Carleton UNIVERSITY
Canada's Capital University

EUREKA!

NEWSLETTER OF THE FACULTY OF SCIENCE

Spring 2008

Bubbling with curiosity

- First-year experiences
- Award-winning faculty
- Physics on the world stage

Carleton UNIVERSITY SCIENCE

Spring in science

The returning birds, blossoms and bursting leaf buds on campus reflect a season of new beginnings; similarly, the Faculty of Science is bustling with new activity, planning for the future and welcoming Carleton's new president, Professor Roseann Runte.

Through retreats, town hall meetings and many discussions, a new strategic plan for the Faculty of Science is coming together. I expect the plan to be finalized in July, and invite you at that time to visit a website outlining the plan. We've had great news of an extraordinarily high success rate in our applications to the granting councils for research funding and equipment. This reflects the high quality of researchers in our faculty. I'd like to thank Mark Forbes, associate dean of research, for his efforts in reviewing our draft proposals and mentoring new faculty members in their first grants. The associate dean for undergraduate affairs, John Armitage, is leading plans for a student success centre in the Faculty, for this fall. Though the mentoring and care for our students is the responsibility of all of us on staff and faculty, this centre will support those activities in a focused and deliberate manner.

It's been a pleasure to watch our new Science Café in Ottawa gain public interest and support. Our professors have given their time on Wednesday evenings to share their science with the public at the Wild Oat Café. Supported by the Carleton University Alumni Association (CUAA), our aim is to inform and discuss with the community topics that can affect our lives—and topics that are simply interesting! You'll get a taste of the Café from one of the featured speakers on page 3.

Of course, there are many ways to connect with the community, and I have tried to fit in as many as possible. In March, the CUAA invited alumni to "come in from the cold" and meet me in the Nesbitt Building to hear about future plans for the faculty and to reconnect with former professors. I also took the show on the road, travelling to British Columbia to give two lectures as part of the CUAA FOCUS tour and meeting with alumni in Hong Kong in January. In May, a few faculty members and I had the opportunity to meet with local science teachers to discuss science education and opportunities for Carleton to get involved in the high school classroom.

As always, I invite your feedback on the topics covered in *EUREKA!* and on the Faculty of Science.

George Iwama
Dean, Faculty of Science

EUREKA!
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carleton.ca/science/

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Newsletter Mission Statement
EUREKA! is published for the alumni, faculty, staff, friends and partners of the Faculty of Science. The newsletter is intended to communicate the faculty's goals, strategic direction and activities in order to connect alumni to each other and the university. It is published in collaboration with the department of university advancement.

The department of university advancement protects your personal information. It is used by the university to inform you about programming, events and offers from our affinity partners, to communicate Carleton news, and for fundraising purposes. To update your name or address or stop mail, please contact advancement services at 1-800-461-8972.

On the cover

Biology instructor Mike Runtz photographed this ice on Cranberry Lake, Ont., in December. After a night of howling winds, the ice formed over shallow water full of aquatic plants. Runtz suspects wind injected large amounts of air into the water, which was trapped by the plants. As the air was released into the fast-freezing water, the bubbles flattened out when they hit the ice. But why did they stack up? One suggestion is that each time a bubble froze into the ice it formed a small depression that attracted the next bubble.

Do you have a better explanation? Post your informed answers and best guesses at eureka.carleton.ca.

Your input is important!

Please send your feedback, letter to the editor or story ideas to newsletter_editor@carleton.ca.

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Visit eureka.carleton.ca to share your opinions.

Big developments in the smallest things

By Sean Barry

One of the earliest examples of nanotechnology—the control of things a billion times smaller than a metre—is the Lycurgus Cup, a famous example of Roman pottery circa AD 260. The cup appears green when illuminated from the outside, and red when illuminated from the inside. This remarkable characteristic arises from silver and gold nanoparticles in the ceramic of the cup that interact with visible light to produce a colour that the metals themselves normally cannot.

Evidence that Roman artisans tried and failed to replicate this phenomenon suggests the cup was a fluke. However, it didn't take long for this effect to be employed and controlled in stained glass windows. From as early as AD 500, stained glass windows integrated vibrant and durable reds and yellows that also result from the same "coinage metal" nanoparticles.

Today, modern research is almost obsessed with the minute. And while the existence of nanotechnology isn't new, the tools for measuring on this scale are. Following different rules than the visible length scale, the nanoscale is a new science frontier. Thanks to modern microscopy, the ability to image and measure objects that are the size of 1 to 100 nanometres—or tens to hundreds of atoms depending on the atom—is routine, and every field of research contains some aspect of nanoscience.

Microscopy, including the trusty electron microscope, has given scientists the ability to "see" what they might be able to change and how their efforts affect the nanoscale. Our ability to manipulate atoms and molecules is becoming almost artistic: the journal *Nature* showed this artistry in 2006 when it reported Caltech researcher Paul Rothemund was able to repeatedly and accurately doodle smiley faces and maps of the world from single strands of DNA.

