BEES:

How global climate change is creating quite the buzz

INSIDE:
The Blue Brain Project,
The Recycling Triangle,
Interviews, Reviews,
Fun Facts, and more!

NUScience

Northeastern University's First Science Magazine

Photographed by Rahul Desai

Letter from the Editor:

Dear Reader,

You hold in your hands the very first issue of NU Science Magazine, a brand new media group to Northeastern's campus this year. Completely student developed and student run, we want to keep you up to date with what's going on in the Boston community and at our University, while maintaining a reader-friendly vibe. We're not about publishing undergraduate research papers, we're about making science accessible to the community, with interesting articles that are relatable in an every day context.

In every issue you'll find a feature topic, in this one, global climate change. This topic will form an overarching theme for the issue, but not everything will relate directly to it. In addition you'll find a wealth of short articles, interviews with professors, co-op students, and scientists in the Boston area, and reviews of lectures, books, and exhibits.

As this is our first attempt at producing a magazine, we would love your feedback! Find something you love or hate? Let us know! We're open to all suggestions and comments, and look forward to growing and developing in content and range over the next few years. Thanks for picking up a copy! We hope you enjoy reading it as much as we did creating it!

Kristina Deak
President

NOTE: All sources for articles on backlog. If you're interested in further reading, please contact us!

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The Periodic Table of... November

What's going on this month?

1 H Sunday																	2 He Monday
3 Li	4 Be Wed.											5 B Thurs.	6 C Friday	7 N Saturday	8 O Sunday	9 F Monday	10 Ne Tuesday
11 Na Wed	12 Mg Thurs.											13 Al Friday	14 Si Saturday	15 P Sunday	16 S Monday	17 Cl Tuesday	18 Ar Wed.
19 K Thurs.	20 Ca Friday	21 Cs Saturday	22 Ti Sunday	23 V Monday	24 Cr Tuesday	25 Mn Wed.	26 Fe Thurs.	27 Co Friday	28 Ni Saturd	29 Cu Sunday	30 Zn Monday	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Te	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
55 Cs	56 Ba	57 La	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
87 Fr	88 Ra	89 Ac	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt									

November 9 – Biology Lecture Series
"Pecking at the Origin of Vertebrate Diversity: Insights from Darwin's Finches"
90 Snell Library – Noon

Every Wednesday – NU Science Magazine General Meeting
"The best time you'll have all week"
340 Curry Student Center – 7:30 pm

November 30 – Biology Lecture Series
"Chemical Mediation of Antarctic Macroalgal-Herbivore Relationships"
90 Snell Library - Noon

November 17 – Physics Lecture Series
"Mechanics of Twisted Biopolymers"
114 DA – 4:00

Every Sunday, the MIT Museum in Cambridge offers free admission from 10 am - Noon!

November 19 - General Meeting for Pharmacy Student Organization - 435 CSC - 6pm

What's Going on Today?

Where Have All the Narwhals Gone?

Everyone knows that unicorns don't exist, but the "unicorn of the sea?" It may be on its way out too. Narwhals, the mid-size Artic whale known for their eight-foot long protruding tusk, are currently being threatened by the effects of global climate change. According to some sources, the whales are experiencing up to a 10% decline in population each year due to variations in the ice layer around their natural habitats. One problem is the melting of large regions of artic ice, which causes some of their food supplies to become rare. The other, interestingly, is that too much ice is building up in the region of Baffin Bay in northern Canada, one of their primary wintering sites. This build-up prevents the Narwhals from surfacing frequently enough to obtain sufficient oxygen for survival. Climate change is wrecking havoc on these creatures, who clearly just want to swim in peace. So next time you see someone driving a hummer down Mass Ave, show them a picture of what they are helping to destroy; the beautiful, stunning, and a little creepy, Narwhal.

-Kristina Deak, Marine Biology

Here's just a few snapshots of some of the advances being made in science around the world...

A Picture's Worth a Thousand Memories

Losing your memory is perhaps one of the most terrifying concepts in existence to many people. And yet it is a plausible reality, with up to 5.2 million Americans living with a form of dementia, with at least 500,000 of these below the age of 65. Cognitive psychologists Martin Conway and Chris Moulin of the University of Leeds seek to help patients struggling with memory disabilities through the application of their brainchild, SenseCam. This devise is a camera worn by the patient that takes a thousand or more light adjusted images sporadically throughout day-to-day activities. The patient then reviews a selection of these photographs to stimulate recollection of the events they experienced.

It sounds eccentric, but does it actually work? The team worked with an elderly woman, labeled Mrs. B, who suffered from memory loss due to issues with an infection. Of her own accord she could remember events for up to 5 days after they happened. By using diary entries, the normative means of recollection in today's therapy, these memories could last for up to 2 weeks. Amazingly, after using the SenseCam Mrs. B could recall more details about the events she experienced and was able to hold on to the memories for a few months.

The theory behind the operation of the camera lies within its random collection of data. Functioning similar to the human brain, it fails to distinguish between specific events that a diary may put emphasis on, which leads to more realistic representations of what brain activity was like at the time. For example, Mrs. B was able to remember 50% of images for an event if she studied what she had written about in her diary, but 90% if she simply studied the pictures taken.

The researchers claim that while their research is compelling, a real-world application wouldn't be readily available until at least 10 more years of study had gone by. Says Conway, the primary founder of the research, "By that time, I'll need to wear one permanently, myself."

-Kristina Deak, Marine Biology

From Theory to Market: Scaling Up a High-Tech Process

Aleks White

Aleks White is a Research and Design Engineer for GVD Corporation, a small start-up company that researches and commercializes advanced materials applied to surfaces by a process known as chemical vapor deposition (CVD). In his six years at GVD, Aleks has worked on various CVD coating processes, most notably, the development of polytetrafluoroethylene (PTFE, commonly known as Teflon®) and silicon polymer coatings.

