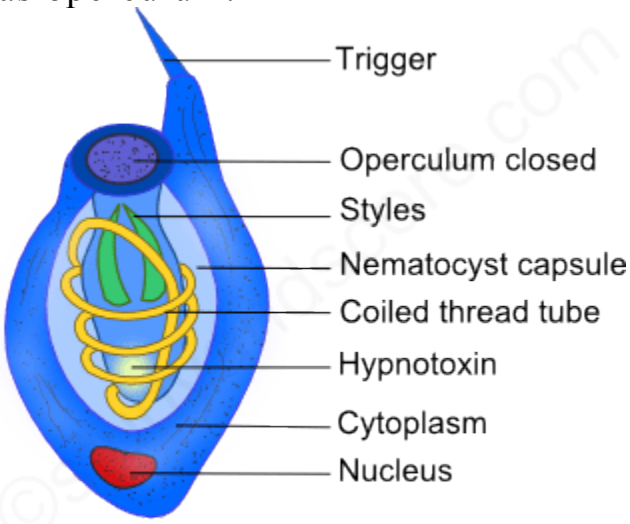
DEFENSE STRUCTURE IN CNIDARIA

The body wall of all the coelenterates contains special defensive structures called as stinging cells or nematocysts. Because of the presence of these cnidocytes the phylum Coelenterata is also known as Cnidaria. Each cnidocyte contains a fluid filled membranous capsule called cnida. Cnidocytes help not only in defense but also in locomotion, adhesion and capture of prey.
The presence of these defensive structures is one of the most important characteristic features of coelenterates. These are not actually cells by are cell organelles found in the specialized cells called as cnidocytes or cnidoblasts. Cnidoblast is a Greek term “knide” meaning nettle and “blast” meaning germ.
Cnidoblasts develop only from modified interstitial cells of epidermis and are not found in the gastrodermis. When fully developed, cnidoblasts migrate to the tentacles through mesoglea by means of amoeboid movement.

Structure of cnidoblast
Cnidoblast is an oval or rounded cell with a basal nucleus on one side. Inside the cnidoblast an oval or pyriform bladder called as stinging capsule is present. This stinging capsule is also called as nematocyst. The nematocyst consists of a tiny bulb made of chitin. This bulb is filled with poisonous fluid or hypnotoxin, which is chemically a mixture of proteins and phenols. On end of this bulb is extended as a narrow, long, hollow tube like filament which is coiled round the poisonous sac. This filament is called as thread tube. The base of the thread tube is swollen to form a shaft. Inside the shaft there are three large spines called as barbs and three spiral rows of minute spines called as barbules. The shaft is externally covered by a lid-like structure called as operculum.



STRUCTURE OF CNIDOBLAST

The outer end of the cnidoblast projects freely beyond the epidermal surface as a tiny, pointed hair-like process called cnidocil or trigger. Groups of supporting rods surround the central core of cnidocil. The central core is structurally similar to the

