RESEARCH at RIT

Fall/Winter 2014-15

SPOTLIGHT ON

FORWARD THINKING

What's Next?

University leaders weigh in on RIT's future research endeavors

R·I·T

RESEARCH at RIT

Research Vision

During the implementation of the last strategic plan, RIT's sponsored research portfolio experienced significant growth. We are thinking ahead and looking at ways to further exploit the university's unique assets, grow our research portfolio and drive student success.

I recently had the pleasure of celebrating my 15th anniversary of working at RIT. It has been truly amazing to watch this institution transform over that time. From the sheer number of students to the beautiful additions to our campus to our institutional reputation both here and abroad, the growth has been nothing short of remarkable.

An area of institutional growth at RIT that rivals any of these others is the growth in our research endeavors. Whether you want to count books and publications, presentations or exhibits, patents and copyrights, proposals or sponsored research dollars, or any one of a score of different metrics associated with scholarly productivity, the increases have been dramatic. In the same span of time when many institutions across the nation were working very hard to "up their research game," RIT went from a modest portfolio to a research engine that rivals many of the other finest private technological schools in the nation. Institutions we never would have dared compare ourselves to when I arrived at RIT now consider us to be serious competition.

The question that presents itself to us at this point is, "What's next for RIT?"

To help answer this question, we are dedicating this issue of our magazine to what the future might hold for research at the university. Within these pages, we certainly can't mention every area of research that our faculty and students are pursuing. This is merely a sampling. For this issue, we received input from each of RIT's college deans and others, who have been giving a lot of thought to the question of what's ahead. Much of their thinking is being driven by the university-wide effort to draft our next strategic plan. Although it is still a work in progress, even at this stage it is clear that the prevailing sentiment across campus is that research plays a pivotal role in our future. More specifically, that excellence in interdisciplinary research and student experiences, focused on some of the major challenges confronting society today, will be key to building one of the truly great technological universities of our time.

I hope you enjoy this glimpse into the future of research at RIT.

Best regards,

Ryne Raffaelle
Vice President for Research
and Associate Provost

Inside this Issue

On the Cover

The illustration shows a potential path that opioids can take in the brain and spinal cord. Alan Gesek, an RIT adjunct professor and a 2013 graduate of RIT's Medical Illustration MFA program, created the 3D model of the brain as part of a video to help people battling addiction. Substance abuse research is one area RIT hopes to grow.

Research Growth: Since the start of the 21st century, sponsored research funding has steadily grown due to RIT adding doctoral programs, creating multidisciplinary research centers, and creating a strong innovation ecosystem.

A Look Back and the Road Ahead

by Ryne Raffaelle

RIT is currently creating its blueprint for the next 10 years. Since the adoption of the last strategic plan in 2005, the university has transformed from a fine regional university to one of national prominence. The challenge ahead is how to become a world-class university without peer.

Greater Emphasis on Scholarship and Research

Around the turn of the 21st century, RIT leadership instituted a new vision for research.

"We will be first in that class of universities that forms real, effective, and meaningful partnerships with industry and government," said then RIT President Albert Simone when he announced his intentions. It was felt that the time had come for RIT to engage in an increased level of sponsored research and scholarly dissemination that would help the university emerge on the national stage. "First in Class" became the catch phrase.

This was partially in response to declining student demographics in the northeast and the need to expand the geographical base from which we were drawing students. RIT leadership also recognized that expanding the research portfolio would assist the university in what it had always done well—provide students with a hands-on experiential learning experience that would serve them well in their future careers. As student enrollment climbed, it was clear that additional resources would be required to provide meaningful research opportunities on campus to supplement the other hands-on experiences students received through their co-op placements and other opportunities, such as senior design projects.

In conjunction with the increasing level of sponsored research was an acknowledgement that competing at the national level for research funding would require an expansion of our terminal degree programs. Thus RIT

added to its one pre-existing and very successful doctoral program in imaging science (1989). New Ph.D. programs were launched in microsystems engineering (2002), computing and information sciences (2005), color science (2007), astrophysical sciences and technology (2008), sustainability (2008), and engineering (2014).

Creation of Interdisciplinary Research Centers

Another trend at RIT was the transition from the model of an individual principal investigator (PI) working with an undergraduate or graduate student to one of interdisciplinary research centers. These centers incorporated multiple grants and PIs, many graduate and undergraduate students, and an increasing number of Ph.D. students and even some post-doctoral researchers. A new designation was established in 2009, titled RIT Research Centers of Excellence. These centers include the NanoPower Research Labs (NPRL), Digital Imaging and Remote Sensing Lab (DIRS), Multidisciplinary Vision Research Lab (MVRL), Laboratory for Multiwavelength Astrophysics (LAMA), Center for Detectors (CFD), Center for Computational Relativity and Gravitation (CCRG), Center for Advancing Science/Mathematics Teaching, Learning and Evaluation (CASTLE), and Media, Arts, Games, Interaction and Creativity (MAGIC) Center. All of these initiatives resulted in dramatic growth in both the number of proposals and the number of new research awards received.
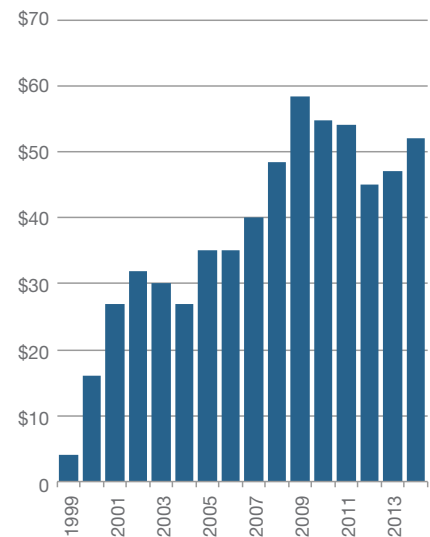
Total Research Funding
(in millions)
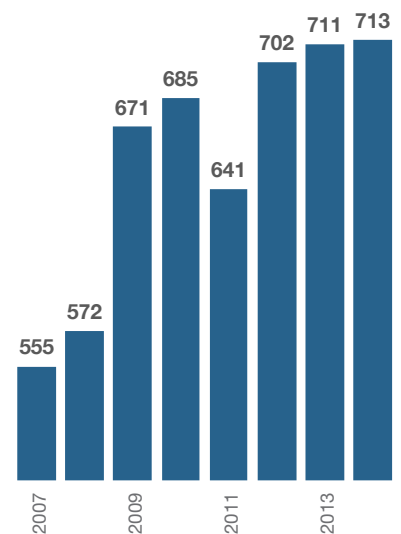
Proposals Submitted
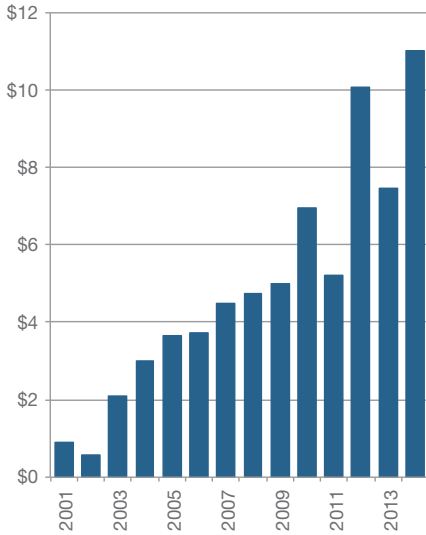
Total NSF Awards
(in millions)

Funding Levels
(2014 Fiscal Year)

- Other $4,861,416
- Federal Passthrough $4,515,554
- Corporate $3,582,139
- State $7,967,848
- Federal $19,547,879

Number of Awards by Source
(2014 Fiscal Year)

- Other 45
- Federal Passthrough 87
- Corporate 131
- State 13
- Federal 113

Upward Trajectory of Sponsored Research

Sponsored research funding grew from a campus-wide total of $5M in 1999 to well over $50M per year today. The number of proposals submitted annually has approximately doubled in the same time frame and has exceeded 700 for the last three years in a row. The number of awards received in a given year has quadrupled over this same period, exceeding 400 new awards this last fiscal year alone.

One of the most noteworthy accomplishments during this period was the increase in the number and value of National Science Foundation awards. These are some of the most competitive and prestigious sponsored research awards in academia. NSF funding has climbed steadily since 2001 and exceeded $10M in fiscal year 2014. This is a reflection of the quality of proposals.

