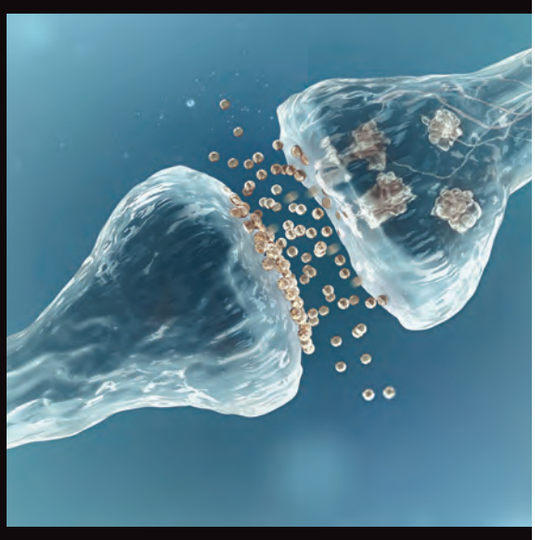
Spring 2017

NJIT
New Jersey Institute of Technology

# A World-Class Technological Research University



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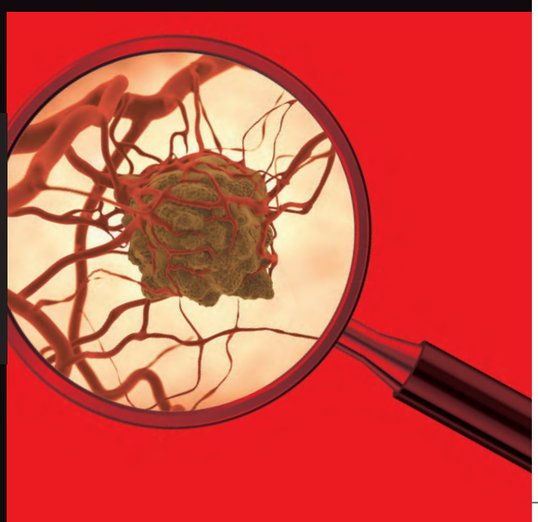

# $1.74 BILLION

NJIT's annual economic impact on the State of New Jersey

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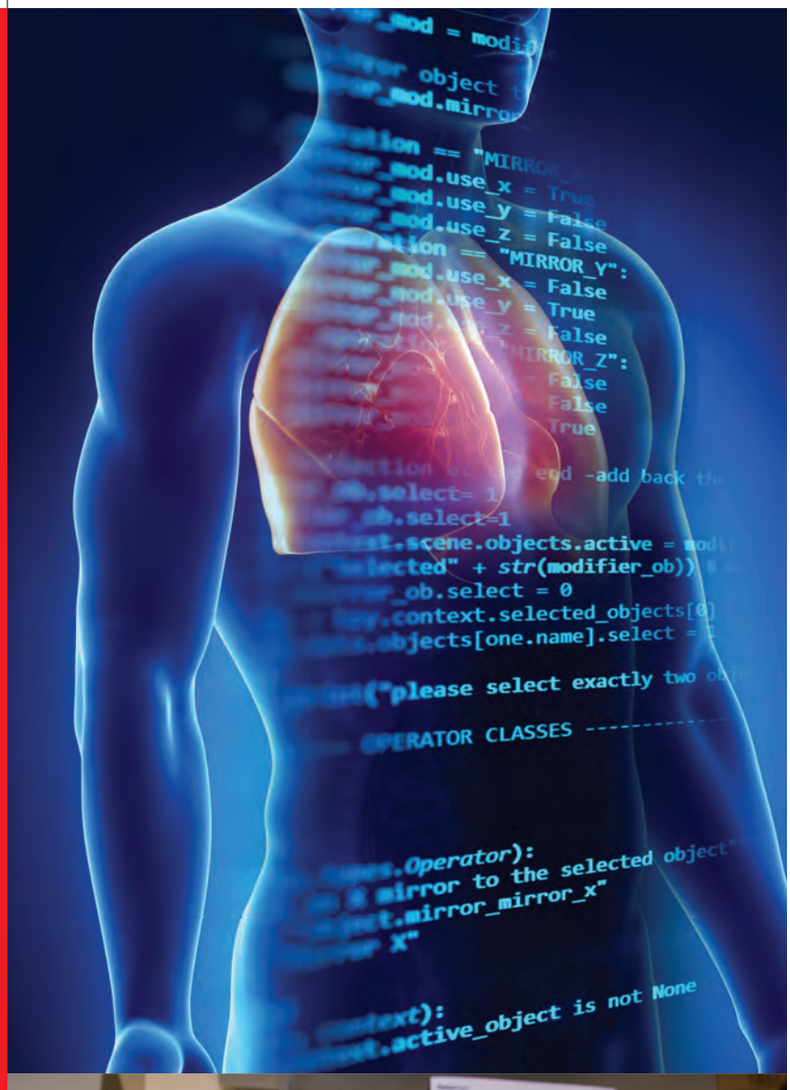
# INSTITUTE *of* BRAIN *and* NEUROSCIENCE RESEARCH

