The Promoter

Spring 2011 No. 13

What makes our department and our students distinctive? In my first year on the job as Head, I have spent a lot of time answering this question. It comes up when talking to high school students considering Carnegie Mellon University, with undergrads thinking about joining our Ph.D. or M.S. programs and by employers looking to hire our graduates. Also, it is often asked by faculty candidates who are imagining a future at CMU and by granting agencies, foundations or donors who are considering supporting our projects.

For undergraduate students, our focus on research as a central part of education sets apart our department. Involvement in research has a tremendous impact on students' intellectual development. Even for those who leave research or science, the tools of skeptical inquiry and data-driven decision-making serve them well. We value undergraduate research so highly that we have expanded opportunities for students to do science with the initiative *Transforming the First Year Student Experience*. The initiative's goal is to give first year undergraduates a taste of what science is all about very early in their college careers. For some students, this taste occurs in the HHMI-funded *Phage Hunters* course or in a new course called *Cellular Response to the Environment*. For others, it may happen in *How Biological Experiments Work* or the Summer Research Institute program supported by a new HHMI grant and headed by Dr. Aaron Mitchell. Our Director of Undergraduate Laboratories, Dr. Carrie Doonan, and her team of teaching assistants even provide opportunities for middle and high school students to sample the joys and challenges of research. Carrie's dedication to these efforts earned her the university's 2011 Mark Gelfand Service Award for Educational Outreach.

The kinds of research that we do and the way that we do it also distinguishes us from other places. Research in our department is characterized as highly interdisciplinary, collaborative and quantitative. Most labs are involved in multiple and complex collaborations. This collaborative approach has resulted in the formation and continued success of a number of important centers, including the NMR Center for Biomedical Research, the Molecular Biosensors and Imaging Center, the Center for the Neural Basis of Cognition and most recently, the Center for Nucleic Acids Science and Technology (CNAST). Funded by the David Scaife Foundation and led by Drs. John Woolford (Biological Sciences) and Bruce Armitage (Chemistry), CNAST involves biological sciences and chemistry faculty who are dedicated to both understanding the diverse roles of DNA and RNA in biological processes and to leveraging their huge potential as tools for research and therapy. Ventures like CNAST represent a collaborative approach to innovative science and technology development and underscore what makes CMU a great place to work. The barriers to creating these kinds of research efforts are lower at CMU than any place that I know, and students are key. Nothing jump-starts a collaborative project like a motivated and talented graduate student who seems particularly interested in stretching to learn new approaches and fields.

I invite the alumni of the department to tell us where you are now and what made your education "one-of-a-kind" at www.facebook.com/CMUBiologicalSciences.

Carnegie Mellon University
DEPARTMENT OF BIOLOGICAL SCIENCES

www.cmu.edu/bio

Computational Biology

By Kristen McConnell

Fundamental changes in biomedical sciences have occurred over the past 20 years due to advances in imaging, genomics and proteomics. As a result, our ability to acquire large data sets in these areas is increasing at an unprecedented rate. In order to make use of this vast amount of newfound information, increasingly sophisticated computational tools are needed to organize, validate and interpret this data in terms of the underlying biological mechanisms and processes. The field of computational biology is devoted to developing these types of analyses by applying the tools of computer science, statistics, and mathematics to problems in biology and biomedical sciences. Carnegie Mellon University has positioned itself at the forefront of research and education in computational biology by bringing world-class strengths in computer science, machine learning, statistics and biology together with a tradition of interdisciplinary thinking.

CMU offers degrees in computational biology at every level. The B.S. in Computational Biology program was the first computational biology degree-granting program in the country when it began in 1989. This program, which was started by Dr. Robert Murphy, has recently been restructured into a joint program between the Department of Biological Sciences in the Mellon College of Science and the newly formed Department of Computational Biology, which is housed in the School of Computer Science. Admission to this exclusive program is limited to interested sophomores and involves a special application process. Students in the program enroll in courses from both disciplines and gain training on topics such as genetics and data structures. The importance of computational approaches in biology has led the department to require future biology majors to take an introductory computational biology course. With this requirement, the department hopes to maintain its status as a leader for training the next generation of biologists.

The M.S. in Computational Biology program offers an advanced degree to students who wish to explore computational biology without committing to the length and depth of a doctoral program or who desire a more immediate and practical training for an industry career. This program also draws returning professionals who seek to enhance their skills and training in this growing interdisciplinary field. A mix of computer science, machine learning, math, statistics, biology, chemistry, biomedical engineering, and information management courses is available for students. Many students also conduct in-depth research within a faculty laboratory and obtain external internships after their first year of study at locations such as the Mayo Clinic, Merck & Co., Dow AgroSciences, IBM, the J. Craig Venter Institute, and Novartis Institutes for Biomedical Research.

Shannon Quinn, a 2010 alumnus, explains how the M.S. program has prepared him to work in the computational biology field.

I came from a computer science background, one with a specialization in software engineering. Hence, I not only needed to learn how to use my problem-solving strategies in the biology domain, but also how to apply more theoretically rigorous and statistical methods to answering the questions at hand. The Carnegie Mellon faculty and students alike excelled in helping me achieve both these goals: from engaging lectures to discussions on cutting-edge literature with professors; from TAs enthusiastic and knowledgeable about their own research and eager to assist others to fellow graduate students working together to answer a question none of them could solve alone; from the availability of problem-solving tools at Carnegie Mellon to the incredible cross-departmental initiatives encouraging extra-CMU collaboration. The level of preparation is world-class, and I would not be where I am now without it.

Upon graduating, Quinn decided to continue his education in computational biology. He is now a doctoral student in the joint CMU and University of Pittsburgh Ph.D. Program in Computational Biology.

Other graduates of the M.S. program have gone to industry, government or consulting positions at Dow AgroSciences, Bloomberg LP and the Venter Institute, as well as doctoral programs at Oxford University, Princeton University, Columbia University and Johns Hopkins University.

Students interested in a doctorate can also gain excellent training in computational biology at CMU. The joint Ph.D. Program in Computational Biology, whose home on the CMU side is the new computational biology department, offers specialized computationally-focused training in areas including computational genomics, computational cell biology and modeling. Additionally, the Ph.D. in Biological Sciences program housed within the Department of Biological Sciences provides students training in applying computational biology tools; it also attracts students who are not sure that they want specialized training in computational biology to be the primary focus of their thesis work. The Ph.D. in Biological Sciences program is truly an interdisciplinary experience, since the department encompasses multiple research foci, including biochemistry, biophysics, structural biology, cell and developmental biology, computational biology, molecular biology and genetics, and neuroscience. Numerous students work on thesis projects that span these disciplines and include a computational biology component; therefore, students receive individualized training, rich in diverse intellectual and technical resources.