Without a doubt this ability to control the nanoscale is fascinating, but is it useful? What does it *do*? Right now, nanotechnology makes iPods, USB flash drives and Xboxes. It improves solar cell efficiency by 300 per cent and changes how sunblock works. But it doesn't put tiny robots into your bloodstream, or assemble human skeletons from the thin air. It will improve, sometimes dramatically, the way things work: golf balls will drive straighter thanks to a company called NanoDynamics, and socks will stink less, or less often, thanks to NanoHorizons. But flying artificially intelligent cars powered by nanotechnology are still in the distant future. In the same way that antibiotics changed the face of medicine in the 1930s and biotechnology changes food production and pharmacology today, nanotechnology will change tomorrow. The process will be slow, reasoned and steady with momentary blips of very exciting advances.

Too often nanotechnology is offered as a panacea for the scientific problems society faces. It is presented as a cure-all, packaged impressively in modern research and sold with aplomb to all buyers. But perhaps a more reasonable approach would be to see nanotechnology for what it is—the application of basic and applied science to solve technical issues and discover new phenomena. Cast in this light, nanoscience and nanotechnology become simply science and technology enacted on small length scales because of an improvement in our tools. Or to co-opt a phrase: "All problems are nanoscience if your only tool is a scanning electron microscope."

The original version of this article first appeared in Ottawa Life.

Sean Barry is an associate professor in the department of chemistry. He was a featured speaker at the Science Café, an informal event for the general public and Carleton researchers to discuss scientific issues and topics of interest. Presented by the Faculty of Science and the Carleton University Alumni Association, the Science Café runs every other Wednesday from February to May in Ottawa. Visit carleton.ca/science for details.

A break from the ordinary

By Mandy Sinclair

Spending reading week in Mexico implies a relaxing vacation in the sun. But for Navya Kalidindi and 24 other Carleton students involved in the second annual Alternative Spring Break (ASB), Mexico provided continuous learning opportunities.

A third-year biology and biotechnology student, Kalidindi embraced the ASB opportunity to learn about justice and poverty in the advent of globalization—subjects not taught in the science classroom. The community service learning initiative organized by the First Year Experience Office challenges students to make connections between the service they provide to the community and the knowledge and skills they acquire at university.

"At the end of the week, I had a greater understanding of public affairs, poverty and globalization in Mexico," says Kalidindi.

Stationed in Cuernavaca, Mexico, the students' time was balanced between experiential learning and service projects, and lectures and discussions at the Cuernavaca Center for Intercultural Dialogue on Development. The group spent two days digging foundations for two Habitat for Humanity houses, one day painting and cleaning up an elementary school and another visiting families in a squatter settlement.

Kalidindi is the first science student to participate in the ASB program, and values the breadth it provides in her education.

"I consider academics to be very important," says Kalidindi, "but I think there are other things Carleton does to ensure we have a well-balanced university experience and allow us to grow as a good member of society."

Prospecting for employees

By Mandy Sinclair

Employers in the mining industry are digging for geology grads as the demand for skilled employees grows. The *Globe and Mail* reported in March that only 1,200 geology students will graduate this year, yet the mining industry in Canada has 9,000 positions to fill.

The demand for employees meant that many of the 64 Carleton students attending the Prospectors and Developers Association of Canada conference in Toronto in March had pre-arranged interviews with potential employers. Students attended lectures on aspects of geology and met with geoscientists, entrepreneurs, investors and businesses representing all aspects of the mineral industry.

Similarly, a two-day career event hosted by the Carleton University Society of Economic Geologists student chapter attracted 11 organizations and saw nearly 100 students interviewed—with some students receiving more than one job offer.

Coalition chess

Nearly a century ago, Arnold Schoenberg electrified the chamber music world with iconoclastic atonal compositions and secured a unique place in the history of music. A painter, music theorist and teacher of composition, Schoenberg was also the inventor of coalition chess, a strategic board game where four players form alliances to overcome their opponents on an expanded chess board. The complexity of Schoenberg Coalition Chess has made its playability questionable and inhibited its popularity, but Michel Paquette hopes to change all that.

Paquette, a computer science doctoral candidate, took on the challenge of creating an online version of coalition chess for the international Schoenberg symposium hosted at Carleton in July 2007.

"The idea intrigued me since it was coming from the music department. My critical mind was thinking, 'What could an artist have made which is scientifically so interesting? I have to see this!' And I was won over."

The game's complexity results from the tremendous numbers of playable combinations from four sets of pieces. As Paquette explains, there is no way that a human or a single computer could play all the games, or even experiment with all the starting configurations of the board in its lifetime. (To see all possible starting combinations within 100 years, the pieces should be reconfigured more than 221x1015 times per second.)

"The artificial intelligence of this game will have to be built over many years, certainly more than 10 years for any good purpose," says Paquette.

