



The State University  
of New York

SUNY **Research**  
Transforming **Lives**  
and Shaping the **Future**

# Capacity to Lead



The State University of New York is the largest, most comprehensive university system in the United States.

The pioneering research, innovation and entrepreneurship that take place throughout SUNY transforms lives.

We partner with businesses and state and federal agencies to foster research breakthroughs and economic growth while working to solve major societal problems.

From advanced materials and quantum science and engineering to translational medical research and clean energy, SUNY faculty and students are discovering solutions, powering the economy and improving our world.

#### Photo Credits *Front & Back Cover*

*Front (top to bottom):* Advanced nanoscale electronic device development – SUNY Polytechnic Institute Albany NanoTech Complex; Optogenetic Brain System to give blind people sight – SUNY Downstate Health Sciences University (Courtesy of Barrow Neurological Institute Publications Department); Reality Deck visualization facility – Stony Brook University; New carbon capture membranes – University at Buffalo.

*Back (top to bottom):* 3-D printed coronary phantom – University at Buffalo Clinical and Translational Research Center; Advanced manufacturing of flexible hybrid electronics – Binghamton University; Forensic chemistry research – University at Albany; Materials research for quantum technology – University at Buffalo; Wafer processing research and development – SUNY Polytechnic Institute Albany NanoTech Complex.



## POWERING THE INNOVATION ECONOMY

64

Campuses

1.4M

Students

12K

Research  
Laboratories

\$1.6B

Annual R&D  
Expenditure

2.7K

Principal  
Investigators

7.3K

Active  
Projects

1.5K

Patents

700+

License  
Partnerships

100+

Operational  
Startups

863K

Square Feet  
of Incubation Space

22

Small Business  
Development Centers

\$26.8B

Total  
Economic Impact

# Engineering, Computer and Information Sciences



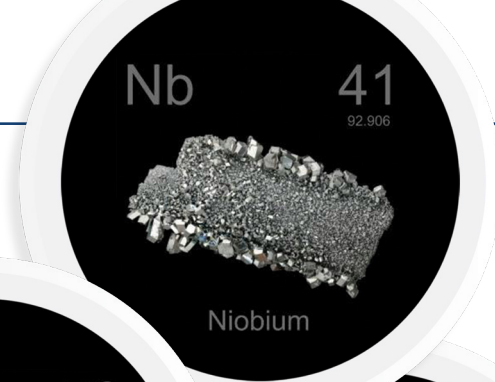
SUNY researchers are setting the stage for faster, lighter, cheaper and more secure sensors, components and computers that directly impact how we communicate, travel, conduct financial transactions and treat illnesses.

*Computer scientists are developing algorithmic and statistical methods for analyzing audio-visual human behavior.*

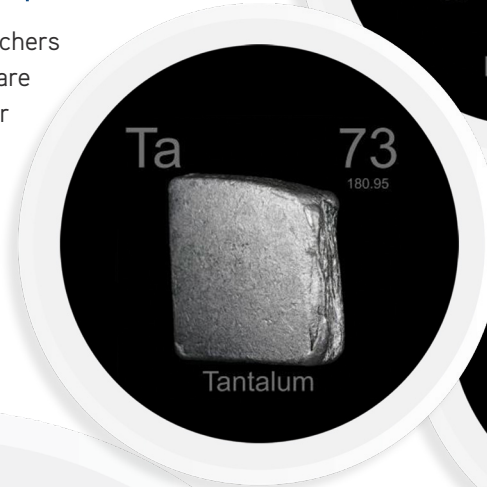


## Creating Nanoscale “Synapses”

Neuromorphic computing researchers at SUNY Polytechnic Institute are designing nanoscale computer chip switches called “memristors” that combine processing and memory functions in one place, speeding computation and saving energy.



Niobium



Tantalum



Hafnium

*New materials play a critical role in building memristive devices.*

## Providing Emotional Intelligence to AI Systems

Research on automatic emotion recognition technology conducted at the University at Albany has the potential to dramatically improve artificial intelligence systems in fields ranging from robotics, health care and security to education and marketing.

## Building Better Human-Machine Partnerships

The University at Buffalo Artificial Intelligence Institute (UBuffalo.AI) is exploring how to fuse machines’ ability to ingest and process information with concepts, such as reasoning, judgment and strategizing.

