Cnidocyte and Nematocyst

From Wikipedia, the free encyclopedia (https://en.wikipedia.org/wiki/Cnidocyte)

A **cnidocyte** (also known as a **cnidoblast** or **nematocyte**) is an explosive cell containing one giant secretory organelle or *cnida* (plural*cnidae*) that defines the phylum Cnidaria (corals, sea anemones, hydrae, jellyfish, etc.). Cnidocyte is also called the "stinging cell". Cnidae are used for prey capture and defense from predators. Despite being morphologically simple, lacking a skeleton and many species beingsessile, cnidarians prey on fish and crustaceans. A cnidocyte fires a structure that contains the toxin, from a characteristic subcellular organelle called a **cnidocyst** (also known as a **cnida** or **nematocyst**). Nematocyst is also called the "stinging organ". The toxin is usually a hypnotoxin. This is responsible for the stings delivered by a cnidarian.

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Structure and function[edit]

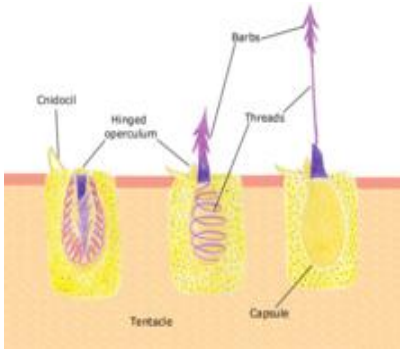
A discharged nematocyst seen under a scanning electron microscope

Each cnidocyte contains an organelle called a cnida or cnidocyst (e.g. nematocyst, ptychocyst or spirocyst), which comprises a bulb-shape capsule containing a coiled hollow tubule structure attached to it. The immature cnidocyte is referred to as a cnidoblast. The externally oriented side of the cell also has a hair-like trigger called a cnidocil. Cnidocil is a mechano and chemo-receptor. When the trigger is activated, the tubule shaft of the cnidocyst is ejected and in the case of the penetrant nematocyst, the forcefully ejected tubule penetrates the target organism. This discharge takes no more than a few microseconds, and is able to reach accelerations of about 40,000 *g*.[1][2]Recent research suggests the process to occur as fast as 700 nanoseconds, thus reaching an acceleration of up to 5,410,000 *g*.[3] After penetration, the toxic content of the nematocyst is injected into the target organism, allowing the sessile cnidarian to devour it.

Discharge mechanism

Cnidae capsule stores a large concentration of calcium ions, which are released from the capsule into the cytoplasm of the *cnidocyte*when the trigger is activated. This causes a

large concentration gradient of calcium across the cnidocyte plasma membrane. The resultingosmotic pressure causes a rapid influx of water into the cell. This increase in water volume in the cytoplasm forces the coiled cnidae tubule to eject rapidly. Prior to discharge the coiled cnidae tubule exists inside the cell in an "inside out" condition. The back pressure resulting from the influx of water into the cnidocyte together with the opening of the capsule tip structure or operculum, triggers the forceful eversion of the cnidae tubule causing it to right itself as it comes rushing out of the cell with enough force to impale a prey organism.



A diagram of the discharge mechanism of a nematocyst

Prey detection

Since cnidae are "single use" cells, and this costs a lot of energy, in order to regulate discharge, cnidocytes are connected as "batteries", containing several types of cnidocytes connected to supporting cells and neurons. The supporting cells contain chemosensors, which, together with the mechanoreceptor on the cnidocyte (cnidocil), allow only the right combination of stimuli to cause discharge, such as prey swimming, and chemicals found in prey cuticle or cuteous tissue. This prevents the cnidarian from stinging itself although sloughed off cnidae can be induced to fire independently.

Types of cnidae[edit]

Over 30 types of cnidae are found in different cnidarians. They can be divided into the following groups:

1. Penetrant: The penetrant or stenotele is the largest and most complex nematocyst. When discharged, it pierces the skin or chitinous exoskeleton of the prey and injects the poisonous fluid, hypotoxin, that either paralyzes the victim or kills it.
2. Glutinant: a sticky surface used to stick to prey, referred to as ptychocysts and found on burrowing (tube) anemones, which help create the tube in which the animal lives

3. Volvent: The volvent or desmoneme is a small and pear-shaped nematocyst. It contains a short, thick, spineless, smooth and elastic thread tube forming a single loop and closed at the far end. When discharged, it tightly coils around the prey. They are the smallest nematocysts. A lasso-like string that is fired at prey and wraps around a cellular projection on the prey, referred to as spirocysts

Depending on the species, one or several types can appear simultaneously on the organism. The specific representation of cnidae is referred to as the cnidome of that species and may represent a dynamic aspect of the cnidarian species that is responsive to prey availability or the developmental stage of the organism.