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THE NONSENSE SUPPRESSOR

Newsletter of the Department of Biology
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IN THIS ISSUE

Ninety-four Graduates to Receive Diplomas at Afternoon Ceremony

Fifty-three women and forty-one men are eligible to receive their degrees at the Diploma Ceremony of the Department of Biology being held on Sunday, May 16, 2004 at 2:30 p.m. in the River Road Auditorium. The ninety-four men and women of the Class of 2004 have satisfactorily completed the requirements for one of the four Biology Department tracks—B.A. in Biology (BIO), B.S. in Biological Sciences: Cell and Developmental Biology (BCD); B.S. in Biological Sciences: Evolutionary Biology and Ecology (BEB), B.S. in Biological Sciences: Molecular Genetics (BMG).

Dr. Thomas Eickbush, Professor of Biology and Department Chair, will be the Master of Ceremonies, welcoming students and guests and also handing students their diplomas.

This year's student speaker, chosen by the faculty for excellence in academics and research and for service to the College, is Maximilian Popp who will be introduced by Dr. Robert Angerer, Professor of Biology.

Dr. Cheeptip Benyajati will present the Catherine Block Memorial Prize, a College award given each year to a junior woman for excellence in science. Sharon Paige (BCD), class of 2005, is the recipient. Dr. Elaine Sia, Assistant Professor of Biology, will present awards to seniors. The Donald R. Charles Memorial Prize, given annually by the Biology Department to students who show great potential and have exhibited excellence in science will be received by Victoria Bottazzo (BCD), Julie Hull (BIO), Jehu Mathew (BMG), Matthew Maurer (BMG), Mark O'Hara (BMG), Maximilian Popp (BMG).

A slide show, organized by Jessica Marcinkevage aided by members of the class will be presented just before the awarding of diplomas. Announcement of honors—Phi Beta Kappa and Latin Honors—along with the reading of blurbs written by the graduates will be done by Dr. Anthony Olek (BIO), Dr. Cheeptip Benyajati (BCD), Dr. John Jaenike (BEB), Dr. David Hinkle (BMG).

A reception will be held immediately following the ceremony in the tent on the front lawn.

Congratulations and Best Wishes to the Class of 2004 from the Biology Department Faculty and Staff

The Department of Biology Graduating Class of 2004

Bachelor of Arts

Nadia Boyd Alber
Koya C. Allen
Jenna Lyn Arndt
Stephan Barrientos
Marco A. Bernobich
Birju D. Bhatt
Seema Shashikant Bhopale
Kristin M. Broderick
Miguel A. Brown
Taylor J. Buckley
Sarah D. Crimmins
Ben A. Cross
Taryn M. Cutting
Lisa Michelle Denmark
Christine W. Du
Molly E. Fuchs
Matthew Jason Furman
Miranda Anne Gauvin
Alice Fitzgerald Goodwin
Kara Rachel Greenwald
Atul S. Gulati
Lindsey Starr Hagstrom
Joshua Hirschhorn
Julie C. Hull
Gabrielle A. Kapsak
Mohammed Faraz Khan
Sairah Khan
Jillian M. Kirstein
Jennifer E. Knipe
Trisha LeRoy
Carmen E. Lewis
Jeannine Elizabeth Manna
Jessica Ann Macinkevage
Andrew H. Marky
Stephanie L. Montrallo
Swathi Nadindla
Jaeyoung Park
Noah D. Pavlisko
Riley J. Payne
Andrew S. Pederzolli
Kaitlin G. Poeth
Nathan Rimmke
Crystalaida Angelita Carlos Rufo
Danielle Clark Ruppert
Rebecca Ryszkiewicz
Alayna M. Sak
Simmi Anil Shirwaikar
Durga Singh
Shaila Singh
Michael Richard Sinkoff
Deepak Sobti
Abraham Mead Spence
Kathleen M. Svala
Jane Tam
Satyen S. Undavia
Grace Anna Vangeison
Scott M. VanValkenburg
Kelly L. Wentworth
Jonathan P. Wilmot
Regine Wong
Yan Ming Alvin Wong

Bachelor of Science

Biological Sciences: Cell and Developmental Biology

Victoria M. Bottazzo
Jacob M. Budny
Nicole Renee Crnkovich
Shailey Sharad Desai
Adam Goldstone
Albert Yung-Hsiang Huang
Evan Kingsley
Peter J. Moses
Snehal Rajendrakumar Patel
Samit Shah
Benjamin B. Solter
Marjorie Sophia Waterman

Biological Sciences: Evolutionary Biology and Ecology

Jessica Cassavaugh
Matthew Cummins
Alexandra Louise Larson
Daniel McLaughlin
Andrea Murphy
Rebecca Ann Schlissermann
Anthony Siniscal
Adam C. Smith
Carolyn A. Waugh

Biological Sciences: Molecular Genetics

Sara Ferri
Dariya S. Glazer
David Iseminger
Anat Kohn
Jehu Mathew
Matthew Joseph Maurer
Mark H. O'Hara
Maximilian Wei-Lin Popp
Peter Damian Sidor
Samuel P. Strom
Jessica M. Szymaniak
Cheryl B. Thomas
Cornelia Emilia Zorca

Undergraduates Take Advantage of a Wide Range of Research Opportunities

The Biology Department of the University of Rochester, together with the research departments of the School of Medicine and Dentistry located just a five-minute walk away, offers to its majors a diversity of opportunities for engaging in hand-on modern biomedical research. Those opportunities are limited only by students' talents and by their persistence in searching for faculty doing research projects that match their interests. Every year Biology majors engage in laboratory research as volunteers, as student employees, for credit in IND 395, and in the summers as research fellows either at the UR or at other institutions as well in paying jobs for biotechnology companies.

Independent Research

Twenty-eight members of the Biology Department graduating class of 2004 have done one or more semesters of Independent Research for credit. Those students, their faculty sponsors, sponsor's department and number of semesters of research each year are:

Fall 01/Spring 02

Julie Hull, John Huelsenbeck, Biology (1); Mohammed Faraz Khan, J.H. David Wu, Chemical Engineering (1).

Fall 02/Spring 03

Samit Shah, Thomas Eickbush, Biology (1); Kara Greenwald, Allen Orr, Biology (1); Rebecca Schlissermann, John Jaenike, Biology (1); Jehu Mathew, Mark Noble, Biomedical Genetics (1); Maximilian Popp, Robert Angerer, Biology (1); Satyen Undavia, David Goldfarb, Biology (2).

Fall 03/Spring 04

Nicole Crnkovich, Benjamin Miller, Dermatology (1); Evan Kingsley, David Pearce, Ctr. for Aging and Developmental Biology (1); Marjorie Waterman, Robert D.

Frisina, Surgery-Otolaryngology (1); Jessica Cassavaugh, John Jaenike, Biology (1); Matt Cummins, John Jaenike, Biology (1); Anthony Siniscal, John Jaenike, Biology (1); Koya Allen, Wei-Ping Zheng, Microbiology and Immunology, Ctr. for Vaccine Biology (1); Jenna Arndt, David Calkins, Ophthalmology (1); Stephan Barrientos, Jiyong Zhao, Biomedical Genetics (1); Birju Bhatt, Carl Pinkert, Pathology and Ctr. for Aging and Developmental Biology (1); Ben Cross, John Jaenike, Biology (1); Joshua Hirschhorn, John Werren, Biology (1); Nathan Rimmke, John Jaenike, Biology (1); Deepak Sobti, Rulang Jiang, Ctr. for Oral Biology (1); Deepak Sobti, Carl Pinkert, Pathology and Ctr. for Aging and Developmental Biology (1); Satyen Undavia, David Goldfarb, Biology (1); Jonathan Wilmot, John Jaenike, Biology (1); Anat Kohn, Elaine Sia, Biology (2); Jehu Mathew, Mark Noble, Biomedical Genetics (1); Matthew Maurer, Elaine Sia, Biology (1); Mark O'Hara, Martin Gorovsky, Biology (2); Maximilian Popp, Robert Angerer, Biology (2); Cornelia Zorca, Martin Gorovsky, Biology (2); Kelly Wentworth, Luojing Chen, Ctr. for Human Genetics and Pediatric Diseases (2).

de Kiewiet Summer Research

The Undergraduate Program in Biology and Medicine (UPBM) has been awarding de Kiewiet Summer Research Fellowships since 1983 to UR students majoring in one of the UPBM tracks. (See article on Summer 2004 Fellows.) Although the number of applicants is small compared to most summer programs, the competition is intense. Students applying must already have a mentor and must submit a detailed research proposal. The summer fellows work fulltime in a lab for 10 weeks. Class of 2004 graduates who have been de Kiewiet fellows are: **Evan Kingsley**, BCD; **Matthew Maurer**, BMG; **Mark O'Hara**, BMG; **Kelly Wentworth**, BIO; **Cornelia Zorca**, BMG. Evan Kingsley did his research in David Pearce's lab in the Center for Aging and Developmental Biology on the project "Retinal pathology of the *Cln3*$^{-/-}$ mouse, a model for Batten Disease." Matt Maurer did research under the direction of Elaine Sia in the Department of Biology. His project was "Protein factors involved in mismatch repair of the mitochondrial genome in *Saccharomyces cerevisiae*." Mark O'Hara and Cornelia Zorca worked on two different projects in Marty Gorovsky's lab in the Department of Biology. Mark did "Analysis of *TWI4*: a homologue of *TWI1*" and Cornelia's project was "Attempts to generate a germline *HHP1* knockout in *Tetrahymena thermophila*." Kelly Wentworth's research was "Identification of the interacting proteins of the protein kinase PKK by a yeast two-hybrid system" which she did under the direction of Luojing Chen in the Center for Human Genetics and Pediatric Disease.

Four UPBM Graduates Earn Distinction in Research

The Undergraduate Program in Biology and Medicine (UPBM) provides majors in the B.S. or B.A. tracks the opportunity to graduate with distinction in research. Students must achieve a minimum GPA of 2.7 and must defend their written thesis at a meeting of their advisory committee. Most students seeking a degree with distinction have worked on a research project for a year or more and have achieved significant results. They then immerse themselves in the time-consuming process of writing the thesis. Those who successfully complete their research and then push on to write the required paper are rewarded with the phrase "Distinction in Research" added to their transcripts.

The four members of the class of 2004 who have earned the honor of "Distinction in Research" are:

Zarina Sultana Ali, BNS, whose project "Neuronal mechanisms of actively steering optic flow: global versus local motion" was carried out under the sponsorship of Charles J. Duffy and William K. Page of the Department of Neurology.

