

Lecture 2. Sponges

Parazoa: The Phylum Porifera (Sponges)

- The first dichotomous branch point in the phylogenetic tree of animals distinguishes between the parazoans and the eumetazoans; organisms lacking true tissues versus those that have truly specialized tissues.
- Tissue is a cellular organizational level intermediate between cells and a complete organ. A tissue is an ensemble of similar cells from the same origin that together carry out a specific function.
- Organs are then formed by the functional grouping together of multiple tissues.



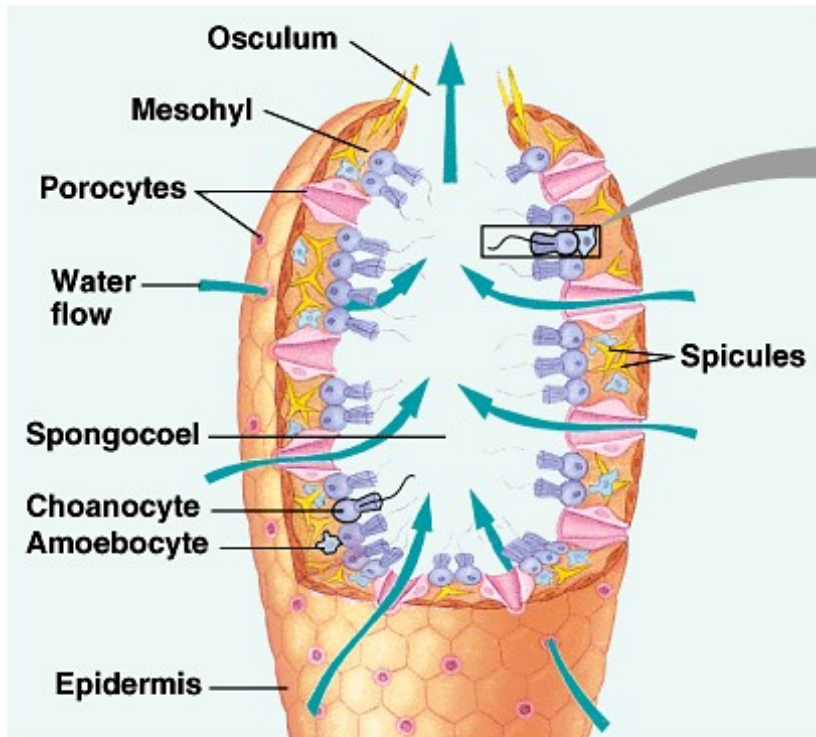
Frank and Joyce Burek



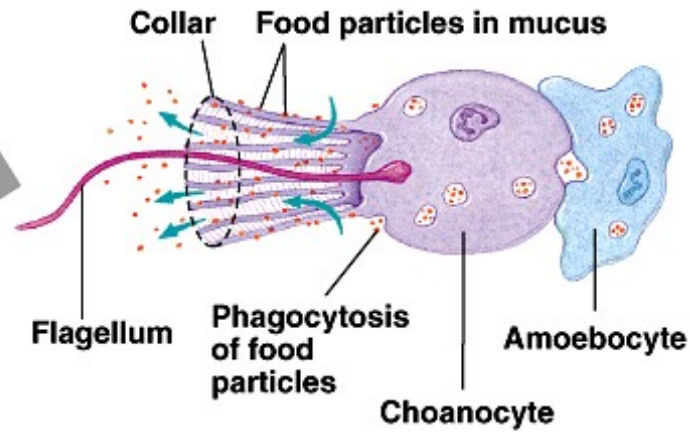
Phylum Porifera: Sponges

- Structurally simplest multicellular animals
- Cellular level of organization
 - **No true tissues or organs**
- Amazing variety of shapes, sizes, colors, but simple body plan
- Sponges are animals with no tissues and no symmetry
- There are different cell types in a sponge, each cell with different functions, but they are not a tightly integrated system like in other animals



