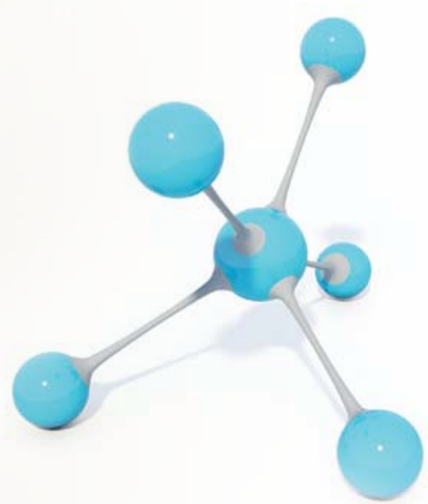
OAKLAND UNIVERSITY » Fall 2009

OURESEARCH

Volume 2, No.1



Message from Virinder Moudgil

Dear Friends,

Can we develop a blood test to identify our risk of Alzheimer's disease? Can we restore brain cell function after a stroke or injury? How do we combat cyber crime? At Oakland University, our expert researchers are finding the answers to these questions and more.

Each year, Oakland invests more than $25 million in research. More notably, our faculty members are currently receiving record amounts of external funding to support unprecedented research and creative endeavors. Every day in our laboratories, life-changing investigations are being conducted. In this issue of *OU Research* you will read about some of these achievements, including the development of a complex computer-based model which will increase the effectiveness of cardiac defibrillators, the development of a system to measure patient satisfaction and improve outcomes, and a study exploring how virtual communities create value to users.

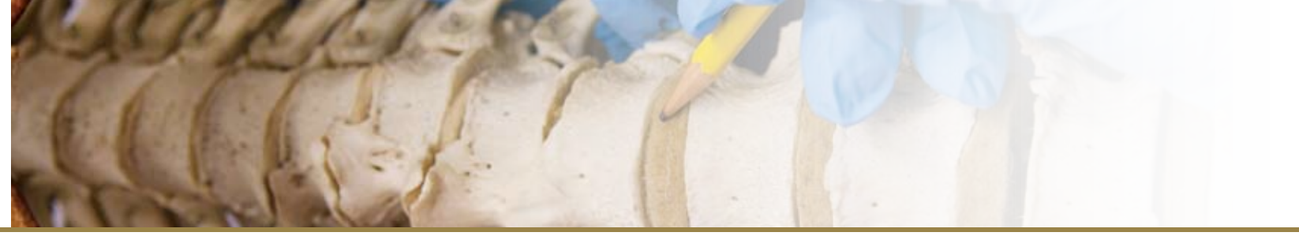
Our accomplished researchers also serve our students as leaders and mentors in classrooms, instructional research laboratories, and field work. Numerous faculty-sponsored student projects have gained regional and national recognition. Our students enjoy a myriad of opportunities to learn through one-on-one interaction with noted and accomplished faculty.

However, we are living in challenging times. The global financial crisis is impacting Michigan's higher education bottom line significantly. And this includes the support available for important research. Fortunately, funds from the American Recovery and Reinvestment Act (a.k.a. the federal stimulus act) will help keep many of our research endeavors moving forward. Among these are OU's Noyce Teaching Scholars program, which targets high-quality science, technology, engineering and mathematics (STEM) career-changers and ground-breaking work with photoreceptor cells to repair glaucoma, among many others. As good stewards of these funds, we're are proud to unquestioningly say that the research this financial support facilitates will make a significant impact on our health, our employment future and our economy. We are grateful to be a recipient of these funds.

At Oakland University, we are extraordinarily proud of the research accomplishments of our faculty and students. I hope you enjoy reading about some of these achievements, and are equally inspired as well.

Virinder Moudgil, Ph.D.
Senior Vice President for Academic Affairs and Provost

Moudgil is an OU professor of Biological Sciences whose more than 30 years of research on steroid hormone action and breast cancer. The research in his laboratory has been supported by funding from the National Institutes of Health. His early work examined structural and functional alterations in the steroid receptor proteins induced by a process of phosphorylation, and his laboratory was the first to report a link between differential actions of ovarian hormones (estrogen and progesterone) and induction of P53 in T47D breast cancer cells. Along with his team of graduate and undergraduate students and a faculty colleague, Moudgil is currently investigating hormonal regulation of tumor suppressor proteins, p53 and retinoblastoma, in human breast cancer cells. He is the series editor of *Hormones in Health and Diseases* and chairman of the Scientific Committee, Meadow Brook Conferences on Steroid Receptors in Health and Disease.



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Group think

The value of virtual communities

In the past, when groups of like-minded people wanted to discuss mutual interests, they staged conferences or conventions. But when those meetings ended, so, too, did their conversations.

Today, "virtual" or Web-based communities offer electronic forums for endless discussion and interaction. How useful are virtual communities to their constituents, and why do some thrive while others fail?

That's something Balaji Rajagopalan, associate professor of Management Information Systems, would like to know. Rajagopalan is studying several virtual communities to determine their inherent value for users and how businesses might glean valuable information from them.

He researches how virtual communities generate value and what makes them successful. He defines a virtual community as a place where technology enables communication; where the community has a subject of interest that binds it together and where people identify themselves with a group.

"Basically, it's a place where people go to share their knowledge and connect with the members of the community," he says. He adds that there are two primary categories of benefits — information and social network. While virtual communities like Facebook focus on delivering social networking benefits, forums like Yahoo Finance generate value through information sharing among the participants.

In his first major study, funded through a $500,000 grant from the National Science Foundation and launched in partnership with colleagues from the University of Texas at Austin, Rajagopalan focused on competition among information sharing based virtual communities.

"When you have multiple communities focusing on related subjects, we wanted to know how they compete and how people chose which community to participate in," he explains.

The research revealed that communities differentiate themselves based on quality versus quantity. For example, some message boards may generate a thousand posts per day. That can be attractive to someone looking for a wealth of differing voices. But the quality of those posts may be lower than the discussions found in a community with less traffic but more dedicated members.

Rajagopalan's study also yielded another benefit: it earned him Best Paper honors from *Information Systems Research*, one of the top journals in the field.

Rajagopalan and his co-researchers, professors Bin Gu and Prabhudev Konana from the University of Texas at Austin, analyzed more than 230,000 messages posted on the Yahoo! Finance message boards for the 30 stocks that comprise the Dow Jones Industrial Average to determine if the advice these virtual community members were giving each other had information value.

Could a person make money, for example, by listening to their fellow message-board members?

"Taken collectively, there's not much information value: one says buy, another says sell," Rajagopalan says. "But if you focus on specific participants, you can track their advice success rates and the information from this group can be valuable."

While virtual communities can serve as fonts of information, they are also fertile ground for spreading rumors. Rajagopalan says he hopes to better understand how rumors are generated and diffused, as well as which types of rumors spread quickly and why. He notes his findings could be of great value to corporations combating rumors and misinformation about their products.

Ultimately, Rajagopalan says his research may help companies understand the power of virtual communities.

"We look at the dynamics of the information generated and how these communities can impact information flow, new product development and the improvement of an existing product," he says. He adds that virtual communities have the potential to revolutionize how a firm interacts with the user community.

For example, when a technology message board launches into a discussion of the latest "smart" phone, it is providing free and unfettered feedback for any company willing to listen.

For companies that put their ears to these virtual doors, the voices of consumers on the other side can help to build their bottom line. And, for those participating in virtual communities, the potential exists for an ongoing exchange of ideas and opinions that can be as invigorating as any Socratic exercise. Surely, a win-win for everyone.

By Liz Lent

Virtual communities have the potential to revolutionize how a firm interacts with the user community.

Balaji Rajagopalan
Associate Professor of Management Information Systems

Rajagopalan received his Ph.D. in business administration from the University of Memphis, Tenn. His current research interests are in the areas of design, development and impact of virtual communities and open source development. His work has been published in several top-tier journals, including *Information Systems Research, Information Systems Journal, IEEE Transactions on Systems, Man, and Cybernetics, and European Journal of Operational Research*. He was awarded a $500,000 National Science Foundation grant in 2002. He has served as the mini-track chair at the Americas Conference on Information Systems for the last eight years, and is the program chair for the Americas Conference on Information Systems to be held in Detroit, Mich., in 2011.

Jacqueline Drouin
Associate Professor of Physical Therapy

Drouin earned her B.S. in physical therapy and her M.S. in exercise science from Oakland University, and also has a Ph.D. in educational evaluation and research from Wayne State University in Detroit, Mich. With a clinical background in acute care, oncology, pediatrics and orthopedics, Drouin's current research focus is studying the effects of aerobic exercise testing and training in individuals with cancer. She recently conducted a study on energy expenditure during radiation treatment for breast cancer that will be presented at the American Physical Therapy Association's meeting in February 2010. Her most recent journal article, an extensive review of the medical literature to examine side effects of breast cancer treatments, was published in the July 2009 issue of the journal *Breast Cancer Research and Treatment*.

Fighting fatigue

Fitness eases cancer treatment effects

For those living with cancer, fighting the disease can feel like only half the battle. The cure — whether chemotherapy, radiation or both — can be nearly as harrowing.

Jacqueline Drouin, associate professor of Physical Therapy, would like to see that situation change for the better. In her studies on fatigue in cancer patients who are receiving such treatments, she is exploring the possibility that physical exercise may help mitigate both the physical and mental toll of those daunting but necessary therapies.

Certainly it's understood that the intrusive nature of chemotherapy and radiation contributes to much of the fatigue, Drouin says, but how much does a loss of physical conditioning add to that toll?

"Patients who are not physically active lose energy and muscle mass," she observes. "Sometimes depression sets in, and whatever natural defenses a healthy body can provide are compromised."

Drouin realized that many oncology patients simply didn't have guidelines or encouragement to become fit. She began researching the subject while a graduate student and got to know several oncology patients who were supportive of her investigation.

One patient with late-stage terminal cancer asked to take part in her research. She established a course of exercise for him. At first, he could walk only a few yards at a time. Within two weeks, he was walking eight blocks.

"The color was back in his face, and he could eat regular foods," Drouin says, explaining that regular exercise tends to limit the nausea associated with chemotherapy. "He was also able to eliminate some of his pain medication."

The man lived several months longer than expected, she says, and, for the duration of that reprieve, experienced an enhanced quality of life.

"That was a real touchstone moment for me," Drouin recalls. Soon after, an oncologist helped her set up a study of women who were in treatment for breast cancer. She established a regimen in which half the women performed aerobics three times a week while the other half did placebo flexibility activities.

"After radiation, the women training were more fit and had less fatigue, less anger and depression and had lost some of the weight gained during treatment," Drouin says.

Drouin has formed a partnership with a team of doctors and researchers at Beaumont Hospital in Troy, Mich., which plans to open a comprehensive cancer care facility in 2010.

With a $15,000 OU-Beaumont Multidisciplinary Grant, Drouin and her Beaumont counterparts, including Dr. John Maltese, physical therapists Reyna Colombo and Janet Seidell, and registered nurses Ann Calcaterra, Christine Mitchell and Angela Maynard, are delving even deeper into the connections between fatigue and treatment.

