Solar energy: Northwestern and Argonne have the “ANSER” PLUS – News briefs, eIRB online, the Sleep Center, Rehab Institute, a chemist’s discovery, and stalking a silent killer.
Record Year for OR Funding
The Office for Research received research awards in 2007 that exceeded $400 million for the first time, increasing 8 percent to $416 million from $384 million in 2006. The new award volume is the highest in University history and was matched by a record number of grants: 2,379 compared to 2,227 in 2006 (www.northwestern.edu/newscenter/stories/2007/10/research.html).

New Northwestern Study: How Healthy Are Chicago Kids?
The Feinberg School of Medicine has received a seven-year, $32 million contract from the National Institute of Child Health and Human Development to be the Chicago study center of the National Children’s Study, the largest study of child and human health ever conducted in the United States. Northwestern researchers will follow 4,000 children in Cook County from before birth to age 31. Jane Holl, pediatrics, preventive medicine, and health care studies, and an attending physician at Children’s Memorial Hospital, is principal investigator on the study (www.northwestern.edu/newscenter/stories/2007/10/health0.html).

Fertility Problems in Cancer Patients Subject of the Oncofertility Consortium
Teresa Woodruff, obstetrics and gynecology and chief of the Feinberg School’s newly created fertility preservation division, heads a landmark national research, clinical, and education program that targets fertility threats posed to women by cancer treatment. The Oncofertility Consortium is comprised of an interdisciplinary team of biomedical and social scientists, oncologists, pediatricians, engineers, educators, social workers and medical ethicists from Northwestern and the University of California-San Diego, University of Pennsylvania, University of Missouri-Columbia, and Oregon Health and Science University. Research will include a thorough examination of the scientific, medical, psychological, legal, and ethical issues surrounding fertility and cancer (www.northwestern.edu/newscenter/stories/2007/09/oncofertility.html).

NICO Adds New Director
Brian Uzzi, management and sociology, has been appointed as co-director of the Northwestern Institute on Complex Systems (NICO), effective September 1. Brian co-directs NICO with William Kath, engineering sciences and applied mathematics (www.northwestern.edu/nico/).

Northwestern Attracts Nanotechnology Star
Chemist Sir Fraser Stoddart, credited with opening up new fields in chemistry, is leaving the University of California, Los Angeles and joining the chemistry faculty at Northwestern. Stoddart developed “mechanical bonds,” in which molecules physically interlock like the links in a chain, for example. These supramolecular processes depend on understanding molecular recognition and self-assembly, techniques that underpin much of nanotechnology. Stoddart will direct the new Center for the Chemistry of Integrated Systems at Northwestern. He and members of his lab will arrive on campus in January (www.northwestern.edu/newscenter/stories/2007/08/stoddart.html).

Jennifer Richeson Named One of Smithsonian’s Young Innovators
Jennifer Richeson, African American studies and faculty fellow of the Institute for Policy Research, was named one of Smithsonian magazine’s “37 under 36: America’s Young Innovators in the Arts and Sciences” in the magazine’s Fall 2007 issue.

A year ago, Richeson was awarded a 2006 MacArthur Foundation “Genius” grant (www.smithsonianmag.com/specialsections/innovators/richeson.html).

InfoEd Proposal Tracking and SPIN Are Live
Northwestern University and Project Café have launched the first two modules of InfoEd, Northwestern’s new software system for managing sponsored research. Proposal Tracking and SPIN are now available for use. Visit http://cafe.northwestern.edu/announcements/ for details about access as well as benefits to central, departments, faculty, and staff.

Kellogg Insight: In-depth Research Information
The Kellogg School of Management at Northwestern University has launched Kellogg Insight, a web-based research digest highlighting Kellogg faculty research. Through articles such as “Do Leaders Matter?” and “Why Do IPO Auctions Fail?” Kellogg Insight bridges theory and practice in business and management issues. Content is refreshed each month. Access Insight at http://insight.kellogg.northwestern.edu.
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The sun as it appeared on October 3, 2007 at 19:19. Image courtesy of SOHO/EIT 304 consortium. SOHO is a project of international cooperation between the European Space Agency and the National Aeronautics and Space Agency.

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Correction
Philip Greenland's title was incorrectly stated in the Spring 2007 CenterPiece. His correct title is senior associate dean for clinical and translational research and Harry W. Dingman Professor of Preventive Medicine. CenterPiece regrets the error.
Solar energy is a small player in the energy field now because coal and other fossil fuels produce energy at a much lower cost. These fossil fuels, however, generate the carbon dioxide that causes global warming. And they are not renewable. In 2050, our planet will need twice as much energy as now produced to fill world needs—and in 2100, we will need three times as much.

For many, the answer is solar energy. And at Northwestern, solar energy is the ANSER, the newly established Argonne-Northwestern Solar Energy Research Center. ANSER combines and expands the research interests of both institutions to take on the challenges of economically viable solar energy use.
The Center for Nanoscale Materials at Argonne. The center is one of five nationwide funded by the U.S. Department of Energy. The Center for Nanoscale Materials is a joint partnership between the Department of Energy and the State of Illinois.

The State of Illinois provided $36 million to construct the 85,000-square foot building, and DOE provided an additional $36 million to develop and build the facility’s advanced instrumentation.

“ANSER is the natural outgrowth of many collaborations already taking place between Northwestern and Argonne,” says Michael R. Wasielewski, chemistry, director of the new center. “Thanks to Northwestern’s collegial nature, we had the connections and activities right here to make it work as we noted when we were writing the solar energy proposal for the Department of Energy grant.”

State of the art facilities exist here and at the Argonne National Laboratory, where the newly built Argonne Center for Nanoscale Materials (CNM) will play an important role in creating new solar materials. CNM is physically attached to the Advanced Photon Source (APS), which is the brightest pulsed x-ray source in the U.S., and serves as an essential tool for studying new solar energy materials.

Northwestern and Argonne researchers have organized into four teams comprised of a total of 26 researchers to work on new strategies for solar energy. Examples of these team efforts include:

- Wasielewski and David Tiede of Argonne will be continuing their bio-inspired work in which chemical processes mimic photosynthesis at no harm to the environment.
- Tobin Marks, chemistry, and Lin Chen, chemistry and a chemist in Argonne’s photosynthesis group, will probe further into the development of flexible, cheap organic photovoltaic structures (similar to the solar cells in calculators, yet based on large-area thin films), that even can be woven into clothing for portable power.
- Joseph Hupp, chemistry, and Michael Pellin, chemistry and senior scientist, group leader, and materials science division associate director at Argonne, will work with nanostructured materials that can increase the efficiency of new electrodes in solar cells.
- Mercouri Kanatzidis, chemistry and a materials scientist at Argonne, and Arthur Freeman, physics, will continue to work with thermoelectric materials to convert solar heat to electricity with improved efficiency.

