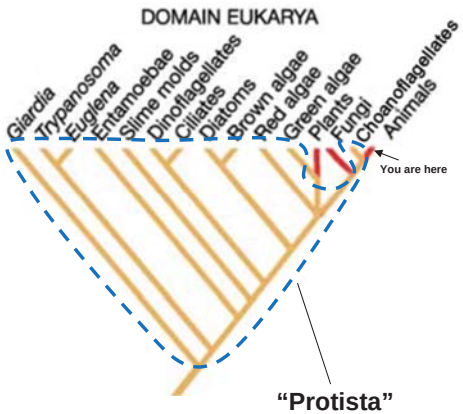
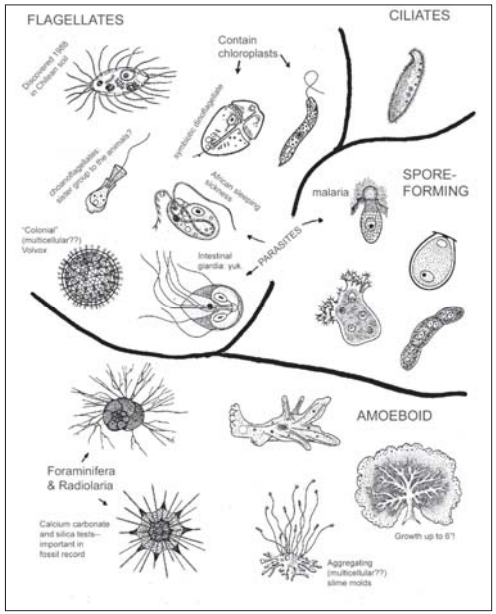
Where did animals come from?



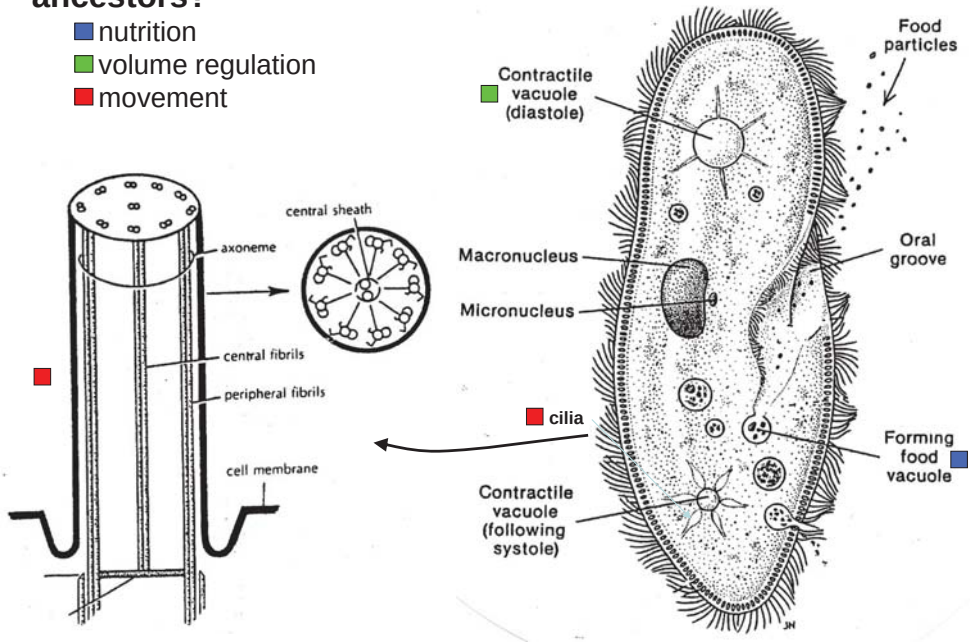
"Protista"
(single-celled eukaryotes
--a paraphyletic mess)



"Protozoa" = "animal-like" protists
Diverse "body plans"

