Today, with 12 schools and numerous multidisciplinary centers and institutes, the University is home to many of the world’s leading scholars and researchers. Committed to making a difference in the world, these eminent professors continue to achieve groundbreaking discoveries across the life sciences, natural sciences, social sciences, business, and other fields of study.

Sponsored research support is integrally important to Penn’s research enterprise. The University received more than $800 million in total new research awards last year alone and is consistently ranked as one of the largest recipients of funding from the National Institutes of Health. In total, federal support accounts for approximately 72 percent of sponsored program dollars, with the remaining 28 percent coming from a combination of foundations, state and local governments, associations, and private industry.

Penn research endeavors account for about a third of the University’s operating budget. While research awards to academic research institutions were relatively flat between 2005 and 2009, Penn will enter 2010 with robust funding for research initiatives. Going forward, the University is poised to receive considerable funding from the American Recovery and Reinvestment Act, aimed at research that will positively impact the nation’s economy.

Looking toward the future, Penn investigators, through creative scholarship and collaboration, are building new and unique bridges between traditionally disparate fields of research, and are developing knowledge that can be applied to solving the world’s most pressing problems.
roundbreaking change requires groundbreaking thought. The serious issues facing our modern world—from pandemic viruses, to acid rain, obesity, and economic instability—cannot be solved by research that is confined to isolated academic silos of the past. At Penn, researchers are committed to integrating knowledge from different disciplines, schools, and professional perspectives to make breakthrough discoveries.

Eminent scholars from each of Penn’s 12 schools have collaborated across campus, across specialties, and across the globe to unravel questions ranging from the origins of humankind, examined in a decade-long, worldwide study of African genetic data by Penn geneticist Sarah Tishkoff, to the evolution of the universe, explored by a balloon-borne telescope designed and built by a team led by Penn astronomer and astrophysicist Mark Devlin.

A collaboration involving an anesthesiologist and critical care specialist in Penn’s School of Medicine and a chemistry professor in the School of Arts and Sciences has identified a fluorescent molecule with anesthetic properties that could lead to better, safer numbing drugs. Work shared by Penn researchers from the schools of Engineering and Applied Science, Medicine, and Arts and Sciences has opened doors to the potential of new cell-based therapies for neurodegenerative diseases; and a group of Penn psychologists, neurologists, and neurosurgeons has discovered that the human brain learns better when the unexpected happens.

At the Wharton School, faculty examined the financial fragility of illiquid mutual funds and the economic benefit of building urban ballparks, aquariums, and recreation sites. A professor in Penn’s School of Engineering and Applied Science studied cockroaches to create a robot able to run on sand.

This report highlights some of the remarkable discoveries achieved by Penn’s researchers over the last year: From the ability of a synthetic DNA vaccine to stop pandemic viruses, to the development of a new protein that could help create synthetic blood, and the identification of a chemical reaction essential to the eradication of acid rain. It chronicles studies regarding the ties between stress and obesity, mental health and handgun ownership, and why a college enrollment gap between lower and higher income students persists.

Dedicated to making the world safer, healthier, and more enlightened, researchers at Penn continue to pursue betterment through knowledge, lifting the University founded by Benjamin Franklin from excellence to eminence.

To learn more about the research occurring at Penn, visit our companion website, www.upenn.edu/researchatpenn.
Scientists have a variety of sophisticated ways to manipulate the living cell, tweaking genes and nuclei using methods deemed impossible until recently. Now, a collaboration of Penn researchers from the schools of Medicine, Arts and Sciences, and Engineering and Applied Science have discovered yet another method, proving it’s possible to transform one differentiated cell type into another.

Penn pharmacologists James Eberwine and Jai-Yoon Sul joined biologist Junhyong Kim to develop this approach, called Transcriptome Induced Phenotype Remodeling (TIPeR), which offers the potential for a new cell-based therapy for neurodegenerative and other diseases. The research overturns the notion that all cells are permanently hard-wired, with little ability to change.

The signature of a cell is defined by messenger molecules called mRNAs, which contain the chemical blueprint for how a cell produces a protein. In their study, Penn researchers flooded a brain cell, or neuron, with foreign mRNA from an astrocyte cell using phototransfection, a method in which light slices temporary pores in the cellular membrane. Once the pores formed, the foreign mRNA entered the cell. Scientists then monitored the cell for changes in its mRNA profile, shape, and physiology.

Within a week, the neurons no longer looked like neurons, but rather like immature astrocytes. The cells also acted like astrocytes physiologically and, when mature, would be expected to help maintain the blood-brain barrier, regulate the chemical environment around cells, and respond to injury—precisely the kind of behavior beneficial to creation and maintenance of healthy brain tissue.

