AUBURN UNIVERSITY

SPECTRUM

2007

A Spectrum of Research in the Departments of:

- Biological Sciences
- Chemistry and Biochemistry
- Geology and Geography
- Mathematics and Statistics
- Physics

COSAM's Ellis Recipient of NSF CAREER Award

on the COVER

This is a three-dimensional structure of the alkanesulfonate monooxygenase enzyme from E. coli involved in carbon-sulfur bond cleavage. This protein is part of Holly Ellis' NSF CAREER Award-winning proposal entitled "Mechanistic Studies of the Alkanesulfonate Monooxygenase System." Ellis is an assistant professor in the department of chemistry and biochemistry.

Associate Dean For Research

Marie Wooten

Discovery, Innovation and Experimentation in 2007

Spectrum provides an insight into diverse areas of research conducted by faculty in the College of Sciences and Mathematics. It is the creative spirit and innovation inspired by research that, for many, fuels a lifetime in academics. From enzyme structure function, to the search for the mechanisms that enable bacteria to colonize lungs, to the geological landscape of the Far East, to real world problems expressed with mathematical formulas, or development of nanomaterials, you will find COSAM faculty bringing discoveries to the forefront of their respective disciplines. In step with our internationally-recognized senior researchers, our success in attracting new faculty has continued to broaden the research and teaching background available to students within our college. In this issue, we highlight the profiles of the newest members of our faculty: Orlando Acevedo, Kevin Fielman, Victoria Jordan, Stuart Loch, J.V. Ortiz, Hyejin Shin, and Wei Zhan.

In tandem with COSAM's mission to provide excellence in teaching and research, is our commitment to outreach. One example of this effort is the relationship between our faculty and K-12 educators. These groups work together in various programs throughout the college to provide professional development and student services. With these, as with any cooperative endeavor, a prime element is the availability of resources. To assist in providing these resources, our office strives for scholarship in the grant writing arena.

Throughout academics, undergraduates are the fuel to the research pipeline. To highlight these contributions and their research accomplishments, this issue contains profiles for our Dean's Undergraduate Research Fellow awardees. In addition, two faculty in the college were recipients of prestigious awards for research or teaching. We recognize these individuals as well as the faculty recipient of the prestigious National Science Foundation Early Career advancement award.

We have strengthened our commitment to diversity by establishing a chapter for the Association for Women in Sciences & Mathematics (AWIS), along with a philanthropic group to support our women's programs, the Society of Women in Sciences and Mathematics (SWSM). In addition, I have served as founding member for the Institute for Women in Sciences & Engineering (WISE) to promote career development for our students and faculty. Altogether, the college has shown a strong commitment to these programs.

This issue of *Spectrum* captures the commitment and excitement that students and faculty have toward discovery, innovation and experimentation. It is this philosophy that is shared by both students and faculty in the College of Sciences and Mathematics.

COSAM's Ellis Recipient of NSF CAREER Award

- Carol Nelson

Holly R. Ellis, an assistant professor in the department of chemistry and biochemistry, was recently given an award through the Faculty Early Career Development (CAREER) Program of the National Science Foundation. The award is in the amount of $844,784 for five years.

According to the NSF, the CAREER program is a foundation-wide activity which offers awards in support of the early career-development activities of those teacher-scholars who most effectively integrate research and education within the context of the mission of their organization.

"We are interested in understanding how enzymes function," Ellis said. "Their primary role is to maintain metabolic pro-cesses in the cell. Our projects focus on sulfur metabolism in the cell."

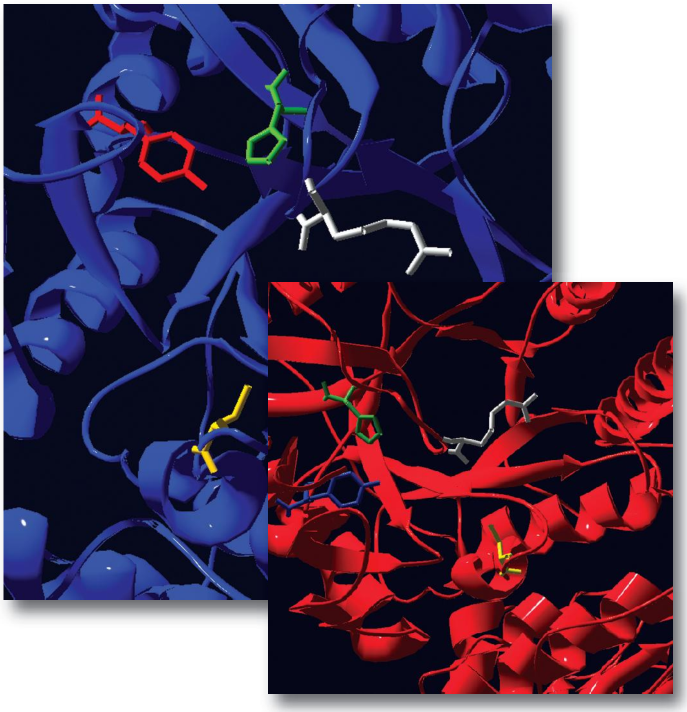
"For this proposal, we are focused on a two-enzyme system found in bacteria. Basically, we are studying the mechanism of sulfur acquisition by these two enzymes. It is interesting because the two act together to carry out a single reaction; when normally, only one enzyme is required to catalyze a single reaction. Our goal is to understand the mechanism of this system in order to apply it to other two-enzyme systems. Relating the results obtained from these studies will enhance our knowledge of a family of enzymes with highly diverse functions. We hope to eventually develop this system to use for biodegradation," Ellis said.

"Dr. Ellis' investigations are clearly seen by the scholarly community as contemporary, imaginative, exemplary and sound. We are proud of her and look forward to following her successes."

- Dr. Stewart Schneller, COSAM Dean

The project also has an educational component. The objective is to enhance COSAM's outreach program, Science in Motion, by introducing biochemical experiments to the existing curriculum. The Auburn Science in Motion program was established by the Alabama State Legislature to bring technologically advanced laboratory experiments to local high school classrooms to increase student interest in science through experimental development, graduate student outreach and direct training to high school educators.

"An NSF CAREER Award is one of the most prestigious recognitions an investigator can receive," COSAM Dean Stewart Schneller said. "Dr. Ellis' investigations are clearly seen by the scholarly community as contemporary, imaginative, exemplary and sound. We are proud of her and look forward to following her successes."



Left: 3-D structure of alkanesulfonate monooxygenase enzyme from *E. coli* involved in carbon-sulfur bond cleavage.