Academic research funding has also evolved. Many funding agencies are placing greater emphasis on applied research and increasingly looking for projects that have strong innovation and entrepreneurship components. These trends have been beneficial fo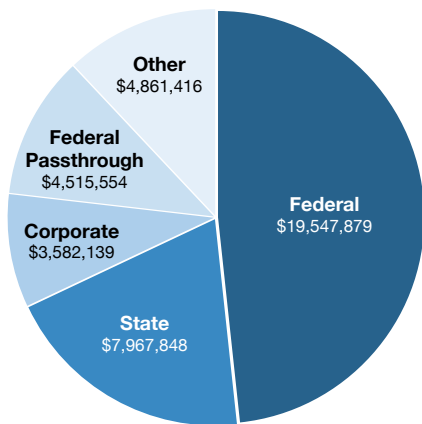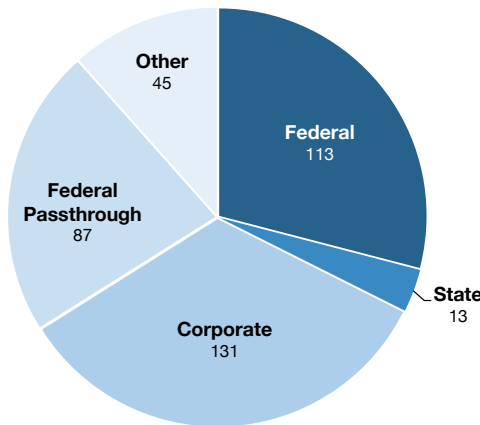r RIT as they are consistent with our traditional hallmarks. Although the majority of funding does come from federal sources, the majority of our projects come from working for and with industry, either through direct grants and contracts or as a sub awardee on federal passthrough projects (e.g., Small Business Innovative Research Grants, etc.).

New Strategic Plan Outlines Future of Research

The question now before the university is what will be the future research path of RIT? This is one of the major questions being explored as RIT prepares its next strategic plan. This question has taken on a new dimension just this year as we have exceeded the Carnegie classification requirements to be ranked as a "national research institution."

The Carnegie Classification of Institutions of Higher Education is

a framework for classifying colleges and universities in the United States. The framework primarily serves educational and research purposes, where it is often important to identify groups of roughly comparable institutions. The Carnegie Classification was created by the Carnegie Foundation for the Advancement of Teaching in 1973. The Carnegie Foundation defines "Doctorate-granting Universities" as institutions that awarded at least 20 research doctoral degrees during the update year. As the data here shows, RIT has now exceeded the 20 doctorates per year average and will be moving into this new classification.
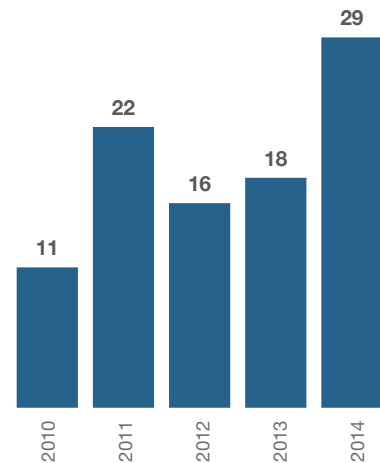
Doctoral Degrees Awarded

RIT's research portfolio has expanded rapidly because it has taken "the road less traveled" approach. The university created interdisciplinary Ph.D. programs as opposed to traditional disciplinary-based programs. It launched multidisciplinary shared research centers incorporating students from all degree levels and adopted a student-centered approach to research. These approaches, in collaboration with federal, state, and corporate partners, have led to the development of technologies for solving real-world problems.

Looking at the confluence of challenges facing society today and the current and emerging RIT strengths and capabilities, it appears there will be ample opportunity to continue the trajectory of sponsored research growth for some

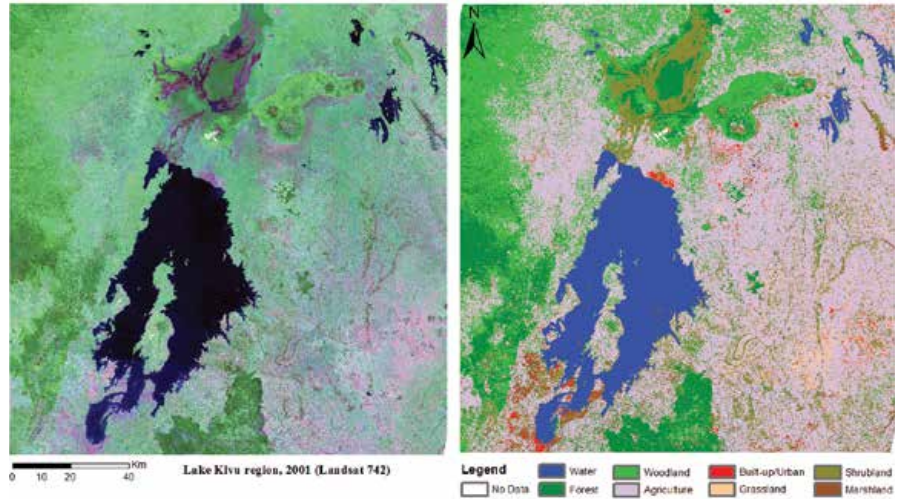**Access and Inclusion:** The university is a longtime leader in this area. An RIT research scientist recently founded an online network of volunteers, e-NABLE, that connects children and adults with 3D-printed prosthetic hands. RIT students are also developing and designing other 3D-printed prostheses.

Global Resilience: RIT's distinctive research includes areas of international interest. One example is the research underway by scientists in the Chester F. Carlson Center for Imaging Science. They conduct remote sensing research focused on imaging the earth's environment. The above image is of the biologically rich Lake Kivu region in Rwanda and the Democratic Republic of Congo. This area is threatened by natural hazards, climate change, and environmental degradation. Using satellite imagery, RIT scientists monitor how human activity is changing the land cover and impacting the region's resilience to change.

time. For example, RIT is positioned to bring together the arts, humanities, sciences, and computer and information sciences in the rapidly evolving domain of digital media better than any other institution in the nation. Nationally and internationally recognized programs in film and animation, interactive games and media, and the new MAGIC Center and Magic Spell Studios are just a few of these assets RIT has in this domain.

Global resiliency is another issue attracting a lot of attention. Detecting, analyzing, and responding to emerging threats to health, cultural, cyber, economic, infrastructure, and ecological systems is on everyone's mind. The university's expertise in imaging and remote sensing, cyber security, and sustainability, and our growing international footprint, provide ample opportunity for RIT to have a major impact.

Closer to home, many are wondering how to reinvent and revitalize the U.S. manufacturing sector. Recently, the Golisano Institute for Sustainability was named a New York state Center of

Excellence in Sustainable Manufacturing. This center, along with the RIT Center for Innovative Manufacturing Studies, Simone Center for Student Innovation and Entrepreneurship, Venture Creations incubator, and our new multifunctional printing labs are just a few places where our faculty, staff, and students are working on innovative technologies, supply chains, and production processes that will lead to job creation and sustainable economic growth for the nation.

Finally, RIT has long been a leader in accessibility and inclusion. The university is producing innovative technologies to provide greater access and create more opportunities for those with hearing, vision, mobility, or other physical and cognitive challenges. Starting with the National Technical Institute for the Deaf, our internationally recognized School of Design, our strengths in computing, engineering, and science, as well as our new Institute for Health Sciences and Technology, it is clear that RIT is delivering the type of research and development that is making the world a better

place. For example, researchers in the MAGIC Center have set up an interactive online map for connecting 3D printers with orthopedists and other volunteers to design, fabricate, and fit mechanically enhanced hands for people, especially children. This community, called e-NABLE, produces prosthetic arms and hands at a fraction of the cost of a conventional prosthesis. RIT has connected people from around the world to come together to make a difference.

It is tremendously exciting to work on RIT's next strategic plan with the goal of becoming one of the truly great technological universities in the world. Although it is impossible to predict the next breakthrough commercial product, scientific discovery, or the path of sponsored research, it is hard not to be optimistic. Whether it's in digital media, global resiliency, design and manufacturing, accessibility and inclusion, or another area, there's no doubt RIT will continue to engage in the type of high-impact student-centered research that makes the university distinctive.

