VIRGINIA COMMONWEALTH UNIVERSITY

VCU School of Engineering

ANNUAL REVIEW

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engineering the future to **Make it Real.**

FROM THE DEAN

In some ways, the School of Engineering at Virginia Commonwealth University is like an early stage company. In the fall of 1996, there was no dedicated building space, very few faculty, and 97 students who decided to take a chance on something new — a School rooted in public-private partnerships, where local industry comes together and says "we need something," and academia responds by trying to meet those goals.

This partnership is the bedrock of the School, which draws in entrepreneurial-minded people and fosters positive change and innovation around the globe. In 20 short years, the School has seen explosive growth and development of a vibrant community of makers.

In the last three years alone, we have:

- Increased our undergraduate enrollment by 24 percent
- Initiated a Vertically Integrated Projects (VIP) program, where students of all education levels can immediately gain research experience in a collaborative, innovative environment
- Tripled our extramural grant funding

There's a remarkable energy here at VCU. Brilliant young minds fill our hallways and classrooms with quality thinking and creativity. I see students, faculty, and staff bustling from place to place — eager to build upon our legacy through cross-disciplinary education and student-centered learning. That's why I hope you enjoy this special issue of our magazine, which celebrates our history, showcases current research initiatives, and gives a glimpse into exciting things on the horizon.

With every story you find in these pages, I hope you can feel the energy and excitement that's translating into promising advancements in areas such as pharmaceutical engineering, health monitoring and disease diagnostics, and nuclear power instrumentation.

We're building the future now.

Barbara D. Boyan, Ph.D.
Alice T. and William H. Goodwin, Jr. Chair
in Biomedical Engineering
Dean, VCU School of Engineering

For this special edition of the annual magazine, we're sharing 20 fun facts that honor key milestones and achievements throughout the VCU School of Engineering's existence.

OUR MISSION:

Through teaching and research, the VCU School of Engineering creates knowledge and transforms ideas in engineering and the life sciences into technologies that enhance regional and global prosperity. We prepare our students for leadership and entrepreneurship through collaborative and interdisciplinary partnerships.

OUR VISION:

To establish the VCU School of Engineering as a preeminent school in education research and technological development at the intersection of engineering, business, medicine and the life sciences.

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MEET OUR ASSOCIATE DEANS

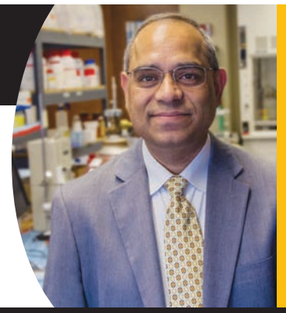
"I joined VCU to lead innovation and outreach programs, and to grow this school. You need an engineer whenever you make something, and with the right operational processes in place, we can really showcase the positive change engineers foster."

— L. Franklin Bost, MBA, IDSA and executive associate dean

Bost is a seasoned executive with experience in marketing and sales, international business development, strategic and business planning, P&L management, and developing and designing medical products. Since February of 2013, Bost established operational processes and financial reporting measures to efficiently align and advance all initiatives and expenditures with the School's strategic plan. In the last two years, he's raised approximately $233 million in funding for the School.

"I want to help faculty and students refine research questions, get funding to test their ideas and then see the successful use of their research results to improve human lives."

— Ram B. Gupta, Ph.D. and associate dean for research



Gupta guides our student and faculty researchers to be concise, compelling and driven. Prior to joining VCU in August of 2014, he served as the director of the Energy for Sustainability program at the National Science Foundation and was an editorial adviser for various journals including *ACS Sustainable Chemistry & Engineering* and the *Journal of Biomedical Nanotechnology*. Gupta's leadership and strategic skills have driven a 22 percent increase in written proposals between fiscal year 2014 and 2015, as well as a 47 percent increase in grant expenditures.

"Teaching is a moving target. That's why analyzing what helps new generations attain self-sufficiency, perseverance and proficiency in their field of study is something that needs to be done in a continuous fashion."

— Afroditi V. Filippas, Ph.D. and associate dean for undergraduate studies

Filippas is responsible for all aspects of the undergraduate program. She has been operating in her current role since fall 2010, significantly growing our enrollment and retention with her energy and enthusiasm for molding holistic engineers who are independent, life-long learners. Previously, Filippas served as the associate chair of the Electrical and Computer Engineering department. Filippas strives to help all students achieve their goals through her own teaching as well as through working with Student Services and the School's Undergraduate Program directors to develop effective advising programs and engaging educational experiences.

"I'm excited to be a part of a flourishing school, where I get to craft an environment where people feel safe, secure and welcome. From their labs, to their equipment and other technologies, I make sure people have what they need to succeed."

— Zvi Schwartz Ph.D., DMD and associate dean for strategic initiatives

Schwartz brings 35-plus years of biomedical engineering and dental medicine experience, and basic research expertise to VCU. He joined the School in April of 2013. His duties include evaluating building space for future expansion to meet the needs of a growing student body and new research initiatives, while also maintaining all existing office space, classrooms and laboratories. With more than 450 journal publications and countless awards under his belt — such as the American Academy of Periodontology's R. Earl Regeneration Award — Schwartz makes sure our engineering facilities best fit the School's strategic and research goals.

"My job is to make the value-added proposition of a VCU graduate degree loud and clear. If we can successfully recruit, retain and graduate talented students from every part of the country and every part of the world, that will indicate VCU's forward momentum."

— Gregory Triplett, Ph.D. and associate dean for graduate studies

Triplett is a first generation graduate who found his voice and ability to make a difference through academic teaching and research. Prior to joining VCU in January of 2016, he spent 11 years at the University of Missouri (Mizzou). There, he received the William T. Kemper Fellowship for Teaching Excellence Award, the Booker T. Washington Advisor of the Year Award and the Air Force Office of Scientific Research's Young Investigator Award. Triplett secured nearly $9 million in total grant funding at Mizzou and more than doubled student participation in honors research.

MEET OUR DEPARTMENT CHAIRS

"We are at the forefront of a technological revolution, and we get to address industries' most pressing problems with our expertise, particularly in the areas of data science and cybersecurity."

— Krzysztof J. Cios, Ph.D., D.Sc., MBA and chair of the Department of Computer Science

Computers can write articles from data. They can rapidly crunch big data to create personalized consumer experiences. Even health care procedures and diagnostics are conducted by computers. Since coming to VCU in 2007, Cios has built up a robust department, equipped with the research skills needed to continue to propel technological progress. He has also established certificate programs that allow students to specialize in data science and cybersecurity, and a dual-Ph.D. program with the University of Cordoba in Spain.

"Nearly 80 percent of our undergraduates are participating in research initiatives. We have some very special, extremely self-motivated individuals who teach me new things each day."

— B. Frank Gupton, Ph.D. and chair of the Department of Chemical and Life Science Engineering

Gupton's perspective on education changed forever when he was pulled aside and asked if he wanted to participate in research with a professor. Suddenly, he saw how what he learned in class related to real-world needs. Now he strives to give VCU faculty and students alike the necessary tools to be successful and productive assets. Gupton originally joined VCU as a research professor in 2007, and was quickly promoted to department chair in 2008. Gupton shares the experience he's gained from 30-plus years in the chemical and pharmaceutical industry to motivate students and put systems into place to increase departmental efficiencies.

"Within the next five years, I want our program to be the program of choice for high school seniors considering biomedical engineering in the Commonwealth. With the right infrastructural enhancements, we can also become the employer of choice for junior faculty." **— Henry Donahue, Ph.D. and chair of the Department of Biomedical Engineering**

Donahue transformed research at Pennsylvania State University by garnering $13 million in NIH funding in his 20-year career with the school. Before he came on board, there was no extramural funding for their orthopedics program. Under Donahue's leadership, the program made NIH's top 10 in orthopedic research funding list. Now he's ready to take VCU's Biomedical Engineering department to the next level. Donahue is excited to continue growing our open, collaborative research culture. Donahue officially joined VCU in January of 2016.

"Our department has nearly doubled in size in the last seven years. It's one of the largest and most popular majors at VCU."

— Gary Tepper, Ph.D., and chair of the Department of Mechanical and Nuclear Engineering

Tepper earned his Ph.D. from the University of California at San Diego. There, he watched his adviser build a new engineering school that is now ranked in the top 25. Tepper joined VCU in 1997 as a tenure-track assistant professor and then accepted the department's chair position in 2009. Along the way, Tepper helped create the nation's first hybrid Ph.D. program in mechanical and nuclear engineering. He's excited to push our strong group of faculty members to achieve their full potential and become stars within their respective research fields.

"The energy and drive of our students is crazy. It's not enough for them to learn, they need outlets to create and do. That's why I want to get out of the way of our students, and let them lead. There's so much potential here."

— Erdem Topsakal, Ph.D. and chair of the Department of Electrical and Computer Engineering

Topsakal, who joined VCU in June of 2015, quickly assembled an undergraduate student advisory board tasked with shaping the direction of department initiatives and helping to rally the student body to apply what they're learning in classrooms out in the community. These students take part in open houses, high school visits and other exciting projects. Topsakal also formed a general advisory board of industry leaders, high school principals and faculty from other institutions to evaluate department programs, its research portfolio and curriculum.

A Legacy of Learning:

20 YEARS IN THE MAKING

School of Engineering leaders past and present share their perspectives.

In the last 20 years, the VCU School of Engineering has grown from an idea on paper into a vibrant and diverse community full of creative problem solvers. We recognize all the key players who have shaped the School and continue its forward momentum — faculty, staff, students, and industry and academic partners.

1996-1999
FORMER FOUNDING DEAN HENRY MCGEE, PH.D.

"When I was told that I could become the father of a whole new school of engineering, I thought, 'wow!' You don't get an opportunity like this very often. It was an easy sell. We started with a blank sheet of paper and filled it with assistant and associate deans to get the ship under way. We required people with creativity, imagination, vigor and excellent academic credentials. That's what it would take to set us apart. You see, we greatly admire premier programs such as Georgia Tech, MIT and Virginia Tech — but we don't want to be just like them. We wanted to create something new and different and exciting to address the tone and needs of the time. I think that's what we did."

1999-2006
FORMER DEAN EMERITUS ROBERT MATTAUCH, PH.D.

"I was too busy to be overwhelmed. We had no dedicated space for classes or laboratories, and yet we fostered a strong sense of community. Each Friday, faculty and I would make gallons of coffee and bring countless bags of bagels for the students who took a chance on a young School of Engineering. I was committed to knowing each of them, their aspirations and helping prepare them to work within the local businesses and industries that invested in the School. We achieved accreditation, established a critical graduate program and did all we could to let people know the VCU School of Engineering was in business. With a well-constructed curriculum, we gave students the opportunity to jump right into rigorous, engineering-specific courses. When quality faculty members came to us, wanting to be a part of our success, I knew we were moving in the right direction."

2006-2011
FORMER DEAN EMERITUS RUSSELL JAMISON, PH.D.

"VCU is an authentic environment where powerful change can happen. There's an unmatched willingness across the entire university to collaborate among the different schools and within departments. In 2008, when universities all across the country experienced a steep decline in admissions, the School of Engineering had a 30 percent uptick in growth. Why? The energy of this campus pulls in highly-motivated students, many of which are first-generation college goers. Our rich, intellectual diversity fuels remarkable innovations and integrity. When businesses interact with our students, whether as interns or full-time hires, they get team players who they can depend on. Our students are ready to work and are unafraid of getting their hands dirty. I'm delighted, because I see these interdisciplinary teams as a keystone for what the university is trying to do — to create a place for anyone to work and find new perspectives and purpose."

2011-2013
FORMER INTERIM DEAN CHARLES JENNETT, PH.D.

"Engineering is not what people thought of it 100 years ago. Engineers can impact all industries — wherever there's a problem that needs solving. I was committed to picking up where my predecessors left off, with all the superb ingredients for building a premier program. Many people don't know there are several large, Fortune 400 companies in Richmond, and other fantastic businesses in Washington, D.C. We encouraged students to explore the breadth and depth of possibilities that exist within engineering to become well-rounded professionals. The involvement and positive response from Richmond businesses is a constant testament to the leadership of faculty and students who are driving positive change in industry and academia."

2013- PRESENT: DEAN BARBARA D. BOYAN, PH.D.

"The best is still to come for the School of Engineering. Through a relentless focus on research, we've nurtured a culture where team-based leadership and learning are a shared responsibility. Every Ram Engineer, whether they're freshmen or faculty, has opportunities to learn, mentor and grow under exciting research initiatives and other independent projects. As we enter an era of unprecedented technological advancement, we're looking for dynamic experiences to empower our ambitious student body and stellar junior faculty. Student success is so important. I want to put more supports and programs in place to give all our students, especially the ones juggling jobs and family commitments, the same right to be, think and dream. I speak for our School of Engineering faculty and leaders when I say we're excited by the opportunity to help VCU meet the challenges that engineering education will face over the next decade."

1996
The School opens with a first class of nearly 100 students.

2000
Several new M.S. and Ph.D. programs in engineering are launched.

2005
Undergraduate student enrollment surpasses 1,000.

1998
The West Hall building and the Wright Virginia Microelectronics Center open at a cost of $42 million.

2001
VCU's long-standing degree programs in computer science join the School.

2009
The Institute for Engineering and Medicine opens.

2014
VCU receives a $230.9 million in-kind grant of software from Siemens, USA.

2008
The East Hall building opens to foster collaboration with the School of Business.

2013
Two programs are established to provide students with even more lab opportunities.

2016
Engineering the future...

Three Brothers, One School

How a young School of Engineering became the perfect place for a family's personal and professional development.

In 1995, Maung Myint and Kyu Aye left Burma for the United States. They left their high-profile government jobs and all the comforts that came with them for their three sons: Lynn, Myo and Tin.

After arriving in Virginia, the boys desperately clawed for opportunities, building new relationships and constantly testing preconceived notions of what the U.S. could offer them. "At times, we wondered if the move would pan out. We needed to show ourselves and our parents that we made the right choice," said Lynn. Through one of those early friendships, Lynn had learned about a new School of Engineering at VCU that was also attempting to realize its full potential. "I always wanted to be an engineer, because math was its own language to me. I could communicate clearly and confidently, which was important as I struggled to pick up the English language," admitted Lynn.

THE FIRST CLASS

Suddenly, Lynn found himself interviewing to be a part of the School's first electrical engineering class with Founding Dean Henry McGee, Ph.D., and with Robert Mattauch, Ph.D., who would later become the School's next dean. During those interviews, Lynn was told how the first class would shape the future of the School. "It was clear that my input for curriculum would be valued and that each student could leave an impression and legacy behind by being a part of the School."

Lynn would go on to help found the School's IEEE chapter, take part in West Hall's groundbreaking ceremony and quickly jumped into an internship with a startup technology company that admired the quick-thinking and risk-taking abilities of VCU students. Every evening, what Lynn was learning in the classroom and at his internship spilled into dinnertime conversations with his two younger brothers. Both Myo and Tin were swept up in stories about the new tools their brother was working with and new buildings being planned. Most impressive were examples of how accessible all faculty members — even the dean — were. According to Lynn, the faculty excelled because they were not just "book smart," they had deep industrial ties and a relentless commitment toward preparing each individual for real-world jobs.

BROTHER TWO GOES INTO BIOMEDICAL ENGINEERING

"If the School of Engineering hadn't been around. I'm not sure if VCU would have been on our radars," said Myo, who started in the School's Biomedical Engineering program in 2000. Myo thrived within the tight-knit community of engineers. His favorite and probably most difficult moments came from all the late nights working through engineering challenges with his classmates. Inspired by that sense of community, Myo became involved in VCU student government and established various programs to cultivate a welcoming community across VCU — one of them being the intercultural festival that now boasts attendance of more than 10,000. After graduating in 2004, Myo went on to the VCU School of Medicine to further his education — which left Tin to complete the family affair with the School of Engineering.

THREE BROTHERS PAY IT FORWARD

Tin graduated with a degree in mechanical engineering in 2006. In addition to being a Product Development and Customer Solutions Engineer at Dominion Voltage Inc., a subsidiary of Dominion Power, Tin now serves as the School of Engineering's alumni board president. His top goal in that position is to increase the participation of the alumni community that can inspire potential students to see the value of a VCU engineering degree. "Alumni need to stay connected with each other and what's happening at the School. I'm creating outlets where we can all continue challenging each other like we did in class — to do great things out in our communities, in academia and industry," said Tin.

Myo passes on what he learned at VCU as the residency training director for the Triple Board and Child and Adolescent Psychiatry programs at Tulane University. The eldest brother, Lynn, owns his own consulting company. He works with clients in manufacturing and marine clients in Korea and Singapore who need his understanding of automation, robotics and project management to make the best use of their resources.

"The School of Engineering enabled all of us to build a future worthy of our parents' sacrifice," said Tin. "We'll continue to work hard to make them and the School proud of what we do."

Fun Fact #1: ***In the late 90s, there were limited evening dining options on campus. So, Lynn Myint, a student from the School's first class, helped buy the School's first microwave.***

School Snapshot: 2015 FAST FACTS

5
accredited departments

BIOMEDICAL · CHEMICAL AND LIFE SCIENCE · COMPUTER SCIENCE · ELECTRICAL AND COMPUTER · MECHANICAL AND NUCLEAR

$32 million
operating budget

89 Faculty

- ALASKAN/NATIVE AMERICAN: (0.1%)
- ASIAN: (19%)
- BLACK/AFRICAN-AMERICAN: (9%)
- HAWAIIAN/PACIFIC ISLANDER: (0.1%)
- HISPANIC/LATINO (6%)
- INTERNATIONAL: (14%)
- TWO OR MORE RACES: (2%)
- UNKNOWN: (1%)
- WHITE: (47%)

56% of graduate students have scholarships

97% of May 2015 alumni confirmed employment or grad school acceptance within six months*

19:1
student to teacher ratio

1,714
Undergraduate students

3.95
average admit
GPA

271 Graduate students
104 M.S. 167 Ph.D.
(48% of M.S. students are female)

sixteen CERTIFICATES

* Represents 68% knowledge rate [calculated from LinkedIn, Hire VCURams and survey response data — and independent reporting]

THE VIP EXPERIENCE

New program offers cutting-edge approaches to undergraduate engineering education and transdisciplinary collaboration.