Aleks' main role in the development of these technologies is in an engineering process known as scaling up. In his own words, "the technology had already been invented or accomplished in [Prof] Karen [Gleason]'s lab [at MIT], we really work on reproducibility and getting [the technology] ready for commercial applications." Namely, processes for these advanced materials have been proven to work in a small scale laboratory situation, but work needs to be done to use this technology on an actual product effectively. This includes being able to apply these materials quickly, economically, and, above all, on a larger physical scale. For example, Aleks and his colleagues were charged with designing a system for the PTFE coating of tire molds. The result was one hundred times larger than the original system in which the technology was developed.

"We really work on reproducibility and getting [the technology] ready for commercial applications"

This massive scale up brings with it a myriad of challenges. According to Aleks, "Many of the challenges are typical for the scaling up of most technologies. What's difficult is finding the right fit. We get lots of calls to see if our coating will work for this or that application, and only a few pass feasibility testing." There are also challenges specific to GVD's technology. For Aleks' silicon coatings, the process is notoriously slow. To counteract this, he experiments with different process chemistries and conditions to speed up the process. "Things take time" he says. Citing a paper by Tom Eagar, a Materials Engineering and Engineering Systems Professor at MIT, he explains "it takes about ten to twenty years from lab demonstration to any commercialization. It takes a while. For instance, conducting polymer coatings have already spent three to four years in [Prof Gleason's] lab already, GVD has been working on them for about two years, and it will probably be five to ten years before production comes."

As for what markets these advanced materials will be used in, it appears to Aleks that the sky's the limit. "In the long term, [our advanced coatings] can end up in any field you can think of," he explains. For now, GVD focuses on items where tolerance for purity and quality control are relatively loose. For PTFE, this means mold release coatings, such as on tire molds, and consumer products like razor blades. For these examples, the purity or chemical resistance of the material is not the deciding factor. More important is the low friction and lubricity of the material. Much research has been done to apply GVD's technology to industries such as Semi-Conductors (most commonly used in computer chips) and MEMS (microelectromechanical systems). These industries, similar to biotech applications, involve high purity and quality control constraints. This necessitates expensive clean-room equipment and strict quality control procedures. Biotech applications require even more time and cost demanding procedures, such as FDA approval and animal testing. "We already have our foot in the door," he explains. "Once we have the infrastructure in place, and the security that brings, we can move on to more high-end applications."

-James Peerless, Chemical Engineering

THE BLUE BRAIN PROJECT:

A look at how our brains really work

One of the greatest challenges we, as humanity, face in understanding ourselves is in understanding how our brains work. Our personalities, emotions, hopes, and dreams are all contained in the three pounds of grey, electrified tissue in our heads. In the past 100 years, scientists have accumulated an immense amount of data about the brain. Yet, there is still so much that we don't know, and little effort has been made to put the pieces together. Other fields of science have been able to accomplish this Herculean feat with the help of new computer technology. Throughout the past few decades, we have seen information technology develop at a blistering rate. Powerful computers have been used to simulate the splitting of atoms and the folding of proteins. Computers played a critical role in decoding the human genome. Now, the Blue Brain Project at the Brain Mind Institute in Lausanne, Switzerland aims to be the first to bring this technology to the world of neuroscience.

Project director and professor at the École Polytechnique Féderalé de Lausanne (EPFL), Henry Markram, founded the Brain Mind Institute in 2002 and the Blue Brain Project in 2006. His hope is to do what many skeptics say can't be done: reverse engineer the human brain and create a biologically accurate computer simulation from the ground up. The multidisciplinary endeavor spans many fields, and some of the greatest minds in computer science, neuroscience and genetics have been recruited to get the job done. IBM has also been working in collaboration with the project and has given the research team Blue Gene, one of the most capable supercomputers today. In spite of the powerful minds and powerful computers at the projects disposal, however, a majority of the neuroscience community still believes their goal is impossible.

The part of the brain that the team is attempting to accurately simulate is the neocortical column (NCC). In humans, this small brain circuit of 60,000 brain cells, or neurons, is the basic functional unit of information processing that is repeated millions of times across the neocortex, the thin, outermost layer of the brain that is responsible for sensory perception, motor control, language and conscious thought. To begin modeling the NCC, a real sample must be painstakingly teased apart, and the structural, electrical, and genetic characteristics of each of the thousands of cells recorded. Although there is already a wealth of data on neuron electrical activity, the technique used to record electrical activity is greatly prone to human error and interference. This technique, the patch clamp technique, involves inserting a microscopic glass pipette containing an electrode into a neuron so it can detect the neuron's electrical charge. Markram wanted more accurate data than what already existed, but doing this tedious process by hand, with thousands of cells could nearly 30 years. Faced with this problem, Markram devised the multiple patch clamp technique. A robot was programmed to record the activity from multiple cells at a time for 24 hours a day, working 10 times more efficiently than a human lab technician. 30 years for this portion of the research was cut down to just 6 months. After accumulating the

