

Chapter 4

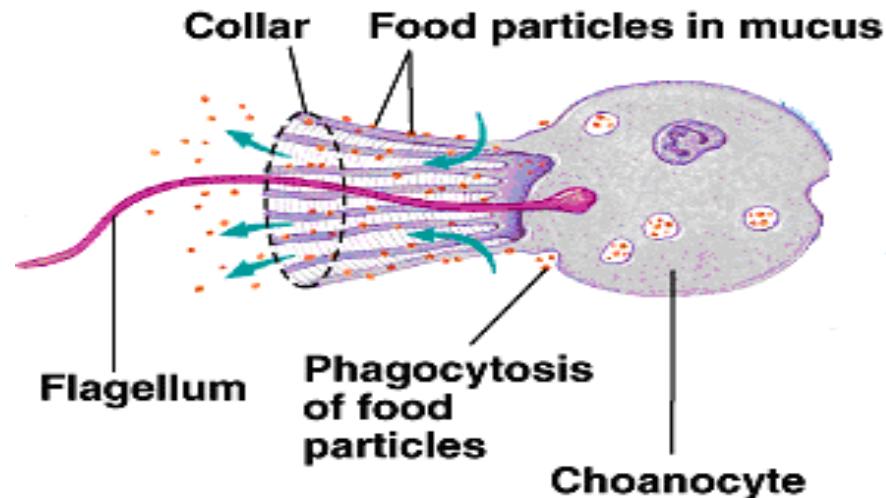
Phylum Porifera

(The Sponges)

Kingdom Animalia

Phylum Porifera

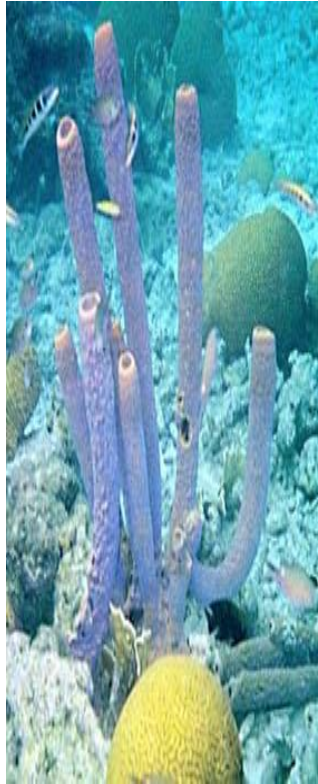
- ▶ **Porifera: (L) = Pori: pore**
- ▶ **Fera: bearing**
- ▶ **Defining Characteristic:**
 - *Microvillar collars surround flagella of choanocytes that could be in the form of single cells or syncytia.*



General Characteristics:

- ▶ The simplest multicellular animals (**metazoans**).
- ▶ Aquatic organisms: **98% marine, 2% freshwater**
(No terrestrial).
- ▶ > 7000 species.
- ▶ **Lack systems** (and organs): like nervous, digestive, respiratory, reproductive...
- ▶ **Sessile** (lack the ability of movement).

Sponge diversity:

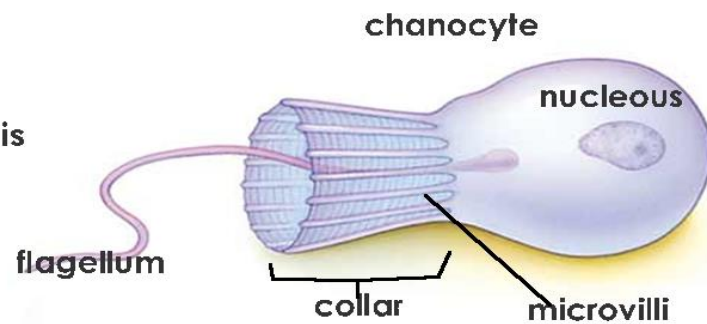
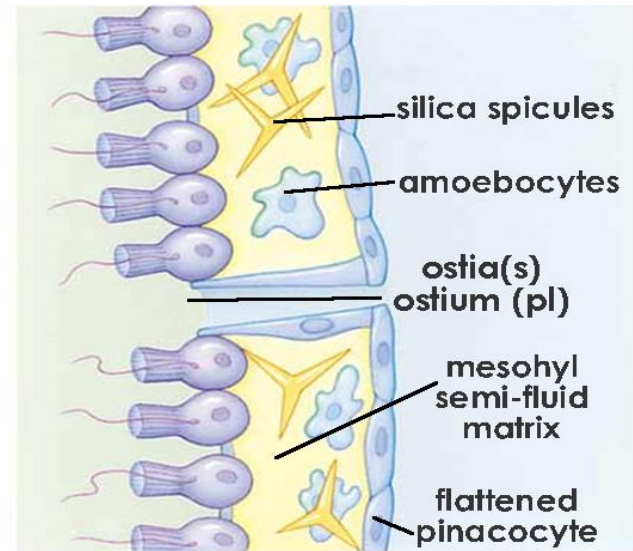
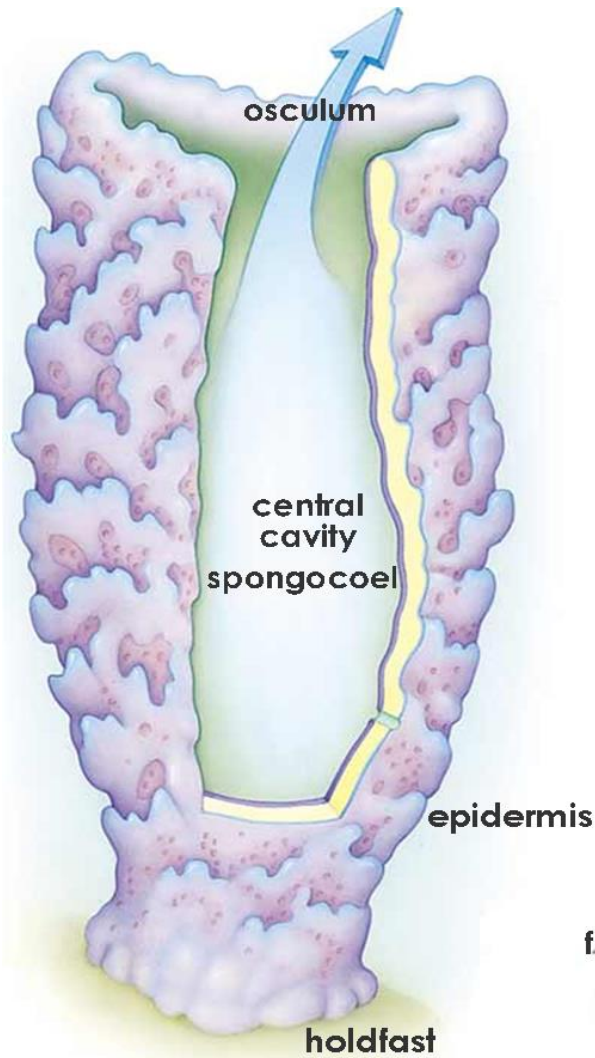


