02 DEAN'S MESSAGE Global Climate Change 10 RESEARCH Manipulating Metabolism to Survive in Harsh Environments 14 EDUCATION Student Links Nutrition to Health and Learning 16 OUTREACH A Lab Crawl, a Green Walk 18 ALUMNI Maria Klawe Earns Honorary Degree

ISSUE 01/2010

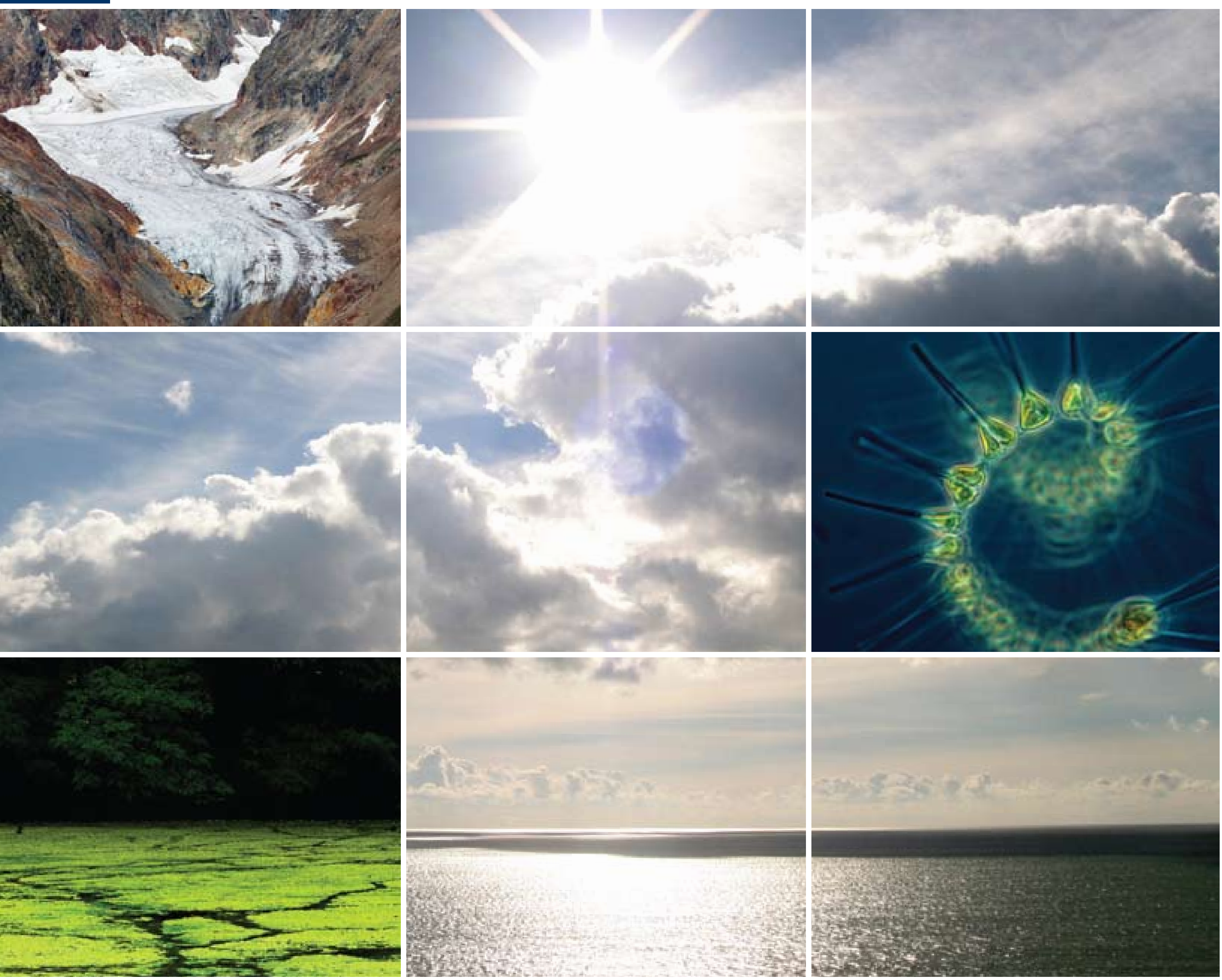
SYNERGY

JOURNAL OF UBC SCIENCE

Global Climate Change

Dynamics and Consequences

The earth is warming up. How fast? How do ecosystems change? How are we changing the earth? And how can we better gauge the future? 06



a place of mind

THE UNIVERSITY OF BRITISH COLUMBIA

GLOBAL CLIMATE CHANGE

This spring UBC announced new greenhouse gas emission targets for our Vancouver campus (see below). We share President Stephen Toope's vision of setting ambitious targets to help mitigate climate change and to demonstrate that our university has the expertise and dedication to develop and implement innovative and sustainable practices.

Our global climate system is warming—average air and ocean temperatures are increasing, the extent of snow and ice cover is decreasing, and sea level is rising. Over the past several decades, we have learned that the complex biogeochemical cycles linking the Earth's atmosphere, hydrosphere, biosphere and lithosphere are increasingly affected by human activities. In 2007, the international organization, Intergovernmental Panel on Climate Change, concluded that "most of the observed increase in

NEWS

UBC Vancouver as a Living Laboratory for Sustainability

UBC president Stephen Toope used an address to delegates at the March GLOBE 2010 conference in Vancouver to announce aggressive new greenhouse gas emissions targets for the university's Vancouver campus.

"We're undertaking this initiative because, as a leading research university, we believe it's important to set ambitious standards to address the realities of climate change and show it can be done," said Toope. "UBC has the expertise and passion to make its commitment to sustainability a continuing reality through the integration of teaching, learning, research and operations and through innovative technologies and partnerships."

UBC has already met international targets established by the Kyoto Protocol for its core academic buildings, which required a 6-percent reduction in greenhouse gas (GHG) emissions from 1990 levels by 2012.

The university aims to reduce GHGs an additional 33 percent from 2007 levels by 2015, reduce GHGs to 67 percent below 2007 levels by 2020, and eliminate 100 percent of GHGs by 2050.

Plans include a partnership with BC Hydro to monitor and optimize the energy efficiency of UBC's academic buildings campus-wide. The measurement tools will be provided by Vancouver-based Pulse Energy (formerly Small Energy, see *UBC Science Connect* 1|2009).

"UBC has set a challenging course that will require further planning, research and innovation," said John Hepburn, vice-president, Research and International. "This rich process is part of making UBC a living laboratory for British Columbia, Canada and the world."

Global Cimate Change: Look for the theme colour throughout this issue to find out about our scientists' and students' involvement with climate change research.

global average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic greenhouse gas emissions."

Researchers at UBC Science are contributing to our understanding of the causes and dynamics of global climate change, and increasing our knowledge of the potential consequences of global warming. This issue of *Synergy* features how—across disciplines such as meteorology, statistics, geochemistry and marine biology—our scientists help answer pressing questions such as: How can we better model the dynamics of global climate change? What are the near-term consequences of global warming, and how can we better gauge and prepare for the future?

Through fundamental research, sharing new knowledge and training the next generation of scientists, UBC Science faculty and students contribute to solving some of the biggest challenges of the time. Innovative projects such as InSEAS (see p. 13) and the blue whale exhibit (see p. 17) are only a few examples of how research and education can inspire a sustainable future.

Simon M. Peacock
Dean, UBC Science

ASTRONOMY

Hubble Data Survey Proves Einstein Right—Again

Physics & Astronomy professor Ludovic Van Waerbeke is part of an international team that has surveyed more than 446,000 galaxies to map the expansion history of the universe. The study, published this March in *Astronomy and Astrophysics*, is the largest ever conducted by the Hubble Space Telescope. "Our results confirmed that there is an unknown source of energy in the universe that is causing cosmic expansion to speed up, stretching the dark matter further apart, exactly as predicted by Einstein's theory," says Van Waerbeke, who pioneered the use of weak gravitational lensing to measure the invisible web of dark matter that makes up 80 percent of the mass of the universe. In addition to the Hubble data, the researchers used ground-based telescope data to assign distances to 194,000 of the galaxies surveyed—a key factor for reconstructing the three-dimensional picture of dark matter distribution.

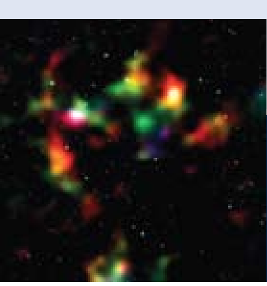
EDUCATION

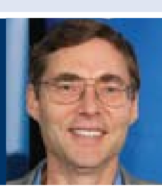
White House Taps UBC Education Guru for Senior Science Post

Physics Nobel laureate Carl Wieman, recruited to UBC to help transform undergraduate science education at the university, has been nominated for a senior position in the White House Office of Science and Technology Policy. "This nomination is an exceptional validation of Carl's ideas and of our collective efforts to improve the classroom experience for students," said Science dean Simon Peacock. "Carl was the catalyst that built on the already-existing energy within UBC Science, and thanks to him we've been able to accelerate our efforts to advance student learning." Wieman joined UBC in 2007 as director of the Carl Wieman Science Education Initiative, designed to help departments scientifically measure and systematically improve undergraduate education. Wieman will take an unpaid leave of absence from the university upon confirmation of his appointment by the US Senate.

