

The Promoter

Winter 2008 No. 10

With 2007 coming to a close amid personal and professional resolutions, we're taking stock of the department's triumphs and challenges and anticipating a productive 2008.



Faculty and Graduate Students at the Annual Stupakoff Departmental Retreat at Camp Kon-O-Kwee

The M.S. and Ph.D. programs have expanded in number, and applications to both programs have been rising. Doctoral student Bistra Iordanova won a Graduate Research Fellowship from the National Science Foundation, and fellow student Ken Hovis received a National Research Service Award from the National Institutes of Health. In addition to their research

training, our graduate students are sharpening their teaching skills, participating in community outreach, and facilitating diversity efforts. A new Teaching Club is operating and a Careers Club is getting underway.

The undergraduate program continues to thrive with the number of students interested in biology still growing. The BioSAC remains very active, earning top prizes for the second year in the annual Relay for Life event—raising over \$20,000 dollars in support of the American Cancer Society. Four of our current students received national recognition, including three Goldwater Scholarships and one Gilliam fellowship. In the fall of 2008, we will offer a new national program call Phage Hunters, sponsored by the Howard Hughes Medical Institute, that is designed to introduce first-year students to research.

Our hardworking and dedicated faculty members continue to shine. Dr. Elizabeth Jones, Head of the Department was honored with the first “Excellence in Education” award from the Genetics Society of America. Professor Robert F. Murphy was named Director and appointed Professor of the newly established Ray and Stephanie Lane Center for Computational Biology. Associate Professors Nathan Urban and Russell Schwartz received the Eberly Family Career Development Professorships, Professor Gordon Rule won the Ryan Award for Meritorious Teaching and Associate Professor Jonathan Minden was awarded the Mellon College of Science Award for Innovation in Education.

Professor Bill Brown, a beloved scholar, teacher, and mentor, passed away this past July. Brown represented the best of our department and will be greatly missed. In his thirty-plus years at Carnegie Mellon, he built a legacy of creativity, collaboration, mentoring and respect.

Inspired during the recent tribute to Brown, former students organized a new departmental alumni group. Carnegie Mellon Biological Sciences Alumni Council (CMBAC) will be dedicated to preserving and strengthening our sense of community. We invite all alumni to “come back” and reconnect with us!

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Interdisciplinary Initiatives

By Danica Cowan, *Senior Undergraduate Student*

In today's progressive society, it is important for students to branch out and obtain a well-rounded education, hence Carnegie Mellon's focus on interdisciplinary programs. Two unique programs that embrace students' diverse interests are the Bachelor of Science and Arts (BSA) and the Science and Humanities Scholars (SHS) programs.

The BSA program is designed for students with exceptional ability in both science and the arts. By dividing their time and talents evenly among classes in the College of Fine Arts and the Mellon College of Science, students diversify their education while retaining a depth of knowledge in both fields. The BSA program gives students the opportunity to take an interdisciplinary approach to their education through seminars and interdisciplinary projects.

For example, Jeffery Walch, an architecture and biology student, completed a project on the effect of the hospital room environment on patient recovery. In

2005, he was first author of "The Effect of Sunlight on Postoperative Analgesic Medication Use: A Prospective Study of Patients Undergoing Spinal Surgery" in *Psychosomatic Medicine*. This study



The above "Untitled" oil painting was created by Victoria Spindel, a senior in the Bachelor of Science and Arts program, in 2006.

determined that patients exposed to more sunlight experienced less stress and pain; therefore, they took less medication, which reduced cost. After graduation, Walch directed a continuation of this project at the University of Pittsburgh Medical Center and involved undergraduates in the team. Walch is currently in the Medical Scientist Training Program, jointly offered by the

University of Pittsburgh and Carnegie Mellon.

In addition to architecture, biology students in the BSA program have studied art, music and design. "When I tell people that I am a biology and design major, they ask how those fields could possibly be related," said junior BSA student Rhoni Rakos. "However, I think that there is a link between all fields, and the BSA program has taught me to be creative in finding that link."

Similarly, the SHS program allows students who are gifted in the humanities and the sciences to broaden their education. First-year students participating in this invitation-only program live in special interest housing in New House, and attend seminars and SHS Student Advisory Council functions to help develop interpersonal relationships and foster the growth of ideas.

Together, these two programs allow biology students to tailor an educational plan that incorporates their interests and talents.

