



Barbara Hallett and Meghan Ward

## Physics Scholarship Honours Hallett

**E** DUCATOR. SCIENTIST. FRIEND. Those are some of the words colleagues and former students used to describe physics professor Ross Hallett, who passed away in 2010. The University hosted a symposium in his memory, attended by deans, department chairs, friends and family on June 24. The symposium also honoured Meghan Ward, a master's student in physics and the first recipient of the Ross Hallett Memorial Award in Biophysics.

"Ross's memory through the scholarship will live on in perpetuity," said CPES dean Anthony Vannelli as he thanked Ross's wife, Barbara, for establishing the scholarship, which is the only biophysics graduate scholarship at U of G.

Hallett joined U of G's faculty in 1969 and held numerous leadership positions, including CPES assistant dean (research and graduate studies). He played an instrumental role in developing a new course called Introductory Physics for the Life Sciences and co-authored the course's textbook, *Introductory Biophysics*, now in its fifth edition.

Department of Physics chair Eric Poisson said the scholarship will honour Hallett's legacy while enabling the department to encourage its best students.

"I think it's a great thing to support science," said Ward. "It's a great way to keep his memory alive."

## Engineering Student Named 40 Under 40

**M**OST PEOPLE take water for granted, but for people living in developing countries, water is a matter of life or death. Laura Robertson, a fourth-year environmental engineering student, learned that lesson first hand during a co-op term in rural Cambodia. That experience inspired her to make water awareness a priority on campus. Her efforts earned her a spot on the *Guelph Mercury's* 40 Under 40 list.

"It was a great surprise to find out and a real honour," says Robertson. "Ever since I came to Guelph, I just feel like I've learned so much and been so inspired by all of the wonderful people in the academic community and the Guelph community itself."

While in Cambodia, she studied the effectiveness of a household ceramic water filter. "Everybody consumes water on a day-to-day basis, and it's something we can't live without," she says.

The annual list recognizes people who are making a difference in their community and abroad through arts and culture, athletics, research and volunteerism. Robertson was among 13 U of G faculty, staff and students to make the list this year.

## Grant Boosts Science Olympics

**T**HE SCIENCE OLYMPICS, one of the University's most popular science outreach programs for youth, will be able to attract hundreds more Ontario high school students and teachers, thanks to a new federal grant announced in July.

U of G will receive a three-year \$12,500 grant for its annual Science Olympics from the PromoScience program of the Natural Sciences and Engineering Research Council of Canada.

The day-long, campus-wide competition makes learning fun for teens, says Bonnie Lasby, recruitment officer for CPES. "They really have to do some critical thinking."

Started at U of G in 2009, the Science Olympics attracts hundreds of high school students each year to compete in more than 20 learning activities in areas such as human anatomy, veterinary science, nanoscience, animal and plant sciences, chemistry, math, engineering and physics.

This past spring, about 610 teens and 40 teachers from high schools between Windsor and Richmond Hill, Ont., took part. Lasby hopes to attract more than 700 people next year and up to 1,000 within three years.

Participants became microbiology detectives, chemical analysts, weed experts, geocaching treasure hunters and mini-veterinarians. This year, they launched mini-rockets to mark the 2011 United Nations International Year of Chemistry.

# Back to School



Dean Anthony Vannelli

**A**S THE CAMPUS BUZZES with students, faculty and staff, I already know this is going to be an exciting school year.

The College of Physical and Engineering Science (CPES) has many reasons to celebrate. I would like to congratulate the School of Computer Science (formerly CIS) on its 40<sup>th</sup> anniversary. This is a milestone worthy of celebration. Over the past 40 years, the school has graduated many talented alumni.

This is also the International Year of Chemistry, and a number of events are

taking place, including a celebratory brunch and speaker series Sept. 24. We encourage alumni to attend this event and learn how chemistry impacts our daily lives.

The School of Engineering (SOE) has been undergoing an expansion, and I am thrilled to announce Phase 1 is officially completed. Students and faculty are enjoying the new lab and teaching spaces. The new atrium is a hub of activity. I am pleased with the progress of Phase 1 and am looking forward to the completion of Phase 2, expected in 2012.

The SOE will host its annual honours and awards banquet Oct. 22. The evening will celebrate the achievements of alumni and friends. We look forward to congratulating the award winners.

In January 2012, we will host the CPES and SOE career and networking nights. We are looking for alumni to share their insight and experiences with our current students. They find the opportunity to speak with you crucial to their success. For more information regarding these and other events, please contact Sonia Mancini at [mancinis@uoguelph.ca](mailto:mancinis@uoguelph.ca) or Maryam Latifpoor-Keparoutis at [mlatifpo@uoguelph.ca](mailto:mlatifpo@uoguelph.ca).

