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Phylum Porifera
-Sponges-

A Caribbean demosponge

Phylum Porifera

- Characteristics of Sponges:
  - Multicellular
  - Heterotrophic
  - No cell Walls
  - Few specialized cells (choanocytes)
  - No germ layers (no gastrulation- no gut)

Phylum Porifera

General Features

- Sessile (immobile) sponges are filter feeders
- Porifera means “pore-bearing”
  - Sac-like bodies with many pores
- Use flagellated “collar cells”, or *choanocytes,* to move water to help filter/feed
- Body is efficient aquatic filter
- Approximately 15,000 species of sponges
  - *Most* are marine
    - Few live in brackish water, 150 in fresh water

Phylum Porifera

Porifera do not have a circulatory, respiratory, excretory system.

Porifera Cell Types: (VOCAB)

•Choanocytes (also known as "collar cells") - sponge's digestive system. Are used to filter particles out of the water. The beating of the choanocytes' flagella creates the sponge's water current.

•Porocytes are cells that make up the pores entering into the sponge's body through the mesohyl (gelatinous non-cellular matrix that holds cells).

•Pinacocytes (pinacoderm), the outer epidermal layer of cells.

•Myocytes are modified pinacocytes which control the size of the osculum and pore openings and thus the water flow.

Phylum Porifera

CELL TYPES CONT

Archaeocytes (or amoebocytes) have many functions; They also have a role in nutrient transport and sexual reproduction, they are cells which can transform into: :

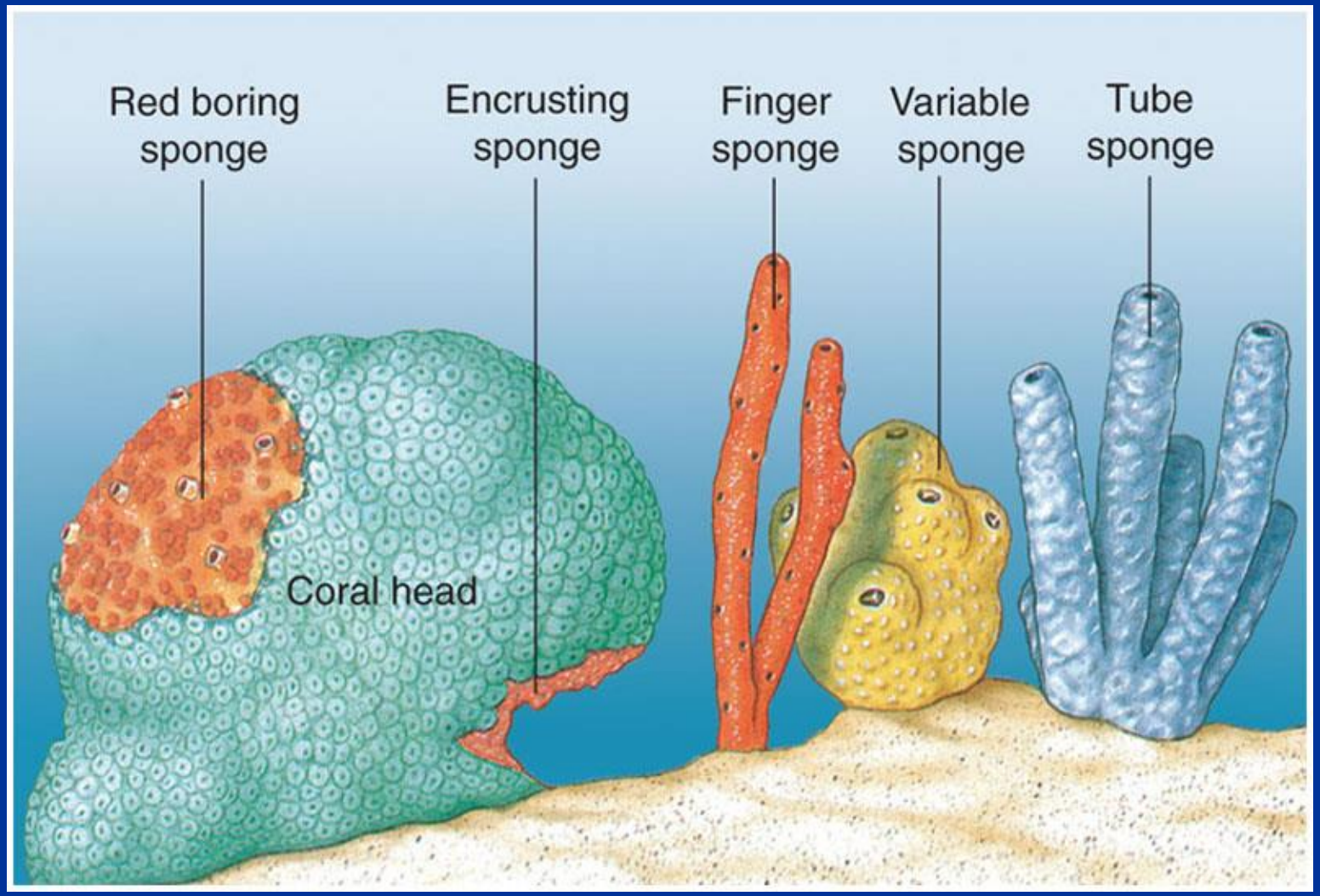
Sclerocytes secrete calcareous siliceous (silicon/oxygen based) spicules which reside in the mesohyl.

Spongocytes secrete spongin; fibers which make up the mesohyl.

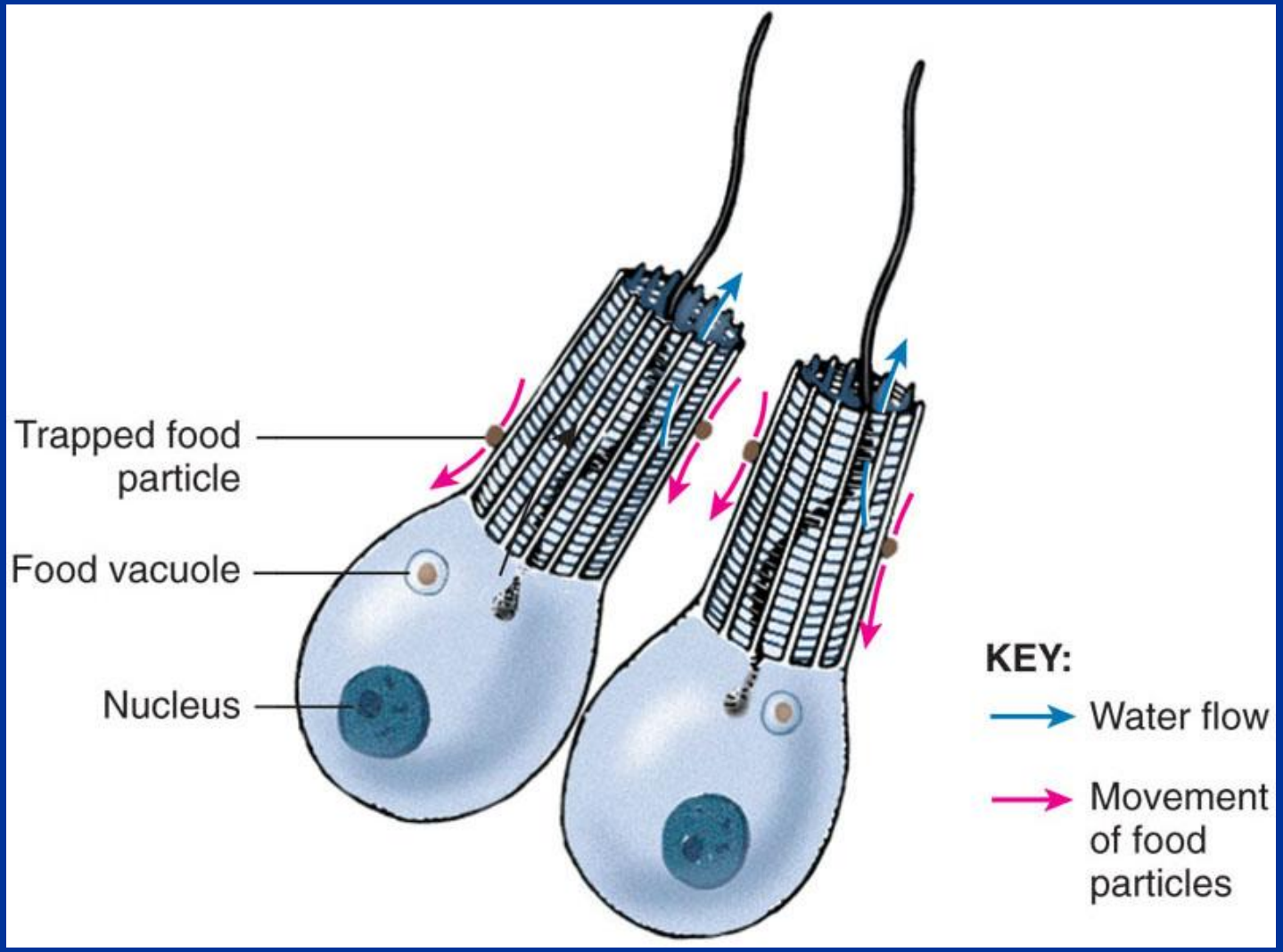
Collencytes secrete collagen.

