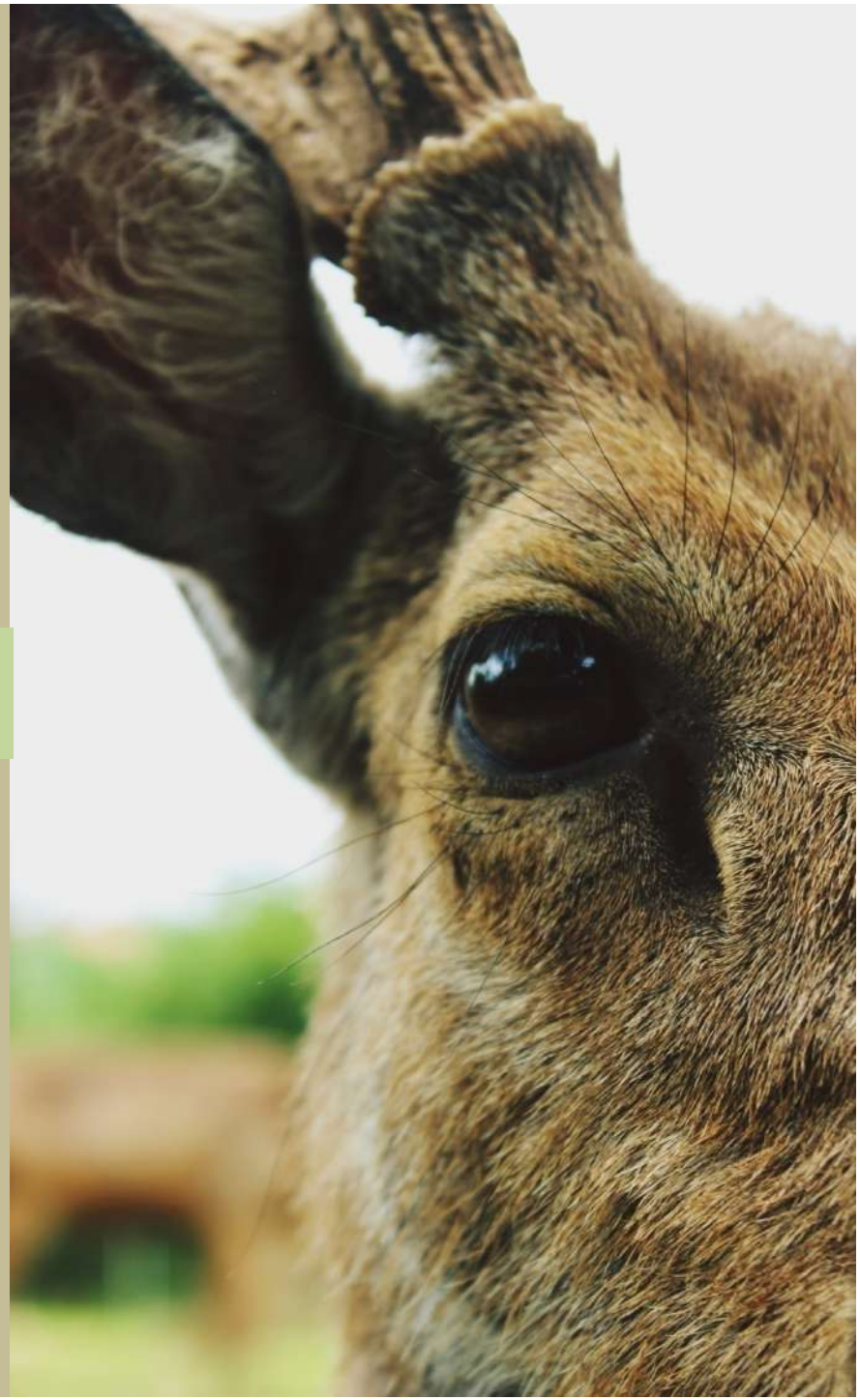
TAKSONOMI HEWAN

CHAPTER 3: PORIFERA

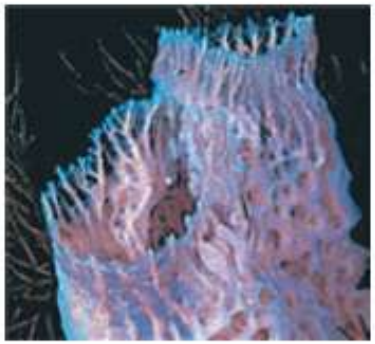


Husni Mubarok, S.Pd., M.Si.
Tadris Biologi
IAIN Jember

WHO IS HE ??

Kingdom Animalia encompasses **1.3 million known species**, and estimates of the **total number** of species range as high as **10–20 million**

Porifera (5,500 species)

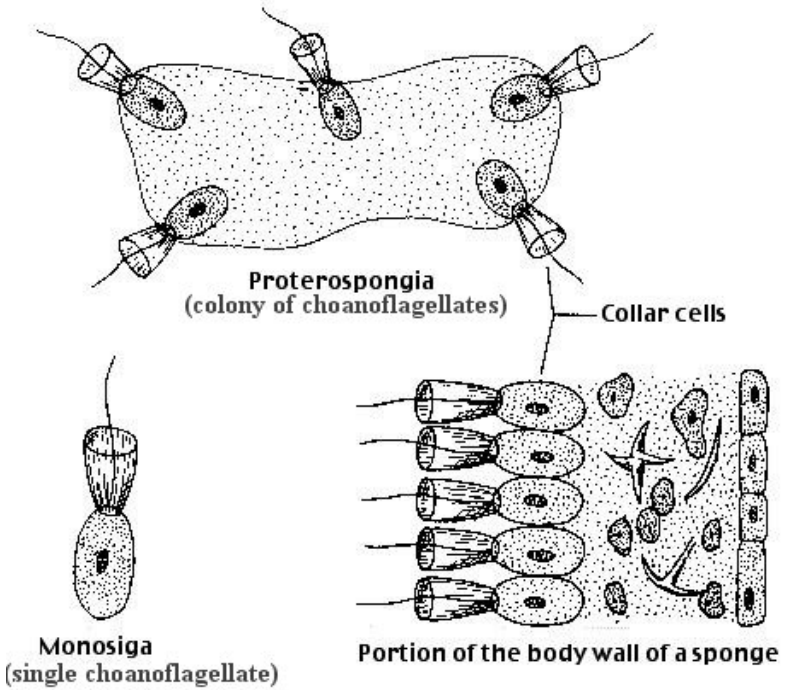


A sponge

Animals in this phylum are informally called **sponges**. Sponges are **sessile animals** that **lack tissues**. They live as **filter feeders**, trapping particles that pass through the internal channels of their body

Porifera probably originated **from flagellated protozoan like Proterospongia**, a colonial flagellate. The colony of Proterospongia has collared and flagellated cells embedded in a gelatinous matrix having amoeboid cells.

Phylum Choanozoa
Class Choanoflagellatea



KARAKTERISTIK PORIFERA

- Shape may be cylindrical, branching,vase-like or globular
- Some are dull in colour but most are brightly coloured, they have **red, orange**, **purple**, **green** or **yellow** colour.

The body is perforated by pores and canals but there **are no organs, such as mouth or nervous system**

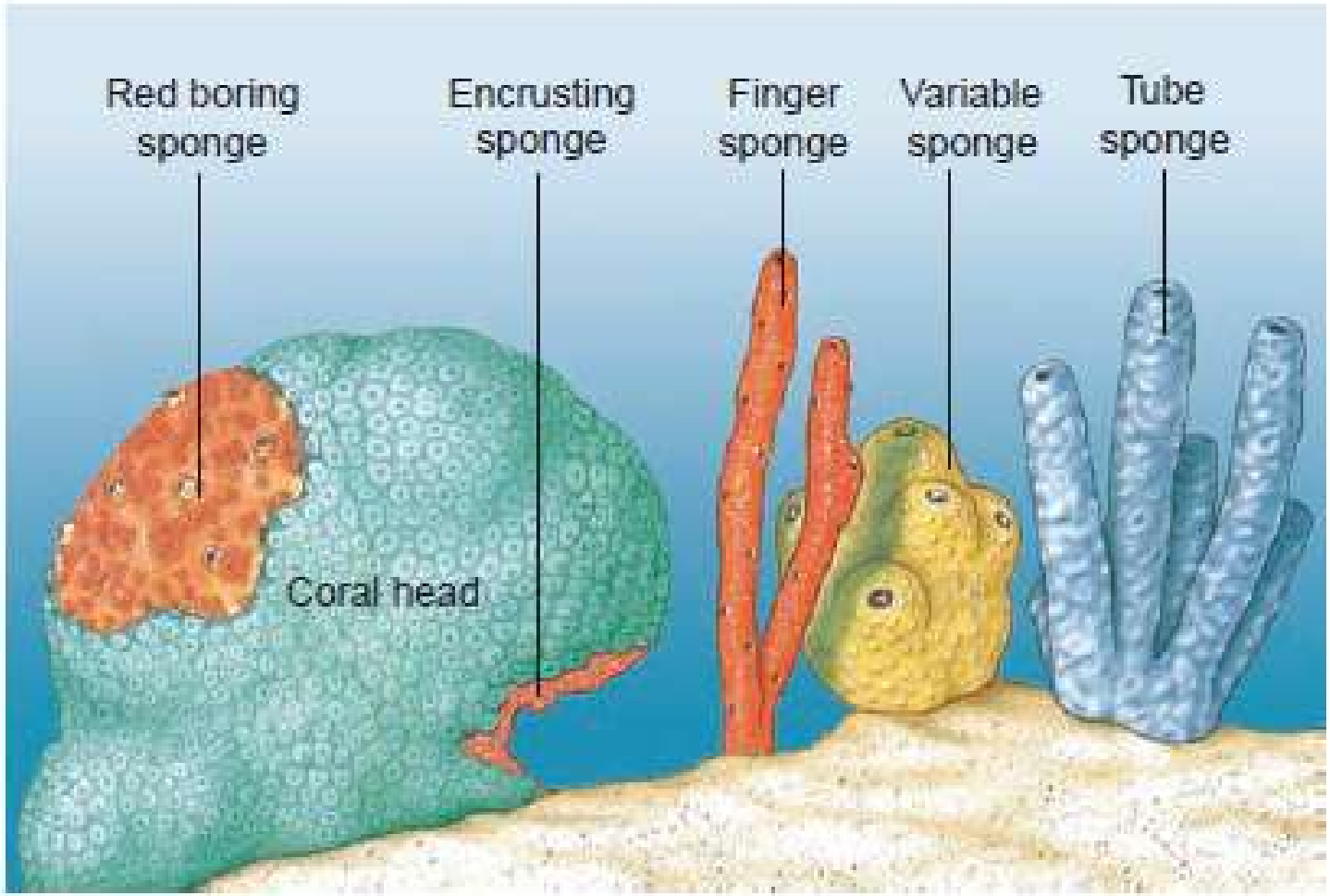
METAZOA *:* all animals **having the body composed of cells differentiated** into **tissues** and **organs** and usually a **digestive cavity lined with specialized cell**

Characteristics of Phylum Porifera

1. Multicellular; body an aggregation of several types of cells differentiated for various functions, some of which are organized into **incipient tissues** of a low level of integration
2. Body with pores (ostia), canals, and chambers that form a unique system of **water currents** on which sponges depend for food and oxygen
3. Mostly marine; all aquatic
4. Radial symmetry or none
5. Outer surface of flat pinacocytes; most interior surfaces lined with flagellated collar cells (choanocytes) that create water currents; a gelatinous protein matrix called mesohyl contains amebocytes of various types and skeletal elements
6. Skeletal structure of fibrillar collagen (a protein) and calcareous or siliceous crystalline spicules, often combined with variously modified collagen (spongin)
7. No organs or true tissues; digestion intracellular; excretion and respiration by diffusion
8. Reactions to stimuli apparently local and independent in cellular sponges, but electrical signals in syncytial glass sponges; nervous system probably absent
9. All adults sessile and attached to substratum
10. Asexual reproduction by buds or gemmules and sexual reproduction by eggs and sperm; free-swimming flagellated larvae in most

Sponges range in size and shape.

