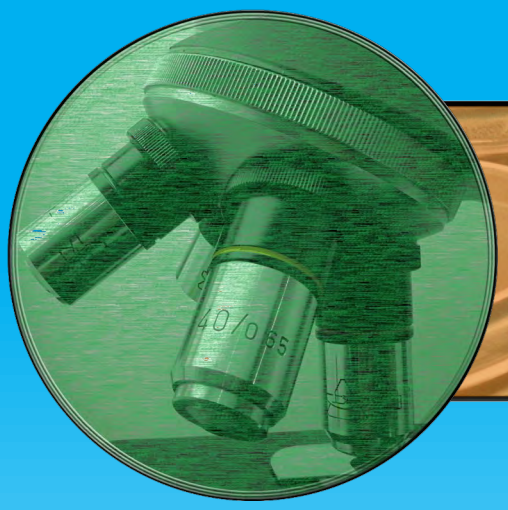


The MicroScope

Fall 2013 Department of Microbiology Newsletter

Getting to Know Unknown Life on Earth

Research of the Karen Lloyd lab

Earth is home to an incredible diversity of life, from the most familiar plants and animals to creatures so bizarre they seem to be from another planet. Certain kinds of one-celled organisms live in remote environments too extreme for most forms of life. Known as extremophiles, varieties can be found in such places as boiling sulfuric hot springs, lakes buried under nearly a mile of ice in Antarctica, or sediments compacted at bone-crushing pressure on the bottom of the ocean. These adaptable microbes are typically members of *Bacteria* or *Archaea*, two of three unique domains—the overarching groups used to classify living things. The third domain, *Eukaryota*, includes all organisms with cells that have a nucleus. Although all bacteria and archaea are unicellular and lack a nucleus, they are evolutionarily distinct, enough to separate them at the highest level of taxonomic hierarchy.

Dr. Karen Lloyd, Assistant Professor of Microbiology, studies certain types of archaea that subsist in subsurface marine sediments, an environment void of all light and bereft of most nutrients found in seawater and the upper layers of seafloor sediments. Her work was featured in the April 11 issue of *Nature* with a paper titled *Predominant archaea in marine sediments degrade detrital proteins* and is co-authored with Dr. Lars Schreiber of Aarhus University, as well as Dr. Andrew Steen, Research Assistant Professor of Microbiology at UT, and other scientists collaborating with Aarhus University in Denmark.

The traditional method of studying microbes is by culturing—growing them in the laboratory and examining subsequent generations. This technique works very well for learning about genomes and cellular processes of abundant, fast-growing organisms. Many types of bacteria are prodigious growers under artificial conditions, especially pathogens. A single cell of the disease-causing bacteria *E. coli* is capable of dividing into new cells every 30 minutes.

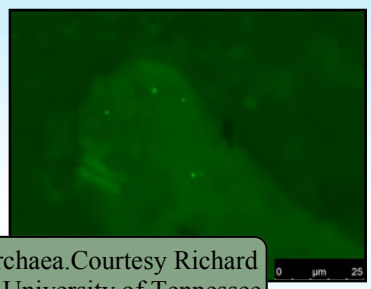


Image of archaea.Courtesy Richard Kevorkian, University of Tennessee

Much microbial research has historically been devoted to fast-growing pathogens, both because of the relative ease of culturing and applications to human health. Culturing does not work for every microorganism, however, especially archaea adapted to specific, harsh environments. Most archaea are slow-growing and slow to reproduce, sometimes taking decades to complete a life cycle. Although some types of archaea do, in fact, live naturally inside the human body, none have ever been shown to be pathogenic. Because they do not cause disease, they have often been overlooked by researchers.

'Unknown Life' - continued on page 2

Words from the ASSOCIATE Department Heads

Dr. Alison Buchan
&
Dr. Steven Wilhelm

Welcome to the 2013 edition of ***The MicroScope***. For those of you accustomed to seeing Professor Jeffrey Becker's prose here, just turn to page 4. This edition of our newsletter includes a special feature on our Head as he finishes his 41st year of service to the Department (and has just been reappointed as head for another term!!). To this end, it falls on us to step up to the big chair for 2013 (at least for this introduction).

Microbiology continues to be one of the strongest programs at the University of Tennessee, with our faculty and students continuing to attract global attention and acclaim. New research grants from the *National Institute of Health*, *National Science Foundation*, *Department of Energy* and other agencies were won by departmental faculty and students this past year, all of which will help maintain the state-of-the-art research of which we are very proud. Microbiology remains a critical focus of research scientists around the world: from viruses to bacteria and fungi, efforts of our faculty are reshaping the very foundations of thought in disease and infection as well as climate change, bioremediation and emerging green energy technologies. Our faculty continue to both publish and play lead editorial roles in top science journals. As an example, see this page for an article on Karen Lloyd, author of a recent paper in the prestigious journal *Nature*.

'Associate Heads' - continued on page 10

THE UNIVERSITY of TENNESSEE

'Unknown Life' - continued from page 1

However, archaea are an integral part of many microbial ecosystems, and their ability to survive under extreme conditions makes them interesting to scientists. Even if researchers could grow all archaea artificially, culturing would reveal very little about ecological processes in their natural habitat. Therefore, Lloyd and the team at Aarhus needed to examine uncultured specimens of archaea living beneath the ocean floor.