International Reputation:
With a greater demand in the world for innovative designs and visual content, faculty and students' creative scholarship takes on many forms. Their work garners international and national recognition. The college is poised to offer new master's degrees in the future and expand its global opportunities in such areas as South America, Asia, and Europe.
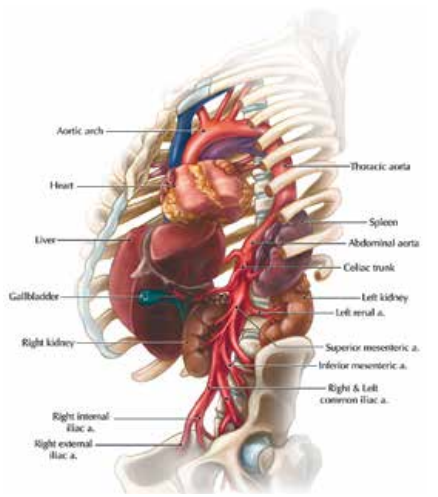
College of Imaging Arts and Sciences by Kelly Sorensen

Google, Apple, Pixar, Disney, Hasbro, Nickelodeon, Corning Museum of Glass, Time Inc., Adobe, The World Bank, Tiffany & Co., SapientNitro, and Gensler Associates. These are some of the companies where graduates from the College of Imaging Arts and Sciences launch careers. Student artists delve outside traditional research to produce innovative and creative work that creates societal impact—whether it's designing sustainable products, producing an animated film, crafting a sculpture, documenting breaking news, or designing a website.

Collaborative Thinking: Left to right, Matt Bridges, electrical engineering technology major; Qunxi Huang, industrial design MFA student; and Zhuo Wang, industrial design MFA student are part of a multidisciplinary student team designing and prototyping a consumer electronic product.

Among World's Best: RIT's School of Design is ranked among the world's best. Industrial design students exhibit annually at New York's Design Week. Among the projects exhibited in 2014 was the snack station (above) created by Tony Han, an industrial design major, as part of a collaboration with Herman Miller Inc.

Cultivating the Creative Process

Lorraine Justice

The college is made up of six schools: American Crafts, Art, Design, Film and Animation, Photographic Arts and Sciences, and Media Sciences. A common theme to all the majors is bringing ideas and concepts to life—where students get hands-on experience under the tutelage of faculty members who are distinguished creative scholars in their particular fields. Students are encouraged to engage in multidisciplinary research opportunities from across the university, including business, engineering, social sciences, and science.

"Creative scholarship is methodical and rigorous," said Lorraine Justice, dean of the College of Imaging Arts and Sciences. "Faculty conduct research and write, produce, and exhibit. Much like a scientist puts forth a hypothesis, the creative research process involves formulating a visual hypothesis."

Conducting Preservation Research

Rigorous research in the area of preservation is another part of the college's research portfolio. Known as one of the world leaders in artifact preservation, the Image Permanence Institute (IPI) conducts scientific research in preservation technology for library, museum, and archive materials. Some of its primary sources for funding and outreach are the National Endowment for the Humanities (NEH) and the Institute of Museum and Library Services.

On the Web
College of Imaging Arts and Sciences
cias.rit.edu

Center for Public Safety Initiatives

Policy Analysis and Research:
Faculty, staff, and students from the Center for Public Safety Initiatives (CPSI) conduct research on crime and recidivism in the City of Rochester. In addition to research, the Center contributes to criminal justice strategy through policy analysis and evaluation.

College of Liberal Arts

by Rebecca Sumner

RIT's College of Liberal Arts continues to expand its research agenda with new initiatives in areas that integrate traditional research in the social sciences and humanities with new interdisciplinary fields in health, computing, science, and engineering. This interdisciplinary research, along with an emphasis on community engagement and global perspectives, represents defining characteristics of the college's research portfolio.

Preserving Dying Languages: Linguist Wilson Silva (green shirt) travels to the Amazon region of Brazil to help native Desano speakers preserve their dying language. Silva has received funding from the National Endowment for the Humanities and the National Science Foundation to document and train native speakers to self-preserve their culture through linguistics.
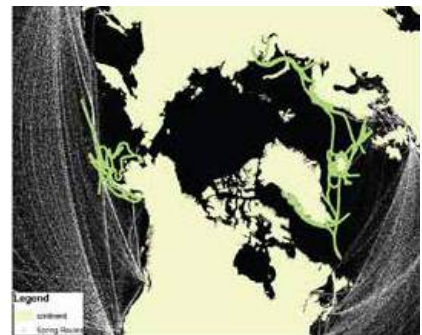
Arctic Shipping: College researchers have projects underway around the world. One example is research conducted by the Laboratory for Environmental Computing and Decision Making, a multi-college interdisciplinary research lab. The lab studies the potential flow of global shipping through the Arctic Ocean under global warming scenarios that may open up increased trade routes through these waters.

Interdisciplinary Research

James Winebrake

One example of interdisciplinary research that integrates technology and the humanities is the digital humanities. "We see great potential for projects that pair technology with language, text, history, and the arts, and faculty in our college are working with faculty across campus to apply technology and software to create new knowledge in the humanities," said James Winebrake, dean of RIT's College of Liberal Arts. "The application of these digital technologies has also been applied to other liberal arts fields, such as journalism, where faculty are applying digital technologies to create new methods and approaches for the production and delivery of news content."

Community Engagement

The college sees growing trends in faculty and students working with local communities to solve local problems in a process referred to as community-engaged research. A prime example of its expanding activities in this domain is the Center for Public Safety Initiatives (CPSI), which continues to produce a variety of high-quality, student-generated research in the area of crime analysis. Led by John Klofas, CPSI has gained a national reputation for its research work, while providing students hands-on training in criminology and data analysis.

Global Perspective

The college is supporting greater work internationally. Faculty are engaged in research projects on every continent, from studies of gang violence in Africa to language acquisition in Asia to literature and cultural studies in South America. The further expansion of international education and research is one of the college's core goals.

On the Web
**College of Liberal Arts**
www.rit.edu/cla

Kate Gleason College of Engineering

by David Bond

The future of research in the Kate Gleason College of Engineering will be defined by its ability to translate deep engineering knowledge in innovative ways that address compelling problems of national and global significance.

Advanced Manufacturing is projected to be a $45 billion global industry. The process is essential in printing electronic devices such as smart sensors, biomedical devices, and fuel cells. The college continues to expand its research in this area with faculty recruitment and cultivating relationships with high-tech firms. Denis Cormier, the Earl W. Brinkman Professor of Industrial and Systems Engineering (left), specializes in 3D printing. Cormier and Chaitanya Mahajan, a student in the new engineering Ph.D. program, work at one of the state-of-the-art pieces of equipment used for 3D printing.
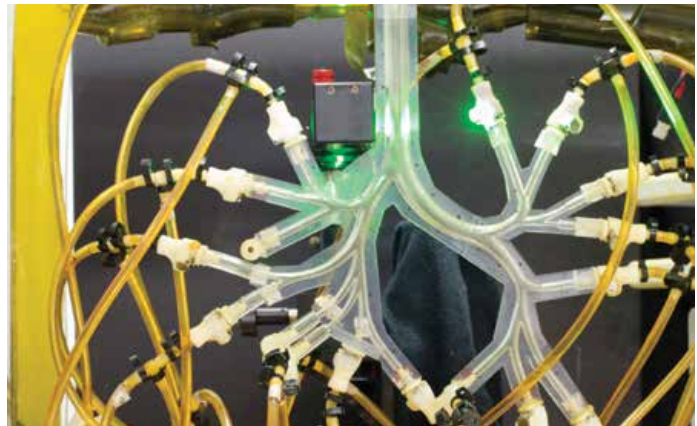
Tobacco Effects: Mechanical engineering students map out velocity profiles of airflow in lung models using particle image velocimetry. Risa Robinson and Steven Day, professors of mechanical engineering, lead the research sponsored by the U.S. Army Medical Command. This work is providing valuable information about the effect of lung disease on gas exchange within the lung and is helping assess the impact of emerging tobacco products such as electronic cigarettes. With NIH funding, Robinson is also studying the harmful effects of various electronic cigarette designs.

Engineering the Future

Harvey Palmer

A major strength of the college is the way in which faculty are inspired by real-life challenges and align their research with the needs of major industry sectors. The college's new Ph.D. in engineering evolves with the challenges faced by society's most critical industry sectors: **Transportation**—including the engineering of new vehicle systems, innovative distribution systems, enhanced security, and safety; **Energy**—focusing especially on novel energy storage and new energy collection technologies; **Communications**—building on extensive expertise in signal processing, sensing and networking; and **Health Care**—creating better devices, advancing informatics, and improving delivery systems.