“In some ways, this is akin to what a virus does,” explains Eberwine. “When a virus infects a cell, it affects the host cell genome and the RNAs that it can make.”
**Flexibility**

The TIPeR approach directs the DNA in the host nucleus to change the cell’s RNA populations, which in turn change the phenotype of the cell. The results were published in the *Proceedings of the National Academy of Sciences*.

“We liken differentiated cells to ecological communities, forests, and meadows,” says Kim. “Each have similar organisms but have settled on particular characteristics that we recognize as distinct. Just as ecological communities can be nudged from one type to another, we thought we could nudge differentiated cells from one type to another through the use of the RNA population.”

“What’s new about this approach is that we didn’t have to make the host cell pluripotent,” adds Eberwine, referring to the more complex process of creating cells with the ability to develop into any type of tissue. “We can directly convert from one cell type to another, without the intermediate step.”

This work, relying upon assistance from Penn faculty in the fields of bio- and mechanical engineering, was funded by grants from the W. M. Keck Foundation, the National Institutes of Health, and the Commonwealth of Pennsylvania.

**DEVELOPING A VACCINE FOR A PANDEMIC VIRUS LIKE AVIAN INFLUENZA IS AKIN TO SHOOTING AT A MOVING TARGET:** The virus mutates quickly, rendering useless vaccines targeted specifically at a single strain.

But new research by a Penn School of Medicine pathologist could lead to a synthetic DNA vaccine capable of building antigens in the body that can induce broader immunity responses and offer protections against diverse strains of pandemic flu.

The novel approach developed by the laboratory of David B. Weiner, professor of pathology and laboratory medicine, and researchers from the Public Health Agency of Canada, BIOQUAL, Inc., and VGX Pharmaceuticals, now called the Inovio Biomedical Corporation, has proven effective against multiple cross strains of the avian flu virus in animals. And unlike traditional live and non-live vaccines, which carry some safety issues, synthetic vaccines can be mass-produced prior to a pandemic and do not require refrigeration, making them easier to deliver and distribute.

In a study funded in part by VGX Pharmaceuticals and the National Institute of Allergy and Infectious Diseases, and published in the journal *PLoS ONE*, researchers looked at a subset of viruses that jumped from birds to humans, identified the most common virus features, and put them into a vaccine. The resulting synthetic substance, the team found, provides an immunity that doesn’t exist in nature.

Because the vaccine is delivered via DNA, the protein production takes place in the body, mimicking a live vaccine. In several animal experiments, all the different viral strains were neutralized.

“We were pleasantly surprised at how broad the antivirus responses could be,” says Weiner. “We didn’t expect it to work quite as well as it did.”

Principles used successfully in Weiner’s research are being applied to the fight against novel influenza A (H1N1), known as swine flu. In animal experiments they have now generated protection both from seasonal as well as pandemic swine flu.

Says Weiner: “There’s a lot of conceptual advantages to DNA, but we have to continue to move them forward and study them in people. I think the success we’ve had with animal models are steps in the right direction.”
Nearly 15 different amelogenins, or proteins, contribute to the production of tooth enamel—and one researcher from Penn’s School of Dental Medicine is interested in figuring out which ones do the heavy lifting in tooth formation, which ones serve secondary roles, and which ones, if absent, create inherited, defective teeth.

“We’re searching for the individual functions of the 15 different amelogenin proteins that somehow impact proper or dysfunctional tooth development,” explains Carolyn Gibson, professor of anatomy and cell biology. “These proteins make the hardest tissue in the body irreplaceable and absolutely necessary for tooth development, which is what makes their behavior so amazing.”

It also makes disorders like amelogenesis imperfecta, an inherited disease that produces faulty enamel and weak, brittle teeth, incredibly difficult to treat.

But in a recent study funded by the National Institute of Dental and Craniofacial Research and published in the *Journal of Biological Chemistry*, Gibson showed that a single protein is able to significantly rescue enamel production.

In the lab, Gibson and her team engineered mice that made an extra amount of the most prominent amelogenin. Still, these mice were born with relatively normal teeth. But if that amelogenin was faulty, the mice suffered from weak enamel, proving the research team had found the most important amelogenin in the creation of enamel. Just to confirm the discovery, Gibson mated mice that produced the most prominent amelogenin with those lacking any of the right proteins. The resulting generation was born with thicker and denser tooth enamel.

Throughout her career, Gibson has refined scientists’ understanding of how the body stitches tooth enamel together. Her work continues to extend science’s ability to translate inherited human diseases into animal models, a technique that hastens research across disciplines.

Gibson plans to build on this study in the hope of understanding the function of all 15 proteins—a milestone that could mean 100 percent rescue of tooth enamel and the novel reversal of a genetic disorder.
SELF-REGENERATING TISSUES MAY IMPROVE DETECTION OF Esophageal Cancer

CANCER OF THE ESOPHAGUS IS RELATIVELY RARE IN THE UNITED STATES, MAKING UP LESS THAN 1 PERCENT OF ALL CANCER DIAGNOSES. Yet its incidence rate is growing faster than any other cancer in the country.