data from the samples, computer programmers put the hundreds of thousands of instructions into Blue Gene. Electrical signals were only a part of the data required by Blue Brain, however. The genetic makeup of thousands of cells also had to be examined to help determine the overall structure of each neuron. To send their electrical signals, neurons have special proteins that are embedded in the cells' membranes called ion channels. These channels control the bursts of electrical activity by opening and closing. By looking at the genes in each cell, researchers could see how the cells are instructed to place these channels and see how cells could create new connections to their neighbors. Since acquiring a living human NCC sample goes beyond ethical means, a rat's NCC was instead used. Rats have been used extensively as models in biological research and, despite the fact the human brain differs greatly in size, neurons function exactly the same way across all species. This means the sensory neuron in a snail and the neurons in a human's or rat's NCC work in the same way. Once the structure and function of single neurons were understood, all the team had to do was copy that model thousands of times in the simulation. Programmers assembled a 3-dimensional simulation of 10,000 neurons that contained all of the instructions they needed to function on their own. Each virtual neuron is actually composed of 400 separate simulations which include which genes were turned on and off and which ion channels were opening and closing. Blue Brain is the only simulation to date that takes these molecular events into account. With all of the neurons in place, a virtual stimulus that simulated signals from the rest of the brain was applied. On the computer's display, continuous waves of activity could be seen surging across the 10,000 neurons without any additional interaction from the researchers. The column functioned autonomously, exactly the way it would as if it were inside an actual brain. This breakthrough is a small step in creating a whole brain simulation, but it showed naysayers that a model could indeed be created.

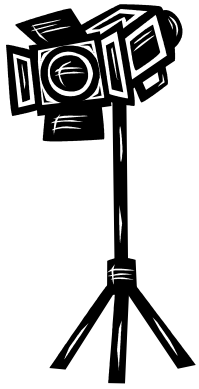
Creating the simulation was really just the first step. Markram now has plans to make the current model even more accurate. The team is comparing the activity of the virtual column to real samples to see what needs to be fine-tuned. Once a higher level of accuracy is attained, the next step will be to begin linking many simulated columns together and, eventually, create a simulation with a mind of its own. However, larger-scale applications won't be possible until technology catches up. If an entire human brain were to be simulated on today's supercomputer technology, the machine could take up several football fields and would generate an electric bill of $3 billion a year. The amount of data it would need to handle is about 500 petabytes, roughly 20 times more data than Google has on their servers. This enormous supercomputer would need to perform 80 quintillion instructions per second (80 ExaFLOPS) to model all the activity in the brain. By some estimates technology with that amount of computational power will be available in 10 years. Until then, it seems our brains will remain the ultimate biological computer, performing the same amount of work with only 25 watts of electricity.

One might ask how a computer simulation of a tiny speck of rat brain tissue could be helpful for human kind. Once scientists are able to model larger portions of the brain, they can begin to see exactly what brain circuits are altered when drugs are used, or how circuits malfunction in various brain diseases. At a conference demonstrating Blue Brain's achievement, Henry Markram discussed the possibility of modeling the brain activity in individuals with autism. He speculates that those with autism have sensitive brain circuits that overreact to stimuli that most people can handle. If this is indeed the case, then this explosive activity could be visualized in a Blue Brain simulation and would offer a deeper understanding of the neurophysiology behind autism. Furthermore, most believe our minds are created by simply by our brain activity. So what would happen once an entire brain is simulated? Will the simulation become conscious or self-aware? If consciousness truly is only trillions of synapses exchanging electrical information, then once computers can do the same, a mind should emerge from a machine. Although this isn't the aim of the Blue Brain Project, Henry Markram believes that this may ultimately happen. If the team isn't able to achieve computerized consciousness, it will only open the door to more questions about what is missing from our models and what, precisely, gives us unique minds. Only the following decades of research and experiments will show us what our brains have to tell us about ourselves and our existence.

-Anthony Moffa, Behavioral Neuroscience

Spotlight on:

Alby Jacob



Alby Jacob, a third year pharmacy student, shares her first co-op experience with the Northeastern community. "Co-op (short for cooperative education) makes Northeastern education richer and more meaningful, providing students with experiences at home and abroad that help them develop the knowledge, awareness, perspective, and confidence to transform their lives"

Alby Jacob

Q. How many co-ops do you complete in order to receive your degree?

A. I am required to complete two co-ops; one in a retail environment and the other in a hospital setting. I can also elect to complete a third co-op.

Q. How did you go about acquiring your co-op job?

A. I posted my resume on NUCOOL and the different companies that were interested contacted me for an interview.

Q. Where did you go on co-op this past summer? And how would you describe your experience there?

A. I worked at the Boston Medical Center in the outpatient pharmacy. It was extremely interesting. My co-op position was considered retail because I worked in an outpatient pharmacy. However, the pharmacy is affiliated with a hospital and therefore we filled about 2000 prescriptions a day. This meant that there was always something to do and something new to learn.

Q. Did you have to use the skills you learned in school during your co-op?

A. Absolutely! In class, we had to memorize the generic and brand names of the top 100 drugs. We also learned how to read prescriptions. Without that basic knowledge I would not have been able to function properly in the field.

Q. How did this co-op affect your decision to be a pharmacist?

A. It certainly strengthened my decision to be a pharmacist. Once I worked in the actual field, I found pharmaceutical studies even more fascinating. It gave me an image to associate with my learning, which I found to be both useful and encouraging.

Q. Based on your co-op experience, would you recommend completing a co-op to anyone else?

A. Most definitely, because no matter how wonderful your professors are, experience will always be the best teacher. It has given me an opportunity to explore different aspects of pharmacy without having to wait until after graduation.

Q. What would you say to the new freshmen that are curious about the co-op program?

A. Northeastern University is renowned for the co-op program. It helps the students decide if they are on the correct career path and if it is, it helps them narrow their choices. It gives students the unique chance to explore their intended professions without having to wait until after graduation.

