Auburn University

Spectrum

COLLEGE OF SCIENCES AND MATHEMATICS

Research

Mathematics & Statistics

Biological Sciences

Chemistry & Biochemistry

Physics

Geology & Geography

COSAM Hosts Cutting-Edge Math & Science Education Program

MESSAGE

From the Associate Dean of Research

Marie Wooten

"*Spectrum* continues to highlight the creative endeavors of our faculty and students in the College of Sciences and Mathematics. The profiles included in this issue provide an insight into the diversity of projects that are ongoing in this college. The creativity exemplified by these individuals is truly remarkable. From internationally recognized researchers who are the cornerstone of this college, to new faculty bringing with them cutting-edge technology and training, the evidence is clear that your college is continuing its march into the world of discovery. In this issue we welcome new faculty members who were hired in the past year: Drs. Dmitry Glotov, Christian Goldsmith, Xiaoying Han, Joshua Inwood and Aaron Rashotte.

The college continues to recognize excellence in scholarship through the Dean's Research Awards which are given annually to outstanding faculty, graduate students and undergraduate scholars. The recipients are recognized at an awards ceremony and lecture given by the faculty awardee. In order to fuel the pipeline and train the next generation, COSAM undergraduate-research fellows are provided scholarships and research support, allowing them to conduct independent research alongside a faculty member of their choice. This mentoring process provides students with a hands-on experience in a "real-world" research setting, and enables them to develop the necessary skills and confidence to continue along a professional path.

Support provided by external funds through contracts and grants is central to our experimental programs. COSAM faculty continue to lead the way in securing nationally competitive awards to stimulate research in the sciences, mathematics and outreach. Support from the National Science Foundation, the National Aeronautics and Space Administration (NASA), United States Geological Survey, Department of Defense, Department of Energy, the National Institutes of Health, and numerous other state and private agencies grew to over $10 million during the past fiscal year. This is the largest amount of external funding ever brought into the college. In an era of declined research funding, our continued growth speaks to the quality of our faculty, the commitment on the part of the college to enhancement of infrastructure, and the visibility of our programs on the national landscape.

This issue of Spectrum magazine captures the passion and commitment of our faculty and students. Join me in learning about the creativity, innovation and discovery that is shared by members of the College of Sciences and Mathematics.

Professor s Research

Provides Opportunities for Marine Biology Students

Picture yourself diving on coral reefs in the Red Sea, or maybe in the Caribbean. This is how **Nanette Chadwick** of the department of biological sciences spends a great deal of her time. She is studying how the behavior of marine organisms, like fish and sea anemones, influence interactions with one another in nature.

"I am interested in symbiosis among marine organisms from the perspective of giant sea anemones and corals," Chadwick said. "There is a high abundance of giant sea anemones on coral reefs: worldwide about 10 species of these anemones that get quite large, and about 30 fish species that live with them."

The giant sea anemones provide unique habitats for certain species of fish, and these fish evolve to live in that particular habitat. There is much known about the fish species, but almost nothing is known about the sea anemone host.

Chadwick said, "The fish depend entirely on the host, so we would like to know the dynamics of the host population: how long they live, whether they recruit in large numbers to the reef, and the way that affects the stability of the fish population.

"Fish produce large amounts of ammonia and when they do that, they fertilize the host. All reef-building corals and anemones have tiny single-celled plants in their tissues, microalgae, and they need nutrients to grow. When you culture the anemones with fish, they grow faster because the fish are fertilizing them, and they are enhanced by the intimate association. Our work has been the first to demonstrate that when you remove the fish, the anemones don't do so well physiologically, and vice versa. We have some undergraduate students working in the lab measuring the fish, and we have found that without the anemones, the fish also grow at a slower rate. Our work is showing how the two need each other – they can live on their own, but they do better together," Chadwick said.

Chadwick's research also focuses on population dynamics. She was recently awarded a National Science Foundation grant to travel to Jordan to conduct long-term studies on the coral reefs.

"It will be part of the Auburn Abroad program where students will be diving on coral reefs and tagging anemones and fish. We would like to see how many anemones recruit to the reefs each year, how fast they grow and their mortality rate, and then figure out the turnover of the population. If we can see how quickly they recruit and recover from disturbances like hurricanes, then we can make recommendations in order to maintain collecting of these organisms at a sustainable rate for the ornamental aquarium trade," Chadwick said.

Additionally, Chadwick and her research group are looking at oxygen exchange between the anemone host and the fish. During the day the anemones produce oxygen, but at night both the anemone host and the fish consume oxygen, and the anemones potentially become oxygen depleted. Other research on corals has shown that at night the resident fish are fanning and aerating the hosts. So, if you take out the anemone fish, the sea anemone host may not be able to breathe.

Chadwick is most concerned with how these marine symbioses enhance biodiversity. Giant sea anemones on coral reefs provide a habitat for dozens of unique types of fishes and shrimps that depend upon them completely. If the host anemone populations become reduced, the resident fishes and other symbionts will begin to disappear as well.

"Biodiversity is something that we need to preserve in the natural environment. As climate changes, as human population grows larger and we have a greater impact, we need to look at ways to preserve biodiversity both in our immediate surroundings, and in our oceans which provide us with a lot of benefits that we don't immediately recognize," Chadwick said.

-Carol Nelson

Bacterial Enzyme Research Aids in *Going Green*

Recycle. Go green. Save the Earth. In this time of environmental awareness, one COSAM professor is doing his part. The department of chemistry and biochemistry's **Doug Goodwin** is working on developing ways to use bacterial enzymes to degrade environmental pollutants.

His research, funded by the National Science Foundation, looks at the structure of these enzymes and their functions. Look at a cell or any living system: Enzymes are some of the major actors in the system. They speed up the reactions within a cell, making the reactions work at a rate that is sufficient for it to function properly.

Every enzyme has what is called an active site, and it is here that the reaction speeds up. A molecule comes into the active site, and it is transformed. However, the active site only comprises a very small part of most enzymes.