How to Save a Life

- Carol Nelson

Did you know that the average life span of a cystic fibrosis patient in the United States is approximately 32 years? Laura Silo-Suh of the department of biological sciences is all too aware of this fact, and is working to change it.

Her research deals with host microbe interactions, particularly, the bacterial pathogen *Pseudomonas aeruginosa* in conjunction with its ability to infect cystic fibrosis patients. *P. aeruginosa* is ubiquitous in the environment, responding to a number of different kinds of stresses. Sometimes it colonizes the human body, and in this particular case, causes the respiratory disease that eventually proves to be the cause of death of most cystic fibrosis patients. The infection is normally contracted early in life, before the age of three, and is carried in the lungs of the patients for the rest of their lives.

P. aeruginosa is highly resistant to antibiotics, and this particular infection does something different than other infections, which allows it to stay in the lungs for a long period of time. “We are trying to find out what is different about this infection, as opposed to a wound infection or a kidney infection or an eye infection,” Silo-Suh explained. “Those are sometimes resistant to antimicrobials, but most of the time can be treated. Cystic fibrosis patients get *P. aeruginosa* in their lungs and cannot get rid of it.”

Over time, the bacteria changes, or gets mutations. “The mutations might not be thought to be advantageous, but they turn out to be very advantageous. They change how the bacteria are living and adapt to the cystic fibrosis lung. Once removed from that environment, the isolates become less competitive in other environments. They’ve totally changed the way they live to really take advantage of the cystic fibrosis lung environment,” she said. “That’s what I am really interested in – what are the changes at the genetic level and how do they affect bacterial behavior and allow them to adapt to this environment?”

“I think there’s hope there, but their lives are short and their quality of life is not good. That’s what we want to change.”

Silo-Suh’s laboratory is looking at the mechanisms that promote alterations in *P. aeruginosa*, the nature of the alterations at the molecular level, and the effect these alterations have on the physiology and behavior of the bacteria. The fact that they are unstable after being removed from the lung environment shows that the isolates are sensitive, and that there are weaknesses present that could be exploited if researchers like Silo-Suh are able to find out what they are. If she and her research team are able to pinpoint certain weaknesses, then therapies could be developed to treat the infection. She does note that a broad range antibiotic, which would have the potential to treat numerous infections, will not work. In the case of the chronic infecting *P. aeruginosa* bacteria, the treatment would have to be tailor-made to specifically treat those isolates.

Silo-Suh is hopeful. There is some suggestion that with the way therapies are going now, a child born today with cystic fibrosis could survive to 40-50 years of age if improvements continue in the direction they are currently going. “I think there’s hope there, but their lives are short and their quality of life is not good. That’s what we want to change.”

Alfalfa seedlings without *Pseudomonas aeruginosa*.

Infection of alfalfa seedlings with *Pseudomonas aeruginosa*. Photos courtesy of Silo-Suh.

One Chemist's Dream Come True

- Carol Nelson

It was once said by French chemist and physicist, Joseph Louis Gay-Lussac, that We are perhaps not far removed from the time when we shall be able to submit the bulk of chemical phenomena to calculation. Michael McKee of the department of chemistry and biochemistry is doing his part to prove this statement true.

McKee's research interests focus on the application of computational methods to current chemical problems. State-of-the-art methods coupled with large parallel computers allow calculations to lead rather than follow experiments, he said. We specialize in computing reaction mechanisms of inorganic systems.

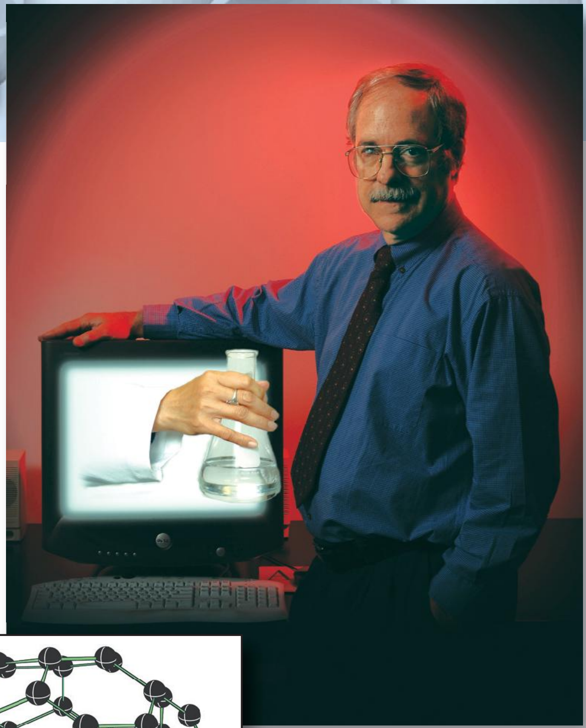
His work involves the application of high-speed computers to solve chemistry problems through the application of quantum mechanism. My group is primarily involved with understanding reaction mechanisms, he explained, whether it involves understanding how an enzyme converts nitrogen and hydrogen into ammonia, or how pollutants affect the atmosphere.

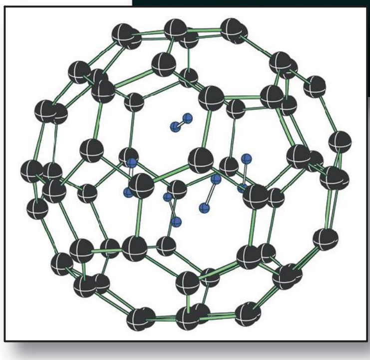
While most people think of chemistry as only experimental, McKee and other researchers like him are working to prove that there are other ways of solving problems and answering questions through a means of creating mathematical models to predict the same properties that can be measured in the laboratory.

McKee has worked with Phillip Shevlin, emeritus professor of chemistry at Auburn University, for over twenty years. His research involved the reaction of carbon atoms with various organic compounds to form very exotic molecules, he explained. Unfortunately, these compounds are much too reactive to be isolated in the laboratory, but their existence can be inferred by their reactions. Thus, only secondary products can be identified.

This is where McKee comes in. Theory can calculate the properties of the initially formed molecule and the ratio of the secondary products.   Since the calculations consider only one molecule at absolute zero, the molecule can be frozen.' With the calculated barriers to secondary products, we can compare predictions and observations.   McKee said that this particular theoretical/experimental partnership has led to twenty-four publications, and he considers it his most productive work.

I believe that computational chemistry is an extension of our means of exploring our world, he said. Right now, there are many experimental' methods that are really a hybrid experimental/theoretical method. The result of the measurement requires the input of both.





Left: Calculations can be used to study buckyball, a new form of carbon. In this study the effect of enclosing five hydrogen molecules (blue atom pairs) is considered.