NeuroNews

By Brett Benedetti, *Fourth-year Ph.D. Student*

Over the last five years, neuroscientists Alison Barth, Justin Crowley and Nathan Urban have established a vibrant research environment in the Department of Biological Sciences, affectionately called the "Great Hall of Brain Science." During this time, these three labs have grown to include 13 graduate students, five postdoctoral researchers, and a host of undergraduates and rotating graduate students. Through their efforts, new insights into brain function are being made in a number of diverse areas, including how sensory stimuli are encoded in the brain, how circuits are wired during development and how synapses and neurons can be

altered by experience or disease.

In the Barth lab, recent work has sought to identify a set of genes whose transcription may be regulated by neuronal activity, while other projects have demonstrated the remarkable capacity for plastic changes in how the rodent brain represents sensory stimuli. In the Crowley lab, international collaborations are helping to describe how specific patterns of connectivity inform circuit development in the mammalian visual cortex. Along with Dr. Hiroshi Kawasaki (University of Tokyo) and Dr. Fred Wolf (Max Planck Institute for Dynamics and Self-Organization),

Crowley was recently awarded a Young Investigator grant through the Human Frontier Science Program. Their work aims to address the ways in which anatomical connections between spatially distinct regions of the visual cortex contribute to the formation of an "orientation map" of the visual world. In the Urban lab, graduate student Ken Hovis received a National Research Service Award to determine how neuronal connections in the accessory olfactory bulb contribute to the encoding of pheromones. Crowley and Urban have also recently been appointed as affiliated faculty at the Lane Center for Computational Biology.

Building on the Legacy



On Saturday, November 10, 2007, many attendees of Dr. Brown's memorial service gathered at The Fence, which had been painted by current students to honor his memory.

William E. Brown, Ph.D. (1945–2007)

For many students their introduction to biology at Carnegie Mellon began with a garbage bag cell model demonstrated by a professor who most will never forget—a professor whose passion for science, commitment to education and genuine concern for every student were virtually unparalleled. That professor was Dr. William E. Brown.

Dr. Brown passed away this summer due to complications following surgery. The loss of Dr. Brown stunned our entire community; one alumnus wrote, "I cannot imagine the biology department without Dr. Brown." Bill Brown had been a vital member of our department for over three decades and had, in fact, been instrumental in establishing it. Upon his arrival in 1973 as an assistant professor, he joined a core group of faculty who were committed to creating an innovative and cutting edge biology department on par with (or even better than) the best in the country. Throughout his career, Bill worked

tirelessly to reach that goal by advancing the educational, research, administrative and service missions of the department. As President Cohon pointed out in his remarks at the campus-wide tribute to Bill, much of the growth and success of our department can be attributed to Bill and his work.

- Department Head: 1993–2000 (1993–1995 acting)
- 1986 Julius Ashkin Teaching Award
- 2002 Richard Moore Education Award
- 2004 Robert Doherty Award
- Leader in developing the Bachelor of Science and Arts Program, Science and Humanities Scholars Program, M.S. in Biotechnology and Management, M.D. /Ph.D. Program and Pennsylvania Governor's School for the Sciences

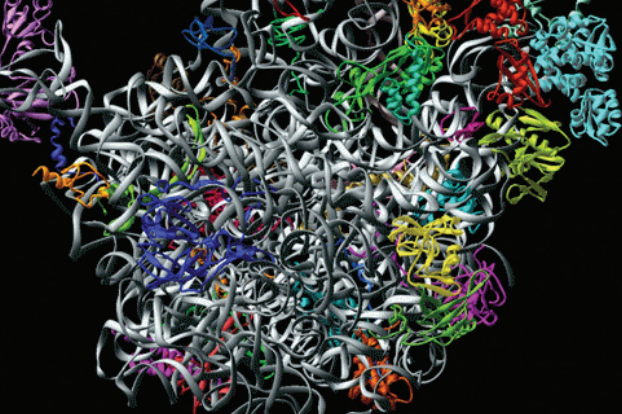
Bill taught many lessons both in and out of the classroom. For instance, when he became Department Head, he hosted a departmental celebration. During the event, he highlighted his philosophy that an organization, like a chain, is only as strong as its weakest link and that everyone, no matter their job, title or rank, has an

important role to play in the department's success. As a remembrance of his belief in them and the importance of their role, he gave each person a chain link and empowered them to do their best. Several still carry that link today, nearly fifteen years later.

