



# The Promoter

Department of Biological Sciences  
Carnegie Mellon

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## Letter from the Department Head

I am pleased to share with you some of the many exciting developments in the Department of Biological Sciences since our last Promoter newsletter. In February 2005 we hosted a two-day advisory board visit, which provided us with a unique opportunity both to chart our growth over the past five years and to plan strategically for the future. The Board described our undergraduate program and our students as breathtaking, and recommended that we double the size of our successful graduate program.

We are proud to report that the Department of Biological Sciences is the largest undergraduate unit in the Mellon College of Science and one of the largest in the University. We now teach introductory biology to more than 500 students. Immediately upon graduation, approximately 50% of our students attend either graduate school or medical school; the remaining students work in science-related fields.

With 85% of our majors participating in research before graduation, undergraduate research remains a departmental cornerstone; we also open our labs to undergraduate researchers from other institutions. Agencies supporting our undergraduate research initiative include the HHMI Undergraduate Science Education Program, HHMI Professors' Program, Beckman Foundation, Merck Foundation, Pennsylvania Tobacco Settlement Fund, NSF Information Technology Research Program, NSF Research Experience for Undergraduates Program, Merck-UNCF, Pfizer Foundation, NASA and McNair Scholars Program.

With the support of the HHMI Undergraduate Science Education grant, the Department has expanded and enhanced course offerings. We have added a laboratory for Cell and Developmental Biology and Neurobiology and have upgraded our lab courses in Molecular Biology and Biochemistry. HHMI grants have also fostered the development of an interdisciplinary lab for first year students.

The Ph.D. in Biological Sciences program is expanding rapidly. In 2005 we accepted a first year graduate class of 15 students, who are beginning their second round of laboratory rotations in preparation for selecting their thesis advisors. We wish them luck and look forward to the 2006 recruiting season.

The Department has added several new degree programs. Robert Murphy developed a professional M.S. in Computational Biology program and William Brown worked with faculty members from Carnegie Mellon's Heinz School and Tepper School of Business to develop a curriculum leading to an M.S. in Biotechnology Management. We teamed with the School of Computer Science to develop a unified, university-wide bachelors degree in computational biology. The Department also partnered with the School of Computer Science and the University of Pittsburgh for a joint Ph.D. program in computational biology.

Since 2000 the Department has recruited faculty in two new areas of research and education: computational biology and neuroscience (see related articles). We are extremely proud of our distinguished group of new faculty. Brooke McCartney was awarded a Basil O'Connor Starter Scholar Research Award from the March of Dimes. Russell Schwartz received an NSF Early Career Development (CAREER) award and was then one of 20 of the 400 CAREER awardees to receive the prestigious Presidential Early Career Awards for Scientists and Engineers. Justin Crowley was named a 2004 Searle Scholar. Alison Barth received a Sloan Fellowship. Dannie Durand, a previous recipient of a Sloan Fellowship, received a Packard Fellowship. And Nathan Urban has been named one of the top 50 innovators in the December issue of *Scientific American*.

To our graduate and undergraduate alumni: please keep us informed of your successes. We love to hear from you! Also, make sure that you visit our Web site ([www.cmu.edu/bio](http://www.cmu.edu/bio)) often to keep up-to-date on the Department's achievements.



**Dr. Elizabeth Jones**  
Professor & Department Head  
Dr. Frederick A. Schwertz  
Distinguished Professor of  
Life Sciences &  
University Professor

# Welcome

## *Biological Sciences Undergraduates*

The biological sciences are in the news now more than ever due to some high-profile events. The Human Genome Project, increased awareness and research into conditions like cancer and diabetes and the popularity of television shows such as CSI and Crossing Jordan have made science a hot subject.

The Department of Biological Sciences is experiencing the effects of this growing interest in the biology areas. This year, 85 sophomores declared a primary major in biological sciences, computational biology or the unified major in biological sciences and psychology. Currently there are 87 sophomores, 72 juniors and 62 seniors in the Department of Biological Sciences, making it the largest undergraduate program in the Mellon College of Science. And the program is set to grow even more, with more than 90 incoming freshmen attending the first year information lunch during Orientation 2005.

