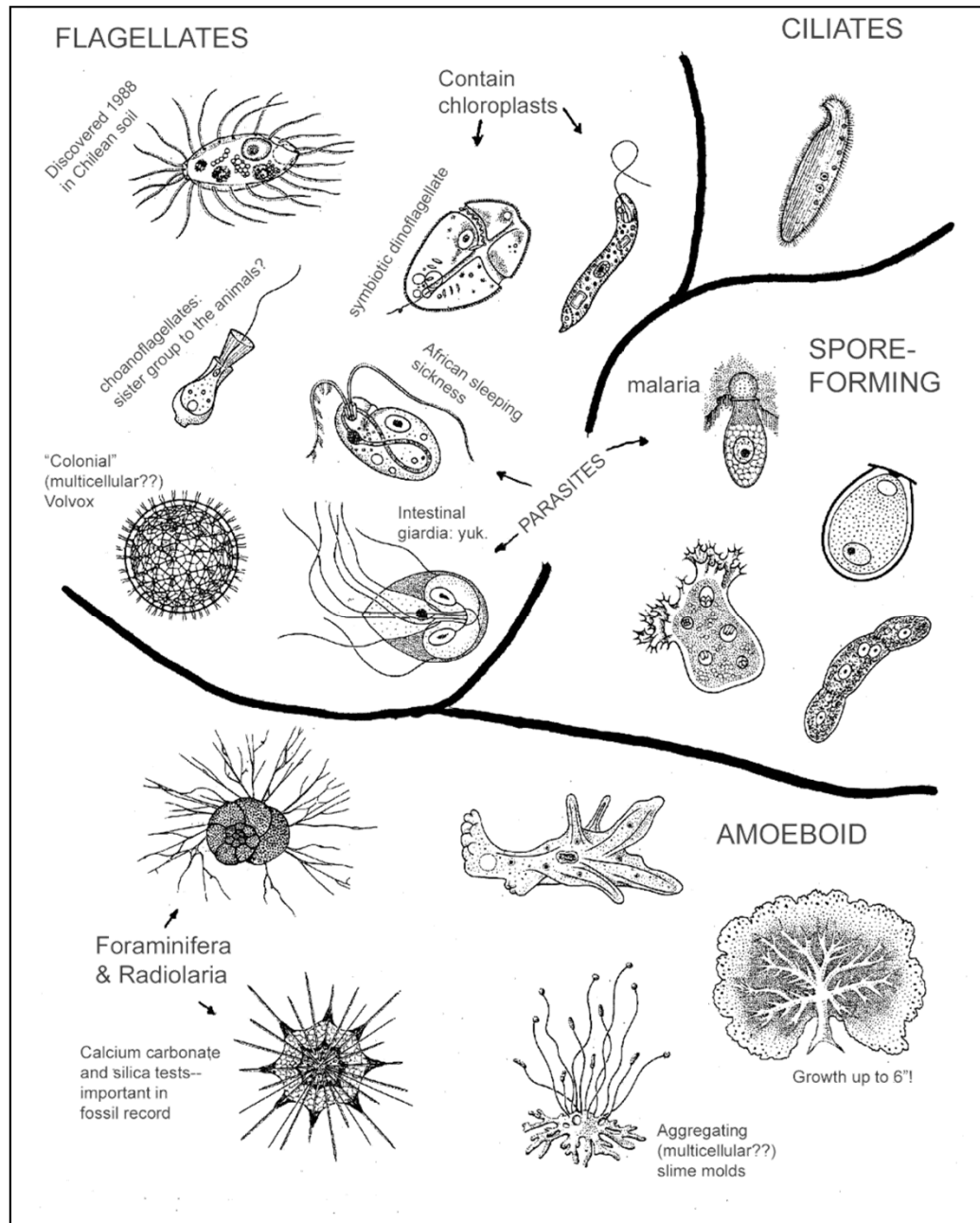


Where did animals come from?



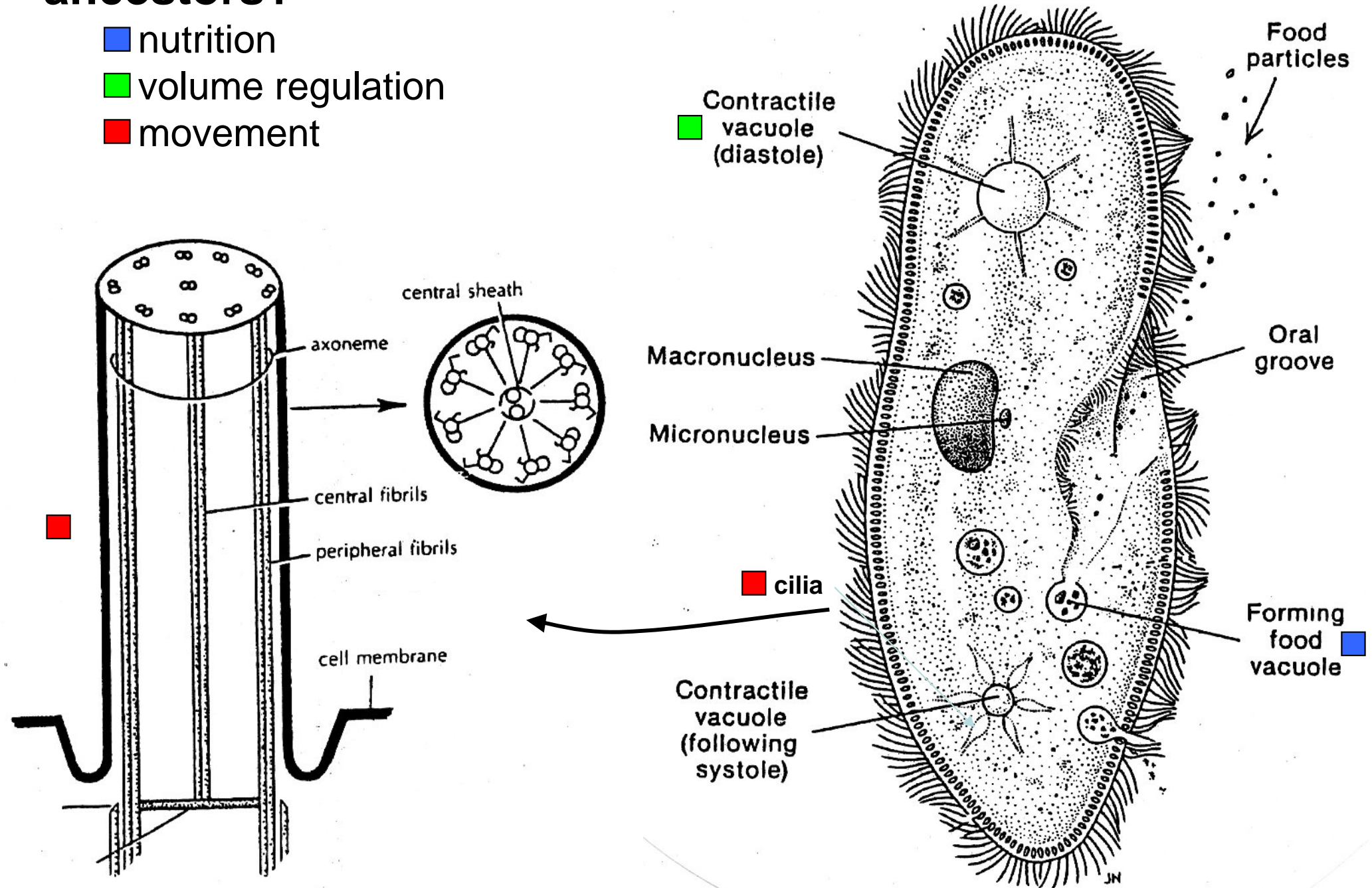
“Protista”
(single-celled eukaryotes
--a paraphyletic mess)

“Protozoa” = “animal-like” protists
Diverse “body plans”



What key traits did they inherit from their single-celled ancestors?

- nutrition
- volume regulation
- movement



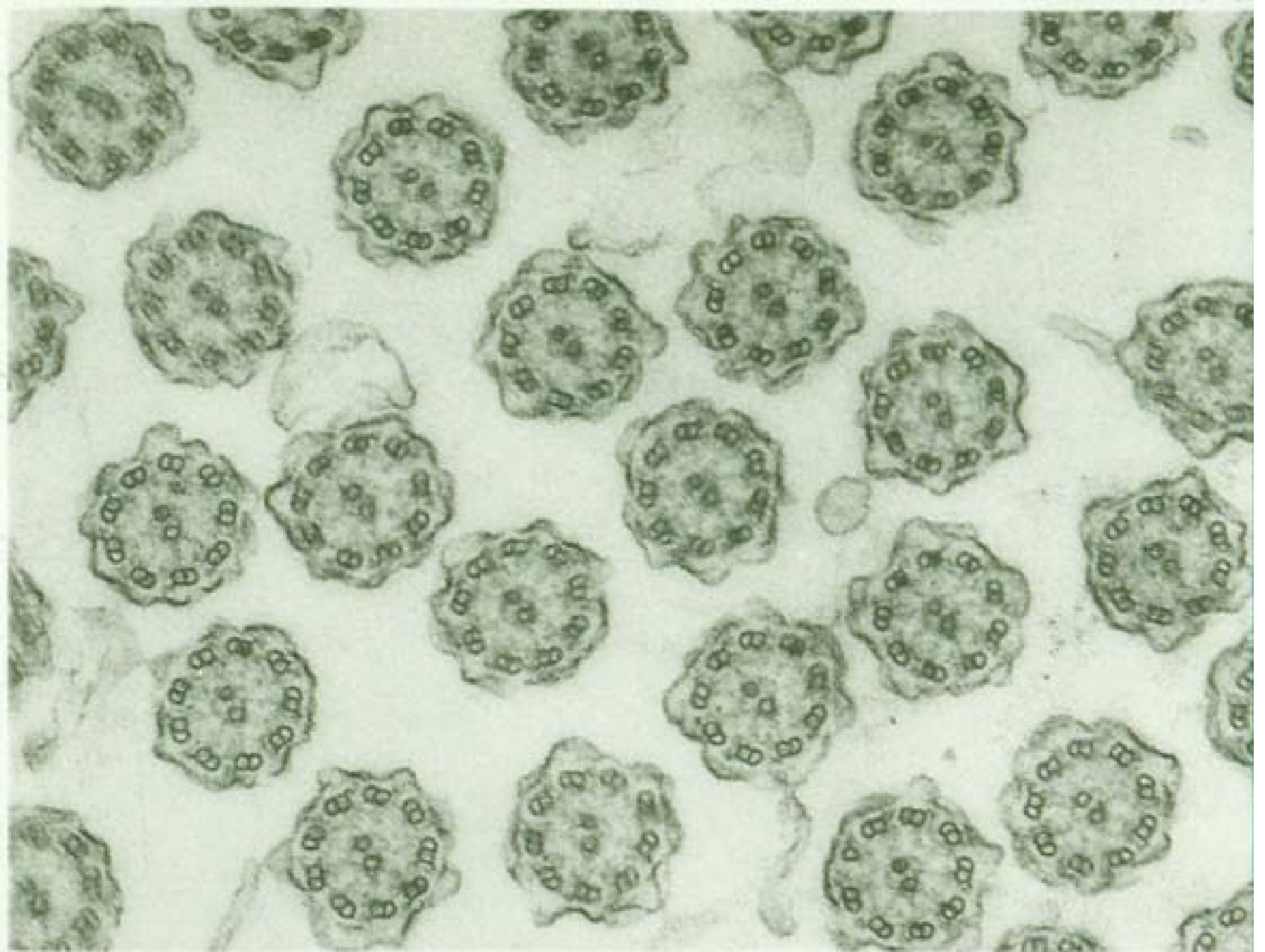
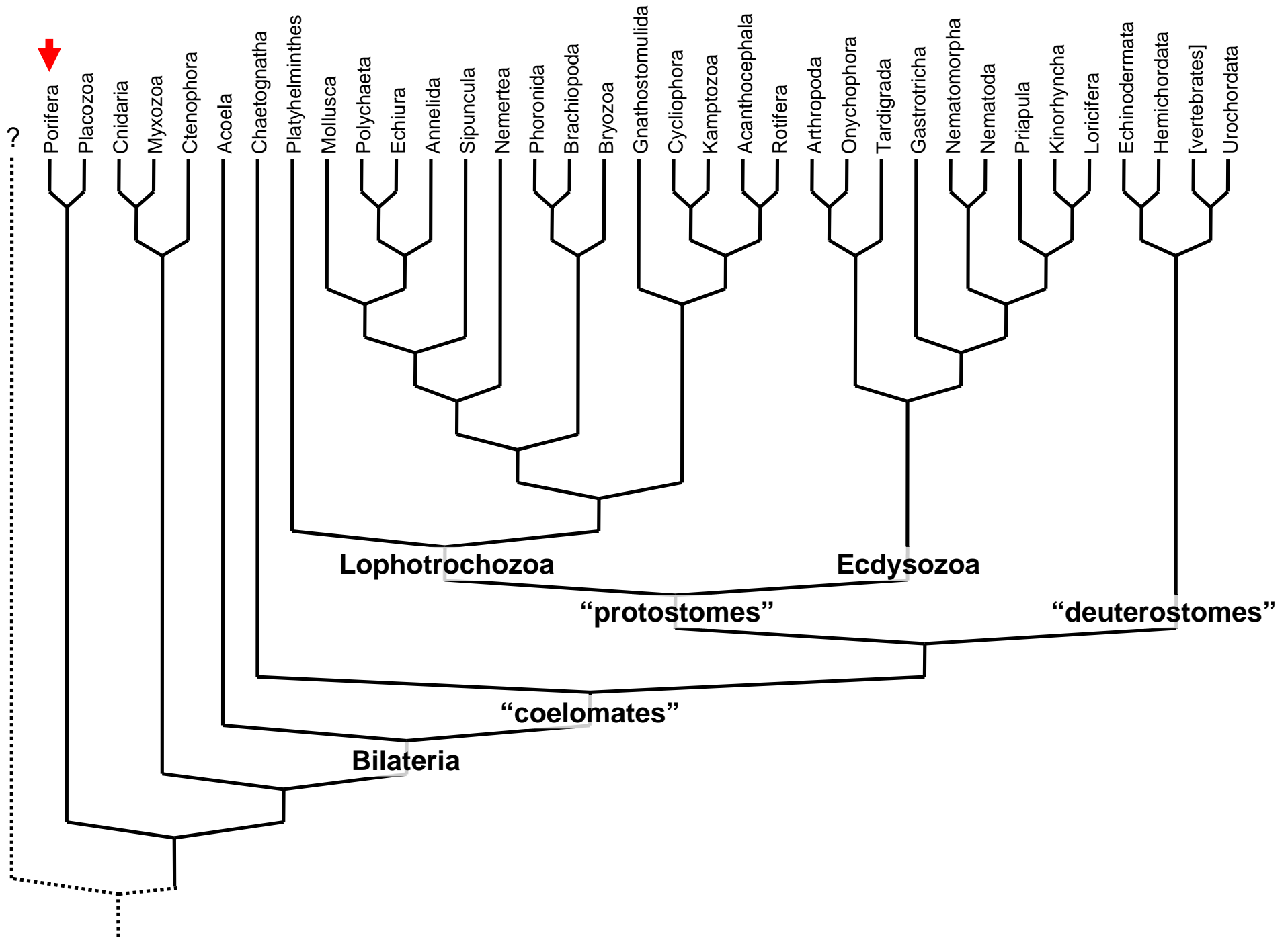