-By Lincey Alexida, Biochemistry/ Mathematics

Today's Innovations in Genomics Research and their Applications

Government-backed projects that will change medicine, environmental innovations, and evolutionary understanding

CAGCAAAGTGAGACATTGTG: Random sequence of letters? Or partially the reason why 10% of the population writes with their left hand? Yes, the aforementioned nucleotide base pair sequence represents nucleotides numbers 61 through 80 on the gene known as LRRTM1, a gene on chromosome 2 associated with left-handedness. This information is a result of the Human Genome Project. The Human Genome project has paved the way for a new era in the scope of scientific research. Thanks to the efforts of hundreds of researchers at over 200 facilities around the globe, not to mention billions of dollars worth of grant money, the sequence of the near 3.3 billion base pairs that make up the human genome was determined, announcing completion in 2003. The project has laid the groundwork for endless developments relating to the intrinsic blueprint for the physical and functional systems of life. The International HapMap Project, The Cancer Genome Atlas Project and the Department of Energy (DOE) Genomic Science Project were initiated soon after the completion of the sequencing of the human genome, ushering in applications for the raw sequencing data – a field known as functional genomics.

The International HapMap Project

After identifying the general nucleotide base pair by base pair sequence of the human genome, the International HapMap Project was initiated in order to make sense of the multitude of newly discovered data. By tracking common differences in specific genes among individuals, researchers have been able to relate differences among genes (sometimes differing by just one nucleotide base pair) to the emergence of genetic disorders and diseases. Genetic differences varying from one individual to the next typically exist in the form of single nucleotide polymorphisms (SNPs), or specific locations within the human genome where a single nucleotide base pair may differ among 1% of the population. Developing databases of these variations and relating them to expressed traits have linked the SNPs to genes for an array of different characteristics, genetics disorders, and predispositions for disease.

The Cancer Genome Atlas Project

Branching off the HapMap Project's techniques, the Cancer Genome Atlas Project tracks genetic variations that specifically correlate to cancer. The basis behind the endeavor incorporates the comparative strategy of haplotyping with the functional intent to engineer related treatments. Researchers have been able to successfully identify particular genetic targets related to cancer, using this genetic information to develop therapies to potentially attack cancer at its source: mutations in the DNA of rapidly dividing cells. Goals of the applied outcome in the area of cancer treatment include better diagnostics, gaining a better handle on the best methods of prevention, and the development of more accurate targets for therapeutics.

DOE Genomic Science Project

Representing the first major union between functional genomics and environmental initiatives, the program's initial goals include the development of technologies that model the biological mechanisms of plants and microbes (small single celled organisms, such as bacteria) to improve the environment. Through pinpointing the genetic information that codes for a range of functional networks, researchers aim to model the functions of a bioenergy-related system, and eventually engineer a similar applicable system. So far, genome-sequencing centers such as the DOE Joint Genome Institute (JGI) have identified relevant targets for analysis such as carbon-consuming aquatic microorganisms, and communities of microbes that are capable of synthesizing biofuels. Latest developments include the sequencing of the genome of the fungus Trichoderma reesei, which contains clusters of genes for enzymes involved in the degradation of complex carbohydrates. In other words, T. reesei are fully capable of breaking down plant mass to produce compounds that may be converted to usable fuel energy. If these capabilities can be controlled and replicated, the hypothetical yielding of new non-fossil fuels is seemingly endless.

-Michelle O'Connor, Biology

MORE THAN A STING:

Global Climate Change and its Effects on Bees

We are all familiar with the term Global Climate Change. We understand that this change accounts for variation in the distribution of weather patterns, temperature, precipitation, evaporation, and solar radiation over time. What we may not fully grasp are the consequences of climate change influenced by detrimental human activity. One consequence in particular represents the backbone of agricultural development, and the ultimate survival of the modern human race: the extinction of pollinating bees. The global disappearance of pollinating bees due to climate change poses the greatest threat to the Earth's growing populations, and may lead to irreversible turmoil if a solution is not reached expediently.

"Bees play an integral role in the food production industry. Each year, approximately 14 billion US dollars of bee-pollinated crops are grown and harvested "

Bees play an integral role in the food production industry. Each year, approximately 14 billion US dollars of bee-pollinated crops are grown and harvested (Lovgren, 2007). In the flowering season of spring, crops throughout the globe blossom and bloom to attract their individual pollinators. Bees are the most prevalent of pollinators and they aid in the fertilization of crops by transporting pollen from the stamen to stigma of blossoms. This fertilization enables the plant to produce its ultimate prize: its seed, encased within or around a fruit. This fruit, whether it be a watermelon, onion, or a cashew, is harvested by humans to support our growing populations. Farmers, especially in the United States, have largely relied on bee pollination for crop production for decades, and their sudden disappearance threatens crop yields for the years to come.

Throughout the past few decades, pollinating bees have mysteriously disappeared at alarming rates. Scientists have named this startling phenomenon, "Colony Collapse Disorder" or CCD. Dave Hackenberg, the first beekeeper to report the Colony Collapse Disorder to researchers, discovered that the bees he had delivered to pollinate a Florida farm had completely vanished: "I came to pick up 400 bee colonies and the bees had just flat-out disappeared… the bees typically return to their boxed hives when their work is done… there were no dead bees, no bees on the ground, just empty boxes" (Lovgren, 2007). To this day, bee researchers and scientists around the globe still have yet to pinpoint the sole cause of CCD, but one recognized conclusion states that a substantial change in climate conditions is the central culprit to the disappearance of these bees.

Our Earth fluctuates in seasonality and climate over periods of time. Natural climate change may be brought upon varying regions by rising temperatures from an enhanced greenhouse effect, cooling temperatures, variation in the Earth's axis with respect to orbit, fluctuating outputs of solar energy, changes in the distribution of land and ocean, and increased or decreased precipitation (Diamond, 2005). However, scientists are now uncovering ways in which harmful human activity is influencing climate change, and altering the natural balance between changing seasons and climates. In respect to the pollinating bees, climate change affects every aspect of their busy and brief lives.