- Up to 2 meters in diameter!
- Encrusting, boring, finger, tube or vase shaped

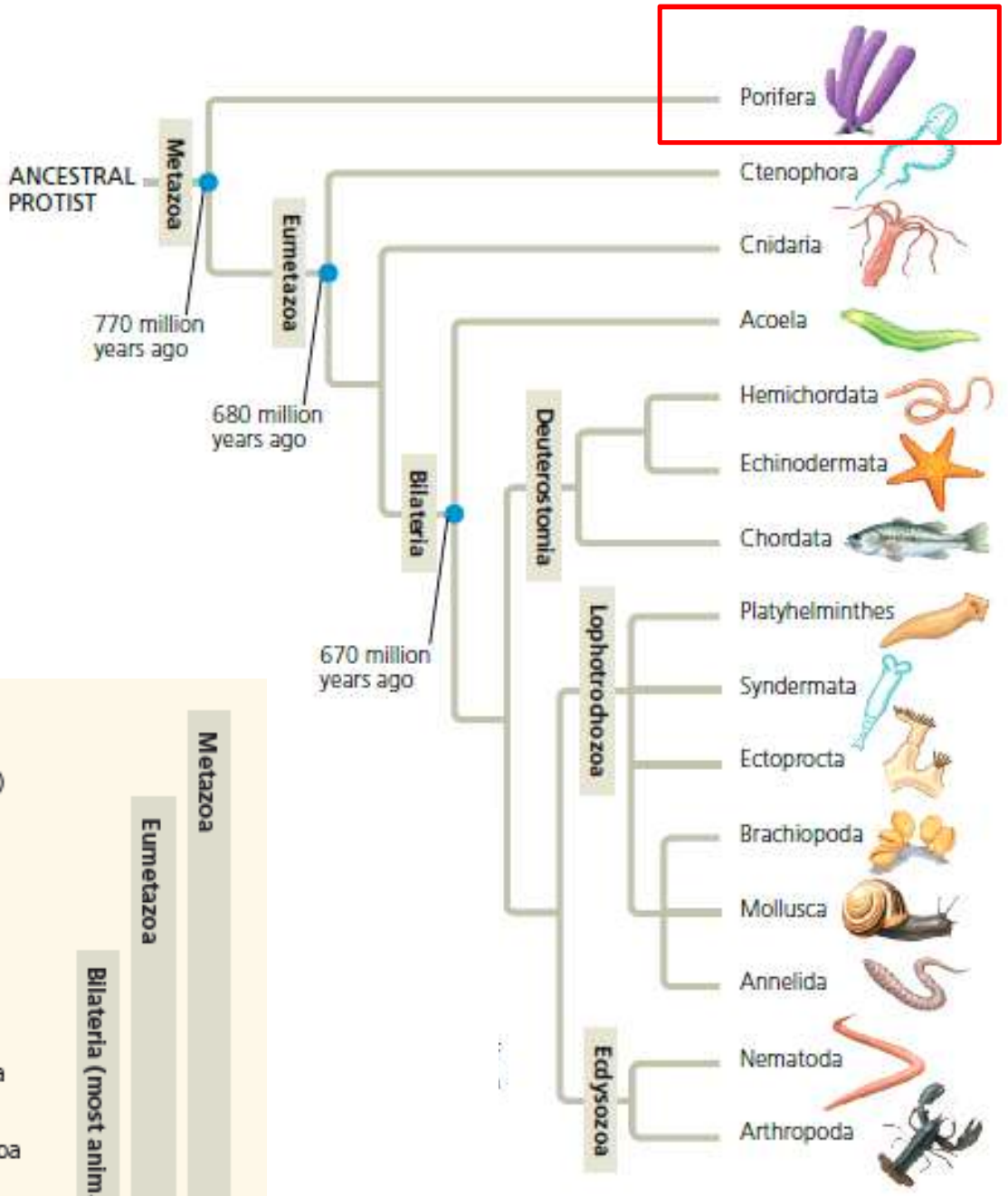


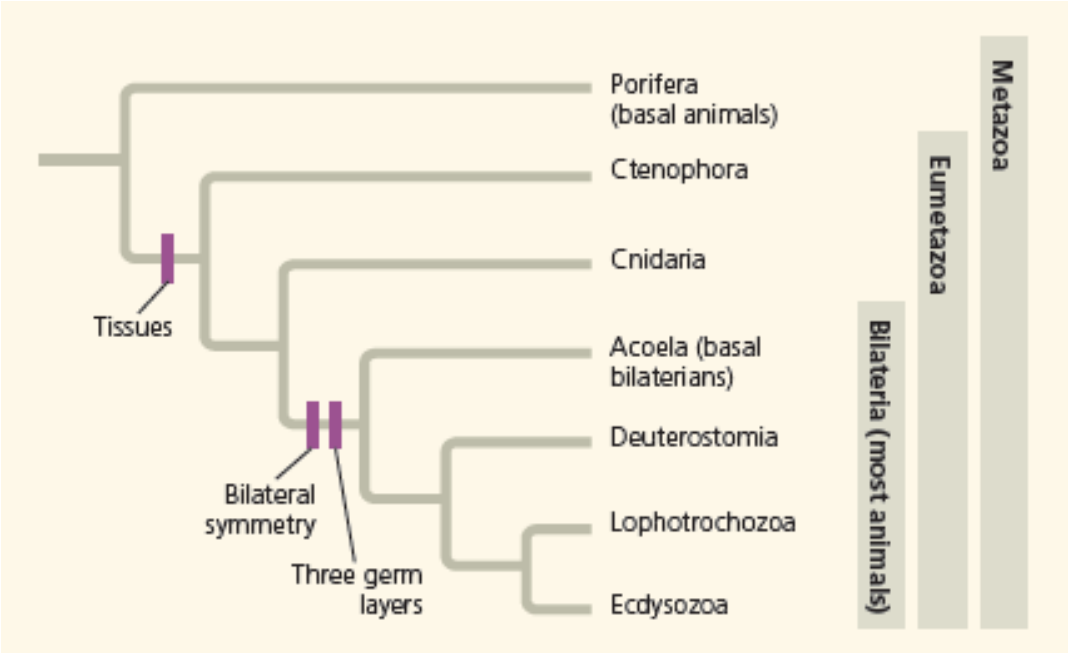
“Dan apakah orang-orang yang kafir tidak mengetahui bahwasanya langit dan bumi itu keduanya dahulu adalah suatu yang padu, kemudian Kami pisahkan antara keduanya. ***Dan dari air Kami jadikan segala sesuatu yang hidup****. Maka mengapakah mereka tiada juga beriman? “*

(QS Al-Anbiyaa Ayat : 30)

Phylogeny of Living Animals

Recent molecular studies indicate that **sponges are monophyletic**, however, as **some studies** suggest that sponges are **paraphyletic**





PLOS | ONE

CORRECTION

Correction: A Higher Level Classification of All Living Organisms

Michael A. Ruggiero, Dennis P. Gordon, Thomas M. Orrell, Nicolas Bailly, Thierry Bourgoin, Richard C. Brusca, Thomas Cavalier-Smith, Michael D. Guiry, Paul M. Kirk

OPEN ACCESS

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Rank
Superkingdom
Kingdom
Subkingdom
Infrakingdom
Superphylum
Phylum
Subphylum
Infraphylum
Superclass
Class
Subclass
Infraclass
Superorder
Order

Main ranks are in bold type; unnamed taxa are not counted.

doi:10.1371/journal.pone.0130114.t001

KLASIFIKASI PORIFERA

KINGDOM ANIMALIA			
SUBKINGDOM N.N.			
	Phylum Porifera		
		Class Calcarea	
			Order Baerida
			Order Clathrinida
			Order Leucosolenida
			Order Lithonida
			Order Murrayonida
		Class Demospongiae	
			Order Agelasida
			Order Astrophorida
			Order Chondrosida
			Order Dendroceratida
			Order Dictyoceratida
			Order Hadromerida
			Order Halichondrida
			Order Haplosclerida
			Order Lithistida
			Order Poecilosclerida
			Order Spirophorida
			Order Verongida
		Class Hexactinellida	
			Order Amphidiscosida
			Order Aulocalycoida
			Order Fieldingida
			Order Hexactinosida
			Order Lychniscosida
			Order Lyssacinosida
		Class Homoscleromorpha	
			Order Homosclerophorida

FORM & FUNCTION

Azure vase sponge (*Callyspongia plicifera*)

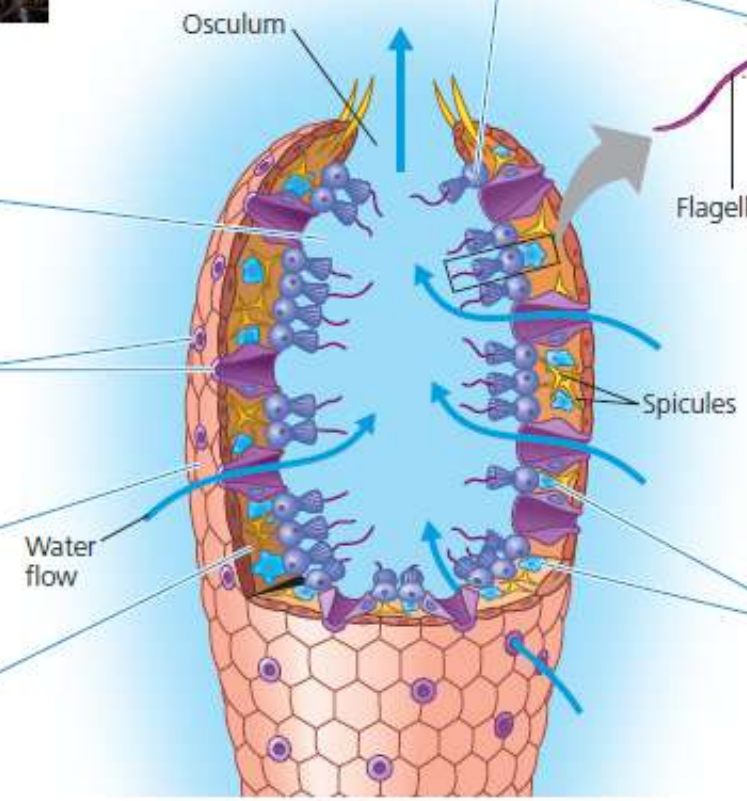
5 Choanocytes. The spongocoel is lined with flagellated cells called choanocytes. By beating flagella, the choanocytes create a current that draws water in through the pores and out through the osculum.

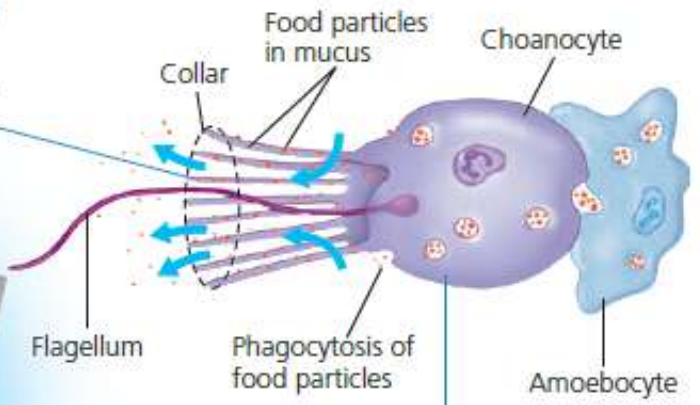
4 Spongocoel. Water passing through pores enters a cavity called the spongocoel.

3 Pores. Water enters the sponge through pores formed by doughnut-shaped cells that span the body wall.

2 Epidermis. The outer layer consists of tightly packed epidermal cells.

1 Mesohyl. The wall of this sponge consists of two layers of cells separated by a gelatinous matrix, the mesohyl ("middle matter").



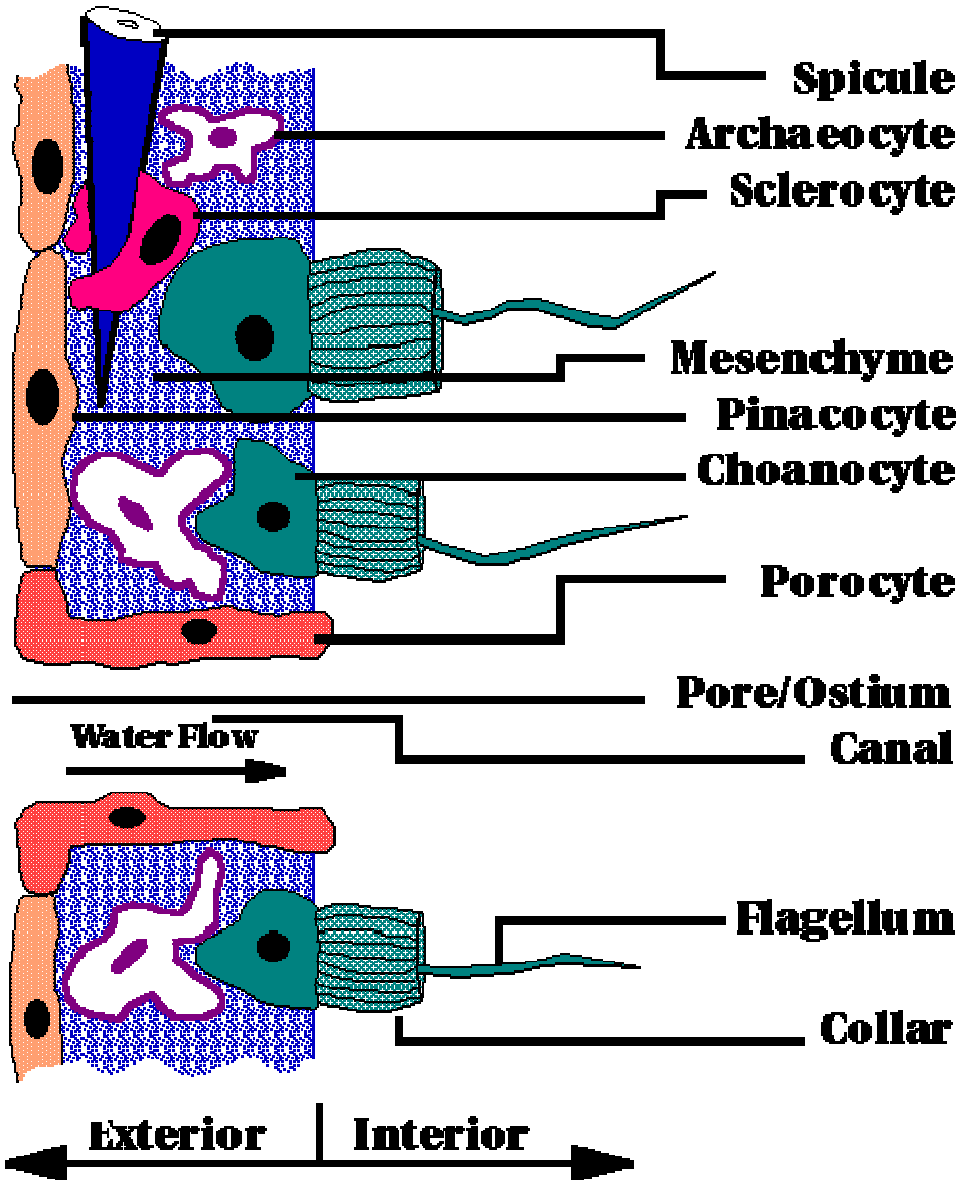


6 The movement of a choanocyte's flagellum also draws water through its collar of finger-like projections. Food particles are trapped in the mucus that coats the projections, engulfed by phagocytosis, and either digested or transferred to amoebocytes.

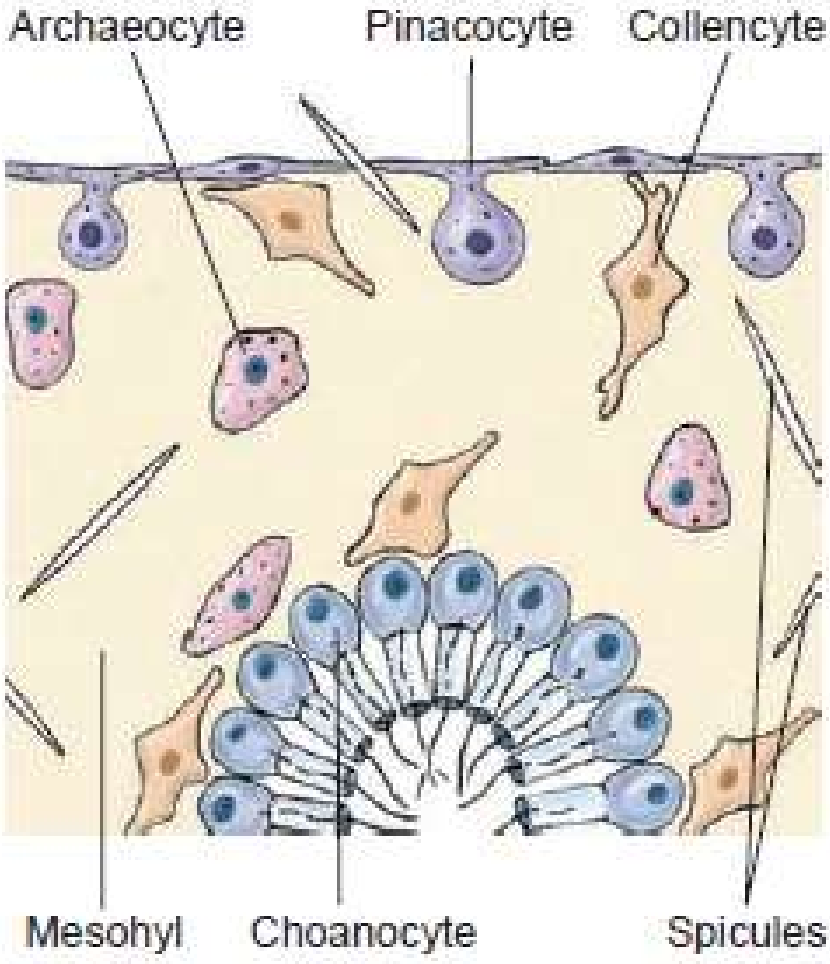
7 Amoebocytes. These cells can transport nutrients to other cells of the sponge body, produce materials for skeletal fibers (spicules), or become any type of sponge cell as needed.