Natasha Girgis, BMB, whose project "Enhanced infection of human monocyte-derived dendritic cells using a modified adenovirus targeted to DC-SIGN" was mentored by Stephen Dewhurst of the Department of Microbiology and Immunology.

Ian Harwood, BBC, whose project "Purification and characterization of human cyclin-dependent kinase 1" was directed by Ravi Basavappa of the Department of Biochemistry and Biophysics.

Daniel Lioy, BNS, whose project "Characterization of the C17.2 stem cell as a model for studying arylhydrocarbon receptor-mediated neuronal development" was undertaken with the guidance of Lisa Opanashuk of the Department of Environmental Medicine.

Seniors Share Experiences Which Have Shaped their Plans for the Future

Evan Kingsley (BCD)

It started with Stanley Hattman's class freshman year. Once the ball started rolling, I couldn't get it to stop. Subsequent classes taught by David Goldfarb, Jack Werren, and Bob Angerer confirmed that biology was my field of primary interest. During sophomore year, I decided that I would concentrate in cell and developmental biology. The intricacy of the mechanism that turns a single cell into a complex organism is filled with many unknowns, and I was drawn to the subject by my desire to know more about such a fundamental process in the life of all multicellular organisms.

That same year, I began working as a dishwasher and media maker in the lab of David Pearce. The Pearce lab researches an autosomal recessive, juvenile onset neurological disorder called Batten disease, or Juvenile Neuronal Ceroid Lipofuscinosis (JNCL). The defective gene in JNCL is *Cln3*, and the lab uses both yeast and mouse models to study the disease. Although I wasn't doing research yet, I became interested in a few of the lab's projects. Fortunately, my position in the Pearce lab would later result in some fantastic opportunities for independent research.

After my first semester of washing dishes, I spent the summer at the Woods Hole Oceanographic Institution as a guest student in the lab of Cabell Davis. Dr. Davis researches local spatial distributions of plankton using a device called the Video Plankton Recorder (VPR). The VPR consists of high-magnification cameras and other sensors mounted on a hydrodynamic frame. It is towed behind a research vessel, where it records video that can be analyzed using computers on deck. I helped optimize the focus detection program that recognizes the plankton in the video images and worked toward creating a user interface for graphing the data collected.

My first semester of independent research took place during my junior year. Since the first outward symptom of JNCL is blindness, I began looking at the retina of the *Cln3*-knockout mouse for any signs of degeneration. Over two semesters of independent research and a summer, thanks to the de Kiewiet program, we discovered that, although there is no major morphological change in the retina, there is a subtle loss of cells in a key retinal layer. The results have found their way into a paper that was recently submitted to Investigative Ophthalmology and Visual Science.

My interest in the fundamental processes of biology has led me, through classes taught by Allen Orr and Tom Eickbush, to the subject of evolutionary biology, specifically molecular evolution. I will be bridging my interests in developmental and evolutionary biology next year with a job in the lab of David Lambert, a new professor here at the University.

I have learned much from the University of Rochester over the past four years, academically, personally, and socially. I thank Dave Pearce for enabling my first foray into scientific research, for much encouragement, and for being an excellent mentor. Cheeptip Benyajati has helped me immensely on my educational journey and deserves more thanks than I can give her. Also, Allen Orr has been wonderful in aiding the planning of my future, and I owe him many thanks.

Nicole Crnkovich (BCD)

Last summer I participated in a summer research program at the University of Chicago with Dr. Jean Greenberg. In Dr. Greenberg's lab I studied host-pathogen interactions using the model system of *Arabidopsis thaliana* and *Pseudomonas syringae*. Last fall I worked with Dr. Benjamin Miller at the University of Rochester Medical Center on a project optimizing novel bacterial detection techniques. Next year I will be pursuing a Ph.D. in Biology at Johns Hopkins University. My coursework, research experience, and the professors I have had during my college career were large motivators in this decision.

Anat Kohn (BMG)

Since my earliest memories I have been extremely fascinated by the biological sciences. This interest is likely a result of growing up in a home where both parents had graduate degrees in the biological sciences and spending much of my childhood playing in labs instead of playgrounds. Since I started high school my father has given me a place to further my scientific experiences at his lab at the Rutgers University Center for Biomaterials. My initial lab experiences were similar to that of a glorified test tube washer. While I was given more interesting tasks I could not fully understand the science behind them, and only knew how to carry them out. As I got older and my knowledge base increased I was given more challenging assignments and gained more insight into how my activities in the lab were relating to the research that needed to be completed.

The summers surrounding my freshman year at college were spent in the laboratory of Dr. Wise Young at the W.M. Keck Center for Collaborative Neuroscience, also at Rutgers University. At the Keck Center I conducted research at the forefront of spinal cord injury research working on ways to promote neuron regeneration. My experiences at the Keck Center really shaped my future at UR, and my quickly approaching future as a UR graduate. At the Keck Center there was a large focus on interacting with the people that our research was aimed at helping. People with spinal cord injury were constantly in and out of the lab trying to learn more about what strides had been made. This has motivated me to continue my study of genetics not only by pursuing a Ph.D. but also by being accepted into MD/Ph.D. programs to receive both degrees. Obtaining both degrees would allow me to directly study a medical problem and work towards a solution, but also work directly with the people afflicted with it.

In order to work towards this goal, I interned at MIT working in the laboratory of Professor Robert Langer for the past two summers. My projects there included research on micro-sphere technologies for drug delivery methods. Uses for this technology include better asthma inhalers as well as methods for releasing medicine directly into the sites of brain tumors. In addition, I participated in initial gene-therapy studies. If someone developed a gene-therapy method that worked safely and efficiently it would revolutionize the medical field. Instead of taking a lifetime of medications, people with genetic disorders (such as Galactosemia and Phenylketonuria) could have their genes altered and they could live a healthy normal life.

To broaden my research experiences I joined the laboratory of Dr. Elaine Sia here in the Biology Department for the past academic year. The lab studies the mitochondria of the yeast *Saccharomyces cerevisiae* in hopes that what they learn from this single celled organism will shed light on human disease and aging related disorders. These types of disorders are thought to be associated with mutations in the mitochondrial genome. My studies were conducted in collaboration with graduate student Leah Jablonski. We focused on studying the mitochondrial genome maintenance gene *MGM101*. MGM101 is a necessary protein for maintenance of the mitochondrial genome; however, its exact role is unclear. Studies have shown that MGM101 may be involved in DNA repair mechanisms within the mitochondria. Throughout the year I have developed various mutant forms of yeast. These mutants allowed us to study how changes to the Mgm101 protein affect protein interactions and respiration. By studying these changes we learned more about how the normal protein functions. This line of research will continue.

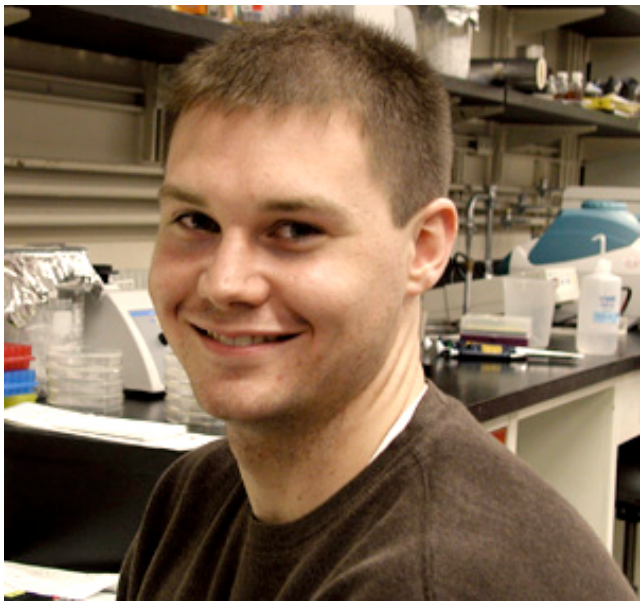
In the up-coming year I will be in the "real world" conducting research at a place undecided at the time this article was written. In addition, I will be applying to MD/Ph.D. programs hopefully to matriculate the following year. I would like to thank all my professors for their commitment to excellence in undergraduate teaching. Additional thanks are due to my advisors Drs. Hinkle and Sia for their support and guidance all these years.

Adam Goldstone (BCD)

During the summer of 2001, I volunteered in the Emergency Department at a hospital near my home in Maryland. I had the opportunity to follow doctors and nurses on their rounds. I measured vital signs in patients and learned how they were triaged. This experience was both interesting and exciting as it helped solidify my desire to become a physician.

Last summer I worked with Dr. Michael Kuehn at the National Cancer Institute in Frederick, MD. We were interested in the downstream effects of *nodal*, an important gene in mouse development. I spent most of the time genotyping mice and setting up matings so we could then do experiments to observe where *nodaal* was expressed in the later stages of development.

Matthew Maurer (BMG)



As an athlete in high school I believed that I wanted to become an orthopedic surgeon. I entered the University of Rochester as a "pre-med" student, majoring in biology primarily because it seemed to be the most logical field of study in light of my future plans. As my first semester progressed I found myself frequently seeking out Dr. Anthony Olek, my first biology professor, to inquire about topics covered in his course. This experience led me to begin reconsidering if becoming a surgeon was still what I desired.

At first my questions were simple. They were formulated to elicit a simple answer to something directly related to the class. However, I seldom received a simple answer, nor did I have my questions ever directly answered. Instead, Dr. Olek would respond to my questions by asking questions, thereby leading me to the solution. Looking back on this experience, I realize that Dr. Olek helped me acquire a skill commonly referred to as critical thinking. Unknowingly at the time, I began applying this approach not only to biology but also to chemistry and was soon discussing much more intriguing questions with my professors of both of these courses. By the end of my first semester at college, I was truly thinking and learning and simply fell in love with doing both.

Although by the end of my freshman year I had not dismissed the idea of a medical degree, I was becoming more and more attracted to basic science. I sought out a summer job in the department of Cell & Developmental Biology in Dr. James McCasland's laboratory at SUNY Upstate Medical University at Syracuse. I was originally hired as a lab aide and my primary duty was to genotype their animals but I also frequently made solutions for the lab and was occasionally lucky enough to wash dishes too. I was asked to return to Dr. McCasland's lab for the following summer and began to design an immunohistochemistry protocol for them. Its purpose was to visualize the dendrites in the somatosensory cortex using light microscopy and note differences between their wild type and mutant mice.