- ▶ **Feeding:** sponges are **suspension-feeders** (filter-feeders): feed on particles suspended in water.
- ▶ **Shape:** Poriferans are often **amorphous** and **asymmetrical** (with few exceptions).
- ▶ Lack anything corresponding to anterior, posterior or oral surfaces.
- ▶ **Have only few different cell types** that are **almost functionally independent**.
- ▶ Body of a sponge is typically like a **fairly rigid, perforated bag**.

- ▶ The empty space of the bag (sponge) is called **Spongocoel**.
- ▶ **Water enters** the spongocoel through numerous, narrow pores in the sponge wall called **Ostia** and leaves through larger openings (1–many) called **Oscula**.
- ▶ Few sponges can reach **1 m in diameter** or height, although the size of most sponges is usually much less than that.



Sponge body plan (simple ascon)



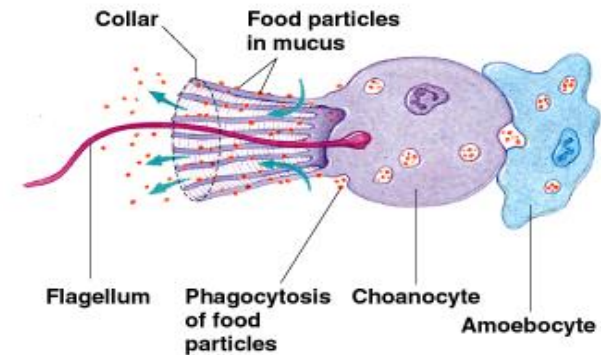
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Cell types of sponges:

A) Choanocytes (funnel–cells) or the **Collar cells**: *flagellated cells that surround the spongocoel.*

► **Functions of Choanocytes:**

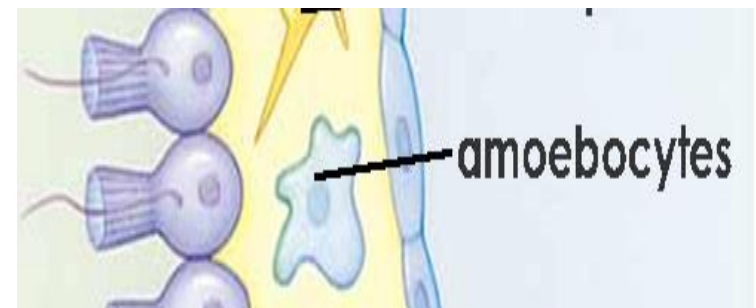
- 1) **Capture small food particles.**
- 2) **Capture incoming sperms** for fertilization.
- 3) Generate **water currents** within and through the sponge.



B) Archaeocytes (Amoebocytes): *amorphous, amoeboid cells that are found in a dead gelatinous layer called mesohyl. (Meso: middle, hyl: matter)*

Functions of Archaeocytes:

- 1) **Digestion of food** particles captured by Choanocytes.
- 2) **Storage of digested food** material.
- 3) May **give rise to sperms** (flagellated) and **eggs**.



- 4) Probably play an active role in **non-self-recognition** reactions.
- 5) **Eliminate wastes.**
- 6) Can become **specialized to secrete the supporting elements** located in the mesohyl layer.
- 7) May **give rise to Gemmules** in some sponges.

c) Pinacocytes: *form the outer, epithelial-like layer; composed of flattened contractile cells.*

Functions of Pinacocytes:

- 1) Form an epithelial-like layer called **pinacoderm**.
- 2) Line the incurrent canals (**Ostia**) and the spongocoel in places where choanocytes are lacking.
- 3) **Contract** to enable the sponge to undergo minor shape changes.
- 4) **Regulate water flow** through the ostia by changing its diameter.