McKee's work has allowed him to collaborate with researchers all over the world; thanks, in part, to the Internet. He has also had the opportunity to spend time in a number of renowned research facilities including the Naval Research Laboratory in Washington, D.C., Air Force Academy in Colorado Springs, Colorado, Sandia National Laboratory in Livermore, California and Los Alamos National Laboratory in Santa Fe, New Mexico.

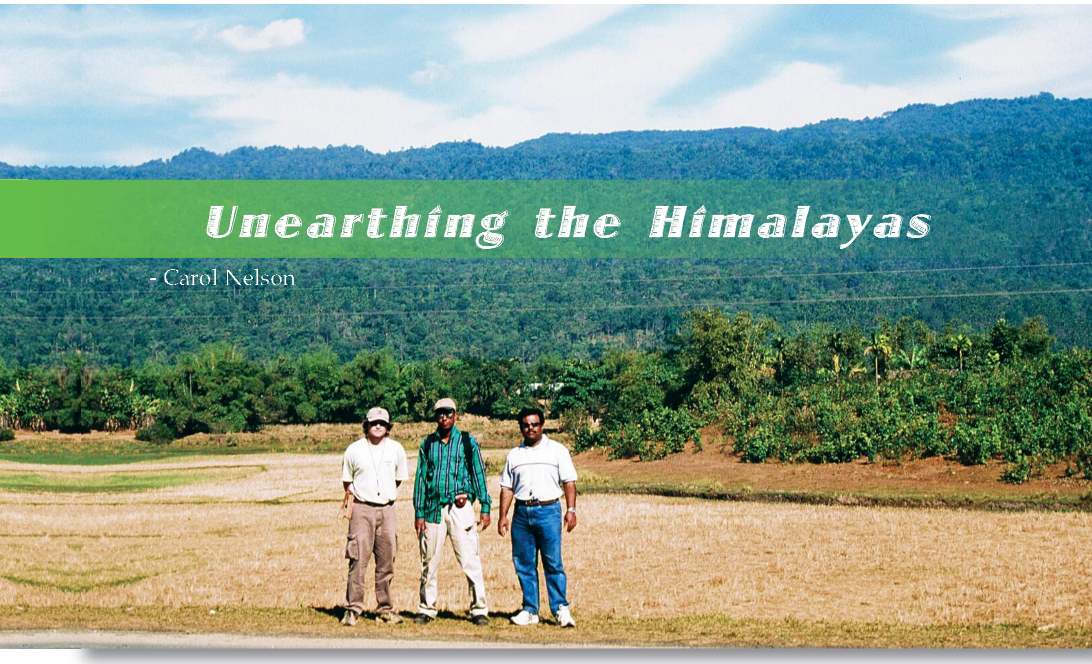
McKee says his work can make Gay-Lussac's dream come true. I like to work with experimentalists, he said. Theory and experiment work very effectively together. I take pride in my work when my results provide a deeper and more complete understanding of chemical phenomena.

"We are perhaps not far removed from the time when we shall be able to submit the bulk of chemical phenomena to calculation.

- Joseph Louis Gay-Lussac

Unearthing the Himalayas

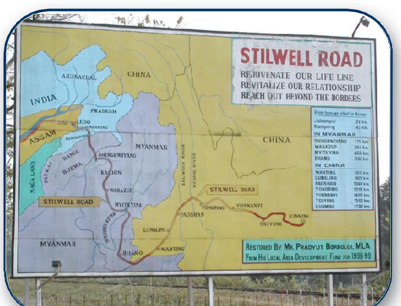
- Carol Nelson



Above: Uddin and two graduate students on a recent trip.

Imagine spending the winter working in the foothills of the Himalayas, collecting sediment samples from dried-up stream banks that drain down the mountainside. This is just how Ashraf Uddin of the department of geology and geography has been spending his winter "break" for years.

Uddin has been studying the uplift and erosion of the Himalayas and Tibetan Plateau, and the transport and deposition of the derived sediment. Previous Himalayan research has documented the composition and sediment of the west, in and near Pakistan, near the Himalayan foothills, and of sediment deposited far from the source in the Bengal Fan in the Bay of Bengal. The Bay of Bengal, in the northeast Indian Ocean, is the world's largest sediment accumulation, resulting from the history of tremendous uplift and erosive forces that have affected the Himalayas.



"Our research program focuses specifically on an area which has received very little study; that of the eastern Himalayan and Indo-Burman Mountain ranges," explained Dr. Uddin. "The geological evolution of the eastern Himalaya is not well understood and has never been the focus of intense scientific investigation. Yet, the consensus among those who have studied the region is that this evolution has affected global climate as well as the chemistry of the modern oceans," he said.

"Prior to my investigation, no other scientist had ever systematically studied the source or source constraints of the voluminous deltaic deposits of Bangladesh and Assam, India," said Uddin. Because of this, his work, funded by the U.S. National Science Foundation (NSF), represents a vital link within the world's largest sediment distribution system and is of great importance to scientists who are working to understand the erosional history of the Himalayas and the rise of the Tibetan Plateau.

There are many unanswered questions concerning the impact of the Himalayan formation on global climate and oceanic evolution. By studying the sedimentary deposits, Uddin and his team can analyze a record of the mountain building that accompanies the uplift resulting from the movement of the Indian continent over millions of years.

For example, in the sediment composition from Bangladesh, which is located at the foothills of the eastern Himalayas, Uddin and his team have found that older sediments (30-40 million years old) most likely did not come from the Himalayas. "That means that the Himalayan mountain belts did not form, or were not high enough to start eroding sediments at that time," Uddin explained. "On the other hand, scientists have found that there are areas in the western segment of the Himalayan foothills where there is strong evidence that the Himalayas already existed and uplifted to a high level to be eroded. This discrepancy in sediment composition from the western Himalayas suggested that the Himalayan mountain belt did not rise simultaneously. The western part rose earlier than the eastern segment."

Since those findings, Uddin and his team have extended their research to include the area of Assam, India, which is the easternmost part of the Himalayas. Data from 30 to 40 million-year-old sandstones suggest that the easternmost extent of the Himalayas uplifted around the same time as the western extreme. "We hypothesize that India was not involved in the collision with Asia to uplift the eastern Himalayas 30 to 40-million-years ago," Uddin explained. "Another continent, maybe Indochina, was involved in that collision. Eastern India came to the position where it is today about 25 million years ago and via a right-lateral N-S fault that is located between Bangladesh and northeast India and Myanmar."

