BioSphere

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Welcome from the Chair

Professor Graham Hatfull, chair, Department of Biological Sciences

Happy New Year! This is the time when it is helpful to review what we have accomplished over the past year, to reflect on progress toward our long-term goals and aspirations, and to consider the prospects for the year ahead.

Overall, the department had a terrific year, with significant advances toward all of our missions. There have been a multitude of achievements and just a few of the highlights include: the hiring of two new faculty members, significant facilities upgrades, the completion of and move into a new research building, new external funding for our undergraduate and outreach programs, and a terrific class of first-year graduate students. With so many notable achievements, it can be all too easy to overlook the incredible investment of time and energy by all the members of the department—faculty, staff, and students—who have contributed in so many ways. I hope you will all share with me in extending thanks to all of our colleagues who have contributed over the past year.

The year ahead also promises to be full of new opportunities and exciting events. We are in the process of searching for a new faculty colleague. We also hope to reoccupy the renovated Langley fifth floor and to implement additional elements of our Howard Hughes Medical Institute (HHMI) funded programs.

But perhaps the most exciting prospect for 2007 is the **30th Birthday Celebration of the Department of Biological Sciences**, planned for **September 14–16**. We are looking forward to a weekend of science and celebration—an occasion to meet past acquaintances and make new friends while discussing the scientific accomplishments of the past 30 years and the promise of new accomplishments in our ever brighter future. I hope you will join us for this event and I look forward to seeing you there!

Please watch for upcoming announcements in *BioSphere* and on the department Web site about our plans for the 30th Birthday Celebration on September 14–16, 2007.

Join us for scientific sessions with presentations from invited department alumni and current members of the department, for social events and mixers, and for tours of the new facilities and interactions with friends and colleagues.

The Clapp, Langley, and Crawford Hall complex is the home of the Department of Biological Sciences.

Mary P. Edmonds Graduate Student Award Winner to be Announced at Department's 30th Birthday Celebration

In our first issue of *BioSphere*, we announced the establishment of the Mary P. Edmonds Graduate Student Award fund in honor of our friend and colleague who passed away in April 2005.

The first winner of the award will be announced at the Department of Biological Sciences' 30th Birthday Celebration on September 14–16, 2007.

For those of you who knew Edmonds, you will remember her as a warm individual and a rigorous scientist who regularly attended seminars and participated in our graduate courses. Edmonds was always happy to offer advice to faculty, students, and post-docs, and it brightened our day when we encountered and chatted with her at the mailboxes or in the hallways.

But, Edmonds' fame stretched well beyond the department. Edmonds was elected to the National Academy of Sciences in 1991 and received several honorary doctorates for her work on RNA processing. Specifically, Edmonds characterized the enzyme that adds polyA "tails" on RNA, and her laboratory identified nuclear enriched, branched trinucleotides. With incredible foresight, Edmonds proposed that these branched species are involved in pre-mRNA splicing, and indeed seminal papers published subsequently confirmed Edmonds' keen insights into the splicing reaction.

If you are interested in contributing to the award fund, please see the link on our Web site at www.pitt.edu/~biohome.

Playing Around with Phage

What could high school students and teachers possibly learn about modern biology by digging in the dirt? For starters, how about basic principles in genetics, microbial ecology and evolution, and protein assembly and folding?

These students and teachers are the beneficiaries of the Phagehunters Program, which was initiated by Department Chair Graham Hatfull with the support of a $1 million Howard Hughes Medical Institute Professorship award. Incredibly, this program will bring the thrill of scientific discovery into the high school classroom for more than 1,000 students a year.

"I don't say anything when I walk into the classroom. I just hand each student a test tube and ask them to get a dirt sample," says Debbie Jacobs-Sera, coordinator of the Phagehunter program and a former high school science teacher. Using basic microbiology techniques, students then isolate novel bacteria-infecting viruses, known as phage, from their samples in two days. Next, the phage genomes are sequenced (back in the department) so that the students can begin to appreciate how bioinformatics techniques are used to analyze genomic DNA. Even if they don't find a new phage, Jacobs-Sera explains, "the opportunity to discover something new makes them want to see more."