Spicules are stiffened rods or spikes made of calcium carbonate or silica which are used for structure and defense.

Sessile Sponges - do not move



Collar of microvilli surrounding a flagellum. Flagellum beats drawing water containing food through the collar.



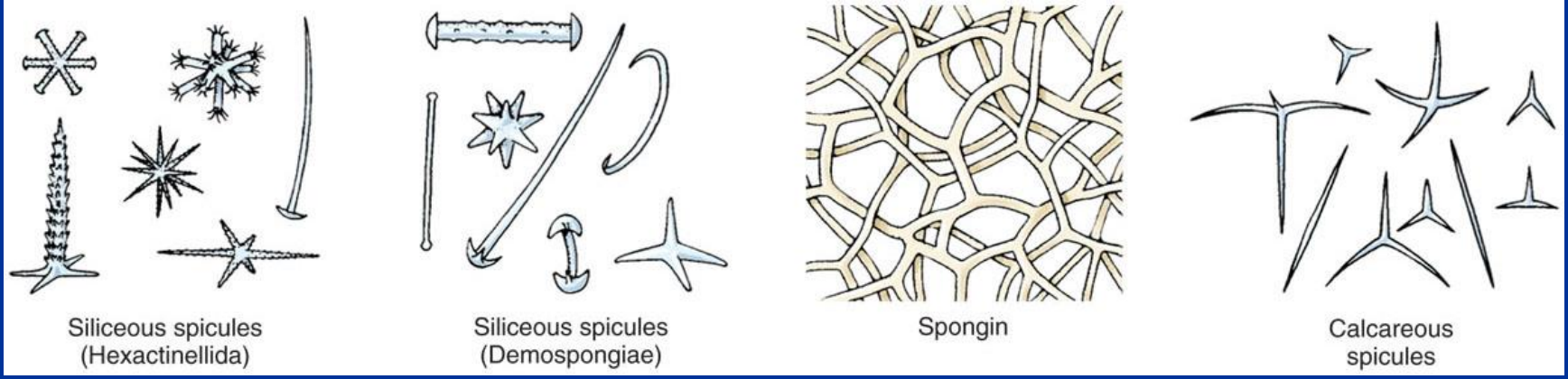
Phylum Porifera

- Marine sponges found in all seas at all depths and vary greatly in size
- Many species are brightly colored because of pigments in dermal cells
- ***Embryos*** are free-swimming, ***adult sponges*** always attached
- Irregular shaped

Phylum Porifera

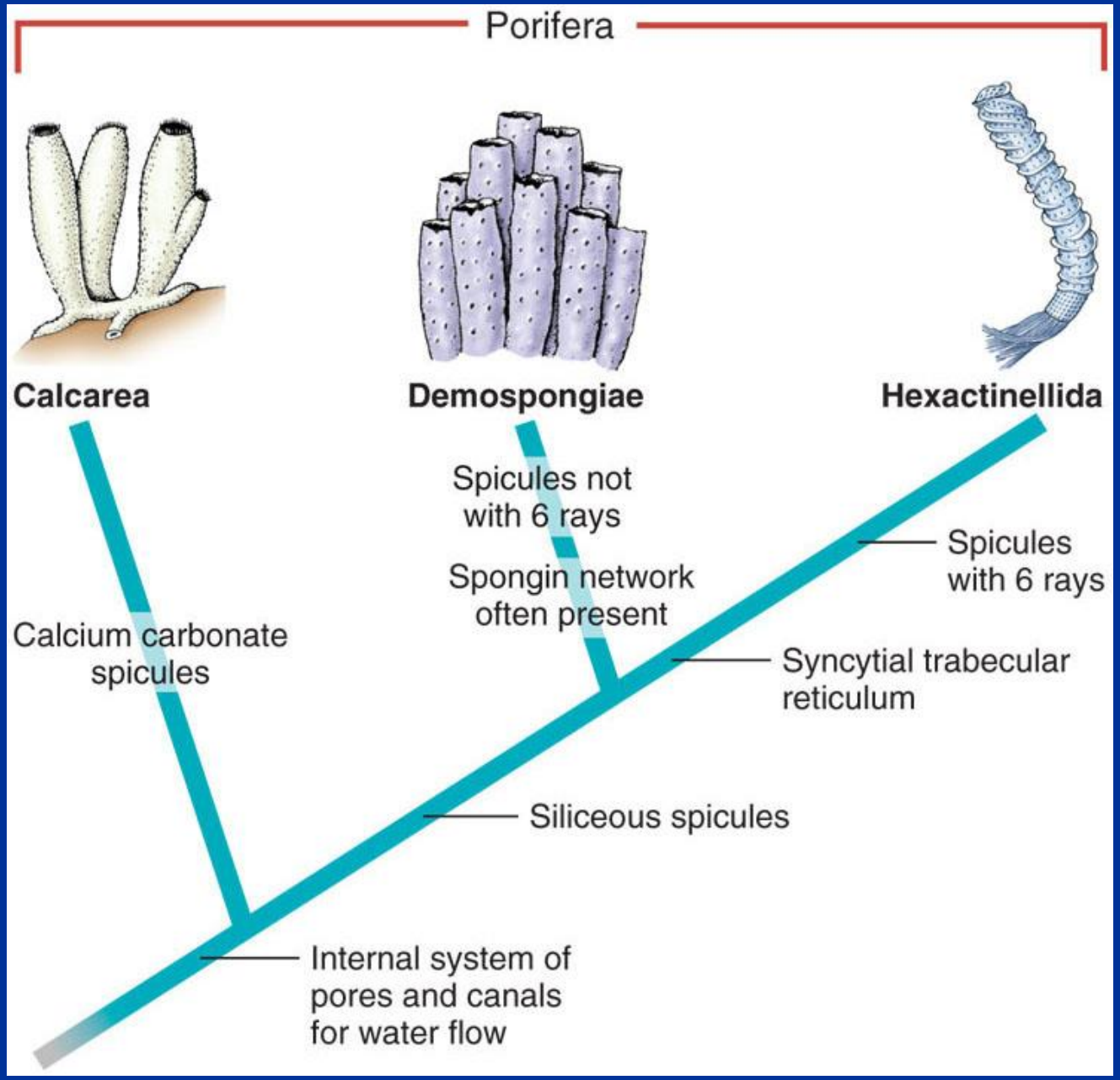
- Skeletal structure of a sponge can be ***fibrous and rigid***
  - Rigid skeleton consists of ***spicules***
  - Fibrous portion consists of ***spongin***
  - **Sponge Classification** is based on the composition and shape the spicules

Skeletal Structures of Sponges



Phylum Porifera

- ***Fossil record*** **of sponges dates back to the** ***early Cambrian (540 mya)***
- **Living sponges traditionally assigned to 3 classes:** ***Calcarea, Hexactinellida, and Demospongiae***


Porifera
Calcarea
Demospongiae
Hexactinellida
Spicules not with 6 rays
Spongin network often present
Spicules with 6 rays
Calcium carbonate spicules
Syncytial trabecular reticulum
Siliceous spicules
Internal system of pores and canals for water flow

