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RESOURCES

Northwestern University supports approximately 60 core facilities on its Evanston and Chicago campuses and at Argonne National Laboratory. Core facilities are research laboratories with instrumentation, services and technical support that are shared by the NU research community. The facilities are created and directed by faculty and supported by the university to meet the collective needs of our research community. Core facilities enable sharing of University resources that individual researchers would not otherwise be able to afford. In most cases core facilities are recharge centers that require payment for the use and services. Some facilities are available to external researchers.

The Executive Director of Research Facilities (Office for Research) and the Director for Research Core Planning (Feinberg School of Medicine) coordinate administration, communication and oversight of core facilities, and are responsible for strategic planning and marketing as well as professional development of staff in core facilities.

Visit www.research.northwestern.edu/facilities.
Pathology Core Facility (PCF)

Merging Research and Clinic: The Pathology Core Facility

The rooms and walls along the eighth floor of Olson Hall are lined with boxes full of valuable research material. Some hold specimens from small Northwestern studies and others hold tissues from some of the largest clinical trials ever done.

In 2001 Northwestern’s Pathology Core Facility (PCF) took over a National Cancer Institute (NCI)-funded biorepository and now serves as the centralized center for the procurement, processing, and distribution of biospecimens obtained from ECOG patients enrolled in clinical trials.

ECOG stands for Eastern Cooperative Oncology Group, one of the largest clinical cancer research organizations in the United States and the world. It conducts clinical trials in all types of adult cancers, and the PCF serves as a reference lab for all of the trials’ specimens. During its peak, the PCF processed more than 60,000 human tissue and fluid samples in just one year.

Founded in 1997 and originally called the Pathology Coordinating Office, the PCF was originally located on the Evanston campus. However, it moved downtown to Olson Hall in 2001 to better serve the Robert H. Lurie Comprehensive Cancer Center and the global cancer community.

“Every comprehensive cancer center needs a pathology facility. They can’t function without one,” says Peter Kulesza, pathology and PCF director. “Moving the pathology core downtown shows Northwestern’s commitment to cancer research and clinical trials.”

Five years later, the PCF became the reference lab for a large, NCI-sponsored, phase 3 clinical trial for breast cancer (known as the PACCT1 trial). Members of the PCF completed all of the histology and specimen procurement for thousands of solid tumors. The tumors have since been embedded into paraffin blocks and archived for future research. The PCF has more than 11,000 paraffin blocks of tissues from that specific ongoing study to date. Some blocks hold tissues from as many as 60 patients.

“The blocks are invaluable; they are precious,” Kulesza says. “They are available to researchers everywhere and someday could be used to find treatments and cures.”

Last fall the Center for Genetic Medicine received a custom-built SmaRTStore freezer system, which the PCF jointly operates with NUgene and uses to fully automate the storage and retrieval of DNA samples. A series of robotic arms loads and unloads samples from the SmaRTStore, eliminating the need for people to go in and out of the freezer. The system barcodes each sample, so it can easily be recalled when needed.

Studies that used to require technicians to do days and days of sample retrieval now take a matter of hours.

The Office for Research has funded several instruments in the PCF to keep the operations running smoothly and keep the facility competitive. “We are really grateful to Jay Walsh and Phil Hockberger for the equipment grant program,” Kulesza says. “Through that program, we were able to get equipment that we wouldn’t have been able to purchase otherwise.”

But as much as machinery in the facility shifts around samples for processing and archiving, Kulesza, an MD/PhD pathologist who sees patients in Northwestern Memorial Hospital’s Fine-Needle Aspiration Clinic, says it’s important to remember that they are not just dealing with blocks of paraffin and slides. Protecting research subjects is an important part of his job and a goal of the PCF.

“These are not just tissues, they are patients,” he says. “Our goal is not just to discover but to help. We care about what happens to the patients.”

Adekunle Raji, PCF technical director who has been with the facility since 2001, says that every member of the lab shares this sentiment. “When we look at samples,” he says, “we always remember that there are patients behind what we are looking at.”

Even though the Pathology Core Facility is a part of the Robert H. Lurie Comprehensive Cancer Center, it serves hundreds of Northwestern users from various disciplines across both campuses as well as outside users at collaborating institutions. The PCF works closely with researchers from Evanston’s Tumor Biology Core and Chemistry of Life Processes Institute and others. The PCF also serves research beyond cancer and will begin sharing samples with the AIDS Research Consortium, which works to conduct clinical trials to learn more about HIV/AIDS.

The PCF is a full-service facility that performs assays and diagnoses on tissues and can provide samples for research.

For more information, visit http://www.cancer.northwestern.edu/research/shared_resources/pathology/index.cfm#.
Clean Catalysis Core

CleanCat: Making Catalysis Possible

Northwestern has the world’s oldest materials science department, a materials science research center with more than 50 years of continuous center funding, and is renowned for materials research.

However, before September 2012, many of the materials created at Northwestern could not readily be tested for their potential in catalysis.

Catalyst development and improvement require an elaborate testing of candidate materials. Sometimes finding the right material can make a chemical reaction cleaner or more efficient, adding to the sustainability of our society. When certain materials are untested, naturally their catalytic properties remain unknown.

“We have an inventory, a library of materials we’ve never looked at,” says Peter Stair, chemistry. “Before we started the facility, we had a lot of people making things that never got tested for a catalytic reaction.”

The facility that Stair speaks of—and served as founding director for—is the Clean Catalysis Core, or CleanCat, that resides in the basement of Tech. The facility officially became a shared core in September and brought manager Neil Schweitzer on board in January. The current director of CleanCat is Kenneth Poeppelmeier, chemistry.