Robert Klenke, Ph.D. and electrical and computer engineering professor, found himself in a rebuilding period after consecutive years of dominating an unmanned aerial vehicle (UAV) competition with a team of students. Klenke realized that rebuilding years don't just impact our favorite sports teams, they can also slow down research progress and knowledge transfer in academia. "I wanted to find an outlet to help us grow self-sufficient research teams, where students can work with a consistent team over multiple semesters to increase research productivity and new ideas," said Klenke. "With the right infrastructure in place, we can help students evolve from learners to productive research leaders."

In May of 2015, Klenke was named director of the Vertically Integrated Projects (VIP) program that connects VCU with 15 other prestigious university members that make up the VIP Consortium, which is driving a cutting-edge approach to undergraduate engineering education. This multi-year program addresses large-scale projects and needs with teams of undergraduate students collaborating with faculty, graduate and postdoctoral students. VCU is using $270,000 in seed funding from the Helmsley Charitable Trust, as well as a $1 million repurposed endowment from the Altria Group to expand VIP projects.

PROGRAM EXPANSION

There are currently three VIP projects at VCU. By fall 2017, Klenke expects to have three more VIP projects up and running. Each VIP project team has a faculty mentor. The teams document daily activities and create tutorials and lab exercises for knowledge sharing and speedy onboarding resources for new team members. At any time, faculty can submit proposals for new VIP projects. Klenke evaluates whether the proposals identify relevant problems that encourage new industry partnerships.

"The VIP program is an excellent way for students to feel a part of the School," said Klenke. "Students are not here to just learn in a regular class and be lectured at. They are here to be part of a team to help the School move forward. As faculty, you have teaching and research. If you can bring those two together, I think it makes it all more rewarding."

MEET VIP TEAM COLLABORATIVE UAVS

UAVs are the most dynamic growth sector of the international aerospace industry. In the next three to four years, the Unmanned Vehicle Systems International predicts there will be more than 70,000 jobs and an economic impact of more than $13.6 billion in U.S. industry. The 20-member VIP team's research led by Klenke focuses on flight control and data payload systems. This includes working with multiple UAVs that use complex algorithms and artificial intelligence techniques to manage themselves as they perform their missions with minimal intervention by ground-based operators.

Freshman electrical and computer engineering student, Matthew Gelber, is tasked with creating a safety dashboard to monitor flight direction, wind and plane speeds, tilt and other factors. "I was really intimidated when I first started on the project. I had no experience," admitted Gelber. "But, I'm learning so much from our upperclassmen and I'm excited to one day become a mentor for incoming team members."

Even Herve Iradukunda, a senior electrical and computer engineering student, believes he's grown a lot through working with the project team. "You constantly get exposure to things you might not experience in the classroom," said Iradukunda. "More than that, I get to see how other people approach problems and that helps me refine my thought process." Iradukunda developed a secondary application that processes images taken by in-flight UAVs and can characterize each image via factors such as shape, color and geolocation.

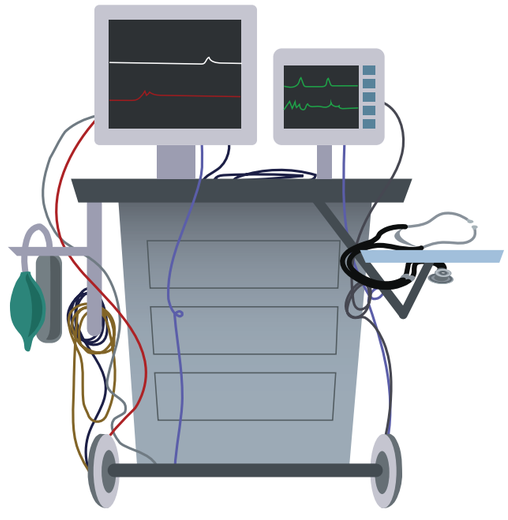
MEET VIP TEAM ENGINEERING CRITICAL PATIENT CARE

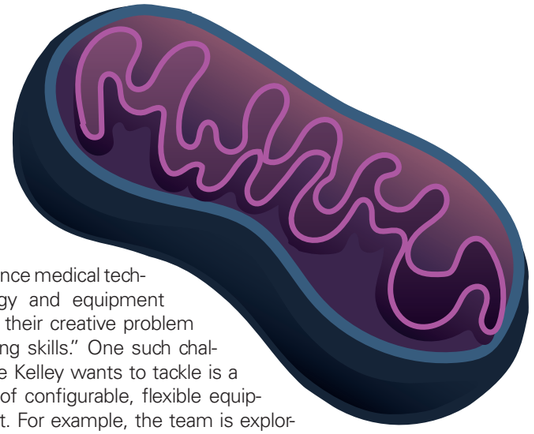
The working conditions and equipment for anesthesiologists have changed very little since World War II, according to Ben Ward, Ph.D. and associate professor. Ward, who's leading this VIP team, recalls troubling observations he made while watching a heart surgery. "What struck me about what I saw was how structured and orderly the work environment was for the surgeons. However, anesthesiologists had to work around tangled and crossed hoses, tubes and wires."

Ward's transdisciplinary team of nearly 20 students will develop a training application for mobile devices and create new equipment designs to help anesthesiologists, technicians and nurses better manage patients in more ergonomic workspaces. "Engineers have this 'just do it' mentality. I am amazed at how quickly the team can conceptualize and deliver," said Coffee Bourne, one of four nurse anesthesia Ph.D. candidates on the team.

Unlike current training programs that require expensive technology to run, Bourne envisions the mobile application to be an easily accessible game where users can learn and compete against one another via "choose your own adventure" simulations. Users will get overview lessons about various topics. Next, they'll be prompted to pick the best way to approach a task based off what they've learned previously. Users are then told whether they chose the best approach, and if they chose incorrectly, they're given more information as to why they did not choose the most appropriate course of action.

"The VIP program allows us to share the challenges anesthesiologists face with a fantastic group of young, excited engineers," said Jessica Kelley, another nurse anesthesia Ph.D. candidate. "I am so thrilled to see how they can help us advance medical technology and equipment with their creative problem solving skills." One such challenge Kelley wants to tackle is a lack of configurable, flexible equipment. For example, the team is exploring designs for a transducer holder with a universal clamp that can move up and down as needed, as patients transition from pre-op to surgery. Ultimately, the team believes their efforts can drastically improve the standard of patient care, while also advancing process efficiency and reducing equipment costs.





MEET VIP TEAM BIOENERGETICS

According to the *Journal of American Medicine*, 78.6 million U.S. adults are obese. Shilpa Iyer, Ph.D. and research assistant professor of chemical and life science engineering, believes bioenergetics is at the core of improving public health concerns such as obesity. "We need to provide people of all ages with the science basics to reinforce healthy living habits," said Iyer, who has focused her research efforts on bioenergetics since 2006.

Bioenergetics is all about how the body creates, processes and uses energy within the body. Building off a prior partnership with VCU's School of the Arts, Iyer has assembled a team of eight engineering and art students to create various interactive and visual tools to teach others about bioenergetics and health issues related to energy deficiencies.

"I'm in an environment where I get to see a completely different way of learning, processing information and communicating," said Benjamin Leach, a senior computer science student. The collaboration with the art students has forced Leach to develop an entrepreneurial mindset. "I have to understand an audience and their needs. I need to know what the best platforms are to deliver a message and be conscious of the words I choose to best reach our different target audiences."

Likewise, Matthew Woolman, the team mentor from the School of the Arts, has seen art students picking up on the importance of precision, diligence and idea testing from the engineering students. "I see the engineering and art students pushing each other in powerful ways. Together, these students can create accessible and entertaining ways to arm the masses with the information they need to make healthy choices."

Fun Fact #2: ***As a final gut-check when validating the School's founding year, a group reviewed a tear-away calendar that was kept by one of the School's early hires. That hire still works for the School and leads its IT department.***

Bridging Expertise For Innovations In Health Care Products

The Institute for Engineering and Medicine promotes collaboration to ignite new health solutions.

The VCU Institute for Engineering and Medicine (IEM) is entering a new phase to enhance collaborative research and development across engineering, medicine and life science disciplines.

Key components of the IEM's mission will be enhancing collaborations in defining clinical needs, creating solutions and engineering development of new products for health care technologies. Combined with capabilities at VCU Health and the VCU Office of Research and Innovation, VCU's Innovation Gateway will ensure innovations resulting from these collaborations are protected as intellectual property. Additionally, the IEM will host educational symposiums and programs to identify opportunities, spark new ideas and foster connections with businesses.

FOSTERING COLLABORATIVE RESEARCH, DEVELOPMENT AND INNOVATION

"Transformational advancements can be accomplished when we harness the full potential in medicine and engineering talents within VCU. We have excellent Schools of Medicine, Dentistry, Nursing, Pharmacy and Allied Health at the VCU Health campus," said L. Franklin Bost, executive associate dean of the School of Engineering. Bost was appointed the IEM director in August of 2015. His industry and academic experience in medical product development, as well as international business acumen and commercialization expertise will push the program forward and allow it to thrive.

Currently, many engineering faculty, graduate and undergraduate students collaborate on research and development projects with our VCU Health colleagues. "The IEM will focus on enhancing and expanding these important relationships for the benefit of patient care," added Bost.

Bost is excited to take VCU's entrepreneurial spirits to the next level. "Together, we can deploy accessible health solutions for a broad range of users to benefit society's quality of life," said Bost. Planning for future activities include a visiting scholars program, a "home base" for special centers such as the VCU's participation in the Atlanta Pediatric Device Consortium, centers for pharmaceutical engineering, human factors and rehabilitation engineering, grant administration support, enhancing relationships with industry companies and other external entities.

Fun Fact #3: ***After reaching a stalemate on the Institute of Engineering and Medicine's architectural design, a frustrated assistant began sketching on a tattered napkin. That sketch would end up being the institute's design.***

Three top goals for the IEM are to:

1. Become a robust center for interdisciplinary translational research, product development and deployment from research in engineering, medicine and life science.
2. Increase funding of interdisciplinary research programs at VCU through grant-sponsored initiatives and collaborations with industry partners.
3. Advance the implementation and commercialization of new technologies, which will create more accessible and affordable health care solutions.

The School of Engineering's Senior Capstone Design and the Vertically Integrated Projects (VIP) programs have multiple medical-oriented design and development projects proposed by clinical faculty. These areas include: cardiology, radiology, obstetrics and gynecology, otolaryngology, dentistry, pharmacy, surgery, rehab engineering and anesthesiology. These are multi-disciplinary teams developing applied solutions to enhance health care practices and patient care.

Biotech Eight — a facility located within the Virginia Biotechnology Research Park — houses IEM offices and conference rooms, as well as pharmaceutical engineering, human factors and rehabilitation engineering labs.

Engineering Experiential Learning

VCU's Cooperative Education program builds resumes with personal and professional development opportunities.

CO-OP

Engineering skills alone are not enough for success in the 21st century. To continue arming students with the experience to meet the demands of industry, John Speich, Ph.D. and associate chair of the Department of Mechanical and Nuclear Engineering, was tapped as the School's Cooperative Education (Co-op) program director. "We're in the process of formalizing our program, and we want to do it right," said Speich. He's currently working with students, faculty, employers and the School's Career Services team to cement a solid foundation for minimum requirements for eligibility, completion and guidelines for industrial partners.

Speich and other program planners envision prerequisite curriculum to aid students' transition into the co-op environment. "A professional development course will expose interested students to job finding, interviewing, communication and workplace success concepts with interactive sessions to help them land a co-op job and make the most out of their experience," added Speich.

HOW IT WORKS

Engineering students alternate periods of traditional curriculum with industry fieldwork, and they are often paid between $17 and $25 an hour. Unlike internships, the Co-op program offers students long-term opportunities to dig in at a business and seek to attain individualized learning and performance objectives. "Exceptional technical skills are not enough if you can't work well with people. That's why we want to see students learn to apply their technical skills productively, while developing soft skills with the aid of a mentor within the business," said Speich.

With clear learning objectives, students will grow in experience and responsibilities as they move through different co-op rotations. Along the way, students will be asked to document their learning and reflect upon how the experience is affecting their growth and their career goals. Feedback will help participating businesses enhance their mentorship capabilities. The insights will also be used to refine the overall Co-op program.

PROGRAM TAKES SHAPE

Students are already actively participating in the Co-op program.

Rachel Judge, a junior chemical and life science engineering student, is currently working for Neutrogena in Los Angeles, CA. She analyzes data and prepares reports to help the Supply Chain Management department investigate product risks and manage inventory. "This experience has pushed me out of my comfort zone," said Judge. "I have to keep up with strict deadlines and work with several cross-functional partners."

Soon, Kathryn Hutchins-Duda, a sophomore electrical and computer engineering student, will begin her first rotation with BMW. "I've never been away from Virginia," admitted Hutchins-Duda. She has gained a lot of lab experience via the Vertically Integrated Projects (VIP) program. Now, she wants to experience the opposite of the fluid, work-at-your-own-pace environment. "BMW has a well-established Co-op program, which I imagine will expose me to a more structured environment than the research lab. I like the idea of getting a taste for multiple environments early in my time as an undergrad, so I make the best decision for my future," added Hutchins-Duda.

DIVERSITY MATTERS

RAMS IN ENGINEERING

"Engineers help people accomplish what they want to accomplish in life. That's why the VCU School of Engineering needs and embraces people from all walks of life and types of backgrounds. We're building a sense of community and belonging to help our students, faculty and research partners become better innovators, better creators and better people through diverse partnerships." **— Lorraine Parker, Ph.D., director of diversity and student programs**

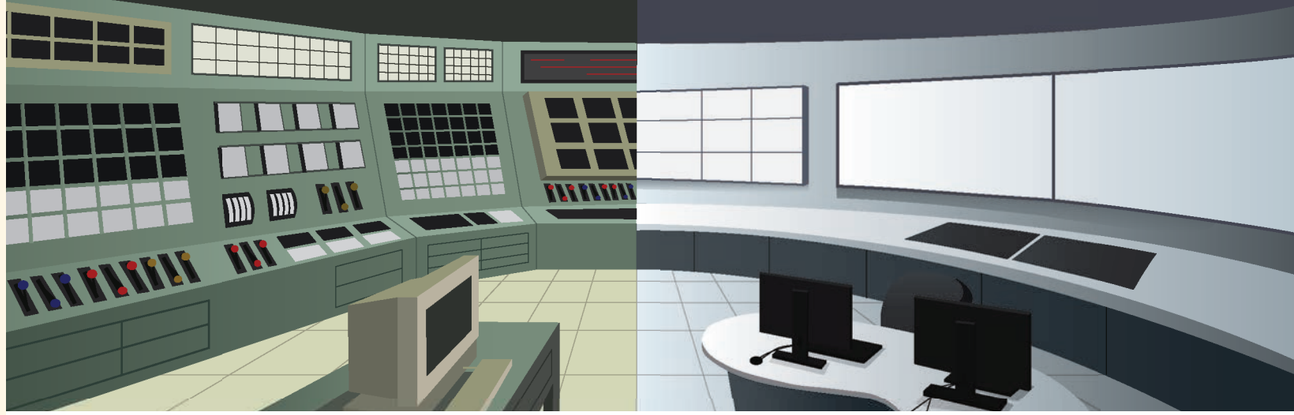
"By learning that differences are something to be embraced, we learn to respect one another. We eliminate ignorance and produce an open environment in engineering that spills over into the workplace and ultimately the globe. I'm a mentor in the VINE [Vertically Integrated Networking in Engineering] group designed to build connections and community between female students and their respective majors." **— Megan Davis, senior computer science engineering student**

"There are so many different viewpoints in the world, and people approach problems from a multitude of unique perspectives. This is not just true for engineering but in life. An appreciation for the differences we all have allows us to grow in our outlook and perspective. I am president of our oSTEM [Out in Science, Technology, Engineering and Mathematics] chapter, which promotes LGBT advocacy and affirmation for STEM students. We strive to make a significant difference in the lives of LGBTQ faculty, staff and students at VCU." **— Jacob Jaminet, junior bioinformatics student**

"Understanding that we all have our differences — ranging from ethnicity to religion — and that those differences are okay is critical. It's perfectly okay that the person next to you is different. Socializing and joining clubs at VCU really connects you with our growing communities. It is amazing to see how much the School of Engineering has grown in such a short period of time. I'm really proud that we brought the SHPE [Society of Hispanic Engineers] to the VCU campus recently. As president of that organization, I'm trying to build a niche familia within the School of Engineering community that will open doors and new opportunities for minority engineers of all ages." **— Andrew Rubio, senior mechanical and nuclear engineering student**

"VCU is a melting pot where people of different intellectual backgrounds work together for a common or uncommon good. In fact, it's that diversity that made me chose the School of Engineering. There's something amazing when people of all ages and experience levels can come together and share wisdom and ideas. Part of being a competent engineer is knowing how to work with a wide variety of people. I'm president of NSBE [the National Society of Black Engineers]." **— Derrick Williams, senior electrical and computer engineering student**

Fun Fact #4: ***The School of Engineering has more than 20 engineering-specific student organizations for individuals to explore their passions and find close-knit communities.***



Making The Case For Modernizing Nuclear Energy

Two U.S. Department of Energy grants put VCU at the forefront of advancing nuclear plant instrumentation verification and testing standards and technologies.

