

The Promoter

Winter 2009 No. 11

2008 was a year of growth for the Department of Biological Sciences. Our undergraduate program continued to expand while maintaining and extending its high standards of scholarship and leadership. Several of our students were awarded prestigious national fellowships, including a Goldwater Fellowship, a National Science Foundation Graduate Fellowship and a Fulbright Fellowship. We also had a Rhodes finalist and a Gates-Cambridge finalist in our senior class. The first semester of the new Phage Genomics course, sponsored by HHMI, was a huge success. Twenty-one first-year students collected and sequenced novel bacterial viruses from the soil of surrounding areas.

The Biological Sciences Student Advisory Council (BioSAC) placed first at the Relay for Life event for a second year, raising more than \$5,000 for cancer research. BioSAC also organized a wonderful Murder Mystery Dinner and is bringing back most of the talent for "Phantom of the Operon" this spring. In addition, the group created a fantastic carnival booth based on the Human Genome Project.

Our graduate students continued to take on leadership roles in the community and to develop forums to explore and train for diverse career opportunities. The Sciences Teaching Club expanded its outreach programs and attended a teaching conference to network and collaborate with other universities (p. 6). Jeanne Morin-Leisk received the Graduate Student Service and Outreach Award for organizing a tutoring program at Schenley High School. Ken Hovis won the Graduate Student Teaching Award for his excellence as a teaching assistant as well as for his leadership in the Sciences Teaching Club (p. 6).

Furthermore, we welcomed two new faculty members, Aaron Mitchell (p. 5) and Manojkumar Puthenveedu (p. 4), as well as our new Assistant Department Head, Maggie Braun (p. 2). Also, Amy Burkert was promoted to assistant dean of the Health Professions Program and Educational Initiatives. Our dedicated faculty members continue to receive awards for their teaching and research. This spring Burkert received the Julius Ashkin Award for Excellence in Teaching, and Alison Barth won both the Research Award for Innovation in Neuroscience and Career Development Award at the Annual Meeting of the Society for Neuroscience. Additionally, Bruce Armitage and I established the Center for Nucleic Acids Science and Technology (CNAST), which focuses on RNA and DNA biology, molecular and experimental tools, and biotechnology research.

Very sadly, we lost another of our beloved founding faculty this year. Elizabeth Jones passed away in June (p. 3). In recognition of her significant impact, the university has named a new departmental undergraduate lounge (Doherty Hall 2312) in her honor and plans are underway for a ribbon cutting celebration during Spring Carnival. We hope to welcome back many of our alumni at the event, so mark your calendars for the morning of April 18th.

We love to hear from our alumni, so visit <https://apps.bio.cmu.edu/alumniDB/> to let us know what you are doing!

John Woolford

John Woolford, Ph.D.
Acting Department Head
Professor and Co-Director, CNAST



C-NAST Co-Directors Bruce Armitage and John Woolford

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Mentoring Undergraduates

By Kristen Boise

According to the National Academy of Sciences, “a good mentor seeks to help a student optimize an educational experience, assist the student’s socialization into disciplinary culture, and aid the student in finding suitable employment.” The Department of Biological Sciences understands the importance of a mentoring relationship; therefore, it offers numerous opportunities for students to interact with faculty members as mentors throughout their undergraduate experience.

The department’s philosophy of fostering these interactions among faculty and undergraduates began with the vision of one individual long before it was the norm. Early in her career, Dr. Elizabeth Jones, former department head, recognized the impact of undergraduates partnering with faculty to work on research projects. Based on Jones’s initiative and inexhaustible efforts, undergraduate research quickly became a part of Carnegie Mellon.

Today, undergraduate research in the department has expanded to programs funded by agencies such as the Howard Hughes Medical Institute (HHMI), the Beckman Foundation, the National

Science Foundation and Carnegie Mellon’s Undergraduate Research Office. In addition to academic year research, the department hosts a vibrant summer research program (SURP), led by Associate Teaching Professor Emily Stark. These highly collaborative research opportunities enhance the education that students receive through their coursework.



