A Better Brain
For the Nation’s Aging
Power Grid
Visit and bookmark the Quest website at http://quest.utk.edu.

On the cover: NASA image showing the usage of electrical power across the North American continent. Read about UT Governor’s Chair Yilu Liu’s smart grid research on page 16.

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SPRING 2011
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Mapping Local History
UT researcher Eric Ogle and Sarah Lowe, associate professor of art, have developed an iPhone app that leads users on a walking tour of downtown Knoxville. The Knoxville African American Tours of Cultural Heritage app maps out 14 sites in and around downtown Knoxville that are significant to local African American history and culture. Using video, images, and text, the app provides interesting facts and background for each site. Ogle, the program coordinator at UT’s Community Partnership Center, led the project, while Lowe designed the app’s interface. For more information, visit http://isse.utk.edu/cpc/beck.

Painting to Change the Way Architects Think and See
UT architecture professor David Fox paints, but not necessarily as a hobby. Through his paintings, Fox is actually helping to change the way architects think and see things. His paintings are a critique of the site analysis process of architectural design, a phase that’s typically a benign means of data collection and nominal graphic notation. His images challenge this idea.

Older, traditional analytical methods are now inadequate, owing to enormous building types such as giant retail spaces, storage, and industrial buildings in a seemingly limitless geography. Digital images (satellite and street photos) allow a new means to interpret the landscape. Fox’s paintings and drawings use architectural diagramming techniques to interpret and construct visual narratives. The diagrams are a means to see differently, such as from miles above in varying scales. The work proposes new visualization techniques. The goal is to challenge the way one thinks by presenting multiple textures and dimensions.

Andy and the Beats Takes on Diabetes
A senior majoring in biochemistry and molecular biology with a minor in theater, Andy Rogers has turned his scientific research into art by producing a musical, Andy and the Beats, inspired by his experience as a young man with type 1 diabetes. The show follows Rogers from his diagnosis through his quest to find a homemade cure, and ultimately his acceptance of the condition. Rogers wrote, produced, directed, and starred in the musical, which developed from a research paper he had written for his major. For more information, visit www.utk.edu/go/n9.

Confronting Bullying
Bullying and cyberstalking have emerged as two major problems for children and teens. David Dupper, professor in the College of Social Work, is helping educate parents and school officials about how to identify and address these behaviors. Dupper, who spent nearly 15 years as a social worker in middle and high schools before entering the field of higher education, has written two books and myriad articles and papers on school violence, bullying, school disciplinary practices, and cyberstalking. He is currently writing a book about bullying in school settings.

To find out more about Dupper’s recommendations on how to avoid bullying and cyberstalking, visit www.utk.edu/go/n3.

Gauging Restaurant Appeal
UT researchers are working on a rubric that will help restaurants more effectively measure the customer dining experience and tailor establishments to meet emerging dining trends. John Antun, director of the UT Culinary Institute, along with assistant professors Wanda Costen and Rodney Runyan in the Department of Retail, Hospitality, and Tourism, have developed a 20-item scale called DinEX that accurately predicts a diner’s satisfaction and whether he or she will return to the restaurant. In addition to the usual factors like food, service, and atmosphere, the researchers found that restaurants are increasingly serving as social outlets, and many diners are considering health as a priority in their dining decisions. For more information, visit www.utk.edu/go/6h.
Recently Published


The recent Tucson shooting that left six people dead and wounded congresswoman Gabrielle Giffords and 13 others sparked a national debate over the use of hateful speech in political rhetoric and commentary. This book explores the intentions of hateful speech and actions, as well as the ways in which hate is manipulated by politicians, media personalities, and others seeking to influence behavior. Haas, associate professor and director of the School of Communication Studies, specializes in research on organizational communication effectiveness, communication in education and society, and public communication.


Janeshek’s first book of poems comprises verses invoking the voices of seductive, forceful women, from Jezebel to—naturally—Bette Davis. The book is a revised form of her doctoral dissertation. Janeshek is a lecturer in the Department of English.


Some experts estimate that as much as 10 percent of medical billing could be fraudulent, and illegal billing practices contribute significantly to healthcare costs for governments, providers, insurers, and patients. This book examines federal laws designed to reduce illegal medical billing, as well as fraudulent practices such as double billing, kickbacks, illicit referrals, and insurance scams. Leap is the Lawson Professor of Business Administration and head of the Department of Management, where he specializes in white-collar crime and deviant behavior in organizations.


This textbook is the first interdisciplinary introduction to cosmochemistry, targeting an audience of undergraduate and graduate students. The book aims to make cosmochemistry accessible to students from a variety of scientific backgrounds, including chemistry, astronomy, geology, and physics, and includes such topics as the chemistry of extraterrestrial materials, the chronology of the early solar system, and the geochemical exploration of planets. McSween, Chancellor’s Professor in the Department of Earth and Planetary Sciences, is well known for his research of meteorites and Mars and his work with NASA.


The eighth volume in this 17-book compilation of Jackson’s letters and other papers focuses on 1830, the second year of his presidency. Published in December 2010, this volume highlights Jackson’s opposition to the Bank of the United States, his involvement with the Indian Removal Act, and his conflict with Vice President John C. Calhoun. During their research for the current volume, Feller and his team made a number of groundbreaking findings, including the discovery of a forgotten model Indian removal treaty drafted by Jackson that had proposed far more generous compensation to the tribes than was ultimately given. The series aims to publish every extant piece of Jackson’s correspondence.
A protein, a biological polymer that performs various functions in our bodies.

A synthetic polymer, a very long molecule composed of a chain of connected beads (monomers).

Whether molecules are synthetic or biological, their motion is the key to many properties of materials.
Electric cars powered by eco-friendly batteries, able to travel over 300 miles without recharging.

Airplanes built with lightweight composite materials stronger and more durable than metal.

A solution that can preserve vital organs for years outside the body for later use to save lives.

Sound like elements of a futuristic science fiction movie? These applications of science are not from *The Matrix*, *Blade Runner*, or *Avatar*. They are becoming reality for Alexei Sokolov, the UT-ORNL Governor’s Chair in polymer science and leader of the Soft Matter Group.

Sokolov’s group focuses primarily on experimental studies into the dynamics of soft materials and molecular biophysics. The research can be divided into four major topics: glass transition and polymer dynamics; dynamics of biological macromolecules; nanocomposite and nanostructured materials; and nano-optics and plasmonics.
“If molecules don’t move in my body, I am dead. Life is a molecular motion.”

—Alexei Sokolov

Sokolov’s research in polymer science focuses on development of new materials for prototype electric cars able to travel much farther than today’s models and for lightweight planes built with stronger composite materials. The Boeing 787 Dreamliner pictured above features lighter-weight construction. Its materials by weight percentages are 50 composite, 20 aluminum, 15 titanium, 10 steel, and 5 other. The craft will be 80 percent composite by volume.
But the batteries in electric cars could be significantly improved by applying the knowledge of molecular motion to polymers. Currently, electric cars only travel between 50 and 90 miles per charge. Rechargeable battery technology uses lithium ions that move between the negative and positive electrodes and back in order to create a charge. This movement occurs within a liquid, which must be contained and adds weight to the battery.

"If we can remove the liquid and use a thin polymer film instead, it will reduce the weight of the battery, remove the big box, and be more environmentally friendly," Sokolov explains.