The Department of Energy's Nuclear Energy Enabling Technologies program has awarded VCU and its collaborative research partners two grants totaling more than $2 million in funding to support two distinctly different approaches to solve the same problem regarding nuclear technology advancements: the safe and secure modernization of nuclear power plants. According to Carl Elks, Ph.D. and assistant professor of electrical and computer engineering at VCU, pain points relating to entrenched legacy nuclear power technologies are starting to build up. There is now an urgency to replace these aging systems with newer digital or microprocessor-based technologies — though the nuclear industry has limited experience with modern information age technology. Taken together, these challenges impede modernization of existing nuclear power plants.

CULTURE OF MAINTENANCE SEEKS CHANGE

The U.S. Nuclear Regulatory Commission demands that all critical systems have "Defense in Depth." That is, failures must be detected and tolerated by different means. In practice, devices must either be diverse in nature or proven to have 100 percent testability coverage to eliminate common cause failures (CCF), which is where a single failure or condition affects the operation of multiple devices. Even though devices with embedded digital technologies can offer improved performance, flexibility and reliability, the nuclear power industry has been slow to adopt them because of regulatory uncertainty, implementation complexity and concerns over CCF.

A FRAMEWORK FOR INDUSTRY CONVERSATION

Under the first contract, Elks will work with long-time friends and colleagues at the University of Tennessee and the Ohio State University to develop and evaluate novel model based testing methods for digital systems that can satisfy demanding safety criteria and address potential CCF vulnerabilities. The group's testing framework will empower testers with guidance on how to select relevant metrics, create test cases and validate critical device safety attributes such as resilience and fault tolerance.

"We want to keep the NRC, academics and industry representatives and regulators connected to what we're learning," said Richard Wood, Ph.D. and professor at the University of Tennessee. "With our data-driven methods, we can start a meaningful conversation about technology approaches and applications that can impact industry standards."

ANOTHER GRANT, A DIFFERENT APPROACH

Under the second contract with DOE, Elks will partner with Matt Gibson, a senior technical leader at the Electric Power Research Institute (EPRI), to create simple digital devices that meet current regulatory standards. "Instead of cobbling together low-cost, commodity equipment pieces that were never optimized for safety to ensure integrity, we must create tailored technologies," said Gibson. The key components of the research will be the design and development of a new architectural approach called SymPLE, which is a concept where verification requirements are "baked in" from the very beginning — allowing verification to be integral to the development process. In addition, this effort will investigate the use of micro-electronic mechanical systems (MEMS) that are inherently diverse with respect to digital and analog technology. The MEMS devices will be fabricated by Gary Atkinson, Ph.D. and associate professor of electrical and computer engineering, at VCU's Wright Virginia Microelectronics Center.

"Regardless of the approach to spark rapid innovation, the industry is ready for change," said Elks. "I want people to have the technology and testing guidance they need to be confident in implementing new technologies, recognizing the associated benefits that can help nuclear energy become a more dominate force in the future."

Fun Fact #5: ***The Mechanical and Nuclear Engineering program is the School's largest department, with 574 undergraduates and 68 graduate students enrolled.***

SURVEYING SMALL WONDERS

Nanotattoos, skin-like electronic systems, show potential advancements for smart home health care.

Woon-Hong Yeo, Ph.D. assistant professor of mechanical and nuclear engineering, has developed a suite of novel electronic systems that can be mounted on the skin and/or inserted in the oral cavity. Working with him is a small army of collaborators that include all the departments within the School of Engineering, faculty from the VCU Schools of Dentistry and Medicine, as well as various outside institutions. Additionally, this research team has collected nearly $1 million in external grants and internal supports to continuously develop skin-like electronic systems.

Before making these strides, Yeo had only a simple insight and simple inspiration. "The majority of health monitoring devices are obtrusive and bulky," said Yeo. "Think about the existing ECG monitors. They're made from hard and rigid metals and plastics, but our skin is curvy and soft." Thus, these devices require conductive gels and taping to fix the gaps and affix to the skin. Critical information, however, can become compromised when the gels degrade and evaporate over time. Plus, the taping causes discomfort and skin irritation.

THE NANOTATTOO IS BORN

For Yeo, the path toward the next generation of smart health and monitoring devices began with a wood stick. In its natural form, a large stick is rigid. But, if a stick gets shaved down enough, it becomes a flexible paper that maintains durability. "So I wanted to pick another material to transform in the same way as wood. I chose silicon and other metals to construct electronics," explained Yeo. From there, Yeo fashioned nanoscopic structures that were flexible, stretchable and designed open-mesh, meandering shaped electronics to follow the mechanical and material characteristics of the skin. He calls them nanotattoos, because the nanomaterial-based system can be worn on the skin without extra tape or adhesives — just like a temporary tattoo. And, as you're about to read, they have a lot of different applications.

FITBIT FOR THE MOUTH

In partnership with MEDARVA Research Foundation and Richard Constanzo, Ph.D. and director of research in the Department of Otolaryngology — Head and Neck Surgery, Yeo has developed an intraoral nanotattoo with sensors that monitor salt or sugar intake. People following strict dietary guidelines and others with a decline or complete loss in their sense of taste can use the device to evaluate their eating habits. In nursing homes and other care facilities, health care professions can receive notifications when patients exceed dictated doctor-recommended thresholds for their favorite salty or sweet snacks.

TAKING FLIGHT

Muscle movements transmit commands that can control prosthetics, robots and even quadcopters. For example, embedded sensors within the nanotattoo on the skin (forearms) interpret muscle movements such as the rotation of wrists, squeezing, and motions to the left and right as different commands to control a helicopter, purely based on human activities.

READING MINDS

The nanotattoo records brain signals on the mastoid and auricle, which allows wearers to interact with computers using their thoughts for a text speller, instead of keyboards. For example, if a person looks at a display of letters on a computer screen, the computer can identify which characters the wearer is thinking of and will spell out what the wearers want to communicate. This application has great potential for people with speech or language impairments.

EVERYDAY ECG WARES

Instead of using plastics or silicone rubbers, this ECG monitoring sensor uses a fabric, and is ideal for long-term monitoring needs on the chest. The small sensor can be mounted to the body and is stretchable, reusable and washable.

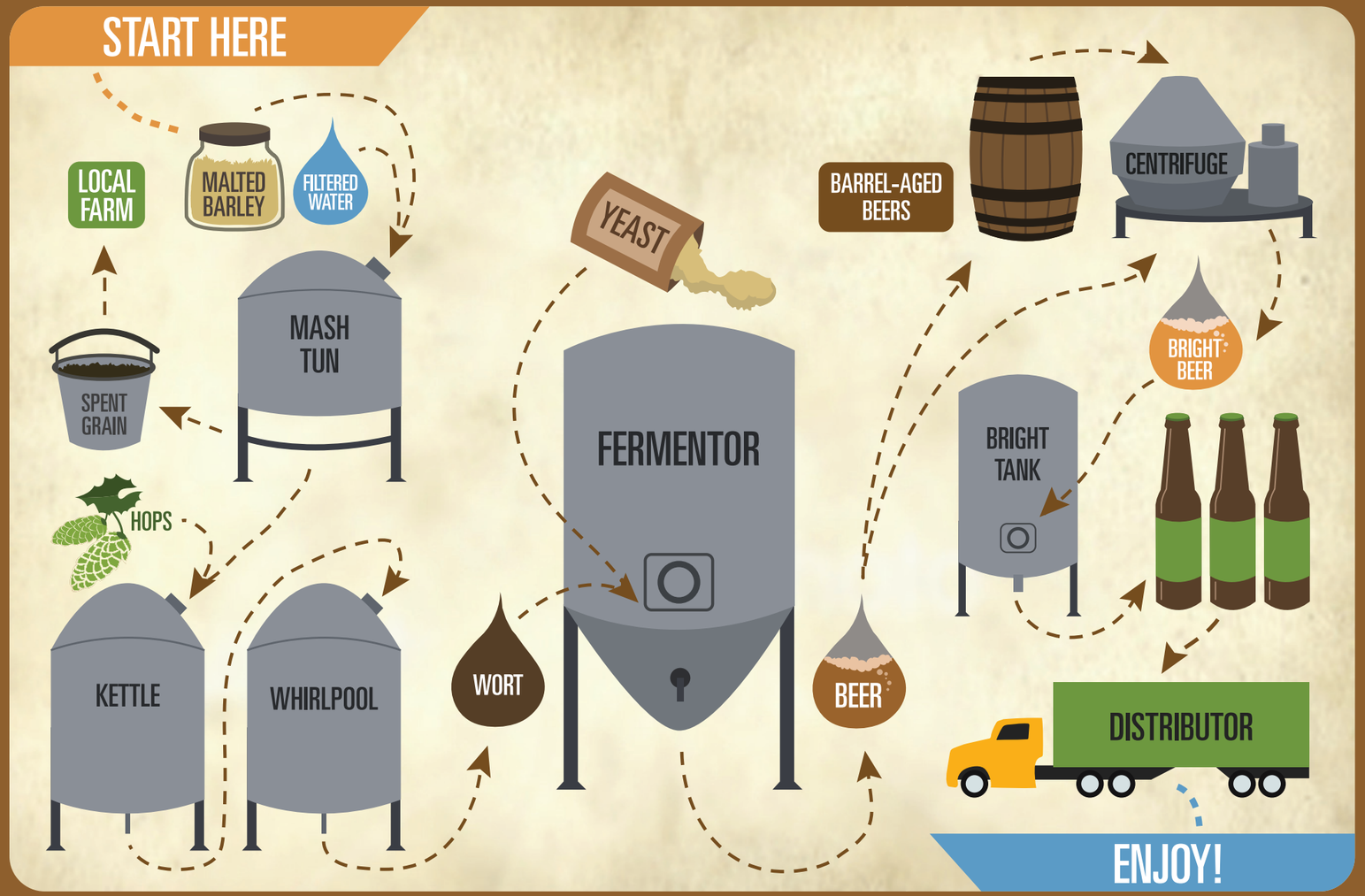
DATA-DRIVEN WOUND MANAGEMENT

Health professionals rely on subjective cues to evaluate cutaneous wound healing. During the healing process, they look to see whether skin color has become red or if excess fluid or swelling is present. Here, this nanotattoo application offers a quantitative, continuous measurement of the skin temperature and hydration of wound tissues.

Fun Fact #6: ***The Engineering West Hall building houses its own back-up generator. The School's founders wanted to ensure severe weather conditions would never interrupt research progress.***

Enhancing Breweries' Liquid Assets

Sparking student creativity and new partnerships in unexpected ways.



"It's exciting to hear about algae that makes biofuels and bugs being used in pharmaceuticals, but there's something special about engineering and beer," said Adam Fisher, Ph.D., who's spent the last two and a half years participating in a collaborative research program with local breweries. Little did anyone involved know, this program would become a springboard for new industrial and academic partnerships. Stephen Fong, Ph.D., associate professor and vice chair of the Department of Chemical and Life Science Engineering, started the program to give students process-engineering experience. But, it was easier to dream up the program than to get it off the ground.

When Fong first approached Kate Lee, director of quality assurance at Hardywood Brewery, he was met with skepticism. "I didn't know what chemical engineering was," said Lee. "I had to look it up," she chuckled. Fong, however, was persistent. To him, it's not enough to tell students that engineering can happen in unexpected places, he wanted to show students via the hands-on experience the brewery offered. Students started off with brewery tours where they learned the basics of the brewing process. It didn't take long for inspiration to set in, which culminated in the students enthusiastically pitching all the ways a little chemical engineering and science could impact Hardywood's processes and products.

THE PITCH AND PRACTICAL APPLICATIONS

Glow in the dark beer and beer that tastes like bananas without actually using bananas were some of the wilder items Lee recalled the students pitching. While neither of those items were implemented (maybe one day), she and Hardywood co-founder, Patrick Murtaugh realized great opportunities in advancing the partnership with VCU. For example, Fong's team introduced Hardywood to DNA sequencing to monitor and identify beer-spoiling bacteria such as pediococcus and lactobacillus. The traditional, manual process is done through plating and takes between five and seven days. DNA sequencing reduces that processing time to four hours and provides direct identification of individual organisms.

The other big benefit gained through the partnership is access to high-end equipment. Hardywood tapped Fong's team to perform alcohol analysis via high-performance liquid chromatography, which allows the team to separate certain chemical compounds out of a liquid. When they isolate the alcohol, they can quickly confirm the alcohol content. Various states require independent testing and analysis, which can be costly for small breweries. "The team lets us know when we're off track, so we don't waste time and resources moving forward with an inconsistent batch," said Murtaugh. Beyond that, Fong's group can help with yeast identification. "Yeast is everything," added Murtaugh. "If we can identify yeast that's faster to ferment without affecting flavor we can turn out more product, be more responsive to our market and make more efficient use of our space."

WHAT'S BREWING NEXT

In addition to devising new ways to extend VCU's growing partnership with Hardywood, Fong has been approached by other breweries to help improve the consistency and quality of their products — including the nation's ninth-largest craft brewer, Stone Brewing Company. Even Virginia Governor, Terry McAuliffe, has taken notice.

Fong was invited to speak at a kick-off event for the governor's Virginia Economy Bioscience Initiative. "We want to better commercialize the research folks are doing at institutions all over the Commonwealth and turn them into economic drivers for the state," said Virginia Secretary of Agriculture and Forestry, Todd Haymore. "The work that professor Fong is doing with the craft beer industry is a great example of the type of collaboration that is possible." At the bioscience event Gail Johnson from Dabney S. Lancaster Community College approached Fong. Now, the two are working toward the creation of fermentation track program with two years of curriculum in the community college setting that has transferable credits to VCU.

CLOSING TIME

A lot of breweries approach Lee for quality assurance advice. "As breweries, we have to make quality beer to maintain our reputation, keep our customers and prove our worth. One thing I always tell people who want to establish sound programs is to look for ways to partner with a university. It's the best thing they can do," said Lee.

We can raise a glass to that.

VCU Researchers Discover Gene Affecting Skeletal Development

A targeted mutation in sperm gene SPAG17 leads to bone malformations in mice.

An interdisciplinary research team lead by the deans of VCU's School of Engineering and the School of Medicine has for the first time explained the association between human height and a specific protein-coding gene found in sperm.

Although the sperm gene SPAG17 has been linked to human height in previous studies, it was not clear how the gene influences linear growth and skeletal development until now. VCU researchers found that a targeted mutation in the gene leads to skeletal malformations in mice such as a shortened hind limb length, fused segments of the sternum and defects in bone mineralization.

Humans have the SPAG17 gene, and genetic variants in that gene are associated with stature. "The mouse tells us the relationship between SPAG17 and bone length, which would explain why there is an association with height," said Jerome F. Strauss III, M.D., Ph.D., dean of the VCU School of Medicine.

Strauss is a professor in the Department of Obstetrics and Gynecology, and researchers in his lab encountered the SPAG17 gene while they were investigating genes that affect male infertility. SPAG17 is one of the genes that controls sperm motility, so the researchers created a mouse that does not produce SPAG17, expecting to find a phenotype that exhibited male infertility.

"It turned out that this animal had other defects that we hadn't anticipated," said Maria Teves, Ph.D., who is a postdoctorate researcher in Strauss' lab and was the first author in a study titled "SPAG17 Deficiency Results in Skeletal Malformations and Bone Abnormalities." "The animals died within 12 hours of birth, their tibia and femur were shorter than the wild-type mice, and they had skeletal malformations and bone mineralization defects."

CALLING IN RESEARCH REINFORCEMENTS

That was when Strauss enlisted help from Barbara D. Boyan, Ph.D., dean of the VCU School of Engineering. Boyan specializes in musculoskeletal biology.

"Researchers from Strauss' lab could see that a problem had occurred, but there are many techniques that we use in biomedical engineering that let us narrow in on what the defect is," Boyan said.

Researchers within Boyan's lab analyzed the shapes of the bones and the way they developed in the embryos. They also did cell culture studies in which they isolated cells from the defective animals to see if the defect in limb length was due to a fundamental alteration in their ability to form bone.

Ultimately, researchers from labs at both schools concluded that the bone malformations in the mice were because of a targeted mutation of the SPAG17 gene and that bone-forming cells also express this gene.

"This was an unexpected finding," Boyan said. "It is not a protein that anybody in my field would have thought to look at."

Researchers emphasize that more studies are needed to fully understand how SPAG17 affects bone and bone structure.

"Our findings are very important because they have revealed functions for SPAG17 that extend the role of this gene to regulation of skeletal development, growth and mineralization," Teves said. "This was just the beginning. The next step is trying to find the mechanisms of why this gene influences skeletal development."

Step inside VCU's virtual reality program that's data mining actionable ways for people to better interact with the real world.

Since joining VCU in 2014, Milos Manic, Ph.D. and professor of computer science engineering, has secured more than $300,000 to set up a virtual reality program at the School. Ironically, the group is focused on tackling real-world problems through simulated environments. "In academia, we tend to go into abstract, theoretical thinking," said Manic. "Those theories don't always hold up in the real world. Through constructed virtual realities, however, we can take into account real-world factors. We can embrace uncertainty, constraints and data polluted with human error to solve problems within reasonable timeframes."

Manic calls his team the Modern Heuristics Research Group. The name alone points to the group's collective desire for pragmatic, untraditional approaches. Luckily, this type of attitude was just what researchers in the U.S. Department of Energy's Idaho National Laboratory were looking for. Researchers within the heavy simulator laboratory discovered a 30 percent discrepancy in fuel consumption across different bus drivers travelling along the same routes with the same equipment.

DATA MINING VIRTUAL SCENARIOS

Under simulated, real world conditions the researchers explored how drivers engage with each other, technology and their driving environment. Real bus drivers would navigate different driving scenarios projected on a windshield, while researchers pulled in mountains of data insights about how driver participants behaved in response to changes in road conditions, weather and routes.