FORM & FUNCTION

MICROSCOPIC VIEW OF A PORIFERAN WALL



FORM & FUNCTION



- The choanocytes pass food particles to **archaeocyte** cells for digestion.
- Digestion occurs entirely within cells, there is no gut.
- Other cell types secrete spicules (**sclerocytes**), spongin (**spongocytes**), & collegen (**collenocytes**).

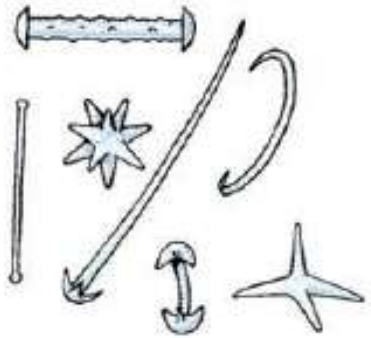
Pinacocytes are thin, flat, epithelial-type cells that cover the exterior and some interior surfaces of the sponge.

- Almost a true tissue.

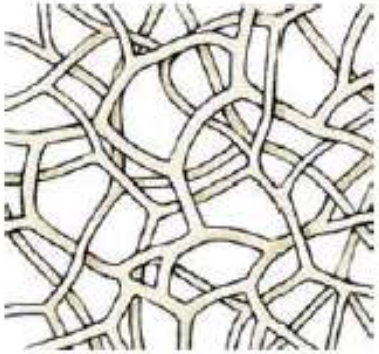
Archaeocytes are ameboid cells that move in the mesohyl

SKELETON

Siliceous spicules
(Hexactinellida)



Siliceous spicules
(Demospongiae)



Spongin

Calcareous
spicules

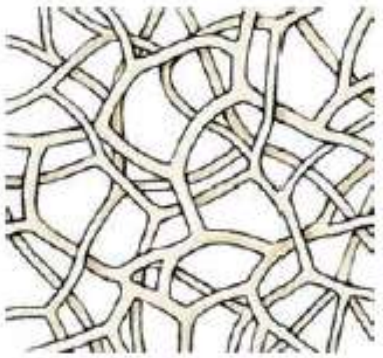
Skeleton → (1) memberi bentuk & struktur, (2) menyokong & melindungi bagian yg lembut (soft) sponge, (3) dasar klasifikasi sponge

Skeleton tertanam di jaringan mesenkim
Skeleton trdiri dr **spikula (spicules/sclerites) yg terpisah**, **spongin fibers** atau **keduanya**

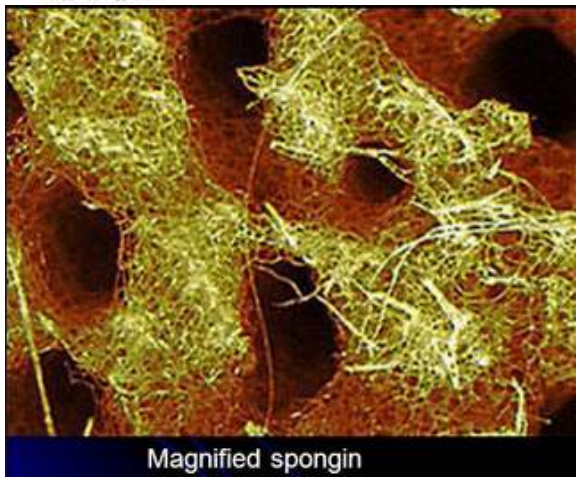
SKELETON –SPONGIN FIBER

STRUKTUR

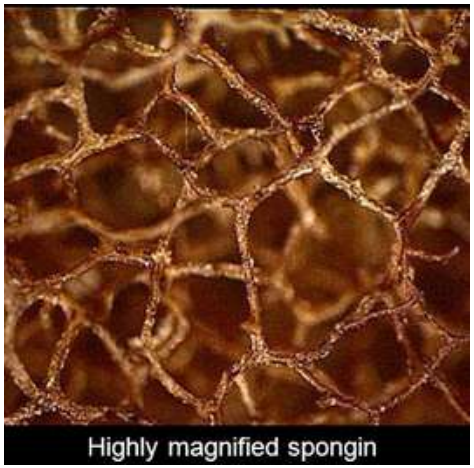
- Organik, ber”tanduk”, substansi yg elastis (terkait dgn silk di komposisi kimia)
- **Skleroprotein** → tdr dr sulfur dan sejenis kolagen
- Tidak larut dalam air & resisten thd enzim pendegradasi protein
- Mengandung banyak Iodine → digunakan sbg obat pembengkakan pada laring
- Class Demospongiae → beragam
- Ada sbg semen yg berhubungan dgn *siliceous spicula*
- Atau dlm bentuk *branching fiber* dmana *siliceous spicula* tertanam
- Di Kertosa → spikula absen & hanya bentuk spongin



Spongin



Magnified spongin



Highly magnified spongin

Development of spongin

Spongin fibers are secreted by flask-shaped mesenchyme cells called as spongioblast cells. During the development the spongioblast cells are arranged in the rows and the spongin rods secreted by them are fused with the neighboring cells to form a long fiber. Later the spongioblasts vacuolated and finally get degenerated after secreting certain amount of spongin.

SKELETON - SPIKULA

STRUKTUR

- **Kristal** mikroskopik → memberi bentuk & padat
- Terdiri dari duri "spines" *or "Rays" that radiate from a point*
- Terbentuk dari **Sel Amoebosit Mesenkim** khusus yg disebut **Sel Skleroblas**

Hydrated Silica

Siliceous spicules (Hexactinellida)

Siliceous spicules (Demospongiae)

Calcium Carbonate ($CaCO_3$)

Calcareous spicules

On basis of type of deposit on core organic matter: All kinds of spicules have a core of organic material around which either calcium carbonate or colloidal silica is deposited. Accordingly spicules are of two types:

Calcareous spicules: The organic material in this type of spicules is calcium carbonate or calcite. This is the characteristic of the sponges of class Calcarea.

Siliceous spicules: The organics material in this type of spicules is Colloidal silica or Silicon. These types of spicules are the characteristic of the sponges of class Hexactanellida.

SKELETON - SPIKULA

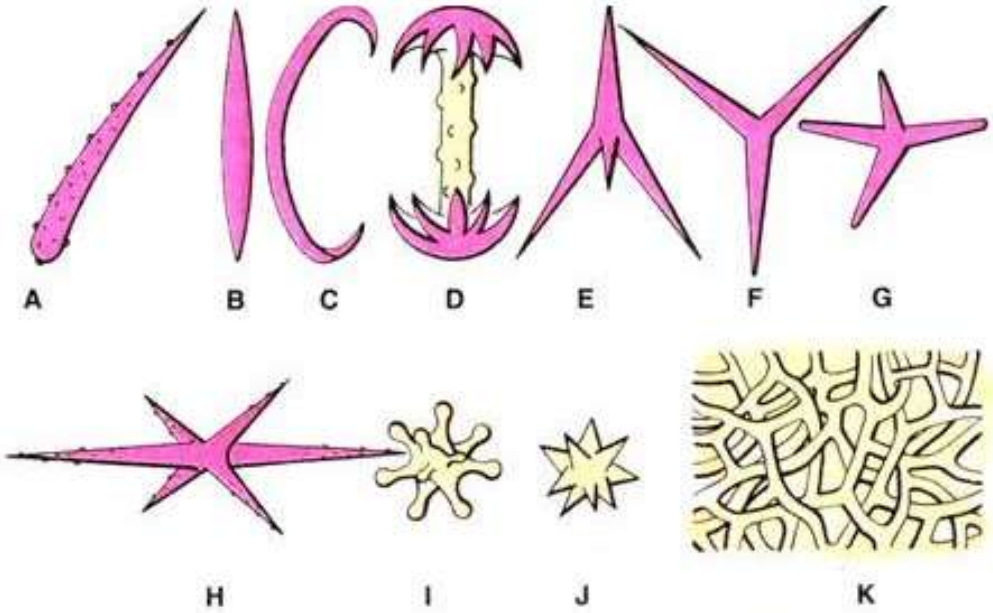
On the basis of size and function: Spicules can be of large size or small size. Accordingly spicules can be of two types:

Megascleres: These are larger spicules constituting main skeleton of sponge body.

Microscleres: These are the small spicules occurring interstitially.

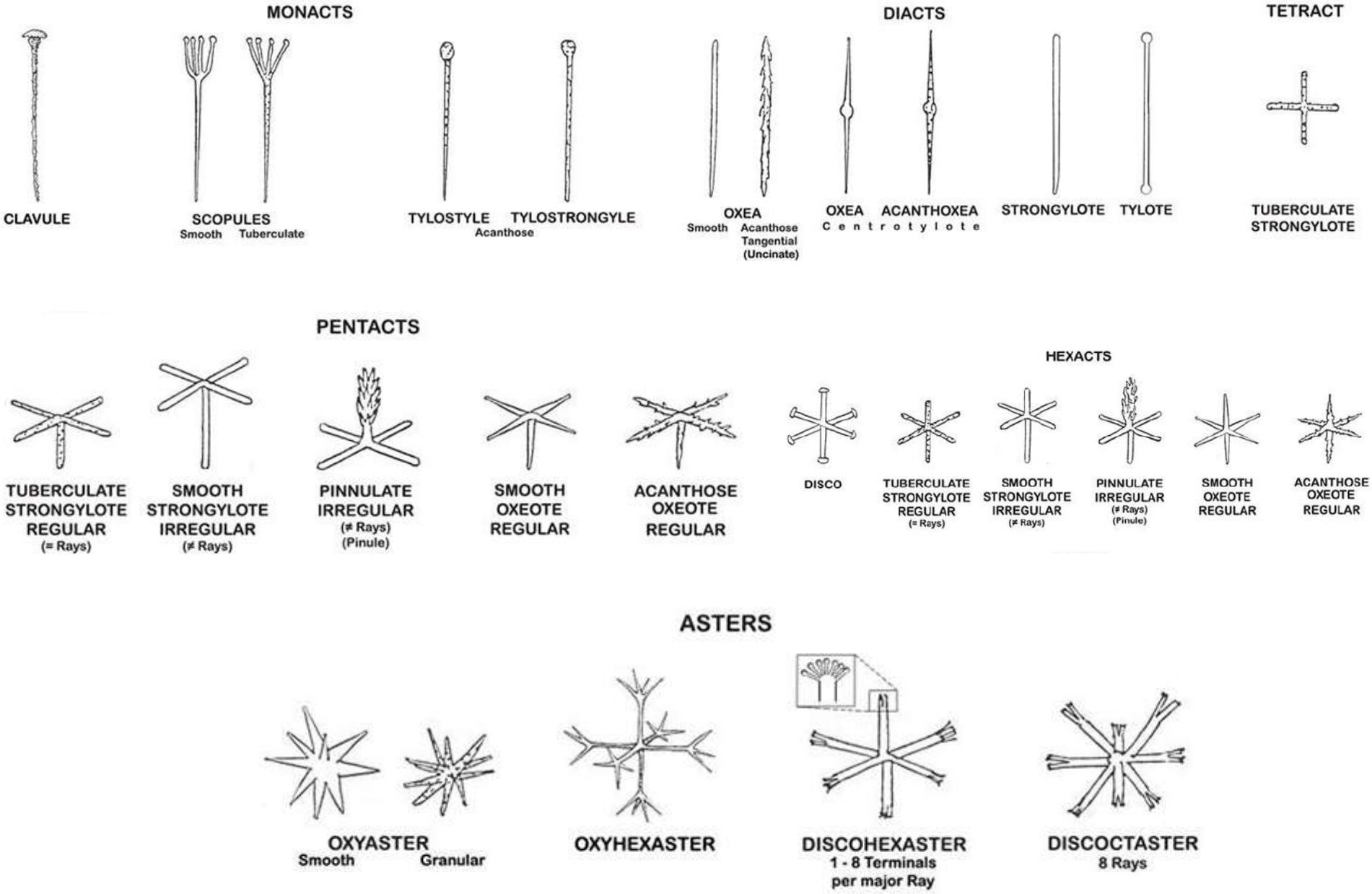
Some Reference:
Megasclere spicules:
Monaxons, Tetraxons, Triaxons, Polyaxons, Spheres, Desma.

Microsclere spicules:
Spires and **Asters**



Spicules and spongin. A—Monactinal monaxon; B—Diactinal monaxon; C—Curved monaxon; D—Monaxon with hooked ends; E—Tetraxon; F—Triradiate; G—Calthrops; H—Hexactinal triaxon; I and J—Polyaxon; K—Spongin fibres.