"These interdisciplinary themes will not limit research undertaken by college faculty and students, but will serve to focus our energies on advancing technology to address grand challenges in the service of society," said Harvey Palmer, dean of the Kate Gleason College of Engineering.

The college launched the Ph.D. in engineering in fall 2014 in an effort to better educate the next generation of engineering leaders on tackling some of the world's most daunting problems. The college's first doctoral program—microsystems engineering—continues to thrive by combining fundamental engineering and science from multiple disciplines to address the numerous technical challenges of micro- and nano-scale systems.

The college's commitment to under-graduate education will only become broader and deeper with increased research. The addition of programs in chemical and biomedical engineering offer expanded opportunities at the intersection of traditional disciplines and greater chances for investigation and discovery.

Choosing to align its research thrusts with societal challenges is also consistent with the college's long standing commitment to becoming the college of choice for women interested in pursuing an engineering career, a mission befitting its association with Kate Gleason, a pioneer in engineering and business for the good of society.

On the Web
Kate Gleason College of Engineering
www.rit.edu/kgcoe

Kevin Durant @KDTrey5 • 14 Feb 2013
I'm aight after, thanks for asking...mad about the loss, but headed to Houston to enjoy my 4th all star game!! #blessed

Kevin Durant @KDTrey5 • 6 Jan 2013
3 techs in 3 games, not like me... @kendrickperkins is a bad influence on my life lol jk..I will be better, sorry guys

Kevin Durant @KDTrey5 • 29 Nov 2012
Some people love you, some people hate you..who cares..

Kevin Durant @KDTrey5 • 17 Nov 2012
So proud of mom for speaking lastnight at @ariseministries! Heard she was great, wish I could have been there! Love u ma!

Yang Yu

Are Tweets Telling of Players' Performance?

Yang Yu, assistant professor of management information systems, is conducting research into how sentiments expressed by NBA players on social media, particularly Twitter, may predict their performance on the court. His research has found there is a positive correlation between sentiment and sports performance. If players' tweets on the day of a game are positive they are more likely to play better than if their comments on Twitter are negative. The correlation pattern is also influenced by other factors. For example, in away games, players' performances are more likely to be affected by their sentiments, and such effect is stronger for players who earn higher salaries. Kevin Durant, of the NBA's Oklahoma City Thunder and the league's Most Valuable Player (2013-2014), has more than 8.2 million followers on Twitter and has sent out more than 22,000 tweets. Yu says Durant is a good example of the connection between social media expression and performance. Yu believes that this type of social media analytics research would be beneficial to coaches and managers in determining game-day strategy. He says this text mining approach could also be applied to professional athletes in other sports. Chun-Keung (Stan) Hoi, associate professor of finance in Saunders College of Business, and Chenyan Xu, assistant professor of computer science and information systems at Richard Stockton College of New Jersey, are his research collaborators. In addition to social media, Yu's areas of research include big data and business intelligence.

Saunders College of Business

by Kelly Sorensen

Saunders College of Business conducts research in a wide range of business disciplines. Areas include accounting, finance, taxes, corporate social responsibility, market outcomes, community source and open source development, urban entrepreneurship, and global business strategies in China. Faculty are featured in the world's most respected research journals of their fields.

Corporate Tax Avoidance is a hot-button topic in both mainstream and social media. Saunders College of Business professors Chun-Keung (Stan) Hoi and Hao Zhang, along with co-authors from RPI and Fordham, recently published articles in *The Accounting Review* and the *Journal of Financial Economics* about corporate tax avoidance. They explore the relationship between corporate culture and tax avoidance and find that socially irresponsible firms avoid taxes more aggressively. Their research also finds that banks demand higher interest rates when lending to firms that aggressively avoid taxes, imposing a cost on corporate tax avoidance that potentially limits such behavior.

Deaf Entrepreneurship: A team of deaf and hard-of-hearing students was among some emerging entrepreneurs who participated in a program called Summer Startup that helps students develop business concepts. A first-of-its-kind study, conducted by Saunders College of Business professors Richard DeMartino, Vic Perotti, Bob Barbato, Raj Murthy, and NTID professor Scot Atkins, found that greater mentoring and educational efforts are needed to both empower and increase the number of entrepreneurs among the deaf community.

Jacqueline Mozrall

Enterprising Culture

An increased emphasis on research complements the college's roots in applied teaching, where classrooms and corporate partners intersect.

"Saunders Student Consulting and Capstone Projects give students the opportunity to analyze and solve real-world problems for companies and demonstrate their expertise to corporate executives," says Jacqueline Mozrall, interim dean of Saunders College of Business. "It's a win-win for the students and the businesses that we serve."

Corporations and students benefit from RIT's enterprising culture. Saunders entrepreneurship courses and faculty support the Simone Center for Student Innovation and Entrepreneurship's IdeaLab, Saunders Student Consulting program residing in RIT's Venture Creations incubator, and the emerging programs of the Center for Urban Entrepreneurship. This provides the ideal environment for Saunders researchers and corporate partners to build off each other.

Saunders College collaborated with the College of Science to create a master's of science degree in computational finance. The degree, expected to launch in 2015, targets students interested in computational or quantitative finance careers.

On the Web
Saunders College of Business
saunders.rit.edu

B. Thomas Golisano College of
Computing and Information Sciences

by Fran Broderick

Golisano College is augmenting its strengths in accessibility and computing security while expanding its research in emerging areas such as pervasive computing, personalized medicine, and games for learning and social impact. The college's research portfolio has grown with the hiring of esteemed researchers.

Cultural Connections through Gaming: Owen Gottlieb's research explores religion, culture, and games including Jewish and multifaith games for learning. His current game project explores ancient legal codes as game systems. His mobile augmented reality game for teaching history—*Jewish Time Jump: NY* (pictured left)—was nominated for Most Innovative Game by the 2013 Games for Change Festival.

Pervasive Computing: Faculty—including Mohan Kumar, Peizhao Hu, Minseok Kwon, Tae Oh, and Nirmala Shenoy—are involved in addressing challenges related to networking, middleware, service composition, and information sharing in pervasive systems.

Accessibility and Learning

Andrew Sears

The college has recruited former head and founder of IBM's Accessibility Research Group Vicki Hanson, as well as computer scientist and linguistics expert Matt Huenerfauth, who has performed leading research in American Sign Language (ASL) animations. Both professors bring cross-disciplinary expertise to RIT that creates new opportunities for research with colleges such as NTID.

"We are continuing to grow our portfolio of cross-disciplinary research in accessibility, security and personalized medicine," said Andrew Sears, dean of the Golisano College of Computing and Information Sciences. "In addition, faculty are securing funding in emerging areas like pervasive computing and wearable tech."

Cross-disciplinary research is also ongoing in the School of Interactive Games and Media where professors including Jessica Bayliss and Owen Gottlieb are exploring games and learning initiatives that help students learn topics through gameplay.

New connections. New security needs.

While computing security has been a major research focus at Golisano College for years—researchers study viruses and other vulnerabilities in the college's secure airgap lab—security research is now expanding to additional departments. Andy Meneely, assistant professor of software engineering, studies software repositories to understand how collaborative development occurs and how software processes can be designed to prevent vulnerabilities like the recent Heartbleed bug.

Finally, college researchers are exploring ways computing pervades each facet of our lives and finding ways that devices can interconnect to enhance these experiences. Mohan Kumar, professor and chair of computer science, and other faculty, are involved in research related to pervasive systems. Kumar co-developed the concept of distributed opportunistic computing in which resources on user devices provide information and services useful to other users and applications. His current research addresses ways to apply distributed, opportunistic computing to areas like health care, transportation, and crisis management.

On the Web

B. Thomas Golisano College of Computing and Information Sciences
www.rit.edu/gccis

Behavioral Health: The college wants to launch a School of Behavioral Health centered on its current research in the fields of addiction, family violence and autism. As the health care industry undergoes a transformation and pushes for integrated care models, RIT's researchers are at the forefront by studying co-occurring treatment models for addiction and family violence. Research students from the college's medical illustration program create 3D models of the brain and spinal cord to show the effects of drugs on the brain and behavior (aggressive behavior/family violence). Alan Gesek, adjunct professor and a graduate of RIT's medical illustration MFA program, created this image.

