THE SCIENCE COALITION
10th Anniversary

UNIVERSITY RESEARCH:
AMERICA'S COMPETITIVE EDGE

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For decades, Americans have supported cutting-edge scientific research conducted in the nation's universities. From medicine to energy, from computer science to structural engineering, and from astronomy to geology and biology, this federally funded university research has helped to create new technologies, new products and new industries, as well as preserve our country's leadership in the global economy, international security, and the exploration of outer space.

But, most important of all, federally funded university research has improved Americans' lives and built our children's futures. By generating jobs, creating new methods for diagnosing and treating illnesses, and finding new ways to defend our communities and our country against terrorism, university research has helped Americans become healthier, more prosperous and more secure.

Federal funding for university research goes to educational institutions of all kinds, all across this country, and it comes from many sources, some more familiar than others. From the National Science Foundation to the National Institutes of Health and the federal Departments of Defense, Energy, and Transportation, to name only a few, our nation's commitment to university research is a smart investment that is maintaining our competitive edge and our way of life.

For the past ten years, The Science Coalition—an alliance of advocates including dozens of major institutions of higher education—has worked to increase America's support for university research. Now, The Science Coalition's tenth anniversary offers an ideal opportunity to celebrate the scientific advances that this investment has helped to produce. Thanks largely to our country's commitment to scientific research, these past ten years have seen extraordinary advances, from mapping the human genome to finding new ways to work with microscopic objects and learning how to "stop" particles of light on a silicon chip, using the electromagnetic energy to power a new generation of smaller and faster computers . In this brochure, the Coalition offers 15 tangible examples of how Americans can benefit from their investment in university research through scientific advances in highway safety, earthquake forecasting, almost instantaneous medical diagnoses, cancer treatments, restoring vision and hearing, purifying water, and fighting terrorism. These stories tell how these and other discoveries are beginning to make a difference in our daily lives.

THE SMART SHIRT

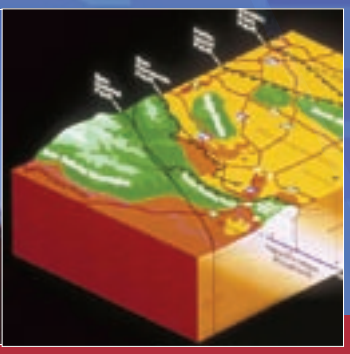
Soldiers' tee-shirts could give triage units instant information about their wounds. Worn by civilians, the same undergarment could let them know immediately if they're suffering heart attacks. Police officers, professional athletes, senior citizens, and emergency medical personnel—all could benefit from finding out immediately about sudden illnesses and injuries.

From far-away battlefields to city streets, fast diagnoses and quick responses to medical emergencies will be possible with The Smart Shirt. At first glace, it's a tee-shirt made of soft washable fabric. But it's special because of what's woven into it—electrical fibers that can detect and record heat and respiration rates, bodily temperatures and calories burned. Truly a Smart Shirt, the undergarment can relay the information wirelessly to dispatchers, doctors, and other quick responders.

Originally developed for the U.S. Navy, The Smart Shirt can speed up the diagnosis, rescue and treatment of wounded soldiers on the battlefield. Now that they're beginning to be produced and marketed by the textile engineering company Sensatex, the Smart Shirts can also be useful for law enforcement officers, firemen, astronauts, military personnel, chronically ill patients, elderly persons living alone, infants and their parents, and professional and amateur athletes—anyone who can benefit from the monitoring and report of their vital signs.

The Smart Shirt results from Americans' smart investments in university science. It was developed by researchers at the Georgia Institute of Technology's School of Textile and Fiber Engineering and its Textile Information Systems Research Laboratory. The research was funded by the Defense Advanced Research Projects Agency (DARPA), the central research and development organization for the Department of Defense, and by the U.S. Department of the Navy.

PREDICTING EARTHQUAKES FROM SPACE



In January, 1994, an earthquake centered in Northridge, California, a suburb in the San Fernando Valley, devastated the Los Angeles area. Fifty-seven people died, about 1500 suffered serious injuries, and total damage was estimated at $15 billion. While the human and financial cost was relatively low for a natural disaster of that magnitude, advance warning could help communities prepare for future quakes.

