RUTGERS–NEW BRUNSWICK
School of Engineering

STEPPING UP

improving lives and advancing technology
through focused research and education

Rutgers School of Engineering empowers the next generation of engineers to build a sustainable world through education, innovation, civic engagement, and a commitment to impactful research. We cultivate a diverse and collaborative community that translates pioneering discoveries into responsible solutions for tomorrow's challenges.

Engineering Without Boundaries

Rutgers School of Engineering builds on its groundbreaking research and educational excellence to further a vision for our students, university, and state that is forward-thinking and transformational. Every day, we step up to the plate as architects of next-generation research, innovators in engineering education, and leaders in preparing students to work in the contemporary world. Our program is robust and comprehensive across the array of engineering disciplines.

Within a leading research university, Rutgers Engineering contributes 30% of Rutgers-New Brunswick's overall research expenditures, along with securing patents and establishing business start-ups. We collaborate across disciplines, industries, and public projects, partnering to solve challenges. With more than 20,000 alumni in New Jersey, we are an economic engine fueling industry with a highly skilled and talented workforce.

STEPPING UP

Stepping Up to Discovery and Innovation

Improving Lives and Advancing Technology Through Focused Research

School of Engineering faculty and students engage in research that improves lives, advances technology, and supports the public interest. Fundamental research crosses the full spectrum of engineering disciplines both within Rutgers and beyond through partnerships with other university researchers, industry, and government.

As one of the leading engineering schools in the nation, we believe it is our responsibility to be at the forefront in educating the next generation to address complex and multifaceted global challenges and to advance through innovation and collaborative research realistic, workable, and equitable solutions for our communities, nation, and planet. Locally, New Jersey's geographic location, industrial base, dense infrastructure, energy goals, defense assets, and health economy provide many opportunities for Rutgers Engineering to fully contribute to the economic growth of the state.

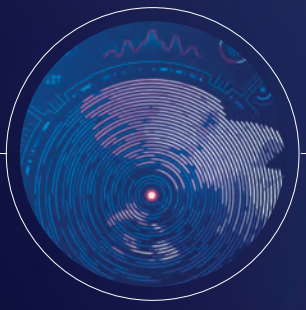
Our expansive research program is both department-focused and transdisciplinary. Organized around ten distinct fields of engineering, Rutgers Engineering is uniquely suited to lead in **defense**, **energy**, **health**, and **infrastructure**.

Engineering for the Future

Infrastructure

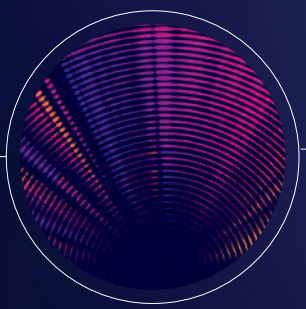
- TRANSPORTATION
- WATER SYSTEMS
- WIRELESS AND 6G TECHNOLOGY
- COMMUNITY RESILIENCE
- PORT AUTOMATION

Health



- REGENERATIVE MEDICINE
- GENE AND VACCINE DELIVERY
- DIAGNOSTIC DEVICES
- PHARMACEUTICAL MANUFACTURING
- IMAGING AND INSTRUMENTATION

Energy



- CLEAN ENERGY
- BATTERY TECHNOLOGY
- ENERGY STORAGE
- AGRIVOLTAICS
- SMART GRIDS

Defense

- HYPERSONIC MATERIALS
- ENERGY SECURITY
- CHEMICAL DEFENSE
- AUTONOMOUS SYSTEMS
- CYBERSECURITY
- ADDITIVE MANUFACTURING

INFRASTRUCTURE

A Hub for Innovative and Resilient Infrastructure Solutions

Infrastructure underpins the foundational systems that support societies and economies. From transportation and communication to energy and water systems, a strong and resilient infrastructure is the backbone of thriving communities.

New Jersey's high-density infrastructure includes roads, tunnels, bridges, and transit. It is also a critical node in the Northeast Corridor for rail commuters and a hub for freight and global trade via the Port of New York and New Jersey. Additionally, coastal flooding, urban heat, and aging stormwater systems demand resilient and sustainable infrastructure solutions. There is also a growing national and commercial focus on Advanced Air Mobility drones, electric vertical take-off and landing (eVTOL), and autonomous aircraft systems, which have significant implications for New Jersey.