Currently they are working with individuals with breast and prostate cancer to develop objective ways to measure fatigue, locate its causes and improve upon the current methodology. They have begun collecting data on the number of kilocalories burned by test patients each day, the number of steps taken, and the quality of sleep.

"Beaumont has been very supportive of the project and its team has offered great ideas on how to advance the research," Drouin says.

OU graduate students have also played an important role in the study, she adds, both with data analysis and the main research.

Physical therapy graduate student Emily Wilson, for example, is helping to explore the effects of radiation treatment on sleep quality and quantity. "For me, it's been a great opportunity to learn about the research process," she says.

Drouin notes that once the baseline data has been collected, she and her team will turn to a more extensive study of aerobic exercise fitness, which can improve cardiovascular fitness and the hormone system — key components in helping patients regain their physical footing once treatment is over.

With more people than ever surviving cancer, health and wellness promotion issues have become paramount.

"In the past, people were happy just to survive this disease," Drouin says. "Today, we want to see them not only survive, but get right back to healthy living."

By Liz Lent

"After radiation, the women training were more fit and had less fatigue."

Spin control

Taking magnetic research to a new level

Andrei Slavin thinks big — with good reason.

The Department of Physics he chairs is having a banner year. The 10-member department has obtained new grant money totaling $2.9 million. It also produces more than 100 publications per year in some of the most prestigious research journals, while undergraduates who major in physics have increased by 14 percent from last year.

When it comes to research, however, Slavin thinks small — very small. His primary efforts are focused on the emerging field of nano-magnetism or magnetism of nano-sized (10^-9 meter) particles and structures.

Deep in this infinitesimal world, big discoveries may await. The work on tiny magnetic structures that Slavin and his research team are conducting could lead to a breakthrough in communication technology, he says.

"We are trying to develop a new nano-sized generator of microwave (10^9-10^ Hz) oscillations using the fact that electrons carry not only the electric charge, but also their own magnetic moment or spin," says Slavin, a theoretical physicist who collaborates with several leading experimental groups in Germany, France, Ukraine, Sweden and the United States.

Last year, Slavin had more than $250,000 in external funding from the U.S. Army Research Office, the U.S. Army Tank Automotive Research Development and Engineering Center (TARDEC), and the National Science Foundation.

Most recently he and several OU scientists were invited to participate in a highly competitive U.S. Army Pilot Program to conduct basic research in the field of spintronics, or electronics in which electron spin is taken into account.

"This area is the modern frontier in magnetism," observes Slavin, the recipient of the OU 2009 Award in Research Excellence.

Indeed, spintronics was still in its infancy when Slavin joined OU in 1991. Nobel Prize recipients (2007) Albert Fert and Peter Grünberg, who independently discovered giant magnetoresistance (GMR) in 1988, are credited with introducing this field of research, which looks at not only the charge of an electron, but its magnetic moment, or spin, as well. The discovery of GMR has made advances in hard disk drives possible.

Slavin's research depends on GMR and its opposite, the spin-torque effect. It is his expectation to develop new fully metallic generators of microwave oscillations that could be used for communication and signal-processing systems in civil, military and space-related applications. In fact, he hopes that these microwave generators will be used in the next generation of microwave signal processing devices in nano-electronics.

"These generators are very small, cheap and can withstand ionizing radiation, which is in contrast to semiconductor transistors," says Slavin, whose research also concerns the fundamental knowledge about the spin-dependent transport effects at nano-scale.

"Our research is unique in a sense that we are trying to develop simple analytic models in the area where our competitors mostly rely on numerical modeling," he adds.

Slavin and his collaborator, Vasil Tiberkevich, recently published a paper in the journal *IEEE Transactions on Magnetics* (April 2009), which highlights their development of a simple model of spin-dependent dynamic phenomena in magnetic nano-structures.

"We demonstrated that the complicated spin-dependent processes in magnetic nano-structures can be explained using the simple model of a nonlinear oscillator studied in the elementary course on Vibrations and Waves, which I teach at OU," says Slavin.

Having worked in the field of nonlinear magnetism for more than 25 years, Slavin's segue into the emerging technology of nano-magnetism was an easy transition. "I realized I could contribute, and it has worked very well."

Since theoretical work requires absolute concentration, his best research is completed when he's away from his administrative and teaching duties and can sit with his computer and attempt to understand experiments done by his collaborators.

"From the outside it looks rather dull," admits Slavin. "Exciting moments come when the experiment is understood and we demonstrate that our simple but general model was capable of explaining the new experiment."

By Alice Rhein

"This area is the modern frontier in magnetism."

Andrei M. Slavin
Professor and Chair of Physics

Slavin received his Ph.D. in physics from St. Petersburg Technical University in St. Petersburg, Russia. Slavin developed the state-of-the-art theory of spin-torque oscillators, which has numerous potential applications in the computer and communications industries. His current research support includes multiple grants from the U.S. Army and the National Science Foundation. This research involves international collaborations with leading scientists in many countries, including France, Germany, Italy, Spain, Ukraine and the United States. Slavin is frequently invited to speak at magnetism and multidisciplinary conferences around the world.

Janet Graetz
Assistant Professor of Education
Graetz received her Ph.D in special education/instructional technology from George Mason University in Fairfax, Va. Since the 1960s, her work has centered on individuals with disabilities, both as a researcher and as a classroom teacher, primarily with children and young adults with autism. She also has worked with individuals with disabilities in state institutions and nursing facilities. Specific research interests include video modeling and quality of life for individuals with autism spectrum disorders.

Strategies for success

Helping students with Asperger Syndrome transition to college

For students with Asperger Syndrome (AS), the move up to college can be a challenge. But to Janet Graetz's thinking, it's all a matter of accentuating the positive.

The assistant professor of Education is focused on creating an approach to academic life that encourages successful transitions for those with AS, an autism spectrum disorder that affects aspects of their social understanding, language usage and sensory integration.

Her work has a practical and immediate application for OU, she says, as the university every year experiences an increase in the number of students with AS.

"Autism is frequently viewed as a deficit model — what individuals can't do — but we need to recognize the gifts and strengths of this population," says Graetz, who has worked with individuals with developmental disabilities for 30 years. "We need to be accepting of individuals who perhaps see the world differently than we do."

With a $29,832 study funded by the Organization for Autism Research (OAR), Graetz is investigating the college experience at OU of 19 students with AS to identify the supports that promote their success in an academic setting.

The study, which began in January 2008, culminates this fall when Graetz and Associate Professor James Javorsky, data analyst for the study, present their results at the OAR Scientific Conference and to the Autism Society of America.

"We wanted to know how individuals with AS describe their college experiences, how stressful they find the experience, and discover what types of support they are presently using," says Graetz, who joined the Human Development and Child Studies faculty at OU in 2003.

Students in the study reported weekly, identifying supports they found helpful, extracurricular activities they participated in, and peer support they received. Unlike typical college students, Graetz says, individuals with AS may struggle with simple socialization, finding it difficult to make casual conversation or establish friendships.

"They may be very bright but still have difficulty in reading social situations," she says. "While most of us learn social cues by watching others, this does not come so easily for someone with AS."

Some individuals do not discover they have AS until they are evaluated as an adult, Graetz says. An earlier diagnosis may have been noted as Attention Deficit Disorder or Specific Learning Disability, she says.

Graetz expresses concern that the plight of adolescents and adults with autism spectrum disorder is overlooked. She notes that most funding in autism research today is aimed at young children, due to the alarming increase in reported cases.

The Centers for Disease Control and Prevention estimates that autism occurs in one of every 150 births — profoundly higher than just a generation ago, when it was said to occur in only one of 10,000 births.

"What works best for older individuals?" she asks. "We still need to address the question of how we improve the quality of their lives and the lives of their caregivers, as well."

Graetz's research also includes: spirituality and AS; the use of video eyewear for adolescents with autism; and quality-of-life issues for adults with autism spectrum disorder. Graetz says she hopes to share her findings with other colleges and high schools so they can better serve their AS populations.

"We at OU are fortunate that our Disability Support Services office is spending a great deal of time addressing the issues that surround these students," she says, adding that the university has offered programs for teachers seeking an autism endorsement for more than 20 years.

She points to the Oakland University Center for Autism Research, Education and Support (OUCARES) as the locus of autism-related work at OU.

"At OU, we prepare teachers to work with students with autism," says Graetz. "We give them the tools to further the lives of their students and also to learn about themselves as practitioners along the way."

By Alice Rhein

"We need to be accepting of individuals who perhaps see the world differently than we do."

Fundamentals

Understanding the invisible world of intermolecular forces

It's more than meets the eye.

For more than 30 years, Maria Szczesniak Bryant, professor of Physical/Theoretical Chemistry, has dedicated her career to building the foundation of basic science. Her research, which includes more than 130 published papers, is not aimed at immediate applications, but rather at enlarging the sphere of general knowledge.

"In a nutshell, basic research discovers new phenomena, new properties of matter, and explains observations," says Szczesniak Bryant. "When these phenomena, properties and observations are well understood, they can be applied to new technologies."

Carrying out basic research in the field of intermolecular interactions may involve looking at how a hydrogen molecule interacts with solid materials and to design such a material where this interaction would have desirable properties, for example. The broader application of that research could be the development of hydrogen storage devices for cars of the future.

"The search for such materials is still ongoing despite the efforts of many scientists," says Szczesniak Bryant.

While technology usually develops through applied science, it is the basic science that lays the groundwork for these future applications.

Explaining the foundation of her research, Szczesniak Bryant says, "Weak interatomic and intermolecular interactions are responsible for a wide variety of phenomena, from protein structure and function to the new phases of matter that exist at one-millionths of a degree K. The experimental measurements provide only indirect pictures of these interactions and the theoretical first-principle calculations are the only direct source of knowledge about them. The focus of my work has been on theoretical description of these forces."

Supported by external grants since 1986, Szczesniak Bryant's research has several thrusts, including: developing the accurate computational methodologies, working towards the fundamental understanding of their origins, and mapping the resulting potential energy landscapes.

"Over the years, my work has spanned a wide diversity of systems governed by these forces: hydrogen bonds, van der Waals complexes, many-body clusters, free-radical associations, interactions of transition metals and Lanthanides," says Szczesniak Bryant, whose 20-year collaboration with Professor Grzegorz Chalasinski of the University of Warsaw, Poland and a visiting professor at OU, has produced several papers that have been cited hundreds of times.

How important are these forces? Hydrogen bonds hold together two strands of DNA. They are responsible for unusual properties of water which have allowed for the miracle of life. Van der Waals forces cause gaseous substances to solidify at low temperatures. Clusters, meanwhile, are clumps of matter from a few to a few dozen of atoms or molecules bound by these forces.

"Clusters behave as neither a solid nor a liquid, but something in between," says Szczesniak Bryant, whose current project funded by the National Science Foundation for $291,400 is titled "Interactions in Open-Shell Clusters."

Some of the species she is currently studying include free radicals, which are important chemical intermediates in atmospheric processes, combustion phenomena, physiology and in interstellar media.