In my junior year, I received a de Kiewiet Summer Research Fellowship to work in Dr. Elaine Sia's laboratory at the University of Rochester. During this time I performed some biochemistry related techniques as well as molecular and genetic research, two areas in which I am very interested. I began by trying to purify the yeast mitochondrial mismatch repair protein, Msh1p, by affinity-column chromatography. I also began the work that I continued through two semesters of independent research. I contributed to Dr. Sia's research interests by investigating genes and the proteins they encode for possible roles in mitochondrial genome maintenance using *S. cerevisiae* as our model system. Multiple approaches were implemented for this task, giving me a great deal of experience in various experimental techniques and also the chance to conceptually integrate the various pieces of data into a logical conclusion. My work involved manipulating the genome by mutating a specific gene. Using the mutant I constructed, I examined changes in mitochondrial phenotypes that are either directly or indirectly related to the stability of the genome. In the latter case, I would follow up with experiments to support a cause-effect relationship between genome stability and a mutant mitochondrial phenotype. I also fused epitope-encoding sequences to the genes of interest for biochemical work aimed at surveying physical protein interactions with Msh1p, our main protein of interest.

Before I applied for the de Kiewiet Fellowship, I had already decided what my next step after college would be. My professors—Dr. David Hinkle, who later became my advisor, and Dr. Sia, who later became my mentor—both spent countless hours (with no exaggeration) answering my questions about biology to satisfy my endless curiosity. It was during this time that I decided I want to study biology in my career. I looked heavily to both Dr. Hinkle and Dr. Sia for advice as I transitioned from a future medical student to a future graduate student and they provided me with invaluable help during that time. I am now preparing to join Johns Hopkins University as a Ph.D. student in the Biochemistry, Cellular and Molecular Biology program.

Besides my parents who did anything to make every opportunity possible for me, I also want to thank every single one of my professors in Biology as well as Chemistry. Special thanks to Dr. Cheeptip Benyajati, Dr. Tony Olek, Dr. David Hinkle, and Dr. Elaine Sia.

Mark O'Hara (BMG)

When I was a freshman, my biology courses worked to open my eyes in a few different ways. Taking Gene Structure and Function and getting my first exam back, I realized that I would need to study a bit more than just the night before an exam in college. I also knew after this class that I wanted to continue to study molecular genetics as my major, something I previously thought might be too difficult to do. While working through Molecular Cell Biology in my second semester, I was awakened to the wonders of experimental techniques which led me to explore these issues further as a teaching assistant the following year and to look into the possibility of doing research as an undergraduate.

This interest only accumulated while I took classes such as Eukaryotic Genomes, Biochemistry, and Molecular Biology over my sophomore and junior years, feeling too overwhelmed with classes, teaching assistantships, and extra-curricular activities to be able to start researching in a lab. Finally, I took my first plunge as a de Kiewiet Fellow in Dr. Martin Gorovsky's lab over the summer after my junior year.

Before I applied for the de Kiewiet Fellowship, Dr. Gorovsky explained to me a bit about the use of *Tetrahymena thermophila*, a ciliated protozoa, as an experimental model system. Among other things, he described the two nuclei—the germline micronucleus and the vegetative macronucleus—and the sexual process of conjugation in which the cells pair and exchange gametic nuclei. In this process, the micronuclear chromosomes are fragmented at specific sites to differentiate into the macronucleus. Although the genetics associated with such a system was enough to make me possibly rethink working with *Tetrahymena*, I quickly changed my mind as he described one of the projects carried out by one of his postdocs, Dr. Kazufumi Mochizuki (Kaz). Kaz had been working with *TWI1* a member of the Argonaute family of genes which have been implicated in RNA interference (RNAi). Kaz found that *TWI1* is essential for DNA elimination in the development of the macronucleus from the micronucleus during conjugation. He devised an extraordinary RNAi-like mechanism—the scan RNA model—to explain how DNA elimination might occur in this system.

I excitedly started working with a gene homologue of *TWI1*, *TWI7* and continued working on this through two independent studies during my senior year. At first I found that it was expressed during conjugation. I next worked on trying to create a knockout construct of my gene. This is where I learned about "real" research—nothing ever works the first time around. For me, nothing really worked until what seemed the one hundredth time. Finally getting the knockout construct, I was able to obtain a germline knockout mutant in *Tetrahymena* and, through a series of different matings, I found that the gene is likely essential for conjugative or vegetative growth.

While my project was cut short by the end of the semester, I saw both sides of research—the frustrating side requiring patience and the exciting side where I actually saw results. I am very grateful to all my professors for helping excite me about biology and especially to Dr. Gorovsky, Kaz, and everyone in the lab for all of their support and patience. I look forward to carrying this research experience into further research projects during medical school in the coming years.

Samuel P. Strom (BMG)

For the past three summers I have worked at Quest Diagnostics Nichols Institute in San Juan Capistrano, California as a Research Associate. Working with the Infectious Diseases and Molecular Genetics research teams, I have had the opportunity to work with some of the most cutting edge techniques and equipment such as automated DNA sequencing and real-time quantitative polymerase chain reaction.

During my second summer I developed a sequencing assay for a gene called *CYP1B1*, mutations of which are known to lead to Primary Congenital Glaucoma (PCG). This disorder leads to blindness, and while it is treatable by surgery, diagnosis is very difficult. The aim of my project was to develop a system to determine which specific mutations lead to this disorder so that a quick, easy, and inexpensive test can be developed to screen newborns. If successful, these tests could prevent up to 10% of all blindness in the United States.

This research project and others at Quest provided me with insight into the joys and labors of laboratory research and I plan to continue this exploration via graduate school in genetics.

Maximilian Popp (BMG)

As an entering freshman, I knew that science interested me a great deal. With two parents who worked at Kodak as chemists, this wasn't surprising, but I still wasn't sure what subject to major in. It was after I took Dr. Hattman's wonderful introductory genetics course that I realized how fascinating and dynamic the cell is. So I promptly decided to major in molecular genetics and become involved in research.

My first introduction to lab research was during the summer of 2001. I worked in Dr. Jeffrey J. Hayes' (Department of Biochemistry and Biophysics) lab through the GEBS Summer Scholars program. I investigated the accessibility of enzymes to DNA complexed with histone proteins. To determine the degree to which T4 ligase is able to gain access to DNA in chromatin, I synthesized nucleosomal substrates containing a ligatable nick oriented either directly away from or directly toward the histone surface, or at intermediate positions between these two extremes. I found that the accessibility of ligase to nucleosomal DNA is extremely limited for all orientations; nicks in all positions were nearly completely refractory. T4 ligase activity may be inhibited in the 154 bp substrate because the histone tail domains sterically block access to the nick site.

In my junior year, I took Dr. Angerer's fantastic developmental biology class and immediately became interested in development. That year, I decided to start doing a Bio 395 course in his lab. I worked on the sea urchin goosecoid protein (SpGsc), a homeodomain containing transcriptional repressor that has been shown to link the specification of cells along the animal-vegetal and oral-aboral axes. The overall goal was to elucidate the regulatory elements that comprise the *SpGsc* promoter in order to understand how expression of *SpGsc* is spatially and temporally controlled. To do this, I conducted a series of electrophoretic mobility shift assays (EMSA) using different candidate regions of the *SpGsc* promoter to probe sea urchin nuclear protein extracts. I also made a series of 5′ deleted *SpGsc* promoter constructs that were used to drive the expression of a luciferase reporter gene. By injecting these constructs into embryos at the single cell stage and including the RNA of a candidate *SpGsc* regulatory protein, it's possible to monitor the luciferase activity during development. This allows a quantitative determination of the amount by which the candidate *SpGsc* regulatory protein is able to modulate *SpGsc* expression. Although these projects did not yield immediate results, they have taught me the value of patience and the enormous role of troubleshooting in science.

During the summers after my sophomore and junior years, I worked in Dr. Bob Weinberg's lab at the Whitehead Institute. My project involved investigating the cohort of genes affected by the prolactin (Prl) signaling pathway in mammary tissue, a pathway that has important implications in mammary gland tumorigenesis. I performed chip-on-chip experiments, looking at the genes controlled by Stat5, a downstream transcription factor in the Prl pathway. To complement these experiments and eliminate any false positive results from ChIP experiments, *in vivo* mouse studies were performed. A recombinant prolactin receptor with an FK506 binding domain replacing the prolactin-binding domain was generated in a prolactin receptor mouse knockout background. After pregnancy, mice were injected with the dimerizing agent (FK506) to induce Prl response, and I harvested mammary glands at various time points. cRNA for microarray analysis was made from both stimulated and unstimulated glands to quantitatively reveal both the identity of the RNA products generated in response to prolactin signaling and the time when they are induced.

The University of Rochester makes conducting undergraduate level research extremely easy and rewarding. The department offers incredible opportunities to do independent research and this, in addition to the many excellent professors (especially Dr. Hattman, Dr. Benyajati, and Drs. Bob and Lynne Angerer) has influenced my decision to go to graduate school. After completing a Take-Five project in Milan, Italy, I will be working towards a Ph.D. at MIT.

(Editor's note: Max was a 2003 Goldwater Scholar.)

Grace Vangeison (BIO)

For the past year and a half I have worked as a Research Assistant in the Center for Aging and Developmental Biology at the Medical Center. I have worked under Dr. David Rempe and Dr. Howard Federoff in trying to further elicit the molecular mechanisms of stroke. The experience has been rewarding and invaluable. Most importantly, my time in the laboratory has been integral to my decision to remain at the University of Rochester to pursue my Ph.D. in Neuroscience for the coming years.

Rebecca Porter (BBC)

My education at UR has helped me to establish a greater appreciation for science and a broader range of career interests. After years of proofreading my mother's medical transcription documents and volunteering in a nursing home, I came to UR confident that I would eventually practice medicine. While this dream is still in place, I now know it will not be the extent of my career. My professors and fellow students have helped to instill in me a passion for the sciences, the ability to think critically, and the desire to conduct research in the basic sciences.

The summer after my sophomore year I sought out a position in Dr. Ming Qi's lab in the departments of Pathology and Laboratory Medicine and the Center for Cardiovascular Research. I was attracted to his lab group which studied the molecular mechanisms of the Long QT Syndrome because of their emphasis on cardiology, the field I planned to pursue in my medical career. I wasn't expecting the lab to be so molecularly oriented and was not hoping for the basic science research experience that I encountered. I spent the first few weeks of the summer orienting myself to the literature and techniques of the research group. Soon, with the help of Dr. Qi, I began to formulate my own project investigating the possibility of alternative splicing of the identified Long QT genes playing a secondary role in the variable phenotypic expression of the dominant Long QT mutations. Unfortunately, due to lack of funding, I was unable to begin the project. Instead, I was asked to work as a lab technician as our former technician had to leave. This position exposed me to all the techniques performed in the lab, which was an incredible learning experience.