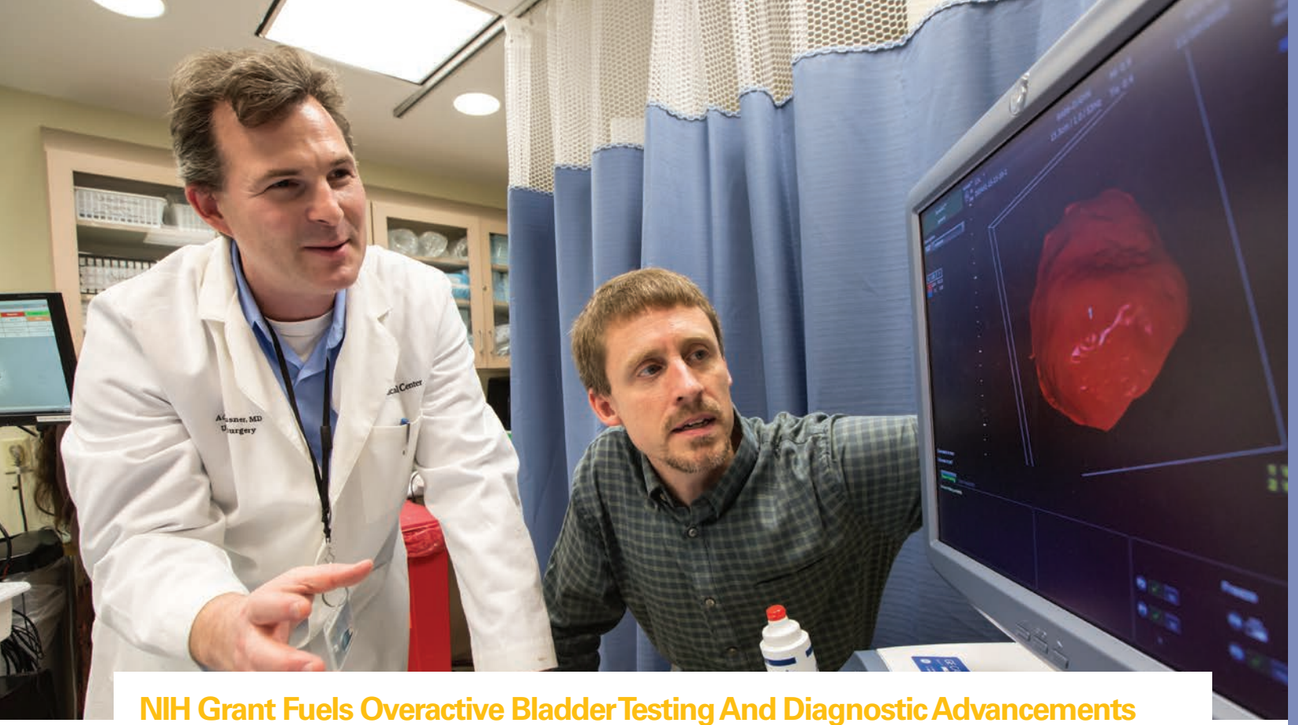
"We were looking at more than 100 different parameters — tire pressure, engine output torque and gas pedal position are a few examples," said Manic. Ultimately, Manic's team developed an Intelligent Driver System (IDS) component, which has the ability to learn, adapt and optimize individual driver performance based off their driving habits. The system would then give drivers ways to maximize their fuel efficiency and safety, such as when to accelerate and when to decelerate. These driving prompts were delivered via an unobtrusive, small display device.

FUTURE STATES

VCU's partnership with Idaho National Laboratory is merely one example of the types of predictive tools and training opportunities that exist via virtual realities. "Imagine a novice surgeon being able to walk into the operating room and hone their abilities under simulated conditions. What about a nuclear reactor operator who can learn and fail, without severe consequences?" Added Manic. "The applications for virtual reality programs that can help people navigate the real world with renewed confidence are endless," added Manic.

The Modern Heuristics Group will continue its journey into virtual realities to improve energy efficiency, cybersecurity and human-machine interactions. The group expects to move into an expanded laboratory space in early 2016.

Fun Fact #7: ***The Computer Science department recently received a #3 ranking on the Top Computer Schools in Virginia list.***



NIH Grant Fuels Overactive Bladder Testing And Diagnostic Advancements

Researchers from VCU's School of Engineering and School of Medicine join forces to analyze the bladder like never before.

Under the $1.7 million NIH grant, VCU researchers hope to implement testing techniques that will allow them to identify subsets of overactive bladder, and really understand the mechanics of what's driving each subset. These targeted diagnoses can aid the creation of tailored medical approaches to treat overactive bladder.

Overactive bladder affects nearly 20 percent of the worldwide population. Common symptoms translate into self-imposed restrictions in activities to avoid leakage from incontinence as well as sleepless nights plagued by a frequent sensation signaling a need to empty the bladder. "Overactive bladder can significantly impact one's quality of life. When patients come seeking solutions to win back life as they knew it, we, as medical professionals, have limited treatment and diagnostic options," said Adam Klausner, M.D., associate professor and director of Neurology, Female Urology and Voiding Dysfunction at the VCU School of Medicine.

A HOLISTIC APPROACH

To improve standard bladder testing, also known as urodynamics, Klausner needed significantly more data about the bladder. That would take a team with the breadth and depth of expertise to ensure a holistic approach to the research. Real progress wasn't achieved until he found John Speich, Ph.D. and associate chair of the Department of Mechanical and Nuclear Engineering, through a mutual mentor. "Professor Speich was helping our mentor Paul Ratz, a professor of biochemistry and pediatrics, design equipment to test the bladder," said Klausner.

Suddenly, Klausner had the ingredients for powerful collaboration: a biochemistry expert who understood the basic science of the bladder, a motivated engineer to create techniques to break down and test different bladder mechanics, and Klausner with clinical expertise as a neuro-urologist. An initial $50,000 grant from VCU's Presidential Research Quest Fund, enabled the team to gather the preliminary data needed to support an NIH research proposal to make improvements to bladder testing that has seen little advancement over the last 50 years.

OVERDUE DIAGNOSTIC AND TESTING ADVANCEMENTS

Current urodynamics tests do not evaluate the bladder muscle itself and use invasive catheters to measure bladder pressure, which might not be the best focus for objective assessments of overactive bladder. The pressure in the bladder often increases very little during filling. "The bladder is this amazing biomechanical structure. For example, bladder cells can stretch up to seven times their original length, depending on the bladder volume," said Speich. "There's so much more we can look at to better understand the underlying physiology and functions of the bladder."

The team will use 2-D, 3-D and 4-D ultrasound technology to study the shape, muscle thickness, tension and other biomechanical parameters that can directly affect the bladder during filling. Additionally, Speich and Klausner created a novel "urgency meter" to record real-time bladder sensations. Other research members include an engineering postdoctoral fellow, several medical students and residents, a radiologist with ultrasound technology expertise and a research coordinator to help with enrollment and project outreach.

*Research reported in this publication was supported by the National Institute of Diabetes and Digestive and Kidney Diseases of the National Institutes of Health under award number R01DK101719.

Cleaning Up Crude Oil Spills

Dispersant formulated from soybean lecithin will address most of the challenges of current traditional liquid dispersants.

Clean up efforts from massive oils spills such as the Deepwater Horizon that occurred in the Gulf of Mexico showed negative impacts to humans and aquatic life. In response to those findings, researchers from VCU sought to create a less toxic oil dispersant alternative. In March of 2015, the researchers, led by Ram B. Gupta, Ph.D., associate dean for research and a professor of chemical and life science engineering published their initial findings in the ACS Sustainable Chemistry & Engineering journal. The research team found that lipid components of soybean lecithin were able to break down oil in water as well as or slightly better than two commercial chemical dispersants.

Soybean lecithin is biodegradable and also speeds up bacteria activity by providing nutrients such as phosphorus and nitrogen to the bacteria. According to Gupta, lecithin will not only clean up the oil but it will also enhance its degradation since the natural bacteria, using nutrition in soy, will rapidly feed on the dispersed oil. "The initial results from modifying the chemical structure of soy lecithin yielded 72 percent effectiveness for cleaning up oil. Today, our refined formulation has achieved 95 percent effectiveness," said Gupta.

COMMERCIAL DISPERSANT COMPARISONS

Soybean lecithin is a natural food-grade surfactant and is not toxic, which addresses most of the challenges of traditional liquid dispersants. "The main components in commercialized dispersants such as Tween 80 and dioctyl sodium sulfosuccinate are up to 36-times more expensive than dispersants formulated with soybean lecithin," said Emmanuel Nyankson, a postdoctoral scholar who works in Gupta's lab.

Crude oil production is at record levels in the U.S. According to the Association of American Railroads, there were more than 8.5 million barrels produced per day in 2014 — and with more oil being produced and transported comes a higher probability for oil spills.

The Environmental Protection Agency must approve the dispersant alternative before the oil industry can embrace it and adopt it. Until then, the VCU research team will continue looking into ways to lower application costs and further enhance the soybean lecithin formulation. "We need a design that can be easily distributed via aircrafts for sea application. The formulation should also work for both cold and warm temperatures to accommodate sea and land applications," added Gupta.

Fun Fact #8: ***Nearly 80 percent of undergraduate chemical and life science engineering students are actively participating in research initiatives.***

Expanding Access To AIDS Drugs

VCU engineering professor receives additional $5 million grant to find cheaper and more efficient ways to manufacture AIDS drugs.

With this grant, the Bill & Melinda Gates Foundation has invested nearly $10 million in funding to support a multidisciplinary project led by B. Frank Gupton, Ph.D. and chair of the Department of Chemical and Life Science Engineering. The project, Medicine for All Initiative, seeks to streamline drugs manufacturing to treat HIV and AIDS in developing countries. Research is being conducted in partnership with the Clinton Health Access Initiative and collaborators at MIT and the University of Washington.

This new phase of the Medicine for All Initiative builds on the project's earlier success achieved with a first-line therapy for the treatment of AIDS. "We are applying the same principles that we used to drive down manufacturing costs associated with nevirapine for these new drug targets," Gupton said. "The lesson that we're taking away from our initial work is that we must be on the right track and this new investment from the foundation just reinforces that."

Gupton's team will find ways to drive down the costs of manufacturing the AIDS drugs tenofovir and darunavir. "Over the lifetime of a HIV-infected patient, they may develop resistance. So they need to have these other drugs, such as darunavir, available as a backup," Gupton said. "But the problem …[with] second-line treatments is that the volume of supply can sometimes be smaller and so they can be prohibitively expensive for many patients."

BRINGING PHARMACEUTICAL ENGINEERING TO RICHMOND

Barbara D. Boyan, Ph.D., dean of the School of Engineering, said the school is proud of the innovative work being done by the Medicine for All Initiative.

"The School of Engineering is proud of the Gupton team and its role in improving the health and welfare of not only Americans but also the global community," she said. "Medicine for All is part of a larger VCU initiative that's brought pharmaceutical engineering to Richmond in a big way. We look forward to continuing the participation of our students', faculty's and staff's expertise to this endeavor." The larger initiative Boyan refers to is the creation of a pharmaceutical engineering Ph.D. program at VCU to forge new paths for drug candidates and improved patient treatments. The VCU Center for Pharmaceutical Engineering will be one of only two pharmaceutical-engineering focused sites available in the U.S., which will partner with the School of Pharmacy and the VCU Medical Center.

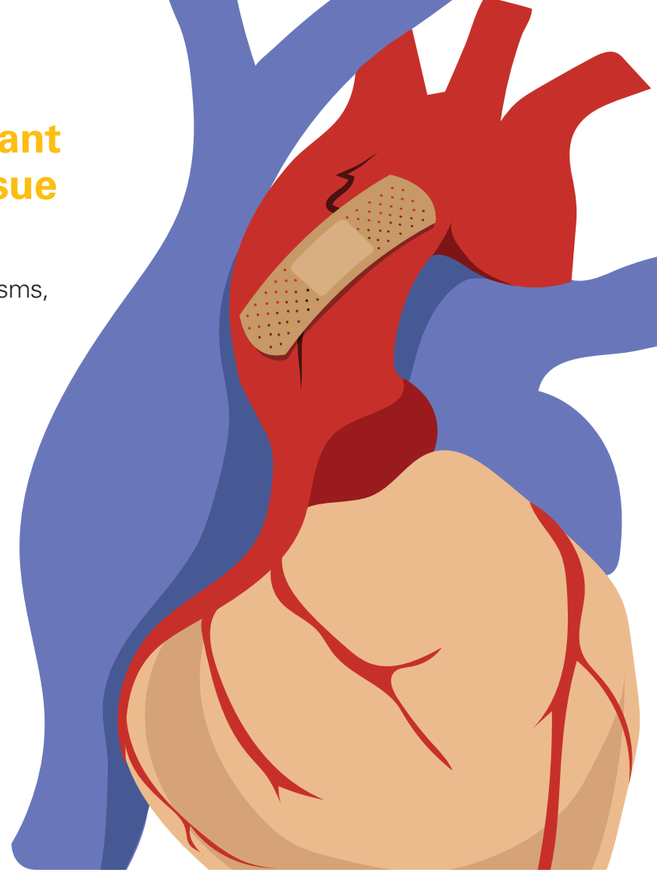
Alongside Gupton, the project involves several collaborators across the country, including Timothy F. Jamison, Ph.D., chair of the Department of Chemistry at MIT, and Brian Marquardt, Ph.D., head of the Center for Process Analysis & Control at the University of Washington.

"The really nice thing about this project is that from the time you come to a solution to a problem and when it actually gets implemented is a lot shorter than you often see in academia," he said. "Part of that is because we have this network of the foundation and the Clinton Health Access Initiative to facilitate these innovations and improvements out of our laboratory and into the marketplace."

Fun Fact #9: ***The original members of the School's Foundation painting took a local artist a year to complete. This piece depicts the original School's Foundation members and is located in the West Hall lobby.***

VCU And Cleveland Clinic Researchers Receive NSF Grant To Create Cardiovascular Tissue Repair Techniques

Researchers will explore ways to treat aortic aneurysms, which kill about 15,000 Americans a year.



The NSF awarded a three-year, $600,000 grant to aid a collaborative research effort between VCU School of Engineering and the Cleveland Clinic.

This project is an extension of an already three-year collaboration with VCU.

"It's such a pleasure getting to work with an expert in stem cell manipulation," said Anand Ramamurthi, Ph.D., director at the Cardiovascular Matrix Engineering Laboratory at the Cleveland Clinic.

Raj Rao, Ph.D., an associate professor in VCU's Department of Chemical and Life Science Engineering, is partnering with Ramamurthi, who brings more than a decade of cardiovascular tissue expertise to complement Rao's extensive stem cell background. Together, they'll explore tissue restoration techniques to treat abdominal aortic aneurysms, which, according to The Society for Vascular Surgery, kill about 15,000 Americans a year.

Without healthy elastic fibers, soft tissues lose their rubber-band like ability to stretch and snap back to their original state. Over time, the lack or disruption of elastin can cause structural weaknesses, and in the case of aortic aneurysms, artery ruptures with life-threatening internal bleeding.

"The way a lot of people are looking at regenerative medicine is to solely focus on either the use of stem cells or the matrices that provide structural support for all living tissues," said Rao. "What excites us about this research is identifying stem cell secretions that stimulate elastic matrix production and repair."

UNLOCKING THE PROTEIN KEY FOR TISSUE REPAIR

"What's so fascinating about elastin is that the vast majority of this protein that our bodies use was created either before or shortly after birth," said Ramamurthi.

To kick start elastin production, Rao and Ramamurthi will harvest the naturally occurring secretions stem cells produce to aid tissue repair. Then, they'll introduce those secretions into the damaged environments that are no longer capable of producing the same secretions.

The team is excited to use these secretions, which can be readily absorbed into the body without being rejected by the immune system, giving damaged tissues a better opportunity to thrive and elastin production to happen.

Rao will introduce testable versions of the secretions, which Ramamurthi will deliver via small polymer containers called nanovehicles into state-of-the-art models created by the Cleveland Clinic that simulate injured tissue scenarios. Both Rao and Ramamurthi will then evaluate how each secretion version affects elastin regeneration—and ultimately tissue repair. The team also plans to convert their research findings into actionable teaching opportunities for fellow researchers and students within their local communities.

"Through our NSF funded project, we hope to provide opportunities for students to learn the power and logistics of collaborative research, understand its principles and learn the skillsets underlying research in both stem cells and nanomedicine for cardiovascular tissue restoration," said Ramamurthi. He and Rao are targeting local outreach programs, such as the Richmond Minorities in Engineering Partnership in Virginia and NSF's Research Experiences for Undergraduates program in Cleveland.

Fun Fact #10: ***Before construction could begin on the School's first building, West Hall, a historic house rumored to have played a role in the Underground Railroad was moved and preserved.***

In The Blink Of An Eye

VCU researchers detect early signs of movement disorders via an automated eye-tracking system.

Despite decades of intensive study, the causes of Parkinson's disease remains unknown, and a cure is still elusive. What's more, there is no standard diagnostic test for the disease.

For the past 12 years, Mark Baron, M.D., professor of neurology and interim director of the VCU Parkinson's and Movement Disorders Center, and Paul Wetzel, Ph.D., associate professor of biomedical engineering at VCU, have collaborated on the development of an automated eye-tracking system that detects and analyzes eye movements as a means to accurately differentiate and diagnose more than 20 neurological diseases.

"It's incredibly simple," said George Gitchel, a biomedical engineering Ph.D. candidate who joined the research team in 2008. Gitchel is also a health science research specialist at the Southeast Parkinson's Disease Research, Education and Clinical Center at the Hunter Holmes McGuire VA Medical Center. "Using infrared light, two head-mounted cameras follow the movement of a patient's eyes as she attempts to fix her gaze on a screen-displayed object. While normal eye movements are highly regulated and follow well-defined patterns, neurological disorders alter eye movements in a fashion specific to the underlying condition."

