How can the salamander help fight degenerative disease?

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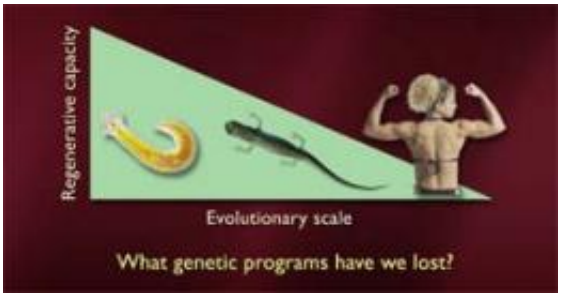

Regenerative capacity is reduced as we go up the evolutionary scale. Image courtesy of EMBL Australia

Ever asked yourself why some animals can regenerate lost body parts, yet we can't grow back a limb? A new Australian research collaboration is offering a chance to solve this puzzle in the fight to cure degenerative diseases.

Biology 101 tells us that if we lose an arm, unless it’s attended to immediately, we run the risk of bleeding to death as the speed with which our cells work to rebuild tissue is not fast enough to stop the blood loss.

It's the price we pay for being complex cellular organisms, unlike the salamander that can lose its arm, jaw and even its heart and still regrow these parts of the body.

Studies show the regeneration process for salamanders begins immediately after amputation starting when the epidermis migrates to cover the stump in less than 12 hours, forming a structure called the apical epidermal cap (AEC).

Over the course of the next few months, depending on the age of the animal, a process of restructuring takes places, similar to that started in the embryo, that leads to the induction of genes and the escalation of motor neurons, muscle and blood vessels until the new limb becomes fully functional.

This remarkable process, called regeneration, is one scientists hope to replicate to some degree in humans as regenerative medicine.

The reward for such a breakthrough could offer a cure for degenerative diseases like Parkinson's disease or Diabetes. This is what a new research institute, EMBL Australia, kick-started by funding from the Federal Government and its partners is aiming to achieve.

"The basic way to explain what we do is to say the salamander can regenerate limbs and the human can't and I don't know why," says Professor Nadia Rosenthal, Director of the Australian Regenerative Medicine Institute at Monash University.

Professor Rosenthal specialises in heart development related research and since plying her trade at the Harvard Medical School has been working for the European Molecular Biology Laboratory (EMBL) one of the leading research institutes in the world.

The EMBL is the flagship of Europe’s molecular biology research community, renowned as one of the top research institutes worldwide and ranked the highest non-US institute in life science research performance with a top-level European network of molecular biologists.

It has 20 member states and in 2008 included Australia, under the guise of EMBL Australia, as its first Associate Member with Professor Rosenthal installed as its Scientific Head.

Professor Rosenthal, along with other life scientists working at EMBL's Australian Regenerative Medicine Institute (ARMI) node based at Monash University in Melbourne, are attempting to understand the regenerative process that permits the replacing or regenerating of cells, tissues or organs to restore or establish normal function. The salamander is just one example of an organism scientists are studying to understand changes in the complexities of regeneration as you move up the evolutionary scale.

It's hoped their studies will lead to the creation of medicines that can fight a number of diseases.

"We are taking the view you can't understand biology by studying one level," says Professor Rosenthal, "you have to integrate across the organism, cell and molecular levels.

"Right now this is called systems biology.

"By combining different levels of biology, we hope to be better at finding drug targets and to control lineage by looking at stem cell-based therapies."

While EMBL Australia is still in its infancy, the organisation has a mission statement to encourage the type of collaboration here that saw its European counterparts win the Nobel Prize for Medicine in 1995 on the genetic analysis of embryonic development in the fruit fly by Christiane Nüsslein-Volhard and Erich Wieschaus.

And the logic is this will be achievable by following the EMBL formula

of offering generous but fixed term packages for high calibre PhD students and postdoctoral scientists to ply their trade and be guaranteed funding by the Government and access to the EMBL Australia partner network laboratories at the University of Queensland, the University of Sydney, the University of Western Australia, Monash University and CSIRO.

Professor Rosenthal is encouraged by what she sees in Australia and has grand hopes for what the local branch of EMBL can achieve long term, especially with facilities like those on offer here at the Australian Nuclear Science and Technology Organisation.

"You can't just put brilliant people in a vacuum; you have to surround them with resources. You need facilities like ANSTO," Professor Rosenthal says.

Imaging techniques offered by ANSTO offer life scientists with a bird's eye look at living organisms from the molecular level.

ANSTO is already doing work in this field. Scientists from the Life Science Institute recently developed a novel imaging radiopharmaceutical to help diagnose malignant melanoma, a cancer for which Australia has the highest incidence in the world.
Preliminary patient studies have been promising, but there is more research to be conducted before clinical staging of this therapeutic treatment can occur.

This is on top of an agreement reached last year with pharma group Bayer who are currently running medical trials on a new imaging technique developed by ANSTO that could open a window into new diagnostic options for patients with Parkinson's and Alzheimer's disease.

The agreement with Bayer Schering Pharma stems from studies

performed by ANSTO scientists, Dr Andrew Katsifis and Ms Filomena Mattner, in the mid-1990s which found new ways to obtain images of neuroinflammation which is believed to be an early characteristic of these debilitating diseases.

Both areas of work show what ANSTO brings to the health and life science realms and the opportunites that could present themselves to collaborate with organisations like EMBL Australia.

On her second visit to ANSTO's Lucas Heights campus, as part of our Distinguished Lecture series, Professor Rosenthal invited a number of her colleagues to witness first-hand some of the work being carried out and to see how this could contribute to their own studies.

"We hope to integrate that as part of the great technologies to which Australian life scientists will have access.

"One of EMBL Australia's core objectives is to create collaborative relationships, which we hope to do with ANSTO," she said.

So when can we begin to see the results of EMBL Australia?

It's a case now of "watch this space", but with world class facilities at its disposal and the potential to participate in major international projects at their fingertips, we might not have to wait very long.

Provided by Australian Nuclear Science and Technology Organisation