Northwestern and Argonne have a decades-long tradition of joint appointments to integrate research and teaching in the sciences and engineering. New joint appointments are being made to enable Northwestern and Argonne researchers to work more closely in the solar energy field. Argonne scientist Lin Chen, for example, has joined...
the chemistry faculty at Northwestern. Her expertise is using the APS for structural work on solar energy-related materials for organic photovoltaic systems.

The educational aspect of solar energy research is crucial, says Wasielewski, for it is the next generations that will most likely come up with important breakthroughs in this field. “Larger, more visible solar energy research efforts in the United States will attract the best students. If we were able to spend up to $5 billion nationally per year, we could make serious progress on this issue. The more we spend, the easier it will be to attract the best students.”

Other nations, Sweden and Australia in particular, are spending much more per capita than is spent in the United States to find ways of making solar energy more efficient and cost-effective. Wasielewski sent one of his students to work with the Swedish researchers at a solar energy research institute in Sweden this past summer.

Most of the researchers working at ANSER are funded by the U.S. Department of Energy, but Wasielewski says they also will be pursuing grants from industry. He thinks they will succeed in attracting more funds: “Northwestern and Argonne offer a uniquely qualified critical mass of people working on solar energy solutions and we have excellent facilities to do the job.”

Center for Catalysis and Surface Science

The Center for Catalysis and Surface Science resides on Northwestern’s Evanston campus, but director Peter Stair divides his time between the center and Argonne National Laboratory. Stair, who has held a joint appointment between Northwestern and Argonne since 2003, set up his own lab in the Chemistry Building at Argonne where he uses state-of-the-art spectrometers to measure the vibrational spectra of molecules with catalysts. He also collaborates with researchers at Argonne, including Christopher Marshall, who uses the APS to characterize catalyst materials while they are in the reactor.

“One of the major advantages to having a joint appointment is that I can be involved in research programs both at Argonne and Northwestern and write contracts and grants for each entity,” says Stair. “It also gives me the ability to make these programs work together synergistically.”

One of these collaborations is sponsored by the U. S. Department of Energy in a program called the Institute for Catalysis in Energy Processes (ICEP). At ICEP, researchers study chemical reactions catalyzed by solid catalysts that relate to energy conversions from one form to another, for instance, the catalysts used by the oil industry to convert sludgy crude oil into fuels and lubricants that can be used in vehicles. Argonne and Northwestern groups are also working together to make a solar fuel, but they are delving more deeply into the chemistry of the process first to understand it more fully.

Stair and ICEP are beginning work on a biomass conversion project. This involves figuring out how to use oxygen from the air to convert biological materials from one form to another. There are many useful chemicals that contain some oxygen that they would like to be able to make directly from their precursors or “parents.” If the amount of oxygen in those chemicals could be controlled, it would move them closer to being used as fuels.

“Our relationship with Argonne enables us to set up opportunities that are mutually beneficial,” says Stair. “For example, a Northwestern graduate student who was writing her thesis was able to work at Argonne where she could make materials she couldn’t make here on campus. We arranged for her to be supported by Argonne, where the materials she made were also useful to the Argonne research. And the cost of supporting a student was far less than Argonne would have paid for another skilled worker.” Stair says, “Everyone wins in that situation—the University, Argonne, and especially the student. I’d like to see even more collaborative opportunities like that where everybody wins.”

For more information on science, engineering, and education at Argonne National Laboratory, visit www.anl.gov.
Northwestern’s Office for the Protection of Research Subjects (OPRS) is making the process of protecting human subjects in clinical trials more efficient by moving to an electronic submission and review system called eIRB.

eIRB, a product created by Click Commerce Inc., is in beta-testing with new submissions for social-behavioral and some biomedical research departments. Expected to be in use across the University next year, eIRB should clear away much of the inconvenience for both reviewers and investigators of getting approvals on paper.

OPRS supports six institutional review boards (IRBs) that safeguard the rights and welfare of people participating in research studies at Northwestern. There are about 70 IRB panel members, most of whom are Northwestern faculty, who oversee all the university’s social-behavioral and biomedical studies that use humans as research subjects.
Investigators cannot conduct research on humans until an IRB approves the proposed study, determining that it is ethical and will adequately inform the subjects about what could or will happen to them.

Before an IRB reviewer even sees a research proposal, however, it must make its way through departmental and ancillary reviews as well as a preliminary review by OPRS staff. Until now, the process has required shepherding paper applications around campus for various approvals and signatures. Once the application is ready for review by the IRB, there are additional tasks including delivery of volumes of paper. Staff must photocopy documents for all panel members, with the two primary reviewers looking at the entire submission. The photocopies have to be delivered across campus—or off-campus for non-Northwestern panel members.

Also, in the paper process there has been no means of quick and efficient communication between reviewers. And if investigators or research staff wanted to learn what stage an application was in, they had to phone or e-mail OPRS.

AnnChristine Thåström, research administrator and regulatory manager in the Bluhm Cardiovascular Institute’s Clinical Trials Unit (CTU), has experienced the difference between cumbersome paper submissions and eIRB. She both prepares and reviews submissions. Before her department began using eIRB last fall, she herself had to move the paper from sign-off by principal investigators through department chairs and if needed, Northwestern Memorial Hospital, waiting for a review and signature at each step—all before the IRB reviewers even received it.

In contrast, eIRB lets investigators use e-mail and complete some steps in parallel. Once the principal investigator (PI) reviews the electronic submission and hits the ‘submit’ button, everyone involved can see it, Thåström notes. Academic department heads who need to sign off can do so from wherever they have secure Internet access. If hospital review is necessary, an e-mail notifies the Northwestern Memorial Hospital’s Office of Research. If review by a radiation safety officer is needed, he or she can review the documents at the same time. “This way is much more efficient. It also saves paper and paper waste,” Thåström says.

Eliminating the paper also drastically reduces problems with lost filings or communications. And much of the effort of tracking submissions also disappears with eIRB. “If the study is in eIRB, a researcher can just log in and look at the activity history,” says Michael Kelley, eIRB system specialist at OPRS.

“Since eIRB automatically creates a history, someone who logs in can see what communications have been sent regarding the submission, what modifications made, when it is assigned to a coordinator, and when it obtains a date for panel review,” Thåström adds. The only parts of the study history a PI cannot see are the actual review forms completed by IRB members, which are private to keep the reviewers anonymous.

Kelley says the system also enables better communication “because all panel members have electronic access to the same information.”

Judith Quinn, program manager for grants administration at Northwestern Memorial Hospital and a member of Panel C, which reviews biomedical protocols, agrees that the electronic system improves communication for reviewers. “The primary reviewers on an application can share thoughts rapidly and make electronic notes on a submission for IRB staff. It’s helpful to know what the other reviewer is looking for,” she says.