Two particular types of archaea have been found in ocean sediments around the world. These are called *miscellaneous crenarchaeotal group* (MCG) and *marine benthic group* (MBG-D), which can be identified by unique sequences in the 16S rRNA gene. The coverage of sampling for archaea is still sparse over much of the globe, but includes locations from every ocean. Everywhere that archaea have been sampled and identified, MCG and MBG-D have been present, so their range is assumed to be more or less worldwide. For this reason, Lloyd and team focused their study on these taxonomic groups in order to generate results that could be applicable to benthic ecosystems globally.

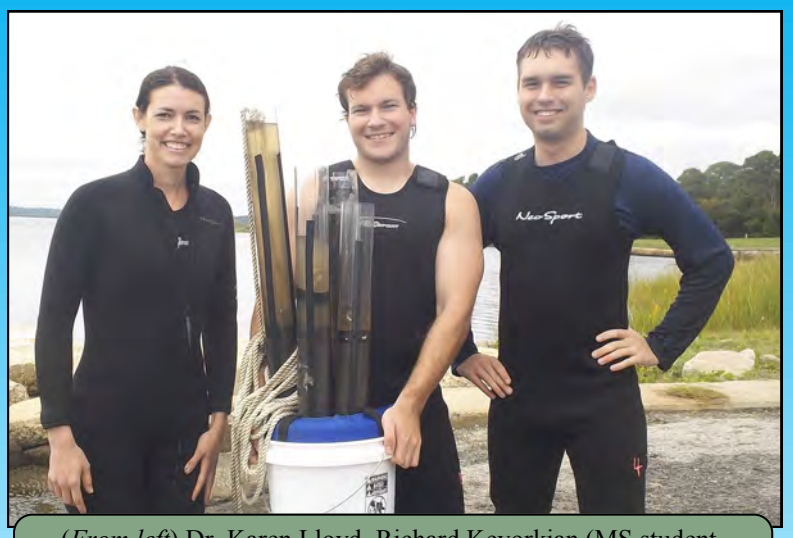
To study the mysterious microbes, Lloyd and colleagues collected sediment from the bottom of a bay off the coast of Denmark and used a series of state-of-the-art techniques to amplify the genomes of individual organisms. First, individual cells were extracted from sediment, then sorted using a laser light. Next, DNA from each individual cell was extracted and amplified so the genome could be analyzed.

The pain-staking cell collection and genome amplification processes revealed four intact cells, one from the MCG group and three from the MBG-D group. Although amplification of DNA was uneven across the genome, and therefore gave an incomplete picture, the researchers could tell enough to classify the specimens on the phylogenetic tree of life. Much is still unknown about the phylogeny of archaea, but they are certainly a diverse and highly adaptable domain of organisms with over two billion years of evolutionary history. By examining the genome, the researchers determined that the MCG and MBG-D groups are only distantly related within archaea—so distant, in fact, that they are more dissimilar taxonomically than any animals—although they are both single-celled ocean-dwellers with similar metabolic functions.

These metabolic functions are what Lloyd and her colleagues were particularly interested in. In the genomes of all four cells, the researchers found genes coding for protein-degrading enzymes, called peptidases, previously known only from certain kinds of bacteria. They predicted that these enzymes, along with peptide-specific transport structures, were located on the outside of the cell walls. The genomes also revealed capabilities to degrade amino acids, the breakdown products of proteins, inside the cell. The extracellular peptidases are believed to be specific to the types of proteins that would be found in bacteria-rich detritus on the ocean floor. This means that when the archaea cells come in contact with proteins in their environment, they can break them down into smaller peptides and amino acids, then absorb and metabolize the amino acids for energy to sustain the cell's life.

This finding is monumental in the field of microbial ecology. According to Lloyd, "The surprising find is extracellular peptidases. These microbes are recycling from the environment around them, not just their own proteins. This has never been observed before in archaea in marine sediments." The only metabolic processes known for other marine sedimentary archaea rely on simple carbon compounds like methane, but the discovery of MCG and MBG-D's unique metabolism reveals an entirely new niche for archaea.

Lloyd says the most enjoyable aspect of the work was camaraderie among her team members. She and the other two post-doctoral researchers cooperated to pioneer new techniques for studying uncultured microbes. Before this study, no one had ever extracted individual cells from ocean sediments, only from seawater. Since Lloyd and her colleagues had success with this process, she hopes such methods can be used in more locations around the world to expand research on archaean taxonomy and ecology.



(*From left*) Dr, Karen Lloyd, Richard Kevorkian (MS student, Microbiology), and Jordan Bird (PhD student, Microbiology) with sediment cores containing archaea from an estuary in North Carolina

Lloyd currently has plans to core sediments in the Baltic Sea from far deeper than her previous study. She, along with UT Microbiology PhD student Jordan Bird, will delve into subsurface ecosystems as deep as 200 meters beneath the ocean floor, a place where life has only recently been discovered. These extreme environments have been buried and cut off from the seafloor surface for hundreds of thousands of years, so the communities of archaea and bacteria that live there are likely to reveal even more taxonomic lineages and physiological processes previously unknown to science. Lloyd's team has secured funding for this project from the *Center for Dark Energy Biosphere Investigations* (*National Science Foundation*), and has already begun similar sampling in a North Carolina estuary to compare archaea specimens from a slightly different environment.