Recent graduates of these Ph.D. programs have gone on to positions in a variety of institutions including the military, at cancer and biotechnology companies like Precision Therapeutic, on Wall Street as hedge fund managers at Goldman Sachs, and to postdoctoral fellowships at Princeton University and Yale University.

Maureen Stolzer, a current Ph.D. in Biological Sciences candidate, states:

> *We have a great [Ph.D.] program here at CMU with leaders in the field of computational biology…faculty care about the science, not just solving a new and interesting computational problem. Also, they strive to disseminate their research to scientists outside the area of computational biology, not only providing tools to experimental biologists, but also explaining how their tools work.*

While numerous biological sciences faculty members oversee computational projects or incorporate computational methods into their research, there are three main computational biology faculty members within the department: Dannie Durand, Robert Murphy and Russell Schwartz.

The Durand lab studies the origins of new genes. These arise through errors in DNA replication and cell division that create new copies; the copies mutate to take on new functions. This process creates expanding families of closely related genes. In plants and bacteria, new genes are also acquired through "horizontal transfer" from another organism. These processes result in the history of a gene family differing from the history of the species containing it. Gene and species histories, represented as trees, can be compared to reconstruct duplications and transfers as well as to identify correlations between the appearance of a new gene and a change in species physiology or morphology.

The Durand lab has also developed and implemented algorithms to compare gene and species trees in the software package *Notung*. *Notung* is used by scientists worldwide to solve problems, such as investigating the origins of proteins that mediate interactions between nerve synapses in multicellular animals. In her own research, Durand is applying *Notung* to identify genes that are transferred between *Streptococcus* strains. This research could help her collaborators at Allegheny General Hospital understand how bacteria acquire new virulence factors and antibiotic resistance genes.

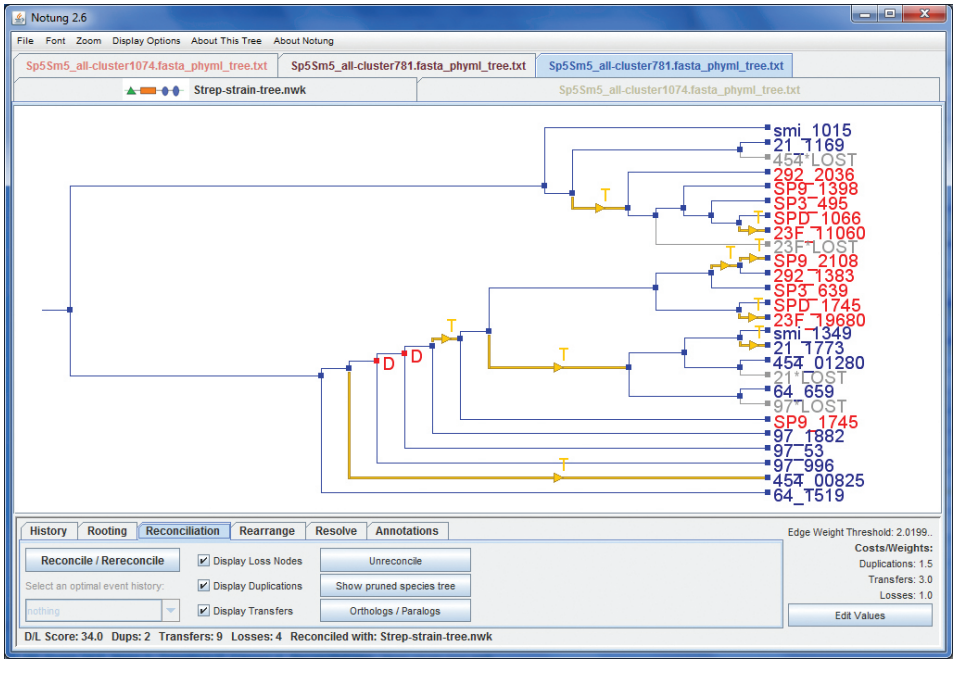
Within the Murphy lab, all projects relate back to one large-scale question: how can we build automated systems to learn where all proteins are located within all cell types under all conditions? In other words, their research relates to the fundamental question of how cells are organized. A combination of cell biology, computational biology and machine learning methods, especially microscopy, are utilized. One current project analyzes changes in protein location between normal and cancerous tissue. A second major focus of the lab is intelligent sampling on very large scales, such as learning the effect of thousands of potential drugs on thousands of potential targets. A third focus is on learning from microscope images how much of a given protein is localized within different compartments in a cell. This work was highlighted by *Nature Biotechnology* as one of four breakthroughs in computational biology for 2010.

Within the Schwartz laboratory, one research focus is simulating complex self-assembly systems, especially the virus capsid assembly. Lab members are attempting to realistically model assembly in living cells compared to the traditional data collection environment of the test tube.

The Schwartz lab also analyzes genetic variations by paying special attention to the inference of phylogenetics – the study of evolutionary relationships among groups of organisms. Most recently, the lab has applied phylogenetics to tumor development. A single cancer type has been shown to contain different sub-types, so reactions to therapies vary. Therefore, if tumors were treated as a changing population, then novel phylogeny methods could be utilized to better identify cancer sub-types, progression markers, and new therapy targets.

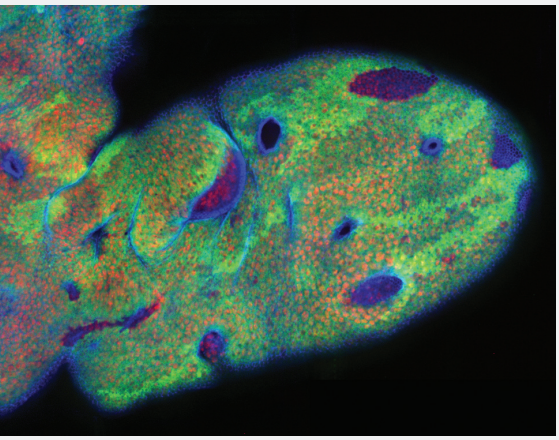
Through faculty research, the Departments of Biological Sciences and Computational Biology are working together to advance computational biology. Their training programs are also preparing students to enter and build this evolving field. Quinn sums up the field's promise best:

> *What excites me most about the field of computational biology is that the tools we use, both computational and experimental, are improving all the time. Yesterday's incredible discovery will serve as tomorrow's baseline research for the next big experiment with new tools, and hence new strategies, at our disposal. The field is constantly shifting, and that makes for incredibly exciting research.*



The evolutionary history of a complex gene family in strains of *Streptococcus mitis* (blue) and *Streptococcus pneumoniae* (red). *Notung* inferred 2 duplications, 9 horizontal transfers and 4 losses in the history of this family.

