ISSUE 01/2013

SYNERGY

JOURNAL OF UBC SCIENCE

a place of mind

THE UNIVERSITY OF BRITISH COLUMBIA

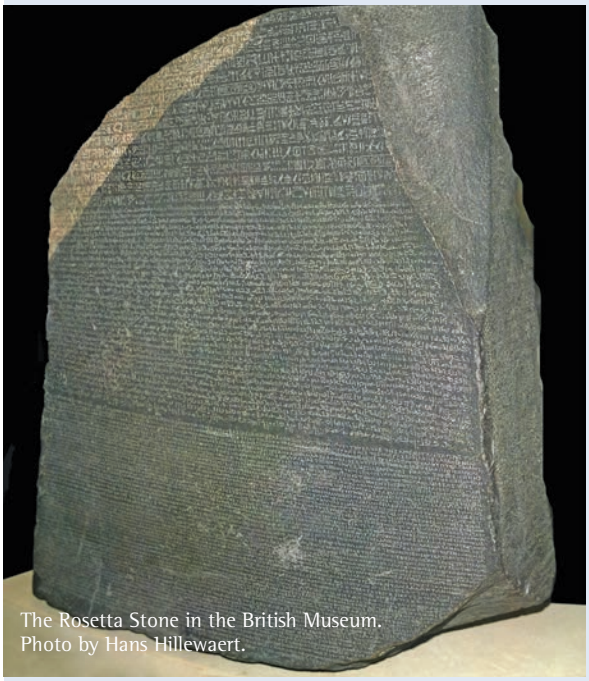
AWARD-WINNING CLASS TAKES STUDENTS

Observe. Hypothesize. Experiment. Analyze. Our new students are well practiced at reciting the textbook definition of the scientific method. But a deeper understanding of the processes and richness of science, and how science is done by creative people just like them, eludes many of our new arrivals. The textbook definition describes well experiments conducted in chemistry and physics labs, but it is impossible to conduct experiments on natural phenomena that operate over millions of years or at planetary or cosmic scales. Observational sciences like geology and astronomy are as vital to our understanding of the natural world as experimental sciences. And what about mathematics (the language of science) and statistics or computer science? Or interdisciplinary fields like sustainability?

NEWS

Digital 'Rosetta Stone' reconstructs ancient languages

UBC statisticians have used a sophisticated new computer system to quickly reconstruct protolanguages—the rudimentary ancient tongues from which modern languages evolved.



The Rosetta Stone in the British Museum. Photo by Hans Hillewaert.

The results, which are 85 per cent accurate when compared to the painstaking manual reconstructions performed by linguists, were published this spring in the Proceedings of the National Academy of Sciences.

"We're hopeful our tool will revolutionize historical linguistics much the same way that statistical analysis and computer power revolutionized the study of evolutionary biology," says UBC statistician Alexandre Bouchard-Côté, lead author of the study. "And while our system won't replace the nuanced work of skilled linguists, it could prove valuable by enabling them to increase the number of modern languages they use as the basis for their reconstructions."

Protolanguages are reconstructed by grouping words with common meanings from related modern languages, analyzing common features, and then applying sound-change rules and other criteria to derive the common parent.

The new tool designed by Bouchard-Côté and colleagues at the University of California, Berkeley, analyzes sound changes at the level of basic phonetic units, and can operate at much greater scale than previous computerized tools.

BEYOND TEXTBOOK DEFINITIONS

Thanks to a very talented team here at UBC, nearly 500 of our students are able to gain that broader view in SCIE 113, a first-year seminar taught in relatively small classes of 25 students (see Synergy 2 | 2010). Students learn about the breadth and depth of science, how to construct and communicate a coherent argument, and how science is connected to other disciplines like engineering and medicine. They also see that they are part of a scientific community that seeks to learn, to discover and to understand the natural world. I had the pleasure of teaching a section of SCIE 113 during the 2010 pilot year. Teaching the course—interacting with my students and fellow instructors—changed the way I think about science. I'm delighted that just last month the Society for Teaching and Learning in Higher Education honoured UBC's SCIE 113 course with the 2013 Allan Blizzard Award for distinguished collaboration in Canadian university education. My congratulations to the entire SCIE 113 team for their work in creating transformational experiences for our students.

Simon M. Peacock
Dean, UBC Science

Weeding out ineffective biocontrol agents

'Keep it simple' might be a good rule of thumb when designing biocontrol programs to combat weeds and invasive plants, according to a meta-analysis of studies by UBC biodiversity experts.

Biocontrol programs use an invasive plant's natural enemies (insects and pathogens) to reduce its population. Most programs combine multiple enemies—typically about three different species, but sometimes as many as 25—with the hope that at least one will prove effective.

But more isn't necessarily better. Some combinations of enemy species can actually end up competing or interfering with each other, instead of attacking the weed.

"It's important to get the right combination of biocontrol agents, as testing species is costly and time-consuming, and no amount of testing can eliminate the risk that something unexpected will occur with the introduction of a new species," says Andrea Stephens, lead author on the paper published in the Proceedings B of the Royal Society (http://rspb.royalsocietypublishing.org).

Until now, biocontrol managers have chosen weed enemies to release based on the individual effect of each species in isolation, with little thought to overall combinations. "Our study suggests that this approach can lead to ineffective biocontrol, because the interactions between the released enemies can reduce the overall effectiveness of biocontrol," says Diane Srivastava, author on the paper and professor with UBC's Biodiversity Research Centre.

Eco-friendly design plans for geological field school earn award

An ecologically friendly, small-footprint design for renovations to UBC's 60-year-old geological field school has received an Award of Excellence from Canadian Architect magazine.

The designs by BattersbyHowat Architects will help create a permanent 'camp campus' and geological training resource for post-secondary institutions across Western Canada, and potentially, internationally.

The new field school near Oliver, British Columbia will be a complete rebuild of the current facilities. New wood frame and plywood-sheet metal cladding construction will expand the capacity of the school while minimizing the impact of the site, which is adjacent to a provincial park. Buildings will be consolidated and a canted wall design staggers sleeping bunks and maximizes use of the building volumes.

Since the 1950s, UBC has based its primary geological field school on this site near Oliver. Thanks to the generosity of alumni and industry partners (including companies such as Mobil and Shell) the university was able to formally purchase the property in 1961. Facilities on the site range in age from 35 to 60 years, and are in urgent need of replacement.

Making the project possible is a planned $2.5 million UBC Geological Field School redevelopment and teaching and learning fund, which will not only revitalize the current site, but also ensure that students have increased access to the quality field training prized by the minerals industry.

View a slideshow of planned renovations to UBC's geological field school at: **science.ubc.ca/fs**


Kevin Leyton-Brown, Computer Science.

UBC's first MOOC attracts 130,000 registrants

A free online computer science course offered by UBC and Stanford University has attracted more than 130,000 registrants, including learners from every Canadian province and almost every nation on the planet.

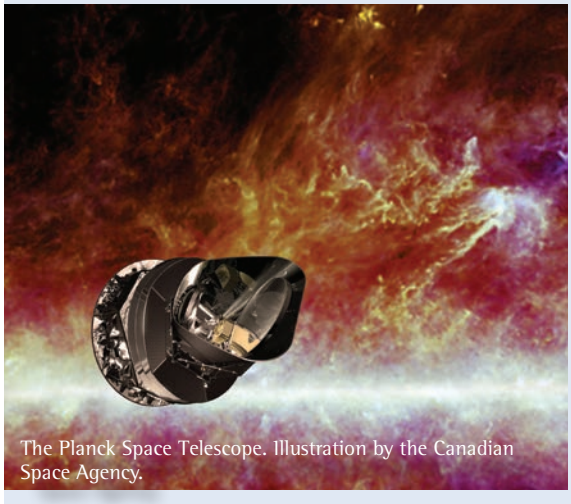
The Massive, Open Online Course (MOOC) on game theory is taught by UBC researcher Kevin Leyton-Brown and Stanford's Matthew Jackson and Yoav Shoham. It is the largest MOOC involving a Canadian university delivered via the United States-based Coursera platform.