"In protein structure and function, we've gotten good at figuring out what is going on in the immediate active site environment," Goodwin said. "We know that very specific groups have to be placed in the active site in a particular way so that all the tools are there to make the reaction go faster. If even one of these tools is out of place or absent, the reaction is not catalyzed and the enzyme ceases to function properly, or even at all."

Because of their understanding of how the tools are put into the active site and what they are doing, scientists can go into the genetic code of an enzyme and change one specific spot. They essentially remove a certain tool from the active site and find out what happens to the enzyme's ability to catalyze the reaction. But, what effect does the rest of the enzyme structure have on the way these reactions take place? This is where Goodwin's work comes into play.

"As you get further away from the active site, it is more difficult to find out how the rest of the protein is affecting the active site," Goodwin explained. "The models to investigate that are much harder to come by. It is a much more complicated problem. We have a system that allows us to figure out how protein structures, which are very distant from the active site, very specifically alter the function of the active site." Once they are able to understand these structures, they can use this information in looking at ways to fight environmental pollution.

Goodwin uses a Circular Dichroism Spectropolarimeter to engineer enzymes for unique functions.

"We'd like to be able to take enzymes and basically engineer them to catalyze the breaking down of the pollutants," Goodwin said. "We can make an enzyme that does the job we want it to do, and we can make enzymes specifically for degrading a particular environmental pollutant.

"We already know that when you make changes to the tools in the active site, the enzyme usually ends up not functioning at all. We need to be able to fine tune the active site by making adjustments to the protein structures that are not directly in the active site, but only subtly affect it," he explained. "We can capitalize on what bacteria already know how to do and use that to our advantage."

For example, certain bacteria are able to live in hot environments and make enzymes that are stable in these very high temperatures.

"The enzymes that you and I make are typically not stable much past the temperatures that our bodies are operating at. If we were to continue to increase the temperature, those enzymes are going to begin to break apart, or come unfolded," Goodwin explained. "That is part of why you cannot sustain a fever above certain temperatures. Your proteins and other biological components just don't hold together so well. These bacteria have figured out how to make proteins that hold together at temperatures approaching 200 degrees Fahrenheit.

"Well, wouldn't it be great if we could take proteins that are made by bacteria that withstand high temperatures like that and engineer those proteins at the same time to do the chemistry that we want?" he continued. "Now we have a new enzyme that addresses, for example, a tough environmental pollutant, and is also stable at high temperatures, so we can use it under a much broader range of conditions than a typical enzyme."

Goodwin said that his research is not only answering fundamental questions about the nature of catalysis in biological systems, but is also providing insight that is a foundation for technological advances through enzyme engineering.

"The ability to engineer new enzymes for unique functions holds great promise for addressing urgent concerns that are global in their scope and impact," he said.

-Carol Nelson

Landscapes and Legacies:
The Racialization of Place

From the late 1800s through the 1960s, Auburn Avenue was a bustling African-American community. The birthplace, home and gravesite of Martin Luther King, Jr. and the once-richest African-American community in the United States, Auburn Avenue was home to the three pillars of African-American commerce in the American South: Citizens Trust Bank, one of the only African-American controlled banks in the country; Atlanta Life Insurance Company, which was founded by a former slave; and the now-defunct Federal Savings and Loan. However, from the 1970s through the 1990s, the area went through steep decline.

The area, now home to the Martin Luther King, Jr. National Park and King Center, is currently on the road to rebuilding and redevelopment. The department of geology and geography's **Josh Inwood** wants to make society more aware of Auburn Avenue and its role in the American South and the United States as a whole.

As an urban/cultural geographer, Inwood's research focuses on urban development, contested notions of identity, landscape studies, social justice and the racialization of place.

"I like to focus on some key urban questions, and many of those revolve around questions of race and racism and how they fit into urban geography or urban systems," Inwood explained. "Jurgen Habermas (German philosopher and sociologist) said that the critical development of the public sphere — the ability of people to come together to debate politics, articulate particular political positions — was hugely influential in the development of modern democracy.

"The problem," Inwood continued, "is that throughout history different groups have been shut out of that public sphere, which led to the creation of counter-publics, or alternative spheres of public engagement; in this case, places where African Americans could come together, debate identity positions, and strategize responses to white racism and segregation in the South. Essentially, this is what Auburn Avenue was, particularly in the 1940s through 1960s."

In conjunction with this, Inwood is also studying the role of landscapes, in particular, the Martin Luther King, Jr. Center and Memorial at Auburn Avenue.

"In geography, we've come to understand that landscapes are things — you can look at them; they are real — but they are also part of a social process. Landscapes have ways of socializing us in particular kinds of ways," Inwood explained. "I argue that the King Center and Memorial represents what I call a normative civil rights vision, which focuses on King's early work in the civil rights struggle where he is very focused on U.S. democracy and redeeming U.S. democracy, using the experience of African-Americans to make America fulfill its promise."

But, Inwood points out the memorial does not really talk about King's later work: "He was very disillusioned with the pace of racial progress in the last years of his life. He says that he has come to realize that the foundational principles of the U.S. are not freedom of democracy, but they are really racism.

"So, (the center and memorial) landscape is a thing, but it's also a part of a process to get us to focus on King and his message in a certain way. It is very focused on his early message, using the existing democratic structure to make good on the American promises; where his later work is an articulation of a rejection of some of those same democratic structures, and the realization that they impose a particular kind of way of thinking, a particular kind of reality for the poor in general and African Americans in particular, which is not wholly positive," Inwood said.

Inwood believes that we, as a nation, have turned our back on the hope of the 1960s in terms of civil rights: "We haven't raised, debated, talked about what was going on," Inwood said. "We have all of these legacies of racism, and I try to bring up these issues in my classes…we need to think critically about the places we live, the spaces we work, the landscapes we're on everyday at Auburn University."