Lloyd is excited and optimistic for the future of her groundbreaking research. She says, "These organisms are almost like aliens in terms of how little we know about them, but we've been living with them for our entire human existence and they were around way before humans were ever here. We know almost nothing about what any of them do and we've just skimmed the tip of the iceberg. I find it fascinating that we now have the tools to begin to determine their role in Earth's environment."

Jesse Weber

The Microbiology Undergraduate Club

The 2012-2013 school year was another productive one for the Microbiology Undergraduate Club (MUC). When the *American Cancer Society* held Relay for Life on UT's campus in April, MUC raised over $2,000, more than any other team of their size. To rally enthusiastic support from the entire campus community, MUC members devised a fundraising scheme targeted at faculty members, literally. For $3, anyone could take aim at either Dr. David Golden (*Food Science & Technology*), Dr. Todd Reynolds, Dr. Liz Fozo, or Dr. Jeffrey Becker with a water gun filled with slime. In the 3 hours that the professors cheerfully endured getting slimed, they raised about $350 from students and other faculty paying per shot of the goop gun. Other activities included swings at a microbiology-themed piñata and members participating in Relay for Life's 12-hour relay walk. Thanks to MUC members' creativity, students and faculty put the "fun" in fundraising for an impressive turnout at the annual charity event.

Dr. Jeffrey Becker and Dr. Liz Fozo place themselves in the line of fire to fight cancer at the April 2013 Relay for Life at UT

The club got its start in Fall 2011 when faculty members in the department decided to improve interaction with students and provide them with more access to networking, career information, and research opportunities, while having fun in the process. After announcing an initial meeting, several students expressed interest and the club took off from there—growing to its current membership of over 40 students. Meetings are held about once per month and each are focused on a particular theme, usually with a guest presenter. Meeting themes cover a wide range of topics related to microbiology, including pathology, food safety, applying for graduate school, working as a physician's assistant, etc. Speakers are from a diverse array of backgrounds and credentials—whether from within the microbiology department, other departments at UT, or other institutions. Additional events include an annual barbeque social and a t-shirt design contest. The winning design, based on votes from club members, is printed on the shirts that are sold for fundraising each year. This year's shirt features the Sunsphere, stylized as a virus, dominating the Knoxville skyline under the slogan, "*Microbiology: Watching over Knoxville since 1982*."

Club member and new vice president Nate Crilly is a Food Science and Technology major, but he joined the club out of interest in a career in virology and animal-born diseases. Crilly says, "There are a lot of things that I like about the club, but my favorite thing is probably the lectures… For example, a researcher from the Body Farm came to one of our spring meetings to discuss her work with soil microbes and decomposition. Earlier in the year, a graduate student held a discussion about the microbiology of sourdough bread. It's a really interesting way to learn more about microbiology in a casual, relaxed environment."

Dr. Liz Fozo is currently the faculty advisor for the club. She took on this role from the club's beginning because she wanted to interact with students and see them succeed both in and outside of school. She describes her job as mainly a facilitator for the students' ideas. MUC members decide what they are interested in and would like to focus on at a meeting, but if they are not aware of how to pursue it or who to talk to, Dr. Fozo is there to make it happen. She says she is impressed by how student-driven the club is. She applauds club members for their organization, creativity, and how much they accomplish on their own initiative. She also admires the faculty's enthusiasm in supporting the club. They are always happy to speak at meetings and attend club events, even if it involves getting slimed. Regarding the Relay for Life event, Dr. Fozo says, "I sent out the initial email asking the department for volunteers and within two minutes Dr. Becker had replied and agreed to do it. The others, too, agreed pretty much right away. There was no hesitation."

The club is gearing up for another successful year starting this fall. They hope to increase membership, plan even more events, take field trips, and continue to promote friendly fun with microbiology.

Jesse Weber

Department Head Jeffrey M. Becker

"I get paid for something I love to do. It's fantastic."

These are the words of Dr. Jeffery Becker, Microbiology Department Head and Chancellor's Professor of Microbiology. This year, Becker begins his third 5-year term as department head. *The Microscope* sat down with Dr. Becker to discuss his career of nearly 40 years so far at UT and what he hopes for the future.

Dr. Becker and some of his students. From left: Brandon Merical, Dr. Jeffrey Becker, Jeffrey Rymer, Sarah Kauffman, Seraj Uddin

What does it mean to you to be a professor?
"It's a privilege, at least I feel. I love to mentor students toward their graduate degrees or PhDs, and also undergrads. I like to introduce them to science and discovery, mainly discovery I would say… Plus, students are always challenging me with new thoughts and ideas. As a professor, I am constantly renewed by new people and new ideas."

What does it mean to you to be department head?
"Again, it's a privilege. A privilege to be a part of building the department up and to be hiring great young people and helping them to succeed. I get to see former students establish careers and contribute to science and society."