Uddin says that these studies provide important clues to understanding the climate system and how Himalayan evolution has affected global climate patterns over time. "On a fundamental level, this research provides opportunities for scientists to more fully understand the geologic history of the earth and the climatological changes that have occurred over millions of years, and which continue to occur," he said.

Also, studying the evolutionary history of a modern mountain belt helps in understanding the history of ancient mountain belts, like the Appalachians. "Our state is located at the southern end of the Appalachian mountain belt that was once as high as, or higher than, the present-day Himalayas," Uddin added. "The model we are generating from the Himalayan region will be used in our upcoming research project on the uplift and erosional history of the southern Appalachians," he said.

Math: The Universal Language of Science

- Carol Nelson

"I want people to see and understand the applications and benefits of mathematics so they can get excited about it too."

A.J. Meir may be a professor in the department of mathematics and statistics, but don't even think about putting him in a box. He wants everyone to know that his work applies to more than just the mathematicians of the world.

"Math is the universal language of science," said Meir. "It allows us to study diverse phenomena in a unified way." He believes that the sciences –natural, life and social sciences – are becoming more and more "mathmaticized" and that along with theory and experiment, computation can definitely be considered one of the pillars of science.

"Computation complements theory and experiment, but, in a way, can overtake them as far as their importance. We can do things through computation that are too expensive or too dangerous, or maybe even impossible, to do experimentally," Meir said. "You can't exactly tinker around with the climate and check hypotheses on how climates develop, but you can test hypotheses' different parameters and various scenarios through computation," he explained. "Also, many equations cannot be solved exactly, but we can use computers to construct approximations to their solutions."

Because of the many applications of mathematics, Meir is involved in a number of research projects. He is currently working with faculty in the department of geology and geography and a graduate student in mathematics on the coupling of underground water flow and seismic activity. "The idea is that if you have an earthquake, it's going to affect the underground water flow, and you can also make it work the other way around. For example, if you pump water, you could produce tremors or little earthquakes. We are trying to model that."

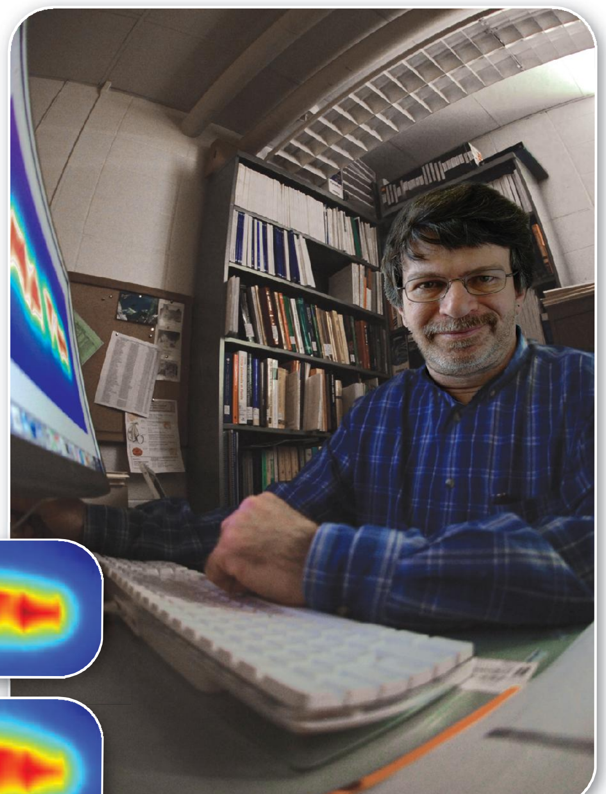
Meir said he recently worked with the chemistry and biochemistry department on mathematical modeling of ion sensors. "We developed a mathematical model – a set of equations – and were able to run computations," he explained. "Based on our simulations, we were better able to understand the sensors and to tune the various parameters of the sensors to optimize their performance and response."

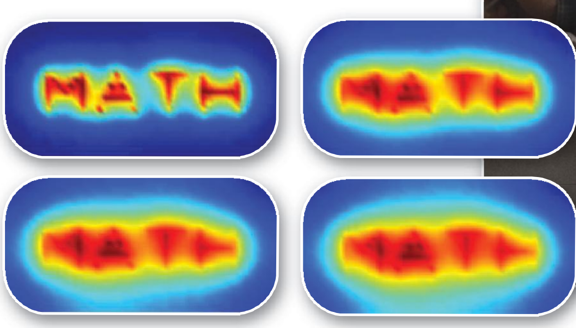
Perhaps his biggest project is his work on Magnetohydro-dynamics (MHD). "This is the theory of the macroscopic interaction of electrically conducting fluids with a magnetic field," Meir said. "It is of importance in connection with many engineering problems; in particular, metallurgy, electro-magnetic casting and aluminum production, plasma confinement and liquid-metal cooling of nuclear reactors. It also finds applications in geophysics and astronomy."

Meir and his team have devised a new formulation of MHD equations and were able to answer some questions pertaining to the equivalence of this new formulation to the standard one. "The main reason for considering and devising this new formulation is its advantages for numerical simulations of MHD flows. I have implemented a finite element computer program which uses this new formulation and approximates solutions of the MHD equations," Meir explained. "I am working on a parallelizable version of the code and developing new algorithms for MHD flow simulation. These codes will be used on supercomputer-class computers to simulate phenomena of interest to scientists and engineers."

Meir's work is never done; as a matter of fact, this is only a small sampling of how his mathematics reaches the rest of the world. He continues to be involved in numerous inter-disciplinary research projects, working with chemists, physicists, engineers, computer scientists, and just about anyone else you can imagine.

"My work is very diverse. The problems we are looking at are motivated by problems that arise in other sciences. We try to model the problem and develop methods to do numerical simulations, which can give us more answers to our questions," Meir said. "I want people to see and understand the applications and benefits of mathematics so they can get excited about it too."