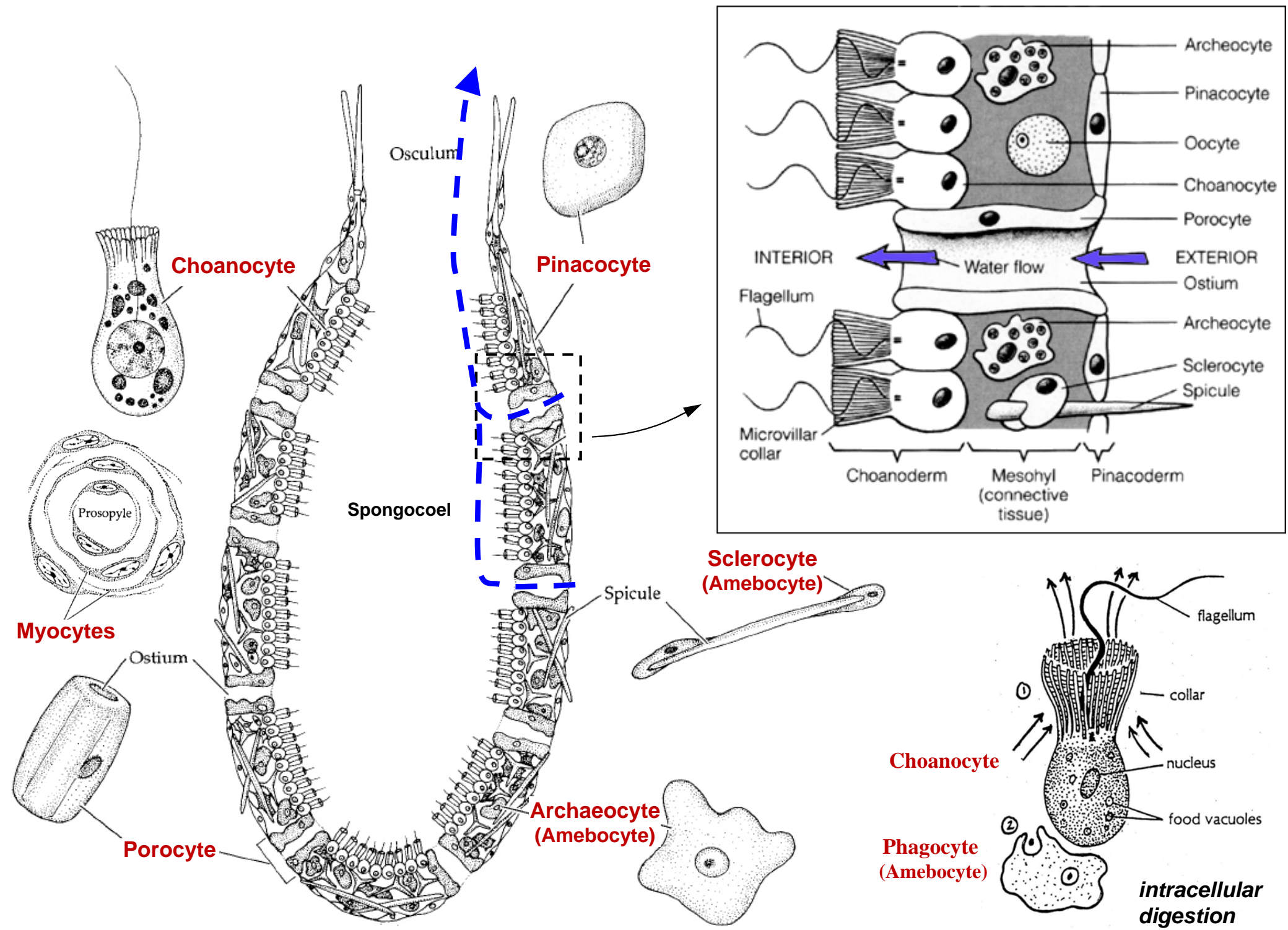
Figure 19-79 These ciliary axonemes from respiratory epithelium are sectioned transversely showing their 9+2 pattern of microtubules.



Phylum Porifera



Theme: simplicity and flexibility of a cellular grade of construction



Choanocyte

Pinacocyte

Spongocoel

Sclerocyte (Amebocyte)

Archaeocyte (Amebocyte)

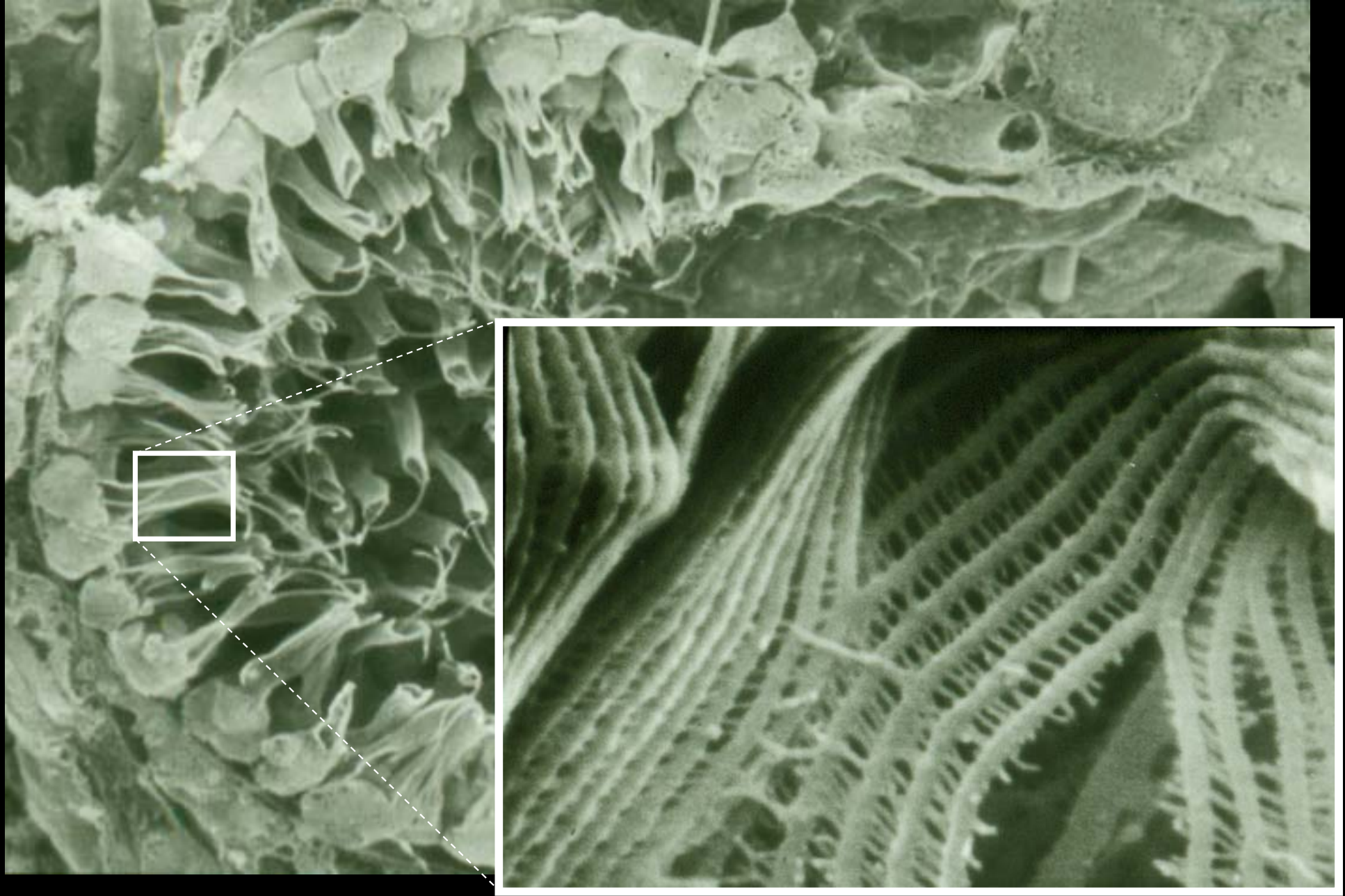
Myocytes

Choanocyte

Phagocyte (Amebocyte)

