BIODESIGN INSTITUTE

CAMPAIGN ASU 2020

WE ARE A FORCE OF NATURE

TOGETHER, OUR POTENTIAL IS LIMITLESS

The Biodesign Institute is a place unlike any other. Imagine hundreds of scientists working together. Biologists, physicists, chemists, engineers, mathematicians—asking questions, learning from one another, and crossing all boundaries to discover new ways to help people everywhere thrive.

Whether it's seeking a cure for Ebola, removing toxic chemicals from air and water, or developing a diagnostic tool to assess widespread radiation exposure, the scientists at the Biodesign Institute take their cues from people and nature.

What do people need, and how can nature show us the way? Today's health and environmental challenges are coming at us fast and furiously. Biodesign scientists have little patience for slow progress. This is a no-holds-barred culture where curiosity and creativity are on overdrive.

Photo credit: Joshua LaBaer

A BOLD VISION: HEALTHY PEOPLE ON A HEALTHY PLANET

WHERE INSATIABLE CURIOSITY AND ENDLESS CREATIVITY MERGE

People have a relentless drive to understand the world around us. From Newton's apple to Sir Alexander Fleming's accidental discovery of penicillin, to the search for Planet X, research scientists are hungry for new knowledge. But at the Biodesign Institute, our focus goes beyond complex questions to practical applications for people.

There is no end to the challenges that face humanity today:

- How can we detect diseases earlier? How can we eliminate the threat of cancer, diabetes, and heart disease?
- Can we find ways to protect our citizens from acts of aggression, both inside our country and out?
- How do we protect and enhance our clean supply of land, air, water, and food?

If the answers were easy, we would already have them. Traditional research—with its steady, measured pace—just can't keep up with the world's scourge of disease, pollution, and plague. With the mapping of the human genome in the year 2000 came an unprecedented opportunity to advance science in ways never before thought possible. Here was the key to unlocking the mysteries of health and disease. Now, scientists would need to find new ways to navigate this amazing discovery together.

Two years later, Arizona State University President Michael M. Crow launched his own experiment: the Biodesign Institute, a new kind of research center at the New American University.

The breakthrough concept for Biodesign came from President Crow's vision of changing the way universities attack research and science: "We need to design our knowledge enterprises to solve the problems that confront us."

Since that time, we've attracted more than $400 million in external funding and created 18 new businesses, approximately 100 patents and licensed technologies, and 640 new inventions.

We are the Biodesign Institute. We are true to the spirit of the American West. We are open-minded, optimistic, and daring.

OUR DONORS' IMPACT

Our nation's ability to embrace the future is increasingly compromised by decreases in government funding for scientific research. The Biodesign Institute at Arizona State University is a place where your personal investment—regardless of the size—will make a real impact for people, for the state, and, perhaps, for the world and generations to come.

"AT THE BIODESIGN INSTITUTE, WE ARE COMMITTED TO CATCHING DISEASE BEFORE IT CATCHES US. WE KNOW WE CAN FIND CREATIVE AND CLEAN SOLUTIONS FOR ENERGY, AIR, AND WATER. WE ARE SURE WE CAN INVENT DIAGNOSTICS AND TREATMENTS THAT ARE ACCESSIBLE AND AFFORDABLE. WE ARE GROWING NEXT-GEN RESEARCHERS WHO BELIEVE THEY CAN DO THE IMPOSSIBLE."

