

LABORATORY EXERCISE 3

PHYLUM CNIDARIA

Cnidarians (coelenterates) represent the first metazoan phylum whose members are capable of muscular locomotion. Their bodies are organized on a tissue basis and they possess a simple nervous system, a sac-like gut organ (not a system) and, in some cases, an exoskeleton. In order to become familiar with the characteristics of the animals in this phylum, read the appropriate parts of your text BEFORE attempting this exercise.

GENUS OBELIA –*Obelia sp.*

Hydrozoan medusas may or may not be retained on the parent polyp before producing or releasing the gametes. Hydrozoan life cycles range from those in which the medusa is entirely absent (e.g. *Hydra*), to those in which it is reduced (e.g., *Obelia*), to those in which it is dominant (e.g., *Gonionemus*). Examine the structure of the medusa of *Obelia* from prepared slides. There has been a tendency in cnidarian evolution for the polyp stage to become colonial, and many hydrozoan and anthozoan species form complex colonies. The colony is formed by asexual budding of polyps with incomplete separation of the buds. Note the organization of the *Obelia* colony. Also note the location of reproductive and feeding individuals and the presence or absence of the perisarc (the acellular, non-living protective covering of the coenosarc) and the collection of tubes (gastrodermis and epidermis) of the colonial hydrozoans. Familiarize yourself with hydranths (feeding polyps) and gonangia (reproductive polyps). How does the gonangium obtain nutrients? Can you diagram the life cycle of the animal?

GENUS HYDRA –*Hydra sp.*

Familiarize yourself with the histology of *Hydra* with the use of prepared slides of *Hydra* sections. Identify the epidermis, mesoglea, and gastrodermis. In which layer(s) do you find cells bearing flagella? In which layer(s) would you expect to find nerve fibers; contractile fibers? Does the mesoglea comprise a cell layer as substantial as the other two layers?

BEHAVIOR. Obtain a live *Hydra* from a stock culture and place it in a Syracuse dish containing some pond water. Allow sufficient time for the animals to become adjusted to the new environment. Once they have attached to the glass, they will extend their tentacles radially and you may begin your observations, using a dissecting microscope. Test the *Hydra*'s reactions to light tapping on the side of the dish; slow rotation of the dish; light touch with a clean probe on the midbody, mouth, and tentacles. If you touch only one tentacle, do others contract too? Push it free from its attachment to the dish -- how does it move? Hold the probe against the body as an obstacle -- how does it react?

FEEDING. Take a few drops containing freshly hatched brine shrimp (*Artemia*) larvae from the stock culture, wash the larvae in fresh pond water, and place a few of them in the vicinity of a *Hydra*. What is the response of the animal? How do the tentacles behave? How are the *Artemia* ingested? With a clean fine forceps, remove a segment of a tentacle that has captured an *Artemia* and place it on a depression slide for further observations later. Repeat the feeding exercise using a single large *Daphnia*, and a new *Hydra*. Does the *Hydra* behave differently when encountering a larger prey? Compare the feeding behavior of a recently fed *Hydra* with that of a starved individual. Continue experimenting with feeding *Hydra* in order to test the following points:

- (1) What is the normal sequence of events in the feeding process? About how long do each of the stages take?
- (2) Does *Hydra* feed exclusively on living prey because only living prey is motile? Wiggle some dead prey against the tentacles. In the case of dead prey, does the degree of "deadness" have any effect on *Hydra's* reaction to it?
- (3) Can non-living material be made more "palatable" to *Hydra* by soaking them in freshly squashed "prey-juice"?
- (4) Add some fresh "prey-juice" (glutathione) to the water in which *Hydra* sits. Does *Hydra* react to this? Add some more. Any change?
- (5) What are the physiological mechanisms that explain the physical ability of *Hydra* to swallow anything? Can all its swallowing movements be explained in terms of muscle fibers known to exist in its body?

In your notebook, construct a scheme based on your recorded observations and experiments which sets forth a defensible interpretation of the mechanisms involved in the feeding reaction of *Hydra*.

PSEUDOFEEDING. *Hydra* can be induced to show the typical feeding response without presenting any prey to the animal. Loomis (1955) discovered that the feeding response is elicited when *Hydra* is placed in a medium containing reduced glutathione. Place one or two unfed *Hydra* in a Syracuse dish containing ~5 ml pond water. When they are attached to the glass and are relaxed, introduce a drop of reduced glutathione solution and observe the reaction. If the concentration of glutathione is increased, you may be able to induce the animal to turn completely inside out. What would be the arrangement of the tissue layers in such an animal? How could the animal resume its normal tissue arrangement? Can glutathione induce the feeding response in a recently fed *Hydra*?

NEMATOCYSTS (aka CNIDA). Place a complete *Hydra*, or part of one, on a vaseline-ringed slide and gently lay a cover slip over the animal. Using a compound microscope, look in the region of the tentacles for nematocysts; you will probably see both discharged and undischarged nematocysts. Are nematocysts limited to only the tentacles? How many types of nematocysts does *Hydra* possess? Can you induce the discharge of nematocysts by

increasing the pressure of the cover slip? While observing under the low power objective (10x), introduce a drop of methyl green-acetic acid under the coverglass. What happens? Why?

Sketch at least two types of nematocysts. You should now return to the captured *Daphnia* or *Artemia*. Place the prey on a slide and tease apart the carapace. You may be able to see "volvents" wrapped around setae and also larger "stenoteles" which have penetrated the carapace of the crustacean. It is thought that the nematocysts release a toxin that is responsible for the rapid immobilization of the prey.

OPERATIONS. Plan and execute an operation on a *Hydra* that has been well fed on *Artemia* or *Daphnia* (which ever fed best). Interesting regeneration results can be obtained by splitting the oral surface longitudinally, or cutting the animal transversely, or removing some or all of the tentacles. Place the animals in clean, aged water in a vial stoppered loosely with cotton. Diagram the cuts carefully, label the vial and place it in the part of the room indicated by the instructor. Try to check the *Hydra* once or twice before laboratory next week, carefully diagramming changes. If time permits change the water in the vials daily. Use only aged water ("pond" water) and be careful not to dump out the specimens.