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Research and discovery at the University of Victoria

Not magic, MAGEX

Illuminating how pollutants affect health

By Diane Haughland

Pesticides, drugs and industrial effluents are released into the environment daily, yet we know little about their effects on our health or the health of wildlife. But what if we could peer into an animal's cells and compare molecular activity before and after exposure to a chemical? Magic? Not at all. UVic biochemist Dr. Caren Helbing, research associate Dr. Nik Veldhoen, and members of her laboratory have created a tool that enables scientists to do just that with frog cells.

Called MAGEX (for Multi-species Analysis of Gene EXpression), it shows great promise in helping scientists identify harmful chemicals and understand how they cause cell damage.

MAGEX is a microarray — a small slide that has gene fragments, strings of DNA, attached to it in an ordered grid. These gene fragments can specifically stick to cDNA that represents the genes in a cell that are turned on. A sample of cDNA from cells exposed to a chemical is washed over the microarray. cDNA in the sample that matches that on a spot on the slide sticks to that spot. Matching DNA shows up on the slide as a bright spot – the more cDNA that attaches to the slide, the brighter the spot.

"A microarray is analogous to a satellite picture of Earth at night," Helbing explains. "Each of the bright spots on the satellite picture pinpoints human activity. The size and the brightness of the spot tell how large and how busy that activity centre is. The size and brightness of spots on a microarray indicate levels of gene activity. By comparing microarray gene patterns of exposed cells to unexposed cells, scientists can find out how gene activity has been altered by the chemical," she says.

Before microarrays, scientists could examine only one gene at a time. "Today we can look at a more complete picture of cell activity and monitor the activity of hundreds to thousands of genes using a microarray," says Helbing. Her own MAGEX array contains about 450 well-known gene fragments.

Peter Blashill photo

Helbing and friend with microarray image

Why design a microarray for frogs? Most of the chemicals we use end up in our water, where amphibians live during their tadpole stage and metamorphosis," Helbing says. "Frogs are exquisitely sensitive to their environment. They are regarded as sentinel species, giving us indications about the state of our environment that impacts humans and wildlife. MAGEX could help researchers in developmental biology, cancer biology, physiology and genetics understand the affect of chemicals on normal cell activity," enthuses Helbing.

While other microarrays are specific to one species of animal, Helbing's array is unique in that it can be used with at least three species. "We know it works with the common laboratory frog (African clawed frog) and a second type of frog found in many parts of the world (Rana species)," says Helbing, "and right now we're testing whether it works with alligator genes."

The more species that can be examined with MAGEX, the more global its usefulness. Currently, Helbing is working with Dr. Graham van Aggelen at the Pacific Environmental Science Centre (Environment Canada) and other collaborators from Canada, the United States and Japan who are interested in the MAGEX array for its versatility.

facts from the EDGE

- Helbing's research is funded by the Natural Sciences and Engineering Research Council (NSERC), the US Environmental Protection Agency and a prestigious NSERC faculty award.
- Helbing's graduate students Rachel Skirrow, Dominik Domanski and Connie Mackenzie are conducting research on the cell signaling pathways of hormones, and her graduate student Mary Wagner is working to identify the role played by a tumor suppressor in the normal development of an organism.
- Helbing is working with the Genomics Research on Atlantic Salmon Project (GRASP) to develop an Atlantic salmon microarray, an important tool for improved monitoring of wild salmon health.

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- To market MAGEX, Helbing and her colleagues are working with UVic Innovation and Development Corporation (IDC), which helps bring the products of UVic research to market. They have formed a company called ViagenX Biotech Inc., which will be offering MAGEX commercially later this year.
  www.viagenx.com
  www.uvic.ca/idc/home.htm
- Helbing's homepage includes more information about her research
  web.uvic.ca/~chelbing/
- The metamorphosis from tadpole to frog is triggered by one hormone – thyroid hormone. Find out more about Helbing's research on hormones and cell to cell communication at:
  communications.uvic.ca/Ring/99oct01/cells.html

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