launched at NJIT on March 6, 2017

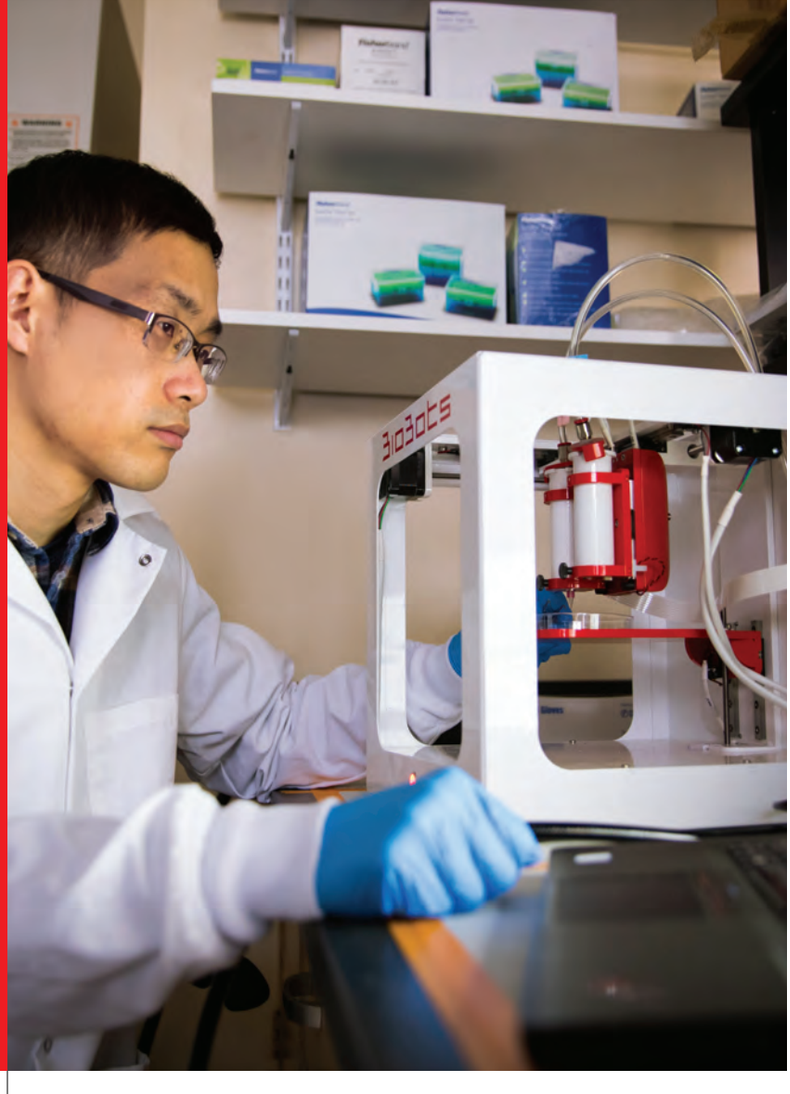


# Speeding up data discovery in the fight against cancer

The fight against cancer is leading researchers to delve faster and deeper into the data generated daily in our online lives. Songhua Xu, assistant professor of information systems in NJIT's Ying Wu College of Computing, is an expert in web intelligence, and his work could dramatically accelerate progress in the quest to find a cure for cancer.

Dr. Xu's research shows that cancer mortality trends can be captured quickly, reliably and economically by mining readily available online content, including obituaries. Using breast and lung cancer as test cases, Dr. Xu and his colleagues from the Oak Ridge National Laboratory found a high correlation between their data and official statistics reported by the Centers for Disease Control and the National Cancer Institute, which can take several years to collect, validate and disseminate.