Undergraduates in Focus: The McCartney Lab



A *Drosophila* pupal wing containing patches of *APC* mutant tissue (marked by the lack of green). The cell membrane is stained blue and DNA red.

Many improvements in current cancer treatment have been the result of accidental discoveries; however, intelligent future progress requires that drug interventions be designed to target the processes of cancer development. Such drug innovation necessitates that the molecular mechanisms of tumorigenesis be well characterized.

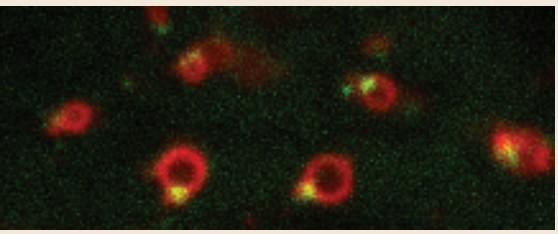
Undergraduate researchers in the McCartney laboratory study one such mechanism: the function of the tumor suppressor *Adenomatous polyposis coli (APC)*. Disruption of *APC* is thought to initiate approximately 80 percent of human colon cancers. In order to better understand how the disruption of *APC* promotes cancer development in humans, students research the function of *Drosophila melanogaster's* two *APC* proteins (*APC*1 and *APC*2) in cytoskeletal regulation, signal transduction and cell fate. The lab's ultimate goal is to identify new molecular targets for the treatment of *APC*-induced colon cancer.

Since joining the department in 2003, Associate Professor Brooke McCartney has developed this research group into a particularly successful undergraduate training laboratory. Students joining the lab are welcomed into a vibrant teaching environment where hierarchy is minimized. Even in the first weeks of a project, students are encouraged to present at lab meetings and follow scientific literature at lab journal club. All are also encouraged to present at symposia like Meeting of the Minds and national conferences like the Annual Drosophila Research Conference. And when work by an undergraduate is published, their authorship is fully recognized. Further, opportunities to develop research-related presentations and proposals for outside scholarships and graduate school applications are supported by all, often with other undergrads and McCartney alike offering advice and support.

The benefits of this environment are reflected in the success of former undergraduate students. Students have gone on to attend Harvard University, the University of California, Berkeley and the Massachusetts Institute of Technology; take research positions at the National Institutes of Health; and be recognized by the National Science Foundation's Graduate Research Fellowship.

– Kellie Kravarik, *Senior, MCS*

The Endosome: A Subcellular Recycling Powerhouse



Endosomes showing Arp, an actin marker, localized on the tubules.

The word 'recycling' makes most people think of bottles and cans; however, Assistant Professor Manoj Puthenveedu thinks of the endosome, an organelle that acts as the recycling center within every cell of the body. The endosome determines whether proteins that travel through it are sent to the plasma membrane or the Golgi apparatus for reuse, or to the lysosome for degradation. To gain insight into this sorting function, Puthenveedu uses plasma membrane signaling receptors.

In his most recent research effort, Puthenveedu used fluorescence microscopy to observe the distribution of two different receptors, beta-2 adrenergic receptor (B2AR) and delta opioid receptor (DOR). B2AR was first concentrated in tubules that budded into vesicles, and then was recycled back to the plasma membrane. In contrast, DOR was excluded from the tubules; it was sent to the lysosome for degradation.

Puthenveedu discovered both B2AR and non-B2AR endosomal tubules, thereby challenging the current belief that a uniform population of tubules buds off this organelle. Furthermore, the B2AR tubules appeared to be stable, whereas the non-B2AR tubules were less so.

Because the actin cytoskeleton is a known requirement for efficient B2AR recycling, concentrated patches of actin that Puthenveedu observed at the base of the stable B2AR tubules hinted at an explanation of how the tubules were stabilized. Puthenveedu hypothesized that the stable tubules allowed time for the slower diffusing B2AR to become concentrated in the tubules, whereas the less stable tubules budded off too quickly for B2AR to enter. Using fluorescence recovery after photobleaching (FRAP) to monitor rates of protein diffusion, he confirmed that B2AR required more time than other proteins to diffuse into tubules.

With help from his graduate student Rachel Vistein, Puthenveedu is now researching how actin and its interacting proteins are localized to these patches in order to understand how these stable tubules are regulated.

To learn more about Puthenveedu's recent findings, read "Sequence-dependent sorting of recycling proteins by actin-stabilized endosomal microdomains" in the November 2010 issue of Cell.

– Cassandra Priddy, *3rd-year Ph.D. Candidate*

Lessons from Qatar By Peter Berget, Ph.D.

Carnegie Mellon University in Doha, Qatar (CMU-Q) offers degree programs in Computer Science, Business and Information Systems, all of which have the same general education and distribution requirements as CMU-Pittsburgh, including two science courses. Instruction in biology fills one of these needs, and the idea of a stint teaching biology at CMU-Q interested me. Initially, this interest grew from conversations with my late colleague and long-time friend, Bill Brown, who spent the 2006-2007 academic-year in Qatar as a visiting professor of biological sciences. He would describe the interesting cultural differences as well as how invigorating and challenging it was to teach Modern Biology to the international students on the new campus. Bill's enthusiasm coupled with the fact that no one had taught Modern Biology since Bill's stay was all it took to get me to sign up for the first summer session of 2010.

I offered to teach two biology courses during the six-week session: *Modern Biology* (03-121) and an expanded version of my freshman seminar course on *Genes and Diseases* (that got the special topics course number 03-410). I was both pleased and slightly anxious that 26 students signed up for *Modern Biology*. The enrollment suggested that there was a lot of interest. Eight students also signed up for the *Genes and Diseases* course, which I found gratifying.

The interesting parts of teaching both courses revolved around my students and the class dynamics. All of the students were either rising sophomores or juniors, and all were quite talented. The majority were women. Many dressed "traditionally," meaning their heads were covered with a scarf (hijab) even if they wore western clothes, or they wore traditional black robes (abayas), many with intricate embroidery, and a hijab. Less than half of the men wore traditional white robes (thobe) and headgear, which were composed of a square scarf (ghutra) and a black circular cord (agal) to hold the ghutra in place. At first, the unexpected clothing made me aware that I was not in Pittsburgh, yet by the end of the summer session I didn't notice the difference between western and Arabic clothing. It's all about what you're used to seeing.