-Carol Nelson

Theorems and Equations: Finding New Function in Biology

Bertram Zinner, from the department of mathematics and statistics, says he is interested in biology, but knows that he is no biologist. It is because of this that he has teamed up with biological sciences' Steve Dobson to conduct research and to teach ecology and calculus for biologists. The Zinner-Dobson team is an example of what it takes to answer complex questions when the research requires a multi-disciplinary approach. But, how does Zinner's mathematics translate to Dobson's biology?

"Through differential equations, models in morphology, or probability statistics," Zinner explained. "Biologists have questions to ask, and I am able to help them through statistics problems. The field of mathematical biology is wide open. All kinds of math can be applied, but not a lot of people are doing it. I feel like I have something to offer. I have always liked life sciences, and I feel like I can make a contribution in biology, at least to some extent."

Zinner creates models and translates the biological problems into mathematical language. Once it is translated, the problem can be solved and adapted, which leads to the application of theorems and equations.

"Some may look down on the work I do because I may not be creating original or new theorems, but I feel good about it because in the end it has helped someone," Zinner said.

He may not be creating a new theorem, but he is providing something new in biology; maybe a different way of looking at things, a way that someone may not have thought of before.

"We have talked about many topics to work on," said Dobson, "and Bertram's breadth of modeling ability is truly exciting."

Dobson said that their work basically falls into three categories. The first is using matrix algebra to study population regulation. In this area, Zinner and one of Dobson's former students, Madan Oli, developed a characteristic equation for studying the sensitivity of population growth rate to aspects of reproduction and survival.

"Their equation is applied to the sorts of data that conservation biologists and ecologists collect on a wide variety of plants and animals, and it is becoming broadly used to model plant and animal populations," Dobson said.

Their second research topic is non-linear mathematical properties of animal populations.

"These non-linear mathematical properties are usually termed 'chaos' in the popular press, and they lead to extreme fluctuations in population size such as the well-known 10-year cycles of snowshoe hare in Northern Canada and Alaska," Dobson explained. "We have modeled the three-four year cycles in abundance of voles (related to lemmings), and have shown that voles cross into the first stage of the chaotic realm and thus cycle. This is exciting new work that helps to explain cyclic populations — one of the major unsolved mysteries in ecology."

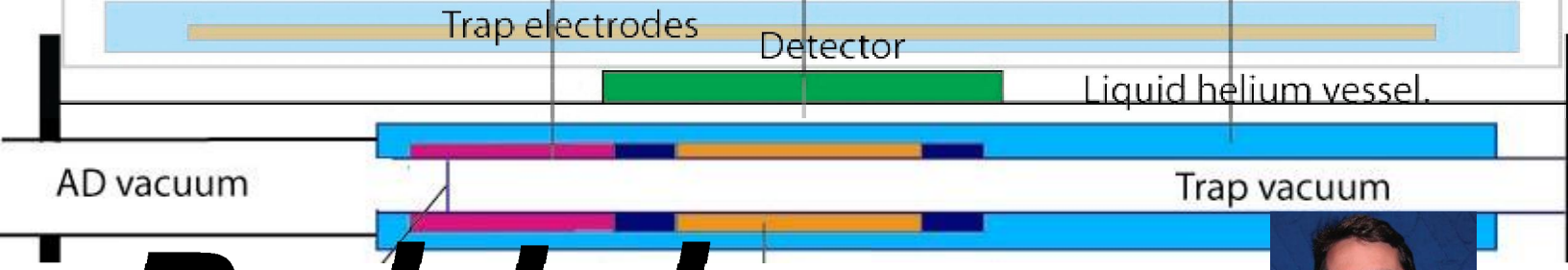
Zinner and Dobson's final area of collaboration is in population genetics. They have developed models that explore the influences of such social phenomena as spiteful behavior and mating patterns on the genetic properties of populations. Dobson explained, "our interest is both in understanding how such behaviors as spite and multiple mating by females can evolve, but also how these and other phenomena influence the loss of genetic variation from social populations of animals."

Zinner said that the key to these collaborations is the willingness from both sides to learn the language.

"I've taken some biology courses. I also took a sabbatical and spent time at the Mathematical Biosciences Institute at the Ohio State University in Columbus, Ohio," he said. "Math is what I know how to do well; what I am comfortable with. I feel good in problem solving — I enjoy it. I feel a sense of accomplishment when I help figure out something tricky that you can't see, then something happens, and you see it and can solve it."

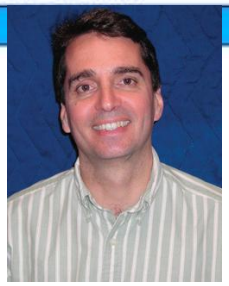
-Carol Nelson

"This is exciting new work that helps to explain cyclic populations — one of the major unsolved mysteries in ecology."
-Bertram Zinner



Robicheaux

Putting Physics to the Test



The department of physics' **Francis Robicheaux** is doing research that takes him to Geneva, Switzerland to the world's largest particle physics laboratory, the European Organization for Nuclear Research, known as CERN. There he is a part of the ALPHA (Antihydrogen Laser Physics Apparatus) Project working to make and hold the simplest antimatter atom.

What is antimatter? In 1930, theoretical physicist Paul Dirac predicted that for every type of particle of matter, an equivalent particle of antimatter must exist. The antimatter particles have the same mass but opposite charge of their matter counterpart. Basically, the antimatter particle is the mirror image of the matter particle.

In this case, Robicheaux and his collaborators are working with hydrogen/antihydrogen. The goal of their experiment is to make and hold an antihydrogen atom:

"The problem is that everything that we come in contact with is made of matter, and when antimatter comes in contact with matter, it disappears and radiation comes out of it," Robicheaux explained. "A few years ago, some scientists were able to make antimatter, but it sort of wandered away and hit the walls of their experiment and turned into radiation. We are not only trying to make it, but to also hold it. Because you can't hold antimatter with anything made of matter, we will try to hold the antimatter in a vacuum using electric and magnetic fields. Unfortunately, this means everything must be extremely cold and we must encourage the formation of antihydrogen atoms using gentle forces."