New Rhodes Scholars to Focus on Organic Chemistry, Health Care

Two UBC Science students—one studying honours chemistry, the other a former physiology student now studying medicine—have been awarded prestigious Rhodes Scholarships by the University of Oxford. The $150,000 scholarships will enable Kayli Johnson and Jaspreet Khangura to focus their studies on the synthesis of complex natural products and on international health issues, respectively. Only 11 Rhodes Scholars are named annually across Canada, and this is the first time that two UBC students have received the award in one year. "This not only underscores UBC's academic excellence, but also our students' commitment to community engagement and international issues," said Simon Peacock, UBC dean of Science. "We're extremely proud to have two young, outstanding leaders in science recognized with such a distinguished scholarship." Both students have been heavily engaged in volunteerism, student leadership and peer support, including UBC's SciTeam student development program.





(L-R) Aerial photo of UBC's Point Grey campus. Photo: UBC Public Affairs • Smoothed reconstruction of the total matter distribution in the Cosmic Evolution Survey field, created from data taken by the Hubble Space Telescope and ground-based telescopes. Photo: National Aeronautics and Space Administration and the European Space Agency • Nobel laureate and physics professor Carl Wieman nominated for the position of Associate Director of Science in the White House. Photo: Martin Dee

Computer Scientist to Head National New Media and Animation Research Network

GRAND network members (L-R) Sid Fels, Cristina Conati, Kellogg Booth, Kosta Beznosov, Alison Ariss and Michiel van de Panne. Photo: Gable Yeung

Kellogg Booth—a UBC computer scientist with a distinguished history of leading multidisciplinary collaborations—will head a $23.2-million new media, animation and graphics research network to be hosted by UBC.

The Graphics, Animation and New Media (GRAND) Network, a federal Network of Centres of Excellence, will be a joint academic collaboration between UBC, Simon Fraser University, Emily Carr University of Art + Design and the British Columbia Institute of Technology.

"Social networks and new media represent some of the most significant popular adaptations of computer technology," says Booth, a professor with the Dept. of Computer Science. "GRAND will enable research collaborations to address issues and explore opportunities in this fast-growing sector."

The network's 56 investigators will probe social networking, personal identity and data security, virtual museums and galleries, e-learning and e-health services. Outcomes will include new knowledge and technologies, trained personnel and economic benefits from commercializing the potential of new media, animation and games.

GRAND will also place considerable focus on student learning opportunities.

Carl Wieman, who heads UBC's efforts to transform undergraduate science education, will collaborate with network investigators to improve the effectiveness of display sharing in classroom and other learning environments. Dolby Computer Science Research Chair Wolfgang Heidrich will lead the network's efforts in integrating image capture and physics-based animation—work being followed closely by industry partners Autodesk and Pixar Animation Studios.

BIODIVERSITY

One-Off Ivory Sales Could Spur Poaching, Hurt Ecosystems

UBC zoologist Rene Beyers belongs to an international group of researchers calling on the Convention on International Trade in Endangered Species (CITES) to deny recent petitions from several African nations to "downlist" the conservation status of their elephant populations. The recommendations—spearheaded by Samuel Wasser at the University of Washington and published in the March issue of *Science*—might have helped spark a decision by CITES to deny the petitions at a major meeting just two days after the publication. "The immediate fear is that downlisting elephants or allowing one-off sales in any African nation will stimulate the market for illegal ivory everywhere," says post-doctoral fellow Beyers. In 2008, a one-off sale of stockpiled ivory from South Africa, Botswana, Namibia and Zimbabwe was brokered by the European Union in exchange for a nine-year moratorium on future sales from those nations. Tanzania and Zambia then petitioned CITES to downlist the conservation status of their elephants. Continued reduction of these keystone species populations could have a detrimental impact on the nations' ecosystems.

Global Cimate Change: Look for the theme colour throughout this issue to find out about our scientists' and students' involvement with climate change research.

COMPUTATIONAL SCIENCES

UBC Mathematicians Add Up National Honours

This spring, four UBC mathematicians were recognized with national honours. Rachel Kuske, professor and head of the Dept. of Mathematics, was awarded the 2011 Krieger-Nelson Prize for Research Excellence by the Canadian Mathematical Society (CMS). The citation notes Kuske's contributions to the study of differential equations for a wide range of applications—from neuroscience to mathematical finance to hydraulic-fracture mechanics. The CMS's Jeffery-William Prize for Research Excellence was awarded to Kai Behrend, one of the world's leading experts in the theory of algebraic stacks and the geometry of moduli spaces of stable maps. Nassif Ghoussoub took home the CMS's Borwein Career Award, which recognized his exceptional contributions to Canadian mathematics. Daniel Coombs received the 2010 Early Career Award in Applied Mathematics, adjudicated by the Canadian Applied and Industrial Mathematics Society and the Pacific Institute for the Mathematical Sciences. The award recognizes exceptional research in applied mathematics done within 10 years of receiving a PhD.

ANALYTICAL TOOLS AND HEALTH

Barcoding Zebrafish Screens to Boost Drug Discovery

A platform co-developed by UBC statisticians, which barcodes the behavioural responses of zebrafish to chemical compounds, could dramatically speed up the discovery of new psychiatric drugs. The new system, detailed in the January issue of *Nature Chemical Biology*, was developed by UBC researchers Jennifer Bryan and Rick White, and Harvard's Randall Peterson and David Kokel. It can video capture and track the behavioural effects of up to 14,000 chemicals at a time. "The capacity of this approach is quite distinctive," says Bryan, an associate professor in the Dept. of Statistics and the Michael Smith Laboratories. "The UBC team was able to turn behavioural observations into more manageable barcodes that capture how the behaviour in a treated group differs from that in an untreated control. This makes it possible to generate visualizations of the massive screening datasets generated by this powerful tool, and to group compounds based on the similarity of their associated barcodes." In initial screenings the system was able to evaluate the effects of compounds on more than a quarter million embryos.

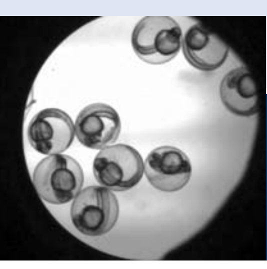
CLIMATE CHANGE

Genome of Ocean Dead Zone Microbe Mapped

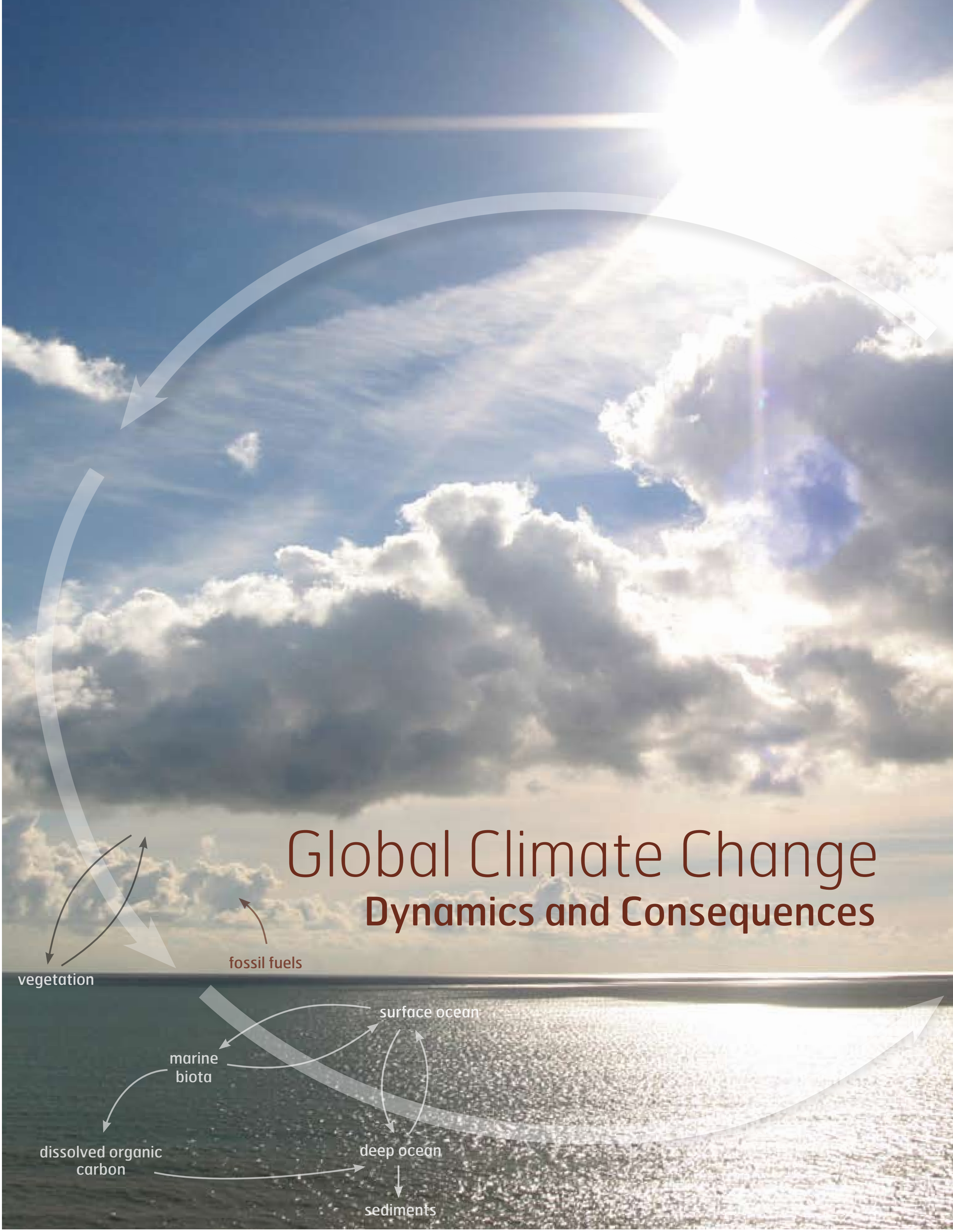
UBC microbiologists have helped map the genome of SUP05, a microbe that is silently shaping the ecology of Earth's expanding ocean dead zones. "Microbes specialize in metabolic innovation and many can use nitrates, sulfates and metals, 'breathing' these compounds instead of oxygen," says Steve Hallam, assistant professor of Microbiology & Immunology, who worked with scientists at the US Department of Energy to map the microbe. "The genetic blueprint of SUP05 opens the door to studying the who's who of dead zone ecology and provides an experimental framework for asking an entirely new set of research questions. The answers could help us monitor and mitigate the impact of dead zone expansion and intensification." Dead zones are areas of low dissolved oxygen concentrations, which are caused by climate change. They are a source of greenhouse gases and sinks for nitrogen, robbing many ocean life forms of this critical nutrient. The zones—found off the coasts of BC, Oregon, Chile, Namibia and elsewhere—are expanding and will directly affect marine fisheries and seabed ecosystems. However, very little is known about the metabolism of the zones' microbial communities. Hallam, Canada Research Chair in Environmental Genomics, has studied the microbe population in Saanich Inlet, a fjord on Vancouver Island in British Columbia.

