

MCB Transcript

Fall 2001 • Vol. 4, No. 2

Newsletter for Members and Alumni of the Department of Molecular & Cell Biology at the University of California, Berkeley

Catching the Wave: Berkeley Surfs

Ahead in Structural Biology

A plan to propel UC Berkeley to the forefront of structural biology research is nearly complete. With the arrival this fall of John Kuriyan, known for his mechanistic studies of signal transduction and nucleic acid polymerization, and the arrival in Spring of Jennifer Doudna, whose work has changed the way we think about RNA, MCB will have assembled one of the most remarkable collections of structural biochemists anywhere in the world.

The plan can be traced back about ten years, says Robert Tjian, the Biochemistry and Molecular Biology professor who has been instrumental in recruiting the current

cadre of structure mavens to Berkeley. Structural biology, with its emphasis on teasing molecular mechanisms out of information about the shape and interaction of molecules, has always been near to Tjian's heart. He was convinced that Berkeley could become a molecular structure powerhouse. "I felt that Berkeley really needed a strong presence in structural biology. We were a worldwide leader in the physical sciences and chemistry, so not to have a strong structural biology program just seemed a waste of resources," he says.

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A Structure for Structure: Architect's model of the Stanley Hall replacement building, the future home of structural biology at Berkeley.

Newsletter

Changes its Name

Thanks to all of you who sent in your ideas in response to the Newsletter Naming Contest announced in the last issue. We had a total of 22 entries which ran the gamut from silly to sophisticated, and after careful consideration, we are pleased to announce that the MCB Department newsletter is now officially called the *MCB Transcript*.

The Winner — Ron Swanson was the first of two entrants to suggest "the Transcript," and so he gets the grand prize of a free year's subscription to the science news weekly *New Scientist*. Ron got his Ph.D. in Alex Glazer's lab in 1991 and is now Director of Molecular Biology at Syrrx, a drug discovery company in San Diego.

The Runners-up — Mike Kouri, an MCB major at American River College in Sacramento who hopes to transfer to Berkeley in the spring, gets one of the two runner-up prizes for suggesting "The Berkeley Sequencer." Arian Schulze, who got his bachelor's degree in anthropology at Berkeley in 2000, gets the other for proposing "The Cellular Digest." Mike will get a department T-shirt (produced each year by the undergraduate club mcbUSA. See p. 6 for more on undergraduate clubs), and Arian opted for a department mug.

Laurie Issel-Tarver also gets honorable mention (and a T-shirt) for being the second entrant to suggest "The Transcript." Laurie was a graduate student in the Rine lab and received her Ph.D. in Genetics in 1996. She is now a curator at the *Saccharomyces Genome Database (SGD)* at Stanford and an adjunct faculty member in the Biology Dept at Ohlone College in Fremont.

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Of course, the university already had Chemistry professor Sung-Hou Kim, who was using the classic structural biologist's tool, X-ray crystallography, to work out the structures of several interesting macromolecules including the cancer protein Ras. David Wemmer, also in Chemistry, was developing nuclear magnetic resonance as a structural tool. And MCB's own Robert Glaeser was pioneering important structural methods like electron crystallography.

But Tjian and BMB professor Michael Botchan had a larger vision, so in the early 1990s they began to recruit top-flight structural biologists to MCB. The first was Tom Alber, who joined the department as an



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Current and past issues of the newsletter are available on the MCB web site (<http://mcb.berkeley.edu/news/>).

associate professor in 1992 to study the structure of the protein assemblies that funnel cellular signals to the transcriptional machinery. Later came Tracy Handel and Susan Marqusee, leaders in the study of protein folding. "They built the core," says Botchan. "They showed the more traditional biochemists how much could be done with a structural approach."

From there the department continued to attract top people. James Berger, a 1997 hire, specialized in the structural dynamics of transcription, how helicases and polymerases unwind DNA and make RNA. Carlos Bustamante added microscopy to the department's repertoire of structural biology tools with his studies of protein-nucleic acid complexes by scanning force microscopy and single molecule fluorescence microscopy. He has also developed methods of manipulating single molecules with optical tweezers, and was named this year by *Time* magazine as one of the country's best 18 scientists.

Eva Nogales, already a bright star when she joined the department in 1998, has continued to pioneer methods of electron microscopy to study molecular structure. With electron microscopy, biologists can examine much larger protein complexes than they can by X-ray diffraction.

