Phylum Porifera: The Sponges

Reproduction and Development

1. Asexual reproduction:
   a. Is the primary form of poriferan growth.
   b. Allows considerable regenerative ability.
   c. Budding and fission are common.
   1. Relative abundance changes with season in many species.

Reduction Bodies

1. Marine sponges produce them when environment becomes unstable.

Gemmules - freshwater sponges

1. Resistant structures containing archaeocytes
2. Formed in cold weather, regenerate when conditions are warmer.
3. Possible genetic recombination

Reproduction and Development

2. Sexual Reproduction
   a. Is highly variable.
   b. Most species are hermaphroditic.
   1. Often exhibit sequential hermaphroditism.
   a. Protandry: male structures develop first.
   b. Protogyny: female structures develop first.
   2. Some species alternate.
   a. Some species are gonochoristic.
   b. Some populations are mixed.
Gamete Production

a. Because sponges are sessile - sperm are released into the water.
   1. Often done synchronously
   2. Produces "smoking sponges"

b. Sperm are captured by chaonocytes - transported to eggs.

Zygote Release

Poriferan Development

Cleavage divisions --> multicellular swimming larva.

1. Amphiblastula larva:
   a. A partially ciliated larva characteristic of Class Calcarea.
   b. Begins as a ball of ciliated cells: a coeloblastula.

Development - Calcarea

1. Coeloblastula either undergoes inward migration of cells which later become chaonocytes.
2. Or, develops internal cavity with flagella, forming a stomoblastula,
   a. Then inverts to form free swimming amphiblastula larva.
   c. After settling, metamorphoses into an olynthus which grows into a larger sponge.
**Development - Demospongiae**
1. Parenchymula larva:
   a. A completely ciliated larva characteristic of some Calcarea and many Demospongiae.
   b. Solid ball of cells with outer flagellated cells.
   c. Settles, flagellated cells migrate inward, forms a *rhagon*.

**Immunocompetence in Lower Phyla**

Conditions necessary to demonstrate presence of an immune system:

a. Evidence of antagonism toward foreign substances.
   
   b. Antagonism must be specific toward substance.

   c. Future responses must be altered by initial response.
   
   i.e., the system must "remember."

**Immunocompetence**

Inverts until recently were thought to lack immunity.

a. Now known to be untrue.

b. Sponges known to aggregate, aggregate with "self".

   c. Is this immunity sensu stricto?

Hildemann et al. 1979 addressed this in *Callyspongia diffusa*:

a. Large purple sponge from Hawaii.

   1. Long fingers that interdigitated with itself.

   2. But never with other colonies or with other species.
**Callyspongia**

**Experimental Procedure**

1. Wired pieces of sponge to plastic plates, 2 pieces of sponge/plate.
   a. From same colony
   b. From different colonies
2. Maintained at 27°C in lab.

**Summary of Results I**

1. Same colony sponges always fused.
2. Different colonies never fused.
   a. Discoloration, etc. among allogenic individuals.

**Summary of Results II**

3. When allowed to rest after introduction, toxic reactions occurred more rapidly than before.

**Evolutionary Context**

1. Why be able to do this?
   a. Avoid competition
   b. Avoid colonization by non-relatives
1. Sometimes inbreeding is not bad.
How Widespread?

a. *Lots* of encrusting animals do this
   
   1. Surprisingly, many complex organisms don't:
      a. insects
      b. molluscs

Tunicates and Urochordates

- Many people now think that the origins of our immunological responses lie in the recognition of self and non-self among our encrusting chordate ancestors.
- Much interesting research going on here

Fossil Record

1. Note different groups.
2. Extinctions of other animals similar to sponges

Phylum Cnidaria:
Hydroids, jellyfish, anemones, corals.

Historical Remarks

**Aristotle**
(384-322 BC)

- Classified different groups according to body type.
- Identified the “radiate animals” as distinct from the “bilateral animals.”

**Jean-Baptiste Lamarck**
(1744-1829)

- Coined term *Radiata*.
- Based on radial symmetry (following Aristotle).
- However, we will see that body symmetry can be somewhat misleading.
Historical Remarks

Coelenterata

3. More recent, but no longer used, although Conway Morris suggests that this term is still meaningful.

Phylum Cnidaria

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4. The indusium is formed by the elongation of the lophophore, which serves as a filter for the ingestion of food.
5. The lophophore is a sheet-like structure, which is modified internally to form the lophophore, which is the feeding organ.
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Life Cycle of Stony Corals

1. **Planula stage**
   - The planula is a free-swimming larva that is the first stage in the life cycle of stony corals. It consists of a single larval form and is typically found in shallow waters near coral reefs. The planula feeds on plankton and other small marine organisms.

2. **Settlement**
   - The planula settles on a hard substrate, such as a coral reef or a rocky outcrop, where it will attach itself. This process begins when the larva comes into contact with a suitable surface. Once attached, the planula develops into a **polyp** stage.

3. **Polyp stage**
   - The polyp is a small, colonial or solitary structure that grows from the settled planula. It has a single, hollow tube-like structure with tentacles that extend outward to capture food. The polyp feeding stage is crucial for the growth and development of the coral. The polyp feeding stage is typically the longest stage in the life cycle, lasting several years.

4. **Reproduction**
   - During the polyp feeding stage, some polyps develop gonads and begin to reproduce sexually. This stage is characterized by the release of gametes, which fuse to form a **zygote**. The zygote then develops into a **planula** and repeats the cycle.

5. **Coral formation**
   - As the polyp grows and the zooids (individual polyps) secrete calcium carbonate to form the coral structure, the coral becomes more complex. The reef-building coral eventually forms a large, structurally complex colony that can span meters in diameter.

6. **Continued growth**
   - The coral continues to grow and mature over time, forming larger and more complex structures. This growth is facilitated by the feeding activities of the polyps and the secretion of calcium carbonate, which forms the coral skeleton. The coral continues to grow throughout its lifespan, with some species reaching ages of several centuries.

7. **Reproduction**
   - Throughout the coral's life, it undergoes periodic reproduction, which helps to ensure the survival and spread of the species. The coral can reproduce both sexually and asexually, allowing for the growth of new colonies and the expansion of coral reefs.

The life cycle of stony corals is an intricate process that involves a series of stages, each characterized by specific ecological and biological processes. Understanding these stages is crucial for the conservation and management of coral reefs, as they provide insights into the health and resilience of these ecosystems.