College of
Health Sciences and Technology

by Kelly Sorensen

With people living longer, the need is even greater to produce future researchers and employees in the workforce to tackle the nation's critical health issues such as obesity, diabetes, and mental health. To address these challenges, the College of Health Sciences and Technology (CHST) is looking to grow its future research and educational programs in the areas of behavioral health and wellness.

Academic Programs: An undergraduate program in biomedical sciences is the college's largest academic program. Its other degree programs are in diagnostic medical sonography (BS), medical illustration (MFA), nutrition management (BS), physician assistant (BS/MS), and health systems administration (MS).

Exercise Science: Expanding the college's exercise science program to include a new undergraduate BS degree is one of the future initiatives. Christopher Demczar, a biomedical sciences major with a concentration in exercise science, tests his aerobic capacity in the RIT Fitness Lab alongside Seann McArdle, right, Fitness Lab and Wellness Coordinator.

Behavioral Health

Daniel Ornt, M.D.

The college's vision is to create a School of Behavioral Health. With a focus on research, the goal is to launch a master's degree in behavioral health and a Ph.D. in clinical psychology. Caroline Easton and Cory Crane, both clinical psychologists, conduct research on addiction and intimate partner violence. Their work is helping to shape proposed legislation in the treatment and prevention of domestic violence. Helping children deal with behavioral issues is the focus of research of pediatrician Laurence Sugarman, M.D., director of the Center for Applied Psychophysiology and Self-regulation. He examines how biofeedback techniques can help reduce anxiety in children with autism.

Wegmans School of Health and Nutrition

Emphasizing nutrition and physical activity is an objective of the college's recently formed Wegmans School of Health and Nutrition. The school has a bachelor's degree in nutrition management and an exercise science minor. The college plans to establish new degree programs in exercise science, health and wellness, and applied nutrition.

"We see community-based research as a key component to developing new approaches and programs that make health and wellness a priority," said Daniel Ornt, M.D., dean of the College of Health Sciences and Technology. A new campus facility set to open in 2015 will house the school and a primary care clinic to be run by Rochester General Hospital. An alliance between RIT and Rochester Regional Health System helps support the university's academic programs, clinical training, and applied biomedical research.

On the Web
College of Health Sciences and Technology
www.rit.edu/chst

Analyzing Biomedical Imagery: Nathan Cahill, standing, along with imaging science doctoral student Kfir Ben Zikri, is developing algorithms for a longitudinal study of lung nodules in CT scans.
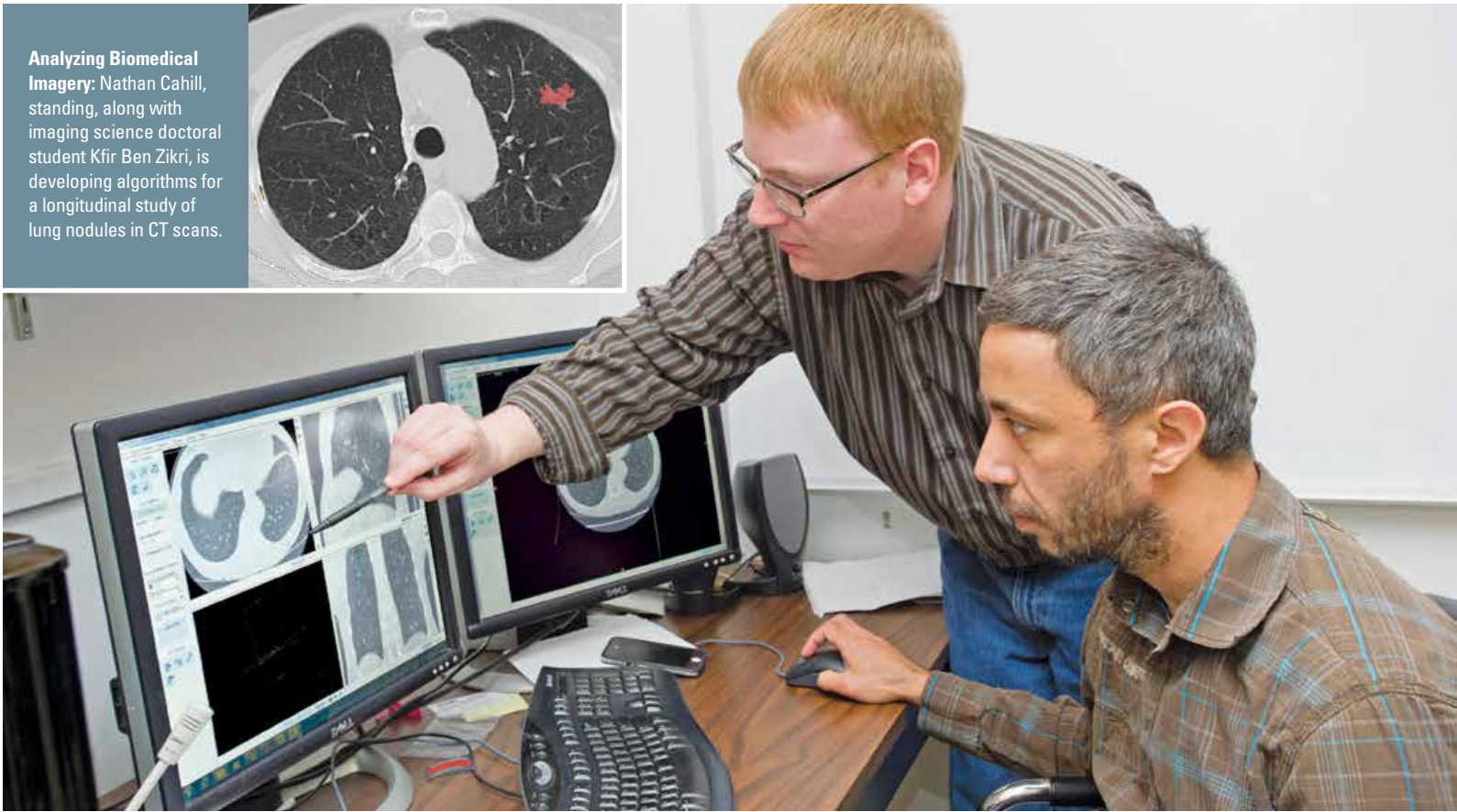
Researching NTHi: Lea Michel studies nontypable Haemophilus influenzae (NTHi), which causes ear infections, sinusitis, and acute chronic bronchitis. She works in collaboration with Dr. Michael Pichichero, a pediatrician and Director of the Research Institute at Rochester General Hospital.

Amino Acid Pathways: André Hudson screens a transgenic plant, Arabidopsis thaliana, to understand the effects of over-expressing an enzyme involved in amino acid biosynthesis. Hudson, along with colleagues, discovered a novel aminotransferase from plants, bacteria, and algae that is involved in a novel pathway for the essential amino acid lysine. This discovery of a novel pathway was instrumental in broadening the understanding of lysine biosynthesis in living organisms.

College of Science

by Mark Gillespie

The College of Science continues to build on its collaborative, interdisciplinary, and multidisciplinary research and to develop new research clusters, laboratories, and centers. By applying the expertise of physicists, chemists, statisticians, mathematicians, computational scientists, and imaging scientists to human and environmental problems, researchers are developing novel solutions.

Tackling National Problem: As the college looks to the future and the national issue of educating students in the STEM disciplines, it has established the Center for Advancing Science/Math Teaching, Learning and Evaluation (CASTLE). Its mission is to improve science and math education and to foster collaboration among elementary and high school educators and researchers. CASTLE receives much of its external funding from the National Science Foundation.
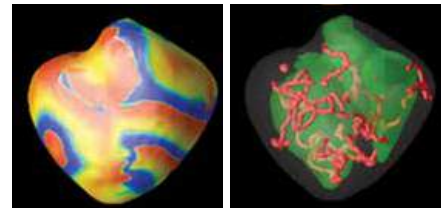
Cardiac Arrhythmias: Using mathematical modeling and simulation, Elizabeth Cherry models cardiac electrical dynamics in normal and diseased states to help better understand the nature of cardiac arrhythmias. Her research, funded by the NSF, integrates math, computer science, physics, engineering, and biology. The image above shows a visualization of electrical scroll waves in the heart during a state corresponding to fibrillation.

Breadth of Research

The college has well-established areas of research in imaging science, color science, detectors, astrophysical sciences, and the physical sciences.

Sophia Maggelakis

The college's world-renowned Chester F. Carlson Center for Imaging Science generates millions in research funding annually and serves as the hub for its Ph.D. program in imaging science. Now, the college has its sights set on new innovations.