CleanCat houses four reactors used for catalytic study. The reactors allow researchers to test several different catalytic materials, exploring a range of reaction conditions, such as various temperatures, combinations of reagents, and reaction times.

A core facility that specifically aids catalysis research is incredibly rare. In fact, Stair posits that it is quite likely the only facility of its kind in the country. Schweitzer says the collaborative atmosphere of Northwestern’s Center for Catalysis and Surface Science perfectly paved the way for CleanCat.

“It’s amazing how well researchers work together at Northwestern,” Schweitzer says. “It would be hard to imagine this facility at an institution where everyone is used to working alone. But the collaborative environment of the Center really makes the core facility possible.”

According to Stair and Schweitzer, most researchers developing new materials do not have access to catalysis testing at all. And those who do have reactors in their own individual labs lack continuity with other catalysis research groups.

“It hasn’t always been easy to compare the results from one lab to another because everyone does things a little bit differently,” Stair explains. “Students have different levels of training in completing the chemistry and interpreting the results.”

Schweitzer, who joined CleanCat from Argonne National Laboratory, trains users and consults on experiments to make sure research techniques are consistent across the board. His training also gives researchers skills they may not have learned otherwise.

“Sometimes a researcher will make a material that he or she thinks would be good for catalysis,” Schweitzer says. “But if their group doesn’t specialize in catalysis, then they may not know how to approach the problem and do the experiments. Now we can offer help for that.”

In addition to training and consulting, Schweitzer is systematically evaluating, maintaining, and upgrading the equipment in the core.

As the core’s name implies, it specializes in catalytic reactions that are clean or atom-efficient, meaning that the number of starting materials equal the number of products generated so no atom is wasted. Both Stair and Schweitzer say they have noticed that catalysis research is trending in this direction.

“The idea is to look at chemistries that either reduce our energy footprint or create less waste,” Stair says.

For more information about Northwestern’s Clean Catalysis Core, visit https://www.facilities.research.northwestern.edu/browse-facilities/clean-catalysis-core.

For information about Northwestern’s Center for Catalysis and Surface Science, which is also directed by Poeppelmeier, visit http://www.catalysis.northwestern.edu.
Next-generation DNA and RNA sequencing have made it possible not only to look at individual genomes but also to rapidly compare genetic sequences among multiple genomes. These approaches can be used to determine differences in genomes and gene transcripts from person to person, among population groups, and between normal and diseased cells.

To take advantage of this groundbreaking technology, Northwestern opened the Next-Generation Sequencing (NGS) Core facility in December in 2012.

“There was a significant need for additional next-generation sequencing options for researchers on both campuses,” says Matthew Schipma, director of the NGS core. “Researchers were relying on other institutions all over the country to get their sequencing done.”

Over the past few years, technological advances in sequencing have ushered rapid changes in sequencing instrumentation. After considering instrument costs and current sequencing demands, the University decided to partner with BGI Americas, the largest sequencing company in the world. “The cost is significant for just one instrument and a new model comes out nearly every year,” Schipma says. “So we would always be chasing the next model.”

“Because you need a certain number of samples to run the machine efficiently, there could be long wait times to fill a sequencing flow cell,” adds Grant Barish, endocrinology, who serves as scientific advisor to the NGS core along with John Crispino, hematology/oncology.

“Or, on the other hand, there might be more people demanding sequencing than we can handle with one or two sequencing instruments. It can sometimes take up to eleven days before a machine finishes one run. So there could be a backlog of people waiting many months to get their data. Our partnership gives us great flexibility in terms of sample capacity, given the massive scale of sequencing performed by BGI.”

Through BGI, the NGS core can access a wide variety of state-of-the-art equipment, including the Illumina HiSeq2000 and Roche 454 FLX. Core services include:

- RNA-seq, or “whole transcriptome shotgun sequencing.” This technique involves using high-throughput sequencing to look at the expression of genes in samples, to determine, for example, what is turned on or off in specific conditions or disease states.
- Chromatin immunoprecipitation sequencing (ChIP-seq). ChIP-seq is a technique to locate the genome-wide binding sites of specific proteins along DNA.

- De novo assembly. Used when an organism’s genetic sequence is unknown, de novo assembly enables bioinformaticists to stitch together DNA sequences to unravel a genome.

The NGS core has a wet lab in the Lurie Building to assess the quality and quantity of RNA, DNA, or sequencing libraries prior to sending samples to BGI for sequencing. The core also handles all sample shipments and returns of sequencing data, uploading the sequencing reads directly onto Northwestern servers.

After the sample is sequenced, the biggest challenge is analyzing it. A typical instrument run will generate hundreds of millions of reads, or short stretches of DNA. For investigators who are not familiar with analysis, it can be overwhelming. Schipma and his bioinformatics team meet with investigators to find out what questions they would like answered in their experiments. Then the team performs analysis that is tailored to the project.

Barish has used the core facility for his own research examining hormone receptors. He uses RNA-seq to explore the changes in gene expression incurred by gain or loss of function of a particular transcription factor and its role in the macrophages. He then uses ChIP-seq to see where the transcription factor is occurring along the genome in the macrophages.

“Next-generation sequencing is becoming more of a necessity in some biological research,” Schipma says. “Grant review boards expect to see NGS on proposals because the benefits are so widely recognized.”

Funding for the NGS is provided by Feinberg and the Office for Research.

For more information, email ngs@northwestern.edu.
Northwestern Medicine Enterprise Data Warehouse (EDW)

EDW Makes Research and Health Care Easier

After the Affordable Care Act was signed into law on March 23, 2010, many hospitals and health care providers scrambled to determine how to put health information into electronic medical records. Northwestern, on the other hand, was ready for the challenge.