For now, with the online version available to anyone for play, Paquette is working on improving its popularity by creating a 3D environment.

"For people like me, for whom playing chess against a computer doesn't cut it, coalition chess offers the added challenge of collaboration and social interaction mingled with strategy."

Visit the Online Schoenberg Coalition Chess Project at coalitionchess.com.

Bridging to university

By Mandy Sinclair

Before starting university, high school graduates don't typically work on real research projects, engage in the subject matter of their interest and work directly with world-renowned researchers—much less get paid for it! However, for participants in the eight-week Bridging Summer Research Internship in Science program in the Faculty of Science at Carleton University, these opportunities are realized.

As a physics major and the inaugural recipient of this hands-on internship, Miriam Diamond spent summer 2007 working with Peter Watson, professor in the department of physics, on a project for the world-renowned Sudbury Neutrino Observatory (SNO).

Researchers at SNO have provided great insight into neutrinos coming from the sun that oscillate between three different "flavours" on their way to Earth. As an intern, Diamond had the opportunity to research neutrino signals and write computer programs for SNO to analyze specific data for the research project. She also attended physics meetings and seminars and interacted with other researchers at Carleton.

"What I enjoyed most about the program was the opportunity to get first-hand experience working on a real physics research project—it makes studying the material much more exciting now that I've seen what it can lead to," says Diamond.

The experience and mentoring Diamond received during her internship have given her the confidence to explore her research interests. "Dr. Watson has been a wonderful mentor to me, offering guidance when I needed it, but allowing me to pursue aspects of the research project by myself."

Engaging students in the subject matter is a top priority in the Faculty of Science, which offers bridging opportunities in all nine departments to students based on academic achievements in secondary school.

When presented with the bridging opportunity, Diamond's decision to accept was obvious thanks to the research projects she could be involved in. "Carleton's physics program is absolutely one of the best in the country and the department is involved in some of the most exciting projects in the world."

For Diamond, the bridging internship program has been her greatest Carleton experience and the greatest academic experience of her life. "Having a first-hand glimpse into the world of physics research, I now know that I definitely want to pursue a career in physics."

A seminal seminar

If giving a presentation and being critiqued by the professor in front of a room full of your first-year peers sounds daunting, you likely avoided Don Wiles' first-year seminar on science. Pity.

Wiles, a chemistry professor emeritus, is one of those teachers you wish you'd had. He's passionate about teaching and passionate about Carleton. Despite retiring in 1990, he's entering his fiftieth year of teaching at Carleton in September. He started teaching in the first-year seminar program when it was introduced eight years ago, and has been organizing it for the past four years.

What sets the seminar apart from other first-year courses is the small class size of 18 to 22 students and its intention to teach science communication rather than science content. Learning the written and oral communication skills required of a working scientist takes time, and Wiles winces at the thought of students making their first presentation only later, when they defend their honours thesis.

"Students in the seminar learn early on how to communicate their research to diverse audiences and how to think on their feet," he says. "They gain a lot of confidence."

More than that, Wiles believes the seminar sets the tone for a student's university experience. "In the first term of their first year, students are criticized on their presentation, and they criticize me on mine. That confidence and trust, to tell a professor what he did wrong, to know that professors can be questioned and talked to, is important. Beyond the seminar content, students learn to trust the system, accept positive criticism and work with colleagues."

> "Students in the seminar learn early on how to communicate their research to diverse audiences and how to think on their feet

For Mutiat Enikanolaiye, now a second-year biochemistry and biotechnology student, the small class size made all the difference. "The professor actually knew my name and my face! With about a dozen students sitting in a circle speaking directly to the professor, you couldn't help but participate, learn and actually think during the class—and the course gave me an initial network of friends, other intelligent, curious and often confused first-year students like me."

"The class made me a better scientific writer, and writer in general," she says. "Dr. Wiles always said that if we could not explain something to our grandmothers then we didn't really understand it, and that I'll remember for a good while to come."

Helen Holden, in third year biochemistry, echoes those sentiments.

Because of the requirement for class participation, she had opportunities to work on presenting her ideas clearly and logically. "The course gave me a lot more experience and confidence with public speaking, and that summer, I was even hired by Carleton to do presentations for the parents of incoming students," she says.

"Dr. Wiles put together a practical and inspiring course," says Holden. "He had a genuine regard for each of us as individuals, and gave us room in the curriculum to tailor the course to our interests. I brought away skills and knowledge that I appreciate again and again as an upper-year student."

Moshi Kotierk's social research has taken him out of fungal genetics and into wildlife management.

Bear necessities

In April, the Canadian government was advised by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) that polar bears are at risk, particularly from Arctic ice melt as a result of climate change. While the polar bear population appears to be increasing in some areas, in others it is declining—resulting in their classification as a species of special concern. The report calls for careful management of the polar bear harvest in coming years; the federal government must provide a management plan by 2014.