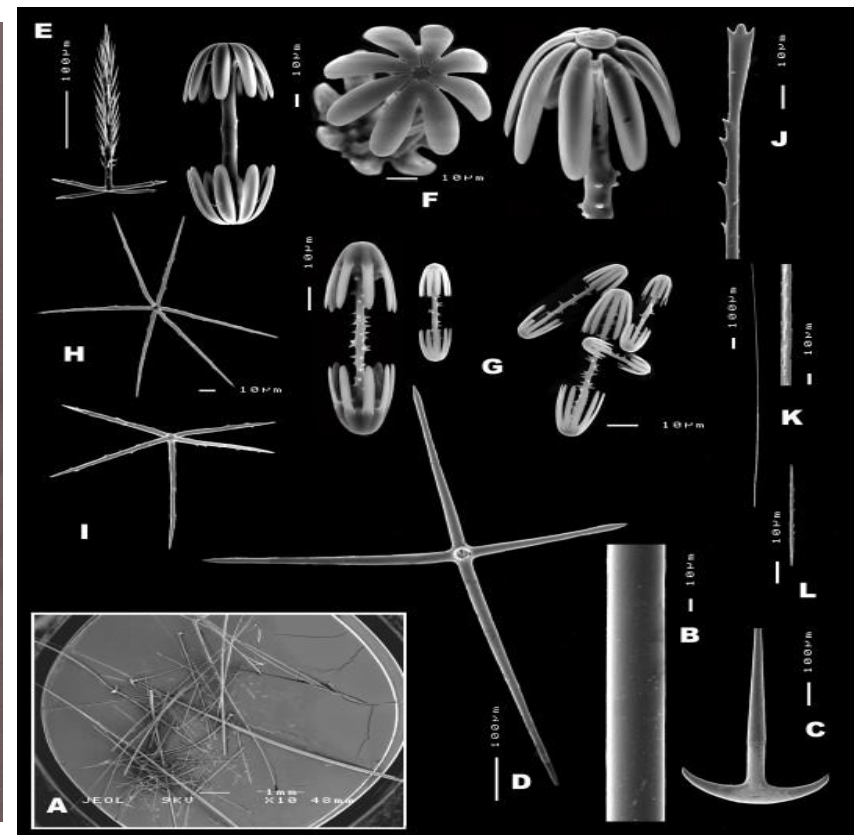
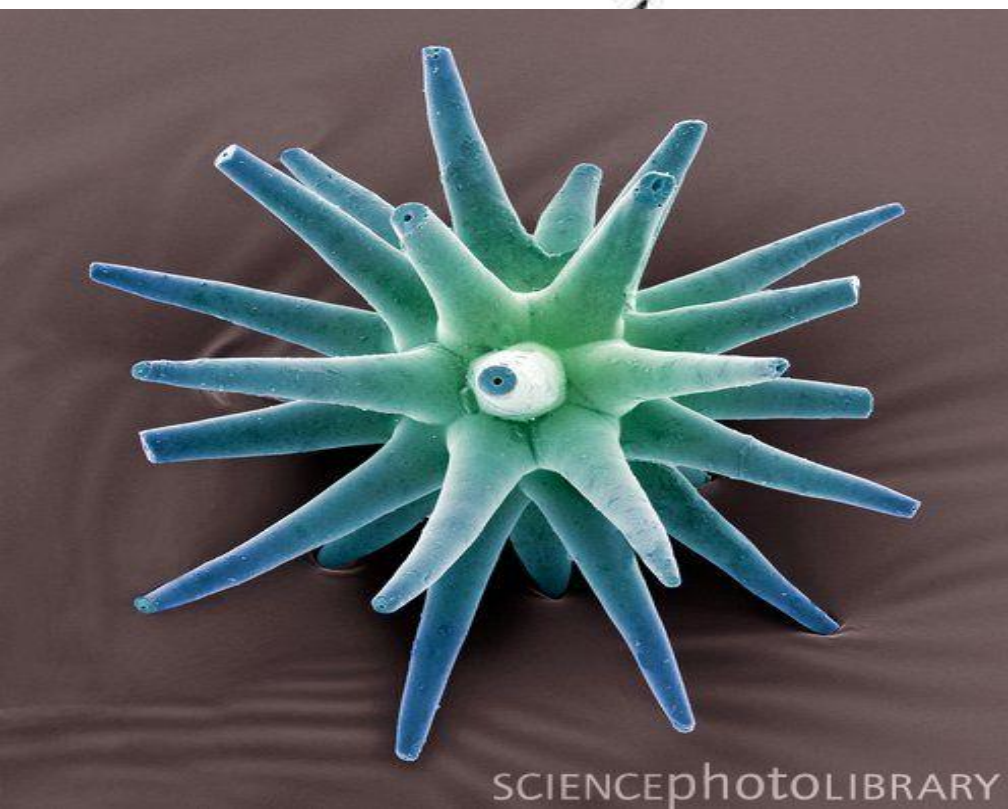


Sponge supporting elements:

Types of Supporting Elements:

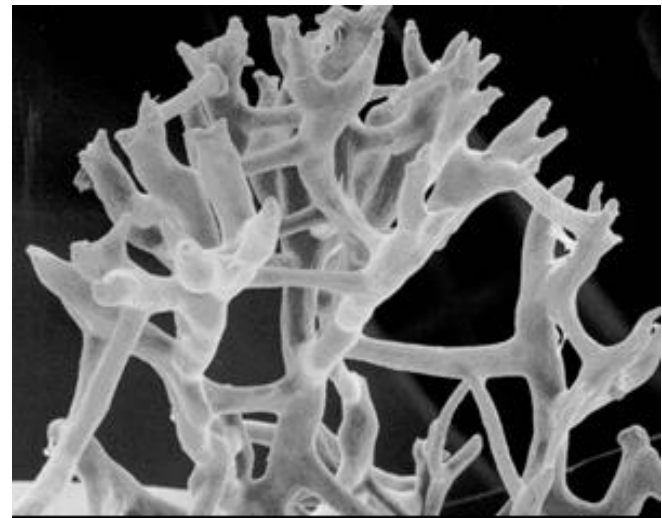
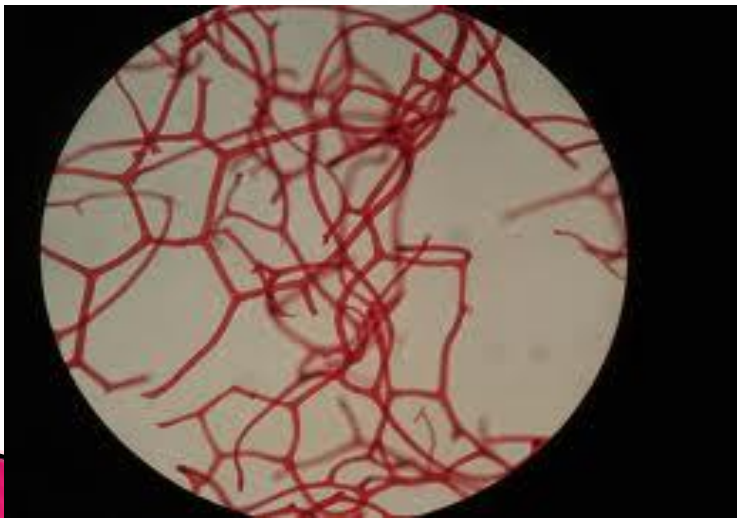
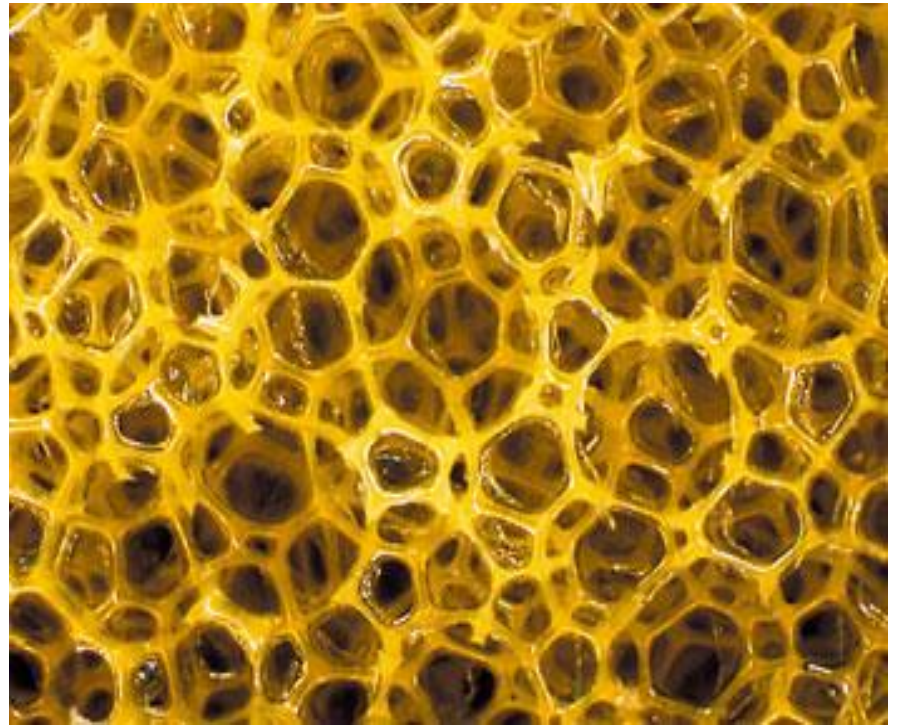
1) Spicules:

- Could be **siliceous or calcareous**.
- Secreted by special archaeocyte cells called **Sclerocytes**.
- Have **different shapes**.
- **Help in classification** of sponges.
- **Maintain shape** of a sponge.
- **Discourage predation**.