Since 2007, the Feinberg School of Medicine, Northwestern Medical Faculty Foundation, and Northwestern Memorial Healthcare Corporation have contributed to the Northwestern Medicine™ Enterprise Data Warehouse (EDW), a joint initiative to create a single, comprehensive, and integrated repository of all clinical and research data on campus. While the EDW was originally created to facilitate research, it has become an improved way to handle health care data. The federal government instated a program called "Meaningful Use" in 2009 that promotes the spread of electronic health records to improve health care in the United States. Northwestern Memorial was the first hospital in the nation to have its EDW certified for Meaningful Use reporting.

"Northwestern is a national leader in this area,” says Andrew Winter, director of the EDW. “After we were certified, our phones rang off the hook. We conducted webinars with roughly 100 of our peer institutions and hospitals to show them how we were handling the data for Meaningful Use.”

Meaningful Use will allow electronic medical records allow information to be shared more easily among doctors’ offices, hospitals, and across health systems, leading to better coordination of care.

For example, sometimes a patient will walk into an emergency room and not remember the names of his/her medications. If the emergency doctors have access to the patient’s records, then they do not risk over-prescribing him/her or ordering unnecessary and costly tests.

“It gives providers seamless access to records for patient care,” Winter says. “This increases the level of care while reducing cost.”

The EDW contains more than 20 terabytes of data from more than 50 different source systems, including medical records, billing, financial, and human resources data. Investigators who want to access the EDW for projects can request an appointment for consultation online. The EDW team tries to respond within one week to all requests.

The EDW has a recharge rate of $70 per hour, with most requests taking between 8 and 12 hours of work. It also has a Pilot Data Program to provide financial assistance to investigators. Details can be found here.

Located on the 11th floor of the Rubloff Building in Chicago, the EDW has 11 data architects, three software developers, and six individuals supporting operations. The data architects feed data into the EDW and optimize it for analysts. The analysts move data out of the EDW and into the hands of the end user. And the operations individuals keeps the EDW running and safe. The EDW also has 100 “powerusers” who are able to login directly to the database and run queries.

Many EDW powerusers use the system to recruit patients for clinical studies or to complete research. By reviewing data from stroke patients treated at NMH, Andrew Naidech, neurology, studied which types of patients responded best to which treatments. What he found changed the course of treatments for stroke patients.

Sanjay Mehrotra, industrial engineering and management sciences, uses data sets from the EDW to create predictive models for health care. These data-driven methodologies examine evidence-based health care decisions under risk and uncertainty to improve quality of care and reduce cost and inequity.

Northwestern students have also benefited from the EDW. They have been able to access real data to mock up vignettes for research projects. For their Area of Scholarly Concentration (AoSC) projects, medical students engage in a four-year longitudinal research project that is complementary to their basic science and clinical training. The EDW provides the data for this work.

"Historically, research has not been included in medical education,” Winter says. “But learning how to research is really an important aspect of education.”

For more information about the EDW, visit https://edwapps.nmff.org/EDWPortal.
Integrated Molecular Structure Education and Research Center (IMSERC)

**IMSERC Celebrates Grand Opening**

The Integrated Molecular Structure Education and Research Center (IMSERC) celebrated its grand opening on May 17. Originally known as the Analytical Services Laboratory, IMSERC opened in the 1960s and was housed in an old parking lot that was transformed into a makeshift workspace.

Now IMSERC lives inside of a two-story, 12,000 square foot laboratory on the north side of Tech between the B and C wings. It houses several state-of-the-art instruments, including nuclear mass spectrometers, mass spectrometers, and x-ray diffractometers.

“This space provides the infrastructure that was desperately needed to house the modern instrumentation to characterize the complex compounds that are synthesized at Northwestern,” says Andrew Ott, director of IMSERC. “In addition, this new lab provides an ideal learning and collaborative environment. The new IMSERC will not only facilitate education and research but will be a great recruiting tool for years to come.”

The design of the new space focuses on natural light, flexible open spaces, and an emphasis on cleanliness and safety. It also has a 25-person cyber-enabled classroom, giving students and researchers a quiet place to analyze the data they collected with instruments at IMSERC.

For more information about IMSERC, visit [http://imserc.chem.northwestern.edu](http://imserc.chem.northwestern.edu).

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Center for Clinical Research (CCR)

**New Center for Clinical Research**

Last month marked the opening of the new Center for Clinical Research (CCR), a program of Northwestern University’s Clinical and Translational Sciences (NUCATS) Institute. The CCR is designed to help researchers address their study needs. Led by Lewis J. Smith, MD, associate vice president for research and director of the CCR, an experienced and dedicated team of clinical and translational research faculty and staff provides and supports a wide range of services and resources. Those services and resources include:

- Clinical research space at Northwestern Memorial Hospital and Lurie Children’s Hospital with nursing, nutrition, and specimen processing and analysis support.
- Study budget preparation, review, and reconciliation.
- Regulatory filings such as IRB submissions.
- Research participant recruitment.
- Clinical research coordinators for hire.
- [ClinicalTrials.gov](http://ClinicalTrials.gov) registration and results reporting support.
- Biostatistics services.
- Clinical research navigation.
- Advocacy for and assistance with clinical research issues.
- Good Clinical Practices (GCP) training and assistance.
- Business development.
- Catalogue of and links to additional clinical research resources, services and space at Northwestern and outside facilities.