I also ran into a few teaching "surprises" while in Doha. My *Genes and Diseases* course required students to write a short paper on a particular disease every week. It had completely slipped my mind that English was a second language for all of my students; as a result, I needed to add a rough draft option before the final paper was handed in. Another teaching surprise involved technology. In my *Modern Biology* class in Pittsburgh, I make daily use of the i>clicker classroom response system, which was new to CMU-Q. At my request, the Instructional Technology office shipped a set of 50 i>clickers and two base stations to CMU-Q, and between my setup and the students' mastering of the system, we tackled the learning curve together.

I also began to integrate some of the local culture into my lectures. For example, when I discuss restriction enzymes in *Modern Biology* at the Pittsburgh campus, I always refer to a variety of English language palindromes (like "racecar"), because DNA recognition sites of useful restriction enzymes are double-stranded palindromes (e.g., Bam H1 is 5'-GGATCC-3'). So what about Arabic palindromes? I incorporated the following example into my lecture:

بَلَحٌ تَعَلَقَ تَحْتَ قَلْعَةِ حَلَبْ

It translates roughly as: "A date is hanging under the Citadel of Aleppo." (Aleppo is the largest city in Syria.) The students loved it.

I had a wonderful time on the CMU-Q campus. (Notice that I didn't say anything about how hot it was–it was). The CMU-Q building is one of the most beautiful ones in Education City, an area in Doha devoted to research and education. When I wasn't teaching, I found some time to travel with CMU colleagues to both local and somewhat distant places. We traveled on more than one occasion to the main Doha marketplace (souq), a very large and colorful indoor/outdoor mall where we enjoyed Mideastern restaurants, lots of little shops and even places where you could buy and sell a camel or goat. We also visited the Museum of Islamic Art, which is a stunning modern building containing both ancient and modern art and artifacts. And although I did not have enough time to travel outside of Qatar, I did have time to drive up north to Al Khor, a small fishing village with lovely beaches and deluxe resorts. Al Khor is also the hometown of Sheikha Mozah Bint Nasser Al Missned, the second wife of the ruling Emir of Qatar, Sheikh Hamad bin Khalifa Al Thani; she is the chairperson of the Qatar Foundation that oversees the Education City campus. On my trip to Al Khor, I nearly circumnavigated the entire desert country of Qatar – which is about the size of Connecticut. I mostly saw sand. When I go back to CMU-Q, I'll try to use Doha as a base to visit more of the interesting Middle Eastern countries and southern Europe.

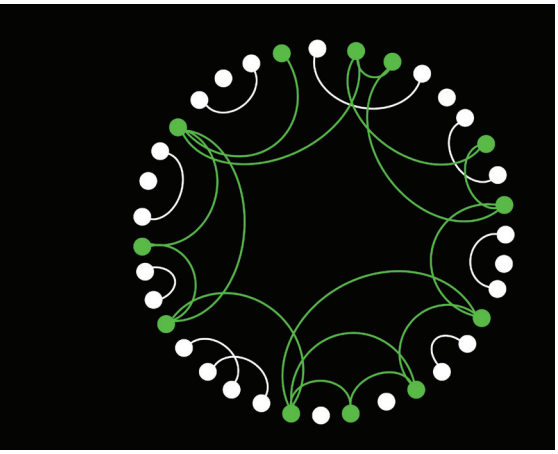
Top: Dr. Berget trying on a thobe. Bottom: Dr. Berget at the CMU-Q building.

To read more about Dr. Berget's summer in Qatar and view more photos, visit: http://web.me.com/peterberget

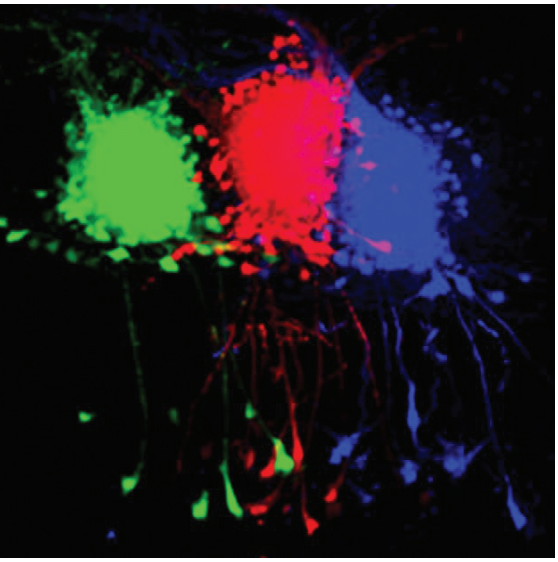
Brain, Mind and Learning

By Nathan Urban, Ph.D.

How does our brain change when we learn someone's name, or learn to play the violin, or learn to talk again after suffering a stroke? How is the brain of a CMU graduate different from the brain they had when they first arrived on campus? Questions like these provide some of the motivation behind a new Brain, Mind and Learning initiative launched earlier this year at CMU. This initiative seeks to enhance the university's existing strengths in brain science by bringing together researchers in many departments working in areas such as neuroscience, psychology, computer science, bioengineering and other disciplines, including a number of faculty in the Biological Sciences Department. This approach to developing brain science is an excellent example of the CMU way – interdisciplinary, highly distributed and highly quantitative. The goals of the initiative involve both building bridges between programs, and also raising funds to strengthen key existing components of CMU's research and education programs.



Neural networks in the mammalian neocortex may display properties of small-world networks, where cells are not randomly connected. The Barth lab has discovered that a small subset of highly active neurons act like "hubs" to propagate neural activity across the brain.



Olfactory bulb neurons labeled by local electroporation.

The Brain, Mind and Learning Initiative was kicked off in January at an on-campus panel discussion led by Provost Mark Kamlet and featuring four CMU faculty members: Dr. Mike Tarr, co-director of the Center for the Neural Basis of Cognition, Dr. Marcel Just from the Department of Psychology, Dr. Justine Cassell, head of the Human-Computer Interaction Institute, and Dr. Nathan Urban, head of Biological Sciences. The panel's expertise ranged from cellular and molecular studies of single neurons to detailed analysis of human behavior and patient populations. The lively discussion included comments and questions from the 300 or so students, faculty, alumni and guests that were gathered in the Rashid Auditorium. A video of the event can be viewed at the Brain Mind and Learning initiative website, http://www.cmu.edu/research/brain/.