Rutgers Engineering's research in critical areas related to the full infrastructure scope is represented across engineering departments, most notably civil and environmental engineering, electrical and computer engineering, materials science and engineering, and aerospace engineering. Research funding includes federal and local agencies such as the Departments of Energy, Transportation, and Homeland Security, the FAA, FEMA, NJ Transit, among others.

Rutgers Engineering Edge

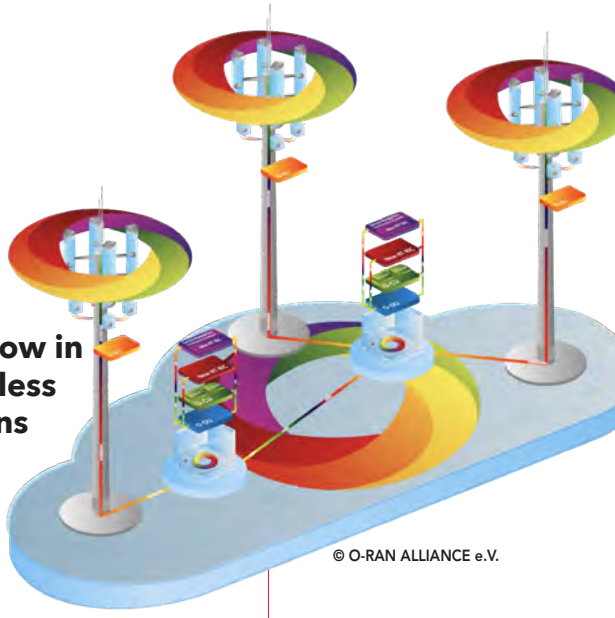
- **Leveraging strengths in resilience, sustainability, automation, advanced cyberinfrastructure, and aeronautics, Rutgers Engineering is a hub for innovative infrastructure solutions.**
- **Ongoing projects in critical areas, including transportation, water infrastructure, port automation, and community resilience, are in partnership with key industry and government stakeholders.**
- **Rutgers Engineering's Center for Advanced Infrastructure and Transportation (CAIT) and the Wireless Information Network Laboratory (WINLAB) are leaders in wireless networking and infrastructure improvement.**

Helping Bridges Withstand Extreme Temperatures

Climate change poses a potentially devastating threat to the nation's bridges, with some predicting the collapse of one in four U.S. bridges due to extreme temperatures by 2050. Structural deformation from climate extremes could accelerate aging and compromise bridge safety and stability.

Bridge safety is paramount for Rutgers engineers. Rutgers is home to the world's first outdoor laboratory capable of simulating deterioration that occurs on bridges by inflicting and intensifying stresses from the environment and heavy traffic on sections of bridges in the lab. CAIT's Bridge Evaluation and Accelerated Structural Testing lab, dubbed the BEAST, is built to induce and speed up deterioration as much as 30 times, making it possible to simulate 15 to 20 years of wear-and-tear in just a few months. The BEAST has allowed Rutgers Engineering to further relationships with major agencies, including USDOT, NJDOT, NJ TRANSIT, and the Port Authority of NY/NJ, as well as industry testing new roadway materials.

The Future is Now in Next-Gen Wireless Communications



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As rapid advances in wireless technology continue to deliver higher networking speeds, more consistent connections, and increased capacity, the need for seamless integration of wireless technologies couldn't be greater. Rutgers University's WINLAB is part of the Department of Commerce's $1.5 billion Wireless Innovation Fund consortium to support the development of open and interoperable wireless networks.

This is the latest development in the NSF PAWR COSMOS testbed that has been deployed in West Harlem in collaboration with Rutgers, Columbia, and NYU since 2018. According to WINLAB director and electrical and computer engineering Distinguished Professor Narayan Mandayam, "The focus on ultra-high bandwidth and low-latency wireless communication, tightly coupled with edge computing and optical x-haul in a dense urban area, will enable us to push the envelope in wireless networking."

Greener by Design

CAIT is working with the U.S. Department of Transportation to investigate the use of steel slag in cement and concrete, which has been identified as an alternative with significant carbon reduction potential. Creating innovative alternatives to traditional construction materials would reduce greenhouse gas emissions while still being strong enough to withstand harsh environmental conditions.

