

Remake of the human body

Why is it that some animals can regrow whole limbs, but humans fail miserably in this area? **Nyssa Skilton** reports

The trick to mending a broken heart may lie in your ability to grow one back. Zebrafish can do it – scientists have cut away the bottom half of a zebrafish heart and, within a month, the fish grows the organ back. Like a science fiction creature, they can also regrow parts of their jaws as well as their muscles and fins.

They're not the only ones with incredible regeneration abilities. The salamander, a lizard-like amphibian, can regrow whole limbs, skinks can drop their tails to escape a predator and grow them back at a more convenient time, and even plants can grow from single cells or small cuttings. But a human can't regenerate a fingertip.

Regenerative medicine has become a booming area as scientists work to uncover what makes some animals so skilled at growing parts of themselves back, while others, like humans, struggle.

Professor Nadia Rosenthal, who is the founding director of the new Australian Regenerative Medicine Institute at Monash University in Melbourne, visited Canberra recently to speak at Parliament House about her research. The work is part of a \$4 million Australia Fellowship from the National Health and Medical Research Council to look at how to enhance the heart's regenerative capacity in ageing and disease.

At 56 years old, Rosenthal seems the perfect proponent for the research. She barely looks a day over 45 and talks about her work with the enthusiasm of a little girl.

She says increasing our capacity to regenerate will have major ramifications for just about every aspect of medicine.

The aim is not to make people immortal, although some may find that appealing.

"The scheme is to try to reduce the number of age-related debilitating diseases and situations so that people can live out a full life and die of 'natural causes', whatever that means," Rosenthal says.

"What we're aiming to achieve is to increase the health of the population. The big tragedies are these horrendous degenerative diseases like ALS [amyotrophic lateral sclerosis] or Alzheimer's or Parkinson's. They just take people out in the most grizzly way, often leaving them with perfectly functioning brains and bodies that can't get up out of the bed, or the other way around."

Regenerative medicine refers to the repair or replacement of human tissues and organs.

Stem cells, from which other cells develop, play a major role in this field, but scientists still have much to learn before they harness their abilities to generate and regenerate the body.

The origins of regenerative medicine go back further in time than many realise. When a patient receives a blood transfusion or a bone marrow transplant, they are replacing parts of themselves with new parts that can take on new roles in the body. Humans can regenerate in some ways; watch what happens to the skin after a



Professor Nadia Rosenthal, who is the founding director of the new Australian Regenerative Medicine Institute at Monash University in Melbourne, visited Canberra recently to speak at Parliament House about her research. Photo: Karleen Williams

paper cut. Children are particularly adept. "Anyone who's had a kid and watched a scratch heal – it's just like magic. Within three days the skin is completely better."

But our regeneration abilities appear limited to linings such as the skin, the inside of the throat and the inside layer of the intestines and stomach.

Rosenthal describes what happens when the skin is

punctured or scraped, making actions with her hands.

"You just see the skin going rrrrrrr, fixing everything. There's a program in there and clearly the program is moving along at full speed. We can't seem to do that with every organ."

It makes sense because these are the parts of us being constantly bombarded by the outside world. But it also doesn't, because the consequences of a heart or brain

that don't regenerate are still severe: death or a brain injury.

As we grow older, our regenerative abilities weaken.

Rosenthal studies how to make the environment around damaged tissue help incoming cells regrow the tissue.

One of the big problems is scarring, which prevents regeneration.

"One of the things we have to

understand is how to reduce what is essentially an inflammatory response to injury," she says.

"We have to reduce it to its essential role, which is to clean up the mess at the front end of the response to the injury, but not to let that clean-up go for a long, long time, because then that scar will prevent new tissue from growing in its place."

Rosenthal believes one of the key secrets to understanding our regenerative capacity is to understand how it goes awry when cancer cells form.

Cancer in some ways is "regeneration gone haywire".

"A tumour is something you don't want to grow, whereas you do want to grow back injured tissue in your heart or perhaps in your spinal column. Some of the same pathways have to be activated to do that because the body doesn't have that many ways of regrowing."

Other researchers at the Regenerative Medicine Institute examine zebrafish, which are particularly useful to study because the transparency of the zebrafish embryo allows researchers to see every cell in the forming embryo.

They are interested in the development of the organism and the regeneration later on. As Rosenthal puts it: how to make a fish and then how to remake a fish.

Scientists know a lot about the processes involved, but they don't know what turns the switch from not regenerating, like after a human has a heart attack, and being able to like the zebrafish.

"These are very simple childlike questions, but we have no answers for them yet," Rosenthal says. "I've been curious about this forever."

She's not the only one keen to find some answers. The cosmetics industry is "incredibly interested", but Rosenthal is sceptical about how much they actually know.

"Some of the things that get marketed in the cosmetics industry are just complete hogwash. I see them pick it up out of the scientific literature and think they can put it in a cream and make a difference."

Society has discovered numerous ways to keep people alive, increasing life expectancy by more than 20 years in the past century to 79 years for men and 84 for women in Australia. But it's still working to cure the degenerative diseases that come with old age.

Rosenthal says regular exercise and healthy eating are the most important things people can do to stay healthy as they grow older.

"But there are inevitable limits biologically to our capacity to maintain ourselves. We do give out eventually. We are a machine and the pieces do give out."

■ Over the next two weeks, *The Canberra Times* will explore different areas of regenerative medicine to take a closer look at how some animals regenerate as well as the regenerative capabilities of the human brain.