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

- nutrition
- volume regulation
- movement



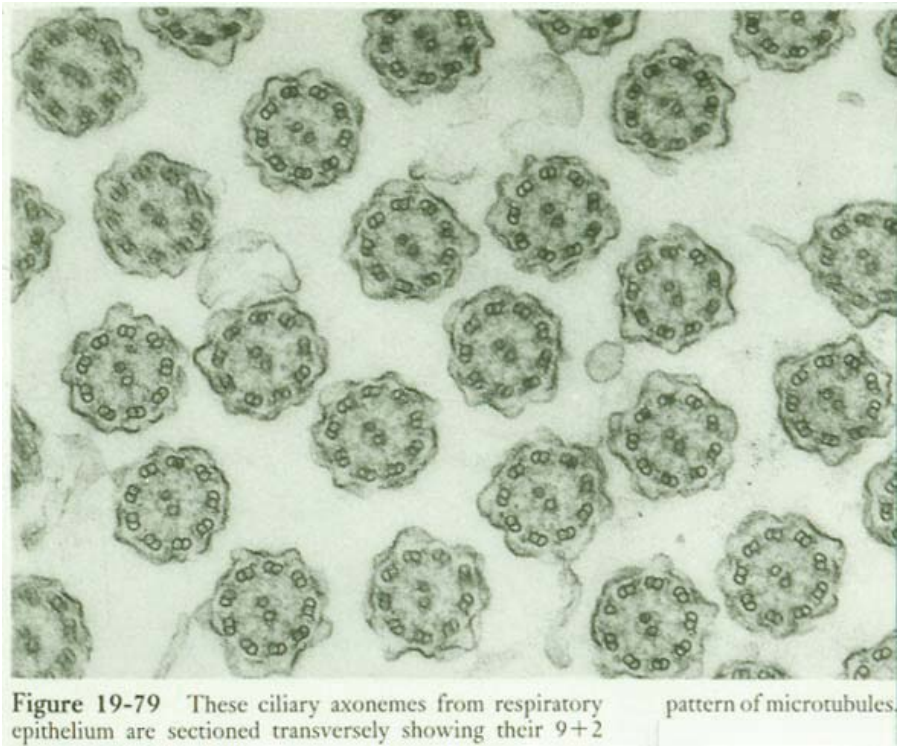
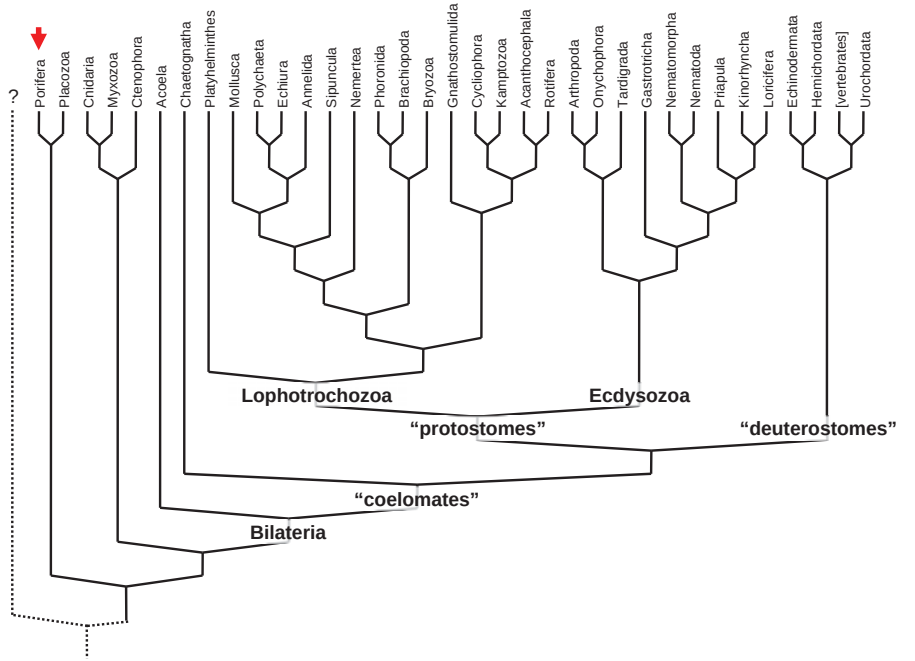
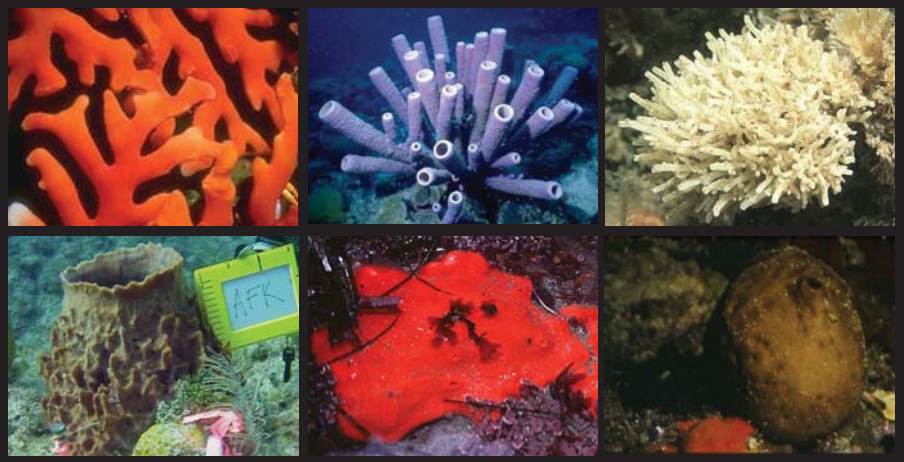


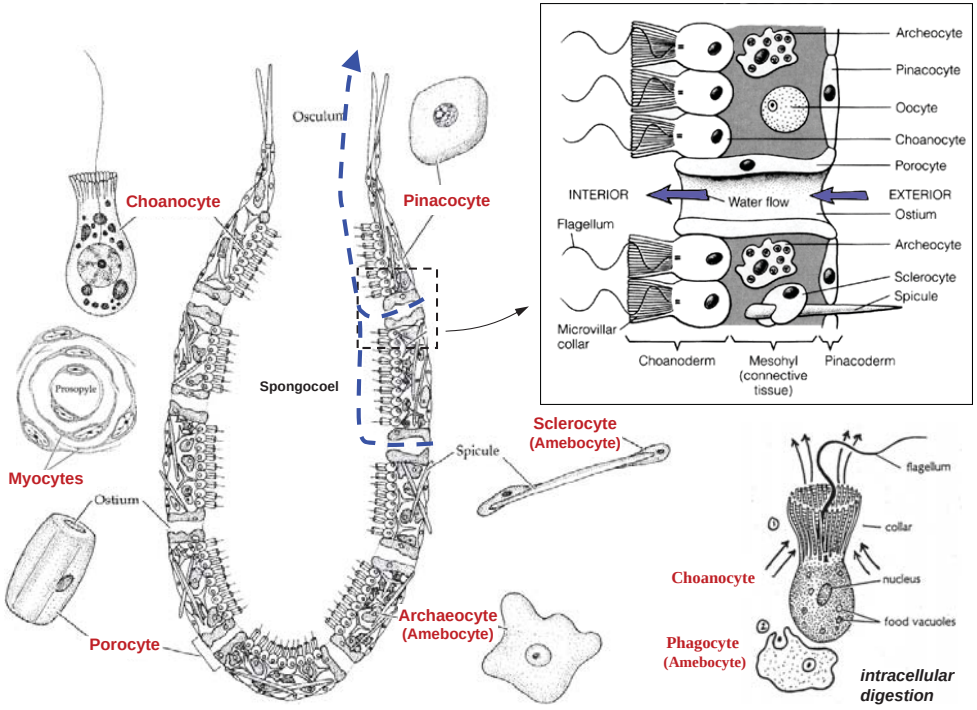
Figure 19-79 These ciliary axonemes from respiratory epithelium are sectioned transversely showing their 9+2 pattern of microtubules.