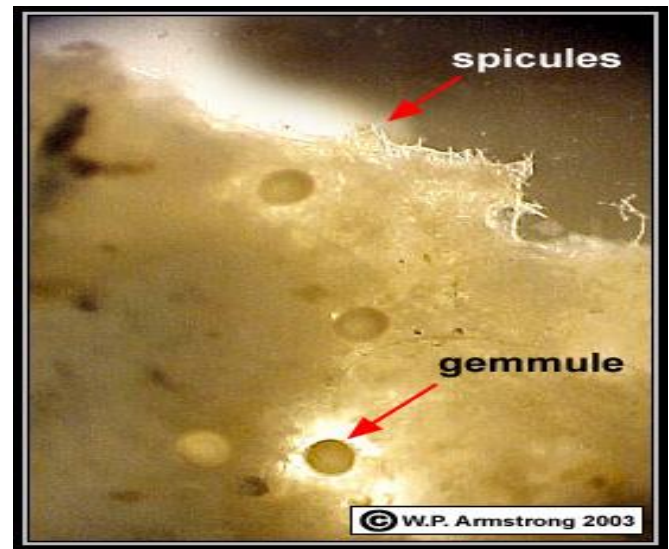
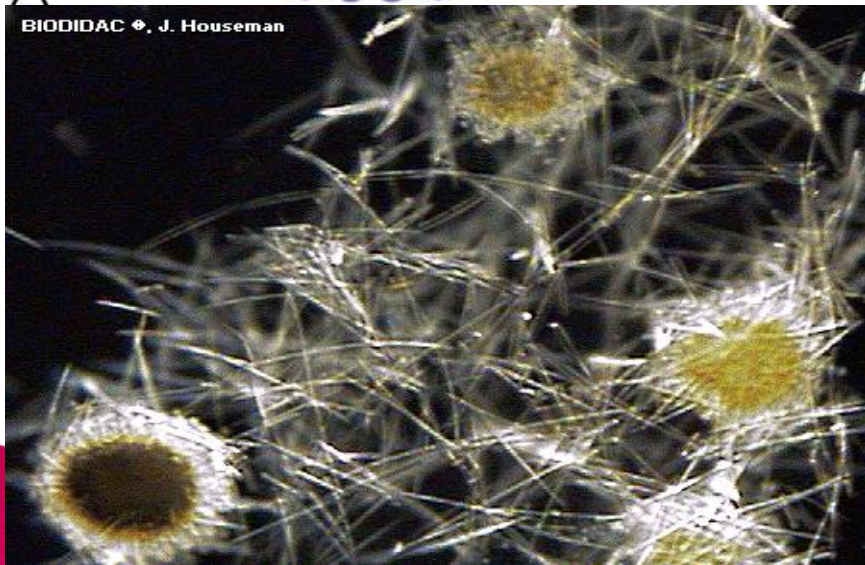
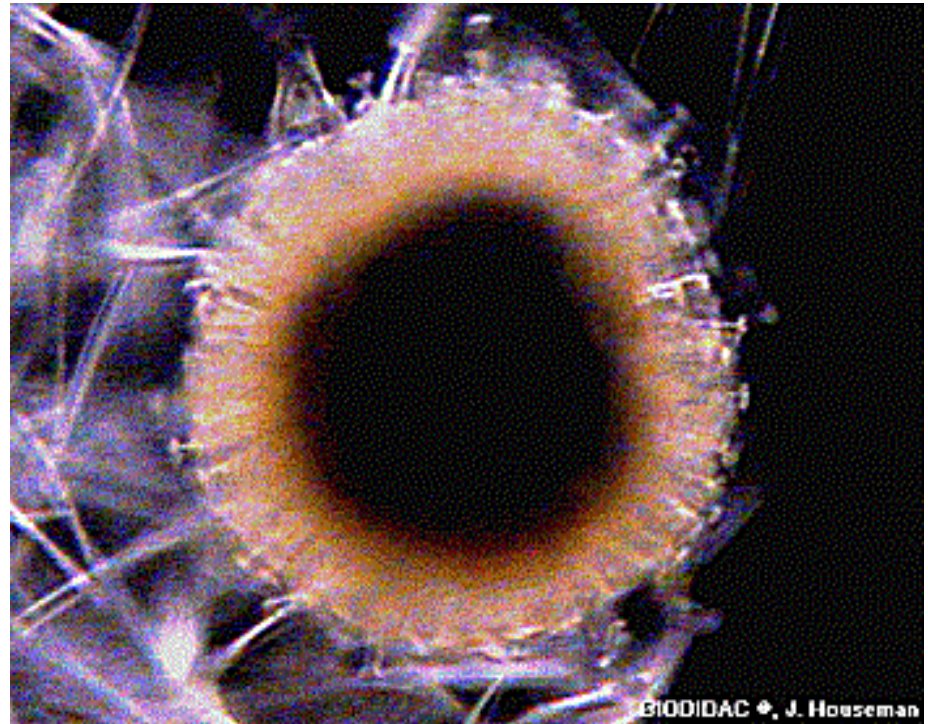
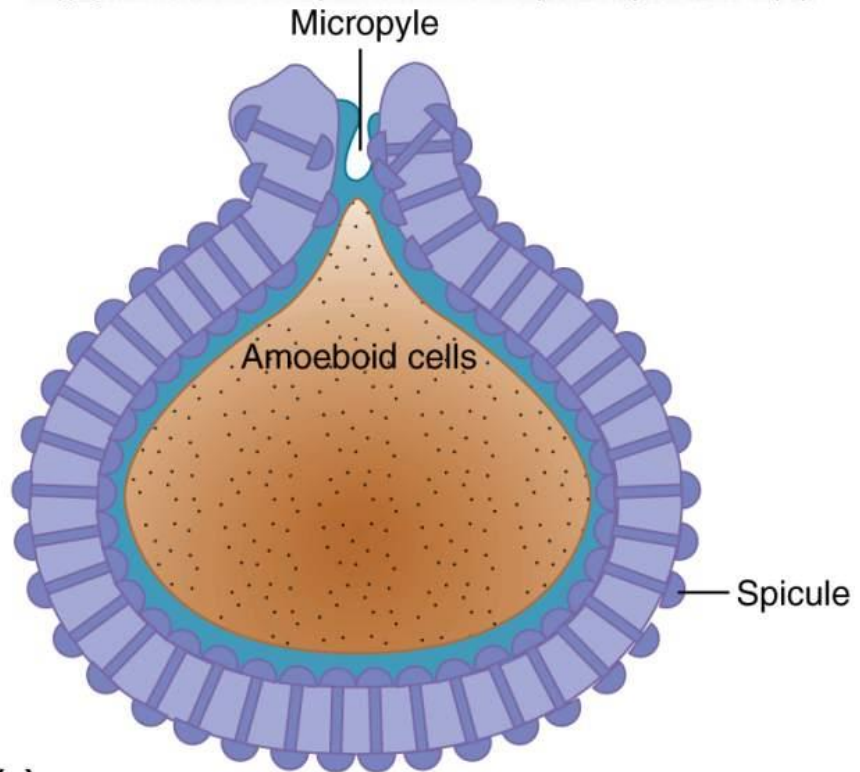
2) Spongin fibers:

- Composed of **collagenous protein** fibers.
- Secreted by special archaeocyte cells called **Spongocytes**
- **Maintain shape** of a sponge.
- **Help in classification** of sponges.



Gemmule formation in sponges

- At certain times of the year, many **freshwater sponge** species (and a few marine ones) produce dormant structures called **Gemmules**.
- These are **resistant, dormant** structures that are **formed by archaeocytes**.
- Formation begins when archaeocytes accumulate nutrients by **phagocytizing other cells**; then certain cells **secrete a thick, protective covering** (capsule).