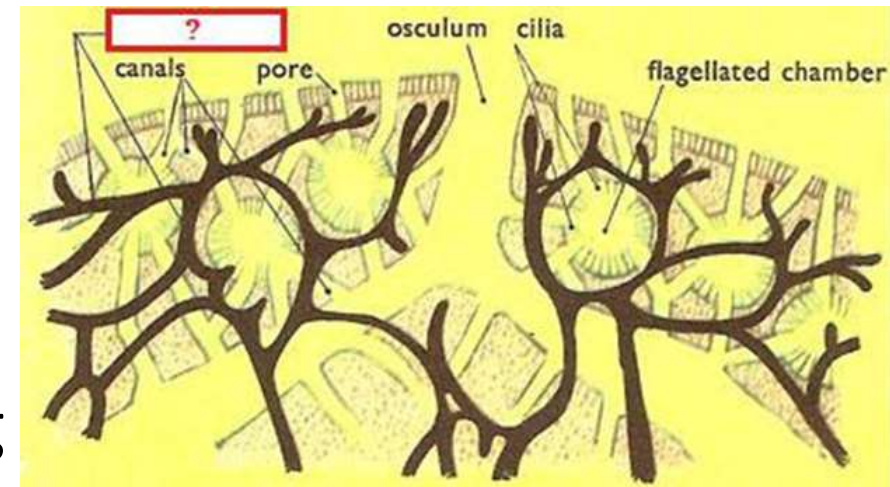


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- The cell layers are loose conglomeration of cells. They are not really tissues as they are unspecialized.
- Numerous pores (ostias)—allow water to enter
- Collar cells (choanocytes) with flagella beat, pulling in water and food (-cyte: cell)
- Influx passes through the matrix, where amoebocytes and collar cells absorb food
- Structure maintained by spicules of mineralized material

- **Spicules**: calcareous or siliceous support elements in the mesohyl, produced by sclerocytes.
 - prevent movement
 - Preserving sponge's shape
 - keeping pores open and maintaining internal channels



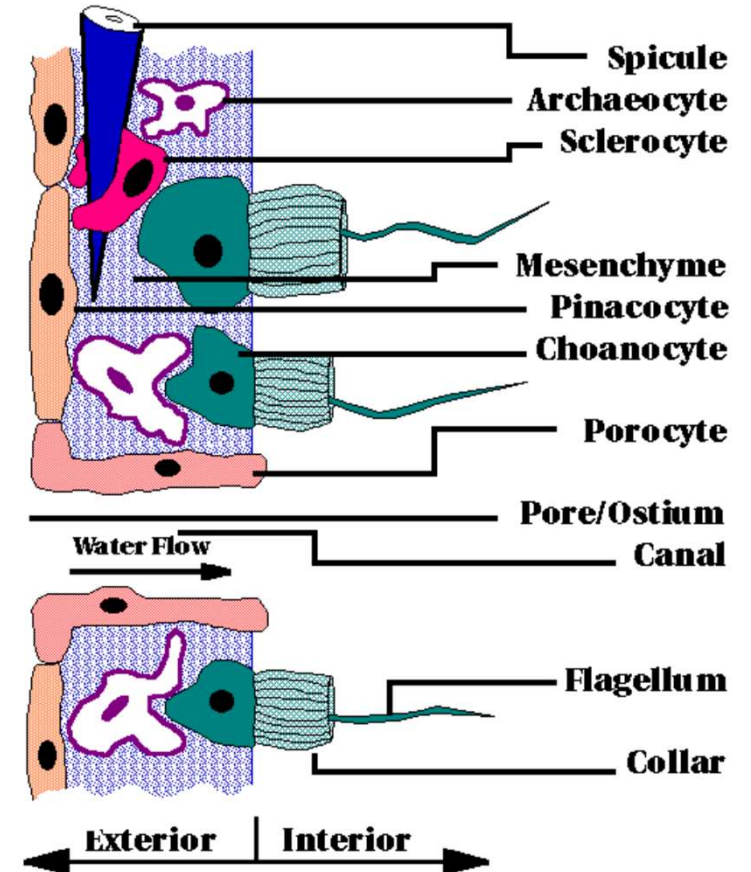
- **Spongin** :a modified type of collagen protein, forms the fibrous skeleton
- Secreted by sponge cells known as spongocytes. Spongin gives a sponge its flexibility. True spongin is found only in members of the class Demospongiae.

Pinacocytes : These cells are the "skin cells" of sponges. They line the exterior of the sponge body wall. They are thin, leathery and tightly packed together. The pinacocytes also digest food particles that are too large to enter the ostia

Choanocytes : are versatile cells. Their flagella beat to create the active pumping of water through the sponge, while the collars of the choanocytes are the primary areas that nutrients are absorbed into the sponge. Furthermore, in some sponges the choanoflagellates develop into gametes.