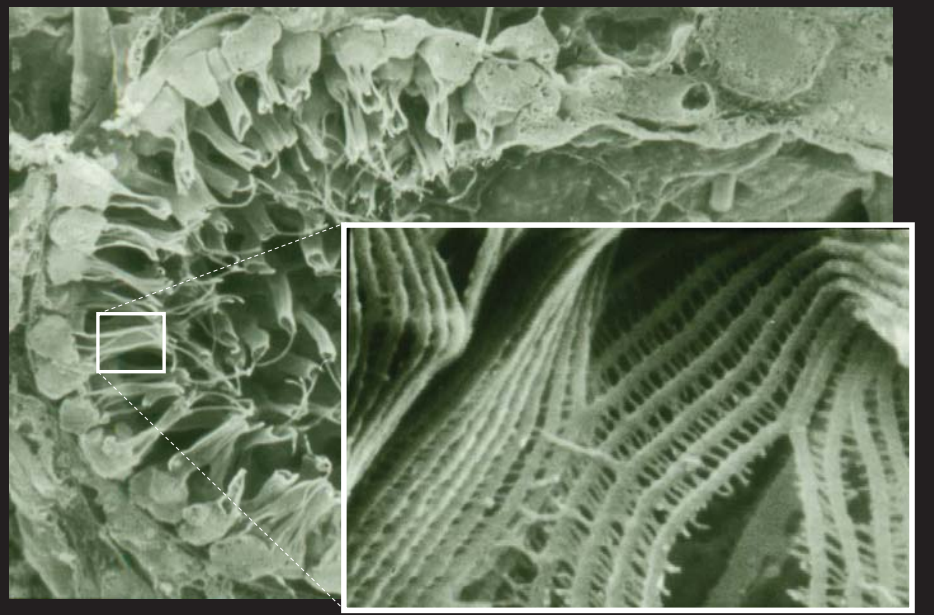
Phylum Porifera



***Theme**: simplicity and flexibility of a cellular grade of construction*

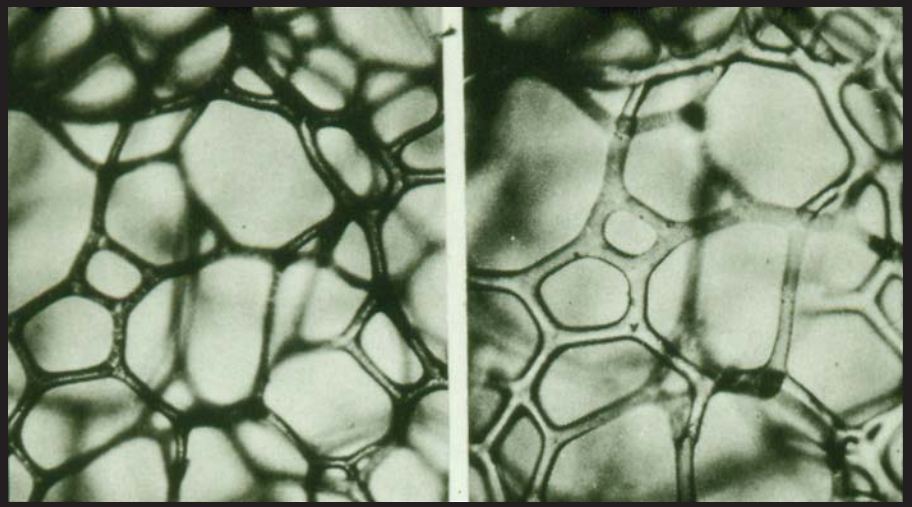


Choanocytes



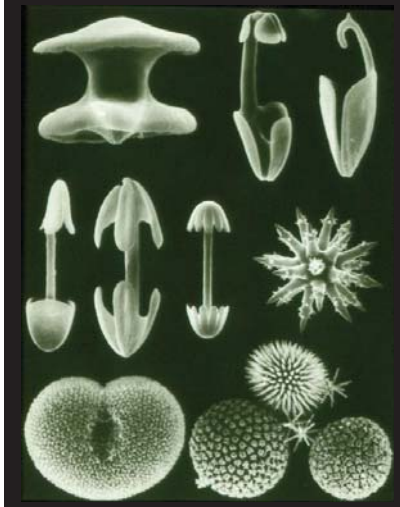
Microfibrils on choanocyte collar

Endoskeleton: spongin



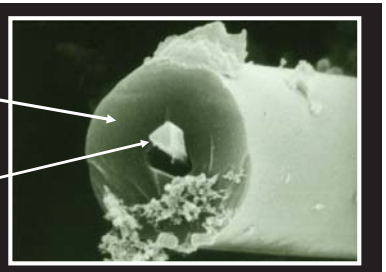
Spongin fibers (polymerized collagen)

