

In memory of a snail

By Mathilde van der Merwe

You step out into the fresh early morning air. The sweet smell of basil and cherry tomatoes reach your nose and you lovingly look down at your vegetable and herb garden. The young shoots of your spinach started to break the soil a week ago and you count them, thinking of all the joy they'll bring, once they are in full bloom and you can start your harvest. Suddenly a shiny trail catches your eye and you follow it to where it disappears, behind the curly young leaf of one plant. Your dew-fresh euphoria comes to an abrupt end when you spot it: A big fat slimy snail feasting away at your precious vegetables. You yank it from its meal and throw it high, watching with satisfaction as it arcs over the wall.

One might find it hard to guess what the connection is between the creature that just left your hand and your ability to tie your shoelaces. What does a snail have in common with your ability to learn and remember? This snail has a bigger, slimier and more sparsely clothed brother that made an impressive entrance at the Nobel Prize ceremony a decade ago. His name is *Aplysia*, a marine slug, and this slimy friend has contributed a great deal to our understanding of learning and memory.

At *Aplysia*'s front end is a head, with a snout and grazing tongue adapted to feed on seaweed, and two rather long "ears", a feature that earned it the colloquial name of "sea hare", regardless of the fact that these ears are actually the smelling organs. Different species of sea hare vary in size, from tiny ones of about two centimetres, to a giant of almost one meter, weighing fourteen kilograms. The sea hare that is the subject of fascinating brain cell research is *Aplysia californica* and this one looks a little like an amorphous, hairless, water-breathing guinea pig of about fifteen to twenty centimetres in length.



The Californian sea hare is found in the Pacific Ocean, along the coast of California, where it feeds mainly on red algae, which contributes to the animal's red-brown colour. Following the transfer from its natural habitat to the laboratory, the sea hare has earned its place in history when neuroscientist Eric Kandel won the Nobel Prize in Physiology or Medicine in 2000. The reason why this sea hare is so well suited to neuroscience studies is because it has the largest nerve cells in the animal kingdom, the cell nucleus measuring up to one millimetre in diameter. Together with this advantage, its nervous system has only about 20 000 cells, a small number when compared to the billions found in the human nervous system. Kandel's idea that such a simple invertebrate animal would reveal universal neuronal mechanisms also employed in more complex organisms, such as humans, was spot-on, as his research spanning five decades attests.

The study of memory and learning, centred on the sea hare as a model organism, started half a century ago with behavioural experiments. Sea hare specimens were poked and prodded and their reactions meticulously observed. Results of these studies lead to questions like “What happens in the brain of an animal when it actually learns something? How does it remember?”, and “Once acquired, where or how is learned information stored?” The answers that came with time showed that connections between nerve cells are not made and left as they are after development, but rather that these connections can be enforced by external stimuli and can be altered by experience. One is indeed never too old to learn that practice makes perfect.

As the research focussed deeper and deeper into the cell, the time became ripe to change the nervous system under study from the simplest form in sea hares, to the more complex forms in mammals. Using mice, neuroscientists provided evidence of specific genes that are switched on during learning and memory storage. Answers to some of the most baffling questions on Alzheimer’s and Parkinson’s diseases are now, for the first time, within reach.

Can you remember why you just sent the snail on a nerve-wrecking journey over the wall? You most definitely can and, thanks to the sea hare, we even know how.