Quinn points out other efficiencies of the electronic system: “If an application is basically all right and requires only minor edits or clarifications, you can ask the PI for these before the panel convenes, and there is a better chance that a submission might
not need to be deferred. There are also more eyes to catch when a submission is missing an essential piece of information, which can be noted and sought using eIRB while the submission continues through the process," she said.

“If I want to ask the PI to make revisions and my co-reviewer also has changes he or she would like,” Quinn continues, “we can use eIRB to contact our IRB coordinator, who then will send all requested revisions to the PI and/or study team at one time (prior to the full panel meeting). This coordination makes it easier for the PI to handle all requests for revisions, clarifications, and edits at once, rather than receiving multiple requests.”

Kelley believes that when fully implemented, eIRB will not merely eliminate the logistical inefficiencies associated with a paper-based system but also will create new opportunities for communication and collaboration. “Connecting persons to information rather than to paper means we can collaborate in ways that are simply not possible in the paper realm,” he says. “The true power of the system is that we are radically lowering the barriers to information.”

Self-service tracking should also save staff time, Kelley notes, freeing both OPRS and research staff to “be even better resources to the research community.”

Reviewers using the eIRB during beta testing have received one-on-one training from a staff member. Quinn says that by the end of an hour’s training, she could navigate the system, complete her reviewer sheets, make comments and revisions to consent documents, and review the history of a submission. She added that support staff have been “very available” since her initial training.

OPRS expects to start accepting all new research submissions electronically after January 1, 2008. It also will begin to transition existing paper submissions to electronic format next year. In preparation for the rollout, OPRS is finalizing training material for the research community. Details of the training sessions will be announced on its listserv. Members of the research community can check the OPRS eIRB web page for updates and sign up for its listserv at www.research.northwestern.edu/research/oprs/irb/eirb/. —Kathryn I. Calkins

Who Sits on an IRB?

Under federal regulations and Northwestern policies, our institutional review board’s (IRB) membership consists of people with appropriate experience and expertise to review the research that is conducted at the University and its affiliates. Additionally, Northwestern IRBs also include non-scientist members and members who are not otherwise affiliated with the institution (neither they nor family members are Northwestern employees or agents). All IRB members receive training on ethical guidelines for human subjects research and on the applicable federal and state regulations.

Institutional review boards have the authority to:

• Approve, require modifications to, secure approval of, defer action on, or disapprove research protocols involving human subjects
• Require progress reports from the investigators
• Oversee the conduct of research
• Suspend or terminate approval of a study
• Place restrictions on a study
• Conduct reviews and inquiries regarding research activities as needed to obtain information necessary for the fulfillment of their responsibilities under the institutional assurances
• Provide information as necessary to the Office for Research, the Office of the Dean of any of Northwestern’s schools, and the appropriate administrative offices of those affiliates for whom the Northwestern IRBs serve as IRB for their institution.

For more information about Northwestern’s Institutional Review Board, go to www.research.northwestern.edu/research/oprs/irb.
Rehabilitation Institute of Chicago
WHERE STROKE RESEARCH OFFERS NEW HOPE

The Rehabilitation Institute of Chicago (RIC), on Northwestern’s Chicago campus, is one of the hospitals affiliated with Northwestern through the consortium of the McGaw Medical Center. All members of the medical staff have faculty appointments at Feinberg School of Medicine and serve as important links between medical education and medical practice. The Searle Rehabilitation Research Center at RIC is the world’s largest research center of its kind, with more than 250 research projects currently underway.

More than 700 stroke patients are treated each year at RIC, more than almost any other hospital in the United States. Because of the close relationship between clinical treatment and investigative research at RIC, many of the current research projects are concerned with exploring the reasons for and rehabilitation from stroke. Generally, participants in RIC’s research studies are six months or more post-stroke, and are stabilized in their recovery.

Stroke, a blockage or rupture of a blood vessel in the brain that injures or kills brain cells, is the third leading cause of death in the United States (after heart disease and cancer) and the leading neurological cause of long-term disability. There are an estimated 750,000 new strokes each year.

This article describes three areas of RIC research to help stroke patients recover the language and motor abilities their strokes have taken from them.

**Sensory Motor Performance Program: Robots and Reality in Rehabilitation**

Jim Chin, an exhibited lettering artist from the southwest suburbs of Chicago, suffered a stroke a little more than a year ago. After being treated at a community hospital, he was admitted as a patient to RIC. After his release from RIC, he returned to participate in a number of research studies conducted by T. George Hornby, physical medicine and rehabilitation. Hornby is on the faculty of RIC’s Sensory Motor Performance Program, one of RIC’s eight research areas, headed by William Z. Rymer, RIC’s research director.

When Chin was a patient, therapists Jennifer Moore and Heidi Roth recruited him for a research study. Chin helped test a robotic device that is strapped on to a patient’s legs when he is on a treadmill, helping his legs move and his brain reorganize to support his walking. This robotic device, the
Lokomat, was developed six years ago, and RIC was the first in the country to have it. Hornby’s research with Chin and others led him to conclude that while the robot is effective in helping train weak muscles, it is not as smart as a therapist in helping an individual recover his stride and gait. “Exercise has to be inherently hard,” Hornby says. “Otherwise it is not beneficial. We need to challenge our patients.”

Chin agrees. “This study made me work harder than I ever did before. But I have already seen the results: lowered cholesterol, increased heart strength, and greater bone strength.” Chin hopes to advance soon from walking with a cane to walking without either a cane or a leg brace. That would be quite an achievement, since a physical therapist at a different facility said several months ago that Chin would never be able to walk without at least a quad cane.

“Part of our work is to educate the profession about emerging technologies in the field,” says Hornby. “Some therapists are still working with patients in the same ways they did twenty years ago. Continuing education for working professionals is, and has to be, a big part of the work we do.”

As a participant in another study, Chin wears a step watch on his ankle to count his daily practice steps. “We’ve seen patients go from taking 16 steps to 5,000 steps in a day,” Hornby says. “They just have to have the right environment and be willing to work at it.”

After our interview, Chin and his wife are greeted by one of the RIC stroke mentor volunteers they met during Chin’s hospital stay. Through the RIC mentoring program, they were introduced to this woman, an RIC volunteer, who had suffered a stroke more than twenty years ago and has been living on her own ever since. This RIC program, which matches long-recovered patients with patients just beginning their recovery, gives these patients an additional tool for rehabilitation and reintegration into the community.

For Chin, RIC’s strength is not its reputation nor impressive, state-of-the-art equipment—it is the quality of emotional and psychological support that is RIC’s governing spirit. “It’s being treated as if you’re valuable,” Alice Chin, his wife, says. “RIC staff are honest in a positive way.”

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**APHASIA: LIFE WITHOUT LANGUAGE**

Stroke often results in impaired communication skills as well as motor skills. One of these communication impairments is aphasia, which affects both the ability to express oneself through speech, gesture, and writing, and to understand the speech, gestures, and writing of others. Aphasia is usually acquired as a result of a stroke or other brain injury.