"What's exciting for me is that we're reaching a very different set of students, a large fraction of whom aren't enrolled in traditional universities," says Leyton-Brown. "It's great to find that so many among this group share my passion for a rigorous, academic subject like game theory."

The online course, which wrapped up an initial run in February, attracted learners from every Canadian province (including 400 from British Columbia), from every American state and from 183 nations, according to server logs.

One student who participated in the course's video conference chats lives in the Faroe Islands, situated between the Norwegian Sea and the North Atlantic Ocean. "The student was taking the course to learn about how to counter the islands' isolation by bringing more information in from the outside—and he wanted to model this problem using material from the course," says Leyton-Brown.

The game theory course looks at the mathematics and models behind strategic decision making and interactions. It's an outgrowth of a textbook Leyton-Brown wrote with a co-instructor. "Yoav and I wrote several books together back in 2009, which have become fairly widely adopted in our field. MOOCs are the next generation of the textbook. This is the wave of the future."


The Planck Space Telescope. Illustration by the Canadian Space Agency.

Planck space mission unveils universe's baby pictures

The Planck space telescope has produced the most accurate map ever made of the universe's ancient light, with help from a Canadian team led by UBC cosmologist Douglas Scott and University of Toronto researcher Richard Bond.

The first results from the 15-month mission show that the universe is slightly older, expanding more slowly and comprised of more matter than previously thought. The data also reveal a portrait of the universe when it was just 380,000 years old.

Led by the European Space Agency, the Planck space telescope mission has been surveying the sky since 2009. The telescope's accuracy allows it to pinpoint faint, minute patterns—differences in light and temperature that correspond to slightly different densities in the matter left over from the Big Bang.

"We now have a precise recipe for our universe: How much dark and normal matter it is made of, how fast it is expanding, how lumpy it is, and how the remnant radiation from the Big Bang is scattered," says Scott. "It's astonishing that the entire universe seems to be describable by a model using just these few quantities. Now, Planck has told us the values of those numbers with even higher accuracy."

UBC's free, high-quality, non-credit online science courses let you explore genetics, systematic program design, climate literacy and game theory. Learn more at: **science.ubc.ca/support/community/coursera**

Monstrous microorganisms named after sci-fi creatures

UBC researchers have discovered two new symbionts living in the gut of termites, and taken the unusual step of naming them after fictional monsters created by American horror author HP Lovecraft.

The single-cell protists, Cthulhu macrofasciculumque and Cthylla microfasciculumque, help termites digest wood. The researchers decided to name them after monstrous cosmic entities featured in Lovecraft's Cthulhu Mythos as an ode to the sometimes strange and fascinating world of the microbe.

"When we first saw them under the microscope they had this unique motion, almost like an octopus swimming," says UBC microbiologist Erick James, lead author of the paper describing the new protists published in PLoS ONE.

The octopus-like movements and appearance of both protists reminded James of the horrid Cthulhu and Cthylla, and the protists were baptized after the two monsters. Cthulhu is often depicted as a giant, octopus-like entity with wings. Cthylla, his daughter, has a similar appearance.

Most of the larger protists living in termites have already been identified. However Cthulhu and Cthylla are very small—in the range of 10 to 20 microns, while the bigger protists are around 50 to 150 microns—and had passed unnoticed until now. But although tiny, the protists and their brethren have a big impact, much like their fictional namesakes.

"The huge diversity of microbial organisms is a completely untapped resource," says James. "Studying protists can tell us about the evolution of organisms. Some protists cause diseases, but others live in symbiotic relationships, like these flagellates in the intestines of termites."

Drugs targeting blood vessels show promise for treating Alzheimer's

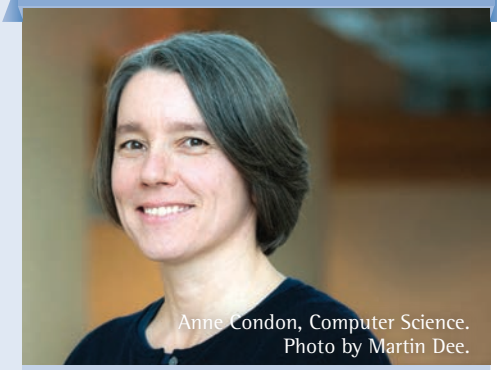
UBC researchers have successfully normalized the production of blood vessels in the brain of mice with Alzheimer's disease (AD) by immunizing them with amyloid beta, a protein widely associated with the disease.

While AD is typically characterized by a build-up of plaques in the brain, recent research by the UBC team showed a near doubling of blood vessels in the brain of mice and humans with AD. The study, published in Scientific Reports, shows a reduction of brain capillaries in mice immunized with amyloid beta—a phenomenon subsequently corroborated by human clinical data—as well as a reduction of plaque build-up.

"The discovery provides further evidence of the role that an overabundance of brain blood vessels plays in AD as well as the potential efficacy of amyloid beta as basis for an AD vaccine," says lead investigator Wilfred Jefferies, a professor with the Michael Smith Laboratories, and the departments of Microbiology and Immunology, and Zoology. "Now that we know blood vessel growth is a factor in AD, it follows that drugs targeting blood vessels may be good candidates as an treatment."

AD accounts for two-thirds of all cases of dementia. The number of Canadians living with dementia is expected to reach 1.4 million by 2013, according to the Alzheimer's Society of Canada.

HONOUR ROLL



Anne Condon, Computer Science. Photo by Martin Dee.

Computing Research Association, Board Member
Anne Condon, Computer Science

American Association for the Advancement of Science, Fellowships
Beverley Green, Botany
Patrick Keeling, Botany
Geoffrey Wasteneys, Botany

Evelyn Hutchinson Award
Association for the Sciences of Limnology and Oceanography
Curtis Suttle, Botany, Earth, Ocean and Atmospheric Sciences, Microbiology and Immunology

Canada Research Chairs
Gabriela Cohen Freue, Statistics
Ken Harder, Microbiology and Immunology
Loren Rieseberg, Botany

Association for Women in Mathematics, Service Award
Rachel Kuske, Mathematics

Genome British Columbia Award for Scientific Excellence
Brett Finlay, Microbiology and Immunology

Berson-Yalow Award
Society of Nuclear Medicine and Molecular Imaging
Eric Price, Chemistry

Queen Elizabeth II Diamond Jubilee Medal
Nassif Ghoussoub, Mathematics

Alfred Sloan Research Fellowships
Nicholas Harvey, Computer Science
Mary O'Connor, Zoology

The burrowing owl's population in its Canadian ranges has dropped to fewer than 1,000 pairs-warranting protection under SARA. Images courtesy Wikipedia, SARA Registry, Canadian Museum of Nature.

The road to better species conservation

Canada's decade-old Species at Risk legislation has had a bumpy ride. But before modifying it, UBC researchers say we should try implementing it more effectively.

Canada's Species at Risk Act (SARA) turned 10 last year. It's a young piece of legislation, but the federal government has already served notice it is considering an overhaul of the act to make it more efficient.

But lack of implementation, not the legislation itself, is to blame for the act's woeful track record, say two UBC scientists.

"There are real limitations to how species are being protected under SARA, but fixing these things doesn't mean reopening the act," says UBC plant evolutionary biologist Jeannette Whitton.