SKELETON - SPIKULA

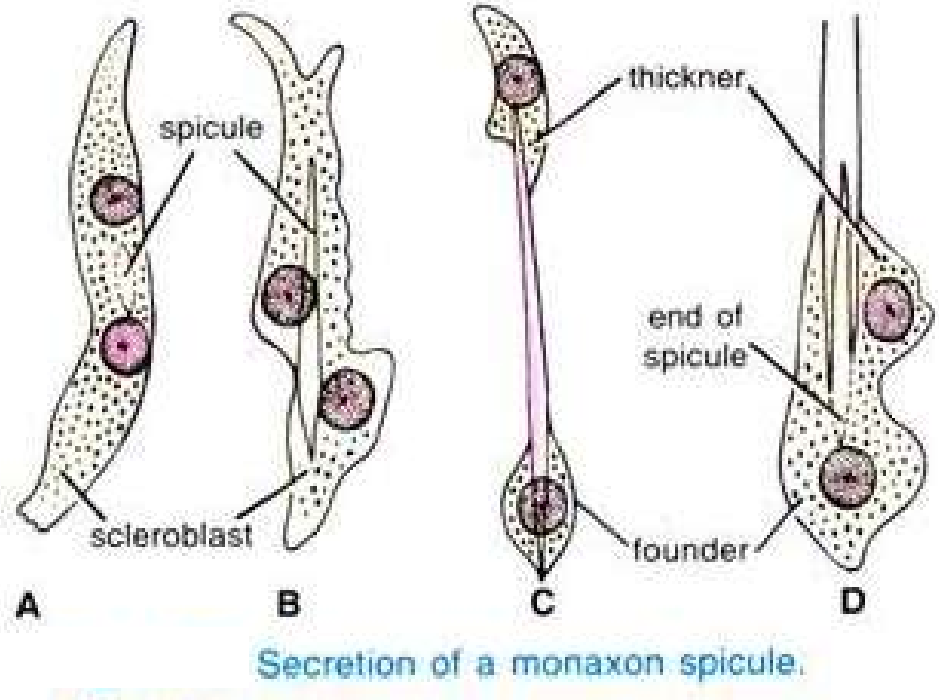


SKELETON – PERKEMBANGAN SPIKULA

On the basis of development, the spicules may be primary which owe their first origin **from a single mother cell or scleroblast**, or **secondary** which arise **from more than one scleroblast**.

Development of Monaxon Spicules

In calcareous sponges, a monaxon spicule is secreted within a binucleate sclerobast → from incomplete division of an ordinary scleroblast → The calcium carbonate is deposited around an organic axial thread in the cytoplasm between the two nuclei → two nuclei draw apart until the scleroblast divides into two → establishing the shape and length

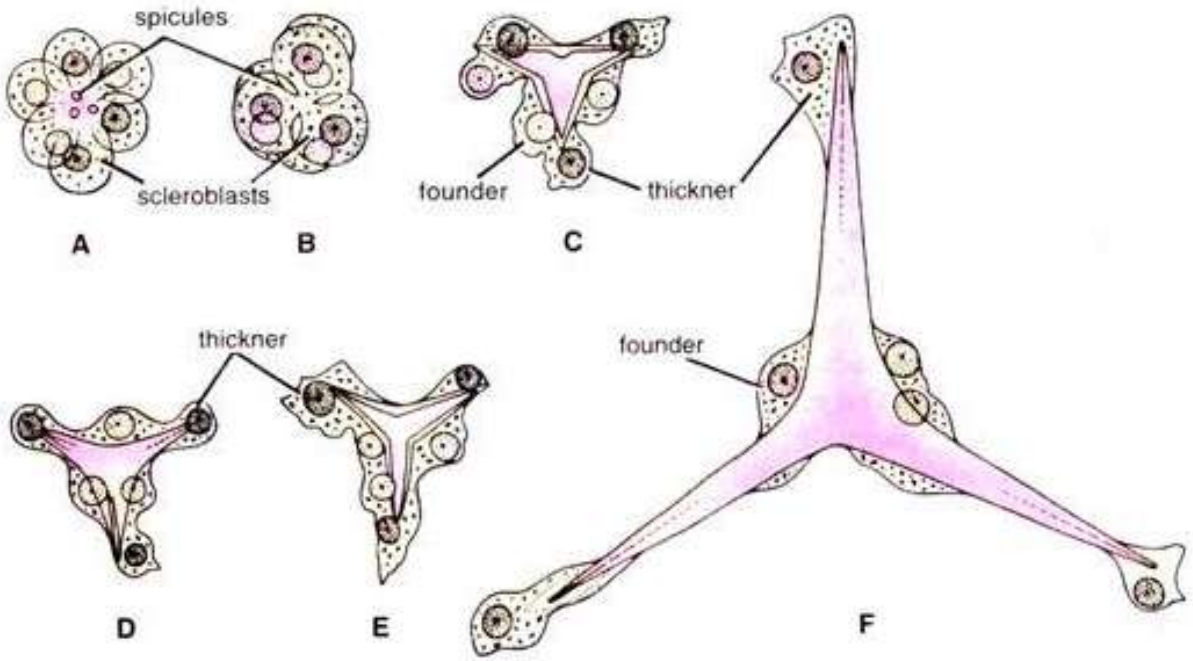


Secretion of a monaxon spicule.

Siliceous spicules is poorly known → one scleroblast called silicoblast

SKELETON – PERKEMBANGAN SPIKULA

Development of Triaxon Spicules



Triaxon or triradiate calcareous spicules are **secreted by three scleroblasts** which **come together in triangle and divide in two**, each into an inner founder and an outer thickner. Each pair secretes a minute spicule and these three rays are early united into a **small triradiate spicule**.

Each ray is then completed in the same manner as a **monaxon spicule**. Later on, three rays or spicules unite together forming a triaxon or triradiate spicule.

SKELETON – PERKEMBANGAN SPIKULA

Development of Other Spicules

In the formation of **quadriradiate** or **tetraxon** spicules, the fourth ray is added to forming triradiate spicule by an additional scleroblast.

The **hexactinal spicules** of **Hexactinellida** arise in the centre of a multinucleate syncytial mass which is probably formed by repeated nuclear division of an original silicoblast.

Microscleres.

Monaxons.

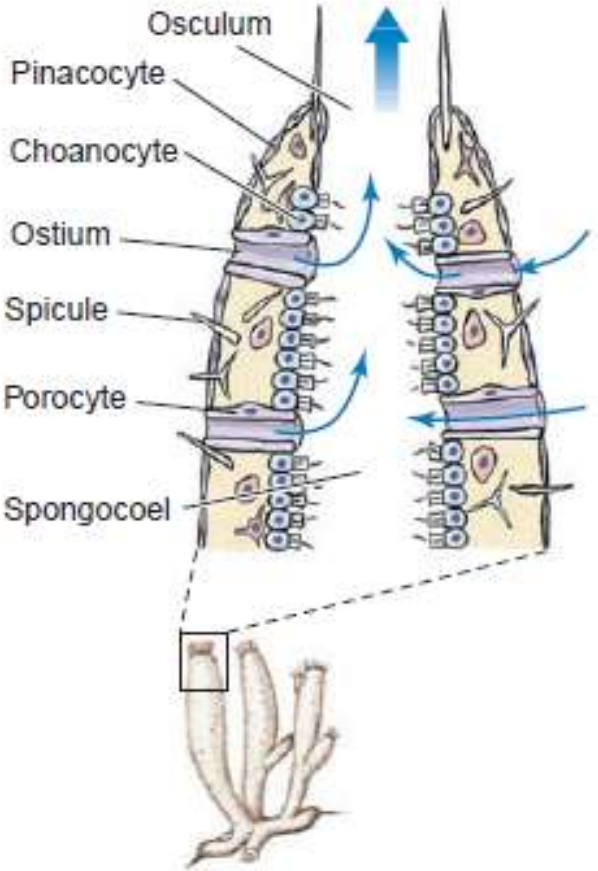
Calcium carbonate spicules.

Siliceous spicules.

TIPE KANAL SISTEM - ASCONOID

- *Simplest organization*
- Air mengalir ke sponge melalui ***microscopic dermal pores***
- Aliran air→ gerakan flagella yg banyak pd **choanocyte**
- ***Choanocytes line*** → *internal cavity:* ***Spongocoel***
- Choanocytes → menyaring air dan mengekstrak partikel makanan
- Used water → a single ***large osculum***
- This design **has distinct limitations**

  Choanocytes line the spongocoel → can collect food **only from water directly adjacent** to the spongocoel wall→Spongocoel to be large, most of the water and food in its central cavity **would be inaccessible to choanocytes**
- Asconoid sponges: **Small & Tube-Shaped**
- Asconoids are **found only in the Class Calcarea**



Asconoid (*Leucosolenia*)

TIPE KANAL SISTEM - ASCONOID

- **Example:**

  Leucosolenia *(Gr. leukos, white, solen, pipe)* → slender, tubular individuals grow in groups attached by a common stolon, or stem, to objects in shallow seawater

Leucosolenia

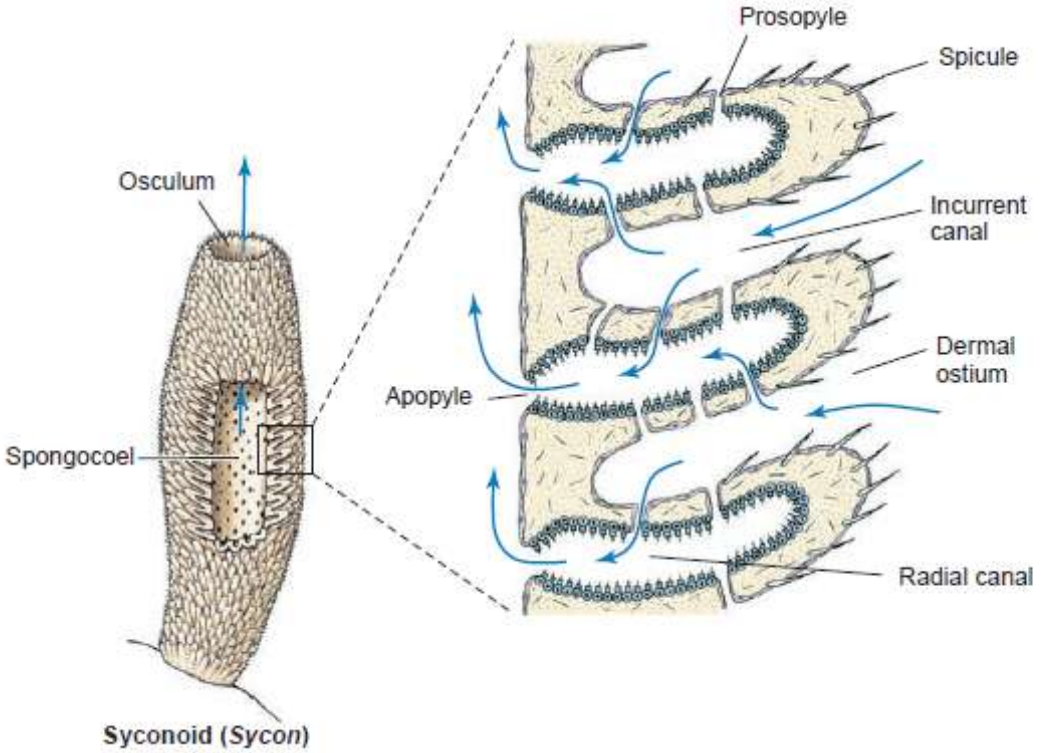
Leucosolenia complicata

- ***Clathrina*** *(L. clathri, latticework),* another asconoid, has bright yellow, intertwined tubes

Clathrina clathrus

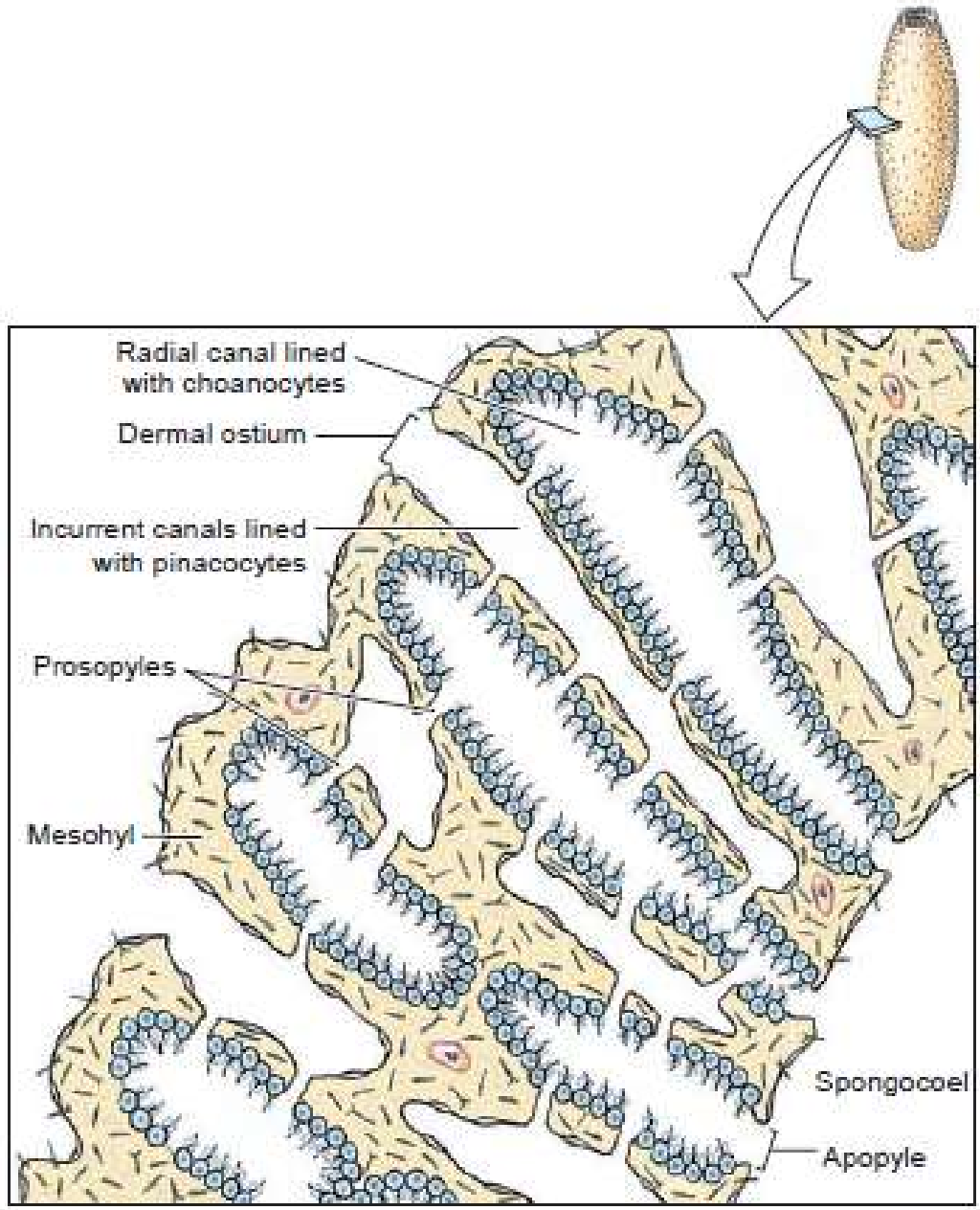
TIPE KANAL SISTEM - SYCONOID

- "**Larger editions of asconoids**"
- Tubular body and single osculum
- The body wall: thicker & more complex
- Folded outward to make **choanocyte-lined canals**
- Folding → increases the **surface area of the wall** and thus increases the **surface area covered by choanocytes**
- The canals are of small diameter → most of the water in a canal is **accessible to choanocytes**