Does that sound far-out or far-off? Not necessarily. Two months before the Northridge Earthquake, researchers from the Massachusetts Institute of Technology published a paper predicting the size and style of a potential earthquake near the San Fernando Valley. Their findings were based on six years of Global Positioning Data, obtained by observing Earth from satellites orbiting our planet, which found that the area's faults were active and building up strain.

As the space-based research becomes more sophisticated, it will be able to predict earthquakes more exactly, giving communities time to prepare by evacuating vulnerable buildings and alerting fire departments, health care facilities, and other rescue operations. Earthquakes' human and financial tolls will be reduced, and our communities and our country will benefit.

Soon predicting quakes by observing the earth from outer space will be a reality. It will represent a real-world return on a far-seeing investment in university research. This research is being conducted by scientists at MIT and the National Aeronautics and Space Administration (NASA) and funded by the National Science Foundation, NASA, and the U.S. Geological Survey.

THE SAFER BARRIER

Racecar drivers at speedways throughout the nation have a much better chance of avoiding serious injuries thanks to a special energy-absorbing barrier that has been installed on NASCAR and Indy Racing League high-speed race tracks nationwide. And, soon, the same safeguards will be protecting everyday Americans driving on our nation's highways.

Installed in all 27 NASCAR high-speed oval racetracks and Nextel Cup Busch, and Craftsman Truck series tracks, the SAFER (Steel and Foam Energy Reduction) Barriers have saved lives and avoided serious injuries by reducing the level of impact when racecars crash into the racetrack's walls. Consisting of a concrete wall and rectangular steel tubes cushioned by plastic foam in polystyrene (plastic) blocks, the soft-wall barrier absorbs the force of cars colliding with it at high speeds.

The results: No fatal accidents since the SAFER Barriers have been introduced. Fewer serious injuries, such as traumas to the head. And less damage to the racecars and the racetrack walls.

While most Americans won't be racing in NASCAR events, the SAFER Barrier may help many more motorists and passengers travel safely. That's because the concept of an energy-absorbing concrete barrier is currently being adapted for our nation's highways.

The SAFER Barrier represents a return on Americans' investment in university science. The structural engineering research that developed the SAFER Barrier was conducted at the Midwest Roadside Safety Facility at the University of Nebraska-Lincoln. The project was partly funded by the Federal Highway Administration, which supports engineering research to improve highway safety.

MICROSCOPIC WIRES DETECT CANCERS

Medical professionals will be able to make almost instantaneous determinations of whether patients are suffering from cancer— and what kind of cancer they have. Their miraculous new diagnostic tool? A microscopic wire.

This advance in the speed and specificity of cancer diagnoses will result from using silicon nanowires—wires that are just a few billionths of a meter wide. These wires can detect molecular markers that indicate the presence of cancer in a person's body, even when those cancer markers consist of only one billionth of the protein present in a drop of blood.

Moreover, while other initial tests can only identify whether cancer is present, the nanowires have the potential to reveal immediately what type of cancer is present. For instance, they can detect the presence of PSA (prostate-specific antigen), which is an indicator of prostate cancer.

These nanowires exemplify how Americans' investments in university science can save lives. The research that developed this new diagnostic technology was conducted at Harvard University and funded by the National Cancer Institute and the Defense Advanced Research Projects Agency (DARPA), the central research and development organization for the Department of Defense.

As a camera zoomed in on his location, graduate student Janos Sallai cautiously approached a suspicious briefcase on a bleacher in the football stadium. The sensor in Sallai's cell-phone was picking up radiation from a small piece of radioactive material hidden in the case. The sensor then sent an urgent message to the antennas on the computers where researchers were monitoring his movements. They quickly concluded a "dirty bomb" was concealed in the briefcase.

It sounds like a nightmare, but it's really part of a dream come true for scientists from Vanderbilt University in Nashville, Tennessee, and the nearby Oak Ridge National Laboratory. Working together, with the help of a sponsorship from the National Science Foundation, they have been developing a system to detect "dirty bombs"—simple devices with an explosive and some radioactive material that could cause death and destruction in the immediate area while spreading panic and radiation throughout an entire city.

Scientists from Vanderbilt's Electrical Engineering and Computer Sciences Department and the Oak Ridge National Laboratory have developed a system that discovers "dirty bombs" and pinpoints their locations. Sensors like those in the cell phone detect radioactive materials and send information to tiny radio-receiving computers being monitored by researchers. The computers also focus security cameras on the site of the radioactive material.