## *Ph.D. in Biological Sciences Students*

In August 2005, the Department welcomed 15 new students into the Ph.D. in Biological Sciences program. The class, one of the largest in recent years, comprises 12 U.S. students from schools such as the University of Washington, Bucknell University, Washington and Jefferson College, Duke University and Spelman College, and three international students from leading schools in Singapore and India. The young scholars entered the program with diverse research interests, which are being explored in the second of three laboratory rotations. After completing their final rotations, students will select advisors, marking the beginning of their doctoral research at Carnegie Mellon.

Many of the matriculants plan to focus their research in the field of neuroscience, investigating such topics as memory formation and plasticity, neurogenesis, imaging techniques to view human behavior, and other systems- and network-level questions. Cell and developmental biology, along with their applications to the study of human function, are also popular concentrations; biochemistry, molecular biology and genetics, and computational biology round out the research areas that students are investigating.

## *M.S. in Computational Biology Students*

This year we welcomed six students from excellent schools in the United States and India into the M.S. in Computational Biology program. An active research community, interdisciplinary opportunities and a successful track record for program alumni attracted students who wish to enter the growing field of computational biology in the biotechnology and pharmaceutical industries, as well as at universities and research institutes. Current student projects range from exploring alternate splicing in *Drosophila* to developing a mathematical model for 2D gel electrophoresis.



# Building Research Skills

*HHMI support helps the Department of Biological Sciences train tomorrow's scientists*

Christina Onorato, a sophomore biological sciences and philosophy major, was curious about the art of conducting research. So curious, in fact, that she decided to devote the summer between her freshman and sophomore years learning how to conduct research. While experiencing the ins and outs of biological research, laboratory safety and the experimental method, she also worked to create genetic markers in *Saccharomyces mikatae*, a budding yeast. These markers will allow scientists to easily track the insertion of genes in the yeast's DNA for other experiments. Not bad for a college freshman. Thanks to the Summer Research Institute (SRI) at Carnegie Mellon, a Professor's program funded through the Howard Hughes Medical Institute (HHMI), rising sophomores such as Christina have a chance to tackle research early in their college careers.



Since 1989, Carnegie Mellon undergraduates seeking research experience can apply for funding through a variety of different programs supported by the HHMI Bioscience Education Grant. HHMI's support has helped undergraduates experience a number of research opportunities in such places as individual faculty labs across campus, interdisciplinary research centers at Carnegie Mellon like the Molecular Biosensor and Imaging Center (MBIC), regional research labs such as the Hillman Cancer Center and the Pittsburgh Zoo, and various

departments in the University of Pittsburgh's Medical School. From 1998 to 2005, 85% of undergraduates in the Department of Biological Sciences have taken advantage of these programs.

HHMI funding has done more than support undergraduate research. With the first award from the Institute, the Department initiated its pioneer program in computational biology. The university allocated funds for an interdisciplinary computer cluster and five tenure-track faculty positions. HHMI grants have provided computers for labs, faculty and support and an annual Computational Molecular Biology Symposium. On this foundation the Department of Biological Sciences has built a wildly successful program — a program that includes a B.S. in Computational Biology, a professional M.S. degree and a new Ph.D. program in Computational Biology (joint with the University of Pittsburgh) that welcomed its first class in fall 2005.

Outreach has been an important activity for the Department as well. Annually, Carnegie Mellon hosts 12 minority middle and high school students who develop science fair projects while learning important research skills through the Math and Science Opportunity Program. These students have won numerous prizes at the local and regional level, with one student advancing to the national finals. The Science Van, a mobile laboratory, travels to elementary, middle and high schools to present “science in action” programs for thousands of students each year.

These are just a few examples of programs that are funded by the Institute. Jared Wenger, a past participant of the SRI, is currently working on a project in Dr. Elizabeth Jones's lab investigating the essential role(s) of the *Saccharomyces cerevisiae* gene *PBN1*. He credits HHMI for his continued research success.