As you can see, we have an incredibly exciting year ahead, and I am looking forward to seeing our alumni, faculty, staff and students participate. I would like to thank you for your support, which is imperative to our success.

## The BetterPlanet Project



# Robot Tests New Armrest



Prof. Michele Oliver

**R**ESearch on REPETITIVE stress injuries among operators of joystick-controlled heavy equipment is an “unplowed field,” says Prof. Michele Oliver, School of Engineering. She studies joystick mechanics to understand how joystick use affects operators, which led to the development of the first dynamically moveable armrest that rotates and moves with the user.

The armrest has been studied in static equipment like excavators and is now being tested in moving machinery like forestry skidders that haul timber. As the machinery rolls over rough terrain, the operator gets jostled around and experiences whole-body vibration inside the cabin.

“One of the things we need to do is make sure the armrest works when you’re throwing a person all around,” says Oliver.

To test the armrest, she ordered a hexapod robot that will arrive on campus in September. The six-legged, computer-operated robot has a joystick and seat mounted on a platform and can move in all directions to mimic the vibrations inside a cabin. The hexapod allows the armrest to be tested in a controlled environment without putting the operator or machinery at risk.

Oliver is a member of a consortium of research-

ers from Ontario and Quebec that has one of the largest libraries in the world of “six degrees of freedom” acceleration measurements from off-road machinery. “We use that data to run the hexapod robot so it throws a person around in the same way a person would be thrown around operating a machine,” says Oliver.

The team is also developing models of the hand, wrist and joystick using motion capture and electromyography, which detects electrical impulses produced by muscle contraction. The models will be used to test prototypes of joysticks and other hand tools before they go to market. “You want to assess whether that design is going to potentially injure someone,” says Oliver.

One of her grad students developed a human-factors-based joystick that models the movements of an operator. The model allows researchers to adjust the length of the joystick and the operator’s arm to account for different body types.

“If you change the length of the joystick, what effect does that have on the load on the wrist, elbow and shoulder?” says Oliver. “Everyone’s different. You can never predict. What causes a repetitive strain injury in one person might not bother someone else.”

## Research Targets Stomach Bug

**A**POTENTIAL VACCINE against bacteria that cause serious gastric disorders, including stomach cancer, may be a step closer following a pioneering study by a U of G chemist.

In the first published study of its kind, a team led by Prof. Mario Monteiro, Department of Chemistry, found a carbohydrate-based antigen caused mice to develop antibodies against a common bacterium linked to gastric cancer.

“This is the first jab at a sugar-based vaccine against *Helicobacter pylori*,” says Monteiro, who completed the study with former undergraduate student Stacey Britton. Their study was published recently in the journal *Vaccine*.

*H. pylori* is among numerous risk factors for stomach cancer and can also cause gastritis and ulcers. About half of the world’s population has been infected by the bacterium during their lifetime. In Canada, the bug is especially prevalent in aboriginal communities. Most infections are handled by antibiotics, but a vaccine would improve current treatment, says Monteiro.

Many scientists study potential vaccines based on proteins to prevent or control infection. Since arriving at Guelph in 2004, Monteiro has studied more complicated conjugates containing both proteins and sugars. The Guelph researchers used a single bacterial strain in mice to induce an immune response against various strains of the bacteria.



## Art Meets Engineering in New Lab

IT'S LITERALLY cutting-edge technology. A new lab at U of G will be equipped with a water jet cutter that can slice through any material. The lab will be shared by faculty and graduate students in the School of Engineering and the School of Fine Arts and Music (SOFAM).

The lab is expected to be completed by this fall. Artists will be able to use the lab to design large-scale artwork, while engineering researchers can use it to study new materials.

The water jet is mixed with powdered garnet and shoots from the nozzle at a speed of Mach 3, cutting through steel, plastic and wood. The water travels so fast, it can cut through cardboard without getting it wet.

This isn't the first time artists and engineers have worked together at U of G.

"There's a cross-fertilization of ideas when you work with people in other disciplines," says Prof. Christian Giroux, SOFAM. "It really feeds my own ideas and my own art practice."

Giroux has collaborated on art projects with John Phillips, School of Engineering, who helped him model a sculpture using 3-D modelling software.