Surprisingly, the time I spent in Dr. Qi's lab piqued my interest in research, instead of simply reinforcing my desire to enter into the medical field as I had expected it to. I decided to apply for the de Kiewiet Summer Research Fellowship for the following summer to further my research experiences. I opted to leave Dr. Qi's lab due to a desire to work in a less clinically-oriented setting and joined Dr. Yi-Tau Yu's lab in the department of Biochemistry and Biophysics. Dr. Yu's group investigates the role of post-transcriptional modifications on small nuclear RNAs (snRNAs) involved in pre-mRNA splicing. My first few weeks in the lab were spent working with a graduate student screening the *S. cerevisiae* genome for proteins that affect the efficiency of splicing in hopes of identifying novel splicing factors. By comparing the level of mRNA accumulation in *in vitro* splicing reactions with different proteins added, we were able to identify several pools of proteins which looked promising for affecting splicing activity. I then moved onto my own project involving U1 snRNA. The purpose of the project was to investigate the role the two conserved pseudouridines in the 5' end of U1 play in selecting and base pairing with the correct 5' splice site in the pre-mRNA, making use of the *Xenopus* oocyte system.

In Dr. Yu's lab I have had the oppotunity to work very independently which has helped me not only to learn the necessary techniques, but to really think about the science behind the experiments. I've also had opportunities to be part of weekly lab meetings, to attend seminars and to meet many of the faculty in the department. These experiences have helped to solidify my passion for science and research and have led me to realize that my interests are not only geared toward clinical medicine. Although I am passionate about medicine, I could also envision myself being fulfilled with a career in research. To give myself some more time to decide between medical school and graduate school, I applied for and received a fellowship to do an additional year of research at the National Institutes of Health starting in June. I hope to gain valuable insight from my time there. Putting together all my experiences in medicine, research, tutoring and being a teaching assistant, I envision myself eventually practicing medicine, supplementing that with research relevant to my clinical work, and hopefully doing some teaching.

Danielle Ruppert (BIO)

Starting the summer before my senior year I began training in the department of Neuropathology and Postmortem Medicine to become a diener. Originally a German term meaning servant or attendant, the medical world uses it to refer to an autopsy assistant. As such, my duties included removing organs, taking pertinent tissue samples for additional analysis, and preparing the bodies to be sent to funeral homes. This unique experience has further confirmed my interest in the human body and my desire to pursue a career in medicine.

Anne Stey (BNS)

I enjoy biomedical research because it gives hope. The discoveries made in the laboratory are ultimately responsible for giving physicians new and better ways to heal and improve the human condition. Although I want to be a clinical physician I plan to continue in research. My area of interest is glutamate excitotoxicity.

One of the ironies of science is that glutamate, the main excitatory neurotransmitter in the brain, is lethal to neurons in high concentrations. This type of cell death is called glutamate excitotoxicity and has been implicated in many neurodegenerative disorders from stroke to Lou Gherig's disease. Cell death is the result of a huge increase in intracellular calcium mediated by the opening of the glutamate/NMDA-activated calcium channel. Once inside the cytosol, calcium is taken into the mitochondria and initiates pathways that lead to cell death. This build up of calcium in the mitochondria is what causes excitotoxic cell death.

My mentor, Dr. Shey-Shing Sheu, is interested in the role of a recently identified calcium channel (the ryanodine receptor) in perpetuating this excitotoxic mitochondrial calcium build up. Over the three years I worked in the lab I had complicated results when working with whole neurons so I switched to working in isolated brain mitochondria. My goal was to see how chemicals that acted on the ryanodine receptor affected calcium content in the mitochondria. I accomplished this by seeing how adding these drugs changed the emitted level of fluorescence of a calcium indicator dye.

The first chemical I used was dantrolene, which closes the receptor or acts as an antagonist. Adding dantrolene resulted in an increase in mitochondrial calcium. Similarly, addition of a different antagonist, azumolene and ryanodine, also showed a calcium increase. The same results with the different chemicals suggested that the drugs' effects were because of their same action on the ryanodine receptor.

The second set of chemicals I used are known to open the channel, or act as agonists. Adding the agonist caffeine elicited a decrease in mitochondrial calcium. In conjunction with the data presented above, this suggested that the ryanodine receptor functions as a release channel for calcium in the mitochondria.

The last chemical tested is known to compromise the structural integrity of the receptor/channel. In effect, it makes the complex "leaky" so calcium can pass through it more easily. In addition, chemicals that bind to the complex do so with more difficulty and as a result are less able to illicit physiological changes. This chemical is FK506 and when added to mitochondria calcium content decreased. Furthermore, when used in combination with ryanodine, the ryanodine induced increase in calcium was prevented. This suggested that both FK506 and ryanodine acting at the ryanodine receptor.

My results suggested that the ryanodine receptor could play an important role in ridding the mitochondria of calcium. This could be therapeutically meaningful if agonists are given for glutamate excitoxicity. These drugs could prevent the mitochondria from becoming overwhelmed with calcium and initiating cell death.

Gabrielle Kapsak (BIO)

In the summer of 2001 I was honored to attend the National Youth Leadership Forum on Medicine: Mission to China, their first international conference. Over the course of a month, we traveled through China and looked at their health care system, health delivery system and Medical schools. We also were able to see how Traditional Chinese Medicine was integrated into the western medical treatments.

During 2002-2003 I shadowed Dr. Fernandez at Strong Hospital. Dr Fernandez is bilingual in Spanish and English and I was able to see how the challenges of providing care to non-native English speakers is being addressed as well as learn about obstetrics and gynecology.

Last summer I was again able to combine my love of travel, learning and service, this time through Teaching and Projects Abroad. I spent the summer in Katmandu, Nepal, helping with the first after school program for underprivileged children and first shadowing at a clinic for the poor in the city and then working in Nepal Orthopedic Hospital, the only orthopedic hospital in the country, changing bandages, stitches, casts and helping in surgery.

All of my experiences have led me to pursue a career in medicine, with an international service component.

Society of Undergraduate Biology Students Emerges from Hibernation

by Jessica Marcinkevage andVicki Bottazzo

At the beginning of the 2004-05 school year the word was out: the Society of Undergraduate Biology Students was back in town. A council that had been in hibernation for six years, SUBS was revived by an enthusiastic committee of UR students at the beginning of the fall semester. The purpose of the group: to rescue biology majors from their many coffee-laden hours in Carlson and promote student involvement and faculty interaction. As a result of rigorous coursework, many biology majors were complaining of being better acquainted with their textbooks than their fellow bio majors. Here's where SUBS stepped in.

Throughout the year SUBS worked to coordinate events on campus, the first being a kickoff picnic (a.k.a. FREE FOOD), where students and faculty played volleyball and discussed everything from *Drosophila* to the Red Sox. During the semester, events continued with two movie nights featuring guest professors to discuss issues presented in the film. And of course what biology experience would be complete without a TGIF celebration? The Friday afternoon activity of "Subs with SUBS" brought undergraduates, graduates, professors, and even some future SUBS members (okay, maybe 15 years from now…) out for some good old Wegman's subs. This year's finale will involve a senior picnic, allowing a final chance to bond over our love for the study of life.

Speaking as outgoing SUBS exec members, we are glad to have been involved in the rejuvenation of the group and are sad to be leaving it when it is off to such a rolling start. However, we know it is in the good hands of the future exec board members. We know when we're back for a Meliora weekend, SUBS will be alive and kickin' (and still offering FREE FOOD!). Thanks for a great year! ☺

More Senior Research/Professional Experiences

Vicki Bottazzo (BCD)

Most students at the University of Rochester use the time during the summer months as an opportunity to gain experience in fields they are interested in and hope to pursue after their education is complete here. Following that lead, and using to my advantage the numerous opportunities that undergraduates have to work at the Medical Center because of its affiliation with the University, I have worked in a laboratory at Strong since the summer after my freshman year. I work in the Specimen Receiving lab, or SMS, as a Clinical Technician. Knowing that I wanted to work in medicine as a career led me to apply for this job and it has not disappointed me. Although it does not include patient care or contact it has allowed me to interact a great deal with doctors, nurses and other health care professionals. I feel that being a part of the team that works in the hospital has taught me many lessons about how to be a successful member of that team once I complete my graduate program as a Physician Assistant.

In addition to hospital experience, an extensive part of my time spent at UR in the biology department has been as a teaching assistant. I have worked as a teaching assistant for three different biology classes, tutored for those biology classes and conducted study groups through LAS as well. Before I began TAing I didn't have a lot of confidence in my abilities to speak in public or convey information to others, especially my peers. I have become much more confident since working as a TA, in both my public speaking abilities and my knowledge of biology. I have also built a good network of peers that I worked with each semester. I was able to be extensively involved in helping others learn biology and I think that strengthened my own experiences here as a biology major.

Jessica Marcinkevage (BIO)

It was difficult for me to choose exactly in what aspect of biology I wished to concentrate my studies; for this reason, the BA biology degree was perfect for me. As a student at the University I've been able to take advantage of the many opportunities available to those

interested in science and research. During the summer of 2003 I was accepted into the Graduate Education for the Biological Sciences Summer Internship program at the University of Rochester Medical Center where I conducted research in the Department of Environmental Health Sciences. My research focused on the role of arsenic as a chemotherapeutic agent used for treating specific cancers. Because of my interest in the topic and the proximity of the lab I was able to continue my research throughout my senior year.

Also, during the Fall 2003 semester I worked as a Teacher's Assistant for Professor Terry Platt's Biochemistry 250 class. I consider it an honor to have been able to work in such a position, having learned a great deal overall through the experience. I have recently accepted a position in the Master of Public Health program at Emory University's Rollins School of Public Health where I will study International Health, focusing on public nutrition. I have had a wonderful four years at the University of Rochester and know that it would not have been any better anywhere else. To my fellow seniors and biology enthusiasts, and to the biology faculty, thank you for giving me the opportunity to learn and grow—with, of course, some good times along the way! I wish you all the best.