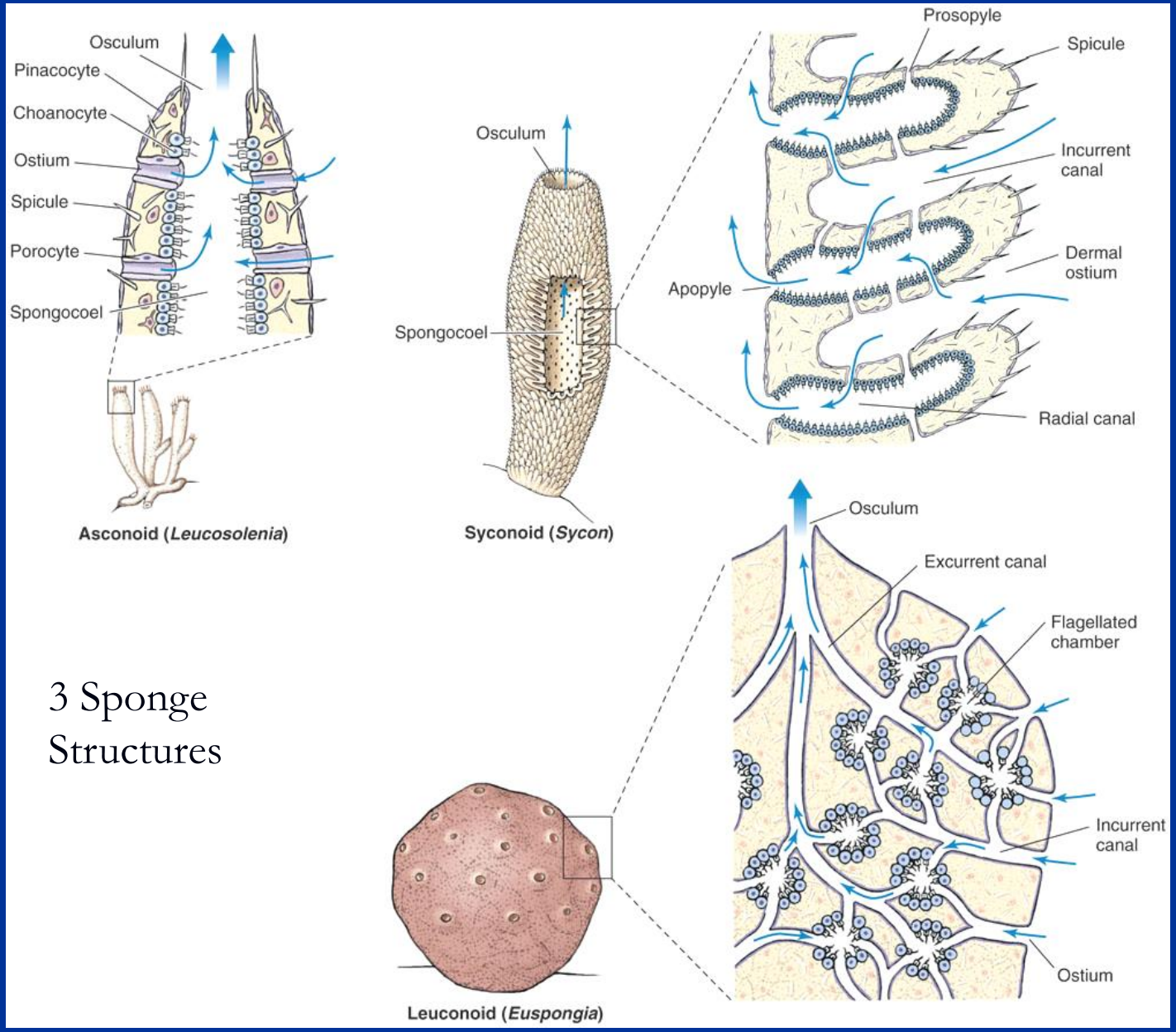
Phylum Porifera

Form and Function

- Body openings consist of small incurrent pores or dermal ostia (In), and the osculum (Out)
- Incurrent pores: Average diameter of 50 μm
- Inside the body
  - Water is directed past the choanocytes where food particles are collected
  - Choanocytes (flagellated collar cells) line some of the canals
    - Keep the current flowing by beating of flagella
    - Trap and phagocytize food particles passing by

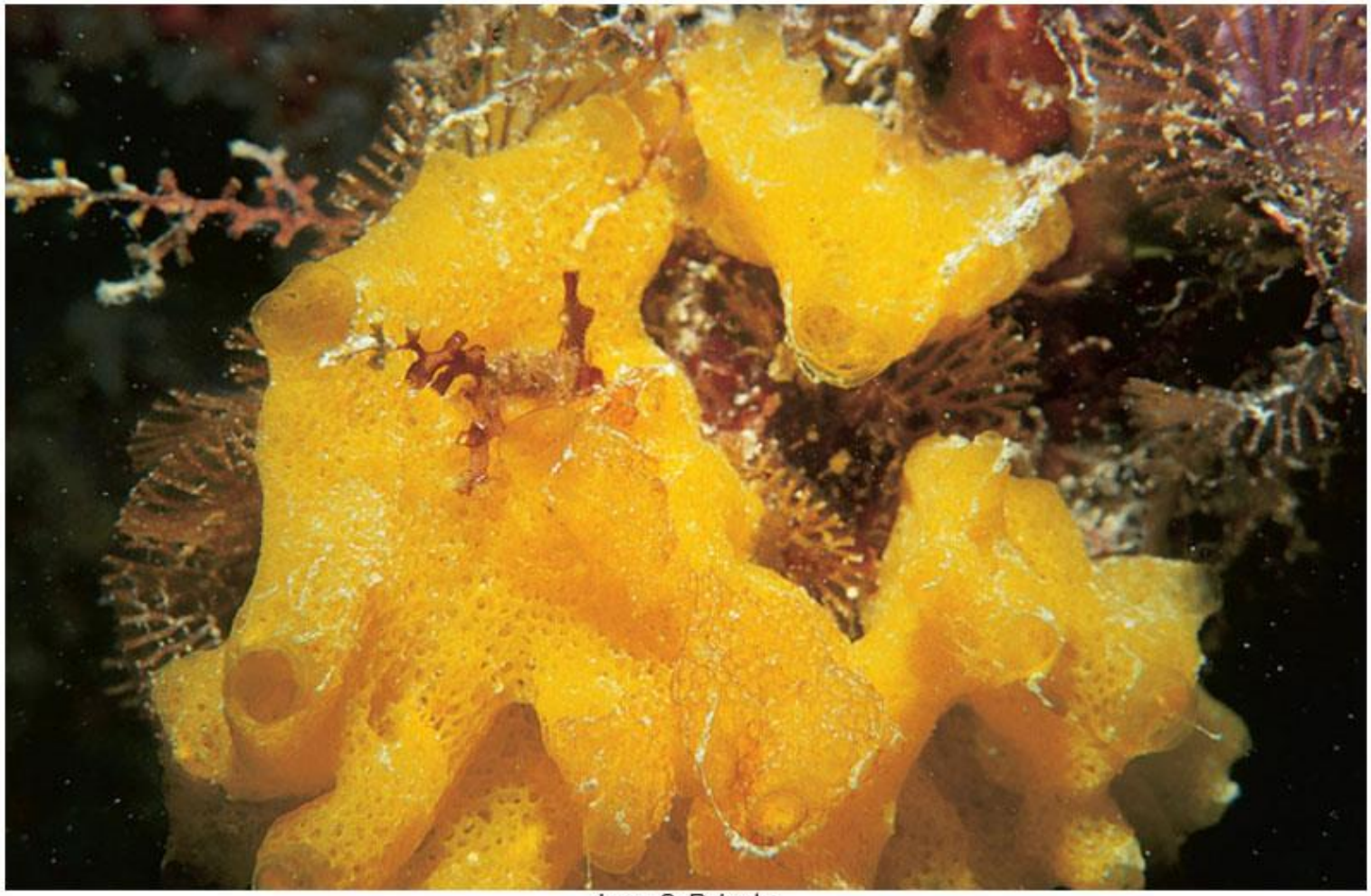
Phylum Porifera

- ***Types of Canal Systems***
  - **Asconoids: Flagellated Spongocoels**
    - ***Simplest* body form**
    - **Small and tube-shaped**
    - **Water enters into a large cavity, the spongocoel**
      - **Lined with *choanocytes***
      - **Choanocyte flagella pull water through**
      - **All Calcarea are asconoids**