At the present time, there is no cure for aphasia, although its effects can be mitigated through speech-language therapy. Leora Cherney, physical medicine and rehabilitation, is director of RIC’s Center for Aphasia Research, where she works to develop and put into practice new rehabilitation activities that will enable people with aphasia to better communicate and expand their involvement with others and with the community.

“Health care has changed over the past 15 years,” says Cherney. “Now aphasia patients usually get just three months of speech therapy, which often isn’t enough to make a big difference.”

As a result, Cherney is investigating ways in which technology can provide some of the needed treatment at a reduced cost to the patient. She developed Oral Reading for Language in Aphasia (ORLA), which involves repeated reading aloud of sentences and paragraphs together with a therapist. ORLA has been programmed onto computers to simulate therapy with a clinician, using a virtual therapist so that users can practice independently. A further extension of the program to the Internet is in the works.

“Research has shown that intensive therapy involving many hours of practice each day is essential for making changes in the brain,” says Cherney. “ORLA is a cost-effective way to let people with aphasia practice.”
Researchers believe that any cure for aphasia would have to directly affect the neurobiology of the brain. Cherney is involved in an industry-sponsored clinical trial using cortical stimulation during speech-language therapy to rewire the aphasia patient’s brain to improve lost language skills. After a functional MRI pinpoints regions of the brain that are still active for language, an electrode is surgically implanted on the surface of the brain. The electrode is connected to a pacemaker-like controller implanted in the chest. During speech-language therapy sessions the electrode is turned on and electrical signals are sent to the brain. The electrode remains implanted during the normally six-week clinical trial, during which the patient receives intense speech-language therapy. Preliminary findings show that results from cortical stimulation with therapy are better than therapy alone, and continue even after the electrode is removed.

The Center for Aphasia Research also has received funding for a double-blind placebo-controlled study of the effects of a specific drug on speech-language therapy outcomes. It is thought that the drug may positively change the brain so that language skills are relearned better with the combined drug and speech-language therapy than with speech-language therapy alone.

An important feature of the center is its many community groups that help bring people with aphasia out of the isolation the impairment can cause and enable them to practice communicating in a supportive environment. “Our philosophy of the groups is, So you have aphasia, don’t let it hold you back,” says Cherney.

People with aphasia meet on a regular basis at the center to discuss general topics such as current events, sports, television and movies, as well as issues facing individuals who are living with aphasia. A book club helps those who have difficulty reading. Cherney says that they choose the books that will best keep participants in the current world. This semester’s book is *The Greatest Generation Speaks* by Tom Brokaw. Cherney says, “We chose the book to tie in with the current PBS series by Ken Burns about the Second World War, so group members can discuss a topic that many others are interested in.”

For a list of the center’s current group programs, see [www.ric.org/research/centers/aphasia](http://www.ric.org/research/centers/aphasia).

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Neuroplasticity Lab: Head over Heels

James Stinear, physical medicine and rehabilitation, completed his postdoc at RIC in the Sensory Motor Performance Program, after earning his PhD from the University of Auckland, New Zealand. In his earlier research, he concentrated on the rehabilitation of upper limbs; he’s now focusing on forms of brain stimulation to help patients regain their walking skills after a stroke. Most of his work is based on the idea of brain plasticity, that the brain and nervous system have the capacity for continuous alteration of the neural pathways and synapses in response to experience or injury.

Stinear and George Hornby pioneered the application of a form of brain stimulation known as paired associative stimulation (PAS), which involves the use of transcranial magnetic stimulation (TMS) of the part of the brain that controls muscle activity to the lower limbs. Based on the principles of spike-timing-dependent plasticity, PAS increases or decreases the efficacy of synaptic transmission of synapses sensitive to the timing of physical action. By adding brain stimuli to actual movement, the researchers expect to improve the patient’s walking ability.

“If we enhance the control of limbs by even 10 percent, it can result in enormous improvement in the patient’s quality of life,” Stinear says. “With a 10 percent to
20 percent improvement in walking, a patient possibly can return to work or at least not remain homebound and can be reintegrated into society. This can make a great social and economic impact.”

Stinear and his graduate students find the most effective walking protocols and new ways to stimulate the brain while the patient is walking. One experiment involves a split-belt treadmill, on which the two legs can move at different paces. While this feels “wacky,” says Stinear, it can help the patient walk more symmetrically. The patient’s gait improves, but the change doesn’t stick when the treadmill is used alone. When brain stimulation is added to the movement, the patient is more able to continue with the improvement.

“Most therapy concentrates on how fast patients walk. But most patients would rather walk ‘normally’ than faster,” says Stinear. “So we’re taking a different tack—if we improve symmetry, velocity will also improve.”

Stinear is particularly excited about work that he and one of his graduate students published in 2006, in which they applied PAS to increase the brain output in the targeted muscle that controls the foot-elevation function, which is extremely important in walking, when that muscle is most active. The results of the study suggest that brain plays a bigger part in walking than previously believed. “Some of us used to think that we walk primarily from the spinal cord,” Stinear says. “This study is evidence that the brain is more involved than was previously thought.”

Stinear’s lab recently received a new four-year grant from the National Institutes of Health’s National Institute of Child Health and Human Development that will allow studies into stroke using low current electrical current and the split-belt treadmills and could lead to clinical trials. Stinear, the principal investigator, is not a physician, but practiced for more than 20 years as a chiropractor. Grant reviewers indicated that his chiropractic specialization in sports and industrial rehabilitation was regarded as a strength in earning the grant.

“As far as we know, we’re the only place in the country that’s doing this kind of research,” Stinear says. “Our research participants realize that they are part of the future. We may have a long way to go in our research, but that’s what makes it so exciting.”

For more information on the research being conducted at RIC, visit the RIC website at www.ric.org.
Fascinating Rhythms: The Center for Sleep and Circadian Biology

When Fred Turek, neurobiology and physiology, was a second-year graduate student at Stanford, he came up with a question about seasonal cycles that no one had ever posed before or, as far as he knew, even asked about. And after he had researched the question and saw the data, it was the “Aha!” moment in his professional career, he says. “I knew that I knew something that no one else on the planet earth knew—or had ever known,” Turek recalls. “The excitement of having discovered something no one else had ever known was mind blowing—I was bitten by the research bug, and I never looked back.”

Turek had discovered how birds use their circadian clock to measure the short days in the fall, which allows them to then be able to respond to the long days of spring that stimulate reproduction. Science magazine honored his discovery by publishing it as a sole-author paper, recognition rarely awarded a graduate student, and Turek’s journey into circadian biology had begun.

Turek now is director of the Center for Sleep and Circadian Biology (CSCB), formerly the Center for Circadian Biology and Medicine, which integrates basic and clinical research on circadian rhythms and sleep into a unified program at Northwestern. CSCB’s twenty faculty members in Evanston and Chicago have built a large sleep research program to complement their work on biological rhythms.