Dr. Maggie Braun

The department was founded with a holistic approach to student advising, offering mentoring that extends beyond the laboratory. Dr. Eric Grotzinger, associate dean of the Mellon College of Science (MCS), served as the first undergraduate advisor and mentor. Dr. Amy Burkert, who was recently promoted to assistant dean in MCS, also served

in the role. In fall 2008, the department welcomed a new undergraduate advisor, Dr. Maggie Braun, who holds a doctorate in molecular, cellular and developmental biology from the University of Pittsburgh. Having advisors with scientific training offers a level of expertise and perspective that many advisors in other colleges cannot provide.

Besides advising, courses such as the colloquium series and freshmen seminars allow faculty members to discuss their research and emerging scientific topics with students. The Phage Genomics course introduces first-year students to the research process, including designing experiments and interpreting novel data.

Mentoring is not restricted to academically focused activities. Both faculty and students participate in the Murder Mystery Dinner, Carnival, and class dinners.

Through all of these programs and activities the department strives to develop successful mentoring experiences for its undergraduates that strengthen their interest in science, improve their overall attitude toward science, and influence their future career goals.

Exceeding All Expectations: A Retrospective

By Jessica McGillen, M.S. in Comp Bio '08

I came to Carnegie Mellon’s Master’s in Computational Biology program because of its interdisciplinary focus and reputation for computational excellence, and I was not disappointed. I entered the program with a background in biological sciences and statistics but little computing experience, and the program’s flexibility allowed me to expand my computational and mathematical skills. I took several electives, including a tough course called Data Structures and Algorithms, which helped me build on basic computing abilities. In just a few semesters, I developed from a complete beginner into a confident and advanced programmer.

Beyond programming electives, the Master’s core courses were especially valuable. Taught by Drs. Robert Murphy and Russell Schwartz, the courses exposed me to a breadth of current problems in computational biology, including sequence alignments, machine learning techniques for molecular imaging, and simulation of regulatory biochemical and genetic networks. At the same time, I learned a wide array of computational methods that will serve as a strong starting tool kit in the future.

Perhaps my favorite part of the program, however, was a Master’s thesis project I carried out under Dr. Shlomo Ta’asan in the Department of Mathematical Sciences. For this project, I strengthened

my mathematical skills by developing and analyzing several different ordinary differential equations models of the long-term human immune response to HIV infection. This spring I plan to submit a related paper for peer-reviewed publication, an exciting step for any aspiring researcher. Most importantly, the project gave me the desire to continue similar work at the doctorate level. Currently, I am applying to mathematical biology programs all over the United States, and I feel certain that my Master’s experience has given me both the preparation and the motivation that I need to pursue a doctorate. Looking back on my Master’s experience, I can say that it has exceeded all of my expectations.

A Lasting Impact: Remembering Elizabeth W. Jones



By Amy Pavlak and Kristen Boise

An excerpt from the Mellon College of Science's Science Connection

Elizabeth W. Jones, who died June 11, is remembered as a superb teacher, mentor, colleague and friend.

"No matter what she was doing, Beth Jones was in the thick of things, participating with all of her energy," said Professor Aaron Mitchell, a former student in Jones's lab. "Working in her lab, I had the impression that she was having the time of her life with us and making sure we did too."

Jones joined the Carnegie Mellon community in 1974 as an associate professor of biological sciences. She arrived with a passion for genetics that never diminished. Her pioneering work in yeast genetics, most notably on vacuole biogenesis, was recognized this year with Genetics Society of America (GSA)'s Lifetime Achievement Award.

But Jones's passion for genetics extended beyond her own research – She was an enthusiastic and dedicated teacher who taught introductory genetics courses to thousands of undergraduates and reached countless more who studied either of the two genetics textbooks she co-authored.

Early in her teaching career, Jones recognized that involving undergraduates in research was a great way to elicit enthusiasm and facilitate learning. Her lab was always teeming with inquisitive undergraduates, and Jones was often at the bench with her students.

"She was more involved with students at every level than anyone else I know," said Professor John Woolford, acting department head of biological sciences. Jones was an ardent supporter of the Biological Sciences Student Advisory Council (BioSAC), overseeing booth construction during Carnival or gamely participating in BioSAC's annual Murder Mystery Dinner.