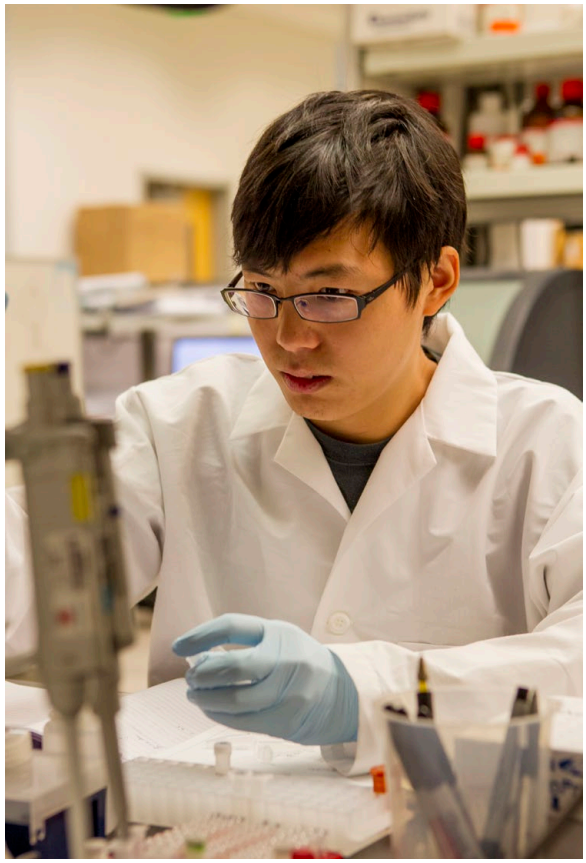
—Joshua LaBaer, *Executive Director, Biodesign Institute*

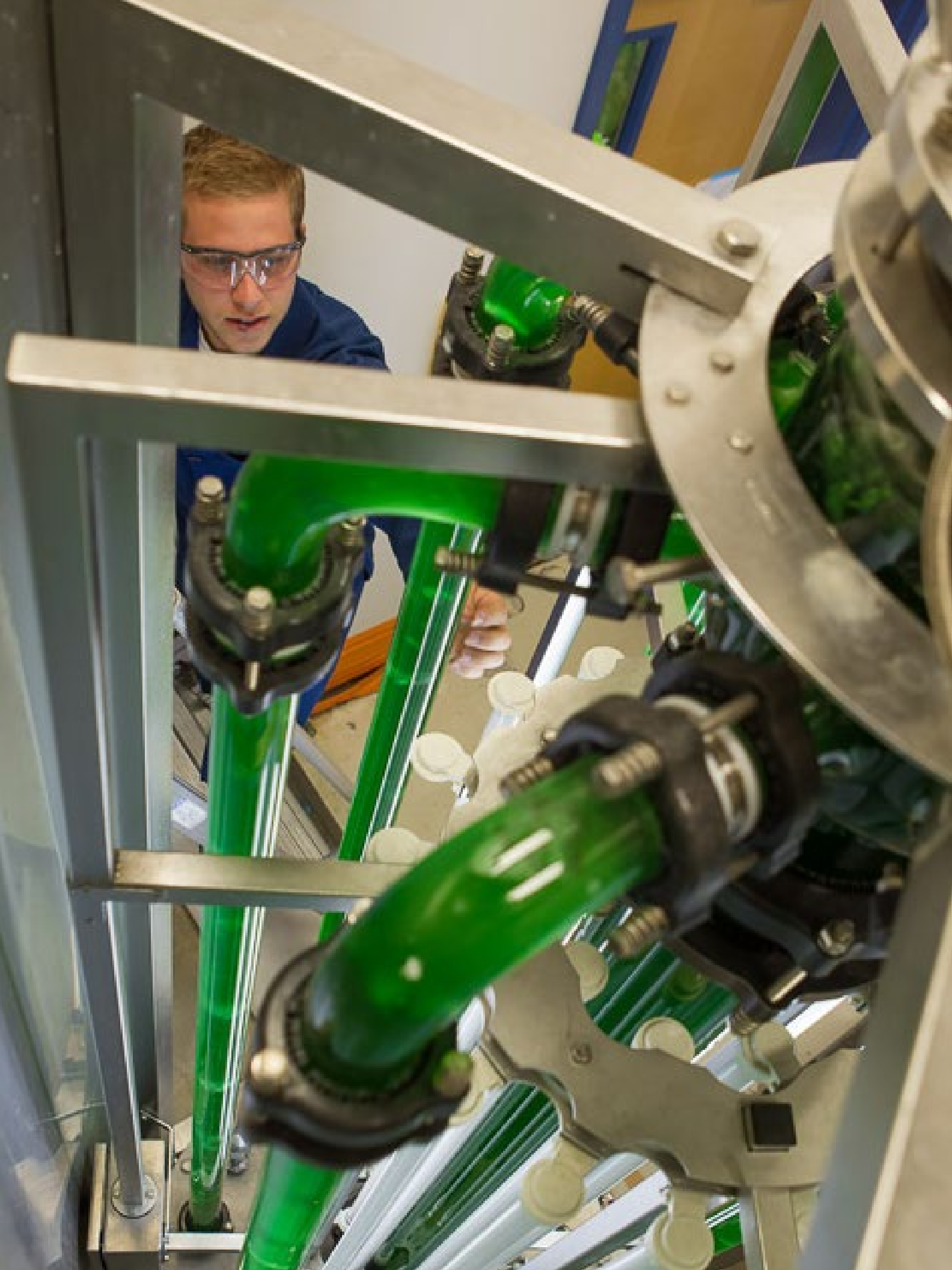
With a donation to the Biodesign Institute, you are making an investment in hundreds of brilliant minds, sharing ideas and making discoveries together, all with the goal of solving some of life's most vexing challenges:

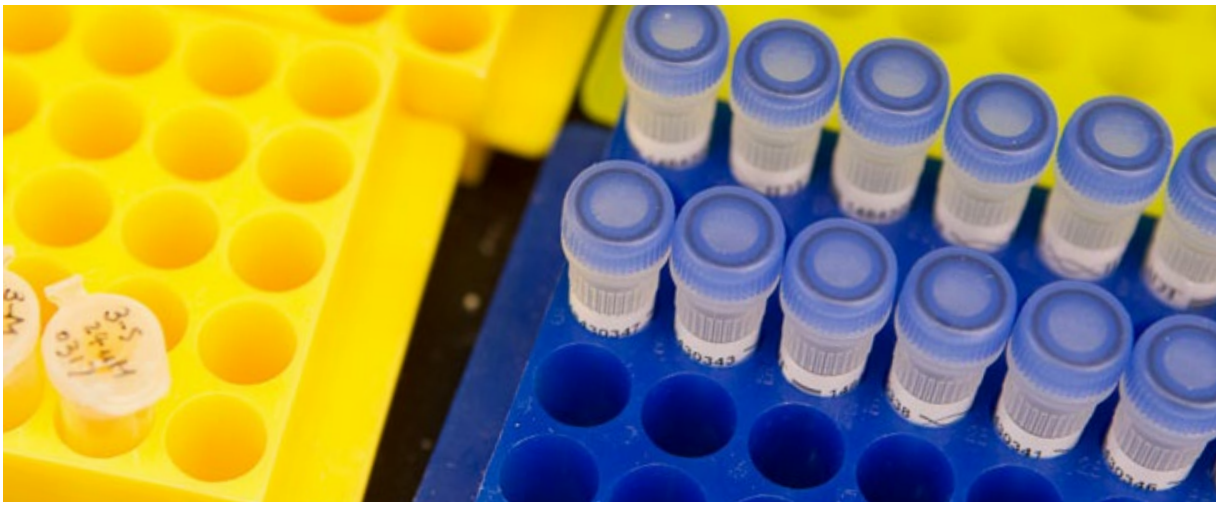
- Discovering the root cause of life-threatening maladies like cancer, diabetes, and autism. Our scientists are currently working to find cures, diagnostics, or more effective treatments for nearly 100 different diseases, from prevalent cancers, diabetes, and immune disorders to childhood orphan diseases.
- Achieving environmental sustainability by expanding options for improving the long-term health of our planet's ecosystem.
- Protecting lives by developing technologies to ensure safety during disaster and conflict.

With your help, we will accelerate lifesaving research; educate thought leaders and learners trained in our research laboratories; attract and retain premier scientific talent; offer opportunities for faculty members, postdoctoral researchers, and graduate students; and provide summer training programs for the future generation of science learners.

Your investment is the ticket to becoming a true partner in understanding and stimulating scientific discovery. At the Biodesign Institute, donors often actively engage with the scientists they support.







TOTAL GOAL: **$41 MILLION**

Biomedicine and health outcomes, sustainability, and security—these are the three major challenges where we are working to make a difference. By harnessing the natural design rules of the very biology that is life on this planet, and by translating solutions from one area to another, we are finding new solutions to these complex challenges.