What do you feel is the best thing about the Microbiology Department at UT?
"We have had spectacular growth in the last ten years, more than double. We have a fabulous core of young faculty and almost all have major external funding and papers in strong journals. I am really excited about the growth and success of both faculty and students. We have undergraduates doing great and getting into great schools and careers. I am very proud of that."

The Jeffrey Becker Lab Then and Now

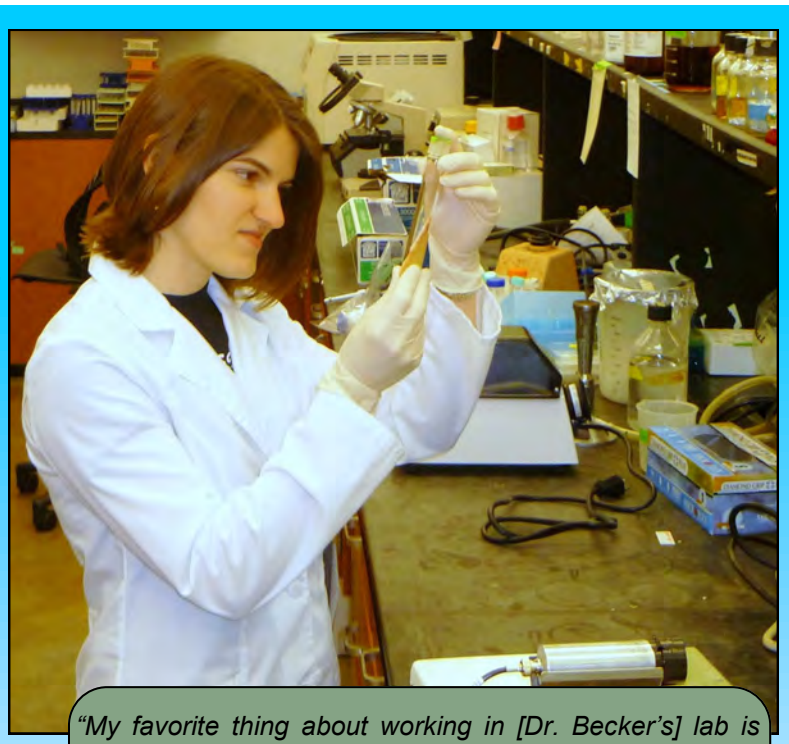
1992

2013

Dr. Jeffrey Becker has led numerous research projects since coming to UT. Most notable is his work with yeast as a model organism to study transport and signal pathways in eukaryotic cells. The research focuses on how receptors in cell membranes recognize external molecules and interact with transporters in the membrane to move selected molecules into the cell. Becker is also interested in how chemical signals travel through the cell and induce particular responses to stimuli.

This knowledge is crucial to development of new drugs because about half of all drugs used in human medicine act on the same family of receptors that Becker studies in yeast. The unique proteins have been conserved in evolution since the common ancestor of humans and yeast. Allergy, pain, heart, and ulcer medications, as well as others, interact with these very same receptors in humans.

Because of the critical applications of Becker's work to human medicine, his research receives long-standing funding from the National Institute of Health (NIH). He is currently in the 35th straight year of NIH funding.



"My favorite thing about working in [Dr. Becker's] lab is the chance to discover something new. When you figure something out…and realize that you are the first to know it, that you are privy to one of the secrets of the natural world, it's an incredible feeling."

-Madelyn Crawford, Undergraduate Class of 2013

Dr. Becker grinning through the Microbiology Undergraduate Club's "Slime a Microbiologist" fundraiser at Relay for Life

In fact, Becker's lab at UT was the first to successfully clone the peptide transport system found in nearly every living organism. This system moves peptides and amino acids, the building blocks of proteins, throughout the cell. The system is active in every aspect of a cell's life cycle: from growth, to metabolism, to nutrient cycling, to reproduction, to death, and everything in between. His lab is also at the forefront of research on ligand molecules. This is a family of compounds that bond to receptor proteins on the outside of a cell and initiate various cellular responses, such as the transport of substances into the cell and along the peptide transport chain. Many types of drugs work by using very selective ligands to bond to specific receptors, in order to produce desired effects in human body cells.

Becker is quick to point out that his work would not be possible without the collaborative efforts of faculty, undergraduates, graduates, and post-doctorates at UT. He also works in close cooperation with Dr. Fred Naider of The City University of New York. Becker acknowledges that no one can possibly have expertise in everything, so collaboration is key to success.

Becker and the rest of the faculty plan to foster and grow more of this collaborative environment in the future. Becker believes the department has plenty of untapped potential that could be realized by adding more faculty members to the team. He is seeking new hires specializing in pathogenesis, immunology, and virology in order to more fully round out the already diverse arsenal of talent in the department. He also wants to continue attracting fantastic undergraduate and graduate students to degree programs and research, and wants elevated undergraduate participation in microbiology labs. His outlook, shared by the rest of the faculty, is one of optimism. A new building dedicated specifically to *Microbiology* and *Biochemistry & Cellular and Molecular Biology* is scheduled to be built on campus in the next five years. With the addition of this building, talented personnel, and fresh students on the horizon, Becker's third term as department head is sure to generate even further success for the Microbiology Department.