# QUANTUM COMPUTING AND ARTIFICIAL INTELLIGENCE

## UNIVERSITY AT BUFFALO

- Center of Excellence in Materials Informatics
- Center for Computational Research
- Artificial Intelligence Institute

## SUNY POLYTECHNIC INSTITUTE

- AIM Photonics
- Center for Advanced Technology in Nanomaterials and Nanoelectronics
- META Center

## STONY BROOK UNIVERSITY

- Center for Quantum Materials
- Brookhaven National Laboratory
- Advanced Energy Research and Technology Center
- Institute for AI-Driven Discovery and Innovation

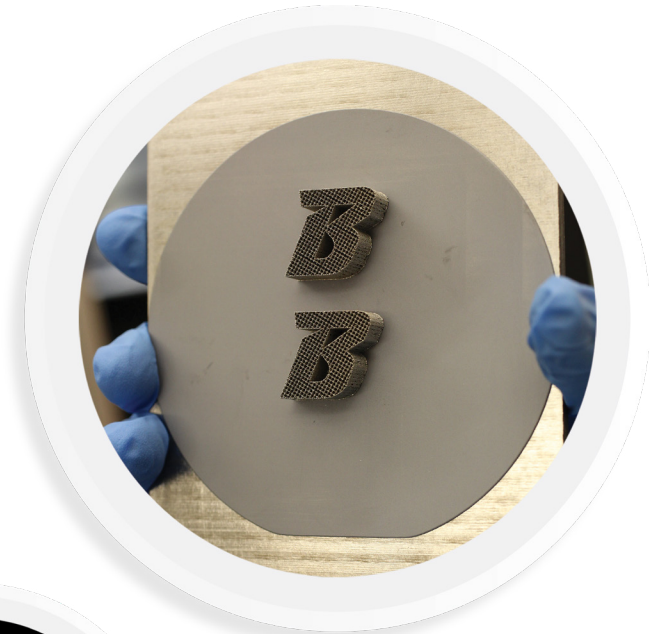
## MAKING STRIDES IN SUSTAINABLE COMPUTING

Engineers at Binghamton University designed a process to 3D print heat removal devices directly on computer chips. Lower operating temperatures will improve the energy efficiency of data centers, which can prevent 3.7 billion pounds of carbon dioxide from being emitted per year.

## TOWARD A LARGE-SCALE QUANTUM NETWORK

Scientists from the Stony Brook University, Brookhaven National Laboratory and DOE's Energy Sciences Network (ESnet) built a quantum network testbed using portable quantum memories that operate at room temperature. This is one of the largest quantum entanglement distribution networks in the world, and the longest-distance entanglement experiment in the United States.

*One way that the researchers tested their technique was by printing the Binghamton University logo onto silicon with the 3D metal laser printer.*



## Did You KNOW?

In the 1990s, researchers at the University at Buffalo developed software that allows a computer to read handwriting and sort mail and packages. The innovation, which improves mail delivery and saves the U.S. Postal Service millions of dollars, is one of the first practical success stories of artificial intelligence.

## ENGINEERING, COMPUTER AND INFORMATION SCIENCES

**2,665**

Number of Projects in 2019

**\$438M**

Total Expenditure in 2019

**\$1.8B**

Total Expenditure Over 5 Years

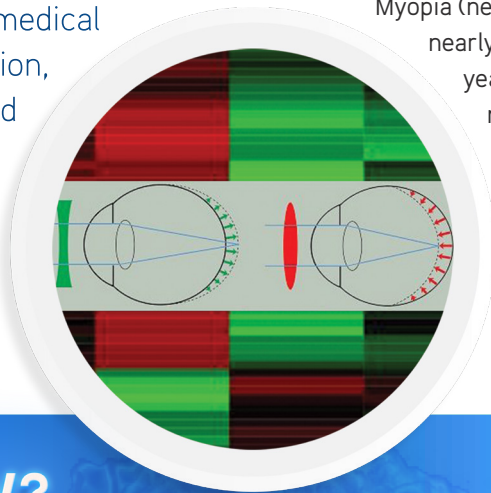
**42,931**

Total Degrees Over 5 Years

# Health and Life Sciences



SUNY researchers and physician-scientists are furthering biomedical and medical knowledge, improving patient care and expanding the treatment options available to physicians and patients worldwide. Current areas of focus include aging, biomedical imaging, pain and addiction, cancer, vision and environmental health and medicine.



