

# IN VIVO

Newsletter of the University of Tennessee Division of Biology

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## Helping graduate students find their niche

Bioinformatics is a relatively new field of study promoted by the Graduate School of Genome Science and Technology (GST) at UT. It is an interdisciplinary area of research using mathematical and computational methods to answer complex biological questions.

Dr. Ying Xu, the senior staff scientist and group leader, and Dr. Dong Xu, a staff scientist, of the Computational Biology Section of the Life Sciences Division of Oak Ridge National Laboratories (ORNL) are using their research and connection to the GST program to increase interest

in bioinformatics. Training graduate students includes exposure to chemistry, biology, physics, computer science, statistics and mathematics. D. Xu said, "We hope to attract more students because the field is rapidly expanding and there is a great demand for trained bioinformaticians in the health industry. We now have more data than our people can handle."

Currently, several GST students are working at ORNL on various projects, and plan to conduct their Ph.D. thesis work in the field of bioinformatics. The key driving force in the rapid development of bioinformatics is the high-throughput production of biological data because of the Human Genome Project that has produced the genetic map of the human genome.

The National Institutes of Health (NIH) has taken the next step: to determine the structures of all proteins within the human genome in its Structural Genomic Project.

### The Research

In support of this new NIH project, a computer program called PROSPECT© has been developed.

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## From the Director

John Koontz, Ph.D.



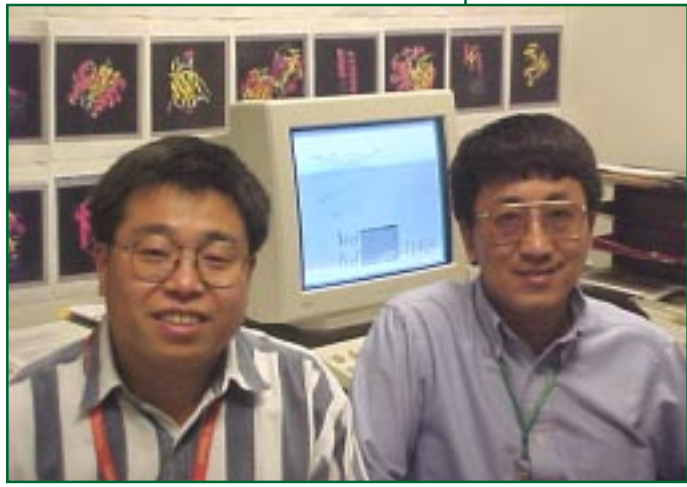
Friends, I am delighted to report that the departments in the Division of Biology were given approval to search for a combined total of eight new faculty

members. By the time you read this, advertisements will have been submitted and perhaps been published for all of the positions. Assuming we are successful, we will have eight new people on our faculty beginning August 1, 2002.

This recruiting period will be a very important time for the departments within the Division and for the University. As I've commented about in a previous issue, faculty members are the soul of the University. In a research-oriented university such as the University of Tennessee, a successful science faculty member is a good teacher and an entrepreneur.

They must train students and maintain an externally funded research program. In order to achieve this, they must be very competitive in their research, anticipating and positioning themselves to take advantage of new trends and opportunities for funding. Any new funding they obtain may only last a few years at best. While they are carrying out the research for which they have existing funding, they are also laying the groundwork for the next successful application

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*Drs. Dong Xu and Ying Xu*

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### Drs. Xu, Continued from page 1

PROSPECT (PROtein Structure Prediction and Evaluation Computer Toolkit) is a computer program for predicting the three-dimensional structure of a protein from its amino acid sequence. Y. Xu and D. Xu have received an R&D 100 Award for inventing the software.



*The protein Anaerobic Cobalt Chelatase. Predicted shape left, experimental right.*

Proteins work as enzymes, hormones and antibodies to do the work of the gene in which they are found. Y. Xu explains, "Protein is what actually accomplishes the biological functions of the gene code. Understanding the protein's role is a key step to unlocking a gene's overall biological function."

PROSPECT uses a computational technique called protein threading to construct a three-dimensional protein model from the amino acid sequence. There are about 1,000 known unique structure folds for proteins, and these are utilized as templates.