Jesse Weber

Department Hosts UT's First Microbiology REU

At the beginning of June, a distinguished collection of ten undergraduate students traveled from universities across the country to gather on the University of Tennessee campus. These were the participants of UT's inaugural Microbiology Research Experiences for Undergraduates (REU). This is a nation-wide endeavor funded by the *National Science Foundation* (NSF) to establish research programs at certain host institutions for students seeking a Bachelor's degree. During the REU, students work with a faculty mentor and a graduate student "big sibling" to complete a research project specially tailored to their interests and abilities. NSF funds well over one hundred REUs in all disciplines of science, but only 21 nationwide involve projects specific to microbiology. UT Knoxville also hosts at least two other NSF REU sites, one in *Biochemistry & Cellular and Molecular Biology* and one in *Materials Science & Engineering*.

The Summer 2013 UT Microbiology REU students in Neyland Stadium. From left: Andrew Garrone (Truman State University, Missouri), Matthew Tuttle (University of Massachusetts Amherst), Emily McCully (Flagler College, Florida), Jessica Stevens (University of Texas at Arlington), Tanya Dilan-Perez (University of Puerto Rico at Mayaguez), Kristie Goughenour (Ohio Wesleyan University), Luis Rodriguez-Carire (University of Puerto Rico Cayey), Nicole Perry (Wittenberg University, Ohio), Mariya Campbell (Georgia State University), and Fransisco Lopez (Rochester Institute of Technology, New York)

Last year, Microbiology Department faculty members Dr. Steven Wilhelm and Dr. Erik Zinser proposed and were awarded a summer REU grant. The first program this year received 165 applicants for only ten positions, so faculty in the department took on the task of selecting the most talented and qualified students from a diverse array of backgrounds and disciplines, but with a common interest for microbiology research. According to Dr. Gary LeCleir, coordinator of this year's REU, the selection process was daunting because so many highly qualified students applied, far more than could be accommodated in the program. The final selection included students from seven different states as well as two from Puerto Rico, with a range of majors including Microbiology, Environmental Science, Biotechnology, and others.

The department aims to promote the diverse, interdisciplinary aspects of microbiology research. Available REU topics for students relate to pathology, microbial ecology, oceanography, genetics, bioengineering, bioinformatics, and more. Faculty mentors are not only from the Microbiology Department, but also *Ecology & Evolutionary Biology*, *Civil & Environmental Engineering*, *Biosystems Engineering & Soil Science*, *Earth & Planetary Sciences*, along with collaborators from *Oak Ridge National Lab*.

REU student Kristie Goughenour is attending her second REU, but the first one specific to microbiology. Although she was accepted into a microbiology REU at a different university this summer, she was impressed by the diversity of research topics available at UT's and felt them to be a better suit for her interests. At the REU, she is researching biofilms in drinking water systems under Dr. Qiang He, Assistant Professor of *Civil & Environmental Engineering*.

Matthew Tuttle, from the University of Massachusetts Amherst, says UT was his top choice out of the REUs he applied for because he wanted to focus on environmental science and microbial ecology, for which he thought UT offered the best opportunities. His project is studying Antarctic subglacial ecosystems under Dr. Jill Mikucki, Assistant Professor of Microbiology.

Applicants were considered based on their academic history, personal statement, and letters of reference. LeCleir and the rest of the 5-member admissions committee sought students showing potential for quality research and with interest in a science career, but also focused on students from universities without much opportunity for faculty-led student research in the field of microbiology. This is in fact the main goal of the NSF grant: to introduce top-tier scientific research to undergraduates who might not otherwise have such an opportunity.

The funding covers costs of the research programs, housing on campus, travel to Knoxville, and a living stipend for all the students in the REU, at no extra cost to UT. The grant is awarded for three years with potential for further renewal thereafter. This year's program is the first of three, and hopefully many more, microbiology REUs to come at UT.

In addition to working closely with faculty and graduate students, REU participants attend weekly seminars on topics relevant to scientific research and careers. These are led by scientists from both UT and *Oak Ridge National Lab* and include themes such as ethics in science, designing a project, making and presenting a poster, graduate school and career opportunities, and much more.

'NSF REU' - continued on page 8

Taking the "Fun" Away from Pathogenic Fungi

Todd Reynolds' Collaborative Effort Toward a Medical Breakthrough

Dr. Todd Reynolds working in his lab at UT

Every year, well over one billion people worldwide suffer from some sort of fungal infection. Most of these are relatively localized on the body and easily treatable, like athlete's foot and ringworm. However, serious invasive fungal infections can be debilitating and even lethal. Even as medical technology advances, invasive types of fungal infections have become a worsening problem in the last half-century.

Technology has improved at keeping immune-compromised patients alive, but these people are more susceptible to infections by fungi and other microbes. Healthy bodies are typically not at great risk because a normal immune system can keep most fungi in check. However, as healthcare facilities are able to support a growing number of immune-compromised patients, serious fungal infections are becoming more common. A fungus that begins as an infection of mucous layers, other soft tissue, or implanted medical devices may enter the blood stream and become systemic, taking over the deep organs. This type of infection causes a 20-40% mortality rate in the United States.