Their research has consisted of two broad phases. Initially, for about two years, only patients with clinically confirmed disorders were tested, allowing the researchers to identify the patterns and parameters that describe particular diseases. Then, once they'd accumulated enough data, the team transitioned to seeing every new patient and comparing diagnoses made with and without the eye-tracking system. Before Gitchel's arrival, Baron and his team had managed to test around 50 patients. Since then, they have looked at more than 3,000. These large numbers furnished data that made it "obvious that we could diagnose everything with incredible precision," Baron said.

ADVANCED EYE DIAGNOSTICS FOR THE MASSES

Over the years, the research team has improved the system's diagnostic accuracy from 75-80 percent to nearly 100 percent today.

With the hope of licensing their technology to a company, Baron and his collaborators agreed to partner with VCU Innovation Gateway in December 2012. Then, in August 2014, they filed for an international patent on the software they've developed. As Gitchel pointed out, "Anybody can buy the eye-tracking equipment off-the-shelf. It's the research we've done over the years to figure what happens with an individual disorder, and the automated nature of our software, that's what's so valuable."

In addition to being noninvasive and inexpensive, the researchers' system is easy to implement, requiring minimal training time, minimal physician interaction and a mere five minutes to administer the test. What's more, unlike the common electroencephalogram or electromyography, the eye-tracking system produces data that do not need to be interpreted; when their current work is complete, the system will automatically generate a diagnosis.

A neurosurgeon recently visited the Hunter Holmes McGuire VA Medical Center with a patient whose rare diagnosis had proved elusive. After Baron and Gitchel quickly and easily identified the condition using their system, the astounded physician said, "This is the greatest thing I've ever seen! Why doesn't everyone have this?"

Fun Fact #11: ***The School of Engineering Foundation owns several facilities which are leased to the School for $1 annually.***

Straintronics' Role In Next-Generation Computing

How VCU researchers are forging a new path toward low-energy computing and signal processing capabilities.

Complex tasks such as decoding the human genome and analyzing data from space observatories necessitate groundbreaking advances in computing machinery. Since 2010, an interdisciplinary collaboration between two School of Engineering departments has yielded the invention of new technologies to propel next-generation, low-energy computing and signal processing capabilities.

Research teams — led by Supriyo Bandyopadhyay, Ph.D. and Commonwealth professor of electrical and computer engineering, and Jayasimha Atulasimha, Ph.D. and Qimonda associate professor of mechanical and nuclear engineering — use straintronics to switch the magnetizations of nanomagnets by applying mechanical strain on them using electrical means. These nanomagnets act as binary switches to process digital information similar to the way electronic logic devices work. "Right now, we're focused on simulations to study switching speeds, energy dissipation and error probability as well as proof-of-concept experiments. These insights are critical to understanding how switching speeds impact energy efficiency as well as demonstrate that these device concepts actually work at the nanoscale," said Atulasimha. Theoretically, the energy dissipated to perform logic operations is up to 100,000 times smaller than in devices using traditional transistors.

REAL POTENTIAL

"We're not using conventional technologies and approaches," said Hasnain Ahmad, an electrical and computer engineering Ph.D. candidate. "Each day I get to challenge everything I know about technology when fabricating and testing these nanomagnetic devices. I get to work with new materials and instruments that force me to devise new techniques to push the research forward."

Noel D'Souza, a mechanical and nuclear engineering postdoctoral fellow who's been working on this research since 2010, echoes Ahmad's sentiment. "There were so many challenges we faced in the beginning. We were starting from scratch. And now, I really believe we're on the cusp of a breakthrough."

Industry leaders and academics alike are eager to hear the latest updates on this research that's garnered more than $2 million in funding. IBM, Texas Instruments and Intel Corporation are a few businesses taking part in an industry consortium that visits VCU annually for one-day presentations on research progress.

"When I read other people writing or blogging about our research and press coverage for our research both in the U.S. and abroad, it gives me a boost of confidence. It reaffirms the momentum we've achieved and the substantial benefits our technology can bring to academia, government labs and private industry," said Bandyopadhyay.

Silk Sensors

VCU researchers create flexible, degradable health monitoring devices.

In late November of 2015, the journal of *Advanced Materials* — one of the top materials science journals — reported exciting advancements in research using combined silk proteins with photolithography techniques. This is the third time *Advanced Materials* has featured the work of Vamsi Yadavalli, Ph.D., associate professor of chemical and life science engineering, in the last three years.

"There's a massive history of using silk, which has fabulous properties that you cannot get with synthetic materials," said Yadavalli. Silk offers high strength and degradability — and the FDA already approves it for many applications with the body. As a proof of concept, Yadavalli's team detected blood glucose via their newly created, flexible and degradable sensor device. The protein-based devices can be as small as one micrometer in size. For comparison, a single human hair is between 80 and 100 micrometers in diameter.

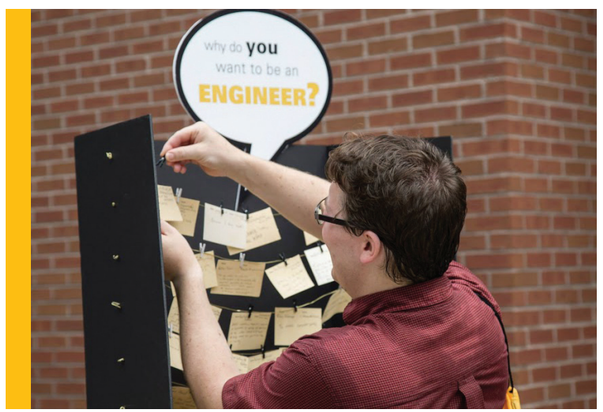
"The biggest advantage of devices such as ours is that medical professionals don't have to go in and retrieve the device. They'll work great in transient electronics applications, where we can program the device to degrade within a specified timeframe," add Yadavalli.

Now that the team has a working proof of principle, they will continue working with the silk sensors to detect neurologically relevant transmitters such as dopamine.

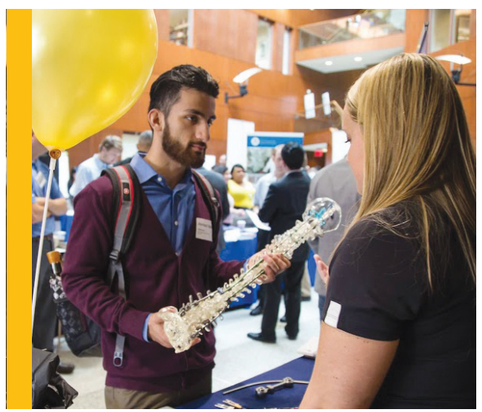
NO BOUNDARIES

Whether on campus or around the globe, our students are committed to helping people improve the way they work and live. They know how to get their hands dirty and have fun. We give them the hands-on research and real-world experience they need to thrive — no matter where they go.

Teams of visiting high school students from all over Virginia get pumped up for the 2015 FIRST Robotics Competition.



For Welcome Week, we asked incoming freshman why they want to be an engineer. Our favorite response: "To fix and break things — all in the name of science."



The 2015 Fall Internship & Career Fair hosted nearly 100 businesses looking to hire interns, co-ops and full-time employees.

Twenty-four hours and one mission: push your ability to problem solve and be creative. That was the motto for students attending the second-annual RamHacks programming hackathon.

Electrical and computer engineering students constructed a light display to welcome nearly 1,000 athletes and countless spectators to campus for the UCI World Road Championships.

Banners celebrating each of our five engineering departments were installed at our Engineering East Hall building.

The Engineering Student Council presented the Children's Hospital Foundation with a check for $1,500.

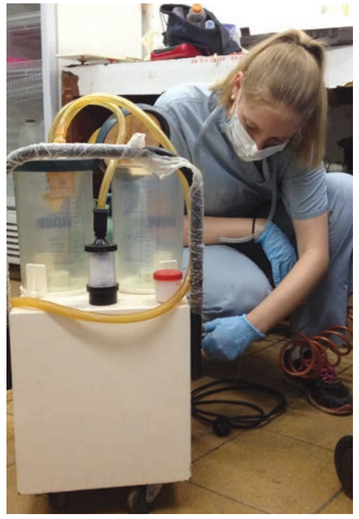
A team of academics and conservators gathered at our Nano Characterization Center. They used the microCT scanning equipment to study the dental remains of a Jamestown boy who died in 1607.

Start your engineers! The annual Broad Street Mile's Spirit Run was dominated again by the torque speeds of our mechanical and nuclear engineers.

Journey Of Transformation

A group of biomedical engineering students go abroad to challenge their skills and embrace constraints.

Russell Jamison, Ph.D. and professor in the Department of Biomedical Engineering and the Department of Chemical and Life Science Engineering, has a deep obsession with highly-constrained environments — far removed from the state-of-the art technologies and machine shops students have grown accustomed to in school. That's why Jamison is a big supporter of the Engineering World Health (EWH) Institute, a program that aims to improve health care in developing countries and provide students with the opportunity to gain real-world experience with industrial design, social entrepreneurship, business planning and global ethics. In the summer of 2015, five biomedical engineering students used EWH as an outlet to test and challenge their current skills.



THE BEGINNING

Apprehension filled the air in the early days of the students' journey abroad. A 30-day crash course covered language basics, cultural awareness and gave insight into what to expect when working in small clinics and hospitals. Each student who signed away two months of their summer to fix health equipment in developing countries knew the importance of the work they'd do. Health facilities in developing nations rely on donations of medical devices to meet roughly 80 percent of their total equipment needs.

Students were broken into small teams and assigned to various locations in the field, including Nicaragua and Rwanda. In that second month, the training wheels came off and the real work began." It was overwhelming at first. The moment we entered the clinic, we were given equipment to fix," said Anisa Kannan. "I didn't even know where to start."

Photo: Alexander Kreher, VCU Photo & Film

FROM INSECURITIES TO IMMENSE GROWTH

As time went on, the students relied less and less on local technicians. And, instead of getting stuck in the weeds of problems they faced, they thought on their feet and got creative with their solutions. Cutting the tip off a caulk bottle as a replacement nebulizer nozzle, replacing worn down rubber linings with cut up tire pieces from a local junk yard and breaking apart a thrift store flashlight for microscope parts are a few scrappy solutions the students came up with.

"As soon as we fixed the microscopes, someone would be using them. That was really satisfying to immediately see our impact within the clinic," said Sindora Baddam. Students also worked with autoclaves, electrocardiograph machines and suction pumps.

For Kannan and Veronica Peterkin specifically, they spent a good chunk of their time in Nicaragua trying to hunt down a replacement flow sensor for a broken adult ventilator. "The model was outdated. Every company I called told me I was crazy to look for such an old part, and then they tried to upsell me models that were 10 times more expensive than what the clinic needed," recalled Peterkin. With help from friends making calls from the U.S., they tracked down the part and purchased it with stipend money from EWH. To cut down shipping costs, the students had the part shipped directly to EWH headquarters so the institute's president could bring it to the program's closing ceremony event.

LOOKING BACK

Perhaps the most rewarding part about the students' journey was their newfound confidence. "It's easy to fall into the habit of chasing perfect grades and doing what your teachers want," said Peterkin, who also worked in Nicaragua. "When I was abroad, I stopped being a student. I knew what I was doing needed to be done, and people were counting on me. I regained the perspective of why I'm here — to learn and think creatively. I'm here because I want to be a great engineer."

In fact, all five students agreed that they had become infinitely better engineers — motivated to evaluate problems with an open mind, conscious to make the most out of available resources. "I'm not throwing away any more broken phone chargers or busted monitor equipment," said Baddam. "I can fix them."

CONSTRAINT COMES TO CLASS

Maybe we're thinking incorrectly about innovation. Maybe those lofty preambles of "the world is your oyster" and "imagine there are no constraints" actually limit creativity.

That's the premise of a new course Jamison is rolling out to sophomore students in spring of 2016, which focuses on developing engineers through design curriculum for highly-constrained environments. Jamison believes this program will foster appreciation in simple solutions that can be more valuable than deeply technical ones. "We need more students to experience what EWH delivers. We can do so much more to create low cost, user-friendly and accessible solutions to impact our global quality of life," said Jamison.

Fun Fact #12: ***The VCU School of Engineering established the first Biomedical Engineering program in the state of Virginia in the fall of 1998.***

A Global Power Perspective

Students get hands-on experience at training reactor in Germany.

Study abroad programs rich with engineering-specific curriculum are rare. "Normally, the tools and equipment we want students to become familiar with are readily available for engineering programs," said Sama Bilbao y León, Ph.D., associate professor in mechanical and nuclear engineering and director of nuclear engineering programs at VCU. One may ask then, why would a group of mechanical and nuclear engineering students embark on a two-week program in Dresden, Germany in June of 2015?

Many students with a nuclear engineering focus don't get to operate a working nuclear reactor. Instead, they get textbook pictures or a "look but don't touch" tour at a local power plant facility. "At VCU, we are committed to applied learning. I wanted to find a way to get our students access to a nuclear reactor — to gain experience seeing one in action, with the opportunity to touch and take control of the reactor," Bilbao y León stressed. "In addition, a global understanding of the energy landscape is absolutely vital."

PROGRAM PLANNING BEGINS

In 2014, Bilbao y León submitted a proposal to the annual Quest Global Impact Awards for a Study Abroad program managed by VCU's Global Education Office (GEO). Bilbao y León was awarded one of the 2014 GEO Global Impact Awards, which provided the grant funding needed to kick-start the program and help cover travel expenses for participating students. From there, it was a matter of coordinating curriculum, planning travel logistics and marketing the new program to students. The three-credit course was made available to mechanical and nuclear engineering students for the first time during the summer of 2015.

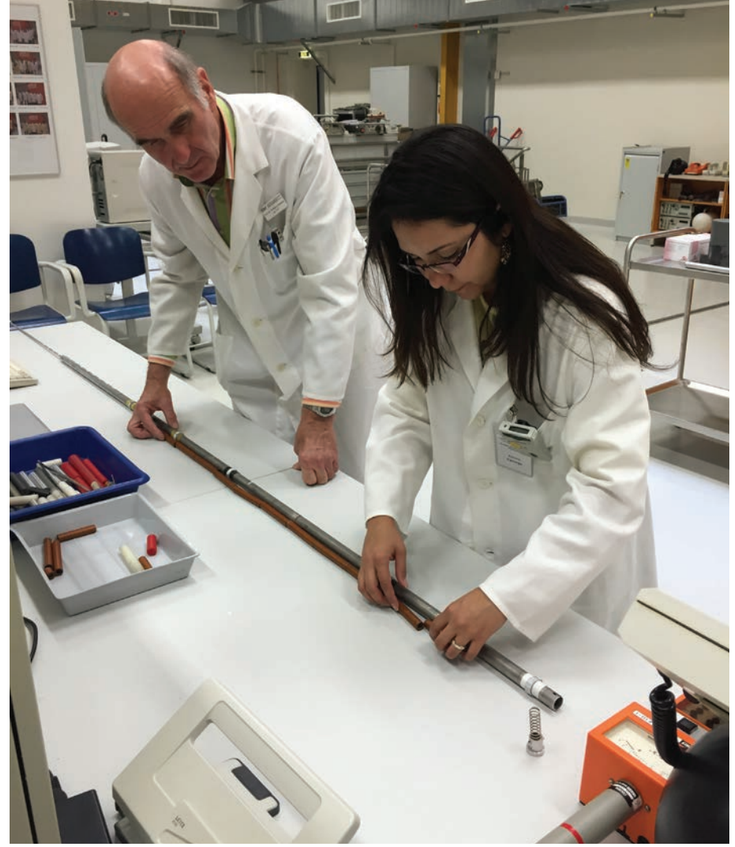
"When I learned about the study abroad program, I had to sign on. It was definitely an opportunity you don't normally get, where we could work with international engineering students and faculty," said Nathan Kirby, a senior mechanical and nuclear engineering student. Five other undergraduates and two graduate students also made the trip to the Technical University of Dresden, which houses the AKR-2 training reactor, Germany's most modern research nuclear reactor. The university's student body is 36,737, and nearly 30 percent of those students are studying engineering.

GAINING CLARITY, GRASPING NUCLEAR CONCEPTS

Each morning, Bilbao y León would meet with the VCU students over breakfast at one of the Technical University of Dresden's residence halls. Then the group would jump into a rigorous day filled with a German language class and a theoretical lecture on relevant reactor aspects, followed by a five-hour laboratory session where students applied what they learned in the lecture. Each evening students were required to write lab reports summarizing what they were trying to achieve in their reactor experiment, their procedure, what measurements were taken and what the expected behavior versus actual results were.

"Everything I've been learning started to click," said Mark Massie, a graduate mechanical and nuclear engineering student. "When we got in the weeds with our experiments, having to think through and explain why we were seeing certain behaviors and how we could adjust the outcomes, I could finally connect the dots."

The main topics covered during the program were reactor physics, thermohydraulics and reactor kinetics. Students were trained in the start-up and shut-down procedures for the reactor, performed calibration of the control rods, and measured and characterized the reactor's neutron flux. After their initial training, the students independently operated the reactor and performed all the above evolutions under the supervision of AKR-2 faculty and staff.



Of course, students were given a little time to unwind and experience the history and culture of Dresden and the Saxony region. They hiked in the nearby Saxon Switzerland National Park, visited the Dresden and Meissen royal palaces and toured the Volkswagen transparent factory.

WHAT'S NEXT

The Department of Mechanical and Nuclear Engineering plans to offer the study abroad program again in the summer of 2016 and beyond. "This course provided our students with the opportunity to learn about different technologies, perspectives and approaches for the production of electricity. To stay current and become the best professionals in their field, it is essential for well-rounded engineers to have an understanding of the big picture. They need to continuously challenge their assumptions, and consider the global energy and environmental situation," said Bilbao y León.

For Jessica Bishop, a senior mechanical and nuclear engineering student, the trip was definitely worth it. "I can do more than tell people how reactors work now. I can show them. Those are special skills that will make me stand out among other job candidates," she said. "If this program continues, it will continue to set VCU apart from most universities in the United States."