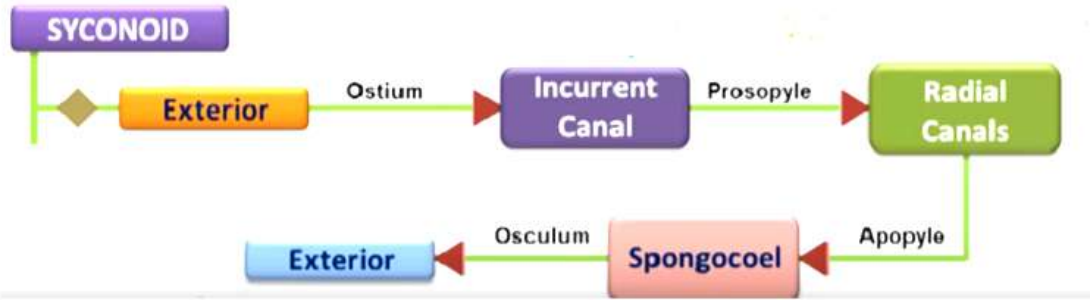
Water → **Dermal Ostia** → **Incurrent Canals** → filters through **Tiny Opening (Prosopyles)** → the **Radial Canals** → **Food** is ingested by the **choanocytes** → choanocytes's flagella forces the **used water** through **Internal Pores (Apopyles)** → **Spongocoel** → **Osculum**

TIPE KANAL SISTEM - SYCONOID



TIPE KANAL SISTEM - SYCONOID

- Food capture **does not occur** in the syconoid **spongocoel so it is lined with epithelial type cells**
- **Example: *Sycons , Grantia***
- **During development**, syconoid sponges pass through an asconoid stage, flagellated canals form by **evagination** of the body wall
- This developmental pattern provides evidence that syconoid sponges were **derived from an ancestor with an asconoid body plan**, but the **syconoid condition is not homologous** among all the sponges that possess it.
- Syconoids : **found in class Calcarea** and **some members of class Hexactinellida**

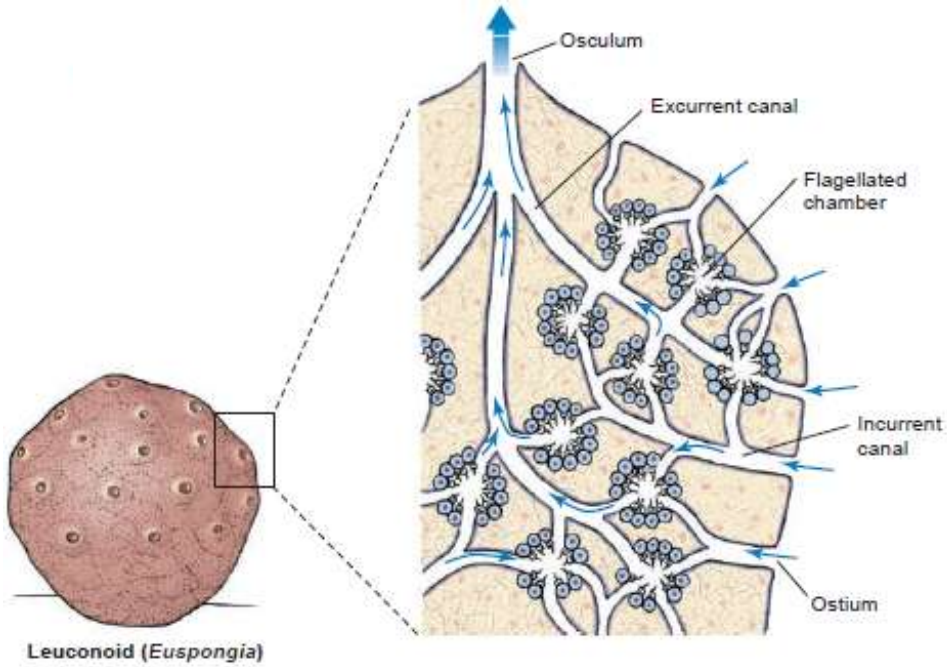


Sycon ciliatum

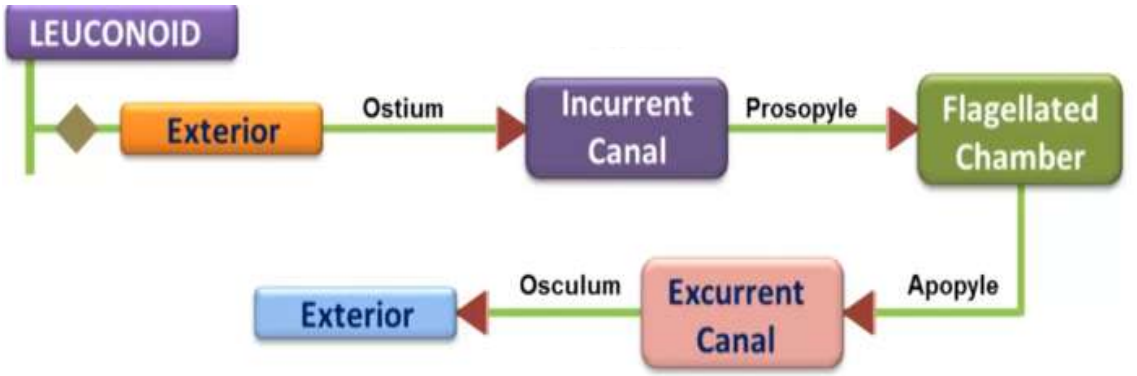
Grantia

TIPE KANAL SISTEM - LEUCONOID

- **Most complex**
- the **surface area of the food-collecting** regions with **choanocytes** is greatly increased
- **choanocytes line the walls of small chambers** where they can effectively filter all the water present
- Most sponges are of the leuconoid type
- Leuconoid bodies account for most species within **class Calcarea** and are the most common types in other classes.



Euspongia officinalis



TIPE KANAL SISTEM - LEUCONOID

- Ex: ***Leuconia***
- Small leuconoid sponge (10 cm tall and 1 cm in diameter)
- *Leuconia* has more than **2 million flagellated** chambers where food collection occurs
- *Leuconia,* all water is expelled **through a single osculum** at a velocity of 8.5 cm/ second—a jet force capable of carrying used water and wastes far enough from the sponge **to avoid refiltering**

Leuconia

- Some large sponges can fi lter 1500 liters of water a day,
- unlike *Leuconia,* most leuconoids form large masses **with numerous oscula** , so that water exits from many local sites on the sponge
- Ex: ***Mycale laevis***

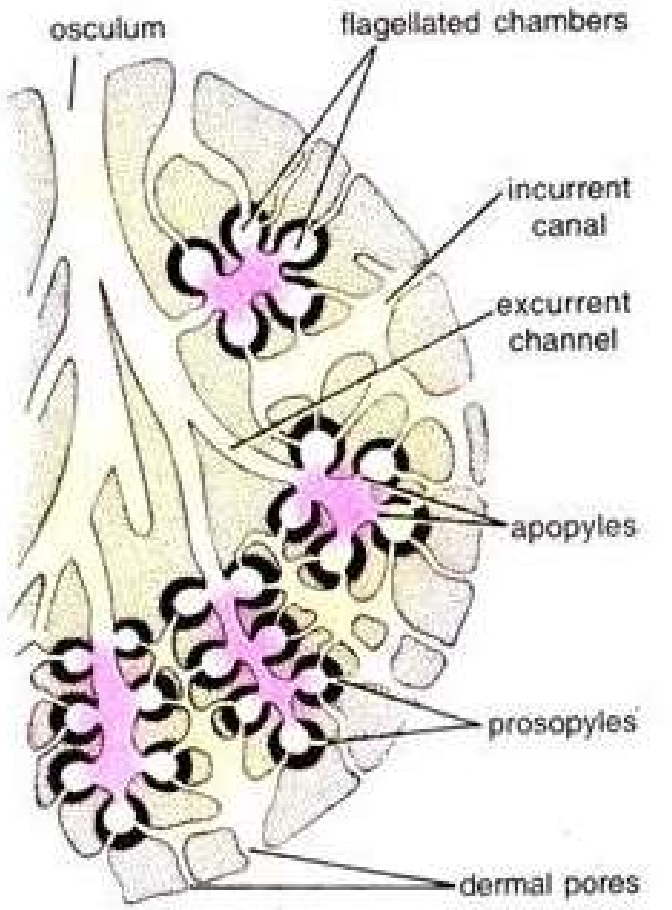
Mycale laevis

TIPE KANAL SISTEM – MODIFIKASI LEUCONOID

- **EURYPYLOUS**

  Flagellated chambers are wide and thimble-shaped, each opening directly into the excurrent canal by a wide aperture called **apopyle** and receive the water supply direct from the incurrent canal through the **prosopyle**.

Genus: Plakina
Plakina kanaky

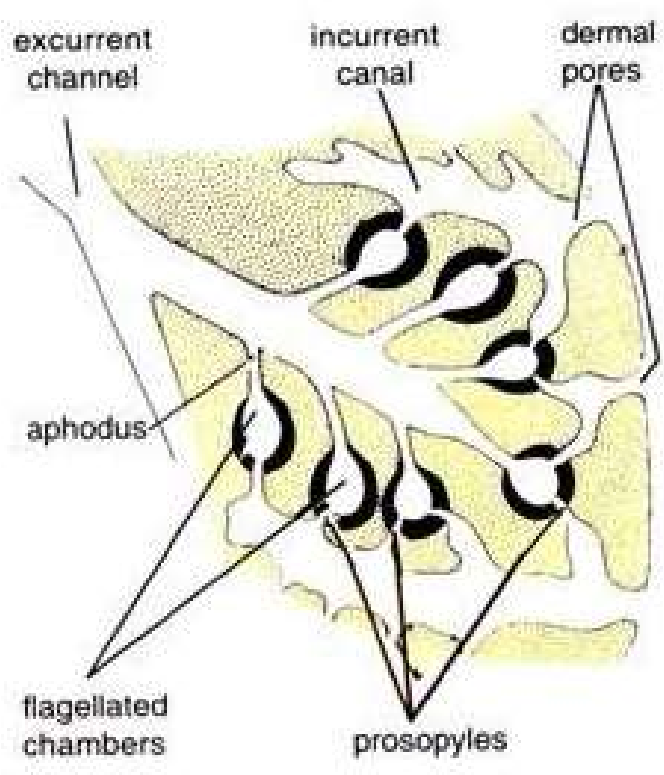


The current of water takes the following route → dermal pores or ostia → subdermal spaces → incurrent canals → prosopyles → flagellated chambers → apopyles —> excurrent canals spongocoel → oscula → out.

TIPE KANAL SISTEM – MODIFIKASI LEUCONOID

- **APHODAL**

  Flagellated chambers are **small and rounded**. The opening of each flagellated chamber into the excurrent canal is drawn out into a **narrow tube**, usually not of great length, termed **aphodus**.



Genus: Geodia
Geodia neptuni

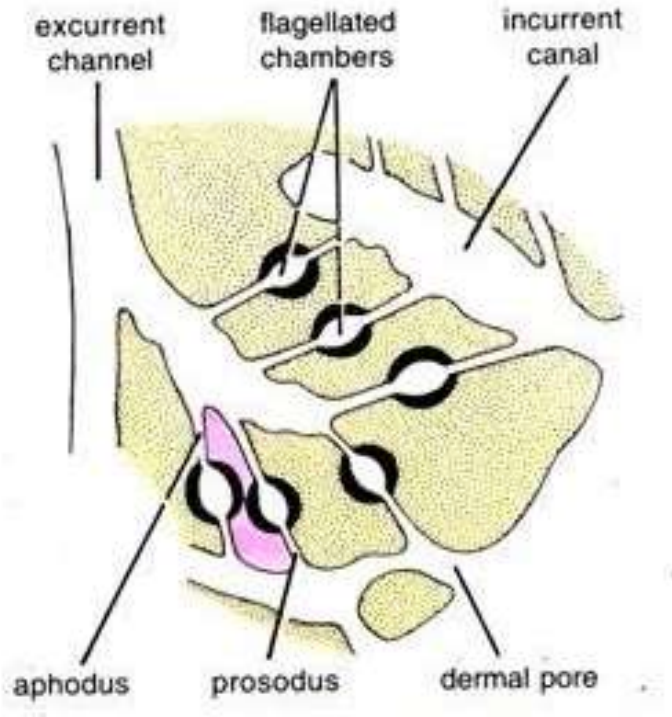
Genus: Stelleta
Stelleta clavosa

The route of water current is as follows dermal pores or ostia → subdermal space → incurrent canals → prosopyles → flagellated chambers → aphodus → excurrent canals→ spongocoel → oscula → out. This type of canal system is found in Geodia and Stelleta.

TIPE KANAL SISTEM – MODIFIKASI LEUCONOID

- **DIPLODAL**

  In some cases there is also a narrow current tube, the prosodus between the incurrent canal and the flagellated chambers, such a condition is called **diplodal**. This type of canal system is found in Oscarella, Spongilla, etc



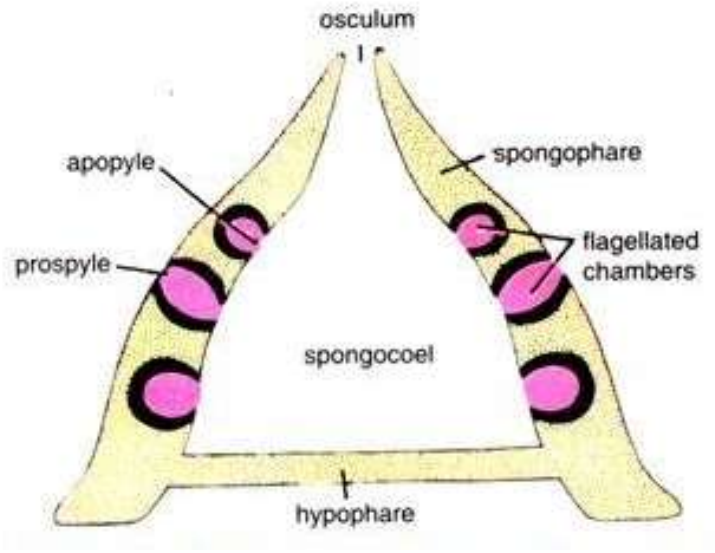
Genus: Oscarella
Oscarella lobularis

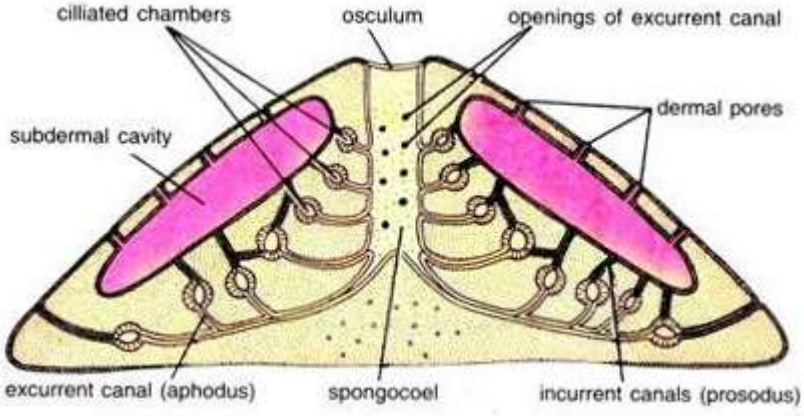
Genus: Spongilla
Spongilla lacustris

Dermal pores or ostia → subdermal spaces → incurrent canals → prosodus → flagellated chambers → aphodus → excurrent canals → spongocoel → oscula → out.