From courses and degree programs to new discoveries and technologies, Bill's impact is wide-reaching, and he will live on forever in the hearts and minds of all who knew him. Your fondest memory of him may be as an inspiring teacher, an innovative researcher, a visionary leader, a jolly Santa Claus, a valued colleague, a trusted mentor or a dedicated friend. Many do not know the breadth and depth of all that Bill was and all that he did. He never wanted accolades but perhaps the best tribute we can give to his memory is to continue the work he began and never to forget that each of us—students, faculty, staff and alumni—have important roles to play in building upon his legacy.

To read a complete obituary, view the webcast of his memorial tribute or donate to the William E. Brown Scholarship fund, visit: http://www.cmu.edu/bio/news/2007/brown_tribute.shtml





Not Only the Messenger

By Erin Martin

For years, the little nucleic acid called RNA was considered just the go-between from DNA, the key to all of our genetic information, to proteins, the substances that actually do the work of making our bodies function. But thanks to a few recent discoveries and what a famous philosopher of science, Thomas Kuhn, calls a “paradigm shift,” RNA has gone from “only the messenger” to a multi-functional instrument.

It all started with DNA’s discovery by Watson and Crick. Frances Crick and scientist George Gamow, perhaps realizing that there was more to RNA than simply moving information down the line, started the RNA Tie Club in 1954, which purported “to solve the riddle of RNA structure.” Messenger RNA and transfer RNA were identified, and although RNA’s purpose still seemed quite narrow, scientists began seeing glimpses of RNA’s diversity.

Examples of RNAs that regulate cellular activity and RNAs that cause reactions in cells began emerging. Scientists still tended to regard these regulatory and catalytic RNAs as curiosities or exceptions, so it wasn’t until splicing was discovered in 1977 that it became clear RNA was serving an important regulatory function.

Thomas Kuhn describes the moment when scientific knowledge is overturned as a “paradigm shift.” Instead of following a straight line of discovery—systematically building knowledge that fits a paradigm—science routinely undergoes “aha!” moments. When these “aha” moments reach a critical mass and the current paradigm begins splintering, a scientific

revolution can occur. An example of a paradigm shift that created a revolution was Einstein’s theory of relativity, which upended the view of physics as simple Newtonian mechanics. A current shift started with another “aha” moment—the discovery of RNA splicing.

This mechanism adds or subtracts data from the messenger (DNA) to the recipient (proteins). Splicing is like the mailman opening one of your letters, cutting out a paragraph about Grandma, and adding a paragraph about Aunt Sue. Same letter, different message.

Professor Javier López, who has been with the Department of Biological Sciences since 1990, studies alternative splicing in RNA. According to López, alternative splicing is one of the processes that contribute to human complexity. “When the human genome was sequenced, there seemed to be no correlation between the number of genes and the complexity of the organism. Far fewer genes were found in humans than was expected,” said López. “Part of the explanation is alternative splicing.” Instead of one gene making one kind of protein, alternative splicing changes the messenger RNA so that the same gene can make different proteins, each having functional differences.

López’s lab also discovered and is currently studying recursive splicing, a mechanism of processing that is specific to genes with long introns. According to a Carnegie Mellon press release describing López’s discovery, recursive splicing “removes long introns by steadily paring them down

in a predictable fashion and joining the remaining exons.” It is remarkable that enormous genes, some of which take days to transcribe and process, can be expressed efficiently and correctly. Recursive splicing is one of the mechanisms that appear to be responsible for such feats.

“Over the past two decades many new roles have been discovered for RNAs as catalysts, as components of subcellular structures, and as regulators of gene expression,” said López. “RNA was probably the molecule responsible for both information storage and catalysis in early life, but we thought that these roles had been taken over by DNA and protein, respectively. It turns out that we still live in an RNA world.”

Professor Mark Macbeth, who joined the Department of Biological Sciences in the spring of 2007, studies a different process—RNA editing. When mutations happen in DNA, they are carried through the RNA and show up in the protein. With RNA editing, a protein changes the “message” during the RNA stage.

“Like an editor of a newspaper changing what a journalist has written, this RNA editing protein can make changes in the RNA and that makes changes in the protein,” explained Macbeth. Typically, one DNA codes for one RNA and that makes one protein. When RNA editing occurs, a different protein is produced than the one that the DNA intended. Macbeth wondered, “Why did we evolve to have this protein that changes the RNA?”

Using biochemical, structural and genetic methods, Macbeth investigates how and why some RNAs are targeted for editing. One focus is to elucidate the structure of these RNA editing proteins, using x-ray crystallography, which creates an image of a protein by plotting x-ray scatter after it is directed at a protein. “Once we figure out what these proteins look like,” Macbeth explained, “we can figure out what the RNA editing protein is looking for. And knowing the features of edited RNAs will help us find other RNAs with similar features that are also edited.”