Jones's commitment and enthusiasm inspired other faculty members within the department and university so much that research became an integral part of undergraduate education. "Beth Jones is the person who really started undergraduate research here," said Indira Nair, vice provost for education. "Carnegie Mellon was recognized as one of the pioneers in undergraduate research solely because of Beth having started really early when it wasn't fashionable."

The Howard Hughes Medical Institute (HHMI) has recognized Jones's and the

department's commitment to undergraduate research, awarding six consecutive grants totaling \$9.3 million in support of bioscience education. With HHMI support, Jones developed highly interdisciplinary undergraduate programs, such as the Summer Research Institute.

Jones's impact stretched beyond undergraduate education. As department head she was a leader in expanding the department into diverse new areas, including computational biology and neurobiology, by aggressively recruiting high-quality faculty. She also extended the department's growth in the more traditional areas of cell and developmental biology.

Jones had a vision for leading the Department of Biological Sciences into the future and educating budding biologists. Woolford said, "There is a legacy of students who have gone on to become inspired scientists and teachers. It's an infinitely progressive legacy – a living legacy."



To honor Jones's passion for and dedication to undergraduate education, the university has established the "Elizabeth W. Jones Memorial Fund." Contributions to this scholarship fund may be made to: Carnegie Mellon University, P.O. Box 371525, Pittsburgh, PA 15251-7525.

Pathways of Importance

By Kristen Boise

Diabetes, neurological disorders, cystic fibrosis, HIV infection and cancer are just a few of the debilitating diseases attributed to secretory defects. The fundamental cellular process of secretion is also responsible for numerous physiological functions, such as releasing digestive enzymes in the gastrointestinal tract, surfactants in the lungs and neurotransmitters in synapses. Three scientists in Carnegie Mellon's Department of Biological Sciences – Professor Adam Linstedt, Assistant Professor Tina Lee, and the newest addition to the departmental faculty Assistant Professor Manojkumar Puthenveedu – have focused their research efforts on unraveling different

aspects of this process. A deeper understanding of the secretion process has the potential to greatly impact human health.

The secretory pathway comprises a series of steps during which a protein is prepared for secretion. A protein destined to leave the cell begins its journey in the rough endoplasmic reticulum (ER), a membrane-bound organelle present in all eukaryotic cells that is responsible for the synthesis, folding and maturation of all secretory and membrane proteins. After proteins are synthesized and folded inside the ER, they are packaged into membrane-bound carriers and delivered to the Golgi complex, which further modifies the proteins to prepare them for secretion. Investigating the structures of the ER and the Golgi complexes is the central interest of the Lee and Linstedt laboratories.

By understanding how the ER and Golgi structures are generated, the investigators hope to learn which aspects of the structure are most important for the organelles' function. Both Linstedt and Lee are especially interested in exploring how the organelles' structure influences the manner in which proteins are transported from the ER to the Golgi, within the Golgi and from the Golgi to the protein's final destination within the cell – a process called membrane trafficking.

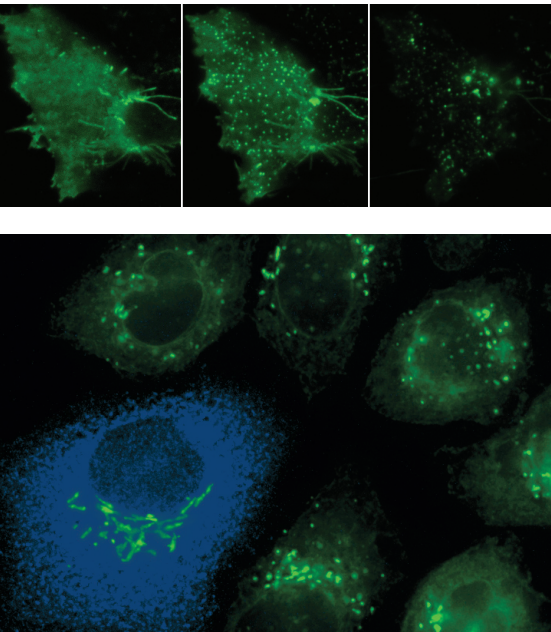
The Linstedt and Lee labs utilize two complementary approaches to understand the basic mechanisms of protein transport within cells. The first is to deplete specific proteins from living cells using small interfering ribonucleic acids (siRNAs) and then examine the consequences on organelle structure and function using a combination of imaging tools and biochemical assays. This approach is very powerful: when the

depleted protein is replaced with altered versions, researchers can test which parts of the protein are critical for the function of living cells.