Dr. Xu's novel big-data approach will help public health officials and policy experts to understand more quickly the impact and effectiveness of new cancer screening and treatment discoveries.

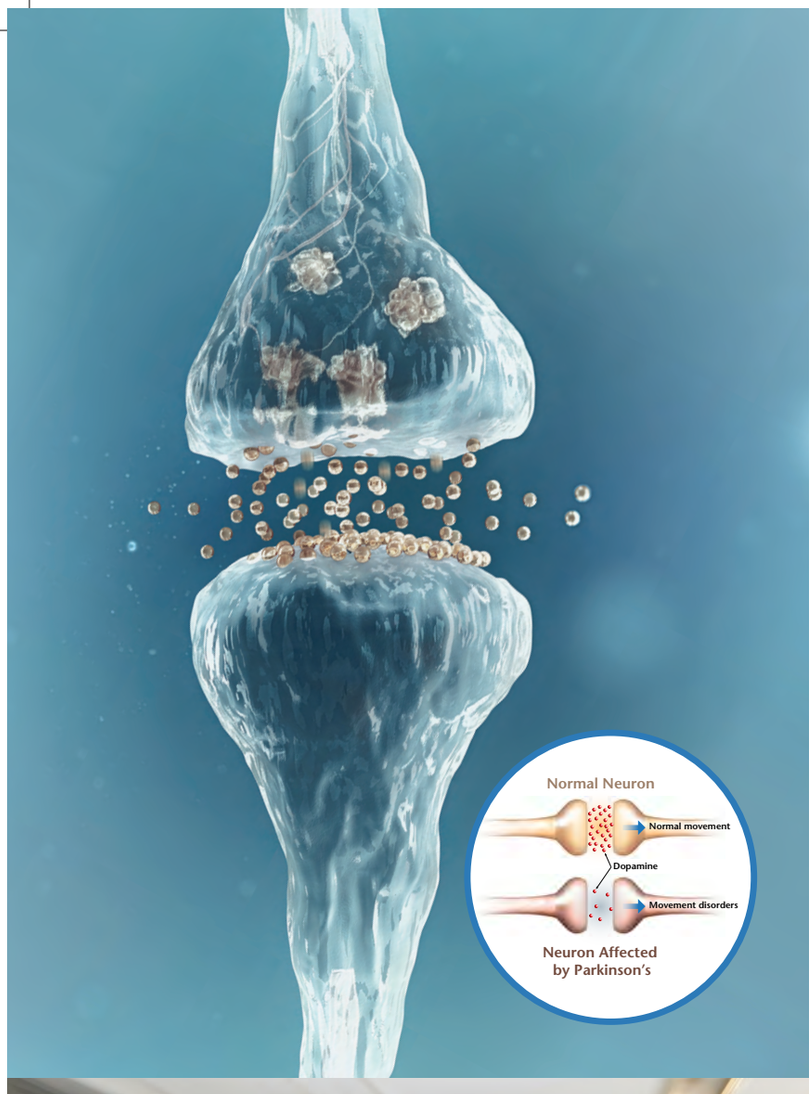


# Developing biomaterial inks for 3D printing applications

Nowhere is the promise of 3D printing greater than in the field of biomaterials, and at the forefront is the work of NJIT's Murat Guvendiren. An assistant professor in the university's Newark College of Engineering, Dr. Guvendiren and his team are developing "bio-inks" that can print cellular material to merge with existing live tissues. What's more, these inks are fundamental to the biomanufacturing revolution.

Dr. Guvendiren is focusing specifically on creating bio-inks that can be "tuned," or easily modified, to meet user-defined specifications for tissue engineering and regenerative medicine. His aim is to enable surgeons, for example, to customize biomaterials precisely for the task at hand, be it the repair or replacement of skin, cartilage, bone or cardiac tissue.

Dr. Guvendiren envisions creating a library of bio-inks whose properties, such as stiffness, degradability or bioactivity (triggering cell growth), can be precisely adjusted by simply modifying the model that determines the makeup of the particular bio-ink.




# Shedding light on electrical activity in neural networks

Parkinson's disease. Epilepsy. Depression. Drug addiction. Every one of these disorders afflicting millions of people across the globe traces its roots to what's happening in the neurons in our brains and at the cell-to-cell junctions called synapses. A better understanding of the basic biophysical processes at work on the neural level is crucial to finding cures for these complex diseases. That's why the work of Farzan Nadim is so important.