## Detecting the Onset of Alzheimer's

Research at the University at Albany's RNA Institute led to the development of a quick, noninvasive test that will diagnose Alzheimer's in its earliest stages.



## Finding a Cure for Nearsightedness

Myopia (nearsightedness) is expected to affect nearly half the world's population in 30 years. Research on the molecular mechanisms that control eye growth conducted at the SUNY College of Optometry provides a new understanding of how myopia progresses and opens the way for the development of drugs to prevent it.

# CLINICAL AND TRANSLATIONAL RESEARCH

### UNIVERSITY AT ALBANY

- Gen'NY'Sis Center for Excellence in Cancer Genomics
- RNA Institute
- Health Sciences Campus

### BINGHAMTON UNIVERSITY

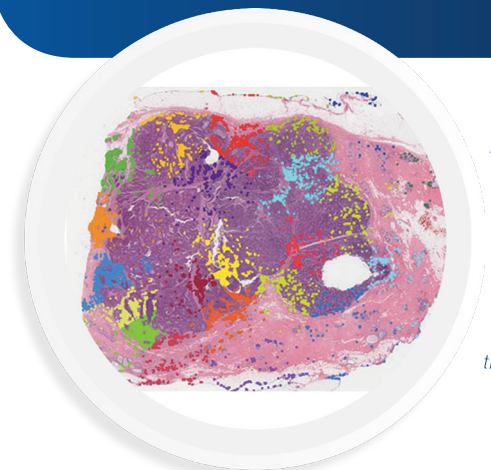
- Developmental Exposure Alcohol Research Center
- School of Pharmacy and Pharmaceutical Sciences

### UNIVERSITY AT BUFFALO

- Center of Excellence in Bioinformatics and Life Sciences
- Center for Advanced Technology in Big Data and Health Sciences
- BioXFEL Science and Technology Center
- Clinical and Translational Science Institute
- Jacobs School of Medicine and Biomedical Sciences
- School of Pharmacy and Pharmaceutical Sciences

## Did You KNOW?

The Collaborative Study on the Genetics of Alcoholism at SUNY Downstate Health Sciences University is the most comprehensive research project ever to be conducted on the inherited aspects of alcoholism. Covering everything from molecular to clinical care, the multidisciplinary study closes the circle from gene discovery to translational research.



An artificial intelligence algorithm was trained to recognize patches with lymphocyte cells in this breast cancer tissue image.



### Targeting Diseases Transmitted by Biting Insects

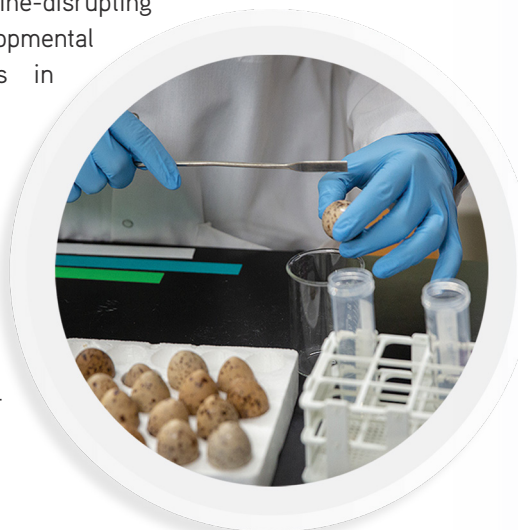
At the University at Albany, the School of Public Health and the Department of Atmospheric & Environmental Sciences are joining with seven other universities and three state departments of health on a \$10 million initiative to address West Nile virus and other vector borne diseases.

### Understanding How Chemical Exposure Impacts Newborn Development

University at Buffalo chemists are studying how chemicals accumulate in fish, birds and bird eggs – to learn whether chemicals can pass from mothers to their young.

A study at SUNY Downstate linked personal care products used during pregnancy to adverse effects in newborns. The findings add to the growing body of evidence showing that endocrine-disrupting compounds can lead to developmental and reproductive problems in animals and humans.