Government Invests $1 M in Sustainable Mining Research

A centre for smart mineral exploration and mining research helmed by UBC geologist Greg Dipple has received $1 million in start-up funding from Western Economic Diversification Canada. "The Dept. of Earth & Ocean Sciences at UBC enjoys very strong partnerships with industry, and this centre will serve as a base for continued collaboration," says Dipple, professor and head of the department and an expert in fluid rock interactions. The new Centre for Environmental Change and Planetary Stewardship will house an environmental interfaces laboratory to investigate and mitigate industrial impacts on the environment, conduct three-dimensional modelling for mining research, and enhance field-based mineral exploration research and training. It will become a core component of UBC's future Earth Systems Science Building, a project that has received significant support from the Government of British Columbia and industry.



(L-R) Tanzania and Zambia are among the most significant sources of illegal ivory in Africa. Photo: Wikipedia Commons • Video capture typical of an untreated control well of zebrafish embryos. Photo: Harvard University



Global Climate Change

Dynamics and Consequences

Observed increases in air and ocean temperatures, widespread melting of polar and glacial ice, and rising sea levels clearly indicate that the earth is heating up. UBC scientists are helping to answer critical questions: How fast? What is the tipping point whereby living systems become irreversibly compromised? How can we better quell, predict and prepare for climate change?

Scientists across the globe have established that we are at a pivotal point in the history of our planet. Survival of life as we know it is a numbers game. Earth's population has grown from 1.6 billion in 1900 to over 6.8 billion in 2010. Exponential growth, coupled with industrial and technological development, has resulted in increased burning of fossil fuels.

Over the past century, atmospheric carbon dioxide (CO_2) concentration has risen to a higher level than at any time within the last 800,000 years. Since 1960, atmospheric CO_2 has increased from 315 to 388 parts per million by volume (ppmv). By the year 2100, levels are predicted to rise to 750 ppmv if there is no effort to cut emissions (from *Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, IPCC 2007).

During the 20th century, global air and sea surface temperatures rose by roughly 0.74 degrees Celsius (°C). Scientists estimate that in this century global temperature will rise by 1.8 to 4.0 °C (IPCC 2007), largely as a result of increased CO_2 emissions. The last 50 years have likely been the warmest period in the past 13 centuries.

The transfer of energy through physical, chemical and biochemical processes among the earth's atmosphere, oceans, soil and living organisms drives the complex dynamics of climate. When the global energy balance changes, the earth's climate changes (see text box). UBC scientists are working to map climate change over geological time scales and measure anthropogenic impacts in recent history to better understand the implications for future generations.

Human Evolution—A Hiccup in Time

Within the framework of global warming, it is difficult to believe we are living in the midst of an ice age. "If you look at the long-term changes of climate, we find ourselves in one of the rare cold periods, where ice remains on the poles," says Roger Francois, Canada Research Chair in Marine Geochemistry and Climate Change Studies. His work in paleoceanography involves understanding how ocean biology and chemistry have controlled atmospheric CO_2 and greenhouse gas effects in the past, and how changes in ocean circulation have affected temperature distribution on the earth.

The current ice age began around 1.8 million years ago. It is marked by periodic shifts in climate from cold glacial phases to warm interglacial periods like the one we are living in now, which started around 10,000 years ago. Shifts from glacial to interglacial phases are initiated by periodic changes in Earth's orbital parameters, which alter the distribution of solar heat to the earth's surface. However, these orbital changes in themselves are too small to produce the dramatic contrasts in climate and must be amplified. One of the main amplifiers is the level of atmospheric CO_2, which changed naturally in concert with climate, varying between 180 ppmv during glacials to 280 ppmv during interglacials. "Now, we are clearly 'rocking the boat,' having raised atmospheric CO_2 to 388 ppmv and counting," Francois says.

While *Homo sapiens* have been on Earth for over 150,000 years, it has only been during the last 10,000 years that the climate has been stable enough for humans to change from nomadic hunter–gatherers to agrarian groups and to civilization as we know it. "In a sense we are what we are because of a fluke in climate evolution," says Francois.

Evidence from ice cores, sediments and speleothems has shown that prior to 10,000 years ago very abrupt changes in climate occurred within just a decade or two. "The issue now is that we may well be the victim of our own success, because we are becoming such an important part of the climate equation that we could potentially shift the climate back toward an unstable period."

The Carbon Cycle and Radiative Forcing

Carbon is the fourth most abundant element in the universe and provides the chemical backbone of all life on Earth. The interchange of carbon between the atmosphere, the terrestrial biosphere (plants, animals, soil and freshwater systems), the oceans and the sediments (minerals and fossil fuels) is known as the **carbon cycle** (see illustration). Nature has been efficiently recycling carbon atoms for billions of years. **Radiative forcing** is the change in the balance between solar radiation coming into the atmosphere and radiation emitted back into space. Positive radiative forcing (caused by greenhouse gases) tends to warm the lower atmosphere of the earth, and negative forcing (such as caused by aerosols) tends to cool the atmosphere. Now, human activity is disrupting the balance. We are releasing CO_2 into the atmosphere faster than it is being absorbed in natural carbon sinks, such as the ocean. This rise in atmospheric CO_2 is altering the global energy balance and generating mechanisms that could force climate to change rapidly.

(L-R): Phil Austin, assoc. prof. in the Dept. of Earth & Ocean Sciences • Roger Francois, Canada Research Chair (CRC) in Marine Biogeochemistry and Climate Change Studies • Maria (Maite) Maldonado, CRC in Phytoplankton Trace Metal Physiology • Christopher Harley, assist. prof. in the Dept. of Zoology.

Scientific Evidence of Human Impact on Climate

The question of whether the increase in atmospheric CO_2 is caused by burning fossil fuels rather than natural carbon cycles is easy to answer, says Phil Austin. The carbon in fossil fuels comes from plants, which preferentially store the light isotope, carbon-12, over the heavier stable isotope, carbon-13. Measurements taken in the atmosphere, ocean, ice cores, tree rings and corals show the ratio of carbon-13 to carbon-12 is steadily decreasing as fossil carbon enters the atmosphere as CO_2. "We know from measuring the isotope content that the 40-percent increase in atmospheric CO_2 since 1750 is due to fossil fuel burning and not the natural carbon cycle," he explains. "Also, background oxygen levels are decreasing, and that is what you would expect if carbon release is coming from combustion."

Claims that global warming is due to natural climate forcing by sun spots or cosmic rays are equally unfounded. "While the lower atmosphere is warming, the upper atmosphere is cooling. These findings are consistent with an increase in CO_2 but not with increased solar radiation, which would add energy to the upper atmosphere," Austin explains.

The Confounding Compounding of Multiple Variables

Warming sea water is causing the oceans to expand, and increased fresh water from polar and glacial ice-melt has caused the sea level to rise at roughly 3 millimetres per year over the past 10 years. While an increase in atmospheric CO_2 drives up air and ocean temperature, increased CO_2 uptake by the ocean also makes sea water more acidic. "Adding CO_2 is like carbonating the ocean," says Christopher Harley, UBC assistant professor in the Dept. of Zoology. "The ocean pH we are seeing today is already more acidic than at any time over the past many millions of years."