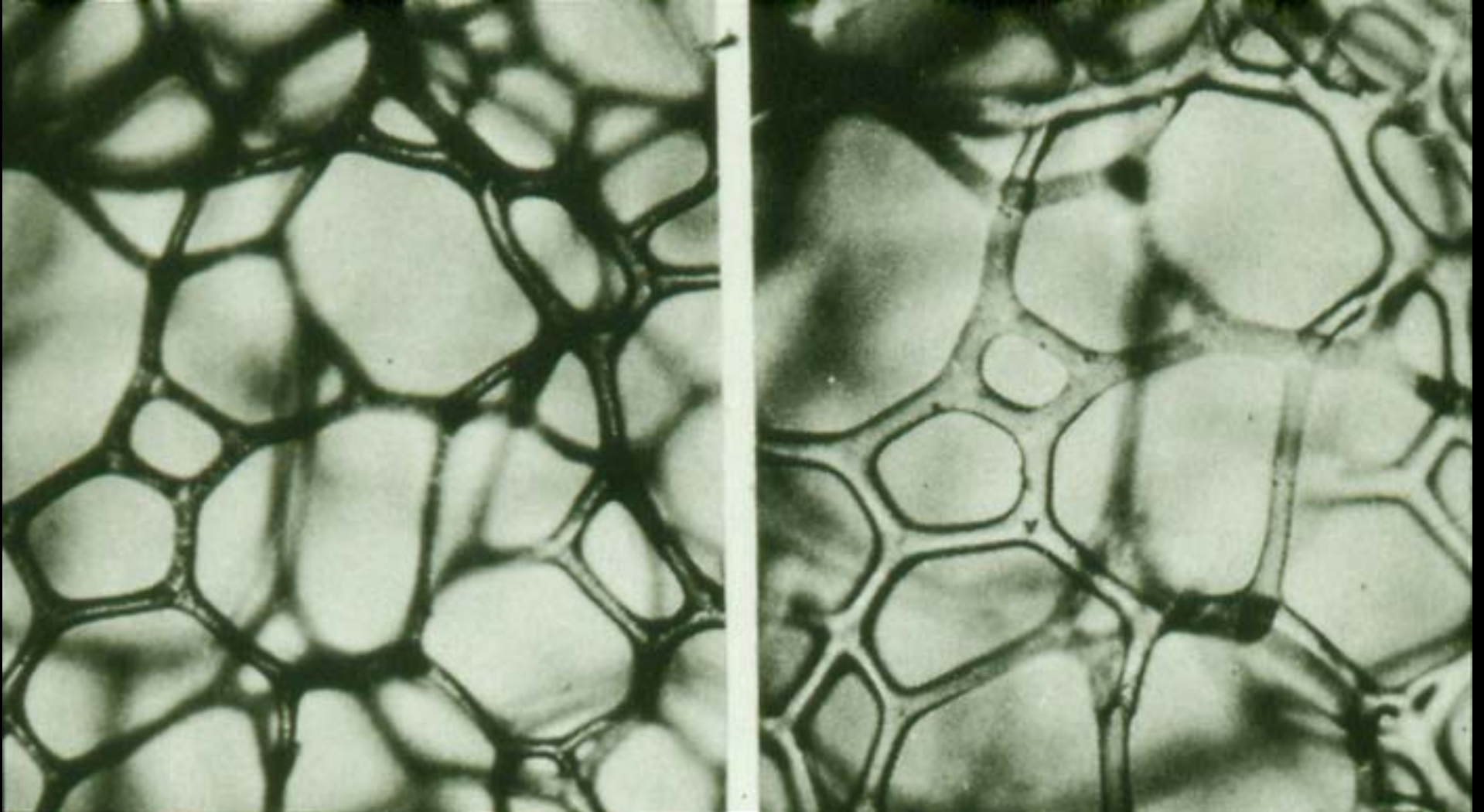
intracellular digestion

Choanocytes



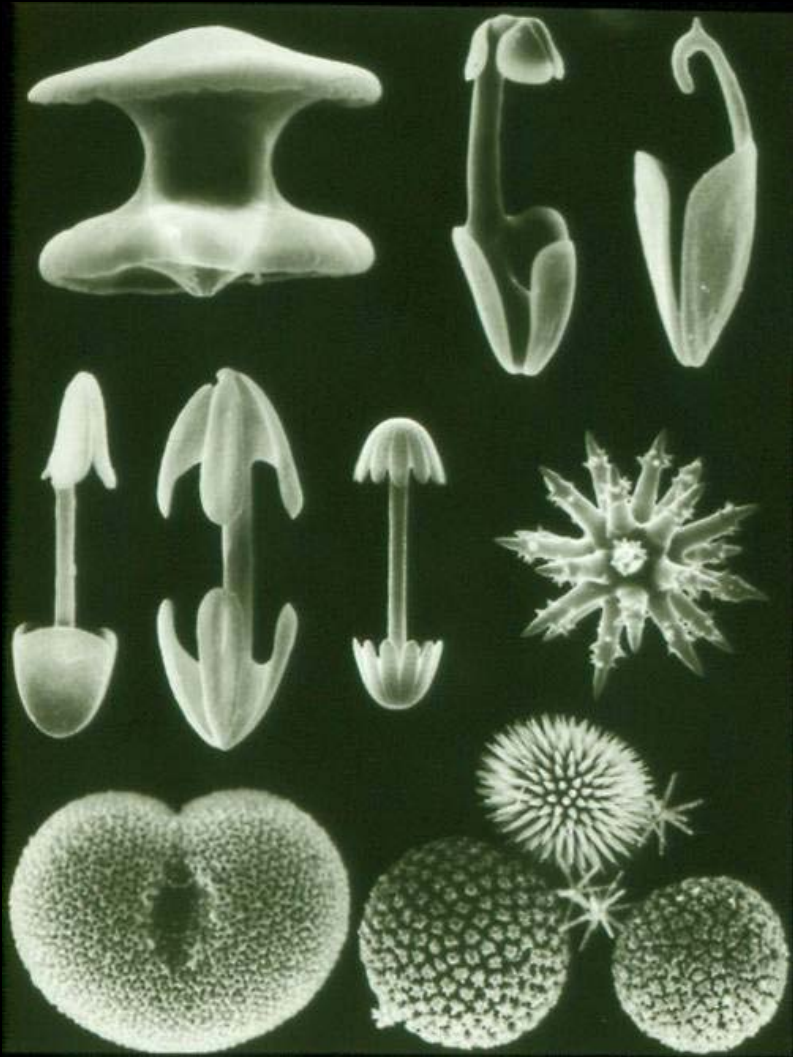
Microfibrils on choanocyte collar

Endoskeleton: spongin

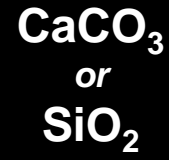


Spongin fibers (polymerized collagen)

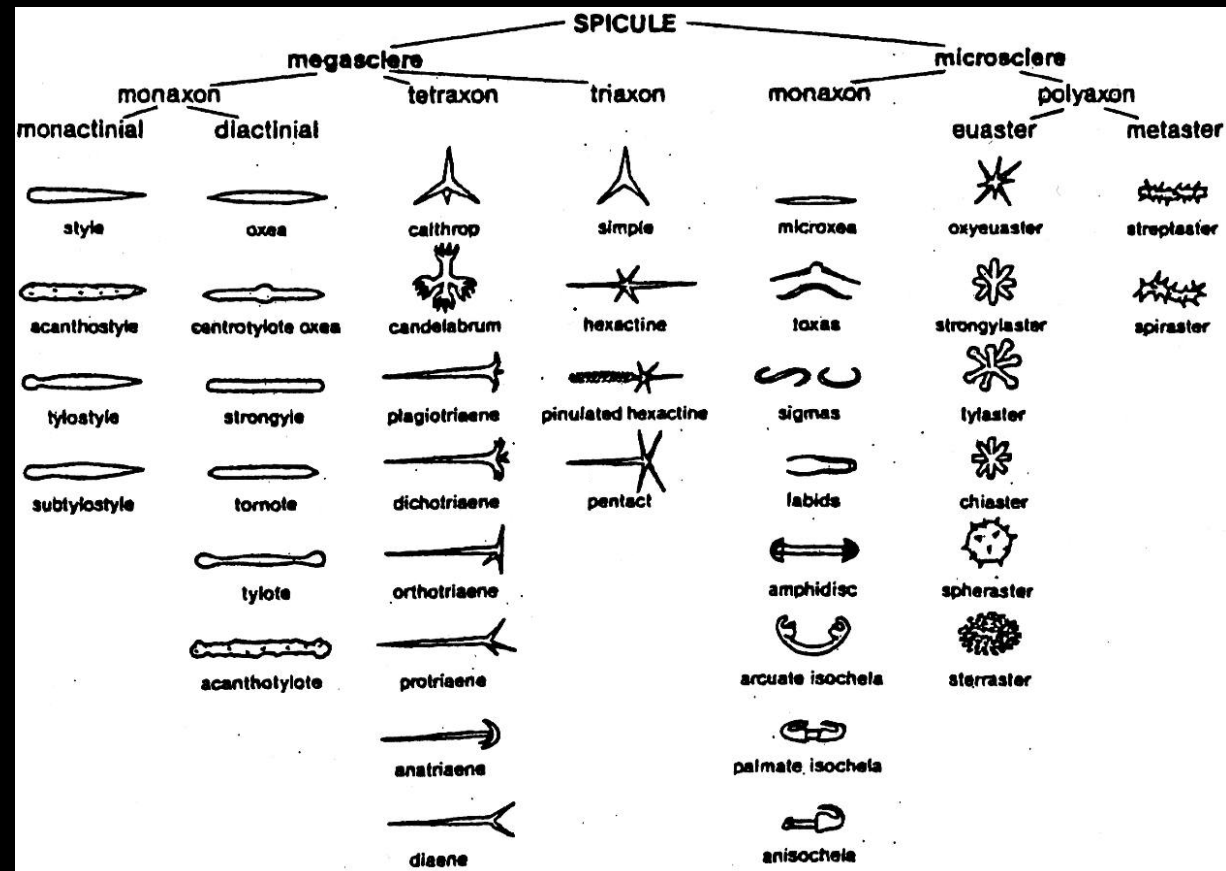
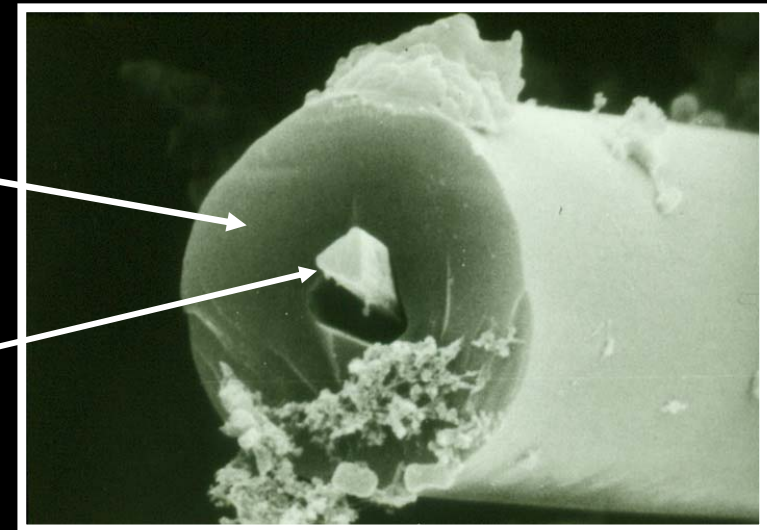
Endoskeleton: spicules