Robicheaux's role in the project is that of theorist. The group tells him the different ways they are going to attempt to make the antimatter, and with this information, he is able to tell them what he thinks will happen based upon how it's been made, it's properties, and whether or not they should be able to hold it.

"They come to me to ask, *'Why isn't it working?'* The experiment tests the different ways that they want to try," Robicheaux said.

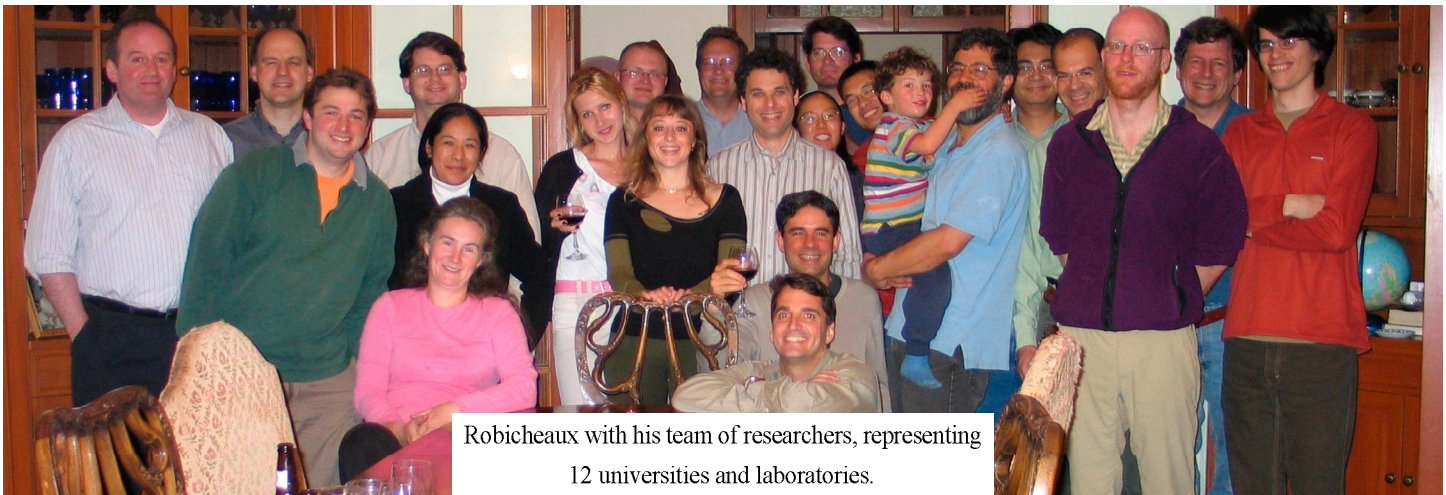
But, why is it important to make and hold antimatter? Robicheaux explained: "Antihydrogen is supposed to be exactly the same as hydrogen. It is a very basic theory in physics that they are the same, but no one has been able to test it as precisely as we hope to."

Through the experiment, if they are able to make and hold the antihydrogen, they will be able to find out if it really is the same as its hydrogen counterpart.

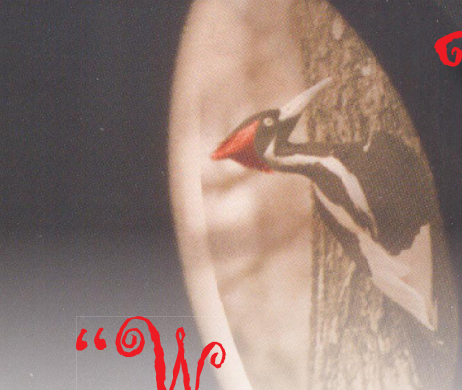
"We would be able to test one of the most basic theories in physics," Robicheaux said.

The collaboration is made up of researchers from 12 universities and laboratories, and funded in part by Robicheaux's joint grant from the U.S. Department of Energy, awarded to researchers from the University of California Berkeley, the University of North Texas and Auburn University.

-Carol Nelson



Robicheaux with his team of researchers, representing 12 universities and laboratories.



Documenting Evolution

"When I was about 14, a high-school biology teacher took me on a bird walk," said Professor **Geoffrey Hill**. "It was the first time I realized that you could look through binoculars at birds and identify what they were. I was amazed that my teacher could call them by name."

Hill's amazement grew into a life-long passion and career. Today, he is an alumni professor in biological sciences, specializing in the behavioral and evolutionary biology of birds.

"Studying bird coloration allows us to address a fundamental challenge to Darwin's theory that evolution by natural selection is responsible for the diversity of life," Hill said of his passion. "Plus, we gain all sorts of insight into how biological systems work."

As a prominent ornithologist, Hill has published four books. Topics in his books range from in-depth reviews of the function and evolution of plumage coloration, to an account of a search for a rare woodpecker in Southern swamps.

"'A Red Bird in a Brown Bag' is a summary of all the things my students and I learned about red plumage coloration in House Finches," Hill said of his first book, published in 2002. "With my colleagues, I tested theories on mate-selection, male-male competition, the evolution of color patterns, and the physiological basis for color variation. The book was written primarily for my professional colleagues, but I tried to write it in a prose that is not overly technical so that an amateur can read it too."

"I've been fascinated by birds since I was a little kid." -Geoffrey Hill

Unlike his first book, Hill's next two books are a highly technical two-volume set, published in 2006 as a contribution to scientific literature on bird coloration.

"A summary of animal coloration hadn't been written since the 1940s, so for years I wanted to write a book on animal coloration," Hill said of the two-volume publishing process. "Kevin McGraw was an outstanding master's student of mine at Auburn, and his specialty is the pigments used to color feathers. Together, we tried to write a book on animal coloration."

Hill and McGraw's attempt to write comprehensive volumes on such an enormous subject proved problematic.

"Animal coloration includes the coloration of invertebrates such as color-changing cephalopods and butterflies with colored scales on their wings, as well as all the colorful vertebrates… it was just too overwhelming. There were literally thousands of papers published on the topic. We were forced to scale our treatment back to include just fish and birds," Hill recalled.