“The Summer Research Institute gave me an introduction to conducting scientific research,” says Jared, a biological sciences major with a minor in chemistry and options in genetics and cell biology. “Continued support from my faculty mentor and funding from HHMI have allowed me to do research throughout my career at Carnegie Mellon.”

# Novel Neuroscience

On July 17, 1990, President George Bush declared the 1990's to be the "Decade of the Brain." He called on scientists, private foundations and industry to dedicate time and effort for conquering neurological disorders as well as increasing public awareness of brain function. He challenged all those doing neuroscience research to work on solving some of humanity's most debilitating brain diseases.

When President Bush made this proclamation, the city of Pittsburgh already had a strong presence in neuroscience. The University of Pittsburgh and its School of Medicine had launched impressive forays into multidisciplinary studies of cognition. University leaders however, sought to expand their research efforts into different aspects of neuroscience, and wanted to draw on the talents of Carnegie Mellon University in such fields as biological sciences, computer science, psychology and statistics. Leaders at the University of Pittsburgh and Carnegie Mellon, with the help of funding from the Richard King Mellon Foundation, started the Center for the Neural Basis of Cognition (CNBC) in 1994. James McClelland, a professor in the Carnegie Mellon Psychology Department, led the CNBC effort. Later, to strengthen the collaboration between universities, Peter Strick, a professor from the University of Pittsburgh, joined him. Now a shared program between the University of Pittsburgh and Carnegie Mellon, the CNBC describes its research program as "dedicated to the investigation of the neural mechanisms that give rise to human cognitive abilities."

The Center also offers graduate training in the cognitive sciences, in affiliation with several Ph.D. programs and the University of Pittsburgh's M.D. program.

In 1999, the CNBC review board examined the Center's achievements over the previous five years and issued recommendations for the future. One recommendation was to expand research into molecular neuroscience, to complement research already taking place at the CNBC. The Center turned to the Department of Biological Sciences to implement this suggestion.

The Department already had a strong presence in molecular biology through the research of faculty members Peter Berget, William Brown, Jonathan Jarvik, Elizabeth Jones, Adam Linstedt, Jonathan Minden, John Woolford and A. Javier López. It was decided that the

Department would expand its research into neuroscience. Associate Professor Javier López was chosen as the departmental liaison, heading a search committee responsible for hiring faculty who followed the Department's mission and vision and complemented the CNBC's research.

While the Department was exploring exciting research in molecular biology, developmental biology and genetics, among others, only López was involved in research impinging on neuroscience, and was teaching the "Biology of the

Brain" class. López organized a subset of the Department's existing seminar series that aimed to help the Department become familiar with neuroscience and also to allow faculty members in the Department to make contacts in the different neuroscience fields. Initially the Department invited eight speakers – they presented a range of such differing topics as mammalian and *Drosophila* neuroscience and cellular and developmental neuroscience. The leaders of the Department were enthusiastic about starting a neuroscience



The Great Hall of Brain Science, 1st floor, Mellon Institute

program, and began the search for neuroscience faculty. There was not a specific hiring plan; rather, the Department sought qualified applicants to add to its research strategies. Soon, the Department hired three faculty members — Nathan Urban, Alison Barth and Justin Crowley. They joined Assistant Professor Eric Ahrens, who at the time was beginning research using Nuclear Magnetic Resonance (NMR) microscopy to study aspects of the nervous system of mice.

Each new faculty member

# at Carnegie Mellon

by Erin Martin Kratt

focused their research in areas that linked to the Department's existing research and to that of each other. A core interest among the neuroscience group centers on different ways to image, or to capture a picture or movie of neuronal function. For example, Alison Barth is interested in how learning and memory are captured in the brain. She images gene expression - the process by which the instructions that are coded into genes are processed to create proteins - that occurs when a sensory object, such as a whisker in a mouse, is stimulated. Justin Crowley looks at neuronal function in developing brains to deduce how visual systems are formed *in vivo*. Nathan Urban seeks to identify the neural circuits in the olfactory region of the brain.