# Statistical Models Predict Survival Rates



Prof. Jeremy Balka

ONE OF THE FIRST questions people ask when they are diagnosed with a serious illness is, "How long do I have to live?" Statistical models can help doctors answer that question by predicting life expectancy and cure rates based on clinical data.

"Survival analysis deals with time-to-event data," says Prof. Jeremy Balka, Department of Mathematics and Statistics. "We're modelling times until an event happens. For instance, if somebody gets diagnosed with breast cancer, how long they may have to live." Some people are immune or not susceptible to certain types of diseases, he adds.

Cure-rate modelling has also been used for prostate cancer, leukemia and non-Hodgkin's lymphoma.

"The tricky part comes in trying to separate those that are cured from those who sim-

ply haven't died yet," says Balka. At the end of a five-year study, for example, the patients who have survived may succumb to the disease in the future.

Variables such as the patient's age and stage of disease can influence the prognosis. A younger patient whose cancer was diagnosed at an early stage may have a better outcome than an older patient in a more advanced stage of the disease.

Balka also looked at time-to-infection rates for burn patients based on the type of disinfectant bathing method they received in hospital. Burn patients who contract *Staphylococcus aureus* infections often spend more time in hospital and face higher mortality rates.

Cure-rate modelling was the subject of a paper Balka co-authored that was published in the *Journal of Applied Statistics*.

# Ocean Floor Holds Key to Origins of Life

**T**HE BOTTOM OF THE SEA may seem like an unlikely place for life to begin, but the hydrothermal vents that spew water and gases heated by the Earth's core may have provided the right conditions for the formation of DNA molecules. Hydrothermal vents are located as deep as two kilometres below the ocean's surface.

"In these environments, there's the energy and raw materials that are needed to make the precursors to DNA molecules," says Alex Lowe, a master's student supervised by Prof. Peter Tremaine in the Department of Chemistry. These molecules, called nucleic acid bases, are among the building blocks of DNA and RNA.

"I measure their molecular volume and their heat capacity, basically their size and their ability to absorb heat energy," says Lowe. "These are the data needed for models to determine under what favorable conditions they will form from their raw components," such as cyanide and formaldehyde. Other molecules like amino acids and lipids are also thought to form under these conditions.

According to the hydrothermal vent theory, the high temperature and high pressure found in these vents provide molecules with the energy they need to form larger molecules.

"The reason we're looking at hydrothermal vents is that they act as natural chemical reactors," says Lowe. "They're porous enough that the raw materials can concentrate in these little pockets, like mini test tubes, and form the smaller precursor molecules that self-assemble into RNA in water."

Instead of travelling to the bottom of the sea, Lowe uses a high temperature densitometer to measure molecular volumes under high pressure at 350°C. Although molecules can join together under these high temperatures, they can also fall apart. Lowe is trying to find the conditions at which they remain stable.

He studies these molecules in the hydrothermal chemistry research lab, which is specially equipped with high precision instruments to mimic the conditions found on the ocean floor.



Alex Lowe

Theorists can then use the measurements produced by the lab to test their hypotheses.

Astrobiologists could use the findings to compare the conditions on the sea floor with those found on other planets to see if they could support life.

"If we know the conditions for the precursor molecules of life to form, then we can take a look at other planets," says Lowe. He adds that Europa, an ice-covered moon of Jupiter, has geysers on its surface that indicate a similar hydrothermal environment may exist under the ice to produce these molecules and possibly support simple organisms.



## U of G to Teach Afghani Students

**W**ATER IS A precious resource, especially in countries like Afghanistan where rainfall is scarce. That's why the University of Guelph is sharing its water management expertise with Afghani students.

Starting this fall, the University will offer online distance education courses to 40 students in Afghanistan. The students will use Skype to communicate with instructors. Two U of G faculty and two grad students will spend several weeks in northern India, where they will provide face-to-face instruction and lead study tours of irrigation sites.

The University answered a request for proposals on capacity-building initiatives from the Asian Development Bank in December 2009.

Guelph will offer courses ranging from AutoCAD to English as a second language.

The courses will be tailored to suit Afghanistan's dry climate and other challenges.

"Salinity buildup is a big problem in the soil if you don't drain the soil properly," says Prof. Ed McBean, School of Engineering. "As the water evaporates, it leaves behind the natural salts. Over time, you get buildup of those salts and that will interfere with the crops you're trying to grow."



## Lab Studies Water Chemistry in Nuclear Reactors

**C**ORROSION IS THE enemy of cars — and nuclear reactors. That's why the hydrothermal chemistry group at U of G is studying the chemistry of water in nuclear reactors to keep them running smoothly.