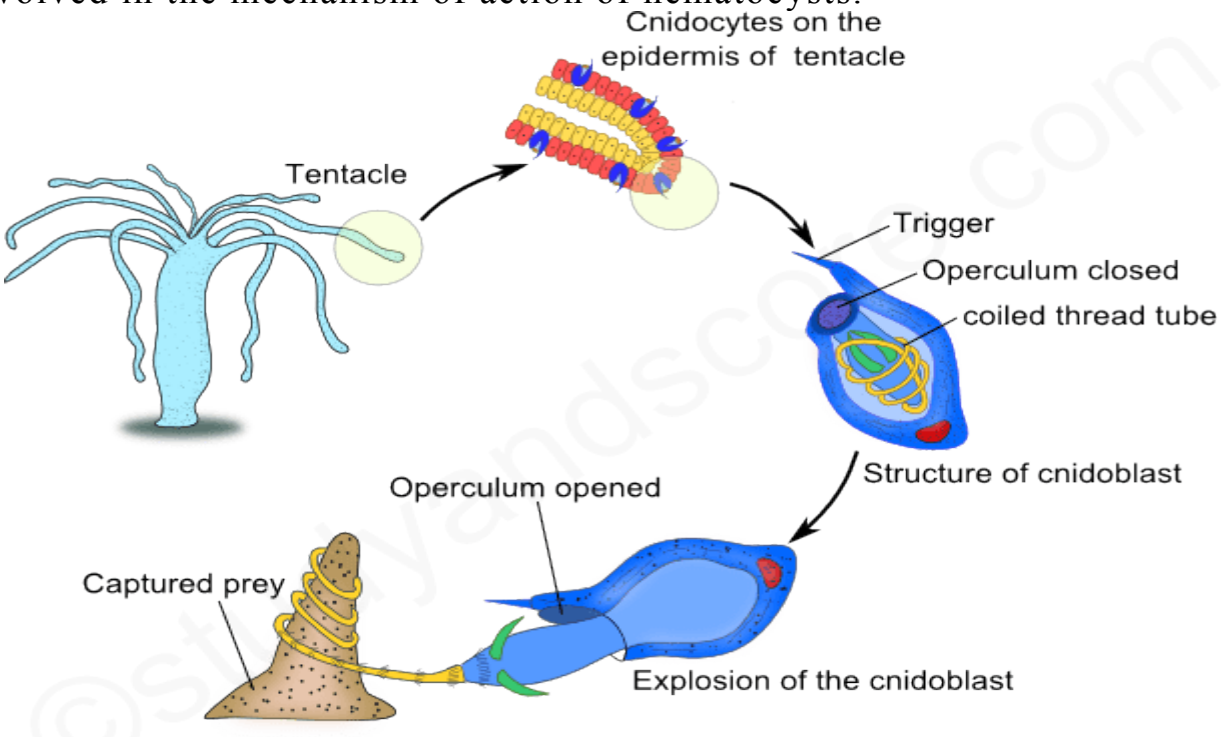
cilium with fibers in 9+2 pattern. The cytoplasm of the cnidoblast contains contractile muscle fibrils.
The cell organelles present in the cytoplasm of the cnidoblast include endoplasmic reticulum, free ribosomes, Golgi bodies, mitochondria and multi-vesicular bodies as revealed by electron microscopic studies.

Distribution of nematocyst

Nematocysts are found scattered single or in groups (very rare) throughout the epidermal region of the cnidarian body. These special defensive structures are absent on the basal disc. They are abundant at the oral region and on the tentacles where they form batteries of nematocysts.
A battery of nematocyst is the structure comprising of two large central nematocysts surrounded by 10-12 small nematocysts. All these large and small nematocysts are enclosed within a single large epithelio-muscle cell. Cnidoblasts are not formed in the tentacles rather they are formed in the epidermal region and then they migrate to the tentacles. During this migration of large number of cnidoblasts some of them encyst in clusters in gastro vascular cavity to form battery of nematocyst.

Mechanism of Defense

The discharge or explosion of nematocysts takes place when cnidocil is stimulated by food, prey or enemy. Both the presence of food and touch together initiates the process of explosion and not any one alone. Hence both the mechanical stimulations like contact of food and chemical stimulations like approaching enemy are involved in the mechanism of action of nematocysts.



DEFENSE MECHANISM OF CNIDOBLASTS

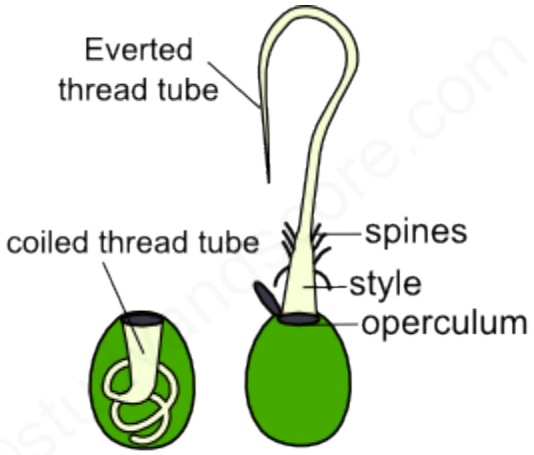
Though the exact mechanism of discharge and enzymes involved are not known, but is very much evident that the response is wholly local without the involvement of nervous system. The wall of nematocyst remains impermeable to water except during discharge. On stimulation, the wall of the capsule suddenly increases its permeability causing rapid intake of water and consequently the osmotic pressure inside the capsule increases. Now as a result the operculum is forced to open up, then the coiled thread tube turns inside out and finally the whole nematocyst explodes to the outside. As the thread tube everts, the barbs and barbules present inside the shaft unfold to the outside.