While both positive and negative effects of increased temperature have been documented on individual species, much less is known about the effects on marine communities and their ecosystems. Even less is known about the effects of ocean acidification. "Scientists tend to study one variable at a time, but ocean temperature and CO_2 concentrations are increasing simultaneously," explains Harley. "In many cases, the cumulative effects of these changes will be much worse than we might expect."

Good for Sea Stars—Bad for Mussels

To better understand the combined effects of increased temperature and CO_2, Harley and his lab have studied the common sea star *Pisaster ochraceus*, a keystone predator—a species that has a disproportionate effect on its environment relative to its biomass. Surprisingly, they found that rising temperatures and, more significantly, higher CO_2 levels increased sea star growth rate. Studies of other marine species showed a negative effect. Mussels, a favourite food for the sea star—and for humans—do not fare well.

"The mussel is the poster child for species that will fare the worst due to climate change, particularly in British Columbia," Harley says. Acidification is making their shells more brittle, increased temperature and CO_2 is producing larger and hungrier predators, and warmer water is decreasing mussel habitat. While sea stars may be winning out over mussels in the short-term, the long-term effects of disrupting the balance in the food chain—and the ecology of an entire marine ecosystem—are unknown.

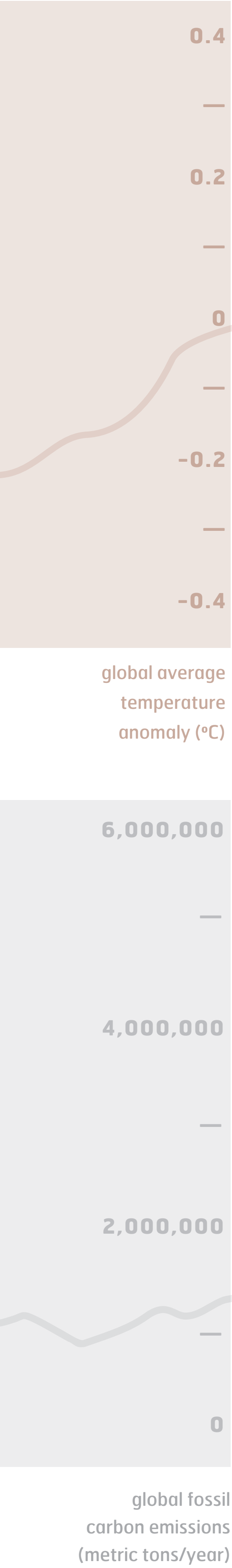
"Tipping the Tides"—Understanding Rates of Change

Climate change and its impacts occurred gradually over the 10,000 years before the industrial revolution. But when the scales are tipped in nature, rates of change are unpredictable. Harley has shown that certain changes can occur very rapidly once some threshold or "tipping point" is reached. He and his team studied the intertidal red algae *Mazzaella parksii*, which constitutes miniature seaweed forests that harbour snails and other marine life. They found that high temperatures, coupled with low tides and calm seas, spelled disaster for the tiny algae. When coastal air temperature hits 24 °C during a waveless low tide, they die; below that temperature, there is little change at all. "We expected that changes in the algae growth would be more gradual or linear, but above the tipping point the algae was wiped out," Harley says.

Mighty Phytoplankton—Primary Producers and CO_2 Fixers

Some things in nature are taken for granted—like phytoplankton. These microscopic, unicellular marine organisms are responsible for transforming 45 gigatons of carbon from CO_2 to organic carbon—roughly half of the total carbon fixation on Earth. One-third of the organic carbon produced by phytoplankton is exported to deep ocean, which serves as a carbon sink.

1860 1900



Phytoplankton live in surface water, down to 200 metres in the water column, or as far as light can penetrate. When they evolved 3.5 billion years ago, the earth was nearly anoxic. When oxygenic photosynthesis developed, phytoplankton started to pump oxygen into the atmosphere. "All of the oxygen we breathe today we owe to photosynthetic primary producers like phytoplankton," says Canada Research Chair in Phytoplankton Trace Metal Physiology Maria (Maite) Maldonado.

Iron is the fourth most abundant element in the earth's crust and the most important trace element (micronutrient) for most organisms. Because iron can take up and release electrons very readily, it is the best catalyst in redox reactions, a fundamental chemical process in living systems. Maldonado is studying how marine phytoplankton acquire, metabolize and use iron and other trace elements, to better understand how these organisms affect the global carbon cycle and, thus, climate.

When phytoplankton evolved, iron was readily available. Currently, about 40 percent of the earth's oceans are iron-limited. Maldonado's group has provided strong evidence that marine phytoplankton are able to access iron bound within organic compounds. "The biggest pool of dissolved iron in the ocean is this organic source, which we previously thought was unusable to them."

Her group is presently investigating how phytoplankton may substitute copper (Cu) for iron (Fe) in some key metabolic pathways. In collaborations with colleagues at TRIUMF, they used Cu radionuclides to make the first measurement of intracellular Cu concentrations in Fe-limited phytoplankton. This work has changed the way oceanographers think about copper. Oceanic Cu has been considered a toxic trace metal to phytoplankton, but their results suggest that Cu is essential for marine phytoplankton, especially when Fe is low.

Iron Seeding—A Case Against Meddling with Nature

Much current research focuses on increasing carbon sequestration (capturing and storing CO_2) and providing new sinks for industry to obtain carbon credits under the Kyoto Protocol. Maldonado was involved in the first in situ iron fertilization experiment in the Southern Ocean, adding 1,700 kilograms of iron over 50 square kilometres of ocean. Within five days the group observed increased phytoplankton biomass, improved photosynthesis and a reduction of CO_2 concentration in surface water from 360 to 325 ppmv. A month and a half later, however, the phytoplankton bloom had expanded to 1,100 square kilometres.

"Although these experiments have improved our understanding of the role of Fe in controlling oceanic primary productivity, the efficiency by which Fe fertilization sequesters CO_2 to the deep sea remains constrained," says Maldonado. "Given our poor understanding of the unintended impacts of massive oceanic Fe fertilization, this is not a feasible strategy to lower atmospheric CO_2."

Introducing iron into the ocean—like the introduction of cane toads to Australia to eradicate beetles, or the invasion of carp into North American waterways and lakes—can have unforeseen, even disastrous consequences.

Forcing *versus* Feedback—A Cloudy Picture

The *Fourth Assessment Report* (IPCC 2007) states: "...the global average net effect of human activities since 1750 has been one of warming, with radiative forcing of +1.6 Watts/meter^2."

"That forcing is really closer to +3 Watts/meter^2, but our own pollution is actually reducing the effect of this energy increase in the short term," says Phil Austin, UBC associate professor in the Dept. of Earth & Ocean Sciences. "The aerosols emitted from exhaust and coal-fired industry reflect so much sunlight that we are reducing the radiative forcing by one-third." As we produce cleaner energy sources, the planet will initially warm even more, because pollution in the form of aerosol particles is washed from the atmosphere within days, while CO_2 molecules stay in the atmosphere and upper ocean for centuries. Despite the short-term consequences, we have to reduce greenhouse gases and pollution to increase prospects of survival in the long term.

Austin works with the Cloud-Aerosol Feedback and Climate Network at UBC to determine the direct and indirect effects of aerosols in the atmosphere and on clouds. "Sixty percent of the variation found in the 23 models that contribute to the IPCC data is due to their different assumptions on clouds," he explains.

The altitude of clouds determines their impact on the greenhouse effect. Cold, high clouds absorb thermal radiation from below and emit very little upward to space, thereby enhancing the greenhouse effect and increasing warming. Low clouds are closer to the earth's surface temperature, and because they are brighter, they reflect sunlight back into space, thus cooling the planet.

"That's part of the cloud feedback question we are trying to solve," says Austin. "If you heat the planet up, are clouds going to increase or decrease, and will they increase at high or low altitudes?" Most models show that low clouds break up and reflect less radiation for warmer temperatures.

"The biggest long-term problem is that one-quarter of all the greenhouse gases we emit will remain in the atmosphere 10,000 years," says Austin. "Given what we already know, we have an ethical responsibility to future generations to be proactive."

Manipulating Metabolism to Survive in Harsh Environments

Zoologist Jeffrey Richards has shown that hypoxia tolerance in sculpins is directly related to inherent traits such as having a low metabolic rate (specimen shown is scalyhead sculpin, *Artedius harringtoni*). Despite this adaptation to low oxygen environments, their survival rate is jeopardized as globally increasing water temperatures boost fish's metabolism while further decreasing oxygen availability. Photo: Ben Speers-Roesch

Why do some animals survive in extreme environments while others perish? UBC zoologist Jeffrey Richards studies fish and other aquatic species to better understand the mechanisms that control and coordinate acclimation to severe or rapidly changing environments.