Koya Allen (BIO)

As most undergraduates do, I started off working in several different laboratories doing the typical grunt work—glassware, autoclaving, etc. Luckily I had the opportunity to take things a step further by doing an Independent Research project in an Immunology Laboratory. Under the direction of Dr. Weiping Zheng I was able to do research on the *Foxp3* gene. This project is still underway but the goal is to make a working fusion protein which would be involved in the regulation of T cells. This was a very good experience. I learned a great deal of new laboratory techniques and procedures and was able to get a better grasp of what it means to be a research scientist. The knowledge I obtained from this experience goes far beyond anything a textbook or a lecture course can offer.

Miguel Brown (BIO)

Since my senior year in high school I have worked at Ortho-Clinical Diagnostics, a division of Johnson & Johnson through the high school co-op program. I have been kept on as a college intern. While the work that I have been doing there is not biologically related, it has opened doors of opportunity to work within the company. Upon graduation I hope to obtain a lab position in one of Johnson & Johnson's companies.

Shailey Desai (BCD)

At first I wasn't sure what to expect from my year of research at the University of Colorado Health Sciences Center in Denver but I have enjoyed every moment working as a research assistant in Dr. Lori Sussel's lab. Having the opportunity to build on the foundation of scientific knowledge I gained at UR has been one extremely insightful experience.

Currently I am studying intestinal development in the mouse. More specifically, I am looking for the intestinal cell types that are affected by the *Nkx2.2* gene known to be important for proper pancreatic development. Since I have successfully found an intestinal phenotype for *Nkx2.2* null mice, we are now trying to determine how this gene plays a role in the intestinal cell differentiation pathway and maybe even diabetes.

Initially I performed immunofluorescence with wildtype and *Nkx2.2* mutant mouse intestinal tissue to determine which cell types are affected by the gene. Those results showed that while stem cells, gut epithelial cells, enterocytes, and goblet cells are not affected by *Nkx2.2*, enteroendocrine cells are. Serotonin, gastrin, secretin, GIP, CCK, and substance P gastrointestinal peptide levels are downregulated in the *Nkx2.2* mutants compared to wildtype. However, PYY and NPY peptide levels remain the same. In addition, as previously found in the pancreas, glucagon/ghrelin double staining shows that *Nkx2.2* mutants produce less glucagon and more ghrelin secreting cells than normal. Now I am verifying these results by in-situ hybridization, real-time PCR and a gain-of-function cell transfection experiment.

This year in Colorado has shown me that my years in Rochester have given me a unique way of thinking which will be part of me for the rest of my life.

Christine Du (BIO)

During the summers of 2002 and 2003 I was a research fellow in the Strong Children's Research Center Summer Program. I was mentored by Dr. Olle Jane Z. Sadler and did clinical research studies with music therapist Rosemary Oliva, MT-BC. I used a Biograph program and ProComp+ for biofeedback sessions and participated in organized music groups for pediatric patients. My projects included:

The purpose of the project "The Use of Music Therapy/Relaxation to Induce Drowsiness/Sleep" was to develop, standardize, and test the efficacy of music therapy intervention as procedural support for pediatric patients receiving lumbar punctures. I drafted surveys, recruited patients, collected and analyzed data and explained the study at a poster presentation.

For the project "Stress Reduction/Relaxation in Bone Marrow Transplantation" I aided in recruiting patients and interventions.

"Music Therapy as Procedural Support During Botulinum A Toxin Injections for Pediatric Patients" was undertaken to develop, standardize, and test the efficacy

of music therapy intervention. I modified the original protocol, recruited patients, collected and analyzed data. These were ongoing projects which I continued working on during my senior year. The abstract of the Botox study was recently published in Pediatric Research Supplement Abstract Issue, Volume 55(4), Part 2 of 2, Abstract # 492, Page 87A as "Music Therapy as Procedural Support During Botulinum Toxin Injections."

During the time I spent working on these studies I met people and had experiences that will forever make an imprint on my life. I am grateful that I was able to learn and grow by working with Dr. Sahler and her colleagues and I thoroughly enjoyed my time with all of them.

Lindsey Hagstrom (BIO)

I have participated in research the past three summers at the University of Minnesota investigating Natural Killer cells and their function in adult peripheral blood and umbilical cord blood samples. Additionally, I did research the summer after my freshman year at the Parker Hughes Institute in Roseville, MN, where I examined the efficacy of several different drugs manufactured by the Institute in killing one strain of brain tumor (glioblastoma) cells and breast cancer cells. I have also volunteered in the Oncology Unit of Strong the past two years. I was a TA for Bio 111, Bio 110 and Bio 205 as well. Finally, I took a trip to Chimaltenango, Guatemala, this past January for a week to act as a medical translator and work side by side with surgeons and nurses assisting in hernia and Ob/Gyn surgeries.

Albert Huang (BCD)

Every summer since freshman year I have conducted research in one laboratory or another. My first summer, I assisted in a Systemic Lupus Erythematosus Lab at the University of Florida generating whole blood cultures, running various assays and helping the postdocs with their research as well. This was a great opportunity for me to observe how research and patient care melded together. I was able to observe and interact with many SLE sufferers during their time in the clinical trial.

The following summer I conducted independent research at the University of Pennsylvania's Center for Experimental Therapeutics. I learned how to use many pieces of machinery integral to cellular research while finding out more aspects of research medicine. I also met many individuals from all over the world in that lab and learned much about their various backgrounds.

The summer before my senior year I was fortunate to acquire a research associate position at Harvard Medical School's Cutaneous Biology Research Center where I conducted apoptosis gene regulation research in *Drosophila*. Along with basic lab techniques I learned a great amount about genetics and gene manipulation. I was also able to receive guidance both in my research and in my higher education plans from the people in the lab as well as neighboring labs.

In my summers of research I have learned a lot about life as well as science and medicine. Without these experiences as well as my experiences here at the University of Rochester, I am sure that I would not be the person that I am now, nor would I have decided on the same path for my future.

Julie Hull (BIO)

After transferring to the UR during my sophomore year, I was eager to get involved with research. I discussed this desire with my biostatistics professor, Dr. Huelsenbeck, and was thrilled when he asked if I'd like to assist his graduate student in order to gain some experience. After one semester of working with his student, I began working on an independent study. My goal was to engineer phage T7 to have non-optimal codons in its coat protein and then assess its fitness in comparison to that of a wild type phage. This project continued through the summer, and while it was a bit frustrating at times, it was that summer that I really began to work independently and efficiently in the lab.

Unfortunately, the Huelsenbeck laboratory moved to California and I began searching for another lab. I landed in Dr. Yu's lab in the Department of Biochemistry and Biophysics. I was hired to help one of his graduate students which gave me a chance to get situated in my new surroundings. Over the summer, however, I participated in the UR's REU/GEBS program and was given my own project. I began studying the effect of pseudouridylation at position 35 of $tRNA^{TYR}$ on the processing of the molecule. I presented a poster illustrating my topic and results at the end of the summer and was able to continue work on this project through the fall semester.

As an undergraduate, I have also served as a TA for two courses, Molecular Cell Biology and Principles of Genetics. I thoroughly enjoyed both my research and teaching experiences at the UofR. These experiences have given me the ability and the confidence to move on to the next step. Next year, I will begin working towards a Ph.D. at the University of Virginia.

Rebecca Schlissermann (BEB)

Not knowing exactly what career in biology I liked, I pursued a diverse range of activities within and outside of Rochester. In summer 2001, I took a six week Aquatic Entomology course at Stone Laboratory, a field station of Ohio State U. The next summer, 2002, I worked as a research assistant with Dr. Tom Getty of Michigan State U. I spent my days hanging out in a stream labeling *Calopteryx maculata*, the black winged damselfly. Dr. Getty's previous graduate

student had found a correlation between body fat and color of the damselflies so we followed up that study by trying to see if color made an impact on mating success. Back in Rochester I pursued an independent study in Dr. Jaenike's lab.

This past summer I had an internship with the Erie County Forensic Laboratory. I spent a lot of time in the biology department, but also worked in the chemistry lab, firearms division, and fingerprint lab. Forensic science appealed to me as a practical use for biology. I'm looking forward to starting my master's degree in forensic science next fall at Virginia Commonwealth University.

Marjorie Waterman (BCD)

Since my degree requirements were completed in December 2003, I have decided to take the Spring semester to work in the Neonatal Intensive Care Unit (NICU) at Strong Memorial Hospital. I wanted to learn more about patients, medications and hospital practice before I attend medical school in the fall. I have also been conducting research on age-related hearing loss (presbycusis) in the lab of Robert D. Frisina, Ph.D. Of particular interest to our research group is gene regulation in mice having presbycusis. In February, I presented a poster at the annual meeting of the Association for Research in Otolaryngology (ARO) in Daytona. My findings were significant in that a particular pathway in the degradation of the auditory pathway was further defined. In the summer of 2002, I obtained my EMT-B license and have been working with MERT since. I have also volunteered in the pediatric in-patient unit at Strong, as well as at Bertrand Chaffee Hospital in Springville, NY. As a sophomore I worked as a study group leader for Molecular Cell Biology and as a junior was an Organic Chemistry I workshop leader. I have been employed in the office of Ruth A. Lawrence, MD since freshman year maintaining a database on human lactation and the factors that influence a mother's decision to breastfeed. Since December, I have also been working closely with Dr. Lawrence editing the sixth edition of her textbook, *Breastfeeding: A guide for the Medical Profession.*

de Kiewiet Research Fellowships Awarded to Eight UPBM Majors for Summer 2004

Eight undergraduates majoring in four of the B.S. tracks of the Undergraduate Program in Biology and Medicine (UPBM) have been awarded de Kiewiet Research Fellowships for the summer of 2004. The de Kiewiet Fellowships were established in 1983 in memory of former UR president C.W. de Kiewiet. Every year since then they have provided the opportunity for UPBM undergraduates to spend the summer doing research full time. This year each Fellow will receive a stipend of $3,000 for ten weeks of research in the laboratory of a University researcher as well as a housing stipend.

Listed below are the recipients of the 2004 de Kiewiet Summer Research Fellowships, their projects and their mentors.

Max Banko, BMG major, class of 2005, has known he wanted a career in science since elementary school. While a high school student his career plans were confirmed when he did a fulltime summer research internship at Pacific Northwest National Laboratories. As a UR junior Max has already achieved a stellar academic record as well as gaining extensive laboratory experience. During the summer of 2003 he had a GEBS internship to do research in Dr. Elaine Sia's Biology Department lab and has continued that work as formal Independent Research during the year. Taking his research forward this summer, Max will be working on "Synthetic lethality screen for proteins that genetically interact with the mitochondrial DNA polymerase, Mip1p."