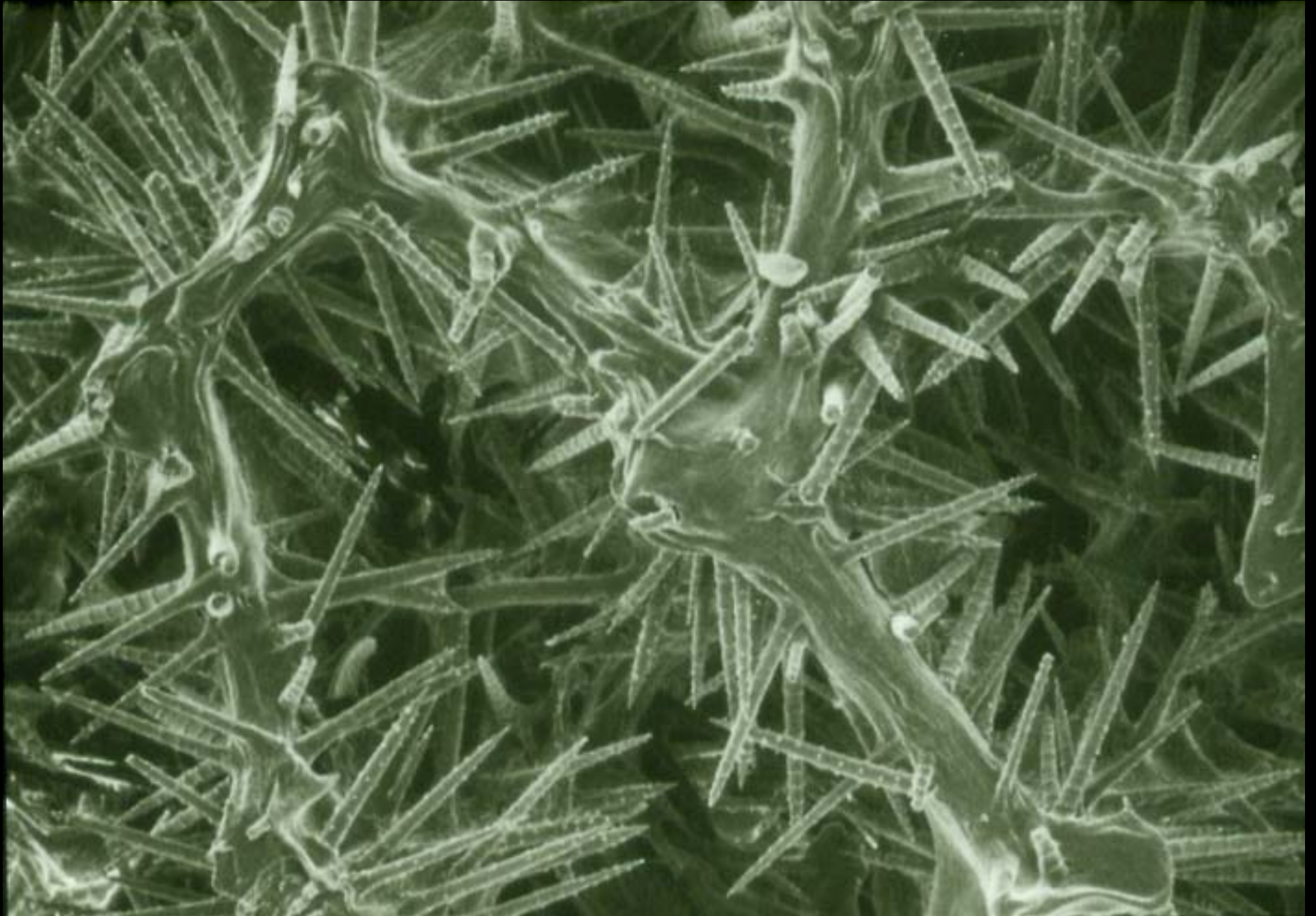
inorganic



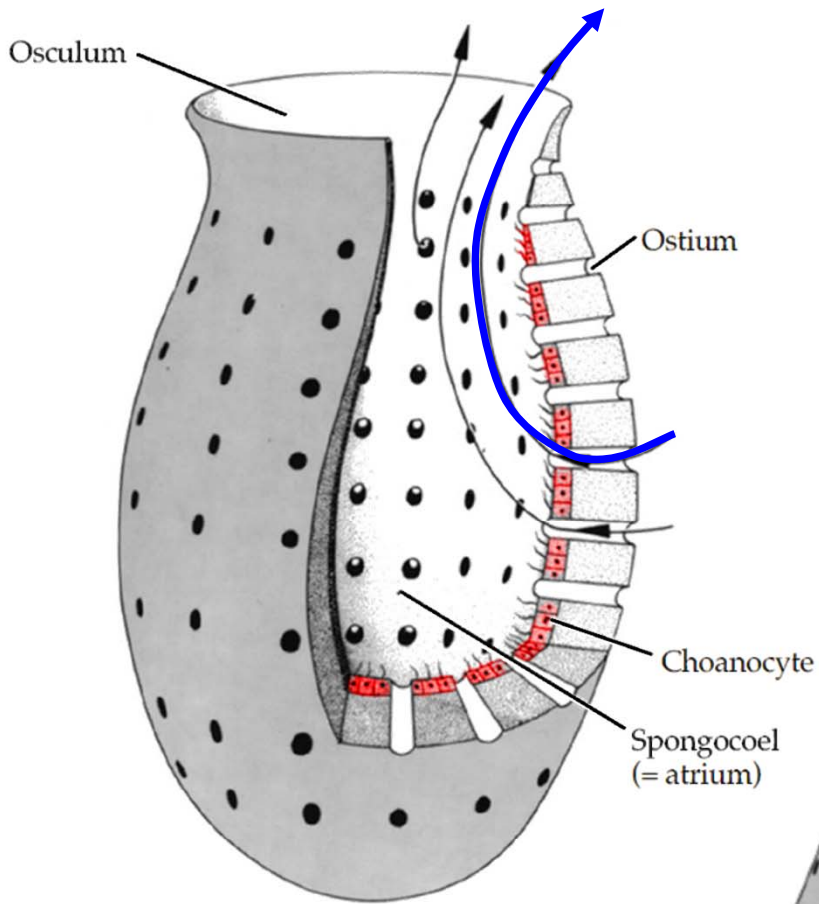
organic
protein
core



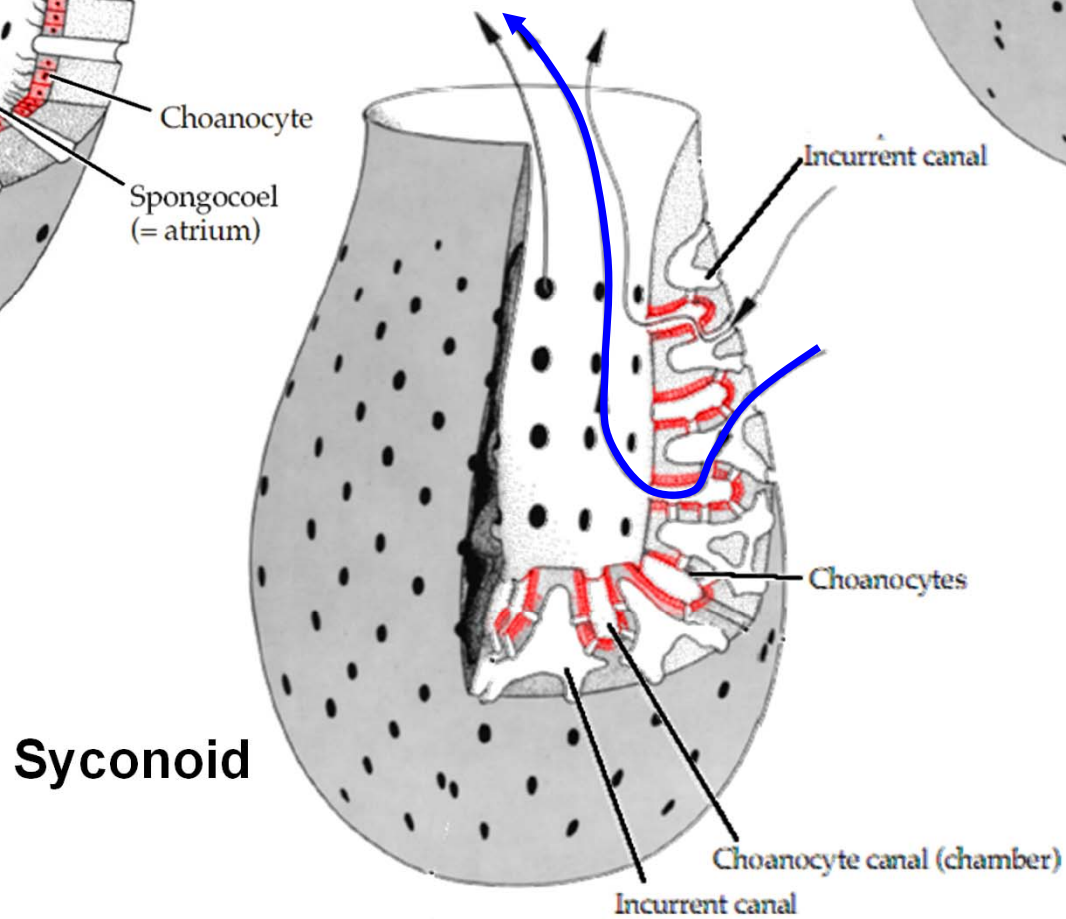
Endoskeleton: Spicule-spongin matrix



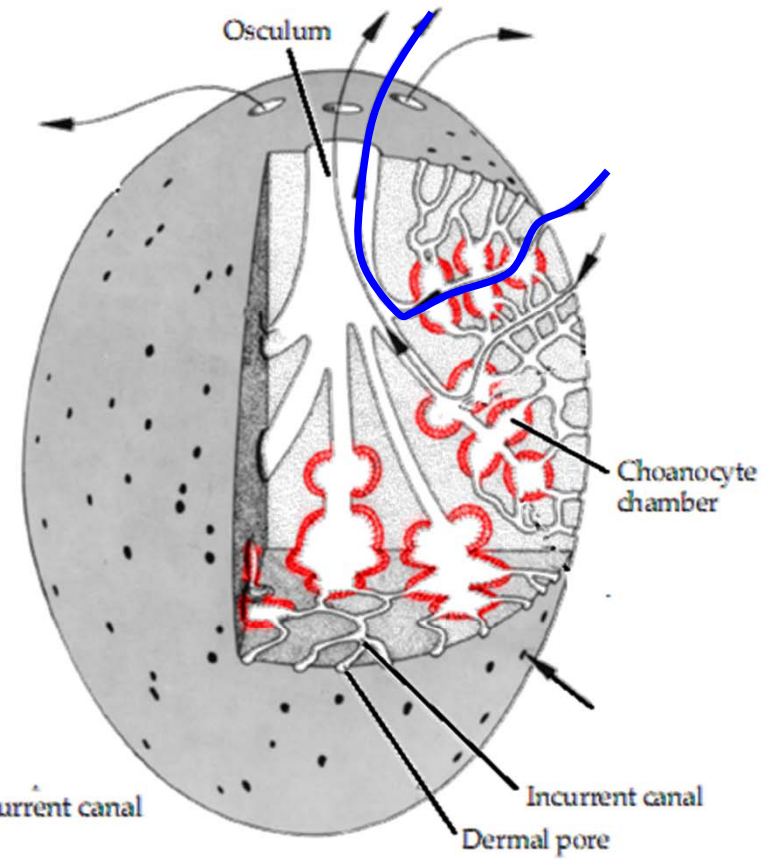
Grades of construction



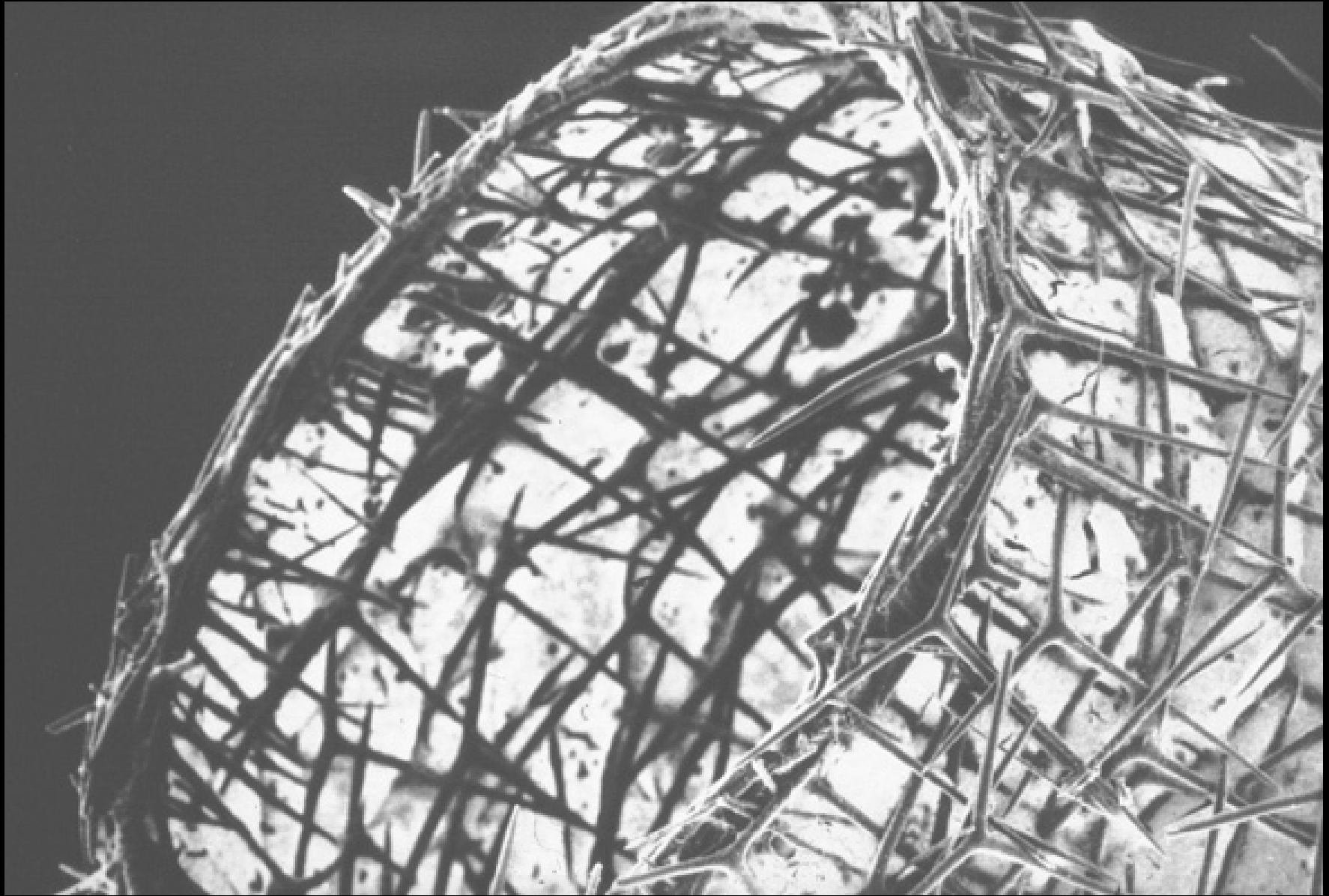
Asconoid



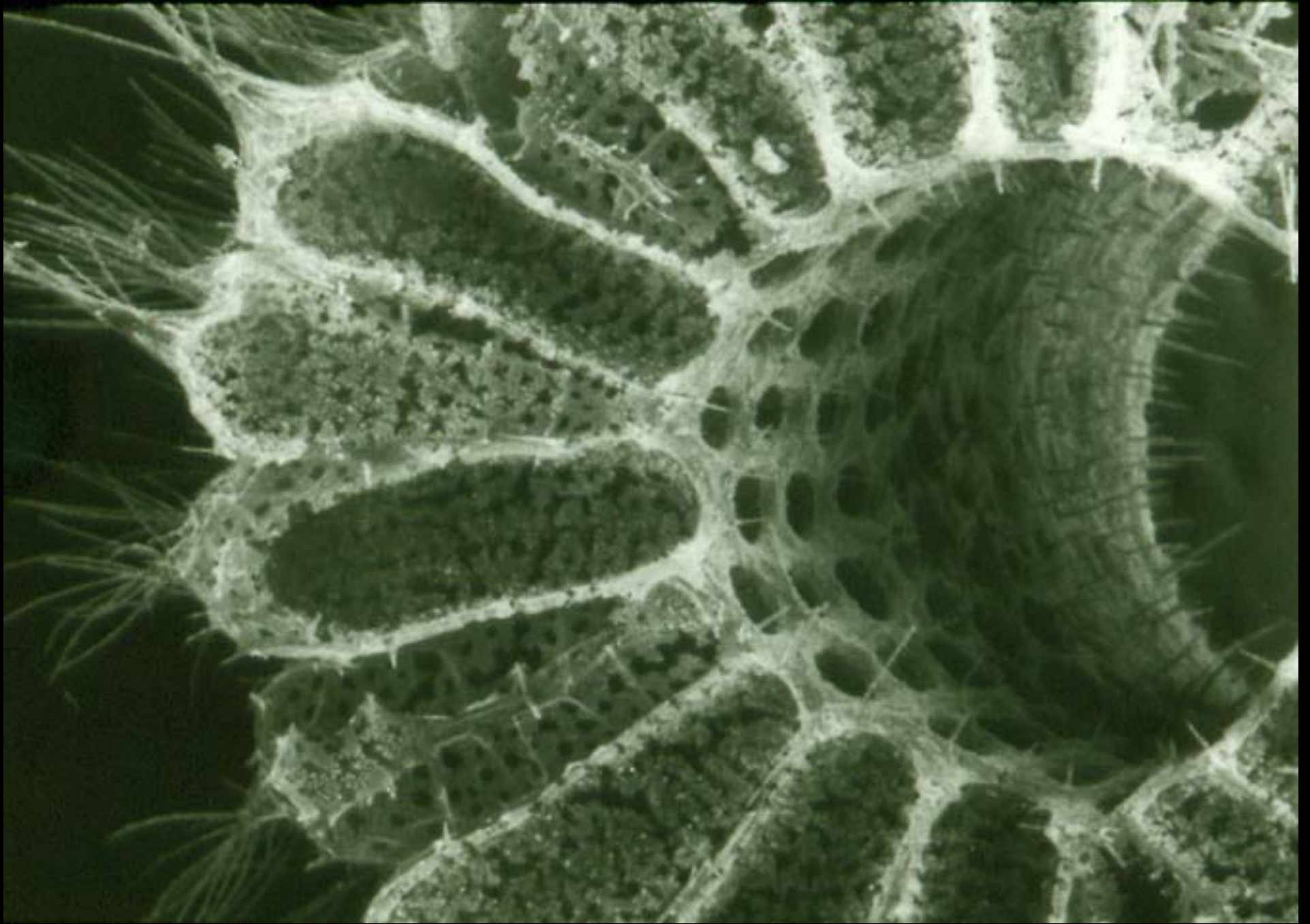
Syconoid



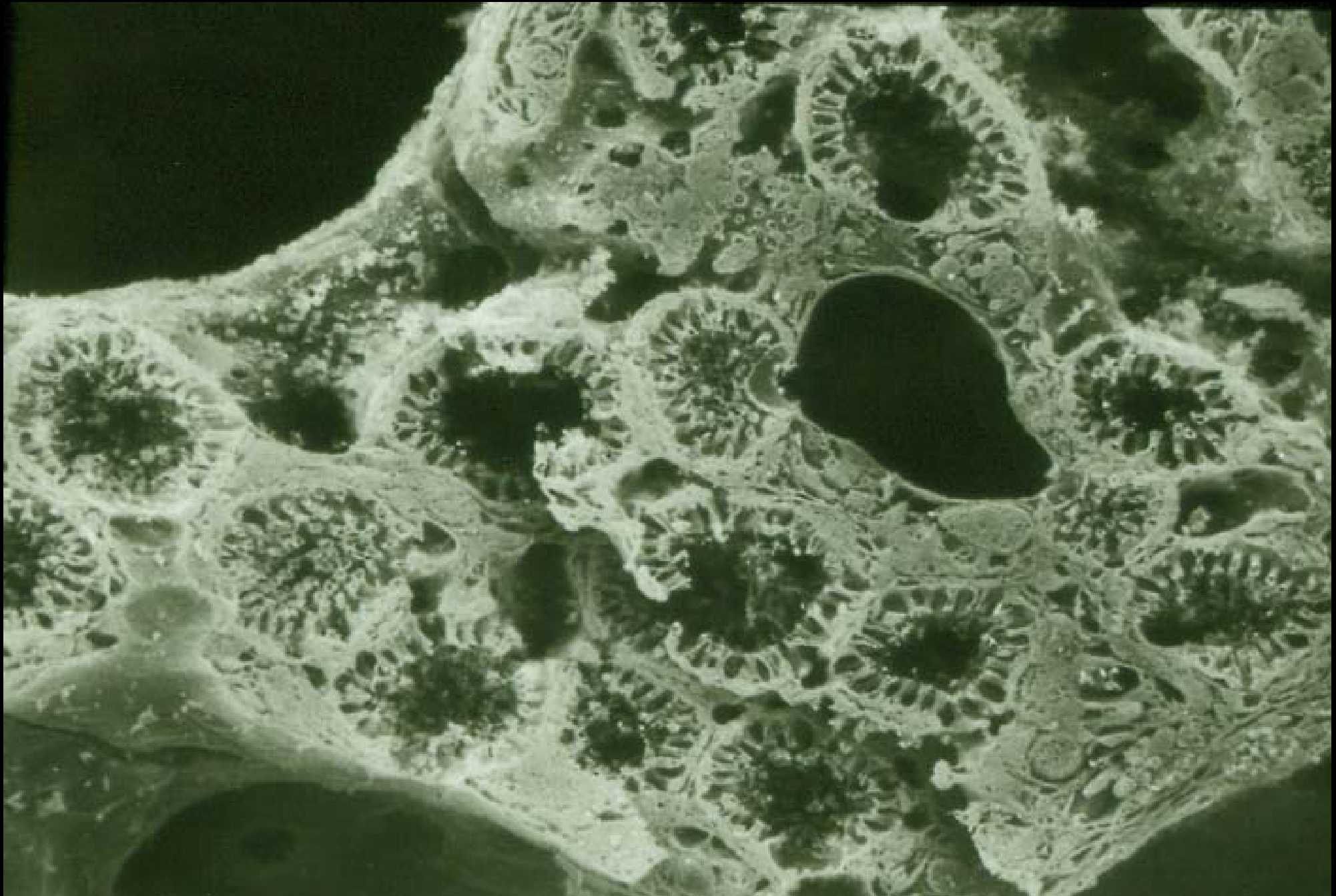
Leuconoid



Asconoid: choanocyte-lined spongocoel

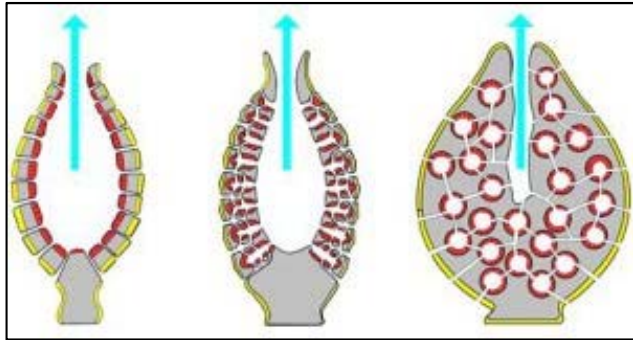


Syconoid: choanocyte-lined channels

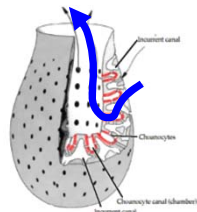