The BEAST subjects bridges to extreme environmental and traffic loading to simulate decades of deterioration in months instead of years. The quantitative data captured on materials and components performance could save billions in infrastructure costs.

STEPPING UP

health

Creating New Technologies to Deliver and Receive Healthcare

The field of healthcare is undergoing a significant transformation, driven by technological advancements and evolving patient expectations. Engineering is a key driver in the areas of personalized medicine, digital health integration, AI-powered diagnostics and treatment, and preventative healthcare.

As the COVID-19 pandemic underscored, there is a need for agile, domestic, and technologically advanced medical manufacturing. Pursuing groundbreaking innovation and strategic partnerships, Rutgers Engineering is leveraging New Jersey's status as a biopharma powerhouse, which boasts more than 400 biotech and pharmaceutical companies, earning its title as the "Medicine Chest of the World."

Building on its established success in pharmaceutical manufacturing, Rutgers' Center for Structured Organic Particulate Systems, or C-SOPS, is addressing critical challenges facing the nation's drug supply chain, including pathways for more rapid manufacturing of cell-based therapies essential for next-generation treatment of diseases.

Additionally, Rutgers Health houses New Jersey´s largest academic health center, including two medical schools and a pharmacy school.

Rutgers Engineering Edge

- **Focused research success in areas such as pharmaceutical manufacturing, regenerative medicine, diagnostic devices, and gene and vaccine delivery.**
- **Innovative technologies and devices integrate traditional engineering with AI and machine learning, data-driven modeling, 3D printing, and others.**
- **Research funding across engineering departments serves as a platform for trainee development, with outcomes more broadly geared toward workforce development in New Jersey and the pharmaceutical and healthcare industries.**

Rapid, Reliable Test Results from One Drop of Blood

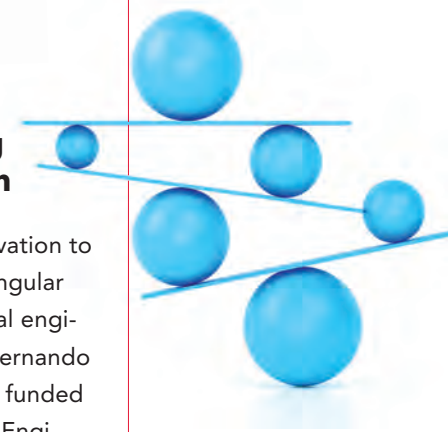
Digital healthcare uses information and communication technologies to improve healthcare delivery, enhance patient care, and promote wellness. Umer Hassan, an assistant professor in the School of Engineering's Department of Electrical and Computer Engineering and Rutgers' Global Health Institute, has developed a point-of-care biomedical platform able to monitor a patient's response to surgical site infections (SSI) so they can be promptly diagnosed and treated. SSIs are not only costly to treat, but they are also an all-too-frequent cause of post-surgical deaths. The device, automated and integrated into hospital settings, performs expedited measurements of inflammatory proteins, which are routinely used in hospitals for patient monitoring.

According to Hassan, the benefit of the proposed platform is its automation and the fact that it would only need a drop of blood to test for inflammatory proteins compared to current time-consuming, costly lab tests. "We can potentially use the proposed sensor near the patient's bedside," Hassan notes. "This will allow rapid, frequent patient immune system monitoring from the drop of blood and would help bypass non-specific visual indications of infection."

Stronger Domestic Drug Production Supply Chain

Bringing twenty-first century innovation to drug manufacturing has been a singular focus for chemical and biochemical engineering Distinguished Professor Fernando Muzzio for three decades. Initially funded as a National Science Foundation Engineering Research Center, the Center for Structured Organic Particulate Systems (C-SOPS) is at the forefront of developing and applying cutting-edge engineering methodologies for the design and optimization of pharmaceutical products and processes. Through ongoing partnerships with the Food and Drug Administration, C-SOPS is one of only four teams and is the only university-led team working with the U.S. Department of Health and Human Services and the Defense Advanced Research Projects Agency (DARPA) to transform U.S. pharmaceutical manufacturing by leveraging new technologies to develop a regulatory framework able to make medicines available wherever and whenever they are needed.

C-SOPS advances research on pharmaceutical control and manufacturing.