However, the problem facing Sokolov and his research team is that ions do not move through polymers as fast as they move through liquid. By discovering how the ions are moving, Sokolov can help design the right molecules and chemistry to help ions move as fast as possible.

"We are probably five to ten years away from this technology becoming a reality," Sokolov says. "But even then, we will still work on improving the technology."

Understanding the fundamentals of molecular motion also provides the potential to develop a way to preserve proteins over time, a process that can have far-reaching effects on regenerative medicine. Developing technology for re-growing organs and tissues is one of the current problems. The next challenge is to keep the organ or tissue alive. This is also the problem with organ transplants in current medicine.

When a protein is exposed to humid air, it immediately begins to degenerate. For example, when you purchase a piece of meat from the butcher, you have a limited window of time before the meat goes bad. You can put it in the freezer to preserve it longer; but the optimum flavor is gone because biological systems contain water, which crystallizes and destroys cells and tissues.

"We have already developed a solvent that can keep biological molecules active for 10 years," Sokolov explains. "Now we want to bring this technology to cells, tissues, and organs for transplants."

The aerospace industry has already begun using polymers in place of metals. Boeing, for example, has created the 787 Dreamliner aircraft that contains 50 percent composite materials in its primary structure, including the fuselage and wings. However, explains Sokolov, the use of such materials in automobiles is not yet feasible. "We are a ways off from replacing the metal in our cars because it is too cost-prohibitive at this point," he says.

"The main goal of our research is to develop a fundamental understanding of molecular motion and its relationship to the macroscopic properties of polymers and other materials,” Sokolov says.

Molecular motion, as the name suggests, is the motion or energy change that occurs in a molecule. According to Sokolov, all synthetic and biological molecules depend on molecular motion. "If molecules don’t move in my body, I am dead," he explains. "Life is a molecular motion."

When applied to polymers—large molecules composed of repeating structural units—Sokolov’s work involves fabricating the molecules in an effort to control their properties and create materials with useful characteristics. The term “polymer” is usually associated with plastics, but encompasses a large class of natural and synthetic materials.

“The advantage of polymers is that they have many unique properties we can use by changing their molecular structure and architecture,” Sokolov explains.

One example of the advantage of polymers is their mechanical property. By adding specific nanoparticles to a polymer, Sokolov and his team can create lightweight, polymeric-based composites with greater mechanical strength and toughness than metal and thus significantly improve the fuel efficiency of cars, trucks, and airplanes.

Sokolov always wanted to discover something that no one else knew and, since high school, wanted to be a physicist. As a professor of polymer science at the University of Akron, he became interested in glass transition as a general understanding of polymers and became fascinated with molecular motion.

“I realized the potential of polymers 12 years ago,” Sokolov says. “We are trying to answer questions no one else could answer by studying the most fundamental issues of molecular movement. Although it’s far from application, it excites me to unravel phenomena that nobody else understands. The breakthroughs and totally new ideas and technologies are what drive our research.”

The aerospace industry has already begun using polymers in place of metals. Boeing, for example, has created the 787 Dreamliner aircraft that contains 50 percent composite materials in its primary structure, including the fuselage and wings. However, explains Sokolov, the use of such materials in automobiles is not yet feasible. "We are a ways off from replacing the metal in our cars because it is too cost-prohibitive at this point,” he says.
For many, becoming more physically active after surgery is the furthest thing from their mind.

But Clare Milner believes the more active they become, the more likely their walking patterns will improve, and the chances of needing a second knee replacement will decrease.

So, with the help of a pedometer, a dedicated research team, and a technologically advanced lab, she is working to better understand how to get these people moving again.

Milner, assistant professor of kinesiology in the Department of Kinesiology, Recreation, and Sport Studies, specializes in biomechanics, focusing on lower-extremity injury and rehabilitation.

Her current research involves examining the gait of people who have undergone one total knee-replacement surgery, have completed their rehabilitation, and are at least one year post-surgery. These factors are important because the participants have gone through the recovery period and the arthritis pain in their knee should be gone.

“The focus of the study is to determine if they are back to a normal walking pattern in their everyday activities,” Milner says. “If not, is that something that may lead to problems with their other knee?”

In a previous study, Milner looked at healthy older adults without any knee problems and adults who have had total knee replacement surgery. After measuring both knees and other...
joints to see how they were moving, Milner made some statistical comparisons to find out what the differences were.

To measure the gait of a person in the biomechanics laboratory, Milner places markers on a participant’s feet, legs, thighs, and waist. As the subject walks across the floor over force platforms, a camera system connected to the platforms allows her to track the person’s walking pattern. Body positions and angles at the joints are measured up to 240 times every second. When this information is transferred to a computer, the movement in the ankles, knees, and hips can be calculated.

Study volunteers tend to be older adults, ages 50 to 70, who have osteoarthritis. They are required to be overweight and not very active (less than 7,000 steps per day). Overweight people have a very high risk of developing arthritis in their knees, the most common factor in determining whether a total knee replacement is needed.

“Arthritis is a disease that wears out the surfaces of the joints,” Milner says. “As the population continues to become heavier, more people will probably need knee replacements at a younger age because they have been heavy for a longer period of their life.”

Milner’s recent case studies aim to increase the number of daily walking steps a person with a knee replacement takes to see if it can improve the walking pattern as well.

“These case studies look at results of gradually increased walking,” Milner says. “We’re not saying anything about changing the way a person walks, just walking more frequently.”

Many knee-replacement recipients find it difficult to become active after surgery because they had painful knees and limited mobility for a long time before the surgery.

“After the pain in their knee is gone may be a good time to make a lifestyle change, to become more active and take more steps,” Milner says.

At the start of the study, if Milner finds that participants are not very active but are interested in becoming more so, she uses a pedometer to measure the number of steps they are taking initially and sets a goal for increasing that number. She and fellow researchers ask participants to keep an activity log to make notes about what new things they are doing to work more activity into their day.

People seem to enjoy having a tool that measures what they are doing, so they can see when they achieve a certain goal for the week. “I remember one of the people in a case study said, ‘You know, at the end of the day, I would find myself walking up and down the long hallway to get that number up where it needed to be,’” Milner explains.

At the end of the two-month study, Milner looks for changes in walking patterns. In addition to studying the movement of the knee that has been replaced, Milner is trying to understand what factors might lead to having the other knee replaced.

“When I was working on my post-doctoral research at Penn State, that was the first time I had worked with people who had a knee replacement,” Milner says. “People who volunteered for our study seemed really interested in learning how to reduce the chance of needing a second surgery.”

Milner also expresses interest in the “next level”—understanding the way someone walks and reducing the need for another knee replacement.

“If we can understand the process, especially what factors might lead to a second knee replacement, maybe there’s something we can do to help,” Milner says.
Unearthing the Cycles of Civilization
By Meredith McGroarty

Agamemnon
Gold Death-Mask
16th century BC
Mycenaean National Archaeological Museum
Athens Greece
Fifteen hundred years before
the Goths and the Vandals fractured the
Roman Empire and ushered in the period com-
monly referred to as the European Dark Ages,
a similar phenomenon befell ancient Greece,
which saw the achievements of Mycenaean
society collapse in the 12th century BC, lead-
ing to a widespread decline in material culture
and social development in the Greek world.
These cycles of growth and decay have played
out several times in ancient civilizations, and
University of Tennessee researchers are lead-
ing an archaeological project that aims to look
at these prehistoric phases as a tool to under-
stand how and why great societies begin or
cease to exist.