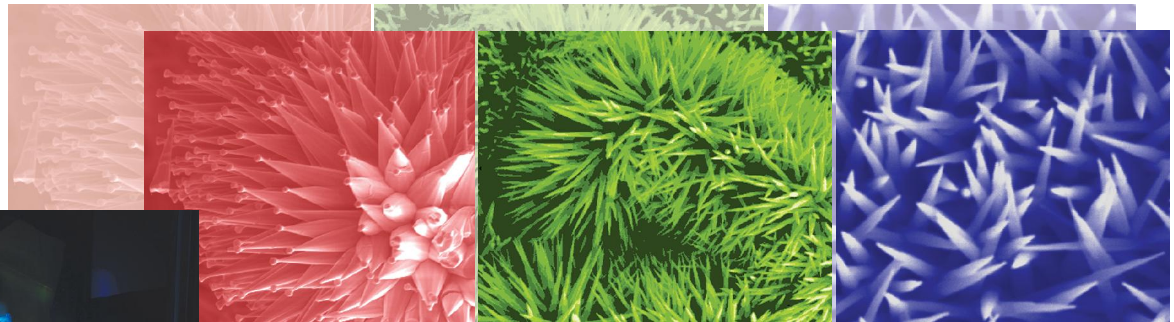




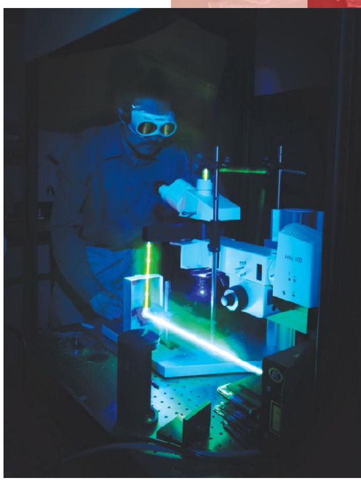
"Math Diffusion:" These describe the temperature field at four different times, if the space is heated by a heating element in the shape of the letters M, A, T, and H.

Kicking Off a Brighter Future Through Nanotechnology Research

- *Timothy Meeks & Minseo Park*



Nanoflowers, Nanoplant, Nanothorns: Electron micrographs (false color) of semiconductor nanostructures synthesized by Hee Won Seo at Auburn University Physics Department.



When researchers in the department of physics at AU's College of Sciences and Mathematics talk about taking a closer look at things, they mean it. Leaders in the field of nanotechnology research, Auburn physicists work on manipulating nanometer-scaled structures.

How small is "nano"? Consider that one nanometer (nm) is a million times smaller than a millimeter. In practical terms, in nanometer scale, you are 2 billion nanometers tall! Still hard to grasp? Then consider that if you put a single nanoparticle (a particle with a nanometer size) next to a football, the difference between the nanoparticle and the football is comparable to that between the football and the earth.

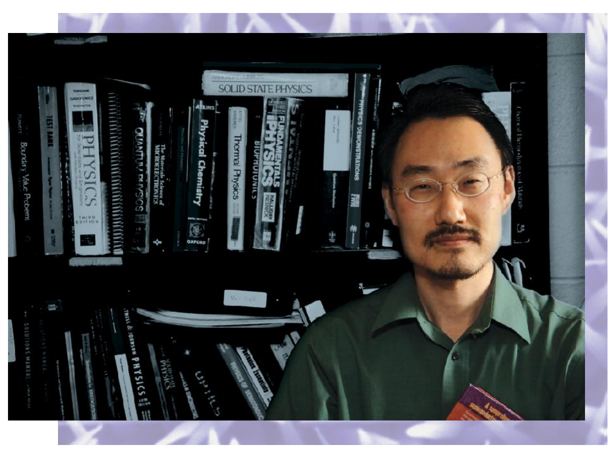
Now that you have nanovision, let's consider what impact nanotechnology and the research work at Auburn University has on you and the world around you. One of the most visible applications of nanotechnology is the miniaturization of electronic gadgets you use every day - from computers to cell phones. By exploiting properties of the nanomaterials, novel electronic devices can be fabricated surpassing the performance of their ancestors. But nanotechnology research has applications that expand beyond miniaturization and includes breakthroughs that can lead to better energy efficiency, changing the way diseases and injuries are treated and long-term sustainable development of the Earth's resources.

Under the leadership of Minseo Park, physics researchers are working on synthesis and characterization of nanostructured materials. By twisting the "recipes" of the individual particles, researchers can "cook" nanomaterials with a specific shape. What are the practical applications for these materials? For example, due to its needle-like feature, the materials labeled nanothorn (see illustration) emit electrons very efficiently. This phenomenon is called field emission and is one of the promising developments for flat-panel displays. Therefore, this material may ultimately find its application in ultrahigh definition TV through which you can watch your favorite football games with a superior picture quality, brightness and viewing angle. This research is ongoing and the challenges with each discovery provide incentive for AU researchers to continue their quest for new knowledge at each opportunity.

While nanotechnology research is in its infancy, discoveries in the laboratory are already evident in the real world. For example, take a closer look at the traffic signals in the city of Auburn. In recent years, the lamps in the traffic signals were replaced from conventional Edison-invented incandescent lamps to a more efficient, longer lasting light-emitting diode (LED) type. Scientists and engineers were well aware of the fact that the LED bulb is more energy-efficient and has a longer life than the incandescent bulb. In addition, the LED-based traffic signals are highly visible and bright even in adverse weather conditions.

Graduate students and faculty members at Auburn are working to shape the future of nanotechnology. Students and faculty in COSAM's Department of Physics are engaged in exciting research in the field of nanotechnology that will provide leadership and vision for the future of a nanotechnological society. "I have been privileged to be a part of state-of-the-art nanotechnology research here at Auburn, and I have enjoyed appreciating the beauty of nanostructured materials," said Park's former graduate student, Dake Wang, who has just become an assistant professor of physics at Furman University, South Carolina.

When you consider the field of nanotechnology, Park and other researchers are operating on an extremely small scale, but their discoveries have the potential to have a big impact. "Because of its longtime commitment to pioneering research, it is not surprising that the AU Department of Physics is trailblazing research in nanotechnology," says COSAM Dean Stewart Schneller.



Auburn University Research Park

The research park will enhance the image and reputation of Auburn University and will foster the recruitment of outstanding faculty, students and businesses, and offer them quality venues for collaboration in learning and discovery.

- Dr. Ed Richardson
Auburn University President

Proposed Site Plan

- Charles Martin, Office of Communications and Marketing

Auburn University research and technology have made impacts throughout the years on an ever-increasing global scale. New ideas from AU's best and brightest scientists will be the foundation for a new campus-based Auburn Research Park with up to 156 acres of room to expand. The park will be an invaluable tool in helping Auburn University convert innovative research into revenue producing, useable technologies in the marketplace.

The park, to be located on South College Street at the Southern entrance of campus, will be complimentary to AU's research mission and will propel AU into an even higher national and international research leadership position, creating a top academic and commercial hub in the Southeast.

Teamwork is the key ingredient to spreading AU technology and in bringing companies to Auburn as they explore AU as a potential collaborator in high-tech industries. Partnering on the project are the City of Auburn, State of Alabama, Auburn University and the Auburn Research and Technology Foundation, each of which knows the value of Auburn University scientists and their discoveries. The Auburn Research and Technology Foundation is a 501(c)(3) non-profit organization formed in 2004 to oversee development of the park.