This technology will be useful to the American military, the Department of Homeland Security, and police and fire departments. One day, this exercise may not be just a rehearsal—it just might be the real thing.

DETECTING 'DIRTY BOMBS'

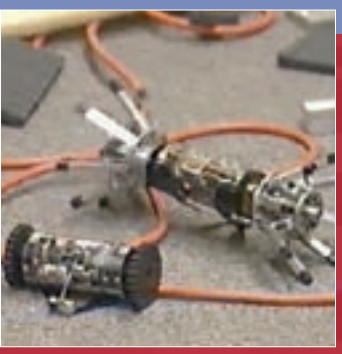
Not long from now, when terrorists or criminals take hostages, rescuers may respond with a new secret weapon: tiny robots that can scout out the scene before a rescue attempt is made. The robots will be sent through windows or onto roofs, from which vantage points they will radio the positions of hostages and captors or other useful radio information.

Is this science fiction? Actually, it's federally funded science research. With a $4.9 million contract from the Defense Research Projects Agency (DARPA) and multiple grants from the National Science Foundation, the University of Minnesota's Department of Computer Science and Engineering has set up a new Center for Distributed Robotics, where faculty researchers, including Associate Professor Nikolaos Papanikolopoulos and associate Professor Richard Voyles, are designing a system of small and medium-sized robots.

Here's how it will work. Using a tank, helicopter, or other large transport vehicle—the "shuttle" - rescuers will set up computers about a mile from the scene of the crisis. Next, a crew of medium sized robots, called the MegaScouts, will carry the smaller robots to within 300 feet of the building. From there, the robot "scouts," each about two inches long and less than a half a pound in weight, will hop or roll to the building.

The scouts will be equipped with sensors to detect heat, motion, chemicals or biological agents. Using radio transmitters and guided by pre-programmed computers, they'll report data to help the rescuers find hostages, captors, and weapons.

For the armed forces, police departments, and rescue teams, the MegaScouts and scouts will be invaluable partners in hostage-takings and other emergencies. For the American public, the scouts are just one more example of how federally funded university research makes all of us safer.



MINI-ROBOT RECONNAISSANCE TEAM

CLEANER WATER THROUGH NEW TREATMENT TECHNOLOGY

Communities and factories throughout the country can clean their wastewater to meet more exacting federal standards, thanks to a new technology developed at the University of Idaho, with help from the U.S. Environmental Protection Agency (EPA).

When they clean their discharged water, the treatment plants need to get rid of almost all the phosphorus. That's because too much phosphorus encourages the rampant growth of algae—and too much algae pollutes the water and kills the fish. In the past, water treatment systems have only had to reduce phosphorus levels to 500 parts per billion. Now, in many places, including the Spokane River in the Northwestern states, proposed federal regulations set the maximum phosphorus level at 50 parts per billion.

That means water treatment systems must become much more effective—and that's why a new filtration system is so important. With funding from the EPA, University of Idaho Environmental Chemistry Professor Greg Möller and Environmental Engineering Affiliate Faculty Remy Newcombe developed a new water filtration agent—sand coated with iron oxide. This specially coated sand is unusually adsorbent, taking phosphorus and other pollutants out of the solution as wastewater flows through the large tanks. The system then pumps out the water, leaving the sand which now contains the phosphorus and other harmful substances.

Now, the new treatment system is being developed and marketed by Blue Water Technologies, a company based in Hayden, Idaho. Together with the city of Hayden, the company has founded a research facility that is exploring whether the treatment process can also remove other pollutants, such as endocrine disrupting chemicals (e.g. birth control pills, antidepressants, etc.), from wastewater, which not only harm fish and other aquatic wildlife populations, but which can also contaminate human drinking water supplies.

Cleaner water and new technologies—the EPA's initial investment in university research is continuing to produce new benefits.

A BETTER HEARING AID MODELED ON A FLY'S EAR

More than 31 million Americans are hearing-impaired, and approximately seven million use hearing aids. But, while hearing aids can work wonders, they can't do one important thing that human ears do at every waking moment: concentrate on what a person wants to hear and filter out the background noise. That's why, even with the help of a hearing aid, a hearing-impaired person may have difficulty following a conversation in a crowded room.