"I am interested in many unusual ways these species interact with each other and with other surrounding molecules," she says. "My principal tool to study how these interactions take place is computational quantum chemistry."

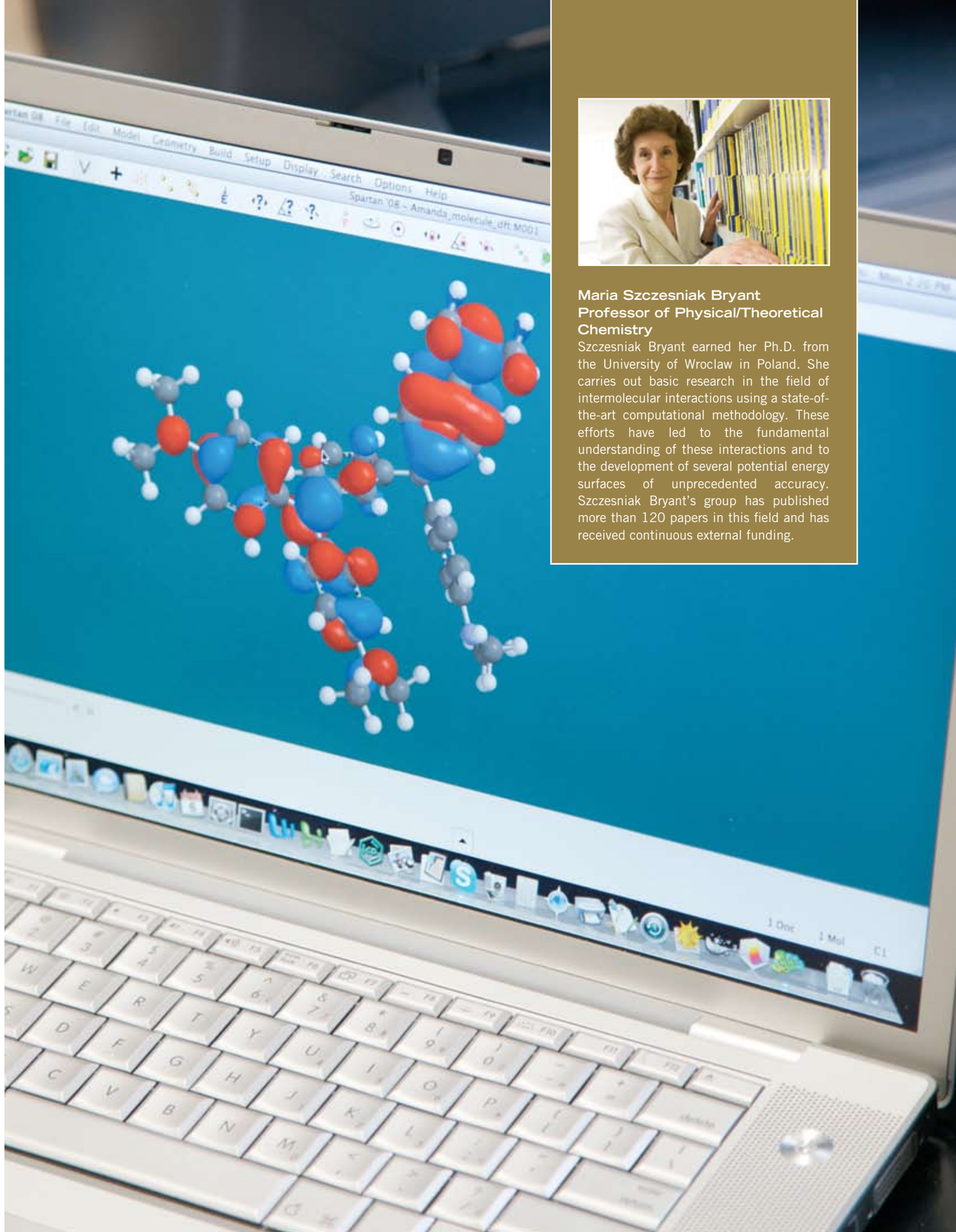
She says scientists are interested in clusters for a variety of reasons, one of which is that they allow them to follow a transition from a single molecule to the bulk matter adding one molecule at a time. "Important chemical and biological phenomena, such as solvation, for example, can be studied at the molecular level."

Over the years, Szczesniak Bryant's group has consisted of graduate students, post-doctoral fellows, research associates, undergraduate students and senior collaborators. Many of her former junior colleagues have gone into careers in academia.

There are other benefits to society from its investment in basic science. "We pass this knowledge on to students in our courses and train highly educated future scientists and citizens," she adds.

By Alice Rhein

"We pass this knowledge on to students in our courses and train highly educated future scientists."



Maria Szczesniak Bryant
Professor of Physical/Theoretical Chemistry

Szczesniak Bryant earned her Ph.D. from the University of Wroclaw in Poland. She carries out basic research in the field of intermolecular interactions using a state-of-the-art computational methodology. These efforts have led to the fundamental understanding of these interactions and to the development of several potential energy surfaces of unprecedented accuracy. Szczesniak Bryant's group has published more than 120 papers in this field and has received continuous external funding.

Hoda S. Abdel-Aty-Zohdy
Professor of Electrical and Computer Engineering, Founder and Director of Microelectronics System Design Lab

Abdel-Aty-Zohdy received her B.A.Sc. degree (with first class honors) from Cairo University and her M.A.Sc. and Ph.D. from the University of Waterloo, all in electrical engineering. She is a Distinguished Lecturer for the IEEE Circuits and Systems Society and has authored 168 publications. She has chaired, organized and served on many engineering professional committees and served as the technology leader of bio-inspired systems at the WPAFB . She was a research fellow for AFOSR, DARPA, NAS/NRC, and NSERC and a plenary speaker at the IEEE NAECON, 2009; the keynote speaker at PACRIM 2007; speaker of the OU President's Colloquium in 2005; plenary lecturer at the ICT05; and keynote speaker at NEWCAS 2004, the ECCTD 2003, MWSCAS 2003 and the IEEE ICCC 2001. She has presented tutorials at the IEEE NAECON09, and MWSCAS03.

Integrated circuits

On-site and on-time decision applications

Oakland University's Microelectronic Systems Design Lab (MSDL) has gained reputation as a center of innovation in the high tech world among many high tech-related engineering centers, and among faculty and students who are researching cutting-edge integrated circuits, hardware biologically inspired systems, and integrated circuits capable of on-site and real-time decision making applications

This is due primarily to the efforts of Hoda S. Abdel-Aty-Zohdy and her graduate and undergraduate students in electrical and computer engineering. Many of her former doctoral students have since gone on to leadership positions in academia, industry and government, nationally and internationally.

Abdel-Aty-Zohdy is a leader in neuromorphic very large scale integrated circuits (VLSICs). Her lab specializes in devising new ways to use different materials (polymers, graphite, protein, and silicon) with novel approaches that allow computers to "almost" reach the human brain capability. Using the classical Von Neumann's computing machines to build a brain-like computer (smart in making decisions and adjustable to the surrounding environment) would require a volume of about 40 gigaliters, and consume power of about 10 gigawatts. Biological human brain comprises only 1 liter in size, and consumes just 15 watts of energy. Neuromorphic approaches will provide solutions within reasonable space and power.

One particular development led Abdel-Aty-Zohdy and doctoral candidate Jacob Allen to design and implement the complete decision-making Spiking Neural Network (SNN) electronic nose with one million possible inputs. This integrated system approach to SNNs mimic that of biological spiking phenomenon and can detect an almost unlimited number of odors. The result of a nine-year relationship and grant support from the Air Force Research Lab, this unique device was granted a U.S. patent and could be further used for all biological sensors and detectors, signal processing and de-noising and decision-making applications in medical and radar detection applications.

"Our Spiking Neural Network System has the potential of filtering out the noise in radar signals while filling in missing information on the signals it wants," adds Abdel-Aty-Zohdy.

Scientists have long sought to model the brain and unlock its secrets. Understanding brain dynamics (how humans think) is a holy grail of science that is still a mystery after about 45 years of diverse research. The body of neural related knowledge spans scientific disciplines from physiology to engineering. The motivations of neural network research can be classified broadly into two categories. In one category, researchers are attempting to understand and explain biological neural systems. In the second category, researchers are attempting to solve specific problems using techniques inspired by biological systems. The two categories define the bio-inspired technologies.

Abdel-Aty-Zohdy is one of the most highly-cited researchers in the area of bio-inspired technologies. She has given many invited talks around the world, including distinguished lectures and keynote/plenary addresses. She was recently called upon to serve as a leader of this area at the Wright-Patterson Air Force Base, 20072008. The lab currently works with several Michigan-based companies, including ECD, Ovshinsky Innovations, and Graphi-Tech Inc., to expand the scope of new hybrid multifunction logic circuits to include those that can self-generate energy. "Devices with these capabilities could be used in deep space, or to monitor the heart rate and respond accordingly," she says. Other research being explored by Abdel-Aty-Zohdy and her students involves technologies that have the potential to reduce the size of computing systems while increasing their capabilities, speed, and decision-making abilities.

By Sandra Beckwith

"Devices with these capabilities could be used in deep space, or to monitor the heart rate and respond accordingly."

Eye site

Shedding light on glaucoma treatment

Glaucoma is the leading cause of blindness in the United States, according to the National Institutes of Health, and anyone can develop it. Those with a family history, African Americans over 40, and everyone over 60 are at a higher risk, but glaucoma has no prejudices.

"Primary open-angle glaucoma is an irreversible disease that affects more than 60 million people worldwide," says Shravan K. Chintala, an associate professor of Biomedical Sciences at Oakland University's Eye Research Institute. "Ironically, 50 percent of its victims are unaware of the damage to their retinas."

Dubbed "the silent thief of sight," glaucoma is not a single disease, but a group of diseases in which death to retinal ganglion cells is a common end. Those with the disease aren't aware of it because it is generally painless and symptoms creep up slowly. As the disease progresses, vision narrows until a pinpoint of light may be all that remains.

A normal eye, like an inflated balloon, needs a specific pressure to maintain its globular properties. The internal pressure is maintained by a substance called *aqueous humor*, but if the flow of this fluid is obstructed, the pressure increases. Although an elevation in intraocular pressure remains the only proven risk factor for glaucoma, the mechanisms that initiate the insult and subsequently lead to retinal ganglion cell death are poorly understood.

Chintala's laboratory is focused on understanding the role of proteases in the death of these cells. His hypothesis is that elevated intraocular pressure leads to the production of proteases, or enzymes, in the retina, and these enzymes cause the death of retinal ganglion cells.

Through his investigation, Chintala has found three proteases (matrix metalloproteinase-9, tissue plasminogen activator and urokinase plasminogen activator) that promote the death of retinal ganglion cells by degrading the extracellular matrix in the ganglion cell layer.

With a $740,000 grant from the National Institutes of Health, Chintala is investigating ways to decrease the production or inhibit the action of those proteases.