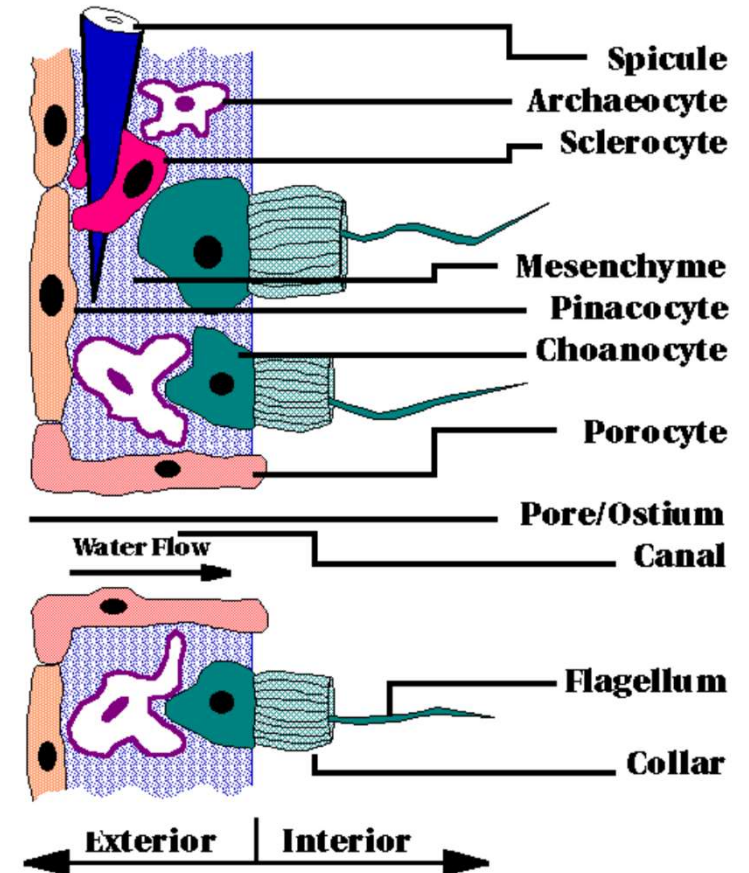
Mesenchyme : Between the two layers is a thin space called mesenchyme or mesohyl. The mesenchyme consists of a proteinaceous matrix, some cells, and spicules.