When a seasonal region has an earlier or later warming period, plants respond accordingly by blooming early, which in turn affects the overall behavior and survivability of the bees. The blossoming plants and bees share a symbiotic relationship, in which the two organisms work cooperatively together for the benefit of each other. The nectar in the flower provides bees nourishment for their growing colony, and their pollination of the flowers ensures plant survival and reproduction. So if the plants bloom early, the bees respond quickly to this, and they begin pollinating.

There's one big problem. The early blooming season brought upon by a change in climate cannot sustain bees. Typically when a region experiences warmer temperatures earlier on in the season, there still remains scattered cold spells, especially at night. Plants are more resistant to damage from sudden drops in temperatures over short periods of time, but bees are not. In order for a beehive to survive, it must maintain an overall temperature of 93 degrees Fahrenheit (Lindsey, 2007). Worker bees must crowd around the queen and her larvae in order to maintain this temperature, and one single cold night could prove utterly destructive to the colony. Bees that respond to early blooming seasons affect the overall success of pollination each growing season. If climate change trends continue, the population of bees will face extinction, and in turn, so will important crops.

A decline in natural bee pollination of our crops each year has tremendous effects on the human race. Bees pollinate over 300 plant species and harvested crops per year, which includes nearly all of the fruits and vegetables found in a healthy diet. The decline in bee diversity will limit our food intake, and overall health will decline due to deficiencies in crucial vitamins found in plants (Roach, 2006). Vitamins aside, a decrease in bee pollination over time will result in immeasurable amounts of crop loss, and there simply won't be enough food production to sustain a population already suffering from such a deficiency. Bees also pollinate plant species that animals rely on for survival, which also directly affects the survivability of those animals and the humans that consume them.

"Bees pollinate over 300 plant species and harvested crops per year..."

It is now frightening to imagine a world without bees. Studies indicate a direct link between Global Climate Change and the rapid decline in worldwide bee populations. Controls must be taken to ensure their survival. In the United States alone, the value of bees as pollinators is estimated to be as high as 18 billion US dollars (Sanford, 1998). So what is the solution? Raise taxes to come up with that $18 billion sum and develop technology to pollinate plants ourselves? Or perhaps what we really need to do is to get a grasp on our contribution to climate change, and limit or transform the negative human impacts that enhance and hasten these changes. There still is time to reverse the disappearance of bees, and involvement in their protection is crucial to not only their survival, but ultimately ours.

-Emily Snead, Environmental Science

The Recycling Triangle

Not so much different than the Bermuda Triangle, the Rrecyclinge Ttriangle can seemingly consume recyclables without explanation.

For both recycling skeptics and avid recyclers to make informed decisions about utilizing those new recycling bins on campus, consideration should be given to the payoff of recycling programs, as well as to recycling habits.

"It's a full circle process. It's not just about your one blue container," said Jennifer Berry, manager of public and strategic relations for Earth911.com. Beyond the environmental and hazardous waste considerations, many industries are dependant on the cost-efficiencies and employment opportunities that recycling offers , Berry said . And according to a Glass Packaging Institute survey, "if a person thinks recycling is good for the environment, they are nearly 83% more likely to recycle."

"Aluminum cans are 100% recyclable and can be recycled indefinately."

According to the Glass Packaging Institute's website, recycling 10 average-sized glass containers saves enough energy to operate a computer for over three hours. Earth911.com describes outcomes of many recyclable items, including the aluminum can. Aluminum cans are 100 percent recyclable and can be recycled indefinitely. Within 60 days of a student recycling one can, it can reappear on store shelves as another can. Since the aluminum industry pays more than $800 million annually for recycled empty aluminum cans, communities and charities can significantly benefit from recycling.

But "Following Trash and Recyclables on Their Journey," an article in the Sept. 16 issue of The New York Times , noted that waste management outcomes vary significantly by location. Thus, knowledge of recycling systems at private institution Northeastern University and within the City of Boston is critical to evaluating the actual impact of student recycling.

"As long as students, faculty, and staff want to recycle and put it where it belongs, we guarantee it gets to where it's going," said Peter Lembo, Northeastern University's solid waste and recycling manager who coordinates the university's Recycling Department. Lembo said that, according to last year's analysis, Northeastern University was recycling at 35 percent, almost triple the rate of the City of Boston.

Lembo said his staff sorts mis-recycled products and the recyclables are eventually passed on to private companies.

Institution Recycling Network, Inc. is one of Northeastern University's major recycling services. IRN exists as a cost-competitive recycling

service that aims to facilitate successful recycling programs while adhering to high environmental standards, said IRN principle, Dana Draper. For instance, IRN prioritizes the reuse market over fuel production routes, and avoids exporting commodities .

Yet, Boston has a somewhat different method of recycling. In 2003, the city instated standards that require landlords to provide recycling options for tenants. A single-stream recycling system now allows residents to combine all types of recyclable items in one recycling container, said Susan Cascino, recycling director for the city's Department of Public Works.

Cascino said she is "I'm "100 percent confident" that the recyclables get successfully recycled, said Cascino. The City of Boston uses Casella Waste Systems, Inc., a recycling company that processes the recyclables on site, but ships them out to be marketed.

"We're going to be moving toward zero waste at some point," said Mark Evans, in the sales department of commercial recycling and marketing at Casella Waste Systems, Inc. Evans said that the company is not just interested in loading material into a hole, but rather provides a monetary and time efficient service that is working toward a better environment.

Yet according to several experts,students are responsible for maximizing the effectiveness of recycling.

"When you try to recycle things that your program doesn't accept, you actually do more harm than good," said Berry. She said college students should be aware that greasy pizza boxes can contaminate an entire batch of paper recycling.

Plastic foam such as Styrofoam, food products, and plastic bags should stay out of recycling bins, Cascino said. Other commodities that the City of Boston's recycling website says should stay out of the recycling bin include light bulbs, ceramics, and hazardous materials.