"Anything like corrosion in the pipe or any leaks in the pipe could lead to impurities," says Lucas Applegarth, a postdoctoral fellow in the Department of Chemistry, who is looking at the interactions between salt, metals and acids in the water of nuclear reactors.

Impurities can be harmful if they build up. "We need to know how to prevent any sort of precipitation," says Applegarth. "We need to make sure it's a free-flowing system."

Much like a car, a nuclear reactor's parts are also susceptible to corrosion. "The pipes will corrode and thin over time," he says, adding that corrosion can be controlled by maintaining the right pH balance in the water. If the tubes become corroded, they can be isolated and repaired without turning off the reactor. Canada currently has seven nuclear reactors in Ontario, Quebec and New Brunswick.

# Biomimicry Learns from Nature's Designs



Jamie Miller

**L**ooking to make a more aerodynamic car? Look to the sea turtle. Designing a better wind turbine blade? Consider a whale's tail flukes. Want to produce a self-cleaning window? Start with a butterfly wing.

Copying nature's designs might help engineers and architects to make better vehicles, bridges, buildings and other products, says Jamie Miller, a PhD student in engineering. Referring to painstaking evolution that has sculpted today's plants, animals and other organisms, he says: "This is four billion years of research and development."

What would nature do? That's the rallying cry for a growing international design movement that looks to the natural world for sustainable ideas. "Biomimicry wants us to ask not what we can take from nature but rather what we can learn from it," says Miller.

Besides helping us improve products, he says biomimicry might help save threatened species or ecosystems by stressing the need to preserve "natural designs." That idea resonates with members of U of G's Biodiversity Institute of Ontario, including integrative biology professor Alex Smith.

"Much more of life remains unknown than is known," says Smith, who studies ants in Costa Rica and other parts of the world. "With such a huge degree of biological illiteracy, it is reasonable to presume that most design solutions remain untapped."

Biomimicry means looking at creatures for function as well as form. Take this sea turtle, says Miller, plucking a specimen from among skulls, skeletons and stuffed creatures in U of G's wildlife collection. Look at the creature's streamlined shell, including its fluted hind edges. Maybe those features can help an automaker design a more fuel-efficient car. Or consider how some bones are thick to absorb more stress and thinner in other parts of the skeleton. How might a manufacturer adapt a skeleton in designing a light, safe vehicle body?

Miller became interested in biomimicry to help design low-cost products for humanitarian relief. After his undergrad at Queen's University, he worked in Indonesia with an environmental NGO. He also worked in Sri Lanka during his master's degree at Queen's with Kevin Hall, now vice-president (research) at Guelph.

Last fall, Miller came to U of G to work with engineering professor Khosrow Farahbakhsh on water and wastewater systems. He says Guelph's strengths in life sciences, engineering design, agriculture and environment make the University an ideal place to pursue cross-disciplinary interests in biomimicry. For more information, visit [www.whatwouldnature.do.ca/](http://www.whatwouldnature.do.ca/).

# Lab Develops New Plant-based Materials



From left: Laura Doyle, fourth-year biological engineering; Nishath Khan, fourth-year engineering systems and computing; Makoto Schreiber, second-year nanoscience; Prof. Manjusri Misra and Vida Poursorkhabi, PhD candidate in biological engineering.

**A**T FIRST GLANCE, lignin looks like crude oil, but this plant material could be the next black gold, with applications ranging from technology to medicine.

Lignin comes from a variety of plants, such as trees, grass and agricultural crops. Cellulose, a fibrous material also found in plants, is used to make paper and bioethanol. Lignin is a byproduct of both manufacturing processes.

“We’re thinking of how we can utilize it in some applications to gain value for lignin,” says Prof. Manjusri Misra, who is cross appointed in the School of Engineering and the Department of Plant Agriculture. She is part of a team of researchers at U of G’s Bioproducts Discovery and Development Centre, where new materials are invented and tested.

Batteries that contain lignin-based carbon fibres require less recharging time, making them ideal for use in mobile electronic devices like cell-phones, laptops and pacemakers.

Misra received funding from the Canada

Foundation for Innovation to purchase specialized equipment called a nano spinnerette to make ultrafine nanofibers with a diameter that is one 50,000<sup>th</sup> the diameter of a human hair. The Guelph lab is one of only a few labs in the world that are producing lignin-based nanofibers.

The cobweb-like fibers can be layered on any form, such as protective skin patches for burn patients. The patches, which contain about one million fibres, are more compatible with the body’s tissues than traditional dressings and help reduce scarring. Medicinal ingredients can be incorporated into the fibers to speed healing.