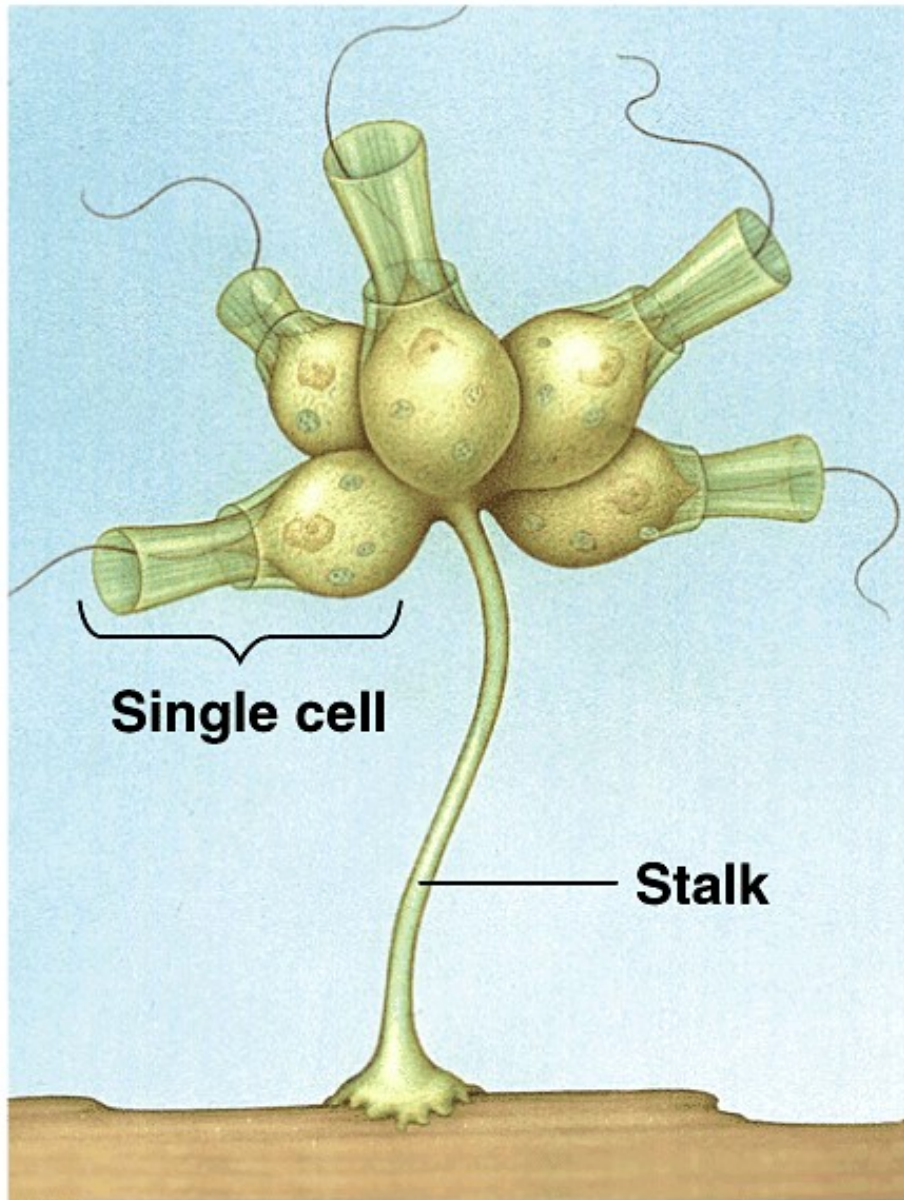
MICROSCOPIC VIEW OF A PORIFERAN WALL



- **Archaeocytes (amoebocytes):** These cells are totipotent, which means that they can change into all of the other types of sponge cells. Archaeocytes ingest and digest food caught by the choanocyte collars and transport nutrients to the other cells of the sponge. In some sponges, archaeocytes develop into gametes.
- **Sclerocytes :** The secretion of spicules is carried out by sclerocytes. Other cells, called spongocytes, secrete the spongin skeletal fibres when those are present.
- **Myocytes and Porocytes :** Poriferans do not have any muscle cells, so their movement is rather limited. However, some poriferan cells can contract in a similar fashion as muscle cells. Myocytes and porocytes which surround canal openings and pores can contract to regulate flow through the sponge.

MICROSCOPIC VIEW OF A PORIFERAN WALL





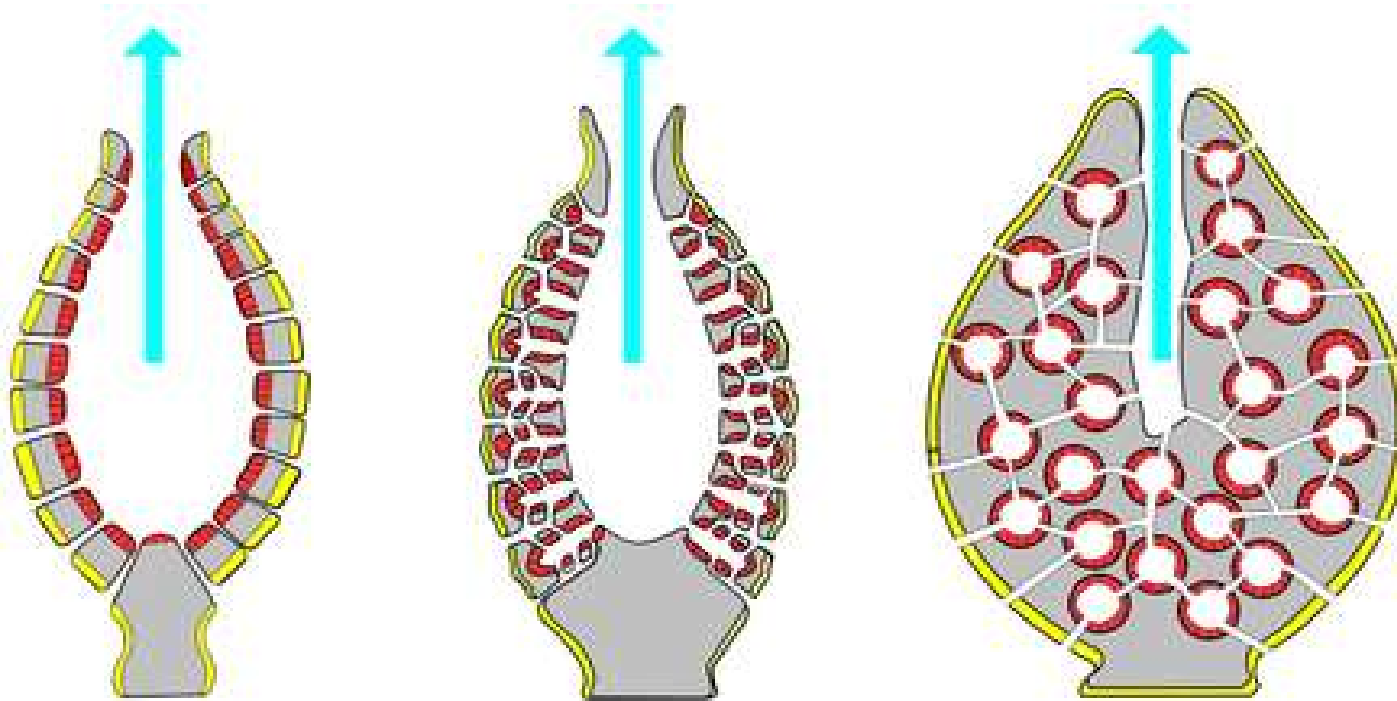
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Animals probably evolved from colonial, flagellated protists, like this choanoflagellate colony.