So by the turn of the millennium, Berkeley had one of the stronger structural biology programs in the world. But the most recent appointments have catapulted the university to the top of the heap.

Jennifer Doudna, known for having overcome numerous technical challenges in order to crystal RNA, will join MCB in January, 2002. Doudna was a real coup, says Tjian. She was already a full professor at Yale, and was busily cracking the study of RNA enzymes, or ribozymes, wide open. Yet she had completed her Ph.D. only 10 years before. "She was the ideal new hire," Tjian says, "young but established in a new area."

Jamie Cate (profiled in the Spring 2001 issue), who joined the department in July, had also made a name for himself despite still being in the early stages of his career. While a postdoc in Harry Noller's lab at UC Santa Cruz in 1999, he generated the most detailed X-ray structures of the ribosome to date.

But perhaps John Kuriyan (profiled this issue) was the icing on the cake. With his reputation for remarkable successes in tackling all manner of tricky molecular structures, Kuriyan was one of the dream candidates Tjian and Botchan had hoped to recruit. As it turns out, there was no need to recruit Kuriyan. He just happened to be looking at Berkeley at the same time Berkeley was eyeing him. "John came out of the blue," says Botchan. "He decided he wanted to be at a major university where chemistry and biology were cross fertilizing." Berkeley was the logical choice.

Besides the people, there are other factors making Berkeley a top structural biology destination. One is the Advanced Light Source at LBNL (see cover story in the Spring 2000 issue). The ALS uses synchrotron radiation from accelerated electrons to generate powerful X-ray beams. It is one of only a handful of such facilities in the world and is essential to state-of-the-art X-ray crystallographic work. While crystallographers at many universities have to travel great distances to find an X-ray source, here they take a 3-minute drive up the hill.

Another draw is the Stanley Hall replacement building which will grace the top of campus in about five years. Eventually it will house 40 labs from many departments, but among its main focuses will be structural biology, computational biology and imaging. Adding to the collaborative atmosphere, the design will allow researchers from different disciplines to share common space and common equipment, including 13 state-of-the-art nuclear magnetic resonance imaging machines. Construction is scheduled to begin in 2003.

Through all of this, the face of structural biology itself is changing. It used to be that researchers would study whatever molecule they could coax into forming a crystal. Now, with efficient recombinant over-production systems, most proteins can be crystallized and the structure can be solved in a matter of weeks. Furthermore, microscopic techniques now provide an entry point for the study of much larger complexes of proteins and nucleic acids, and NMR allows them to be studied in solution.

These days, a structural biologist can choose any problem and plunge directly into the question of how a molecular machine works. It becomes good old biochemistry, says Botchan, getting "down and dirty" with mechanism. Structural biology is the wave of the future, and Berkeley is riding the crest.



X-ray Target: a Kuriyan lab crystal of the SH2 domain from V-Src.

NEW FACULTY



John Kuriyan



David Bilder

According to Robert Tjian (BMB), “the modern crystallographer is really a biologist who uses a physical technique to answer biological questions.” If that is true, John Kuriyan fits the bill. He is widely renowned as a crystallographer extraordinaire who, in his 14 years at Rockefeller University in New York, has tackled fundamental biological questions with resounding success. In November, he joined MCB as Chancellor’s Professor of Biochemistry and Molecular Biology with a joint appointment in Chemistry.

Kuriyan has taken a very close look at some of the macromolecules that have intrigued molecular biologists for decades. Broadly speaking, these fall into two categories — DNA replication and signal transduction.

One of the remarkable properties of DNA polymerases is their ability to travel along the substrate, a DNA strand, for thousands of nucleotides without falling off. To get a handle on the structural basis of this processivity, Kuriyan’s group, in collaboration with Michael O’Donnell at Rockefeller, crystallized the ring-shaped clamp that holds *E. coli* polymerase to the DNA together with a subunit of the protein complex that loads the clamp. They found that the clamp loader opens the ring so it can slip around the DNA strand. Currently, Kuriyan’s group is analyzing a 2.7 Angstrom crystal structure of an intact five-protein clamp loader assembly.

