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The Microscope

Microbiology

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2010

## The Microscope (2010-2011)

Department of Microbiology

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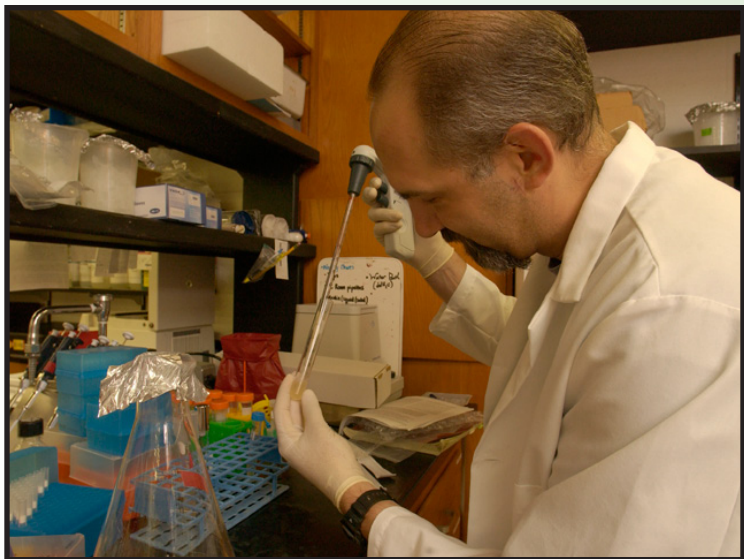
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# *The Microscope*

## *The 2010-2011 Department of Microbiology Newsletter*



Dr. Tom Masi performs an experiment in the Sparer lab.

**The Microscope sat down to chat with Dr. Tim Sparer about his research, lab work and why he became a microbiologist at UT.**

### **What brought you to UT?**

The chance to be part of a revamping of the microbiology department. There was so much hope for the department with Jeff [Becker] taking over as chair and the potential of hiring a whole bunch of new faculty. It seemed like a chance to be a part of something new.

### **What are the main research focuses of your lab at the moment?**

Really two main lines of research. Cytomegalovirus viral chemokines and their role in viral pathogenesis and the role of constitutively active CXCR2 in cancer. I study a chemokine, a small chemoattractant cytokine, that we