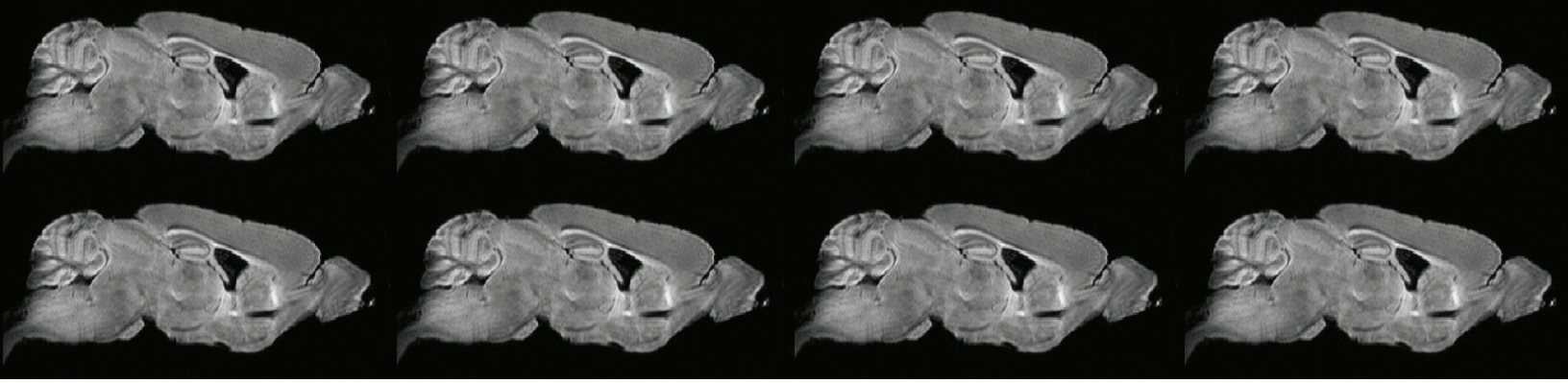
Neuroscientists in the Department of Biological Sciences are an important part of this initiative through their work on questions that relate to biological mechanisms to brain plasticity and repair. Here we highlight some of this work.

Dr. Eric Ahrens
Cell Tracking in the Brain

Movement of cells through the body is a critical mechanism for the body's response to injury, infection or a tumor, and also for normal development. Getting the right cells to the right place quickly enough is key to mounting an adequate response to a variety of challenges. Work by Ahrens is targeted at developing ways in which the mobilization and movement of cells can be tracked in an intact animal. Several projects in the lab focus on movement of cells in the nervous system, especially in the context of autoimmune diseases such as multiple sclerosis.

Dr. Alison Barth
Memory Networks

How does experience transform the brain? The mammalian brain contains millions to trillions of neurons, and finding the cells and synapses that encode memory is akin to finding a needle in a haystack. The Barth lab has taken advantage of the fact that highly active neurons – those cells that are most likely to drive perception and encode memory – will induce gene expression that can be tagged using fluorescent markers. Visualizing these highly active cells has provided important insights into how circuits are constructed in the neocortex, and how experience alters the function and connectivity of specific cells. Recently, the Barth lab has identified that these highly active cells make up a special, densely interconnected network in the brain. These special cells both receive and transmit more information than their neighbors, revealing principles of network function in the cortex that are similar to those found on the internet.



Dr. Manoj Puthenveedu
Trafficking of Receptors in Abuse

For some of us, "This is your brain on drugs" conjures up images of 1980s-era public service announcements featuring eggs cooking in a frying pan. Work in the lab of Dr. Manoj Puthenveedu seeks a more nuanced and microscopic view of this question. Specifically, the Puthenveedu lab works on understanding the effects that drugs of abuse, such as morphine, have on neuronal function, specifically at the level of single cell surface receptors. Using sophisticated imaging of live cells, researchers can watch the dynamics of receptors as they move in and out of the cell's membrane, becoming sensitive and then insensitive to ligands in the extracellular space. This process will regulate the cell's sensitivity to these compounds and may be linked to mechanisms of drug tolerance and addiction.

Dr. Nathan Urban
Understanding Brain Complexity

The brain is both a biological organ and a computational device. However, brains do not reliably or accurately perform the basic operations of digital computers (addition, subtraction, etc). Brains are easily outperformed by a $2 calculator when it comes to long division. How is it possible that despite this underlying unreliability brains can perform remarkable tasks? Work in the Urban lab uses experimental and computational approaches to answer such questions and has shown that in several cases, the noisy, messy, unreliable nature of biological mechanisms can be beneficial to biological computation.

Awards & Scholarships

Alison Barth, Ph.D. (Faculty) was the recipient of the 2010 Friedrich Wilhelm Bessel Research Award from the Humboldt Foundation, the 2010 NeuroCure Award administered by the German government in Berlin, the Eberly Family Career Development Professorship in Biological Sciences, and an honorable mention for the Emerging Female Scientist, Carnegie Science Awards 2010.

Amy Burkert, Ph.D. (Faculty) was promoted to vice provost for education. She also received the 2010 Alumni Association Faculty Service Award and the 2010 Faculty Role Model Award.

Carrie Doonan, Ph.D. (Faculty) won the university's Mark Gelfand Service Award for Educational Outreach.

Molly Evans (B.S., '11) was the MCS recipient of the CMU Women's Association Award.

Cameron Exner (B.S., '10) received the Dr. J. Paul-Fugassi and Linda E. Monteverde Award.

Josef Franke, Ph.D. (Postdoc) was awarded an American Heart Association Fellowship.

Richard Gerkin, Ph.D. (Postdoc) received a National Research Service Award from the National Institutes of Health.

Stephanie Guerra (B.S. '12) was awarded a 2011 Barry M. Goldwater Scholarship.

David Hamilton (M.S. '12) received an ASEE SMART Scholarship Award from the DoD.

Andrew Kehr (Ph.D. '16) received a National Science Foundation Graduate Research Fellowship Honorable Mention.

Kellie Kravarik (B.S. '11) was awarded a 2010 Barry M. Goldwater Honorable Mention.

Shu Ying Kwan (Ph.D. '11) received the departmental 2010 Graduate Student Service Award.

Brooke McCartney, Ph.D. (Faculty) received the Eberly Family Career Development Professorship in Biological Sciences.

Aaron Mitchell, Ph.D. (Faculty) was named editor-in-chief of Eukaryotic Cell, an American Society for Microbiology publication.

Robert Murphy, Ph.D. (Faculty) was appointed to the National Advisory General Medicine Sciences Council.

Kelsey Murray (B.S., '11) was the recipient of the 2010 Gilman International Scholarship.