To assist the newly appointed neuroscientists in their research, the University built a new state-of-the-art research facility on the first floor of Mellon Institute. The Neuro Suite or "Great Hall of Brain Science," as it has been dubbed, features cutting-edge research facilities including setups for *in vivo* and *in vitro* physiological and optical recording of the activity of neurons. The suite also contains a two-photon laser scanning microscope for *in vivo* imaging, fixed tissue microscopy and a system for digitizing the morphology of stained neurons so that they can be analyzed by computational methods. At approximately 5,000 square feet, the Neuro Suite contains three labs, common space, faculty offices and a conference room. Coexisting in this space are faculty, research staff, graduate

students, postdoctoral fellows and undergraduates conducting research.

In fact, undergraduates asking the question, "Can adult neurogenesis be regulated?", inspired one of Nathan Urban's current research projects. For a

is related to neuronal death. The main goal of these experiments is to increase the survival rate of these undifferentiated neurons. Once the neurons survive at a higher rate, scientists can alter these neurons and force them into areas in the brain where cells are needed. These

*"The human brain, a three-pound mass of interwoven nerve cells that controls our activity, is one of the most magnificent — and mysterious — wonders"*

*George Bush, Presidential Proclamation 6158*

long time scientists believed that neurogenesis — the creation of new neurons in the brain — did not happen once animals reached adulthood. Research, however, has shown that adult neurogenesis does occur and it does so most frequently in the olfactory area of the brain; as much as 1% of cells in the olfactory bulb are replaced each day. Only a select few of these neurons are integrated into the surrounding brain to maintain stable olfactory function while the vast majority die. Why is the mortality rate for these neurons so high? And is there a way to control this neuron death?

The Urban lab seeks to answer these questions by altering the networks in which the neurons function. To affect these networks, Urban changes the amount or the quality of the outside stimuli that a neuron receives. In the lab, experimental animals are either deprived of olfactory stimuli by various methods (such as closing one nostril) or they are bombarded with novel scents in an effort to find out if olfactory stimulation

alterations may benefit people suffering from neurological diseases caused by the loss of cells in the brain — such as in people suffering from Parkinson's disease.

While the "Decade of the Brain" is over, research involving the brain is still going strong, especially at Carnegie Mellon. In the most recent Advisory Board meeting held for the Department of Biological Sciences, board members praised the Department's expansion into neuroscience, stating that "there is definitely a vision and a set of priorities. The Department is moving forward, and has done so by investing in areas like neuroscience..."

# Alumni News



## **Julie Jadlowiec '05 (Ph.D.)**

After receiving her Ph.D. in Biological Sciences, Julie accepted a postdoctoral fellowship in the Molecular Biosensor Imaging Center at Carnegie Mellon.

## **Shoba Subramanian '05 (Ph.D.)**

Shoba moved to San Francisco after completing her Ph.D. in Biological Sciences to start a postdoctoral fellowship at University of California, San Francisco. Shoba misses the close-knit scientific community in the Department of Biological Sciences.

## **Xiang Chen '05 (Ph.D.)**

Xiang recently accepted a postdoctoral associate position at Yale University after completing his Ph.D. in Biological Sciences

## **Mamta Puri '05 (Ph.D.)**

Mamta moved to Evanston, IL after finishing her Ph.D. in Biological Sciences to work as a Research Scholar at Evanston Northwestern Healthcare. She misses the openness and approachability of the faculty and students at Carnegie Mellon.

## **Peter Zullo '05 (M.S.)**

Peter has just accepted a position with ID Business Solutions as a field consultant for Wyeth Pharmaceuticals. He is pleased to report that this is exactly the position he's been hoping for after receiving his M.S. in Computational Biology.

## **Supriya Kumar '04 (Ph.D.)**

Supriya is working as postdoctoral scholar at the University of Chicago. She is part of Chung-I Wu's lab, where she studies the genetic basis of speciation in *Drosophila*.

## **Kiran Penumacha '04 (Ph.D.)**

After completing the M.S. in Computational Biology in 2004, Kiran accepted a position as an associate at Pitney Bowes in Long Island City, NY. The best part of his Carnegie Mellon education, he says, was the people.