“There aren’t many of us, but we accomplish a lot,” says Phyllis Zee, neurology, associate director of CSCB. “We work together, we share our facilities to maximize our opportunities on grants and with our students. We ask what could move our research farther ahead. And we support and promote one another. The magic of CSCB is how fluidly we interact with each other.”

Clock Watching

CSCB’s executive director is Martha Vitaterna, neurobiology and physiology. Her scientific “aha” moment came when she was a graduate student in 1992, working in the lab with Joseph Takahashi, Larry Pinto, and Turek, neurobiology and physiology. There she first determined that the mutant gene she had been following in successive generations of mice was truly mutant, and that she had isolated a gene essential for normal circadian behavior. Her results helped define what is known as the Clock gene (for circadian locomotor output cycles kaput), which changes the intrinsic length and persistence of circadian rhythm.
Circadian rhythms are the daily rhythms generated within the body that help coordinate the timing of internal bodily functions, including sleep, as well as interactions with the external world. In mammals, the Clock is located in a section of the brain known as the suprachiasmatic nucleus (SCN), a small region at the base of the hypothalamus, just above the point where the optic nerves cross. The identification of the Clock gene helped unravel the mysteries of circadian rhythms and their influence in many—or most—of the body’s processes, including not just sleep cycles, but cardiovascular, neurological and endocrine disorders, metabolism, drug delivery, and addiction.

Vitaterna is currently working with Turek in researching the relationship of circadian rhythms and the basic mechanisms involved in the timing of birth. Given the rising incidence of premature birth in the United States, the March of Dimes is funding their study on the timing of birth and the causes of premature birth.

Turek often explains his own research by drawing a Venn diagram of three interlocking circles, identified as circadian clock, sleep, and metabolism. His work takes him into the mechanisms of those processes, conducting further genetic experiments with mice. The results of one of his recent studies, published in Science with CSCB colleague, Joseph Bass, as the senior author, suggest that the circadian clock gene network plays an important role in mammalian energy balance. The disruption of this gene can lead to obesity and the metabolic syndrome, which increases the risk of coronary heart disease and diabetes.
**Time (and) Flies**

Another CSCB colleague, Ravi Allada, neurobiology and physiology, uses fruit flies as a model to determine why we sleep. The fruit fly genome was sequenced—or decoded—in 2000, and therefore it is an ideal model to use in studying sleep behavior. “With flies, we can screen over 3,000 at any time,” says Allada. “And we can do it quickly. Flies are a rapid system to use to sift through thousands of genes.”

Genes are important not just because they pass on inherited traits from our parents. When we are awake, the expression—or turning on—of genes happens tens of thousands of times. Hundreds of genes are involved in sleep and waking. Allada is working to find out which genes are driving the changes. To understand which genes are important in certain processes, researchers need to manipulate individual genes and understand what the consequences are.

Sleep is necessary—whether in a fly, a mouse or a human—because animals generate large numbers of physiological and molecular changes when they are awake, Allada explains. These changes accumulate and have a cost to the organism. They—and we—sleep to reverse these changes.

As a postdoctoral fellow at Brandeis, Allada helped identify what is now called the *Clock* gene in fruit flies. As a MD, uppermost in his mind is how to connect what he learns in the lab back to the clinical arena. Part of his research is to determine how certain drugs like caffeine or antihistamines influence sleep. Exploring the genetic response to these drugs can point the way to new drugs targeting those genetic substrates.

The breakthrough moment in Allada’s research was when he was able to pinpoint the neural circuits in the fly brain that are crucial to sleep, a part of the fly brain that is also important to long-term memory. The results of his study, which was co-authored by Jena L. Pitman, Jermaine J. McGill, and Kevin P. Keegan, all from Northwestern, were published in *Nature* in June 2006. This research was supported by the National Institutes of Health and by a Burroughs Wellcome Career Award in the Biomedical Sciences.

“Northwestern is a great place to do this kind of research because of the depth and breadth of the sleep program. It was Northwestern’s genetic approach to circadian biology that brought me here. I truly believe we’re at the cutting edge of this type of research,” says Allada. Turek adds, “At Northwestern we are poised to do for the field of sleep today what we did for the field of circadian rhythms 10 years ago—uncover the genetic networks regulating sleep and wake phenotypes in mammals, and with Allada in fruit flies as well. And there will be many genetic overlaps—you can count on it.”

**Bench to Bedside and Back**

“This is the time in the history of sleep research, when we have science right at our fingertips. Research into sleep and circadian rhythms is so exciting now,” says Phyllis Zee, who also is director of the sleep research lab at the Feinberg School of Medicine. “Our center creates a very rich environment for trainees—it’s really the best of both worlds. Our researchers mentor and interact individually with students and can help individualize programs, with work here in Chicago and on the Evanston campus,” says Zee.

Sixteen beds are available through Feinberg and Northwestern Memorial Hospital. Northwestern’s sleep research center is the largest in Chicago and one of the largest in the nation, one of the few that combine research, clinical practice, and education. Zee and her staff run industry-sponsored clinical trials in the sleep labs, where the systems are identical at all locations so all can use (and contribute to) the same data base. They have directed more than 3,000 sleep studies.

Zee’s own research focuses on three different areas: the effects of age upon sleep patterns; sleep characteristics in circadian rhythm sleep disorders; and the effects of sleep deprivation on performance. In addition, her lab collaborates with Xiaobin Wang at Children’s Memorial Hospital and Martha Daviglus, epidemiology, to study the relationship →
between sleep, metabolic, and cardiovascular disorders. Setting the stage for sleep research at the national level, Zee also chairs the NIH Sleep Disorders Research Advisory Board.

“We do it all,” says Zee. “Basic research, translational research where we get feedback from the clinical population, and also genetics and other phenotype issues such as sleep drive.” Zee’s lab currently is conducting an NIH study on circadian sleep disorders, examining how genetics make some people “owls” (night people) and others “larks” (morning people). They also use functional MRI for an interdisciplinary study of sleep, learning, and memory. One of the questions they are looking at is why some people have a predisposition to cognitive impairment in old age.

Sleep deprivation affects brain function related to contextually dependent performance. Sleep deprivation leads to reduced activity within right dorsal prefrontal cortex associated with selecting the correct response (GREEN), and within the left Insula associated with processing erroneous responses (BLUE). Sleep deprivation leads to a decrease in right ventral lateral prefrontal cortex activation and a compensatory increase in activation within left ventral lateral prefrontal cortex (RED) when subjects are inhibiting inappropriate responses. These data suggest that sleep-deprived individuals will be less able to select appropriate responses, inhibit inappropriate responses, and detect and process errors that have been made. Images courtesy Zee laboratory.
Gaining Insights on Losing Sleep

Kathryn Reid, neurology, works with Turek and Zee on a number of studies, including the relationship between sleep and aging. Before coming to Northwestern to work with Turek, Reid earned her PhD at the University of Adelaide, Australia, studying the productivity of workers with altered sleep patterns caused by shift work. She recently published an article in the *American Journal of Geriatric Psychiatry* exploring how sleep-related problems in the elderly were often overlooked in most clinical examinations.