Shannon Quinn (M.S. '10) received the departmental 2010 Graduate Student Teaching Award.

Elizabeth Ransey (Ph.D., '17) received a National Science Foundation Graduate Research Fellowship.

Sonal Shruti (Ph.D., '10) received the MCS Guy C. Berry Graduate Research Award.

Nathan Urban, Ph.D. (Faculty) was named the department head of biological sciences and the Dr. Frederick A. Schwertz Distinguished Professor of the Life Sciences.

Alan Waggoner (Faculty) was awarded the 2010 Distinguished Service Award from the International Society for the Advancement of Cytometry.

Quinn Weisman (B.S., '11) was named the departmental Andrew Carnegie Scholar.

Cold Call, Hot Career

de Vries

When pressed for advice to students, entrepreneur and Carnegie Mellon alumnus Glen de Vries stresses the importance of integrity, tenacity and adaptability, offering, "Whatever challenge comes up, be ready to pound away at it." Co-founder and president of the successful medical software development company, Medidata, de Vries has plenty of experience with challenges, changes and risk.

New York native de Vries came to CMU intending to be a chemistry major, but soon changed to biology with a side of computer science. Looking for pocket money, he took a campus job for the Development office making cold calls to alumni (yes, you know those calls). One night, he picked up the phone to call a biology alumnus, expecting to make his $5 commission. But he didn't expect that call to change the direction of his career. Now, de Vries points to that one call as a pivotal moment in his life. "Medidata was born entirely because of my job on campus." As de Vries chatted with the biology alumnus, Dr. Aaron Katz from Columbia Presbyterian Medical Center, he not only earned his $5 commission for securing a donation, but he also was invited to visit during his next break, which eventually led to a job offer.

In addition to the campus job and a "wonderful time" at CMU, other memorable, shaping experiences for de Vries include undergraduate research in the biological sciences department in the lab of Dr. Susan Henry, where he spent much time separating yeast tetrads. Also, de Vries remembers taking Advanced Genetics, "the coolest class I ever took," with Drs. Jon Jarvik and Elizabeth Jones, where he engaged in the perennial intellectual contest between undergraduates and graduate students. "[We] were always trying to outshine the grads …we would take an unpopular opinion just be contrarian and to see how long we could keep everybody at arm's length while we would paint ourselves into a little scientific corner." Risky, indeed. "I remember Glen as a particularly happy, playful and talkative guy, also very smart, who really liked being who he was and where he was....it makes me feel really good to know how well he's done," states Jarvik.

After graduating from CMU with a B.S. in Biological Sciences, de Vries joined Katz's molecular biology lab, a fortuitous result of the aforementioned cold call. The lab worked on developing a novel, specific and sensitive assay for micrometastases of prostatic neoplasms and needed patients to enroll in its study. Soon, this new assay interested a number of clinics in the region, and the study evolved into an *ad hoc* multi-center clinical trial. As de Vries and a surgical resident in the lab, Edward Ikeguchi, juggled a sea of experimental data from these various centers, they found that resources available for inputting and generating 'clean data' were inadequate, and mused about developing an easily accessible electronic database for clinical results, an idea that spurred their eventual venture into the world of Electronic Data Capture (EDC).

The young partners converted de Vries's one-bedroom apartment into a studio with a server room and plunged their fledgling company into diverse projects: websites for clinical practices, early interactive applications such as pre-qualifying patients for trials, and building a minority health network. Continued success led to financial support from friends and family, angel investors, and venture capital firms. Another partner, Tarek Sherif, joined the group, Medidata, which now focused more clearly on clinical trial software development. The successes multiplied. Today, Medidata is a global leader in the clinical trial software market, with tools ranging from optimization of efficient study parameters to processing of complex streams of data, and with revenues of $166M (2010) and more than 700 employees worldwide. The company partners with pharmaceutical companies, academic institutions, and governmental agencies, and sees its work as trending toward ever-increasing efficiency in clinical trial data management.

Claiming that he has "the best job in the world," de Vries is enjoying the ride. He has recently been profiled in Crain's *40 Under 40* (2010) and awarded the Ernst & Young Entrepreneur Of The Year® 2010 Award for the New York area. As the recent copy of *Nature* on his side table attests, de Vries nurtures his interest in the sciences and savors the blend of medical science and information technology at Medidata, characterizing work there as "clinical trials by fire – you learn a lot about the life sciences. Real world." As he describes their robust internship program, he challenges students to get comfortable taking risks.

So who knows? Together with a degree from Carnegie Mellon, a risk-taking spirit, adaptability and luck, a phone call can change a career.

– Emily Stark

Alumni Updates

Robert (Bob) Aarhus (B.S. '84) retired from the U.S. Army Medical Service Corps after 25 years. His final assignment was at the U.S. Army Health Facility Planning Agency. He is now a contract task manager and clinical informatics specialist for the Defense Health Services Systems Program Office in Falls Church, Va.

Candice Anderson (B.S. '07) works as an IHC/clinical lab technician for Precision Therapeutics, Inc. in Pittsburgh.

Barbara Bralver Barnard (B.S. '70) retired from her position as director, Office of Research and Sponsored Programs at Lehman College of The City University of New York.

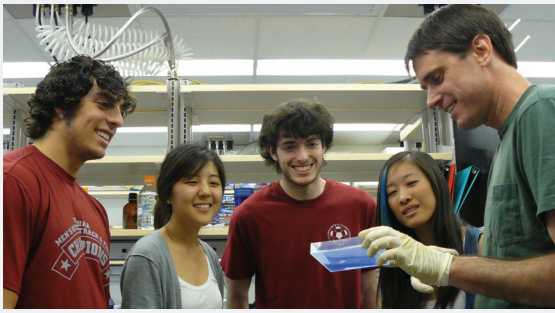
HHMI & Undergraduate Research

The life sciences expand almost daily, challenging educators as they prepare the next generation of scientists, physicians, and biomedical engineers. Classroom instruction provides foundational material, but most students look further to integrate their knowledge and understanding. Independent research and discovery-based lab experiences, funded by the Howard Hughes Medical Institute (HHMI), have addressed this challenge.

Carnegie Mellon University alumni emphasize the pivotal role HHMI-sponsored activities had in preparing them for advanced training. Cameron Exner, a first-year graduate student in the Molecular and Cell Biology Department at Berkeley, says her HHMI Summer Scholar experience was "my first opportunity as an undergraduate to focus entirely on research without having to worry about classes at the same time, an experience similar to training as a graduate student." Michele Stewart, who will attend veterinary school this fall after a National Institutes of Health Vaccine Research Center internship, participated as both an HHMI Undergraduate International Scholar and a student in the HHMI Summer Research Institute. She relates, "I'm confident that without these experiences I would not have my current job." She believes the experience gave her a distinct advantage over other applicants. Justine Harkness, a Ph.D. student in the University of Pittsburgh's interdisciplinary biomedical sciences program, joins other alumni and current students in citing such benefits as development of critical thinking and teamwork skills, as well as enhanced self-confidence.