And so they can. Any student who has participated in the Phagehunter program can join the Hatfull lab after school and continue investigating phage biology under the watchful eyes of

Jacobs-Sera and her army of undergraduates. Participation by the high school students is voluntary, and when a new high school student arrives, he or she is assigned a mentor from among the undergraduate researchers who have been trained in mentoring techniques. The success of this program is evidenced by the current number of undergraduate researchers (14) and high school students (37), 10 of whom may be in the lab on any given day.

Jacobs-Sera likens the atmosphere in the lab to a playground in that both the undergraduate and high school students are given a fair amount of freedom to determine the direction of their research. "What are you going to do with that?" she challenges them, and then works with each team to surmount technical barriers.

And good stuff comes back—not just in terms of scientific knowledge gained. These students learn that people who do science are "just regular people," and they learn that scientists have to work together to solve problems. Once or twice a week Jacobs-Sera and Steve Cresawn hold "notebook meetings" where the students can talk about their work and brainstorm. Longitudinal research experience is the key, according to Jacobs-Sera. And, as many of us know, it takes time to move students from mastering techniques to mastering the process of research.

Another one of the goals of the Phagehunter program is to reform how science teachers develop their curricula: In a one-week summer workshop, teachers also become part of the research process by developing the skills to pose research questions and the techniques to answer those questions. Twenty high school teachers participated in the first summer workshop in 2005, and 15 of them returned this summer to extend their training and to mentor new teachers.

Because of its success, Jacobs-Sera has now taken the program on the road—bringing phagehunting into classrooms as distant as Chicago and North Carolina. The program has also spread to Montana under the direction of Marissa Pedulla, a former post-doctoral research associate in the Hatfull lab and now an assistant professor at the University of Montana.

So, does all this digging in the dirt make a difference? In its four-year existence, 20 undergraduate phagehunters have passed through the program and *all* of them have gone on to pursue careers in science.

Imagine what will happen when those thousands of phagehunting high school researchers enter college.

Student Achievements Recognized at Department Kickoff Meeting

"The most valuable part of my education has been my research. I will always remember the excitement of bench work, the experiments, the concepts, even the equipment," says this year's Norman H. Horowitz Fellowship awardee, **Amanda Foltz,** as she reflects on the path that took her from Outstanding Freshman in 2004 to earning one of the two undergraduate research awards bestowed by the department.

Amanda Foltz

Foltz first experienced the excitement of research as a participant in the School of Arts and Sciences First Experience in Research program, which places second semester freshmen into research labs. Indeed she says that this was a turning point in her career. "I came to the University of Pittsburgh because it has a great medical school, and I thought that medicine was the only career you could do if you had an interest in science. Without the First Experience, everything would have ended up so differently for me and I would not have ended up on the career path that was right for me." What is her chosen path? Foltz now hopes to attend graduate school and pursue research in biomedicine.

What does it take to become one of the top 10 students in a class of more than 1,000? Lots of studying, to be sure, but also a genuine interest in the topic, according to **Quynh Vo**, who earned the Ella P. Stewart Award for her efforts in Foundations of Biology.

Quynh Vo

Eric Gardner, winner of the Allison P. Kephart Award for his potential for a successful career in biology, echoes Vo's observations, as do the students recognized as Outstanding Freshman:

Eric Gardner

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Student Achievements Recognized at Department Kickoff Meeting *(continued from page 3)*


Alexandra Ammons


Nathan Mohney


Devin Potts


Ravi Pandit


Kerry Hahn

Alexandra Ammons, Kerry Hahn, Nathan Mohney, Ravi Pandit, and **Devin Potts**.

In addition to academic success, these students also share a common motivation for attending the University of Pittsburgh—opportunities to participate in research, great courses, and volunteer efforts. Like Foltz, Gardner notes that the University of Pittsburgh gives him the chance to get involved in research early and to stay involved. Mohney liked the fact that the University is recognized worldwide for its research accomplishments and provides a broad range of undergraduate experiences for students interested in the health professions.

Two other upperclass students were also recognized for their research achievements at the department kickoff meeting this year: **Sarah Hainer** and **Cynthia Metz** received the Colella Award to recognize their outstanding research efforts during the summer of 2006. This award, endowed by Samuel L. Colella in 2004, provides $750 to support research efforts.