*(Continued on page 2)*

## **Words from the Department Head**

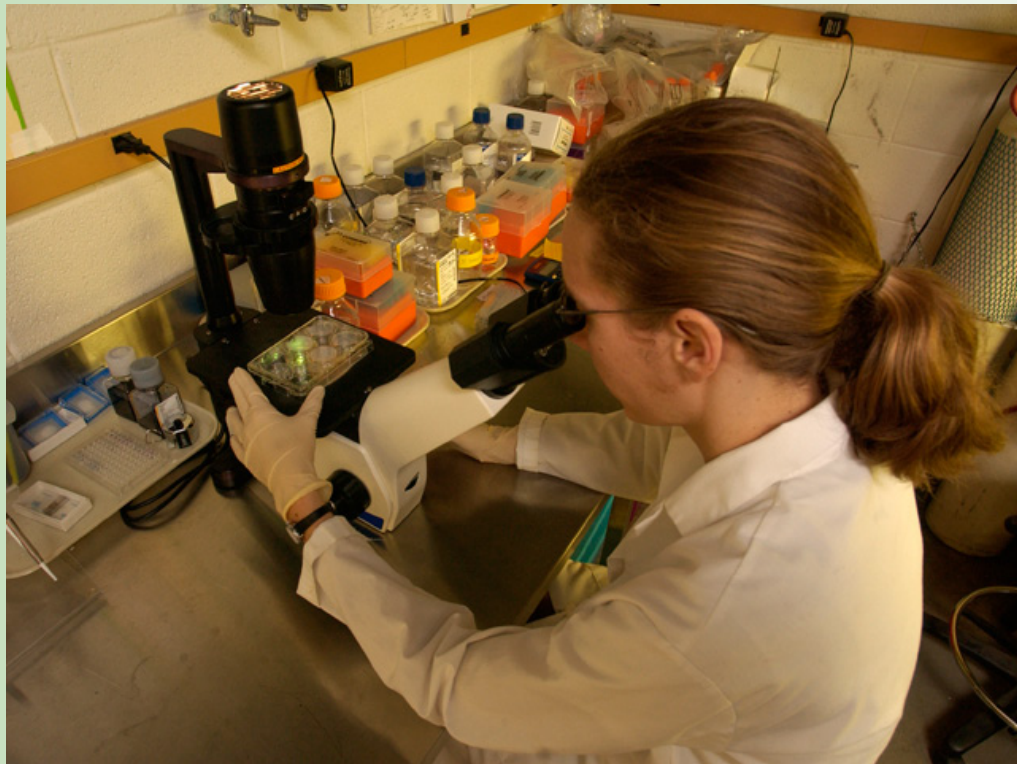
**Professor Jeffrey M. Becker**



Welcome again to the Annual Newsletter of the Department of Microbiology! Our Department is fully engaged in providing our undergraduate students with a deep appreciation of modern microbiology and with opportunities to carry out research in the laboratories of our faculty members. We are dedicated to providing our graduate students with a great experience in teaching and in performing research at the frontier of modern science. The wide scope and strength of our Department in both microbial ecology and pathogenesis has resulted in many significant contributions to science with projects funded by institutions including the National Institutes of Health, National Science Foundation, American Heart Association, and Department of Energy.

This year we welcome three new members to our Department: Nathan Schmidt, Karen Lloyd, and Jill Mikucki. They come to our Department with impressive training and promise to add greatly to the strength and vigor of our research and teaching. The growth of the Department over the last eight years has been remarkable as we have added a total of eleven new faculty members!

*(Continued on page 3)*



believe was stolen from the host in order to increase its target vehicles (cells) for its dissemination throughout the body. Through its millions of years of coevolution within the host, it has tweaked this protein to induce immune cell migration without getting killed itself. It's quite a trick! This means that in the process of studying these viral chemokines we will learn a lot about how our proteins bind and signal to the chemokine receptors in the body. In fact, this has led us to our most exciting discovery so far.

We are now looking into mutation in the chemokine receptors and their role in cancer development. There are millions of possible mutations that can lead to cancer but we are looking at ones that affect chemokine receptors. A mutation on the chemokine receptors CXCR1 and CXCR2, could lead to cellular transformation, the first step in cancer development. We are also trying to address whether mutation in these receptors could also lead to increased metastasis. Metastasis is when a cancer cell moves to another location in the body. Because chemokines are involved in cellular migration, we think there might be a link between expression of these mutant receptors and cancer metastasis.

We are also beginning projects looking immunity to CMV in obesity. With 34 percent of the US population classified as obese, understanding how adipose cells, in particular from obese people, affect immune responses viral infections is of significant interest.

#### **Which new bit of research are you most excited about?**

I really think that the discovery of a constitutively active chemokine receptor (CXCR2) could open up doors to some unique insights into G protein coupled receptor activation. My former graduate student, Giljun Park, found a single point mutation in the amino terminus of the CXCR2 receptor can lead to constitutive activation. How can a mutation on the outside of cell lead to constitutive activation? We don't know but we are in the process of designing experiments to see if the amino terminus is some how "locking" the receptor in the off position.

When there is a mutation or when the receptor binds to its ligand, it pops up and turns on the receptor. We have generated several mutations at this same position and they lead to constitutive activation but different "types" of activation. Think of it as the receptor as a light. We are saying that this receptor is not just an on/off switch, but more like a dimmer switch. The different amounts of light are different signaling pathways. Our mutations are locking it into one of these different "on" positions. It could really change the way that we look at GPCR activation.

#### **Could you tell me a little bit about the new cancer research you've just started?**

We are now trying to find out whether these mutations are found in different cancers. Ideally we would find a mutation in the chemokine receptor that correlates with a specific metastasis or increased metastasis. We have found the mutation in small cell cancer cell line but now we are putting it to the real test by looking at clinical samples from cancer patients to see if they have these mutations. If they do, we would hope to be able to use some existing drugs that interfere with CXCR2 activation which may help to slow down or prevent the cancer's metastasis.

#### **Is there anything in particular that you love about your job?**

I love finding new discoveries. When you get that nice piece of data that really tells you something, it's an awesome feeling. It really keeps me coming to work everyday. Someone once said, "You'll never work a day in your life if you love your job..." It's a little cheesy, but I keep that in mind when there are rough days/weeks. I also like being in charge of my research. There is no one (directly) telling me what I need to work on. Right now I'm writing a grant with an engineer looking at the signal transduction induced by shear forces (like those found in the cells lining arteries). Way outside my comfort zone but a pretty cool concept that I'm learning about.