Adding to the problem is the small number of effective antifungal drugs. There are currently three major classes of antifungals that are commonly used to treat systemic infections, but they are not effective for all patients because of varying levels of toxicity and resistance in the body, based on the individual person being treated.

Dr. Todd Reynolds, Associate Professor of Microbiology, is working to solve this problem. He and collaborator Dr. Richard Lee, medicinal chemist at St. Jude Children's Research Hospital, have secured a *National Institute of Health* (NIH) grant to discover pre-therapeutic compounds for treating human fungal infections. These compounds are not drugs in themselves, but prototypes that may eventually be used to create new drugs. Reynolds hopes to find a compound that will damage fungal cells, but not harm human cells in any way. This compound, once discovered, could become the key ingredient in a future antibiotic.

The difficulty in treating fungal infections comes from the fact that human and fungal cells share many of the same components in their construction, so an antibiotic compound must be extremely specific to the biochemistry of fungal cells. Reynolds believes a key to this specificity has been found, and he plans to figure out how to exploit it.

The cell membranes of both fungal and human cells contain a particular phospholipid, an important fatty molecule, that is crucial to healthy functioning of the cell. This phospholipid is called phosphatidylserine (PS). Although both human and fungal cells need this lipid, the difference is that the protein used to synthesize PS molecules is different in fungal cells than in human cells. If the researchers can find a compound that inhibits this particular fungal cell protein, it could be used safely inside a human body to kill fungi.

Reynolds and Lee are focusing their tests on the fungus *Candida albicans*, because it is one of the most common causes of human fungal infections. *C. albicans* is the usual culprit of female yeast infections, and it can cause thrush and systemic bloodstream infections in immune-compromised patients such as those with HIV/AIDS or immunosuppression from chemotherapy or organ transplants, respectively. *C. albicans* is actually naturally present in most human bodies, where it resides harmlessly on mucous membranes, but an unhealthy immune system can allow the fungus to grow out of control and become infectious. The fungus can spread through the bloodstream if surgically implanted medical devices like intravascular catheters become contaminated before or after insertion into a patient.

The first step of Reynolds' research was to show that *C. albicans* is not infectious when the protein that makes PS is missing from the cell. Primary tests involved destroying the gene for this protein in a sample of *C. albicans*, growing some of the mutant cells in laboratory cultures and injecting some into mice. As it turns out, the fungus could survive without PS in cultures, but could not grow at all in the animal host, indicating that the PS synthesis enzyme is indeed a promising target for drug discovery.

The next step is to find a compound that will inhibit this protein, so that normal *C. albicans* cells will lose PS in their cell membranes, thereafter behaving like mutants with PS removed, and stopping infection. To discover such a compound, a strategy was developed that takes advantage of a particular compound called papuamide A (papA), that normally kills *C. albicans*. When the fungal cells are exposed to papA, the compound binds to PS molecules on the cell membrane and forms pores in the cells. This kills normal *C. albicans*, but mutants without PS or cells with PS synthesis chemically inhibited will not be killed because they have no PS for papA to bind to. Therefore, if a sample of *C. albicans* survives treatment with papA, this indicates that it may not have PS in its cell membrane and therefore cannot remain infectious. PapA itself is not practical as a drug because it will bind to PS on human cell membranes as well, but it is useful in a laboratory setting to determine the potency of treatments targeting PS in the fungus.

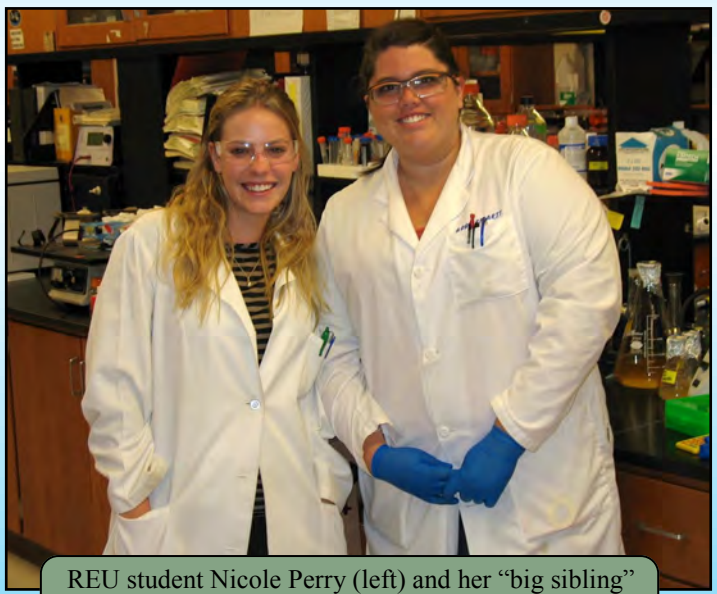
'Pathogenic Fungi' - continued on page 8

'NSF REU' - continued from page 6

Another focus of the program is to ensure comfortable and enjoyable accommodation for the summer. Students relocate to Knoxville for the duration of the ten weeks, so the department wants them to make the most of their stay. Several social events including cookouts, dinners on the town, and sports games allow for some friendly fun outside of the laboratory, and weekend outings like city tours, hiking trips, or whitewater rafting let them experience the best East Tennessee has to offer.