## **Nicole Brandon '04 (M.S.)**

After completing the M.S. in Biological Sciences in 2004, Nicole accepted a position with University of Pittsburgh Medical Center as a Research Specialist.

## **Ericka Anderson '04 (B.S.)**

After completing her B.S. in Biological Sciences, Ericka began graduate school at Massachusetts Institute of Technology. She currently works in the Page Lab.

## **Lisa Podgurski '03 (B.S.)**

Lisa began attending Harvard Medical School after graduating with a B.S. in Biological Sciences and Psychology.

## **Javier Lorenzo '03 (B.S.)**

Javier began attending Stanford University School of Medicine after graduating with a B.S. in Biological Sciences.

## **Heather Weitzel '03 (Ph.D.)**

As a lecturer here in the Department of Biological Sciences, Heather teaches Experimental Cell and Developmental Biology, Experimental Techniques in Molecular Biology, Genetics and Molecular Biology to Carnegie Mellon undergraduates.

## **Pamela Antunez de Mayolo Bush '02 (Ph.D.)**

Pamela appreciated the experiences of completing a Ph.D. program, including her research, her advisor and her relationships with fellow graduate students. She now works as an Investment Programs Manager for Pittsburgh Life Sciences Greenhouse.

## **Kristina Jackson Behan '01 (Ph.D.)**

Now an Assistant Professor of Biology at University of West Florida, Kristina appreciated what Carnegie Mellon offered to students. "The resources of the University are fantastic, including the libraries, the equipment and the brains of the professors and students," she said.

## **Stephen Jesch '01 (Ph.D.)**

Since receiving his Ph.D. in Biological Sciences, Stephen has been working as a postdoctoral research fellow at Cornell University in the Henry Lab.

## **Ann Bradley '00 (B.S.)**

Ann recently accepted a position as a scientist at Integral Consulting, Inc. in Annapolis, MD. Her work includes both ecological and human health risk assessment as well as scientific analysis for litigation support.



*Ka-Young An and Peter Zullo, M.S. in Computational Biology*

Please visit [www.cmu.edu/bio](http://www.cmu.edu/bio) to learn more about what Biological Sciences alumni are doing!

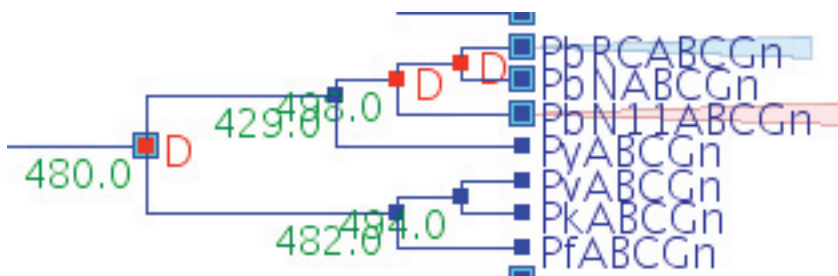
# Faculty Profiles

by Parul Nisha, 4th year Ph.D. student

*The emerging field of computational biology at Carnegie Mellon*

## Dr. Dannie Durand

Associate Professor Dannie Durand was working for a telecommunications company when she attended a two-week computational biology course at DIMACS, an institute for discrete mathematics at Rutgers University. Durand, who has a Ph.D. in Computer Science from Columbia University, found the interdisciplinary approach to problem solving so fascinating that she moved to the University of Pennsylvania to work on mathematical population genetics for two years. Later, she worked at Princeton as a Alfred P. Sloan - DOE Fellow in Computational Molecular Biology for another two years. She then joined Carnegie Mellon University as a faculty member in 2001. The Durand lab is interested in understanding evolution of novel genes and how that relates to evolution