Using newly discovered esophageal stem cells, Anil K. Rustgi, a professor of medicine and genetics and chief of gastroenterology at Penn’s School of Medicine, is engineering new, self-regenerating tissues in the lab—tissues that might one day be used to battle esophageal diseases, both benign and malignant. Rustgi’s work, published in the Journal of Clinical Investigation, could also soon be used to create replacement therapies for diseases like gastroesophageal reflux disease (GERD) and to understand a condition called Barrett’s esophagus, a precursor to esophageal adenocarcinoma. These common disorders affect millions of Americans.

With funding from the National Cancer Institute, Rustgi’s laboratory first set out to develop new techniques to identify and characterize esophageal stem cells in mice that had properties of cell renewal. Studying these cells “would start to give us clues not only about basic stem cell processes, but how things go in aberrant directions during inflammation, as well as cancer,” Rustgi says.

In experiments, those cells grew into esophageal lining tissue that the investigators labeled with a fluorescent marker. The team transplanted the viable cells into mice that were given esophageal injuries meant to mimic human illness. As they’d hoped, the new cells participated in the repair of the injured lining.

This is the first time anyone has tried to marry conceptual thinking with experimental approaches when looking specifically at esophageal injuries, Rustgi notes.

“There’s the hope to improve detection and diagnoses of these diseases, and identify potentially innovative ways to try and treat them,” he says.
Stress Leads to Overeating

America is suffering from an epidemic of obesity—and it’s an epidemic with far-reaching consequences.

Obesity can cause heart disease and increase the risk of some cancers, and one in four Americans currently has Type-2 diabetes specifically because of weight problems.

Tracy L. Bale, an associate professor of neuroscience in Penn’s School of Veterinary Medicine, says the underlying causes of obesity are complex and behavior plays an important role.

In research funded by the Penn Rodebaugh Diabetes Center, the Penn Center for Molecular Studies in Digestive and Liver Diseases, and the University Research Foundation, Bale discovered that emotional health and stress are significant factors in overeating, and that stress exerts enormous influence over the brain’s reward system.

Bale conducted two separate studies that support the programming and reward properties of high-fat diets. Rodents, like humans, enjoy fatty foods and are similarly affected by stress. In the first study, baby mice given fatty diets were shown to prefer similar foods as adults.

In the second study, she constructed a box in which adult mice could travel between an enclosed dark space, which they prefer, and a bright, open space, which they tend to avoid. Mice raised on both fatty and non-fatty diets were placed in the box; high-fat food mice went on a low-fat diet prior to testing. The dark space contained low-fat, less appealing food, and the bright space, the high-fat food. The mice previously raised on high-fat food risked potential harm in the open space to reach that food.

“Essentially it’s a very powerful study because it says that if you are in a withdrawal state, you will risk your life, potentially, to have high-fat food when you have perfectly acceptable low-fat chow in [a safe space],” Bale says.

While not everyone who is stressed overeats, Bale says if other underlying contributing factors can be identified, better therapies or preventions can be developed.

“If you’re more aware of what your behaviors are forcing you to do,” she says, “you might be able to change those behaviors and achieve greater success.”

HIV is difficult to treat because the virus mutates so quickly, leaving it unrecognizable to antibodies and T cells, the body’s powerful, natural weapons against disease.

But two professors in Penn’s School of Medicine, along with the medical research company Adaptimmune, have developed a technique that could better help T cells find and fight HIV in the body.

James L. Riley, research associate professor of pathology and laboratory medicine, and Carl June, professor of pathology and laboratory medicine and director of translational research at the Abramson Family Cancer Research Institute, along with Angel Varela-Rohana, a graduate student in Riley’s lab, have altered CD8 cells, also called killer T cells, to help them better control HIV. CD8 cells play a major role in controlling viral infections because they can recognize infectious agents within a cell.

Their study, published in the journal Nature Medicine, was funded in part by the National Institute of Allergy and Infectious Diseases and Wellcome Trust, UK.

In the normal course of infection, HIV depletes CD4 T cells, which cause the HIV-1 specific CD8 T cells to progressively lose their ability to control HIV-1 replication and become exhausted.
Creating synthetic blood has been a dream of medical researchers for generations. But numerous attempts and millions of dollars spent have failed to create a viable blood substitute. Most attempts have focused on reengineering a natural protein, but a team of biochemists from Penn’s School of Medicine took a different tack: They built the world’s first completely synthetic protein, and, like blood, it is capable of transporting oxygen. Their findings represent a major step toward the goal of making substitute blood.