Steven Chan, BBC major, class of 2005, thought his career goal was to become a doctor until he took Molecular Biology, the first course in which he studied original experiments and learned how data is interpreted and experimental design tested. Through discussions with his instructor he found his way to the lab of Dr. David Goldfarb in the Biology Department where he has been doing a semester of Independent Research laying the foundation for this summer's project. Steve will be exploring "Multiple translocation pathways across the nuclear pore complex."

Patrick Corey, BEB major, class of 2005, had teaching experience TAing Bio 110, 111 and 111L before he got involved in research. Pat began his journey into the realm of research last November when he approached Dr. Jim Fry of the Biology Department about doing an Independent Research project in his lab. Pat's strong interest in evolution led him to choose a project on the relationship between adaptation and reproductive isolation in *Drosophila melanogaster*. The excitement generated by this project has led Pat to decide to combine his interest in medicine with his new found interest in research and to aim at earning an MD/Ph.D. His de Kiewiet project is "Ethanol induced responses of *Drosophila* species."

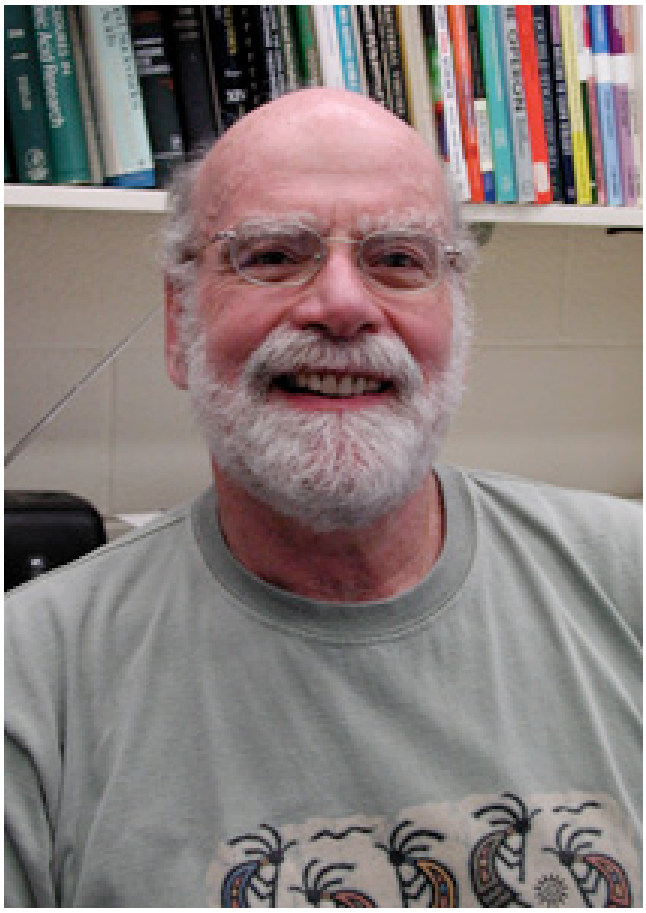
(Continued on page 17)

Long, Successful Career in Biology Research Grew From a College Major in Physics

Stan Hattman, Ph.D. Reflects on Stan Hattman

How did a nice boy from Brooklyn end up spending more than half his life doing science/teaching at the University of Rochester? Could I have been subliminally drawn by the name Rochester, having grown up one city block from Rochester Avenue. I attended an all boys high school, Brooklyn Technical H. S. and, despite having a highly science/technical oriented curriculum, I never took a biology course. After graduating in 1956, I started CCNY as a physics major (math minor). My new commute was over an hour each way, so I gave up varsity swimming and concentrated on the books. Since 5 credit courses met 5 days a week there was little breathing room. Despite doing very well, in my sohomore year I became disenchanted with physics. (Advanced Mechanics tended to have that effect on students.) I still didn't dream of switching majors. Then in the fall of my junior year I had an epiphany. It was in my first biology course—what was to be a year long, mindless exercise in memory/taxonomy. Even worse, the fall bio lab started at 8:00 am which meant I had to leave home at 6:30 am. I still remember the lonely, freezing winter walks in the dark to the subway—made spooky by my footsteps echoing in the empty streets, or the sounds of snow crunching under my boots.

What was this epiphany? It came during one of the first dissection exercises; viz. the earthworm. It's embarrassing to admit, but I confess—I was blown away when I discovered all that 'stuff' inside. Wow, I was so naïve that I was expecting a hollow tube. Biology suddenly became interesting. Now, was there some way I could apply physics to biology? I didn't know, but it seemed like a viable notion. I played with that idea for some time and then I discovered that one of the CCNY physics faculty members was reputed to be a 'biophysicist'. After I visited with him he agreed to mentor me in an independent study course in the coming spring semester. He did this by farming me out to a cancer research lab at the Francis Delafield Hospital. Having had little meaningful biology and no organic chemistry, all I did was shave the hind quarters of mice so that (un)irradiated tumor tissue could be injected, practice pipetting, and watch/talk with the lab folk. Halfway through the semester I was informed that in order to get college credit for the course, I would have to write a term paper. Uh-oh!! Since I had nothing substantive to show for my 'work,' my mentor gave me a choice of topics: radiation effects on bacteria or radiation effects on viruses. Viruses sounded 'sexier', so I chose the latter. In 1959, the literature was limited, but there was enough to occupy



me. I could even apply target theory and use some simple differential equations in my paper which I printed by hand because I did not type.

The approach of summer demanded an important decision. After working six years as a lifeguard, I now decided to pass that up for a position in the clinical radio-iodine lab at Sloan-Kettering Institute (arranged by my mentor). After one week, I had mastered all there was to learn, so in my spare time I began hunting all around the building to see what else was going on. It was my good fortune to find a small group doing X-ray inactivation studies on bacteriophage and phage-infected cells. I could not have been happier and I went there at every opportunity. I started reading original journal articles and discovered the recently published book, *Bacteriophages*, by Mark Adams which I still have on my shelf. I decided that phage research was what I wanted to do and I arranged another independent study, but at Sloan-Kettering with the phage group. My time was divided between courses on campus and research on the so-

called 'oxygen effect' on phage-infected cells, a higher sensitivity to X-irradiation damage in the presence of oxygen vs nitrogen. As a footnote, my data was subsequently published, but I was neither co-author nor even acknowledged for doing the experiments. No matter, I was still thrilled to see my data in print.

With the fall semester drawing to an end, I had to begin thinking about graduate schools. Several had programs in biophysics, including MIT and Johns Hopkins University. From my reading *Bacteriophages*, the leading workers were readily identified by having the largest numbers of citations in the Bibliography. By chance, one of them, Salvador E. Luria, later a Nobel Prize recipient, had recently moved to MIT. One of my buddies had known him at U. Illinois, Urbana, and said he was a great guy. This seemed like a great configuration of the stars; so, with the blessing of my CCNY and Sloan Kettering mentors, I applied to MIT over Thanksgiving break. Surprisingly, before the new year, I received their acceptance. And so it was that my fate was decided.

Within weeks of arriving at MIT, I switched to the Microbiology track. Deep down I had known all along that I had no more interest in physics or biophysics. Still it was necessary to pay the price for having had such a weak background. Now I had to take the undergraduate courses in Biochemistry, Genetics, Physical Chemistry and Organic Chemistry. There were no lab rotations at that time. So in the summer of '61, I attended the Cold Spring Harbor Symposium on Gene Regulation and stayed on to take the Bacterial Genetic lab course along with a dozen or so post-docs and seasoned scientists. One of the participants was Heinrich Matthei, whose name is probably unknown to everyone still reading this. During one afternoon break, I remember him describing his research to a group of fellow students, all of whom seemed excited by his account. I glanced at the writing on the blackboard and sniffed, "Oh, biochemistry," and I looked away. What Heinrich was relating was his ground-breaking post-doctoral work on *in vitro* poly U-directed polyphenylalanine synthesis. To this day, I am embarrassed—and miffed that Heinrich did not share the Nobel Prize with his mentor Marshall Nirenberg.

I returned to MIT and started research in the Luria lab. I worked on two projects that hit dead ends. Although we did publish a NOTE on one of them, there was no real thesis project in sight. A year later, in the summer of '62, I spent time in Geneva, Switzerland, working in the lab of Werner Arber (later , also a Nobel Prize recipient) on the transfer of phage host-specificity through successive growth cycles in different hosts. This experience convinced me that I had to study the host-specificity phenomenon which had been discovered by Luria working with phage T2. After returning to MIT I pushed to drop my old project, and Salva finally agreed. Ten years earlier Luria came upon an *E. coli B* strain which he designated $B/4_o$. It was isolated during the selection of phage T4-resistant variants. These mutants fell into two phenotypic classes: resistant only to T4, and resistant to phages T3, T4 and T7. Surprisingly, a single growth cycle of phage T2 in $B/4_o$ (but not B/4) yielded a modified form, designated T*2, that had lost the ability to infect all *E. coli* B and K12 strains, hence the name "host-induced-modification". However, T*2 phage was able to infect a related enteric bacterium, strain Sh of *Shigella dysenteriae*.