Sarah Hainer

As important as research has been to Foltz, she credits "several amazing professors" with keeping her engaged in her molecular biology coursework. Consequently, the department was pleased to recognize a future professor with the Stanton Crawford Teaching Award. Undergraduates describe this year's awardee, **Heather Hendrickson**, as knowledgeable, down-to-earth, and very funny.

In addition to providing a good learning environment for her students in microbiology, Hendrickson developed problem-solving exercises and the "Inside the PCR Reaction Tube…" Web site to explain the PCR reaction. Notably, this site comes up as the second entry in a Google search for "PCR."

> *"To realize that other people believed that I had the ability to succeed made me want to work harder."*

Hendrickson likens being a teacher to being a hiking coach: She believes that she can point out the direction and the important sights along the trail and show students how to climb, but it is also important to let her charges struggle with the obstacles so they can become independent learners.

Several other graduate students will be able to excite the next generation of scientists based on their selection as participants in the National Science Foundation-sponsored GK–12 program. These students—**Tarek Elnaccash, John Jennings, Cassie Majetic, Melissa Moser, John Paul, and Tom Pendergast** will work with primary and secondary school teachers in the Pittsburgh Public School District to bring current and inquiry-based science curricula into the classroom. Cassie aptly summarized the goal of this program as "providing a positive educational experience in biology [that] leads students to explore science with genuine enthusiasm."

Recognizing achievement on the other side of the lectern, **Justin Pruneski** received the Ivy R. McManus Award for his outstanding performance as a first-year graduate student. Pruneski has embarked upon his research career in Joe Martens' lab, exploring the role of intragenic transcription in gene regulation.

Although recognizing undergraduate and graduate student achievement is a yearly event for the department, there is nothing ordinary in the recipients' experiences. "I was so excited to have won the Outstanding Freshman Award," recounts Foltz. "To realize that other people believed that I had the ability to succeed made me want to work harder."

We hope that all of our 2005–2006 award winners will enjoy similar future success, and appreciate the fact that all that hard work can indeed pay off.

Undergraduate Student Science Clubs Collaborate as the Science Alliance

At a University rated seventh in the nation in National Institutes of Health (NIH) funding, it should come as no surprise that our undergraduates are passionate about science. With more than 30 undergraduate clubs devoted to science and engineering, there is no lack of activities.

To better coordinate the many undergraduate science clubs, Justin Darragh, president of the Neuroscience Club, and the officers of 11 clubs—the American Chemical Society, Alpha Epsilon Delta (premed honorary), Tri-Beta (biology honorary), the Biology Club, the Dental Science Club, Future Educators of America, the International Health Club, the Neuroscience Club, the Organization for Women in Science, the Premedical Organization for Minority Students (POMS), and the Student National Pharmaceutical Association—recently created the Science Alliance.

So far, the Science Alliance has hosted several joint meetings, including a panel discussion with students from the University of Pittsburgh Medical School and a seminar by Ray Mizgorski, director of the Preprofessional Health Advising Office. The culminating event for the year was Science Alliance Week—"Science at its Wildest."

Science Alliance Week featured a week of science-themed movies, food, and games. For example, the Neuroscience Club and Alpha Epsilon Delta showed the entire season of "Gray's Anatomy," and Tri-Beta and the Biology Club sponsored a research poster session, trivia contest, and quiz show. POMS and the Dental Science Club organized a medical/dental games night, and on Friday of that week, the Science Alliance hosted a three-hour social featuring food and games that was attended by more than 60 students.

For more information on the indicated clubs, please go to www.sorc.pitt.edu/search/index.html.

Howard Hughes Medical Institute Undergraduate Researchers Selected

Ten undergraduate student researchers are the recipients of $4,000 research stipends for the academic year 2006–07 as part of the department's new Howard Hughes Medical Institute (HHMI)-funded initiative. The awardees are: **Timothy Sampson** (Hatfull lab), **Alexis Carulli** (Arndt lab), **Reem Hanna** (Hildebrand lab), **Neil Umbreit** (Jacobson lab), **Nora Jameson** (Brodsky lab), **Nathaniel Howitz** (Traw lab), **Robert Culik** (Pipas lab), **Heather Perry** (Chapman lab), **Nicholas Jones** (Oke lab) and **Petrov Kostadin** (Martens lab). Beyond their research, these students will serve as the nucleus of an active community of undergraduate researchers from both within the Department of Biological Sciences and among other natural science departments. So far, the students have met four times and discussed how to build an undergraduate research community. Specifically, as Nancy Kaufmann, the assistant director of the HHMI program puts it, "They are hoping to help bridge the gap between incoming freshman and the undergraduates who are already in laboratories," and several of the program participants have already been meeting with groups of freshman who want to know more about research.

