Phylum Porifera (Sponges)

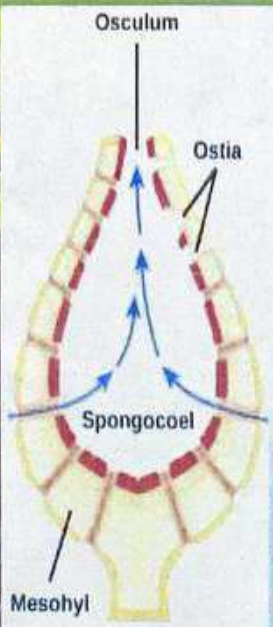


Definition

- Porifera is the only phylum of the ***Parazoa*** (no true tissues) in the Kingdom Animalia.
- More than 5000 animal species of Sponges constitute the Phylum Porifera
- Sponges are mostly marine inhabitants , but few are fresh water.
- They found wherever there are rocks, shells, or coral to provide a suitable substratum.
- Most sponges prefer relatively shallow water, but some groups live in deep water.

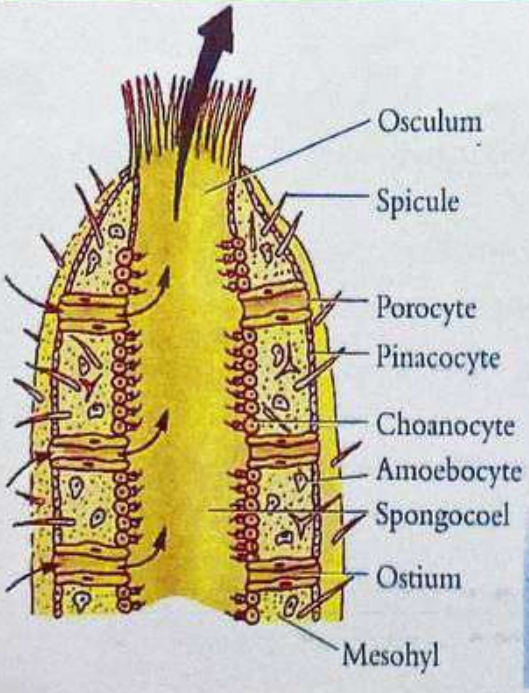
Structure of Sponge





- Body wall encloses large cavity called ***spongocoel***.
- Water enters spongocoel through numerous pores ***ostia***
- Water leaves spongocoel through large aperture ***osculam***.
- Body wall consists of jelly-like substance called ***mesohyl***
- Mesohyl sandwiched between two thin layers of cells.

Body Wall Layers



1. The outer layer (epidermis)

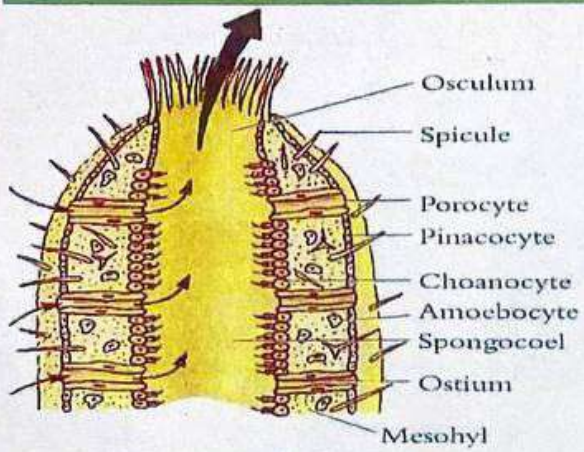
a) Pinacocytes (Plate-like cells):

- Cover the exterior and some interior surfaces.
- Digest food particles that are too large to enter the ostia.
- At the base of the animal are responsible for anchoring it.

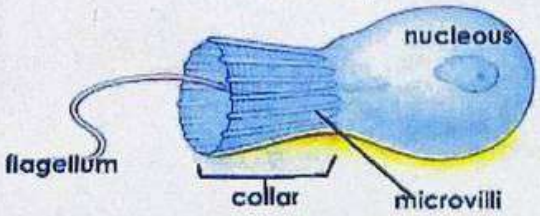
b) Porocytes (Tube-like cells):

- Form closable inlet valves around **ostia**
- They are contractile and can change the size of the openings of the ostia
- Controlling the flow of water through the sponge.

Body Wall Layers



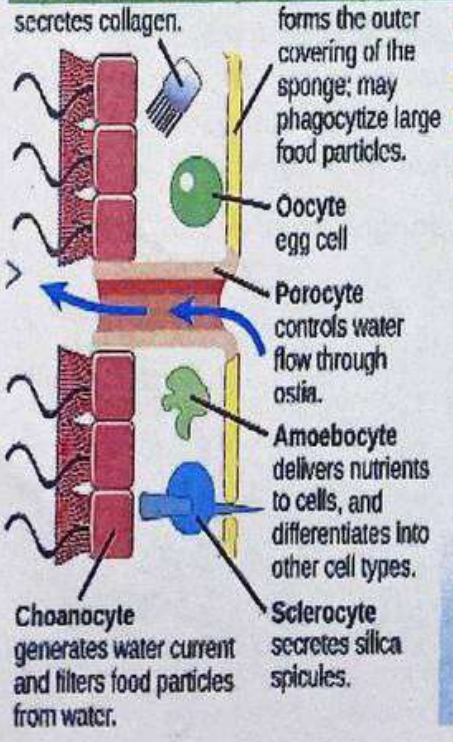
chanocyte



2. The inner layer

- Made completely of vase - shaped cells called ***choanocytes***.
- These cells have a collar of fine fibrils connected by microvilli
- The collar surrounding the base of a single flagellum
- Flagellum is used to propel water through the pores of into a central cavity,
- The collar is used to trap food (bacteria) by phagocytosis.