The government's revision process starts with listing recommendations. Government receives recommendations from the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), an independent body of scientists that assesses the status of species. Government can then accept, deny or send the recommendations back to the committee for further review.

There are biases in the listing process, however. Northern species are less likely to be listed. No commercially exploited fish has ever been listed. In 2006 COSEWIC recommended that the porbeagle shark, found from northern Newfoundland into the Gulf of St. Lawrence, be added to SARA's list. The population of porbeagle sharks has crashed by 90 per cent and is at high risk of extinction. But the species hasn't been included due to concerns over lost income if fishing was banned. Atlantic cod and cusk have also been denied protection under SARA, despite marine scientists' fears that they might be wiped out.

"COSEWIC's reports are subject to peer review. The Minister's

ENDANGERED

Species Barrens willow

Threats
Habitat loss and damage

ENDANGERED

Species Killer whale

Threats
Toxic pollutants; collisions with vessels

THREATENED

Species Swift fox

Threats
Loss of grasslands to farmland; hunting

reasons for not accepting a species recommendation is not subject to the same scrutiny," says UBC zoologist Eric Taylor.

For example, in 2005 the Sierra Club of Canada questioned the government's decision to not include Cultus and Sakinaw lakes sockeye salmon under SARA, saying the decision was based on flawed economic analyses.

Once a species is listed as endangered, threatened or extirpated, government must prepare a species Recovery Strategy and an Action Plan. However, the process to get from recommendation listing to Action Plan can take years. Species are often trapped at the thin point of a funnel, waiting to receive a finalized Action Plan. In fact, Action Plans have been completed for only six Canadian species.

What's more, both Whitton and Taylor feel the finalized plans can often be flawed—suffering from a lack of peer review of recovery teams and the resulting reports. Taylor recommends that recovery teams be led by independent scientists to avoid conflicts of interest.

Another issue affecting endangered species is that SARA is limited to federal lands. Most public, or Crown, lands in Canada are under provincial jurisdiction. In BC, only four per cent of the land is federal. There is a "safety net" provision under SARA that can protect areas normally under provincial jurisdiction, but it is rarely, if ever, employed.

"There are provisions for conservation agreements, which could be used to include private land owners," says Whitton. "The government could provide incentives to encourage conservation."

Another wrinkle is critical habitat designation. For a number of years, critical habitat was not identified in, or was sometimes removed from, Recovery Strategies, despite a legal requirement that strategies contain such information. Designation has improved in the past two years, in great part due to litigation.

One case that illustrates this point is the killer whale lawsuit organized by Ecojustice. In 2004, killer whales were SARA-listed. A final Recovery Strategy was released in 2008. According to Ecojustice, Fisheries and Oceans Canada (DFO) exerted bureaucratic pressure to weaken the legal protection of critical habitat and to remove references to ecosystem features of critical habitat in this final document. Then on September 10, 2008, DFO issued a statement claiming that resident killer whales' critical habitat was already protected by existing laws and policies—in short, declaring nothing had to be done. Ecojustice launched a lawsuit saying DFO failed to require legal protection for the killer whales' critical habitat. Eventually, the federal Court of Appeal found that DFO had, indeed, failed to legally protect killer whales.

The last issue SARA faces is enforcement. "Enforcement is often lacking," says Taylor. "For example, habitats are damaged, but there are no fines. Often, there is little monitoring."

Despite flaws in implementation, both Whitton and Taylor agree that SARA is valuable because it draws new or additional attention to a species. When a species gets listed, it often spurs activity.

"SARA brings species to the attention of municipalities and conservation agencies," says Whitton. "It's a piece of legislation that may have more power through its framework and process than through direct action."

In 2002, the Salish sucker (a small fish with Canadian populations occurring only in BC) was listed as endangered. Its inclusion on SARA's list precipitated survey work. UBC grad and ecologist Mike Pearson became interested in the plight of the fish and worked with locals to find out more about it. Last year, the Salish sucker was downgraded to threatened. Although the environment for the fish hasn't improved, scientists noted a small increase in the number of known Salish sucker locations.

The Massasauga rattlesnake has also benefited from the public interest generated by a listing. Public education by local enthusiasts and conservation agencies is changing attitudes against the timid snake.

"SARA has spurred a lot of on-the-ground activity," says Taylor. "And simple things like having better species distribution data can make a huge difference."

ENDANGERED

Species
Blue racer constrictor

Threats
Loss of habitat; deliberate killing by humans

SPECIAL CONCERN

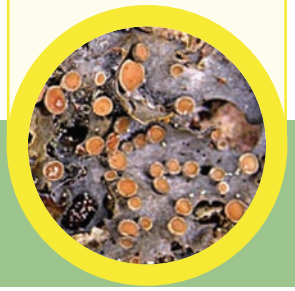
Species
Deepwater sculpin

Threats
Habitat loss and degradation

THREATENED

Species
Flooded jellyskin lichen

Threats
Habitat loss and degradation



A world of potential: Teaching old drugs new tricks

Searching for synergistic combinations of old drugs, UBC microbiologists discover surprising potential in a 40-year-old anti-parasite treatment.

For most Canadians, tuberculosis is a dreadful relic of the past, a disease we relegate to the horse and buggy era. But TB is very modern. A third of the world's population is currently infected with Mycobacterium tuberculosis, and it remains the second most common cause of death from infectious disease. Only a handful of antibiotics are active against it, and the few conventional drugs that work are failing against growing numbers of drug-resistant cases.

Nineteenth century Canadian physician William Osler proclaimed: "Tuberculosis is a social disease with a medical aspect." It is a disease that ravages the poorest and most vulnerable populations. Forty per cent of tuberculosis cases are in India and China. Africa has 24 per cent of the world's cases.

"There's a perception that tuberculosis isn't a Canadian disease," says Charles Thompson, a professor with UBC's Department of Microbiology and Immunology.

"People don't know others who have tuberculosis. But it is here. It's in the poor areas of Vancouver in the Downtown Eastside. Aboriginal people are disproportionately infected. And for many people in developing nations, some forms of drug-resistant tuberculosis are a death sentence."

However, hope may be found, not in new drugs, but in old ones.

Thompson and colleagues at the UBC Centre for Tuberculosis Research are looking at ways to repurpose drugs in their fight against tuberculosis. Reusing old drugs or combining them in new ways to produce treatments for tuberculosis is vital—there just aren't many new TB drug candidates in the pipeline.

The standard arsenal of drugs we use to fight tuberculosis was developed in the 1950s and 1960s, when the disease was a concern in the United States and Europe. Interest in drug development waned, however, as the disease became rarer in the developed world.

Last year the US Food and Drug Administration approved Sirturo for the treatment of multi-drug-resistant tuberculosis. But it is the first new drug aimed at the disease in more than four decades.

"Pharmaceutical companies don't see the potential for revenue from developing countries where tuberculosis is more prevalent," says Santiago Ramón-García, a tuberculosis researcher at UBC. "Things have changed in the last 10 years, with philanthropic organizations becoming more interested. But developing new drugs is extremely expensive and time-consuming."

It takes approximately 15 years and hundreds of millions of dollars to bring a new drug to market. But we already have hundreds of antibiotics to treat other bacterial diseases. Identifying synergistic combinations that interact and enhance each other's effects, or uncovering novel properties of already approved drugs, could speed the introduction of new tuberculosis therapies at lower costs.