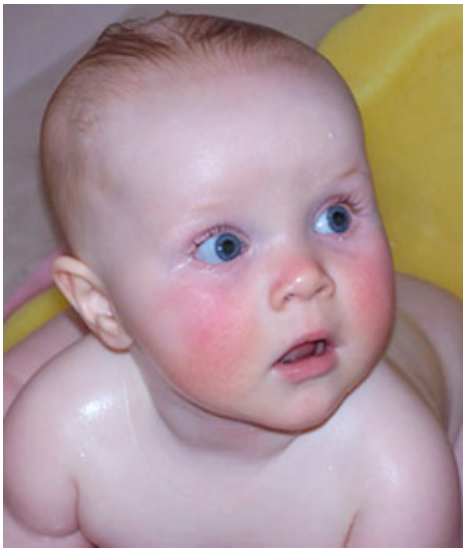
I began by checking out all the bacterial strains that I would be working with. Since the Luria lab used agar media with various sugars and dyes, I decided to streak out my cultures on these plates in order to examine their carbohydrate utilization abilities. I was not surprised to see that $B/4_o$ was *gal*$^-$, while the parental B and mutant B/4 were *gal*$^+$. I thought, OK, different receptors were affected by the B/4 vs. $B/4_o$ mutations, and these might require different carbohydrate-utilization capabilities. It had no special significance to me, and I just made a mental note of the observation. To confirm the production of T*2, I carried out a one-step growth experiment in *E. coli* strain $B/4_o$, monitoring progeny phage titers on different host strains. Everything went as expected; the very next day, Toshio Fukasawa arrived from Japan. As I was thinking about what I should do next, he began informally describing his research to my bench neighbor. Interested in galactose metabolism, Toshio had isolated and characterized the enzymatic defect in each of a number of *E. coli* K12 *gal*$^-$ mutants. One such *gal*$^-$ strain [W4597] behaved strangely. When he infected it with phage T4, although the cells lysed at the normal time, they did not appear to produce progeny phage; i. e., there was no apparent increase in phage titer when assayed on *E. coli* K12 or B strains. BINGO!!! It was suddenly all clear to me, and I burst into their conversation that I had just solved both his problem and the T*2 mystery. At this point, I should mention that phage T2 (as well as T4 and T6) DNA is highly unusual. First, all the cytosine residues are replaced by 5-hydroxymethylcytosine [hmCyt]. Moreover, these residues are glucosylated [by phage-induced glucosyltransferases] to produce hmCyt-glucose. As it turned out, Toshio's odd W4597 *gal*$^-$ mutant strain was defective for UDPG-pyrophosphorylase, an enzyme involved in the synthesis of UDP-glucose. This cellular metabolite was the glucosyl donor for the phage glucosyltransferases. Thus, I predicted that strain $B/4_o$ *gal*$^-$ had the same enzyme defect as W4597, that T*2 DNA lacked glucose, that *gal*$^+$ revertants from $B/4_o$ would not produce T*2 phage, and that T4 grown in W4597 would have a normal titer if plated on *Shigella* Sh (i. e., it would have a T*4 phenotype). Within a month, all these predictions were corroborated, and my "thesis problem" was no longer a problem. Talk about being in the right place at the right time!

We published these results, which represented the first case where the chemical basis of a host-induced modification had been elucidated. It would be two more years before W. Arber showed that DNA

methylation was involved in host-induced-modification of phage □. However, DNA methylation, not glucosylation, was the more general mechanism for conferring host specificity, as well as playing a role in a wide variety of other biological functions. Well, that was more than 40 years ago. I've done a lot of science since then, but all subsequent discoveries came after considerable effort. Nothing occurred with the lightning insight I experienced on that fateful day in 1962, although my love of phage never diminished in all the years. At Rochester I've had basically two independent careers: one was studying regulation of gene expression (transcriptional and translation regulation of the *mom* operon in bacteriophage Mu); the other was devoted to study of the enzymes that mediate DNA methylation in prokaryotes and lower eukaryotes and their biological function(s). I can say with some (im)modesty that I've made good contributions to both fields. Now, although I will be hanging up my professional garb on July 1, that will not be true of my lab coat. So, see you around Hutch.

(That is if he's not spending more time with his two new grandchildren.)

Meet the newest Hattman grandchildren—Rebecca's son Andrew Conlin Spencer (4 1/2 months in the picture) and Ursula's son Gavin Winter Suskin (2 weeks old in the picture).



(de Kiewiet Summer Fellows continued from p. 14)

Brandi Davis, BBC major, class of 2005, spent 40 hours a week one summer coordinating an international conference on Heme Oxygenase for Dr. Mahin Maines while at the same time volunteering in the lab of Dr. Jeffrey Hayes in Biochemistry and Biophysics. She began working with *Physarum polycephalum*, a slime mold, trying to find DNA sequence information. All that was in pursuit of her desire since the age of 6 or 7 to be a scientist when she "grew up." She has been a TA for BIO 111, BIO 111L and CHM 131L along the way and found that teaching these courses helped her to re-evaluate her own research work. All this has led to her de Kiewiet project "Generation of a cDNA library and identification of histone H1 clone from *Physarum polycephalum*." Brandi hopes to enter a Ph.D. program and eventually both to teach and to do research at a University.

Vanessa Franco, BNS major, class of 2005, did summer research in an Environmental Protection Agency Program at the University of Cincinnati while she was still in high school. Just before graduating from high school Vanessa contacted a few researchers at UR and came up with an offer to work in Dr. Marc Schieber's lab her freshman year. She has stayed there for two and a half years including two summers. Her de Kiewiet project, "Determining the variation in post-spike effects during errors," has grown out of her experiences there. Vanessa is interested in the possibility of entering an MD/Ph.D. program.

Andrew Hart, BNS major, class of 2005, came to UR with the intention of studying the mind and the brain from a biological perspective. He worked for eight months as a laboratory assistant in one lab in the Center for Aging and Developmental Biology and then spent three summer months doing research in a neighboring laboratory. Last January he began an Independent Research project with Dr. Kathy Nordeen in the Department of Brain and Cognitive Sciences. It is this project, "The role of dopamine in avian vocal learning" that he will expand during his de Kiewiet summer.

Jason Moore, BNS major, class of 2005, has a long list of activities: TA for BCS 200 Statistics and Experimental Design and for the NSC 203 Laboratory in Neurobiology, tutor in the College Writing Program, Business Manager and Primary Science editor for Journal of Undergraduate Research. For a career Jason is interested in the effect that scientific research can have on the field of medicine, especially in discovering treatments for diseases. He hopes "to translate clinical observation into scientific hypotheses and scientific

research into clinical treatments" and will pursue an MD/Ph.D. to reach that end. His de Kiewiet research project will be done in the laboratory of Dr. James Ison in the Department of Brain and Cognitive Sciences. The title is "Effects of aging in mice and humans on gap detection for within- and between-channel frequency signals."

Julie Sullivan, BEB major, class of 2005, considers herself lucky to have had the opportunity to do research last summer in the GEBS program at UR because she has been able to continue her project in the laboratory of Dr. John Jaenike in the Biology department beyond the summer. That study, on levels of reinforcement in *D. recens* and *D. subquinaria*, has culminated in a paper for *Evolution* on which Julie will be a co-author. The focus of her de Kiewiet project, while involving *Drosophila*, as did her summer of 2003 research and that of her fall semester, will be slightly different from her original project. This summer's project is "Behavioral ecology in *Drosophila innubila* and *Drosophila recens*" which involves behavioral studies of *Drosophila* mating. Julie plans to go to graduate school and make a career out of research in evolution and ecology.

Congratulations

Awards and Grants

Marty Gorovsky has been made a Fellow of the American Academy of Microbiology.

Naina Phadnis was chosen by the University to receive the Edward Peck Curtis Award for Excellence in Teaching by a Graduate Student. She received $500 for her outstanding teaching efforts and the Department received $250 to improve undergraduate course materials or laboratory equipment.

Qun Yu has been awarded a Messersmith Fellowship. This prestigious fellowship, which the University awards to only one or two outstanding graduate students in the sciences each year, will contribute one year of support to Qun's graduate stipend. Qun is studying chromatin boundary elements that define domains of gene expression in the yeast model organism. Qun is advised by Xin Bi.

John Jaenike has been awarded an NSF grant for 2003 through 2006 for his project "Evolutionary ecology of male-killing *Wolbachia* in *Drosophila innubila*".

Robert L Minckley was awarded a grant of $45,000 for his project "Borderland ecosystem effects of the invasive plant saltcedar to a keystone ecological process" by Center of Environmental Research & Policy effective 1 June 2004- 30 May 2005.

Births

Xiaoyun and **Junqiang Ye** are the proud parents of a girl, Jenny Zixuan. Jenny was born on Saturday, February 28, weighing 6 lbs. 15 oz. She was 20 1/2 inches long. Junqiang is a graduate student in the Eickbush lab.

Amit and Sonia are proud parents of a boy, Joshua Mark Fernandes. Joshua was born on Friday, March 5 weighing 7 lbs. He was 19 3/4 inches long. **Sonia D'Silva** is a graduate student in the Miller lab.

Adam and Rebecca Mason are the proud parents of Laura Alice Mason born March 31, 2004, weighing 6 lbs. 9 oz. and 19 inches long. **Adam Mason** is a postdoc in the Goldfarb lab.

Other

Jack Werren is promoting the full genome sequencing of *Nasonia*, an emerging model system for studies of complex genetic traits. A full genome sequence will make positional cloning of genes more practical. This May the NSF Frontiers in Integrative Biological Research (FIBR) group on Biology of *Wolbachia* is meeting outside Tucson, Arizona, to coordinate the use of *Wolbachia* in research and education. **Jack Werren, John Jaenike** and **Cathy Westbrook** are organizing this meeting.

On the non-science front, **Jody LaRose** is happy to report that Sunshine, her Shetland Sheepdog, has earned her Novice Agility titles in both "Standard" and "Jumpers with Weaves" AKC dog agility competition.

Class of 2003 Choose Permanent Labs

Five graduate students completing their first year have been assigned to the labs in which they will do their doctoral research. **Chun Chen** will do her work in Bradford Berk's lab in the Department of Medicine; **Lu Gao** has chosen Robert Bambara's lab in the Department of Biochemistry & Biophysics; **Rhitoban Ray**

Choudhury has joined Jack Werren's lab in the Department of Biology; **Deborah Stage** and **Jun Zhou** will be working with Tom Eickbush in the Department of Biology. **Susan Elizondo** will do a fourth rotation with Xin Bi in Biology.

Arrivals and Departures

Molly Saweikis is the new Lab Tech in Jim Fry's laboratory. Molly earned a BS in Biotechnology at RIT in 2002. Her interests are rock climbing, Brazilian jiu-jitsu and pets.

Hong Qin, Ph.D. will be a visiting professor in the Goldfarb lab with the title of Assistant Professor, Center for Aging and Developmental Biology. Dr. Qin comes from a postdoc position at the University of Chicago.

Robert Gromadka began his postdoctoral studies in January of 2004 in the Gorovsky lab. He received his Ph.D. from The Institute of Biochemistry and Biophysics PAS (Poland). Robert will analyze the function of RNA-dependent RNA polymerase in DNA elimination. Robert's hobbies are reptile breeding and creating stained glass. When not in the lab, Robert likes to roller skate with his friends. In Poland, he spends much time in a stable and horseback riding.

Tomoko Noto joined the Gorovsky lab as a postdoc in February, 2004. She received her Ph.D. from Kanazawa University in 2003. Tomoko's research project will focus on the functional study of *TWI* gene family in *Tetrahymena*. Besides research, she likes reading books and snowboarding.