The clinical applications of RNA editing research are mainly neuronal. RNA editing can involve serotonin receptor sites, affecting how serotonin is transmitted, which contributes to such mental illnesses as depression and schizophrenia. Determining when, where and what RNA is being edited may be an effective way to approach treating mental illness.

Professor John Woolford’s RNA research interest lies in ribosomes—mainly how they assemble. Of great medical importance, ribosomes are intracellular structures composed of RNA and proteins that manufacture other proteins used in cellular function. Mutations in the assembly of ribosomes have been linked to disorders that arrest development, some types of cancer, blood disorders, autism and other neurological disorders.

“We are interested in how the proteins and RNAs are brought together to make a very detailed structure, the ribosome, and what catalyzes the binding of ribosomal proteins to RNA,” explained Woolford. “There’s folding, and refolding and re-refolding of RNA until you get to the final structure, the ribosome.”

Woolford began studying ribosomal RNA using genetic and proteomic approaches, and has branched into computational

methods. “We’ve teamed up with computational biologists as well to try and keep track of the 170 assembly factors and the 83 components—so that’s 253 molecules that we have to keep our eyes on when studying the assembly of ribosomes,” he explained.

RNA research started as an afterthought to huge scientific discovery that was DNA. More recently, however, a paradigm shift in scientific thought has caused RNA, that afterthought, to be recognized for its importance in everyday cellular function. Three faculty members in the Department of Biological Sciences recognized RNA’s significance and now are adding their findings to the growing body of RNA knowledge.

“RNA is just so great,” enthuses Mark Macbeth. “It’s not just a copy of DNA; it can do all this stuff with only four nucleotides, while proteins need 20 amino acids.”

Structural Biologist Joins Faculty



This year, the growing field of structural biology at Carnegie Mellon welcomed a new member. Mark Macbeth, who earned a Ph.D. in Biochemistry

and Molecular Biology from the University of Chicago and completed a postdoctoral appointment at the University of Utah, joined the Department of Biological Sciences on May 1, 2007.

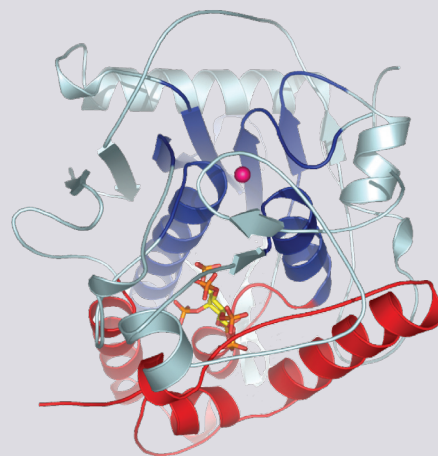
Macbeth’s laboratory studies the structure and the function of adenosine deaminases

that act on RNA (ADARs), which are a class of enzymes responsible for regulating nervous system function. Macbeth views ADARs from two angles: a biochemical angle using mutagenesis and a structural angle using X-ray crystallography.

Macbeth’s first goal as a Carnegie Mellon faculty member is to discover what an ADAR looks like when it’s bound to RNA. He anticipates much collaboration within the Department as well as with members of the new joint Carnegie Mellon–University of Pittsburgh program in Structural Biology and Biophysics.

“There are many faculty who have never worked on structural problems before,

and who now are interested in working together,” he said.



The crystal structure of the catalytic domain of human ADAR2.

Fostering Diversity with New Programs

By Jeanne Morin-Leisk, *Second-year Ph.D. Student*

There is a quiet diversity revolution happening in the Mellon Institute. In the past, expanding to a diverse student, faculty and staff population in Biological Sciences has been difficult to cultivate. The problem is summarized by Dr. Peter Berget, “The pipeline of minority individuals [in Biology] starts out not very full and it just gets emptier.”

Recently, the Mellon College of Science (MCS) has initiated outreach programs to enhance diversity. These diversification initiatives encompass not only the recruitment and retention of historically underrepresented groups, but also extend the realm of outreach into the surrounding public school systems and communities.