"One of the unique features of the proteases is that basal levels of these are required for processing visual information in the retina, wound healing of the cornea, and wound healing of the skin," says Chintala, who was also one of the team members who identified ELAM-1 (endothelial leukocyte adhesion molecule) as the first known molecular marker for glaucoma in humans.

"However, when the levels of these proteases are increased more than the basal levels, these proteases cause significant damage to the retina and scar formation in the cornea."

Chintala, who completed training in neurobiology from M.D. Anderson Cancer Center and training in cornea from the New England Medical Center of Tufts Medical School in Boston, Mass., before joining OU eight years ago, says his long-term goal is to investigate what mechanisms regulate the levels of these proteases in the retina.

Along with his research team, which includes two former post-doctoral fellows, Xu Zhang and Raghuveer Mall, and Mei Cheng, a former research technician, Chintala is investigating whether certain agents with the potential to inhibit synthesis or action of the proteases can prevent glaucoma in laboratory animals.

In addition, undergraduate students work in Chintala's lab every summer through the Summer Undergraduate Program in Eye Research (SUPER) program.

"One great thing about the SUPER program is that, after obtaining research experience, a majority of the students thus far have followed career paths to medical schools and optometry schools," he says.

While Chintala says he is seeking to understand how glaucoma robs eyesight, his ultimate aim is to develop pharmacological agents that inhibit the adverse action of these proteases to prevent the ganglion cell loss. In other words, his research could lead to the development of appropriate therapeutic agents that could prevent or attenuate blindness in glaucoma patients.

And, for now, that's where his sights are set.

By Alice Rhein

"After obtaining research experience, a majority of the students thus far have followed career paths to medical schools and optometry schools."

Shravan Chintala
Associate Professor of Biomedical Sciences

Chintala received a Ph.D. in microbiology from Osmania University in India. He obtained his formal training in cell biology at the Cleveland Clinic Foundation and in molecular biology and neuroscience at the University of Texas M.D. Anderson Cancer Center. Chintala has extensive experience on small animal models related to glaucoma and on the function of matrix metalloproteinases (MMPs) and plasminogen activators in the death of retinal ganglion cells. He helped identify ELAM-1 (endothelial leukocyte adhesion molecule) as the first known molecular marker for glaucoma in humans. Chintala's current and previous research is funded by the National Eye Institute. He previously also received funding from the Massachusetts Lions Eye Research Fund.

Brad Roth
Professor of Physics,
Director of the Center for Biological Research

Roth received his doctoral degree in physics from Vanderbilt University and is widely published, highly cited and recognized for his work in researching bioelectrical and biomagnetic phenomena. He was a research fellow at the National Institutes of Health (NIH) before becoming a professor at Oakland University.

Roth has mentored many graduate and undergraduate research students. For six years he has been president of OU's Chapter of Sigma Xi, the national scientific research society. Outside the university community, Roth was recently elected as a fellow in the American Physics Society and is on the editorial boards of *The Journal of Cardiovascular Electrophysiology* and *Heart Rhythm*.

Shock value

Making cardiac defibrillation more effective

We have seen it so many times on television dramas that we almost feel we could do the procedure ourselves: the ER patient is in cardiac arrest, the physician rushes in and yells "clear!" Paddles rub together, the patient's body jumps, and the heart monitor begins a steady, rhythmic beep again. Saved.

But, in reality, it's only a 50-50 chance that a defibrillator shock will be successful. Scientists at Oakland University and Beaumont Hospitals are working to determine how to make it a sure thing.

Experts say the most common cause of cardiac arrest is a heart attack that results in ventricular fibrillation, which affects more than 300,000 individuals in the United States each year. Eight out of 10 victims of ventricular fibrillation die within about five minutes.

But early defibrillation — within the first three to five minutes after collapse — can result in higher long-term survival rates for victims of ventricular fibrillation. Bradley Roth, professor of Physics, thinks we can do even better.

"When a heart experiences ventricular fibrillation, the only way to restore a normal rhythm is to apply a strong electrical shock, or defibrillation," explains Roth, who, with fellow researchers, is developing computer-based models to determine how defibrillation works.

"Defibrillation can be done at the wrong time, and in general, is not good for the heart," he says. "It causes pain for the patient, can damage the heart, and can have other negative side effects in the long run. But this research can eventually help us determine a way to administer a weaker, yet more effective defibrillation procedure."

Roth's research is based on the bidomain model, a set of mathematical equations that govern the electrical properties of cardiac tissue. The model, developed in the late 1970s, is a two- or three-dimensional cable model which predicts electrical behavior averaged over many cells. The model accounts for the different electrical conductivities of the intracellular and extracellular spaces.

By expanding on this model, researchers can describe how electrical impulses move through the heart. In the heart, electrical signals move down cardiac fibers to make the atria, or upper chambers, contract before the ventricles, or lower chambers. The signal fans out in all directions, skipping from muscle cell to muscle cell so that every cell in the heart responds by contracting. The cells relax briefly while awaiting the next signal. The computer-based model accurately describes how electrical signals move along cardiac fibers and then through muscle cells of the heart. It can also describe what happens when this rhythm breaks down.

Roth explains that, in ventricular arrhythmia, something happens to cause an extra beat signal that becomes self-perpetuating. The extra signal spreads out across the heart as a spiral, then re-enters the natural pathway, causing extra contractions. The result is a faster beat, which can quickly become chaotic. This leads to life-threatening ventricular fibrillation, in which the lower chambers of the heart are unable to pump.

Roth's research uses simulated defibrillation, employing realistic heart geometry to plot the surface of the left and right ventricles. When a shock is applied, researchers are able to calculate where the heart surface is depolarized and where it is hyperpolarized, which are the conditions required to perform defibrillation. The model provides insight into how to conduct a successful defibrillation.

The research, which Roth began in graduate school at Vanderbilt University and continued after joining OU's faculty in 1998, has been funded by grants of more than $500,000 from the National Institutes of Health, the American Heart Association (Midwest Affiliate) for approximately $250,000, and an OU-Beaumont Multidisciplinary Research award for $15,000.

"We are still a ways from completely understanding ventricular fibrillation," says Roth. "If we can more clearly understand the 'why,' we will be able to more effectively use defibrillation and eventually design procedures to prevent ventricular fibrillation. It's promising, but our work is just getting started."

By Susan Thwing-McHale

"When a heart experiences ventricular fibrillation, the only way to restore a normal rhythm is to apply a strong electrical shock, or defibrillation."

Breaking the spell

A better approach to conquering addiction

It's a puzzle that has vexed researchers and social scientists for decades. What causes some people to relapse into alcoholism while others succeed in overcoming their addiction?

Finding the answer to that question is not simply an academic exercise to Keith Williams, associate professor of Psychology. His research into the underlying biological and psychological mechanisms behind alcoholism and substance abuse could have far-reaching effects.

Indeed, in the United States alone, nearly 18 percent of the population — 1 in every 12 adults — abuses or is dependent on alcohol, according to the National Institute on Alcohol Abuse and Alcoholism (NIAAA).

"Unfortunately, it's ubiquitous," says Williams. "I don't think I've ever met anyone whose life was not touched in some way by alcoholism or substance abuse. We all know someone who's had a problem with it."

The prognosis for recovery is not encouraging. Statistics from the NIAAA show that relapse is a common occurrence, with only 1 in 10 individuals who are in treatment for alcoholism able to maintain long-term sobriety.

Williams's research into this troubling aspect of human behavior begins at the point where psychology and biology meet, by studying the pharmacological and behavioral mechanisms of drug reinforcement and craving. He also explores possible pharmacological therapies for alcoholism.

"My focus is on a biopsychological model that looks more toward the biological side of the study," he says. "How do people develop alcoholism? What part does genetics, hormones or brain receptors play? Are there genetic markers that could alert us to the potential for dependency? There's still a lot we don't understand."

Funded by a $150,000 grant over three years from the National Institutes of Health, Williams is working to bring new light to this old problem. His research is focused on understanding the pharmacological effects of "opiate antagonists," drugs which have allowed some people to overcome their addictions.

Opiate antagonists may help to reduce the craving for alcohol or drugs by blocking the release of endorphins in the brain, thereby preventing the addictive "high" that results from alcohol or drug intake. The premise is that, without the rewarding effects of drinking, there is less likelihood for recovering alcoholics to relapse into abusive behavior.

Williams's research involves the clinical use of a widely prescribed opiate antagonist, naltrexone, on animal models. Though the drug is considered effective and has been approved by the Federal Drug Administration for use in treatment, Williams says there is much more to learn about its role as a behavior modifier.

"Scientists already know that naltrexone works, but it's not clearly understood how it works," he observes. "My research is looking to further characterize how the drug works and, hopefully, find ways to use it more effectively to prevent the chance of relapse."

In his lab trials, Williams observes the effects of naltrexone on rats that have been trained to self-administer ethanol. Some early indications show that naltrexone may be more effective in curtailing alcohol intake when the drug is injected in an extended-release form, rather than taken orally. Other indications suggest that physical exercise may work in connection with the drug to prevent a relapse into abusive behavior.

The insights gained through these experiments may help clinicians to design better treatment plans for addiction, Williams says.

He is also paying close attention to the role that hormones may play in predicting susceptibility to relapse. In fact, he believes clinicians one day may be able to look for biological or genetic markers that indicate susceptibility for relapse, in the same way hormones now are used to predict a relapse into depression.

Whatever is gained from his research, he believes, will provide further ammunition in the war against addiction.

"Alcoholism and drug abuse are very complex problems," Williams admits. "There are biological, psychological and social components involved, and it's compounded by the relatively easy availability of these addictive substances.

"Ultimately, the aim of my research is to create conditions where we are able to understand the control mechanism behind addiction," he says. "Armed with that knowledge, perhaps we can alter the outcome."

By Kevin Knapp

"I don't think I've ever met anyone whose life was not touched in some way by alcoholism or substance abuse."

Keith L. Williams
Associate Professor of Psychology

Williams received a Ph.D. in biopsychology from the University of Michigan in 1998. He held a post-doctoral fellowship in the departments of psychiatry and pharmacology at the University of Michigan for three years before joining the faculty at Grand Valley State University. His research interests include the pharmacological and behavioral mechanisms of drug reinforcement and craving. He comes to Oakland University with a multi-year grant from the National Institutes of Health to support his efforts to clarify the ability of opiate antagonists to reduce self-administration of alcohol.

Huirong Fu
Associate Professor of Computer Science and Engineering

Fu received a Ph.D. from Nanyang Technological University, Singapore, in 2000. She was a post-doctoral fellow at Rice University in Texas from 2000 to 2002, before joining the Department of Computer Science at North Dakota State University as an assistant professor. In 2005, Fu joined the faculty at Oakland University, where her research interests have focused on computer information assurance and security, wireless and mobile networks, and multimedia communications systems. With funding provided by the National Science Foundation, Fu's research is helping to establish OU as a leader in Michigan in information assurance.

Cyber crime stoppers

Protecting computer systems from attack

Computers help orchestrate our lives in ways we take for granted. Whether it's for work, school or recreation, the computer is key.