“Sleeping well is so closely related to good health,” Reid says. “If physicians would take a closer look at their patients’ sleep behaviors, and provide treatments, they could greatly improve the quality of life for their elderly patients.”

Sleep issues don’t affect just the elderly. In an article in last year’s June issue of the journal *Pediatrics*, CSCB and Feinberg faculty members Zee and Margarita L. Dubocovich, molecular pharmacology and biological chemistry and of psychiatry and behavioral sciences, assessed the impact of sleep loss in adolescents. This study, which was done with students and parents from Evanston Township High School, determined that current high school start times deprive adolescents of sleep, and force students to perform academically in the early morning, a time of day when they are at their worst. Potential solutions to this problem could be changing school start times and giving standardized tests later in the day, the authors suggested. Martha Hansen, lead study researcher at Evanston Township High School, presented the study on high school students at the International School on Chronoeducation held in Erice (Sicily, Italy) in May 2007. Dubocovich and Hansen attended this event at the invitation of the Summer Institute of Mind, Brain and Education. Zee and Dubocovich emphasized that more research on adolescent circadian rhythms is needed.

“In my mind, the big “aha” moment in sleep and circadian rhythms is very recent,” says Zee. “We are even now setting the stage for understanding the underlying complexity of a disorder rather than just the phenotypes or outward characteristics of the individual. It’s the realization that sleep and circadian rhythms is ideally positioned to play a major role in the development of preemptive and personalized medicine of the future.”
Now the story takes a bright new path. At the end of March, ground was broken for a new center for biomedical research. It will bring together chemists, biologists, and engineers to develop new medicines and diagnostics.

The lead donor is none other than Rick Silverman, John Evans Professor of Chemistry. Together with his family, Silverman has pledged a portion of the royalties he receives from sales of Lyrica to help build the $100 million center. The Richard and Barbara Silverman Hall for Molecular Therapeutics and Diagnostics is expected to be occupied and running by fall 2009.

Silverman Hall will contain four stories above ground and one below, housing 16 research groups and about 250 faculty, staff, and students. The new facility will be physically connected to adjacent research buildings via pedestrian bridges, encouraging those scientists to share the most advanced equipment and exchange ideas with researchers in the new building. Unlike the walled-off spaces in which scientists traditionally work, these labs will open onto one another, with natural light shining from one end of a floor to another. Chemists will be next to engineers who will be next to biologists. Their shoulder-to-shoulder collaboration is expected to shed light on problems which resist solution by one group alone.

Lyrica’s long path to market makes its now far-reaching effects seem all the more remarkable. “In pharmaceutical research if you’ve discovered a drug and it’s on the market treating diseases, I don’t know what else you could ask for,” an enthusiastic Silverman remarked during an interview when the drug came
on the market. “I had no plans of that happening [discovering something commercially viable]. But since it did, I’m just so ecstatic for people who need this drug.”

Such successful drug discovery is a well-documented rarity. Only about one in 20,000 screened compounds makes it to clinical trials, and only about one in 10 that gets to clinical trials meets FDA approval. But perhaps it’s not so surprising that the discovery happened at Northwestern, where Silverman has been teaching and doing research since 1976.

“There’s much more collaboration here than at [other research universities],” Silverman explained. “The faculty is superior. We know we can’t do everything ourselves, so we depend on our colleagues to help us. This is a great place to do that. I think Northwestern really has a uniqueness in its collaborative, interdisciplinary nature.” As if to illustrate the point, Silverman also holds an appointment in biochemistry, molecular biology, and cell biology.

After receiving a PhD in organic chemistry from Harvard and doing two years of postdoctoral research in enzymology at Brandeis, he has spent his career at Northwestern applying the principles of organic chemistry to the design of enzyme inhibitors. In the case of Lyrica, he was trying to find an anticonvulsant agent for possible use in the treatment of epilepsy. The disease can be caused by an imbalance between the neurotransmitter that excites nerve cells and one that inhibits them. Silverman was focusing on an inhibitory neurotransmitter—blocking its breakdown—in order to balance the nerve-exciting neurotransmitter. His experiment worked brilliantly, but not in the way he expected.

Silverman recalled, “I thought it would be a nice, short project for a visiting professor from Poland, Ryszard Andruszkiewicz, to synthesize a series of analogues of GABA, an inhibitory neurotransmitter, make them with different sizes and shapes, and test them with our target enzyme, GABA aminotransferase, and with the enzyme that precedes it, glutamate decarboxylase. When he showed me the results I thought he had made a mistake: he was a chemist but had never done biochemistry. The results were the opposite of what we would expect—these compounds were making more GABA rather than preventing its degradation by GABA aminotransferase. So I sent him back to the lab; he repeated it and again got the same results. It was totally unexpected.

“I thought, wow, this is a new mechanism for raising GABA levels. Instead of inhibiting GABA aminotransferase to prevent its degradation, we could activate glutamate decarboxylase to make more GABA. The new [compounds] should be anticonvulsant agents.”

After months of further lab tests, Silverman called Northwestern’s Technology Transfer office, which arranged for two pharmaceutical companies to test the compounds in mice. One wanted Silverman to send only the most promising compound, which turned out to be ineffective. The second, Parke-Davis, tested them all. According to Silverman, the company said all the compounds had weak anticonvulsant activity except one, “which was just phenomenal.” That one became Lyrica.

At that point, Parke-Davis (later purchased by Pfizer) became interested in developing the compound. Licensing agreements were signed, and Silverman, the “father” of the drug compound signed away any further control over its future.

“Once this happened, I was done with that compound,” said the scientist. “Done to the point where they weren’t telling me anything.” From the animal testing through the three phases of clinical trials, Silverman could find out no specifics about the drug’s progress, except the information already in the public domain.

But in the ensuing years, the busy researcher has had many other demands on his time: new discoveries, thousands of undergraduate students (majors and non-majors alike) to intrigue with chemistry, scores of graduate students and post docs whose lab work he guides, and many, many meetings to attend.

“I’m almost never in the lab,” he said. “You’re looking at where I work [at his desk, in his office, beside his computer]. I conceive and design the research projects, bring the necessary collaborating investigators on board, then try to convince new graduate students (and postdocs) to work on these projects. I see two of my research students a day about their progress in research. We discuss what’s
been going wrong, what’s been going right, what to change, how to change it, and what direction to take in the research. I also review a lot of papers and grant proposals and I write my own papers and grant proposals. I’m on lots of committees, including those concerning the new building.”