The software uses algorithms to predict the structure of the unknown protein, thereby identifying it and its properties. Scientists can use these models in three ways 1) to better understand the biological structure of proteins, 2) characterize diseases or 3) create new drugs.


For example, PROSPECT has helped **Dr. Cynthia Peterson** of UT's BCMB department in her study of the human plasma protein called *Vitronectin*. This protein regulates blood coagulation, fibrinolysis,

angiogenesis, wound healing and cell migration. Peterson said she used PROSPECT because "we have not been able to determine *Vitronectin*'s structure by the more traditional methods like NMR or X-ray crystallography."

With the three dimensional prediction, Peterson studied "the covalent bonds that might occur between domains and came up with a very exciting structure that is in press in the journal *Proteins*. Using the software has also helped Peterson consolidate funding from the American Heart Association so she can continue to verify and refine the model and, more specifically, study how the anticoagulant, Heparin, is binding to the protein.

PROSPECT was tested recently at an international benchmark competition called the Fourth Community Wide Experiment on the Critical Assessment of Techniques for Protein Structure Prediction (CASP4). PROSPECT finished sixth overall in the fold recognition category out of 123 international groups and was the only software to use the threading technique.

*"... there is a great demand for trained bioinformaticians in the health industry. We now have more data than our people can handle."*

Since PROSPECT has been made available over the internet, more than 40 academic organizations have licensed the software, including MIT, UCLA, the University of Texas, Columbia University and Dartmouth College. While the software is free to academic entities, corporations such as Bioinformatics Solutions, Inc., Rigel, Inc. and Genset, S.A. have paid for its use. 

<http://compbio.ornl.gov/structure/>

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## A Word from the GST Director

Jeffrey Becker, Ph.D.

We are very excited about our new Graduate School of Genome Science and Technology! Our school is providing an educational framework for entrée into biology of the 21<sup>st</sup> Century. Biological sciences are now experiencing a fabulous period of growth with increasing opportunities based in part on achieving genomic sequencing. Eric Lander of the Whitehead Institute of MIT has compared sequencing genomes to that of establishing the periodic table of the elements. Just as the atomic chart is the foundation of the chemical sciences, genomes are the templates upon which life processes may be explored and



*Gaynelle Russell, Jeff Becker,  
Kay Gardner, and  
Rhiannon McKivitt*

The goals of GST are to recruit high quality graduate students, to develop exceptional graduate courses delivered by new technologies, and to foster collaborative research between UT and ORNL scientists. To achieve these goals, GST focuses on the new developments in the biological and computational sciences that stem from genome sequencing efforts to provide our students the background and experience in multidisciplinary research efforts to be successful researchers in the changing market of basic research.

Today, new scientists coming out

of educational programs mostly have been trained in narrowly focused programs. Recognizing that modern research is multidisciplinary, GST is designed to overcome some of the problems these graduates have when they arrive at their first job.

Comprised of faculty and staff from the Oak Ridge National Laboratory and many UT Colleges including Arts and Sciences, Human Ecology, Veterinary Medicine, The University of Tennessee Medical Center at Knoxville, and UT-Memphis, GST is the only graduate program in the United States with a full integration of university faculty and national lab staff in all the activities required for graduate teaching and research.

Research opportunities for students are available at many sites with faculty from these campuses serving as co-mentors on research projects. Students are encouraged to develop research projects at the interfaces of the following emphasis areas: mammalian genetics, structural biology, bioinformatics and computational biology, and bioanalytical technologies. Many of the student-initiated research projects will foster linkages among laboratories of GST participating faculty.

Science of the 21<sup>st</sup> century will require multidisciplinary research, which GST students will be prepared

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*Director, Continued from page 1*

for more funding.

A good faculty member must have the energy, initiative and entrepreneurial spirit of a successful business owner. Thus, while we are excited about the prospect of eight new colleagues we understand the difficulty and significance of the decisions we will make in going through the recruiting process. You can learn more about the positions by visiting the Division web page ([www.bio.utk.edu](http://www.bio.utk.edu)).