TIPE KANAL SISTEM - RHAGON TYPE

- A broad base and it is **conical in shape** with a single osculum at the summit.
- **The basal wall** is termed the **hypophare** which is without of flagellated chambers. The upper wall bearing a row of small, oval flagellated chambers is called **spongophare**.
- Spongocoel is bordered by oval flagellated chambers opening into it by **wide apopyles**.
- **Dermal pores or ostia** open into **sub-dermal spaces** which extend below the entire surface of the body.
- **Branching incurrent canals** lead from the sub-dermal spaces into small flagellated chambers
- The flagellated chambers alone are lined by **choanocytes**.





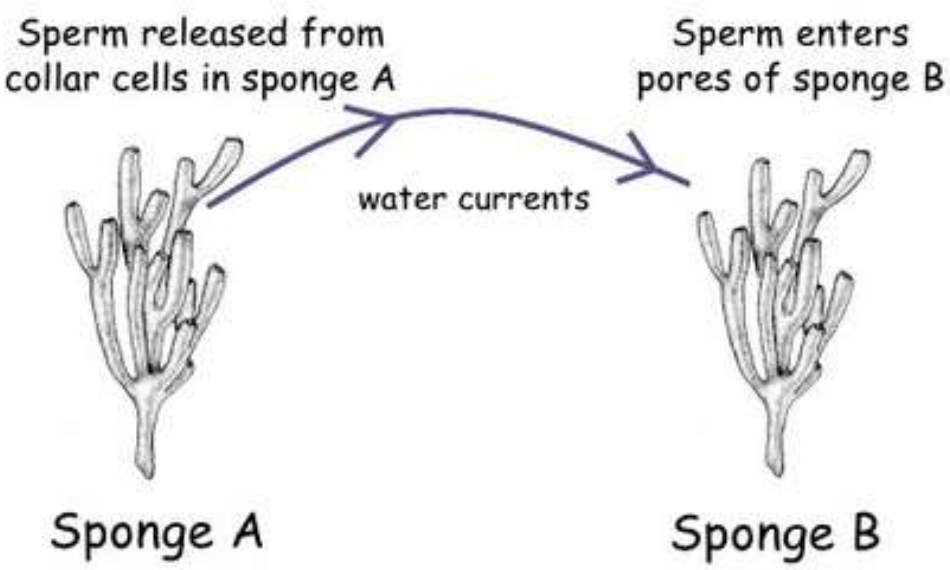
Spongilla

The incurrent and ex-current canals may be complex and branched. The spongocoel opens by a single osculum. The course of current of water is ostia→ sub-dermal spaces → incurrent canals → prosopyles → flagellated chambers → apopyles → ex-current canals → spongocoel → osculum → out.

REPRODUCTION - SEXUAL

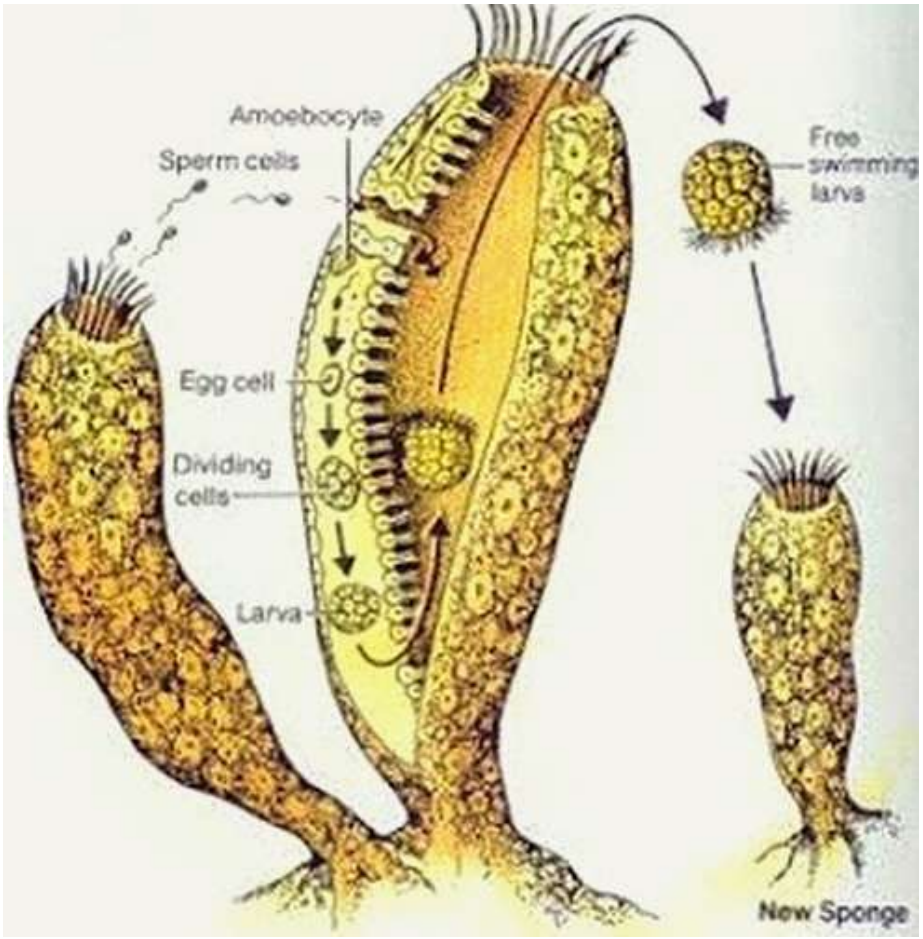
- Sponges use the "broadcast method" of reproduction

  1) Sexual reproduction - sponges are hermaphrodites (have both male and female reproductive parts)

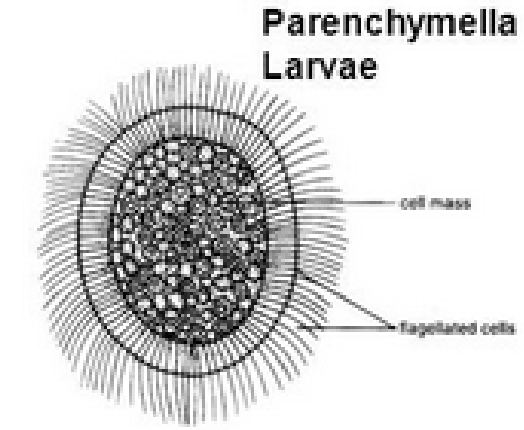


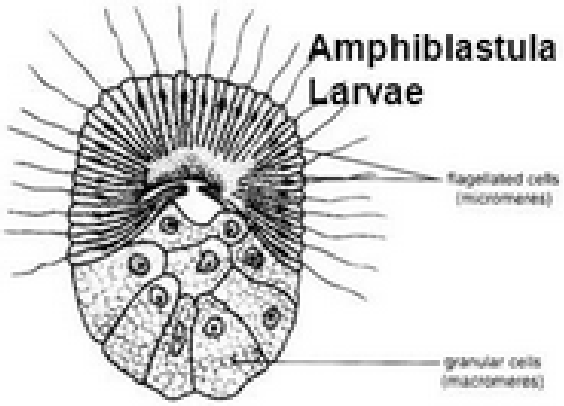
- Fertilization occurs inside sponge B (amoebocyte carries sperm to egg)
- Flagellated larvae develop and leave by the osculum → drift off and settle elsewhere

Sycon



REPRODUCTION - SEXUAL





Amphiblastula.

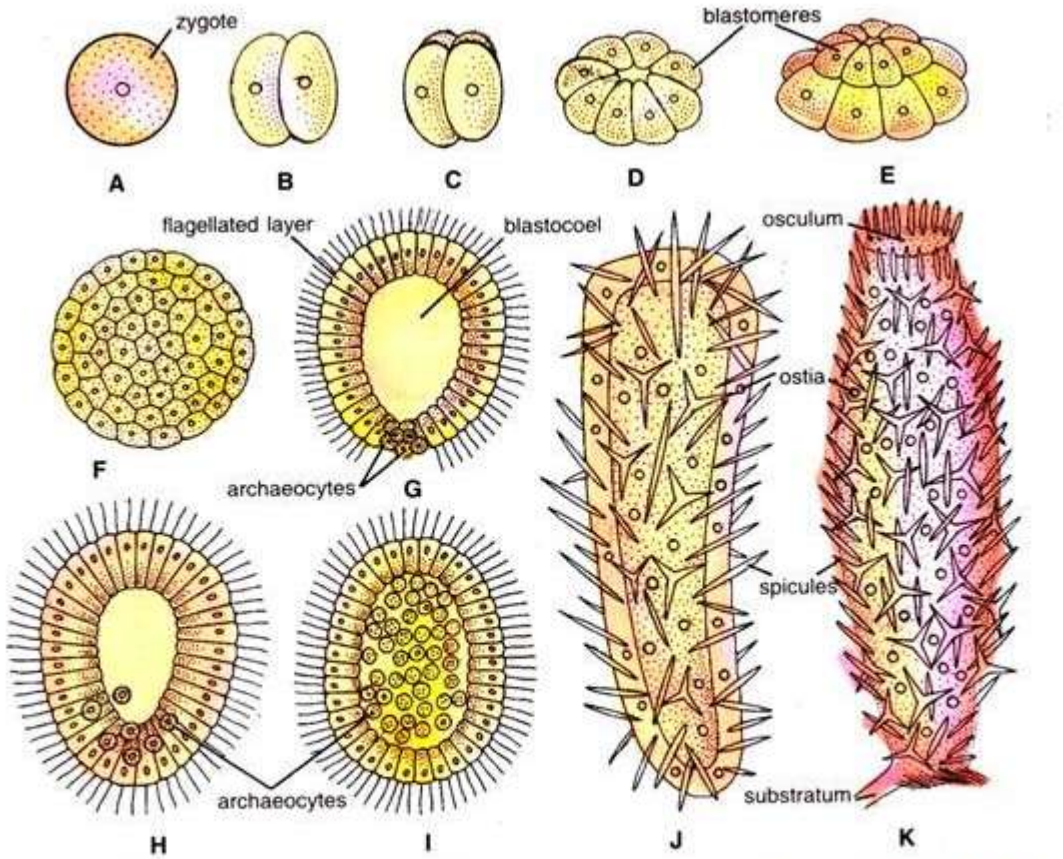


Fig. 25.7. *Leucosolenia.* Stages in development. A—Zygote; B to E—Cleaving stages; F—Early blastula; G and H—Coeloblastula ; I—Parenchymula; J—Young sponge; K—Adult sponge.