Just as environmental stressors shift the global energy balance, they also affect the energy balance of species and organisms. When an animal moves into a changing or challenging habitat, it requires more metabolic energy to "make a living." Zoology associate professor Jeffrey Richards is studying the physiological, biochemical and molecular mechanisms that coordinate cellular response to stress and looking at how these multiple pathways are interlinked. "Lots of work has been done on how an animal makes energy under the stress of hypoxia, or low oxygen conditions," says Richards. "I want to understand how animals are changing the way they use energy."

Gene Pools *versus* Tidal Pools—Effects of Lineage and Environment

Richards found the perfect natural laboratory in BC's tidal pools. Not only are they teeming with life, but the individual pool environments are highly variable. A high tide pool that has emerged during the day can rise in temperature by up to 25 degrees Celsius. In concert with this increase in temperature, plant productivity can boost oxygen to four times normal levels. If it rains, the tidal pool suddenly changes from sea water to fresh water. At night, the same pool might be completely anoxic, or lacking in oxygen. "A pool high in the intertidal zone experiences hypoxia more frequently and for longer duration than a pool at middle to low tidal zones," he says.

Richards and his group studied 12 different species of sculpins, small fish from the family Cottidae that live along the shores of BC's West Coast. Different species inhabit different vertical zones in the marine environment: hypoxia-tolerant species live higher up in the intertidal zone, whereas species that require more stable supplies of oxygen are found in subtidal and deeper zones. The correlation between hypoxia tolerance and traits such as gill size has been observed before, Richards notes. However, these common traits might be due to the fact that different species are closely related and thus show similarities, which are not necessarily due to habitat adaptation.

Using a modelling method called phylogenetically independent contrast, Richards and his group were able to differentiate between the effects of species relatedness and natural selection on the traits of sculpins. In the *Proceedings of the Royal Society* (2009), his group was the first to publish that hypoxia tolerance in fish is related to having a big gill surface area, a hemoglobin protein that binds oxygen very well, and a low metabolic rate. "All of these features are in the animals even before they are exposed to low oxygen," he explains. "They are inherent traits of hypoxia-tolerant animals under normal conditions."

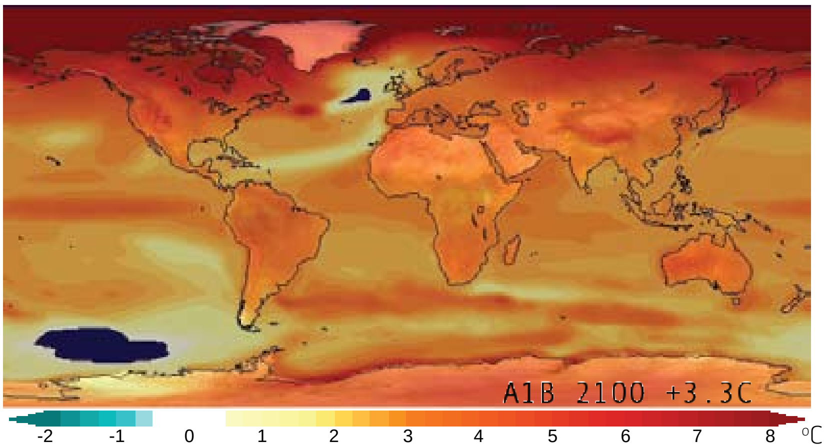
In further studies of behavioural responses to hypoxia, they found that under extreme low oxygen conditions,

> *continued on page 13*

For more information on this research please visit www.zoology.ubc.ca/person/jrichard

Jeffrey Richard's basic research is funded by NSERC. He is also collaborating with researchers from the Department of Fisheries and Oceans to study why salmon runs are depleting and what species of trout fare best in different lake environments.

Degrees of Uncertainty: Analyzing Climate Change Models



This snapshot shows the global surface temperature change by 2100 (relative to the1870–1899 average temperature baseline) as simulated by the community climate system model CCSM3 (of the US National Center for Atmospheric Research), which uses a mid-range climate change scenario with atmospheric CO2 concentration increasing to 720 ppmv by 2100. Source: Snapshot and full animation available at www.cgd.ucar.edu/ccr/strandwg/ccsm3_visualization.html

Predicting climate change involves modelling an extremely complex interplay of factors, which include—and are intensified by—anthropogenic impacts. Statistician Claudia Tebaldi analyzes multiple climate models to try to increase reliability and quantify uncertainty.

Common questions about climate underscore common misperceptions, such as: How can the climate be warming when we have had such a cold summer or snowy winter? While weather forecasts predict conditions over the short term, global climate models, also known as general circulation models (GCMs), predict the effects of climate change in upcoming decades and centuries. GCMs incorporate physical laws into calculations to simulate the interactions of the atmosphere, oceans, land surface and sea ice. The phenomena of climate are now intertwined with human perturbations that are increasing the uncertainty and complexity of climate models.

"All of these models are extensively validated in how they simulate observable quantities, such as the effects of perturbations like volcanic eruptions or the cycles of cooling and warming over geological time, and how they reproduce important phenomena such as ocean circulation, El Nino and other behaviours," says Claudia Tebaldi, UBC adjunct professor in Statistics. She is also a research scientist with Climate Central, a non-advocacy organization of scientists and journalists headquartered in the US and created to communicate the most significant information about climate and energy science.

Tebaldi works with the World Climate Research Programme's multi-model ensemble, WCRP CMIP3, an unprecedented and complex collection of output data from the 23 global climate models used by the Intergovernmental Panel on Climate Change Working Group I. "You can think of each GCM as an artificial surrogate of the entire earth," she explains. GCMs are run for a common set of experiments, producing large datasets of climate projections for a number of scenarios. All models agree that, globally, temperature will increase, wet areas will get wetter, dry areas dryer, sea levels will continue to rise, and extremes of temperature and precipitation will be intensified. However, they disagree in how much these trends will change.

Factors in an Uncertain Future

To better assess climate change, researchers have used model averaging that aims to cancel out individual model biases. The theory is that

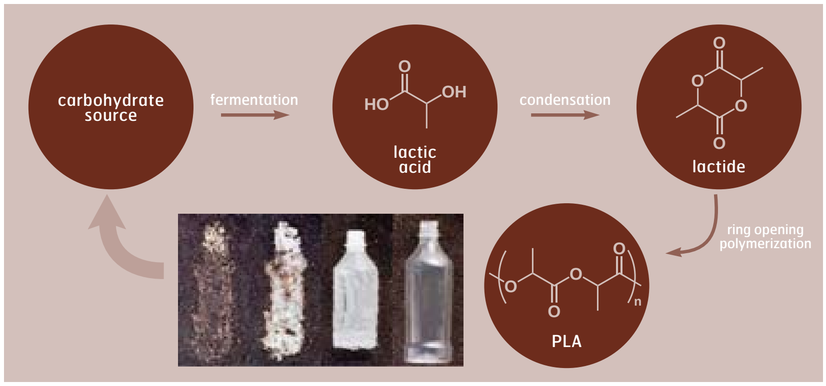
> *continued on page 13*

Reconciling Regional and Global Climate Models

While GCMs are good at modelling large-scale processes, like storm tracking or circulation pressure systems, climate modelling has become an increasingly regional concern. Because GCMs are simulating parameters on a global scale and for long periods of time, computing power limitations still dictate that their resolution has to be lower than regional models. Regional models are limited to specific domains that can be resolved at a much finer scale, and often only for slices of times. However, regional models are driven by global dynamics so must be nested within global models, making them subject to the same sources of uncertainty and errors. Reconciling regional and global data adds another layer of complexity to climate change models.

For more information on this research please visit www.stat.ubc.ca/People

Designing Green Plastics: Molecule by Molecule



Polylactic acid (PLA) is considered a "green" polymer as it can be synthesized from renewable carbohydrate sources and used for producing biodegradable plastics. Parisa Mehrkhodavandi's research focuses on optimizing the chemical reactions involved with the formation of such polymers.

Organometallic chemist Parisa Mehrkhodavandi is developing novel polymerization catalysts to produce green polymers for a wide array of applications—from packaging to drug delivery and bone repair.

All plastics are polymers—large molecules formed by linking together simpler molecules or monomers. Since the 1950s, plastics have become the most widely used group of materials in the world. However, once their use ends, the durability and toxicity of these primarily petroleum-based polymers countermands their benefit.

UBC assistant professor in the Dept. of Chemistry, Parisa Mehrkhodavandi focuses her research on green polymers that are biodegradable, bioassimilable and often made from renewable sources. Her group designs, synthesizes and evaluates inorganic and organometallic catalysts for controlled polymer formation.

PLAying with Lactide Rings

One class of green polymers that Mehrkhodavandi is investigating is polylactic acid (PLA), which is used in everything from biodegradable plastic cutlery to dissolvable sutures. The first step in PLA synthesis is to take sugar and generate lactic acid. The next step—and the proprietary technology—is removing the water from lactic acid to form lactide, a six-member ring-shaped molecule that can be easily opened and polymerized (see illustration).

To form PLA, lactide is heated to 180 degrees Celcius (°C), at which temperature the white powder becomes a gooey substance. It then must be mixed with an additive to give it the desired properties. Many of these additives and catalysts are toxic, such as tin—the only FDA-approved catalyst for polymers used in medical applications such as soluble stitches. Another toxic additive is bisphenol A, an industrial chemical used to harden plastic, which has been linked to breast cancer and prostate cancer.