In one initiative, a small group of Biological Sciences graduate students has teamed up with Dr. Newell Washburn from the Chemistry department to persuade Schenley High School in Pittsburgh to institute a tutoring program. This graduate tutoring initiative program aims to spark curiosity and excitement in the sciences among local high school students, eventually encouraging their enrollment into an undergraduate science program. High schools are a good place to start, but initiatives addressing retention at the undergraduate level have also been undertaken this year by the Mellon College of Science. Betty Mbom,

a senior studying biological sciences, has spearheaded a new program called COMPASS – Coaching Minority Progress and Academic Success in Science. COMPASS pairs upperclass minority students with incoming first-year minority students. The aim of the program is to provide a comfortable and safe way to



COMPASS Mentors and Mentees
(left to right) Bottom: Kamal Ibrahim and Heather Bernard Top: Chrystal Miller, Tamara Hamilton, Alana Cheeks-Lomax, Betty Mbom, Denise Asafu-Adjei, and Sobie Maduka

familiarize the incoming students with all of the resources available to them that they may otherwise overlook. Moreover, the program gives incoming students an immediate connection to other students who have a few years of experience here at Carnegie Mellon and have gained valuable insights that they are excited to share. The program has proved successful in its first year. Faculty advisor Dr. Amy Burkert says, “Through this connection,

I now interact, almost weekly, with these first year students as well as their upper-class mentors and not just at formal COMPASS events.” Mbom is grateful for the strong faculty and staff support, especially that of Dr. Rea Freeland, Associate Dean of MCS, for her program and is positive about its growth and sustainability for years to come.

Strong support from faculty members ensures that they assist the students in making outreach strides. Biology faculty have teamed up this semester to write an Underrepresented Minority grant application that will allow them to take on undergraduate students of primarily underrepresented groups and advise them through a research experience in their laboratories. This “total immersion summer program” is expected to bolster undergraduate interest in graduate training in the biological sciences, specifically that which is available at Carnegie Mellon.

As programs such as the graduate tutoring initiative and COMPASS gain momentum, the hope is that the number of underrepresented applicants to the Department of Biological Sciences will grow and fill up the leaky pipeline, all the way from undergraduate to faculty positions. “Diversification causes change,” says Dr. Berget, “and it is always for the better.”

Alumni Updates

Romulo Baltazar (B.S. '96) is a radiology resident at Maimonides Medical Center in New York City and was accepted into a fellowship program in Musculoskeletal Radiology at University of California, San Diego.

Barbara Barnard (B.S. '70) is Director of the Office of Research and Sponsored Programs at the Research Foundation CUNY. She is also a breast cancer survivor.

Heather Bassett (B.S. '93) is an internal medicine resident at Vanderbilt Medical Center.

Kristina Behan (Ph.D. '01) is Associate Professor in the Department of Biology, Clinical Laboratory Sciences Program, at University of West Florida, Pensacola, FL.

James Burnette (Ph.D. '00) has moved to the University of Georgia in Athens to be a Science Educator in the Department of Plant Sciences.

Alumni Updates

Nicole Bush (B.S. '05) received her M.S. in Cell and Developmental Biology at Vanderbilt University. She is now in a Pediatric Nurse Practitioner program at Johns Hopkins University.

Radha Chitale (B.S. '02) is working on an M.S. degree in Science Journalism at Boston University.

Grace Choy (Ph.D. '03) is a Research Educator at the University of Texas at Austin. She is part of a new department called the Freshman Research Initiative.

Joanna Dragich (B.S. '99) is completing a postdoctoral fellowship at the University of California, Los Angeles.

Rebecca Frederick (B.S. '01) graduated with a Ph.D. from the University of Utah and began postdoctoral training in Allan Spradling's laboratory at the Carnegie Institute of Washington, Baltimore.

Rachel Gougian (B.S. '06) received an M.S. in Health Care Policy and Management from Carnegie Mellon's Heinz School.

Heather (Shaw) Grisafi (B.S. '01) is a third-year resident in Radiology at West Virginia University Hospital.

Amy (Berman) Hahn (B.S. '85) is Associate Professor and director at the Transplantation Immunology Laboratory, Albany Medical College in Albany, NY, and part-time lab director at the HLA Laboratory, Upstate Medical University Hospital in Syracuse, NY.

Elena Hawryluk (B.S. '01) is working on an M.D./Ph.D. in Cellular Biology and Physiology at the University of Pittsburgh.

Andy Hsieh (B.S. '06) is a second-year graduate student in the Department of Chemistry at the University of California, Berkeley.

David Hui (B.S. '00) started a biotechnology company that specializes in using adult stem cells for cardiovascular diseases.