At UBC, researchers screen clinically approved drugs, looking for combinations that could be effective against tuberculosis. It may sound like searching for a needle in a haystack, but the efforts have

> "Finding synergistic combinations or repurposing drugs for TB treatment is much cheaper and faster than developing new drugs."
> — **Charles Thompson**

already yielded some surprising results. Leah Lim, Carol Ng, Ramón-García and Thompson recently discovered that avermectins, a family of drugs previously believed to be inactive against all bacteria, can kill the bacteria that causes tuberculosis, including drug-resistant strains.

Avermectins have been used for many years to eliminate the parasitic worms that cause river blindness and elephantiasis. However, nobody realized they might be effective against tuberculosis until UBC researchers performed in vitro tests, pitting the drugs against the bacteria that cause TB.

"Avermectins were developed in the '70s," says Ramón-García. "The companies that developed it as an anti-parasitic drug for humans and pets reported testing it against a variety of pathogens threatening people in developed countries, but not against M. tuberculosis. Tuberculosis was just not a priority for them."

Now that researchers know avermectins can kill M. tuberculosis, they need to determine exactly how they work. It's reverse engineering, at a microscopic level.

"We are operating under a new principle," says Thompson. "Finding synergistic combinations or repurposing drugs for TB treatment is much cheaper and faster than developing new drugs."

Still, it takes a considerable amount of effort to test drug combinations, and with only a few researchers doing the work, and a plentiful catalogue of drugs to screen, it's a daunting task.

"Traditionally there would be teams of dozens or hundreds of people working on this. We've made some key discoveries, but we need to expand," says Thompson, who hopes they can conduct in vivo tests of the avermectins in the near future.

If the research continues to show promise, the payoff could be considerable. Avermectins could bring new hope for people affected with tuberculosis, especially those struggling with drug-resistant strains, some of them right here in Canada.

Centre for Tuberculosis Research
ctbr.ubc.ca

TB by the numbers

CANADIAN COMMUNITIES

21% Of cases reported in Canada occur among Aboriginal peoples. Health Canada, 2008.

3% Average annual increase in cases among Aboriginal populations over the past decade. Public Health Agency of Canada.

1 in 5 Homeless people with TB in Toronto died within a year of their diagnosis. Emerging Infectious Diseases.

DEVELOPING WORLD

8,700,000 New cases of TB reported worldwide in 2011. World Health Organization.

13% Of new cases are co-infected with HIV. World Health Organization.

1.4 million Worldwide death toll due to tuberculosis in 2011. World Health Organization.

40% Of new cases are reported in India and China. World Health Organization.

Nanoengineering a better heat trap

Solar panels are expensive, fragile and inefficient — we need fundamentally better ways to realize the sun's promise of abundant, renewable and clean energy. Two UBC scientists are taking very different approaches to nanoengineering simpler, more efficient components for solar cells.

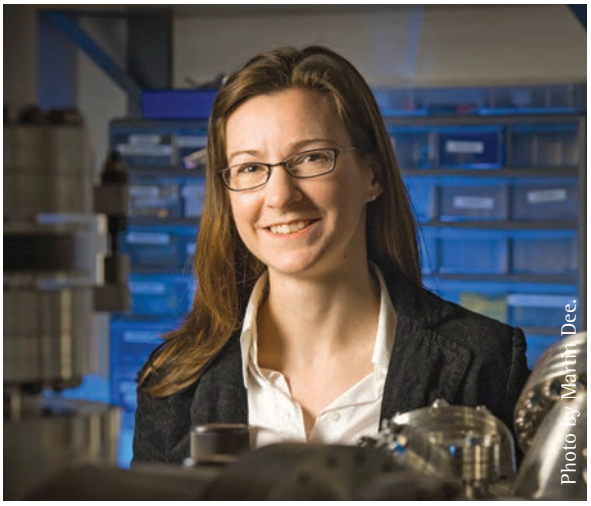


Photo by Martin Dee.

Nature, the brilliant nanoengineer

By Sarah Burke, Physics and Astronomy, Chemistry

Everyone is talking about energy. Cost, sources and the impact of fossil fuels on our planet are in the news daily. With the proliferation of new technologies and the growth currently taking place in countries like China and India, the demand for energy is not about to ease up.

Yet we are surrounded by the most amazing model for clean and nearly limitless energy – plants gather all the energy they need from the sun. And why not? There's a lot of it. The sun radiates 9,000 times more energy than humans on the planet are currently consuming. No other renewable source comes close to that potential.

We are starting to use solar cells already – monolithic slabs of traditional semiconductors – but they're expensive and energy intensive to manufacture, distribute and install.

There is, however, a class of materials, based on polymers and organic molecules, that is emerging as an alternative for generating energy from the sun. These materials are, essentially, plastics.

Organic solar cells promise a comparatively low-energy input in manufacturing, and lighter transportation and installation. The material also lends itself to novel installations, including architectural features and partially transparent window coatings that produce energy while reducing cooling costs. Since they can be more easily deployed to remote locations, they are also suitable for remote and poorly serviced areas.

So why aren't we using them? We haven't yet solved problems around their energy conversion efficiency and their degradation. To date, these organic solar cells can't compete economically with traditional solar technologies, much less fossil fuels that produce electricity for about one third the cost of traditional solar.

Yet what we know from photosynthesis is that nature is a brilliant nanoengineer, guiding energy with exquisite control. This is most likely an important aspect for efficiency, and we need to figure out something similar in our artificial systems.

A look at gross domestic product and energy consumption makes the connection between energy, quality of life and economic progress clear. The world's energy demand will rise as standards of living increase around the world. Energy conservation efforts are part of the equation, but creating abundant and accessible energy sources like organic solar cells could be the game changer for humanity.

In 1931, Thomas Edison said: "I'd put my money on the sun and solar energy. What a source of power! I hope we don't have to wait until oil and coal run out before we tackle that." Researchers at UBC, across Canada and around the world are working to make that dream come true.

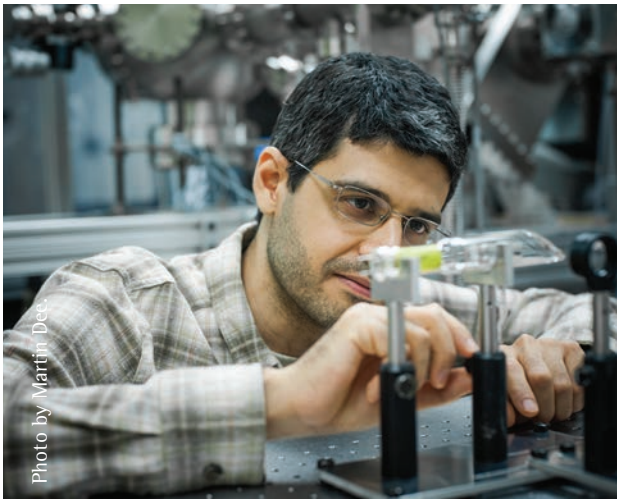


Photo by Martin Dee.

Carbon nanotubes on every rooftop

By Alireza Nojeh, Electrical and Computer Engineering

Our UBC research team has discovered a new method of trapping heat, called the "heat trap" effect, and has used nanotechnology to create a novel device for converting sunlight to electricity.

Solar cells are now found all around us, from rooftops to portable electronic devices to experimental solar-powered vehicles. These cells typically operate based on the photovoltaic effect, where the absorption of light leads to the creation of mobile electrons in a semiconductor, which generates electric power. However, among other factors, costly materials and complex manufacturing processes have limited the commercial success of many of these devices.

An alternative approach consists of using focused sunlight to heat a metal to thousands of degrees. At such elevated temperatures, electrons literally boil out of the material. If another piece of metal is placed nearby, it can collect these electrons and create electric current, thus delivering electric power. This method, called thermionic conversion, is in principle simple and inexpensive. Theoretical studies show that thermionic devices can be quite efficient and generate very high electric power relative to their size and weight. These devices have been of interest for decades for organizations like NASA.