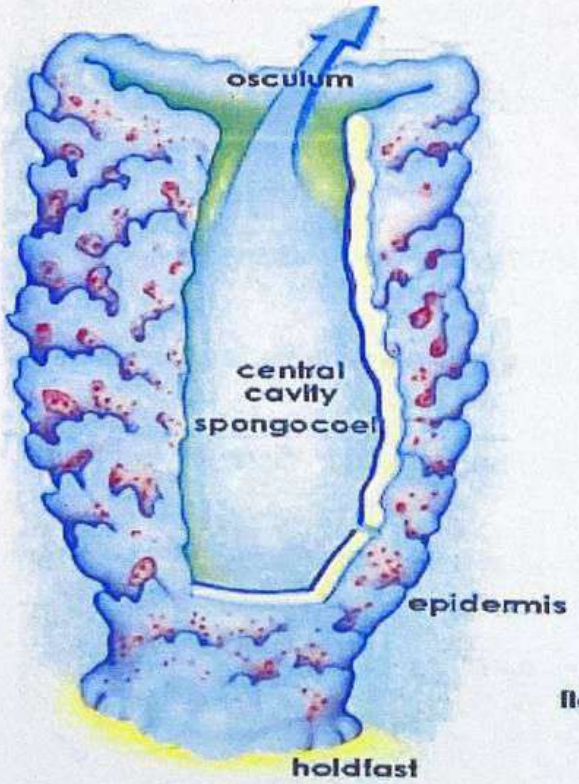
Body Wall Layers

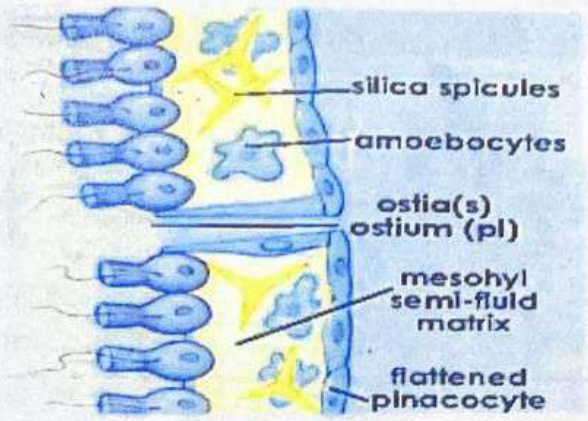


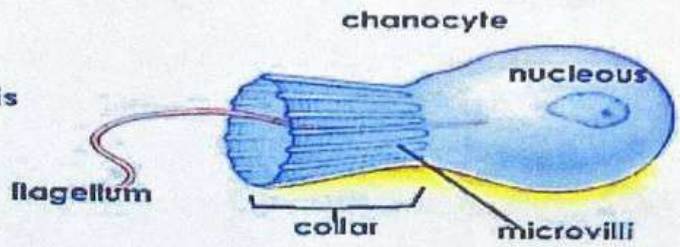
3. Mesohyl

- Connective tissue supported by the skeletal elements.
- Contain ***Archaeocytes*** move by pseudopodia (***Amoebocytes***).
- These cells change into another cells to perform their main functions:

1. Pick up food from choanocytes, digest it, carry nutrients to other cells.
2. Carry oxygen to other cells, and eliminate waste products.
3. Convert into ***Oocytes & Spermatocytes*** (for sexual reproduction)
4. They are the basis of some asexual reproductive ***gemmules***.
5. They maintain the structure of the sponge via converting into:
   - ***Spongioblast*** that secrete the spongin fibers of the skeleton.
   - ***Scleroblast*** that secrete spicules
   - **Collencyte** that secrete collagenous fibrils.



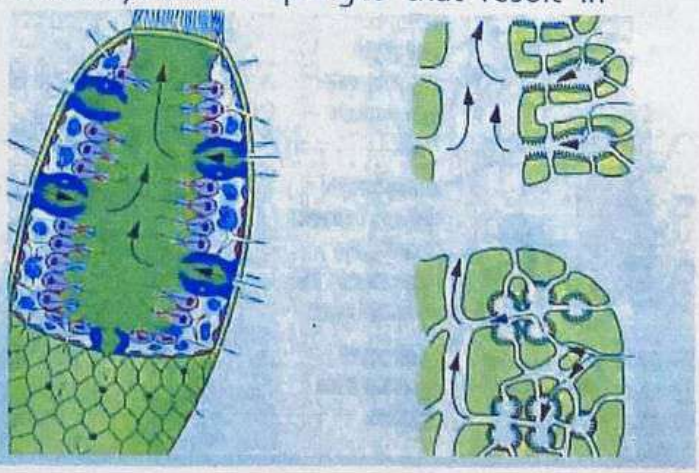




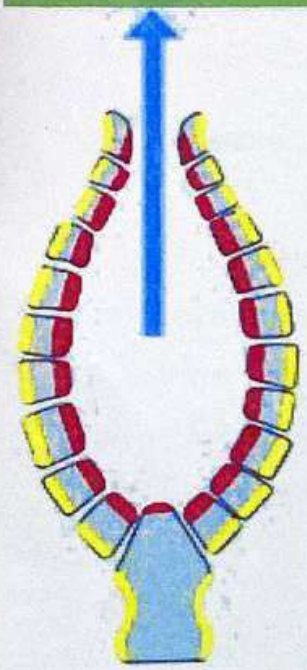
Water Flow & *Sponge Shape*

- Most of the canals system are lined with choanocytes to keep the water flowing through the canals in the correct direction (enters the ostia to spongocoel and leaves through osculum) by beating their flagellum.
- There are three main types of canal system in sponges that result in different shapes:

1. *Asconoid sponges*
2. *Syconoid sponges*
3. *Leuconoid sponges*

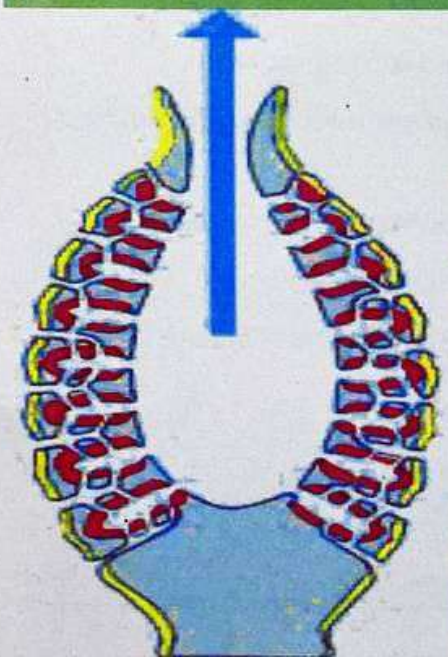


1. Asconoid shape



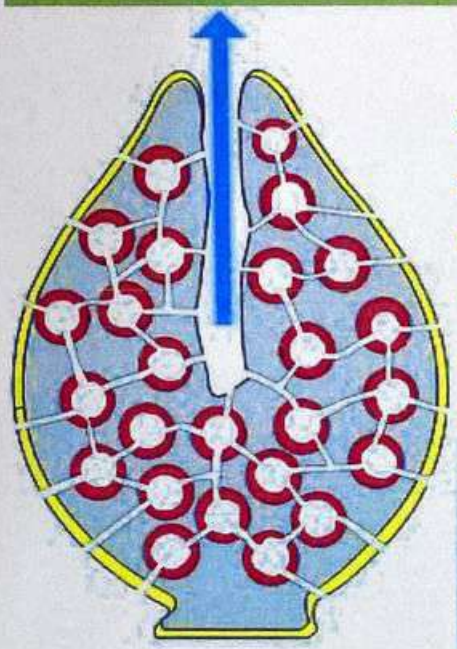
- The simplest body structure in sponges.
- The canals run straight from ostia to spongocoel.
- All the spongocoel is lined with choanocytes
- Diameter is seldom exceed 1 mm (limits the size of animal)
- Grow in groups attached to some object in shallow seas.

2. Syconoid sponges



- Slightly complicated by branching canals.
- Water not flow straight in to the spongocoel.
- Body wall is pleated & become thicker (few cm. diameter).
- The spongocoel is not lined with choanocytes only the canals.
- This increase in the number of choanocytes and pumping
- Do not form groups as do asconoid sponges.

3. Leuconoid shape

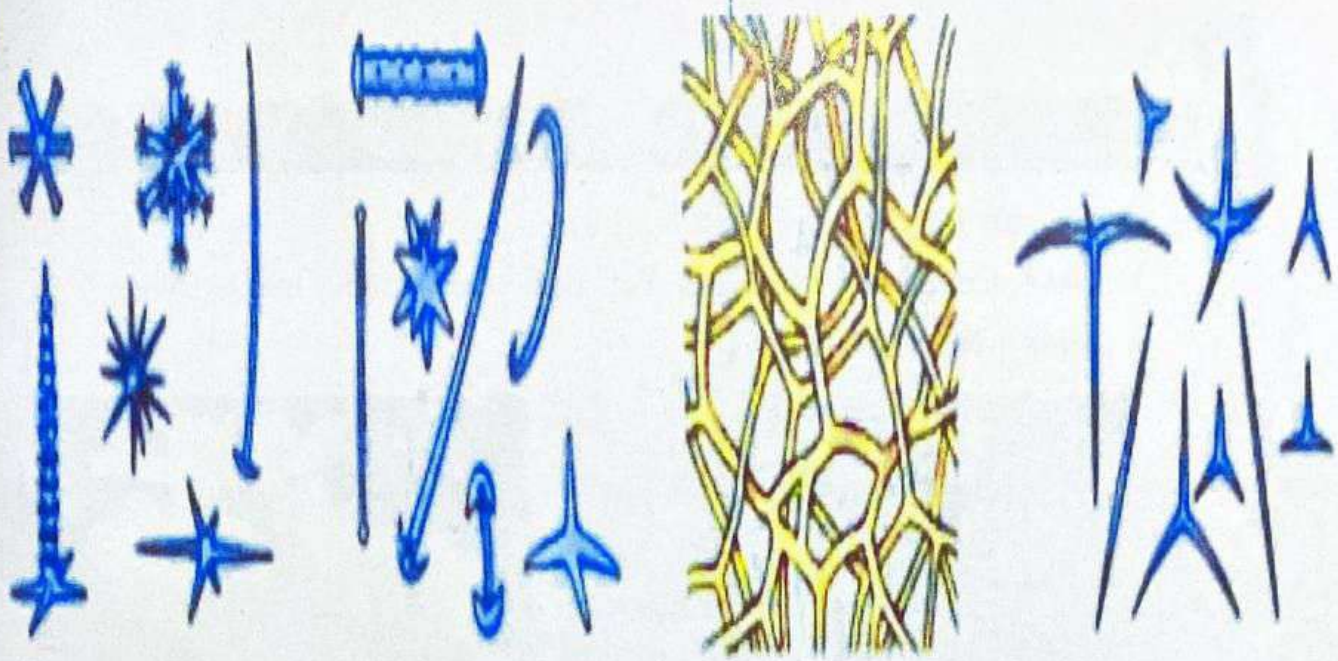


- More complicated (longer canals & more branched)
- There are no choanocytes in the canals.
- Canals lead to **chambers** lined by **choanocytes**.
- No real spongocoel just a central exit leading to **osculum**.
- Body wall grow in any direction to over 1 m in diameter.
- Water flow slower & makes choanocytes easier to trap food.
- Live in large groups each sponge having its own osculum.

Sponge skeleton

The mesohyl of sponges is stiffened by skeleton of two main components:

1. ***Spongin Fibers*** (Protein fibrils) forms a tough fibrous network that Conjunction with the spicules.
2. ***Spicules*** (Crystals) produced from compounds precipitated by **scleroblast:**
   - vary in shape from simple rods to three-dimensional stars with up to six rays
   - Spicules are either **calcareous** (calcium carbonate) or **siliceous** (silicate salts).
   - Serve at least two roles in the sponge:
     a) Kind of mesh-work internal skeleton
     b) Protective device against predation.



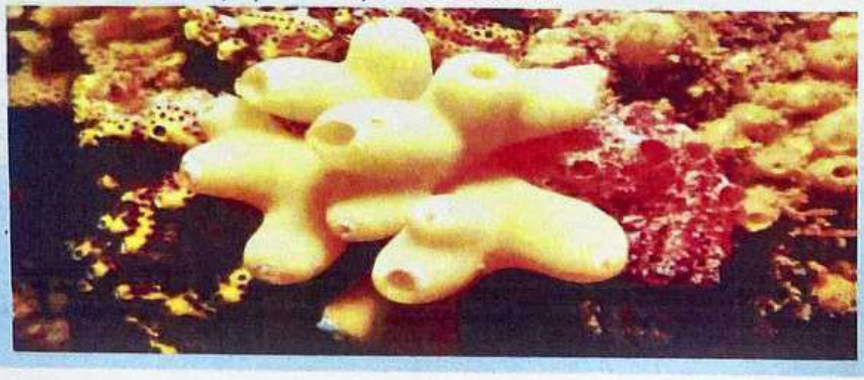
Siliceous spicules | Spongin fibers | Calcareous spicules

Sponge Classification

Spicules are important in the classification of sponges into three classes:

1. Calcarea (calcareous sponges):

- Have spicules of calcium carbonate that have 1, 3 or 4 rays, without spongin fibers.
- They found as asconoid, syconoid, or leuconoid.