Leuconoid: choanocyte-lined chambers

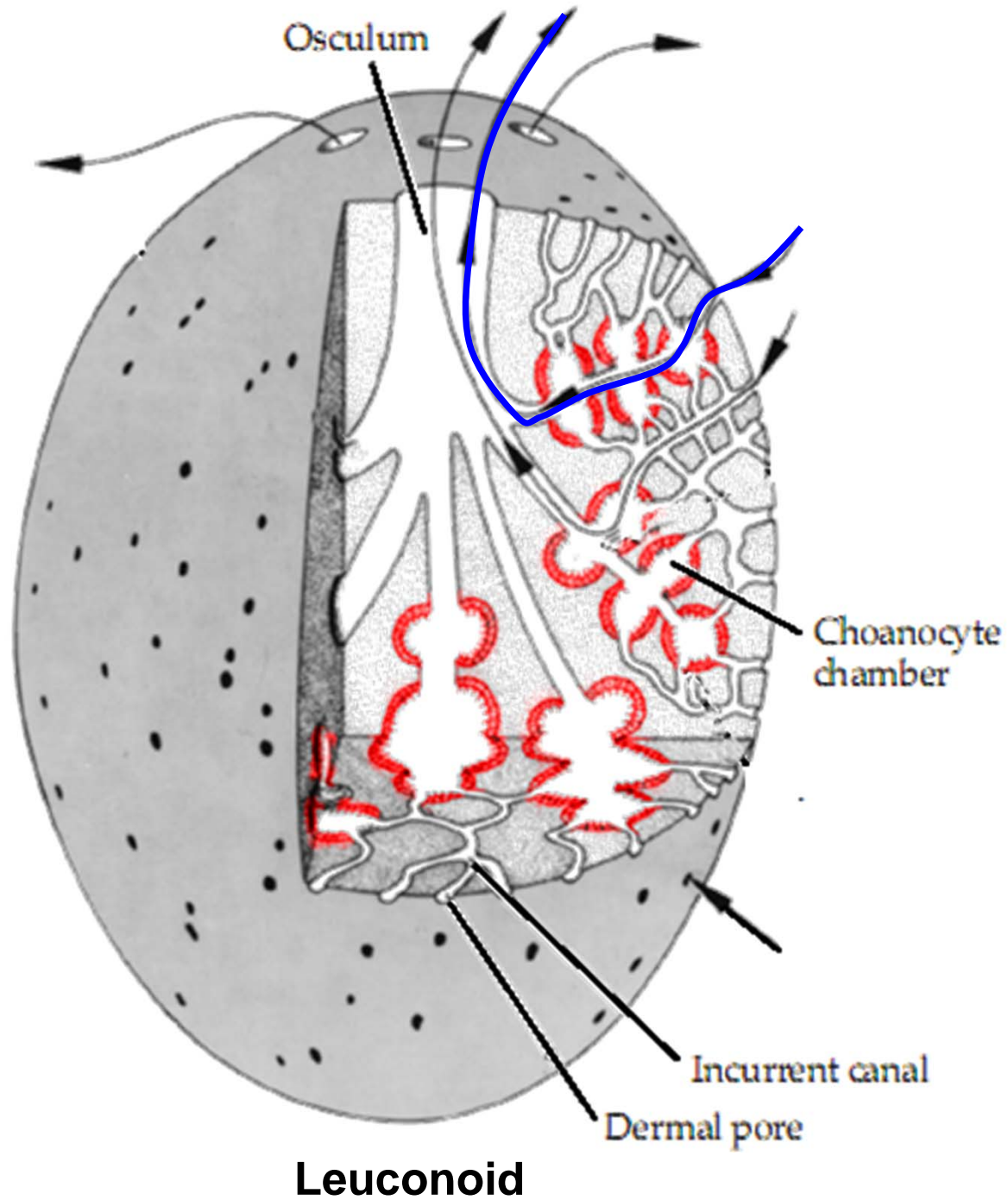
Grades of construction: relative size



Asconoid

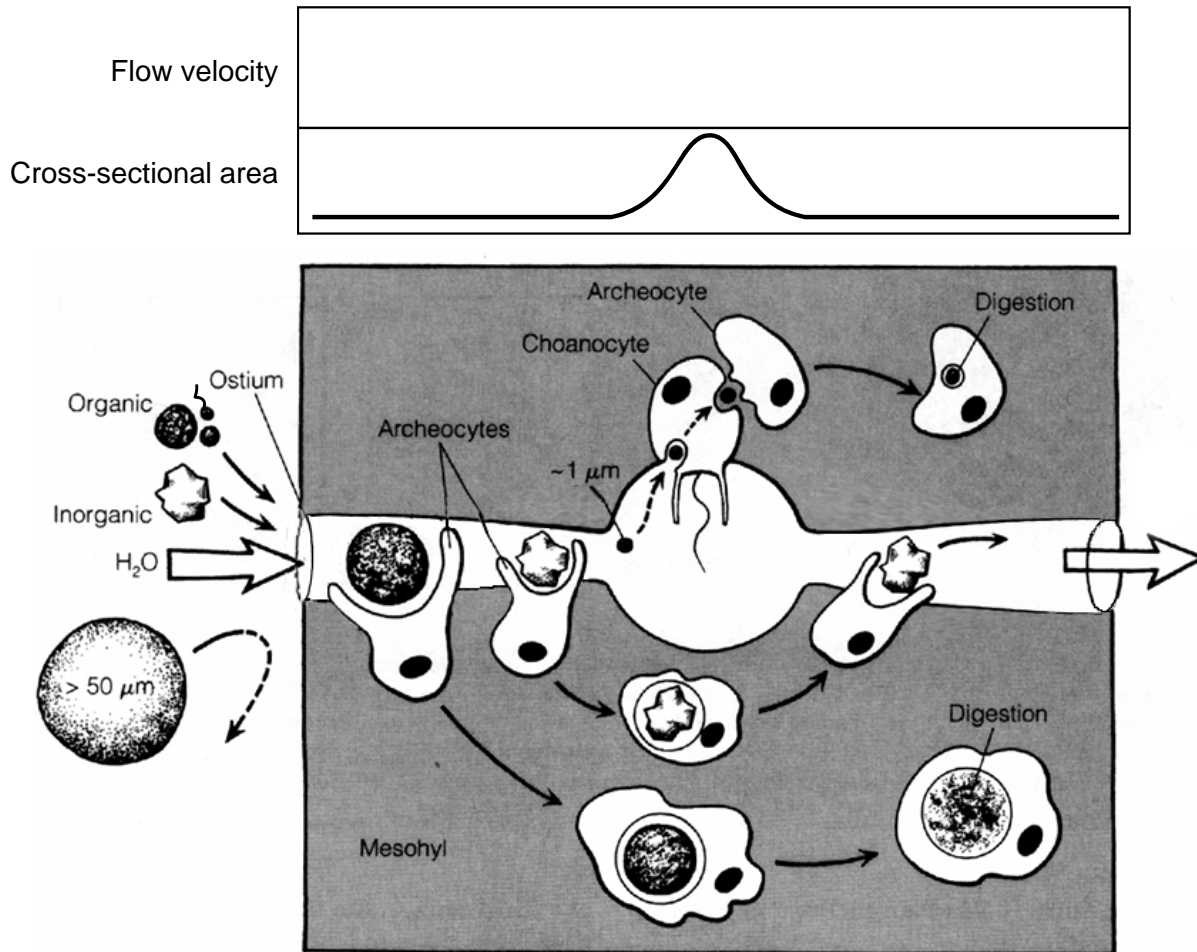


Syconoid



Leuconoid

Sponges play with flow



Induced flow by Bernoulli's principle

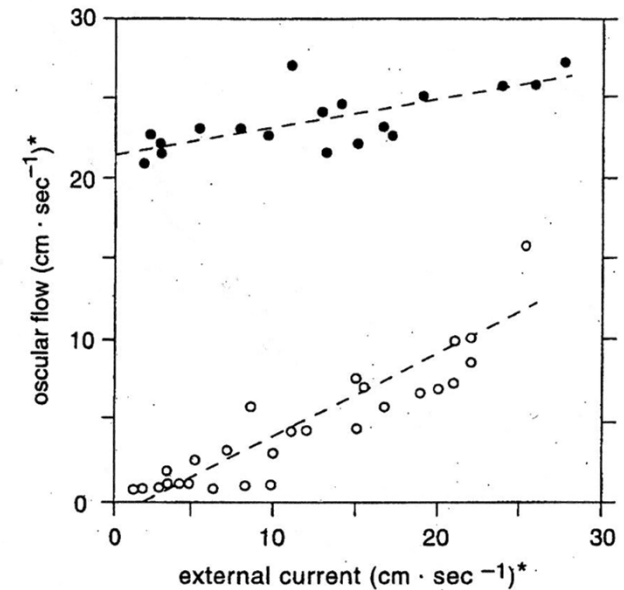


Figure 4.6

Influence of morphology on water flow through the marine sponge *Haliclona viridis*. (●) Velocity of water leaving sponge oscula for undisturbed sponges. (○) Data for sponges whose choanocytes were inactivated by immersing sponges in freshwater for several minutes.