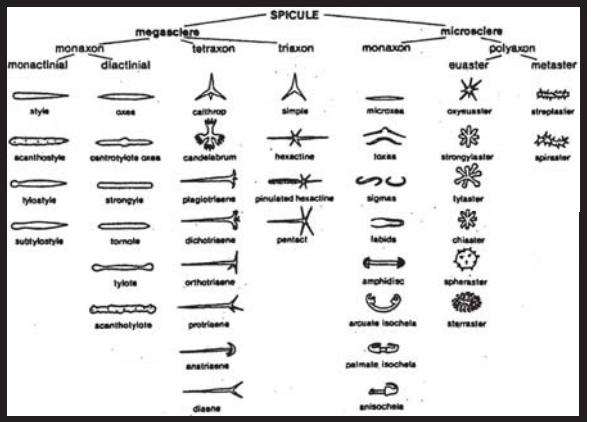
Endoskeleton: spicules



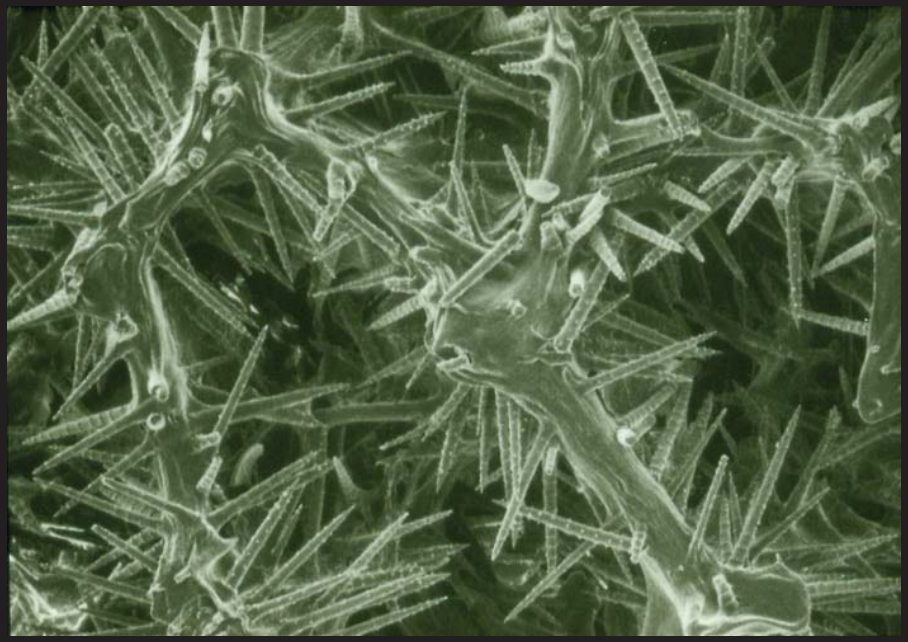
inorganic
$CaCO_3$
or
SiO_2

organic
protein
core

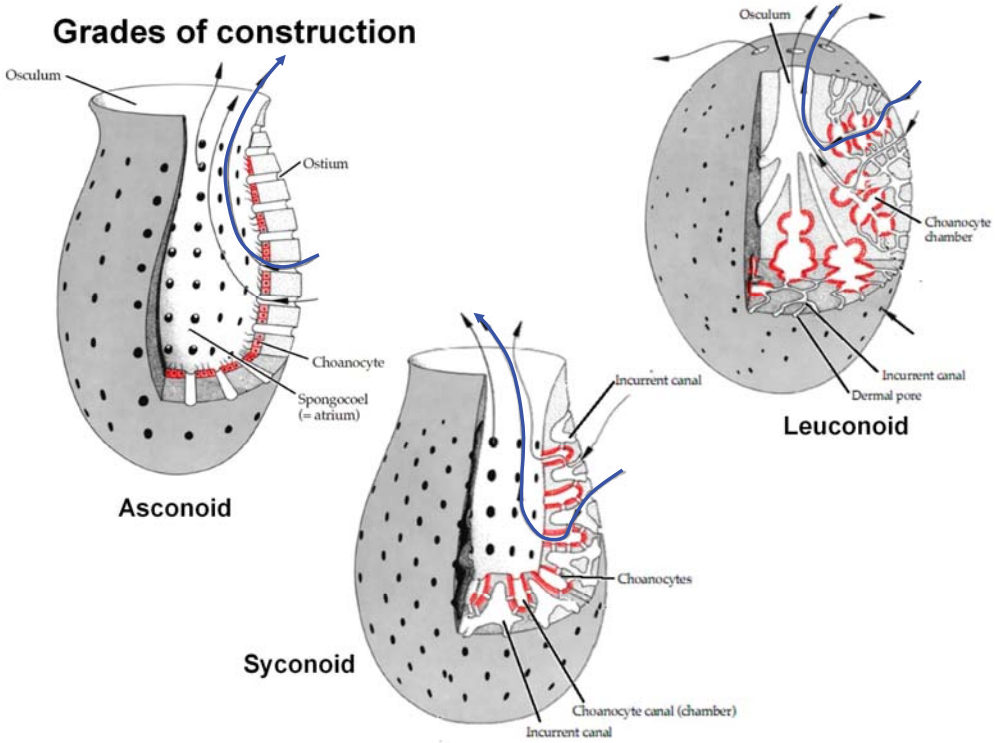


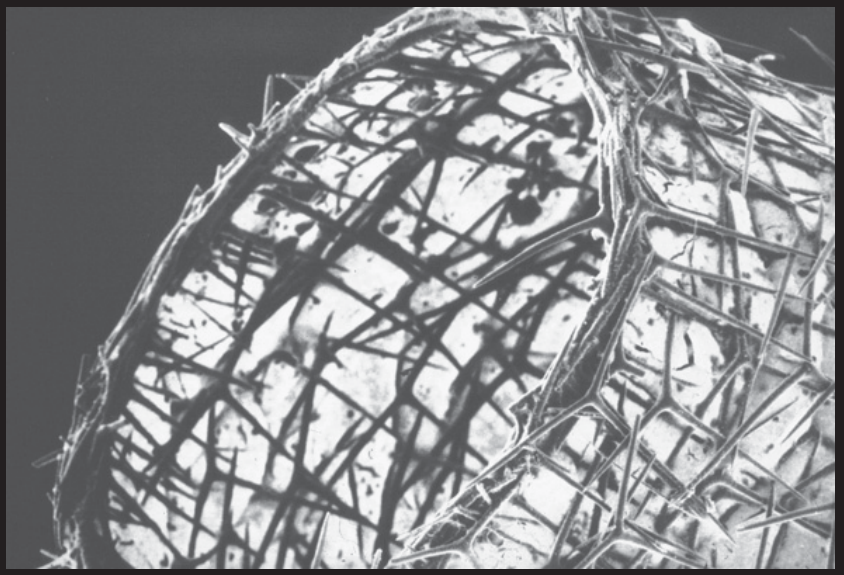


Endoskeleton: Spicule-spongin matrix

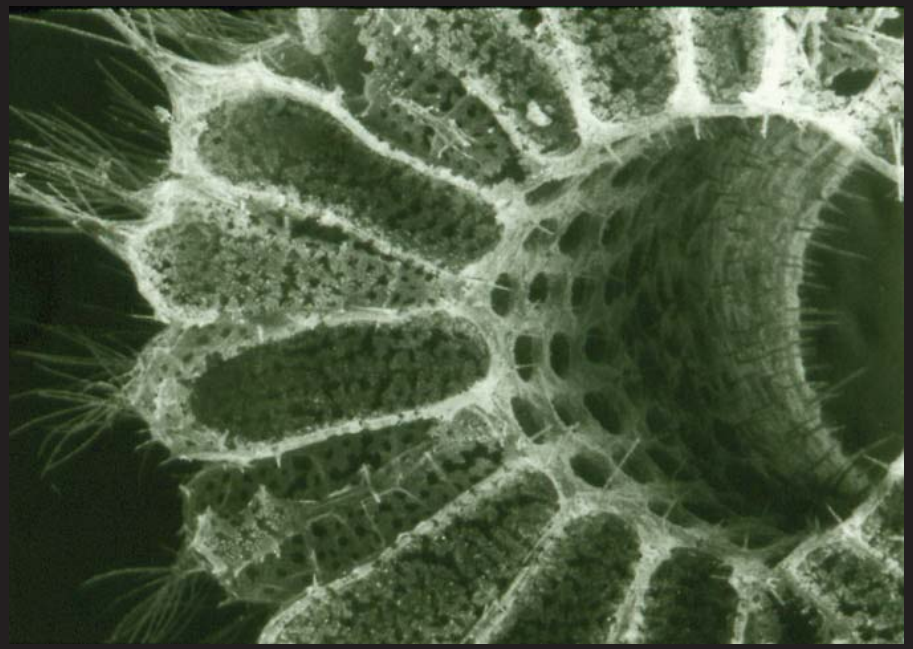


Grades of construction

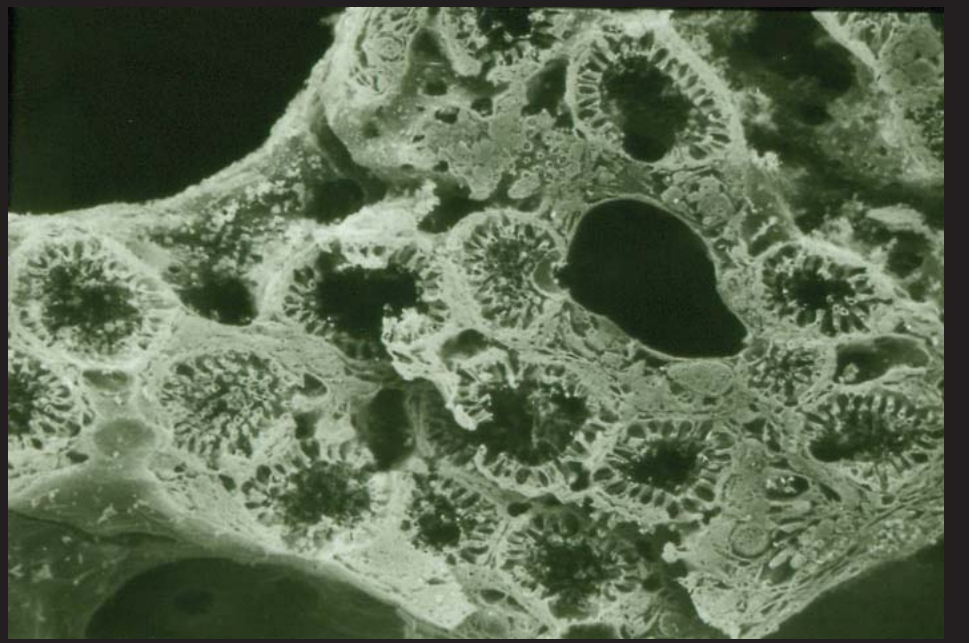




Asconoid: choanocyte-lined spongocoel

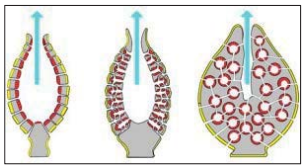


Syconoid: choanocyte-lined channels



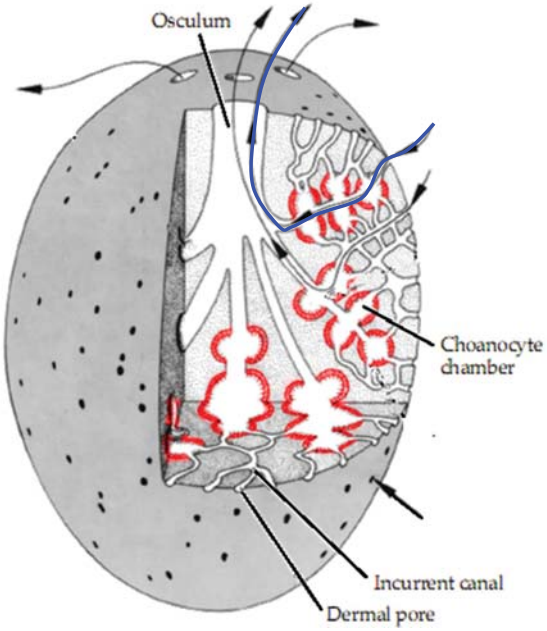
Leuconoid: choanocyte-lined chambers