“The idea of binding oxygen stably in a protein and introducing that protein into humans on the side of the road or a battlefield has been long-known to revolutionize one aspect of medicine,” says P. Leslie Dutton, a professor of biochemistry and biophysics, who co-authored the paper with Christopher C. Moser, associate director of Penn’s Johnson Research Foundation.

Compared to natural proteins which over time have evolved into complex structures, the design of Dutton and Moser’s protein is remarkably simple, making it easy to tweak. Their team added a heme—a chemical group that contains an iron atom—to bind oxygen molecules. Then they designed the exteriors of the helix-shaped protein columns to repel water and protect the oxygen payload inside.

Their work is the culmination of 15 years of research and was conducted with co-authors J.L. Ross Anderson, a postdoctoral researcher at Penn, and former Penn postdoc Ronald L. Koder. Lee A. Solomon, a Penn Ph.D. student, and Konda S. Reddy of the Johnson Research Foundation also contributed to the study.

The research, published in Nature, was funded by the National Institutes of Health, the U.S. Department of Energy, and the National Science Foundation.

The researchers note that their findings may have wider applications. A more robust protein system capable of capturing light and producing oxidants and reductants, they say, could be used to make solar fuels. And designer proteins introduced into human cells could help researchers eliminate drug resistances.

“To say that proteins could be designed to be applied to other aspects of human health and welfare is no longer in the realm of fantasy,” Dutton says.

RESEARCHERS CREATE New Protein From Scratch

CREATING SYNTHETIC BLOOD HAS BEEN A DREAM OF MEDICAL RESEARCHERS FOR GENERATIONS.

But Riley and June were able to engineer killer T cells to recognize a wide variety of HIV-1 strains that had “escaped” the natural CD8 response. In laboratory cultures, these T cells controlled HIV infection of natural strains and those that had escaped from CD8 cells.

“Cells that weren’t normally HIV-specific beforehand...became HIV-specific,” says Riley. “These cells are fresh and have not been altered by HIV-1 disease. These are a new set of players to go onto the field, and so we’re hoping they are armed with better tools to fight HIV-1 infection.”

In 2010, the researchers hope to begin treating patients with advanced HIV using this new technique.

Riley is also searching for more T cell receptors that will recognize HIV so that, in the future, they can infuse T cells with two or three different specificities.

“If HIV has taught us something, it’s that you need agents that disrupt multiple targets at the same time,” he says.

To say that proteins could be designed to be applied to other aspects of human health and welfare is no longer in the realm of fantasy,” Dutton says.

A New Weapon in the Against HIV

“These are a new set of players to go onto the field, and so we’re hoping they are armed with better tools to fight HIV-1 infection.”

Killer T cells given a new version of the natural T cell receptor were able to recognize all versions of a key HIV molecular fingerprint on the surface of infected cells and cleared HIV infection in the laboratory cell cultures.
Between 40 and 50 million Americans are anesthetized each year out of medical necessity. Yet despite 160 years of research, scientists have yet to unravel the physiological mystery of how these numbing drugs work at the molecular level.

Recently, however, by identifying an intrinsically fluorescent molecule with anesthetic properties that “lights up” as it travels through an organism, binding to certain molecular targets, Penn scientists stumbled upon an innovative approach for studying the way anesthetics work. The breakthrough by Roderic G. Eckenhoff, a professor of anesthesiology and critical care in the School of Medicine, and Ivan J. Dmochowski, an assistant professor of chemistry in the School of Arts and Sciences, could lead to better, safer anesthetic drugs for humans.

Their findings arrive as evidence is mounting that the effects of anesthesia may last longer than previously thought, and may even cause permanent changes in the brain. “It would be great if we could give a pill or an injection and have it just go to the right target and be completely safe,” Dmochowski says. “But because we don’t know what the targets are, it’s very hard to make better drugs.”

Known anesthetic compounds lose their numbing effect if labeled with a fluorescent marker, making it difficult to track new receptive targets in the central nervous system. So Eckenhoff and Dmochowski took a different approach to the problem.

It’s hoped that the research will lead to the development of a screening tool for identifying patients who are genetically predisposed to the most common side effects of general anesthesia.
First, they conducted experiments that proved the fluorescing compound 1-aminoanthracene, or 1-AMA, has its own anesthetic properties. Looking at translucent tadpoles, they were able to watch as 1-AMA traveled through the specimen.

Dmochowski’s lab used confocal microscopy to create high-resolution images of the compound in action. The team was surprised to see the fluorescence preferentially binding to certain types of cells and targets, with heavy concentrations in the brain region of the tadpole. Previously it was believed anesthesia was distributed and absorbed more evenly throughout the body.

In addition, researchers found that 1-AMA provides a valid tool for screening for new compounds that may have anesthetic potency.