As a University-wide core resource, CCR services are available to all clinical and translational research investigators, trainees, and staff at Northwestern and affiliate institutions. [Click here for more information.](http://imserc.chem.northwestern.edu)
Mathews Center for Cellular Therapy (MCCT)

Moving Research Forward

The halls in the Mathews Center for Cellular Therapy (MCCT) are spotless and sprawling. They run along the peripheries of glassed-in workspaces that MCCT director Ann LeFever calls “labs within a box.” Totally insulated from the outside world, the labs circulate sterile air and are equipped with 32 alarms and 100 sensors that erupt should anything disrupt the encapsulated atmosphere.

“Because every aspect of our operation is regulated, we have procedures for everything,” LeFever says. “The products we manufacture are for clinical administration, and this necessitates that the facilities, equipment, personnel, documentation, and processes are all maintained under validated standard operating procedures.”

Welcome to a facility that adheres to good manufacturing practices (GMP). GMPs are federally legislated regulations that are enforced by the United States Food and Drug Administration. They ensure uniformity, consistency, reliability, reproducibility, quality, and integrity. GMPs are set to safeguard the health of patients. This is important because the cellular therapies and other biological products that are manufactured at the MCCT are given directly to patients at Northwestern Memorial Hospital and Lurie Children’s Hospital.

Giving higher doses of chemotherapy to cancer patients might kill more diseased cells, but it also destroys healthy blood cells in the bone marrow. This could lead to life-threatening infections, excessive bleeding, and other serious problems due to low blood cell counts. The MCCT has laboratories dedicated to cellular processing that provide stem cells to patients in order to restore the chemotherapy-damaged immune system.

“Higher doses of chemotherapy can destroy the immune system,” LeFever says. “By transplanting stem cells into the patient, doctors can reconstitute that immune system.”

In addition to aiding patients, the MCCT also supports clinical researchers. For example, Richard Burt, medicine: immunotherapy and autoimmune diseases, uses the expertise of the MCCT to isolate specific hematopoietic stem cells and then transplants these cells to treat Myasthenia gravis, an autoimmune neuromuscular disease. Using stem cell transplantation, Burt’s group eliminates misbehaving immune cells and replaces them with healthy ones, essentially regenerating a new immune system.

Along with the cellular processing labs, the MCCT also has four GMP suites to support research. The facilities offer researchers, clinicians, and biotech companies regulatory compliant labs and services to manufacture highly manipulated and complex biotechnology products. After completing basic research in their labs, researchers can move their project into the MCCT.

“Our labs are clinical grade,” LeFever says. “So therapies and devices developed here can go directly into clinical trials.”

LeFever and her staff provide guidance on developing products, complying to regulations, and certifying products for use. Only one product is allowed in one suite at a time to prevent cross contamination. Researchers can work in a suite with the
comfort of knowing that each piece of equipment in the MCCT has been calibrated and tested under rigorous conditions to produce the most accurate and consistent results.

The MCCT’s GMP laboratories have been instrumental for bringing new cellular therapies to Northwestern Memorial Hospital. The preferred treatment option for renal kidney failure is a kidney transplant. Following the transplant, the patient must take immunosuppressive medications for life, and they run the risk of a serious infection or other toxic effects. Doctors need a way to educate the patient’s immune system to accept the donated kidney while still maintaining full immune protection against infection.

Joseph Leventhal, transplant surgery, collaborates with LeFever and the GMP facility to solve this problem by combining their scientific and clinical expertise to develop a practical and scalable method for growing regulatory T cells, or “Tregs.” These immune cells have two important qualities: (1) They can be selected to recognize only the cells of the donated organ; and (2) they can then suppress only the immune responses that would otherwise lead to transplant rejection. Up until now, however, it has been difficult to grow enough Tregs to suppress transplant rejection. The MCCT-developed solution is to use its patented immune system modulators and processes to grow Tregs from the recipient to protect the transplant from rejection. The JEOL 3200FS field-emission electron microscope, which is the heart and soul of the core facility. The facility also has a smaller electron microscope, the JEOL 1400, used to prescreen samples.

"The CryoEM allows us to image biological samples at scales from entire cells and organelles to single molecules, sometimes at atomic resolution," says facility director Vinzenz Unger, molecular biosciences. "Exploiting this versatility and factoring in very exciting recent technological advances, CryoEM is poised to become a key technology for the advancement of life sciences in the ‘post-omics’ era.”

Unger uses the facility for his research to understand how cellular processes function at the molecular level. In particular, he is focused on problems ranging from the transport of simple ions such as copper, to understanding how cells change the shape of their membranes, to the molecular basis of synaptic scaffolding. In many cases, using the high-powered microscope led to “a-ha!” moments in his own work.

"By using cutting-edge technology,” he says, “we can see what nobody else has yet seen. We can go where no one has gone before.”

Unlike Northwestern’s Biological Imaging Facility—which has tools to image an array of samples, such as fixed cells...
or polymers at lower resolutions—the CryoEM Facility is dedicated to high-resolution imaging of biological and other soft materials. Its microscopes are so sensitive that commonly used chemicals used for preserving samples to do lower resolution work would contaminate the instruments to the point where high-resolution work would no longer be possible. Even the facility’s space in the basement of Silverman Hall was renovated with the instruments’ sensitivity in mind: the room is soundproof with a stabilized temperature and humidity control. Workers installed a 7,000-pound granite slab that supports the large microscope, isolating it from the vibrations in the building.

The “cryo” part of cryo-electron microscopy refers to the necessity of rapidly freezing specimens before viewing them under the microscope. By first freezing the samples, biological activity is ceased but structure is preserved, allowing the specimen to become stabilized in a lifelike state. To prepare samples, the facility provides a Cryoplunge instrument, which flash freezes samples in aqueous solutions. From there, no further processing is needed. The sample can be observed without having been stained or fixed in any way, showing it in its native environment.