Still, progress has been limited. The few existing prototypes use elaborate heating systems involving large, complex, light-focusing and heat-reception mechanisms only available in specialized test facilities. The reason is the fundamental challenge of heating a conductor to the high temperatures needed to boil off electrons. Although one can easily heat an insulator using sunlight and a simple lens (like burning paper using a magnifying glass), this doesn't work for conductors, where the generated heat dissipates to a wide area. Impractically large amounts of light are needed to reach the required temperatures.

But this was before our UBC team observed the heat trap phenomenon. Through this effect, the heat generated in a carbon nanotube array illuminated with light can become trapped, easily increasing the surface temperature to thousands of degrees. Our team has been able to build a small, compact thermionic solar cell prototype and successfully demonstrate its operation.

Carbon nanotubes — tubular carbon structures with tiny nanoscale diameters — are materials with rich and promising electrical, optical, thermal and mechanical properties. An array is made of millions of individual nanotubes and looks like an unremarkable black material to the naked eye. Yet, this discovery shows how the novel properties of nanostructured materials may provide solutions to decades-old energy problems.

UBC ALUMNI WEEKEND 2013

SATURDAY MAY 25

We've super-sized our Alumni Weekend offerings in celebration of UBC Science's 50th anniversary. Free admission to our museums, documentary screenings, open houses, exclusive panel sessions for our alumni, and more. With more than 25 events to choose from, there's something for everyone!
science.ubc.ca

Sci Team and SPAC Annual Reunion
Abdul Ladha Science Student Centre
12:00 pm – 2:00 pm

PHYSICS AND ASTRONOMY

PHAS Open House 2013
Hennings Building
10:00 am – 3:30 pm

Greening Your Life with a Little Physics and Chemistry
Hennings Building: 201
10:15 am – 11:15 am

Public Solar Observations
North Side of Hennings Building
11:00 am – 2:00 pm

Getting a Grip on the 'God Particle'
Hennings Building: 202
1:15 pm – 2:15 pm

Is Your Next-Door Neighbour an Alien Planet Hunter?
Hennings Building: 201
2:30 pm – 3:30 pm

CHEMISTRY

Greening Your Life With a Little Physics and Chemistry
Hennings Building: 201
10:15 am – 11:15 am

The Magic of Chemistry
Chemistry Building: B250
Starting: 11:30 am, 2:15 pm

Look, I'm a Chemist!
Chemistry Building: D211
1:15 pm – 3:15 pm

Nitobe Memorial Garden Tours
Starting: 12:45 pm, 2:00 pm, 3:15 pm

FREE ADMISSION

BEATY BIODIVERSITY MUSEUM

Free admission all day!

Museum Tours and Puppet Shows
Ongoing: 10:30 am – 3:30 pm

Raising Big Blue Screening
Starting: 11:30 am, 2:15 pm

Big Blue and Other Skeletons in My Closet
2:30 pm – 3:30 pm

COMPUTER SCIENCE

How Recruiting More Female Students Improves CS Education
Hugh Dempster Pavilion: 110
12:30 pm – 1:30 pm

Is This The End of the University?
Hugh Dempster Pavilion: 110
1:30 pm – 2:45 pm

Computer Science 45th Anniversary Reception
ICICS Building: Atrium
2:45 pm – 5:00 pm

EARTH, OCEAN AND ATMOSPHERIC SCIENCES

Investing in Innovation
Earth Sciences Building
1:30 pm – 3 pm

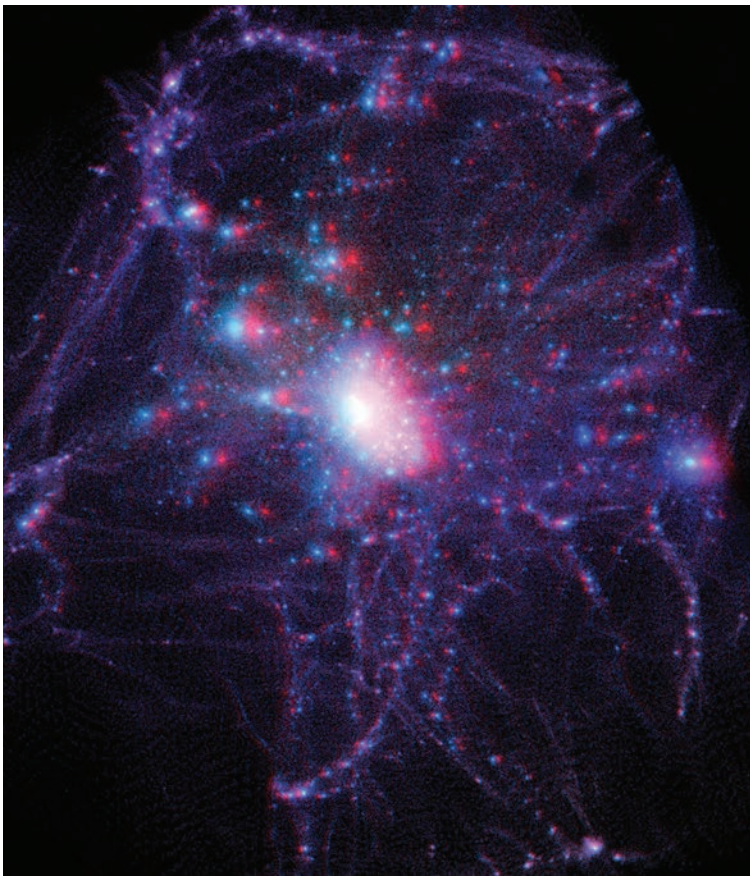
New Omni Globe at Pacific Museum of the Earth
EOAS Main, behind the Earth Sciences Building
10 am – 4 pm

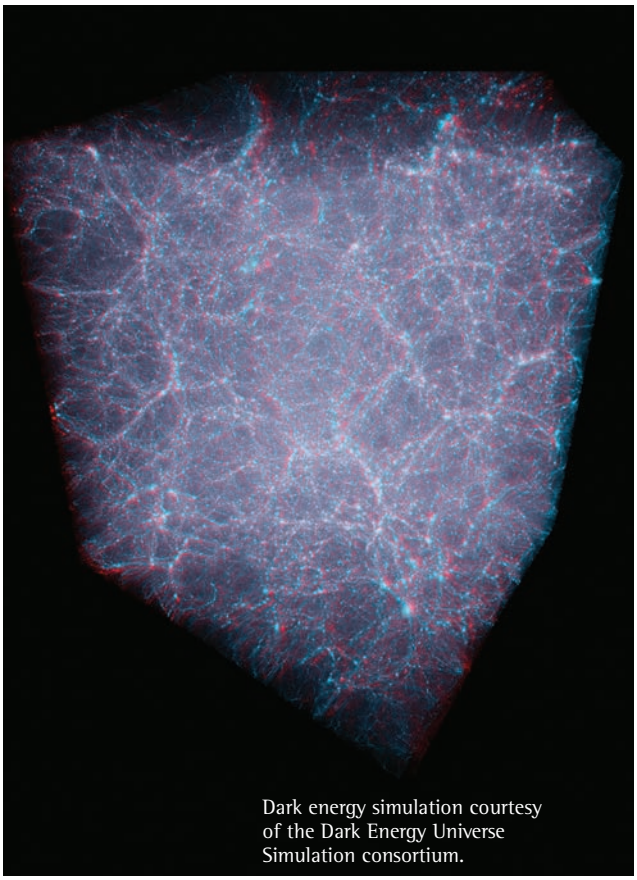
Earth Sciences Building Tours
11:30 am – 12:15 pm
1:15 pm – 2:00 pm

UBC SCIENCE 50TH ANNIVERSARY RECEPTION

Earth Sciences Building
3:00 pm – 4:00 pm

UBC Botanical Garden Canopy Walkway Tour
On the hour:
10:00 am – 3:00 pm
FREE ADMISSION





Dark energy simulation courtesy of the Dark Energy Universe Simulation consortium.