Paul Cheresh joined the Gorovsky lab in April of 2004. Paul received his Ph.D. from Northwestern University in 2003. As a postdoctoral fellow, Paul will study the role of gamma tubulin in the biogenesis and regulation of centriole/basal body formation in *Tetrahymena*. When not studying the lower eukaryotes, Paul likes to run with the Genesee Valley Harriers. His other interests include yoga, photography, the histories of science and architecture, ethnic food and conversation.

The Gorovsky lab will miss their hard working undergraduate students, **Cornelia Zorca** and **Mark O'Hara**, who will graduate in May.

Michael Clark will be a Postdoctoral Fellow in the labs of Jack Werren and John Jaenike. He will be working on several projects on interactions between *Wolbachia* and their insect hosts. Michael has been doing a post-doc with Tim Karr at the University of Chicago.

Cathy Westbrook is a new Laboratory technician in the Werren Lab. She received a B.A. in Biology in 1996, from the University of California, Berkeley, and an M.S. in Entomology in 2003, from Cornell University. Cathy is engaged to Bill Turechek, a plant pathologist at Cornell. She is the owner of a 12 year old puppy dog named Leibniz. Cathy likes to play soccer and to cook.

Laura Baldo, visiting scientist in the Werren lab, has returned to her home institution, U. Milan, Italy.

Off Campus

James Fry was an invited speaker at the Symposium on Comparative Biology of Ethanol Consumption, Society for Integrative and Comparative Biology in New Orleans, LA, January 6-8, 2004. The title of his talk was "Ethanol tolerance in *Drosophila*: evolutionary and ecological genetics." At the Gordon Conference on Plant-Herbivore Interactions in Ventura, CA, March 2-5, 2004, Jim's talk was "Towards an evolutionary genetic understanding of host specialization in insects".

Dave Goldfarb spoke on autophagy of the nucleus and cell death in yeast at, the Department of Anatomy and Structural Biology, Einstein College of Medicine, 12/10/03 and the Biology Department, University of North Carolina, Asheville, 4/26/04.

Marty Gorovsky gave an invited talk at a Meeting of the French Society of Protistology in Montpellier, France on May 12. The title of his talk is "The role of RNAi in genome rearrangement in *Tetrahymena*". On May 17 Marty will give an invited talk at the NAS Sackler Colloquium on Biology of RNAi in Washington, DC. The title of his talk is "Small RNAs in genome rearrangement in *Tetrahymena*".

Stan Hattman performed with Afrikuumba, the African Dance and Drum Ensemble, at Monroe Community College during its International Day celebration on April 28.

John Jaenike spoke at an invited seminar at Penn State.

Robert Minckley gave a talk on "Evolutionary and ecological consequences of floral exploitation by specialist bees" at Cornell University on February 9, 2004 and at Brock University on January 24.

Allen Orr gave a seminar at The College of William and Mary, Department of Biology, in February, 2004. In March he gave the Plenary Lecture at the Mechanisms of adaptation, genetic differentiation and speciation meeting, Tutzing, Germany, "Population genetic theories of adaptation." In April, Allen gave the

Lecture to Staff Scientists at National Institutes of Health, National Institute of General Medical Sciences on "The genetics of speciation in *Drosophila*" and at the Carnegie Institution of Washington, Department of Embryology, 26th Annual Mini-Symposium (Topic: Evolution), he spoke on "The genetics of speciation in *Drosophila*."

Louise Vanni and **Kathy Giardina** attended an NSF Regional Grants Conference held at Columbia University March 15-16, 2004. The conference offered several general and specific sessions led by top officials from NSF. Louise and Kathy attended sessions on Biological Sciences and Grant award and Administrative issues. Jean Feldman, Policy Office head, Office of Budget, Finance and Award Management, Division of Grants and Agreements, gave an outstanding presentation. Other topics covered were: NSF overview, proposal preparation, merit review, and challenges and opportunities and new directions.

Jack Werren spoke at the following seminars and conferences: Seminar on Organismic and Evolutionary Biology, U. Mass, 2004; *Wolbachia* FIBR Working Group Meeting (Organizer); 45th Annual *Drosophila* Meetings Workshop;conference on Genetics of Non-Drosophilid Insects (Co-Organizer & Speaker); seminar at Baylor Human Genome Center, "Using haploid genetics in a complex eukaryote: *Nasonia* as an emerging model system"; conference speaker at Keystone Meeting Genetic Variation in Model Organisms; seminar at NYU, Biotic Resources: Integrating Development, Genetics, Evolution, and Systematics Program; seminar at Department of Entomology, U. Mass, "Plant gametophytes: evolution, development and function; opening lecture, Ascona, Switzerland, 2nd *Nasonia* Workshop, Schiermonnikoog, Netherlands.

Recent Publications

Eickbush

Christensen S, T.H. Eickbush. 2004. Footprint of the retrotransposon R2Bm protein on its target site before and after cleavage. J Mol Biol. Mar 336(5):1035-45.

Bibillo A, T.H. Eickbush T.H. 2004. End-to-end template jumping by the reverse transcriptase encoded by the R2 retrotransposon. J Biol Chem. 279(15):14945-53.

Fry

Fry, J.D. 2004. How common are overdominant mutations? Genetics 167 (1): in press.

Fry, J.D. 2004. Estimation of genetic variances and covariances by Restricted Maximum Likelihood. *In* A. Saxton, editor, *Genetic Analysis of Complex Traits with SAS*. SAS Books for Users Series, SAS Institute, Cary, NC., in press.

Fry, J.D. 2004. On the rate and linearity of viability declines in *Drosophila* mutation-accumulation experiments: genomic mutation rates and synergistic epistasis revisited. Genetics 166:797-806.

Fry, J.D. 2003. Multilocus models of sympatric speciation: Bush vs. Rice vs. Felsenstein. Evolution 57:1735–1746.

Fry, J.D. 2003. Detecting ecological trade-offs using selection experiments. Ecology 84:1672–1678.

Fry, J.D. and S.V. Nuzhdin. 2003. Dominance of mutations affecting viability in *Drosophila melanogaster*. Genetics 163:1357-1364.

Messina, F.J., and J.D. Fry. 2003. Environment-dependent reversal of a life history trade-off in the seed beetle *Callosobruchus maculatus*. Journal of Evolutionary Biology 16:501-509.

Goldfarb

Strawn, L.A., T. Shen, N. Shulga, D.S. Goldfarb and S.R. Wente. 2004. Minimal nuclear pore complexes: Genomic strategy defines FG repeat domains essential for transport. Nature Cell Biol. 6:197-206.

Jarolim, S., J. Millen, G. Heeren, P. Laun, D.S. Goldfarb and M. Breitenbach. A novel assay for replicative lifespan in *Saccharomyces cerevisiae*. FEMS Yeast Res, in press.

Kvam, E. and D.S. Goldfarb. Nvj1p is the nuclear receptor for oxysterol binding protein Osh1p in *Saccharomyces cerevisiae*. J. Cell Science, submitted.

Patent Pending: Materials and methods for identifying genes and/or agents that alter replicative lifespan. Filed as U.S. Serial No. 10/790, 456 on March 1, 2004.

Gorovsky

Mochizuki, K. and M.A. Gorovsky. 2004. Small RNAs in genome rearrangement in *Tetrahymena*. Curr. Opin. Genet. Dev. 14:181-187.

Hattman

Hattman, S. and E.G. Malygin. 2004. Bacteriophage T2 and T4 Dam DNA-(N6-adenine)-methyltransferases. Prog. Nucl. Acid Res. & Mol. Biol. 77: 67-126, in press.

Jaenike

Dombeck, I. and J. Jaenike. 2004. Ecological genetics of abdominal pigmentation in *Drosophila falleni*. Evolution 58: 587-596.

Shoemaker, D.D., K.A. Dyer, M. Ahrens, L. Sheill, C. Militzer, and J. Jaenike. 2003. Molecular evolutionary effects of *Wolbachia* infections: decreased diversity but in-

creased substitution rate in host mtDNA. Genetics, submitted.

Dyer, K.A. and J. Jaenike. 2004. Evolutionarily stable infection by a male-killing endosymbiont: Molecular evidence from the host and parasite genomes. Genetics, submitted.

Minckley

Minckley, R.L, J.H Cane, L Kervin and D. Yanega. 2003. Biological impediments to measures of competition among introduced honey bees and desert bees (*Hymenoptera*: Apiformes). Journal of the Kansas Entomological Society 76: 306-319.

Minckley, R.L and T.H Roulston. 2004. Incidental mutualisms and pollen specialization among bees. In, N.M. Waser and J. Ollerton (eds.) *Specialization and generalization in plant-pollinator mutualisms*. Univ. of Chicago Press.

Orr

Coyne, J.A. and H.A. Orr. *Speciation*. 2004 Sinauer Associates, Sunderland, MA. 480 pp.

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Werren

Werren, J.H. 2003. Invasion of the Gender Benders. Natural History 112:58-63.

Baldo, L., J.D. Bartos, J.H. Werren, C.. Bazzocchi, M. Casiraghi and S. Panelli. 2003. Different rates of nucleotide substitutions in *Wolbachia* from arthropods and nematodes: arms race or host range? Parasitologia 44: 179-187.

Baudry, E., K. Emerson, T. Whitworth and J.H. Werren. 2003. *Wolbachia* and genetic variability in the birdnest blowfly *Protocalliphora sialia*. Molecular Ecology 12:1843-1854.

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M. Lachmann, N.W. Blackstone, D. Haig, A. Kowald, R.E. Michod, E. Szathmáry, J.H. Werren, and L. Wolpert. 2003. Cooperation and conflict in the evolution of genomes, cells, and multicellular organisms. In *Genetic and Cultural Evolution of Cooperation*. Dahlem Conference Publications, Berlin, GE.

Bordenstein, S.R., D.H.A. Fitch and J.H. Werren. 2003. Absence of *Wolbachia* in Nonfilariid Nematodes. J. Nematol. 35(3):266-270.

McAllister, B.F., L.W. Beukeboom and J.H. Werren. 2004. Site-specific mapping of the paternal-sex-ratio (PSR) chromosome. Heredity 92 (1): 5-13.

Werren, J.H. 2004. Heritable microorganisms and reproductive parasitism., New York.

Velthuis, B.J., W. Yang, T. van Opijnen and J.H. Werren. 2004. Intra-specific variation in sexual isolation: Genetics of female mate discrimination in *Nasonia longicornis* (Darling) (Hymenoptera, Pteromalidae). Animal Behavior, in press.