“It’s just like your own skin,” says Misra. “You can’t even see the wound.”

The lab is collaborating with the Harvard Medical School to test new applications for tissue engineering, such as a girdle-like covering for enlarged hearts and hernia patches. The fibers can also be made into tubes to repair damaged blood vessels. When implanted in the body, the new parts grow with surrounding tissues.

## Protein Research Could Lead to Better Drugs

**M**EMBRANE-EMBEDDED proteins account for more than half of existing drug targets and serve as gatekeepers in the cell wall by regulating the flow of materials and information. When these processes malfunction, they can trigger disease.

Prof. Vladimir Ladizhansky, Department of Physics, is studying the three-dimensional structures of membrane proteins to find out how they work. “This information is critical for designing more efficient drugs,” he says.

The findings could provide pharmaceutical companies with a better understanding of how drugs interact with receptors. The research could also address drug resistance in cancer cells, which are equipped with molecules called multi-drug resistance transporters that export toxic substances like chemotherapy drugs from the cell, making them ineffective.

X-ray crystallography and solution-state nuclear magnetic resonance are widely used for obtaining high-resolution 3-D images of proteins that can be dissolved in water, but they’re not as effective for water-insoluble membrane proteins.

At the University of Guelph’s NMR Centre, Ladizhansky is developing a new technique called solid-state magic-angle spinning nuclear magnetic resonance that allows membrane proteins to be studied in their native environment.

# Graduating Student Gets Top Honours



Randi Phinney

**G**ROWING UP IN a small town didn't stop Randi Phinney from pursuing her dreams. Not only did she graduate from

U of G this year with a B.Eng. in biological engineering, she also received several awards for her academic achievements, including the Helen Grace Tucker Design Prize, the PEO Gold Medal, the E.B. MacNaughton Prize, the CPES Graduation Prize and membership in the CPES Society of Excellence.

"Each and every teacher I had during my elementary and high school careers contributed to my academic and personal development, and the support I received from my family was always encouraging," says Phinney, who grew up in Keewatin, Ont. "My success is truly a reflection of the community I grew up in and the stimulating learning environment that was created by the engineering faculty at the University of Guelph."

Phinney also completed two co-op work terms at Tetra Pak Dairy & Beverage Systems in Sweden. Starting this fall, she will begin an M.Sc. in food technology at Wageningen University in Holland.

## Brownfields Get a New Lease on Life

**I**T'S A DIRTY JOB, but someone has to clean up brownfields. Land that was once used for industrial purposes may look like any other land, but looks can be deceiving. The land may not be safe enough for future developments because of what lies beneath the surface. Contaminated soil or groundwater may pose a threat to human health and the environment. As a senior toxicologist at Dillon Consulting in Oakville, it's Bryan Leece's job to ensure brownfields are safe.

"It's a multi-stage process," says Leece, B.Sc. '81. "The first component is site investigation to find out exactly what's there. You usually base that on what you know about the property and the kinds of industrial activities that have gone on there so you have some idea of what to look for."

When the results of the site investigation are

ready, they are compared to provincial and federal regulatory standards. If the level of contaminants exceeds the limit, the next step is to decide what needs to be done.

One option is to remove the contaminated soil and replace it with soil that meets environmental standards. Another option is to conduct a human and environmental risk assessment to determine what, if any, level of remediation is required.

"The object of the remediation is to focus on what absolutely has to be done to provide human and ecological protection," says Leece.

The future use of the land also determines the extent to which it needs to be cleaned.

"Residential properties typically need to be cleaner than commercial or industrial properties," he says.

"Getting the land back to productive use is really where the satisfaction comes from."

## CPES Alumni News

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## U of G Events

**Sept. 24:** Homecoming

**Sept. 24:** 3<sup>rd</sup> Annual EAA

Homecoming Event and AGM

**Sept. 24:** International Year of  
Chemistry celebration

**Oct. 22:** School of Engineering  
Honours and Awards Banquet

**Jan. 2 to 6:** School of  
Engineering Business and  
Entrepreneurship Boot Camp

**Jan. 17:** CPES Career Night

**Jan. 18:** School of Engineering  
Career Night

## SOE Hosts Alumni Banquet

The School of Engineering will celebrate the successes of its alumni and friends during its annual Engineering Honours and Awards Banquet Oct. 22 in the Science Complex Atrium.

To purchase tickets, visit [www.alumni.uoguelph.ca](http://www.alumni.uoguelph.ca).