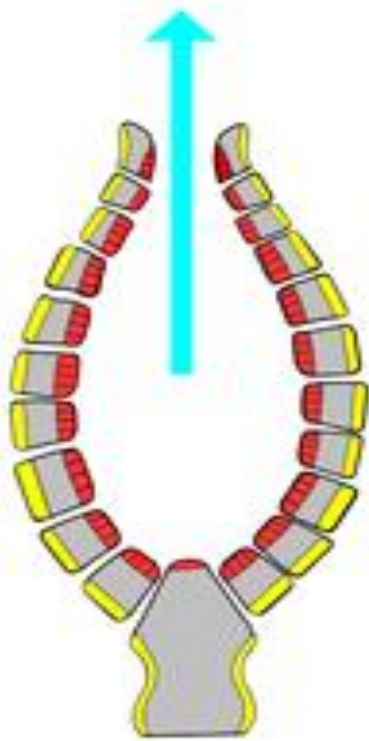


- Gemmules are resistant to desiccation (drought), freezing, and anoxia (lack of oxygen).
- Gemmules of many sponge species need few months of low temperature in order to be able to hatch (this is called **Vernalization**).
- Gemmules could remain dormant for **25 years** before hatching successfully.

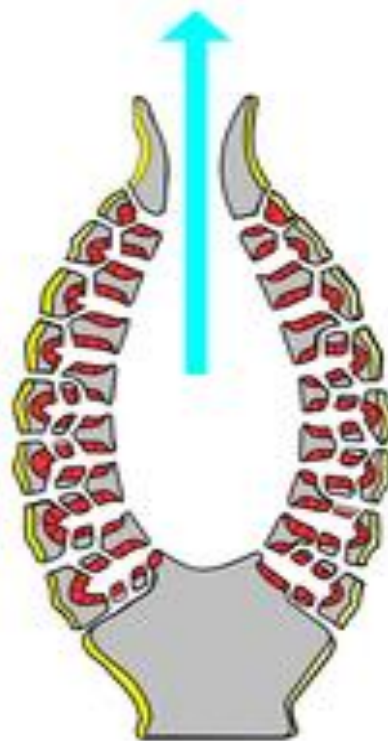
- ▶ **Gemmule formation** is an effective **way of asexual reproduction** resulting in numerous genetically identical offspring.
- ▶ Under unfavorable conditions, instead of Gemmules, some freshwater and marine sponges undergo **Tissue Regression**: *a sponge is reduced into a compact cellular mass with an outer protective covering.*

Poriferan Diversity:

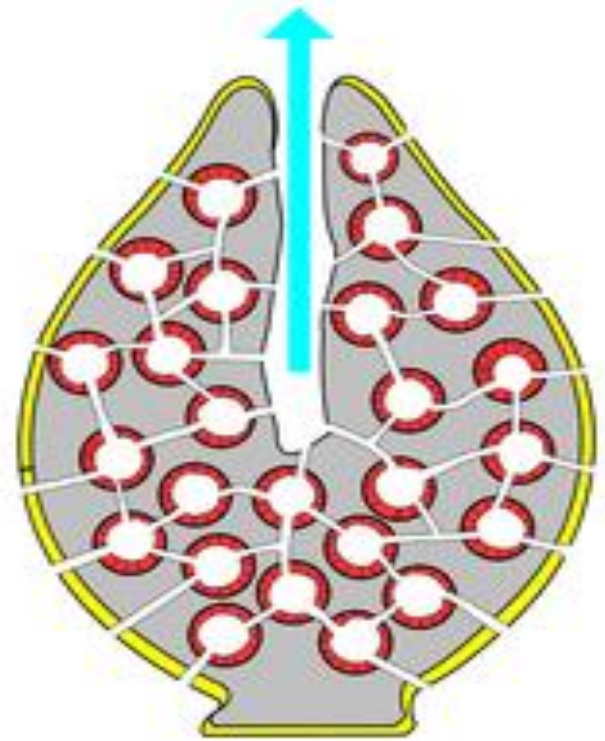
- ▶ There are three basic levels of sponge construction that differ in surface area available for feeding:
 - 1) **Ascon** (Asconoid shape): **simple body**
 - 2) **Sycon** (Syconoid shape)
 - 3) **Leucon** (Leuconoid shape): **more complex, most common.**



Ascon



Sycon



Leucon

- The increase in construction complexity implies **maximizing current flow** through spongocoel and **increasing surface area available for food collection**.

Classification of Sponges

- ▶ Depending on the **chemical composition** and **morphology** of the supporting material, sponges can be classified into:

1) Subphylum Cellularia

(pinacoderm is formed of cells).

Class Calcarea

Class Demospongia

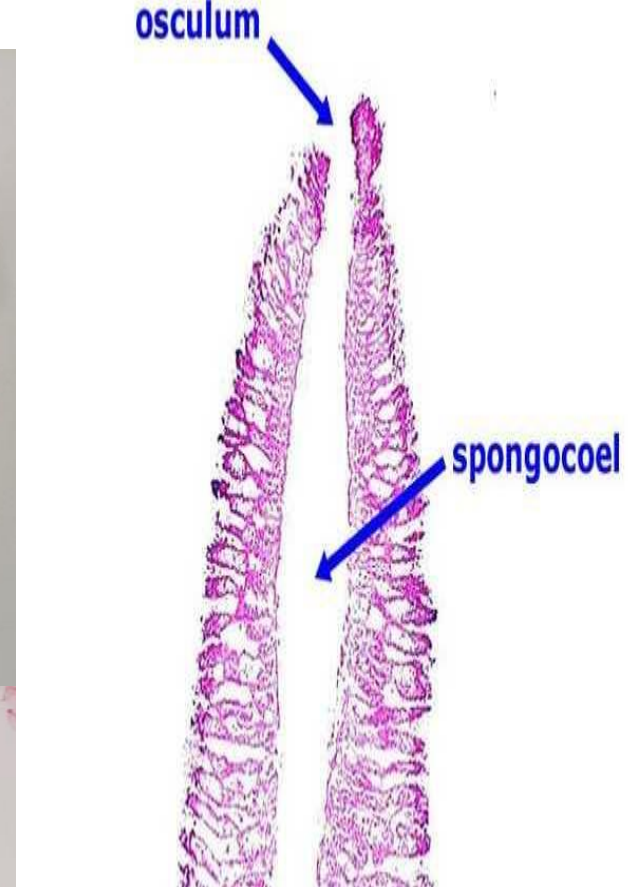
2) Subphylum Symplasma

(outer layer is syncytial)

Class Hexactinellida

Class Calcarea:

- Spicules are made up of **only calcium carbonate (CaCO_3)**.
- All body plans are represented in this class.
- All are **marine**.
- The **only living asconoid** forms are found in this class.
- Examples: ***Grantia (Scypha) & Leucosolenia***.