Eventually, Hill and McGraw decided to focus their work on just birds. The result is "Bird Coloration, Volume One, Mechanisms and Measurements" and "Bird Coloration, Volume Two, Function and Evolution."

"Even the topic of bird coloration was too overwhelming for the two of us to tackle alone," Hill said. "*How do birds see color? What are the physics involved when the microstructures of feathers scatter light to create colorful displays? What is the role of genes versus the environment in determining color variations?* Even within this sub-discipline of bird coloration, the subtopics involved huge literatures. We finally decided to enlist the help of our colleagues in the field. We created the table of contents, wrote five of the 23 chapters, and invited co-workers to write the other chapters."

After almost 60 years with no comprehensive review of the coloration of any vertebrate group, Hill and McGraw published the two-volume collection that summarizes what has been discovered about the colors of birds.

"Now I am working on a layman's version of the two volumes," Hill said. "By 'layman' I mean bird enthusiasts and other biologists whose specialty isn't birds. There is a huge appetite for information on birds."

In the last year or so, Hill has become acutely aware of the large number of bird enthusiasts nationwide. With the 2007 release of his fourth book, "Ivorybill Hunters," Hill has been invited to speak at a number of events and meetings where bird lovers gather.

"In the past few months, I've spoken at a bird festival in Fairhope, at an annual meeting of the Alabama Ornithological Society, at the Chattanooga Aquarium, and at the annual meeting of the Bluebird Society in Athens, Georgia. Some of these groups want to hear about bird coloration and some of them want to hear about the Ivory-billed Woodpecker," Hill said. "My latest book, "Ivorybill Hunters," recounts our discovery of a population of Ivory-billed Woodpeckers along the Choctawhatchee River."

Public enthusiasm for Hill's latest book is in part driven by the fact that until a recent discovery in Arkansas by the Cornell Lab of Ornithology, the Ivory-billed Woodpecker was generally considered to be extinct. The other reason Hill's latest work has been well received, is that it was written for the general public.

"'Ivorybilled Hunters' is not a scientific volume. It's a travel log. It's not meant to be a serious scientific account. It's a fun account," Hill said as he reflected on the time he spent in the swamps of Florida, searching for the Ivory-billed Woodpecker with two of his colleagues. "I look at publishing as a scientific duty. If we don't disseminate what we discover — be it the function of red feathers or evidence for a bird that was thought to be extirpated from Florida — we might as well not conduct our research."

-Candis Hacker

For a signed copy of *Ivorybilled Hunters*, visit the Auburn University bookstore. All of Hill's publications are available at www.amazon.com.

2008 Dean's Research Award Recipients

Graduate Ph.D.
Heather Trevino
Biological Sciences

Faculty
Steve Dobson
Biological Sciences

Undergraduate
Amanda Savrda
Geology & Geography

Graduate Ph.D.
Carma Cook
Chemistry & Biochemistry

Graduate M.S.
Germari de Villiers
Geology & Geography

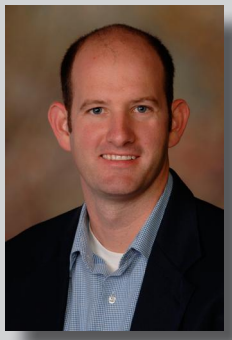
New Faculty in COSAM

Aaron Rashotte
Biological Sciences
Research Interests:
Plant developmental genetics.

Christian Goldsmith
Chemistry and Biochemistry
Research Interests:
Inorganic and bioinorganic chemistry, mimicing enzymatic oxidation processes and developing probes for bio-imaging.

Xiaoying Han
Mathematics and Statistics
Research Interests:
Applied Mathematics

Dmitry Glotov
Mathematics and Statistics
Research Interests:
Nonlinear partial differential equations and applied mathematics.



Josh Inwood
Geology and Geography
Research Interests:
Urban development, contested notions of identity, landscape studies, social justice and the racialization of place.

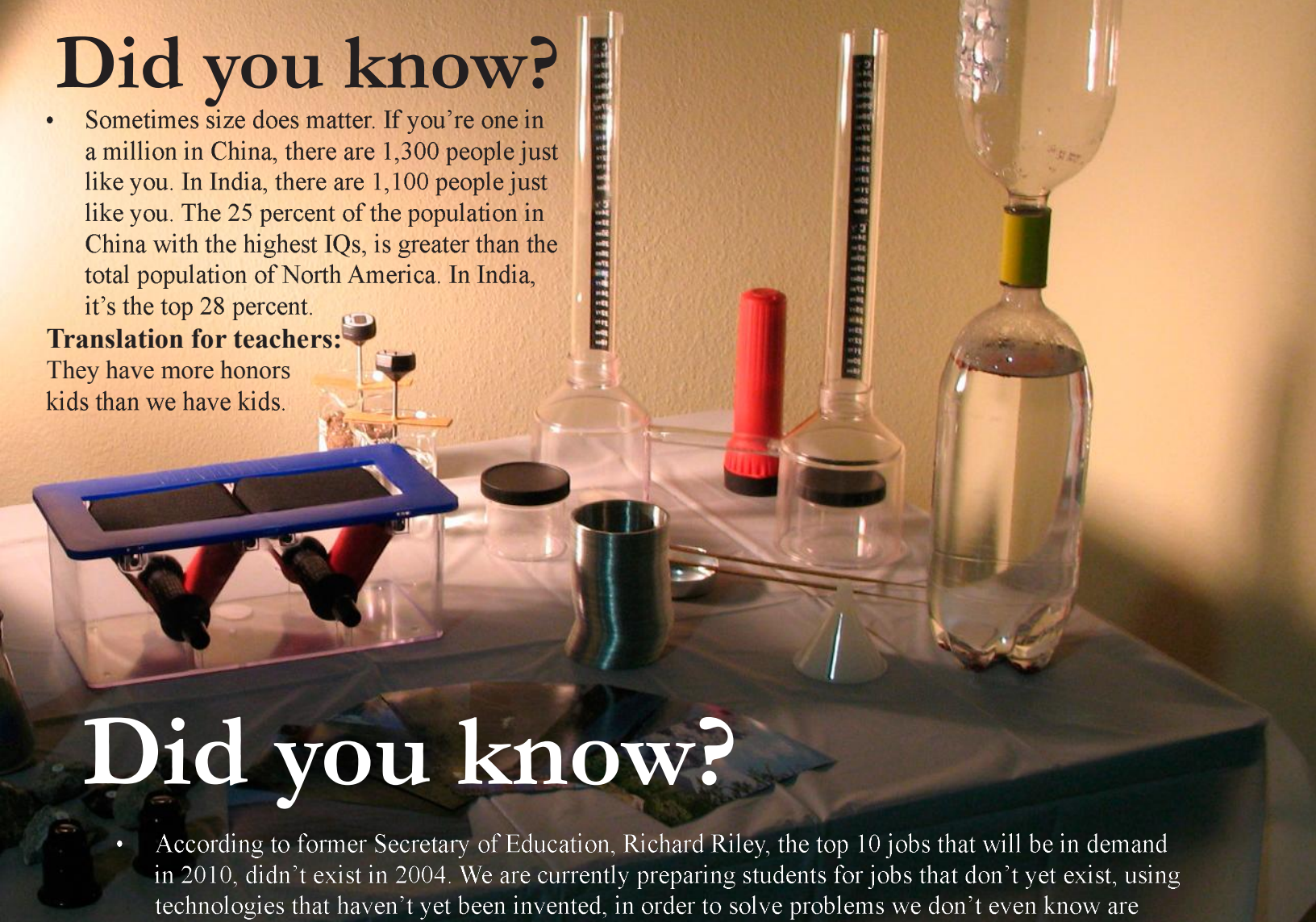
Did you know?