Computers also power countless other systems, from toys to vehicles to fighter aircraft to massive power grids. Some operate independently, but many computers are part of a system, connected through networks, like the Internet.

Unfortunately, these systems are often vulnerable to unwanted interference or malicious attacks. Cyber crime — unauthorized persons (or "hackers") breaking into computer systems and networks of banks, businesses, credit card companies and even governments — now occurs with alarming frequency, and sometimes with devastating results.

Huirong Fu, associate professor of Computer Science and Engineering, is working to develop strategies to fight cyber crime and assure the security and integrity of computer networks. She also plans to bring advanced theories on cyber crime and security into the college classroom.

As the principal investigator on the project, which is funded by a $115,000 grant from the National Science Foundation (NSF) in its Course, Curriculum and Laboratory Improvement Program, Fu is collaborating with Xiaodong Deng, OU associate professor of Management Information Systems, and Patrick Corbett, professor of criminal law and procedure at Michigan's Thomas M. Cooley Law School.

One of the goals is to enhance education through collaboration between schools. The project uses an interdisciplinary approach, integrating technological, business and legal topics related to cyber crime and security. This way, students studying computer science learn about business and legal issues, and vice versa.

"Information security is more than a technical issue — it's also a social issue," Fu explains. "Engineering students need to learn how to defend against cyber attacks, but they also need to learn about the relevant laws. The same is true with the law students. Once they understand what hackers can do, they can learn to make better laws in this area."

Students in Fu's class at OU learn how cyber attacks are launched, how to defend against various attacks and how to manage networks that might be vulnerable to attacks. Students work in authentic computer environments that (for security purposes) are disconnected from the Internet. To date, more than 100 students have been trained in this real-world setting.

Fu says she also takes this environment — which she refers to as a "mobile lab" — to perform demonstrations for students at Cooley Law School.

The project includes a significant outreach component, with researchers making presentations to area schools, students and parents, educating them in network security and how to protect their computers and personal information.

"We want people to understand that you have to be very careful, both technically and socially," Fu says.

She is also the principal investigator for another important cyber security research project, which seeks to prevent cyber crime in an emerging realm of communication technology: vehicle-to-vehicle networking. With $256,000 in funding from the NSF Cyber Trust Program, Fu and fellow researchers Fatma Mili, Debatosh Debnath, and Daniel Aloi are working to ensure the security of future vehicle networks.

Fu explains that computers can be used to notify drivers of upcoming traffic congestion, road hazards or allow vehicles to communicate with each other. For example, when a driver switches on a turn signal, that impulse could be transmitted by computer to several surrounding cars, instead of only being seen by one or two nearby vehicles.

These networks are particularly complex, she says, because vehicles are usually in motion, unlike a computer that sits on a desk. Still, Fu and her colleagues hope to get the jump on cyber criminals by finding a way to make vehicle systems tamper-proof.

"What we learn will help us educate the next generation of the automotive industry," Fu explains. "There will be security issues for vehicles in the future, and we want to work with companies to help assure the security of those vehicular networks."

By Amy Lynn Smith

"We want people to understand that you have to be very careful, both technically and socially."

Minding the gaps

Research strives to restore brain function

Michael Chopp believes we're all going to lose our minds, eventually. It's just a matter of time.

"Everyone will have a neurological injury, if we live long enough," says the Distinguished Professor of Physics and scientific director of the Neuroscience Institute at Detroit's Henry Ford Hospital.

Chopp, one of the world's most prominent specialists in medical physics and neuroscience, has made it his life's work to study the possibilities of restoring the brain after stroke, injury or disease.

It's a condition with which he has a sad familiarity.

"My own grandmother, whom I lived with at one point, passed away after a stroke," he explains.

An acknowledged leader in developing brain cell therapies, Chopp holds four patents on his research and the cell therapies he's developed and has pioneered the use of statins, cord blood, bone marrow and the headline-grabbing drug Viagra to foster growth of new brain cells, blood vessels and electrical connections in tissue near the site of injury or disease.

His therapies aim to "remodel" the brain by making it take on functions that have been lost through tissue damage.

"Think of the brain as a house," says Chopp, who also is an avid runner and voracious reader. "If a tree falls on your house, what you want most is to fix the damage to restore your daily quality of life. Remodeling the brain is like remodeling a house. It may require new plumbing, such as new blood vessels; new electrical connections or new synapses; and new rooms or new brain cells in order to regain function."

One tool he relies on to assess that remodeling is the Neuroscience Institute's Magnetic Resonance Imaging (MRI) test. This non-invasive analysis uses magnetic signals, rather than X-rays, to create images based on differences between types of tissues. This helps Chopp and his team of OU doctoral candidates determine the integrity of the new "cables."

Chopp has secured grants from the National Institutes of Health and has earned two multi-million dollar Project Grants — a rare honor for the research arena. He also boasts eight RO1 grants and 10 other NIH grants.

Since joining OU in 1976, Chopp has received more than $30 million in grant funding, directed 18 doctoral dissertations and written more than 300 research publications.

"I write about six hours every day," admits Chopp, who's been married for 40 years to Bela Chopp, director of OU's Counseling Center.

Chopp is both prolific and widely respected. His stroke research was recognized by the American Heart Association as one of the top 10 medical advances of 2001. Last September, he received a rare invitation from the World Health Organization to speak in Geneva on how to best to treat strokes.

"Michael has put Oakland University on the map," says Norman Tepley, former chairman of Physics at OU and now the research director of the Neuromagnetism Laboratory at Henry Ford Hospital. "Scientists in Washington D.C., London, Paris and all the capitals of the world know about OU because of Michael. I should know, because we'd get applications from grad students from all over the world who wanted the opportunity to work with him."

One reason for such name recognition is that Chopp actively promotes his research. He travels the globe frequently to present his findings."I just got back from Beijing yesterday and next week I'm headed to Barcelona and Dresden, (Germany,) after that," he says, adding that his recent excursions include India, Japan and Austria. "If you want your work to have an impact and find new applications for the research, you have to get it out there," he explains.

For the record, Chopp pays close attention to his findings.

Inspired by what he's learned in his research, Chopp says he recently asked his internist — who gave him a clean bill of health — to put him on a low dose of statins, just as a precautionary measure.

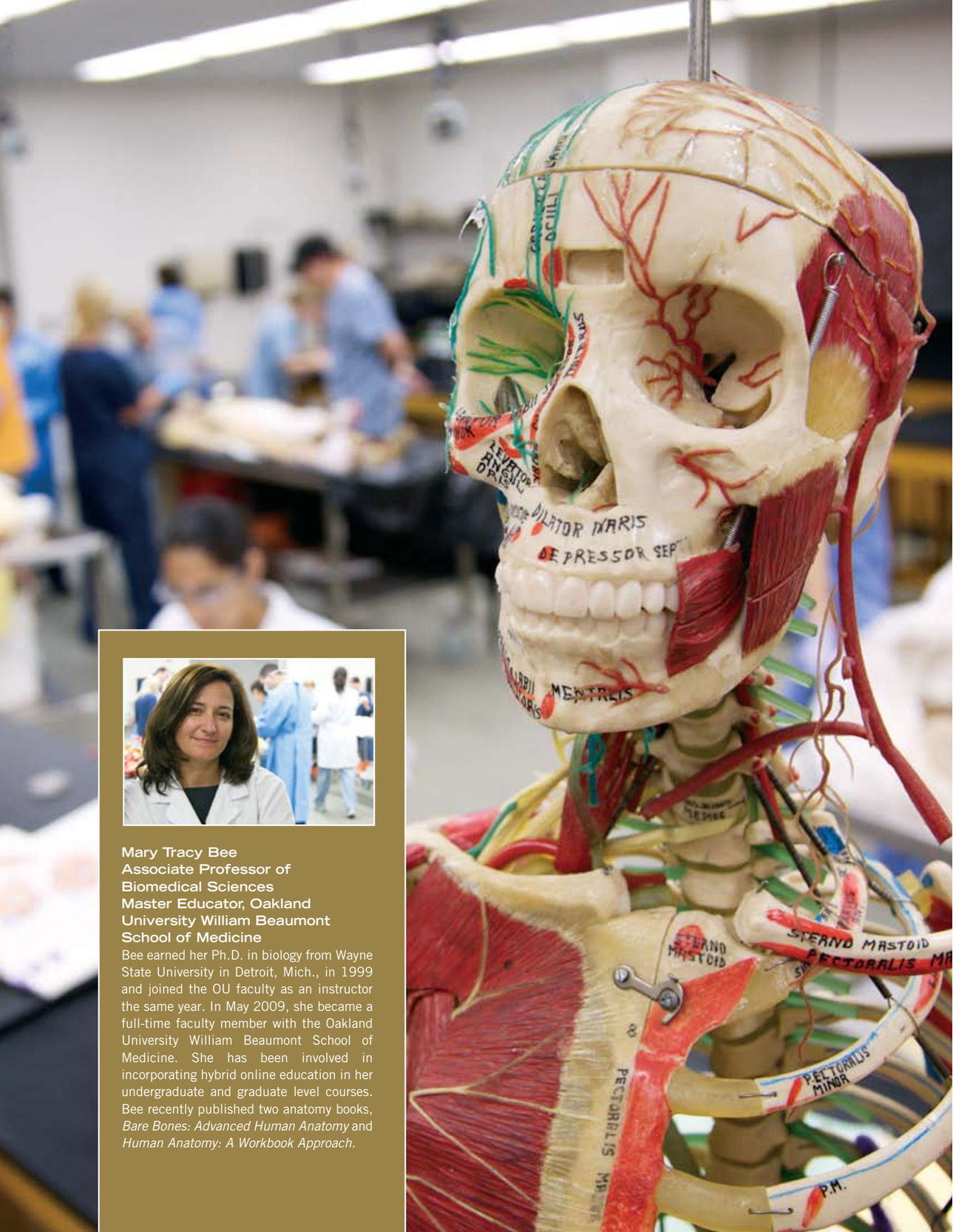
There's no brain he doesn't mind, including his own.

By Rene Wisely

"Everyone will have a neurological injury, if we live long enough."

Michael Chopp
Distinguished Professor of Physics

Chopp earned a Ph.D. in physics from New York University. He is one of the world's most prominent specialists in medical physics and neuroscience. Since joining OU in 1976, he has produced more than 300 research publications that have been cited thousands of times in professional literature. His work has been supported by grant funding amounting to more than $20 million and has resulted in significant contributions in the areas of magnetic resonance imaging, the physics of stroke, neurological disease and injury, treatment of brain tumor, and brain repair and remodeling.



Mary Tracy Bee
Associate Professor of Biomedical Sciences
Master Educator, Oakland University William Beaumont School of Medicine

Bee earned her Ph.D. in biology from Wayne State University in Detroit, Mich., in 1999 and joined the OU faculty as an instructor the same year. In May 2009, she became a full-time faculty member with the Oakland University William Beaumont School of Medicine. She has been involved in incorporating hybrid online education in her undergraduate and graduate level courses. Bee recently published two anatomy books, *Bare Bones: Advanced Human Anatomy* and *Human Anatomy: A Workbook Approach.*

Anatomy lesson

Leading-edge approach engages pre-med students

The best educators bring a subject to life. That can be a challenge when that subject is anatomy, typically considered a "dead" science.