"What we are doing is developing catalysts that control the polymer's properties on a molecular level so that the use of additives can be minimized or prevented," says Mehrkhodavandi.

Structure Defines Properties

Stereochemistry refers to the spatial arrangement of atoms within molecules. Chirality refers to the three-dimensional structure of enantiomers—molecules that have identical chemical properties but are mirror images of each other, much like the right hand is to the left hand. Enantiomers of the same molecule can cause different effects; for example, when the drug thalidomide was produced with the wrong enantiomer, it caused birth defects. Chirality is a key factor in polymerization because lactic acid is a chiral molecule.

Controlling the physical properties of a polymer also requires understanding its tacticity, which is the orientation of adjacent carbon centres within a macromolecule. "Along the backbone of polylactic acid are a number of carbon centres, which have methyl groups dangling from them," explains Mehrkhodavandi. "If we can control the direction in which these methyl groups are pointing, we can control polymer properties such as rigidity, melting point and solubility."

For example, if all methyl groups on the carbon chains are isotactic, or pointing in the same direction, they will stack together nicely to form a highly crystalline material at 180 °C as opposed to a gooey substance. Mehrkhodavandi's group has developed several catalysts capable of controlling polymer tacticity.

Indium, an Intriguing Chiral Catalyst

Chiral aluminium catalysts have been very successful in the stereospecific ring-opening polymerization of lactide because they are good

> *continued on page 13*

For more information on this research please visit www.chem.ubc.ca/personnel/faculty/mehr

This research was funded in part by grants from the Canada Foundation for Innovation, British Columbia Knowledge Development Foundation, and Natural Sciences and Engineering Research Council (Canada). Parisa Mehrkhodavandi holds an NSERC University Faculty Award.

Manipulating Metabolism to Survive in Harsh Environments – *continued*

hypoxia-tolerant sculpins will swim to the surface to breathe, rather than shut down their metabolism. "Animals try to avoid compromising positions. If you have to turn yourself off in a tide pool, which you can't escape from, you could be toast," explains Richards.

Hypoxia—Global Consequences

The prevalence of low oxygen freshwater and marine environments is increasing due to anthropogenic nutrient loading, or eutrophication. "The Gulf of Mexico is basically dead because of runoff from agriculture, fertilizers and sewage treatment," Richards says. Increased nutrients accelerate algae growth, which disrupts the ecosystem and rapidly decreases dissolved oxygen. The result is displacement of organisms and massive fish kills.

Higher temperatures, caused by global climate change, will have two major effects on animal survival rates in low oxygen environments. First, warmer water holds less oxygen and increases the impact of eutrophication. Second, a rise in global temperature increases the metabolism of ectotherms (fish, lizards, reptiles), so they consume more energy to stay alive. "One of the key strategies in being able to survive low oxygen is turning off metabolism, and this becomes harder to do at warmer temperatures," Richards says.

InSEAS

A major new 22,000 sq. ft. aquatic research facility, the Institute for the Study of Environment and its Aquatic Systems (InSEAS), is under construction at UBC. "InSEAS labs will have specially constructed fish tanks and equipment that researchers will be able to manipulate in every imaginable way and maintain for extended periods of time under very controlled conditions," says director Jeffrey Richards. The renovation project is part of the Biological Sciences Renew program, funded by the federal government, with infrastructure funding from the Canada Foundation for Innovation.

Degrees of Uncertainty: Analyzing Climate Change Models – *continued*

multi-models should provide better predictions than a single model. "The benefits of averaging are easy to understand, but it could overstate or understate a problem," says Tebaldi, who has identified and is working to resolve several challenges to this approach.

Some models may be better than others for specific aspects of the simulation, yet they are all weighted equally in averaging. Future predictions cannot be based simply on an extrapolation of past data and present data, since the rate of change is increasing in many respects. For example, historical average high and low temperatures are changing. In addition, much of the model uncertainty is due to a limited understanding of processes such as aerosols and cloud dynamics (see page 9).

Another challenge is dealing with possible threshold behaviour and runaway feedback. For example, what would happen if the permafrost melts, releasing huge methane deposits stored beneath? "We are using models that have been tuned to do well on a system that hasn't been subjected to big perturbations and during a time when climate hasn't changed very much," Tebaldi says. "In assessing uncertainty in climate model predictions, I try to account for as many idiosyncratic features as I can, but it is a work in progress."

Designing Green Plastics: Molecule by Molecule – *continued*

at differentiating between right-handed and left-handed enantiomers, selectively polymerizing one over the other. However, the process is slow. Mehrkhodavandi's group synthesized a highly active, chiral indium catalyst, the only non-aluminium catalyst to differentiate the lactide enantiomers and also polymerize at significantly faster rates.

The indium catalyst was used in a process called living polymerization (see text box), where different polymers, each consisting of a different kind of monomer, can be attached to one another to form a very stable chain of polymers. "Using this catalyst, you can combine polymers that have different structure and properties, and we are just beginning to explore and recognize the kinds of materials we can make," says Mehrkhodavandi, who credits her graduate student Amy Douglas for starting the project. "We want to find out if the indium catalyst will polymerize other monomers such as molecules that contain sulphur or nitrogen. If any catalyst will, it will be indium."

Living Polymerization

Normal polymerization involves three major phases: chain initiation, chain propagation and chain termination, where all of the monomers are consumed and the active catalyst reacts with itself to form an unreactive species. In living polymerization, chain termination doesn't happen, so more monomers or even different monomers can be added and enchained to the polymer.

Food for Thought: Student Links Nutrition to Health and Learning in a Connected World

Calling Alia Dharamsi a "foodie" would be a bit of an understatement. A fourth-year Integrated Sciences (INSC) student, Dharamsi has turned her passion for all things nutrition related—the social, cultural, physiological and developmental impact of food—into a guiding principle.

"We can't live, we can't have civil society, we can't have children learning well in school, we can't have families functioning together, if people don't have food," says Dharamsi, who just graduated this May. "Food is the basis of our society—we gather together to share meals, to learn about each other. And it's at that basic level that I want to have an impact."

That passion has guided the Wesbrook and Premier Undergraduate Scholar throughout her studies, community service and travels. In 2007 she became president of the UBC Meal Exchange, leading the student-driven chapter of this national non-profit organization to raise more than $54,000 worth of food for local families. This achievement places the chapter among the most successful in Meal Exchange history. Through that experience—and volunteering with the UBC AMS Food Bank—Dharamsi was able to connect her studies in nutrition and physiology to the day-to-day effects food security issues and hunger have on individuals and families. "I got involved in INSC shortly after joining Meal Exchange. I'm fascinated by the impact that food and nutrition has—not only on society—but on our ability to fight disease, to learn and to function as living, breathing units. And the great thing about the INSC is that you build your own program, and then rationalize why."

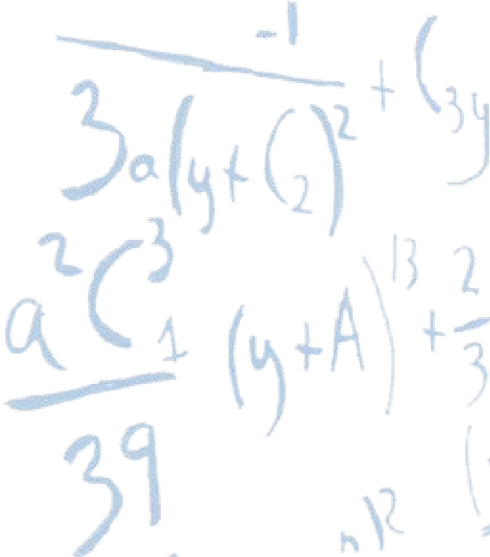
Dharamsi has also made food a key ingredient in her work as a mentor and tutor in Vancouver's inner city schools. Through the UBC Learning Exchange's Trek Program and the Let's Talk Science program, she not only shares her expertise in science and math with high school students, but also conveys the role that nutrition plays in learning. "Children need food and proper nutrition to think, and they need to know the importance of this directly. You can't learn if you're hungry, and you can't be expected to participate in class if your stomach is empty."

There's another hurdle: most of the students Dharamsi mentors are girls, many of whom have all-too-common mental blocks associated with math. "It's one of those things that I struggled with immensely early on and had to conquer. And what frustrated me was hearing girls say: 'Oh, girls aren't supposed to be good at math.' Math can open so many doors—though young students might not see that immediately. It's vital to let them know, and see, that university is cool, being smart is cool, and that post-secondary education in science is entirely within their grasp."

Summer work as a research assistant and volunteer at the St. Paul's Hospital Sinus Centre in Vancouver exposed Dharamsi to scientific inquiry in the real world. At St. Paul's she built a distributed surgical database that has become critical to the research being conducted at the Sinus Centre. And, time allowing, she continues to help out with several other projects.

Dharamsi capped off her four years as a UBC undergrad with a service trip to a small village just outside La Antigua, Guatemala—an experience that tied together her passion for helping people acquire the food, water and shelter they need, along with building knowledge and capabilities.