A new doctoral program in mathematical modeling is under development. This program will be interdisciplinary and provide graduates with a foundation in the development and application of mathematical models of real-world problems.

"Humanity's challenges do not acknowledge the arbitrary categories of academic disciplines. The College of Science, therefore, isn't afraid to combine the expertise of researchers across all of our disciplines," said Sophia Maggelakis, dean of the College of Science.

The college is developing a portfolio of research clusters under the area of Bio+Sciences (biochemistry, biomathematics, biophysics, bioimaging, biotechnology, bioinformatics, and biostatistics). The college's portfolio of research related to climate study and to STEM education continues to grow and has allowed partnerships with colleagues from other colleges and universities.

Undergraduate science and math students frequently work alongside faculty to conduct original research and regularly present at international and national conferences and publish, as co-authors, in peer-reviewed journals. The college is currently running three NSF-funded Research Experiences for Undergraduates (REU) programs.

On the Web
College of Science
www.rit.edu/cos
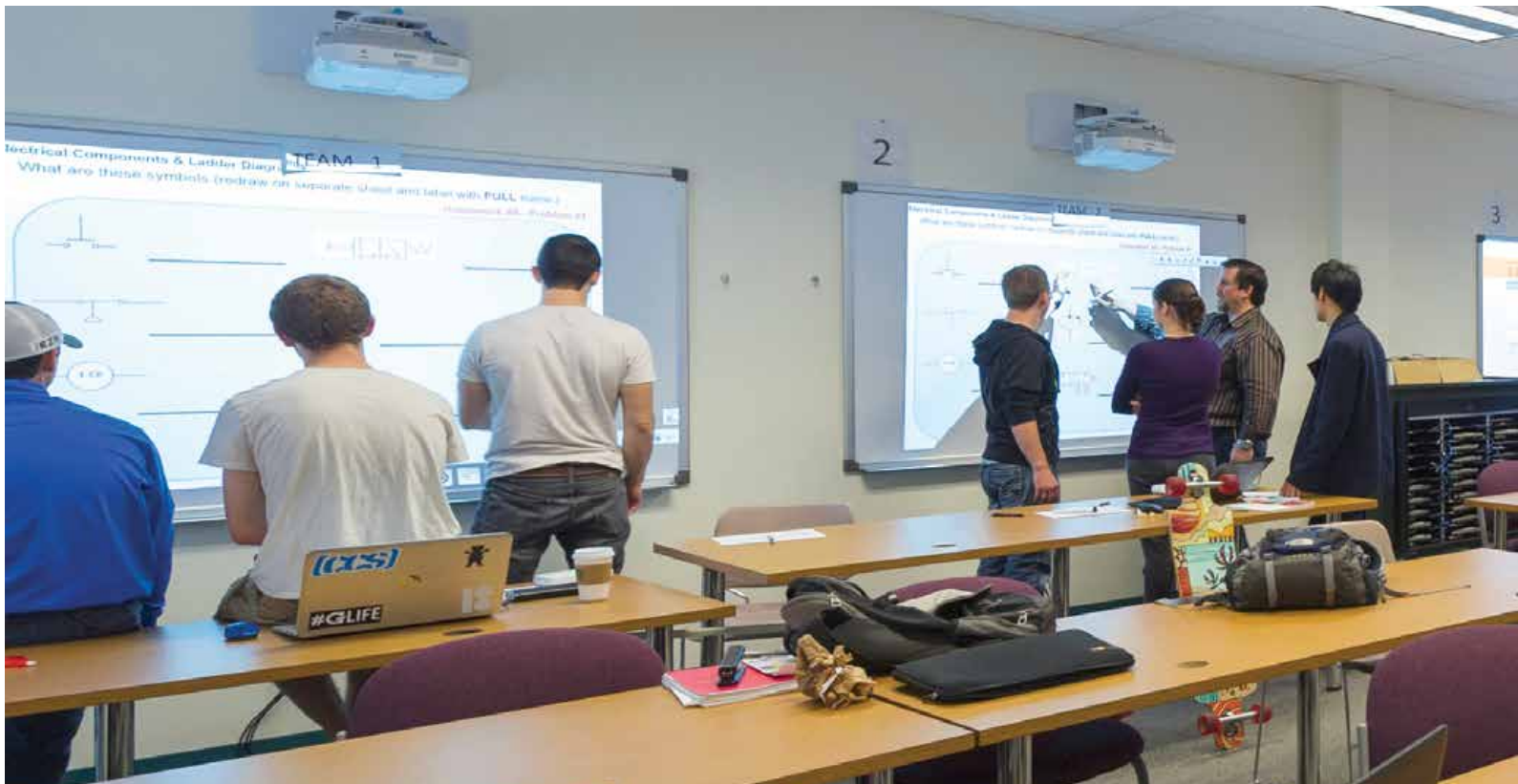
College of
Applied Science and Technology

by Kelly Sorensen

RIT is the second largest producer of science, technology, engineering, and mathematics degrees among all private universities in the nation. To build on this niche, the College of Applied Science and Technology (CAST) hopes to launch an interdisciplinary Ph.D. and university-wide center in STEM education. The goal is to better prepare teachers and professors how to teach these subjects to the next generation of scientists and engineers.

Vision to launch a Ph.D. in STEM Education

H. Fred Walker

CAST's School of Engineering Technology and Department of Service Systems offer a large number of undergraduate and graduate degrees in engineering technology, service systems, human resource development, and applied science.

One of the college's long-term goals is to offer a Ph.D. in STEM education.

To make this vision a reality, a cohort of CAST faculty members is working toward doctoral degrees in curriculum instruction and the science of learning at the Graduate School of Education at University at Buffalo.

"We want to participate in a university-wide Ph.D. program in STEM education based on a common core curriculum that would be administratively housed in this college," said H. Fred Walker, dean of the College of Applied Science and Technology. "The intent is for CAST faculty members to teach the STEM-education content and the content-specific courses would be taught by faculty across the university. The degree could be customized to each college's needs."

Another goal of the college is to launch a center in STEM education to be run by CAST and the College of Science.

On the Web
College of Applied Science and Technology
www.rit.edu/cast

Technology-Rich Interactive Classroom: Surrounded by technology, students learn fundamental engineering concepts through interaction. The traditional lecture format does not exist. Projectors, smart boards, software, and Web cameras encircle the room. Concepts are presented visually as groups of students work simultaneously to solve problems. Rob Garrick and Larry Villasmil, associate professors of manufacturing and mechanical engineering technology, have received external and internal funding to enhance the classroom with new forms of instructional technology. They are seeking partners to explore how these interactive pedagogical environments can enhance learning for all students and especially underrepresented students.

Packaging Science: Packaging science is one of the college's academic programs that draws support from industry. Industry partners—American Packaging Corp. and The Wegman Family Charitable Foundation—donated money to RIT to establish the Center for Sustainable Packaging, an education and research center dedicated to the development and use of sustainable packaging. In addition, companies sponsor student-design competitions. Above is a photo of the winning design for Wegmans barbecue sauce packaging created by a student team from RIT's packaging science, graphic design, and industrial design programs.

Ph.D. Pursuits: By 2015, 96 percent of faculty members in the College of Applied Science and Technology will be doctorally prepared. Pictured above are some of the faculty currently pursuing a Ph.D. in a variety of disciplines.

On the screen: about metal like characteristics of an element theyre really talking about how likely it is to give away electron well talk about other characteristics of a metal especially the ones the way that we kind of perceive metals

Visual Attention and Information Retention: Junior and senior faculty members from NTID and the Chester F. Carlson Center for Imaging Science (right) are working together on research that examines deaf students' gaze behavior associated with reading captions in videos of STEM lectures. Students may miss crucial information because they must divide their attention among the instructor, interpreter (or captioning screen), and the graphics. Researchers will investigate how the distance between captions and displays affects students' ability to retain information. Above, Kasmira Patel, a human-computer interaction major, watches a video about the periodic table in chemistry with professor Poorna Kushalnagar. The wall screen shows Patel's gaze behavior.

National
Technical Institute for the Deaf

by Kelly Sorensen

The National Technical Institute for the Deaf (NTID) is a leader in the development of pedagogical theories and best practices for teaching deaf students. NTID researchers created C-Print®, real-time captioning, that is used in high school and college classrooms around the world. NTID faculty have numerous research projects underway that address how to integrate text, video, and graphics in the classroom when teaching students on various subjects, particularly the STEM disciplines.