Kaitlyn McEnaney, director of marketing and public relations for Husky Energy Action Team, said that the new recycling bins on campus have increased recycling , which proves that there is a demand for recycling. "Recycling makes substantial strides to creating a more sustainable campus," McEnaney said, "which is in everyone's best interest in the end."

"Northeastern University was recycling at 35 percent, almost triple the rate of the City of Boston."

For more information on Northeastern University or City of Boston recycling programs or hazardous materials pick-up, visit http://www.northeastern.edu/facilities/waste.html and http://www.cityofboston.gov/publicworks/recycling/.

-Shannon Barrow

A Waste of Space

We all know about the dangers of groundwater pollution. We see the problems of litter in our parks, or light pollution in the city. Each time we are outside, we worry about smog in the air and depletion of the ozone. But, for most people, the thought process ends with the last traces of our atmosphere. What you may not know is that there is a bigger issue past that point, and it's much more dangerous than that used coffee cup by the side of the road.

There are currently hundreds of bags of trash floating around in space. There are also thousands of pieces of spacecraft and rocket stages, discarded parts from the Hubble Telescope, and at least one glove dropped during a spacewalk. These are all types of orbital debris, defined by the UN Committee for the Peaceful Uses of Outer Space as any man-made object that orbits Earth and serves no useful purpose. The U.S. Space Surveillance Network currently counts at least 20,000 pieces of debris in orbit, and that's only what they can count.

High-powered telescopes on Earth can detect and track debris in space that is bigger than ten centimeters. However, smaller items pose the most danger. Any item between one and ten centimeters is large enough to cause damage, yet small enough to escape detection. As this debris begins to orbit, its speed increases so much that it could destroy a communications satellite. According to NASA, orbiting debris has an average velocity of 11 km/second. Larger objects, like rocket stages, can break up into smaller pieces, creating hundreds of hazards from a single piece of debris.

As noted before, these pieces can cause major damage when they collide at high speeds with a satellite or spacecraft. In early September, the space shuttle Discovery was forced to alter its course slightly to dodge a piece of orbiting debris that had been released by an earlier spacewalk. The International Space Station has had some close calls with orbiting debris in the past, and now has a special module in which to escape in case of disaster. Such a module is certainly necessary, as a ten centimeter piece of debris could be enough to crack the space station's shell and cause it to depressurize, killing anyone inside. Debris can also be dangerous when it reenters the atmosphere. Although most items burn up before reaching Earth, some materials survive and can strike people or property when they hit the ground. In addition to these potentially fatal situations, space debris is also an everyday nuisance, interfering with scientific instruments and readings.

There are many possible solutions to the space debris problem, though none are ideal. Better monitoring equipment could help prevent collisions, although as the amount of debris increases this will be harder and harder to accomplish. Spacecraft could be given thicker shields to protect them from damage. Space missions could go out to directly retrieve debris, yet this is costly and infeasible in some situations. Stored energy (in the form of batteries and propellants) could be removed from larger objects before discarding them to prevent them from breaking into smaller pieces. Discarded parts of spacecraft could be programmed to re-enter the atmosphere; however, this would only affect future missions and would do nothing about the debris currently in space. This option also leaves open the possibility that debris will make it through the atmosphere intact and cause damage on the ground.

The government realizes that space debris is a problem, yet seems unsure on how to solve it. NASA has procedural requirements for limiting debris, and the UN Committee on the Peaceful Uses of Outer Space also has a set of guidelines. These are, however, only guidelines, and no one is watching to make sure they are being followed. In mid September of this year, the Pentagon issued a call for possible debris cleanup proposals. Boeing has expressed interest in the project, but there is no telling when or what exactly will be completed. All these problems are compounded by the fact that no country owns space – each has different laws regarding it, and as private companies begin to get involved, it only becomes more muddled.

The simplest solution seems to be waste prevention. Science has advanced far enough to get us into space – surely it can solve the problem of debris as well. Outer space has the potential to become anything; we should not make it a dumping ground that it too dangerous to navigate. There is no way of knowing what uses we will have for space in the future. If we pollute it now, we could lose opportunities that we have no idea even exist.

-Sadie Lang, Environmental Science

The Large Hadron Collider: More than just Science Fiction

If you have read Dan Brown's Angels & Demons, you have probably heard about the Large Hadron Collider, or LHC. Unfortunately, the description Brown paints isn't at all that accurate – the truth about the LHC, however, is far more fascinating. Located at CERN, the Mecca of the physics world, the LHC is the largest particle accelerator in the world. Actually, it is the largest machine in the world! The LHC is a circular tunnel with a diameter of 3.8 meters, positioned 50 to 175 meters underground. It is designed to accelerate particles nearly to light speed in order to learn more about dark energy, dark matter, extra dimensions, the Higgs boson, and many other exotic proposals. Essentially, a particle accelerator does exactly that – it accelerates particles until they collide at high speeds. The tunnel of the accelerator is a vacuum comparable to the emptiness of space. A proton or ion beam is injected and accelerated around the 27 meter ring to almost light speed. The particles are kept on course by 1,232 dipole magnets. A very high magnetic field must be created to keep the particles bent on the correct trajectory. Therefore, the magnets are superconducting and kept cool by a cryogenics system with special cables designed to conduct current without resistance. After 400 million revolutions, spanning ten hours, the beams collide, resulting in, hopefully, the answers scientists are seeking out. Theoretically, the power of the LHC could be enough to recreate the conditions a few seconds after the Big Bang. This would include the creation of dark matter (matter that has mass, but is invisible to the naked eye) and dark energy. Scientists believe that the matter we see and interact with in our everyday lives is actually only 4 percent of all matter. Dark matter and dark energy make up the other 96 percent and are only detectable by their gravitational interactions. If the experiments at the LHC succeed, then the quantum properties of dark matter and energy can be studied directly.