Fun Fact #13: ***In 2008, the department relocated to the Engineering East Hall building. In fall of 2010, the Department of Mechanical Engineering officially changed its name to the Department of Mechanical and Nuclear Engineering.***

Teachers Workshop Aims To Establish Stronger Nuclear Science Understanding

The "Science of Nuclear Energy & Radiation" workshop brought nearly 30 middle school and high school teachers from around the Eastern U.S. together for four days.

"One night, I read about the death of nuclear energy practices in one of my daughter's textbooks," announced Eugene Grecheck, President of the American Nuclear Society, to the crowd of teachers gathered at the annual science teachers workshop hosted at VCU in July of 2015. Grecheck, who worked for Dominion Virginia Power for more than 30 years, went on to explain how he asked his daughter's science teacher about their understanding of nuclear power. "The teacher didn't even know we have four nuclear units operating in Virginia," Grecheck sighed, clearly frustrated.

Experiences similar to Grecheck's are why the four-day workshop exists. It's also why it's particularly important to educate teachers in nuclear science and technology, where preconceived ideas and unscientific influences such as movies and newspaper headlines disseminate misinformation.

REDEDICATION TO SCIENCE

Many presentations, including Grecheck's, ran late because the teachers had so many questions they needed answered. It was clear they wanted to inspire students and get them involved in global energy discussions. "Our students will be future decision makers. We need them to be passionate now. They deserve the facts about energy," said Kathleen Snelgrove, who teaches at Lexington High School. "Teachers can no longer separate science from associated political and economic aspects, so it's a priceless opportunity to share ideas, ask questions and learn with fellow teachers." The breadth of information they gained access to with the workshop's $75 registration fee surprised Snelgrove and other attendees. Room and board, as well as all meals and transportation costs were covered.

Attendees toured local nuclear power plants and medical facilities, and participated in a range of courses to inspire activities and projects for their classrooms. Some topics covered during the workshop included: nuclear power plant basics and safety, how to use Geiger Müller counters, energy source comparison and careers in nuclear, and the biological effects and beneficial uses of radiation.

"My hope for this workshop is that we can give teachers the tools they need to foster healthy conversations about nuclear science and technology," said Sama Bilbao y León, Ph.D., associate professor and director of nuclear engineering programs at VCU. "These teachers will influence my children, your children, everyone's children. I don't want teachers to love nuclear. That would be great, but it's not the point of this workshop. The point is that we give teachers the information they need to present nuclear science accurately, correctly and fairly."

Fun Fact #14: ***The first Virginia Science Teachers Workshop took place in 1981. In 2006, VCU started hosting the event.***

Collecting Big Data Footprints

Long-time research collaborators take their partnership to international heights.

Xubin He, Ph.D., professor and graduate program director of the Electrical and Computer Engineering department, is working with Huazhong University of Science and Technology (HUST) to establish an international research institute focused on creating design techniques to improve data reliability and performance. Coordination efforts are currently underway to create rotation periods for students from VCU and HUST to conduct research within each university's state-of-the art laboratories.

"This next step in our partnership with VCU helps both universities attract more high-quality research students, while enhancing the breadth and depth of our research," said Dan Feng, Ph.D. and dean of the School of Computer Science and Technology at HUST. Feng also serves as director of the Data Storage and Application lab at HUST.

MANAGING BIG DATA

Data storage is a booming industry, with lots of opportunities. Just a decade ago, computational speed dominated research efforts and water cooler conversations. According to He, data is more important now. "Data empowers decision-making and drives business progress. No one can tolerate data loss, whether that data represents favorite photos or industry trends and analytics," added He. And yet, trying to increase data capacity or replace obsolete data systems can shut down vital data centers for days.

Research teams from both universities find creative solutions to global data pain points. For example, these collaborative research teams reduced overhead costs associated with data failures by up to 30 percent. Their algorithms allow businesses to encode data that can be easily retrieved, instead of having to rely on costly data copies or redundant data centers.

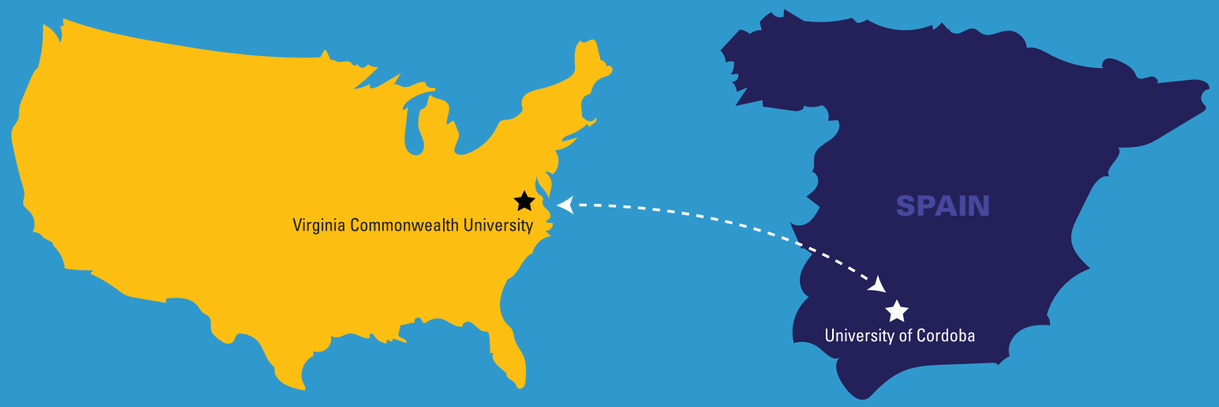
Currently, in addition to HUST, He's team also works with top data storage companies such as EMC, which ranks 128 in the Fortune 500 and had reported revenues of $24.4 billion in 2014.

THE NETWORK EFFECT

He has a simple philosophy to gauge the success of university research efforts — he looks at who else is there. "At top data storage and systems events such as USENIX's File and Storage Technologies conference and USENIX's Annual Technical conference, we're presenting with peers from Harvard, MIT, Princeton and other premier universities we admire," said He. These conferences typically accept about 30 presentation papers — that's less than 20 percent of the global submissions they receive.

"Professor He's leadership represents one of many efforts to build our international reputation in industry and academia," said Erdem Topsakal, Ph.D. and chair of the Department of Electrical and Computer Engineering. "HUST is ranked 19 on the U.S. News World & Report's Best Global Universities for Engineering list. When leading universities like HUST want to work closely with you, you know you're doing something right."

Fun Fact #15: ***During an especially long building planning meeting, someone recommended placeholder names for the current engineering buildings based off their directionality: Engineering East Hall and Engineering West Hall. While the recommendations were only meant to end the meeting, the names stuck.***



VCU Launches Dual-Ph.D. Program With The University Of Cordoba

The program is the first of its kind between VCU and an international university. It is also one of the first such programs in the U.S.

A new dual-Ph.D. program between the VCU School of Engineering Department of Computer Science and the Department of Computer Science and Numerical Analysis from Spain's University of Cordoba will kick off during the spring semester of 2016. "Global companies such as Microsoft, Google and IBM want workforces with cross-cultural experiences and bilingual skillsets. This new program will give students an unparalleled foundation to function well in diverse environments," said Krzysztof J. Cios, Ph.D., D.Sc., MBA and chair of the Department of Computer Science. "There will be great employment opportunities for students graduating from this program, both in the U.S. and in Europe."

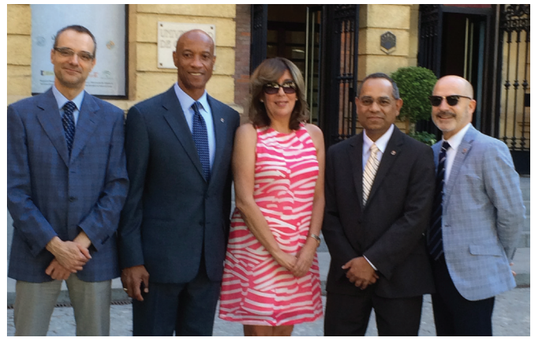
To be eligible for the program, the students must have a master's degree in computer science. Once in the program, candidates will experience an immersive and rigorous set of didactic and research requirements. .

WHERE CULTURE, RESEARCH AND LEARNING COLLIDE

"I'm so excited to see two years of collaborative planning pay off!" Said Sebastian Ventura, Ph.D., associate professor of computer science and numerical analysis at the University of Cordoba. "There are many advantages to this program for students. They get dedicated advisers from both universities, and they get six months of experience collaborating with well-respected research teams abroad (in the U.S. for Spanish students, and in Spain for American students)."

To graduate, students must publish at least one journal paper that tackles an original research problem before their final defense takes place. The work must receive approval from both programs. After completing the dual-Ph.D. program, graduates will earn a Ph.D. degree in engineering within the computer science track from VCU and a Ph.D. degree from the University of Cordoba's Advanced Computer, Energy and Plasma Physics program.

"VCU is well known internationally for its distinction and extraordinary commitments to advancing the human experience everywhere," said VCU President Michael Rao, Ph.D. "This new dual-degree Ph.D. program with the University of Cordoba is an important new step onto the global stage. Cordoba is well-regarded across the globe for excellence, and they have been an ideal partner for years. Joining together the University of Cordoba and VCU's globally recognized School of Engineering makes both institutions stronger and serves to educate and work with communities of scholars on two continents. I am excited about the significant difference this extraordinary dual-degree program will make for VCU, Cordoba and the world."



Ram Gupta, Ph.D. and associate dean for research (pictured second from the right), visits with faculty and staff from the University of Cordoba.

Fun Fact #15: ***Former Dean Emeritus, Robert Mattauch, Ph.D., gave out more than 200,000 bagels during his time as dean, and he held many early engineering gatherings at a local bagel shop. Before he retired, the bagel shop encased a bagel in bronze to thank him for his patronage.***

STUDENT HIGHLIGHTS

BIOMEDICAL

In honor of our **20th anniversary** we're featuring the achievements of 10 current students and 10 alumni.

ROSHNI MALIK got an initial taste for engineering when she led a FIRST Robotics team in high school. She loved how it united people with different skillsets, such as design and programming, together to creatively solve a problem. It's that same love for collaboration that brought Malik to VCU, where opportunities for interdisciplinary research and partnerships with VCU Health abound.

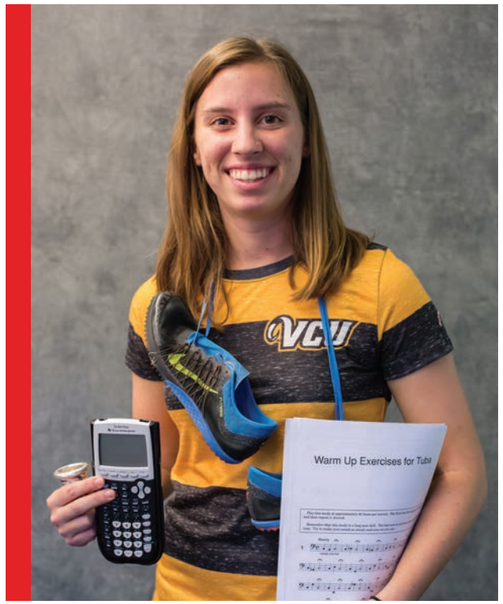
In addition to her involvement with Theta Tau and the national Biomedical Engineering Society, Malik is a former scholar of the Dean's Undergraduate Research Initiative (DURI). Through the initiative, Malik partnered with faculty and a graduate mentor to investigate how certain growth factors can cause cancer. She explored how the addition of a specific protein affected the growth factor and impacted cells. Additionally, Malik presented her research findings at a prestigious biomedical engineering conference. Last summer, Malik interned with the Research and Development department at Boston Scientific. There, Malik shared what she learned during her DURI research and tested various endoscopic needles. Her significant contributions to the team impressed Boston Scientific reps so much that the company is sponsoring her Senior Capstone Design project, which focuses on finding ways to eliminate tissue accumulation at the ends of pulmonary stents.

After leaving Egypt with a desire to continue his engineering education, **NABIL MIKHAIEL** bounced from city to city looking for the right fit. Chicago was too cold. Boston and New York were a bit too fast-paced. When Mikhaiel landed in Virginia, however, he knew he'd found an inclusive educational community to meet his career aspirations. Mikhaiel immediately sought out research opportunities, emailing faculty to take a chance on someone with no wet lab experience. Rebecca Heise, Ph.D. and biomedical engineering assistant professor, quickly responded to Mikhaiel's email. He was shocked that she personally offered to help him collaboratively build up his experience.

With help from Heise and a graduate student mentor, Mikhaiel explores the mechanics of the lungs to find novel ways to treat chronic obstructive pulmonary disease. For example, the research team is creating hydrogel from pig lung proteins to create scaffolding for regenerative therapies using stem cells. He continues to refine the hydrogel via a chemical process called cross-linking, which Mikhaiel hopes will increase cell regeneration and growth. Mikhaiel was promoted from a voluntary lab position to a paid position as a DURI scholar. He's also tutoring four biomedical engineering classes and is a teaching assistant for a practicum class where students come up with practical, cost-effective designs for medical devices.

STUDENT HIGHLIGHTS

CHEMICAL AND LIFE SCIENCE



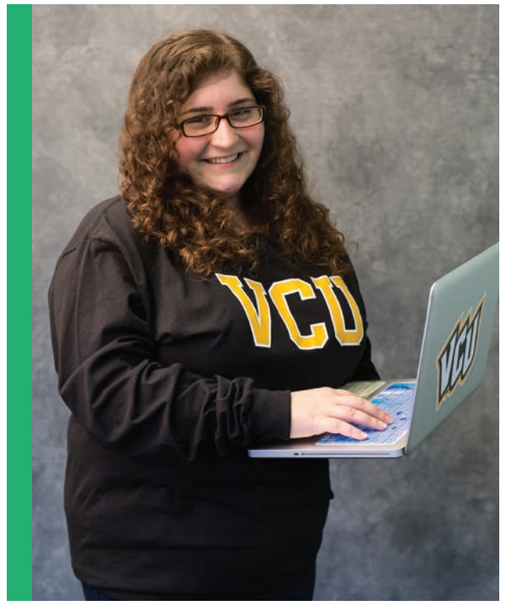
An average Tuesday for **LINDSEY SEELEY**, a chemical and life science engineering major, begins at 5:00 a.m. She gets in a morning run, then works an 8:00 a.m. to 5:00 p.m. co-op shift and then she hustles on to evening classes that last until 6:45 p.m. Seeley still finds time to participate in drum corps, and even considers picking up a minor in chemistry to go with her minor in mathematics. Since coming to VCU as a presidential scholarship recipient, Seeley's clearly made the most of every minute of her college career. Instead of being slowed down by a stress fracture to her femur, she jumped into analyzing how different polymers react to being dipped into water — also known as dynamic contact angling — with Kenneth Wynne, Ph.D. and commonwealth professor.

Wynne's lab is focused on creating antimicrobial polymers that can be used in catheters and other medical devices, without any unwanted substances leaching out into the body. In her current co-op position, Seeley works in DuPont's Business Innovation unit. There, Seeley's investigating ways to transform a weather wrap for buildings — which must be manually rolled onto the building — into a liquid spray for faster application. Seeley's favorite thing about VCU is the breadth of skills she's learning. She hopes to find a job at the intersection of her love for science, math and sports.

RAVEN SMITH is one of 10 engineering students across the country to receive Toyota's inaugural $75,000 Jesse L. Jackson Sr. Fellows Scholarship. Smith, who's majoring in both chemical and life science engineering and chemistry, was selected from hundreds of applicants. She has a 4.0 GPA, and participates in several student organizations such as the National Society of Collegiate Scholars. Smith credits her ability to make an impression with Toyota to the rich professional developments opportunities given to her by faculty of the Department of Chemical and Life Science Engineering. For example, Smith learned from Steven Fong, Ph.D., associate professor and vice chair, how to approach problem solving with an emphasis on communication skills.

Currently, Smith is working with Christina Tang, Ph.D. and assistant professor, in a polymer nanomaterials lab. Research teams use nanoparticles to encapsulate different medicines or proteins for cancer treatments. Ideally, the team is trying to create an advanced form of chemotherapy via these nanoparticles that can be programmed to target and attack the cancer cells. As Smith nears graduation, she's still considering whether she wants to pursue full-time opportunities with Toyota or continue her education with a jump into veterinary school.

COMPUTER SCIENCE

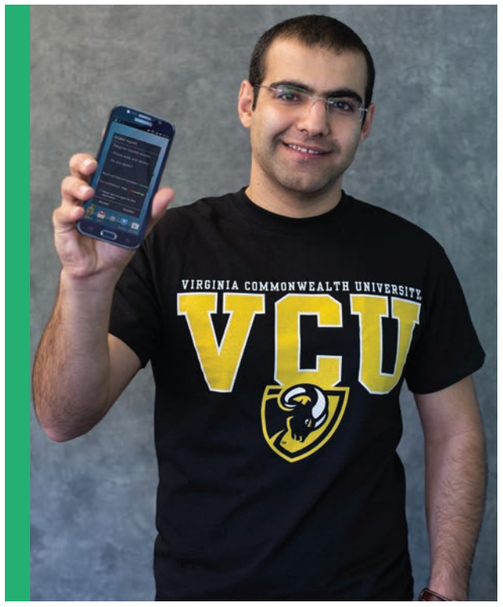


For **MELISSA NIERLE**, a computer science student, talk is cheap. To be successful and really contribute to society, Nierle dedicated herself to finding a profession where she could take action, innovate and create. When she was a junior in high school attending a women in engineering event, she learned that engineering offered her the perfect opportunity to tackle real-world problems and foster positive change. Now, she's taking on leadership opportunities in Virginia and beyond. She's an avid speaker at local Meetups for developers. Nierle was even invited to speak at 360iDev's mini conference about updates to Apple's programming language, Swift.