Since 2004, UT classics professor Aleydis Van de Moortel has
co-directed the Mitrou Archaeological Project, or MAP, an annual
summer field project that takes place at Mitrou, an islet in the
North Euboean Gulf in central Greece. The abundance of settle-
ment remains, graves, pottery sherds, and many other finds
make the site an ideal location to study the changes that were
taking place in that region during the Bronze Age and Iron Age.

“Mitrou is a very rich archaeological site, and the periods for
which it has the most material are periods of transition that are
not well understood,” says Van de Moortel, associate professor
and Lindsay Young Professor in the Humanities.

Van de Moortel’s research focuses on Aegean prehistory and
the rise and fall of complex societies. She first learned about Mitrou
from a colleague shortly before arriving at UT in 2002.

In addition to field research, MAP also includes a field
school where students receive instruction in excavation and
analysis techniques. MAP is a joint venture of the University of
Tennessee and the Greek Archaeological Service, conducted
under the auspices of the American School of Classical Studies
at Athens. Its team comprises students, faculty, and staff from
more than 14 countries, and four to six UT students partici-
pate in the project each year. Outside funding for MAP comes
mainly from the Institute for Aegean Prehistory, the National
Endowment for the Humanities, and the Loeb Foundation at
Harvard University.

The story of human civilization at Mitrou starts back in the Early
Bronze Age. The earliest excavated level dates around 2400 BC, an
era of moderate sophistication in the Greek world.
In Early Bronze IIB, in several parts of Greece we have large corridor houses. This is the first official architecture we have in Greece. These buildings were designed with very substantial walls, and they had terracotta roof tiles. They were the political centers of these early settlements,” Van de Moortel says. At Mitrou, roof tiles and substantial walls were found, but it is not yet clear whether there was a corridor house.

Around 2200 BC, this early society collapsed, and from then until approximately 1650–1600 BC, the Greek mainland had a village culture with simple houses and no physical evidence of powerful leaders. Starting around 1600 BC, there is evidence of a rapid increase in power among local elites. Before MAP, this evidence came primarily from graves, but Mitrou is the first site to provide major new insights into this social development from settlement remains.

Two large complexes were built on Mitrou—possibly belonging to two leading families vying for power—and a network of broad, well-paved roads was laid out over the earlier settlement, indicating a stronger central authority and demonstrating a transition to a more urban society.

Finds at Mitrou also provide more insight into the foundations of the new elite’s power. The discovery of a horse bridle piece from the Balkans suggests the presence of a trading network between Mitrou’s elite and the north, as Mitrou was located on strategic land and sea routes. Evidence that purple dye—a luxury in ancient times—was produced on Mitrou could indicate that Aegean leaders traded purple cloth with eastern civilizations in exchange for copper and tin, which were needed to produce bronze, the key metal for Bronze Age weapons and tools.

MAP archaeologists also found elite graves with gold jewelry and the remains of helmets covered with boar’s tusks, indicating that the local elite in the late 16th and the 15th centuries BC became increasingly wealthy, gradually adopting elements of Mycenaean elite culture.

Although this adoption of Mycenaean practices appears to be gradual and voluntary, evidence at Mitrou and other sites suggests that the establishment of palatial societies around 1400 BC involved violence. In the early 14th century BC, Mitrou was destroyed by fire, perhaps as a result of an earthquake, but possibly through warfare. Van de Moortel suspects that the area was taken over by one of the more powerful neighboring rulers, probably the leader of Orchomenos. She explains that Mitrou never developed a palace itself and shows remarkably little activity throughout the 200 years.

The patterns of rise and fall seen at Mitrou raise important questions about how societies change, collapse, and rebuild.
years following its destruction (approximately 1400–1200 BC), even though this period marked the height of Mycenaean palatial society. Only when Mycenaean palaces collapsed did Mitrou begin to recover, albeit slowly, never attaining the level it did in the 16th and 15th centuries BC.

Excavations at Mitrou and at other sites in the Aegean are also shedding more light on what happened after the collapse of Mycenaean palatial society, a period sometimes referred to as the Greek Dark Ages.

“We have several sites in the North Euboean Gulf area that are flourishing in the 12th century but not in the palatial period. For the first time, naval warfare imagery appears in several areas of the Aegean, including at a site near Mitrou. I think we’re starting to see here the rise of a new elite that succeeded the palatial elite and gained power from naval raids,” Van de Moortel says.

In the 12th century BC, many sites in Greece still had an urban character, but by 1100 BC society had become rural again. Possible explanations for this change range from immigrations by new people to large-scale abandonment of the land as a result of natural disaster or warfare, with the remaining people unable to maintain a coherent urban structure. Mitrou is one of only a few sites never abandoned, and thus it provides a rare opportunity to study this transitional period.

From the end of the 12th century until the 10th century BC, Mitrou was home to a village society that was less advanced than the civilization that had occupied the islet 500 years previously. Van de Moortel and her team are now examining the human remains and all aspects of Mitrou’s material culture to see whether they can find an explanation for this reversion to a rural society. Mitrou was ultimately abandoned in the late 10th century BC, and has remained uninhabited ever since.

The patterns of rise and fall seen at Mitrou raise important questions about how societies change, collapse, and rebuild, Van de Moortel says. The fall of a fairly advanced social structure in the Early Bronze Age, the rapid rise of a local elite class in the 16th century, and the failure of the people of Mitrou to rebuild after the disaster of the 14th century are all important indicators of how civilizations do or do not survive.

“Our finds at Mitrou are reshaping scholarly debate on how complex societies come about, and also on what happens when a complex society disintegrates. How do people survive? How do they look back to the older society?”
Houses and cars. Children and education. Retirement savings. Investments. Vacations? Families have many financial decisions to make, and muddying the waters is that giant spoiler: the economy.

How can a family work efficiently to allocate money needed for its day-to-day operations—not to mention planning for the future—and still maintain financial solvency? How can it arm itself for the everyday battles that threaten its peace of mind?

The financial management of a family often is put in the hands of a financial planner, a person who keeps a finger on the pulse of the economy, an ear to the ground of investment opportunities, and an eye constantly on the family’s future. Good financial planners are knowledgeable and experienced. They are responsive and nimble, and they base their timely recommendations on sound and thorough research. A family is fortunate to have this kind of person protecting its interests.

Now transfer that scenario to a national scale. Add congress and a president. Multiply the financial picture by billions and escalate the risk to reflect a possible threat to our way of life. A family this size—with decision-making power that impacts a nation and the world—needs a financial planner equal to the task.

UT Knoxville is home to just that kind of financial planner. It’s called the National Defense Business Institute, a young enterprise in the College of Business Administration’s Center for Executive Education. NDBI’s sole purpose is to provide practical research and services to the U.S. Department of Defense and assist the private defense industry in acquiring weapons and managing business more efficiently.

What financial planners do for families, NDBI is doing for the U.S. military.

Every day, military decision-makers are charged with providing the best weapons for real-life warriors. The process of identifying a threat, determining how to respond, and building the capability to take action can take years to complete. If it takes too long, the risk might have grown, the rules of engagement might have changed, or the damage might have been done. Millions of dollars could be wasted in the process.

As families balance their checkbooks in a tight economy, the U.S. military must also balance its

The College of Business Administration’s National Defense Business Institute is the only major university-affiliated institution devoted entirely to helping government and industry acquire weapons systems and services more efficiently.
spending against an ever-shrinking, time-sensitive budget.