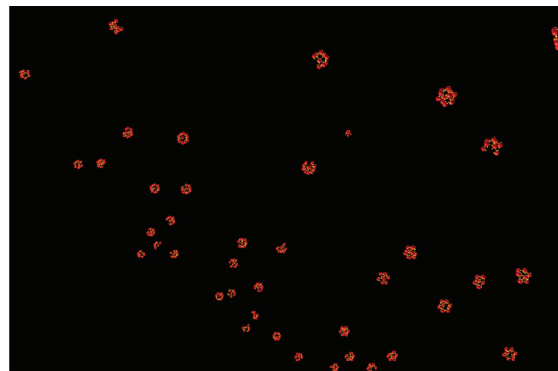
of novel morphology or cellular functions. The lab's focus is primarily on how this relationship has evolved in vertebrate genomes. Among other things, Durand and her colleagues have developed a computational tool to look at the history of duplication in the evolution of a gene family. Making use of this tool, they are now collaborating with researchers at the University of Puerto Rico Medical School to predict gene duplications in malarial parasites and to tie them in with drug resistance to malaria. Very recent duplications occurring in one species of the malarial parasite, as compared to its sibling species, are evidence of adaptation and could be involved in drug resistance. These kinds of interpretations cut down on experimental time and avert research in the wet lab.

## Dr. Russell Schwartz

Assistant Professor Russell Schwartz is one of the youngest members of the faculty in Carnegie Mellon's recently formed computational biology program. Schwartz got an early start in the interdisciplinary area of computational biology when he realized that he wanted to work on biology-related problems while getting his undergraduate degree in electrical engineering and computer science. After receiving his Ph.D. in Computer Science, followed by a short postdoctoral fellowship and a couple of years working in industry, he joined Carnegie Mellon as a faculty member in 2002. The present focus of the Schwartz lab is to develop methods to simulate biochemistry on a small scale, with a particular interest in self-assembly systems like virus capsids. Such problems are at the fore-

front of today's fast growing fields of biological and health sciences; the huge amount of information about complex biological systems and how their many components interact require computer methods to analyze them and build models to make sense of the data. A big gap exists between what we know is going on in the cell and what we can simulate accurately on a computer. Russell and

his colleagues are a part of the enormous effort being put towards bridging that gap. By working on abstract problems in biophysics and general properties of self-assembly of virus capsids, the Schwartz lab is now moving towards asking more complicated questions about self-assembly of particular viruses.



# Faculty News

## Javier López

López has discovered that a novel mechanism, called recursive splicing, removes long introns by steadily paring them down in a predictable fashion and joining the remaining exons. The findings were published this summer in *Genetics*. This process, which the investigators discovered in the fruit fly *Drosophila*, has been conserved over tens of millions of years of insect evolution and also appears likely to occur in humans.

## Jonathan Minden

Minden, along with researchers at Northwestern University, have for the first time found evidence that a class of molecules called microRNAs (miRNAs) plays an important role in regulating how eggs develop just before the onset of fertilization. Their work has important implications for understanding reproduction and development.

## Dannie Durand

Comparing genomes of different species can tell you when new genes evolved and what they do for their respective hosts. But pinpointing the ancestry of any given gene is a complex computational task. Now, powerful new software, developed by a team of investigators headed by Dannie Durand, makes gene “archeology” considerably easier.

For more information on faculty achievements, visit [www.cmu.edu/bio](http://www.cmu.edu/bio)

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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](http://www.cmu.edu/police/statistics.htm).

Obtain general information about Carnegie Mellon University by calling 412-268-2000.

## Making a Connection

*Ways to connect with the Department of Biological Sciences:*

### 1. Speak at our departmental seminar series

We are always looking for speakers to engage the department in a variety of topics in the biological sciences. Holding a seminar for our students is a great way to reintroduce yourself to the department.

### 2. Act as a contact for students interested in networking

Our students are looking for opportunities to meet Carnegie Mellon graduates who are in the field. Volunteering to act as a contact for our students can give them a taste of how things are done “in the real world.”

### 3. Help support a Graduate Student Travel Award

While we have many talented students who would like to present their exciting research at important national and international conferences all over the country, often they do not have the money to attend. Your contribution can help a student achieve this goal.



For more information about connecting with the Department, please contact Jennifer Sciuлло, Assistant to the Department Head, at 412-268-1810 or [jsemper@andrew.cmu.edu](mailto:jsemper@andrew.cmu.edu) or visit [www.cmu.edu/bio/connect](http://www.cmu.edu/bio/connect).