Despite rapid technological advances since its purchase four years ago, the JEOL 3200FS remains a state-of-the-art instrument. Notably, before the CryoEM Facility opened in September, there were no other similar microscopes in Illinois. The current setup provides a much-needed resource that Unger hopes will be used by other institutions in the area, including the University of Illinois-Chicago and University of Chicago.

“We are the only CryoEM facility for Chicago and the greater Chicago area,” Unger says. “No doubt, having this instrument and keeping abreast with more recent technological improvements to the instrumentation increase Northwestern’s standing in the local community and will allow researchers to make unprecedented advances in the life sciences.”

In order to prepare users to handle the equipment, facility manager Jonathan Remis trains interested parties. “Training is free,” he says. “But we only train people with a serious commitment to continue using the facility.” To ensure this commitment, trainees are required to pay for and reserve 15 hours of time on the microscope after training. Remis also provides support ranging from specimen development, preparation, imaging, and structure determination.

“Northwestern has a training mission,” Unger adds. “We want to empower researchers through training in the facility, so they can take this expertise back to their labs.”

For more information about the CryoEM Facility, visit www.facilities.research.northwestern.edu/browse-facilities/cryoem-facility.

### Biological Imaging Facility (BIF)

#### BIF Joins CLP

Northwestern’s Biological Imaging Facility (BIF) has joined the Chemistry of Life Processes (CLP) Institute’s consortium of five research centers and eight core facilities. BIF will reorganize under the umbrella of CLP’s Center for Advanced Molecular Imaging (CAMI) with the goal of supporting and integrating biomedical imaging research.

Robert Holmgren, molecular biosciences, will serve as BIF’s faculty director, succeeding Catherine Woolley, neurobiology. William Russin will remain in his role as BIF’s director of operations.

BIF is a research and training facility that serves the imaging needs of more than 500 scientists representing 144 different labs from 23 different departments. It offers users a wide range of imaging capabilities from the latest in spinning disk confocal microscopy to electron microscopy, supported by extensive sample preparation instrumentation and access to multiple image processing and analysis software packages.

For more information about the Biological Imaging Facility, visit http://www.bioimaging.northwestern.edu/.
Nearly every human ailment has some basis in our genes. Using data from human DNA, scientists and clinicians have many more powerful ways to study the role genetic factors play in complex illnesses, such as cancer, diabetes, and heart disease. Genomics can be used to solve many problems, and the genomic research at Northwestern just keeps getting better.

Northwestern’s state-of-the-art Genomics Core Facility originally resided inside two spaces on the Chicago campus—one in the Montgomery Ward Building and the other in the Tarry Building. Last year both spaces came together into a single laboratory in Tarry specifically designed to support genomics research. That space is sectioned into compartments to separate experiments.

“Before, we had two open floor plan labs in two different buildings and the experiments were done in two different locations,” says Nadereh Jafari, director of the facility. “Now most of our experiments and protocols are performed in separated areas in one large laboratory. This format minimizes the potential for impurities and increases quality. Having all of our core equipment in one location has increased staff cross training and communications.”

The Genomics Core has played a critical role in supporting a number of large studies. One example is the Hyperglycemia and Adverse Pregnancy Outcomes (HAPO) study led by Boyd Metzger and William Lowe, both medicine: endocrinology. As part of the HAPO Study, the Genomics core extracted DNA from 25,000 samples recruited from 15 different field centers around the world. These DNA samples have provided critical infrastructure for a number of NIH grants examining genetic variants that impact maternal metabolism during pregnancy and fetal growth and adiposity. Currently, the Genomics Core is preparing DNA from 14,000 HAPO mothers and their HAPO children in a new NIH-funded follow-up study of the original HAPO Study.

Another ongoing collaboration at the core is a large methylation analysis on thousands of samples for Lifang Hou, preventive medicine, at the Lurie Cancer Center. This large study includes samples from different cohorts like Women’s Health Initiative clinical trial and MOBILIZE Boston, a cohort that studies the associations between particulate matter air pollution, DNA methylation, and cardiovascular disease.

The core has closely worked with different departments in Evanston campus as well, including the Physical Sciences Oncology Center (PS-OC) and Proteomics Center for Excellence.

The Genomics Core has also worked with Northwestern student groups, including the award-winning International Genetically Engineered Machines (iGEM) synthetic biology team. In the last two years the team won a gold and a silver medal at the 2012 and 2013 iGEM Jamboree.

Housing an Ion Torrent (PGM), an Ion Proton system, a 3730 DNA sequencer, a Sequenom MassArray and an Illumina iScan enables the core to provide services for high, medium, and low throughput genome sequencing, genotyping, methylation and expression profiling, Ampliseq technology, and custom and
fixed cancer panels.

In the next few months the Genomics core will roll out a new application to be used for Sanger sequencing. The core will begin using a GeneSifter Lab Edition system for traditional sequencing. This replaces the Corefac and will simplify the samplesubmission process.

“The genomics-related technologies and industry moves very fast, but we work hard to stay on top of new advances in this field and provide the related services to our research community,” Jafari says. “Our goal is to provide our investigators access to new instrumentation and technologies so that they can excel in their research.”

The Genomics Core Facility is a part of Northwestern’s Center for Genetic Medicine. For more information about the core, visit www.cgm.northwestern.edu/cores/genomics/index.html.

Instrument Shop

Shop Instrumental to Northwestern Research

When Harold Kung, chemical and biological engineering, developed a prototype for a new kind of battery with 10 times the capacity of current models, he turned to Northwestern's Instrument Shop for help in manufacturing some of its essential components.