3 Sponge Structures

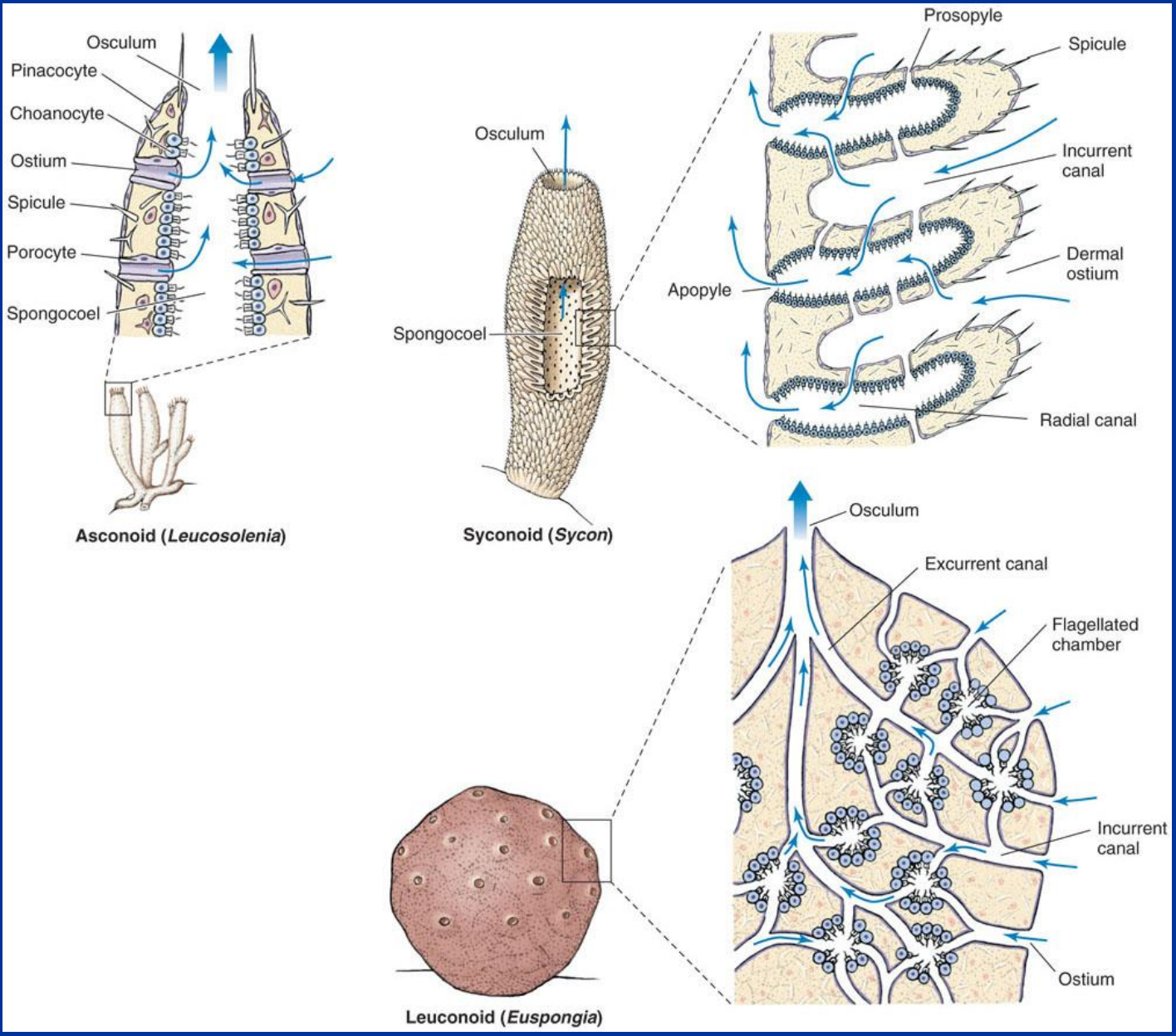
Calcarea Sponge



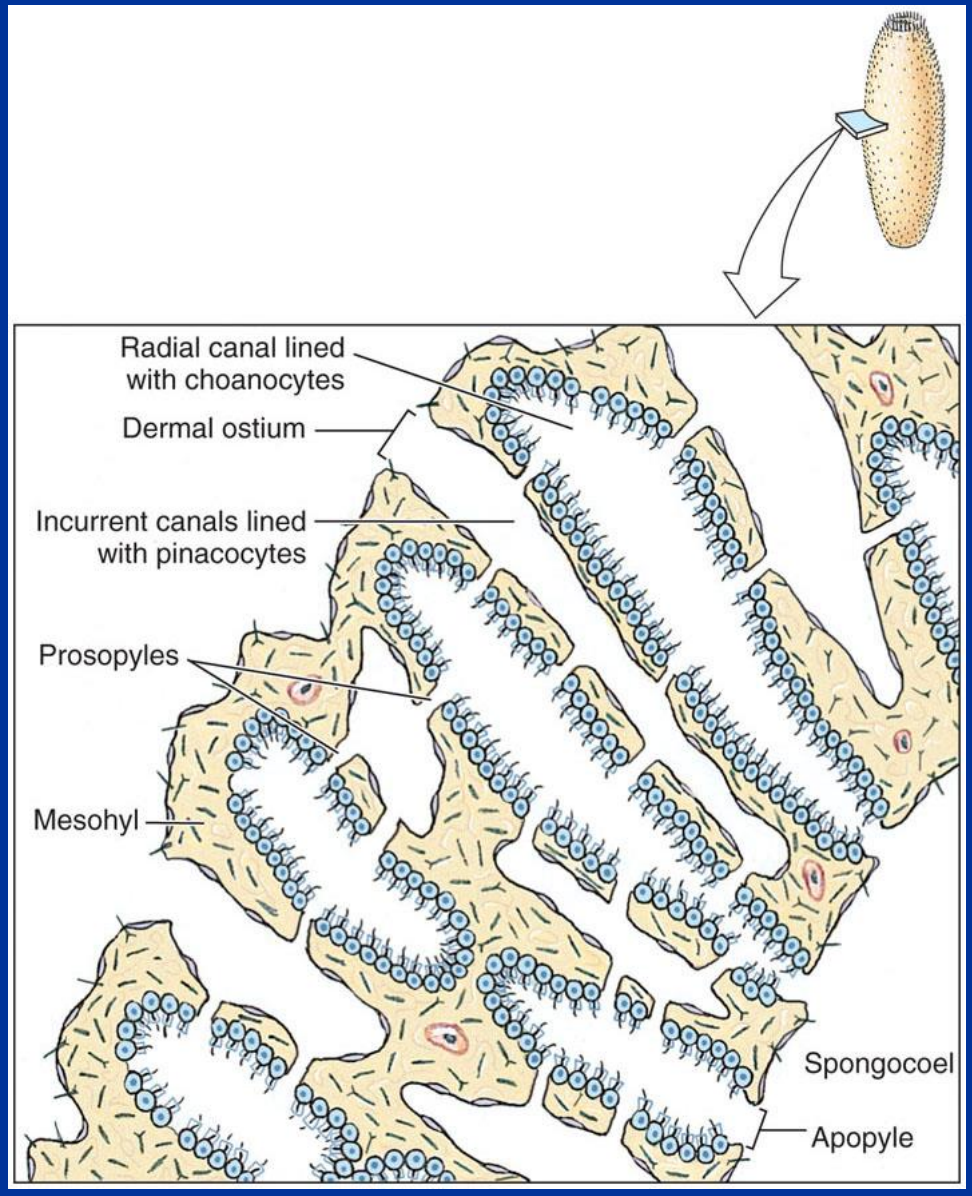
Larry S. Roberts

Phylum Porifera

- **Syconoids: Flagellated Canals**
  - Resemble asconoids but ***larger with a thicker body wall***
  - Wall contains ***choanocyte-lined radial canals*** that empty into ***spongocoel***
    - Water enters radial canals through tiny openings
  - ***Spongocoel*** is lined with epithelial cells rather than choanocytes
  - Food is digested by ***choanocytes*** - ***in radial canals***
  - Flagella draw water through ***internal pores*** in the spongocoel and out the osculum
  - Classes Calcarea and Hexactinellida have syconoid species (ex: ***Sycon***)


Osculum
Pinacocyte
Choanocyte
Ostium
Spicule
Porocyte
Spongocoel
Asconoid (Leucosolenia)
Osculum
Spongocoel
Syconoid (Sycon)
Prosopyle
Spicule
Incurrent canal
Dermal ostium
Apopyle
Radial canal
Osculum
Excurrent canal
Flagellated chamber
Incurrent canal
Ostium
Leuconoid (Euspongia)