The whole goal here is to create a knowledge-based industry. It will put Auburn University on par with other major research universities.

- Phillip Dunlap
Economic Development Director,
City of Auburn

Potential industries for the park include, among others, alternative energy, information technology, pharma-ceuticals, transportation, wireless engineering, food safety, fisheries and aquaculture, biosciences and space exploration.

The first building should be completed in late 2008 and will cover approximately 50,000 square feet over three floors. Designed to hold both large and small clients, the structure will offer the flexibility to attract firms of all sizes and with different needs. Future expansions could see up to another 10 to 12 buildings.

Providing the research foundation are AU's talented faculty, such as Vitaly Vodyanoy of the College of Veterinary Medicine and Dave Worley of the College of Sciences and Mathematics. A high-resolution microscope developed by Vodyanoy led to his being named AU's 2005 Creative Research Award winner. The microscopes are currently being made available to laboratories around the world.

Research by Worley, the 2006 Creative Research Award recipient, is leading to safer drinking water in India through advanced water filters. HaloSource, Inc. is commercializing the product through an agreement with AU, and it plans future product introductions in other countries.

Individuals or entities who are interested in locating their technology or businesses in the park should contact Dr. Ralph Zee, Acting Associate Provost & Vice President of Research for Auburn University at 334-844-2301 or, via the internet, at zeeralp@auburn.edu.

Site Selection magazine, a national trade publication, ranked Auburn/Opelika Metropolitan Statistical Area the top economic development area among metro areas with populations under 200,000 people.

Dean's Research Award Recipients

The mission of Auburn University places the departments that compose the College of Sciences and Mathematics at the focal point of the university's long-term success and its future ambitions. The departments in COSAM pride themselves in the high quality of research conducted by faculty and graduate students. To recognize these accomplishments, the Dean's Research Award is presented annually to one faculty member, three graduate students, and one undergraduate student. The recipients are determined from nominations in each of the following areas: biological, mathematical, and physical sciences. We commend this year's recipients and offer thanks to our alumni and friends whose annual fund gifts have provided the resources for the awards.

Peter D. Johnson, Jr.
Faculty Recipient
Department:
Mathematics & Statistics

Asuman Turkmen
Graduate Student Recipient
Department:
Mathematics & Statistics

M. Shamsudduha
Graduate Student Recipient
Department:
Geology & Geography

Dake Wang
Graduate Student Recipient
Department:
Physics

Alex Tucker
Undergraduate Recipient
Department:
Biological Sciences

Undergraduate Research Fellowship Recipients

Thomas Brandon Key
Major: Geology
Mentor:
Mark Steltenpohl

Kelly E. Moreland
Major: Molecular Biology
Mentors: Marie Wooten
& Doug Martin

Vedran K. Oruc
Major: Biomedical Sciences
Mentor:
Smita Mohanty

Chad A. Smith
Major: Zoology, Conservation & Biodiversity
Mentor: Ken Halanych

Jason D. Stewart
Major: Physics & Mathematics
Mentor: Allen Landers

Alex C. Tucker
Major: Microbiology
Mentor:
Sang-Jin Suh

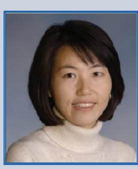
New Faculty in COSAM

Orlando Acevedo
Department: *Chemistry & Biochemistry*
Research: *Application and development of new computational tools that target organic and enzymatic catalyst design, alternative environmentally-friendly solvent design, and drug discovery.*

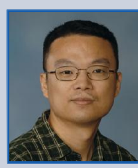
Kevin Fielman
Department: *Biological Sciences*
Research: *Interaction of organisms with environment at the gene and protein level; from gene expression mechanisms to how species ultimately respond to changes in environment at the ecosystem level.*

Stuart Loch
Department: *Physics*
Research: *Calculation of atomic data and its use to analyze the spectra from laboratory and astrophysical plasmas; relevant to magnetically confined fusion experiments used to investigate the fusion energy as a potential power source.*

J.V. Ortiz
Chair
Department: *Chemistry & Biochemistry*
Research: *Developing computational methods that clarify the electronic structure of molecules of biological and technological importance.*



Hyejin Shin
Department: *Mathematics & Statistics*
Research: *Multivariate analysis, functional data analysis and inference for stochastic processes; development of theory and methodology for classification and discrimination for stochastic processes.*



Wei Zhan
Department: *Chemistry & Biochemistry*
Research: *Novel electro-analytical techniques and biofunctional materials to provide new tools for clinical diagnosis and biomedical research.*

COSAM Faculty Honored at University Awards Ceremony

- Carol Nelson

2006 Gerald & Emily Leischuck Endowed Presidential Award for Excellence in Teaching Recipient, Robert Lishak

2006 Creative Research and Scholarship Award Recipient, S. Davis Worley.

As part of the university's sesquicentennial celebration, Auburn honored four faculty members and recognized several others at the Faculty Awards for Excellence in Instruction, Research, and Outreach ceremony in September.

Among those honored were COSAM's Robert Lishak, an associate professor in the department of biological sciences, and S. Davis Worley, professor and former interim chair of the department of chemistry and biochemistry. Lishak was one of two recipients of this year's Gerald and Emily Leischuck Endowed Presidential Award for Excellence in Teaching; and Worley was the recipient of the Creative Research and Scholarship Award.

The Gerald and Emily Leischuck Endowed Presidential Award for Excellence in Teaching is a prestigious honor which recognizes those faculty members who have demonstrated effective and innovative teaching methods and a continuing commitment to student success through advising and mentoring inside and outside the classroom; while the Creative Research and Scholarship Award honors faculty who have distinguished themselves through research, scholarly works, and/or creative contributions to their fields.

Lishak has been a member of the Auburn faculty for 30 years. His area of specialization is the study of animal behavior, with his research focusing on the acoustic behaviors of animals. His studies have been published in peer-reviewed journals, and he has been honored with a number of awards for teaching, outreach and advising including the Burlington Northern Foundation Faculty Award for Teaching, the College of Sciences and Mathematics Dean's Award for Outreach and the Auburn University Alumni Association Undergraduate Teaching Excellence Award. Lishak is very active in the college's outreach activities and community programs including AU Explore, Y.E.S. and many others.

"I admire Dr. Lishak for the way he transfers his passion for biology by engaging the students in his classes. He speaks to the students, not at the students, and this manifests itself in an incredibly successful learning experience. Recognition of Dr. Lishak with a Leischuck Award is acknowledging one of Auburn University's classroom stars," remarked College of Sciences and Mathematics Dean Stewart Schneller.