> "Children need food and proper nutrition to think, and they need to know the importance of this directly. You can't learn if you're hungry, and you can't be expected to participate in class if your stomach is empty." – Alia Dharamsia



Mornings were spent painting the learning centre, updating school electrical systems and completing cement work at local schools. Afternoons were spent teaching literacy to local students.

To someone already well versed in the impact that food scarcity and poverty has on Vancouver communities, the trip was an uneasy analogue. “The parallels between the inner city [here] and the developing world are striking. Kids who don’t see their parents. Children who can’t read. Children who don’t have three meals a day. Children and families not meeting their protein or calorie requirements. It was an amazing, humbling experience.” It’s also an experience that may have helped cement Dharamsi’s long-term plans.

Though not a prototypical life sciences and pre-med student, Dharamsi will be moving on to medical school to focus on pediatrics. But her eventual goal is to work with a non-governmental organization like the World Health Organization or Médecins Sans Frontières, with an eye to bringing more clinical balance to public health policy planning.

“I live and breathe food, and UBC and INSC have enabled me to combine my passions. I can talk about the science—why our bodies actually need proper nutrition and the impact it has developmentally—but I can also talk about food from the social sciences perspective, from the humanities and developmental angle.”

Photos: Martin Dee

Science Alumnus Gives $2M to Help Transform Math and Computer Science Courses

David Cheriton—a UBC Science alumnus and founding investor in Google—has made a $2-million gift to the Carl Wieman Science Education Initiative (CWSEI). The investment will support the initiative’s efforts to transform courses in the departments of Computer Science and Mathematics.

“The professors that I encountered during my undergraduate education at UBC set me on a career path that has been wonderfully rewarding both personally and financially,” says Cheriton. “Investment in the next generation is the best and most important one I can make, and education has to top the list.”

Cheriton received his Bachelor of Science in Mathematics from UBC in 1973 before pursuing his master’s degree and PhD at the University of Waterloo. He returned to UBC as an assistant professor in computer science from 1979 to 1982 before moving on to Stanford University, where he currently heads the Distributed Systems Group. In 1995, he became one of Google’s key founding investors.

“The CWSEI provides enormous support and guidance to UBC science faculty in making the classroom experience more rewarding for both teachers and students,” says Simon Peacock, UBC dean of Science. “By improving student learning and helping us graduate engaged, scientifically literate citizens, Prof. Cheriton’s gift will have a lasting impact far beyond our math and computer science classrooms at UBC and partner institutions.”

Since 2007, the Nobel laureate–led CWSEI has helped UBC Science departments undergo curriculum and course improvements, including the establishment of learning goals, adoption of new and proven teaching techniques, and scientifically evaluating and documenting student achievements. Almost 50 courses in the nine UBC science departments have undergone transformations with the help of specially designated teaching and learning fellows. More than 18,000 UBC students are expected to benefit from CWSEI activities this year.

A Lab Crawl, a Green Walk: Young Minds Explore Science and UBC

Opportunities to discover tree taxonomy, superconduction and life sciences greeted high school students attending the regional science fair at UBC Point Grey campus.

Some of the students who attended UBC Science lab tours and demonstrations at this April's Greater Vancouver Regional Science Fair (GVRSF) might just call the experience a walk in the park. But the aptly named A Walk on the Green Side—a 45-minute tour that let grades seven to 10 students discover the tree and plant life on campus—took in more than botanical life.

"I love the university and think that potential students should experience all of it," says Shona Ellis, senior instructor with the Dept. of Botany, who has put on the tour for the past five years. "So I like to talk not only about the botanical life of Point Grey, which is considerable, but the history of the campus and its architecture. Not many people know that in the early '60s the entire campus was designated a botanical garden."

Not surprisingly, Ellis's tour takes in the magnificent elm outside UBC's Physics and Chemistry buildings, the many trees that line the campus malls, and the famous upside-down tree (a Camperdown Elm). But Ellis also includes details on some of the memorable buildings on campus, including the Ike Barber Learning Centre, the First Nations Long House and the Chemistry Building, which was the original Science Building.

Close to 20 tours and demonstrations were put on by UBC faculty members, instructors and graduate students, as hundreds of high school students descended on campus to compete in the GVRSF. Demonstrations ran the gambit from microscopic zoos to the world of computers.

In addition to Ellis's "green" walk, UBC Science tours took students to one of the premier facilities on campus, the Advanced Materials and Process Engineering Laboratory (AMPEL). In the AMPEL Building, demonstrations delved into the world of physics.

Physics & Astronomy's Walter Hardy wowed students by levitating a magnet above a sample of superconducting material cooled by liquid nitrogen. He also demonstrated superfluidity in liquid helium, a point at which the helium is able to overcome friction.

"These demonstrations are a very direct way of exhibiting some of the really spectacular things that occur in matter," says Hardy, professor emeritus with the department. "They're typically things that I think everyone should see at least once in their life."

UBC's Michael Smith Laboratories and Centre for High-Throughput Biology (CHiBi) welcomed almost 30 students to tours themed around micro-organisms, mammalian cells and new technologies. Offerings included a demonstration of CHiBi's fluorescence microscopy system.

"Students become very enthusiastic when they're asked to perform hands-on tasks during the lab tours," says Véronique Lecault, a Chemical and Biological Engineering PhD student who helped put on the tours. Lecault also coordinates the UBC Let's Talk Science Partnership, which connects UBC science and engineering students with school teachers to deliver hands-on and engaging scientific experiments in classrooms.

"I've seen students not wanting to leave a lab before they had a chance to write their name with a laser dissection microscope! The best reward for the researchers who volunteer their time is to see the 'spark' in the eyes of the students when they learn something new and exciting about science."

Lecault notes that UBC science students are heavily involved in outreach activities leading up to the science fair. Supported by a Faculty of Science Outreach Grant, and in partnership with the UBC Learning Exchange and Let's Talk Science, more than 50 undergraduate and graduate students mentor at inner city secondary schools, helping students get their science fair projects up and running.

(Top) Science Fair participants got first-hand insights into the world of all things "micro" • (R) The UBC Science Entrance Award winners at the 2010 GVRSF included Arooj Hayat, Jonathan Zhou, Darrick Lee and Owen Lu.
Photos: Andy Mikula

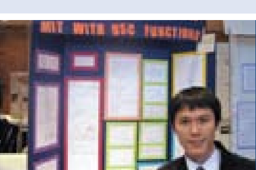
Expanding Minds: From High School Fairs to UBC Science

Not only are exceptional projects from the GVRSF selected to advance to the Canada-Wide Science Fair in May, but projects in up to six categories are also recognized with $2,000 UBC Science Entrance Awards. The 2010 scholarship winners investigated wind energy, mathematical grouping systems and interactions between herbal and traditional medicines. They are:

- Arooj Hayat
  Britannia Secondary, Vancouver
- Darrick Lee
  Richmond Secondary, Richmond
- Owen Lu
  Richmond Secondary, Richmond
- Jonathan Zhou
  Pinetree Secondary, Coquitlam

"We're obviously very interested in attracting the best young scientists to UBC," notes Paul Harrison, associate dean, Student Services, who was on hand to bestow the entrance scholarships. "But the lab demonstrations and scholarships also reflect our view of the importance of nurturing an affinity for hands-on research as early as possible, and of working to create opportunities for research at the undergraduate level once students have arrived."

UBC hosts the annual GVRSF (www.gvrsf.ca), which was organized by an enthusiastic team of volunteers and chaired by UBC Science alumna Dennise Dombroski this year. The Science Fair Foundation of British Columbia, a not-for-profit registered charity, supports and promotes the Science Fair program at the regional and local levels throughout the province.



Blue Whale Exhibit Arrives at UBC

Canada's largest blue whale skeleton becomes the marquee exhibit at a new UBC museum that will balance public outreach and research.

It took trains, ferries, two flatbed trucks and a crane, and the Beaty Biodiversity Museum welcomed its largest permanent exhibition item—a 25-metre-long blue whale skeleton. One of only six similar exhibits in North America, the skeleton is now the centrepiece in a collection that features more than two million plant, insect, fish, vertebrate and fossil specimens showcasing BC's natural history.

Andrew Trites, the director of UBC's Marine Mammal Research Unit who led the blue whale project (see photo), Mike deRoos, the master articulator responsible for piecing the specimen back together, and Wayne Maddison, director of the museum, were all on hand to witness the titanic arrival in April.

"Kids of all ages will be able to see, smell and touch whale bones and other specimens, and to hear stories about these creatures' lives in the wild and how they're connected—down to their DNA—to other living beings," says Maddison, Canada Research Chair in Biodiversity and a professor in the departments of Botany and Zoology. "They'll also get a sense of what biodiversity researchers do and what sort of questions we're striving to answer, which will hopefully inspire them to be part of the solution."

The museum, located adjacent to the Biodiversity Research Centre, will make its collections available to researchers as well as the public. The research centre's work will range from pure curiosity-driven research to conservation policy assessment, answering some of science's most fundamental questions while mitigating risks faced by species and ecosystems.