Kung is not alone when it comes to relying on the shop’s services. Located on the ground floor of the Technological Institute, the Instrument Shop - Evanston is a core facility that serves the essential machining needs of a wide variety of investigators.

“We make and modify hardware for researchers on the Evanston and Chicago campus. We’re on campus or a shuttle ride away; so we’re convenient,” says Shop Manager Jeff Sundwall. “We also have a better idea of what the researchers are trying to achieve, compared with an outside machine shop.”

Sundwall and his staff of three machinists work closely with faculty, postdocs, grad students, and other core facilities to design and manufacture many of the essential components that keep Northwestern’s research enterprise humming.

“The Instrument Shop is looking forward to better serving the research community by continuing to shorten the design to delivery time, further assisting the design process, and reducing fabrication costs,” says Philip E. Hockberger, director of Core Facilities.

Using industrial computer numerical control machines and computer-aided design software, the shop is an essential resource for many scientists. Examples of recent projects include work for:

Giles Novak, physics and astronomy, worked with the shop to develop a cryogenic rotator for a crystal polarization modulator. The device was a key component of a NASA-funded balloon-borne imaging polarimeter that was recently used by Novak and his collaborators to determine the magnetization of interstellar gas clouds. Next month, Novak will begin a three-year term as Instrument Shop faculty director (see sidebar).

Andy Ott, director of the Integrated Molecular Structure Education and Research Center (IMSERC), requires precisely manufactured sample deposit discs with millimeter-scale etchings for use in a mass spectrometer. The Instrument Shop makes these discs to order. Additionally, during a recent move to new space, the shop provided essential services to keep IMSERC running.

Theresa Horton, program in biological sciences, monitors a mouse’s temperature to predict fertility cycles. To do so, she mounts on its tail a customized fiberglass piece made by the Instrument Shop. (Finding a material that wasn’t especially “tasty” to the mouse was key to this project.)

Greg Olson, materials science and engineering, creates metal samples for destructive property testing, so he turns to the Instrument Shop and its wire electrical discharge machining tool to cut these samples to precise specifications.

Teresa Woodruff, obstetrics and gynecology, needed a tissue-slicing guide for sample preparation. The Instrument Shop designed a square metal box with an inlaid grid system that allowed specimens to be sliced easily and consistently.

Nasir Basit, director of operations for the Northwestern University Micro/Nano Fabrication Facility, recently moved its clean room facility into new space, but discovered that some of the floor panels were not manufactured to specifications. Rather than losing weeks of time waiting for replacement tiles from Korea, Nasir turned to the Instrument Shop to modify the
specialty clean room floor tiles to ensure proper air circulation in the lab.

The Northwestern University Instrument Shop is located on the ground floor of Tech, room NG-40. Instrument Shop Manager Jeff Sundwall is available to discuss jobs on a walk-in basis. He can also be reached at 7-4315.

**Instrument Shop**

**Novak named New Faculty Director for Instrument Shop**

**Giles Novak**, physics and astronomy, has been appointed faculty director of the Tech Instrument Shop - Evanston for a three-year period beginning in June. Novak, who joined the Northwestern faculty in 1993, will directly oversee the shop, a full-service machining, fabrication and repair facility that has been supporting the research mission of the University for approximately 40 years.

Among his responsibilities as faculty director, Novak will chair the faculty advisory committee, supervise staff and their professional development, lead fundraising efforts to expand the shop's capabilities and services, and partner with the Office for Research to make strategic decisions to ensure its financial stability.

Novak conducts research in the area of astrophysics and astrophysical instrumentation. His research group is currently building instrumentation for balloon-borne as well as high altitude ground-based telescopes, which they will use to observe cold Galactic clouds where new stars are forming.

Novak has served on the Kuiper Airborne Observatory User’s Group, SOFIA Science Steering Group, NASA-APRA and NSF astronomy division proposal review panels, and the National Science and Engineering Research Council Physics Evaluation Group of Canada. He was also the lead author of the SOFIA Design Reference Mission Case on “Magnetic Fields, Turbulence, and Star Formation.”

“The Instrument Shop performs a vital service to researchers,” says Novak, “not least because of the training it provides to graduate students who learn design skills via their interactions with the shop’s experienced instrument builders.”

For more information about the Instrument Shop, click here.

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**Hockberger Appointed Executive Director of Research Facilities**

**Phil Hockberger** has been named executive director of research facilities in the Office for Research (OR). Effective June 1, the move is a “natural extension” of his responsibilities as director of core facilities, a position he’s held since 2009.

As executive director, Hockberger will be the OR point person for advice on developing, maintaining, and advancing state-of-the-art research facilities that are essential to the research mission of the University. The position is also responsible for providing advice on strategic planning, marketing, and tactical business management of research facilities, as well as professional development of directors and managers of research facilities.

“I’m very excited to take on these additional responsibilities,” Hockberger says. “This role will facilitate better communication and coordination within the Office for Research as well as across campuses on issues pertaining to research facilities.”