But one enterprising Oakland University lecturer has discovered a dynamic approach to teaching anatomy — and has conducted research that proves its effectiveness.

Mary Tracy Bee, associate professor of Biomedical Sciences and a master educator at the Oakland University William Beaumont School of Medicine, uses what she refers to as "hybrid online teaching" to educate students.

Bee initially used a traditional lecture approach to teaching, combined with lab work, such as cadaver dissection and exams. But she quickly recognized that students needed the flexibility "to learn when they're ready to learn."

After some thought, Bee came up with the concept of putting lectures online, so students could access them at their convenience. The response from students was overwhelmingly positive, and now she uses the technique for all of her anatomy classes.

"You can really tell the difference in how well the students grasp the material now," Bee says. "When you see those lights go on in a student, it's very exciting."

Each week, Bee presents a one-hour lecture in class and provides a second one-hour lecture for students to watch online. There are online quizzes, which give students immediate feedback on their understanding of the information — and what they need to review if a question was answered incorrectly. At live lectures, there's time for students to ask questions about the previous online lecture and also conduct their lab work.

"Anatomy is a subject that must be taught visually as well as conceptually," says Natalie Kzirian, who recently completed Bee's human anatomy class. "Dr. Bee's online lectures showed the best pictures so I could really visualize what structures looked like. It also helped me learn the function of the structure — and it was nice to be able to watch the lecture again if I needed more clarification."

Having recognized the value of this hybrid teaching method, Bee was intrigued when "best practices in anatomy education" was a hot topic at an American Association of Anatomists conference a year or two ago.

"Without even realizing it, I was right on the cutting edge of what everyone was trying to implement," she says. "That's when I decided I needed to do some research on this approach."

Bee taught one class using traditional lectures, another using nothing but online lectures, and a third using the hybrid online teaching approach. Grades increased by 11 percent and student satisfaction increased by 42 percent in the class that offered the hybrid approach.

"Student satisfaction is the biggest benefit," Bee explains. "Today, when students are juggling work, school and family obligations, nobody can learn effectively when they have other things on their mind. Plus, students tend to lose focus after sitting in a lecture for an hour."

Student Kzirian says she appreciated the flexibility of being able to watch lectures at her convenience — and in advance, which permitted her to prepare for topics that were more difficult to master.

"Those who studied the material early did much better than students who studied it a week or so before the exam," notes Bee.

An additional benefit of Bee's online lectures is that students have the option of delving deeper into specific subjects. For example, students interested in orthopedics can click on a link to view one of Bee's advanced lectures on a topic, such as knee joints.

Bee says the online approach may also ease the anxiety some students feel about performing cadaver dissections. Most important, as her research has shown, Bee's hybrid online anatomy course engages students more effectively than the traditional method.

"To take something so difficult — a dead science like anatomy — and bring it to life online is really exciting," she says. "It shows that the manner in which you present something can make a huge difference in students' ability to learn."

By Amy Lynn Smith

"To take something so difficult — a dead science like anatomy — and bring it to life online is really exciting."

Patients, please

Advocating for health care customers

There's little doubt that the trend in medicine toward greater specialization is responsible for significant advances in knowledge and treatment of health conditions. Unfortunately, we may also be losing something very important as we shift from the era of the general practitioner to the age of the specialist.

Patricia Wren thinks there is a great deal of opportunity in the insights and opinions of patients, which, in today's complicated health care environment, can often be overlooked.

The assistant professor of Wellness, Health Promotion and Injury Prevention says she believes such input not only should be encouraged, but ultimately can help lead physicians toward more effective treatments.

"Today's increased specialization has really narrowed the focus in treatment," she says. "That's been very good for science but in some cases it leads doctors to pay more attention to a specific organ than to the patient it belongs to. To my thinking, that's getting it backwards."

Wren says her extensive research into quality-of-life issues and patient-centered outcomes convinces her that patient opinions are both valid and valuable in determining proper courses of treatment.

"Including the patients' voices in the process of clinical trial and intervention research almost always yields better outcomes," she explains. "Why? Because patients are able to articulate their concerns and describe in detail their symptom experience. And, ultimately, patients are fantastic judges of a treatment's success and failure."

A self-described "mutt" in the research field, Wren collaborates with physicians and nurses, as well as other social scientists, on a variety of projects related to the treatment of glaucoma, breast cancer, ulcerative colitis, stroke, and pelvic floor disorders in women.

Wren currently employs OU students to conduct standardized telephone interviews with participants in clinical trials and intervention studies. They collect data used to measure the success and patient satisfaction with specific treatments.

This adjunct information, Wren says, is used to help develop a valid index of symptoms that can be used by physicians in determining course of treatment.

For example, in her study of pelvic floor disorders — which is funded by a nearly $10 million grant (over 10 years) from the National Institute of Child Health and Human Development — Wren administered questionnaires that assessed both the severity of pelvic symptoms and the impact of those symptoms on women's ability to engage in their usual activities of daily living.

She discovered that some women had symptoms but had compensated to avoid the condition having a negative impact on their lives. Subsequent focus groups with female patients led Wren and her researchers to create a new instrument — the Measure of Adaptations for Pelvic Symptoms (MAPS) — which is now being used in ongoing research trials.

In her glaucoma research — which is funded by a $300,000 grant from the National Eye Research Institute — Wren examined patient outcomes in those treated initially with medicine and those who had initial surgical intervention.

"We asked patients to report their symptoms and any side effects of these two treatment courses," Wren says. "Armed with that information, ophthalmologists are better able to counsel newly diagnosed glaucoma patients about what to expect, given the treatment option they choose."

In Wren's work researching patients with ulcerative colitis and Crohn's disease, she aims to develop a new patient-centered measure of disease severity that will help doctors assess treatment options.

"Endoscopies are expensive and invasive and, as with any medical procedure, have associated risks," she says. "We're hoping to use patient input into their own disease experience to craft a reliable, valid, sensitive questionnaire that will measure a patient's disease severity that might be used in place of clinical tests, in some circumstances."

Wren says her work helps physicians to appreciate the merit in gathering patient-centered outcomes data, which can make for better clinical research and improved outcomes for patients.

"As a social scientist, I see myself as being a liaison between the physician and the patient," she explains. "My role is to help give a voice to patient concerns. What they have to say is valuable."

By Kevin Knapp

"Patients are fantastic judges of a treatment's success and failure."

Patricia Wren
Assistant Professor, Wellness, Health Promotion and Injury Prevention

Wren received her Ph.D. in higher education and her M.P.H. in health behavior/health education from the University of Michigan in Ann Arbor, Mich. Her interest in health promotion has led to her research in a variety of projects, often collaborating with physicians, to study quality of life and other patient-centered outcomes, including satisfaction, health expectations and compliance with medical regimens. Her current research focuses on a number of different projects related to glaucoma, breast cancer, ulcerative colitis, stroke, and pelvic floor disorders in women.

John M. Finke
Assistant Professor of Chemistry
Finke received a master of science degree and a Ph.D. in chemistry from the University of California at San Diego. He held a La Jolla Interfaces in Science/Burroughs Welcome Postdoctoral Fellowship. He joined the faculty at Oakland University in 2005. His research focuses on the aggregation pathway of certain peptides into neurotoxic amyloid fibrils. He does both laboratory-based and theoretical (modeling) research. This work has potential applications in understanding and treating Alzheimer's disease.

The road to a cure?

Researching a possible blood test for Alzheimer's

Will you have Alzheimer's disease?

Currently there is no way to predict or prevent the onset of Alzheimer's disease. However, research now being conducted by Assistant Professor of Chemistry John Finke, in conjunction with Beaumont Hospitals researchers, may lead to a predictive blood test.

At present, doctors must determine if a patient has Alzheimer's by excluding other causes for memory loss and cognitive decline. The only definitive diagnosis is gained by performing a brain autopsy, following the patient's death.

But Finke aims to develop a blood test that would detect changes in certain protein cells used to convey messages between brain cells in blood plasma — and predict the potential onset of the disease. His research primarily is focused on the protein Abeta, which has been linked to Alzheimer's disease.

Finke investigates the structure-activity relationships of protein assemblies, including cytotoxic aggregates formed by polyglutamine and Abeta protein, and non-toxic assemblies formed by polyglutamic-acid and F-actin. He uses fluorescence resonance energy transfer (FRET), circular dichroism, protein separations, transmission electron microscopy (TEM), Western Blots, enzyme-linked immunosorbent assay (ELISA), and computer modeling to develop the blood test.

Using florescence to make microscopic measurements of molecules, Finke creates a computer-generated image of the protein that may be useful in identifying the drugs that can be used to fight Alzheimer's.

"You can play tricks with light in the smallest areas of the body — in cells that are so small you can't even use a microscope," Finke explains. "We can see molecules by adding light-emitting chemicals to them. The chemicals then 'talk' to each other by transmitting light."

While he first began studying how proteins fold into the correct shape, Finke became interested in how these proteins sometimes can "misfold." After that, he began studying the shape of defective proteins and investigating the structure-activity relationships of the proteins.

"We noticed that in a healthy person the proteins are a curled-up type, and in Alzheimer's patients they have a different, 'bad' form. When proteins go bad, like they do in an Alzheimer's patient, the two light molecules get farther apart," he says. "We thought that if this happens in our tests, we can determine the same thing through a blood test in actual patients. And if we can identify this sooner — before the symptoms present in patients as a precursor to the disease — we can eventually become more effective in treatment."

Finke began his research as a National Institutes of Health post-doctoral fellow at the University of California, San Diego, where he also completed his graduate work in protein folding and his post-doctoral work in computational modeling of proteins. He joined the OU faculty in 2005 and received a Dreyfus Foundation Faculty Startup Award, a $30,000 research award for new professors, that same year. The research grant allowed Finke to purchase the equipment he needed to get his research moving.

Finke also is conducting a related research project with Beaumont neurologists Dianne Camp and David Loeffler, funded by an OU-Beaumont Multidisciplinary Research Award. The work in both cases is laboratory-based and involves theoretical modeling.

Finke says the next step in his research is to begin tests using human tissue from donors, including the good and bad forms of brain tissues. Then they will conduct tests on blood samples with the aim of determining the "shape" of molecules and discovering how to convert the bad molecules to good.

Ultimately, this could help lead the way toward designing drugs for Alzheimer's treatment.

"The question for patients at first will be 'Do you want to know if you will suffer from Alzheimer's when there isn't a cure right now?'" Finke says. "Current drugs appear to only briefly delay Alzheimer's in its early stages and do not halt or reverse disease symptoms. This research could lead to better treatment drugs… and knowing if you are predisposed to the disease, earlier, could mean a better, more effective treatment, and hopefully, someday, a cure."

By Susan Thwing-McHale

"This research could lead to knowing if you are predisposed to the disease."