MOVING ANSWERS FASTER FROM LAB TO LIFE

There is no question that health care in the 21st century will move from a population-based approach to highly personalized medicine. Your DNA, your microbiome, your brain functioning is unlike any other. Treating disease with the methods that work for the masses is no longer our only option. With recent giant leaps in understanding how proteins work, mapping the human genome, and plotting the gut microbiome, new information is now at our fingertips—new information that will lead to earlier detection of disease, precision treatments, and even cures. It will also lead to custom-fitted solutions. That's where the Biodesign approach takes hold—and fast.

Currently, more than 5 million Americans suffer from Alzheimer's disease. This has profound implications for Arizona, with a population of more than 1 million people over age 65 living today, expected to expand to 24 million by 2050. Recently, we joined forces with the world famous neuroscientists at Banner Sun Health Research Institute in order to work faster for answers to Alzheimer's, Parkinson's, and other neurodegenerative diseases. Today, these neuroscientists are surrounded by new tools and new ideas from biologists, geneticists, engineers, and technologists, all eager to crack the mysteries of human aging and neuro-debilitation. Already, we're on to a diagnostic that will detect the onset of Alzheimer's at a very early age.

We are also focused on diseases of the very young. Recently, a team of scientists from the

Biodesign Institute and the Ira A. Fulton Schools of Engineering have discovered a new method for treating the symptoms of autism by improving the gut microbiome through fecal microbial transplants. The initial clinical trial involved only 18 participants. The team is currently seeking funding for the larger-scale research that will enable progress toward FDA approval.

It was a team of researchers at the Biodesign Institute who created the technology for two Americans struck with Ebola in Nigeria. An enterprising botanist named Charles Arntzen found his answer in an unlikely place—a killer plant called tobacco now became a manufacturing plant for this lifesaving serum. The search for answers to identifying, treating, and stopping infectious diseases across the planet is one focus of the Biodesign Center for Immunotherapy, Vaccines and Virotherapy.

In a move that will change the face of medicine as we know it, Biodesign scientists are miniaturizing a potent technology designed to reveal the inner mechanisms of proteins. Once understood, we will have the key to all and every disease. Unfortunately, there's an incorrigible traffic jam: with only three X-ray free electron lasers in the world, scientists must compete for limited time to conduct their experiments. In the basement of the new Biodesign Institute C building (slated to open in spring 2018), chemists, engineers, and physicists are working together to build a miniature version of what is currently an instrument the size of 22 football fields. With success, researchers all over the world will have access to this affordable option and together can pursue cures for disease and new forms of energy.

In an effort to become a global hub for research and discovery and advance medical research that promises to save lives and vastly improve the quality of life for people who struggle with debilitating diseases like high blood pressure, stroke, or cystic fibrosis, Biodesign researchers are seeking $20 million to build the world's first compact X-ray free electron laser, which will further enhance ASU's reputation as the nation's most innovative research university.

KAREN ANDERSON DIAGNOSING BREAST CANCER EARLY

Ten years ago, immunologist and oncologist Karen Anderson was examining the body's response to cancer, searching for biomarkers that could detect the disease as early as possible, when treatment can be most successful. Her research in New England labs was promising, but painstakingly slow. "I was trying to identify five proteins at a time, and it was taking months," she says. So she moved her research to ASU, where the Biodesign Institute's technology accelerated her findings. "Now we can display 12,000 at a time."

Already, she is partnering with the private sector to translate her research into real-world early-detection methods for breast, ovarian, and other cancers. "There are breast cancers that grow too fast to be caught by yearly mammograms or that show up in women too young to be getting mammograms," says Anderson, who is an associate professor at the Biodesign Virginia G. Piper Center for Personalized Diagnostics, School of Life Sciences, and Mayo Clinic Arizona. "Our focus has been to improve detection and reduce mortality."

Meanwhile, Anderson is investigating precision vaccine therapy, using the body's immune response as a way to target specific cancers and reduce the risk of recurrence after treatment.

"Working here has leapfrogged my research forward," she says, noting that she collaborates with engineers, chemists, and physicians to attack problems.