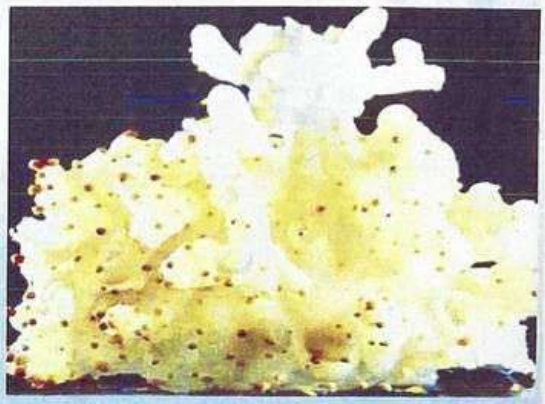


Sponge Classification

2. Hexactinellida (glass sponges):

- Have spicules made from silica that are 6 rayed, without spongin fibers
- Found in leuconoid shape only

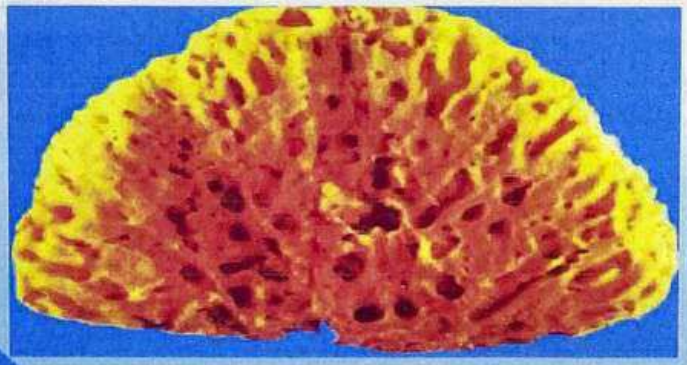


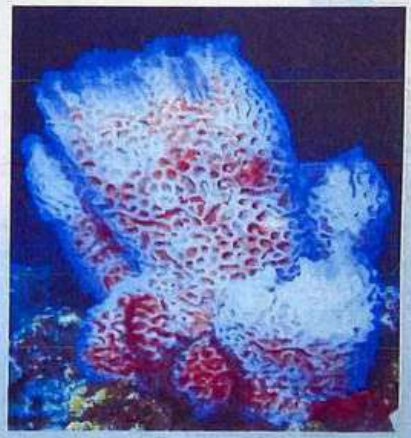


Sponge Classification

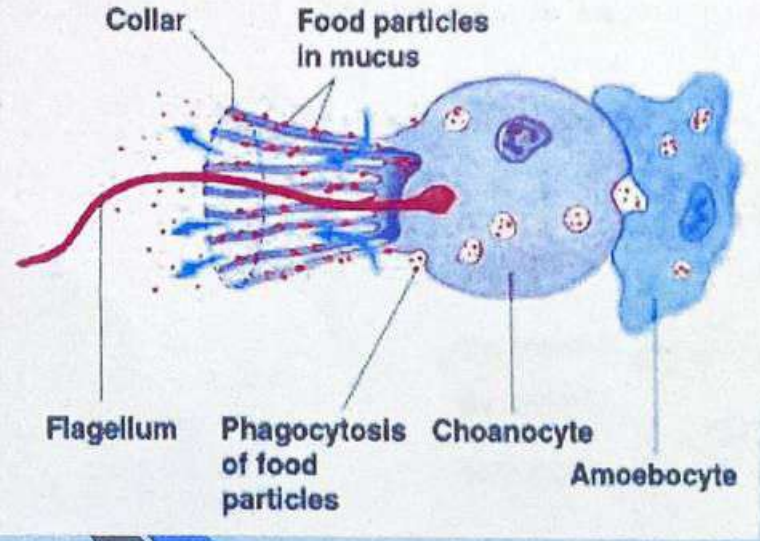
3. Demospongiae (demosponges):

- Have spicules made from silica with 1, 2, or 4rays joined by meshwork of spongin fibers.
- Found as leuconoid shape only.





Sponge Feeding



There are several methods of feeding:

1. **Phagocytosis** (Most marine sponges)
   - Large food particles Filtered by ***pinacocytes***
   - Small particles captured by ***choanocytes***
   - ***Archaeocytes*** transport food packaged in vesicles from cells that directly digest food to those that do not

Sponge Feeding



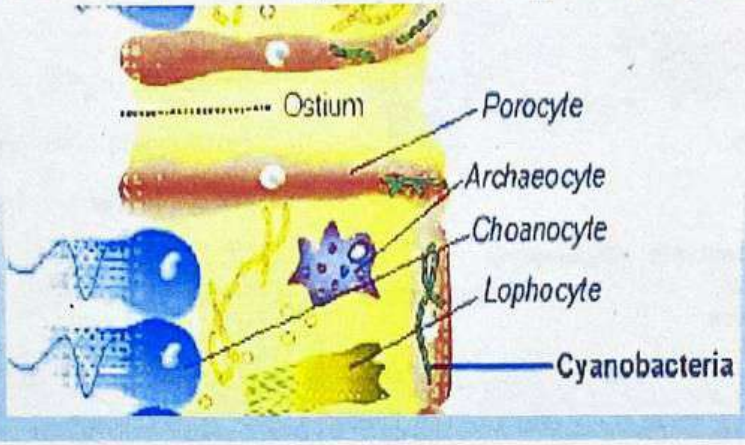
2. ***Carnivorous*** **sponges** (few species)

When the supply of food particles is very poor, so they prey on crustaceans and other small animals.