Mary Iovine (B.S. '93) is Assistant Professor at Lehigh University. She and her husband, **Alexander Brands (B.S. '93)**, just welcomed their second child in Dec. 2007.

Arun Jayakumar (B.S. '96) is a physician in the U.S. Air Force. He deployed to Iraq in 2006.

Charles Kelly (B.S. '68) is Director of Fairfax Identity Laboratories, which provide human identification DNA profiles for both civil and criminal judicial matters. He aided in identifying victims of the World Trade Center attacks in 2002.

Zia Khan (B.S. '02) is at Princeton University, working on a Ph.D. in the Computer Science Department's Quantitative and Computational Biology Program.

Mary LaLonde (B.S. '99) received her M.D./Ph.D. from Stony Brook University.

Robert Last (Ph.D. '86) is Professor in the Departments of Biochemistry, Molecular Biology and Plant Biology at Michigan State University.

Lauren Le Beau (B.S. '03) is working in the pharmaceutical industry as a project manager at ClinPhone, Inc. She designs software to help pharmaceutical and biotech companies run clinical trials.

Teresa Leonardo (B.S. '96) is completing an AAAS Science and Technology Policy Fellowship on the Global Climate Change team at the U.S. Agency for International Development.

George Matcuk (B.S. '98) is completing a radiology residency at Los Angeles County/University of Southern California Medical Center and is accepted into a fellowship in Musculoskeletal Imaging at the University of Southern California to begin in 2008.

Vanessa McClain-Duer (B.S. '06) is Associate Scientist at L'Oreal USA working on skincare research and development.

Kimberly McGraw (B.S. '91) and her husband joyfully announce the birth of their son, Ian Henry, born in May 2007.

Andrea (Dent) Michalek (B.S. '93) is President of Topular, a consulting firm that helps technology companies launch new products.

Kara Mischler (B.S. '00) is a second-year resident in Emergency Medicine at the University of Florida in Jacksonville, FL.

Aaron Mitchell (B.S. '77) is Professor and Interim Chair at Columbia University. He also taught a summer course at Woods Hole, MA.

Susan Montenegro (B.S. '06) is earning her Pharm.D./M.P.H. at the University of Maryland School of Pharmacy.

Huned Patwa (B.S. '88) is Associate Professor at Yale University's Department of Neurology and Chief of the Neurology Service in the VA/CT Healthcare system.

Robia Pautler (Ph.D. '99) is currently Assistant Professor and Co-Director of Graduate Education at Baylor College of Medicine. She welcomed the birth of her daughter, Emma, in May 2007.

Julia Polat (B.S. '05) is attending Boston University School of Medicine. She welcomed the birth of her daughter in February 2007.

Audra Pompeani (B.S. '03) is working on a Ph.D. in Molecular Biology at Princeton University.

Mamta Puri (Ph.D. '05) is a postdoctoral scholar at Northwestern University.

Sheree Rybak (Ph.D. '97) is working for an intellectual property law firm in the area of patent and trademark law.

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Help support graduate student travel awards.

Help support undergraduate research efforts.

Speak at our seminar series.

Become a mentor.

For more details, visit

www.cmu.edu/bio/connect

Alumni Updates

Jeremy Stark (B.S. '93) is Assistant Professor of Radiation Biology at the Beckman Research Institute of the City of Hope in Duarte, CA.

Glenn Telling (Ph.D. '90) is Professor of Microbiology, Immunology and Molecular Genetics at the University of Kentucky. He also serves as Chair of the Food and Drug Administration Transmissible Spongiform Encephalopathy Advisory Committee and Science's Board of Reviewing Editors.

Peter Ward (B.S. '96) is Assistant Professor of Anatomy at the West Virginia School of Osteopathic Medicine.

Jared Wenger (B.S. '06) is working on a Ph.D. in the Department of Genetics at Stanford University, in the lab of Gavin Sherlock.

Neel Vibhakar (B.S. '97) is Assistant Medical Director of the Emergency Department at Baltimore Washington Medical Center.

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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 412-268-2056 or the Vice President for Enrollment, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA 15213, telephone 412-268-2056.

Carnegie Mellon University publishes an annual campus security report describing the university's security, alcohol and drug, and sexual assault policies and containing statistics about the number and type of crimes committed on the campus during the preceding three years. You can obtain a copy by contacting the Carnegie Mellon Police Department at 412-268-2323. The security report is available through the World Wide Web at www.cmu.edu/police/statistics.htm. Obtain general information about Carnegie Mellon University by calling 412-268-2000.