Now, for people who need a more sophisticated hearing aid, help is on the way and it's coming from a most unusual place—the lowly fly. Here's how: The reproductive cycle of the parasitic night-fly, the Ormia ochracea, demands that it lays its eggs on or near live crickets. As for the cricket, it chirps to attract a mate. So the Ormia has evolved with specialized equipment to home in on its cricket host by hearing its chirps and sensing where the sounds are coming from. Unlike other animals, the fly's tiny eardrums are connected to each other, and they respond to sound waves by moving in different directions, allowing the fly's brain to determine where the sound is coming from.

The night fly's tiny but sensitive ears were noticed by two researchers at universities in upstate New York: Ronald Hoy, a professor in the Neurobiology and Behavior department at Cornell University, and Ronald Miles, chairman of the Mechanical Engineering Department at the State University of New York at Binghamton. Working together, they're designing a hearing aid with small microphone diaphragms that will detect sounds and locate their sources in much the same way that a night-fly's ear works. Once these hearing aids are available, hearing-impaired people will be better able to distinguish sounds in noisy places.

Their research is being funded by the National Institutes for Health, the National Institute on Deafness and Other Communications Disorders and the Defense Applied Research Projects Agency.

CHEAP, CLEAN, RENEWABLE NON-POLLUTING FUEL FROM PLANT WASTES AND UNIVERSITY SCIENCE

For decades, Americans have searched for a fuel that's cheaper, cleaner to burn, and less dependent on foreign trouble-spots than petroleum. Now that $50-a-barrel oil is making the quest for a petroleum substitute more urgent than ever, we're finding that fuel right here in the USA in plant wastes of all kinds—from sawdust to cornstalks and wild grass.

These plant wastes are called biomass, and biomass contains lots of the most common molecule on earth—cellulose. Just like starch, cellulose consists of glucose molecules, but it's all packed tight so that trees and grass can stand up on their own. If those molecules could be broken open, the plant wastes could be converted to liquid fuel, speeding up the process by which similar wastes naturally become petroleum over millions of years.

At the University of California at Riverside, the Center for Environmental Research and Technology has received a contract from the U.S. Environmental Protection Agency to demonstrate how biomass can be converted into wood alcohol—methanol—a clean-burning liquid fuel that can be used in cars and trucks, electrical power generators, and factories. The UC Riverside center will be building an experimental facility that will test the "Hynol Process" to turn wastes from trees and plants into gas, then into steam, and then into liquid methanol.

If this works, then the dream of inexpensive, renewable and non-polluting fuel will come closer to reality—thanks to federally funded university science.

FUELING THE CLEAN CAR

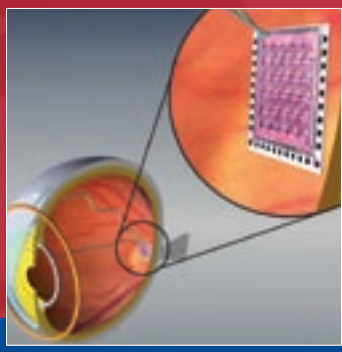
Imagine a "dream car" that moves through rush-hour traffic without polluting. That's what a hydrogen-powered car can do.

But where will the hydrogen come from for the car's fuel cells? At Virginia Tech, Chemistry Professor Karen Brewer and a team of researchers are developing a way to convert energy from light—solar power—into hydrogen gas, which can then be transported, stored, and pumped into the cars.

The research team has created complex molecular systems—"molecular machines"—that use light to collect electrons, and then deliver the electrons to water (H_20), which is split into oxygen (O_2) and hydrogen (H_2) gas.

The researchers are working with the Air Force Research Laboratory, studying what happens in the molecular systems after the light is absorbed. The National Science Foundation and the U.S. Department of Energy are also funding the research.

RESTORING SIGHT IN BLIND PATIENTS



Millions of Americans are losing their eyesight because of macular degeneration—the deterioration of the macula, the central area of the retina. When healthy, the light-sensitive cells in this paper-thin tissue at the back of the eye send visual signals to the brain. But damage to the macula causes blind spots and blurred or distorted vision.

With federal funding, researchers at the University of Southern California's Keck School of Medicine are developing an artificial retinal implant that holds out the promise of restoring sight in blind patients with macular degeneration and other eye diseases, including retinitis pigmentosa.