Sponge Feeding

3. Endosymbiosis (Freshwater & many marine species)

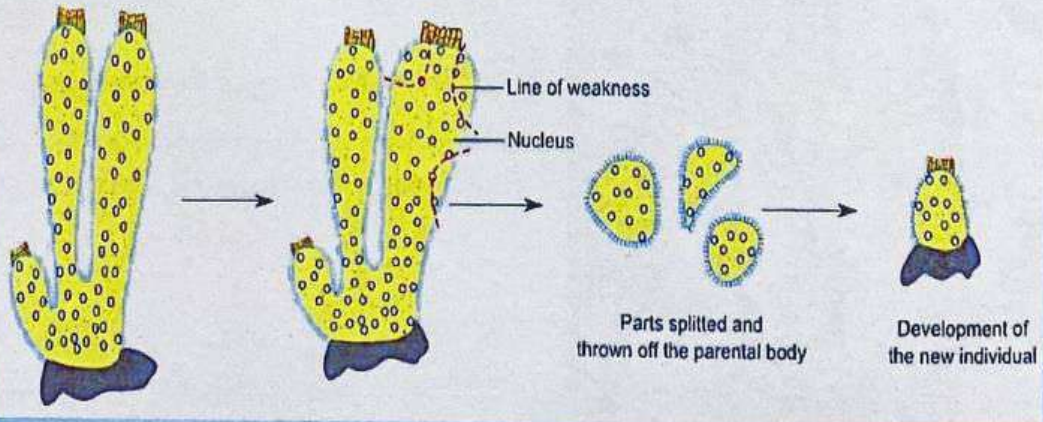
- Archaeocytes & other cells of sponges host ***endosymbionts*** (green algae & cyanobacteria)
- Benefit from nutrients produced by these photosynthesizing organisms.



Asexual reproduction of Sponge

1. Fragmentation:

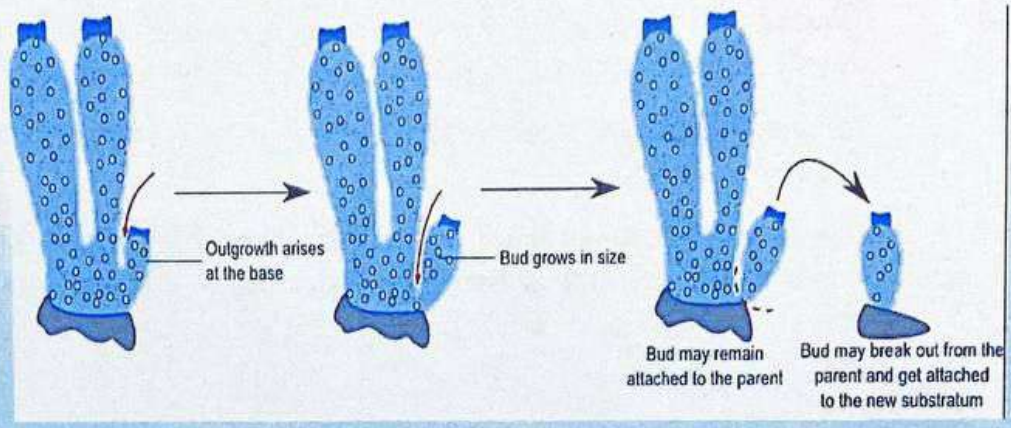
- Pieces of sponge are able to regenerate into whole new sponges.



Asexual reproduction of Sponge

2. Budding:

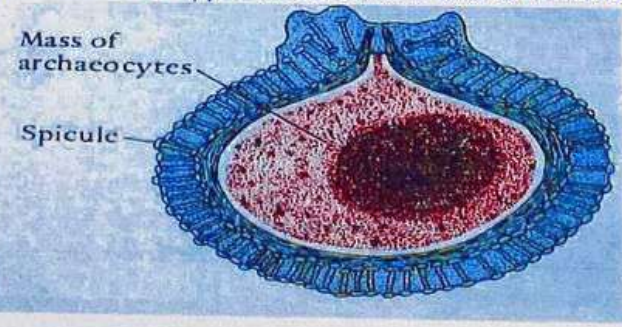
The buds may remain attached to the parent or separate from it, and each bud develops into a new individual.



Asexual reproduction of Sponge

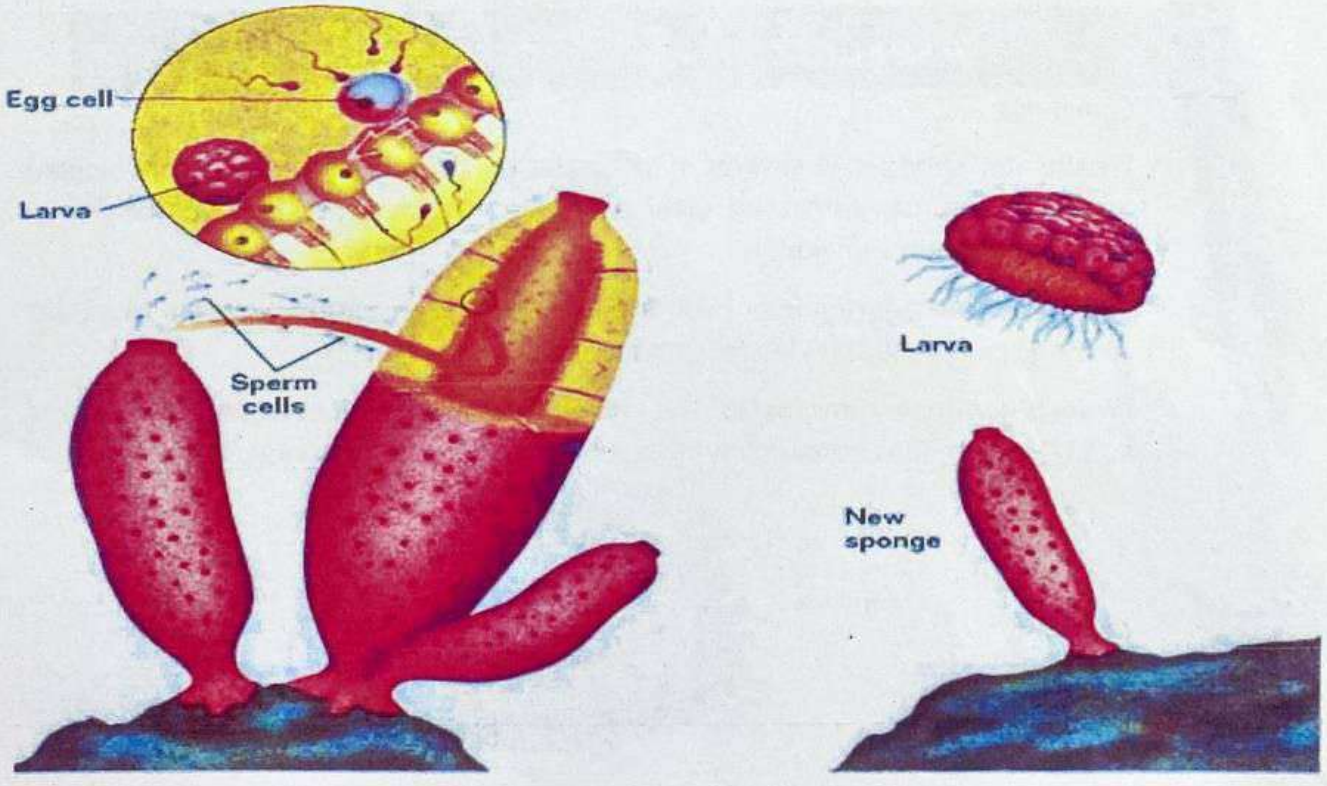
3. Gemmules:

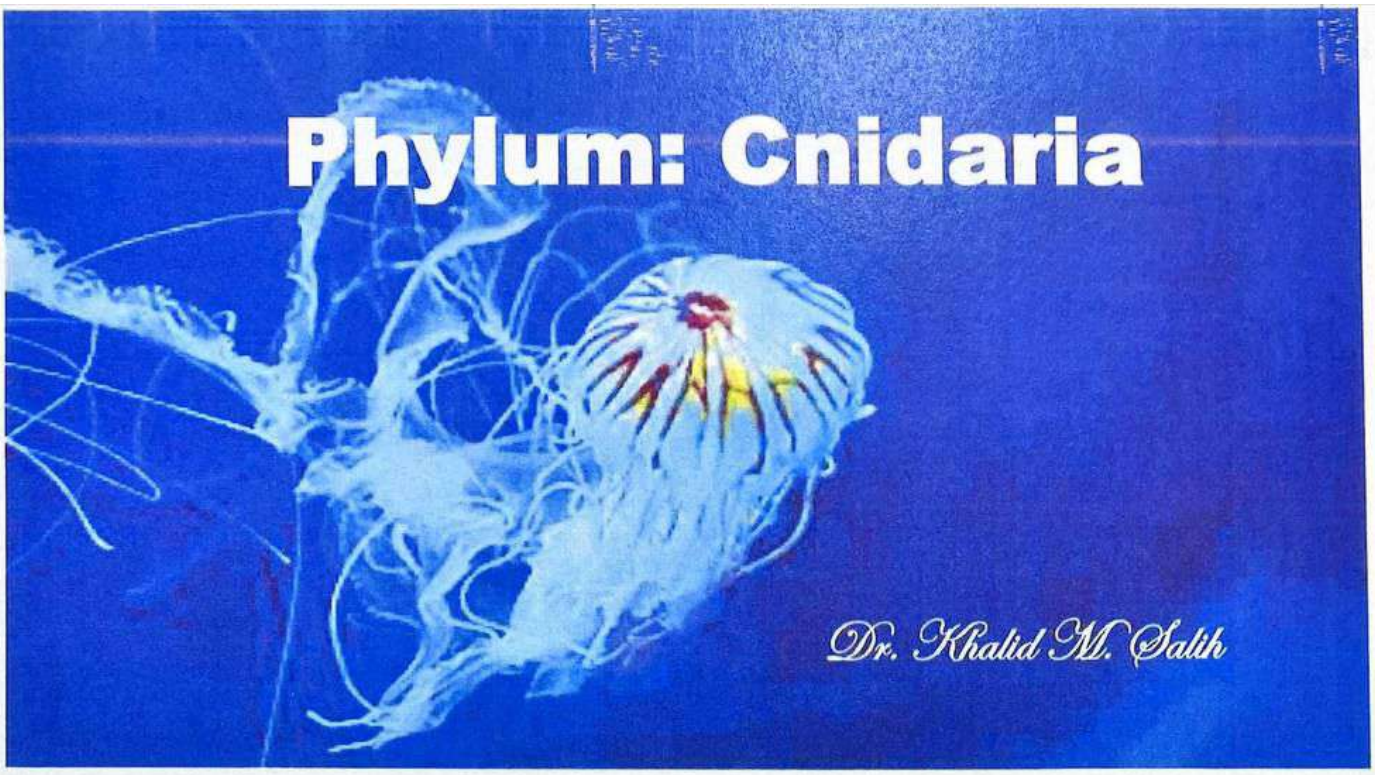
- Freshwater sponges & several marine species, form resistant structures called *gemmules* that can withstand adverse conditions such as drying or cold and later develop into new individuals.
- Gemmules are aggregates of sponge ***archeocytes*** and food, covered by a hard coating containing spicules or spongin fibers.
- When a gemmule germinates, the archeocytes round the outside of the cluster and transform into other cell types needed to make a functioning sponge.



Sexual Reproduction in Sponge

- Most sponges are *hermaphrodites* (function as both sexes, the same individual producing eggs and sperm), but in some species the sexes are separate.
- ***Sperm***s are produced by choanocyte, while ***Eggs*** are formed by transformation of archeocytes, or of choanocytes in some species.
- ***Fertilized eggs*** either released into the water or retain until they hatch into a swimming larvae.
- The larvae are flagellated and swim about freely for a short time and attaching to a suitable substrate and develop into young sponges.