- **Nintendo invested more than $140 million in research and development in 2002 alone. The U.S. federal government spent less than half as much on research and innovation in education.**
- **One of every eight couples married in the U.S. last year met online.**
- **There are over 106 million registered users of MySpace (as of September 2006). If MySpace were a country, it would be the 11th largest in the world (between Japan and Mexico). The average MySpace page is visited 30 times a day.**
- **There are over 2.7 billion searches performed on Google each month.**
- **The number of text messages sent and received every day exceeds the population of the planet.**

Did you know?

- Sometimes size does matter. If you're one in a million in China, there are 1,300 people just like you. In India, there are 1,100 people just like you. The 25 percent of the population in China with the highest IQs, is greater than the total population of North America. In India, it's the top 28 percent.

Translation for teachers:
They have more honors kids than we have kids.



Did you know?

- According to former Secretary of Education, Richard Riley, the top 10 jobs that will be in demand in 2010, didn't exist in 2004. We are currently preparing students for jobs that don't yet exist, using technologies that haven't yet been invented, in order to solve problems we don't even know are problems yet.

What Does it All Mean?

*Information taken from AMSTI video presentation.

"The future is going to be quite a bit different from our past. We are now competing globally, said Steve Ricks, State Director for the Alabama Math, Science, and Technology Initiative (AMSTI), "and that's where AMSTI comes in.

AMSTI is the Alabama Department of Education's statewide initiative to improve math and science teaching.

"The goal is to teach kids to be problem solvers and life-long learners so they can solve problems later on and incorporate new information, said Beth Hickman, AMSTI Auburn University director.

AMSTI schools are given all the professional development, equipment and materials, and on-site support they need to be successful science and math educators in the kindergarten through 12th-grade classroom setting.

"This program is unique with the amount of support and longevity of support that teachers receive, said Wayne Strickland, Science Specialist with AMSTI.

"I love it, said Amber Nolan, a seventh-grade teacher at Drake Middle School in Auburn. "I talk about it with the other teachers every day, sometimes as much as three times a day.

The teachers discuss the various AMSTI projects they are utilizing in their classroom, and share with one another what worked, where the challenges lie, and how the students responded to each task.

At Drake, evidence of AMSTI experiments are in almost every classroom. In one corner, radish plants covered in butterfly larvae are on display in light boxes. In another corner are more light boxes, illuminating butterflies and saucers of nectar. Each saucer of nectar is dyed a different color. What color nectar do butterflies prefer? In still another corner are student-made ponds, created from dirt, straw, leaves, duckweed, gravel and spring water.

"From week to week the ponds change. They grow," Strickland said as he picked up a student-made pond to take a closer look.

These projects represent a fraction of the experiments provided in an "AMSTI kit. An AMSTI kit is correlated with a course of study such as "Catastrophic Events, "Energy Machines and Motion, or "Organisms From Macro to Micro. Within the kit is the equipment necessary for each experiment, such as videos, spring scales, rubber bands, potting soil, slides, safety goggles, rock samples, flashlights, text books, and teacher guides.

"The kits have all the supplies the teachers need. We want to make it so that no teacher has to go to the store in the middle of the night for items they need in the classroom, Strickland said.

Equipment, training, and constant on-site support are wonderful for teachers and students, but does the program work?

"In every case, on every standardized test given by the SDE (State Department of Education) AMSTI schools outperformed non-AMSTI schools, often dramatically, Ricks said.

Not only are math and science scores increasing, but reading and writing scores are improving as well.

"AMSTI also teaches the students critical thinking, and has them write their ideas on paper, so it increases their vocabulary, Hickman said in response to the improved reading and writing scores.

Furthermore, according to AMSTI Math Specialist, Sheila Patterson, teachers in AMSTI schools are seeing an improvement in student behavior.

"You are going to be actively engaged, having a hands-on, minds-on and hearts-on experience in the classroom, Patterson said. "This deters off-task behavior."

The program also has evidence to support an increase in teacher content knowledge, an improvement in student understanding of abstract concepts, and an increase in student interest and participation.