Healthcare X6

By its nature, most of the faculty in biomedical engineering are working in healthcare. Clusters of faculties in electrical and computer engineering, mechanical engineering, industrial engineering, and materials science and engineering have activity in this area, either as the core of their research or collaboratively with others.

STEPPING UP

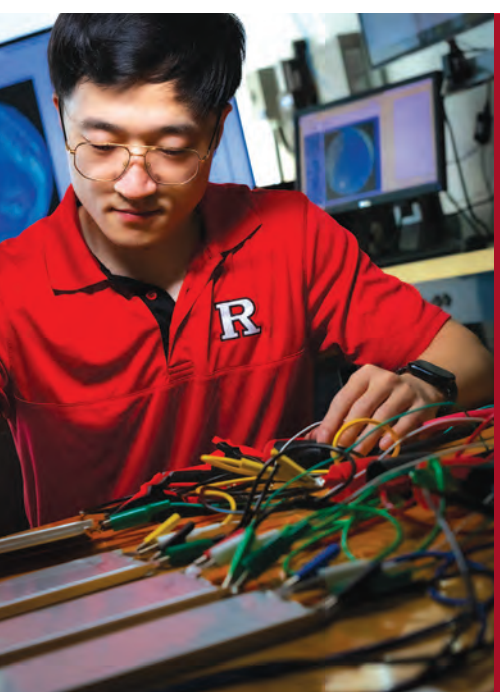
ENERGY

Leading the Charge for Sustainable and Renewable Energy

A truly global energy crisis, fueled by conditions ranging from an over-reliance on and shortage of fossil fuels to slowing economies, has spurred an all-hands-on-deck approach to developing sustainable and renewable energy sources and technologies for the future.

New Jersey's high population density and aging energy infrastructure are driving innovative research in energy storage, smart grids, and reliability. Working together, Rutgers Engineering and the State of New Jersey are national leaders in the field of clean energy, with New Jersey setting one of the nation's boldest clean energy goals: achieving clean energy by 2035.

Energy security requires a diverse portfolio of solutions—from traditional sources optimized through advanced engineering to breakthrough technologies that will power the future economy. Collaborations within Rutgers, with other universities, government labs, industry, and international partners, will ensure that growing energy needs can be met reliably and economically.



Rutgers Engineering Edge

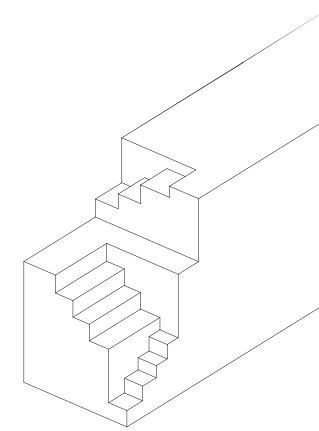
- **A multidisciplinary team of Rutgers faculty from seven departments in the School of Engineering, along with the broader Rutgers academic community, is addressing the challenges posed by the need for clean energy.**
- **Rutgers Engineering solutions are revolutionizing battery technology, generating electricity on farmland, transforming seaweed into fuel, exploring emerging fusion technologies, and more.**
- **Rutgers Engineering is making crucial contributions to New Jersey's clean energy goals through advanced research, workforce training, and productive industry collaborations.**

Harvesting Electricity on Active Farms

Since 2024, the multi-million-dollar state and federally funded Rutgers Agrivoltaics Program (RAP) has been seeking to generate and harvest electricity by installing wind farms on actively farmed land. Researchers in the School of Engineering and the School of Environmental and Biological Sciences are learning how agrivoltaics—with its potential to help meet state renewable energy goals—might impact crop yields and disturb animals on three fields, including at a first-of-its-kind installation of vertical bi-facial solar array panels on a Rutgers University animal farm field. For farmers, electricity generated on their tillable land could offset their electric bills. "It's the beginning of a new industry," predicts Dunbar Birnie, a materials science and engineering professor, who is the solar design expert attached to the cross-university and cross-disciplinary RAP team.