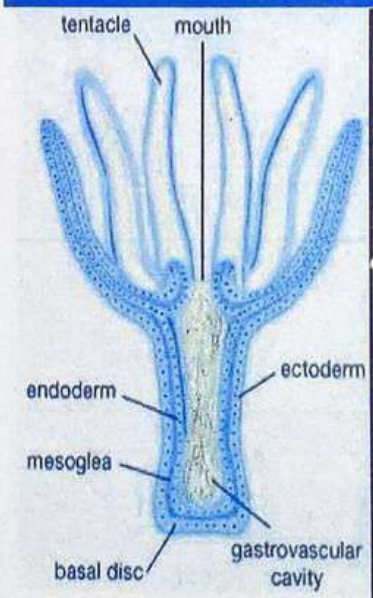


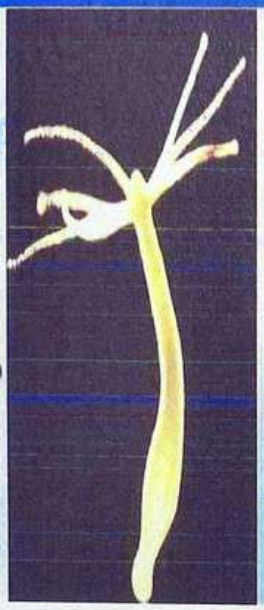


Definition

- **Cnidaria** comes from the Greek word "***cnidos***" which means stinging (nettle).
- Formerly known as coelenterata (Gr. ***Koilos*** = hollow, ***enteron*** = gut) take its name from the large cavity in the body that serves as the intestine.
- Coelenterates are the simplest of ***metazoans*** includes about 9000 species, some are found in fresh water, but the greater number are marine.

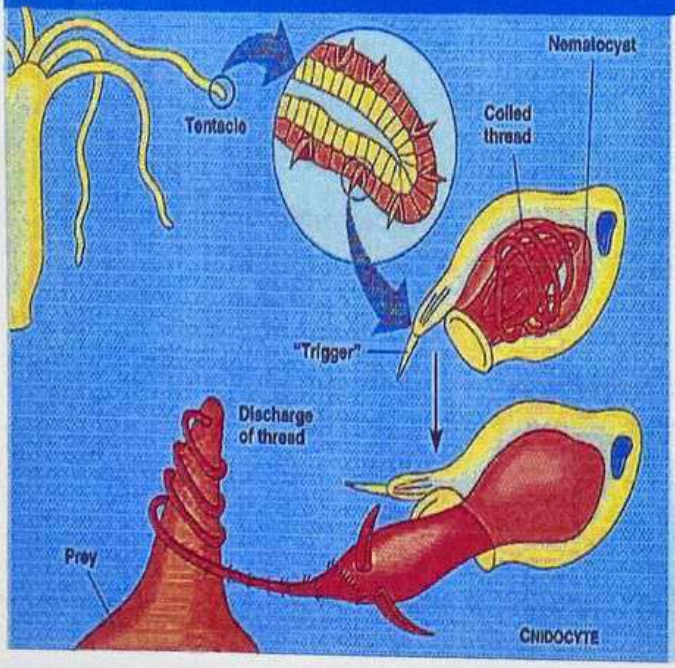
Body Structure





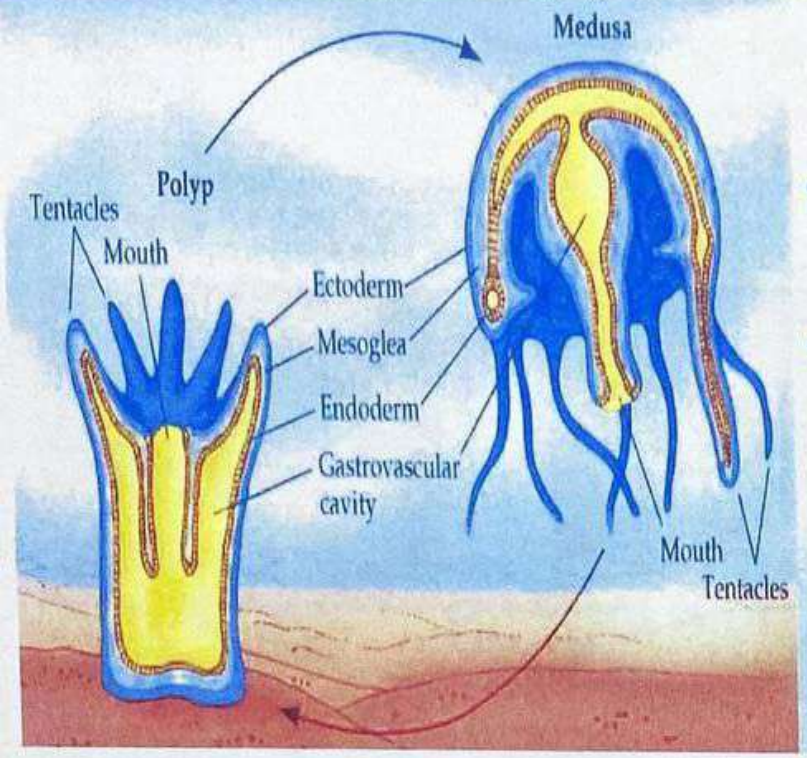
- Body is radially symmetrical with oral and aboral ends but without definite head.
- Body is formed of two layers (***diploblastic*** animals):
- Outer layer (**ectoderm**), inner layer (**endoderm**), a jelly-like non-cellular **mesoglea.**
- A central ***gastrovascular cavity*** opens to exterior by the mouth, but anus is absent.
- No separation between digestive cavity &body cavity (***acoelomates***).
- ***Tentacles*** are elongate, flexible, tactile processes around the mouth with ***cnidocytes.***

Cnidocyte (Cnidoblasts) (Nematocytes)



- ***Cnidocyte*** (nettle cell) is a venomous cell unique to the phylum Cnidaria.
- Found in ectoderm of tentacles to catch prey and defend against predators.
- Each cnidocyte contains a bulb-shape capsule (***cnidocyst***) (***cnida***) (***nematocyst***), containing a coiled hollow thread-like structure and also has a hair-like trigger called a ***cnidocil.***
- When trigger is activated, hollow thread penetrates target organism, and toxic content of nematocyst is injected into target organism.
- The injected neurotoxins paralyzes the mobile prey, thus the sessile cnidarian devour it.