"I can't imagine any place else that has this kind of capability. This is an environment where we really have the opportunity to shift the needle on cancer detection."

"THIS COUNTRY IS THE PRODUCT OF UNBELIEVABLE CREATIVITY AND ENERGY, GENERATION AFTER GENERATION. OUR CREATIVITY, OUR INGENUITY, OUR SCIENTIFIC SKILL, OUR ABILITY TO UNDERSTAND NATURE, HAS BEEN, IS, AND FOREVER WILL BE THE PATH TO HUMAN ENHANCEMENT—TO MAKE LIFE BETTER. ONCE WE UNDERSTAND IT—IN A WAY IN WHICH WE CAN BUILD AND REPLICATE IT AND MAKE IT HAPPEN ON OUR OWN—THAT WILL BE UNBELIEVABLY POWERFUL. BIODESIGN IS FOCUSED ON THE FUTURE AND STRIVES TO GAIN THAT UNDERSTANDING THROUGH ALL ITS LAB EXPERIENCES, PROJECTS, AND PROGRAMS."

—Michael M. Crow, *President, Arizona State University*

HARNESSING NATURE FOR A HEALTHIER PLANET

Whether its pollution, climate change, deforestation, food, energy and water scarcity, or the trashing of our oceans, the assault to our planet continues.

Through bold, biology-based techniques, scientists at the Biodesign Institute are working to solve the world's sustainability challenges with interdisciplinary and problem-oriented teams seeking disruptive solutions to protect the environment. Of our 14 total centers, several are focused on:

- Monitoring the health of cities: Providing access to safe drinking water, clean air, healthy food, and renewable energy sources during adverse climate change
- Improving the effectiveness of producing feedstocks for biofuels
- Analyzing waste in cities and megacities to detect health hazards
- Developing economical ways to reuse materials
- Learning how plants efficiently convert sunlight into renewable energy to dramatically improve the sustainability of our planet

At the Biodesign Center for Applied Structural Discovery, scientists uncovered the inner mechanics of photosynthesis, enlightening an old mystery for the first time. Understanding how plants convert the sun's energy into chemical energy is the first step in developing new forms of clean and abundant energy.

Professor Rolf Halden's study of urban metabolism metrology is helping diagnose the health of entire cities with near-real-time indicators of disease, like his measurement of mass prescription medications that are found in raw sewage.

ROLF HALDEN SEARCHING THROUGH SLUDGE FOR SOLUTIONS

For public health engineer Rolf Halden, flushed waste tells a fascinating story that can help eliminate disease-causing chemical and biological agents. He and his team at the Biodesign Center for Environmental Security examine urban effluent for health clues—for example, a spike in prescription and illicit drugs in cities hosting large events like rock concerts, or a surge in biomarkers like hormones that point to biological stress associated with obesity, diabetes, heart disease, and cancer.

His passion is the Human Health Observatory at ASU, which includes the National Sewage Sludge Repository with samples from hundreds of cities across the country.

"The effluent of our cities is an information superhighway that can help us avoid epidemics and improve public health, with progress observable in real time."

Today, Halden and his team are monitoring the metabolism of 160 cities, covering 32 million people. With additional dollars, they will be able to monitor, diagnose, and help minimize the source of environmental toxins for many more.

DEFENDING OUR NATION AGAINST THREATS AND ATTACKS

Bioterrorism, nuclear terrorism, cyberterrorism, or the accidental or intentional import of exotic diseases are not the kind of things we like to think about. Yet there's no doubt, as a nation we must be prepared. Ensuring our troops have the technologies they need in the field to monitor and respond to threats is also a focus of our work at the Biodesign Institute.

The Biodesign Institute has played an integral part in establishing the university's role in national defense. Biodesign researchers have already gained an international reputation for the work they have done in tracking and treating pandemic threats, such as Ebola, the development of a practical diagnostic for the Zika virus, and advances in understanding and applying nanotechnology.

The Biodesign Virginia G. Piper Center for Personalized Diagnostics and its partners are developing technologies to rapidly assess radiation absorption in individuals. The test could save thousands of lives in the event of a nuclear incident.