At the same time, the Nunavut Wildlife Management Board was holding consultations on proposals from the Government of Nunavut's department of environment to reduce polar bear hunting on Baffin Bay. A contentious issue, the government cites overharvesting in Nunavut and Greenland while Baffin Bay people give evidence of increasing populations.

Before these stories hit the headlines, Moshi Kotierk, BScHons/01, MSc/04, was already on the scene.

Kotierk, a fungal geneticist by training, is a social science researcher in the wildlife management division of Nunavut's department of environment. As part of a project examining the legal, policy, administrative and ethical framework within which sport hunting is practised, his job is to gauge public opinion on wildlife and management issues. Since polar bears are prized by Inuit for their nutritional and cultural value, and as a source of income from hides and sport hunting expeditions, emotions run deep.

"Some people think the idea of managing wildlife isn't natural or appropriate; some believe you can't manage something from God; others want conservation of polar bears so

that the hunt can continue in the long term," says Kotierk, who began his research in Davis Strait where a polar bear capture project was underway, and will head next to Foxe Basin.

"The way that people in the south are wary of genetically modified food is the way that people in the north are wary of their food being drugged and immobilized by researchers. The suitability of research practices also needs to be managed."

In the cross-cultural environment of the vast territory, Kotierk sees himself as a bridge between scientific and traditional knowledge. Being a speaker of Inuktitut and a natural-born teacher, Kotierk navigates between two cultures, filling in gaps in understanding and strengthening relationships as he goes.

Raised in Igloolik, Nunavut, until he was 12, Kotierk's parents moved him and his siblings to Ottawa for their education. After completing high school and two biology degrees at Carleton, Kotierk returned to his home town.

"In the short time I've had to reflect on my choices, I'm glad that a master's degree was my main goal. The work I did contributed to the greater knowledge in fungal genetics as well as my own knowledge," says Kotierk. "While my job now is quite a jump from genetics, I'm making a positive contribution."

"You often hear that decisions are made without input from the people being affected, but now I'm the person asking for the input. People appreciate being asked for their opinions and to share their knowledge, and I hope this work will lead to benefits for these communities."

! Fast fact...

The Carleton University Art Gallery presents *Nanuit: The Polar Bear in Inuit Art* from May 5 to August 24, 2008.

Business intelligence

The world of business intelligence has changed since Don Campbell, BCS/87, entered the high-tech world more than 20 years ago—and Campbell continues to push the envelope in how business information is collected, integrated, analyzed and presented.

As chief technology officer for Cognos, recently acquired as an IBM company, Campbell is the internal champion for research and innovation, overseeing the company's technology adoption strategy.

"The competitive nature of business means there is always the drive for faster, more efficient decision making," says Campbell. "Think back 20 years ago, before the internet. Individuals weren't as empowered with information—you were reliant on a central IT department for data. Now, we have information self service that opens a world of possibilities for users."

Moving forward, says Campbell, the role of the individual will become even more important in the decision making of an enterprise. Take the popularity of social networking websites, for instance: tapping into vast amounts of personal knowledge can supplement and enhance data that businesses use.

"The challenge is to arm people with valuable and accurate information using the technology and social means available," says Campbell, who is leading the charge on new technology in search, unstructured data analysis, location intelligence, mashups and wireless information delivery for performance management.

In addition to leading the creation of several award-winning products, Don Campbell is himself an award winner. He was named to the Top Forty Under 40 by the *Ottawa Business Journal* in 2003 and in 2005 he received the International Business Award for best product development or engineering executive.

In his 21-year career with Cognos, Campbell has worked in research, software development and management. The foundation for his current role was laid when Campbell tired of looking at numeric data in tables and spreadsheets, and suggested a better way to consume information. Given a small team with which to develop a visual representation of information, Campbell watched his idea grow into Cognos Visualizer, an award-winning three-dimensional, interactive dashboard product.

"I'm comfortable not always knowing where I'm going. I couldn't champion innovative culture if I didn't have that belief," says Campbell. "It's okay to fail—in research, the success rate should be low, otherwise you're not pushing the envelope. The challenge is knowing when to let go."

Imparting that innovative spirit to the next generation is one of the highlights of Campbell's job. Whether he's speaking at Carleton's Sprott School of Business, at conferences around the world, or in the cubicles and boardrooms of Cognos' Ottawa office, Campbell is happy to provide guidance and mentoring. "I take pride in supporting and sponsoring young minds. They have all the potential in the world."

As for his own potential, Campbell is excited by the research opportunities that IBM and its vast network of groups and businesses will provide. "Being the head techie with that kind of global reach has to keep me excited!".

! Fast fact...

With top student talent travelling from the university to Cognos, the company invests in education at Carleton. Cognos sponsors the annual Innovation lecture series, the NSERC/Cognos Industrial Research Chair, and two prestige scholarships.

One can make a difference

To celebrate the Kiwanis Club of Ottawa's 90th anniversary, its president Bill Gosewitz challenged the membership to raise $90,000 this year through the Winterlude Bed Race. In return, Gosewitz would shave his head.