Grades of construction: relative size



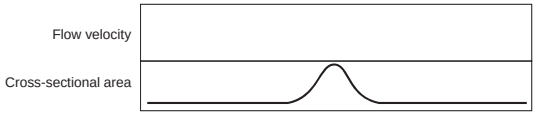
Asconoid

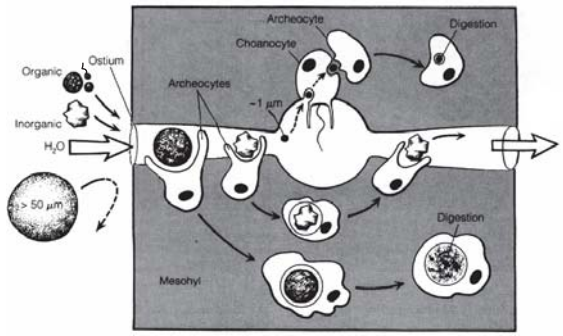
Syconoid



Leuconoid

Sponges play with flow





Induced flow by Bernoulli's principle

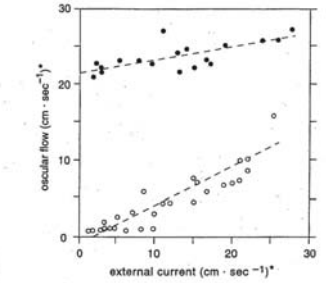


Figure 4.6
Influence of morphology on water flow through the marine sponge *Haliclona viridis*. (•) Velocity of water leaving sponge oscula for undisturbed sponges. (o) Data for sponges whose choanocytes were inactivated by immersing sponges in freshwater for several minutes.

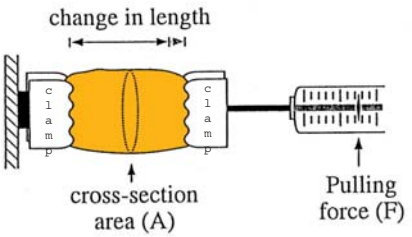