Taking the measure of the cosmos, on a dime

Using common cell phone components and smart design, UBC researchers are building Canada's largest radio telescope in British Columbia's Okanagan Valley.

Tucked away in the radio quiet of British Columbia's White Lake Basin, the telescope's massive, undulating cylindrical reflectors might remind passersby of an out-of-place skateboard park.

But with a footprint the size of two American football fields, the UBC-led $11-million Canadian Hydrogen Intensity Mapping Experiment (CHIME) will be anything but down-to-earth.

"We plan to map a quarter of the observable universe," explains UBC astrophysicist Mark Halpern, the project's principal investigator, who along with colleagues began clearing and excavating the site at the Dominion Radio Astrophysical Observatory (DRAO) southwest of Penticton this spring. "This is an ambitious, made-in-Canada endeavour to survey the largest volume of the observable universe ever attempted."

With no moving parts, CHIME's radio telescope will rely on the rotation of the earth and digital reconstruction to scan half the sky every day. The telescope's 100-square-metre collecting area—five 20-metre-by-100-metre cylindrical reflectors side by side, with feeds, amplifiers and digitizers—will be filled with 2,560 low-noise receivers built with components adapted from the cell phone industry.

The research team is taking a phased approach to the project. They've already piloted the hardware on a traditional two-dish system at DRAO, in part to gauge the impact of the area's radio-frequency interference.

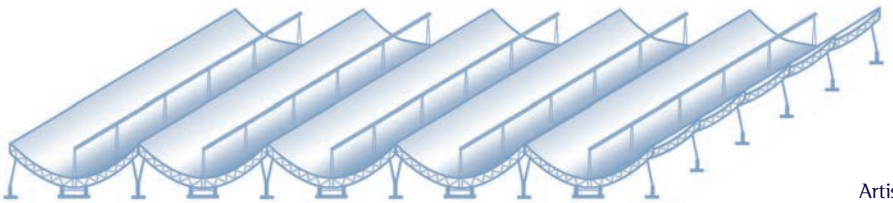
"The CHIME telescope will be the most sensitive instrument in the world for this type of research, and the DRAO is one of the best sites in the world for this type of research," says UBC astrophysicist and project co-investigator Gary Hinshaw. "This is something that the Canadian astronomy community can be really proud of."

Signals collected by CHIME will be digitally sampled nearly one billion times per second, then processed to synthesize an image of the sky. On the ground, that means the telescope will generate a whopping 17 terabytes of raw data per second.

Hydrogen intensity mapping, a new technique pioneered by a University of Toronto team, enables a radio telescope to survey huge volumes of space for a fraction of the cost of other methods. CHIME will generate a three-dimensional map of the clouds of hydrogen gas that

"The CHIME telescope will be the most sensitive instrument in the world for this type of research, and the DRAO is one of the best sites in the world for this type of research. This is something that the Canadian astronomy community can be really proud of."

— **Gary Hinshaw**



Artist's rendering of the CHIME telescope.

permeate the cosmos in a web-like structure.

The smart design in part explains CHIME's relatively modest budget—when compared to the cost of building more traditional telescopes in the field. But UBC researchers, with colleagues from McGill and the University of Toronto, are seeking to answer very large questions.

They want to pinpoint when, and why, the expansion of the universe began to speed up.

For most of the 20th century, physicists supposed that the force of gravity would slow the rate of expansion of the universe. But in 1998—thanks to new observations of distant supernovae provided by the Hubble Space Telescope—cosmologists discovered that the expansion of the universe was actually gently accelerating.

"The recent discovery that the rate of expansion of our universe is increasing rather than slowing down has forced us to re-examine basic assumptions about what the universe is made of," says UBC astrophysicist and CHIME co-investigator Kris Sigurdson.

The new observations led cosmologists to postulate a new theory—a mysterious "dark energy" woven into the vacuum of space itself is subjecting the universe to a constant outward push and speeding its expansion.

Data collected by CHIME will help cosmologists understand the history of the universe, and in turn, how dark energy is driving its expansion. It will also allow them to peek back in time, via light from the most distant parts of the universe.

CHIME is funded in part by a $4.6-million investment from the Canada Foundation for Innovation.

The power of hands-on science

Photo by Don Erhardt

Sometimes frustrated, but always undaunted, Timothy Jayme realized his potential (and the value of a good pair of goggles) in the lab.

Landing a coveted undergraduate research experience requires tenacity, and sometimes just a bit of luck. Timothy Jayme, a fourth-year UBC Science student and president of the Microbiology and Immunology Students Association, knew he wanted to gain research experience. He started by researching several labs he was interested in working with and crafting introductory emails. He didn't get the response he had hoped for.

"I was disappointed. I had no experience, but I wondered, without experience how am I going to get this opportunity?" he says. "I decided to take things into my own hands."

Jayme began attending Life Science Institute lectures. One evening he found himself sitting next to Pauline Johnson, an expert in infection, inflammation and immunity.

"I thought, 'This is my chance. You better say something smart!'" Jayme recalls.

Jayme chatted with Johnson and explained he was interested in gaining research experience. Each year, Johnson receives more than 40 requests from undergraduate students seeking to work in her lab—well beyond her team's capacity to accommodate.

"The difficulty is deciding which students would benefit most from the experience," Johnson says. "In Tim's case, I was impressed that he had taken the initiative and shown an interest in learning more about research. The rest is history!"

Johnson's lab studies the factors that regulate tissue inflammation and immune responses. At the lab, Jayme harvested mouse bone marrow, then converted the cells into bone marrow-derived dendritic cells and macrophages (both types of cells are crucial in initiating an immune response in the body). Jayme stimulated the cells with proteins and analyzed the expression of various genes.

It was an exhilarating experience—the kind of work that could yield new ways to treat chronic inflammatory diseases such as arthritis. But things didn't always go as planned. The first time Jayme prepared to harvest bone marrow he was feeling confident and in control. Then, it happened.

"I got a splash of muscle tissue on my face," Jayme explains.

Despite his safety training, it was still a bit of a shock. Should he stop? Should he clean his goggles? "I thought I couldn't let anyone know so I told myself: 'Act natural.' For the rest of the dissection, I had tissue on my face."

Sometimes, the work was frustrating. It took seven weeks to grow cell cultures. Day after day Jayme checked on his cells. The cells were his babies, precious and in need of nurturing. But all that care and attention didn't necessarily lead to success each and every time.

"When something goes wrong, it's a hard pill to swallow. You have to go back and figure out what didn't work. The first time it happened, I felt defeated. I thought 'I can't do this,'" he says. "I learned this happens and you have to keep at it."

Jayme discovered that he could talk to graduate students at the lab and that many of them shared the same frustrations, but also the same passions. They encouraged his


Photo by Don Erhardt

"It was more than a science experience, it was a life experience. Hands-on research allows us to realize what we can accomplish."
— **Timothy Jayme**

questions and told him to press on.

Perseverance was one of the most important lessons Jayme learned during his time at the lab. He also discovered how to ask better questions. He improved his planning and organizing skills. Now, during final exams, his learning goes beyond memorizing. The research experience also left him with more confidence as he attempts to pursue a career in pediatrics.

"It was more than a science experience, it was a life experience," he says. "Hands-on research allows us to realize what we can accomplish."