When it looked like Gosewitz would get to keep his curly locks, Kanta Marwah, a trustee with the Kiwanis Club of Ottawa Medical Foundation and a distinguished research professor and professor emerita at Carleton, stepped forward with a gift of $20,000—and a plan for how to spend it.

With Marwah's gift matched by the Medical Foundation and $10,000 from the club's members, the Kiwanis Club donated $50,000 to Carleton to establish the Kiwanis Club of Ottawa Medical Foundation and Dr. Kanta Marwah Scholarship in Medical Physics. Matching funds from the university mean that endowment fund will provide an annual scholarship of up to $10,000 a year for a doctoral student researching medical physics.

"The mandate for the Medical Foundation is the advancement of medical treatment and research," says Marwah. "What better way than to support the students doing research in the medical area, and in perpetuity?"

"Our motto is one can make a difference, and our Bed Race committee and Kanta Marwah have stepped forward to help make a difference," says Gosewitz, who heads the largest Kiwanis Club in Canada. Each year the Ottawa club gives thousands of hours to community service and raises thousands of dollars for the community.

For more on the medical physics program, see EUREKA! *Spring 2007.*

Extreme makeover: Steacie edition

By middle age, time has taken a toll, priorities have changed, and many start to think about a lift here and a tuck there. For the 42-year-old Steacie Building, a major makeover is underway to maximize and renew space, modernize laboratories and incorporate a new program in food science and nutrition.

In April, the complete demolition of chemistry labs kicked off the first of three phases of the $12.6-million renovation. In their place is a "super lab" for first-year chemistry and organic chemistry courses. By September, the lab will accommodate almost 30 per cent more students and give the university flexibility in scheduling.

"The super lab will ensure we continue to offer our students hands-on training in state-of-the-art research and laboratory facilities," says George Iwama, dean of the Faculty of Science.

The next two phases of the renovation project will include upgrades to the computer classroom, and a retrofit of additional undergraduate teaching labs and rooms for preparation and instrumentation.

A new "super lab" will accommodate 30 per cent more chemistry and organic chemistry students in state-of-the-art facilities.

Calling it a day: faculty retirements

Peter Watson, professor of physics

Photo: Chris Strangemore

Peter Watson

When the ATLAS particle physics experiment begins in Geneva this summer, it will search for the Higgs boson using a method suggested 35 years ago by Carleton's Peter Watson, M.K. Sundaresan and Lazer Resnick. In 1973, the trio was the first to publish how the possible effect of the Higgs boson might be observed. Watson, then a research associate, was trying to understand an anomaly in the short-lived muonic atoms. Now on the verge of retirement, the former dean of science will see one of his earliest ideas put to the test.

Since arriving at Carleton in 1971, Watson has worked in a variety of fields of theoretical physics, including quark models, broken colour models, and Higgs and neutrino phenomenology. As a member of the Sudbury Neutrino Observatory (SNO) collaboration, Watson's principle interest is in possible neutrino signals from astrophysical sources such as γ-ray bursters and pulsars. With the analysis of SNO data winding up in a year's time, "it fits in quite nicely with retirement plans," he says.

Respected among his colleagues for sharing best practices and resources on teaching methods—and how to motivate students to study physics—Watson was feted with a Carleton University Teaching Achievement Award in 2005 for his creation and use of technology-assisted learning. The Faculty of Science gave him a teaching award in 2007 for his commitment to science education via outreach to high schools and the community, innovative course delivery and new programs. (See page 11.)

"I'll certainly go on teaching as long as there is an opportunity," says Watson. "It's always been the most satisfying part of what I have done."

Gerald Buchanan, chancellor's professor of chemistry

Photo: Chris Strangemore

Gerald Buchanan

When Gerald Buchanan arrived at Carleton in 1971, the field of nuclear magnetic resonance (NMR) spectroscopy was in a primitive stage: the department of chemistry had an NMR spectrometer, but no one knew how to use it. Thanks in part to Buchanan's late nights spent getting the machine to work, and his nearly 150 publications, the field of NMR at Carleton can now claim a mature—but not staid—status.

In fact Buchanan, in his latest work with Igor Moudrakouski at the National Research Council, invented a new method of doing magnetic resonance imaging that holds the potential of rapid, non-invasive gastrointestinal imaging within a few seconds.

A former chair of the department of chemistry, Buchanan is a decorated teacher, twice winning the Faculty of Science Teaching Award and receiving the Carleton University Teaching Achievement Award in 2002. In 2004, the president gave him the special professorial designation of chancellor's professor.

"I have enjoyed tremendously the stimulating interactions with some very bright students," says Buchanan, who has supervised the research of more than 50 students at all levels. "It has been really satisfying to see them go on to successful careers in academia, industry and government."

As for his own future, travelling to see his grandchildren is a priority, but Buchanan will stay at Carleton part-time to teach the food, drugs and health course and "dabble" in areas of magnetic resonance spectroscopy and imaging.