$V_{in} = V_{through} = V_{out}$

Table 4.1 Water Transport Characteristics for a Marine Leuconoid Sponge.

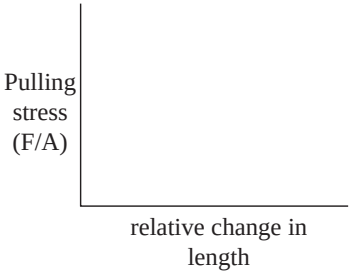
The sponge on which the data are based had a total volume of 2.4 cm^3. *From LaBarbera, M., and S. Vogel. 1982. Amer. Scient. 70:54–60.*

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^{-4}	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

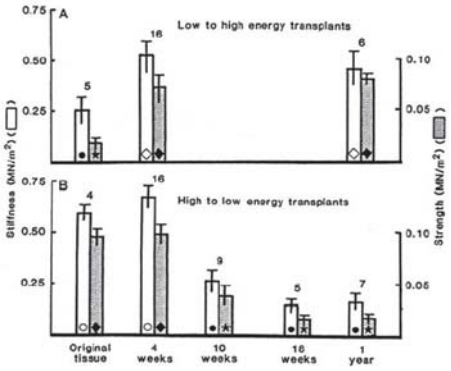
Sponges play with form

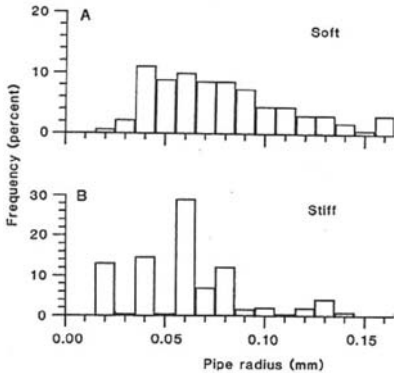


phenotypic plasticity (Palumbi 1984)

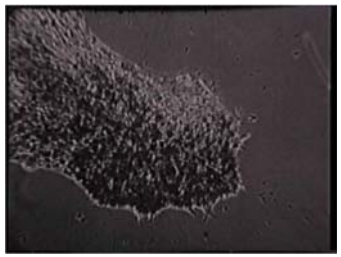


PALUMBI (1984)