The thread tube once discharged cannot be withdrawn in other words; the nematocyst once exploded cannot be used again. After the explosion the cnidoblasts migrate to the gastro vascular cavity and are digested. The exploded nematocysts are replaced within 48 hours.

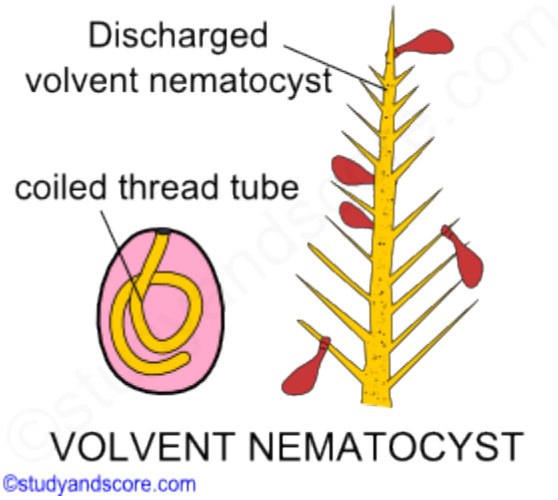
Types of nematocysts

There are about 30 different types of nematocysts found in phylum Coelenterata. Their type is constant for particular species. As far as Hydra is concerned, there are four basic types of nematocysts which serve various functions. The following is the description of all of them.

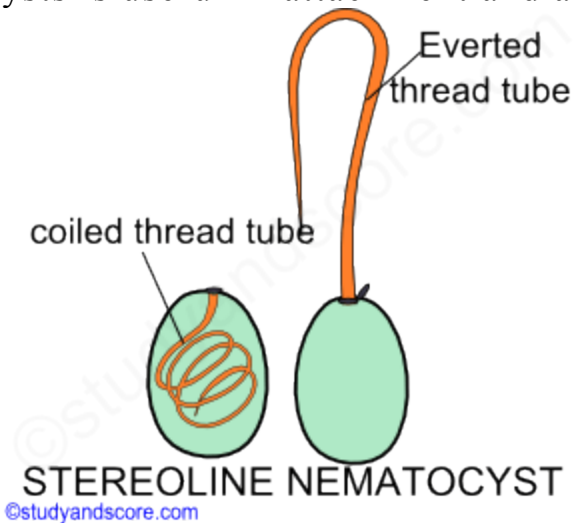
Penetrant nematocyst: These are also known as stenotele. These kinds of nematocysts are very large and complex compared to other types. These nematocysts are pear-shaped almost occupying the entire space of cnidoblast in which it lies. Its thread is also long and hollow, coiled transversely and bearing three large barbs and three rows of small spines. When the thread tube is discharged, it shoots out with great explosive force to pierce the victim body and injects the poisonous fluid which paralyses or kills it outright. The hydra then seizes its prey with tentacles and draws it into its mouth.



Volvent nematocyst: These are also known as desmoneme. These kinds of nematocysts are small and pear-shaped. They contain a short, thick, spineless Eleatic thread tube forming single loop. When discharged, it tightly coiled round the small projections like hair or bristles of the prey and thus stopping the movement of the prey.



Stereoline glutinant nematocyst: These are also known as small glutinant atrichous isorhizas. These kinds of nematocysts are oval or elongated in shape. They do not have shaft. They discharge a straight unarmed thread tube open at the tip. This kind of nematocysts is useful in attachment and anchorage.



Streptoline glutinant nematocyst: These are also known as large glutinant or holotrichous isorhizas. These kinds of nematocysts are oval or cylindrical. Their thread tube is long with a narrow shaft which forms three or four coils. It bears a spiral row of small spines. These are mainly useful in attachment and to impede the movement of small animals.