"Teaching at a university is a privileged existence," he says. "Carleton has been a wonderful fit for me and I hope that I can continue to make some contribution to it for many years to come."

Faculty stars

Carleton University honours its best and brightest researchers with annual Research Achievement Awards. Established in 1989, the $15,000 awards enhance the quality of research conducted at Carleton.

Cold play

Humans have lost their ability to shut down and survive in the cold. Despite having all the same tissues as hibernating mammals, if we attempted to lie down all winter we would be plagued by bed sores and atrophied muscles. And without slowing down our metabolism, we would also need to eat and drink, interrupting that long winter's nap.

Photo: Brigette Bouvier, Ottawa Citizen

Kenneth Storey has identified the molecular technology the wood frog has evolved over time to survive freezing.

"Humans developed an extremely narrow lifestyle," says Kenneth Storey, professor of biochemistry and Canada Research Chair in molecular physiology. "We've reorganized our molecular signals away from hibernation, but we can flip those switches back."

Storey's program of research focuses on dormancy at all levels of biological organization: from the molecular to the genetic, from tissues and organs to the whole animal. Whether switching off an organ for transplant or slowing down a patient's metabolic rate to prolong the time a surgeon has to operate, dormancy is important for medical science. Even more important for Storey is the thrill of studying the unexplored.

"We do discovery science in this lab," he says. "This is the research Darwin would have done if he'd had the same equipment."

With an infusion of funds from his 2008 Research Achievement Award, Storey's latest explorations are how newly discovered small molecules, microRNA, can interfere with cell function in order to turn off human organs; how epigenetic mechanisms that activate and inactivate cellular genomes can turn off and stop life signs and disease processes; and how the widespread process of autophagy—whereby cells and organs reversibly eat themselves during times of stress—works.

"This award helps keep me out of grant prison," says Storey. "It gives me freedom to pursue new avenues of discovery."

Learning from mistakes

If everything in education is fallible—teachers, teaching techniques, textbooks—how do students learn accurately? John Oommen, chancellor's professor in the school of computer science, explores this question in designing electronic teaching and learning strategies.

"The entire field of designing and implementing tutorial-like systems is fascinating," says Oommen. "It is amazing how much 'learning' is possible even in the most imperfect settings."

Traditionally, the field of intelligent tutorial systems has dealt with the problem of real-life students learning from a program guiding, teaching and testing the students. Oommen has created a tutorial-like model where the teacher program can make mistakes probabilistically, with teaching material that can also contain errors, and yet the student (a real person or a program) is capable of learning within that setting. The student is also a member of a classroom of students, all of whom could also have inaccurate knowledge. Each student can learn from the teacher and from any students. Using a Socratic model, the teacher asks multiple choice questions about the material, which increases in complexity chapter by chapter. Finally, the model also lets the teacher improve teaching skills through interacting with and feedback from the students.

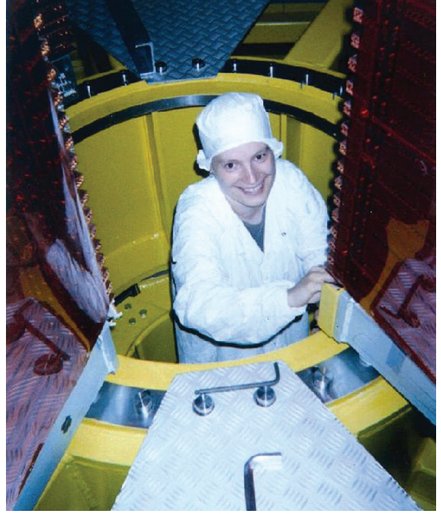
In April, John Oommen (pictured) and post-doctoral researcher Dragos Calitoiu were presented with the Best Paper Award from the International Conference on Health Sciences Simulation for their simulation methodology that can predict how a disease spreads to infect healthy people in a certain geographical region.

Currently in the research stage of the project, Oommen's prototype demonstrates that such a teaching/learning paradigm is feasible and expedient. He'll use his 2008 Research Achievement Award to develop a research monograph and help bring the tutorial system another step closer to real-world application.

FISHY BUSINESS

Steve Cooke, assistant professor of biology, is working with Scott Hinch at the Forest Sciences Centre at the University of British Columbia on climate warming and high salmon migration mortality. The research team was awarded a three-year strategic grant by the Natural Sciences and Engineering Research Council of Canada.

The *pulse* of international particle physics


Manuella Vincter at work on ATLAS.

Around the world, giant machines are smashing together protons and sending beams of electrons and positrons colliding into each other—and Carleton University physicists are there to make sense of the chaos and unravel the secrets of the universe.

David Asner, an assistant professor of physics at Carleton and a spokesperson for the CLEO Collaboration at Cornell University, is delving into the mysteries of the charm quark as part of the CLEO-c program. The Cornell Electron Storage Ring collides beams of electrons and positrons to produce new particles, and the CLEO particle detector observes them. The measurements are critical for understanding the strong force that binds protons and neutrons and governs quark behavior.