The Microbiology Department's summer REU is really only one highlight of undergraduate research happening in the department. Undergraduates have access to research alongside faculty and graduate students at any time while studying at UT. Current undergraduate research projects at UT focus on computational biology, algal blooms, virology, and microbial ecology—just to name a few. While the department has development funds from alumni to support a number of undergraduates during the summer, other students find support from the UT Office of Research. This year, three UT undergraduate students were awarded Office of Research summer fellowships to perform research in departmental labs. LeCleir says, "Students here [at the University of Tennessee] have great opportunities to work closely with well-respected scientists. I feel like the faculty is really accessible to undergrads, as well as top-of-the-line, cutting-edge research equipment."

The Microbiology Department hopes to build on the success of this year's REU to attract even more students in the future, along with supplementary funding to expand the program. This should go along with enhanced funding and opportunities for UT undergraduates to continue the work currently underway in UT's labs, and ideally increase the number of UT students involved in research, presentations, and publications generated at the university.



REU student Nicole Perry (left) and her "big sibling" Abby Smartt pausing for a pose in the lab of Dr. Steve Ripp (*Center for Environmental Biotechnology*)

Jesse Weber

'Pathogenic Fungi' - continued from page 7

In initial tests, Reynolds and Lee treated *C. albicans* with 5,000 known compounds to see if any treated samples would survive exposure to papA. Out of these, only one compound showed signs of being an inhibitor. This proved that the pair of researchers were on to something, and helped convince the NIH to award them a grant for further research.

Candida albicans under a microscope

They began work on the next phases of the project in February of this year. The plan is to screen 500,000 more compounds for the ability to inhibit PS synthesis in *C. albicans*. Assuming a similar success rate to the previous screen, the researchers would find about 100 possible inhibitors that could all be studied further to determine their usefulness as antibiotics.

The initial screens are being conducted at St. Jude Children's Research Hospital. Their facilities in Memphis, TN are equipped with robotic platforms that can perform screenings of several hundred thousand compounds at a microfluidic level. Using multi-well plates with over 300 individual wells, each containing a culture of *C. albicans*, a fully automated process introduces the various compounds into fungal cultures via an array of pins driven by a robot. Once the compounds have had sufficient time to react with the cells, papA is also introduced to the cultures using robotics. The robot is capable of electronically scanning the wells to determine whether or not *C. albicans* have survived the treatment, and thereby determine which of the various compounds are successful at causing resistance to papA (suggesting they are inhibiting the synthesis of PS).

Once potentially useful compounds are identified, secondary screenings will take place in UT's laboratories to determine exactly how the inhibiting mechanisms work. Tests will also be conducted to find any undesirable qualities of the compounds, such as toxicity to cultured human tissue cells or an invertebrate animal model (wax moth larvae). This entire process is scheduled to take three years.

Reynolds is optimistic about the project's chances of producing useful information. He says, "We think this has potential to reveal a lead compound for a new antifungal, or research tool, or both. A very strong potential." He and Lee have already found one compound that might work, and many more are likely to turn up. Even if all PS-inhibiting compounds eventually prove to be toxic or impractical for use in an antibiotic drug, they will surely be useful in other research about how fungi interact with their host environments.

Jesse Weber

The University of Tennessee Department of Microbiology

2012 - 2013 Awards

Departmental Awards

Jordon Howe and **Brook Watson** both received the *D. Frank Holtman Microbiology Undergraduate Academic Achievement Award*.

Jeffrey Rymer and **Chad Effler** were both awarded the *Lisa Kahn Undergraduate Research Award*.

Rachel Webb, Micaha Hanson, and **Abby Smartt** all received the *MUC Leadership Award* for outstanding contribution the Microbiology Undergraduate Club.

Nathan Cude and **Chris Gulvik** Were both presented with the *Excellence in Graduate Research Award*.

Sarah Davis and **Ashley Frank** were both awarded the *Graduate Teaching Award*.

Shafer Belisle, Michelle Chua, Pranay Dogra, Caroline Grunenwald, Elizabeth Johnson, Mohammad Moniruzzaman, Holly Saito, Morgan Steffen, and **Jia Wen** all received *David White Travel Awards* to continue research abroad.

Vitaly Ganusov received the *Undergraduate Faculty Teaching Award*.

Corenthia Starks received the *Staff Award.*

Non-Departmental Awards

Kristen Vaughn, Jessica Velez, and **Anna Victor** all received *UT Office of Research Undergraduate Awards* for summer research.

Brandon Merical and **Hannah Cox** were both presented with Microbiology Department Gift Fund Awards for summer research.

Elizabeth Padilla received a *Science-Policy Congressional Fellowship* to spend nine months working in Washington, D.C.

Madelyn Crawford was awarded both the *Chancellor's Honors 2013 Top Collegiate Scholar* honor and a NSF Pre-Doctoral Fellowship for graduate studies.