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In his 32 years on the Auburn faculty, Worley has earned a number of awards, including the 2004 College of Sciences and Mathematics Dean's Research Award and the Charles Stone Award for Outstanding Chemist in the Southeast from the Carolina-Piedmont Section of the American Chemical Society. He continues his research in a number of areas including synthesis and testing of antibacterial N-halamine monomers and polymers for water disinfection and antimicrobial coatings. His water purification technology was featured in the "TIME Global Health Summit" last fall, and was recently introduced in Bombay, India.

"Having the privilege of sharing the chemical discipline with Dr. Worley, I can appreciate the breadth of the significance of his research endeavors," said Schneller. "His ability to translate successful basic research into useful products is both educational for his research team, but also shows a versatile individual who truly understands the vertical design of exploration. Dr. Worley's dedicated research career truly represents what the Creative Research and Scholarship Award is intended to acknowledge."

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Also recognized were COSAM's own Kenneth Halanych of biological sciences and Michael McKee of chemistry and biochemistry as two of the recently named alumni professors for 2006. The professorships are sponsored by the Auburn Alumni Association, and are presented on the basis of research, publishing and teaching.

"As newly selected alumni professors, Drs. McKee and Halanych join a very select group of Auburn faculty," Schneller said. "With their acclaim as highly-regarded classroom instructors and internationally recognized researchers, it is not surprising that they both met the rigorous standards for the well-deserved recognition the Auburn Alumni Association has bestowed on them."

Auburn University Office of Communications and Marketing contributed to this story.

Michael McKee (left) and Ken Halanych (center) of COSAM joined by Debbie Shaw (right) of the Auburn Alumni Association and other 2006 Alumni Professors at the University Awards Ceremony.

UNDERGRADUATE

Thomas Brandon Key
Major: Geology
Mentor: Mark Steltenpohl

Thomas Key, department of geology and geography, is investigating the plate tectonic evolution of some very unusual types of rocks discovered by his mentor, Mark Steltenpohl, exposed in coastal islands of the Lofoten archipelago, in arctic Norway. The rocks are called eclogites, and their mineral assemblages require that they formed at great depths (greater than 40 km) within the Earth.

The Lofoten exposures are among only two other known exposures on Earth, but these eclogites occur only in ancient fault zones that contain pseudotachylytes, which are black veins of ultra-fine grained rock that form when catastrophically rapid fault movements frictionally melt the host rock. In a sense, they are fossilized earthquakes. Earthquakes occur at these great depths today beneath the Himalayas where India is actively being subducted beneath Asia. (The deadly October 8, 2005 earthquake in Pakistan formed much shallower, however, at a depth of roughly 26 km.)

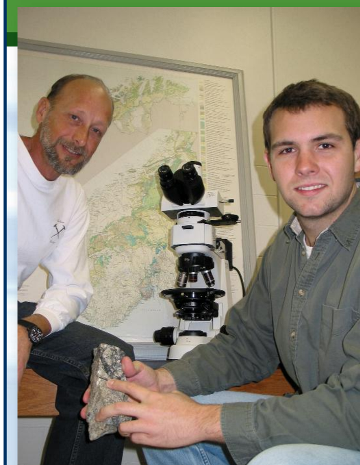
Seismologists are stymied because they must rely on remote methods (seismometers) to make inferences about what might be happening at depth in the Earth when an earthquake occurs. Four hundred million years of uplift and erosion have exposed the Lofoten fault zones and they provide a unique opportunity to directly examine the rocks and structures responsible for such deadly events.

Thomas has been performing laboratory studies on rock specimens which were collected from Lofoten by Steltenpohl and both are planning field studies during the summer of 2007 to further explore these rare exposures.

Alex C. Tucker
Major: Microbiology
Mentor: Sang-Jin Suh

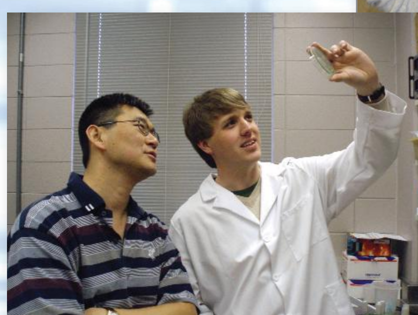
In the laboratory of Sang-Jin Suh, Alex Tucker has been elucidating the physiological role of the small, hybrid RNA molecule tmRNA in the bacterial pathogen *Pseudomonas aeruginosa*. This bacterium is notorious for infecting people with suppressed immune systems, including those who suffer from severe burns, AIDS, cancer, and cystic fibrosis.

In several bacteria, tmRNA has been demonstrated to be important in antibiotic resistance and environmental stress resistance. Preliminary data suggest that tmRNA is important for optimal production of several virulence factors in *P. aeruginosa.* Suh and Tucker are currently in the process of determining the role of tmRNA in the environmental stress resistance, including antibiotic resistance, of this bacterial pathogen. The ultimate goal is to determine the role of tmRNA in the pathogenesis of *P. aeruginosa* and assess whether this molecule can be a potential target for new therapeutic approaches to combat *P. aeruginosa* infections.



Thomas Brandon Key
Major: Geology
Mentor: Mark Steltenpohl

Chad A. Smith
Major: Zoology, Conservation & Biodiversity
Mentor: Ken Halanych



Alex C. Tucker
Major: Microbiology
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Marine life around Antarctica flourishes despite a history of extreme cold, repeated glaciation events, and high degree of isolation. Interestingly, the genetic diversity of organisms is dependent upon their environmental history and to what extent they have contact with other populations.

Chad Smith, together with graduate student Rebecca Hunter and mentor, Ken Halanych, is conducting DNA analysis of the Antarctic brittle stars. His current work focuses on the most common brittle star around the southernmost continent, which can make up 33% of the marine invertebrate biomass in some localities. He is looking for genetics clues that may tell us how this animal responded to past changes in climate and geology.

RESEARCH

Kelly E. Moreland

Major: Molecular Biology

Mentor: Marie Wooten & Doug Martin

Gene therapy is a promising method of correcting disease-causing genetic mutations throughout the body, including the central nervous system. Moreland's research is an integral part of a project whose ultimate goal is to perform gene therapy for an inherited neurological disease known as gangliosidosis, which occurs in humans and animals. Individuals affected with gangliosidosis have an enzyme deficiency that leads to toxic buildup of lipids in the nervous system. Moreland is testing the stability and utility of several forms of the missing enzyme to identify the best candidate for gene therapy.