Revolutionizing Battery Technology

"Batteries power our lives and transform society," says Glenn Amatucci, a professor in the Department of Materials Science and Engineering and director of the Energy Storage Research Group, which recently collaborated with subcontractors Lockheed Martin Corporation and The Charles Stark Draper Laboratory Inc., on a $10 million Robust Energy Sources for Intelligence Logistics in Extreme, Novel and Challenging Environments (RESILIENCE) project. While the project aimed to develop a high-performance new battery with twice the lifespan and half the size of predecessors able to power military drones on sustained surveillance flights in extreme conditions, its groundbreaking technology could ultimately be used to develop smaller, longer-lasting batteries for everything from cell phones to biomedical devices.



Building Blocks for Energy Careers

Renewable energy. Smart grids. Clean vehicles. Long-lasting batteries. Rutgers' interdisciplinary Master of Engineering degree in Energy Systems integrates technology and science with business, IT, public policy, and regulatory study. The program promotes interdisciplinary collaboration through six School of Engineering departments, along with the Edward J. Bloustein School of Planning and Public Policy and the Rutgers Business School.

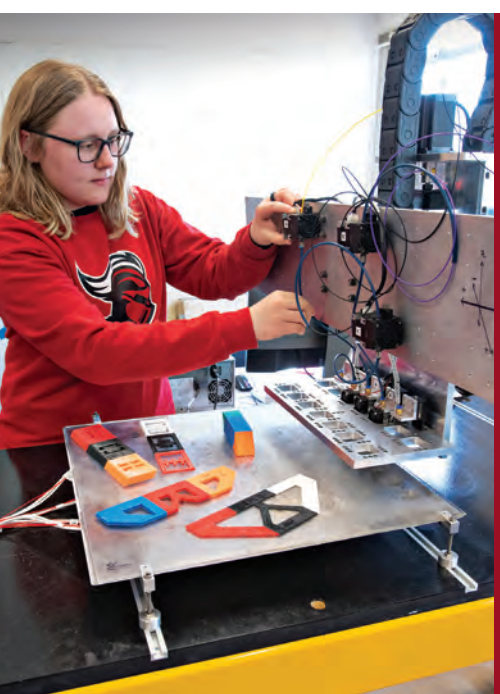
defense

Securing the Future through Defense and National Security

Being able and equipped to defend and protect U.S. skies and borders is a top national priority—and one that depends on updated defense systems and technologies, as well as highly trained engineers. This arena includes aircraft and weapons, cybersecurity, and the complex software needed to support military operations.

The Department of Defense and Department of Homeland Security, as well as other federal and defense industry-funded advanced research projects, target strategically crucial areas, such as hypersonics, cybersecurity, autonomous systems, and the deployment of additive manufacturing for defense, among others.

With Joint Base McGuire-Dix-Lakehurst and Picatinny Arsenal, as well as major defense contractors such as Lockheed Martin and BAE Systems calling it home, New Jersey's national military and defense presence offers Rutgers Engineering opportunities for collaboration and implementation of its security-focused research. Defense-related research and development funding, as well as partnerships with federal agencies and defense industry partners, are vital to the discovery of innovative solutions to pressing national challenges. Rutgers Engineering is well-positioned to address escalating cybersecurity and infrastructure threats.



Rutgers Engineering Edge

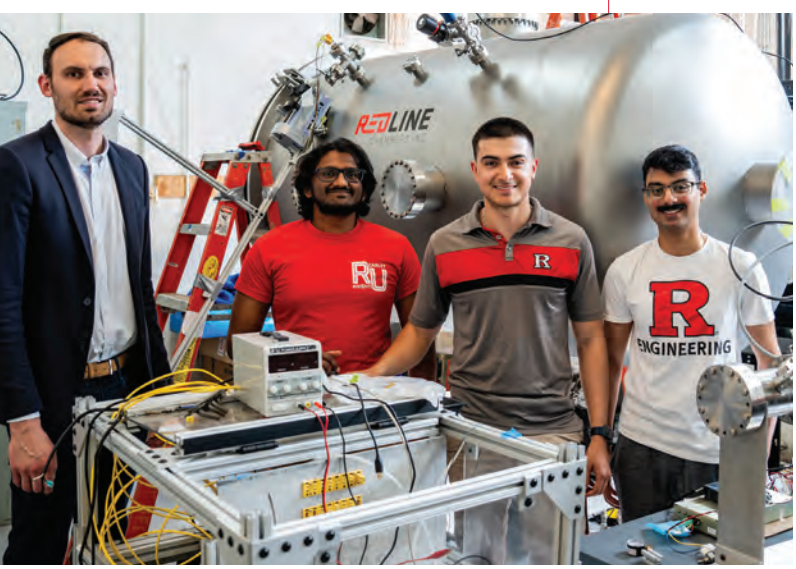
- **Within Rutgers Engineering, defense research is rigorously applied in aerospace, mechanical, electrical, materials, and systems engineering.**
- **Faculty members are pursuing new developments in unique hypersonic testing and simulation capabilities, drone design and automation, game theory and cybersecurity, smart manufacturing, and novel materials.**
- **Ongoing conversations with defense partners, including Picatinny Arsenal and Army Research Laboratory DEVCOM, enable faculty researchers to respond to current defense capability needs.**
- **Aerospace engineering and cybersecurity concentrations and certificates train future engineers for leadership roles in defense technology and innovation.**