These opportunities are outgrowths from Nierle's co-op with BMW, where her mentor encouraged her to spread her talents with larger programming enthusiast communities. As VCU's first student to snag a co-op position at BMW, Nierle worked in BMW's Mobile Solutions team to create apps facilitating manufacturing process improvements as well as external-facing apps for drivers. In addition to an upcoming internship with WillowTree Apps, Nierle is working with VCU's Parkinson's and Movement Disorders Center to create a mobile app for patients suffering from Parkinson's to document medication and daily routines for their doctors.

BAHMAN RASHIDI travelled to VCU from Iran for the opportunity to work closely with his well-respected mentor, Carol Fung, Ph.D. and assistant professor of computer science. Rashidi, a Ph.D. candidate within computer science, has already published eight articles with Fung who is an expert in cybersecurity. Together, he and Fung are creating a framework to address an important security problem for Android users who want to download mobile apps. Android phones require users to grant permissions — such as access to user data or their device's camera and pictures — when downloading any mobile applications. This is a serious security issue, because users can't fine-tune and limit what types of information the applications they want to install get access to.

The new framework allows Android users to download applications in a probation mode. During this temporary timeframe, users can evaluate whether they're comfortable with associated data and security permissions that must be accepted for the app to download. Additionally, the framework also provides information and recommendations to guide users on whether an app download is safe. After users feel like they understand a new app, they have the opportunity to permanently download the app and mark it as trusted. Rashidi hopes this framework will limit instances where users may make decisions that compromise their data.



STUDENT HIGHLIGHTS

ELECTRICAL AND COMPUTER

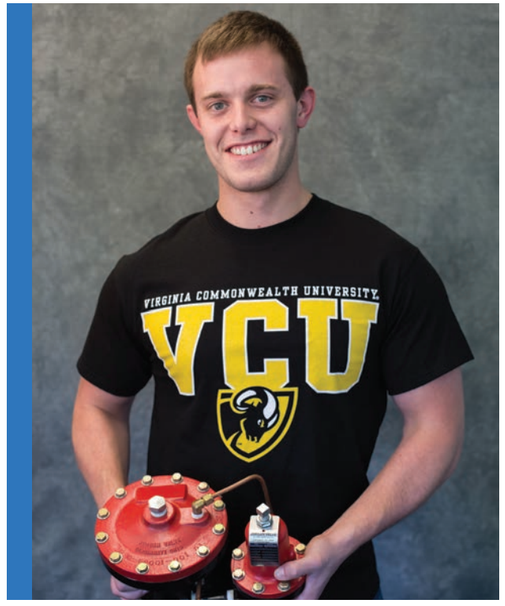
For many years, **SHELLIE LUNDQUIST** was orbiting her dream profession. When she expressed an interest in a technical career, she was often advised to take alternative, more "appropriate" routes for her gender. In future roles, she felt her opinions and individual contributions weren't fully valued. With a nudge from a mentor at Newport News Shipbuilding, Lundquist enrolled at VCU to take her career to the next level as an electrical and computer engineering major. Lundquist juggled family commitments, part-time jobs and schoolwork.

When Afroditi Filippas, Ph.D. and associate dean for undergraduate studies, encouraged Lundquist to take on more responsibilities, Lundquist didn't think it was possible. And yet, Lundquist grew empowered and confident under Filippas' continued encouragement and belief in her. Lundquist is now breaking down those gender barriers in Virginia. She founded Wohack, an offshoot of Hack RVA to get women involved in Virginia's maker community. She's taught soldering and woodworking workshops, and has even connected interested male participants from other groups to traditionally female activities such as fiber arts and paper crafting. Following graduation, she will work in the Altria's Engineering Leadership Development Program, a four-year program in which the company will rotate her through various aspects of the company, such as research and development, maintenance and engineering, and business leadership development.

UMAR HASNI'S first college experience in Pakistan was full of phases — he became a writer, a marketer and a radio show host. His curiosity and overwhelming energies bounced between each tangent, never sticking to one thing. He lacked direction and a clear outlet for his energies. After coming to VCU and teaming up with Erdem Topsakal, Ph.D. and chair of the Department of Electrical and Computer Engineering, Hasni has not only thrived but he's helped rally the entire electrical and computer engineering undergraduate student body to showcase their skills and get involved in the community in special ways. Hasni is the chair of Topsakal's undergraduate advisory board, an outlet where Hasni gets to lead and motivate groups of people.

Together, the board has completed projects for community events, open houses and may even attempt to break a world record. Outside of the advisory board, Hasni is immersed in developing a cost-effective and patient-specific hypothermia treatment applicator for breast cancer using 3D-printed technologies. Hasni wants to merge his technical chops with team-based leadership skills he's picked up to start his own company. He's already seeking patents for a new business innovation.

MECHANICAL AND NUCLEAR



DYLAN DAWSON never intended to go to college, but found himself unfulfilled. After graduating from high school, he took a year off and worked several odd jobs. And yet, Dawson always knew he wanted to be an engineer. Since he was a young, he had an affinity for taking things apart to understand how every nut and bolt worked, and once his curiosity was satisfied, he'd put it all back together. At VCU, Dawson, who is a mechanical and nuclear engineering major, chases challenges. He credits the strong relationships he's built with faculty for his success. According to Dawson, faculty don't accept good work, they relentlessly push students for great outputs. He's excelled and looked forward to the most rigorous of courses such as Heat Transfer, in which he completed the first three weeks of coursework before the semester began.

Dawson currently works as a project engineer for DuPont's chemical manufacturing plant. There, he leads design work for capital improvement projects — researching new equipment and associated costs, solid modeling and drafting designs and overseeing safety evaluations. Dawson didn't see himself working in a manufacturing plant either, but through this co-op opportunity he's found his engineering heaven, where each day brings new challenges. After graduation, Dawson plans to continue working for DuPont while he pursues a master's degree from VCU.

Ten years ago, **SVETLANA RUSEVA** began strategically planning a way to join VCU. At that time, she came to the U.S. from Bulgaria via a student exchange program. During her stay, she fell in love with the educational system and strong development opportunities that existed. She targeted the School of Engineering for its Nuclear Engineering program. Ruseva believes clean sources of energy are critical to supporting growing global populations. As an expert planner, Ruseva spent the next eight years saving up money and knocking out basic course requirements before officially enrolling at VCU. Her mother, father and sister are all engineers, so Ruseva is laser-focused to make them proud and achieve her career goals.

She's dominated her classes, maintaining a near-perfect GPA under the guidance of faculty mentors who she believes have shaped her as a person and have pushed her to become an active industry participant. Additionally, Honeywell, a global leader in manufacturing clean energy technologies, hired her to take part in a $10-million project after she impressed them as an intern. She's also earned an undergraduate scholarship funded by the Nuclear Regulatory Commission for academic excellence and her interest in becoming a nuclear industry leader. Ruseva's committed to using her global energy expertise to educate the general populace about nuclear energy and advance industry standards for a more robust energy future.

ALUMNI HIGHLIGHTS

SONYA BHAVSAR chose VCU for its accredited Biomedical Engineering program — the only accredited program in the state when she applied. As a freshman, Bhavsar was invited to follow doctors and patients around with an engineering eye for creative solutions. She was even able to observe a heart surgery, which deeply influenced her future career path. After receiving her master's degree in mechanical engineering, Bhavsar joined Abiomed, the company behind the world's smallest heart pump and the world's first total replacement heart. Bhavsar works in Abiomed's Academic Research department where she collaborates with outside academic institutions to source ideas and investigates potential device improvements.

After 10 years in industry, **OSCAR MARTIN** sought a Ph.D. in chemical and life science engineering at VCU to take his career to the next level. There, he learned the important skills to design and conduct research experiments, but also how to make clear recommendations to scale his research efforts into commercialized products. With exposure to various types of research areas including basic chemical engineering, biotechnology and polymer materials science, Martin thrives in his role as CIO of DuPont Teijin Films. He oversees all research and development for U.S. electronics, packaging, industrial and consumer products within a bustling team of 20.

ALLEN CALDERWOOD is VCU's first graduate with a bachelor's degree in computer science to snag a job at Google. While in school, Calderwood took every opportunity to show his creativity and sharp problem-solving skills. He participated in VCU's annual RamHacks hackathon as well as various out-of-state programming events. Calderwood also interned with AMC Technology, a global leader in customer-relation management and contact center interactions. As an Engineering Resident at Google, Calderwood is jumping in on large-scale distributed processing and test-driven development projects. Google's elite Engineering Residency program is specifically designed to transform recent college graduates into product industry leaders.

RONALD HALL was drawn to VCU's tight-knit community. He wanted the opportunity to develop personal relationships with faculty and students who were invested in his individual success. Since being told in high school that engineers build Transformers, he was hooked. Luckily, he also had a love for math and science that would drive him to do great things for VCU and the U.S. with a bachelor's degree in electrical and computer engineering. Hall was part of the National Society of Black Engineers' founding chapter. During his freshman year, Hall got to intern with a "U.S. government organization" where he now works. We're not at liberty to share anything more…

ENEREL MUNKHZUL came to VCU excited at the opportunity to study both mechanical and nuclear engineering for her master's degree. During her studies, she interned at Argonne National Laboratory where she conducted computational fluid dynamic (CFD) analysis on an advanced nuclear reactor design concept. Munkhzul presented her findings at the prestigious International Congress on Advances in Nuclear Power Plants conference. After graduation, she joined NextEra Energy Resources, the largest generator in North America of renewable energy from the wind and sun. As an Associate Fleet Performance and Diagnostic Center Engineering Operator, Munkhzul ensured optimal performance of turbine and auxiliary equipment across over 100 wind farms. She recently accepted a new position with Holtec International's SMR-160 team as a mechanical design engineer.

After earning his bachelor's degree in biomedical engineering from VCU, **CHRISTOPHER DOSIER** picked up his Ph.D. from Georgia Tech. Now he's back in Virginia working for SpherIngenics Inc., an early-stage company focused on enhancing stem cell therapies for reconstructive procedures, which is located in the Virginia Biotechnology Park. Dosier's responsible for operational oversight of the research laboratory and conducting experiments focused on cartilage tissue and chronic wound treatments. Dosier attributes his research success to early opportunities to gain diverse experience in physics, chemistry and mathematics, in addition to engineering, at VCU. He's also in VCU's Executive MBA program.

LAURA HAYWARD graduated from VCU with her bachelor's in chemical and life science engineering. She's been relentless in her pursuit to learn how to manipulate cells for improved health outcomes. Hayward credits the open communication and easy access to faculty and student mentors for her ability to learn quickly and excel, which led to her receiving a Fulbright Fellowship in research. For her fellowship, Hayward spent 10 months working on next-generation sequencing techniques and bioinformatics to drive personalized medicine diagnostics and treatments at the Australian Institute for Bioengineering and Nanotechnology at the University of Queensland. Now, she's pursuing a medical degree to serve communities with cellular diseases.

After earning her master's degree from AGH University of Science and Technology in Poland, **BEATA STRACK** joined VCU to get her Ph.D. in computer science under the mentorship of faculty whose work and commitment to research she valued. Her main project was to build a model of a small cortical region to model neuron behavior leading to epileptic seizures. Strack also used machine-learning techniques to discover new trends or data clusters in profiles of patients with diabetes and other health conditions. Now she works for an internal division at Google, where she applies her machine learning expertise to improve the company's ability to access and make sense of large volumes of documents.

JASON VAN GUMSTER is a dual-threat, with bachelor's degrees in computer engineering and kinetic imaging from VCU. Van Gumster prides himself on the network he built. Being surrounded by people who were genuinely passionate and extremely driven engineers pushed him to make the most of his education. At Crane & Co., van Gumster designs security features to defend against counterfeit money production. He also applies engineering practices to improve processing and software efficiencies. In fact, with his help, a process that used to take two months can now be completed in a matter of hours. Van Gumster's committed to sharing his diverse experiences and insights, and has published two books about animation software tools.

Since the age of 15, **LAUREN EDGERTON** has dedicated her life to racing, and with her bachelor's degree in mechanical engineering, she's got the chops to build her own motors. She owns Lauren Edgerton Racing, and has been a crew member on a NASCAR Whelen Modified team and has officiated for Arena Racing USA. Edgerton is a mechanical engineer within the Lethality and Effectiveness Branch for a premier naval science and engineering institution that's critical to new design concepts, systems integration and interoperability for U.S. Navy fleet ships.

GROWING MOMENTUM

We are ever advancing, ever diversifying and are continuously realizing our ambitions. Leadership provided from our faculty and staff, as well as top research efforts from our colleagues, their laboratories and facilities distinguish VCU as a place of momentum.

IN THE LAST FOUR YEARS, WE'VE EXPERIENCED:

Enrollment

166
Ph.D. candidates (most in School history)

7%
increase in Ph.D. candidates

21%
increase in master's students

24%
increase in undergraduate students

Grants

115%
increase in grant expenditures

16%
increase in grants submitted

Faculty

25%
increase in faculty

462
total employees

ALUMNI IN ACTION:

4,118 Alumni

405%
increase in monetary donations by alumni (since fiscal year 2010)

268%
percent increase in new alumni contributions (since fiscal year 2010)

75%
uptick in support from 2014

Assistant Professor Fung Earns Prestigious Young Professional Award

Carol Fung, Ph.D. and assistant professor in the Computer Science department, earned the Young Professional Award for her outstanding leadership and research contributions from the Institute of Electrical and Electronics Engineers (IEEE) network and service management community.

Beneath Fung's unassuming persona is a well-respected voice that's making quite the impression with industry and academic peers. "It's a real honor to be nominated and recognized by this community of peers, which I've been a part of since 2008," said Fung about the IEEE, the world's largest technical professionals association, which boasts 400,000 members in 160 countries. "So many years of hard work just got rewarded," added Fung. "I was very happy!" She said, with an enthusiastic smile.

Fung currently serves as the general chair of the IEEE's Dissect Workshop group. Through workshops at IEEE events, industry and academic professionals gather to discuss cyber security for future networks, such as cloud and software-defined networks.

FUNG'S JOURNEY INTO ACADEMIA BEGINS

In 2013, Fung joined the VCU School of Engineering after earning her Ph.D. from the University of Waterloo in Canada as a gold medal graduate. During her work on her Ph.D., Fung had taken on teaching assistant roles, but she attributes a great deal of her professional development to her first full foray into teaching at VCU.

"At the School of Engineering, I see everyone working hard. It's a healthy and competitive environment where I feel pushed and encouraged to challenge myself and do my best," explained Fung. Whether actively collaborating with other faculty members or via quick hallway conversations, Fung has leaned on her peers to find new ways to motivate students and keep her teaching style engaging.

And if you ask students about Fung, many say there is something special there.

"Professor Fung is laser-focused on her research and her students — and every time I talk with her, she makes a meaningful contribution to our research," said Bahman Rashidi, a Ph.D. computer science student who has worked with Fung for more than a year. "She takes the time to make sure students have what they need to succeed and understand what people's individual goals are," he added.

"Her classes are challenging, but it's her attention to detail and dedication to her students — even the high schoolers who come in to shadow our work — that makes professor Fung exceptional."

Krzysztof Cios, Ph.D., D.Sc., MBA and chair of the Computer Science department, knew of Fung's relentless determination and deep passion for computer science when he hired her. Under Cios' guidance, Fung was admitted into VCU's prestigious Career Academy, an intensive program where faculty critique and hone their grant writing skills.

"Carol is a pleasure to work with. She is still growing, and this is only the beginning of her successful career in computer science and academia," said Cios.

Fun Fact #17: ***The School of Engineering has a dedicated Career Services department. After a student sent out nearly 1,000 resumes without hearing back from a single company, he landed a job within a week after receiving resume and interview guidance from the department.***

NSF CAREER Grant Winners
Gain Confidence, Resources For Research Success

Two engineering faculty members collectively earned nearly $1 million in NSF CAREER Grant funding, which will propel research efforts in the Computer Science and Mechanical and Nuclear Engineering departments. "VCU is a very research-active institution, but to attract high-quality graduate students — which are really the foundation of any research — you have to have funds," said grant recipient, Tomasz Arodz, who is a Ph.D. and assistant professor of computer science. "It's often tough for young professors to get funds to start with."

Likewise, fellow NSF CAREER Grant recipient, Arunkumar Subramarian, Ph.D. and assistant professor of mechanical and nuclear engineering, said this funding sets his team up to conduct strong and differentiated research. "It takes complex infrastructure and equipment to work with batteries at the atomic to nano-scale level. This investment shows we're on the right track to making battery technology more sustainable, while increasing the lifespan of batteries we rely on for transportation and our favorite devices," said Subramarian.

DIGGING DEEPER INTO RICH PROBLEMS

Conventional lithium-ion batteries use cathodes made from lithium cobalt oxide, which is non-abundant, toxic and has safety issues. Subramarian's interdisciplinary research brings together materials science, mechanics, electric transport and chemistry expertise to make a more durable battery using sustainable materials. Currently, batteries made from sustainable electrode materials can be recharged up to 100 times before they lose capacity. Subramarian strives to extend the lifespan of these sustainable materials to up to 1,000 cycles or more.

Arodz applies sophisticated algorithms to help biologists break through and make more sense of endless cellular observations such as different levels of expressions of genes, or mutations of genes. With the NSF funding, Arodz hopes to further refine statistical and computational methods to link various biological data profiles with certain diseases or health complications. "With the five-year commitment of funding that comes with an NSF CAREER Grant, you get a certain freedom to explore problems more deeply," said Arodz, who credits VCU's CAREER Academy for helping him during the grant application process. The academy is a year-long program that offers peer reviews of academy members' projects, work with assigned mentors, moderated mock reviews of proposals, and endless grant-writing resources and advice from prior participants.