Biologists think that sponge choanocytes are very similar to choanoflagellate cells, and they believe that it is highly likely that sponges arose from choanoflagellates that lived in late Precambrian seas.

Biologists believe that the molecular evidence points to ancient choanoflagellates as close relatives of the ancestor of all animals.

Most sponges work rather like chimneys!



Asconoid

Syconoid

Leuconoid

Pinacocytes

Choanocytes

Mesohyl

Water flow

- **Class Calcarea (Calcereous Sponges)**
- They are characterized by [spicules](#) made out of [calcium carbonate](#) in the form of [calcite](#) or [aragonite](#). While the spicules in most species have three points, in some species they have either two or four points.
- Calcereous sponges are small, usually only a few inches high, and are generally dull in appearance, although several species are brightly colored.
- Members of this class are among the simplest sponges, and all three morphological types—*asconoid*, *syconoid*, and *leuconoid*—are represented.



- The **Demospongiae** are the largest class in the phylum Porifera. Their "skeletons" are made of spicules consisting of fibers of the protein spongin, the mineral silica, or both.
- The demosponges include 90% of all species of sponges and are predominantly leuconoid in structure.



- **Hexactinellid sponges** are sponges with a skeleton made of four- and/or six-pointed siliceous spicules, often referred to as **glass sponges**.
- Glass sponges are relatively uncommon and are mostly found at depths from 450 to 900 metres (1,480 to 2,950 ft)
- They are more-or-less cup-shaped animals, ranging from 10 to 30 centimetres (3.9 to 11.8 in) in height