Putting VLEO at the Service of National Security

With a Defense Advanced Research Projects Agency (DARPA) grant, Assistant Professor Steven Berg is seeking a way to enable sustained flight at VLEO (very low Earth orbit), the "no man's land" between spaceflight and atmospheric flight. Enabling flight at roughly half the altitude of traditional satellites, according to Berg, unlocks new capabilities in terms of higher resolution imaging, which is vitally important for defense and intelligence operations. VLEO also makes disruption from adversaries more difficult, while providing a cost benefit by using smaller, less expensive launch vehicles. "With competitors such as China announcing plans for the VLEO flight regime, there's a strong interest within the DOD to counter these plans," says Berg.

Controlling In-field Additive Manufacturing Defects

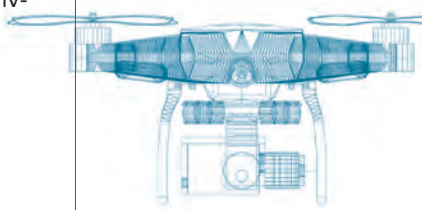
According to Department of Mechanical and Aerospace Engineering Associate Professor Rajiv Malhotra, additive manufacturing (AM) printers offer significant potential for in-field 3D printer fabrication by defense personnel. In-field AM provides in situ for the manufacturing of mission critical parts in extreme and dynamic environments, including battlefields. Yet it lacks the features that ensure reliability of in-factory AM to mitigate printing defects. With NSF funding, Malhotra and his partners have developed a new Conditional Reinforcement Learning (ConRL) approach for real-time data-driven mitigation with the unprecedented ability to "mitigate defects at 10x greater speed." The team's results will make it possible to perform the rapid defect mitigation essential to delivering needed parts in in-field AM.



Department of Mechanical and Aerospace Engineering Assistant Professor Steven Berg established the SPACE Lab (Space Propulsion with Advanced Chemistry and Energetics), which is exploring spacecraft and rocket propulsion, propellants and energetics, spacecraft environments and operations, and general applications of plasma chemistry.

A Launchpad for the Future

As the only public university in New Jersey offering an aerospace engineering degree, Rutgers Engineering boasts dedicated facilities to conduct dynamic research. The Emil Buehler Aerospace Lab is a two-story testing space for aerospace and drone projects



involving everything from modeling and controlling next generation air transportation systems to the safe control of UAVs, flight control, and protection. The Rutgers Hypersonic Expansion Tube and the Net-Zero Wind Energy Test Center are among the unique onsite facilities where students gain hands-on experience that prepares them to enter the workforce of industrial and government collaborators.

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ABOUT RUTGERS SCHOOL OF ENGINEERING

Rutgers University–New Brunswick's School of Engineering is home to educational opportunity and research innovation, preparing a richly diverse body of undergraduate and graduate students with the ability to solve problems, make meaningful societal advances, lead through discovery, and excel in the global workplace. Ranked among the nation's leading engineering programs, the school is centrally located in the Northeast Corridor amid a powerhouse of industrial, pharmaceutical, high-tech, transportation, and financial industries, offering professional access and research collaboration.

With seven academic departments and 10 dynamic engineering majors, Rutgers School of Engineering is also home to innovative and forward-thinking faculty whose nationally recognized research drives progress in areas such as wireless communications, advanced infrastructure and transportation, pharmaceutical engineering, national security, and energy storage.

Learn more at soe.rutgers.edu.

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