



### Exhibit message

Cone shells (a kind of marine snail) have a muscular tube or proboscis that holds a tiny harpoon-shaped tooth. This tooth is speared into prey and conotoxin venom is pumped into the prey to kill it.

### Quick facts

The cone shell venom, known as conotoxin has killed about 30 humans. It is reputedly a painless death, as the conotoxin is an analgesic or pain-killer.

Tiny amounts of conotoxin are actually being developed into a pain-killer for patients suffering from AIDS, cancer, diabetes, shingles and surgery recovery. Conotoxin is possibly 10 000 times stronger than morphine, may be non-addictive and have no side effects when used in tiny medical doses.

After being speared by a cone shell, humans go into a coma within 20 minutes and usually die hours or days later from suffocation as the diaphragm muscle controlling breathing shuts down. A diver in New Guinea who was poisoned by a cone shell managed to survive by quickly accessing an iron lung and he worked the venom out of his system over time.

### Graphic panel text

Cone shells spear their prey with a harpoon-shaped tooth.

The tooth is held on the end of a muscle called a proboscis. The proboscis slowly approaches prey, then rapidly spears the victim.

Then conotoxin venom is pumped through the hollow tooth and the paralysed prey is dragged inside the cone shell to be digested. A new tooth is used each time to spear prey and these are stored in a sac—like a quiver full of arrows.

Scientists don't know how new teeth are reloaded on to the end of the proboscis.

Humans can die within minutes if speared by cone shells, so beware!

### Want to know more about cone shell hunting behaviour and venom?

There are nearly 500 species of cone shell. Most cone shells live in Indo-Pacific waters (water temperature 22–29°C), while some smaller species live along the south coast of Australia (water temperature 5–12°C).

The cone shell detects if any prey is nearby by drawing water in through its siphon. Concentrations of proteins given off by prey in the water are detected by the cone shell's siphon, so it can locate the prey.

Once prey is found, the cone shell very slowly stretches its proboscis out towards the prey. This movement can take several seconds.

Then in a fraction of a second, the cone shell spears the prey by shooting out its proboscis and plunging its tiny radular tooth into the prey.

A venom cocktail of proteins that affect the nerves is pumped from a muscular bulb or venom gland and out through the hollow tooth and into the prey. This venom, known as conotoxin contains many different peptides (proteins). It blocks nerve communication and causes paralysis in victims.

Different cone shell species have different conotoxin proteins, but they mostly work by blocking the prey's nerve signals. The conotoxins cause the prey to spasm for a few seconds before becoming paralysed.



Throughout the prey's spasms, the cone shell keeps hold of the prey, with its radular tooth embedded in the prey and a thread between the tooth and the proboscis. Visit Dr Bruce Livett's website <http://grimwade.biochem.unimelb.edu.au/cone/envenom.html> to watch a Quicktime video showing a cone shell capturing and engulfing a gobie fish.

Once the impaled prey is still, the cone shell pulls it back inside with its proboscis and 'swallows' it whole. The cone shell 'swallows' by enveloping the prey with a stretchy muscular sheath.

The prey is digested over many hours until the cone shell spits out any undigested shell or bone.

### Extra for experts

Cone shells are classified according to the type of prey they eat. For example:

- fish eating cone shells are piscivorous (and are the most toxic to humans)
- mollusc eating cone shells are molluscivorous
- worm eating cone shells are vermivorous

The cone shell's radular teeth are made in its radular sac, which is hidden under its shell.

After the cone shell has used up a radular tooth to capture prey, it reloads another tooth from its radular sac. Scientists do not know how the radular teeth are made, or how they are transported through the 'buccal cavity' to the tip of the proboscis for reloading.

Cone shells that eat molluscs inject several radular teeth into the prey, one at a time. After one tooth has been injected, they reload and inject several more individual teeth into the one prey.

Death by cone shell envenomation in humans is usually caused by asphyxiation. Conotoxin inhibits certain receptors (nicotinic acetylcholine) in the diaphragm muscle. When the diaphragm muscle cannot move, it cannot expand and compress the chest cavity and lungs. The symptoms shown after a cone shell envenomation are similar to curare poisoning in humans.

Conotoxin is more complex than snake venom. There are up to 50 different peptide components in a single cone shell venom, whereas snake venom usually only contains up to a dozen peptides.

In the cone shell venom, different conotoxins inhibit the movement of sodium, calcium and potassium ions, which are important for electrical impulses in nerves. Other conotoxins block the movement of glutamate and acetylcholine.

### Further information

Many thanks to Dr Bruce Livett and Professor Alan J Kohn for their valuable help with the Cone Shell exhibit.

Dr Bruce Livett, Cone Shell and Conotoxins <http://grimwade.biochem.unimelb.edu.au/cone/index1.html>

Envenomation by a cone shell (includes quicktime movie of cone shell capturing fish) <http://grimwade.biochem.unimelb.edu.au/cone/envenom.html>

Professor Alan J Kohn, cone shell researcher <http://depts.washington.edu/zooweb/kohn.html>

Snail toxin could ease chronic pain. *Nature*. 19 July 2002. <http://www.nature.com/nsu/020715/020715-11.html>

Venoms Striking Beauties. California Academy of Sciences. <http://www.calacademy.org/exhibits/venoms/>