focus on
Research
Faculty of Agricultural and Environmental Sciences
McGill University

June 2007

Dean's Message

Research and discovery in the life sciences is at the heart of much of what we do at McGill s Faculty of Agricultural and Environmental Sciences. The work of the Faculty has evolved considerably with rapid advances in molecular sciences, encompassing the new knowledge being generated through tools such as genomics, proteomics and bioinformatics. Our researchers are applying their skills in these areas in order to discover new drugs for human diseases. In addition, we are using bioinformatics to design new plants that will have improved nutritional quality, and also reduce environmental degradation. I invite you to read more about the Faculty s work in these new and exciting research areas, all geared to improving your quality of life. We also invite you to participate in our road to discovery.

Chandra A. Madramootoo, PhD, Ing.
Dean, Faculty of Agricultural and Environmental Sciences
McGill University

Searching for hands-on training in biotechnology?

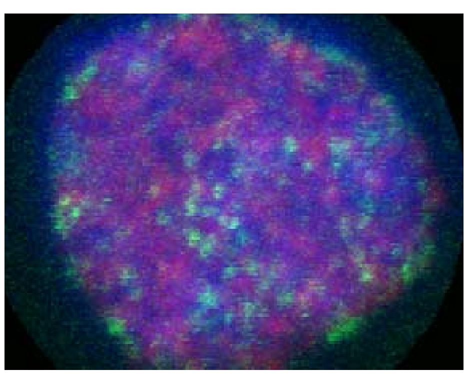
The Faculty offers two graduate programs in biotechnology for students who already hold an undergraduate degree in the biological sciences. The 16-credit Certificate program aims to prepare students for entry into the biotechnology industry. The 45-credit M.Sc. Applied (Biotechnology) is for students interested in pursuing a career in industrial/life sciences research. Both programs are offered in the Faculty s Institute of Parasitology. Students obtain practical laboratory training with the latest tools in biotechnology as well as industry experience. Students also gain training in genomics, advances in high-throughput screening, proteomics, and bioinformatics. For more information: www.mcgill.ca/biotechgradprog

Using large animals to understand disease in humans

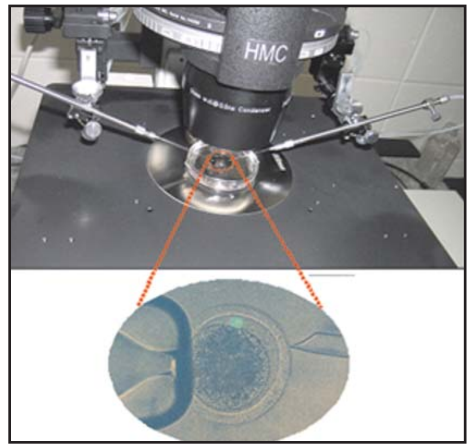
The birth of Dolly the sheep in 1996 marked a milestone in the history of reproductive cloning technology. The technology used in the cloning process and somatic cell nuclear transfer has had a broad range of benefits from improving animal production and health to rescuing endangered species. It has also allowed scientists to study cell reprogramming and to generate cell lines with potential therapeutic avenues.

Vilceu Bordignon studies mechanisms controlling nuclear reprogramming in swine embryos produced by somatic cell nuclear transfer. He is also developing a nuclear transfer approach to generate large animal models of diseases to be used in biomedical research. Some outstanding applications being explored by Bordignon and other McGill researchers include the production of swine models to study atherosclerosis, muscle growth and resistance to gram-negative infections.

It is envisioned that in the future, these technologies will have broad applications in the health and biotechnology sectors, including in the development of drugs



Male germline stem cells carry unique epigenetic modifications that control gene expression such as methylated histones as shown (red).
Photo: S. Kimmins



Embryo reconstruction by nuclear transfer using genetically modified cells. Photo: V. Bordignon

and in cell/tissue therapies.

When genome meets the environment

Sarah Kimmins works in the emerging field of epigenetics which is the study of heritable biochemical information that is not coded in the DNA. Altered epigenetic patterns are a hallmark of cancer.

Kimmins and post-doctoral fellow **Maren Godmann** have bred a transgenic pig that will overexpress an epigenetic modifying protein implicated in cancer. They predict that this pig will be a valuable large animal cancer model. Other studies are underway that deal with how environmental factors such as nutrition, pharmaceuticals and environmental toxins affect the epigenetic layer and gene function. Kimmins team has recently linked antidepressants to altered sperm cell development through modification of the epigenetic layer. These drug-induced epigenetic alterations could in turn cause infertility or disease in offspring.