#### **Is there anything else you could see yourself doing as a career?**

Opening a rock-a-billy bar or a professional soccer player. Okay, I can dream, can't I? I like the campus life. It keeps me young. Even though it can be hard to encourage students to go into this life--it really isn't easy or stress free--but I try to at least show them how cool this work is.

#### ***(Continued from page 1)***

Microbiology continues to be a leading force in science with its long-standing, strong identity as a distinct scientific discipline supported by extremely robust national and international organizations. Microbiologists have historically played important roles in major advances in the biological sciences contributing to humanity's health and welfare and winning a majority of the Nobel Prizes for Medicine and Physiology. The continuing threat of epidemics, the rise of drug resistant microbes, and the recognition of the huge number of uncultured microbes that play an important role in the environment and human health call attention to the importance of the discipline of microbiology.

I think it is appropriate to list some of our goals and plans for the future (see below). We ask for your help in realizing these objectives.

- Improve graduate stipends and convert GTAs to GRAs.
- Support research programs of existing faculty and build collaborations among UT microbiologists.
- Obtain modern research instrumentation and facilities.
- Review microbiology curriculum.

*It is indeed a great honor to serve as Head of the Department. I thank all of the faculty, students, and staff for their great contributions, and I thank our alumni and supporters for their generous gifts that allow our students to participate in research and attend scientific meetings.*

## Q&A with Cara Turski UT Junior in Microbiology

What brought you to the University of Tennessee?

I worked here during high school and Dr. Wilhelm offered to let me continue my research my freshman year. It was such a great opportunity that I couldn't pass it up. Very few undergraduates, especially freshman, get research opportunities.

What is your current position in the Wilhelm lab?

I am an undergraduate research assistant. Basically I have my own experiment I am working on, am mentoring a high school student, and since I've been at the lab the longest I am overseeing the culture collection and doing other general lab management things.

What are your plans after you finish your undergraduate degree?

I am thinking about doing Americore for a year and then going to graduate school for public health. George Washington has a microbiology public health program I am really interested in.

What is your favorite part of your job?

Dr. Wilhelm gives me a lot of creative independence with my experiments. I like the challenge of that--I bang my head against the wall a lot but its very rewarding in the end. I also really love the sense of community its given me. Our lab is very close knit and I've gotten to meet so many people I otherwise wouldn't have had the opportunity to--graduate students, post-docs, and visiting professors.

Why did you choose the Wilhelm lab?

I've always been interested in viruses and the environment so in high school when I got to select from a list of possible labs, I picked Dr. Wilhelm's because it combined those interests.

# Current and Former Students- Making the Department Proud



This year, Madelyn Crawford, a sophomore in the department received the Barry M. Goldwater Scholarship that will financially assist her during her remaining two years at UT. The Barry M. Goldwater Scholarships are awarded yearly to sophomores and juniors pursuing careers in research in mathematics, the natural sciences or engineering.

This year, the Goldwater Foundation has awarded 275 scholarships from a pool of almost 1,100 nominees. In order to compete for a Goldwater Scholarship, students must be nominated by their college or university. As a four-year institution, UT is allowed to nominate up to four students each year.

"Each year we continue to receive applications from students with more research experience than the previous year. For instance, it's not uncommon for applicants to already have a publication in their field, in addition to conference appearances," said Rebekah Page, assistant director of UT's Office of National Scholarships and Fellowships "The success of our students this year is solid evidence that the undergraduates at UT can successfully compete with those from institutions like Harvard, which also had three Goldwater Scholars this year."

Madelyn has been doing research in Jeff Becker's lab since spring of her freshman year. After completing her bachelor's degree in biochemistry and cellular and molecular biology, she plans to pursue a doctorate in microbiology and molecular genetics. A member of the Chancellor's Honors and Haslam Scholars programs, Crawford competed in this year's EURECA competition and serves on the editorial board of UT Knoxville's Pursuit: The Journal of Undergraduate Research.

-Courtesy of Tennessee Today-

## UT Alumni in Science



**Name: Dr. Michael Thigpen**

Current Occupation: Leading researcher in infectious diseases at the Centers for Disease Control

Recently, Dr. Thigpen, an undergraduate alumnus from the Microbiology Department was conducting research into HIV prevention in Botswana and around the world. He led a study which found that it might be economically viable for countries like Botswana to put many

of their high risk citizens on preventative drugs to attempt to stop the spread of HIV through the population. Although he does not advocate putting whole populations of various countries on preventative drugs, it could help specific populations in heightened danger of infection.