Many congratulations to this outstanding group of students, and we look forward to watching how this program develops in the coming years.

Meet Our Faculty: Joe Martens

Assistant Professor Joseph Martens

Early one morning while Joe Martens was examining the results of his latest experiment, he realized that he was looking at something quite novel. In fact, what Martens was about to discover would require a rewriting of our textbook view of transcription. "We knew that the expression of the yeast *SER3* gene, which encodes an enzyme required for serine biosynthesis, was strongly repressed when yeast cells were grown in serine-rich media. But, the results from two critical experiments were pointing toward a mechanism that was totally unexpected."

Normally, as indicated in our textbooks, the transcription of genes is controlled when specific factors bind upstream of the gene and "tell" the gene to either turn on (by protein factors known as "activators") or turn off (by protein factors known as "repressors"). It turned out that Martens had uncovered a novel mechanism of gene repression. What he found was that a nonprotein-coding gene had been transcribed in order to repress the expression of the adjacent gene.

Indeed, Martens is part of a growing community of researchers investigating a newly appreciated phenomenon in eukaryotic genomes: widespread expression of nonprotein coding DNA. In addition to gene repression, transcription of nonprotein coding DNA has been implicated in controlling chromosome architecture, mRNA turnover, translation, and transcription initiation.

What he found was that a nonprotein-coding gene had been transcribed in order to repress the expression of the adjacent gene.

However, the importance of transcribing these DNA regions was not fully appreciated until recent whole-genome studies revealed that this might be the dominant genomic output in most eukaryotes. In other words, *the majority* of ongoing transcription in the cell is devoted to regulating other genes. This phenomenon, which Martens reported in the journal *Nature* in 2004, currently motivates much of the research in his laboratory, and ongoing efforts are using the genetic, genomic, and biochemical tools that make yeast an ideal model eukaryotic system.

Martens is also hoping to identify other mechanisms by which the transcription of "junk DNA" can regulate gene expression or other cellular processes.

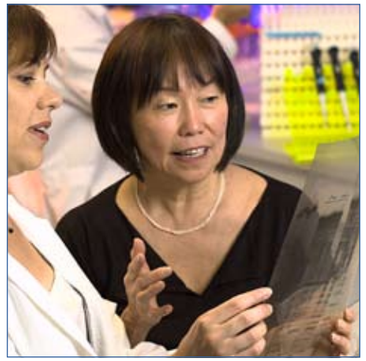
To explore these phenomena, Martens—who joined our faculty in 2005—has recruited Justin Pruneski (a second-year graduate student), Sarah Papperman (a research technician), and several undergraduates, including one of our 10 new HHMI Undergraduate Fellows (Kostadin Petrov).

Prior to joining the department, Martens was a postdoctoral research fellow with Fred Winston at the Harvard Medical School. Before that he was a graduate student at the University of Western Ontario in London, Ontario.

When not working alongside his students in the lab or participating in the Friday social hours, Martens can be found at home with his wife, Marilyn, and their two children, Reese (who was born late last year) and Owen (3 years old).

So, if discussing new mechanisms of gene regulation is not your cup of tea, then be sure to ask Martens about his other passions—soccer and hockey. But if you do, you might miss out on hearing about the next discovery that requires the textbooks to be rewritten!

Meet Our Faculty: Linda Jen-Jacobson



Professor Linda Jen-Jacobson

What does DNA look like? For many of us, the DNA that we imagine is built of the rigid blue and red plastic sticks and balls we used in chemistry classes. The balls and sticks are then linked to form a double-helical, anti-parallel pair of strands. This image, engrained in all of us, was born of the seminal studies by Watson and Crick.

Unfortunately, our DNA model is wrong.