Safer surgeries

Blood testing for better outcomes

When Lisa Mileto describes her recently completed diabetes research project, the words "high impact" spring to mind.

The results of the collaboration with Beaumont Hospital in Royal Oak, Mich., may lead to improvements in the way diabetic patients' blood sugar levels are monitored, says the associate professor of Nursing.

"What we've learned may not only strengthen protocols for blood sugar management for surgical patients at Beaumont," she says, "but maybe improve perioperative diabetes care nationally."

Mileto, a nurse anesthetist and director of the Oakland University-Beaumont Graduate Program of Nurse Anesthesia, explains that hospitals have strict measures in place for patients with diabetes, which are intended to prevent them from experiencing high or low blood sugar levels.

With hypoglycemia, or low blood sugar, the brain is deprived of an adequate supply of glucose, its primary food. This can result in a variety of problems, from anxiety and tremors to confusion and loss of consciousness. Despite precautionary steps, some diabetic patients still experience hypoglycemia before, during or after surgery.

Mileto says that data collected over five years shows that low blood sugar occurs in less than 3 percent of all perioperative glucose tests, while very low blood sugar is found in 0.1 percent of glucose tests. While those numbers are relatively small, she says the potential for reducing them further was promising.

She and a multidisciplinary Surgical Diabetes Task Force at Beaumont began last September to identify factors contributing to hypoglycemia in diabetic patients during the perioperative period. They also sought to analyze both treatment and the effectiveness of those measures in correcting low blood sugar.

Led by Dr. Fatema Omran, an internist, and Mileto, the research team included Dr. Solomon Rosenblatt, endocrinology; Dr. Richard Han, anesthesiology; Barbara Harrison, assistant professor of Nursing; nurse anesthetists Anne Hranchook and Tammy Dukatz; and nurse anesthesia students Seth Fisher, Keri Nowakowski, Margo Krugger and Matt Margraf.

The findings were presented in August at the American Association of Nurse Anesthetists national meeting.

Mileto explains that, while oral medications or insulin are often needed to achieve and maintain appropriate blood glucose levels, diabetic patients who undergo surgery are at risk for both high blood sugar and low blood sugar. Prolonged fasting, interrupted medical regime, surgical stress, general anesthesia, intermittent point-of-care testing and co-existing disease are all factors that can lead to high or low glucose levels, she says.

Because anesthesia interferes with reflexive swallow, patients scheduled for surgery are often required to fast for eight hours prior. For a patient with diabetes, this raises the level of concern. "Continuous blood glucose monitoring technology may be on the horizon, but currently blood sugar values can only be checked intermittently — before, during and after surgery," adds Mileto.

As part of the study, graduate students reviewed nearly 500 patient records in which blood glucose readings less than 70 mg/dl occurred on the day of surgery. "As expected, we found that low blood sugar is associated with later surgery start times, insulin use and increased time between glucose monitoring," says Mileto. The presence of insulin on the preoperative medication list was also associated with perioperative hypoglycemia. Afternoon surgical start times and fasting times of longer than eight hours occurred in more than half of all subjects that experienced hypoglycemia.

The study concludes with the recommendation that when surgery is delayed or cannot be scheduled in the early morning, consultation with the patient's diabetes care physician and development of a blood glucose management plan for the day of surgery is imperative.

The findings also suggest that a lack of pre-emptive dextrose treatment when blood sugar levels are trending downward results in hypoglycemia more frequently than bolus insulin therapy for correction of perioperative hyperglycemia, or high blood sugar.

"To me, this study served to confirm that consistent monitoring is vital in controlling blood sugar levels in diabetic patients," Mileto adds.

By Alice Rhein

"Continuous blood glucose monitoring technology may be on the horizon, but currently blood sugar values can only be checked intermittently — before, during and after surgery."

Lisa A. Mileto
Associate Professor of Nursing
Mileto received her master's degree in anesthesiology from Mercy College in Detroit, Mich., in 1989. Since 1993, she has been with Oakland University-Beaumont Graduate Program of Nurse Anesthesia, beginning as a clinical coordinator, then assistant director, and currently as director. She is also director of Surgical Services Education at Beaumont Hospital in Royal Oak, Mich. Mileto contributed the chapter "Generational Dynamics in Nurse Anesthesia Education," to *A Resource for Nurse Anesthesia Educators*, which was published in August 2009

Research centers and institutes

Center for Applied Research in Musical Understanding (CARMU)

The mission of the Center for Applied Research in Musical Understanding (CARMU) is to build and advance a research-based pedagogy of teaching for musical understanding, as well as support pre-K-12 music educators in Michigan, the United States, and internationally. The center seeks national and international eminence in applied research in musical understanding and supports faculty, graduate and undergraduate research in musical understanding.

Oakland University Center for Autism Research, Education and Support (OUCARES)

OUCARES integrates academic course work, knowledge and research with hands-on work to prepare professionals to be leaders in the autism community. Through these academic and service programs, OU also provides supportive individual and family programs. OUCARES encourages the exchange of ideas relating to the education and support of individuals with autism spectrum disorder as well as providing services and support needed to improve daily living.

Center for Biomedical Research

The mission of the Center for Biomedical Research is to vigorously promote and support biomedical research and education at Oakland University and allied institutions, to recruit and retain outstanding biomedical scientists, to facilitate collaborative biomedical research projects and to develop gift, grant, and contract support for biomedical research programs, graduate and undergraduate training, as well as core facilities and equipment.

Center for Creative and Collaborative Computing

The mission of the center is to provide an environment for students, faculty, and participating industry professionals to collaborate and create novel information technology applications to keep our industry competitive and at the forefront of technology. The center is seen as an integral component of the future success of the computing and information technology related undergraduate and graduate programs.

Center for Integrated Business Research and Education

CIBRE at the School of Business Administration connects business professionals, students and academics to address and shape the future of business research and business education locally, regionally and globally. CIBRE provides a place where business leaders, researchers, professionals and students can share resources, ideas and identify actions to address organizational issues, educate current and future professionals, and support economic development in the community, and the world.

Counseling Center

The School of Education and Human Services Counseling Center is a teaching and research facility for the Counselor Education program that offers personal and career counseling to the community at no cost.

The English as a Second Language Center (ESL)

The ESL Center is charged primarily with monitoring and implementing the English Proficiency Requirement on campus. The center offers a full range of ESL courses at all skill levels and supervises the ESL Endorsement Program, the ESL Institute Programs, the Individual ESL Instruction Program, and the Hispanic Outreach Program (HOP). During its eight years of operation, HOP has received financial support from the College of Arts and Sciences, local corporations and Michigan government agencies.

Eye Research Institute

The ERI has a 40-year history in vision research and has received more than $50 million from external funding sources, mainly the National Eye Institute (NEI). Each year the institute, in conjunction with the Center for Biomedical Research, awards competitive $3,000 Summer Vision Research Fellowships to OU undergraduates. In addition to conducting vision research, the ERI is also formally associated with the Department of Ophthalmology at Beaumont Hospitals.

Fastening and Joining Research Institute (FAJRI)

FAJRI is the only known facility of its kind in the world: an academic, nonprofit research facility dedicated solely to the fastening and joining of materials. This one-of-a-kind facility pursues fundamental and applied research to develop and disseminate new technologies in fastening and joining engineering. Through its research, FAJRI helps improve the safety and reliability of equipment, machinery and mechanical structures. The research conducted also significantly improves the mobility and combat-readiness of military vehicles.

Galileo Institute for Teacher Leadership

The Galileo Institute for Teacher Leadership is dedicated to improving the learning of all students, elevating the education profession, enhancing the leadership skills of teachers, and fulfilling the vital role of public education in achieving a civil, prosperous and democratic society. The commitment to the concept of developing teacher leaders, to defining what teacher leadership is and why it is so important is at the heart of the institute.

Ken Morris Center for the Study of Labor and Work

The Ken Morris Center for the Study of Labor and Work is a division of the Department of Human Resources Development. Founded in 1972 as a Labor Education Program, the center was renamed in 1983 for Ken Morris. Its primary goal is to help develop potential leaders who possess the analytic, interpersonal and organizational skills to respond to human needs in an era of rapid social change. The program seeks to join education, skill development and service in the pursuit of this goal.

Lowry Center for Early Childhood Education

The Lowry Center offers early childhood education programming to children from 18 months to 5 years old using the newest innovative equipment, materials, and practices to cultivate the development of young children. The center's mission is to provide an exemplary laboratory center for early childhood education for the university and the neighboring communities.

Prevention Research Center

The Prevention Research Center is designed to promote community health through education, promotion, and translational research. Translational research discovers which strategies work in the community: the community of youth, or the community of women, or the community of senior citizens — all at high risk. The center brings experts from OU and the community together to make a difference in people's lives.

Reading Clinic

Dedicated to helping children between the ages of 6 and 17 with any type of reading or writing difficulties including learning disabilities, dyslexia, Attention Deficit Disorder and Attention Deficit Hyperactive Disorders, the clinic diagnoses the nature and extent of a child's reading and writing capabilities and works to improve them.

OU SmartZone Business Incubator (OUINC)

Oakland University's SmartZone Business Incubator (OU INC) provides entrepreneurial resources and strategic business solutions to develop intellectual property. The incubator supports existing and grows new technology-based and life science businesses with university resources, decision support technology, business counseling services and financial/capital acquisition assistance.

Student research award recipients, 2008-09

Student award recipients receive financial assistance to support their research as well as the opportunity for travel support to present their research at a professional conference. The program is sponsored by the Office of the Provost.