In the last issue I pointed out that the state legislature passed a budget that was going to require cutbacks at our university. Within the past month the new provost, Dr. Loren Crabtree, has announced an initiative to look at the current organization of our campus. To quote from his announcement:

*"...Interim President Eli Fly has directed The University of Tennessee system to prepare a plan by October 15 for a 4-6% internal reallocation which would be effective July 1, 2002.*

*To comply with President Fly's directive, we have appointed eleven task forces to study the reorganization of academic units in order to improve efficiency and effectiveness by eliminating redundancy and duplication. Efficiency could be gained by realigning similar units, eliminating redundant administrative services, and reallocating released resources. Effectiveness could be gained by reorganizing faculty into affinity groups and streamlining the curricula, thereby creating new opportunities for research and teaching."*

Although the Division went through a reorganization initiated seven years ago, we are getting into the spirit of this initiative and thinking about new ways of doing things. The last reorganization was somewhat painless in that we retained four departments with only a modest realignment of emphases. Anything new will require that we be somewhat

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### IN VIVO

An Alumni newsletter published by the Division of Biology

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## New research methods spawn new research centers

The UT-ORNL Graduate School of Genome Science and Technology has come a long way from its inception. The dream that is GST began in 1946 after ORNL built a soon to be abandoned, postwar plutonium separation building. According to **Dr. Barry Berven**, associate director of the Life Sciences Division and acting director for the Joint Institute for Biological Sciences, the genesis of GST came from forward thinking scientists who wanted to study the long-term consequences of exposure



*Berven stands in a new tissue lab beside a new hood*

to radiation on living organisms.

The mammalian system that was best understood at that time was the mouse. From this small creature grew the largest program at ORNL in the 1950's with over 400 staff scientists and 400 more visiting researchers. Berven said, "Of course, the research extended beyond that (radiation) to immunology, cancer and toxicology to all aspects of biology and developmental biology."

In 1963, **Dr. Andy Holt**, **Dr. Alexander Hollaender** and **Dr. R. C. (Clint) Fuller** from the University of Massachusetts-Amherst began making plans for the creation of the Graduate School of Biomedical Sciences that would link the academic resources of UT to the research labs of ORNL. Hollaender was able to secure much of the funding from the Atomic Energy Commission and a new partnership was born.

The structure and name of the school was changed in 1997. This change was necessary to keep the program current with modern research methods. In the past two decades, research programs have changed from the isolated principle investigators and their graduate students to a team-oriented design.

Berven said, "The value of the program is the interdisciplinary aspect that we bring to the graduate education experience. We have mammalian genetics and genomics, structural

biology, analytical technologies and computational biosciences. That's part of the curriculum, part of the student's educational experience because that is how it is in real life. So, we think this is a well-rounded educational and research experience. I would suspect that these students will not have a problem finding a position once they leave."


The future for students in the GST program will include new facilities. The new Environmental and Life Sciences Laboratory, which contains office space and ten molecular labs, is scheduled to open this fall. Among the research conducted here will be a focus on embryonic mouse stem cells.

Breaking ground in November is the new home of the laboratory for Comparative and Functional Genomics or new Mouse House (see facing article). This 14 million dollar, state of the art animal facility will provide the mouse models needed for genetic study.

Another building to be added in the future is for the Joint Institute for Biological Sciences. This will house the graduate program providing virtual classrooms and office space for UT faculty. Within a few years all personnel associated with the Life Sciences Division will be housed in the Marilyn

Lloyd Environmental and Life Sciences Complex, or West Campus of ORNL.


In August, UT-Battelle contracted with a private firm, Colliers Keenan, Inc. of Columbia, South Carolina to build three additional buildings on the West Campus. These buildings are for the Joint Institute for Computational Science, Engineering Technology Facility and a research office building.

The work to improve the physical structure of ORNL is focused on both improving the educational experience of GST students and the research facilities for UT and ORNL scientists. The close proximity will better facilitate interaction between faculty and students. 

<http://lsd.ornl.gov>

### *Becker, continued from page 3*

to perform by the nature of their inter-laboratory projects. Each student is required to complete a one-year laboratory rotation in four labs at a minimum of two sites. This intense, varied lab experience gives GST students exposure to several fields to facilitate development of multidisciplinary studies. GST students will be trained to enter academia and other institutions such as national labs and the pharmaceutical and biotechnology industries.