Biodesign researchers Stephen Johnston, George Poste, and Neal Woodbury led a four-year effort to develop a novel diagnostic technology called immunosignaturing for rapid, pre-symptomatic detection of exposure to infectious disease agents.

Professor N.J Tao is focused on advancing electrochemical microscopy, the foundation for major technologies such as batteries, fuel cells, chemical sensors, biological sensors, and methods of chemical analysis and corrosion prevention.

With Rolf Halden's sewage monitoring system, public health organizations can better localize the source of an outbreak and take appropriate action to combat its spread.

These technologies serve to equip the medical and defense communities with the tools they need to monitor public health, improve early diagnostics, and determine the best possible methods of treatment. These are vital tools in a world where biological hazards pose an ever-present danger. Across the world, scientists are fighting a battle against new classes of infectious diseases and other biological threats, and ASU's Biodesign Institute is operating on the front lines of that battle.

BREANNE MCCARTHY ’16 BIODESIGN'S NEXT-GEN RESEARCHERS

Breanne McCarthy's undergraduate experience was out of this world—literally.

During her first year at ASU, she found an opportunity to work in Cheryl Nickerson's lab at the Biodesign Institute on astrobiology experiments that could impact protection against bacterial threats.

“My first study with Dr. Nickerson's lab was really cool, because we were studying how the spaceflight environment will change bacterial resistance or susceptibility to antibiotics,” says McCarthy, who earned a double bachelor's degree in biological sciences and biochemistry. “I actually got to lead a teleconference with our collaborators at NASA.”

On top of accumulating a few mission patches when her experiments went to the International Space Station, McCarthy earned ASU's Moeur Award for academic excellence. She also loves helping people. In her free time, McCarthy served as the president of the Barrett Leadership and Service Team (BLAST). Once a week, she and other BLAST students tutored low-income and homeless kids.

McCarthy is combining her interest in science with her love of helping people by studying medicine at Johns Hopkins University.

“I have always loved science and think it is amazing that you can create new knowledge through research,” she says. “The incredible opportunities for research were one of the biggest factors that brought me to ASU.”

JOIN US IN SOLUTION-ORIENTED SCIENCE

At the Biodesign Institute, we've created a way of working that's never been done before. It's an experiment that has paid off handsomely. A decade later, we have the people, the knowledge, the tools, and the desire to create solutions that are affordable and accessible, and raise the quality of life for us all.

We are crossing scientific and intellectual boundaries every day. But, we need more resources.

It's no longer the case that scientists can rely on the government to fund solutions at the pace that people need. In fact, most government-based funding supports incremental advances. By its very nature, it is difficult for the government to take risks on big breakthroughs. That's where private citizens, foundations, and corporations come in.

At the Biodesign Institute, we take risks. We hit the long ball. We are impatient for answers. We tackle the problems that other scientists say "can't be done."

As Stuart Lindsay biophysicist, and director of the Biodesign Center for Single Molecule Biophysics says, "It's really worth risky funding for some important goals, because people will achieve them. If you get teams of bright people collaborating on a focused goal, you really can work miracles."

An investment in the Biodesign Institute through Campaign ASU 2020 will help us reduce human suffering and deliver answers faster, providing you with the opportunity to walk with the scientists and witness real-world impact during your lifetime. Now is the time to make a difference. ***Join us.***

With your generous support, Arizona State University has reinvented the public research university. We are both more inclusive and more accomplished than ever, with ASU students and faculty earning unprecedented levels of recognition for their achievements. Our graduates leave here as master learners who are capable of rising to meet any new and unfamiliar challenge. ASU students, faculty, and graduates also are firmly rooted in their communities and committed to advancing the common good. Together, we have created a model for other universities to follow. Your support during Campaign ASU 2020 will help us break more new ground by raising $1.5 billion to propel our vision for higher education into the next decade and beyond.

ARIZONA STATE UNIVERSITY is a comprehensive public research university, measured not by whom we exclude, but rather by whom we include and how they succeed; advancing research and discovery of public value; and assuming fundamental responsibility for the economic, social, cultural, and overall health of the communities it serves.

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