Professor of neurobiology in NJIT's College of Science and Liberal Arts, Dr. Nadim is investigating what governs neural processing across all animal and human nervous systems. Combining computational, analytical and experimental techniques, his research studies the network of nerve cells in the central nervous system of lobsters and crabs, and seeks to understand how the cells generate the patterned electrical activity that triggers the animals' stomach muscles during grinding, chewing, digesting and filtering food. Shedding light on how neurons generate these rhythmic activities and why the cells sometime misfire and disrupt the normal oscillating pattern will help us understand, on a cellular and network level, more complex neural circuits like the human brain.

# Mining data on hospital readmissions to improve care

One of the biggest drains on the U.S. health care system is the revolving door of hospital readmissions. Since October 2012, the Centers for Medicare and Medicaid Services has taken steps to reduce the high rates of readmission for patients with heart failure, heart attack, pneumonia and other chronic conditions. Hospitals are incentivized to improve care and prevent a patient's return trip within 30 days of discharge.

The work of Senjuti Basu Roy, assistant professor of computer science at NJIT, aims to help hospitals more accurately predict the risk of readmission for heart-failure patients and to focus on quality patient care and resource utilization. Dr. Roy and her colleagues devised a novel data-mining framework that predicts the risk of readmission in a series of stages and integrates different variables such as gender, race, marital status and severity of illness at each stage. Using real-world hospital patient data, their analytic model significantly outperformed other predictive methods. Members of the research team also created an innovative framework of algorithms to help clinicians employ personalized treatment plans to minimize the 30-day readmission risk for individual patients.

# Recognizing an innovator: NJIT professor hailed by National Academy of Inventors

NJIT Distinguished Professor of Chemical Engineering Kamalesh Sirkar, an internationally renowned expert in membrane separation technologies who holds over 30 patents, was inducted as a fellow of the National Academy of Inventors (NAI) in April.

Dr. Sirkar is best known for developing the concept of membrane contactors, a process that permits two phases that do not mix, such as two liquids or a liquid and a gas, to contact each other at the pores of a membrane — without dispersing into each other — in order to introduce or extract specific compounds across it. The technology is used, for example, to produce concentrations of oxygen at much less than one part per billion in ultrapure water needed for semiconductor production. He also developed a novel membrane distillation technology capable of converting sea and brackish water into potable water much more efficiently than the standard method of reverse osmosis. Dr. Sirkar has authored more than 175 scientific journal articles and book chapters, and is a co-editor of the widely used Membrane Handbook.

Innovative membrane technologies developed by Dr. Sirkar (prototype shown above) help to separate and purify air, water and waste streams and improve manufactured products like pharmaceuticals, solvents and nanoparticles.

The NAI fellows program is the highest professional recognition given to academic inventors who have demonstrated a highly prolific spirit of innovation in creating or facilitating outstanding inventions that have made a tangible impact on quality of life, economic development and the welfare of society. NAI fellows are nominated by their peers.


PHYSICS PROFESSOR WINS NSF CAREER AWARD

Assistant Professor of Physics Bin Chen is a 2017 recipient of a prestigious Faculty Early Career Development (CAREER) Award from the National Science Foundation (NSF). The award provides Dr. Chen with a five-year grant to probe the physical mechanisms underlying solar explosive events using a new generation of radio telescopes, including NJIT's Expanded Owens Valley Solar Array in California, as well as revolutionary new analytic methods.

His project has the potential to significantly advance knowledge on key topics in heliophysics and astrophysics. It is also critical to meeting the goals of the National Space Weather Strategy and Action Plan, which aims to develop new tools to forecast space weather and mitigate the threat it poses to satellites, electric power grids and communications systems.

The experience gained from the research will also inform development of the Frequency Agile Solar Radiotelescope, a transformative solar radio telescope slated for construction in this decade.

Twenty-two NJIT faculty members have now garnered CAREER awards, which recognize young faculty who have shown outstanding potential as both educators and researchers.