Class Demospongia:

- The largest class; contains **more than 90% of all sponge** species.
- **All have leucon** construction.
- Supporting elements may be composed of **spongin and/or silica but never CaCO_3** .
(a small group # lacks fibers and spicules).
- **All freshwater sponges** (<300 species) are found in this class.

- **Freshwater species** have **contractile vacuoles** that are found elsewhere only in protozoans.
- Examples: *Spongia*, *Microciona*, & *Spongilla*.



Spongia



Microciona

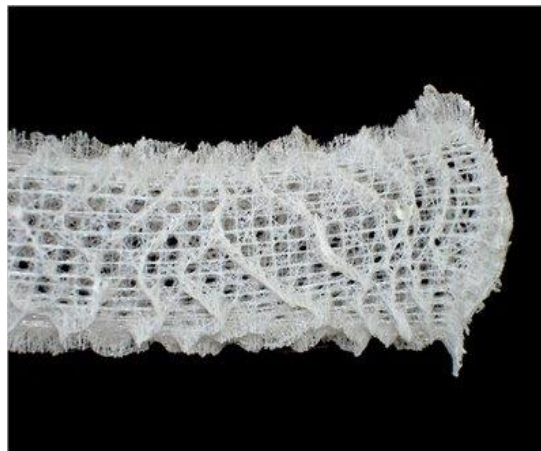


Spongilla

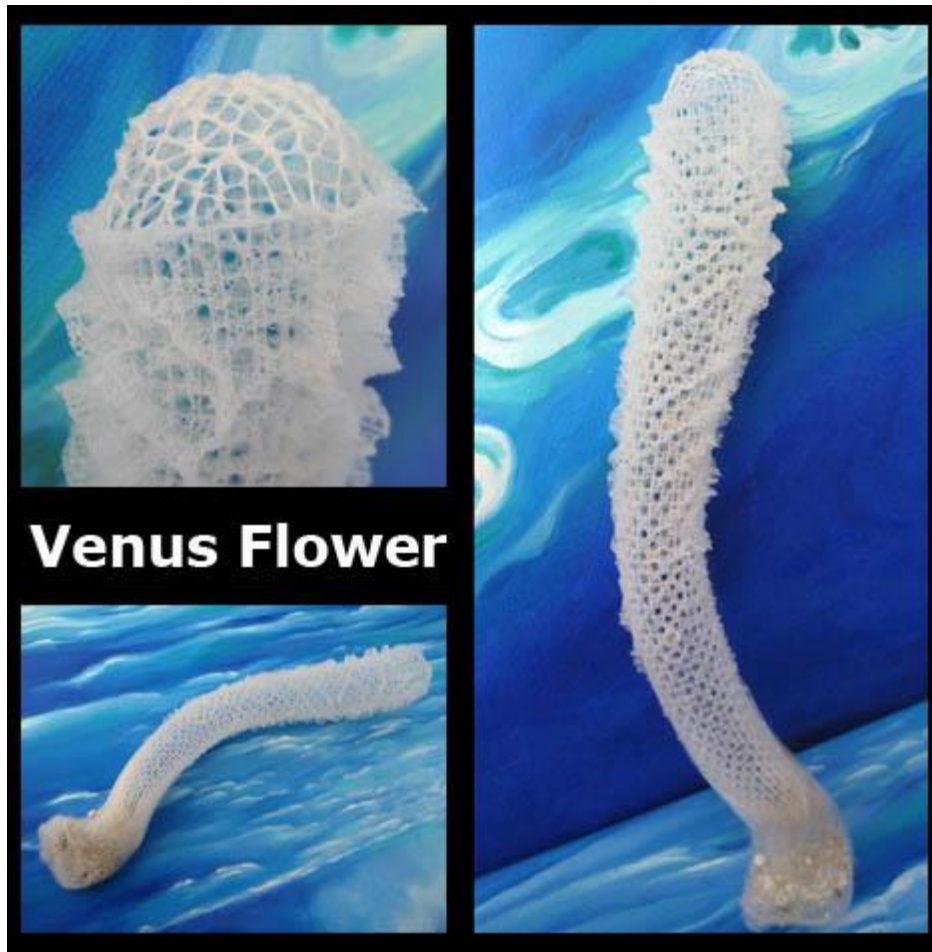
Class Hexactinellida:

- Body is supported entirely by **6-rayed siliceous spicules and pectin.**
- Known as **Glass Sponges.**
- Outer layer is **syncytial** (many nuclei contained within a single plasma membrane) and **lack contractibility** (no pinacoderm layer).