Using this technique, Linstedt identified a group of proteins involved in forming the Golgi ribbon, a complex structure of Golgi subcompartments, or stacks, interconnected by tubules. Using siRNAs, he inhibited the expression of the Golgi proteins GM130 and GRASP65 and found that the Golgi stacks did not fuse into a ribbon. In cells without a Golgi ribbon, some of the unlinked stacks had higher levels of enzymes, including GalNAc-T2, whereas others had lower levels, unlike when the stacks are oriented properly in a ribbon and have an equal distribution of Golgi enzymes. Uniform enzyme levels could be critical, according to Linstedt, because cells with an unlinked Golgi ribbon have under-processed proteins. Impaired processing can lead to severe developmental defects in a variety of organisms, from mice to humans.

The second approach to examining protein transport involves reconstituting sub-reactions of the biosynthetic pathway in broken or permeabilized cells. Such cells allow the investigator to deplete or add specific proteins or small metabolites in a controlled manner, then view the functional consequences. With this method, the Lee lab identified a key factor involved in the formation of an extended ER network. The factor, a variant of the enzyme nucleoside diphosphate kinase (NDKB), binds directly to acidic phospholipids in the ER membrane and may assemble to form a scaffold that stabilizes the extended membrane network.

While Lee and Linstedt focus on how organelle structure influences protein



Banner: Fluorescently-labeled Golgi apparatus (orange glow). Top: Fluorescence micrograph of a cell showing endocytosis of a surface receptor (Frame 1: Before activation, Frame 2: 30 seconds after activation, Frame 3: Five minutes after activation). Bottom: The blue cell possesses a properly assembled Golgi apparatus (in green), while the other cells do not.

Alumnus Joins Faculty

By Kristen Boise



Aaron Mitchell (MCS '77) and his wife, Barbara Beizer Mitchell (MCS '77)

When Aaron Mitchell first stepped onto Carnegie Mellon's campus several decades ago, it was as an undergraduate in the biological sciences. This July, he returned to the department as an accomplished geneticist, microbiologist and faculty member. "It is really nice to work someplace that means so much to me," Mitchell stated.

His enthusiasm and experience have already allowed him to take on numerous departmental roles, such as teaching the introductory genetics course, advising graduate students and serving as the new principal investigator of the Howard Hughes Medical Institute (HHMI) programs. Mitchell was also able to use the few short months since his arrival to design, organize and staff his laboratory.

The Mitchell laboratory studies *Candida albicans*, a fungus that is a natural commensal organism, normally found in the gastrointestinal and genitourinary tracts. However, excessive amounts of the fungus affect approximately sixty thousand people in the United States per year. Most people are familiar with it as the cause of yeast infections, thrush and other non-life threatening infections, but it can also cause potentially lethal infections. Risk factors for contracting a serious *Candida* infection include using broad-spectrum antibiotics, having any sort of immune debility, or having an implanted medical device such as a pacemaker or artificial joint.

In light of these serious clinical issues, the Mitchell lab is trying to obtain more of a mechanistic understanding of this fungus. One approach the lab has used is to analyze regulatory mutants defective in such infection-related traits as biofilm formation. Biofilms are surface-associated microbial communities that can grow, for example, on implanted medical devices to seed infections. The analysis of these mutants is combined with large-scale analysis of gene expression to define the gene products that directly enable *Candida* infection. A focus of the lab's analysis is the construction of the *Candida* cell wall, components of which are targets for antifungal drugs.

Additionally, the lab studies another yeast, *Saccharomyces cerevisiae*, as a model for *Candida albicans*. *S. cerevisiae* has terrific molecular resources, such as comprehensive mutant libraries and genome wide protein interaction data, which allow mechanistic information to be obtained faster. Mitchell said, "One of our hobbies in the lab is to try to get *Candida* more up to speed in terms of all kinds of tools that are available to study. We're starting with a Hyundai and trying to make it into a Cadillac. *Saccharomyces* is a Porsche."