Leading the charge to cut through this cumbersome process is J. David Patterson, executive director of NDBI. Patterson brings a wealth of knowledge to the field, having spent 30 years examining defense acquisition and business management for the U.S. Department of Defense and private military contractors.

Before joining UT, Patterson was principal deputy undersecretary of defense, comptroller for the U.S. Department of Defense, a position in which he advised the U.S. Secretary of Defense on annual budgets; developed legislative strategies; and implemented financial policy, financial management systems, and business modernization programs.

“We have an opportunity to influence the national security agenda through our work with the defense industry,” Patterson says. “NDBI is the only major university-affiliated institute specifically focused on providing government and industry resources for achieving economically effective defense acquisition programs.

“NDBI has become the go-to folks for the defense industry,” Patterson continues.

Over the past two years, the NDBI team has completed about a dozen major research initiatives for the U.S. Air Force. That equates to a major research study every two months or so—previously unheard of in the military research industry.

In general, research for the Air Force has focused on two areas: organizational efficiency and weapon acquisition strategies. NDBI has helped the Air Force manage its business programs more efficiently so it can maintain the same level of national security with a smaller budget.

To effect positive change in the organizational structure, NDBI studies have shown the Air Force how it might effectively integrate its new deputy chief management officer position, mandated by the U.S. Congress, into its headquarters staff. The NDBI team also identified improvements to the weapon acquisitions review process and recommended reinstating a program control office that oversees spending, cost estimating, and other functions related to acquisitions.

On behalf of the Air Force, NDBI team members have also analyzed complex weapon systems, developed acquisition strategies and proposals, and evaluated decisions through decision models. In all cases, team members provided the Air Force with comprehensive analyses of data, conclusions and implementation plans that are sensitive to the needs of the organization.

“NDBI provides a unique approach to studying and analyzing information for government agencies,” says Patterson. “The government works on an annual decision cycle, so what value is there in providing research findings two years after they are requested? With our four- to six-month turnaround, the U.S. government can make decisions based on comprehensive real-time data,” he says.

The process of moving a defense concept into the warfighter’s hands is laden with obstacles and mired in myriad decisions. Analyze the threat. Determine the requirement. Develop capability. Advocate funding. Add to this the increased emphasis from the Oval Office and Department of Defense to be more efficient and sustain the same level of national security with a diminishing budget, and the process can become an incredibly daunting challenge.

But NDBI’s proven and driven group of financial planners provides opportunities for the U.S. government to successfully meet the challenge. From analyzing weapon systems to developing acquisition strategies and decision models, Patterson and his team of dedicated analysts and researchers inspire innovation and effective business management within the defense acquisition system. They are proving that it is possible to spend taxpayer dollars wisely. By helping the U.S. Air Force and others do their important jobs more efficiently, they are helping ensure military strength despite uncertain funding.

The checkbooks may be bigger and the challenges more daunting, but these outstanding financial planners are enabling quicker decisions that help put efficient defense programs into operation faster.

“We have an opportunity to influence the national security agenda through our work with the defense industry.”

— J. David Patterson
Building the Brain of a Smart Grid

By David Brill

The blackout of 2003, the worst in U.S. history, revealed the weaknesses in the nation’s aging power system. Governor’s Chair Yilu Liu is determined to relegate such disasters to the past by developing a grid that’s as agile as it is smart.

“With the tools available in 2003, system operators could not recognize the severity of the situation until hours later. There was no global picture of the entire system. Everyone was looking at a relatively small piece of the larger puzzle.”

—Yilu Liu

Photography by David Luttrell
After sunset on August 14, 2003, the residents of New York City who peered upward got a glimpse of something rarely visible in Gotham. Above the darkened city, beyond the towering skyscrapers, spread a canopy of winking stars. The hundreds of unfortunates pinned in elevators or trapped underground in inert subway cars were afforded no such view, though all New Yorkers could trace their descent into darkness to northeastern Ohio. There, at about 4:00 p.m., a chance encounter between a sagging, overloaded power line and a tree triggered a cascading power outage that affected 50 million people in seven states and Canada. For some, the blackout lasted 30 hours.

Yilu Liu, the UT-ORNL Governor’s Chair for power systems in the College of Engineering, is working to devise a smarter electric grid that automatically resolves minor disruptions before they escalate to major blackouts. She believes part of the answer may lie in a powerful but low-cost technology housed discretely in a small beige box called a Frequency Disturbance Recorder, or FDR.

Taking the Pulse
Liu’s FDR is to the nation’s power grid what an electrocardiogram is to a hospital patient. While the EKG measures the electrical activity of the human heart, FDRs networked via the Internet are able to register the electrical pulse moving through the wires that connect power stations to toasters, air conditioners, and TVs.

Currently, the frequency monitoring network, or FNET, housed in UT’s Power Information Technology Laboratory, tracks 80 FDRs placed around the country. The number will ultimately grow to 2,000 along with the GridEye units deployed by ORNL. At this number, it will provide high density coverage of the U.S. grid.

FDRs are capable of measuring subtle fluctuations in power supply by sampling the frequency, voltage, and phase angle (collectively known as phasor) 1,440 times per second. The unit’s GPS receiver provides a timing signal—precise to the microsecond—as the unit’s algorithm detects and records the fluctuations. All information is sent in real time via the Internet to servers at the Power Information Technology Laboratory, where all data are archived.

Minor disruptions, though detectable by the FDRs, are of little consequence. Not so with major disturbances, like the one that resulted in the blackout of 2003, when the normal 60-hertz frequency dropped as low as 52 hertz in some regions.

Getting the Global Picture
FNET went online in 2004. Had it been fully operational a year earlier, it could have provided power-system operators with the real-time information necessary to avert the worst blackout in U.S. history, or at least to limit its scope and duration.

Instead, system operators relied on data provided by the existing Supervisory Control and Data Acquisition network of monitors mounted at substations. SCADA, though useful, has limitations, particularly when compared to FNET. While FNET takes 1,440 measurements per second, SCADA logs one measurement every 2–4 seconds. FNET measurements are GPS-time-synchronized, while current SCADAs are not. And while SCADA tends to focus on local anomalies, FNET assesses the health of the entire U.S. grid.

“With the tools available in 2003, system operators could not recognize the severity of the situation until hours later,” says Liu. “There was no global picture of the entire system. Everyone was looking at a relatively small piece of the larger puzzle.”

FNET enables dramatic visualization of such disturbances on a map, with the contented green of a system in stasis suddenly flashing in waves of red, orange, blue, and purple, representing wildly fluctuating frequencies. The waves emanate outward from the source of the disturbance.

For example, when nuclear reactors unexpectedly tripped offline in Florida in 2008—resulting in a statewide power outage—FNET’s sophisticated triangulation algorithms processed its units’ GPS-timed signals to instantly locate the source of the disturbance. Today automatic alerts go out instantaneously to the organizations responsible for monitoring and maintaining the flow of electricity through the grid.

If the event threatens a major power disruption, these organizations could then take action to avoid systemic collapse and prevent damage to equipment by strategically shutting down individual loads and power-generating facilities or reducing the voltage supplying the system.

“We may not be able to predict that a certain power line will touch a tree,” says Liu, “but we can detect disturbances that can cause major disruptions.”