A goal of GST is to foster collaboration among scientists at the participating institutions leading to higher research productivity and increased grant applications. Many interdisciplinary and multidisciplinary projects have been initiated, and some have already produced spectacular results leading to major publications and grant submissions. GST is committed to interacting on a daily and continuing basis with all of the biological science entities at UT. We trust that GST will contribute meaningfully to the continued growth of biological education and research at The University of Tennessee. 

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## Of mice and scientists

**Dr. Dabney Johnson**, section head for the Mammalian Genetics and Genomics program at ORNL, is responsible for providing mutant mice for genetic studies. She also serves



as an adjunct faculty member for the GST program. Graduate student **Lisa Webb** and research assistant **Claretta Sullivan** help with Johnson's research.

The Laboratory for Comparative and Functional Genomics, or the Mouse House, as it is commonly called, is located in Oak Ridge at the Y-12 plant. Johnson's research operates at the cross-section of genetics and genomics. She said, "Our job is to march down a chromosome gene by gene, make changes in the gene and then sit back and let the animal tell us what the job of that gene is."

Of the 70,000 mice under her care, Johnson says there are four results in the test subjects when the genes are manipulated. First, the genetic change can cause obvious problems, such as limb deformity. Second, if the gene was essential for development, the embryo will not form at all. Third, the animal will look normal, but will have behavioral or other subtle disorders. Fourth, the gene change will not hurt the animal physically or behaviorally.

Some members of the first three groups are advertised on the web to help other organizations get the mice they need to study their particular genetic problem. For example, mice are advertised as having a "balance defect", "super sensitivity to alcohol" or "having an abnormal startle reflex". In the case of the latter, organizations studying schizophrenia may want these mice

to use for their genetic research.


Mice from the third category are also sent to sister institutions in Tennessee through the Tennessee Mouse Genome Consortium to undergo various behavioral and physical tests to screen for subtle abnormalities. Some of these mice are also housed until they reach "old age", which to a mouse is about 18 months. At this point, they are re-tested to look for age-onset problems such as heart disease, Alzheimer's, and cancer.

The National Institutes of Health (NIH) and the Department of Energy (DOE) provide the primary funding for the Mouse House. The NIH wants mutant mice to study human genetics. They are particularly interested in studying such ailments as schizophrenia and depression genome-wide.

The DOE wants to understand the basic job of each gene in the human genome, which is why chromosome 7, having many of the same genes as human chromosome 19, is studied so extensively. The DOE is also changing focus to look not only at the offspring of exposed parents, but to study the parents also to track the genetics of susceptibility to environmental factors.

The Mouse House will soon have a new location at the ORNL West Campus (X-10), where it will be housed with the other Life Sciences personnel that are under the umbrella of UT-Battelle. Johnson has plans to incorporate more ORNL scientists in the future to help with the processing of complex data and further technological development.

"We hope to soon have electrical engineers and analytical technicians co-housed here," Johnson said. "If

you have 100 mice to look at each week, it can't be a tedious assay. It needs to be as automated and as high tech as possible." 

<http://bio.lsd.ornl.gov/mgd/johnson.htm>

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## Renovations and temporary buildings

John Koontz, Ph.D.

If you have come back to the campus within the past two months you may have noticed one or two new buildings that are referred to as Biology Annex. You might have wondered if biology is expanding so much that it needed two new buildings: i.e. what purpose are these serving?

The Hesler Biology Building, a building where many of you took classes, is scheduled for renovation to begin sometime this fiscal year. Those of us involved in this refer to Hesler as old wing or new wing Hesler. The original renovation plans were that the old wing would be renovated. However, as planning progressed the new wing was included. The old wing was dedicated in 1934 and the new wing in 1964.

Total usable space in the existing structure is approximately 77,000 square feet. The program statement for the renovated space indicated a need for about 83,000 square feet. When final planning began we learned that we would actually have about 69,000 square feet available in the completely renovated building. The reduction in square footage came as a result of meeting new construction codes for fire prevention,


etc. Consequently, we had to figure out how to eliminate the need for approximately 14,000 square feet of space. This was eventually resolved by moving certain functions to other buildings and agreeing that there were some things we would have to do without.

During the planning process we had to take into account that a significant number of teaching laboratories would be out of commission while the renovation was underway. Space to accommodate this type of activity is not readily available in other buildings around campus. To solve this dilemma, two new buildings were constructed. These new buildings were designed and constructed to meet the specifications for these teaching laboratory activities set forth in the original program statement. In that respect they are excellent space for these activities.