Polymorphism



- ***Polymorphism*** is the occurrence of structurally and functionally more than two different types of individuals within the same organism.
- organisms exist in two different body forms:

  1. ***Polyp*** is cylindrical and usually fixed & represents asexual stage.

  2. ***Medusa*** is umbrella like and usually free swimming & represents sexual phase.

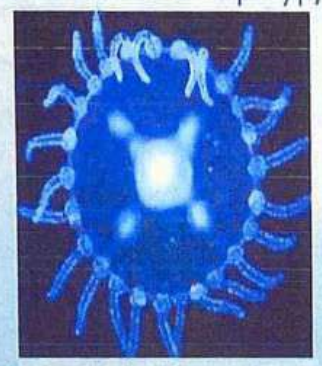
Classification of Cnidaria

The Phylum is divided into 4 Classes:

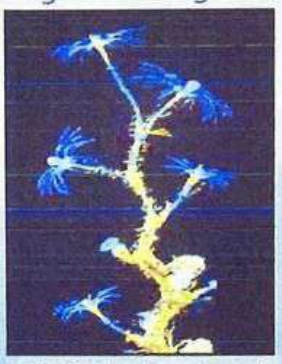
1. Hydrozoa (meaning water-animals)
2. Anthozoa (meaning flower animals)
3. Scyphozoa (meaning bowl animals)
4. Cubozoa (Box jellyfish)

1. Hydrozoa (water-animals)

- Attached to bottom of freshwater & marine, their tentacles &mouth pointing up.
- Some live alone (solitary), some live in groups (colonial).
- Most hydrozoans alternate between a polyp and a medusa stage (***Obellia***).
- Few of them live as a polyp, never goes through a medusa stage (***Hydra***).



Obellia (medusa shape)



Obellia (polyp shape)



Hydra (polyp shape)

2. Anthozoa (flower animals)

Usually live at the bottom of ocean in a polyp form only and include:

1. ***Anemones*** are very colorful with hundreds of tentacles & their body remains attached to a surface. They are pretty to look at, but deadly to fish swim too close.
2. ***Coral reef*** are smaller and live in colonies (hundreds or thousands of polyps) live together, sharing living tissue and food resources.



Anemones



Coral reef

3. Scyphozoa (bowl animals)



Aurelia

- Group of animals called ***true jellyfish*** with size (12mm- more than 2m), and have tentacles over 40 meters long.
- Their life cycle involves an alternation between sessile *polyp* phase and a free-swimming *medusa* stage that is usually predominates.
- ***Aurelia*** swim around ocean with their mouth & tentacles pointing down.
- They are graceful, but their stings may cause skin rashes, muscle cramps, or even death.
- They are not important as a food source, though they are eaten in some countries.

4. Cubozoa (Box jellyfish)

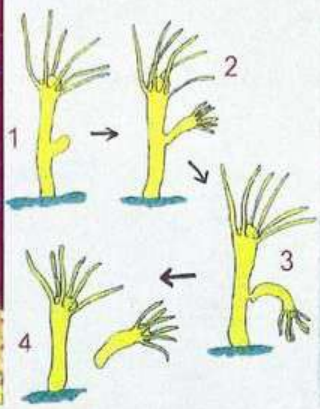


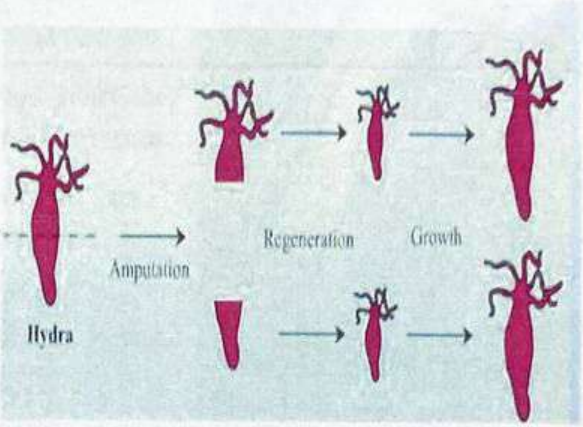
- They are similar in form to the true jellyfish, but:
  1. Their bells are square shapes
  2. They can swim pretty fast
  3. They possess four eye clusters (one set at each side of bell, and each set consisting of six eyes.
  4. Their tentacles are evenly spaced out in four sets.
- There are about 20 known species found in tropical and semitropical waters.
- The Australian stinger ***Chironex fleckeri*** is among the deadliest creatures in the world, having caused human fatalities. Which is also known as the **Australian sea wasp**.

Asexual Reproduction of Cnidarians

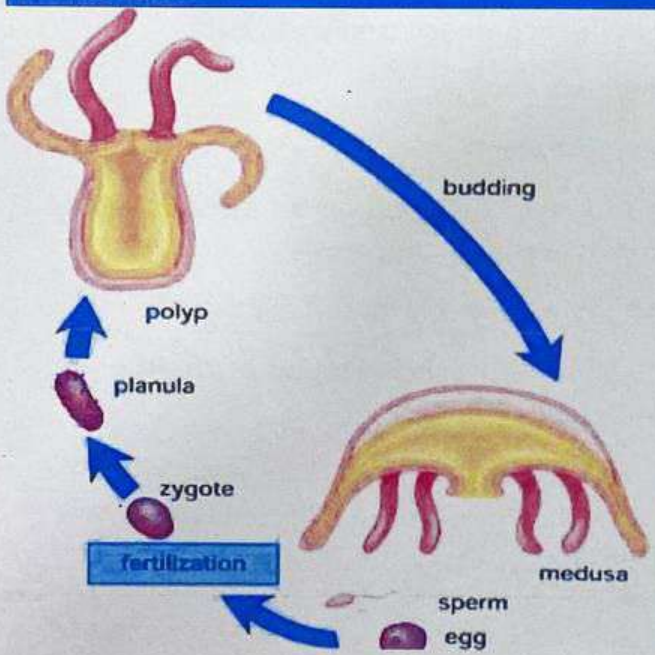


1. produce ***buds***
2. divide down the middle (***regenerating***) when divided into segments or are attacked by predators.





Asexual Reproduction of Cnidarians



- involves a complex life cycle with both polyp and medusa stages.
- fertilized egg grows to a larva (***planula***)
- Larva swims until it finds a good site, and then becomes a polyp.