Exploiting the Best Resources
Liu’s work represents a critical lobe of what will evolve into the brain of a smart grid, and she credits the wealth of shared resources at UT and ORNL with major advances in her research, as well as the
support from EPRI and some 20-plus major electric power utilities and manufacturers. The project relies on UT’s Kraken and ORNL’s Jaguar supercomputers, among the world’s fastest, to simulate, much more quickly than real time, the potential ripple effects of disruptions to the power supply.

Eventually, data such as those created by FNET will feed into a “self-healing” system of intelligent algorithms capable of triggering automatic remedial action. “When major disruptions occur, there is no time for human response,” says Liu.

Most Americans take for granted the steady flow of electricity until they find themselves fumbling in the dark for a flashlight. Much worse are the effects of large-area outages on industry, commerce, transportation, and national security. Power outages are troublesome and expensive. According to a 2004 study by Lawrence Berkeley National Laboratory, outages cost the United States about $80 billion a year.

Liu makes it clear that even a smart grid will be susceptible to occasional disruptions, but she and her colleagues are determined to reduce their frequency and range—something that will benefit all Americans.

“We’re all connected to the system,” she says. That’s not necessarily a good thing, if a toppled tree in Ohio can turn out the lights in New York City. Someday, though, as Liu’s research pays off, a descent into darkness will be an entirely voluntary pursuit.
The Internet.

Every day it connects people all across the world. But as it connects some, it leaves others behind, deepening the digital divide between the Internet’s have-nots and have-nots.

This divide is especially great in the rural regions of southern and central Appalachia. It is well documented that these areas are statistically below the national average in information literacy, Internet use, computer ownership, and telecommunications infrastructure.

Many mundane activities are now performed only online, but so are some critical ones, such as filing for government services or applying for jobs. With the majority of the population in Appalachia cut off from Internet access in their homes, either due to lack of service or not being able to afford it, they head to the one place that does have it—the library.

According to research conducted by Bharat Mehra, associate professor in the School of Information Sciences, and his colleagues, basic Internet access is the most important information resource rural libraries provide. It has the power to improve everyday life.

It gives people the potential to achieve greater social equity and empowerment.

Mehra is one of the world’s preeminent scholars in defining the digital divide, a concept he describes simply as “the troubling gap between those who use computers and the Internet and those who do not.”

Mehra is working diligently on closing that gap. In 2009, he and co-principal investigators Kimberly Black and Vandana Singh received a $567,660 grant from the Institute of Museum and Library Services to develop the Information Technology Rural Librarian Master’s Scholarship Program aimed at bridging the digital divide in the southern and central Appalachian regions. The foundation of the ITRL program is a customized curriculum for the master’s program in library and information science based on research Mehra and his team conducted to document the authentic experiences and realities of today’s rural librarians.

“There are many unique circumstances rural librarians are forced to deal with on a daily basis that are not covered in a traditional library and information science curriculum. We incorporate those into our program,” he says.
The first step was to administer a needs-assessment study consisting of focus group interviews with 50 library professionals from across southern and central Appalachia. The feedback was then used to tailor the curriculum to address the most prevalent issues. For example, the group was asked to identify the most critical information needs of rural clients in their libraries. The most common answer would shock many with its simplicity—teaching people how to use the Internet, or a computer.

“Library professionals desperately need competencies and skills in information technology to help their local libraries and communities deal with some of the unique cultural, social, economic, and environmental challenges of the region,” Mehra explains.

Another survey question was used to determine what types of training would help rural librarians be more effective in their positions. Mehra and his colleagues discovered a myriad of skills such as public administration, human resources, and leadership that were believed to be essential for rural library professionals. Other skills, such as a “high touch” approach to customer service, connecting with diverse clients, forming partnerships and collaborations with other agencies and institutions, conflict resolution training, and grant writing were also requested.

As a result, in addition to six information technology courses, the curriculum includes five courses dedicated to rural library management and services. The course content focuses on the necessary skills identified in the team’s research.

For example, the course in public library management and services teaches students methods of data collection and analysis to better understand the needs of their users and improve rural library services. The grant development course shows how to develop strategic relationship management skills and respond to external funding opportunities. The rural librarianship course expects students to conduct an in-depth analysis of a rural library community for developing a long-range marketing and public relations plan that promotes the use of cutting-edge library services in rural areas.

The custom ITRL curriculum is currently being delivered via distance education to a cohort of 16 paraprofessionals in six states, extending from Maryland to Tennessee. The students—separated by hundreds of miles—attend classes together in real time every week using Voice Over Internet Protocol technology. They will graduate in 2012 with a master’s degree focusing on information technology and rural librarianship from the SIS.

“Libraries have become key players in reaching out to rural communities. Sometimes the library is the only place where Internet connections are available in the area because it is so geographically isolated,” says Mehra. “Through better preparation, rural librarians will become ‘change agents’ with a strong potential to make a positive, progressive difference in the everyday lives of the people in their communities.”

As the program progresses, Mehra and his team will continue to collect quantitative and qualitative data in the form of student surveys and interviews. Before each course, he inquires about their expectations for the class and afterward asks if their expectations were met, thus ensuring that goals and objectives identified in the grant proposal are met.

“It’s been one of my key missions to work with disenfranchised or underserved people, to encourage our students to engage with them—partner with them as equals—to help improve their everyday lives,” he says.

After the students graduate, their work as change agents will truly begin. Mehra says they will partner with other rural libraries and communities to promote progressive changes in their environments. He also intends to take this program to the next level with an evaluation of broadband connectivity in rural libraries and its impact on economic development.
Crystals stir our imagination. We cherish the clarity of gemstones. Some have even assigned them intrinsic healing energy. Scientifically speaking, the crystal, with its exact, almost predefined, internal structure, is a marvel in and of itself.

“The fact that you can actually synthesize [them] has always seemed like the most amazing thing to me,” says Chuck Melcher, director of the Scintillation Materials Research Center.

The SMRC was formed through a collaboration of the University of Tennessee and CTI Molecular Imaging, a corporation founded by four UT alumni. In 2005, CTI MI merged with Siemens Medical Solutions, forming Siemens Medical Solutions Molecular Imaging. UT and Siemens formally signed a contract establishing the center in October 2005.

Melcher and his SMRC colleagues grow, study, and improve the scintillation crystals responsible for illuminating the images generated by positron emission tomography (PET), X-ray computed tomography (X-ray CT or CAT), and security scanners.
“Just the perfection,” he adds. “A crystal the size of your thumb has something like $10^{23}$ atoms in it, all positioned in exactly the right place; this is many times more than the number of stars in our galaxy, [estimated to be in the hundred billions ($10^{11}$)].”

At a glance, it seems unlikely that you could take specific atoms and line them all up perfectly to create the exact crystalline structure you want.

“But you actually can do that,” Melcher says.

Today’s advanced medical imaging combines PET and X-ray CT into a powerful, noninvasive, three-dimensional tool for diagnosing illnesses inside the body. PET and CT technologies take advantage of different basic physical processes and produce powerful complementary results.

Most of us are familiar with the noisy, doughnut-shaped systems, with horizontal patient beds that slide into tunnel-like interiors.

“With a CT scan, the X-ray source is on one side of the tunnel and an arc of scintillators on the other,” Melcher says. “X-rays released from the source travel (transmit) through the patient—or not, depending upon what they encounter along the way—and are detected on the other side. The X-ray CT produces excellent three-dimensional images of internal anatomical structures.

“For a PET scan, the patient is injected with a radioactive tracer. In this case the gamma-rays fly out (emit) in all directions from inside the patient; they are detected by a continuous ring of scintillators.