The study was funded by the National Science Foundation, the National Center for Research Resources, a Henry and Camille Dreyfus Teacher-Scholar Award, the National Institutes of Health, and a University of Pennsylvania Institute for Medicine and Engineering Seed Grant.

The work is ongoing. But it’s hoped that the research will lead to the development of a screening tool for identifying patients who are genetically predisposed to the most common side effects of general anesthesia.

“The hope is we’d have a light-switch-like anesthetic, where you turn the light switch on, the patient goes to sleep, you turn it off, they wake up—that’s it. The side effects are gone and there’s no lasting changes in the brain,” Eckenhoff says.
RESEARCHERS HAVE DISCOVERED THE ELUSIVE MIDDLEMAN in the complex chemical reaction essential to the atmosphere’s ability to break down pollutants, including those that cause acid rain.

The Penn-led study improves science’s basic understanding of a natural, yet short-lived chemical process and will allow environmentalists to better model how pollutants like nitric acid are removed from the air.

Marsha Lester, a professor of chemistry in the School of Arts and Sciences, and a colleague from Purdue University, were the first to identify the chemical intermediate known as OH-HONO2. For more than 40 years, the transient, unstable molecule had avoided detection because of its tendency to rapidly dissociate or undergo reaction.

“The OH radical, or hydroxyl portion of this intermediate, is essentially an atmospheric detergent that removes harmful pollutants like nitric acid, or HONO2, from the lower atmosphere,” says Lester, editor of the Journal of Chemical Physics. “The reaction involving this molecule proceeds faster as temperatures drop, which is the opposite of most chemical reactions. The reaction rate also depends on atmospheric pressure, making experimental detection problematic.”

The breakthrough was provided by an improved experimental methodology called infrared action spectroscopy, which simultaneously identifies the chemical by its infrared fingerprint and its stability. The researchers used supercomputers to calculate the validity of the spectral signature.

The resulting paper, published in a special edition of the Proceedings of the National Academy of Sciences, showed for the first time a key step in the oxidation of pollutants in the Earth’s atmosphere, which is akin to the human body’s ability to metabolize food.

“We’ve speculated about this unusual atmospheric intermediate for many years, and then to actually see it and learn about its properties was very exciting,” says Lester.

A Protein Influences Stem Cell Renewal

STEM CELLS AND THE MICROENVIRONMENT THAT HOUSES THEM, KNOWN AS THE NICHE, HAVE A CLOSE RELATIONSHIP—forming an interdependent, functional unit that contributes to a number of key functions, including renewal, aging, and even death. But the niche, and its role in helping stem cells thrive, remains only partially understood by scientists.

Now, for the first time, a researcher at Penn’s School of Veterinary Medicine has identified a specific protein in the mouse testis called colony stimulating factor 1, or Csf1, that directly influences stem cells to increase the rate of division. The origin is the Leydig cell—located in the testis and the source of testosterone—which secretes Csf1 and enhances self-renewal of stem cells.

The finding, published in the journal Development, is based upon more than a decade of research from Ralph Brinster, a professor of reproductive physiology, and provides a significant new model in the study of stem cells and their niche.

“We know that the niche is critical for the survival of stem cells,” says Brinster, whose work is funded by the National Institutes of Health and the Robert J. Kleberg Jr. and Helen C. Kleberg Foundation. “This is the first niche factor to be identified in mammals that has been determined to be a factor in stem cells.”

A host of environmental influences may effect the health of the niche, Brinster notes, including the presence of a female. For instance, in a related paper, published in the journal Biology of Reproduction, Brinster found that boarding male
Penn biologist Nancy Bonini has shown that RNA contributes to neurodegenerative disorders. The study, published in the journal Nature and funded by the National Institute of Neurological Disorders and Stroke, demonstrates in fruit fly models that a source of toxicity occurs one step lower in the process than previously thought—at the RNA level, rather than solely in the protein that the RNA builds.

To identify potential contributors to these diseases, Bonini and her team, which includes Penn biologists Zhenming Yu and Xiuyin Teng, as well as former student LingBo Li, screened the fly to find genes that can change a protein’s toxicity.

"By recreating in the fly various human diseases, we have found that toxicity is going on at the RNA level," says Bonini, an investigator with the Howard Hughes Medical Institute and a professor in the School of Arts and Sciences.

"The challenge for many researchers is coupling the power of a simple genetic model, in this case the fruit fly, to the enormous problem of human neurodegenerative disease."