People often have negative stereotypes of other groups' abilities, for example
"Deaf students are not good at _____."

The threat of confirming that stereotype can negatively affect one's performance

Three Necessary Conditions:

1. Identification with stigmatized group
2. Performance evaluation in individual or group setting
3. Awareness of stereotype in performance context

Stereotype Threat Study: New groundbreaking research funded by the NSF examines how stereotype threat may affect the performance of deaf students in solving mathematical problems. Principal investigator and NTID researcher Ron Kelly, along with co-principal investigators Jerry Berent and Peter Hauser (NTID) and Jeremy Jamieson (U of R) are collaborating on the three-year grant. Stereotypes are the perceptions and misperceptions of others toward an identifiable group of people. The three necessary conditions for stereotype threat to occur are listed above.

Teacher and Scholar: Bonnie Jacob, assistant professor in NTID's science and mathematics department, engages undergraduates in mathematics research. With funding from the NSF and Brigham Young University's Center for Undergraduate Research in Mathematics, Jacob mentors student research assistants. Students presented their results at BYU in spring 2014 and have co-authored journal articles with Jacob.

Gerry Buckley

Centers-Based Research Model

"In the past few years, scholarship at NTID has shifted from a research department-based approach toward a more inclusive centers-based model," said Gerry Buckley, NTID president and RIT vice president and dean. "Research and scholarship are organized into centers focusing on four areas of proven success that will continue to be the focus of the future—teaching and learning; communication; technology, access and support services; and employment and adaptability to social changes and the global workplace. Faculty from multiple departments come together in centers to work on strategic research projects."

Two new research and development centers are housed within the newly-constructed Rosica Hall—the Research on Employment and Adapting to Change, and the Research Center for Teaching and Learning. Rosica Hall is also the home to the Deaf Studies Laboratory, the Collaboratory on Economic, Demographic and Policy Studies, the Deaf Studies Laboratory, and the Technological Education Center for Deaf and Hard-of-Hearing Students (DeafTEC). Funded by an NSF grant, DeafTEC is a nationwide resource center for high schools, community colleges, and employers.

As part of NTID's research initiatives, senior faculty researchers mentor junior faculty members in developing their research programs. This has already led to newly funded research projects and additional opportunities for student research.

On the Web
National Technical Institute for the Deaf
www.ntid.rit.edu

A Green Building:
The $40 million, 84,000-square-foot Golisano Institute for Sustainability is among the top one percent of all green buildings in the United States earning Leadership in Energy and Environmental Design (LEED) Platinum certification from the U.S. Green Building Council—the highest standard that can be achieved.

Golisano Institute for Sustainability

by Kelly Sorensen

The Golisano Institute for Sustainability (GIS) is at the forefront of sustainability research in the areas of sustainable manufacturing, pollution prevention, energy systems, fuel cells, the built environment, nanotechnology, smart grid technology, remanufacturing, and resource recovery.

World-Class Living Laboratory

Nabil Nasr

GIS plans to grow and expand its research in these areas in the future and leverage its research with a unique interdisciplinary Ph.D. program in sustainability.

Students and faculty conduct research in the Golisano Institute for Sustainability, a world-class "living laboratory" that features a fuel cell powering the building, an internal microgrid managing energy inputs from solar panels and wind turbines, and a rainwater re-use system.

Leading by example to reduce its own environmental footprint, GIS uses less energy and creates less waste while conducting cutting-edge research and producing the next generation of sustainability scientists.

GIS is in its sixth year of managing the multimillion dollar New York State Pollution Prevention Institute, which provides research support, services, and pollution prevention technology solutions to New York state companies.

Recently, GIS was named an Empire State Development-funded Center of Excellence in Sustainable Manufacturing, providing process improvements and research technology transfer to New York state manufacturers.

"Through our research and educational initiatives, GIS is building on its proven record of research in manufacturing, remanufacturing, and developing sustainability standards and processes," said Nabil Nasr, associate provost and director of the Golisano Institute for Sustainability.

On the Web
Golisano Institute for Sustainability
www.rit.edu/gis

Life Cycle Assessment: In the future, GIS wants to combine this research with its resource recovery and life cycle assessment studies to expand its research on the environmental impacts of manufacturing processes. From left, sustainability Ph.D. candidate Barbara Kasulaitis; Callie Babbit, assistant professor; and Erinn Ryen, a recent graduate of the sustainability Ph.D. program, disassemble computers to identify high environmental impact materials.

Fuel Cell Research: One future focus of the Center of Excellence and Sustainable Manufacturing program will be using the GIS test beds to expand fuel-cell and fuel-cell component research and commercialization efforts with New York state companies. Mike Waller, third-year doctoral student in sustainability (above), works in GIS' fuel-cell laboratory.
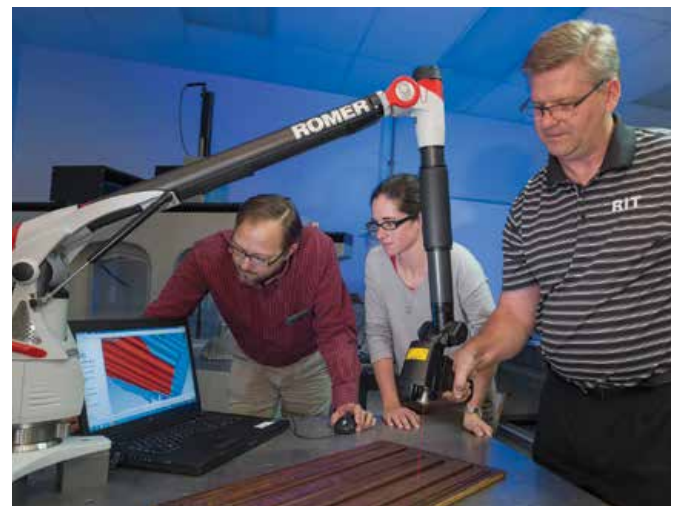
Digital Manufacturing: GIS is a team member on the $70 million federal award to the Digital Manufacturing and Design Innovation Institute. The goal is to help U.S. manufacturers improve their competitiveness using advanced digital manufacturing and design technologies. Above, GIS staff members Mike Thurston (left), Mark Krystofik (right), and sustainability master's student Missy Hall (center) use 3D scanning equipment to assist a company working on the manufacture of parts for an architectural restoration project.

Simone Center for
Student Innovation and Entrepreneurship by Kelly Sorensen

The Simone Center for Student Innovation and Entrepreneurship works closely with all the RIT colleges to offer experiential, multidisciplinary learning for students interested in innovating and commercializing their ideas and projects. It brings together students and faculty from all different disciplines to collaborate, develop products, and form businesses.

Innovation and Entrepreneurship Ecosystem

Richard DeMartino

The Simone Center's IdeaLab program is one example of how it fosters interdisciplinary collaboration that can lead to commercialization opportunities. Student teams comprising different majors work together to solve a real-world problem faced by an organization or company. Over the course of a weekend, called IdeaLab weekend, various student teams are each assigned to a problem. Community partners such as Rochester Regional Health System, Al Sigl Community of Agencies, and Association for the Blind and Visually Impaired, are some of the organizations bringing their problems to IdeaLab. Students focus on brainstorming, problem solving, conceptualizing, and designing. If the organization likes the team's solution, the students enter an IdeaMake semester to continue working on the solution. This could include extensive human-centered design, prototyping and commercialization research.

"The IdeaLab tackles problems and creates a cohort of students from a variety of disciplines—design, engineering, business, biomedical sciences, gaming, communications—to work together to solve problems from scratch," said Richard DeMartino, the Albert J. Simone Endowed Chair for Innovation and Entrepreneurship. "Bright students from RIT's strong academic programs receive multidisciplinary experience in

Experiential Learning: The Simone Center works with academic programs to advance multidisciplinary innovation projects. Pictured left to right are Yolegmma Marquez de Vidal, an MFA industrial design student, Rohith Ganesan, an MS student in the Manufacturing and Mechanical Systems Integration program, Patricio Corvalan, an MFA student in Industrial Design, Richard DeMartino, director of the Simone Center; and Stan Rickel, director of the Industrial Design graduate program.

taking an idea and pushing it forward from brainstorming solutions to design to prototyping."

The Student Incubator initiative is another one of its unique program offerings. The program focuses on product and business development. Experienced entrepreneurs and business developers provide coaching to students interested in starting a business or product commercialization.