More than 85 percent of CMU biology majors participate in mentored research during their undergraduate careers. "Carnegie Mellon students want to participate actively in their education, and nothing suits them better than applying their knowledge in a research lab," says Aaron Mitchell, professor of biological sciences, who oversees the HHMI undergraduate education program in the Mellon College of Science.

While HHMI grant opportunities exist for research during the academic year and conference presentations, the summer program remains the primary focus. New to this year's program will be a series of journal clubs to augment social and collegial activities. Almost 50 HHMI-supported students are expected to participate.



(Left to Right) HHMI Researcher Donald Mignogna and HHMI Scholars Joohyeon Lew, Andre Hersan, and Amy Wang with their summer advisor, Dr. Mark Macbeth.

For program details, visit www.cmu.edu/bio/hhmi.

The Howard Hughes Medical Institute plays a powerful role in advancing scientific research and education in the United States. For more information, visit www.hhmi.org.

Chandana Batchu (B.S. '10) accepted an applications associate position with Fluidigm Corporation in San Francisco, focusing on applications such as Next Gen Sequencing and Single Cell Gene Expression.

Brett Benedetti (Ph.D. '10) is a postdoctoral fellow with Dr. Gordan Fishell at New York University's Smilow Neuroscience program.

Andree Bouillot (B.S. '07) began working in the budget office of Massachusetts General Hospital in May 2010.

Kelly Broadlick (B.S. '06) works as a sea-kayaking guide on the San Juan Islands, Wash. from May to October.

Sandra Brockman-Lee (Ph.D. '94) is senior counsel of oncology at Sanofi-aventis.

Gabriel Brooks (B.S. '01) will be starting a cardiology fellowship in July 2011 at the University of California, San Francisco. Brooks also welcomed a son, Maxime.

Marija Buhler (B.S. '03) and husband, Rob, welcomed the birth of their daughter, Paige Sophia, on January 5, 2011.

Jim Burnette (Ph.D. '00) is now an academic coordinator and professional researcher at the University of California, Riverside in the College of Natural and Agricultural Sciences.

Vivian Cheng (B.S. '01) works at GlaxoSmithKline as a process consultant in Regulated Clinical Support. In July 2010, she became president of the Philadelphia Alumni Chapter.

Anna Chin (B.S. '08) completed her Master's of Public Health from Dartmouth in June 2009. She is currently a first-year medical student at the University of Massachusetts.

Jessica Chu (B.S. '04) began a postdoctoral fellowship in immunological research at the National Institute of Allergy and Infectious Diseases in Bethesda, Md.

Kate Cummings (B.S. '07) will graduate from Michigan State University College of Veterinary Medicine in May, then will begin a 1-year small animal rotating internship at Michigan Veterinary Specialists in Southfield, Michigan.

Parth Dahal (B.S. '10) is completing a Master's program in Biomedical Science at The Commonwealth Medical College (TCMC). Dahal was also just accepted to medical school at TCMC.

Alumni Updates

Beverly Babcock Deerhake (B.S. '62) and her husband lived overseas for 13 years in Egypt, Norway, and Trinidad, and traveled to 110 countries.

Mindy DeRouen (B.S. '02) started a research consulting position with Stem Cell Advisors, Inc. in February 2010. In October 2010, she also began a postdoc with the Cancer Prevention Institute of California. DeRouen and her husband welcomed their first child, Oliver Michael, on December 13, 2010.

Vardhan Dharnidharka (M.S. '10) is a financial software developer at Bloomberg LP.

Benjamin Ely (B.S. '10) works at the New York University Child Study Center as a neuroscience research assistant, and is pursuing a master's degree in biology.

Danielle Eytan (B.S. '09) began a 5-year medical school program, which includes a year of research, at the Cleveland Clinic Lerner College of Medicine in July 2010.

Timothy Feinstein (Ph.D. '08) is a postdoctoral fellow with Dr. Jean-Pierre Vilardaga in the Department of Pharmacology and Chemical Biology at the University of Pittsburgh. His work focuses on regulation of PTH receptor signaling by retrograde trafficking.

Swetha Garimalla (M.S. '10, B.S. '08) is a bioinformatics specialist at the University of Arkansas for Medical Sciences.

Cesar Guerrero (B.S. '05) will be starting a dermatology residency at SUNY Buffalo in July 2011.

Amy (Berman) Hahn (B.S. '85) is president of the American Board of Histocompatibility and Immunogenetics, the president-elect of the American Society for Histocompatibility and Immunogenetics, and was just elected the histocompatibility representative to the United Network for Organ Sharing/Organ Procurement and Transplantation Network Board of Directors.

Timothy Helbig (B.S. '10) was awarded a National Science Foundation Graduate Research Fellowship.

George T. Hung (B.S. '92) started a new position as the director of business and marketing intelligence at the Alfred Mann Foundation.

Carly Huth (B.S. '07) recently passed the Pa. state bar and the UPSTO bar ('patent bar'), and will soon be a licensed patent attorney.

Charlotte Jennings (B.S. '09) received an honorable mention for a National Science Foundation Graduate Research Fellowship.

Deepak Kana Kadayakkara (Ph.D. '11) is a postdoctoral fellow in Hyam Levitsky's lab in the Department of Oncology and Immunology at Johns Hopkins University's School of Medicine.

Megha Kapur (M.S. '10) is a research associate scientist at PERCIVIA in Cambridge, Mass.

Rupinder Khandpur (M.S. '10) is working with Dr. Russell Schwartz at CMU as a research programmer.

Lauren Krogh (B.S. '09) was awarded a National Science Foundation Graduate Research Fellowship.

Shelly Kucherer (B.S. '09) is a first-year medical student at New York Medical College.

Prateek Kumar (M.S. '05) will be joining the Cancer Human Biobank initiative in Maryland as a senior bioinformatics data architect.

Melissa Lee (B.S. '09) completed a Master's in Health Care Policy Management from CMU and started an information technology analyst position at Johnson & Johnson in Raritan, N.J.

Elyse Maiorini (B.S. '08) is in her second-year at the Harvard School of Dental Medicine.