The LHC under the Franco-Swiss Border

The Higgs boson describes how particles acquired mass after the Big Bang, assuming, of course, that all particles were massless directly afterward. The Higgs boson, itself, is a particle; however, scientists still do not know its mass or have ever been able to produce it in a lab. The LHC will determine if it even exists.

Supersymmetry defines a partner that is the same except for one detail for every particle. The creation of dark matter and the Higgs boson would prove that superpartners exist and test the theory of supersymmetry. The LHC could also contribute to the discovery of extra dimensions. Einstein's theory of relativity says that space can bend, contract and expand. We live in four dimensions: height, width, depth and time, but what if more than four dimensions exist? The weak pull of gravity suggests that other dimensions share the force with those three we see. The high energy experiments performed at the LHC could physically demonstrate this theory by expanding space so that particles can move in and out of different dimensions. I know what you're thinking: If the experiments at the LHC are so fundamental to particle physics then why haven't we learned about them? Well, the LHC isn't exactly up and running. Beams were first sent on September 10, 2008 and the superconducting magnets malfunctioned, breaking nine days later. Particles are expected to beam again before the end of the year and perhaps by early next year we will finally be able to unveil some of the deepest secrets of the universe.

-Tara Dhingra

Spotlight on: Professor Jennifer Cole

Jennifer Cole

How you might know her: Professor Cole teaches a wide variety of environmental science courses, from Hydrogeology, Groundwater Geochemistry, and Biological Oceanography to the popular Natural Disasters and Catastrophes and Eating and the Environment classes. She is the director of the Environmental Science program, as well as the faculty advisor for several student groups, including the NU Terra Society.

How she got where she is today: "I have always been unbelievably drawn to and committed to science," says Cole, and her career certainly exemplifies this. Her scientific studies began officially at the age of 16, when she went to college early, soon attaining her Bachelor's in Environmental Science at the University of Massachusetts. She later went on to earn a Master's degree in Environmental Science from Bard College and a Ph.D in Hydrogeology from Syracuse University. She had always planned to go into education, but very quickly became aware of the paltry sum a college professor could expect to make, and made the decision to go into environmental consulting. Although consulting paid quite well, it proved to have its downside; instead of saving the earth, like she had always imagined, she found herself fighting for people and companies who wanted to destroy it. Thus, a disillusioned Cole returned to the world of academia, and has happily spent the last ten years here at NU. Her years in the consulting business were not entirely without merit, however; having been on both sides of the environmental debate, she has an informed view of the pros, cons, and necessary evils of both environmental degradation and protection.

Research: Throughout her career, Cole has done extensive research in many areas, much of it focusing on wetlands. For example, she has studied global carbon cycling processes in large wetlands, nutrient transformation and transport in large wetlands, CAT scan analysis of peat bogs, and macroalgal physiology (seaweed in wetland environments). She has done local research here in Boston, looking at declining water levels in the Back Bay and consequent environmental ramifications. In the future, she would like to look into the topic of "edge effects" on wetlands—the hydrological and geochemical effects on wetlands that have been bisected by roads or other development.

Outside of the classroom/laboratory: Cole's biggest passion, aside from science, is running. She is an ultramarathon runner—anywhere from 50 to 100 miles, depending on the race. In her spare time, she enjoys reading, doing yoga, and rescuing pitbulls (she currently has three).

A typical day in the life: A self-described "reverse ADD" sufferer, Cole tends to focus on one single thing for a long period of time, and says she has trouble pulling away from something she's focusing on. Thus, every day of the week is different for her, as she tackles one big project a day. Therefore, a "typical day" doesn't really exist for her, but her duties include: teaching; dealing with students—anything from writing recommendations and helping students find jobs, to advising various student groups and helping students apply to grad school as well as spending more time on the Internet than she'd like, including answering emails (she gets around 300 a day!), and—lest we think that only students are susceptible to its addictive charms—wasting time on Facebook.

On NU's efforts to "go green": Cole is "so proud and thrilled" to be part of a university that makes such strong efforts to become more sustainable. Among these achievements are: being ranked with a perfect score by the Princeton Review's Green Honor Roll; creating its own "sustainability week" to raise awareness for and promote a more sustainable campus; sending members of the university to Copenhagen to observe the international environmental policy proceedings there; starting a highly successful composting program in the dining halls; and more.

On a "green" NU in the future: "What I would like to see happen in the future is what I think will happen in the future," said Cole. "Northeastern will continue to set the bar for sustainability." She noted one positive indicator of this that is currently in motion—committees are already in existence that deal with the next steps towards a sustainable campus. However, Cole emphasized that one of the most important aspects of the whole process is the student body of Northeastern. The students are "dynamic, active, and passionate," and are the "driving force" behind many of the "green" policy changes that have already occurred, and will continue to occur in the future.

-Rebecca Willett, Anthropology

How Health Care Reform Will Change the Way You Take Drugs

"In Massachusetts you may already be guaranteed health insurance, but the aftermath of health care reform will have a drastic impact on the innovation of new drugs by curtailing the investment incentive currently present for Biotech Companies."

QUIZ TIME: Which of the following statistics apply to the U.S. Biotech industry? Is it a) the industry's lobbyists number 1,228, or 2.3 for every member of Congress, b) in the last decade generic drugs have saved $734 billion, or c) treating diseases with new biologic drugs can cost $48,000 per year?

The answer is all of the above. With yearly revenues upwards of $315 billion, it is no surprise that the biotechnology and pharmaceutical industries are in the cross hairs of politicians on Capitol Hill. These industries, under much scrutiny for political lobbying and outrageous profits, are the backbone of medical innovation yet one of the major contributors to healthcare costs in this country – which are rising twice as fast as inflation.