Jeffrey Rymer, Jasmine Vazin, and **Austen Webber** were all winners at the 2013 EUReCA competition for undergraduate research.

The Microbiology Undergraduate Club won the *Top Small Fundraising Team Award* during the *American Cancer Society's* Relay for Life at UT.

Elizabeth Padilla-Crespo received the *Cokkinias Graduate Fellowship*.

Abby Smartt received the *Alexander Hollaender Graduate Fellowship*.

Sarah Davis was awarded the NIH *Ruth L. Kirschstein National Research Service Award* pre-doctoral fellowship.

Melanie Eldridge was awarded a *Fulbright Foreign Scholarship* to conduct research in Brazil and has also accepted a faculty position at UT.

Gary Sayler was named a fellow of the American Association for the Advancement of Science (AAAS) for distinguished research.

Gary Sayler, Jill Mikucki and **Karen Lloyd** were each named *Quest Scholars of the Week* during 2013.

Teresa Compton, President of Microbiology Department Board of Visitors, received *The University of Tennessee Alumni Professional Achievement Award*.

The University of Tennessee Department of Microbiology

Faculty and Staff

Faculty

Jeffrey M. Becker
Chancellor's Professor

Alison Buchan
Associate Professor

Elizabeth Fozo
Assistant Professor

Vitaly V. Ganusov
Assistant Professor

Terry Hazen
Professor and Governor's Chair

Igor B. Jouline
Joint Faculty Professor

Karen Lloyd
Assistant Professor

Frank Loeffler
Professor and Governor's Chair

Jill Mikucki
Assistant Professor

Todd Reynolds
Associate Professor

Gary S. Sayler
Beaman Distinguished Professor of Microbiology

Nathan W. Schmidt
Assistant Professor

Pamela L.C. Small
Professor Emeritus

Tim E. Sparer
Associate Professor

Chunlei Su
Associate Professor

Steven W. Wilhelm
Professor

Erik Zinser
Associate Professor

Staff

Rachelle Allen
Administrative Coordinator

Sarah Kim
Administrative Support Assistant

Elizabeth McPherson
Senior Lecturer

Brietta Lusby
Administrative Support Assistant

Bethany Miracle
Academic Support Specialist

'Associate Heads' - continued from page 1

We also continue to provide top educational opportunities for our students, both graduate and undergraduate. We have an ongoing effort to refine our undergraduate courses to introduce active-learning based approaches that better engage students in the learning process and result in deeper understanding of science content and theories. This past year also saw the start of the Department's *Research Experience for Undergraduates* program funded by the *National Science Foundation (*check out page 6): the program has brought 10 top undergraduate students from numerous US states and Puerto Rico to Knoxville this summer to work in the labs of departmental faculty. Finally, while our departmental undergraduate club continues to expose students to various careers and practical aspects of microbiology, it also engages participating students in community events, including fundraising. In fact, the club raised $350 during the first annual "Slime a Microbiologist" fundraiser for Relay for Life. A big thanks to Drs. Becker, Golden, Fozo and Reynolds for sitting as targets during this well-attended and messy event!

Indeed, there are sometimes too many great stories to tell in these few pages: congratulations to alumnus Dr Melanie Eldridge on her Fulbright award and to current students Sarah Davis for her *Ruth L. Kirschstein National Research Service Award* pre-doctoral fellowship from the NIH, Elizabeth Padilla for her *Science-Policy Congressional Fellowship* and undergraduate Madelyn Crawford on her *NSF Graduate Research Fellowship*. Check out page 9 for a full list of our successes!

It has been said that the best way to predict the future is to create it – between discovery and innovation, the faculty, staff and students of our department continue on this path and we want to take this opportunity to thank our colleagues, current students and especially our alumni for their ongoing and wonderful support. We also want to thank Professor Becker for his leadership in this effort (and ok, we are done with this big chair now, it is all yours!!!).

We Want to Hear from You!

Your full name: _____

Address: _____

Graduation year(s): _____

Degree(s): _____

Place of employment: _____

Job title and description: _____

_____

_____

How did your time at UT prepare you for this position?_____

_____

_____

You may also send your comments to microbiology @utk.edu. Please include "The MicroScope 2013-2012" in the subject line.

Gift Contribution Slip

Name _____ Year of Graduation_____
Address _____
City _____ State _____ Zip _____

Signature_____
Credit Card # _____ Expiration Date_____

o Visa o MasterCard o Other _____

Return your tax deductible contribution to:
The University of Tennessee Department of Microbiology
M409 Walters Life Sciences
Knoxville, Tennessee 37996-0845

Enclosed is my contribution of:
o $25
o $50
o $50
o $100
o Other $ _____

My gift is designated for:
o Scholarships (include fund)
o New Equipment
o Department General Fund
o Other _____

You may visit the Office of Alumni Affairs and Development online at: http://volsconnect.com/

All information is confidential. You can also contact us at (865) 974-3441.

THE UNIVERSITY of TENNESSEE

Department of Microbiology
M409 Walters Life Sciences
Knoxville, Tennessee
37996-0845

The MicroScope