Recently, the CLEO Collaboration observed a new way to reproduce basic particles of atoms. In 30 years of study no one had witnessed the charmed-strange meson decay into more stable proton or neutron particles, until a physicist at the University of Florida inferred its presence from data on energy and momentum of other particles. John Yelton found 13 instances of charmed-strange mesons decaying into protons and anti-neutrons.

"Observations of these rare decays have the promise of increasing our understanding of the underlying mechanisms of how the world is put together," says Asner.

More answers are sure to come from the ATLAS project, one of the largest collaborative efforts in the physical sciences. Led by Professor Gerald Oakham, Asner is part of Carleton's ATLAS team with Manuella Vincter, associate professor and Canada Research Chair in particle physics. Using the Large Hadron Collider (LHC) and the ATLAS detector, physicists will explore the fundamental nature of matter and the basic forces that shape our universe.

"Not only will ATLAS help unlock more secrets about the nature of matter but the kind of physics involved will have huge implications for all of us, the way fundamental physics experiments did at the turn of the 20th century," says Oakham.

A system the size of a five-storey building located 100 metres underground, the ATLAS detector will search for new discoveries in the head-on collisions of protons at the highest energies ever produced in a laboratory. The powering up of the LHC and the first collisions in ATLAS later in 2008 will be a major international event. The two energy measuring modules Carleton contributed to ATLAS are already installed and ready to go.

Fall marks the formal opening of SNOLAB in Sudbury, Ont. Featuring the deepest underground laboratory in the world, SNOLAB transforms the Sudbury Neutrino Observatory (SNO) experiment into a permanent, world-class research facility that will host new, complex experiments to continue where SNO left off. Carleton is the administrative leader of SNOLAB in partnership with five universities and several international partners. Over a 10-year period, 500 graduate students, post-doctoral fellows, engineers, technicians and other personnel will be trained at the new facility.

In April, the Government of Canada announced a $6.1-million investment to support the excavation of additional research space and equipment purchases for SNOLAB's CRYOPIT, a new underground research facility dedicated to the study of astroparticle physics.

The new facilities, engineered specifically to meet unique safety issues, will allow a range of experiments utilizing noble liquids and gases.

"By expanding the lab facilities, we're seizing a vital opportunity to solidify Canada's position as a world leader in the field of astroparticle physics," says David Sinclair, a Carleton physics professor and director of facility development for SNOLAB.

"For the foreseeable future, SNOLAB will be the largest, deepest and cleanest facility available for this type of research."

UNDERGROUND, IN CANADA AND JAPAN

With help from Honda Canada, two leading-edge underground laboratories for particle physics are exchanging graduate students to encourage young researchers to learn from each other.

Japanese student Kota Ueshima from the University of Tokyo and Olivier Simard, a Carleton University doctoral student, are the first students to be awarded an inaugural Honda fellowship. Ueshima joined Simard at SNOLAB in Subury, Ont., this spring and Simard will work at the Kamioka Observatory in Japan for three months this summer. While SNOLAB studies neutrinos from the sun, Kamioka studies neutrinos produced in the atmosphere.

"I am curious to visit Kamioka as it is the father of the SNO experiment where I started working with amazing researchers from Carleton," says Simard. "Carleton's department of physics is becoming one of the best in Canada for its involvement in world leading research projects."

Fast fact...

The Carleton University physics department offers its students an opportunity to be involved with ATLAS and research at SNOLAB. Carleton is also a full partner in Triumf, Canada's National Laboratory for Particle and Nuclear Physics.

Head of the class

The Faculty of Science annually presents awards in recognition of its outstanding faculty and staff members. *EUREKA!* presents the winners of the 2007 Faculty of Science Teaching Awards and the World of Difference staff award.

Sean Barry, assistant professor, chemistry

With high evaluations in courses that contain content difficult to teach and learn, Barry maintains patience and an ability to help students grasp and understand new material. Students remark that he teaches relevant mathematics, makes chemical concepts clear and drives the material home with concrete examples. He chaired a curriculum review committee to recommend areas of the chemistry curriculum most in need of change, and has contributed to the development and revamping of course and labs. His expertise was instrumental in the development of the nanotechnology program.

Susan Aitken, associate professor, biology

Aitken's dedication to her students extends beyond the classroom and outside regular working hours: she regularly uses MSN to help students study after hours. She is open to student feedback on the courses she teaches and makes changes based on the comments while introducing new material and updating course syllabi regularly. Her course evaluations praise her ability to impart the course material, her caring attitude and her extraordinary efforts to communicate with students. Beyond her teaching duties, Aitken's professional knowledge was instrumental in the development of the new food science and nutrition program.