During UBC's Alumni Weekend festivities this May, Science alumni were able to visit some of the labs associated with the research centre—and to catch a glimpse of the whale skeleton in the museum's glass atrium. Museum staff members are ramping up public programs, set to begin this fall, which will engage school children with hands-on experiments.

Major funding for the Beaty Biodiversity Centre, which houses the Biodiversity Research Centre and the Beaty Biodiversity Museum, has come from the Canada Foundation for Innovation, the Government of British Columbia, the Djavad Mowafaghian Foundation, and UBC alumni Ross and Trisha Beaty.

Photo: Martin Dee

Illustration: Derek Tan

Blue Whale Exhibit Previews

Help us celebrate biodiversity at summer previews of Canada's largest blue whale skeleton. The previews are single-day showings (11 am – 3 pm), and are free to the public:

June 19 | July 17 | August 21

ALUMNI

"I always wanted to be an alumna of UBC. I fell in love with this campus when I was 13." – Maria Klawe

UBC Bestows Honorary Degree on Maria Klawe

The former dean of Science and head of Computer Science reflects on her time at UBC and on taking a Canadian perspective south of the border.

"It's part of Canadian culture not to rave about our own institutions," notes Maria Klawe, fresh from receiving an honorary degree from UBC this May. "But I have a sense that students and parents don't fully understand how special UBC is. I've been at elite institutions in the US where they're just now initiating programs that UBC instituted 10 years ago."

Klawe, currently president of Harvey Mudd College in Claremont, California, spent 15 years at UBC. She was head of Computer Science, then vice-president, Student & Academic Services, and finally dean of Science. Klawe left Canada in

CLASS NOTES AND EVENTS

'71 George Khachatourians, PhD
Microbiology

Now a professor with the Dept. of Food and Bioproduct Sciences at the University of Saskatchewan, George Khachatourians has received the Canadian College of Microbiologists' highest designation: Academic and Research Microbiologist. An international authority on microbial and food technology, Khachatourians helped found several spinoffs, including Saskatoon's Biolin Research, which is investigating ways to produce high-performance fibres from flax straw.

'77 Ian McTaggart-Cowan, PhD
Honorary Degree

Ian McTaggart-Cowan, a nationally recognized conservationist who became a faculty member of UBC in 1940, passed away this April, just shy of his 100th birthday. During his 35 years at the university, he served as head of the Dept. of Zoology and as dean of Graduate Studies, travelling widely and publishing an impressive body of work. McTaggart-Cowan played a large part in convincing Canadian governments to recruit trained wildlife biologists for management agencies. He also helped pioneer science on television, with shows widely featured beyond Canada's borders. The Cowan Vertebrate Museum—moving to its new home in the Beaty Biodiversity Museum this year—houses over 40,000 specimens of mammals, birds, amphibians and reptiles.

'90 Tobin Tanaka, BSc
Physics

A UBC physics degree and a diploma in meteorology helped Tobin Tanaka lay the groundwork for a career as a forensic document examiner. "Having an understanding of optics, electrostatics, pattern recognition and the basic philosophy of science was essential," notes the former UBC Physics Society president. "My background also enables me to bring a layer of diversity that complements my colleagues' educational backgrounds." It's a novel career path that Tanaka, a Beyond the BSc mentor, has been sharing with current UBC Science students. "No university in North America offers a program that allows you to step directly from university to a job as an examiner, so a solid grounding in science is a must. Being a Beyond the BSc mentor was a great experience that I hope provided students with some insight into the career."

ALUMNI
(L-R) Tobin Tanaka, BSc Physics • Thomas McLaughlin, BSc Honours Biophysics

2002 for a senior post at Princeton before taking the helm at Harvey Mudd in 2006.

During her tenure at UBC, campus-wide orientations for first-year students were launched and a strong relationship between the Faculty and the Science Undergraduate Society were forged. A persistent advocate for women in science and technology, Klawe worked to double the number of women faculty members appointed to UBC Science while she was dean. A UBC endowment for women students in computer science has been named in her honour.

But Klawe takes particular pride in having nurtured a fledgling computer science department at the university. "Probably the most exciting time was the early period, growing Computer Science. And seeing how the department has evolved has been truly gratifying."

The honorary degree not only recognizes Klawe's research (which includes investigating the effects of gender on electronic game-playing), but also her view that computer science can play a crucial role in improving the world. That belief has sparked her appointment to the Microsoft board of directors and election to the American Academy of Arts and Sciences.

'09 Thomas McLaughlin, BSc
Honours Biophysics

The weather might not have been ideal for a night-time run through Squamish, British Columbia, but Thomas McLaughlin had the time of his life as an Olympic torchbearer this February. "I entered a story-writing contest about being a role model for healthy living in my community, with winners getting spots to carry the Olympic torch. My entry talked about my budding career in medicine and about my time with UBC REC. I actually won!" Torchbearers—including UBC Science students Amy Hung, Brian Le, Ming An Mike Wu and Jenny Hong—each had the chance to carry the torch approximately 300 metres on its journey.

UBC HOMECOMING AND "BODY PAINTING THERAPY SESSION"
September 18, 2010

Need a place to channel those persistent blue-and-gold body-painting urges? UBC Homecoming unites fans from every generation to cheer on our Thunderbird football team. With a new head coach on board, you'll want to catch the big game. Winning is more exciting with you here!

EOS FIELD SCHOOL REUNION AND WINE TOUR
Early fall, 2010

Alumni volunteers are working hard to plan a field school reunion in Oliver, BC, for Earth & Ocean Sciences graduates from 1960 to 1980 and their friends. A great opportunity to revisit the field school, reconnect with classmates and professors, and enjoy great wine in an Okanagan autumn.

LATCH ON TO GREAT MINDS: PRESIDENT'S ANNUAL BLUE AND GOLD REVUE
November 29, 2010

Come out and enjoy an evening of interviews, inventions, videos and music with and by UBC's most outstanding students, faculty, staff and alumni. It will be a veritable intellectual cornucopia of the great minds in the UBC community.

SCIENCE FUTURES: IMAGINE DAY 2010
September 7, 2010

Share your experiences with undergraduate Science students as they start off a fresh year. A few hours of your time as an alumni speaker can make a lifetime's difference to students navigating their degree and career options.

For more information contact
Matt Corker at alumni@science.ubc.ca

EDITOR IN CHIEF Carola Hibsch-Jetter WRITING Mari-Lou Rowley, Pro-Textual Communications (cover story and research profiles); Chris Balma; Carola Hibsch-Jetter COPY EDITING/PROOFREADING Vicki McCullough DESIGN/LAYOUT www.mediagroup.ubc.ca PHOTOS Provided by UBC Science or as indicated. All rights reserved. COVER IMAGE Atmosphere and Ocean (Nick Free), Melting Glacier (Tobias_K), Phytoplankton (NOAA MESA Project). CIRCULATION 33,000 (twice a year) PUBLISHED BY The Faculty of Science, University of British Columbia, www.science.ubc.ca, synergy@science.ubc.ca

Your Feedback on *Synergy*!

Many thanks to our readers who took time to comment on *Synergy's* new look and feel. We were pleased to learn that our recent editorial and graphical design changes met your expectations very well. In line with previous feedback, respondents reported highest interest in learning about research discoveries and advances at UBC Science. *Synergy's* new design got rave reviews—the choice of recycled paper stock was particularly appreciated (please see below how you can get involved with "saving a tree"). We will continue to tap into your feedback as *Synergy* evolves. Congratulations to Vladimir Choi (BSc '07, Microbiology & Immunology) and Susanna Chow (BSc '07, Physics), whose feedback earned them a coffee shop gift card and a copy of Peter and Rosemary Grant's latest book on Darwin's finches! We are always interested in your comments.

synergy@science.ubc.ca

Update Your E-mail

Whether you want to receive *Synergy* online or on paper, take the time to update your e-mail address with UBC. You will receive meaningful event highlights and opportunities from UBC—no Nigerian bank transfer requests or menacing chain letters!

www.science.ubc.ca/update
or call (1) 604-822-3404

Moved or Moving?

Does someone on this address label not live here anymore? Are you receiving *Synergy* at the right address? Moving? Remember, life milestones (like buying a home or starting a new job) could earn you UBC alumni rewards. But you have to update your records!

www.science.ubc.ca/update
or call (1) 604-822-3404

Get *Synergy* Online

Sign up online to receive future copies of *Synergy* electronically, and help us cut paper copies and shipping (and greenhouse gas emissions). The first 10 Science alumni who opt in will receive official UBC Science luggage tags—made of recycled computer circuit boards.

www.science.ubc.ca/update
or call (1) 604-822-3404

Return undeliverable Canadian addresses to: UBC Science (Synergy)
1505 – 6270 University Boulevard, Vancouver, BC Canada V6T 1Z4

www.science.ubc.ca

Printed in BC, Canada, on a Forest Stewardship Council certified paper that is manufactured using 100% recycled post-consumer waste. A total of 183 kilograms of greenhouse gases (GHGs) were emitted during the transportation of the paper. These GHG emissions together with GHGs emitted during the printing process of *Synergy* will be offset through investments in energy efficiency and non-fossil fuel technologies.