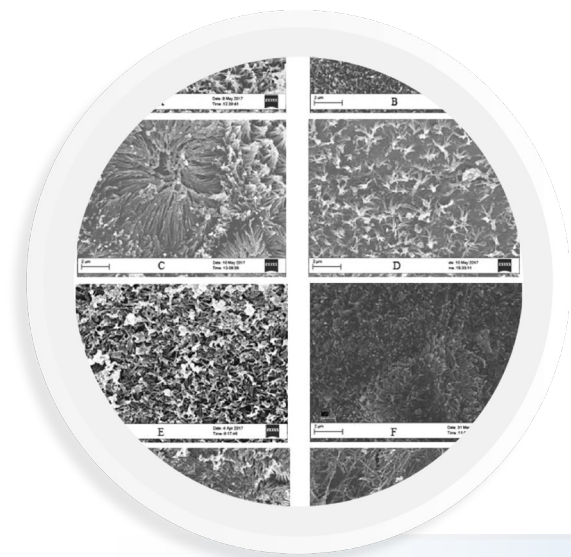
University at Albany researchers conducted the first study to use newborn bloodspots to measure the association between endocrine disrupting chemicals and birth size, gestational age, and head circumference.



### Investigating Nanoparticles in Our Food

Researchers at Binghamton University are looking at how the nanoparticles we consume may be affecting the way our gut functions.

*Silicon dioxide nanoparticle exposure affects small intestine function in an in vitro model.*



#### STONY BROOK UNIVERSITY

- Stony Brook University Hospital
- Clinical and Translational Science Center
- Center for Biotechnology
- Renaissance School of Medicine

#### UPSTATE MEDICAL UNIVERSITY

- Upstate University Hospital
- Institute of Human Performance
- Center for Environmental Health and Medicine
- Institute for Global Health and Translational Science

#### SUNY DOWNSTATE HEALTH SCIENCES UNIVERSITY

- University Hospital of Brooklyn
- Clinical and Translational Science Center

#### SUNY COLLEGE OF OPTOMETRY

- Schnurmacher Institute for Vision Research
- Clinical Vision Research Center

### Using Machine Learning to Improve Cancer Diagnosis

Machine learning research at Stony Brook’s new Institute for AI-Driven Discovery and Innovation focuses on digital pathology methods. Cancer diagnosis error rates drop significantly when AI and human analysis are used in tandem.

#### HEALTH AND LIFE SCIENCES

**6,748**

Number of Projects in 2019

**\$300.5M**

Total Expenditure in 2019

**\$1.4B**

Total Expenditure Over 5 Years

**77,435**

Total Degrees Over 5 Years

# Natural Resources and Conservation



SUNY researchers are working to understand ecosystems and watershed processes, protect natural resources, and develop new technologies that will ensure a sustainable future.

## Did You **KNOW?**

SUNY Distinguished Professor M. Stanley Whittingham won the 2019 Nobel Prize in Chemistry for his work leading to the development of the lithium-ion battery. At Binghamton University, Professor Whittingham continues to conduct groundbreaking research that is changing the way the world stores and utilizes energy. Professor Whittingham joins 15 other SUNY faculty members who have been awarded the Nobel Prize.



## Maximizing Renewable Energy

Scientists at the Atmospheric Sciences Research Center at University at Albany are using data from satellites, commercial airlines, and surface sensors to better forecast the weather that affects wind farms and solar panels.

## Advancing Ocean Conservation Through Science

The Institute for Ocean Conservation Science at Stony Brook University's School of Marine and Atmospheric Sciences conducts world-class scientific research that increases knowledge about threats to oceans and the animals that inhabit them. This research has led to policy improvements, including international trade restrictions on great white sharks and a U.S. ban on the sale of wild beluga caviar.



## Restoring America's Forests

Researchers at the College of Environmental Science and Forestry have developed a blight-tolerant American chestnut tree and are working to restore this iconic cultural symbol to its native range. These concepts and techniques could be used to manage other important trees that are affected by invasive species.



# WATER QUALITY

## UNIVERSITY AT ALBANY

- Department of Atmospheric and Environmental Sciences
- Atmospheric Sciences Research Center
- Center of Excellence in Atmospheric and Environmental Prediction and Innovation

## BINGHAMTON UNIVERSITY

- Center for Integrated Watershed Studies

## UNIVERSITY AT BUFFALO

- RENEW Institute

## BUFFALO STATE COLLEGE

- Great Lakes Center

## SUNY COLLEGE OF ENVIRONMENTAL SCIENCE AND FORESTRY

- Great Lakes Research Consortium
- Center of Excellence in Healthy Water Solutions

## STONY BROOK UNIVERSITY

- School of Marine and Atmospheric Sciences
- New York State Center for Clean Water Technology

## Protecting Against Harmful Algal Blooms

Researchers at the College of Environmental Science are leading a concerted effort to evaluate the extent of toxic blue-green algae blooms throughout the state and develop monitoring systems to protect drinking and recreational waters. Stony Brook University is conducting similar studies in Long Island's coastal waters.