He is still working on the enzyme that led him to the discovery of Lyrica, GABA aminotransferase, this time with new implications. It is, in fact, the same enzyme that was the focus of one of his early grants here at Northwestern in 1979, making different classes of molecules with the goal of inhibiting the enzyme.

**In another area of research, Silverman is**

designing compounds to selectively inhibit the neuronal form of the enzyme nitric oxide synthase. Showing promise in animal trials is a compound from Silverman’s lab that reduces the brain damage caused by neurodegenerative diseases such as Parkinson’s and stroke, as well as cerebral palsy, by lowering the concentration of nitric oxide.

Silverman’s fascination with chemistry began at age eight, when he and his older brother performed an experiment in their bedroom.

“In those days [mid 1950s] with chemistry sets you could actually make explosions,” says the chemist, sounding like a boy again. “The experiment was called an invisible flame. We didn’t see the flame but all of a sudden our bedroom curtain was on fire. At that point, Mom walked in—”

The chemistry set became forbidden fruit and was quickly taken away. For five years, the longing to do more “cool” experiments grew, until Silverman reached high school and could legitimately study the subject. At Pennsylvania State University, it was organic chemistry that captivated him. It still does.

In “Orgo,” he explains, students memorize a set of theorems or rules, then are given new problems and are asked to find which rules will solve them.

“You can’t learn just by memorizing. Memory has to lead to an understanding. Then you’ll know how to apply the rules, when to apply them, when you can’t apply them. That’s an analytical process. That’s why I have students who end up in management consulting—they can solve problems.”

Former students have also used their chemistry background in careers like patent law. Of those who stick with chemistry, he speaks with pride of his former graduate student Kent Gates, chemistry professor at the University of Missouri-Columbia. Gates’ work investigating the medicinally useful biological effects of anticancer agents has been featured multiple times in *Chemical and Engineering News*.

**Silverman is as passionate about teaching — organic and medicinal chemistry to undergraduates and enzyme chemistry to graduate students—as he is about drug discovery.** He says he enjoys the interaction with students and the feedback. The feeling is mutual, as evidenced by the glowing evaluations he receives from students—“Silverman is amazing!!! It’s worth getting up at 8 a.m. just for his class”—and the numerous excellence-in-teaching awards he has won, including the Charles Deering McCormick Chair in Teaching Excellence, the highest honor for teachers at Northwestern. Teaching also has had an effect on his research, he says. In designing a course on medicinal chemistry, for instance, he started thinking more broadly about the subject. That larger perspective prompted him to write a widely-used text, *The Organic Chemistry of Drug Design and Drug Action* (Academic Press, San Diego, 1992; in its second edition as of 2004). He is author of two other books and 240 articles on organic chemistry, medicinal chemistry and enzymology. He holds 38 patents.

Lest one think he spends all his time on campus, his life is rounded out by a family whose pictures are proudly displayed in his office. He likes to spend time with his wife, Barbara, a retired speech therapist and grown children, Matthew, Margaret, and Philip. Not one is a chemist, nor were his parents (a typing teacher and a fundraiser) but then, one Rick Silverman would be enough for any family.

**After all, this is a man who applies scientific principles even to golf: “I’m not that great, but I like to play. I think that it’s because I’m a scientist that I’ve stuck with it. It’s not supposed to be, but can be, a very analytical sport. You determine what went wrong in your swing and why and then try to change it. You’re doing an experiment every time you take a shot.” —Nancy Deneen**
Chicago’s Joseph Cardinal Bernadin died from it. So did Luciano Pavarotti. Pancreatic cancer, the fourth most common cause of cancer deaths in the United States, is known as a silent killer, with no method of early detection. Until now, Northwestern biomedical engineer Vadim Backman has developed a minimally-invasive optical technology demonstrably effective in the early detection of colon cancer that now appears promising for detecting pancreatic cancer.

This new technique could lead to the first screening method for pancreatic cancer in asymptomatic patients, according to Vadim Backman, biomedical engineering. If detected early, when the tumor can be successfully removed, the survival rate for pancreatic cancer, now less than 5 percent, could grow to 100 percent if a precancerous lesion is found and to 50 percent for a Stage 1 cancer.

The extraordinarily sensitive technique takes advantage of certain light-scattering effects and can detect abnormal changes in cells lining the duodenum even though the cells appear normal when examined with a conventional microscope. The results, published in the August 1 issue of the journal Clinical Cancer Research, show that the changes accurately predict the presence of cancer.

Backman and Yang Lui, a former graduate student of Backman’s (now a senior scientist at Johnson & Johnson), teamed up with physicians at Evanston Northwestern Healthcare (ENH) to test the technique in a pilot study of 51 patients. The researchers found they could detect both early- and advanced-stage pancreatic cancer without touching or imaging the pancreas. [See CenterPiece, Winter 2007, for more on Backman’s collaboration with ENH physicians.]

The pancreatic cancer screening test currently is in a larger clinical trial at Evanston Hospital to validate the effectiveness of the technique. Funded by the National Science Foundation (NSF) and the National Institutes of Health (NIH), the study has approximately 200 participants. The pilot study also was supported by NSF and NIH.

In addition to Backman, Yang (lead author), Randall E. Brand, and Hemant Roy, of ENH, other authors on the CCR paper titled “Optical markers in duodenal mucosa predict the presence of pancreatic cancer,” are Vladimir Turzhitsky and Young L. Kim, from Northwestern’s department of biomedical engineering, and Nahla Hasabou, Charles Sturgis, Dhiren Shah and Curtis Hall, from ENH’s department of internal medicine.

Visit www.northwestern.edu/newscenter/stories/2007/07/backman.html for video and audio stories about Backman and this technique.  

Vadim Backman
University Research Centers
Northwestern University has a long history of leadership in interdisciplinary research programs and centers. Twenty University centers—as well as more than 90 school-based centers—support interdisciplinary research that spans a wide spectrum of areas. At Northwestern—research thrives.

Argonne/Northwestern Solar Energy Research Center
Director, Michael Wasielewski
Helping the world meet increasing energy needs through solar energy will be the goal of a new research center established by the U.S. Department of Energy’s Argonne National Laboratory and Northwestern University. The Argonne-Northwestern Solar Energy Research Center, or ANSER Center, will combine and expand the research interests of both institutions to address the grand scientific challenges posed by the need for economically viable solar energy use.

Roberta Buffett Center for International and Comparative Studies
Director: Andrew B. Wachtel
www.cics.northwestern.edu
Founded in 1998, CICS promotes collaborative scholarship across the university on crucial world problems. With more than 180 affiliated faculty members, CICS, now BCICS, is a hub of internationally focused research, education, and outreach at Northwestern.

Center for Applied Psychological and Family Studies
Director: William M. Pinsof
e-mail: family-institute@northwestern.edu
CAPFS’s mission is to enhance the biopsychosocial health and well-being of individuals, families, and larger groups by educating and training mental health professionals and by conducting research to improve mental health services.