University Research Committee Student Research Awards

Southeastern International Conference on Combinatorics, Graph Theory and Computing in Boca Raton, FL, March 2009
Student Researcher: Scott Anderson
Faculty Member: Serge Kruk, associate professor, Mathematics

Synthetic Model Studies for Oxalate Degrading Manganese Enzymes
Student Researcher: Derk Averill
Faculty Member: Ferman Chavez, associate professor, Chemistry

Feminist 'Zines: An Examination of Activism and Social Change in Contemporary Feminism
Student Researcher: Kathleen Burt
Faculty Member: Jo Reger, associate professor, Sociology and director, Women's Studies

A Workshop on Video Data Analysis for Reading Research presented at the National Reading Conference in Orlando, FL, December 2008
Student Researcher: Carmela Gillett
Faculty Member: John McEneaney, professor of Education

The Effectiveness of an Intensive Rehabilitation Program on Recovery of Ambulation in Persons with Spinal Cord Injury
Student Researcher: Eleonora Kishelova
Faculty Member: Cathy Larson, assistant professor, Physical Therapy

Real Time Control of a Novel Adaptive Occupant Safety System Using Intelligent Control Techniques
Student Researcher: Mohannad Murad
Faculty Member: Manohar Das, professor of Engineering and acting chair of Electrical and Systems Engineering

Helitrons: Their Impact on Maize Genome Evolution and Diversity
Student Researcher: Matthew Oetjens
Faculty Member: Shailesh Lal, associate professor, Biological Sciences

A Comparison of Hold-Relax and Active Range of Motion on Thoracic Spine Mobility
Student Researcher: Danelle Preston
Faculty Member: Melodie Kondratek, assistant professor, Physical Therapy

Presenting at a Combinatorics Conference
Student Researcher: Susan Toma
Faculty Member: Serge Kruk, associate professor, Mathematics

Associations Between Event-Related Rumination and Posttraumatic Growth in Japanese Youth
Student Researcher: Blair Trevorrow
Faculty Member: Kanako Taku, assistant professor, Psychology

The Effectiveness of an Intensive Rehabilitation Program on Recovery of Ambulation in Individuals with Spinal Cord Injury
Student Researcher: Tygre Whittington
Faculty Member: Cathy Larson, assistant professor, Physical Therapy

Provost Undergraduate Student Research Award

Identification of Novel Metalloid Transporters
Student Researcher: Joseph McDermott
Faculty Member: Zijuan Liu, assistant professor of Biological Sciences

The Role of Hyperexcitability in Determining the Mechanism of the Upper Limit of Vulnerability in the Heart
Student Researcher: Nicholas Charteris
Faculty Member: Bradley Roth, professor of Physics

Diatom-Colonized Substrates as a Model for Evaluating the Effects of Habitat Fragmentation
Student Researcher: Tawnee Milko
Faculty Member: Scott Tiegs, assistant professor of Biological Sciences

Invasibility of Four Exotic Earthworm Species as Assessed by Temperature Tolerance
Student Researcher: Andrew Stonehouse
Faculty Member: Scott Tiegs, assistant professor of Biological Sciences

Provost Graduate Student Research Award

Modeling and Implementation of Reconfigurable Embedded Systems
Student Researcher: Belal Sababha
Faculty Member: Osamah Rawashdeh, assistant professor of Electrical and Computer Engineering

Ionic Liquids Adsorption /Desorption Dynamics During Electrode Oxidation and Reduction Processes
Student Researcher: Yu Du
Faculty Member: Xiangqun Zeng, associate professor of Analytic Chemistry

Effects of a Recently Discovered Invasive Earthworm, Amynthas hilgendorfi, on the Forest Soil Ecosystem in the Great Lakes Region
Student Researcher: Holly Greiner
Faculty Member: Scott Tiegs, assistant professor of Biological Sciences

Design and Fabrication of an Electro-thermal Micro-Switch with Latching System
Student Researcher: Jay Jamshid Khazaai
Faculty Member: Hongwei Qu, assistant professor of Electrical and Computer Engineering

Design and Microfabrication of a CMOS-MEMS Force Sensor
Student Researcher: Mohd Haris Md Khir
Faculty Member: Hongwei Qu, assistant professor of Electrical and Computer Engineering

Synthesis of Cysteine Dioxygenase Model Compounds
Student Researcher: Piotr Pawlak
Faculty Member: Ferman Chavez, associate professor of Bioinorganic Chemistry

Understanding the Relationship of Social Support, Postpartum Depression Symptomatology & Breastfeeding Duration among Low-Income Women
Student Researcher: Christina Ritter
Faculty Member: Anne Mitchell, associate professor of Nursing

Flexible Process Modeling and Execution in the Health Care Domain
Student Researcher: Abishake Subramanian
Faculty Member: Vijayan Sugumaran, professor of Management Information Systems

Development of a Fully Autonomous Surveillance Quadrotor System
Student Researcher: Hong Chul Yang
Faculty Member: Osmah Rawashdeh, assistant professor of Engineering

Oakland University Stimulus Awards

Oakland University was among five Michigan colleges chosen to receive federal stimulus funds through the National Institutes of Health. The stimulus money was awarded to:

Shravan Chintala, associate professor of Biomedical Sciences
Proteases in IOP-mediated glaucomatous damage
This project will advance understanding of the mechanisms underlying pressure-mediated ganglion cell loss in glaucoma.

Ken R. Elder, professor of Physics
Modeling Non-Equilibrium Microstructure Formation
This project will develop efficient computational methods for modeling non-equilibrium processes and microstructure formation. This work will help scientists optimize material performance as microstructures play a key role in material function.

Frank Giblin, professor of Biomedical Sciences and director of the OU Eye Research Institute
Proteins of Normal and Cataractous Lenses
The objective of the work is to evaluate the role of oxidative stress in the development of human nuclear cataract, the most common type of lens opacity in older adults, and the type most likely to require surgery. The results will provide valuable information on protecting the aging human lens against oxygen- and UVA-induced damage, and on guarding against formation of nuclear cataract.

Andrew Goldberg, associate professor of Biomedical Sciences
Molecular Scaffolding for Photoreceptor Outer Segment Structure and Renewal
The long-term objective of this proposal is to define the molecular scaffolding that underlies the dynamic architecture of vertebrate rod and cone photoreceptor outer segments (OSs). Retinal photoreceptors provide the cellular basis for sight. This project will provide a better understanding of photoreceptor outer segment structure in health and disease.

Kenneth Mitton, associate professor of Biomedical Sciences
Coordination of Gene Expression in Retinal Development
This funding provides support for two summer students in advance genomics research to accelerate progress on the goals to breed and analyze homozygous FIZ1- genetrap (knock out) mice.

Nessan Kerrigan, assistant professor Chemistry
Catalytic Asymmetric Dimerization of Ketoketenes
The objective of this project is to develop a new organic chemistry methodology that would innovate natural product and drug molecule synthesis.

Zijuan Liu, assistant professor of Biological Sciences
Arsenic Accumulation by Aquaglyceroporins and Phosphate Transporters in Zebrafish The establishment of a zebrafish model can help to understand arsenic induced multiple diseases. This supplement will aid in the development of the scientific infrastructure in the U.S. by providing research experiences for undergraduate students.

Mark Olson, assistant professor of Education
Oakland University Noyce Scholars Program
This project will prepare three cohorts of 10 highly qualified secondary mathematics and science teachers to teach in high needs schools.

Bradley Roth, professor of Physics and director of the OU Center for Biomedical Research
Magneto-Acoustic Effects in Imaging
The primary goal of this project is to study magnetic forces on electric currents in biological tissue, and to analyze and develop new imaging techniques that use these "magneto-acoustic" effects.
Core Center for Quantitative Biology
This funding will support development of a Core Center in Quantitative Biology at Oakland University.

Barry Winkler, professor of Biomedical Sciences
Photoreceptor Vulnerability and Glutathione Status
This project will test the hypothesis that a deficiency in glutathione accounts for the selective vulnerability of photoreceptor cells to chemical toxins and environmental stress. The expected outcome will be to provide therapeutic agents to protect against damage to retinas from oxidation and chemical toxins.

Xiangqun Zeng, associate professor of Chemistry
Development of Recombinant Antibody Based Piezoimmunosensors
Improved immunsensors are urgently needed in clinical diagnosis and environmental monitoring. The specific aim of this project is to develop scFv based immunosensor for cell surface marker analysis.

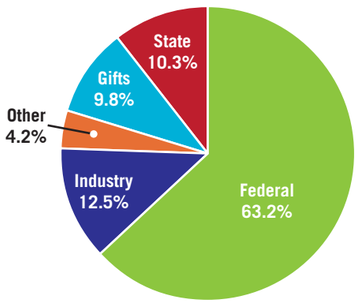
Grants and contracts agency list — FY 2008

American Academy of Nurse Practitioners
American Chemical Society
American Federation for Aging Research
Batelle, Pacific Northwest Divsion
Beaumont Hospital
BETA CAE Systems USA, Inc.
Blue Cross and Blue Shield of Michigan
Camille and Henry Dreyfus Foundation
ChevronTexaco
Chrysler LLC
City of Detroit
Clinton County RESA
Community Foundation for Southeastern Michigan
Continental Teves, Inc.
Cummins Technical Center
Department of Health and Human Services
Detroit Area Pre-College Engineering Program, Inc.
Fieldstone Alliance Inc.
Fine-Strong Enterprise Co., Ltd.
Ford Motor Company
Foster-Miller
General Motors Corporation
GM Powertrain
Health Resources & Services Administration
Infogation Corporation
JADI, Inc.
Kellogg Foundation
Knight Foundation
Kresge Foundation
Macomb County
Magna International, Inc.
Merck Company Foundation/AAAS
Michigan Council for Arts and Cultural Affairs
Michigan Department of Community Health
Michigan Department of Education
Michigan Department of Labor & Economic Growth
Michigan Economic Development Corporation
Michigan Space Grant Consortium
Michigan State University
Michigan Universities Commercialization Initiative
Microstar Technologies LLC
National Institutes of Health
National Science Foundation
National Writing Project
Oak Ridge National Laboratory
Oakland County
Oakland County Community Mental Health Authority
Octillion Corporation
Office of Naval Research
Organization for Autism Research (OAR)
Procter & Gamble Pharmaceuticals, Inc.
Reading Recovery Council of North America
Rehabilitation Institute of Michigan
Research Corporation
Robert Wood Johnson Foundation
ROPARD
Rose Hill Center
Saint-Gobain Ceramics
Science Applications International Corporation (SAIC)
Southeast Michigan RC&D Council
SpinDance, Inc.
Spland International Inc.
St. John Health
State of Michigan
The E. Matilda Ziegler Foundation for the Blind, Inc.
The Fieldman Sims Foundation
The Lincy Foundation
ThromboGenics NV
Trier University of Applied Sciences
United States Army
United States Automotive Materials Partnership
University of Colorado at Colorado Springs
University of Dayton
University of Illinois at Chicago
University of Michigan
US Army TACOM
U.S. Department of Education
US Environmental Protection Agency
Vision Research Foundation
Vistakon
Waltonen Engineering, Inc.
Warren/Conner Development Coalition

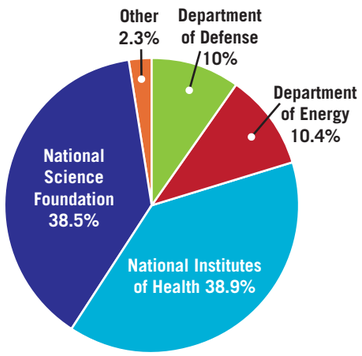
By the Numbers

Fiscal Year 2008

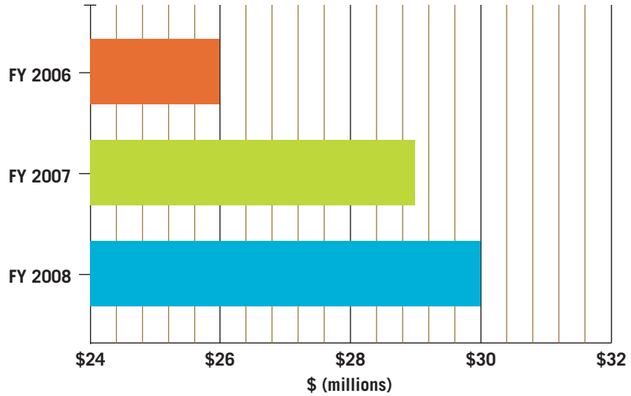
Research support by source



Federal Research Awards by Agencies



Institutional Research Expenditures



Office of Grants, Contracts and Sponsored Research

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