They uncovered that the “muscleblind” gene may interact with the faulty RNA, which contains a long, mutated sequence that binds together to form hairpins, dangerous molecular shapes that can interact abnormally with proteins. The hairpins in the RNA encode an errant protein during synthesis, leading to a glut of misfolded protein within cells of the nervous system, much like what occurs in Alzheimer’s and Parkinson’s diseases. Researchers altered the RNA so it no longer formed a hairpin, yet made the identical protein. The altered gene led to dramatically reduced neurodegeneration. The team also created a toxic RNA unable to code for a protein—which on its own could cause neuronal degeneration.

The findings proved RNA can have a toxic component.

“Our findings point to a prominent role for RNA in polyglutamine disease, adding to a growing body of work on the cellular mechanisms that drive various debilitating, inherited diseases," says Bonini.

It could have a significant impact on how the farming industry cares for livestock, zoos house animals in their care, and experts protect and increase the numbers of endangered species.

mice with females extended the male’s fertility by as much as 20 percent.

“It appears that housing females with a male mouse delays the decline of reproductive processes in the male at the cellular level by somehow affecting the cells surrounding the stem cells that produce spermatogonia in the testes,” he says.

While there’s no definitive evidence that this occurs in other mammals, Brinster says it’s not out of the realm of possibility. If this is the case, it could have a significant impact on how the farming industry cares for livestock, zoos house animals in their care, and experts protect and increase the numbers of endangered species.
A balloon-borne telescope launched 120,000 feet above Antarctica is helping scientists discover how stars and galaxies are formed—and providing new insights into how our universe has evolved.

Designed and built by a team from Penn and launched on a NASA high-altitude balloon, the Balloon-borne Large Aperture Submillimeter Telescope, or BLAST, has given scientists a view of the distant universe without the interference of the Earth’s atmosphere. Led by Mark Devlin, a professor of astronomy and astrophysics in the School of Arts and Sciences, researchers from 11 universities and organizations have used BLAST to identify the distant galaxies responsible for producing the background light and radiation throughout the universe, called the Far Infrared Background, or FIRB.

After analyzing two years of data from BLAST, researchers revealed that the source of the FIRB comes from dust-enshrouded galaxies 7 to 10 billion light years away. The findings were published in the journal Nature.

“We measured everything from thousands of small clouds in our own galaxy undergoing star formation to galaxies in the universe when it was only a quarter of its present age,” says Devlin. “It’s akin to looking back into the past for a snapshot of the universe in its infancy.”

Star formation takes place in clouds composed of hydrogen and dust, which absorb starlight from young, hot stars, heating the clouds to 30 degrees above absolute zero. The light is then re-emitted at much longer infrared and submillimeter wavelengths, meaning as much as 50 percent of the light energy in the universe is infrared light from forming galaxies. Familiar images of the night sky contain beautiful objects, but only half the picture, and half our cosmic history, is visible.

The project started in Arctic Sweden and was completed at McMurdo Station in Antarctica. It required several launch attempts and a mission to recover the precious data unit, and spawned a nationally released documentary, BLAST!, shot on location by Devlin’s filmmaker brother, Paul.

The central component of BLAST is a 2-meter telescope coupled to a camera made of hundreds of bolometers, sensitive thermometers cooled to 0.3 degrees above absolute zero. With this sophisticated system, BLAST can determine the spectrum of submillimeter light coming from distant galaxies, which in turn gives the temperature of each galaxy and, ultimately, an estimate of its rate of star formation.

The study was supported by NASA, the National Science Foundation, the Canadian Space Agency, the Natural Sciences and Engineering Research Council of Canada, and the UK Science and Technology Facilities Council.
NO DECISION IS MADE IN A VACUUM.

Outside forces help guide every decision we make, from the cars we buy to the foods we eat.

An emerging field of research called “network science” seeks to better understand, predict, and design the behavior of the forces that so strongly link and shape us.

Penn’s Michael Kearns is at the forefront of the movement. A professor of computer and information science in the School of Engineering and Applied Science, his most recent study shows how networks can influence the global adoption of minority viewpoints.

“What’s driving this is [that] more and more network interaction is happening in a way that can be measured,” Kearns says. “Because of work in this field, we now have hard data for the first time.”

In research funded by the National Science Foundation and the Office of Naval Research, Kearns showed that even a super-minority can exert vast influence, provided it gains enough network connections to shape popular opinion. For example, in one experiment, as few as six subjects who preferred the color red were able to convince 30 others preferring blue to vote with them and reach a consensus.

Kearns says this exact scenario played out in the 2008 Democratic presidential primary race, where fears of a split vote and a loss of consensus ultimately led strong supporters of Hillary Clinton to back Barack Obama instead.

“I’m trying to boil it down and show that this might be purely an anonymous interaction within a network,” Kearns says.

The study, published in the Proceedings of the National Academy of Sciences, was conducted by Kearns, as well as Stephen Judd, a research associate, and Ph.D. students Jinsong Tan and Jennifer Wortman.