Mitchell has collaborated with fellow faculty member Robert Murphy, and a manuscript describing this work is in preparation. He also has several NIH-funded collaborative projects with Scott Filler at Harbor UCLA Medical Center and David Andes at the University of Wisconsin.

Mitchell received a bachelor of biological sciences degree from Carnegie Mellon in 1977 and a doctorate in biology from Massachusetts Institute of Technology in 1984. Later, he completed a postdoctoral fellowship at the University of California at San Francisco and served as acting chair and professor within the Department of Microbiology at Columbia University before returning to Carnegie Mellon.

secretion from the cell, Puthenveedu focuses on how proteins on or outside the cell are internalized. Specifically, he is investigating how membrane-bound cargo molecules are sorted into appropriate carriers during internalization at the cell surface as well as how they are properly targeted to the correct destination once they have undergone internalization.

In particular, Puthenveedu is interested in the role of membrane trafficking in drug addiction. Biochemically, addiction begins at the cell surface with opioid receptors, which bind drugs such

as morphine and heroin. There is evidence that if opioid receptors are eliminated from the cell, then drug addiction does not ensue. However, opioid receptors are also the docking site for endorphins, endogenous chemicals that are responsible for blocking pain and for inducing feelings of pleasure. The difference between the addictive effects of drugs and endorphins may be in the membrane trafficking of the receptors after activation – whether they are internalized or remain on the cell surface.

"The main problem is that we don't know exactly how endocytosis of these

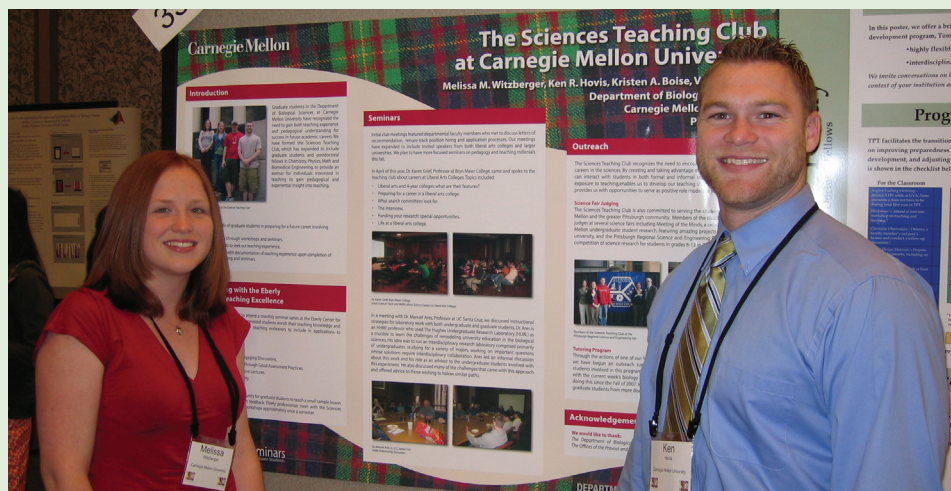
drugs is regulated," said Puthenveedu. "One of the main goals in my first few years at Carnegie Mellon is to figure out if this regulation is different between morphine versus our endorphins, or heroin versus our endorphins. Then, I want to see if I can link this regulation to the propensity of these drugs to cause addiction."

Drs. Puthenveedu, Lee and Linstedt are only beginning to tap the surface of understanding how proteins traffic throughout cells. Their findings may lead to developing treatments for drug addiction, cancer and other pathological conditions.

The Sciences Teaching Club By Kristen Boise

In fall 2007, students and faculty within the Ph.D. in Biological Sciences program organized a Sciences Teaching Club. With its expanding list of activities, the club is providing an important and increasingly sought-after service for graduate students. The club's mission is simple: to offer graduate students, particularly those within science fields, more guidance and opportunities while preparing for a career in higher education.