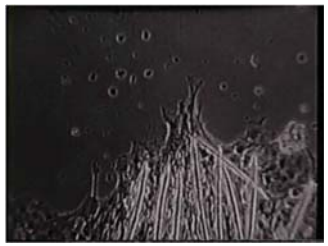




Sponges play with form

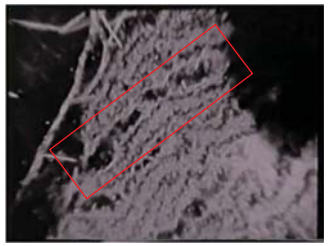


Advancing edge of sponge



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

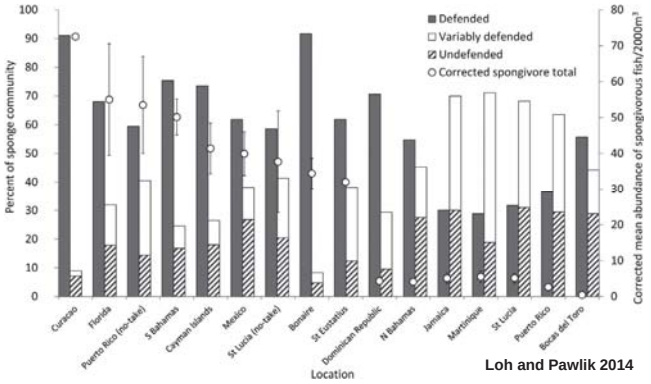


Reconstruction of water channels

Filming speed: 5000x
Choanocytes are brightly lit because they have ingested fluorescent beads

A. Harris, UNC-CH

Sponges play with chemistry: protection



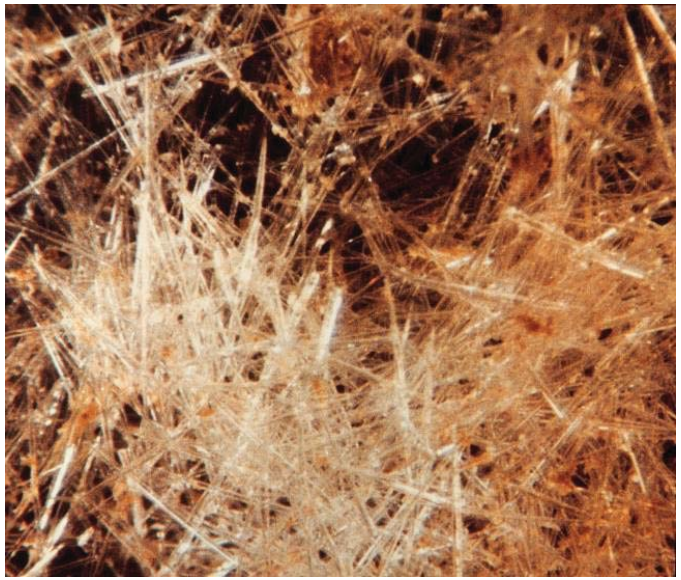
Loh and Pawlik 2014

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*

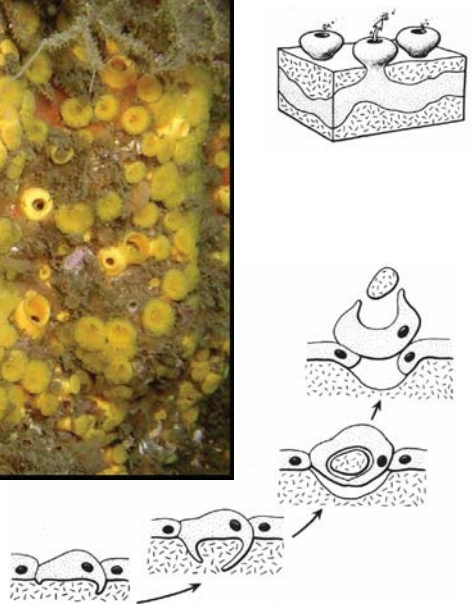
…and with physical defenses



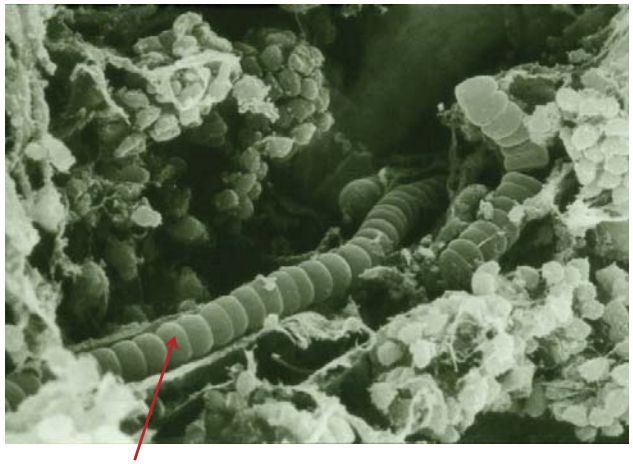
Silica spicules from the stomach of a hawksbill turtle