*The brown tide alga, *Aureococcus anophagefferens* (right), has been notorious on Long Island since it first appeared in 1985 having been responsible for the demise of the largest bay scallop fishery on the U.S. east coast, the loss of eelgrass across Long Island, and the inhibition of hard clam recovery efforts.*

## Uncovering an Emerging Environmental Threat

Students and faculty at SUNY Fredonia discovered that billions of microbeads - the tiny bits of plastic found in some exfoliating body washes and facial scrubs - were being released into the nation's waterways each day. These findings raised awareness of microplastics as a significant threat to the environment and human health, resulting in state, federal and international policy change.



*Less than 5mm long, microplastics easily pass through water filtration systems into rivers, lakes and oceans.*

### NATURAL RESOURCES AND CONSERVATION

**423**

Number of Projects in 2019

**\$15M**

Total Expenditure in 2019

**\$70M**

Total Expenditure Over 5 Years

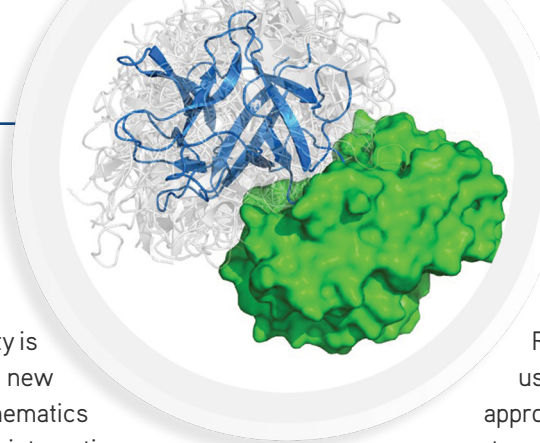
**3,619**

Total Degrees Over 5 Years

# Physical Science, Math and Statistics



SUNY physicists and mathematicians are connecting with colleagues in engineering, computer science, medicine, life sciences and ecology to spur advances in robotics and autonomous systems, quantum technologies, advanced materials, and pharmaceutical research.



Correct structure of a protein-protein complex together with an ensemble of alternative structures.

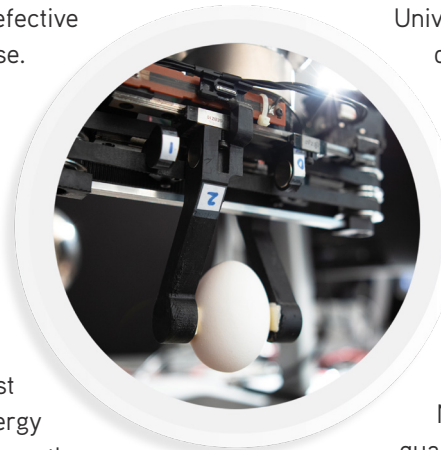
## Advancing Drug Discovery

Stony Brook University is a pioneer in creating new computational mathematics for modeling protein interactions for the whole cell. This is critical for designing drugs that prevent defective protein interactions that lead to disease.

## Pushing the Boundaries of Quantum Science

Researchers at the University at Buffalo are using novel computational and experimental approaches to discover and construct new quantum materials.

University at Albany physicists are developing protocols that optimize fundamental operations at the interface of quantum optics and quantum information processing.



## Collaborative Robotic Solution

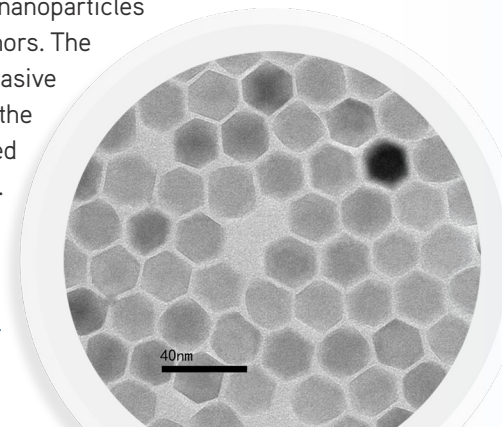
University at Buffalo engineers invented a two-fingered robotic gripper that mimics the adjustable grip of a human hand. The design uses repulsion between magnets to adjust the stiffness of its grip and absorb energy from collisions. This prevents whatever the robot is holding from breaking and makes it safer for people to work with and near the machines.