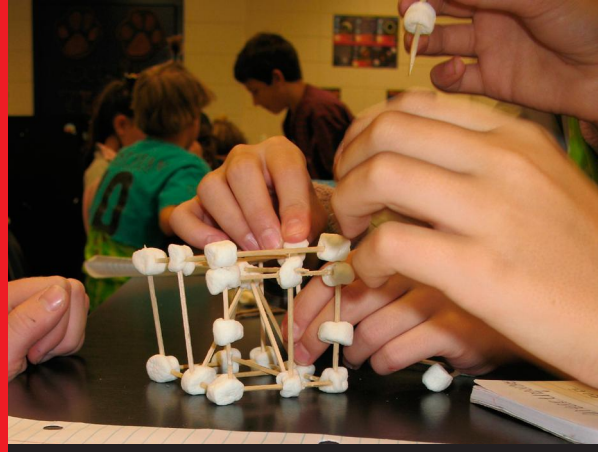
"Other states are looking to us as an example, Strickland said of AMSTI's success.

With so many benefits, it's no wonder AMSTI continues to grow. This year, AMSTI celebrated the ribbon cutting of its newest office and warehouse, located in Auburn and sponsored by the Auburn University College of Sciences and Mathematics.

Continued growth is assured, not only because of the overwhelming success of the program, but also because of steadfast support from state government.

"AMSTI works! said Governor Bob Riley. "We know it works My goal is to see AMSTI in every school in Alabama by 2011.

-Candis Hacker

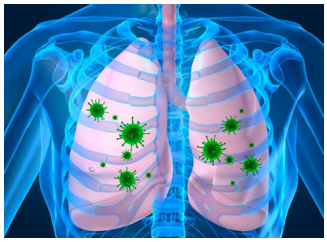


The "Earthquake Resistance" experiment requires students to work in teams. Each team builds a structure using toothpicks and marshmallows. The teams then test the strength or "earthquake resistance" of their structures by dropping them onto various types of foundations.

This project involves cross-pollination and measuring the growth of a Wisconsin fast plant.

Students gauge the growth of their pond by taking samples and looking at them under a microscope. Are there any new organisms?

(from left) ***Mentor, Dr. Laura Silo-Suh, is working with Arpi Shrestha and Peyton Bartholomew to better understand the chronic-infection-causing strains of Pseudomonas aeruginosa.***



In the Silo-Suh lab, **Peyton Bartholomew** and **Arpi Shrestha** are currently working with chronic-infection-causing strains of the bacterium *Pseudomonas aeruginosa*. Particularly they are interested in *P. aeruginosa's* role in infecting patients with the genetic disorder cystic fibrosis (CF). CF is caused by a genetic defect in the gene coding for a transmembrane protein involved in membrane transport of ions. As a result, these individuals secrete abnormally thick mucus in the lumens of the digestive and respiratory tracts, as well as the pancreatic ducts. This abnormally thick mucus is difficult to expel, especially from the lungs, and creates an environment favorable for pulmonary infection.

The research group understands that the initial acute-infection-causing strain of *P. aeruginosa* that establishes infection in CF patients undergoes certain adaptations in the CF lung, which cause it to sustain chronic infection. In the adaptation process, certain genes for virulence factors and other antigenic determinants are silenced via genetic mutation. These mutations enable the bacteria to evade a host's immunological response as well as resist most anti-microbial therapies, making the infection very difficult to treat.

Ultimately, most CF patients infected with *P. aeruginosa* die from pulmonary failure as a result of chronic infection. The purpose of the group's research is to determine the virulence determinants that remain in chronic lung infection isolates of *P. aeruginosa*. Many of these determinants lie in metabolic pathways undertaken by the bacteria, specifically the Glyoxylate Pathway and Citric Acid Cycle. Bartholomew and Shrestha are currently trying to determine whether chronic infection isolates of *P. aeruginosa* can maintain a persistent infection after mutations are induced in the genes' coding for the enzymes involved in these pathways. By determining which genes are essential for maintaining chronic infection, the research group hopes to target these genes, or their protein products, for anti-microbial therapy.

(from left) ***Mentor, Dr. Jerzy Szulga, is helping Kristin Seamon collect earthquake data in order to discover patterns in their occurance.***

Extreme events happen everywhere and anytime: hurricanes, floods, tornadoes, volcanic eruptions, and the odd lightning strike. Earthquakes are perhaps the least predictable and most fatal of these natural phenomena. Yet, given the time and the effort, earthquake prediction might become as reliable as hurricane tracking. **Kristin Seamon**, a junior in applied mathematics, with the help of Jerzy Szulga, professor of mathematics, wants to study how the times between earthquakes are distributed in order to find patterns that would aid in predicting earthquakes.

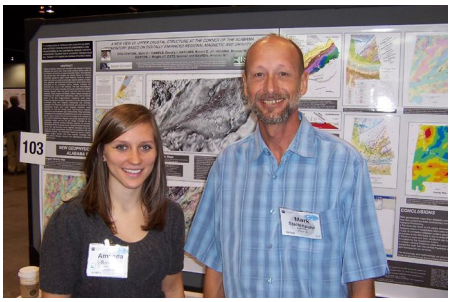
Specifically, data on earthquakes are taken from different geographical regions to calculate the recurrence times. Data can be downloaded from government sites such as the United States Geological Survey (USGS), the Northern California Earthquake Data Center (NCEDC), and the Incorporated Research Institutes for Seismology (IRIS). The format must be adjusted to conform to the applied computer software. Interevent times and magnitudes are then used to create and analyze histograms statistically. The analysis is based on the recent research papers on the subject. Presently, there is a belief that the waiting time for the next earthquake is subject to a "universal scaling law" (Saichev, A. and Sornette, D. 2007. "Theory of Earthquake Recurrence Times". Journal of Geophysical Research.) This means that the distribution function has a specific shape, and only few parameters depend on the location or magnitude.

The stream of random events is of great interest in many situations. Even epileptic seizures and market crashes may follow similar patterns. It is reasonable to expect that the research on earthquakes could very well be applied elsewhere, and conversely, the methods and findings in other areas may shed some light on geological events and aid to minimize the harmful effects of earthquakes.