Sponges play with chemistry: bioerosion

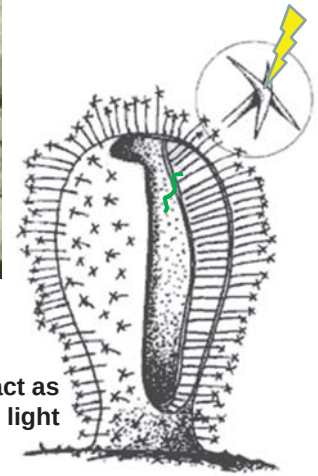
Boring sponge, ***Cliona celata***



Sponges play with light: symbiosis

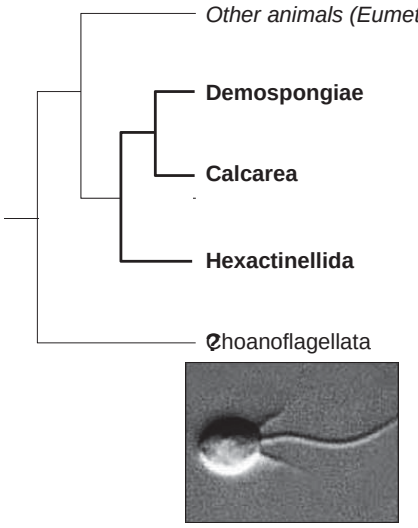


Cyanobacterium symbiont inside sponge tissue



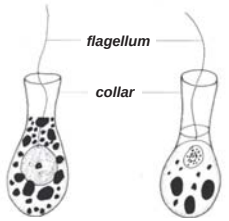
Antarctic sponge *Rossella*: spicules act as "optical fibers" to deliver light

Sponge class characteristics and relationships



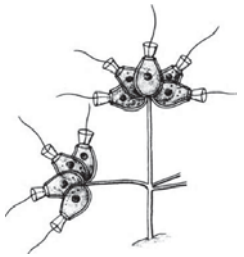
	Grades	Spicule points	Materials	Notes
Demospongiae	*L*	*2 or 3*	*SiO_2 spongin (some)*	*Some freshwater; 95% of sponge species!*
Calcarea	*A,S,L*	*2, 3 or 4*	*$CaCO_3$*	
Hexactinellida	*mostly S*		*SiO_2*	*Syncytial pinacoderm & choanoderm*

your closest non-animal relative

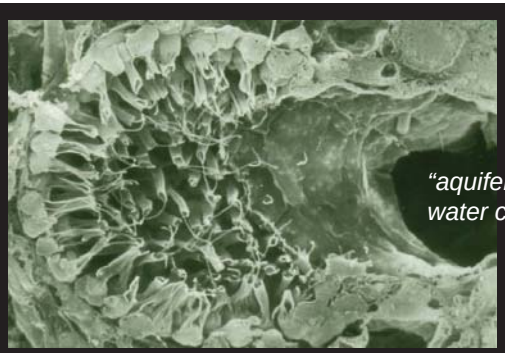


choanocyte

choanoflagellate



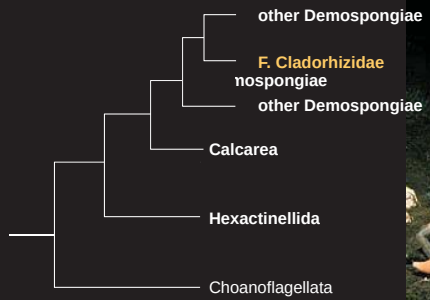
choanoflagellate colony

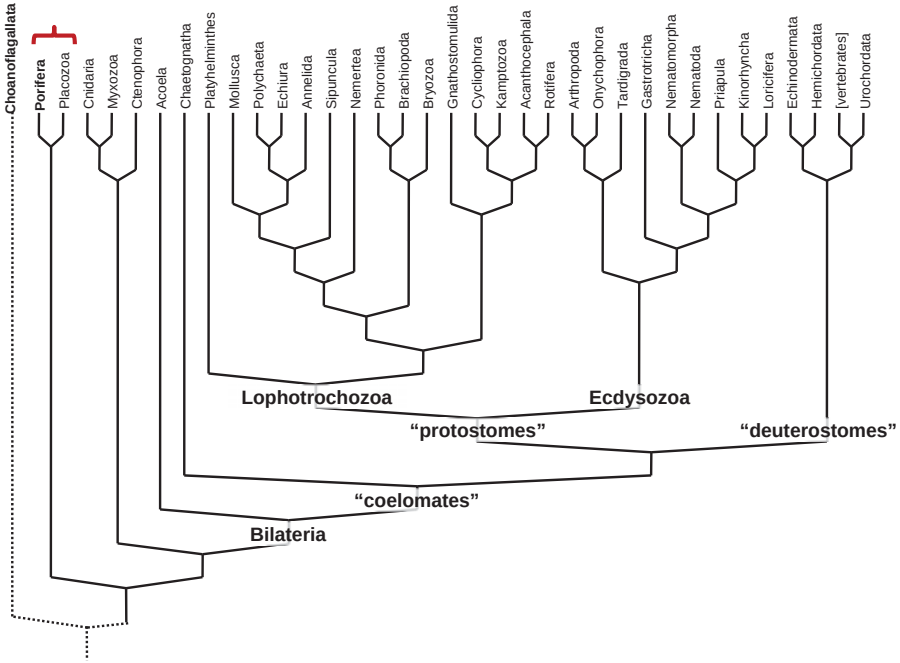


What makes a sponge a sponge?

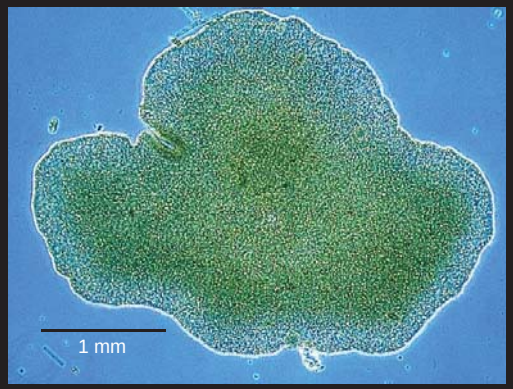
"aquiferous construction"?
water channels and choanocytes

F. Cladorhizidae
carnivorous "sponge"!?
New body plan…
new phylum?





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?**