Center for Catalysis and Surface Science
Director: Peter C. Stair
www.northwestern.edu/catalysis
For more than 60 years, Northwestern University has been at the forefront of catalysis research. In 1984 the University formally established the Center for Catalysis and Surface Science (CCSS) to consolidate research activities in catalysis and related surface science. Catalysis, the chemical reaction created by a catalyst, is an important tool in cleaning up pollution and conserving energy.

Center for Drug Discovery and Chemical Biology
Directors: Linda J. Van Eldik and D. Martin Watterson
www.northwestern.edu/research/cddcb
CDDCB evolved from the faculty-initiated Drug Discovery Program that was established in 1996 to facilitate interdisciplinary research and educational activities. Research at the center focuses on the interface between molecular and integrative basic sciences and the facilitation of the translation of preclinical discoveries into clinical applications.

Center for Functional Genomics
Director: Joseph S. Takahashi
www.genome.northwestern.edu
CFG has as its mission to unify basic research efforts at Northwestern University focused on understanding gene function. The CFG is home to two major initiatives to develop and share mouse genetic resources for the study of nervous system function and behavior.

Center for Reproductive Science
Director: Kelly E. Mayo
www.northwestern.edu/research/crs
CRS was formed in 1987, and it currently coordinates the research and training efforts of 42 faculty in 13 departments. Its research extends from basic research investigations into the molecular processes that occur in living organisms, through applied studies relevant to efficient animal husbandry, and into clinical practices that directly impact human health with respect to fertility and infertility.

Center for Sleep and Circadian Biology
Director: Fred W. Turek
www.northwestern.edu/cscb
CSCB integrates basic and clinical research on circadian rhythms and sleep into a unified program at Northwestern University. The center’s twenty faculty members in Evanston and Chicago have built a large sleep research program to complement their work on biological rhythms in humans and animal subjects.

Center for Technology and Social Behavior
Director: Justine M. Cassell
http://ctsb.northwestern.edu
CTSB supports researchers in their quest to understand the role that technology plays in our everyday social interactions and to facilitate the development of the next generation of technologies that will work towards supporting positive social ends.

Center for Cancer Nanotechnology Excellence
Director: Chad A. Mirkin
www.ccne.northwestern.edu
The NU-CCNE supports multidisciplinary teams of nanoscientists, cancer biologists, engineers, and clinicians who work collaboratively to develop nanomaterials and nanodevices for cancer therapeutics, drug delivery, imaging, diagnostics, and monitoring applications.
Chemistry of Life Processes Institute  
Director: Thomas V. O’Halloran  
www.clp.chem.northwestern.edu  
CLP research facilities will bring together in Silverman Hall the disciplines of chemistry, biology, engineering, and computational science. Previous significant developments by University chemistry and biology groups have attained widespread recognition for important biomedical and systems-level research.

Institute for Bionanotechnology in Medicine  
Director: Samuel I. Stupp  
www.ibnam.northwestern.edu  
IBNAM, established in 2000, bridges the frontiers of medicine, engineering, and science. Advancements in biology and engineering, coupled with the emerging areas of nanoscience and nanotechnology, have the potential to profoundly enhance human health and revolutionize the way medicine is practiced.

International Institute for Nanotechnology  
Director: Chad A. Mirkin  
www.nanotechnology.northwestern.edu  
IINT was established as an umbrella organization for the multimillion dollar nanotechnology research efforts at Northwestern University and with collaborators around the world. The role of the institute is to support research in nanoscience and nanotechnology, house state-of-the-art nanomaterials characterization facilities, and bring together individual and group efforts aimed at developing new nanotechnologies.

Institute for Policy Research  
Director: Fay Lomax Cook  
www.northwestern.edu/ipr  
IPR is an interdisciplinary public policy research institute that stimulates and supports social science research on significant public policy issues and disseminates the resulting findings to policy makers. IPR houses Cells to Society, a research project in which biomarkers are used to study the ways in which societal problems affect human health.

Materials Research Center  
Director: Monica Olvera de la Cruz  
www.mrsec.northwestern.edu  
The mission of the center is to develop and support collaborative, interdisciplinary research and education in the science and engineering of materials that will benefit society. The center also operates a number of shared facilities that are available to the Northwestern community as well as to other institutions.

Nanoscale Science and Engineering Center  
Director: Chad A. Mirkin  
www.nsec.northwestern.edu  
NSEC for Integrated Nanopatterning and Detection Technologies is driven by a vision to develop innovative biological and chemical detection systems capable of revolutionizing a variety of fields. Genuine medical benefits are now emerging as direct products of the center’s research, including detection techniques for markers associated with diseases such as Alzheimer’s disease and prostate cancer.

Northwestern Institute on Complex Systems  
Co-directors: William L. Kath and Brian Uzzi  
www.northwestern.edu/nico  
NICO is a hub and facilitator of path-breaking research in the area of complexity science that transcends the boundaries of established disciplines and finds applications in many fields.

Northwestern Synchrotron Research Center  
Co-directors: Wayne F. Anderson and Michael J. Bedzyk  
http://tomato.dnd.aps.anl.gov and www.ls-cat.org/NSRC oversees access to and use of Northwestern’s two beamlines at Argonne National Laboratory’s Advanced Photon Source for materials science and structural biology research.

Northwestern University Atomic and Nanoscale Characterization Experimental Center  
Director: Vinayak P. Dravid  
www.nuance.northwestern.edu  
NUANCE is a centralized instrumentation facility that offers scanning and transmission electron microscopes, scanning probe and related lithography instrumentation for patterning, fabrication and localized measurements, and other state-of-the-art surface science instrumentation.

Spatial Intelligence and Learning Center  
Director: Dedre Gentner  
http://spatiallearning.org  
SILC brings together scientists and educators from Temple University, Northwestern University, the University of Chicago, the University of Pennsylvania, and the Chicago Public Schools to understanding spatial learning and apply that knowledge to develop programs and technologies that will transform educational practice.

School-based centers  
A listing of other Northwestern University Research Centers may be found online at www.research.northwestern.edu/research/centers/schoolCenters.html.
Cover stories from McCormick


CenterPiece Takes on a New Look

As you might have noticed, the publication you are holding in your hand (or viewing on the Office for Research web site) has undergone a change in format. CenterPiece, the newsletter, is now CenterPiece, the research magazine. Twice a year (in the fall and winter quarters) CenterPiece will report on research that is taking place in Northwestern’s schools, colleges, research centers, and affiliates and the research administrative efforts that support it. In winter quarter, look for excellence in research and the funding that makes it possible in the Office for Research Annual Report.

Also in winter quarter, look for the newly designed Office for Research web site for greater coverage of OR news and achievements (www.research.northwestern.edu/research/).