Nearly every change a cell undergoes

— growth, death or differentiation — depends on extracellular messages being relayed to the nucleus where changes in the levels of gene activity take place. Typically, a series of proteins relay the signal to one another, in bucket brigade fashion, from the cell surface to the transcriptional machinery. The Kuriyan lab is concentrating on signal cascades that use phosphorylation as a molecular switch. Among the proteins they study are tyrosine kinases such as the products of the Src and Abl oncogenes, the kinase domain of the receptors for transforming growth factor b (TGFb) and the Son of Sevenless protein that activates Ras.

In one Abl project, for example, the lab is looking at co-crystals of an abnormal form of Abl implicated in chronic myelogenous leukemia with a small molecule inhibitor of the kinase activity made by Novartis. The structures reveal why the inhibitor is able to bind to Abl but does not bind to other related kinases.

Kuriyan is bringing 16 students and postdocs with him from Rockefeller, as well as his family and two dogs. He says Berkeley will open new doors for his research because of its strength in a number of related areas, particularly chemistry. By contrast, research at Rockefeller concentrates on biology. Kuriyan says he is looking forward to teaching undergraduate courses, which he hasn’t had the opportunity to do since he was a graduate student at MIT.

If you consider the dazzling variety of living things on earth, and then realize that most organisms contain within them an equally staggering array of cell types, you might get a sense of the challenge facing David Bilder. He has set out to understand the signals and pathways that determine the shape and structure of a cell.

To make it more manageable, Bilder is addressing the question with a single type of cell from a well studied organism, the fruit fly. Epithelial cells make up the surface layers of an animal, principally the skin and gut lining. They fit together snugly like bricks or paving stones to form highly regular sheets. Bilder has taken advantage of this regular pattern to screen for mutations in genes that disrupt it.

The most important gene to come out of this screen is *scribble* (*scrib*), mutants of which cause the embryonic epidermis, normally a single layer of columnar cells, to grow in heaps and lose their regular shape. That makes *scrib* a foot in the door to the pathways that control cell shape and growth behavior.

The protein product of *scrib* acts at cell junctions to regulate apico-basal polarity. Bilder has also identified two proteins that interact with Scrib,

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New DNA Analysis Center

Open for Business

... Continued from page 3

Discs-large and Lethal giant larvae, whose names suggest the overgrown phenotypes they cause when mutated. All three turn out to be essential in most of the polarized cell types of the fly, including neurons. Other proteins are known to counter the effects of Scrib, suggesting that polarity in a cell is controlled by a network of factors acting in concert.

One of the main projects in Bilder's lab is to elucidate the details of this network, who the players are and how they interact. Another is to study the roles of Scrib in neural development. Scrib is involved in the asymmetrical division of neuroblasts as well as in the establishment of synapses. Vertebrate homologs of Scrib, Lgl and Dgl are found at contact points between cells, suggesting a conserved role for the proteins in organizing cell junctions.

Bilder also plans to investigate whether mammalian homologs of *scrib* play a role in cancer. Such a role seems plausible, since the *scrib* gene functions as a tumor suppressor in flies — in its absence the epithelial cells grow without bound like the cells of a tumor.

Bilder joins the department as an Assistant Professor of Cell & Developmental Biology. He comes to Berkeley from Harvard where he was a postdoc with Norbert Perrimon for four years. He did his graduate work at Stanford. He says he hopes to build a small lab of four to six grad students and post docs over the next year or two. Students rotating in his lab might get involved in a screen to identify more mutants involved in cell polarity. Other projects involve detailed characterization of *scrib* and cloning of a handful of new mutants that have already come out of the screen.

Bilder is also an avid runner. He ran the Big Sur Marathon at the end of graduate school and participated in two Boston marathons while back east. He says he's looking forward to exploring the trails in the Berkeley hills.

The DNA Sequencing Core, which has served MCB and other labs since 1993, has new equipment, additional staff, and a new name. Now Berkeley scientists and affiliated labs can get all of their sequencing, genotyping, and microarray work done under one roof at the DNA Analysis Core.