These two buildings were completed this past summer. In late July, laboratory benches, laboratory instrumentation and supplies, and as much other usable equipment as possible, was moved from old Hesler to these two buildings in anticipation of teaching in them this fall. We experienced some pains associated with moving into these buildings and finding out whether or not everything

worked. That is likely to continue for a few months as winter approaches and we have colder weather. However, the buildings are now virtually fully occupied and are being used by hundreds, if not thousands, of undergraduates this fall semester.

Those sports fans among you might enjoy the acronyms used for these buildings: the NBA and the WBA. These refer to the Neyland Biology Annex and the White Avenue Biology Annex. Needless to say, these acronyms refer to the location of the buildings and do not infer direct financial support by the men's and women's professional basketball associations. The NBA is adjacent to Neyland Stadium, down the hill behind Estabrook Hall. The WBA is at the corner of James Agee Street (15<sup>th</sup>) and White Avenue, behind Hoskins Library.


In addition to providing teaching laboratory space for all of the Botany department's courses during the renovation process, the WBA will eventually house the herbarium, an internationally recognized collection of plants housing over 500,00 specimens of fungi, mosses, liverworts, lichens, ferns, and cone-bearing and flowering plants. More about the herbarium in the next edition. 

## Current GST students

The GST students are working on the following research projects:

**Rawan Awwad**, "Molecular Gene Regulation of Cytochrome P450s," **Yesim Aydin-Son**, "Functional Genomics: Role of Agouti Gene in Cancer Biology," **Morvarid Bejnood**, "Genetic Analysis of Meiosis," **Yu Chen**, "Computational Analysis of Regulatory Regions," **Laura Chittenden**, "Characterization of Murine Disease Models," **Paul Kasili**, "Optical Spectroscopy Techniques for Biomedical Analysis," **Jennifer Millsaps**, "DNA Analysis in Forensic Applications," **Jane Razumovskaya**, "Computational Analysis of Genes and Proteins," **Christal Secrest**, "Computational Functional Annotation of Hypothetical Genes," **Matthew Sega**, "Microplate

Analysis of Amyloid Proteins," **Tomoaki Uchiki**, "Structural Biology of Yeast Cell Cycle Checkpoint Proteins, Sml1p and Rnr1p," and **Josh Sharp**, "Protein Biochemistry and Mass Spectrometry."

Please note that the first year students are completing required lab rotations. 

*Not pictured:* Heather Dech, Tomoaki Uchiki, Laura Chittenden, and Rawan Awwad.



*Back row left to right: Xinxia Peng, Jane Razumovskaya, Nathan VerBerkmoes, Can Ozen, David McWilliams, Yutao Liu, and Josh Sharp. Middle row: Sam Wang, Morvarid Bejnood, Yesim Aydin Son, Trupti Joshi, Erica Johnson, and Ling Li. Front row: Paul Kasili, Christal Secrest, Jennifer Millsaps, Matt Sega and Yu Chen.*

## Alumni News



### 1930's

**Dr. William Bickley** received his undergraduate degree in 1934 and his masters in Entomology in 1936. During World War II he used his skills for the US Public Health Service in Malaria Control. He was a professor for 34 years at the University of Maryland. During that time he also served as department head for 15 years. He has retired to Silver Springs, Maryland.

### 1960's

**Dr. Dewey Caron** received his graduate degree in 1966 from Entomology. He is currently professor of Entomology and Applied Ecology at the University of Delaware. He teaches General Entomology and Wildlife courses and his research focuses on the use of GDD in scouting ornamental pest insects and IPM control tactics for Varroa mites in honeybee colonies.

### 1970's

**Dr. Brian Boom** earned his M.S. in Botany in 1979. Since 1980, he has been at The New York Botanical Garden, first as a doctoral student, then as a curator, and finally as Vice President for Botanical Science and Pfizer Curator of Botany. He has recently been appointed President and CEO of the All Species Foundation, based in San Francisco. [www.all-species.org](http://www.all-species.org).