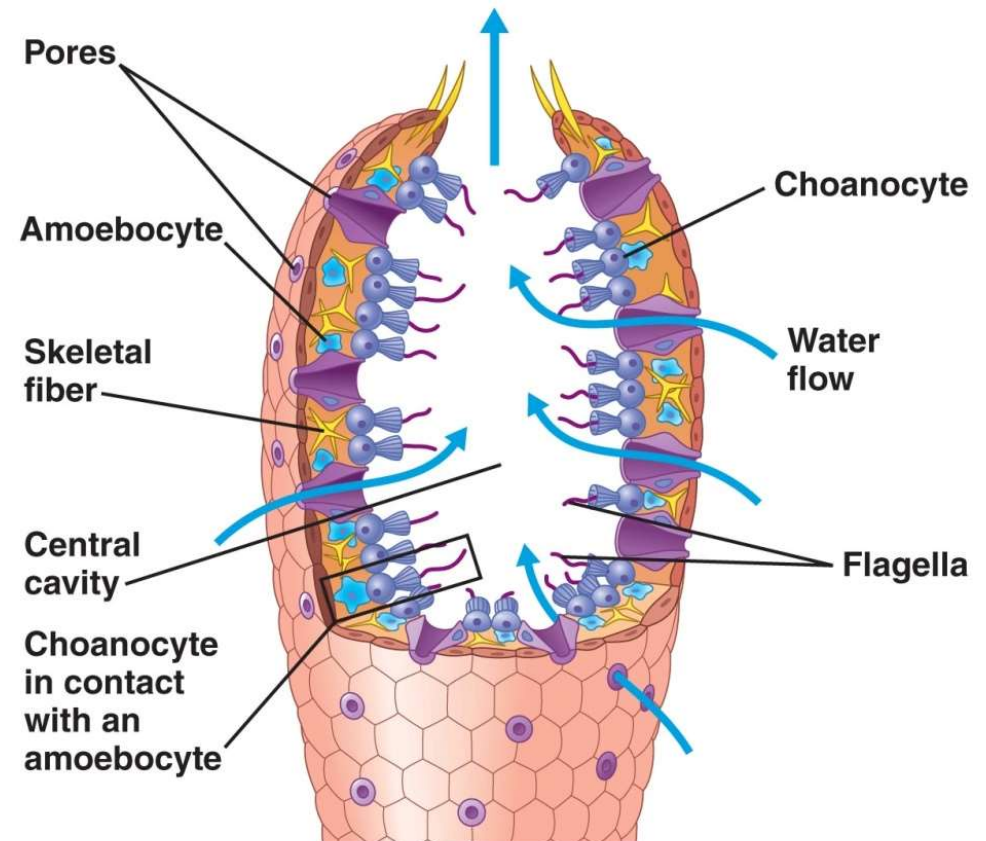


Sponges are divided into classes mainly according to the composition of their skeletons

	Type of cells	<u>Spicules</u>	<u>Spongin</u> fibers	Body form
<u>Calcarea</u>	Single nucleus, single external membrane	<u>Calcite</u> May be individual or large masses	Never	Asconoid, syconoid, leuconoid or solenoid
<u>Hexactinellidas</u>	Mostly <u>syncytia</u> (multinucleated) in all species	<u>Silica</u> May be individual or fused	Never	Leuconoid
<u>Demospongiae</u>	Single nucleus, single external membrane	Silica	In many species	Leuconoid
<u>Homoscleromorpha</u>	Single nucleus, single external membrane	Silica	In many species	leuconoid

Feeding

- The spongocoel is connected to the outside via an opening called the osculum.
- Water is drawn into the spongocoel through the pores, and food particles in the water may pass the sponge's choanocytes.
- The flagellum of a choanocyte pulls in food particles, which get stuck in the sticky mucus of the collar and are picked up by amoebocytes.