As for other students interested in gaining research experience, the key, Johnson says, is persistence. "If you think you are interested in a career in scientific research, you should keep trying to get into a lab, just like Tim did."

In 2012, more than 270 UBC Science students applied for 81 Undergraduate Student Research Award opportunities across the Faculty. Each year, Johnson receives more than 40 requests from undergraduate students seeking to work in her lab.

UBC Science is working to increase the number of undergraduate students that have access to research opportunities through the Science Undergraduate Research Experience initiative. Learn more at: **science.ubc.ca/support/giving/sure**

Dollars for marks, hut nostalgia, and the gals in the cafeteria lounge


A12 North Shore News Wednesday, September 26, 2012

BRIGHT LIGHTS *by Mike Wakefield*

Iola and Gordon Knight

Pioneer skiers and cabin owners from the early days of the North Shore mountains got together reminisce at the 20th annual Pioneer Skiers Reunion Sept. 19 at the Cypress Creek Lodge. The event w

Still going strong. Iola and Gordon Knight make the North Shore News at the Pioneer Skiers Reunion in 2012.

UBC Science is fortunate to have many of its alumni choosing to reconnect with their alma mater by volunteering as a mentor, joining us at events and reunions, and even donating memorabilia. But it's the stories you share—which link our current students and alumni community with a common legacy—that I often find most inspiring. By passing on your reminiscences and life lessons to current undergraduates you not only impart wisdom, you also offer insights that can generate ideas and launch transformations. At UBC we see these type of interactions as the start of an evolution, one that improves upon what has come before and inspires the generations that follow.

Iola Musfeldt Knight (BA Zoology, Animal Science 1945 | MA 1947) shares with us her own stories of evolution and transformation from the 1940s. "That's 1963 that you folk say is the start of Science at UBC? Of course you must know that there was always pure science [biology, physics and chemistry] long before that!"

Prior to the division of the Faculty of Arts and Sciences in 1963, students enrolled in a science program would receive a BA or an MA upon graduation. But don't let the designation of an arts degree fool you, asserts Knight. She considers herself a bona-fide science alumnae and recalls a bit of 'inherent' animosity between the co-joined faculties, due in large part to the shared credential. She credits Ian McTaggart-Cowan (professor of zoology and later department head) with keeping her efforts focussed. "It isn't the degree you get, but the work you put into it," Knight recalls being told. In hindsight, Knight believes McTaggart-Cowan was right, but at the time she definitively recalls thinking: "Yeah sure, but those gals in the cafeteria lounge get the same BA!"

Regardless of divides within the Faculty of Arts and Sciences degree family, Knight did feel a strong sense of community at UBC. As a wartime student, she recalls how the provincial government helped her, along with many others, to attain their educational goals through the Dollars for Marks program. "Many of us would never have had the opportunity to pursue a post-secondary education without D4Ms."

In the summer of 1945, a relatively small UBC community underwent a significant transformation with a sudden swell in its student population from 3,000 to 10,000. Former servicemen were being encouraged by senior administration to return to their studies.

To accommodate the increase, Knight vividly recalls the installation of the first army huts on campus. "These huts were everywhere! Along University Boulivard to East Mall. All around the steam plant on Main Mall. Around Brock Hall. There were also two wartime military establishments on campus: Fort Camp, and Acadia Camp, a residence for Air Force training courses. Postwar, both facilities became student residences for veteran students."

Knight is keen that UBC remains sensitive to our war-time history—perhaps by preserving any remaining army huts that played such an important role in the Vancouver Campus development. My thanks to Knight, her husband Gordon (BASc Civil Engineering, 1949) and the many others who take the time to share a bit of their UBC legacy. I look forward to hearing more UBC Science reminiscences at our anniversary programming at Alumni Weekend (May 25) this year.

Kim Duffell
Alumni Relations Manager
UBC Science

Thanks to the hundreds of alumni, students and industry partners who attended the alumni receptions at RoundUp in Vancouver and at the Prospectors and Developers Association of Canada meeting in Toronto this spring. Keep your schedule free next January and March for more networking and rock talk. We're happy to share photos from our reception at RoundUp 2013, courtesy of Kim Bellavance.

ALUMNI EVENTS

SUS reunion: A thank you from Mona Maleki, president

Many thanks to those who attended the second annual Science Undergraduate Society (SUS) reunion this January! It was a pleasure having you join us as we celebrated the rich history of the society. We hope that you enjoyed the nostalgic take on the evening's programming, and we look forward to future opportunities to gather and engage. It was very exciting for us to hear about your experiences after UBC and we hope that you'll continue to participate in initiatives hosted by SUS and UBC Science. Many thanks to SUS alum Mark Hoenig for sharing photos of the 2013 reunion.

Keep up to date, and view more photos of UBC Science alumni events, past and present, at:
facebook.com/ubcscience | flickr.com/ubcscience

EVENTS

Have a suggestion for an alumni event? Want to help get a reunion off the ground?
Contact Kim Duffell, Alumni Relations Manager, at alumni@science.ubc.ca

Microbiology and Environmental Sciences Mentor-for-a-Day Opportunities
Starting fall 2013

We've added new Career Nights to our existing 2013 mentorship roster. A short-term investment of your time can be a huge source of inspiration and guidance for students. The earlier we hear from you, the more time we have to find the right option—opportunities that focus on women in science, discipline-specific events, or sessions that look at a broad array of careers in science.

Departmental Career Nights
Physics and Astronomy, Biochemistry, Biology, Microbiology and Immunology, and Environmental Sciences. Cross-Discipline Initiatives Women in Science and Engineering, Beyond the BSc.

- science.ubc.ca/support/alumni/getinvolved
- alumni@science.ubc.ca

[a]drift
Through Sunday, August 25, 2013
Beaty Biodiversity Museum
UBC Vancouver

An exhibition by Edith Krause, [a] drift presents human-scale images of microscopic marine creatures. Merging art and science, Krause uses portraiture to showcase individual organisms while carefully avoiding the scientific tendency of splaying them out for identification. These enlarged portraits convey the creatures' ecological importance, reveal forms that are unfamiliar and fantastic, and make visible the invisible.

- beatymuseum.ubc.ca

Spring Graduation Ceremonies
Monday, May 27, 2013
Chan Centre, UBC Vancouver

An inspiring time to be on campus! Congratulations to all our graduating students, and to all the family, friends and supporters who make each ceremony so special. Parking is available at a reduced rate for graduates and guests at the Rose Garden and Fraser River parkades. Allow yourself at least 30 minutes to arrange parking as line ups are anticipated.

- www.graduation.ubc.ca

INVESTING IN INNOVATION

Saturday May 25, 2013 1:30 pm – 3 pm

Google founding investor David Cheriton, entrepreneur Ross Beaty, sustainability investor Eric Peterson and strategic business advisor Kirsten Tisdale discuss how to spot value in ideas, people and businesses. An exclusive UBC Science 50th Anniversary Alumni Weekend event.

science.ubc.ca/50

Toronto Great Trekker Luncheon: Delivering the 2015 Pan American Games

Thursday, May 30, 2013
11:30 am – 1:30 pm
Trump International Hotel and Tower
Toronto

UBC Science alum Barbara Anderson, chief financial officer of the Toronto 2015 Pan-Parapan American Games Organizing Committee, discusses what it takes to deliver a major event on time and on budget. From major multinationals to early-stage entrepreneurial businesses, Anderson's career has included senior leadership roles in a range of organizations. To deliver the games, she will be busy building strong financial teams, implementing financial and information management systems, and establishing performance measurement frameworks.