- ▶ **Inner flagellated layer** is also **syncytial**.
- ▶ Body construction could be **sycon or leucon**
- ▶ Unlike members of the other two classes which live attached to solid substratum, members of this class **inhabit soft sediment**, anchored by **tufts of spicules**



- ▶ Example: *Euplectella* (*Venus's flower basket*)

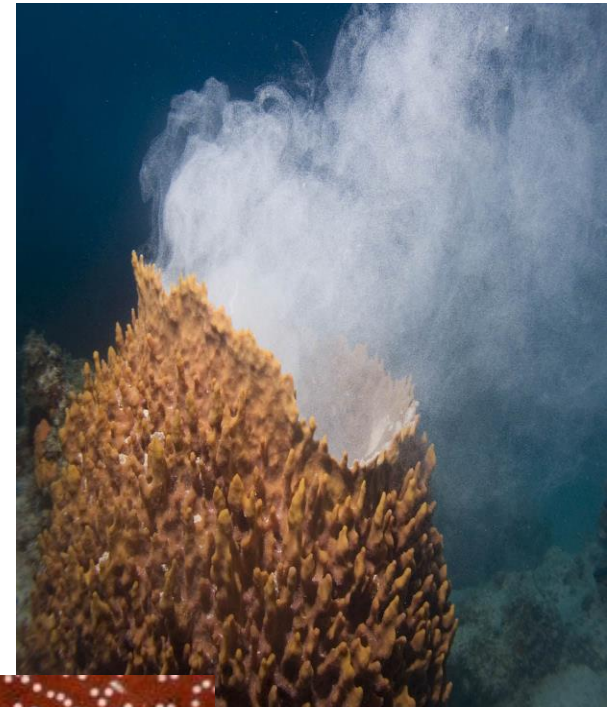
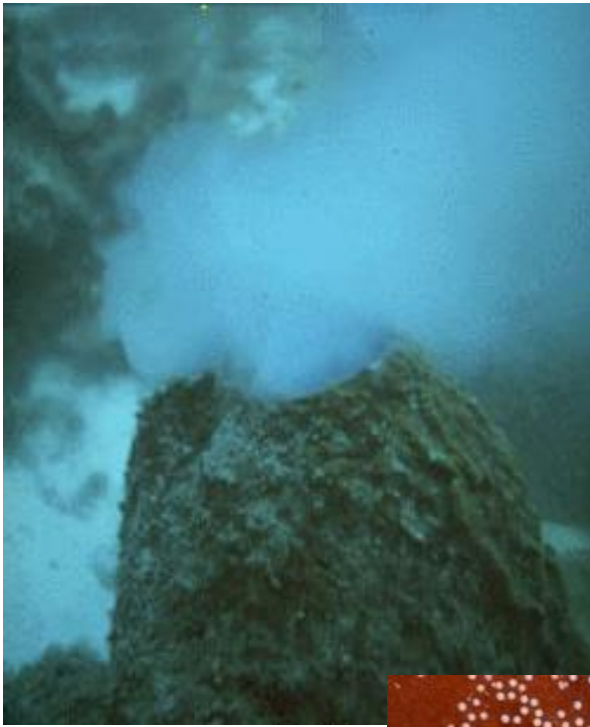


Reproduction and Development in Sponges:

- Sponges reproduce asexually by:
 - ▶ **Fragmentation**
 - ▶ **Gemmule formation**
 - ▶ **Budding**



- Sponges reproduce sexually by:
 - **Egg** and **sperm** production.
 - Many sponge species are **hermaphrodites** (a single individual produces both eggs and sperms).
 - **Fertilization** and early development are typically **internal**.
 - **Sperms are released into surrounding water**, *while eggs are retained in the mesohyl where fertilization takes place*

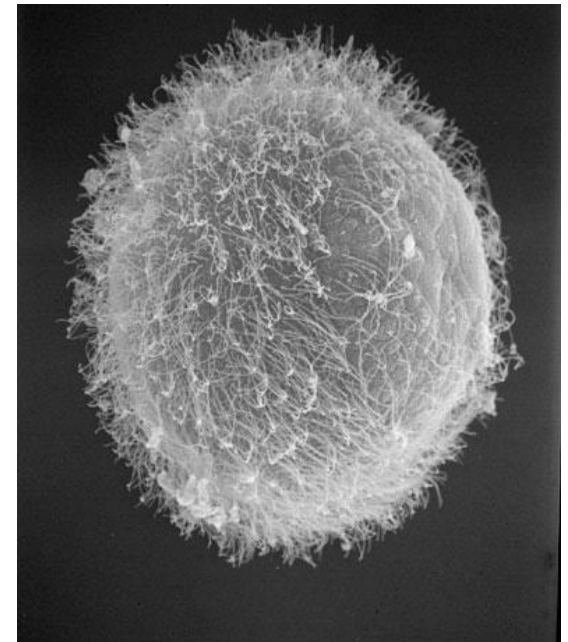
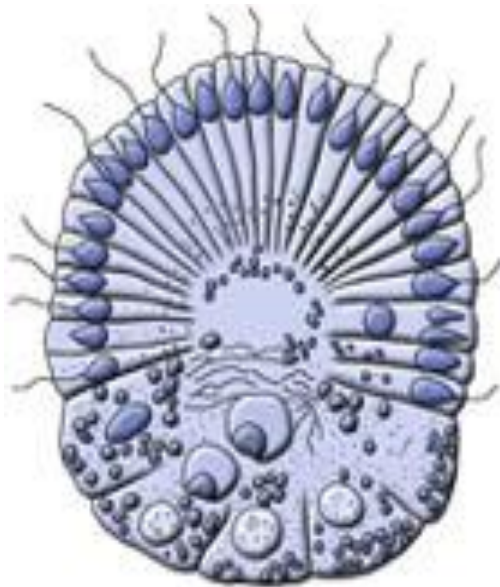


- ▶ **Choanocytes** capture the sperms, dedifferentiate into amoebocytes and enter the mesohyl where eggs are retained.
- ▶ Most sponge species **retain the developing embryos** for a time, releasing them later through the oscula as **swimming larvae**.



▶ Sponge larvae Types:

- **Amphiblastula:** flagellated at one end only.
- **Parenchymella (Parenchymula):** extensively flagellated.
- **Stereobalstula:** flagellated.



- ▶ Sponge larvae are **non-feeding**, they swim for less than 24 hours before they start settling down and metamorphosing to adult from.



End of Chapter