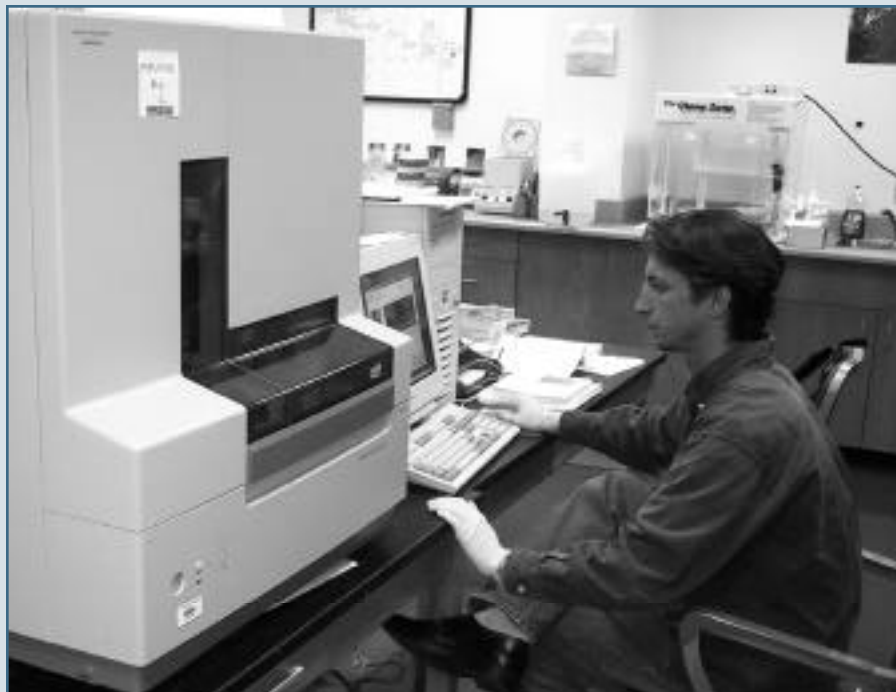
The facility, located in 79 Haas Pavilion beneath the gymnasium, acquired two new Applied Biosystems Prism 3100 capillary sequencers in May. These state-of-the-art machines make sequencing at the center cheaper, faster and better. Each can handle about 200 samples a day, four times as many as the two older 377 slab gel sequencers. And the reads are longer and more accurate on average. All this for less: the core lowered its rates at the end of September from \$19 to \$15 per sample.

In August, the DNA Analysis Core installed the Affymetrix GeneChip system for reading and analysis of Affymetrix microchips, a widely used oligonucleotide

array technology for monitoring gene expression and reading genotypes. Staff were trained and the system up and running by mid September.

To keep it all running smoothly, Joel Credle was hired to help direct the facility in May. He joins longtime sequencing manager Millicent Yee and a staff of three to serve the core's customers at four UC campuses — Berkeley, San Francisco, Davis, and Santa Cruz — as well as a handful of industry groups including the Molecular Sciences Institute in downtown Berkeley and Onyx Pharmaceuticals in Richmond. Before coming to Berkeley, Credle was an Associate Scientist at Eastern Virginia Medical School in Norfolk.

Credle is putting the finishing touches on a new interactive web site that describes all the center's services, equipment and prices. Users will be able to schedule sample runs, get real-time microarray data analysis help, and download sample results as they become available in the data base. The site, located at www.berkeley.mcb/barker/dna-analysis, will be operational by the end of the Fall semester.



Hi-tech Analysis: DNA Analysis Center director Joel Credle monitors one of two new capillary sequencers.

FACULTY NEWS



▲ **James Allison** (Immunology) was honored in August with the international Centeon Award for Innovative Breakthroughs in Immunology.

Bruce Ames (BMB) received the Abbot-ASM Lifetime Achievement Award from the American Society for Microbiology. The prize — a silver medal and \$20,000 — was conferred at the society's general meeting in Orlando, Florida, in May. Ames was also named the first recipient of the \$50,000 Linus Pauling Institute Prize for Health Research for his seminal work linking protein and DNA damage by reactive oxygen species to aging and age-related diseases.

Bruce and Giovanna Ferro-Luzzi Ames (BMB Emerita) donated \$2 million from their foundation for the seismic retrofit of Barker Hall.

Michael Botchan (BMB and Genetics & Development) and **Michael Marletta** (Chemistry and BMB) were both elected fellows of the American Association for the Advancement of Science.

Michael Chamberlin (BMB Emeritus) was named the winner of the Sigma Xi Monie A. Ferst Award for 2001 after a group of former graduate students nominated him. The award is given to "a nationally prominent scientist who has made notable contributions to the motivation and encouragement of research through education, inspiring his or her research colleagues to significant scientific achievements."