The Model 1 device is a test device that has been implanted in 6 patients blind from retinitis pigmentosa. This device measures 4 by 45 millimeters and is studded with 16 electrodes. Incoming images stimulate the electrodes and they, in turn, stimulate the patient's remaining retinal cells. The information travels via the optic nerve to the vision centers of the brain to create an image, with the result that, once again, the patients can begin to see certain aspects of the world around them.

The project currently receives most of its funding from the Department of Energy. The National Science Foundation and the National Institutes of Health are also funding the project. For millions of Americans, this research offers the hope that they will see again.

SPY PLANES THAT FLY ON WINGS OF SEAGULLS

The U.S. Air Force's drones are unmanned spy planes that soar above the countryside, shoot surveillance images and sometimes also fire missiles. Now, a new kind of drone is in the works that can function in tough urban environments—and it's being designed by academic researchers who are studying seagulls.

With funding from the Air Force and NASA, engineers at the University of Florida at Gainesville are designing prototypes for miniature urban drones—six-inch to two-foot planes that can dive between buildings, zoom under overpasses, and even land on apartment balconies. These pilotless planes could be equipped with sensors to detect biological or chemical weapons, so that they could look into buildings where terrorists may be making or storing these weapons. "If the vehicle can search an area by itself, you can have almost instantaneous response to what's being threatened," explained Rick Lind, an assistant professor of mechanical and aerospace engineering at the University of Florida.

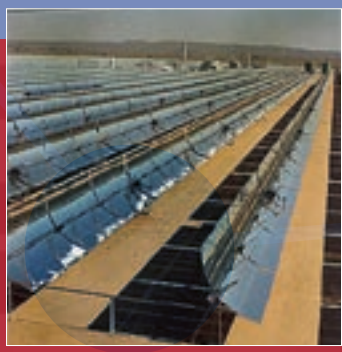
This new generation of drones could hover, dive and climb rapidly, with wings that can change their directions and even their shapes—in other words, "morphing." The engineers at the University of Florida learned how to design wings that can morph by watching how seagulls change the shapes of their wings.

Solar energy is in demand because it is clean, renewable, and doesn't depend on trouble-spots overseas. Long before there was widespread interest in solar power, Roland Winston took a course in physics at the University of Chicago, where he learned how efficiently the sun's light can be concentrated. For 40 years, Winston kept trying to turn this principle—known to physicists as the "Sine Law"—into practical inventions.

Working at the University of Chicago, Winston kept trying to find the best way to focus sunlight on a device that would collect and intensify the sun's energy. With funding from the U.S. Department of Energy, he developed a new kind of light funnel called a "compound parabolic concentrator." His invention is more effective than traditional lenses and mirrors, which produce almost perfect images at the focal point but blur and broaden the images away from the focus. Winston's non-imaging device can concentrate sunlight up to 84,000 times the natural level of sunlight at the earth's surface. In fact, this energy level is 15% more intense than the surface of the sun itself.

This solar energy collector has many practical applications, including producing hot water, steam or electricity for residential, industrial, institutional, commercial and utility customers. A new company, Solargenix, opened a factory in Chicago in 2004 to manufacture solar-energy systems based on this technology. The City of Chicago has already agreed to purchase $5 million worth of solar-energy systems from Solargenix.

A former chairman of the University of Chicago's Physics Department, Winston remains affiliated with the university's Fermi Institute. He's also a faculty member at the University of California, Merced. Thanks to the technology he developed with federal support, buildings in the "windy city" of Chicago can be kept warm from a sun that is available anywhere on earth and without the complex geopolitical issues of foreign oil.



SOLAR ENERGY FROM THE WINDY CITY

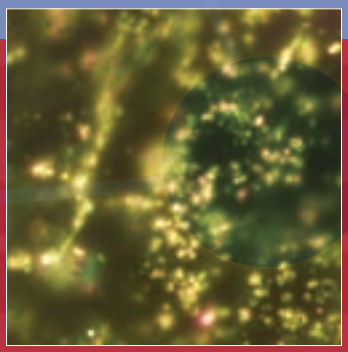
Nanoparticles are so small that you can run out of zeroes describing them. In fact, "nano" is usually defined as about 0.000004 inches in size. But, thanks to federally funded university science, nanoparticles can make a big difference in improving health care.