**Dr. William (Bill) Harvey** received his Ph.D. from Botany in 1971. He is a professor of Biology at Earlham College, Richmond, Indiana. He is involved not only in teaching, but also directs students in research in Immunology. His work focuses on the pleiotrophic features of interferon Alpha on apoptosis and cytokine interactions in a late differentiated B cell tumor.

### 1980's

**Dr. Christopher Craft** graduated in 1983 with his masters from Ecology, in conjunction with ORNL. He is now an associate professor and wetlands ecologist with the School of Public and Environmental Affairs at Indiana University, Bloomington.

**Dr. Joseph Daniel** served as head of the former Zoology department until 1984 when he took the position of Dean of the College of Sciences at Old Dominion University in Norfolk, Virginia. He retired from ODU in 1994, but remains active in research by studying rhinoceros biology and the use of dogs in rehabilitation therapy for juvenile delinquents.

**Dr. Bill Hearl** received his Ph.D. from Biochemistry in 1984. He is now the president and CEO of Capital Genomix in Gaithersburg, Maryland. The company commercializes gene expression analysis and discovery and the rapid development of antibodies directly from DNA sequences. [www.capitalgenomix.com](http://www.capitalgenomix.com).

**Dr. Alan Rabinowitz** graduated in 1981 with his Ph.D. in wildlife ecology. He is currently the director of the Science and Exploration Division for the Wildlife Conservation Society based at the Bronx Zoo in New York. He studies large mammals such as jaguars, clouded leopards, tigers and Sumatran rhinos. He has recently published "Beyond the Last Village" on his work in Myanmar. [www.wcs.org](http://www.wcs.org).

**Esther Roberts** was recently named a patent attorney for the Office of Chief Counsel of the Department of Energy's Oak Ridge Operations. She graduated with concurrent bachelor degrees in Biology, Botany and Piano in 1986. She returned to UT to obtain a law degree, which was completed earlier this year.


**Dr. Rodney Scott** graduated from the Botany in 1989. He currently teaches in the Biology department at Wheaton College in Illinois. He has recently published a general genetics manual, which is titled "Contemporary Genetics Laboratory Manual". [www.morton-pub.com/html/labinvgenetics.html](http://www.morton-pub.com/html/labinvgenetics.html).

**Dr. Shawn Wright** received his undergraduate from Botany in 1986 and his Ph.D. from North Carolina State University in 1998. He is

currently a Research Associate in Horticulture with Ohio State University.

### 1990's


**Rodney Snow** received his undergraduate degree in 1997 and is currently enrolled as a medical student at UT's College of Medicine in Memphis, Tenn.

**Hajnalka Bardos Klieman** graduated in 1998 with a major in Biology and minor in Zoology. After graduation she worked as a park ranger for more than a year. She has returned to school to pursue a masters in Music Education and lives in Oakland, California. 

### Director, Continued from page 3

more bold and willing to accept significant change. There are a variety of options that we could consider regarding our current organization including thinking outside the confines of our Division and going beyond the College of Arts and Sciences. At the present time, the door ought to be considered wide open to a host of various options.

This initiative and composition of various task forces was announced to the faculty a few days ago. Consequently, no recommendations directly affecting the Division have yet been made public. The recommendations of each of the task forces are due by October 15. Indeed, we will probably know about the recommendations by the time you read this.

Following the announcement of these recommendations, the University community will have several months to debate and respond. A final decision will be made by March 22, 2002 for implementation in the 2002-2003 academic year. I will use this forum to keep you abreast of any announcements as they appear and to provide my own opinions regarding their value to the departments in our Division. 

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Newsletter of the University of Tennessee Division of Biology

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OCTOBER - NOVEMBER 2001

## Upcoming Events:

**First-Year GST Student  
Poster Presentation Day**  
Thursday, December 6, 2001  
12:00 p.m.  
Walters Life Sciences Building  
University of Tennessee campus

### Note:

Our Division website has been redesigned! [www.bio.utk.edu](http://www.bio.utk.edu) now includes past copies of the *In Vivo* newsletter and an Alumni section.

The on-line version of the Alumni News allows for more detailed information, provides active links and will be updated as often as information is given to us.

The individual department sites are also currently going through a renovation process.

Keep us up-to-date on your endeavors by using the enclosed envelope or contacting us at [imaples@utk.edu](mailto:imaples@utk.edu).

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