Jennifer A. Doudna (BMB, beginning Spring 2002) received the Eli Lilly Award in Biological Chemistry, which recognizes outstanding young (under 38) biochemists who demonstrate unusual independence and originality. The award was presented at the August American Chemical Society meeting in Chicago.



▲ **Jack Kirsch** (Chemistry and BMB) received an honorary doctorate from Uppsala University in May 01.



▲ **Terry Machen** (Cell and Developmental Biology) received a Miller Research Professorship for Fall semester 2002 from the Adolph C and Mary Sprague Miller Institute for Basic Research in Science.

Mu-ming Poo (Neurobiology) shared the 2001 Ameritec Prize for Paralysis Research with Marie T. Filbin of the City University of New York for their work on signaling pathways in axon guidance. The \$40,000 prize was conferred at the Neurotrauma Symposium in San Diego on November 10, and was sponsored by the charitable non-profit Ameritec Foundation.

Jeremy Thorner (BMB and CDB) was appointed a member of the Committee on Awards of the American Academy of Microbiology, the honorary academy of the American Society for Microbiology, for a three-year term. He was also re-appointed one of three associate editors of Annual Reviews of Biochemistry until 2006. Thorner is also on the editorial board for the "Molecule Pages" of the Alliance for Cellular Signaling (www.cellularsignaling.org).

Donation Website

Makes its Debut

Have you always wanted to give to Cal, but wished you could earmark your dollars for a specific program or activity? Now you can, right on the Internet. The new e-Giving website, givetocal.berkeley.edu, allows anyone in the world with a web browser to make gifts to more than 100 units and nearly 300 funds on campus. These range from the AIDS Memorial Fund to the Young Musicians Program, as well as any individual department, such as Molecular and Cell Biology.

The website arose from a collaboration between University Relations and Information Systems & Technology. It's unique among university internet donation options. While most institutional websites emphasize campus-wide donations or annual funds, e-Giving at Berkeley focuses on specific program funds. Many departments selected their own top funding priorities for inclusion in the site.

So far the site has been a huge success. A bare-bones version debuted in May 2000 and brought in more than \$125,000 by January 2001. That was with virtually no promotion. Now the site is fully functional, complete with profiles of Cal students. Donors can review descriptions of the fund options available and then use a secure online form, which encrypts confidential data, to make their gifts. As word spreads, e-Giving is expected to make donating easier for everyone. Why not give it a try?

JOIN THE CLUB



Two Presidents: Amy Tang of MCBcDNA and Thanh Nguyen of mcbUSA.

Honors Criteria

Changed

The GPA requirement for MCB H196 Honors has been changed retroactively from 3.500 to 3.50 (meaning 3.495 would now qualify). If you believe that you would have qualified for MCB Honors under the new minimum, please contact the Undergraduate Affairs Office at (510) 643-8895.

“Sometimes I feel like just a number.” It’s a common complaint at large universities. For all the advantages of an undergraduate science education at Berkeley — hearing lectures by famous scientists, being surrounded by cutting edge research, getting a chance to work in world class laboratories — undergraduates at institutions as big as Cal have to be proactive in making sure they don’t get lost in the crowd.

One of the main functions of the two MCB undergraduate clubs, mcbUSA and MCBcDNA, is to help undergraduates with an interest in MCB find themselves and connect with the department. “Berkeley has 30,000 students, so it’s easy to feel like a number,” says Thanh Nguyen, president of mcbUSA and a sophomore MCB major. “We want to get them more involved, have them feel like a person.”

The MCB Undergraduate Student Association (mcbUSA) formed about a decade ago, but was inhabited mainly by students on Plan I — MCB majors with a concentration in immunology, biochemistry or genetics. Plan II students (cell and developmental biology and neuroscience) founded their own club, MCBcDNA, a few years later. More recently, the clubs gave up their Plan I/Plan II affiliations and now distinguish themselves by the kinds of activities they sponsor.

Generally, MCBcDNA sponsors one-time events, while mcbUSA develops semester- or year-long programs. Each semester, for example, MCBcDNA hosts the ever-popular MCAT night at which instructors from two of the local test-prep schools (Princeton Review and Kaplan) give talks on how to apply to medical school, covering everything from taking the test to getting letters of recommendation. At the end of the evening, the hosts raffle off a free MCAT prep course at one or more of the participating schools.