Cross Section of Sycon



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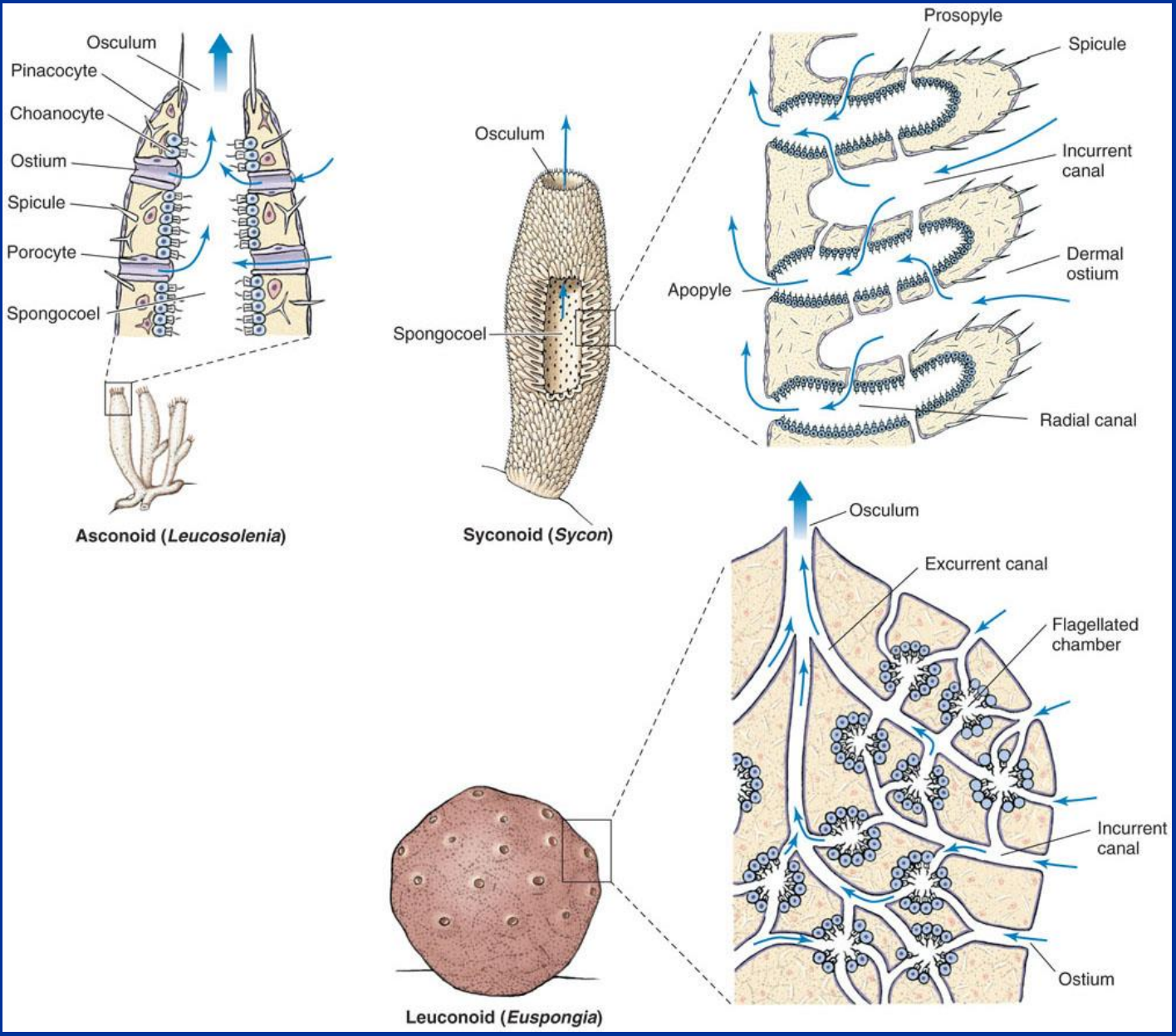
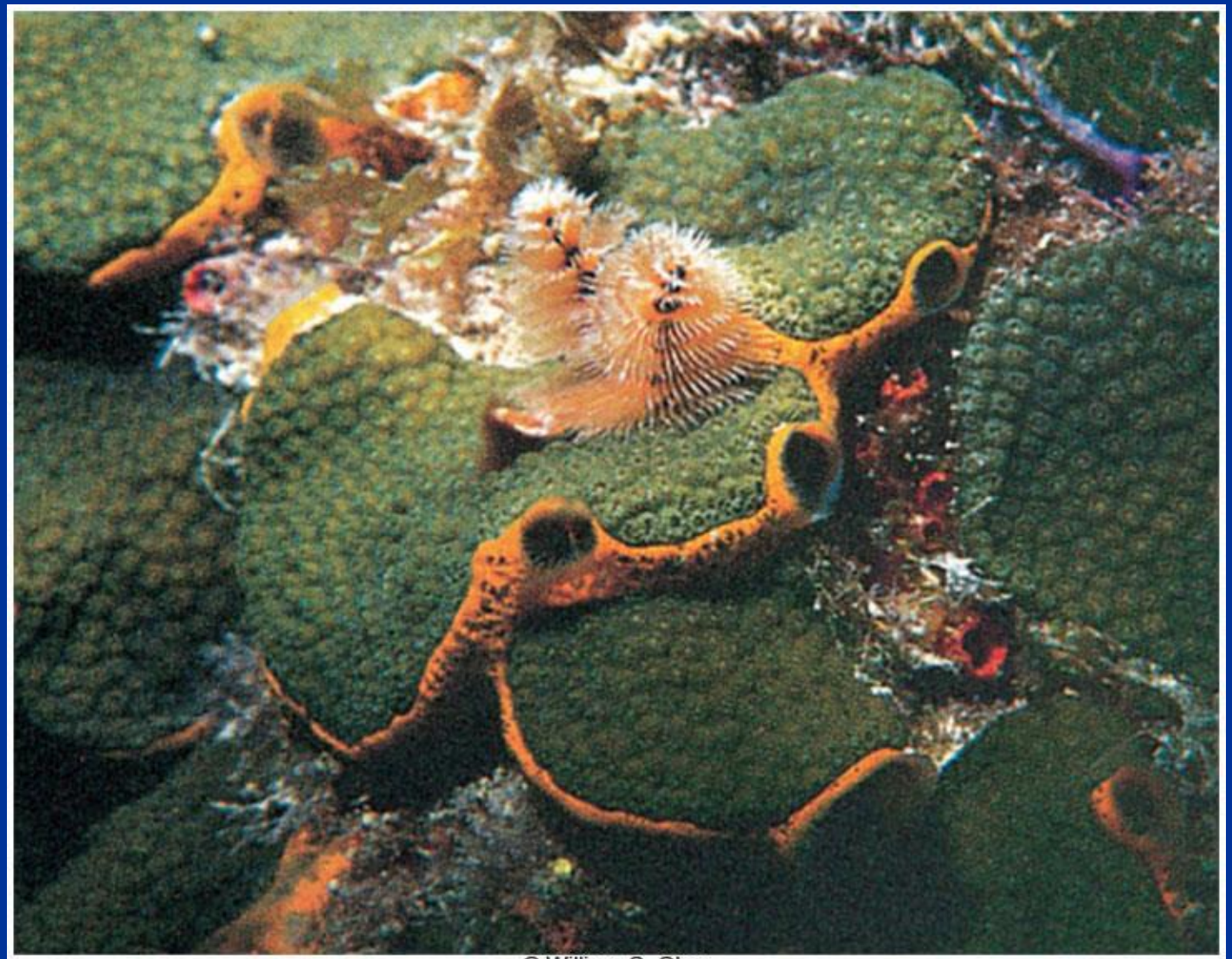
- ***Leuconoids:*** **Flagellated Chambers**
  - ***Most complex*** **and are larger with many oscula**
  - ***Clusters of flagellated chambers*** **are filled from incurrent canals, and discharge to excurrent canals**
  - **Most sponges are leuconoid**
  - **System increases flagellated surfaces compared to volume**
    - **More collar cells can meet food demands**
    - **Large sponges filter 1500 liters of water per day**


Osculum
Pinacocyte
Choanocyte
Ostium
Spicule
Porocyte
Spongocoel
Asconoid (Leucosolenia)
Osculum
Spongocoel
Syconoid (Sycon)
Prosopyle
Spicule
Incurrent canal
Dermal ostium
Apopyle
Radial canal
Osculum
Excurrent canal
Flagellated chamber
Incurrent canal
Ostium
Leuconoid (Euspongia)