The club's mission and hard work earned President Melissa Witzberger and Vice President Ken Hovis an invitation to present a poster at the Center for the Integration of Research, Teaching, and Learning (CIRTL) Forum 2008. The forum's focus was on the preparation of graduate students for



Melissa Witzberger and Ken Hovis, leaders of the Sciences Teaching Club, at the CIRTL Forum 2008.

faculty careers in science, technology, engineering and mathematics. The forum included discussions on the success of graduate student training for a variety of academic environments, the alignment of expectations from higher education institutions on graduating doctoral students and the role future faculty programs can play in addressing the need for skilled graduates.

"There was a general consensus at the forum that there is a profound misalignment in teaching preparation within graduate programs," stated Witzberger. "As a result, we were able to discuss how our club was countering the misalignment and motivating our students to participate in the club's activities."

Witzberger and Hovis met with other groups to share thoughts about what had been successful and unsuccessful for them. "The forum was very useful. We plan on utilizing the information, ideas and contacts we encountered to improve the club's capabilities. It was exciting to truly see the need for teaching," said Hovis.

In addition to attending the CIRTL Forum 2008, the club works closely with the Eberly Center for Teaching Excellence at Carnegie Mellon, which awards

participating students documentation of teaching experience through training sessions and seminars. Club members are encouraged to work toward this documentation. The club also holds its own seminar series, which is geared toward a science audience and covers topics such as being a professor at a liberal arts school and finding a teaching position after graduation.

Furthermore, the club is involved in numerous outreach programs. This past spring, five members served as judges at the Pittsburgh Regional Science and Engineering Fair, held at Heinz Field for students in grades 6-12. The club also provides a science tutoring service for all ages; current participants include undergraduates, non-traditional adult learners and others. In the future, the group plans to expand its outreach activities, host more pedagogy seminars and continue to serve as a discussion forum for its members.

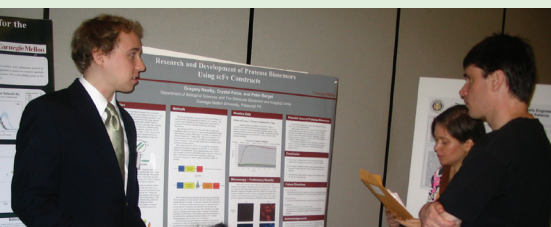
The club, which recently became a university-recognized club, is moving towards involving all Mellon College of Science programs and biomedical engineering students in their activities.



Club members serve as judges at a local science fair.



A club seminar led by guest speaker Dr. Manuel Ares.



Club members judge at the Meeting of the Minds, a university-wide undergraduate research symposium.

Visit www.cmu.edu/bio/teaching-club/ to view the upcoming events of this expanding organization.

Alumni Updates

Tom Anfuso (B.S. '91) manages infrastructure development, release management and testing as vice president of application and infrastructure execution at USAA.

Yuliya Anikanova (B.S. '04) is a fourth-year medical student at Jefferson Medical College.

Carolyn Barbieri (B.S. '00) and her husband Jeff (ECE '00) joyfully announce the birth of their son, Carter Jeffrey, born on February 3, 2008.

Sandra Brockman (Ph.D. '94) practices intellectual property law at Proskauer Rose, LLP in Boston, Mass.

James Burnette (Ph.D. '00) is the HHMI program director for Sue Wessler's HHMI Professorship at the University of Georgia. He also recently developed a course called the Dynamic Genome.

Christina Chern (B.S. '06) received an M.S. in chemical engineering from Texas A&M University in Dec. and accepted a position at the U.S. Patent and Trademark Office.

Radha Chitale (B.S. '06) was awarded an M.S. in science and medical journalism from Boston University and now works as a health writer for the ABC News Medical Unit.

Kevin Collins (B.S. '97) is a postdoctoral fellow in the laboratory of Michael Koelle at Yale's Department of Molecular Biophysics and Biochemistry.

Jamie Conklin (B.S. '05) is a Ph.D. student at Stanford University in the lab of Julien Sage and works on interactive science projects at the Tech Museum of Innovation in San Jose, Calif.

Nicole Daver (B.S. '04) is a fourth-year medical student at the Philadelphia College of Osteopathic Medicine.

Amanda Deming (B.S. '06) served as a health coach for AmeriCorps until July 2007, then worked as a counselor and medical assistant at Philadelphia Women's Center. She currently attends Jefferson Medical College as a first-year medical student.