Using photons to communicate and atoms as nodes to store and process quantum information, scientists at Stony Brook University and Brookhaven National Laboratory are fabricating quantum transistors and logic gates.

## The Future of Cancer Treatment

Scientists at the University at Buffalo have improved the performance of zinc ferrite nanoparticles designed to roast and destroy tumors. The futuristic therapy is minimally invasive and not expected to generate the severe side effects associated with chemotherapy and radiation.

Zinc ferrite nanoparticles possess high heating performance at very low magnetic fields.



### PHYSICAL SCIENCE, MATH AND STATISTICS

**1,848**

Number of Projects in 2019

**\$76M**

Total Expenditure in 2019

**\$323M**

Total Expenditure Over 5 Years

**12,130**

Total Degrees Over 5 Years

## Did You KNOW?

Stony Brook University researchers created the algorithm that solved the problem of reading blurred lines – greatly increasing the efficiency of barcode scanners and opening up new opportunities for the devices.

# Psychology and Other Social Sciences



SUNY's social scientists are collaborating across disciplines to take on today's societal challenges and advance solutions that will improve human well-being.



## The Brain Password

Psychologists and computer scientists at Binghamton University and the University at Buffalo are developing an authentication process that measures brainwaves in response to a series of pictures. Like a password, it's easy to reset, and like a biometric, it's easy to use.

## Addressing the Societal Challenges of New Technologies

Researchers at the University at Albany are exploring the psychology of surveillance evidence and technological advances that affect jurors' decision making.

The University at Buffalo is spearheading a project to examine the ethical issues of using artificial intelligence in the criminal justice system to recommend criminal sentences and bail decisions, and to determine how to allocate police resources.

## Paving the Way for Autonomous Vehicles

Faculty and students at the University at Buffalo are testing the self-driving electric shuttle Olli. Their findings will inform decisions regarding policy, safety, reliability and other future transportation issues related to autonomous and connected vehicles.



### PSYCHOLOGY AND OTHER SOCIAL SCIENCES

**1,100**

Number of Projects in 2019

**\$48M**

Total Expenditure in 2019

**\$198M**

Total Expenditure Over 5 Years

**41,782**

Total Degrees Over 5 Years

## Did You **KNOW?**

Something as simple as a period at the end of your text can have an impact on how the person on the other end interprets your message. A Binghamton University research team found that texters use emoticons 😊, irregular spellings (sooooo) and irregular use of punctuation (!!!) to replace cues found in face-to-face conversations.

# Economic Impact



Research at SUNY produces nearly 300 new technologies every year and supports the formation of research-based startups. Talented faculty and students have turned their great ideas into new companies and products that are driving innovation and creating jobs in every region of New York State.



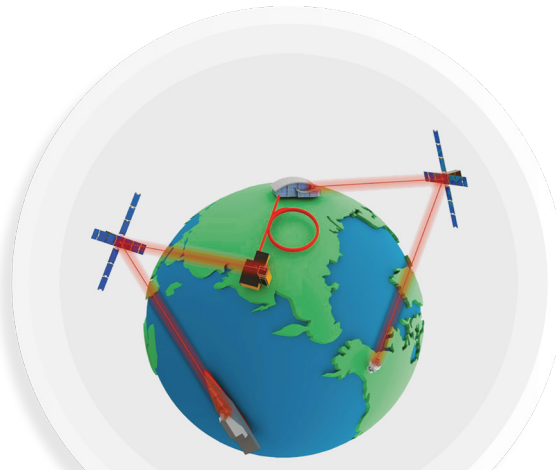
## SMART WINDOWS

Dimien Specialty Chemicals, a University at Buffalo startup, began manufacturing “smart” solar control window films called E3 View in 2016.



## MOBILITY AID

The Biodex Mobility Assist™, the first motorized lift assist and walker in one device, is based on a technology developed at Stony Brook University that gets a person up from a seated position in about 25 seconds.



## QUANTUM COMPUTING

A Stony Brook University research team created a technology that uses quantum memory applications at room temperatures to securely store and transfer information. Qunnect, LLC, licensed the technology to develop hyper-secure long-distance communication networks.