Orange Desmosponge - leuconoid canal system



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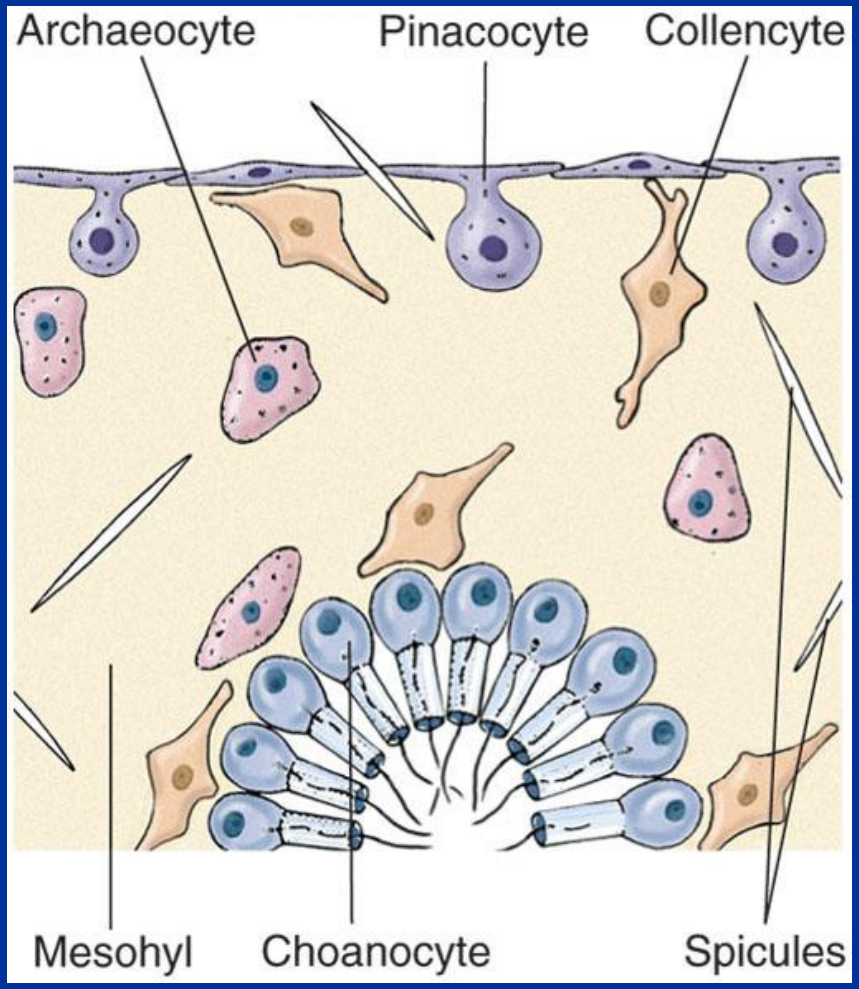
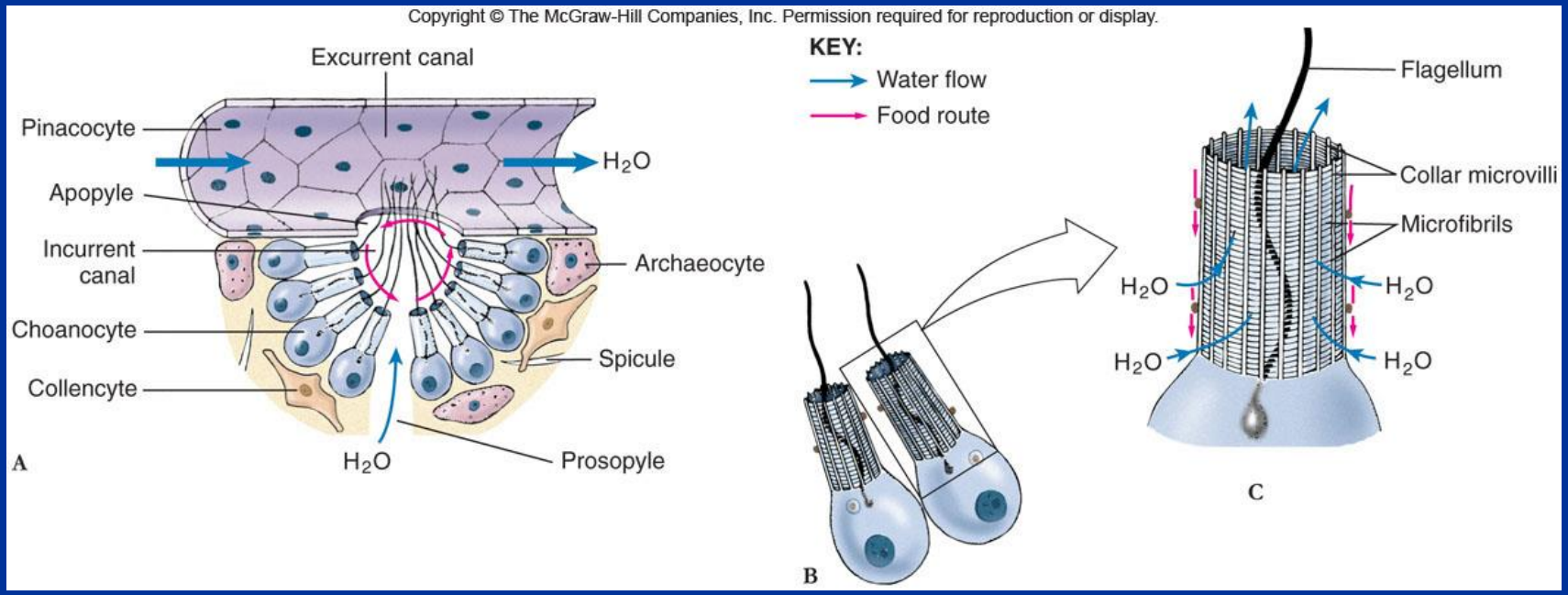
Phylum Porifera

- ***Types of Porifera Cells***



Food Trapping by Sponge Cells



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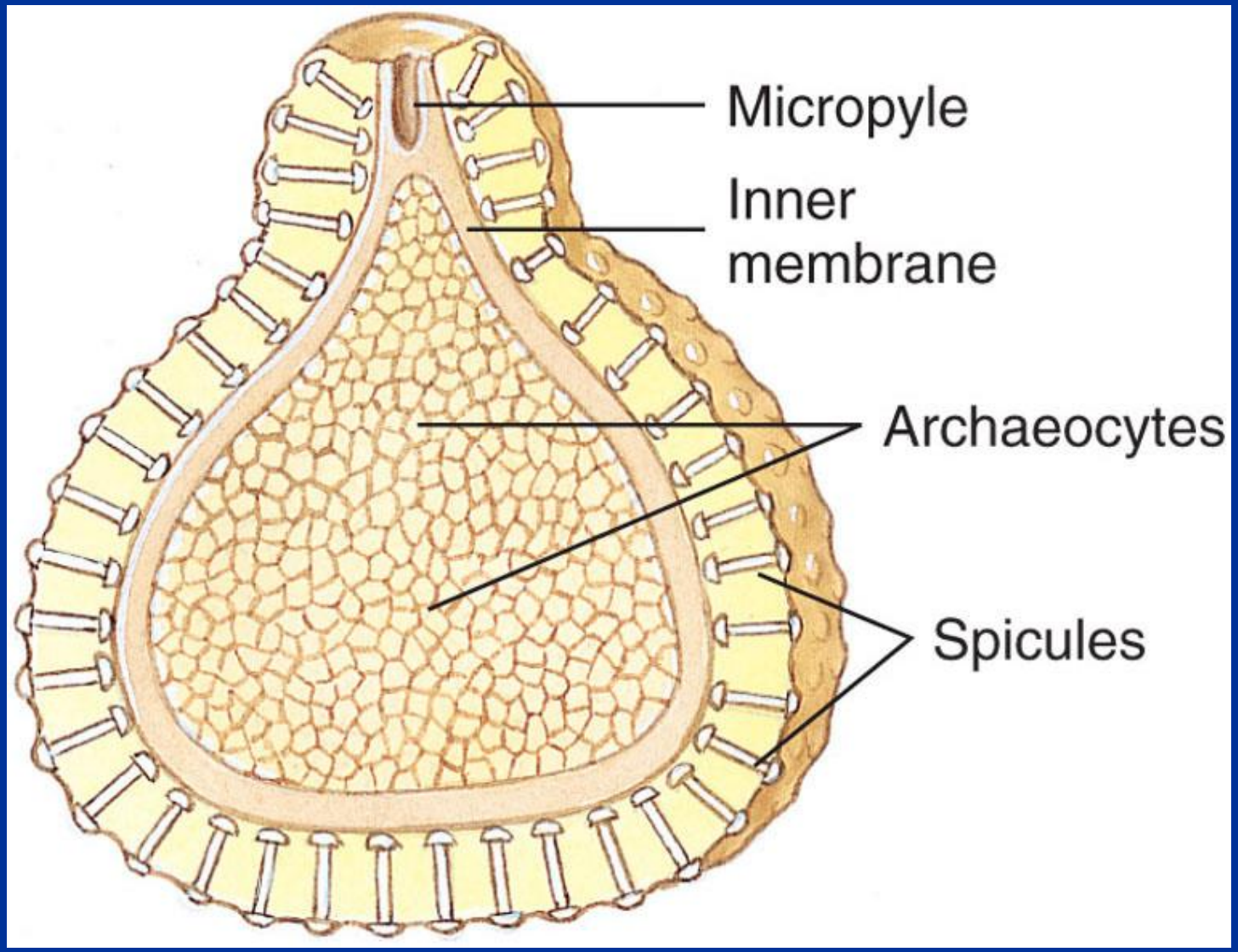
- ***Cell Independence: Regeneration***
  Sponges have a great ability to regenerate lost parts and repair injuries
  - **Regeneration following fragmentation is one means of asexual reproduction**