“In the vast majority of clinical cases the tracer is attached to glucose, which the body metabolizes just like any other glucose. But, not all tissue metabolizes glucose at the same rate.

“Say you have a tumor and you want to know if you have cancer. Malignant tissue consumes glucose at a much faster rate than normal tissue. Malignancies show up on PET scans as bright spots of metabolic activity,” Melcher explains.

During a scan, scintillators embedded in a detector absorb and convert gamma or X-ray radiation into sparks of light. The light is collected by photomultipliers attached to the scintillator crystals and reconstructed down the line by sophisticated computer programs, into three-dimensional images of internal organs, bones, tumors, and in the case of security systems, items packed inside a closed container or suitcase.

Scintillator crystals glow with various colors according to the activator ions incorporated into the structures.
“I used to compare scintillators to film in a camera, before digital cameras took over,” Melcher says. 

Still, the analogy holds; and as with a camera where some type of sensor records an image, the quality of the image depends on the quality or performance of the sensor. 

“If the sensor is finely tuned and is made up of lots of tiny pixels, then you’ll get a high-resolution, clear, sharp image. If not, you get a crummy image,” he says. “How well a sensor performs depends upon the nature of the materials used to make it.” 

To build the scintillation crystal, they start with an activator—an atom well known for its ability to absorb radiation and release that energy as light. 

“Certain elements are particularly useful just because they’re efficient, produce light at more convenient wavelengths, and respond faster than others,” Melcher says. “So what we do is look for compatible host materials in which to incorporate these atoms.” 

This is where the science of crystallography becomes vitally important. 

“Let’s say you want to use cerium as your luminescent atom. You can’t just incorporate it into any arbitrary material. It needs to be chemically compatible, because the cerium has to substitute for an atom in the host material; it should be roughly the same size and have the same valence [also known as an atom’s charge state or combining capacity].” 

“So immediately that limits the possibilities. Beyond that it becomes a matter of how well we can synthesize this particular compound.” 

“It’s really difficult to predict theoretically which combinations of activators and host crystals will work, so this is primarily an experimental process,” he says. 

SMRC researchers grow the crystals using two different techniques. In one laboratory they work with materials sensitive to moisture in the atmosphere. These are handled inside a glove box. The materials are sealed and melted in a quartz tube, suspended in the middle of a furnace. Temperatures are regulated to cool the material at the bottom, growing the crystal from bottom to top inside the tube. 

In a nearby lab, materials not susceptible to atmospheric moisture are mixed in an espresso-cup-shaped crucible made of pure iridium. 

“It’s the only metal with a high enough melting point to resist the 2,000 degrees Celsius inside the growth chamber,” Melcher explains. 

The furnace, with all its attached instrumentation and computing equipment, fills one-third of a 400-square-foot room from floor to ceiling. 

Researchers place the crucible inside a chamber surrounded by a heating coil and ultrahigh-tech insulation. When the compound melts they lower a pencil-sized seed crystal attached to a rod through a protected opening in the top of the furnace.
“We control the temperature such that when the seed crystal touches the surface the melt begins to nucleate, to freeze, onto the crystal. Then, the seed crystal is rotated and slowly pulled up, at about one millimeter per hour.

“This is called crystal pulling,” he says. “The rod is suspended from a high-precision scale; it literally measures the change in weight of the crystal every two seconds as it grows, to see whether it is growing too fast, too slow, or just right. If the crystal is growing too fast, that means the temperature is too low, and a computer will send a signal to adjust the power to the heating coil.”

The researchers at the SMRC have a significant history of success creating useful scintillation materials. For example, the growth process for LSO (cerium-doped lutetium oxyorthosilicate, \( \text{Lu}_2\text{SiO}_5\text{Ce} \)), invented by Melcher and his collaborators some 20 years ago, is still the most common technique for producing scintillation crystals found in PET scanners today.

However, it is the pursuit of the next generation of scintillator technology that drives the center’s research as they attempt to capture even more crystal magic.

**Synthesis of scintillator crystals begins with precise mixtures of highly purified powders that are melted and slowly grown into cylindrical crystals. Pixels are then cut and used to build detector arrays for imaging devices.**

An example of a whole-body combination PET/CT scan showing both metabolic (chemical) and anatomical (structural) images in one scan.
It wasn’t fair, lawmakers said, that some states were defying federal law and assisting illegal immigration. They insisted that the federal government step up and take a harder line on these fugitives and the states protecting them. And so it did, with the controversial and far-reaching Fugitive Slave Act of 1850.

Today’s legal battles over immigration have roots stretching back more than 200 years, to the time when lawmakers were debating the government’s role in the return of fugitive slaves to their owners. The parallels between today’s immigration removal proceedings and 19th-century policies on the apprehension and handling of runaway slaves are the focus of new research by Karla McKanders, an associate professor at the University of Tennessee College of Law.

“I look at legal history, and I make historical comparisons between past discriminatory laws and current laws that target immigrants,” McKanders says. She adds that 19th-century laws controlling the movement of slaves have many similarities to 21st-century immigration legislation, especially in their attempts to clarify the powers and limitations of state and federal governments.

McKanders teaches courses related to refugee law and policy; she also teaches in the clinical program, where she works with her students on actual immigration cases. Part of her research examines past laws on slavery and segregation, and how these laws compare to current state and local laws targeting immigrants. Her findings on the subject have been published in the *Harvard Journal for Racial and Ethnic Justice* and presented at UCLA and Johns Hopkins.

The federal Fugitive Slave Law of 1793 created an administrative process for the return of escaped slaves to their owners (recovery of fugitive slaves was a right granted to slaveholders in the U.S. Constitution). But several northern states quickly began drafting laws forbidding the forced removal of African Americans for the purpose of placing them into slavery.

In 1842, the U.S. Supreme Court ruled that state legislation could not supersede the rights granted to slaveholders by federal law, but the wording of the ruling left the door open for states to pass subsequent “personal liberty” laws that prohibited the use of state officials and resources in capturing escaped slaves. In the end, the federal Fugitive Slave Act of 1850 aimed...
to settle the discord by creating federal commissioners to oversee the return of fugitive slaves and granting authority to federal marshals to enforce this recovery process. Free states could no longer offer any protection to fugitive slaves, nor could they pass laws that hindered slave recovery efforts. The existing personal liberty laws drafted by the states were, in effect, now nullified by federal law.

“The 1850 Fugitive Slave Act can be instructive on how the federal government has addressed conflict among states and localities under the removal system for slaves and the forced migration of slaves for the purpose of sustaining the economy. Specifically, in instances of both current immigration laws and the dispute over the forced migration of slaves there is, and was, an intense debate over whether the federal government should have the exclusive authority to regulate the migration of people versus having many varied state policies,” McKanders says.

Today’s immigration laws, McKanders explains, echo this struggle between states and the federal government over how immigration should be regulated; however, while slavery laws aimed to curb states’ ability to craft their own legislation, current immigration laws proposed by several state governments, like personal liberty laws, attempt to provide states with the authority to regulate immigration.

The most controversial example of such immigration legislation—Arizona’s recently enacted SB 1070—gives state law enforcement officers the power to detain people they have “reasonable” suspicion to believe are in the country unlawfully, and to verify those individuals’ status with federal officials.