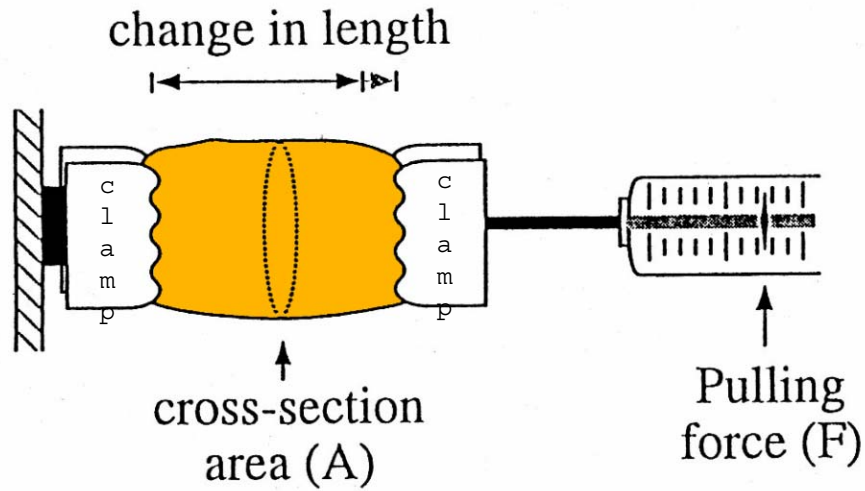
$$V_{in} = V_{through} = V_{out}$$

Table 4.1 Water Transport Characteristics for a Marine Leuconoid Sponge.

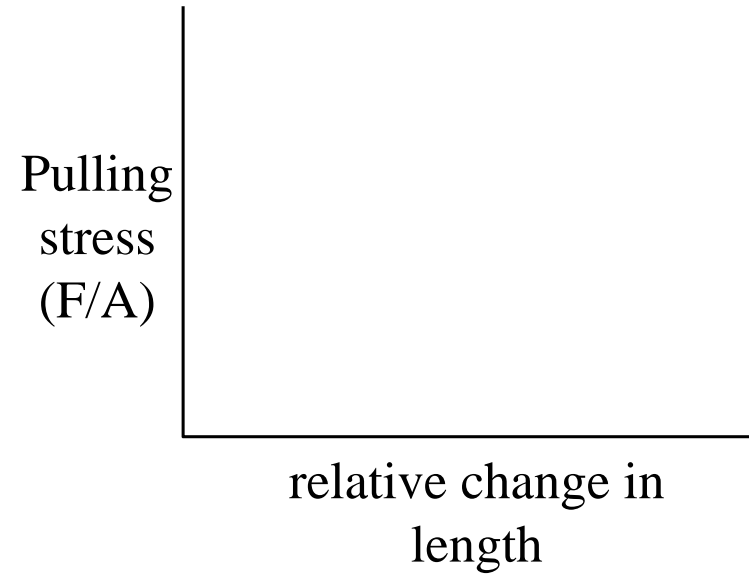
The sponge on which the data are based had a total volume of 2.4 cm³. From LaBarbera, M., and S. Vogel. 1982. *Amer. Scient.* 70:54–60.

Anatomical feature	Approximate no. per sponge	Individual surface area (cm ²)	Total area (cm ²)	Water velocity (cm/sec)
ostia	940,000	3.33×10^{-6}	3.14	0.057
flagellated chambers	2.88×10^7	7.06×10^{-6}	203.0	8.69×10^{-4}
osculum	1.0	0.034	0.034	5.1

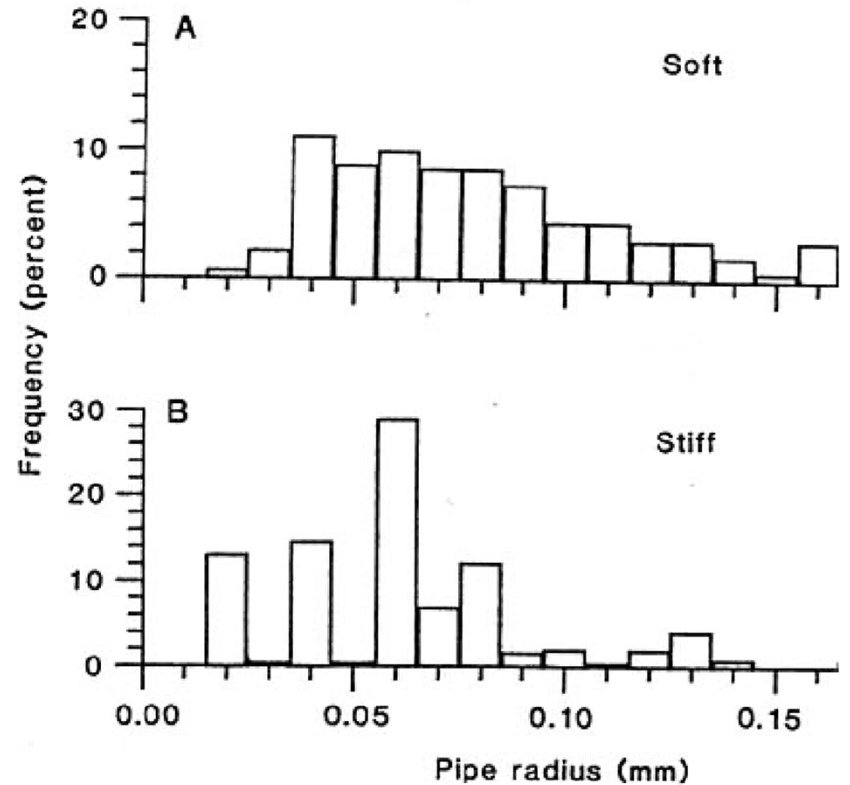
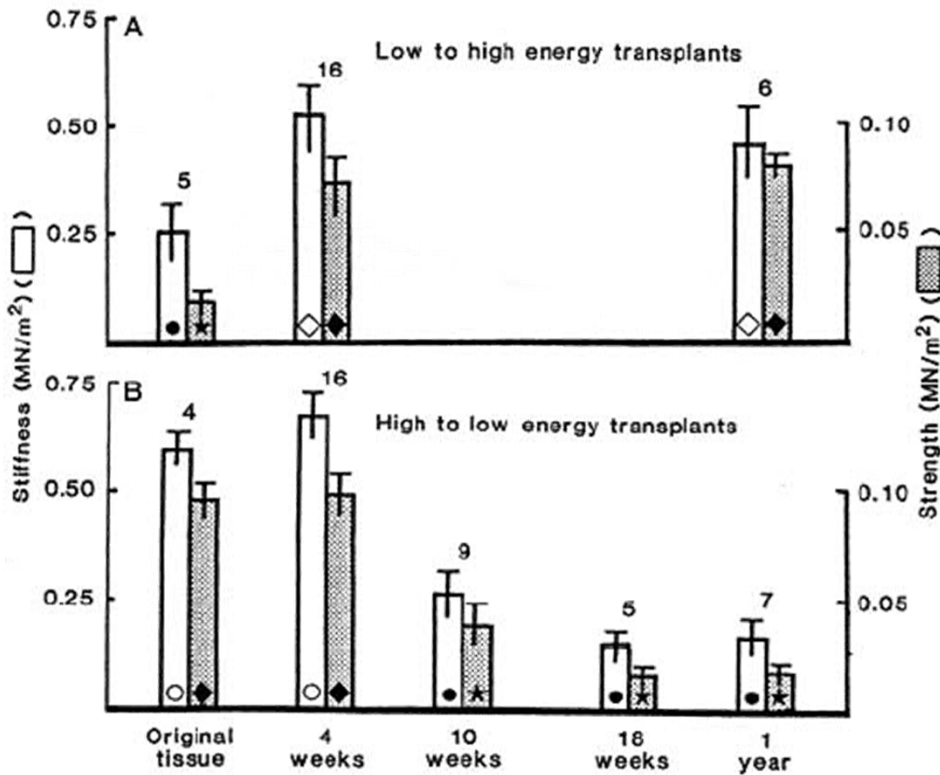
Sponges play with form



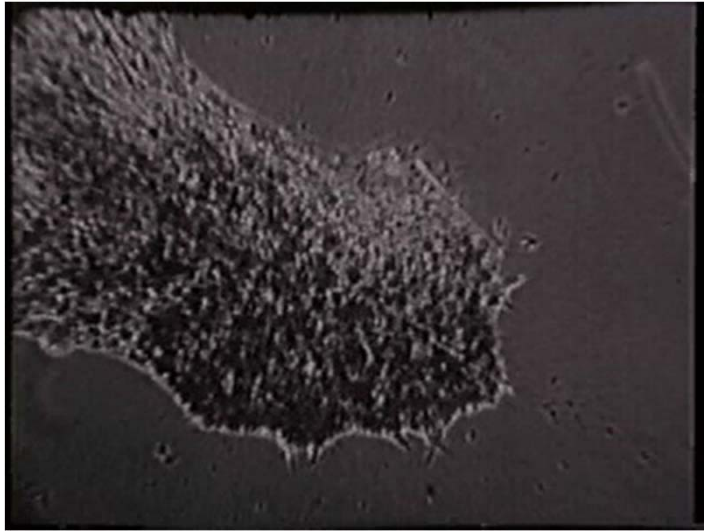
phenotypic plasticity (Palumbi 1984)



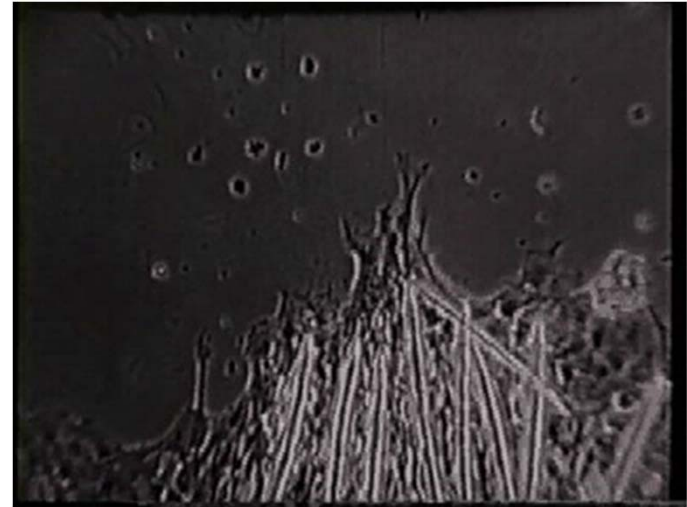
PALUMBI (1984)



Sponges play with form



Advancing edge of sponge

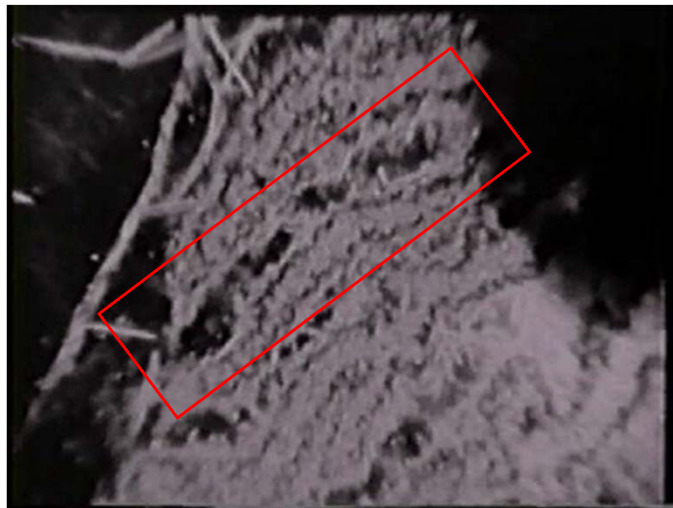


Spicules carried at edge

Filming speed: 500-1000x

Cells crawl at **1 mm/min** (compare to our structural cells @ **0.001 mm/min**)