REPRODUCTION - SEXUAL

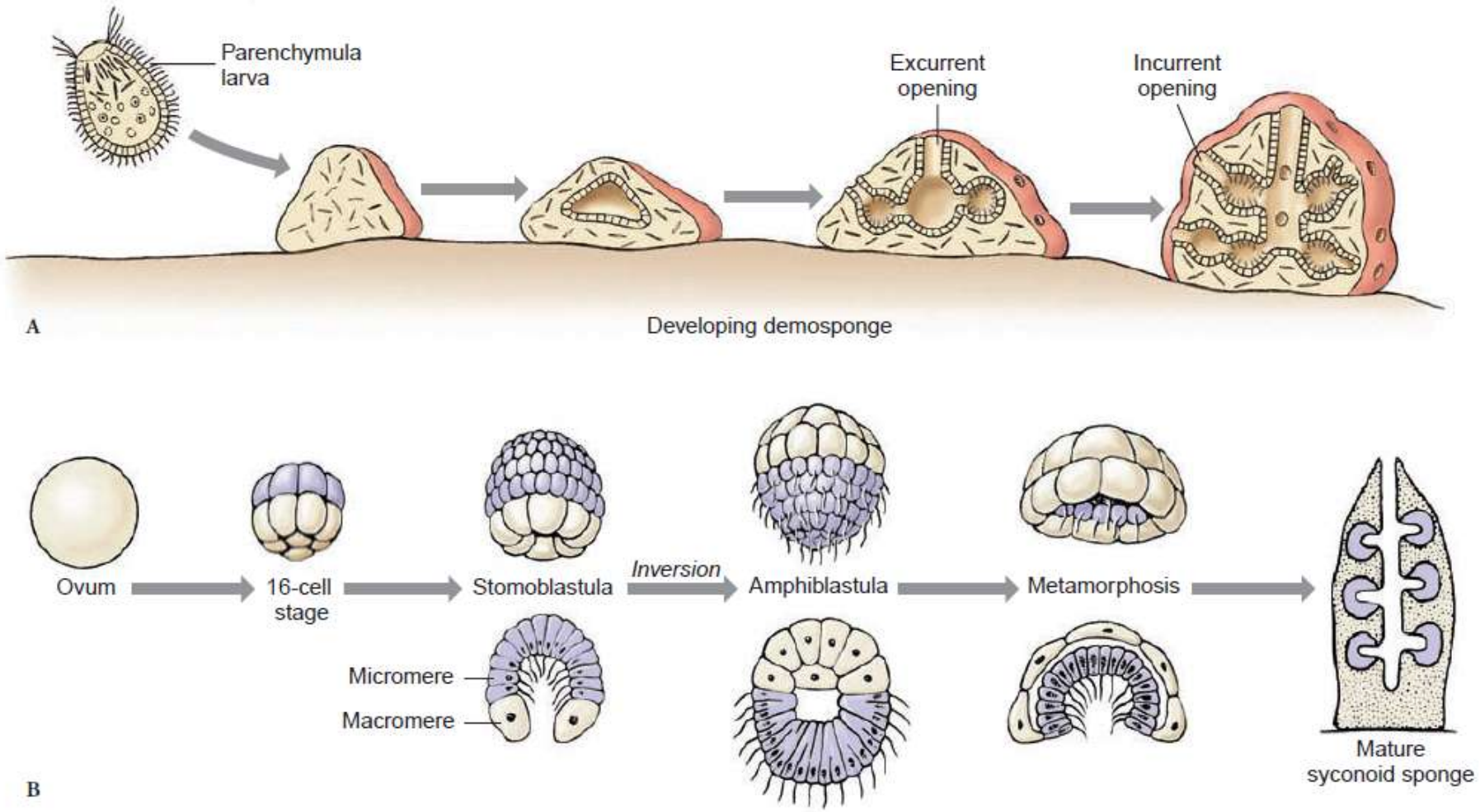
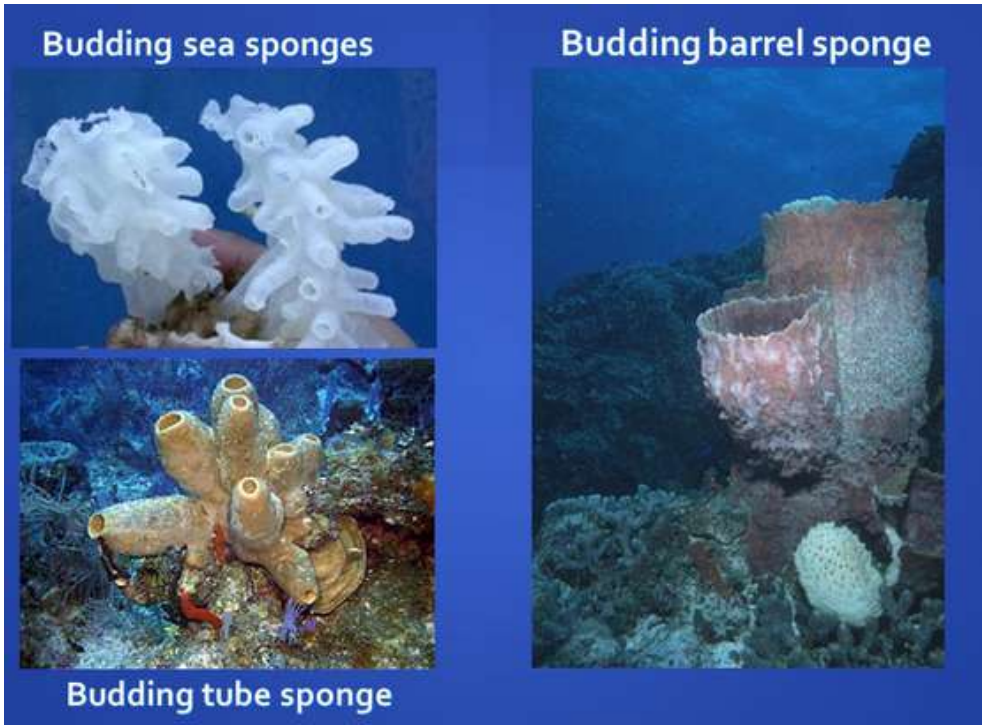


Figure 12.12

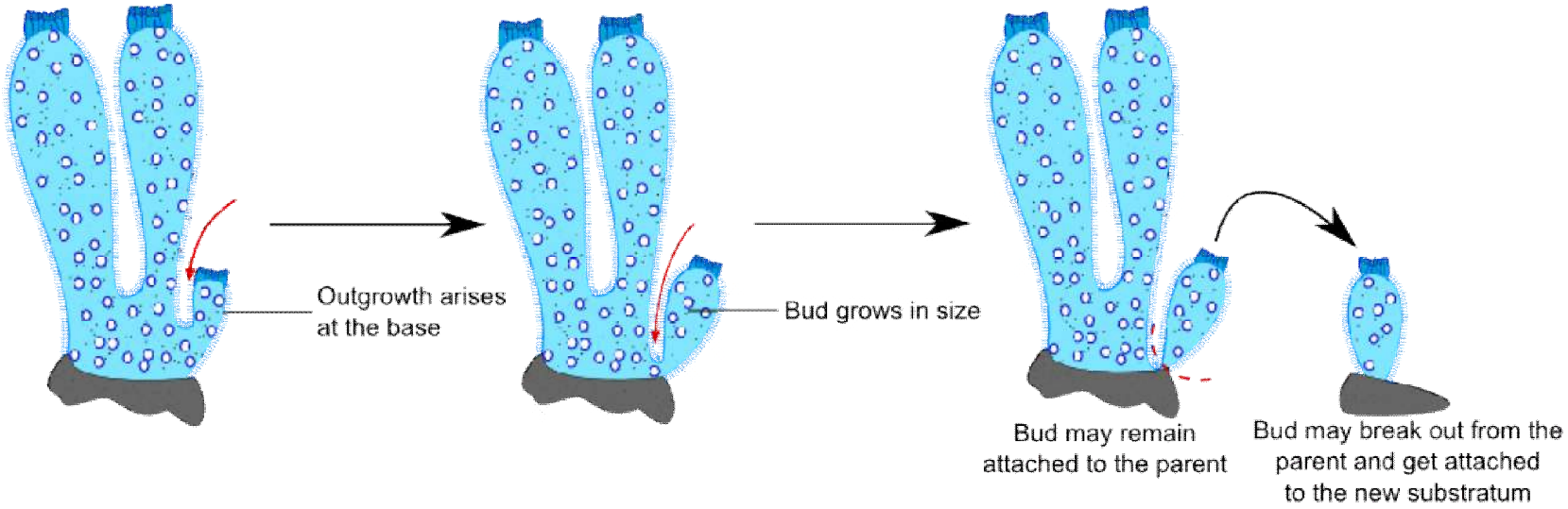
A, Development of demosponges. **B,** Development of the calcareous syconoid sponge *Sycon*.

REPRODUCTION - ASEXUAL

2) Asexual reproduction
- Budding - small growth falls off of sponge and grows a new sponge
- Gemmules - sphere-shaped collections of amoebocytes surrounded by spicules → leave sponge, settle, and wait for improved conditions



Exogenous Budding



ASEXUAL REPRODUCTION: BUDDING

REPRODUCTION - ASEXUAL

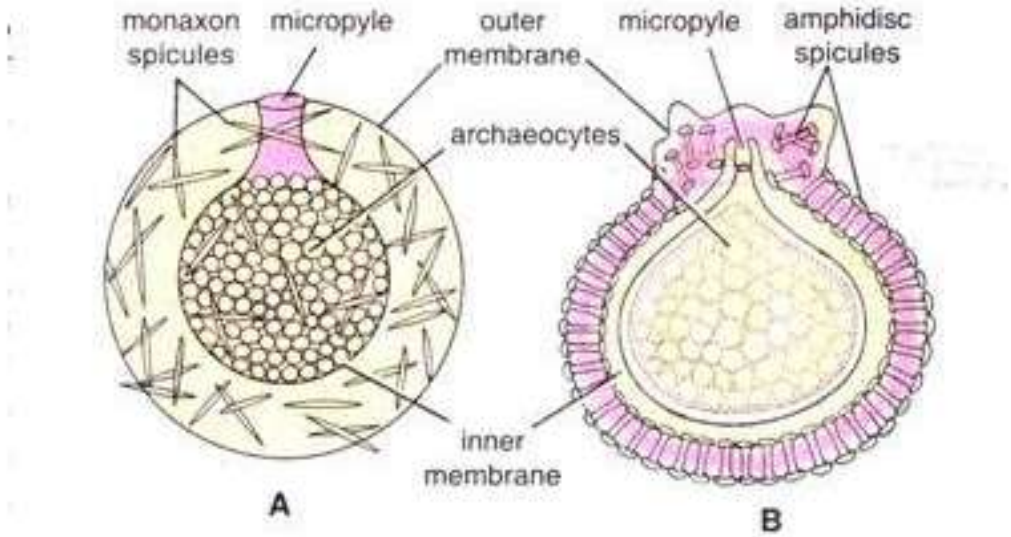


Fig. 28.14. A—Gemmule of *Spongilla*; B—Gemmule of *Ephydatia* (section).

Endogenous Budding:

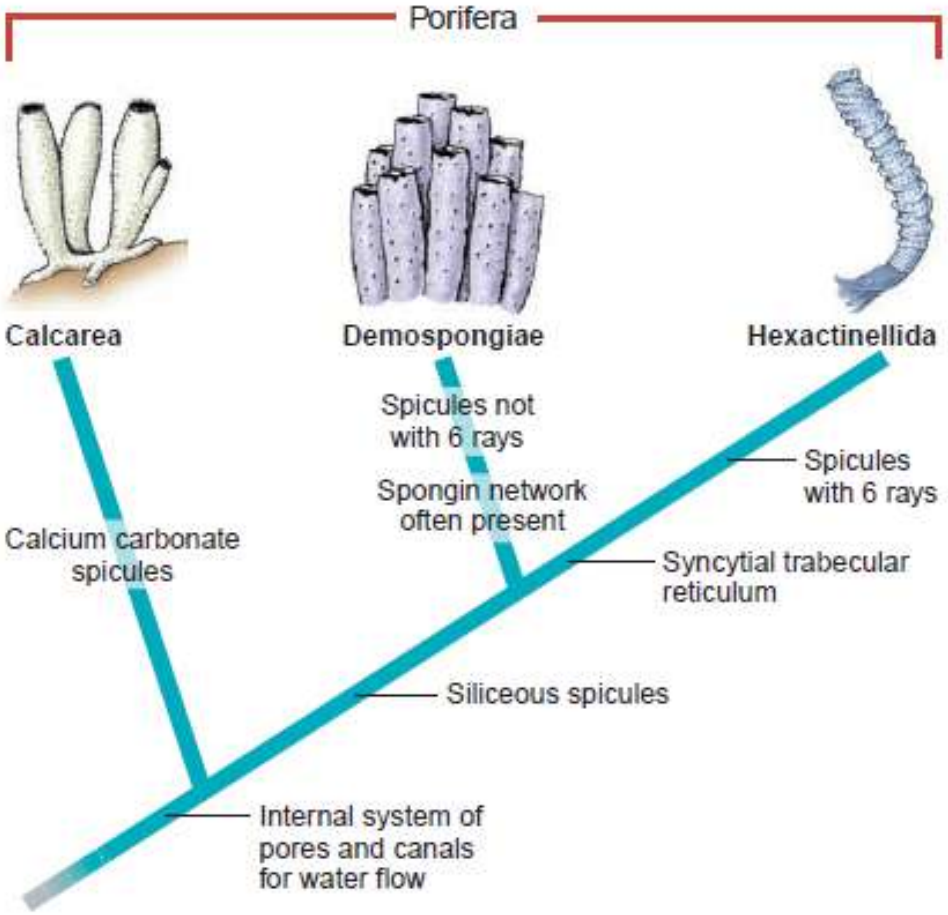
Made up of **Amoebcytes surrounded by a layer of spicules**

Gemmule :

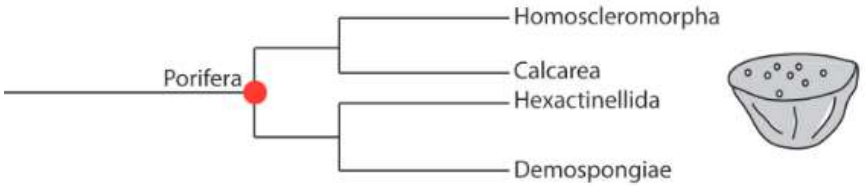
- Internal Bud
- formed internally in all freshwater sponges and some marine sponges.
- Response to Hostile environment
- Resistant to **Dessication** (Drying Out), **Freezing**, and **Anoxia** (Lack of Oxygen)

HABITAT - ECOLOGY

- Sponges often live in dark places
- Sponges provide shelter and food for other organisms
  - Remember the Biology Fun Fact of the Day?
- Certain sponges are involved in symbiotic relationships with bacteria
  - The bacteria provide food and O_2 to the sponge and remove wastes
- Some sponges clean up the ocean floor
- Many produce nasty-tasting/toxic chemicals to discourage munching



- Sponges appeared before the Cambrian.
  - Glass sponges expanded in the Devonian.
- One theory - sponges arose from choanoflagellates.
  - However, some corals and echinoderms also have collar cells, and sponges acquire them late in development
- Molecular rRNA evidence suggests a Common ancestor for choanoflagellates and metazoans.
  - Sponges and Eumetazoa are sister groups with Porifera splitting off before radiates and placozoans.



Evo-devo of non-bilaterian animals

Emilio Lanna

Departamento de Biologia Geral, Instituto de Biologia, Universidade Federal da Bahia, Salvador, BA, Brazil.

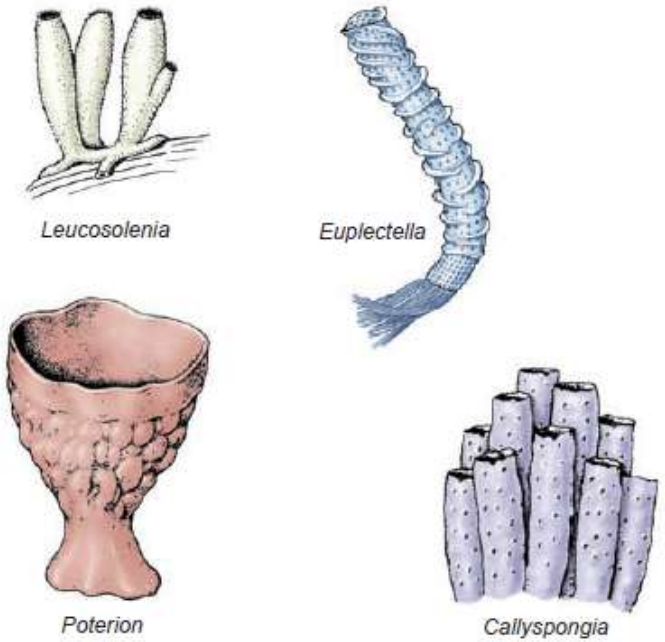


Figure 12.13

Some sponge body forms. *Euplectella* is in Hexactinellida, *Poterion* and *Callyspongia* are members of Demospongiae, and *Leucosolenia* is in Calcarea.

The Sponge Guide

a picture guide to Caribbean Sponges

Home FAQ Species List Search References Updates About Us

Introducing the 3rd Edition!