Ethical arguments regarding this practice aside, Arizona’s law raises many legal questions regarding whether it grants state officials powers that are reserved for the federal government under the Immigration and Nationality Act, McKanders says. Arizona argues that the legislation is an exercise of states’ police powers under the Constitution.

“What Arizona is arguing is that pulling people over, arresting them, and controlling the immigrant population is, under the Tenth Amendment, an appropriate exercise of the state’s police powers. The federal government is asserting that pulling someone over, detaining them, and making a determination about their immigration status is a function of federal immigration law, and making a determination about someone’s legal immigration status is not an appropriate exercise of a state’s police powers,” she explains.

“State laws cannot pre-empt or overlap with federal laws, nor can they take parts of federal law and turn them into state law,” McKanders explains. This will likely be a key legal point in the future as state and local laws are challenged in federal court. The Arizona law is currently being challenged in federal district court, and parts of it have been blocked by an injunction until litigation is finished.

Regardless of the inverse interpretations of state versus federal power in past slavery and present immigration legislation, both types of laws reflect states’ unhappiness with what they see as inaction by the federal government in enforcing its own laws.

“Arizona is arguing that as the federal government is not effectively enforcing federal immigration laws, the states have the authority to enact their own laws regulating immigration” McKanders says.

What is needed, McKanders argues, is clearer national immigration legislation to quell the ambiguity over state and local powers and responsibilities on the issue.

“Our immigration laws are antiquated and really need reform,” she concludes. “There are a lot of advocates who really want immigration to be on Congress’s agenda. If we put something in place, we won’t have laws like Arizona’s and other copycat laws across the country.”
The Unsolved Puzzle of White Nose Syndrome

By Whitney Holmes
Thousands of dead bats litter the cave floor, their bony wings like pine needles, their desiccated bodies indicating death by starvation, a whitish fungus ringing their noses and lining their wings. They are victims of white nose syndrome, one of the most virulent contemporary diseases of wild animals.

The disease, so named because it attacks bats’ muzzles, strikes most often during hibernation, prematurely awakening the bats, who then leave their cave to search for insects during the cold winter months. If they make it back to the roost, they are hungry and depleted of energy, making it likely they will starve to death.

WNS has spread at an alarming rate. It was first discovered in a cave in upstate New York in 2006. Three years later, it was estimated that over one million bats from Canada to Tennessee had been wiped out—prompting officials from the U.S. Fish and Wildlife Service, the Great Smoky Mountains National Park, Tennessee Wildlife Resources Agency, The Nature Conservancy, and others, to close caves and mines to the public to prevent possible importation of the deadly pathogen. Today, scientists can only guess how many more animals have died in caves and mines already contaminated by the fungus.

“It started off slowly at the epicenter in New York,” says Tom Hallam, professor emeritus in UT’s Department of Ecology and Evolutionary Biology. “Then it gained speed, spreading 200 kilometers a year at first. Now it’s progressing at 350 kilometers a year, and there is no indication of it slowing down.”

**Searching for Answers**

Hallam has teamed up with famed bat expert and ecologist Gary McCracken to solve the puzzle of how WNS spreads. Hallam’s research currently focuses on the disease’s dispersal rates, while McCracken’s research analyzes bat behavior. The two are also serving as a repository for Tennessee’s WNS data.

Using computer modeling to project the spread of the disease, Hallam predicts WNS will soon extend as far south as Georgia, Alabama and Arkansas, and as far west as Iowa. There have already been confirmed cases in Missouri, Oklahoma, Indiana, and North Carolina.

Hallam’s models use epizootic and geographical data of the caves in the nation’s karst areas where WNS primarily resides. He also uses ecological and demographic data of bats to examine different rates of transmission of the fungus through the three main arenas of contact: summer roosts, swarms, and hibernacula.

McCracken, head of the Department of Ecology and Evolutionary Biology, spent this past winter installing ultrasound detectors at the entrances of Tennessee’s karst caves. The detectors look for unusual bat flight activity—flying during the day or in winter—that could indicate the presence of WNS.

The detectors also help track the bats—a rather challenging task. The main reason WNS is so difficult to contain is that bats have large home ranges; they fly great distances and spread the deadly disease as they go.

“Treating a disease in a cow is much easier, because cows you can contain in enclosures but bats you can’t,” explains Hallam.

Working with the U.S. Geological Survey, McCracken has also developed and built cameras that operate under infrared light.
that is invisible to people and bats. The cameras will be used for observation of contact rates and behavior before and after the arrival of WNS in the cave. His data will offer a detailed look at the WNS problem in Tennessee to get a better idea of the how the infected bats interact.

“Contact rates often drive the transmission of the disease. So we are actually trying to get empirical data on how often they interact, and potentially how many other uninfected individuals one infected individual could come in contact with in a roosting area, then feed these data into the epidemiology modeling for rates of disease and transmission,” explains McCracken.

While WNS is spread by bat-to-bat contact, it probably also exists as an environmental reservoir, e.g. in the sediment of a cave. This is another factor that makes WNS difficult to contain.

Extreme Measures
Many state regulatory commissions have considered culling, i.e. killing, infected bats. But as the researchers point out, culling would only result in a lot of dead bats while the disease would still persist.

“If you are going to actually control the disease by killing infected individuals, you need to be able to identify individuals that have been infected before they infect others, and we don’t have that ability with WNS,” says McCracken.

In fact, Hallam developed a model that not only illustrated the non-success rate of culling the world’s only flying mammal, but also found that culling often has the opposite effect of increasing the transmission of the disease.

The scientists have been working very closely with state and regional agencies to make sure “mistakes” such as this are not made. Hallam is taking his research a step further by creating models to determine how many caves would need to be treated with a chemical to kill the fungus, to successfully slow the spread of the disease.

Nature’s Pest Control
While the bat may not be an endearing creature, its disappearance could have catastrophic consequences for agriculture, disease, and the economy.

“Bats eat lots of night-flying insects that are major agricultural pests. Their insect consumption reduces crop loss, pesticide use, and downstream damage,” —Gary McCracken
Map shows spread of *Geomyces destructans*, the fungus that probably causes WNS, throughout 23 states. Color codes indicate counties in which hibernacula were affected by the fungus in a given year.

says McCracken. “The economic damage could be significant if we lose these pest-control services.”

It is estimated that a bat eats up to two-thirds its weight in insects per night. This could translate into over 40 corn-earworm moths per night, each of which could lay 1,000 eggs that hatch into cotton-, corn-, and tomato-eating caterpillars. Bats also eat insects that transmit diseases like the West Nile Virus to humans, livestock, and domestic animals.

Obviously, the more we learn about how to slow the transmission of WNS, the better. All of the bats affected today hibernate. So far the fungus has been detected in nine different species. As WNS spreads, it could endanger—some to the point of extinction—two-thirds of the 46 bat species inhabiting the U.S. and Canada. The little brown bat, which was once very populous, may well become extinct. The Indiana bat and the gray bat, already on the endangered list, are even more threatened since the onset of WNS.

A Solution?

There is a glimmer of hope for the bats—from Europe.

“The bizarre thing is that bats with the same sort of fungus have been discovered in Europe, but they seemed unaffected. So we believe that WNS was brought over to the U.S. from Europe,” explains Hallam. “We hope that in the future our bats will become immune like the European bats. Much would have to change, though, including bat behavior; but I would not dismiss this possibility.”