Bradley Malin (B.S. '00) of Vanderbilt University was among 85 researchers named recipients of the 2010 Presidential Early Career Awards for Scientists and Engineers for his work in managing and protecting the privacy of personal information stored in electronic health records and research data files.

Domenic Mantella (B.S. '03) is completing his sports medicine fellowship at UPMC Shadyside, where he has treated the Pittsburgh Steelers, professional skiers and snowboarders at the Winter Dew Tour and other athletic groups.

Allison Marciszyn (Ph.D. '07) is a postdoctoral associate studying the epithelial sodium channel at the University of Pittsburgh.

George Matcuk (B.S. '98) is an assistant professor of clinical radiology, division of musculoskeletal radiology, at the University of Southern California.

Kathleen McCann (B.S. '09) received a National Science Foundation Graduate Research Fellowship Honorable Mention.

Yale Mitchel (B.S. '75) is a vice president in the Cardiovascular Disease Department at Merck Research Laboratories in Rahway, N.J. and heads the atherosclerosis section of the department. He is board certified in Internal Medicine and Endocrinology, a fellow of the Arteriosclerosis, Thrombosis and Vascular Biology Council of the American Heart Association, and a member of the International Atherosclerosis Society and the European Society of Cardiology.

Gregory Newby (B.S. '09) was awarded a National Science Foundation Graduate Research Fellowship.

Yaw Nti-Addae (M.S. '09) is a scientific analyst at Dow Agrosciences.

Panagiotis Papasaikas (Ph.D. '10) is a postdoctoral fellow with Dr. Juan Valcarcel in the Department de Regulacion Genica at the Centre de Regulacio Genomica in Barcelona, Spain.

Andrew Park (B.S. '07) will soon move to the Oncology Commercial Analysis team at GlaxoSmithKline, in order to evaluate opportunities and medicine development strategies for promising new cancer therapies.

Shannon Quinn (M.S. '10) is a first-year Ph.D. in Computational Biology student at CMU, working on the open source software project, Apache Mahout. He also received a summer internship at Google, where he'll be working on predictive advertisement modeling.

Ayush Raman (M.S. '08) is working as a bioinformatics scientist at the Institute for Systems Biology in Seattle on the NIH-supported TCGA project.

Steven Reilly (B.S. '09) was awarded a National Science Foundation Graduate Research Fellowship.

Allison Retotar (B.S. '09) was awarded a National Science Foundation Graduate Research Fellowship.

Aaron Rising (B.S. '04) is a postdoctoral fellow at the University of Florida researching spinal cord injuries.

Ashraf Saleemuddin (B.S. '03) will be starting a gastroenterology fellowship at Boston University Medical Center in July 2011.

Erica Schleifman (B.S. '05) just completed her doctorate in genetics from Yale University. Her thesis was entitled, "Targeted inactivation of the CCR5 gene via PNA induced homologous recombination." On Sept. 25, 2010, she married Matthew Mason.

Debrup Sengupta (Ph.D. '10) is a postdoctoral fellow in the Department of Immunobiology at Yale University.

Jodi Pelekis Shearer (B.S. '87) is working towards a master's degree in teaching at Pace University in Pleasantville, N.Y.

Sonal Shruti (Ph.D. '10) is a postdoctoral fellow in the Marder laboratory at Brandeis University.

Irtisha Singh (M.S. '09) is a bioinformatics analyst in the Department of Biomedical Informatics, University of Pittsburgh. She will begin the Ph.D. program in computational biology and medicine brought together by Cornell University, Weil Cornell Medical College and Memorial Sloan Kettering Cancer Center in the fall of 2011.

Shreedharan Sriram (M.S. '09) is now working for Dow Agrosciences.

Leigh Stuckhardt (B.S. '07) is a program associate for the Roundtable on Value and Science-Driven Health Care at the Institute of Medicine.

Shoba Subramanian (Ph.D. '05) is a postdoctoral research associate with Dr. Aaron Mitchell at CMU.

Justin Van Denend (B.S. '07) received a Master's in Healthcare Management Systems from Duquesne University in 2009. He is now employed by The Living Legacy Foundation, an organ procurement organization. On Aug. 1, 2009, he married Kelly Cahill (H&SS '09).

Johanna Vostok (B.S. '05) completed a Master's in Public Health in Epidemiology at Emory University in May 2010 and now works as an epidemiologist with the Bureau of Infectious Disease Prevention, Response and Services within the Massachusetts Department of Public Health.

Jen Westrup (B.S., '03) is the creative director for Vanderbilt Surgery Media Services. Her wedding to Ryan Slone is set for August 13, 2011.

Jennifer Wig (B.S.A. '09) received an honorable mention for a National Science Foundation Graduate Research Fellowship.

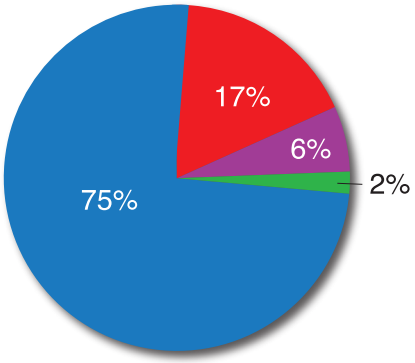
Jessica Williams (B.S. '10) works in Pittsburgh for the National Institute for Occupational Safety and Health, a branch of the CDC. In September, she will be attending graduate school at the University of Pennsylvania.

Naomi Yudanin (B.S. '10) is a first-year student at Columbia University in the Microbiology and Immunology Ph.D. program, where she recently joined Dr. Donna Farber's lab.

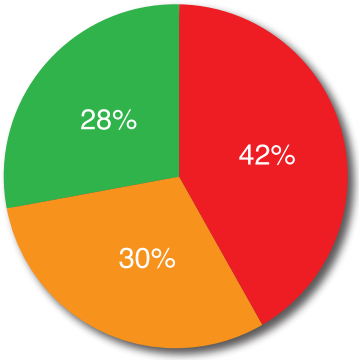
Lee Zeiszler (B.S. '97) is the medical director of diagnostic imaging at University Hospitals Geauga Medical Center and the associate director of community operations for University Hospitals Medical Group Radiology in Ohio.

Fangyuan (Sophie) Zhouzheng (B.S. '10) accepted a project management analyst position at Standard & Poors in New York City, N.Y.

Sandra Zimmerman (Ph.D. '09) is a postdoctoral fellow in the Department of Genome Sciences at the University of Washington.



Ph.D. Graduates since 2004 (n=47)



M.S. in Computational Biology Graduates since 2004 (n=43)

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- Postdoctoral Position
- Further Education
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