HEALTH CARE REFORM will affect scientific research in a precarious way. Over-regulation of pharmaceutical research – leading to reduced patent exclusivity could destroy financial incentives to create new, life-saving medication. On the other hand, succumbing to the powerful drug lobby – allowing increased exclusivity on patents and technologies, will increase healthcare costs dramatically and will be paid for by reduced quality in other facets of the medical system.

The Real Life Story

FOR EXAMPLE, let's say a pharmaceutical company "Drug Inc" determines that a drug curing Asthma will have a market value profit of about $3 billion over their exclusive patent of 12 years. If the research and development of that drug is estimated at about $1 billion, it is profitable for "Drug Inc" to go ahead and begin the research process. Reducing the exclusivity of "Drug Inc's" drug to 5 years will dramatically reduce their market value of this drug to perhaps only $1 billion. Due to the fact that after their exclusive 5 years, generic pharmaceutical companies will begin manufacturing the drug – increasing supply, decreasing demand, and decreasing profit. "Drug Inc" will not be so eager to invest $1 billion into a drug with a market value profit of $1 billion. This cost-saving competition is a killer for financial incentives which have placed the United States at the pinnacle of biotechnology innovation.

Other countries have mechanisms to make judgments about which technologies bring benefits to patients and which mechanisms just make profits for those who made them, the United States needs to fine-tune those mechanisms of judgment to reduce the cost of health care.

The Cure

At the end of the day the answer to health care reform lies in sacrifice. I have not met a doctor who thinks he or she should be paid less, I have not met a hospital executive who thinks he or she can produce quality care with less, and I have not met a patient who is willing to be cared for with less. No one is willing to take less; everyone is willing to take more. Until we get to that point where we have the discipline to compromise, our country will remain in this political deadlock – that is a sacrifice I am not willing to make.

-Samir K. Berry, Behavioral Neuroscience

REVIEWS

What's popular, what's cool and what's happening!

Philip Plait's Bad Astronomy Blog

Dr. Philip Plait, an astronomer with ten years of experience working on the Hubble telescope, began his blog, Bad Astronomy, in 2005 with the purpose of "airing out myths and misconceptions in astronomy and related topics." In its early days, Plait would use his site to debunk fallacious ideas such as astrology and the theory that the moon landing was a hoax through skepticism, reason, and the scientific method. Today, Bad Astronomy has moved to a new home at Discover Blogs, but its ethos remains the same. At the heart of the blog are Plait's insightful analyses of the latest astronomy news and breathtaking pictures of deep space straight from Hubble and other major telescopes. Supplementing the astronomy aspect are various articles promoting the application of skepticism and scientific thinking, most recently in opposition to the anti-vaccination and creationist movements. Rounding out the blog are miscellaneous posts including educational talks Plait gives, media attention for his most recent book, Death From the Skies!, and various links that interest him. No matter the topic of the article, Plait writes thoughtfully and accessibly, explaining complex scientific ideas with ease and wit, while retaining a reverence for science and a sense of wonder regarding the natural world. If you have felt a scientific void in your life, or if you are just looking for a new way to procrastinate, a healthy dose of Bad Astronomy is sure to satisfy. The blog can be read at http://blogs.discovermagazine.com/badastronomy.

-Andrew Grube, Chemical Engineering

"College Night" at the Museum of Science Popular Among Students in the Area

"College Night" at the Museum of Science, held this year on September 21st, 2009, is an annual event in which the museum offers free admission to college students. The event has been highly popular in the past and this year was no different. There was a huge turnout of students from schools all over Boston including Northeastern, Boston University, Wentworth, MCPHS, and many others. In addition to free admission to the museum and all the exhibits, the students were allowed free entrance to an IMAX movie of their choice. One student commented after seeing Adrenaline Rush: "It was such a thrill. It felt like I was in the movie. And this was such a great opportunity because I don't think I would have seen an IMAX movie here on any other occasion," Erin Mansour, 20, a Northeastern University student. These exhibits are highly interactive and interest everyone regardless of their level of experience and knowledge in the sciences. Popular exhibits this year include the "Musical Stairs" and the "Optical Illusions" exhibits. Mansour remarked, "I think College Night is a great idea for the museum as well as for the students. It gets college kids away from their schools and out into the city to see something new and exciting all at the perfect price".

-Bradley West, Chemical Engineering

MYTHBUSTERS

What do YOU think?!

MYTH: A human body, when exposed to the harsh vacuum of space, will instantly explode/freeze rock solid.

Luckily this isn't true. Your body does NOT instantly explode or freeze in a vacuum. Your skin is strong enough to contain your internal pressure so you won't explode, and because there is not air in space you won't immediately freeze, because there's nothing to carry away your body heat; you just slowly radiate away your heat. So if the lack of pressure and the freezing cold of space don't kill you, what does? Asphyxiation; you die from lack of oxygen, similar to as if you had drowned. After about 15 seconds you lose consciousness due to lack of oxygen. The water in your cells and gases in your blood will also begin to evaporate due to lack of pressure and you can suffer from the "bends," just like a deep sea diver. You can survive all of this though, as long as you're not exposed for too long. In a 1965 experiment at NASA's Johnson Space Center a test subject was accidentally exposed to a near vacuum when his space suit leaked. He lost consciousness after 14 seconds and the chamber was re-pressurized within 15 seconds. The subject later said that his last conscious memory was the saliva on his tongue beginning to boil.

Truth: You can survive in the vacuum of space for about 1-2 minutes. THEN you get ripped apart and slowly freeze solid.

-Taylor Elam, Physics

Things you thought you'd NEVER need to know...