Phylum Porifera

- Asexual reproduction can occur by ***bud formation***
  - ***External buds***
    - Small individuals that break off after attaining a certain size
  - ***Internal buds or gemmules***
    - Formed by archaeocytes that collect in mesohyl
    - Coated with tough spongin and spicules
    - Survive harsh environmental conditions

Gemmule- Internal Bud



Phylum Porifera

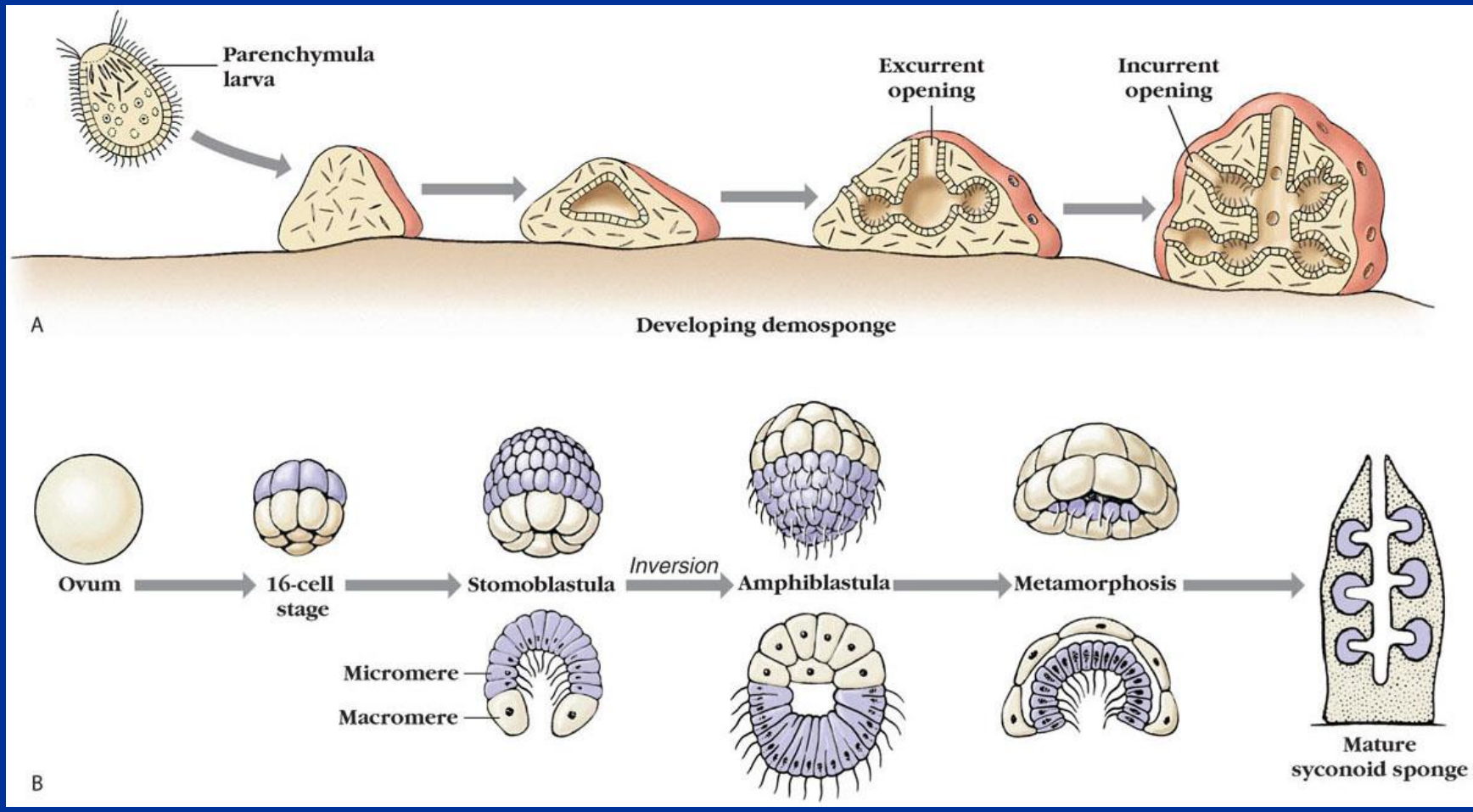
- ***Sexual Reproduction***
  - **Most are *monoecious (have both sexes)***
  - **Sperm and eggs sometimes arise from *choanocytes or archaeocytes***

Phylum Porifera

- In some, one sponge releases sperm which enter the pores of another sponge
- Sponges provide nourishment to zygote until it is released as a ciliated larva
- Some sponges release both sperm and oocytes into water
- The ***free-swimming larva*** of sponges is a solid ***parenchymula***

A. Development of Demosponge

B. Development of Calcareous syconoid sponge



Phylum Porifera

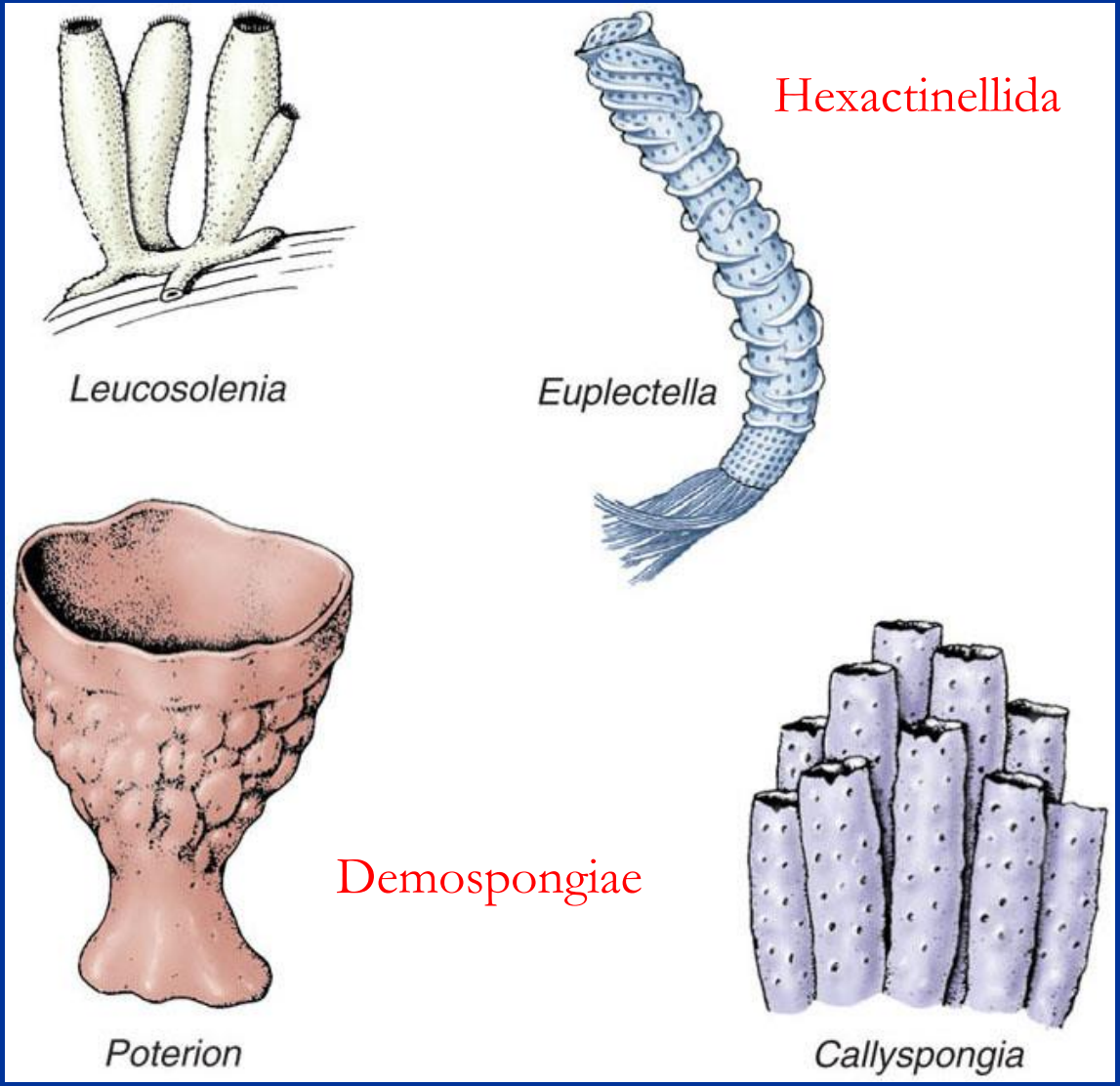
- Classification
  - Class Calcarea
  - Class Hexactinellida
  - Class Demospongiae