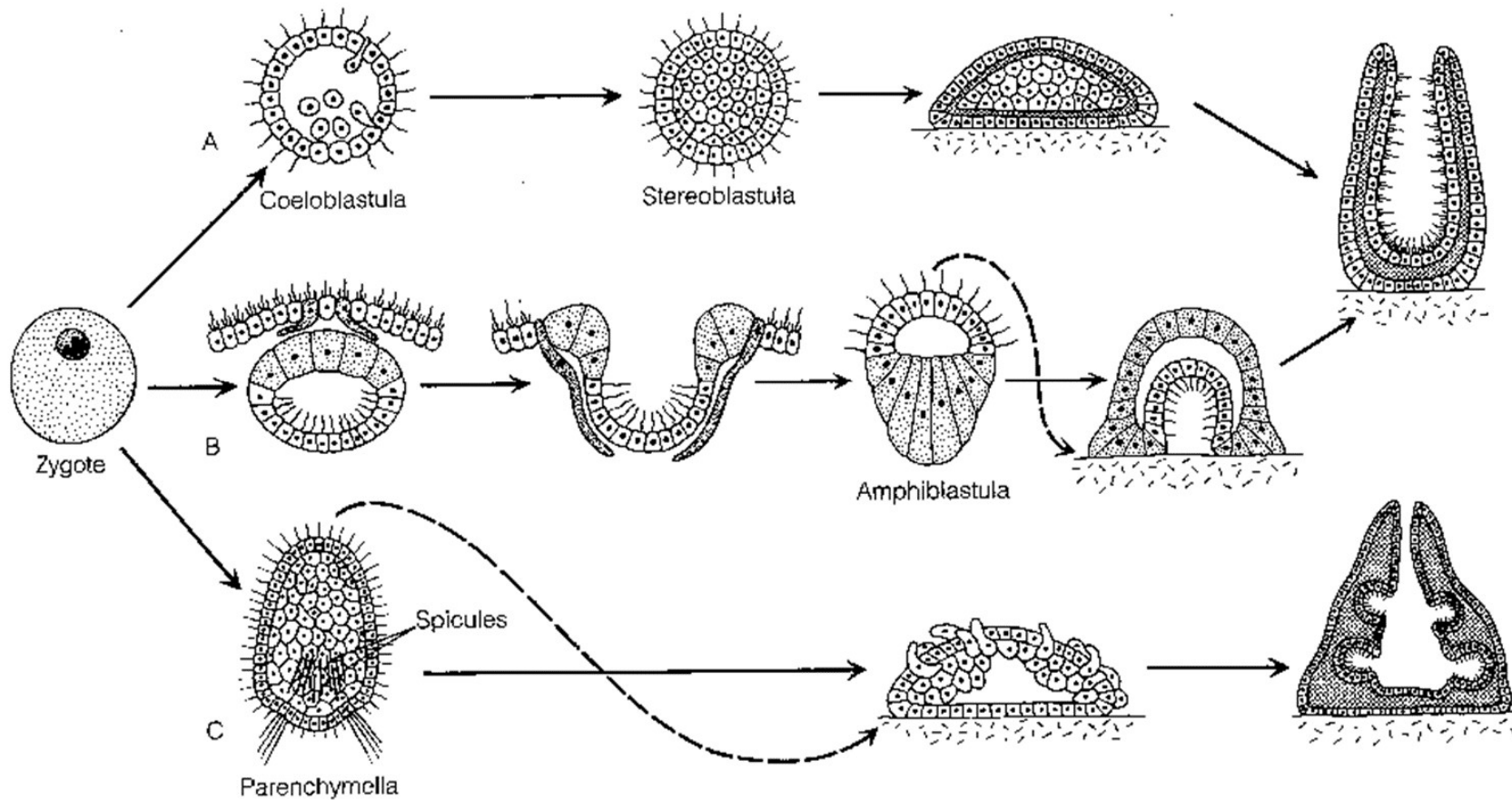


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Reproduction

- Asexual
 - Branches or buds break off, grow into identical sponge
- Hermaphrodites and sexual
 - Male and female gonads, cross-fertilized
 - Broadcast spawning
 - Spermatocytes develop from the transformation of [choanocytes](#) and [oocytes](#) arise from [archoocytes](#).
 - Sperms enter through ostium and engulfed by choanocytes, lose flagellum, and finding eggs
 - Repeated cleavage of the zygote egg takes place in the [mesohyl](#) and forms a [parenchymella](#) larva with a mass of larger internal cells surrounded by small, externally [flagellated](#) cells.
 - The resulting swimming larva enters a canal of the central cavity and is expelled with the exhalant current.





Amphiblastula: hollow, swimming larvae of calcareous sponges and some demosponges.

Parenchymella: extensively flagellated larvae of most demosponges.

Phylum Porifera: Sponges

- 15000 species, mostly marine
- Non-moving (sessile) animals
 - Sessile: live permanently attached to bottom
- No nerves or muscles (no tissue differentiation) - All other animals have true tissues
- Filter feeders: Collect food particles from water
- Most sponges are hermaphrodites.
 - Hermaphrodites function as both male and female in sexual reproduction by producing eggs and sperm.

Phylum Porifera: Sponges

Polymorphism

Flat encrusting growth :
exposed to wave action

Tall and hang-down : in
crevice or still water



http://www.easterncapescubadiving.co.za/index.php?page_name=specie&specie_id=318

Boring sponge

The boring sponge is a thick, bright yellow sponge that bores holes into its host for shelter.



(Bernard Picton/Encyclopedia of Marine Life of Britain and Ireland)

Carnivorous sponges (meat eater)



A. monticola, a new species of carnivorous sponge, uses hooks to trap tiny crustaceans. Photograph by 2006 MBARI

<http://voices.nationalgeographic.com/2014/04/18/sponges-animals-carnivores-science-weird-new-species/>

<https://www.youtube.com/watch?v=m8a0oNsDEx8>
<http://shapeoflife.org/video/sponges-origins>