Sponges can move about 4 mm/day

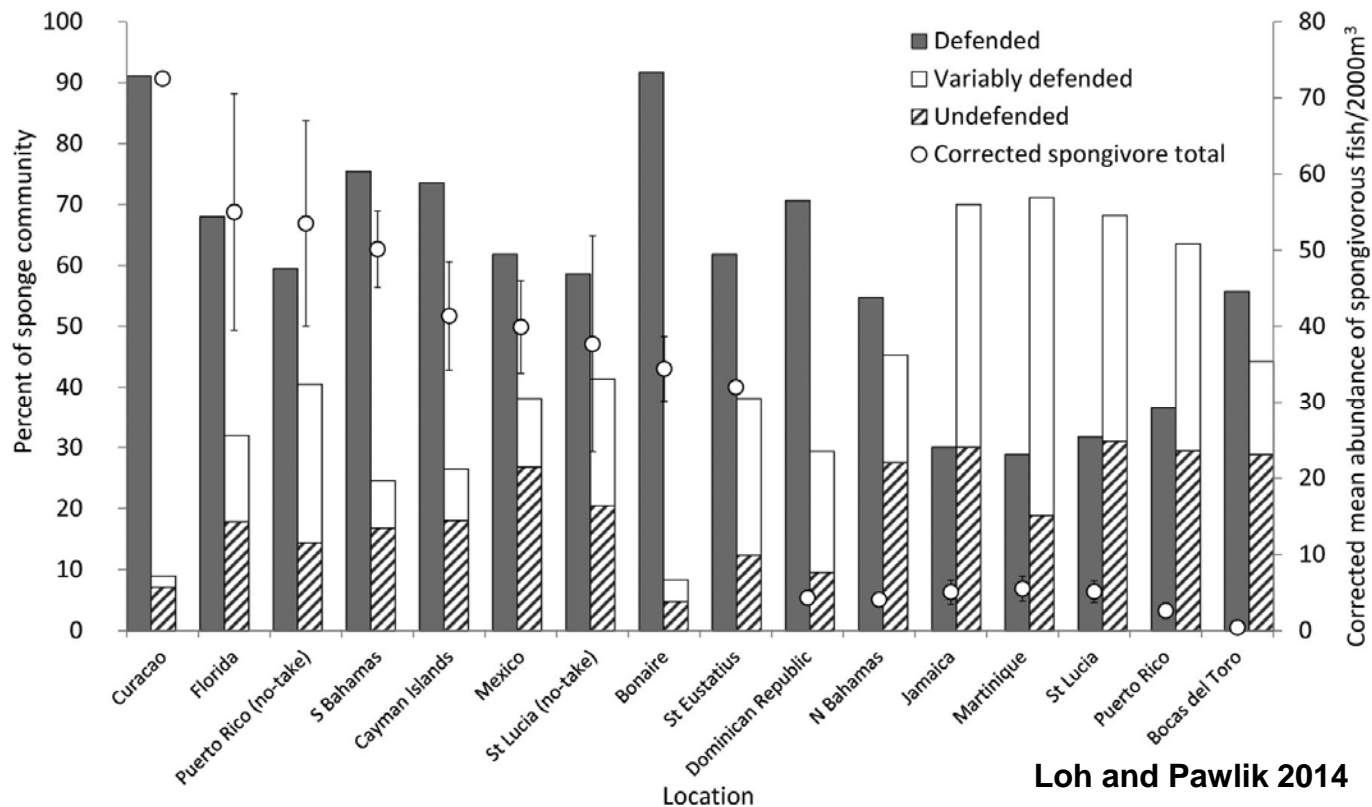


Reconstruction of water channels

Filming speed: 5000x

Choanocytes are brightly lit because they have ingested fluorescent beads

Sponges play with chemistry: protection



Sponges play with chemistry: protection



Sponge growing on the carapace of a crab

The nudibranch *Rostanga* laying egg ribbons on its food, the sponge *Ophlitospongia*



...and with physical defenses

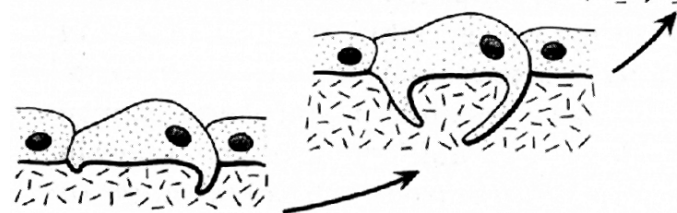
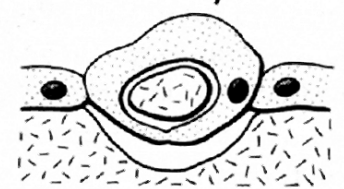
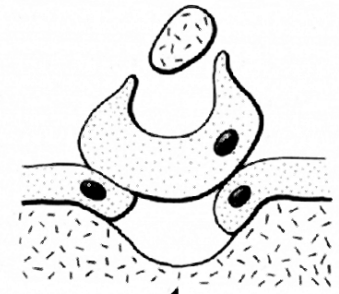
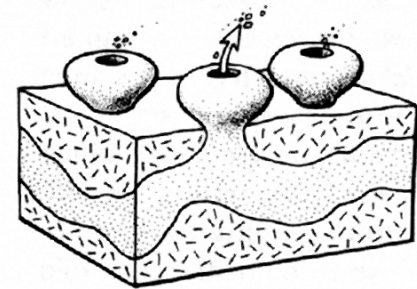


Silica spicules from the stomach of a hawksbill turtle

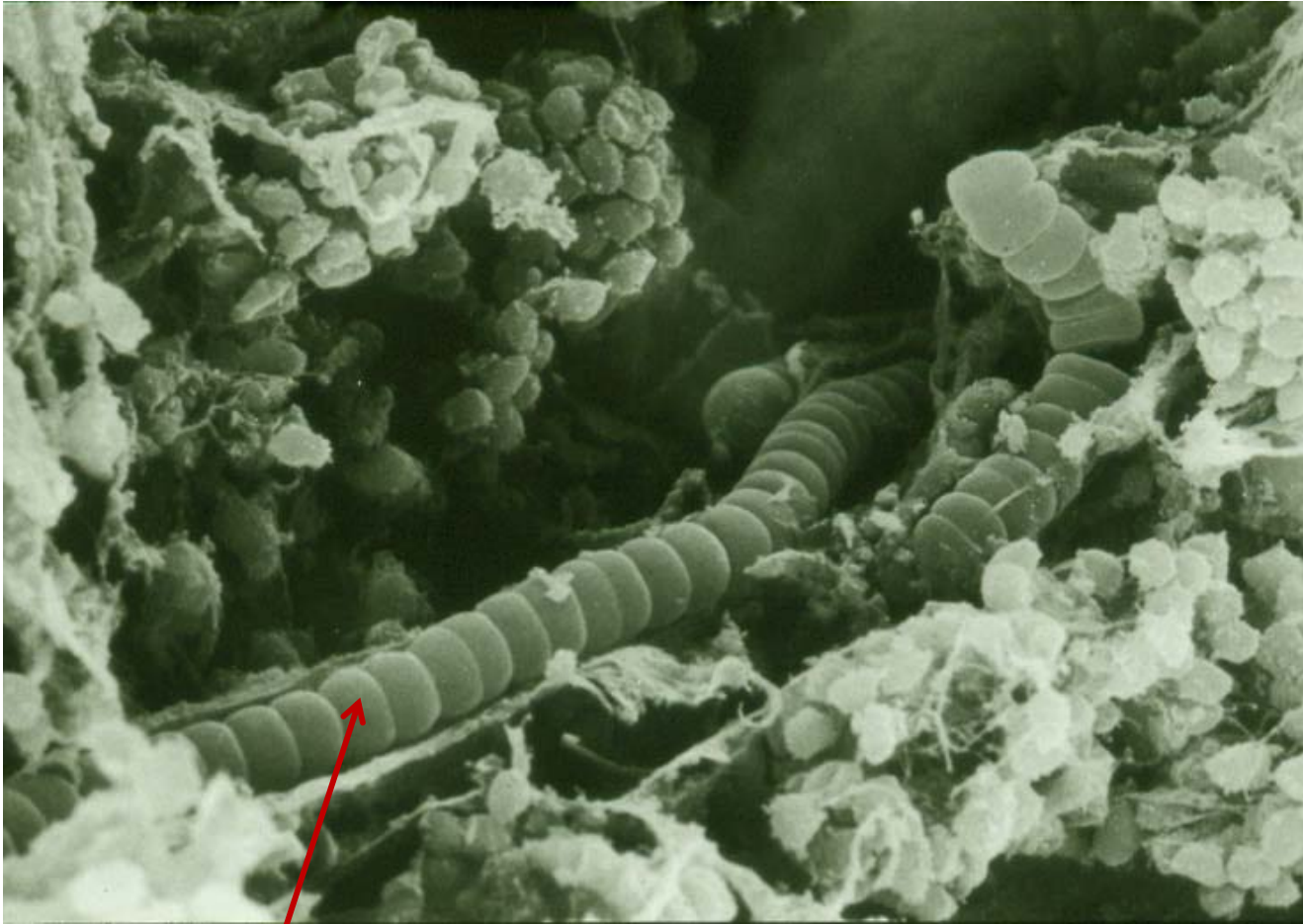
Sponges play with chemistry: bioerosion



Boring sponge, *Cliona celata*

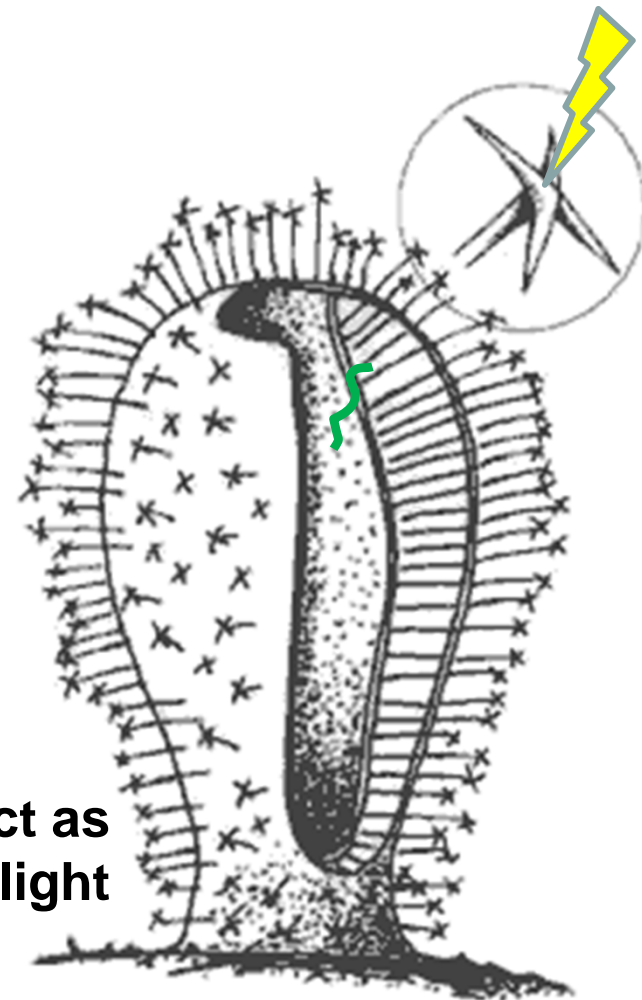


Sponges play with light: symbiosis

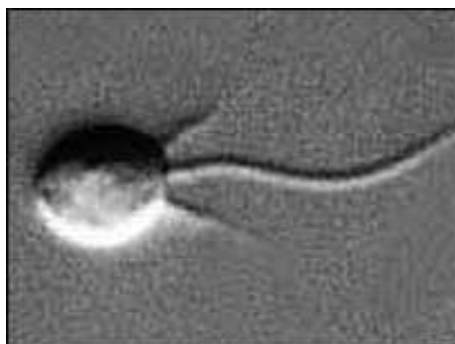
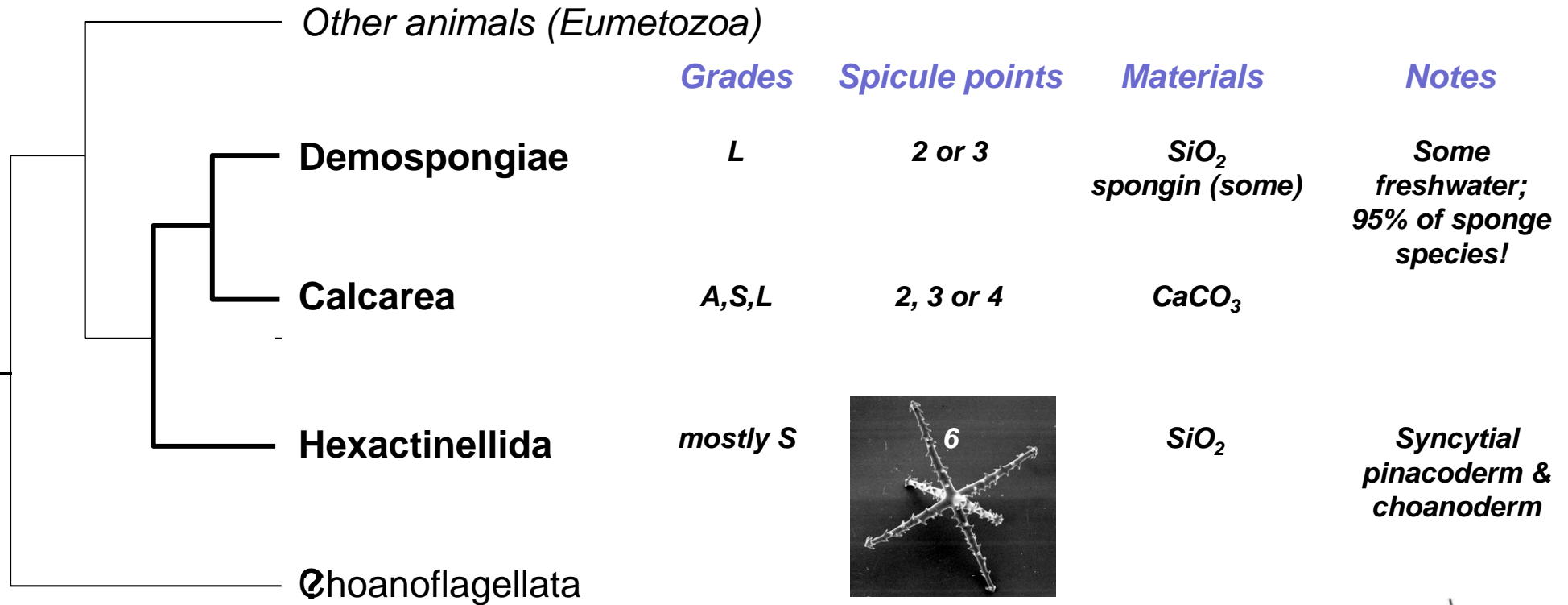