An emerging field of research called “network science” seeks to better understand, predict, and design the behavior of the forces that so strongly link and shape us.
Producing Nanoscale Patterns, IN ONE STEP

PENN RESEARCHER SHU YANG’S LATEST DISCOVERY IN THE FIELD OF NANOSCALE POLYMER SCIENCE may be her most significant yet.

It was also something of an accident. Yang, an associate professor of materials science and engineering in the School of Engineering and Applied Science, initially set out with her students to study the intrinsic properties of a flexible polymer membrane called polydimethylsiloxane, or PDMS. The silicone material is a key ingredient in everything from contact lenses and window sealant to Silly Putty.

Surprisingly, when Yang exposed the membrane to a solvent, pores in the film deformed, naturally creating a diamond plate pattern.

By doing so, her lab may have stumbled upon an innovative method for designing the next generation of computer chips, more efficient and smaller devices for telecommunications, and potentially, new medical devices.

Working with Randall Kamien, a professor of physics in the School of Arts and Sciences, Yang laced the solvent with iron nanoparticles that orient themselves perfectly once the solvent dried. The researchers created a one-step, replicable method for the production of functional nanoscale patterns with adjustable features, sizes, and shapes using a single master “plate.”

Her lab may have stumbled upon an innovative method for designing the next generation of computer chips, more efficient and smaller devices for telecommunications, and potentially, new medical devices.

The discovery, published in the journal Nano Letters, will allow scientists to easily manipulate structural details of the flexible membrane and create a variety of nanostructures. Using this patterning technique, Yang’s lab has fabricated a library of complex plates of gold nanostructures, which potentially will advance electronics, optics, micro-fluidic devices, sensors, and biochips.

The traditional fabrication process for nanoscale patterns requires a set of different master plates with various sizes and layouts, which contribute significantly to the production time and total cost of nanomanufacturing. In this new process, a master can be made for a fraction of the cost and can be reused many times. The features of these new patterns are up to 10 times sharper than the original membrane.

Says Yang of the surprise findings: “That’s the beauty of science. Sometimes it turns out unexpectedly but more exciting than you originally planned.”
LAND ANIMALS USE A PRECISE COMBINATION OF GOOD BODY DESIGN AND BEHAVIORAL SMARTS to run, hop, climb, adapt quickly to icy conditions, and walk with ease over sand or gravel. Daniel Koditschek, a professor of electrical and systems engineering in Penn’s School of Engineering and Applied Science, has been inspired by animals like the cockroach and gecko to create legged robots capable of climbing or moving over tricky terrain in the same way.

In a study published in the Proceedings of the National Academy of Sciences, Koditschek, post-doctoral researcher Haldun Komsuoglu, and colleagues from both Georgia Tech and Northwestern have figured out a way to help legged robots move through granular, sandy terrain.

Sand contains both solid and liquid properties and requires robots to manage subtle changes in stride. With funding from the Burroughs Wellcome Fund, the Army Research Laboratory, and the National Science Foundation, the researchers found some of the secrets to traversing sandy terrain lie in the limb motion. SandBot, a machine based on the body of a cockroach and developed by Koditschek and Komsuoglu, simply thrashed and sank if the legs moved quickly.

But by slowing down the limb motion at certain points, the researchers found the robot was able to walk successfully.

“We’ve been trying to understand what geckos and cockroaches do when they climb very rapidly on vertical or near-vertical walls,” explains Koditschek. “There’s a huge importance to getting the mechanical hierarchy right and complementing that design with the appropriate behavior.”

Now, Koditschek and his team from Penn Engineering’s General Robotics, Automation, Sensing, and Perception Lab are exploring if the tables can be turned, and if robots can serve as physical models to help biologists better understand animal locomotion. The work is being completed with funding from the NSF and in collaboration with researchers at the University of California, Berkeley.

It’s possible that legged robots may one day be used in dangerous search-and-rescue operations and in extraterrestrial exploration. But Koditschek cautions there’s a tremendous amount of fundamental work left to do.

“Robots remain amazingly primitive,” he says, “even relative to the so-called simplest animals such as cockroaches or lizards.”
PHYSICIST ARJUN G. YODH CONDUCTS GROUNDBREAKING RESEARCH ON CONDENSED MATTER PHYSICS, BIOPHYSICS, AND OPTICS. FOR YEARS, HE HAS BEEN A LEADER IN SOFT CONDENSED MATTER PHYSICS AND IN BIOMEDICAL OPTICS, WHERE HE EMPLOYS DIFFUSE OPTICS FOR MEDICAL DIAGNOSTICS, INCLUDING TUMOR IMAGING AND SPECTROSCOPY OF THE BRAIN.

Yodh joined the Penn faculty in 1988 after a two-year postdoctoral fellowship at AT&T Bell Laboratories. Today, he serves as the director of the Laboratory for Research on the Structure of Matter (LRSM), Penn’s center for materials research.