## Advancing Smart, Connected Communities

Abdallah Khreishah, Jo Young Lee, Chengjun Liu and Nirwan Ansari are collaborating on an effort to improve the video-based traffic monitoring systems widely used today. The researchers have devised a novel, next-generation approach that incorporates wireless sensor networks, hierarchical edge-computing and advanced computer vision technology. Supported by a grant from the National Science Foundation (NSF), the work has a wide spectrum of potential applications, including wrong-way driving alerts, congestion detection under bad weather conditions, accident scene management support, suspect vehicle tracking, wildfire detection and alerts, and emergency evacuation.

In partnership with the New Jersey Department of Transportation, multiple pilot tests of the system will be implemented on selected highway corridors.

## Listening to the Ocean

Eliza Michalopoulou explores sound as it travels underwater. The end products of her work in ocean acoustics and signal processing, funded by the Office of Naval Research, are algorithms to help Navy engineers detect submarines in shallow water and may eventually be applied in next-generation systems for protecting U.S. shores against unauthorized underwater incursions. Her computational tools also can provide valuable insight into climate change and oceanic pollution.

## Reducing the Threat of Biological Weapons

Edward Dreizin, whose research has been supported by the U.S. military as well as private industry, is developing and testing new metal-based nanomaterials that can be used more effectively in disabling airborne spores released by biological weapons. His work on reactive nanocomposite powders also has practical applications in energy storage materials and rocket propellants.

# Research S

## Setting a New Standard for Education

The Collaborative for Leadership, Education and Assessment Research (CLEAR) at NJIT, led by James Lipuma, investigates and develops tools, materials and resources to advance educational effectiveness, personalized digital learning and student success from kindergarten through college. NJIT and Dr. Lipuma's team were invited to partner with the New Jersey Department of Education and the New Jersey School Boards Association on Future Ready Schools–New Jersey, a certification program promoting digital learning readiness. Targeting approximately 2,500 K–12 schools with 1.4 million students, Future Ready Schools–New Jersey helps school districts plan for and implement personalized, research-based digital learning strategies to prepare their students for success in the 21st century.

## Remediating Contaminated Sediment On-Site

Using New Jersey's Passaic River as a test case, Jay Meegoda is investigating an innovative approach to cleaning contaminated sediment, an environmental problem that affects many bodies of water across the United States. With funding from the National Science Foundation (NSF), his research utilizes ultrasound and ozone nano bubbles, promising a more cost-effective, efficient and environmentally sustainable on-site treatment method. This new approach is also expected to minimally impact the environment and socio-economic health of the region by eliminating the need to transport and dispose of contaminated material.

SuperStock/Getty Images

# napshots

## Unlocking the Potential of a Renewable Biofuel

Wen Zhang is spearheading an effort to enable the sustainable production of biofuels and specialty chemicals from microalgae. In the quest for renewable fuel sources, scientists have studied the oil derived from algae for decades. Zhang's research into efficient, scalable membrane filtration technologies for harvesting microalgae may finally unlock its potential as a commercially competitive biofuel and lead to transformative solutions that address the grand challenges at the energy-water nexus.

## Using Big Data to Predict Market Volatility

Dantong Yu has developed both data-mining algorithms to detect hidden interactions, patterns and anomalies in complex systems from the climate to genetics, as well as ultrafast cloud-based data-transfer software. His latest work focuses on using time-sequence data related to stock markets and consumer sentiment to create a tool to predict financial bubbles and market volatility. NJIT's new Ray Cassetta Financial Analysis Laboratory is a rich source of data, including temporal stock options information from the lab's Bloomberg terminals.

## Innovating Medical Diagnostics

Kevin Belfield is working at the forefront of medical innovation: the diagnostic frontier of two-photon fluorescence microscopy. This technique, currently at a very promising preclinical stage, uses nontoxic small-molecule and polymer-based fluorescent dyes, or nanoprobes, to image living tissue, with the relevant data acquired by means of an optical fiber. Dr. Belfield's research, supported by the National Science Foundation (NSF) and others, significantly enhances the quality of the data that can be obtained and provides unique subcellular resolution in three dimensions. Its high-resolution, in-depth imaging of the complex process of blood-vessel formation can be a valuable clinical aid for real-time, minimally invasive monitoring of wound healing as well as tumor progression and response to anti-cancer therapies.