**Name: Dr. Guy Caldwell**

Current Occupation: Professor and researcher at the University of Alabama

Named Professor of the Year at the University of Alabama, Birmingham in 2005, Dr. Caldwell has been hard at work since receiving his PhD at UT. After a post-doc at Columbia University, Dr. Caldwell began his research into protein deficiencies related to dystonia. Recently, Dr. Caldwell and his lab have discovered that the protien torsinA is responsible for muscle control and could have treatment implications for Parkinson's Disease as well as cystic fibrosis. The groundbreaking work was recently published in Nature and Cell.

# Microbiology in the News

From Quest Magazine to Tennessee Today, the department has been featured for its cutting edge research and outstanding professors

Erik Zinser, assistant professor of microbiology, has established an independent, internationally recognized research program and is regarded as an extremely creative, capable and promising scholar in his area of research. His work on the marine bacterium *Prochlorococcus* is of utmost importance as scientists strive to understand, model and predict the impact of human activities on open ocean ecosystems and climate. He was recently awarded his second highly-competitive NSF grant, for \$1.4 million.

A recent major contribution provided, for the first time, a means to grow *Prochlorococcus* as colonies on plates and as dilute liquid cultures, a method sought since the discovery of the organism in 1988. The “trick” was to co-culture the *Prochlorococcus* with heterotrophic bacteria, which help them to grow when rare. This finding was extended to show, in a paper published in a leading journal in January, 2011, that the growth of *Prochlorococcus* in its natural environment was dependent on hydrogen peroxide-scavenging microbes at the ocean surface.

-Courtesy of Quest Magazine, Scholar of the Week-



**This year alone, Dr. Jeffrey Becker has been named a Quest Scholar of the Week and a Chancellor’s Professor at UT Knoxville.**

**One of only 5 newly named Chancellor’s Professors, Dr. Becker has been honored with the university’s most prestigious permanent position.**

**His accomplishments were highlighted in Quest Magazine and Tennessee Today.**



Jeffrey Becker, professor and head of the Department of Microbiology, maintains a very active research program. He recently published a paper as lead author in the prestigious Proceedings of the National Academy of Science.

The paper describes a model for testing essential growth genes (those that are necessary for growth and thus difficult to manipulate) from *Candida albicans*. The paper provides a new method for researchers to begin to target these genes in antifungal therapy. To this end the paper lays an important foundation for the development of new drugs and therapies for future medical use.

The paper, cited as Becker, JM et al. 2010. Pathway analysis of *Candida albicans* survival and virulence determinants in a murine infection model. PNAS USA 107 (51) 22044 – 22049, is available on the PNAS website.

-Courtesy of Quest Magazine, Scholar of the Week-



Steven Wilhelm, a professor in the Department of Microbiology, recently published the Manual of Aquatic Viral Ecology, which he edited along with M.G. Weinbauer of the Laboratoire d’Oceanographie de Villefranche (France) and C.A. Suttle of the University of British Columbia. This technical volume is the first of its kind in describing approaches to studying viruses in aquatic systems. It is also the first ebook published by the American Society of Limnology and Oceanography, and is being made available free-of-charge to scientists around the world courtesy of a generous donation from the Gordon and Betty Moore Foundation.

Wilhelm is a leader in the field of viral ecology and is co-chair of the international Scientific Committee for Oceanographic Research’s working group on marine viruses. He earned his Ph.D. at the University of Western Ontario in 1994 and joined the faculty of the University of Tennessee in 1998. In 2009 he was a recipient of the Chancellor’s Award for Research and Creative Achievement.

-Courtesy of Quest Magazine, Scholar of the Week-

Becker has trained more than thirty doctoral students who hold faculty or staff positions at many major institutions, has published more than 240 peer-reviewed articles, and has been awarded grants for research from many national agencies. He holds a National Institutes of Health (NIH) grant in the thirty-third year of continuous funding, and he has received a Research Career Development Award from NIH. Becker is an elected Fellow of the American Academy of Microbiology and the American Association for the Advancement of Science. He serves on the NIH Drug Discovery and Mechanisms of Antimicrobial Resistance Study Section, on the editorial board of Antimicrobial Agents and Chemotherapy, and as associate editor of the journal Microbiology. Becker has been a consultant to the pharmaceutical companies Eli Lilly, Merck, and Smith-Kline Beckman.