The National Science Foundation recognized the center for its programs. DeMartino is the PI on a $300,000, three-year grant from the NSF's Innovation Corps (I-Corps). The funding will be used for a university-wide project to help

convert STEM research into marketable products and services. The project is under the direction of the Simone Center and the Media, Arts, Games, Interaction and Creativity (MAGIC) Center. The Simone Center is able to provide support as funding agencies are increasingly looking for commercialization plans from researchers of all disciplines.

On the Web
Simone Center
www.rit.edu/simonecenter

Video Link
IdeaLab
http://bit.ly/RITIdeaLab
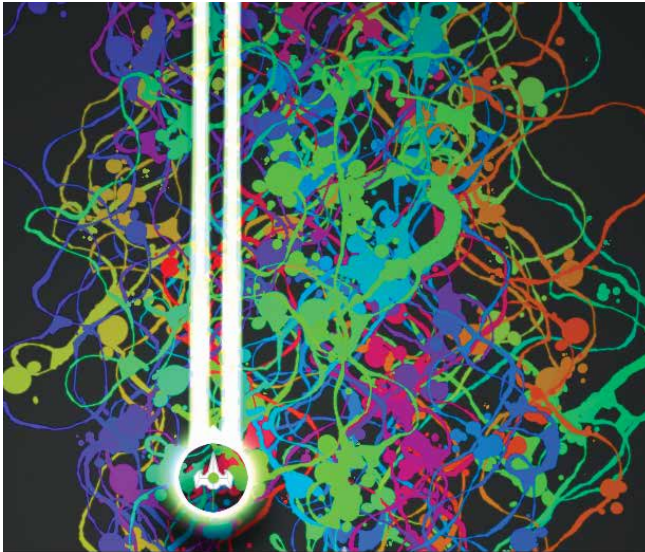
MAGIC Center

by Kelly Sorensen

RIT's MAGIC (Media, Arts, Games, Interaction, and Creativity) Center is a campus-wide research center and commercial studio that works with students and faculty to spur collaboration relating to digital media, technology and the intersection with the arts and the humanities.

Game Development: Undergraduate students in the School of Interactive Games and Media's production studio class are engaged with MAGIC Spell Studios in developing a game with the working title *Splattershmup*.

e-NABLE at Work: Jon Schull, MAGIC research scientist (right), and Jade Myers, a fourth-year multidisciplinary studies student, hold a plaster cast of Lucas LeMay's hand and measure where Lucas's wrist can bend. A plaster cast was made of the 10-year-old's hand in order to create a custom-fitted 3D-printed mechanical hand.

Andrew Phelps

Digital Media and Interactive Design

The center's core mission is to create digital media and interactive design solutions that have real-world impact. MAGIC explores how gameful interaction can be used in both the corporate setting and educational learning environments. Its work in games education relies on collaboration with other schools within RIT and its industry partnerships. MAGIC has strong corporate partners including Microsoft, Apple, Adobe, and Second Ave. Software. MAGIC, along with the Golisano College's School of Interactive Games and Media and the College of Imaging Arts and Sciences' School of Film and Animation collaborated with a regional partner and Harris Corp. RF Communications to create a product concept video that 'looks and feels like a video game.'

MAGIC also works closely with the Simone Center to commercialize student work and help students launch their own media studios.

"To promote student entrepreneurship and engagement, we're exploring crowd-sourced funding, multi-channel commercial distribution, and how MAGIC can best act as both a 1st and 3rd party publisher for the work of students and faculty," said Andrew Phelps, director of MAGIC Center.

Online Community Connects Children with 3D Printed Hands

MAGIC Center is changing the lives of children through a growing worldwide social network of volunteers called e-NABLE. Jon Schull, a research scientist in MAGIC, created e-NABLE to connect children and adults with low cost prosthetic arms and hands made with 3D printers. The volunteers include 3D printers, hobbyists, and software developers. A plastic prosthetic can be made for $20 compared to a typical prosthetic that can cost as much as $60,000. This example of disruptive technology, or an emerging technology challenging the status quo, is another growing area of sponsored research for MAGIC.

On the Web
MAGIC Center
magic.rit.edu

Effective Access Technology

by Kelly Sorensen

More than one billion people worldwide have some form of a disability. This number is growing dramatically with people living longer and the number of veterans returning with service-related injuries. RIT has long been a leader in developing innovations and adapting ones to provide access and independence to people with physical and cognitive challenges.

Inclusion and Accessibility

Faculty and student researchers are developing assistive and adaptive technology to provide greater access and break down barriers. RIT has nearly $16 million in funding and more than 60 research projects in this area.

"RIT does an amazing job leveraging the resources and expertise from a wide number of research centers and disciplines to facilitate innovation," says Dan Phillips, head of the biomedical engineering department at RIT. "We have this amazing ecosystem that exists among the colleges and the service providers of the Rochester community in which our researchers work closely with the providers and their clients to address their needs."

Below are just some examples of technology in development:

1 Smart Cane: This technology will aid deaf-blind persons in navigating surroundings via real-time tactile and directional force feedback. A sensitive tactile pad and micro-controller within the cane even allow a user to tell how far away an obstacle is, based on dull or sharp vibrations. Researchers from the Golisano College of Computing and Information Sciences and NTID have developed a prototype.

2 Pediatric Mobile Stander: Created by undergraduate engineering students in collaboration with CP Rochester, the stander is for children with cerebral palsy who have little to no ability to walk or stand up by themselves. Similar to a wheelchair, it allows children to move around their environment in an upright position and can also be controlled by a third party.

3 Alert Device: In the deaf and hard-of-hearing community, there's a need for an inexpensive alert device that can send notifications to people. Using intense flashing lights combined with vibration, researchers from NTID and the Kate Gleason College of Engineering developed a small device that the user can control wirelessly via Bluetooth through a handheld device such as a cellphone.

4 Google Glass: Vicki Hanson, distinguished professor in the Golisano College of Computing and Information Sciences, is among the researchers leading the way in developing technologies for inclusion. Hugo Nicolau, a postdoctoral researcher working with Hanson, is using Google Glass to test its feasibility for facilitating classroom learning or communication between signing and non-signing individuals. The inset photo is the view of a signer on the Google Glass screen.

5 Reader Stand: Industrial design students have developed a portable stand that holds digital tablets and books to help people with visual impairments read easier. The stand can be adjusted at varying angles. The prototype complements tablets' existing apps that can magnify and recognize text.

6 Skipper's Chair: Engineering students created a skipper's chair to allow someone with physical limitations the ability to sail. The assistive device provides a secure and stable seat with an integrated steering mechanism to allow a person to control the movement of the sailboat without requiring the use of their legs.

7 C-Print® Mobile: C-Print® captioning technology, developed by NTID in 1989, is used to produce a text display of spoken information for individuals who are deaf or hard-of-hearing. The new C-Print Mobile app allows users to view captioning on mobile devices, such as an iPad, in traditional classrooms, labs, and meetings. It runs on iOS and Android devices.

8 AccessBraille: Using an iPad touch screen that mimics a braillewriter, individuals who are blind or visually impaired can put their fingers on the screen wherever it's most comfortable for them to type their braille letters. The screen will read back to them what letters and words they've typed. Stephanie Ludi, associate professor of software engineering, is leading this research.

9 Wheelchair Assistance: Users of manual wheelchairs often have trouble moving up inclines due to the proclivity of the chair to roll backward down the slope. Engineering students designed a device to stop the wheelchair from rolling back down an incline and slow down the chair when moving on a slope. The prototype retrofits to most existing manual wheelchairs.

Video Link
Effective Access Technology
http://bit.ly/RITAccessTech

rit.edu/corporate

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RESEARCH

opportunities for your products and systems

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talented RIT students and alumni to work for you

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R·I·T

Rochester Institute of Technology is internationally recognized for academic leadership in computing, engineering, imaging technology, sustainability, and fine and applied arts, in addition to unparalleled support services for deaf and hard-of-hearing students.

For two decades, *U.S. News & World Report* has ranked RIT among the nation's leading comprehensive universities. RIT is featured in *The Princeton Review*'s 2014 edition of *The Best 378 Colleges* as well as its 2014 *Guide to 332 Green Colleges. The Fiske Guide to Colleges 2014* describes RIT as "strong in anything related to computing, art and design, and engineering."

Contact Information

To learn more about research opportunities on campus, contact us directly or through the RIT research website at **www.rit.edu/research**.

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