Focus on Researchers

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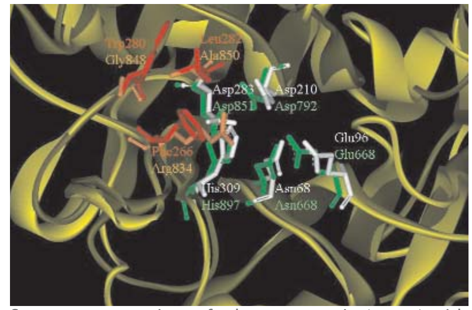
Computers and molecules:
on the fast track to eradicating disease and resistance

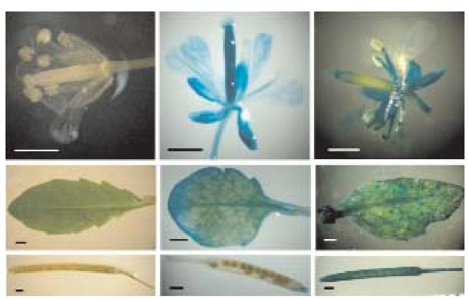
Bioinformatics is a marriage between biology and computer science, using powerful computers and innovative programs to manage, process, and understand copious amounts of genomic and proteomic data that would otherwise take years to interpret. Several Macdonald researchers are working in this interdisciplinary area.

Battling African sleeping sickness

Reza Salavati studies the parasitic pathogens that cause African sleeping sickness, Chagas disease and the group of diseases known as Leishmaniasis. These pathogens lead to one million deaths a year, huge economic losses, and dramatic agriculture consequences in Africa, Asia, and South America. The existing drugs are toxic and are rapidly becoming ineffective as individuals develop resistance to them. As a result of the completion of the genomic sequencing of these parasites along with advances in computational methods, there has been an explosion of new information. Salavati s team is working to determine key genes and molecular processes common to all three parasitic pathogens. In partnership with researchers from around the world and funded by the National Institute of Health, they are developing a high throughput screening platform of chemical compounds to detect molecular processes unique to these pathogens. This research could identify potential targets for drug development.



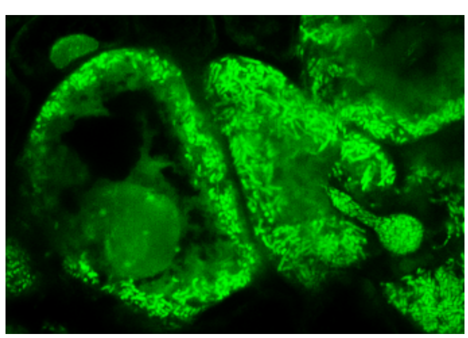
Structure comparison of a human protein (green) with a similar protein predicted from the parasite *Trypanosoma brucei* (yellow). Photo: R. Salavati



Expression of a reporter gene (blue) that is switched by soybean promoters in *Arabidopsis thaliana*. Photo: M. Stromvik

Developing crops à la carte

Martina Stromvik unravels the secrets of soybean promoters, also known as gene switches. Each cell in a plant species has the same genome which contain between 20,000 and 60,000 genes. But each cell type is unique: only a certain subset of genes is switched on simultaneously. The specific switching information is stored in a gene promoter in the DNA adjacent to each gene. Stromvik s research team is applying various bioinformatics tools to identify the promoter that activates genes in a part of the plant. Their discoveries will lead to the development of more desirable traits in crops. For instance, the promoters of a plant can produce a natural pest resistance compound at the site of the attack while maximizing crop yield and minimizing harmful environmental and nutritional effects. A better knowledge of the promoters could be used in the development of nutraceuticals, enzymes or oils for applications in the food and industrial product sectors.



Rhizobial cells (green, rod-shaped) in alfalfa root nodules. Photo: M. Poilly

Enhancing a Natural Fertilizer

Rhizobia are bacteria that form a symbiotic relationship with legume plants such as soybean and alfalfa. Rhizobia supply the host plant with nitrogen when there is not enough in the soil or in the absence of nitrogen fertilizer. In return, the plant provides the Rhizobia with an energy source. Using bioinformatics coupled with molecular biology tools, **Brian Driscoll** studies how the regulation and expression of various rhizobial genes can increase the efficiency of nitrogen fixation in legumes, which could lead to reducing our dependence on synthetic fertilizers.