-Courtesy of Tennessee Today-

## Spotlight on a New Faculty Member- Dr. Vitaly Ganusov

Research done in the Ganusov lab is aimed at understanding the importance of immunity (mainly cellular immune responses) in the control of replication of pathogens within mammalian hosts. This laboratory combines mathematical modeling with a wealth of experimental data available via collaboration with leading experimental laboratories from around the world to investigate how cellular immune responses to intracellular pathogens such as viruses are generated, how they are involved in the clearance of infections, and how pathogens evolve to avoid recognition by the immune response. The lab studies cellular immune responses to several pathogens such as influenza, lymphocytic choriomeningitis virus (LCMV), listeria monocytogenes, mousepox, and HIV.

Vitaly has been involved in a number of studies that characterize the kinetics, efficacy and differentiation of CD8 T cell responses that are involved in the control of replication of viruses and tumors. In particular, using mathematical modeling Vitaly has shown that some of the pathways of generation of memory CD8 T cells are inconsistent with experimental data on the kinetics of T cell responses to LCMV. Several transcription factors that are involved in differentiation of memory CD8 T cells during viral infections such as Blimp-1, T-bet and Eomes have been recently identified. Models of CD8 T cell differentiation that include expression kinetics of these transcription factors in cells over the course of acute infection are currently being developed.

Vitaly's interests in CD8 T cell responses arise from the time of his PhD work done in the lab of Rustom Antia at Emory University in a close collaboration with the laboratory of Rafi Ahmed, the world leader in CD8 T cell immunology. His PhD work on modeling viral evolution from a "within-host" point of view has been developing into a separate field in the area of ecology and evolution of infectious diseases. One of the research topics in the Ganusov lab is to understand long-term evolution of acute viruses such as flu using models of the within-host dynamics of the virus and the host's immune response.

Vitaly did post-doctoral studies with Rob De Boer (Utrecht University, Netherlands) and Alan Perelson (Los Alamos National Laboratory, USA) who are world leaders in the area of mathematical immunology. In these laboratories, Vitaly started developing methods to quantify rates of proliferation and death of lymphocytes in mice and humans. In particular, Vitaly has shown how heavy water or deuterated glucose can be used to estimate the rates of proliferation of CD4 and CD8 lymphocytes in humans following HIV infection. Studies are being performed to extend this work to another commonly used label called bromodeoxyuridine (BrdU) that incorporates into cellular DNA during DNA duplication. Together with Rob De Boer, Vitaly has been developing quantitative methods of estimating killing efficacy of effector and memory CD8 T cells that were generated following acute viral infections such as LCMV, flu and mousepox. These methods in combination with experimental data allow to predict the level of memory CD8 T cells that are required to provide protection against viral challenge. In the group of Alan Perelson Vitaly also became interested in understanding the role that CD8 T cells play in the control of replication of human immunodeficiency virus. Together with their colleagues at Centers for HIV/AIDS vaccine immunology (CHAVI), Vitaly has been involved in the modeling the kinetics of HIV during the earliest stages of infection (20-50 days after infection). Experimental data combined with mathematical models revealed massive and rapid escape of HIV from cellular immunity within the first weeks of infections supporting a vital role for CD8 T cells in the early control of HIV replication. Further studies are being undertaken to quantify the contribution of CD8 T cells to the steady state viral load (set point) in HIV-infected individuals.

Although Vitaly holds B.S. and M.S. degrees in physics, he feels at home in the Department of Microbiology. With his comprehensive background in immunology, mathematics and statistics, he is a valuable addition to the faculty in the Department that will bridge research done in different laboratories with other Departments (such as Math and EEB) and NIMBioS (National Institute for Mathematical and Biological Synthesis) where Vitaly is an affiliated faculty. During his postdoctoral work, Vitaly has been highly involved in supervising graduate students and he looks forward to nurturing of a new generation of quantitative biologists at UT.