## Training the Next Generation of Cyber Experts

NJIT's Secure Computing Initiative (SCI), under the direction of Vincent Oria, Ali Mili, Cristian Borcea and Reza Curtmola and funded by the National Science Foundation (NSF), is designed to fulfill the national need for cybersecurity experts and to enhance discovery while promoting learning. In addition to coursework, students accepted into SCI will work in teams on research projects such as cryptographic solutions for securing data in the cloud and privacy protection for mobile computing, among others. The program is expected to produce scientific results and software to help the United States better protect against new cyberthreats.


**$941.8 MILLION**

estimated annual economic impact of NJIT research-related activity on the State of New Jersey

**TOP 10**

NJIT's Albert Dorman Honors College ranks among the nation's best public university honors colleges & programs

**$26M+**

in federal research grants to the university's Big Bear Solar Observatory in California

Atam P. Dhawan, distinguished professor of electrical and computer engineering, was appointed vice provost for research at NJIT in July 2015. He has published more than 215 articles in refereed journals, books and conference proceedings. He is a fellow of the National Academy of Inventors, American Institute of Medical and Biological Engineering, and Institute of Electrical and Electronics Engineering.

One of the nation's leading public technological universities, New Jersey Institute of Technology (NJIT) is a top-tier research university that prepares students to become leaders in the technology-dependent economy of the 21st century. NJIT's multidisciplinary curriculum and computing-intensive approach to education provide technological proficiency, business acumen and leadership skills. With an enrollment of 11,400 graduate and undergraduate students, NJIT offers small-campus intimacy with the resources of a major public research university. NJIT is a global leader in such fields as solar research, nanotechnology, resilient design, tissue engineering and cybersecurity, in addition to others.

# Q&A

## Atam P. Dhawan

### NJIT Vice Provost for Research

**NJIT's current strategic plan affirms a commitment to multidisciplinary research. What institutional changes are making this commitment a reality?**

In keeping with our strategic plan, 2020 Vision, research at NJIT is focused on four main areas, or clusters. These are life sciences and engineering, sustainable systems, data science and information technology, and transdisciplinary areas where technological challenges posed by complex systems require multidisciplinary solutions.

Institutionally, we have established collaborative, multidisciplinary centers in each cluster to achieve real-world solutions. For example, one focus of the Center for Injury Biomechanics, Materials and Medicine in the life-sciences cluster is better protective helmets for soldiers. The Membrane Science, Engineering and Technology Center in the sustainable-systems cluster is developing specialized membrane technology for energy production, water treatment, pharmaceutical purification and chemical processing.

The next step, establishing transdisciplinary institutes, will encourage integrating results achieved at our research centers to stimulate even more progress. The first of these institutes is dedicated to brain and neuroscience research. In the near future, we anticipate establishing institutes dedicated to materials science and data analytics.

**Are these changes a departure from traditional academic research, and if so why is this necessary?**

The changes we've implemented are the essential evolution of academic research, and not a radical departure from what we always hoped to achieve in the past. The promise of technological, social and economic progress has long been implicit in university research. That expectation is explicit today. The reality is that we expect research to produce benefits such as better treatments for diseases, better energy technologies, and better solutions for environmental protection.

There's no question that meeting such expectations also requires multidisciplinary research. Take the smart phone, a very multidisciplinary innovation. It is a product of integrated advances in numerous disciplines — communications technology, materials science, information science, energy technology and many other fields.

**Does NJIT's evolving research model help the university obtain external funding?**

Another 21st-century reality is that the goal of funding organizations — government, corporations, foundations — is to promote research translatable into products and processes that will impact society and economic growth. NJIT's commitment to multidisciplinary research and transdisciplinary development of real-world solutions is well aligned with this reality.

**Given the trends you describe, how does basic scientific investigation fit into today's research picture?**

In the past, research has often been a "bottom up" process, beginning with fundamental inquiries that could yield practical results in the future. Today, because we typically begin with the need for a particular solution, the path toward investigating relevant underlying science is "top down." Nonetheless, researching a specific solution almost invariably leads to new and unexpected questions at the basic level.

**How does the evolution of NJIT's approach to research benefit students?**

Awareness of the seamless connection between academic research and the workplace most NJIT graduates will enter fosters the appreciation that research is not a one-way path from basic science to application, but a balancing of practical technological needs with our desire for foundational knowledge. At NJIT, students experience a cooperative, research-oriented environment from the time they first come to campus. Competence in research is an indispensable life skill in every profession, not only in science and technology. It is essential preparation for making significant contributions and succeeding in every field.

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