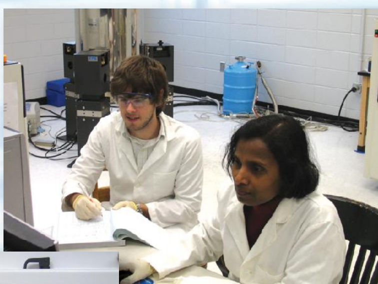
Jason D. Stewart

Major: Physics & Mathematics

Mentor: Allen Landers

Jason Stewart's AMO (Atomic-Molecular) experiment is designed to produce and examine electron collisions with molecules and atoms. The experiment, under the guidance of Allen Landers, is still in the assembly stages. However, great strides toward completion have been made over the course of the last year.

The system will use an electron gun that projects electrons into molecules or atoms (depending on the particle under examination) causing a molecular or atomic interaction, which is studied by the department's instrumentation. The main instrument in use is a mass spectrometer which provides data about the masses of the particles being formed from the molecular or atomic interaction. From that data, they are able to determine the different species of particles being created from the interaction, and thus infer some fundamental information about the atom.



Vedran K. Oruc

Major: Biomedical Sciences

Mentor: Smita Mohanty

Kelly E. Moreland

Major: Molecular Biology

Mentors: Marie Wooten
Doug Martin

Jason D. Stewart

Major: Physics & Mathematics

Mentor: Allen Landers

Vedran K. Oruc

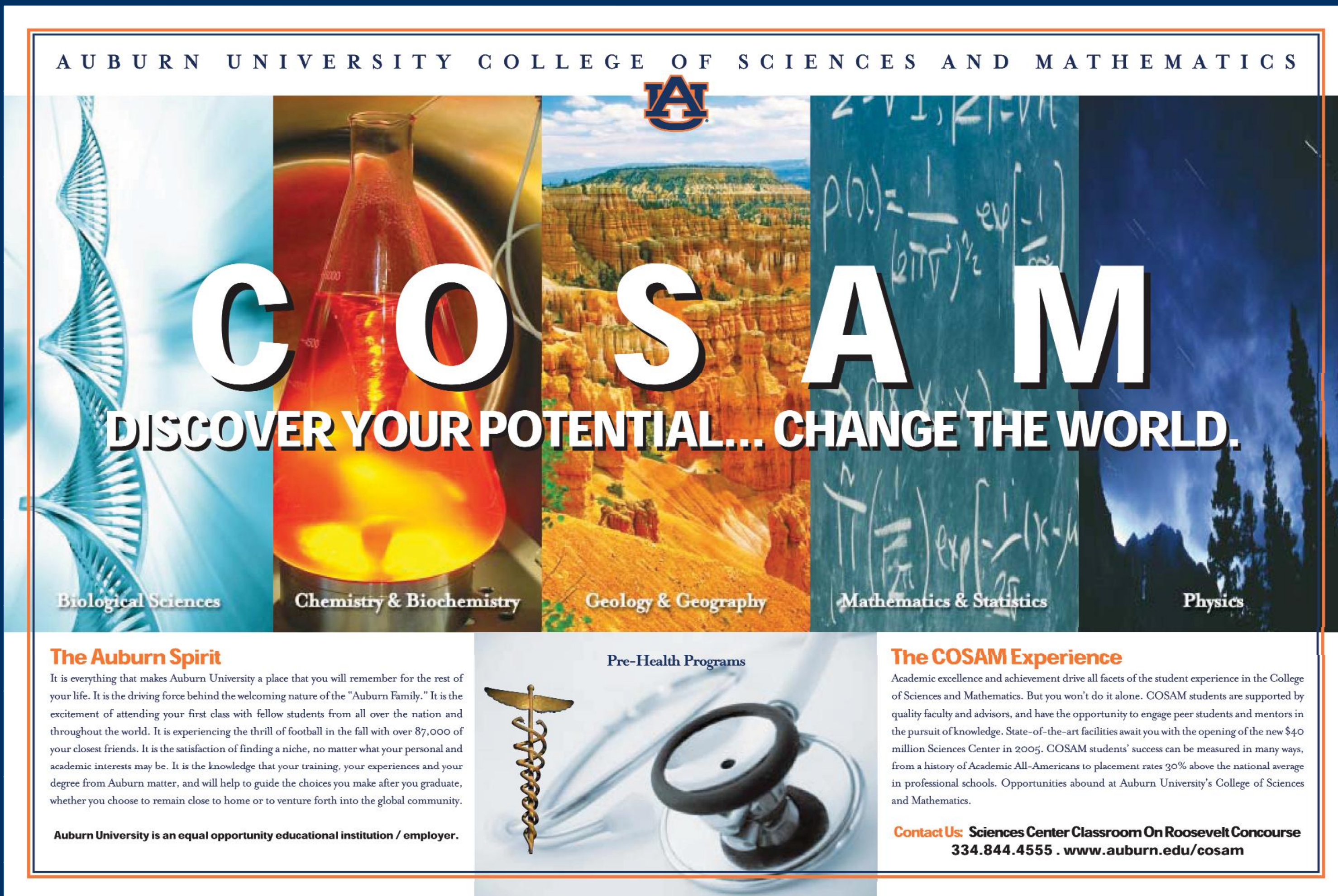
Major: Biomedical Sciences

Mentor: Smita Mohanty

Enzymes, a category of proteins which mediate and control most of the biological processes in the cell, are vital for the proper development and growth of any living organism. Vedran Oruc's work under Smita Mohanty focuses on understanding the function of Oligosaccharyltransferase (OST) enzyme. This enzyme plays a crucial role in the proper functioning of many other proteins and enzymes in a living system.

Defects in the proper functioning of OST enzyme cause a series of problems with clinical manifestation of mental retardation, developmental delay, hypoglycemia, liver dysfunction, gastrointestinal disorders, dysmorphic features, and anorexia. They are using various biophysical techniques to understand the mechanisms of function of this enzyme. The challenge is that this enzyme is insoluble in water.

Such insoluble proteins are called membrane proteins and they constitute about 30% of the human genome. However, such membrane proteins are the target for drug developments. Though this problem makes the protein much more difficult to analyze, they realize that the only way to find a cure for this class of disorders is to first develop a proper understanding of the way in which the OST enzyme operates. Mohanty and Oruc are trying to simulate a native-like environment for this water-insoluble enzyme to characterize its function and mode of interactions with other proteins using many biophysical, biochemical and computational methods.



We Want You!

COSAM **developed this poster to engage and challenge the next generation of scientists and mathematicians. The poster will be distributed at 2007 K-12 outreach activities including AU Explore, YES and L.I.F.E in Science events.**

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