RSVP by Thursday, May 23, 2013
▸ alumni.ubc.ca/2013/events

Sci Team and SPAC Annual Reunion at Alumni Weekend 2013

Saturday, May 25, 2013
12 pm – 2 pm
Abdul Ladha Science Student Centre
UBC Vancouver

As if Sci Team alumni needed an extra reason to come out to Alumni Weekend! We're offering our student leader veterans the opportunity to reconnect, and to share insights with this year's incoming team. Light sandwiches, snacks and drinks provided.
Contact Kali Wilson

▸ wilson@science.ubc.ca

Computer Science 45th Anniversary Reception and Demos

Saturday, May 25, 2013
2:45 pm – 5 pm
ICICS Building
UBC Vancouver

As part of the department's 45th anniversary celebration, UBC Computer Science is showcasing highlights of research and innovation by faculty and students—a humanoid robot, graphics and animation demos, multi-media displays of student work, and more.

▸ cs.ubc.ca

UBC Alumni Night at Bard on the Beach's Hamlet

Thursday, June 20, 2013
6:30 pm – 10 pm
Vanier Park, Kits Point, Vancouver

UBC alumni are invited to a special preview production of Bard on the Beach's Hamlet on Thursday, June 20 at 8:00 pm. Guests will have a chance to connect and enjoy Shakespeare's classic featuring UBC's notable alumni in the cast and crew. For a special rate of $35 per ticket, alumni and friends can enjoy a pre-show reception and remarks by Bard on the Beach artistic director Christopher Gaze.

▸ alumni.ubc.ca/2013/events

Turning the links into the lab

Newly minted professional golfer **Kyla Inaba** (BSc General Sciences, 2009) still calls herself a bit of a science nerd. It's an analytical side that shows in her approach to breaking down her game.

"Working on the kinetic sequencing of the golf swing is huge when it comes to playing at this level," says the former UBC Thunderbird, fresh off a Cactus Tour event in Arizona. "I want to make sure that my swing and body are

CLASS NOTES

Stay connected with 32,000 UBC Science alumni. Drop us a line about recent accolades, professional successes, family developments or interesting world travel. Contact Kim Duffell, Alumni Relations Manager, at alumni@science.ubc.ca

1960s

Calling the geology crew of '62

Many thanks to **James Sadler** (BSc Bacteriology, 1962) for submitting his historic UBC photographs depicting campus life in the 1960s. Not long after graduation Sadler relocated to Eastern Canada and now calls Ontario home. Retired after a 34-year stint with the federal civil service, Sadler, along with his wife Joan, enjoys travelling, gardening and keeping busy with their children and grandchildren—as well as reading and surfing the Web in quieter moments. He encourages any of his crew from the early 1960s to get back in touch.

1970s

Alum inducted into mining hall of fame

Diamond hunting pioneer **Charles Fipke** (BSc Geology, 1970) was inducted into the Canadian Mining Hall of Fame this January. Fipke's work during the 1980s helped increase Canadian geologists' understanding of the relationship between diamond deposits and the indicator minerals associated with them. After graduating from UBC, Fipke became intrigued by the potential of heavy mineral geochemistry as an exploration tool. In 1977, he opened CF Mineral Research in Kelowna, BC, and later managed a diamond exploration program for Superior Oil in Canada's North. According to the Mining Hall of Fame: "Superior abandoned the search, but Fipke persevered, eventually succeeding with a multi-billion dollar discovery near Lac de Gras, Northwest Territories, in 1991."

1980s

A passion for sustainable seafood and French wine

Charles Daxboeck (PhD Zoology, 1981) knows a thing or two about sustainable seafood. After leaving UBC, he relocated to Hawaii to head the Pacific Ocean Research Foundation, collaborating with local and international scientists on studies of tuna and marlin biology. A 30-year member of the scientific and statistical committee of the Western Pacific Regional Fishery Management Council, and its chair since 2011, Daxboeck continues to apply evidence to sustainable fisheries management. He moved to French Polynesia 20 years ago to launch BioDax Consulting, and still consults on seafood safety across the region and provides socio-economic feasibility studies on local

moving as efficiently and as powerfully as possible."

Inaba made the decision to turn pro after a strong amateur season in 2102 and launched her first full professional season with a fifth-place finish at Club West in January. And while a scientific approach helps on the practice range and in keeping a busy schedule organized, she credits mental toughness as a major factor in her success on the course, and in helping her deal with the ups and downs of the transition from the amateur to professional tours.

"Once I'm in competition the game switches from science to psychology, which just happened to be the majority of my electives at UBC: Visualizing shots in my head and relying on routines and the work I've put in on the range. I turn off the science and allow myself to be as free as a 'T' bird out there."

While much of Inaba's free time at UBC was spent on the course with a strong Thunderbirds team (which enjoyed "a pretty sweet schedule in warm 'golfable' climates") she did make time to join intramural volleyball, and enjoy campus life.

"We (a few golfers, roommates and myself) proudly won the science division of Storm the Wall in my second year," Inaba recalls. "Spring time on campus was always my favourite, the sun and the blossoms come out, and needless to say the golf course became fairly irresistible!"

aquaculture and fisheries. When not working, Daxboeck's 12-year-old daughter keeps him busy. He also enjoys playing badminton with his wife, spending time with family and friends, tasting fine wines and foods (not just French), skiing vacations and gardening.

High-flying business person of the year

You may know him from inflight magazines or the newspaper business pages. Congratulations to **Gregg Saretsky** (BSc Microbiology-Biochemistry, 1982 | MBA, 1984) for being named Alberta's 2012 Business Person of the Year by Alberta Venture magazine. Saretsky is currently president and chief executive officer of WestJet Airlines.

1990s

A healthy role in the community

UBC Science alum and veteran registered nurse **Antonia Rozario** (BSc Biology, 1990 | ApSc Nursing, 1995) is grateful to all the UBC professors, mentors and friends who helped guide her 18-year career in the BC Lower Mainland. Her degree has given Rozario the opportunity to be an advocate in her community, engage with others and continually learn new things. In addition to working in the community, Rozario stays connected to her alma mater—most recently by attending UBC's 2012 Science Undergraduate Society reunion. Her challenge to fellow SUS alum: Don't miss the next reunion!

2000s

Applying biostatistics expertise to business

Dana Aeschliman (MSc Statistics, 2001) has left pharmaceutical consulting to enter the field of business intelligence. After working with UBC's Michael Smith Laboratory, the Montreal Heart Institute and Pharsight Consulting Services, Aeschliman has joined Seedbox, an information technology company in Montreal. He hopes to continue discovering new challenges that can be tackled with statistics, and to continue enjoying life in Montreal with his wife Katie and daughter Daphne.

Hollywood honours blockbuster technology

Doug James (MSc Mathematics, 1997 | PhD Mathematics, 2001) took home an Oscar for technical achievement from the Academy of Motion Picture Arts and Sciences this spring. James helped develop Wavelet Turbulence software, which has become the industry standard for generating realistic swirling smoke and fiery explosions for Hollywood blockbusters, including films in the Twilight franchise. James is currently a professor at Carnegie Mellon University.

Rising star in astrophysics earns US prize

The American Astronomical Society (AAS) has recognized **Jason Kalirai** (MSc Physics and Astronomy, 2001 | PhD Physics and Astronomy, 2004) with the 2013 Newton Lacy Pierce Prize in Astronomy. Kalirai—an expert on how stars evolve and die—works at the Space Telescope Science Institute in Baltimore as the James Webb Space Telescope deputy project scientist. The AAS recognized Kalirai for "major contributions to the field of stellar and galactic astrophysics, including establishing a fundamental relation of stellar astrophysics, the initial-final mass relation that maps the fraction of mass loss that stars experience over their lives."

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