Then there is advising night, at which the audience gets to ask anything they want of a panel of MCB juniors and seniors. The idea is to give new students a chance to find out how to survive in MCB, says MCBcDNA president Amy Tang. And at the faculty/student reception, 20 or 25 faculty members give short presentations on their labs and mingle with students over refreshments.

The programs of mcbUSA fall into four categories: outreach, mentoring, liaisons, and the twice-monthly faculty/student luncheons. Outreach gives undergrads a chance to tutor local high school students interested in science. This semester, the students were from Arrowsmith Academy, a local preparatory school. On Shadow Day in early November, about 30 local high schools, as well as home-schooled students, came to campus to follow volunteers through a typical day at Cal.

The mentoring program links students with upper division advisors, and the liaison program, the newest of the four, attempts to get representatives from local biotech companies to come talk and advise students interested in the industry. And last but not least, the faculty/student lunches are very popular and fill up almost as soon as the announcement goes out, Thanh says.

The activities of both clubs are open to all students. Undergraduates who want to help shape the clubs and organize activities can join the executive committee of either club. Interest has been so high in recent years that MCBcDNA now requires an application and an interview for committee membership; mcbUSA is still open to all comers.

For more information on the clubs and their activities, see: <http://mcb.berkeley.edu/groups/mcbcdna> and <http://mcb.berkeley.edu/groups/mcbusa>

ALUMNI NEWS



If you like reading about what your classmates are up to, why not take a minute to send in your own MCB class note. It's quick and easy. Just use the form below or answer the survey online at mcb.berkeley.edu/alumni/survey.html. You can also send e-mail to jonknight@nasw.org. Please note: address changes should be sent to alumrecs@dev.urel.berkeley.edu

■ **Amit Rakhit** (BA 1991) is on staff in pediatric cardiology at The Children's Hospital, Boston, and an Instructor in Pediatrics at Harvard Medical School where he just completed a 3-year Pediatric Cardiology fellowship. He graduated from medical school at Tufts University in 1995 and then did a pediatrics residency at New England Medical Center in Boston. He

says he intends to move to the pharmaceutical industry this fall to direct cardiovascular clinical trials. E-mail: rakhit@cardio.tch.harvard.edu.

■ **W. Daniel Fang** (BA 1992) is a fellow in Interventional Radiology at University of Pennsylvania. He graduated from medical school at Baylor College of Medicine in 1996 and finished his residency in diagnostic radiology at Baylor in 2001. E-mail: d7fang@yahoo.com.

■ **Vanila Mathur** (BA 1992) has just started as a Pain Management Fellow at The New York Hospital - Cornell Medical Center, the Sloan-Kettering Memorial Cancer Center, and the Hospital for Special Surgery in New York City. She completed a residency in Anesthesiology at The New

York Hospital earlier this year after her internship in Internal Medicine at Yale in New Haven Hospital. She got her M.D. at George Washington University School of Medicine in 1997.

■ **Melvin D. Vu** (BA 1997) is currently a 3rd year student working toward his Doctor of Pharmacy degree at the University of Southern California. He also works as an SAT teacher at a private school. meldv@hotmail.com

■ **Tiffany L. Choi** (BA 2000) is a second year pharmacy student at the University of Southern California. This summer she began an internship at Kaiser Permanente that will continue while she studies at USC.

Alumni Survey

To let your classmates and MCB friends know what you have been doing, complete the following and mail it to:

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(Please send address changes to alumrecs@dev.urel.berkeley.edu)

NAME

DEGREE(S) CONFERRED AND YEAR

E-MAIL ADDRESS

May we print your e-mail address?

Yes No

What's your current occupation?

Other activities since leaving MCB:

Any additional information or news:

2000-2001 Master's and PhD Graduates

Fall 2000

- **Alexander Abbas** (Linn) I. Cloning and Characterization of Human DNA Polymerase Theta II. Protein Interactions of Human Damaged DNA Binding Protein.
- **J. Michael Andresen** (Moore) Development and Characterization of an *in vitro* Assay Reconstituting Production of Immature Secretory Granules from the Golgi of the Neuroendocrine AtT20 Cell Line.
- **Erin Cram** (Firestone) Regulation of Cell Cycle in Mammalian Tumor Cells.
- **Gabriela Cretu** (Rubin) Computational and Functional Analysis of Noncoding DNA from Human Chromosome 5q31.
- **Scott Crowder** (Alber) Structural Studies of RNA Recognition by the Splicing Regulator Sex-lethal.
- **Scott Dawson** (Taylor) Evolutionary Implications of Uncultivated Eucarya and Archaea in Anoxic Environments.
- **Jennifer Doyle** (Goodman) Master's by exam.
- **Eric Goedken** (Marqusee) Divalent Metal Binding in the Function and Folding of Ribonuclease H.
- **Ellen Graves (Bergeman)** (Miles) Bioinformatics Tools for Data Collection and Knowledge Discovery in Gene Expression Studies.
- **Nisha Kabra** (Winoto) Study of FADD: The Role of FADD in T cell Activation and Apoptosis.
- **Dana Lau** (Flannery) Growth Factor Rescue of Photoreceptor Degeneration in Animal Models of Retinitis Pigmentosa.
- **Peter Lauer** (Portnoy) Systematic Mutational Analysis of the Charged Amino Acids in the Amino Terminal Domain of the *Listeria monocytogenes* ActA Protein.
- **Robert Maeda** (Anderson) Investigation into the Roles of Easter and Snake in Patterning the Dorsal-Ventral Axis of the Early *Drosophila* Embryo.
- **Sarah McWhirter** (Alber) Crystallographic Analysis of Tumor Necrosis Factor Receptor-Associated Factor 2 (TRAF2).
- **Casey Owens** (Handel) Master's by exam.
- **Michelle Pflumm** (Botchan) The Role of the *Drosophila* Origin Recognition Complex in DNA Replication and Mitosis.
- **Gordon (Teg) Pipes** (Goodman) A Molecular Genetic Analysis of Motoneuron Axon Guidance in *Drosophila melanogaster*.
- **Deirdre Reardon** (Alber) Master's by exam.
- **Siobhan Roche** (Rio) Regulation of P-Element Transposition in *Drosophila melanogaster*.
- **Mark Shulewitz** (Thorner) Septin Assembly Regulates Cell Cycle Progression Through Activation of a Protein Kinase Signalling Pathway.
- **Timothy Sullivan** (Allison) Characterizing the Function of CTLA-4 *in vitro* and *in vivo*.
- **Dawn Tanamachi** (Raulet) The Ly49 Family of Natural Killer Cell Receptors: Genetics Factors Determining Allelic and Variegated Gene Expression.
- **Minnie Wu** (Machen) Using Avidin-chimera Proteins to Study Organelle pH Regulation and Protein Retention in the Secretory Pathway of Mammalian Cells.
- **Julie Hollien** (Marqusee) Comparisons of the Thermodynamics and Folding of Thermophilic and Mesophilic Ribonucleases H: Implications for the Temperature Adaptation of Proteins.
- **Victor Holmes** (Cozzarelli) Biochemical and Structural Studies of Recombination and Chromosome Condensation Proteins.
- **James Holton** (Alber) Elves: Accelerating Crystallography.
- **Per Malkus** (Schekman) Protein Sorting in the Endoplasmic Reticulum (ER): ER-resident Accessory Proteins and Postive Sorting Signals Required for Transport of Secretory Proteins.
- **Miro Pastrnak** (Schultz) Methods for Expansion of the Genetic Code.
- **Julie Simpson** (Goodman) Analysis of the Role of the Roundabout Receptors in Axon Guidance in the Embryonic Central Nervous System of *Drosophila melanogaster*.
- **Justin Skoble** (Portnoy) Mechanism of Actin Nucleation by the *Listeria monocytogenes* ActA Protein.
- **Patricia Valdez** (Robey) Signaling Downstream of Notch in T cell Development.

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- **Kimberly Bland** (Goodman) Characterization of the Midline Axon Guidance Cue Slit and its Interaction with Robo Receptors in *Drosophila melanogaster*.
- **Peter Carlton** (Cande) The Organization and Pairing of Chromosomes in Meiosis.
- **R. Andrea (Lina) De Young** (Winoto) Identifying the Role of the Transcription Factor Nur77 in Thymic Development.
- **Jessica Dines** (Cline) New Aspects of Functional Complexity for the Master Regulator of *Drosophila melanogaster* Sex Determination: Analysis of Structures, Expression Patterns and Activities of SEX-LETHAL Protein Isoforms.
- **Mara Duncan** (Drubin) Characterization of Two Activators of the Arp2/3 Complex Involved in Endocytosis in the Yeast *Saccharomyces cerevisiae*.

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