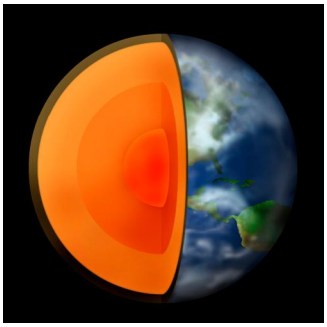
Auburn University's College of Sciences and Mathematics and The HudsonAlpha Institute for Biotechnology have signed a research collaboration agreement that has the potential to leverage the strengths of both the public and private sector. The partnership is designed to jointly conduct research, develop and commercialize products realized from combined efforts.

"We are delighted to enter into the partnership for biotechnology agreement with Hudson Alpha," said COSAM Associate Dean of Research, Marie Wooten. "This agreement will serve as a gateway to facilitate commercialization of our life-science based technologies developed by Auburn faculty and as a means to network with other scientists in the Southeast."

HudsonAlpha's goal of over a dozen affiliated research companies with offices and labs in residence at the Institute will create a critical mass of biotech knowledge and expertise that academic researchers



(from left) ***Amanda Savrda seeks to improve understanding of the plate tectonic history of the southeastern U.S. under the mentorship of Mark Steltenpohl and Lorraine Wolf*** *(not pictured).*



What lies beneath the nearly four-mile thickness of sediments in the Alabama Coastal Plain? That is the question **Amanda Savrda**, an undergraduate student in COSAM's department of geology and geography, is working to find out.

Under the mentorship of Mark Steltenpohl and Lorraine Wolf, Savrda seeks to improve our understanding of the plate tectonic history of the Southeastern U.S. This region holds an important record of the final consolidation of Pangea, a supercontinent that formed more than 300 million years ago as the proto-African (Gondwanan) and proto-North American (Laurentian) plates collided to create the Appalachian Mountains. What is currently known about the deep crustal structure comes from exploratory oil wells that have penetrated and retrieved core samples of "basement" rocks, and from remotely sensed gravity and magnetic geophysical surveys.

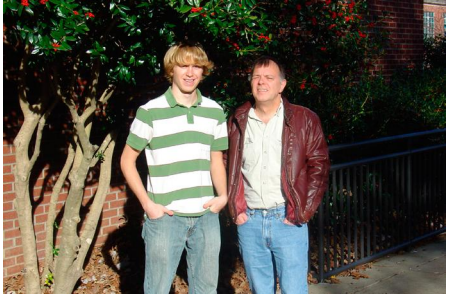
Savrda's goal is to generate a new crustal model that reflects the structural configuration of basement rocks from recently reprocessed digital gravity and aeromagnetic maps of Alabama. Rock samples collected from drill cores will augment her geophysical findings and further characterize the tectonic evolution of the crust. In addition to providing a clearer view of regional geologic history, this project will provide an improved understanding of rocks that host economically significant petroleum resources under the Alabama Gulf Coastal Plain.

find appealing. HudsonAlpha believes professors working outside of academia can feel comfortable moving to a free-standing institute where they know that other academics are nearby and immediately accessible through partnership agreements.

"It is particularly exciting to me because external collaborations with great research institutions such as Auburn help us progress toward all three Institute goals: research, educational outreach, and economic development. Having our first agreement be with an Alabama university was extremely important to us," said Chairman of HudsonAlpha's Board of Directors, Lonnie S. McMillian.

The focus of the first collaboration in genomic research is currently under discussion with professors in the College of Sciences and Mathematics.

-Timothy Meeks



(from left) ***Harris Carmichael is researching light-activated polymers under the mentorship of Dr. Jimmy Mills.***

Under the mentorship of chemistry and biochemistry's Jimmy Mills, **Harris Carmichael's** research is in the field of light-activated polymers. The polymeric materials studied by their group are similar to plastics utilized by millions everyday. From the plastics that constitute food containers, to those of your sunglasses, polymers affect everyday life in a myriad of ways. Carmichael's research is centered on producing highly reactive species, called radicals, which result when light induces reactions of their polymers. After energizing the polymers with particles of light called photons, Carmichael's job consists of finding ways to utilize the radicals in new chemical transformations.

Many of the polymers employed by the research group's lab can be converted to more practical solid forms consisting of thin films. Their aim is to obtain very thin polymeric films that are insoluble in water, flexible, yet exceptionally durable. Such films will allow them to utilize the reactions discovered in the lab for real-world applications. For instance, a possible application of these polymeric radicals is for the separation of toxic species, such as copper, lead and zinc ions, from contaminated waters. One would simply immerse the films in the contaminated waters and expose them to sunlight to trigger transformations of the metal ions that will attach them irreversibly to the research group's plastics. Another application would be to achieve food packages that can kill harmful bacteria. Certain types of the group's films, when properly irradiated with photons, have been observed to inactivate bacteria by means of the high reactivity of the polymeric radicals. Such films could replace the plastics that currently wrap the meat in the grocery stores, and would eliminate bacteria from foods thus providing a safer product for the consumer. A final application is the possibility of producing hydrogen from polymeric materials that are currently waste products from the cellulose industry. Since such polymers are produced from wood, and because hydrogen is a highly energetic gas, the research group's process would generate renewable energy. This process would employ energy from the sun as the driving force and converting photons into valuable chemical energy. With so many possible applications it is clear that Mills's and Carmichael's research could yield a variety of benefits to society.

Auburn University has teamed up with other universities that have a tiger mascot in order to raise funds for tiger conservation efforts. The program is called *Tigers for Tigers* and is sponsored by COSAM s Society for Conservation Biology (SCB). "All the wild tigers left in the world wouldn't even fill the student section in Jordan Hare Stadium," said SCB member Anne-marie Hodge. For more information on *Tigers for Tigers*, visit the Society for Conservation Biology s Web site at www. www.auburn.edu/student_info/societyconbio/.

Photo by Carson Studios

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