In the meantime, the researchers work tirelessly—from inside caves to behind computers—trying to learn what is causing the spread of WNS and how to stop it before the bats disappear.
Growing Older 

&

Loving it

By Kristi Hintz
In 2009, 97-year-old George Moyse set records by completing his first skydive. “Papa Doc” Walter Watson is the world’s oldest doctor at 101. Rabbit Kekai, founding member of the Waikiki Surf Club, is 91 and still an avid surfer today. At age 77, John Glenn became the oldest person to fly in space.

While these may not be typical day-to-day feats, these senior citizens are proof that an active lifestyle doesn’t have to end at a certain age. This belief is at the core of COGS—the Community of Gerontology Scholars—and one that Janet Brown, COGS coordinator and associate professor in the College of Nursing, takes to heart.

“Our aging baby boomer population will be one of the largest older adult populations we’ve ever seen. There are a lot of people with a ‘doomsday’ perspective looking at this as a negative and worrying about the kind of strain they will put on our resources and systems. But that doesn’t have to be the case. We need to switch our thinking on aging,” Brown says.

COGS is composed of gerontology scholars, researchers, clinicians, and students from the colleges of Nursing; Social Work; and Education, Health, and Human Sciences, who, like Brown, believe that helping older adults maintain their function and improve their quality of life can have a positive effect on both the elderly and their contributions to society as a whole.

“It’s all about healthy aging and how we can keep older adults functional and in their homes longer so that they don’t burden society and its resources. We also need to view older people as a valuable resource. The baby boomer population is going to be the healthiest, most financially stable, and best educated that we’ve ever seen in older generations. They can contribute to society in many ways. People just don’t realize the kind of hard work that elderly adults can do,” Brown explains.

In 1998, 77-year-old John Glenn returned to space with the crew of the space shuttle Discovery.

Staying Active
One way for older adults to stay active and involved is through volunteerism. Volunteer activities can range from foster-grandparenting to helping out at one’s church or community center to building Habitat for Humanity homes. But people may be hesitant to employ older adults on projects requiring physical labor because, as Brown explains, not many people have conducted research on elderly adults and physical work. In light of this, Brown, along with several other COGS scholars, conducted a study exploring the culture and health of elders volunteering for Habitat for Humanity.

The group’s study looked at motivation, health, and volunteering patterns of 40 older adults participating in a Habitat Blitz Build. The researchers,
It’s all about healthy aging and how we can keep older adults functional and in their homes longer so that they don’t burden society and its resources.

—Janet Brown

Researching Outcomes

Last year COGS started working with community organizations and agencies that service the elderly. One thing the group can do for these organizations is conduct outcomes research on programs so they can prove their success and possibly receive funding based on those results.

“It’s really important that we let community agencies know that we have researchers here at COGS and that we can help them evaluate their programs. It’s a win-win situation: It helps us with our research and it helps them either improve their services or earn more support for their programs,” Browns says.

One particular community organization that has benefited from COGS research is Senior Citizens Home Assistance Services. SCHAS coordinates the HOPE (Helping Others Provide Exceptional Care) program to train compassionate, dependable, and experienced caregivers.

HOPE provides training for family members who care for elderly adults in the home. They teach caregivers about various aspects of living that many may not think about when caring for an older adult, such as home improvements, personal care, fall prevention, medication management, and legal issues. Caregivers also learn how to take care of themselves—mentally and emotionally—and what other resources are available in the community for them.

COGS was able to help HOPE, a relatively new program, receive funding for its second year and a small grant for advertising based on outcome research. Brown and former COGS scholar Shu-Li Chen evaluated the effectiveness of the HOPE training program and the impact it had on family caregivers.

Several of the women who participated in the COGS study were on hand to do painting and other odd jobs.
“We found that the family caregivers had an increased sense of mastery and confidence in the caregiving role. Through the program, they felt more comfortable and at peace and didn’t get as upset about things they encountered. They got used to their skills, especially about handling behavioral problems,” Brown says.

Scholars at COGS have also conducted research on elders’ decisions to enter assisted living facilities and tried to identify predictors of home-stay care. The study found that decisions are made by weighing and balancing gains and losses related to going where the help is. A unique finding of the study was that the process continued even after elders moved into an assisted living facility.

“Providers of long-term care can now add this new information into care planning for their elderly patients. Understanding the process of decision-making in this segment of the population may lead to the development of interventions that can promote positive relocation experiences among elders and increase the effectiveness of their decision-making behaviors.”

COGS scholars also teach various courses as part of undergraduate and graduate gerontology programs. One of the first courses taught to students in the gerontology program is Aging in Society, a class that Brown feels exemplifies the COGS mission.

“In the class, I work to open people’s eyes to the positives of aging and healthy aging. Many people think that aging is a bad thing, but we like to show them that that’s far from the case. And that’s what we as scholars and researchers do through COGS.”

“We believe nurses can act as change agents in their community to foster active recruitment and involvement of older volunteers.”

—Janet Brown
Trolling for COAL

Alex McLemore (left), Paul Ayers (center), and Matt Gloe (right) prepare to map the riverbed.

Sediment collected during the video mapping process.

By Sharon Pound
Undergraduate researchers Adam Duncan and Alex McLemore formulated a set of research questions when they began their search for coal in the Clinch River. As is common with research, the answers they uncovered led to a whole new set of questions.

Back in 2007, concerns arose that coal deposits swept downstream from mining operations in Virginia were possibly contaminating the Clinch River.

Working with Paul Ayers, a professor in UT’s Department of Biosystems Engineering and Soil Science, Duncan and McLemore employed a UVMS, or underwater video mapping system, mounted on the rear of a pontoon boat, to conduct their investigation. The depth of the UVMS “splash cam” was controlled by a winch system the students developed and monitored.

They discovered that coal beds do indeed exist where the Clinch River enters Norris Lake just south of Tazewell—confirming what Tennessee state legislators and environmental agencies had suspected. The actual source has yet to be determined.

“We felt a very strong sense of accomplishment when we first found coal in the river using a system that we had set up and tested,” Duncan says. “It was refreshing to know our system was successful, but it was amazing and puzzling that we were able to find coal so far from any known source.”

After the riverbed was mapped, bottom samples were taken and analyzed on a coal-to-sediment ratio to quantify the amount of coal.

“The discovery of coal answered one question, yet it opened the door for future research opportunities and enticed us to seek more answers,” McLemore says.

Ayers regularly mentors undergraduate students, with many working on research projects during the summer months. He says the results of the students’ work on the Clinch River can be used by the Tennessee Department of Environment and Conservation and the Tennessee Wildlife Resources Agency to determine how best to respond to the situation.

For both Duncan and McLemore, undergraduate research led to enrollment in graduate school.

“When I started looking at graduate school, I realized that I was doing work that could be applied to that effort,” McLemore says. “It helped me get my foot in the door, to get a taste of research and decide if I really wanted to do research. It was amazing to me how were able to be so hands-on with only one year under our belt.”

Duncan says undergraduate research makes classroom work more relevant. “I felt fortunate to get in on some great opportunities, to be on the cutting edge. I think it makes us better students. Research engages you. You learn how to apply the math equations and methods you learned in class.”

“"The discovery of coal answered one question, yet it opened the door for future research opportunities and enticed us to seek more answers."”

—Alex McLemore
Tomorrow’s defining challenge is the search for sustainable energy resources.

STAIR’s interdisciplinary research provides Ph.D. students in science and engineering the opportunity to understand the core elements of a sustainable system and promotes breadth of knowledge.

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