Julia Wallace, sessional instructor, physics

With evaluations in the top tier in the department of physics, Wallace shares her passion for teaching across the Faculty of Science, also teaching in the integrated science institute and the natural science first-year seminar. As the coordinator of the graduate medical physics practicum course, Wallace generates a manual of projects and oversees the participation of colleagues at Health Canada, the Heart Institute and National Research Council, among others.

Peter Watson, professor, physics

Watson isn't just committed to Carleton students, he is committed to science education. His outreach to high schools and the community, innovative course delivery and development of new programs has been constant throughout his career. Watson has developed computer assisted learning technologies, including the interactive Computer Assisted Learning with the MAC operating system and a Unix version, and makes embedded video available to first-year physics students. In addition to high teaching evaluations from his students, Watson is also respected by his colleagues for sharing best-practices and resources on motivating students to study physics.

Peter Mosher, manager, science stores and chemistry

As manager of the science stores, Mosher has extended the hours of service, implemented a new pricing structure and improved the invoicing system for researchers—all while his permanent staff was on leave. Mosher was able to maintain service without disruption, coordinating temporary employees and work study and co-op students. As a member of the University Joint Health and Safety Committee, Mosher inspected the Steacie and Nesbitt buildings, inventorying chemicals and designated substances, hazardous waste and materials. Mosher also played a crucial role in the schedule of undergraduate and graduate courses in chemistry, taking into consideration lab availability and teaching assistant expertise to ensure students could fulfill the demands of their program.

Prosenjit Bose, professor, computer science

Described as the most difficult first-year course in computer science, discrete mathematics has had a high dropout/failure rate. To turn this trend around, Bose introduced new ways of presenting material to computer science students. With his 2008 Carleton University Teaching Achievement Award, Bose will develop course notes based on his lectures and will create a web-based database of solved problems to help students put into practice the concepts introduced in class. "Teaching is all about communication. Often, in the classroom, it is one-way communication from the professor to students," says Bose. "For the teaching to be effective, it must be two-way."

Exploring evolution

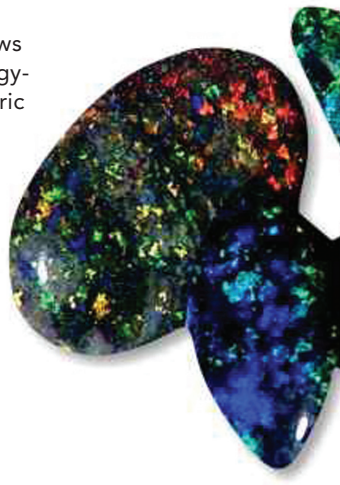
Evolutionary biologists are generating some of the most exciting findings in science today, from fossils of walking whales to new strategies for fighting diseases. Award-winning science writer Carl Zimmer described new directions in evolutionary biology and the challenges in writing about them when he delivered the 2008 Discovery Lecture *The Darwin Beat: Dispatches from the Frontiers of Evolution.*

When asked what the biggest science story of our time is, Zimmer replied: "The ability to read and synthesize DNA is fascinating. By extracting DNA from the Neanderthal fossil, we can now compare the human genome and discover how species evolved, what makes us evolve and the actual changes that make us human. By making DNA from scratch, we can create new organisms, which give us the power to change the way we look at life.

The annual Discovery Lecture is sponsored by the Faculty of Science and the school of journalism and communication.

Opals, not just for jewellery

Recent research into the active colour tuning of opals shows promise for the development of a new generation of energy-saving and full-colour display surface coatings and biometric security systems. Geoffrey Ozin, Canada Research Chair and founding fellow of the nanoscience team at the Canadian Institute for Advanced Research, shared a personal account of this research when he delivered the 2007 Gerhard Herzberg Lecture *P-Ink and Elast-Ink; Lab to Market* in November. Sponsored by the Faculty of Science, the free public lecture emphasizes the relationship between science and society.



Sounds good!

Computer-generated music and sound effects, new real-time mixing methods, and interdisciplinary collaboration may be the solution to current problems in video game audio design, according to Karen Collins, Canada Research Chair in technology and communication at the University of Waterloo. Collins delivered the Cognos Innovation Lecture *Bits, Bytes and Beats: Problems and Solutions in Video Game Audio* in November. The Cognos Innovation lecture series presents leading academic, business and government researchers and innovators on a variety of topical issues. The Faculty of Science is pleased to partner with Cognos in presenting this lecture.

! Upcoming events

Looking for alumni events this summer? Check out Canada Day celebrations in Washington and Hong Kong, or play in the seventh annual Pat O'Brien Golf Classic with the Carleton University Ravens Basketball Alumni Association in Ottawa. Check **alumni.carleton.ca** for complete event listings.

The **2008 Gerhard Herzberg Lecture** on November 4 will feature Rolf-Dieter Heuer, currently the research director for particle and astroparticle physics at the German research centre DESY. Heuer will become the director general of the European Organization for Nuclear Research in 2009. Visit the science website for details closer to the date.

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