Hockberger will continue to oversee the University’s portfolio of shared and core facilities as well as the following new responsibilities:

- Research computing facilities – OR representative in high-performance computing, software licensing, highspeed optical fiber network, and facilities related to the Big Data initiatives.
- Research space and construction – OR representative for research space construction.
- High-end instrumentation – OR representative for coordinating requests of research-related instrumentation exceeding $300,000 per instrument.
- Regional partnerships – OR representative for developing regional research partnerships with other academic institutions and industry.
Core Facilities Honored with Annual Awards

CAM, CTI IMSERC and NU

Among the cores to receive outstanding facility awards this year, the Center for Advanced Microscopy (CAM) — formerly the Cell Imaging Facility — became the first five-time honoree. Three others were named outstanding facilities by the Office for Research. They are the Center for Translational Imaging (CTI), Integrated Molecular Structure Education and Research Center (IMSERC), and Northwestern University’s Atomic and Nanoscale Characterization Experimental Center (NUANCE). A pair of cores received honorable mention: the Developmental Therapeutics Core (DTC) and the Skin Disease Research Center (SDRC). The Medicinal and Synthetic Chemistry Core (ChemCore) was named most improved.

The awards serve to recognize the exemplary achievement of facilities that provide unique instrumentation and services to researchers at Northwestern as well as to other academic and for-profit research organizations.

“These facilities are an integral part of Northwestern’s research portfolio, and the annual awards are our way of thanking the directors and their staff for providing exemplary service to the research community,” says Phil Hockberger, executive director of research facilities. “Over the past five years, nine different facilities have been honored with the top award, a testament to the breadth and excellence of our research core facilities.”

Selections are based upon administrative services, research and technical staff, resource management, self-assessment, participation in educational and outreach activities, communication of services within and outside of the University, and results of a University-wide customer satisfaction survey.

The four outstanding facility awardees receive $2,000 for use related to the operation of the facility (e.g., professional development, hosting a workshop, seminar program) and a wall plaque honoring their achievement. In addition, the director, manager, and staff will be honored guests at an awards luncheon in September.

To learn more about Northwestern’s core facilities, click here.

Life Sciences Collaborative Access Team (LS-CAT)

LS-CAT at Argonne Helps Enlighten Life Sciences

In early 2012, tracking a nanoparticle’s location within a cell was impossible, yet imperative. If researchers could confirm that the ultra-fine particles developed by Gayle Woloschak, radiation oncology, were making their way into the nucleus of a cell, drugs might then be attached to them in an attempt to destroy cancer from within.

“The effort involved in designing and obtaining a first-of-its-kind microscope — the bionanoprobe — is a perfect example of how the partnership between Northwestern and Argonne can work,” says Keith Brister, manager of the Life Sciences Collaborative Access Team (LS-CAT) at Argonne National Laboratory. “The bionanoprobe has the capability of providing three-dimensional maps of exactly where specific elements are located.” The microscope allowed Woloschak to substantiate the concentration of nanoparticles that reached the nucleus. It also gave researchers like Tom O’Halloran, chemistry, a chance to investigate — at the nanoscale — the changes that occur to an egg when penetrated by sperm.

Housed at LS-CAT, the bionanoprobe is one of seven stations at two sectors managed by Northwestern University at Argonne’s Advanced Photo Source (APS). Three stations are part of the du Pont-Northwestern-Dow Collaborative Access Team (DND-CAT) and are used in materials science research. The other four are at LS-CAT.

Beyond the bionanoprobe, LS-CAT allows researchers to study the structure of proteins using intense beams of x-rays focused by mirrors and lenses onto tiny crystals of biological samples. Giant, multimillion-dollar detectors collect the transmitted or scattered x-rays needed to calculate the location of atoms in each protein.
Every protein structure that is determined by non-proprietary work at LS-CAT is then deposited into the Protein Data Bank and made publicly available.

"LS-CAT has been incredibly important to the life sciences community and it has ensured Northwestern’s involvement in answering cutting-edge structural-biology questions," says Alfonso Mondragón, molecular biosciences, and the scientific director of LS-CAT. "Northwestern was one of the first institutions involved in the APS, which provides a very important educational resource that is only available due to our relationship with Argonne as well as our proximity to the lab." Although the APS is oversubscribed, the collaborating partners of LS-CAT are able to schedule 75 percent of the available time with the beamline, which runs 24 hours a day for a three-month, one-month-off cycle. The Department of Energy requires the remaining 25 percent of time be granted to applicants from anywhere in the world.

“What I find absolutely fascinating about the APS are the scientific opportunities that exist here,” says Brister. “Pretty much, any kind of x-ray science can be advanced. A researcher can arrive with some fantasy about doing something new and chances are that we’ll figure out how to do it.”

The user community for LS-CAT typically consists of about 400 researchers from around the nation per year, each typically running one of three basic crystallography experiments over a few days. Brister described the most common tests as those looking to understand a protein to learn more about its role in a biological process, its interactions with a drug, or as part of a genomics project.

“LS-CAT is essential for our x-ray microscopy work and has provided us with a novel tool to explore cell structure and function,” says Woloschak. "Recently, we’ve been tracking drug delivery using the bionanoprobe and other users have been working to examine new 3D images of cells.”

**Partners in Discovery**

An important part of the Northwestern strategic plan is to "Discover creative solutions." It says "We will work together through research and innovation to create solutions to problems that will improve lives, communities, and the world." Our partnerships with Chicago’s world-class institutions have built alliances that will change the future. Throughout the coming year, the Research Newsletter will highlight the unique range of opportunities that Northwestern faculty, students, and staff have to both collaborate and learn from these affiliations.

What is the Advanced Photon Source at Argonne?

The ring-shaped Advanced Photon Source (APS) at Argonne National Laboratory is 1,153 feet in diameter. The facility contains a steel and concrete cyclic particle accelerator in which electrons move at close to the speed of light.

The long pathway results in the APS having the brightest beam of any storage ring in the Western Hemisphere, creating an x-ray so powerful that researchers can see the subatomic structures of biological and inorganic materials.