Phylum Porifera

Class Calcarea (Calcispongiae)

- BONY Sponges
- spicules are made of calcium carbonate
- *Spicules* are straight or have three or four rays
- Most are small with tubular or vase shapes
- Many are drab in color, but some are bright yellow, green, red, or lavender
- *Example: Sycon* are marine shallow-water
- *Asconoid, syconoid and leuconoid* body forms found in class

Calcarea

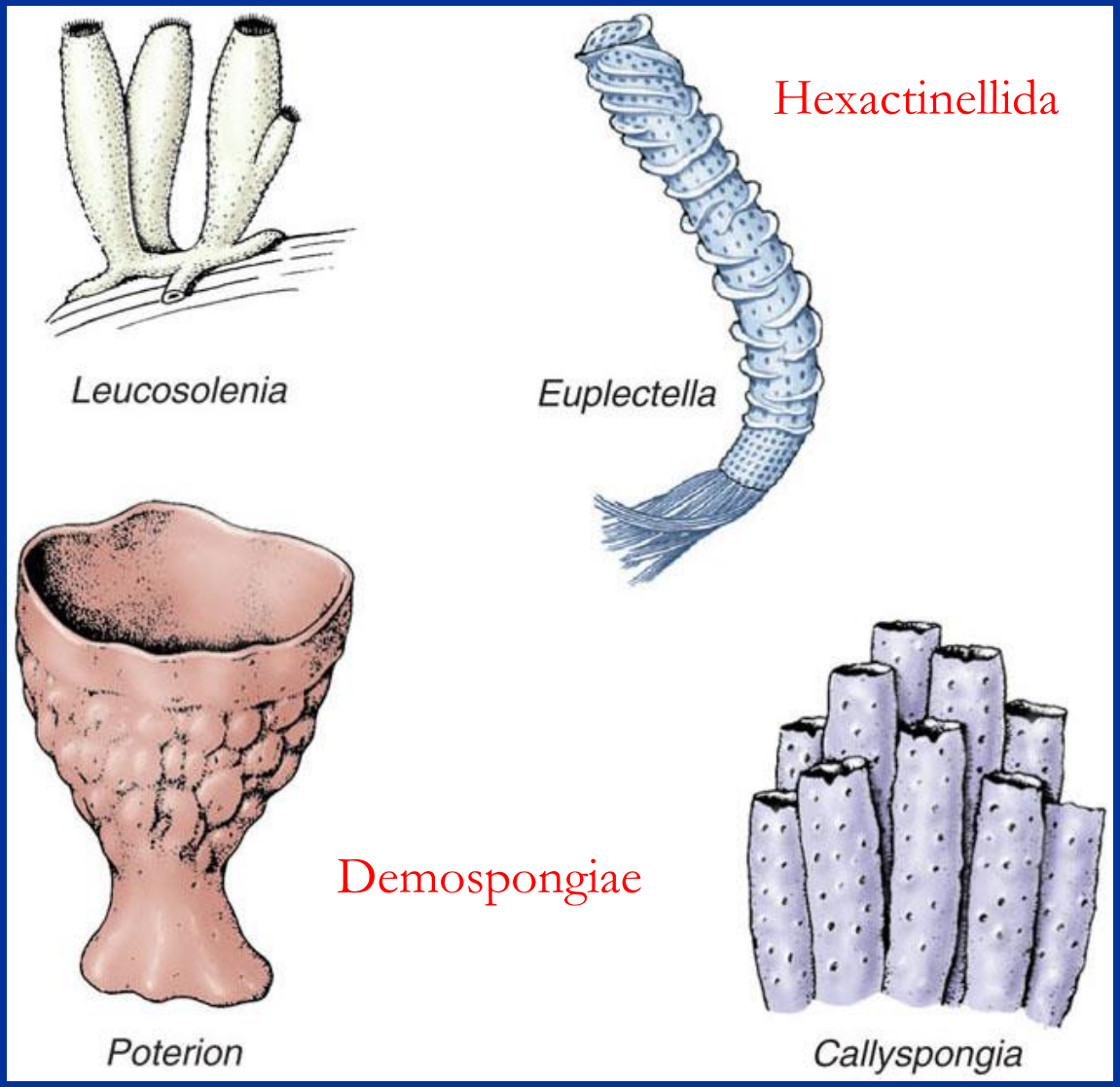

Leucosolenia
Hexactinellida
Euplectella
Demospongiae
Poterion
Callyspongia

Phylum Porifera

Class Hexactinellida

- Glass sponges with six-rayed spicules of silica to form their skeleton
- Strong Internal skeleton with fused spicules
- Nearly all are deep-sea forms, cup shaped
- Syconoid and Leuconoid body plans

Calcarea


Hexactinellida
Leucosolenia
Euplectella
Demospongiae
Poterion
Callyspongia

Phylum Porifera

Class Demospongiae

- Contains *95% of living sponge species*
- *Spicules* or skeletal system contains *spongin*
- *Leuconoid* body form
- All marine except for Spongillidae, the freshwater sponges
- *Freshwater sponges*
  - Widely distributed in well-oxygenated ponds and springs
  - Flourish in summer and die in late autumn
  - Leave behind gemmules
  - Reproduce sexually, but existing genotypes may also reappear annually from gemmules

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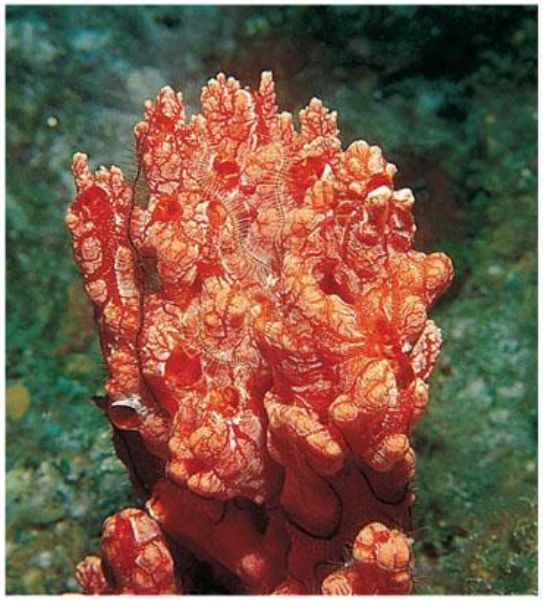
- Marine Demosponges
  - Highly varied in color and shape
- Bath sponges
  - Lacks siliceous spicules
  - Have spongin skeletons

Sponges in Class Demospongiae

A

B



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A-C: Larry S. Roberts; B: © William C. Ober

Phylum Porifera

- **Uses:**
  - ***Dolphins attach sponge to nose, then search for food in sand. Serves as a protection.***
  - ***Humans - commercial sponges, washing***
  - ***Medicinal purposes?? Antimicrobial compounds found on sponges***