For instance, at the University of North Carolina (UNC) in Chapel Hill, a team of researchers has created nanoparticles about the size of some viruses out of a polymer (a synthesized compound) and a cancer drug. Under the direction of Chemistry and Engineering Professor Joseph DeSimone, the researchers then attached the nanoparticle to antibodies that link to proteins that are prevalent in cancer cells. These microscopic particles can target the delivery of the cancer drug to the cells that are stricken by cancer.

In another advance, imaging agents can be attached to the outside of the nanoparticle. This would allow doctors to monitor where the drug is going. Whatever else is attached to the nanoparticle, the polymers will be bio-absorbable and will eventually break down and leave the body.

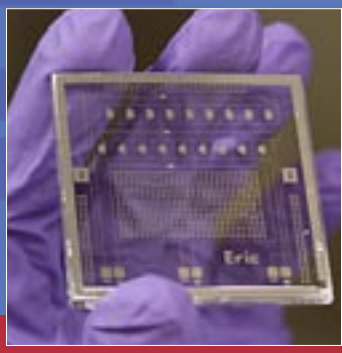
Meanwhile, at Washington University School of Medicine in St. Louis, researchers have designed nanoparticles that can reveal tiny cancerous tumors that are invisible by ordinary means of detection. As soon as thirty minutes after mice were injected with nanoparticles containing imaging materials, small tumors are "lit up" and easily located. The same nanoparticles can deliver cancer-fighting drugs to the tumors.

The U.S. National Institutes of Health's National Cancer Institute is funding the nanoparticle research at the University of North Carolina and at Washington University in St. Louis. By learning more about how health care can make use of these tiny particles, nanomedicine is using the physical sciences to improve therapy, diagnosis and early detection of cancer and other diseases.



TINY PARTICLES DELIVER CURES

THE HANDYLAB— INSTANT DNA TESTING



Just as an expectant mother goes into labor, a hospital nurse quickly takes a vaginal swab, places it in a syringe containing a small amount of buffer solution, and injects the liquid into a small hand-held instrument. Then, by pressing a single button, she triggers a fully automated DNA analysis. In less than 30 minutes, she'll know whether or not the baby could be exposed to Grade B Streptococcus, a potentially fatal form of bacteria.

That diagnostic device is the HandyLab. It's much smaller and simpler than conventional DNA testers, which run samples through several apparatuses, which together can take up a laboratory bench. But, in the new and compact tester, all this equipment is converted into tiny valves that are just a little larger than postage stamps.

Within several years, this small, sophisticated, on-site DNA-testing machine could be on the market. It could be used to diagnose a wide range of infectious and genetically-based diseases. It could even detect airborne pathogens, such as anthrax and smallpox, protecting Americans against epidemics and bioterrorism.

The HandyLab is one more lifesaving reward for Americans' investment in university science. It was developed at the University of Michigan, and pre-clinical trials are being conducted at the University of Michigan Medical Center and at Baylor College of Medicine in Houston. This research was funded by National Institutes of Health grants from the National Human Genome Research Institute and the National Science Foundation.

From its founding in 1995, The Science Coalition has worked to strengthen the nation's support for science by informing the American people and their public officials about the benefits of federally funded university research.

The Coalition tells the compelling story of scientific advancement through federal support to the news media, the Congress, the White House, federal agencies, state and local governments, and other public officials, civic leaders and concerned citizens.

Over the years, the Coalition has honored more than 60 members of the U.S. Senate and House of Representatives with its Champion of Science award for outstanding support for science. Meanwhile, the Coalition keeps the news media and public policymakers informed about important advances and emerging needs in scientific research.

Initiated by a handful of research universities, the Coalition has grown to include the 63 major universities listed below.

For more information about the Coalition and its activities, visit our web page at www.sciencecoalition.org.

THE SCIENCE COALITION
10th Anniversary

THE SCIENCE COALITION 2006 MEMBERSHIP ROSTER

Arizona State University
Binghamton University
Brown University
Columbia University
Cornell University
Dartmouth College
Duke University
Emory University
Georgia Institute of Technology
Harvard University
Indiana University
Inland Northwest Research Alliance
Iowa State University
Johns Hopkins University
Massachusetts Institute of Technology
Michigan State University
Michigan Technological University
New York University
North Carolina State University
Northwestern University
Ohio State University
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