As the electron beam, guided by magnets, circulates in the storage ring, x-ray beamlines break off in tangents of two different types: bending magnets and insertion devices. These tangential beamlines then enter the laboratory spaces to provide x-rays for experiments.

Current LS-CAT Members

Current LS-CAT members are Northwestern University, Michigan State University, University of Michigan, Van Andel Research Institute, University of Wisconsin-Madison, Vanderbilt University, and University of Illinois.

To learn more about LS-CAT, visit ls-cat.org/index.html.
**Rodent (Preclinical) Technical Services Unit (RTSU)**

Nicolette Zielinski Mozny, senior clinical veterinarian, Center for Comparative Medicine (CCM), wants to help scientists conserve one of their greatest resources: time.

“The Rodent (Preclinical) Technical Services Unit (RTSU) is meant to be an extension of an investigator’s laboratory,” says Zielinski Mozny, who is spearheading RTSU. “By performing tasks and collecting data, we are providing the animal biomedical research community with more time and additional resources to complete bench work, submit grants, or complete other research-related activities.”

One of the CCM’s newest services, RTSU is able to rely on the extensive expertise that already exists at the center.

Comprised of five team members from within CCM, the RTSU is able to accommodate studies on both the Chicago and Evanston campuses.

“Our goal is to apply Good Laboratory Practice-like standards in conducting the research we do,” says Zielinski Mozny, pathology. “Due to our unique position within CCM, we have access to subject matter experts who can contribute when needed.”

The current cost to researchers for RTSU use is $34.90 per hour for the technical assistance, documentation of records, and communication of activities. Request for services require at least a 10-day advanced notice to determine feasibility and for scheduling purposes. Individuals interested in requesting RTSU assistance should complete the Rodent Technical Services Request Form on the CCM website. If a service is not listed, RTSU can be contacted to discuss the possibilities of adding it.

“Since CCM is already the service and teaching component that supports all animal use in research, testing, and education at Northwestern, it makes sense to extend our expertise to this set of services for researchers,” Zielinski Mozny says.

[Click here to access the Rodent Technical Services request form.](#)
### Evanston Campus
- Biological Imaging Facility (BIF)
- Biological NMR Center
- Center for Advanced Molecular Imaging (CAMI)
- Central Laboratory for Materials Mechanical Properties (CLaMMP)
- Clean Catalysis Core (CleanCat)
- Computation, Modeling & Bioinformatics Center
- CryoEM Facility
- Cryogenics Facility
- Developmental Therapeutics Core (DTC)
- Electron Probe Instrumentation Center (EPIC)
- High Resolution Electron Microscopy & Surface Structure Facility
- High Throughput Analysis Laboratory (HTAL)
- Instrument Shop
- Integrated Molecular Structure Education and Research Center (IMSERC)
- Jerome B. Cohen X-ray Diffraction Facility
- Keck Biophysics Facility
- Keck Interdisciplinary Surface Science Center (Keck-II)
- Magnet, Low Temperature, and Optical Facility
- Materials Processing & Microfabrication Facility - Cleanroom
- Medicinal and Synthetic Chemistry Core (ChemCore)
- Nanoscale Integrated Fabrication, Testing and Instrumentation Center (NIFTI)
- NU Center for Atom Probe Tomography
- NUFAB Cleanroom
- Optical Microscopy & Metallography Facility (OMM)
- Proteomics Center of Excellence
- Proteomics Core
- Quantitative Bioelemental Imaging Center (QBIC)
- Recombinant Protein Production Core (rPPC)
- Sleep, Circadian and Other Rhythm Experiments Core (SCORE)
- Surface Science Facility

### Chicago Campus
- Behavioral Intervention Technology Development Core (BIT Core)
- Behavioral Phenotyping Core Facility (BPC)
- Bioinformatics Research Collaboratory (BIRC)
- Biostatistics Collaboration Center
- Biostatistics Core Facility
- CCM Rodent (Preclinical) Technical Services Unit
- Center for Advanced Microscopy & Nikon Imaging Center
- Center for Translational Imaging (CTI)
- Clinical Research Office - RHLCCC
- Comprehensive Metabolic Core
- Flow Cytometry Core Facility - Cancer Center
- Flow Cytometry Facility - Interdepartmental Immunobiology Center
- Genomics Core Facility
- Human Embryonic and Induced Pluripotent Stem Cell Facility
- IBNAM Equipment Core
- IBNAM Nanomedicine Cleanroom
- IBNAM Peptide Synthesis Core
- Instrument Shop - Chicago
- Mary Beth Donnelley Clinical Pharmacology Core Facility
- Mathews Center for Cellular Therapy (MCCT)
- Microsurgery Core
- Mouse Histology and Phenotyping Laboratory (MHPL)
- Next Generation Sequencing Facility
- Northwestern Medicine Enterprise Data Warehouse
- NUCATS-Center for Clinical Research
- NUCATS-Clinical Research Unit (Lurie Children's Hospital)
- NUCATS-Clinical Research Unit (NMH)
- NUCATS-Research Bionutrition Services (NMH)
- NUCATS-Research Laboratory Services (NMH)
- NUCATS-Research Nursing Services (Lurie Children's Hospital)
- NUCATS-Research Nursing Services (NMH)
- NUgene
- Outcomes Measurement & Survey Core (OMM)
- Pathology Core Facility
- Skin Disease Research Center (SDRC)
- Structural Biology Facility
- Transgenic and Targeted Mutagenesis Laboratory (TTML)

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Please Note: The use of data in a grant application, progress report or publication that was generated in a core facility contains the implicit understanding that the PI or authors will acknowledge the use of the core facility. Since many of our facilities are supported by federal agencies, such acknowledgment is mandatory.