The problem is that we usually imagine a stationary slice of DNA that lacks the enzymes that build, bend, and destroy this molecule. We still have no way of directly visualizing DNA in its natural habitat. But, there are ways of exploring its molecular interactions, and this has been Linda Jen-Jacobson's goal for nearly 40 years. Although Jen-Jacobson may sometimes have the calm grace of a patiently meditating scholar, she is a radical: Jen-Jacobson has revolutionized the way we think about what takes place between DNA and the enzymes that act on it.

In 1967 Jen-Jacobson was unkindly told "all women scientists fall by the wayside." However, she was also blessed with tenacity, which is perhaps the result of being the daughter of Chinese academics who left Beijing in 1937 during the Japanese invasion. Their goal was to secretly forge a new academic institution—The National Southwestern Associated University in Kun Ming, which they hoped would be beyond the Japanese reach. Jen-Jacobson was born in that secret science society and was even babysat by a future Nobel Prize winner, physicist Chen-Ning Yang. As Jen-Jacobson describes her parents' experience: "They had so much fun… It was like the pioneers in America who were the frontiersmen. They were fighting lions but the fight was external and it caused cohesion among people. This was similar, in the presence of the air raids and the attacks on the scientists by the Japanese. These were the people who were eventually to be the fathers of missile research in China. This was the nucleus of the next generation of scientific research."

Perhaps the unconquerable in Jen-Jacobson is made-up of more than her history. The molecular biophysics conferences Jen-Jacobson attends now have many more women than when she first attended, back when she was one of only two women out of 30 scientists speaking. In more recent years, according to Jen-Jacobson, the percentage of women has appeared to plateau at around 24 percent. When asked what has helped her personally, Jen-Jacobson makes no small matter out of her marriage with Lew Jacobson, another member of the faculty who happens to reside in the next lab down the hall. "I think you really have to have someone there to be supportive, someone who is your best friend. Lew is my best friend."

Jacobson and Jen-Jacobson have talked science for more than 40 years now. Though they are in very different fields (Jacobson studies muscle development and maintenance in *C. elegans)*, the synergism between these scientists is clear. After asking a pointed biophysical question after a recent seminar, Jacobson joked that he is a "biophysicist by cohabitation."

Jen Jacobson's detailed studies of how enzymes specifically recognize particular sites in DNA have surprised colleagues, as well as Jen-Jacobson herself, who says, "It is such an exhilarating experience when you realize that you are articulating new concepts and that you are doing it in a way that everyone is thinking is fresh."

Jen-Jacobson has revolutionized the way we think about what takes place between DNA and the enzymes that act on it.

And her fresh insights have resulted in a body of work that has included several seminal publications, including her 1990 *Science* paper, the longest ever published in that journal. Her work has also earned her the distinction of receiving a 10-year Merit Grant Award from the National Institutes of Health in 2001 for "…superior effort and to give you the opportunity to have risky adventures." Upon receiving the award, Jen-Jacobson recounts, "I felt like Frodo. I am going on a grand adventure. There is this sense of really feeling like I don't know what is in store for me, just like Frodo, but I have been given this very special opportunity."

And fortunately, we, too, have benefited from the special opportunity of having Jen-Jacobson as a colleague and educator.

BioSphere

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Real Time PCR System is Up and Running

In addition to our new research facility (the Life Sciences Annex) and the many renovated research laboratories in the Clapp, Langley, and Crawford (CLC) complex, the department has been acquiring new, shared research equipment.

One of these procurements was an ABI 7300 Real Time PCR System. This state-of-the-art machine is available for use in Crawford 545 and allows the precise quantification of RNA levels for gene expression studies and for the identification of single nucleotide polymorphisms.

Anil Ojha (pictured left) has been one of its first users and is very pleased. "We are using the system to verify our gene expression data from microarray experiments. The biggest benefit is the flexibility in instrument setup." Any of four different chemistries (TaqMan®, Molecular Beacons, Scorpions®, and SYBR® Green) can be used to detect PCR products via the generation of a fluorescent signal. The system quantifies reaction products during each PCR, which allows a 10^7-fold dynamic assessment range. And, up to 96 samples can be analyzed simultaneously. The software is intuitive and provides a full analysis of the results.

Please contact Joe Martens at martens@pitt.edu if you are interested in using the machine.

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