With this edition of the Sponge Guide, we present **over 230 species morphs** of sponges from the Caribbean region. Our catalog now includes **over 2,100 images** that have been tagged with searchable physical characteristics.

We have begun to provide composite images of skeletal structures, a primary tool for identification, for 49 species morphs. In addition, we've expanded the regions we've visited and cataloged to capture more of the geographic and habitat variation of these animals.

Finally, you'll notice some new search features, detailed descriptions and notes, and many other features as you browse and explore the Sponge Guide, 3rd Edition.

Just click the **Find a Sponge** tab on the right to begin. Enjoy!

Data used from the Sponge Guide can be referenced as:

Zea, S., Henkel, T.P., and Pawlik, J.R. 2014. The Sponge Guide: a picture guide to Caribbean sponges. 3rd Edition. Available online at www.spongeguide.org. Accessed on: 2018-02-06 .

Visit: http://www.spongeguide.org/index.php

Class Calcarea

- Calcareous sponges (**Class Calcarea**) have spicules composed of calcium carbonate.
- Small, usually vase shaped.
- Asconoid, syconoid, or leuconoid in structure.

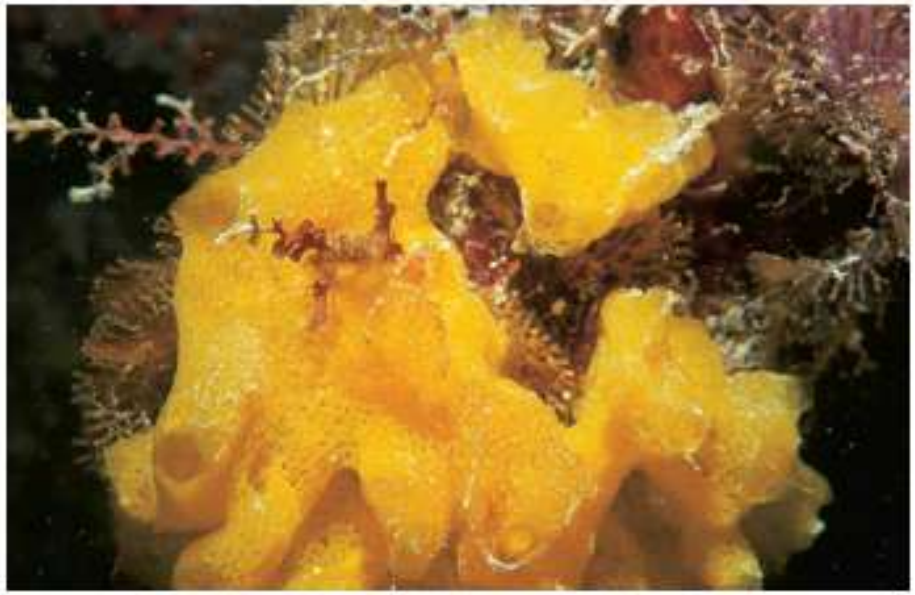


Figure 12.6
Clathrina canariensis (class Calcarea) is common on Caribbean reefs in caves and under ledges.

CATATAN:

Class Demospongiae

- **Class Demospongiae** contains most of the sponge species.
- Spicules are siliceous, but not six-rayed.
- Spicules may be bound together by spongin, or absent.
- All leuconoid, mostly marine.

CATATAN:

Class Demospongiae

A

B

C

Figure 12.15

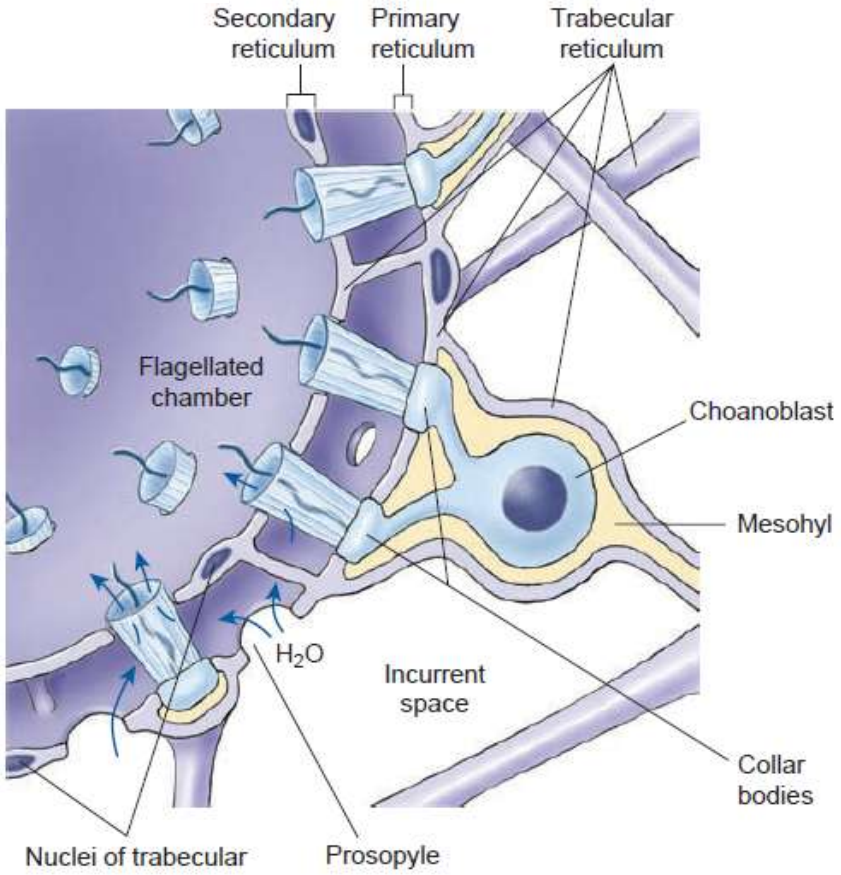
Marine Demospongiae on Caribbean coral reefs. **A**, *Pseudoceratina* crassa is a colorful sponge growing at moderate depths. **B**, *Aplysina fistularis* is tall and tubular. **C**, *Monanchora unguifera* with commensal brittle star, *Ophiothrix suensoni* (phylum Echinodermata, class Ophiuroidea).

Class Hexactinellida

- Glass sponges (**Class Hexactinellida**) are mostly deep sea forms.
  - Spicules are six-rayed and made of silica.
- Hexactinellids lack a pinacoderm or gelatinous mesohyll.
- Chambers appear to correspond to both syconoid and leuconoid types.

CATATAN:

- Some advocate placing hexactinellids in a subphylum separate from other sponges.
- **Trabecular reticulum** made of a fusion of archaeocyte pseudopodia - forms the chambers opening to spongocoel.
  - Trabecular reticulum is largest continuous syncytial tissue known in Metazoa.
- Choanoblasts are associated with flagellated chambers.
- Collar bodies do not participate in phagocytosis – this is the function of the primary and secondary reticula.



Class Homoscleromorpha

Read:

Systema Porifera: A Guide to the Classification of Sponges, Edited by John N.A. Hooper and Rob W.M. Van Soest

Order Homosclerophorida Dendy, 1905, Family Plakinidae Schulze, 1880

Guilherme Muricy[1] & Maria Cristina Díaz[2]

[1]Departamento de Invertebrados, Museu Nacional, Universidade Federal do Rio de Janeiro.
Quinta da Boa Vista, s/no., São Cristóvão. 20940-040 Rio de Janeiro, Brazil. (muricy@acd.ufrj.br)
[2]Institute of Marine Sciences, University of California Santa Cruz, CA 94038, USA. (Diaz@cats.ucsc.edu)

Homosclerophorida Dendy (Demospongiae, Homoscleromorpha) contains a single family Plakinidae Schulze (including Oscarellidae Lendenfeld and Corticiidae Vosmaer), with seven valid genera and about 60 valid species worldwide. Species live mainly in shallow waters but a few have been recorded from abyssal depths (up to 2460 m). Species are often encrusting, lobate, but massive species are common in some genera (*Plakortis*, *Plakinastrella*); surface is usually smooth or microhispid and consistency varies from soft to cartilaginous. All genera possess flagellated exo- and endopinacocytes, a basement membrane lining both choanoderm and pinacoderm, oval to spherical choanocyte chambers with a sylleibid-like or leuconoid organization, and a unique incubated cinctoblastula-type larvae; spicules, when present, are peculiar tetractines (calthrops) and derivatives. Genera are distinguished mainly by four morphological characters: presence of a siliceous skeleton; presence of a cortex associated with a leuconoid aquiferous system and well-developed mesohyl or a sylleibid aquiferous system with poorly developed mesohyl and ectosome; number of spicule size classes; and presence and type of ramifications in the actines of calthrops (tetractinal spicules), with three distinct general morphologies recognized.
Keywords: Homosclerophorida; Plakinidae; *Corticium*; *Oscarella*; *Placinolopha*; *Plakina*; *Plakinastrella*; *Plakortis*; *Pseudocorticium*.

PERAN SPONGE DALAM KEHIDUPAN

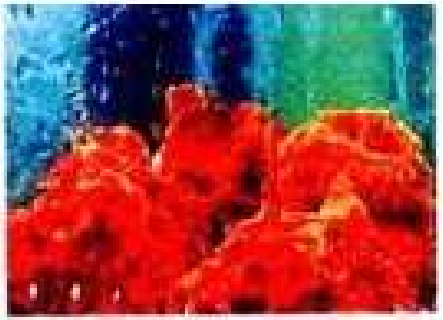
-sebagai spons mandi dan alat gosok
-spongia dan hippospongia, Zat kimia yang dikeluarkannya berpotensi sebagai obat penyakit kanker dan penyakit lainnya.

PERAN SPONGE DALAM KEHIDUPAN

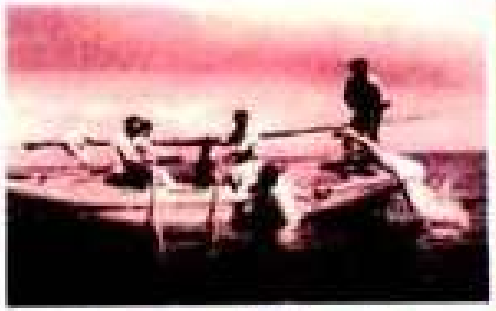
Sponges as swabs.

Sponges as commensals(protective houses).

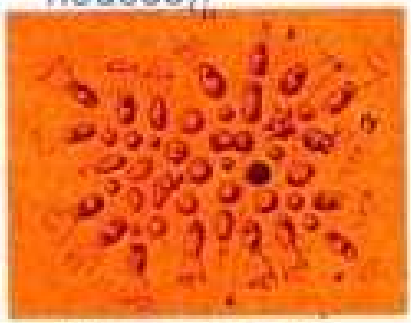
Sponge fishing in Florida.



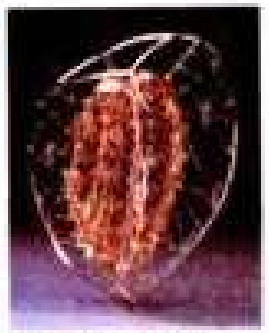
Sponge culture (*Teichhexinella* sp).



Sponge fishing in Kalymnos.



Proterospongia.



Euplectella brooch.

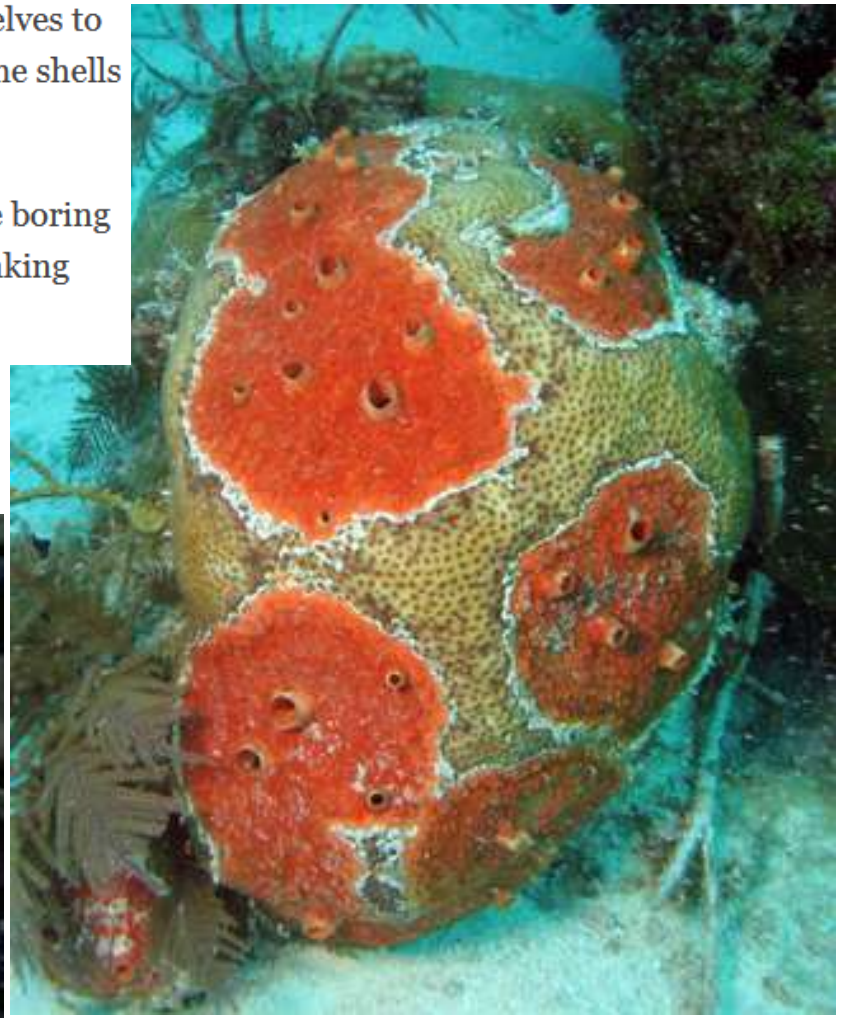
Nudibranch feeding on sponge.

Sponges are economically important.

Harmful Sponge

Only a few sponges are harmful. They may cause the death of some sessile animals by growing over them and cutting off their food and oxygen supply. The boring sponges, like Cliona attach themselves to the shells of oysters, clams, and barnacles, etc. It bores into the shells of these animals and completely destroy them.

The boring sponges also cause great harm to oyster beds. The boring sponges also destroy rocks by penetrating into them and breaking them into pieces.



SOFT SKILL

“Aku rasa kau harus berhenti menilai orang dari penampilannya saja “
[Spongebob Squarepants]

TUGAS

Review Jurnal

TULIS DI BUKU TUGAS

1. Proses terbentuknya gemmule
2. Lengkapi catatan