Cyanobacterium symbiont inside sponge tissue

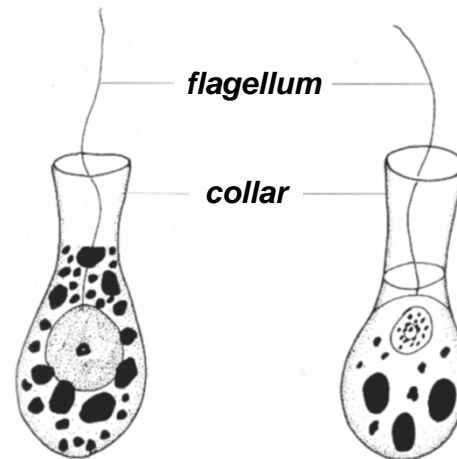
Antarctic sponge *Rossella*: spicules act as “optical fibers” to deliver light



Sponge class characteristics and relationships

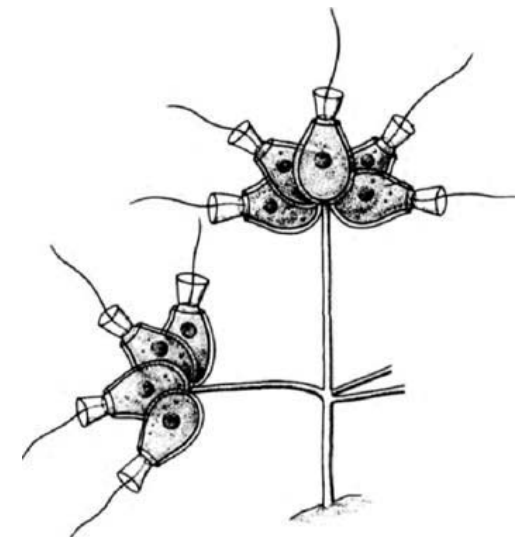


your closest non-animal relative

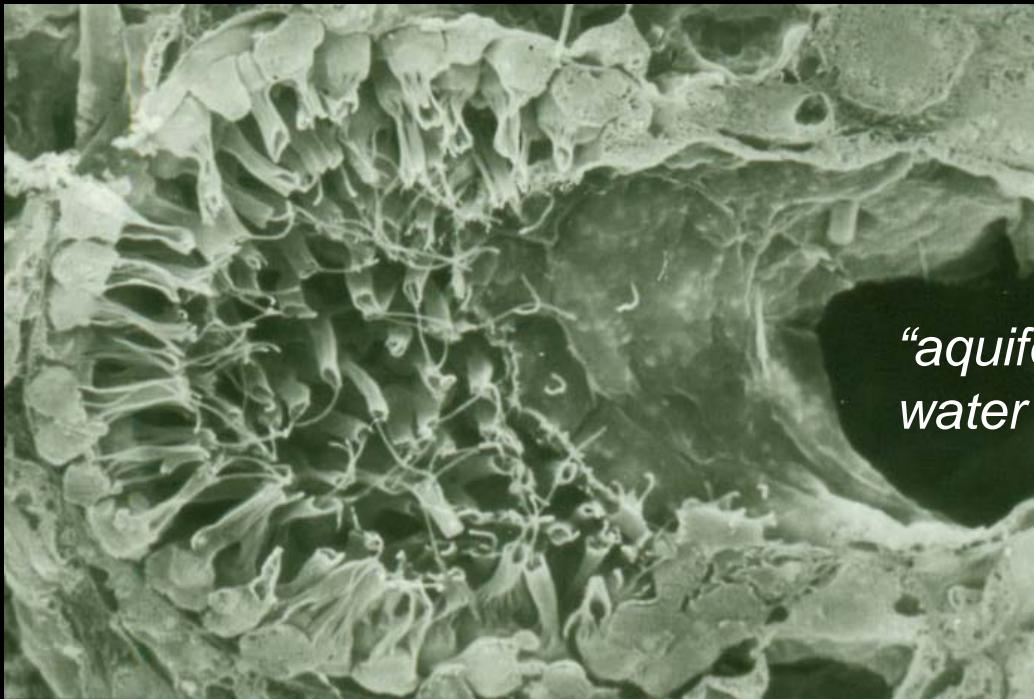


choanocyte

choanoflagellate



choanoflagellate colony

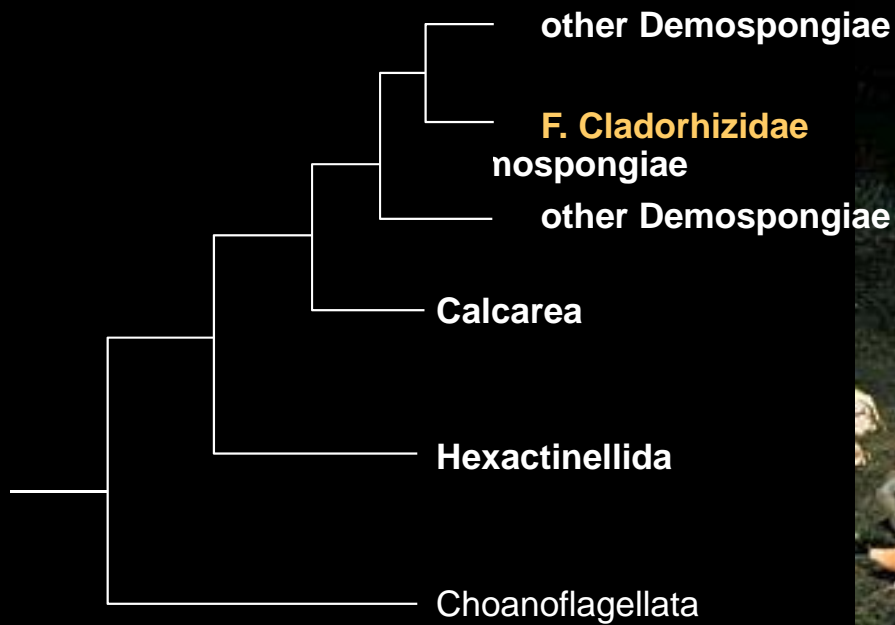


What makes a sponge a sponge?

*“aquiferous construction”?
water channels and choanocytes*

F. Cladorhizidae

*carnivorous “sponge”!?
New body plan...
new phylum?*



.....Choanoflagellata



- Porifera
- Placozoa
- Cnidaria
- Myxozoa
- Ctenophora
- Acoela
- Chaetognatha
- Platyhelminthes
- Mollusca
- Polychaeta
- Echiura
- Annelida
- Sipuncula
- Nemertea
- Phoronida
- Brachiopoda
- Bryozoa
- Gnathostomulida
- Cycliophora
- Kamptozoa
- Acanthocephala
- Rotifera
- Arthropoda
- Onychophora
- Tardigrada
- Gastrotricha
- Nematomorpha
- Nematoda
- Priapula
- Kinorhyncha
- Loricifera
- Echinodermata
- Hemichordata
- [vertebrates]
- Urochordata

Lophotrochozoa

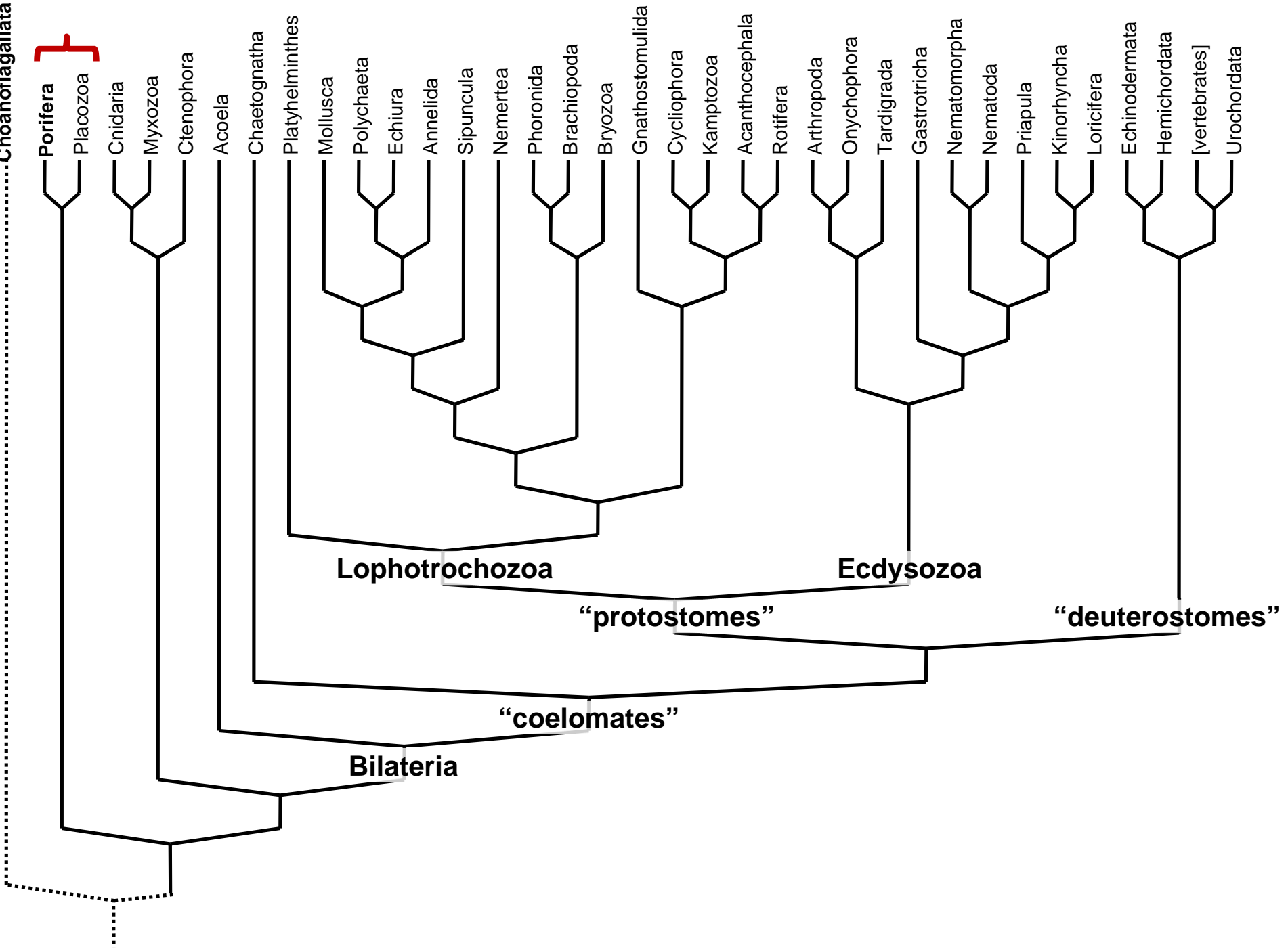
Ecdysozoa

“protostomes”

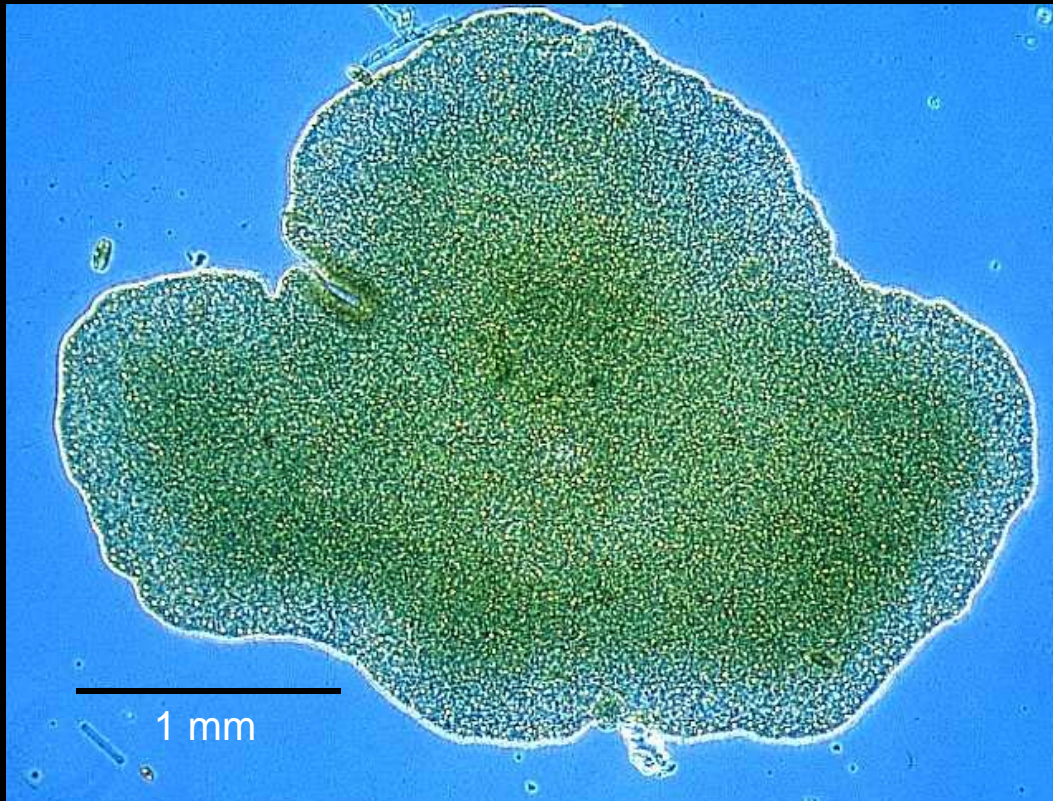
“deuterostomes”

“coelomates”

Bilateria



Phylum Placozoa



- Discovered late 19th c. growing on aquarium glass
- 1 species (*Trichoplax adhaerens*)
- 4-6 cell types
- asexual budding, sexual reproduction
- chromosomes are small, genome is bacterial-sized
- closest relative?

