



### Exhibit message

Funnel webs (particularly females) use ambush techniques to pounce on prey. They stab prey with fangs and inject venom to subdue and kill prey before eating it.

### Quick fact

Some species of funnel web, such as the Northern tree funnel web (*Hadronyche formidabilis*) have been found in nests with half-eaten carcasses of tree frogs larger than the spider itself!

Some funnel web venom proteins are more deadly to insects than mammals. This could be useful for developing an insecticide from funnel web venom.

### Graphic panel text

Blue Mountains funnel web (*Hadronyche versutus*).

There are thirty five different species of funnel web spider in Australia—one species even eats tree frogs! Most funnel webs, like this Blue Mountains funnel web, live on Australia's east coast.

Funnel webs (particularly the females) hide just inside a moist, cool burrow. Silk trip lines around the burrow vibrate when prey brush past them. The waiting funnel web then jumps out and bites the prey to inject venom.

The funnel web's venom contains many different types of molecules. The molecule in the Sydney funnel web venom that kills humans, is actually harmless to its normal prey of insects, frogs and lizards.

### Want to know more about the Blue Mountains funnel web?

The Sydney funnel web is the best-known funnel web, but the other 34 species of funnel web are found around eastern and southern Australia. With urban sprawl, humans are encroaching onto funnel web territory, rather than funnel webs moving into suburbs inhabited by humans.

The larger funnel webs around Sydney tend to be more toxic to humans than the smaller funnel webs found near Adelaide and Melbourne.

Most funnel webs prefer moist, cool micro-habitats under rocks and logs, in shaded banks of leaf litter and sometimes in holes in tree trunks. They're rarely found in open lawns.

A funnel web's burrow is lined with threads of silk near the burrow's entry. Some threads act like 'trip-lines', which passing prey might bump and send a signal to a funnel web waiting just inside the burrow that it is time to pounce.

Female funnel webs tend to stay within their burrows and hunt on the surface at night. Male funnel webs tend to wander away from their burrows, and are more likely to venture into houses and areas where humans are active.

Spider venom, like most venom, contains a mixture of different molecules. Some molecules are active on their prey (such as insects and lizards), while other molecules seem to greatly affect humans and other primates, but not necessarily other mammals.

Male and female funnel webs are similar in size and venom toxicity. However, the venom of the male Sydney funnel web (*Atrax robustus*), is five times more toxic to humans than the female's venom.

Before striking a victim, funnel webs must rear up so their fangs are held up like daggers. The fangs are then forced down and into the victim's flesh. Muscular venom sacs inside the funnel web's jaw pumps venom into the wound.

Sometimes the spider may strike several times. The venom is acidic and painful as it diffuses into the victim's flesh.

Venom travels through the victim's lymphatic system and is a neurotoxin, meaning that it affects the victim's nervous system.



In 1981, a funnel web antivenom for humans was developed by the Australian Professor Struan Sutherland (1936–2002). This antivenom is produced by injecting the funnel web venom into a rabbit and allowing the rabbit's immune system to react and produce immune cells. These immune cells are collected from the rabbit and used as antivenom in humans.

Thirty to forty funnel web bites are recorded in humans each year in Australia, but only a few cases need antivenom treatment. Only bites from the Sydney funnel web (*Atrax robustus*) are known to have killed humans, while bites from the Blue Mountains funnel web (*Hadronyche versutus*) are known to have made humans very ill.

From 1927–1980, 13 deaths were attributed to *Atrax robustus* in the medical literature and news media. Children die sooner from pulmonary oedema caused by funnel web bites, while adults die later from hypotension. Venom reaches the circulation in about two minutes after injection and death can occur between 15 minutes and 3 days after the bite.

### Extra for experts

Some funnel webs belong to the genus *Hadronyche* (such as the Blue Mountains funnel web *Hadronyche versutus*) while others are grouped in the genus *Atrax* (as in Sydney funnel web *Atrax robustus*).

Funnel web venom contains neurotoxins, which affect the nervous system of their prey.

Nerves form a network of connections with dozens of other nerves. The nerves are separated by tiny gaps called synapses. Individual nerves in these networks communicate with each other using electrical impulses and chemicals called neurotransmitters that are released into the synaptic gaps.

Nerves create electrical impulses by shifting positive ions across their cell membranes. Once an electrical impulse has reached the end of the nerve, it releases neurotransmitters across the synapse. These neurotransmitters are taken up by neighbouring nerves and the pattern is repeated, so electrical impulses travel along the next series of nerves.

Neurotoxins cause the nerves to rapidly fire electrical impulses and flood the synaptic gaps with neurotransmitters. This overstimulates the neighbouring nerve and each nerve along the chain is over stimulated in a domino effect.

The neurotoxins in funnel web venom block the movement of positive calcium ions across the nerve's cell membrane. This causes a constant electrical impulse in nerves, and the nerves keep releasing neurotransmitters across the synapse to neighbouring nerves. This flood of neurotransmitters is called increased spontaneous synaptic activity and usually results in nerves being overstimulated.

If nerves are overstimulated, they in turn can overstimulate muscles, so the muscles spasm. Sometimes spasms lead to paralysis and the victim cannot move, although this does not seem to happen in victims of funnel web bites.

When muscles spasm, the body and limbs may jerk around and the heart, blood vessels and other internal organs start to fail. This is why victims of funnel web bites are most likely to die of heart and renal failure and suffocation.

Versutoxin, a peptide in the venom of the Blue Mountains funnel web (*Hadronyche versutus*) has been shown in a laboratory to profoundly increase spontaneous synaptic activity in nerves.

The omega-atracotoxins are a family neurotoxins that block insect calcium ions, but not mammalian calcium ions. These atracotoxins may be used as an insecticide on insects that have developed resistance to chemical pesticides.

Blue Mountains funnel web venom has similar peptides to the omega-atracotoxins and may also be used as an insecticide, blocking insect calcium channels and overstimulating insect nerves until the insect dies.

In the Sydney funnel web, the lethal molecule in their venom seems to be robustotoxin. This protein causes the spontaneous release of neurotransmitters, as well as inhibiting release of neurotransmitters.

Versutoxin, from the venom of *Hadronyche versuta*, also seems to be closely related to robustotoxin.



## Further information

Funnel webs reduce insecticide need.

ABC Science News. Monday, 7 July 2003

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