Arodz and his team of researchers already formulated an algorithm that predicts how one gene regulates another, which is critical in the creation of pharmaceutical drugs. Now, Arodz seeks to design new learning systems that rely not only on data, but make use of already validated information about genes, their products and their relationships. By having tools that analyze new data in the context of already-known information, Arodz is confident researchers can improve the speed and accuracy of biological data analysis. "With this method, we can be more selective and strategic with the datasets we analyze to find important answers for how and why specific biological factors affect health," added Arodz.

Both Arodz and Subramarian are exploring ways to involve undergraduates and community members in future research discoveries.

Fun Fact #18: ***In 2015, eight out of the 12 VCU NSF CAREER Academy members were junior faculty from the School of Engineering.***

Computer Science Professor's Algorithm Gets Worldwide Exposure And Use

To keep pace with the rapid advancements in machine learning and big data mining, MathWorks, the world leader in mathematical software, implemented an algorithm created by Vojislav Kecman, Ph.D., professor within the Computer Science Engineering department. The algorithm was selected for the company's matrix software called MATLAB, which has far-reaching applications in areas of science, medicine, bioinformatics, data analysis and engineering.

Now MATLAB's user base of more than 5,000 universities and about 1,000,000 global users have access to Kecman's Support Vector Machine Technique — also known as Single Data Algorithm (ISDA), bringing international visibility to the Department of Computer Science and the VCU School of Engineering. "The impact of MATLAB's implementation of ISDA is giving us confidence that we are on the right track," said Kecman. "Out of dozens of algorithms, they chose ours because of its efficiency."

According to Kecman, even the seemingly simple tasks of sending a picture via mobile device is a data-intensive process that can be very slow and costly. One of ISDA's applications is to compress images to reduce data complexity and speed up the time it takes to process and send images.

BREAKING DOWN BIG DATA

Over a decade ago, Kecman began collaborating on ISDA with his then doctoral students Te-Ming Huang, Ph.D. and Michael Vogt, Ph.D. Today, Vogt is a researcher at Smiths Group in Wiesbaden, Germany, and Huang is the founder and CEO of Yottamine Analytics, a company whose cloud computing technology is the leading tool for ultralarge data mining in clouds.

Ljiljana Zigic and Gabriella Melki are current Ph.D. students working in Kecman's Learning Algorithms and Applications Laboratory (LAAL), which focuses on developing new big data computational paradigms, adapting algorithms for GPU processing and cloud computing. "Our goal here is to improve algorithms that deal with large data sets," Ljiljana said. "This idea is ten years old, and that tells you a lot about what Kecman is like as a person. He is always pushing for better solutions and never gives up. He's a true mentor to me, guiding me, which is quite rare."

Faculty Mentorship Award Winner Inspires Students To Tackle Educational Opportunities

Daniel Conway, Ph.D., assistant professor of biomedical engineering received the VCU Undergraduate Research Opportunities Program (UROP) Faculty Mentorship Award for his lasting impression on student research and scholarships. Students and faculty alike celebrated Conway's commitment and dedication to learning at the seventh annual Poster Symposium for Undergraduate Research and Creativity. The UROP program funds summer fellowships for undergraduate students, allowing them to develop a project under the mentorship of VCU faculty like Conway.

"I want my students to be happy, so I try to find research aspects that interest them," said Conway. "If they want the experience, and I can provide that, I should." Conway's laboratory work focuses primarily on how cells respond to mechanical forces.

Natalie Noll, a junior biomedical engineering student who studies artery inflammation in Conway's lab, nominated him for this award. "Anybody like him deserves to be recognized for their work," said Noll. "He's definitely changed the path that I was on. Before this experience, I was pre-med, but now I've realized that I want to continue doing research."

Several of Conway's current student researchers have worked in his lab since he arrived at VCU in 2013. "Since I've started working in professor Conway's lab, I've been more eager to apply to more things," said Sindora Baddam, another junior biomedical engineering student. "It started small just by asking to work in professor Conway's lab, then I applied to UROP and now I've even expanded my learning abroad. Each success motivated me to do more. His motivation has impacted my life a lot."

VCU School of Engineering FACULTY

2015-2016 Academic Year

The Virginia Commonwealth University School of Engineering's growth strategy over the next five years includes unprecedented faculty recruitment and retention efforts. Why? So that our students get the very best instruction and the most meaningful real-world experience possible. It is with this dynamic future in mind that we applaud our talented and visionary faculty where they make it real for our students every day.

OFFICE OF THE DEAN

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Research Topics:
- Tissue engineering
- Response of cells to biomaterials
- Mechanisms of action of hormones and growth factors in chondrocytes and osteoblasts

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Research Topics:
- Computer security
- Medical applications
- Database and networks

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Research Topics:
- Device design and development processes
- Entrepreneurial business strategy and development
- U.S. FDA quality system regulations and ISO medical device standards

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Research Topics:
- Microwave and RF modeling and simulation
- Signal processing
- Medical devices

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Research Topics:
- Supercritical carbon dioxide technology
- Hydrogen fuel, renewable fuels, batteries, bioenergy and liquid fuels from biomass
- Nanoparticles and smart medicine

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Research Topics:
- Database design
- Fuzzy database
- Missing Information in relational database

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Research Topics:
- Regulation of bone and cartilage
- Implant and bone substitute mechanism of action and clinical use
- Steroid hormone

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Research Topics:
- Smooth muscle biomechanics
- Robotic devices for medical applications
- Bladder biomechanics and urodynamics

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Research Topics:
- Optoelectronics/photonics
- Electronic materials
- Computational intelligence

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Research Topics:
- Capstone Senior Design program
- Innovation, design and development processes
- High performance polymers and fibers

BIOMEDICAL

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Research Topics:
- Regenerative medicine and tissue engineering
- Musculoskeletal mechanobiology
- Space biology and bioengineering

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- Response of cells to biomaterials
- Mechanisms of action of hormones and growth factors in chondrocytes and osteoblasts

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Research Topics:
- Bioinstrumentation and telemedicine devices
- Technologies for detection and mitigation of drowsy driving
- Ultrasonic imaging techniques for studies of cardiovascular dynamics

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- Pulmonary regenerative medicine
- Mechanobiology

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- Animal defect models
- Biomaterial-cell interactions

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- Innovation and entrepreneurship
- Leadership of teams in ambiguity
- Design for highly-constrained environments

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Website: www.people.vcu.edu/~clemmon
Research Topics:
- Mechanobiology in the extracellular matrix
- Biomechanics of fibrosis
- Cellular contractile force measurements

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Professor
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Research Topics:
- Non-invasive cerebral spinal fluid pressure device
- High noise speech communication system
- Baby echolocator: a device allows babies who are deaf to "see" acoustically, facilitating perceptual motor development

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Research Topics:
- Artificial hearts design and evaluation
- Speech recognition for distorted speech and noisy environments
- Design of Assistive Technology

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Website: www.biomedical.egr.vcu.edu/faculty/rene-olivares-navarrete-ph-d/
Research Topics:
- Surface modifications for dental and orthopedic implants
- WNT signaling
- Mesenchymal stem cell and biomaterials interaction

Dianne T.V. Pawluk, Ph.D.
Associate Professor
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Research Topics:
- Assistive technology for individual who are blind or visually impaired
- Hand prostheses
- Human haptic perception

Anathea Pepperl, Ph.D.
Assistant Professor
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Research Topics:
- Human motion analysis
- Image segmentation in medical and microscopy applications
- Health informatics

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Research Topics:
- Regulation of bone and cartilage
- Implant and bone substitute mechanism of action and clinical use
- Steroid hormone

Jennifer S. Wayne, Ph.D.
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Research Topics:
- Experimental and computational modeling of diarthrodial joint function
- Structural stability of fixation constructs
- Articular cartilage: normal function, reparative techniquess

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Associate Professor
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Research Topics:
- Eye tracking systems and eye movement analysis
- Effects of neurological diseases on eye movement control
- Visual task analysis

Ning Zhang, Ph.D.
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Research Topics:
- Stem cell biology
- Central nervous system trauma and diseases
- Biomaterials for oral biofilm prevention

CHEMICAL and LIFE SCIENCE

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Research Topics:
- Cross-coupling catalysis
- Flow chemistry/continuous chemical processing
- Organic synthesis in pharmaceutical applications

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Research Topics:
- Research and development from conception to commercialization in various therapeutic areas including oncology, cardiovascular and infectious disease
- Process development of new and existing active pharmaceutical ingredients
- Development of efficient and cost effective processes using continuous synthesis and flow chemistry

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Research Topics:
- Metabolic engineering
- Computational metabolic modeling
- Biorefineries

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Research Topics:
- Supercritical carbon dioxide technology
- Hydrogen fuel, renewable fuels, batteries, bioenergy and liquid fuels from biomass
- Nanoparticles and smart medicine

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Research Topics:
- Mitochondrial genetics and bioenergetics
- Induced pluripotency
- Mitochondrial disorders and gene therapy

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Research Topics:
- Undergraduate instructional laboratories
- Laboratory safety
- Capstone Senior Design projects

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Research Topics:
- Biological effects of nanoparticles
- Advanced in vitro exposure systems
- Nanomedicine

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Website: www.engineering.vcu.edu/proteinengineering
Research Topics:
- Protein engineering: peptide biomimetics and protein misfolding
- Time force autocorrelations
- Multiple time scale perturbation theory

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Research Topics:
- Stem cell bioprocessing
- Biomaterials and biomarkers
- Pluripotency

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Research Topics:
- Multifunctional polymer nanomaterials
- Self-assembly of metal-polymer nanoparticles
- Rheology of polymers/biopolymers

Xuejun Wen, M.D., Ph.D.
William H. Goodwin Professor
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Website: www.regenerativemedicine.vcu.edu
Research Topics:
- Biomaterials: natural, pure synthetic and hybrid
- Stem cell biology and engineering
- Cell/tissue engineering and regenerative medicine

Kenneth J. Wynne, Ph.D.
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Research Topics:
- Surface polymer science
- Kinetics nanoscale and mesoscale diffusion
- Antimicrobial and cytocompatible coatings

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Research Topics:
- Functional biomaterials
- Nanoscale surface characterization
- Microfabricated biosensors

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Research Topics:
- Clickable polymers for drug delivery
- Drug delivery for glaucoma
- Brain cancer therapy

COMPUTER SCIENCE

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Research Topics:
- Machine learning
- Data mining
- Computational neuroscience

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Research Topics:
- Machine learning
- Systems biology
- Computational biology

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Research Topics:
- Mobile computing and mobile data mining
- Cybersecurity, network security, and privacy and trust
- Mobile (3G/4G) systems

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Research Topics:
- Security and privacy
- Vehicle networks
- Underwater networks

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Research Topics:
- Big data
- Efficiency and scalability of algorithms
- Parallel, distributed and GPU computing

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Research Topics:
- Software maintenance
- Software engineering
- Applications of information retrieval in software engineering

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Research Topics:
- Network vulnerability assessment
- Security and privacy in social networks and wireless networks
- Approximation algorithm, combinatorial optimization

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Research Topics:
- Security management and collaborative security
- Intrusion detection and malware/botnet detection
- Security in social networks, mobile networks and cloud environment

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Research Topics:
- Quantum complexity theory
- Quantum algorithms
- Theory of quantum entanglement

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Research Topics:
- Modeling and simulation
- Systems biology
- Wireless networks

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Research Topics:
- Machine learning and data mining
- Fuzzy logic modeling
- SVM algorithms for large datasets

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Research Topics:
- Structural bioinformatics
- Intrinsic disorder in proteins
- Structural genomics

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Research Topics:
- Fuzzy neural data mining techniques
- Energy security
- Human-machine interfaces

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Research Topics:
- Natural language processing
- Biomedical text processing
- Information retrieval

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Research Topics:
- Theoretical and applied cryptography
- Information security
- Privacy quantum (resilient) cryptography

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Research Topics:
- Microwave early cancer detection and monitoring
- Microwave hyperthermia and ablation
- Computational electromagnetics

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Research Topics:
- Micro and nanofabrication
- Sensors and actuators
- Energy conversion devices

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Research Topics:
- III-nitride epitaxial structures for light emitters and high-power devices
- Semipolar and nonpolar III-nitride epitaxial structures on silicon and sapphire substrates for light emitters
- ZnO-based heterostructures and transparent conductive oxides (TCOs) for electronic and optoelectronic devices and plasmonics

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Research Topics:
- Straintronics
- Coherent spin transport in nanowires for sensing and information processing
- Nanowire-based room temperature infrared detectors

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Research Topics:
- Engineering education
- Nanofabrication techniques
- Molecular electronics

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Research Topics:
- Medical image processing
- Signal processor architectures
- Document compression for archiving

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Research Topics:
- Embedded systems design and analysis
- Dependability analysis of safety critical systems
- Cyber physical systems

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Research Topics:
- Microwave and RF modeling and simulation
- Signal processing
- Medical devices

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Research Topics:
- Data storage and I/O systems
- Computer architecture
- Erasure coding techniques for reliable big data management

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- STEM education
- Medical image and signal processing
- Artificial neural network applications

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Research Topics:
- GPS applications
- Neural networks
- Linear and nonlinear control theory

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Research Topics:
- Collaborative unmanned aerial vehicles
- Cyber-physical systems security
- Hardware/software codesign

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Research Topics:
- Group III-IV semiconductors
- Light emitting diodes
- Nitride semiconductor heterostructures

● *New Faculty*

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Associate Professor
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Research Topics:
- Sensory intelligence
- Medical imaging
- Computer vision

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Research Topics:
- Statistical signal processing
- Information fusion in sensor networks
- Wireless communications

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Qimonda Associate Professor
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Research Topics:
- Group III-nitride and zinc oxide optoelectronics
- Ultrafast optical spectroscopy
- Physics of semiconductor heterostructures

R. Daniel Resler, Ph.D.
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Research Topics:
- Programming languages
- Compiler design
- Automatic generation of software

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Website: TBD
Research Topics:
- Optoelectronics/photonics
- Electronic materials
- Computational intelligence

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Research Topics:
- Electric power system modeling and optimization
- Renewable integration
- Demand management in smart grids

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Research Topics:
- GPU and heterogeneous computing
- Emerging memory and storage technologies
- Embedded systems

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Research Topics:
- Real-time and embedded systems
- Computer architecture
- Parallel computing

MECHANICAL and NUCLEAR

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Research Topics:
- Chemical sensors
- Nanomaterials
- Radiation detectors

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Research Topics:
- Nanomagnetic memory and computing
- Novel magnetic materials
- Nanofabrication

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Research Topics:
- Nuclear thermal hydraulics
- Nuclear reactor design and safety
- Energy and environmental policy

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Research Topics:
- Device design and development processes
- Entrepreneurial business strategy and development
- U.S. FDA quality system regulations and ISO medical device standards

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Research Topics:
- Design engineering
- Design optimization
- Fuel cell and hybrid technology

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Research Topics:
- Nanoparticles and nanotechnology
- Powder and spray technology
- Particle instrumentation and characterization

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Research Topics:
- Turbulence and flow control
- Microelectromechanical systems
- Large-scale disasters

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Research Topics:
- Respiratory aerosol and fluid dynamics
- Pediatric lungs targeted drug delivery
- Aerosol filtration and bio-aerosols

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Research Topics:
- Engineering education
- Process control engineering
- Manufacturing engineering

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Research Topics:
- Biomagnetics
- Magnetic materials
- Energy harvesting

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Research Topics:
- Failure and fracture in materials
- Peridynamic modeling and simulation
- Multiscale computational solid mechanics

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Research Topics:
- Respiratory therapeutics
- Targeted drug delivery
- Pharmaceutical aerosols

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Research Topics:
- Engineering education
- Reactor simulation
- Reactor theory

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Research Topics:
- Ultra-incompressible superhard materials
- Thin film deposition and characterization
- Superhydrophobic materials

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Research Topics:
- Energy harvesting
- Smart materials
- Fluid mechanics

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Research Topics:
- Electron beam-assisted polymerization
- Electron beam lithography for graphene electronics
- Chemical and biological miniature sensors

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Research Topics:
- Nuclear and chemical separation technology in fuel cycle research and development
- Electrochemical processes
- Special material detection and analysis via laser and mass spectroscopy techniques

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Research Topics:
- Radiation-induced synthesis of nanomaterials
- Modification of nanomaterials properties through irradiation.
- Radiation damage and radiation effects on nuclear materials

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Research Topics:
- Smooth muscle biomechanics
- Robotic devices for medical applications
- Bladder biomechanics and urodynamics

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Research Topics:
- Sustainable batteries
- Nanomanufacturing
- Self-powering of implantable/wearable systems

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Research Topics:
- Response dynamics and vibrations of offshore drilling and production systems
- Deepwater marine riser systems and the various nonlinear effects
- Simulation and control of sophisticated, high-capacity tensioning systems

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Research Topics:
- Modeling interfacial phenomena and superhydrophobicity
- Fluid, heat and particle transport through porous media
- Separation and filtration science

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Research Topics:
- Actinide bearing ceramic nuclear fuel
- Nuclear structural materials
- High temperature materials processing and mechanical testing

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Research Topics:
- Aerosol science and technology
- Nanomaterial synthesis and characterization
- Catalysis and separation

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Research Topics:
- Nanomembrane electronics for human health monitoring
- Human-machine interfaces via skin-like electronics
- Nano-biosensors for disease diagnostics

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Research Topics:
- Surface science and surface engineering
- Transport and self-assembly of colloidal nanoparticles
- Printed functional devices

Fun Fact #19: ***Founding Dean Emeritus, Henry McGee, Ph.D., recalls telling time from the sunlight peeking through stained glass windows in his office instead of a clock.***

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Fun Fact #20: ***End caps on every floor of the School's first building had wrap-around seating and dry erase boards. They became a favorite study spot for students who called them "cubies."***

VCU School of Engineering

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"I speak for our School of Engineering faculty and leaders when I say we're excited by the opportunity to help VCU meet the challenges that engineering education will face over the next decade,"

– VCU School of Engineering Dean, Barbara Boyan, Ph.D.

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