Dorothy Engle (Ph.D. '86) was promoted to chair of the Biology Department at Xavier University.

Steven Garlow (Ph.D. '89) is chief of psychiatry at Emory University Hospital in Atlanta, Ga. His research focuses on understanding risk for suicide completion, including potential genetic risk.

Stefan Groetsch (B.S. '94) is a Lieutenant Commander in the U.S. Navy stationed at Branch Health Clinic in Japan, where he serves as the senior medical officer.

David Hill (B.S. '05) is a third-year M.D./Ph.D. student at the University of Pennsylvania, and is studying the mucosal interface between microbes and the human immune system.

Christopher Hodge (B.S. '01) is training as an anesthesiologist at Massachusetts General Hospital and accepted a fellowship in cardiothoracic anesthesia at UPMC to begin in the summer of 2009.

Zachary Kahler (B.S. '05) is a fourth-year medical student at the University of Arizona.

Prateek Kumar (M.S. '05) is working as a bioinformatics software engineer at the J. Craig Venter Institute in La Jolla, Calif.

Bryan Lewis (B.S. '97) is pursuing a Ph.D. in computational epidemiology and uses large-scale simulations of disease transmission to inform public health policy.

Jonathan Lustgarten (B.S. '04) graduated with a Ph.D. in bioinformatics from the University of Pittsburgh School of Medicine.

Tara Marsh (B.S. '05) is a fourth-year medical student at the University of Pittsburgh School of Medicine.

Marnie Morales (B.S. '06) is a Ph.D. candidate in the neuroscience program at the University of California at Davis studying the function of the proto-oncogene transcription factor N-Myc.

Jessica O'Hara (B.S. '07) is a graduate student in the Department of Molecular Biology at Princeton University in the laboratory of Manuel Llinas.

Priya Palit (B.S. '07) works for the National Cancer Institute researching symptom management and rehabilitation of cancer survivors with chronic GVHD.

Julie Phillippi (Ph.D. '05) is a research assistant professor at the University of Pittsburgh, where she studies cellular and molecular mechanisms of ascending aortic aneurysms in patients with bicuspid aortic valve.

Narayanan Raghupathy (Ph.D. '07) is a postdoctoral researcher at Princeton University.

Bob Reid (B.S. '83) works at Fairfax-Northern Virginia Hematology/Oncology, PC as a hematologist/oncologist and serves as president of the medical staff at Inova Fair Oaks Hospital, Fairfax, Va.

Marni Reinhardt (B.S. '01) is a marriage and family therapist intern in Southern California.

Jeremy Schonhorn (B.S. '86) is a senior scientist at Genzyme Corporation.

Jason Sims (B.S. '06) is attending the University of Pennsylvania School of Medicine.

Audrey Sykes (B.S. '81) recently became director of project management in the Operations Department at QIAGEN.

Yaoyu Wang (B.S. '01) was appointed a research fellow in virology at the Partners AIDS Research Center studying HIV and HCV evolution.

Peter Ward (B.S. '96) is an assistant professor of structural biology at the West Virginia School of Osteopathic Medicine.

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Alumni Updates

Andrea Wiethoff (Ph.D. '00) is working as senior clinical scientist for Philips Healthcare and an honorary senior lecturer at King's College London.

Maggie Young (B.S. '05) is attending the Medical Scientist Training Program at Washington University in St. Louis and works in the lab of Tim Ley studying homologous recombination in stem cells.

Elyse Zheng (B.S. '05) is a biology teacher at Shady Side Academy and married Jim Zheng (H&SS '05) in the summer of 2006.

Peter Zullo (M.S. '05) is a first-year MBA student at Cornell University.

The Promoter Winter 2009

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Inquiries concerning application of these statements should be directed to the Provost, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA 15213, telephone 412-268-6684 or the Vice President for Enrollment, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA 15213, telephone 412-268-2056.

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Volunteer at the BioSAC booth during Spring Carnival. Help support graduate student travel awards. Help support undergraduate research efforts. Speak at our seminar series. Become a mentor.

www.cmu.edu/bio/connect