## The Department of Microbiology Faculty 2010-2011

### *Faculty*

**Jeffrey M. Becker**

**Alison Buchan**

**Elizabeth Fozo**

**Vitaly V. Ganusov**

**Igor Jouline**

**Frank Loeffler**

**Robert N. Moore**

**Nathan Schmidt**

**Jill Mikucki**

**Karen Lloyd**

**Todd Reynolds**

**Gary S. Sayler**

**Tim E. Sparer**

**Chunlei Su**

**Steven W. Wilhelm**

**Erik Zinser**

**Pamela L. C. Small**

**W. Stuart Riggsby**

Chancellor's Professor and Head

Associate Professor

Assistant Professor

Assistant Professor

Joint Professor with ORNL

Governor's Chair and Professor

Professor; Executive Director of the UT Space Institute

Assistant Professor

Assistant Professor

Assistant Professor

Associate Professor

Beaman Distinguished Professor of Microbiology, and Ecology & Evolutionary Biology, Director - Joint Institute for Biological Sciences, Director - Center for Environmental Biotechnology

Associate Professor

Associate Professor

Professor, Associate Head and Graduate Director

Associate Professor

Professor Emeritus

Professor Emeritus

### *Associated Faculty*

John Biggerstaff, Adjunct Associate Professor

Barry Bruce, Adjunct Professor

Brad Fenwick, Adjunct Professor

Martin Keller, Adjunct Professor

Mark Radosevich, Adjunct Professor

Loren Hauser, Adjunct Professor

Nathan Verberkmoes, Adjunct Assistant Professor

David Graham, Joint Faculty Research

Associate Professor

Mircea Podar, Joint Faculty Research Associate Professor

Christopher Schadt, Joint Faculty Research Associate Professor

Melinda Hauser, Research Assistant Professor

Thomas Masi, Research Assistant Professor

Kirsti Ritalahti, Research Assistant Professor

Alice Layton, Research Associate Professor

Steven Ripp, Research Associate Professor

## 2010-2011 Departmental Awards



## Non- Departmental Awards

**Tanzila A. Bashir, Frank T. Dicker and Jessica K. Taylor** received the D. Frank Holtman Microbiology Undergraduate Academic Achievement Award for their outstanding work as undergraduate microbiology students.



**Dr. Erik Zinser** was awarded the Undergraduate Faculty Teaching Award for excellence in undergraduate instruction.

**Madelyn Crawford** received the Lisa Kahn Undergraduate Research Award for her superior work as an undergraduate researcher in the Becker lab.

From the Zinser lab, **Jeremy W. Chandler** has been presented the Graduate Teaching Award for excellence in undergraduate instruction.

**Rachelle Allen** has been awarded the Microbiology Staff Award for excellence in administrative work.

**Pranay Dogra (Sparer lab), Rachel Hill (Su lab), Keats Shwab (Su lab), Morgan Steffen (Wilhelm lab), Tingting Xu (Sayler lab), and Junwei Zeng (Onami lab)** all received David White Travel Awards to continue their research in the future.



**Ashley Frank** (Graduate Student in lab of Alison Buchan) won the best poster award at the Frontiers in Biorefining: Bio-based Products from Renewable Carbon (held at St. Simon's Georgia in October 2010). She was also recently notified that she was accepted as a participant in the US-EC Course in Environmental Biotechnology, which will be held in Lausanne, Switzerland from July 2-23, 2011. The selection was highly competitive as only 12 US participants were invited.

**Marissa Rodrigues** (Graduate Student in lab of Todd Reynolds) won the best poster award at the Southeastern Conference for Yeast Biology in Hattiesburg, MS.

**Pamela Small**, Professor Emeritus of Microbiology, has been named a fellow of the American Association for the Advancement of Science for distinguished contributions to the field of emerging infectious diseases, particularly for research and editorial contributions in the field of neglected tropical diseases.



**Morgan Steffen** received the Wallace-Dean Fellow of the Graduate School. The award carries a 4 year stipend.

**Drs. Erik Zinser and Alison Buchan** have both been awarded major grants from the National Science Foundation.

**Whitney Burton (Layton), Sarah Eakes (Su), Katherine Eisberg (Reynolds), Daniel Jones (Buchan), Jordan Kim (Becker), Alexandra Rogers (Sayler), Cara Turski (Wilhelm), Jenna Zalewski (Wilhelm)** all received an Undergraduate Summer Research positions for 2010. The chancellor's office funds these internships to stimulate undergraduate participation in research.

## We Want to Hear from You!

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Degree(s): \_\_\_\_\_

Place of employment: \_\_\_\_\_

Job title and description: \_\_\_\_\_  
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How did your time at UT prepare you for this position? \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

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