## Did You **KNOW?**

Industry scientists working at SUNY Polytechnic Institute unveiled the world’s first 5nm silicon chip. This improvement enables a significant boost to meeting the future demands of artificial intelligence systems, virtual reality and mobile devices.



#### **VACCINE DESIGN**

Codagenix Inc. is using a breakthrough platform technology stemming from research at Stony Brook University to transform the vaccine creation process.



#### **DRUG DEVELOPMENT**

University at Buffalo spinoff Cytocybernetics created a device that integrates electronics with individual cells to test new medicines for potentially fatal side effects.



#### **GAME CHANGING AUTISM TEST**

Quadrant Biosciences Inc., a startup headquartered on the Upstate Medical University campus, is commercializing a noninvasive saliva test that accurately identifies children likely to have autism spectrum disorder.

## Did You **KNOW?**

Since its launch in 2011, the SUNY Technology Accelerator Fund has invested **over \$2.8 million** to successfully advance the commercial readiness of 46 SUNY innovations.

# Empowering SUNY Research and Discovery



The RF partners with SUNY to make it the best place for faculty, students and staff to research, innovate and solve the world's most pressing problems.

The RF provides a central infrastructure of people, technology and processes to: write and submit proposals to agencies, foundations and companies; establish contracts and manage funding that is awarded to run campus-based research projects; protect and commercialize intellectual property created within those projects; and promote transparency and accountability throughout the process.

For the RF's full financial statements, go to [rfsuny.org/FinancialStatements](https://rfsuny.org/FinancialStatements)



## Initiate Research Idea



- » Provide budget calculations
- » Review proposal for compliance with submission requirements
- » Obtain necessary approvals
- » Submit proposal





## Conduct Research



## Disclose Inventions



- » Negotiate and accept grant award
- » Establish award account
- » Hire staff and set up payroll
- » Process purchasing transactions
- » Bill and collect payments from sponsors
- » Ensure compliance with laws and regulations
- » Complete required financial reports



- » Protect intellectual property with patents and copyrights
- » Conduct industry and market research
- » Develop business strategy
- » Determine commercialization path
- » Manage licensing process



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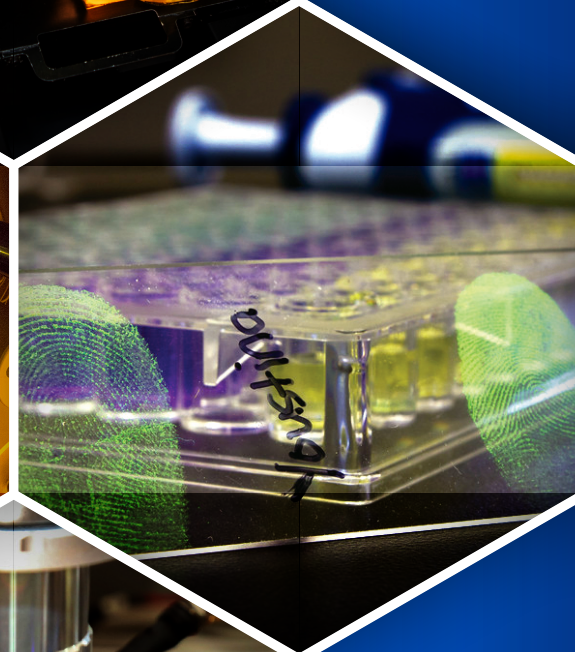
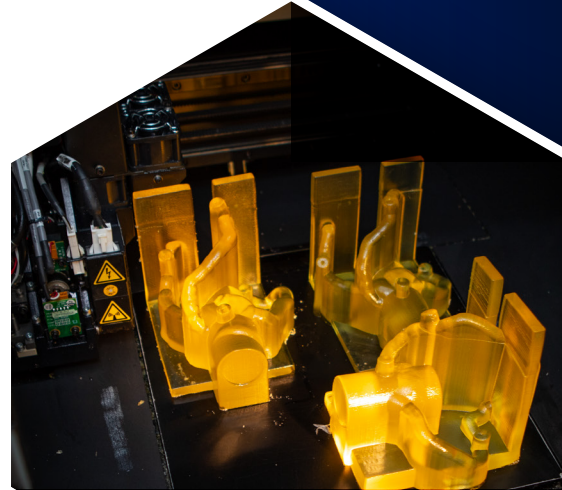


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