Penn President Amy Gutmann appointed Yodh as the LRSM’s 10th director in May 2009, touting his “demonstrated commitment to collaborating with colleagues from across Penn’s campus,” as well as innovative research advances in a number of differing fields. That makes him a perfect fit for the LRSM, which is one of the University’s chief cross-disciplinary institutes, linking research endeavors of three schools and 11 different departments.

Along with a primary appointment in the Department of Physics and Astronomy in the School of Arts and Sciences, Yodh has a secondary appointment in the Department of Radiation Oncology in the School of Medicine. He is also a member of the Institute of Medicine and Engineering, the Bioengineering Graduate Group, and the Abramson Cancer Center.
Q: WHAT EXACTLY IS THE STRUCTURE OF MATTER?
A: Materials are made up of atoms, molecules, and sometimes even bigger classes of objects like particles and filaments. The structure of matter refers to how these constituents are arranged in the material. This class of problem is of interest to LRSM researchers, but the questions we ask are often much broader than that. For example: What is the consequence of a particular arrangement? How does the resultant material respond to forces? How does it respond to light? How is electricity transported through it and how does transport depend on structure and disorder? What are the interactions between constituents and how does this affect their self-assembly? So there’s a whole set of complex interrelated problems that we work on.

Q: WHAT KINDS OF FACULTY DOES THE LRSM ATTRACT AND WHAT SORT OF PROJECTS DO THEY WORK ON?
A: The LRSM is composed of approximately 50 scientists interested in materials in one way or another. Of these, there are small communities or interdisciplinary research groups interested in soft materials ranging from networks and gels to membranes, hard materials including complex oxides and nanoparticles, and biomaterials or bio-inspired synthetic constructs. Some of these folks make materials. Theorists make models and work with experimentalists to understand material properties and material responsiveness to environmental changes, and engineers explore practical applications. It’s a collective effort that is interdisciplinary by design. The LRSM also has substantial education and outreach activities whose impact ranges from K-12 students and their teachers to undergraduates and faculty at other institutions locally, nationally, and even internationally.

Q: WHAT DEPARTMENTS ARE INVOLVED WITH THE LAB?
A: The LRSM has members from practically every department in SEAS, every science department in SAS, and a lot of faculty from the medical school.

Q: YOU PIONEERED THE USE OF DIFFUSE OPTICS AS A TOOL FOR MEDICAL DIAGNOSTICS, INCLUDING THE IMAGING OF BREAST TUMORS AND FUNCTIONAL IMAGING AND SPECTROSCOPY OF THE BRAIN. CAN YOU TALK A LITTLE BIT ABOUT HOW THIS WORK BEGAN?
A: A while back I was learning about the ways the physics community was using light to study milky materials. Then I met Britton Chance [professor emeritus of biophysics at Penn] and we started a dialogue about what we might do with these physics ideas in a medical context. Brit was interested in the problem already. We decided to jointly supervise some Ph.D. students on projects of mutual interest, and as part of these efforts we developed some concepts about how to understand and analyze diffusing light. The approach has turned out to be very interesting clinically, more so than I had expected when we started. But I think Brit had envisioned it. Brit is 96 [years old] now, and we are still collaborating.

Q: HOW WOULD DIFFUSE OPTICS BENEFIT SOMEONE WITH A BREAST TUMOR?
A: We’re still in a research phase, but we’re proving, I think, that we can detect and characterize mid-level breast tumors, and that we can get different kinds of information about them, mostly from their hemodynamics. The approach could be of use to patients that are young, because their breasts are fibrotic so that X-rays are hard to use in this case. The approach could also help with breast cancer patients that are at high risk, for which a lot of screening would be important. The approach could also be used to routinely and repetitively monitor the responses of tumors to cancer therapies. The ease of use of optics is one factor that may make it useful in the long run.

Q: IS THERE A CERTAIN FIELD IN WHICH THE LRSM’S WORK COULD HAVE THE GREATEST IMPACT?
A: There are many interesting frontiers to explore. Bio-inspired materials will find uses in problems ranging from selective stem cell differentiation to drug delivery. Energy-inspired materials will add value to battery or solar technologies or the latest green schemes. Novel carbon-based or particle-based materials are inspiring new ideas for electronics and photonics. Novel materials responsivities will give birth to new classes of actuators, and new concepts about non-thermal media such as granular materials can teach us how robots can be made to move in sandy environments. Even very basic observations about instabilities of soft materials will be used to control everyday substances such as cosmetics, foodstuffs, paints, and pastes.
The decade-long, worldwide project was led by Sarah Tishkoff, a Penn geneticist, and has determined the ancestral origin of modern humans was likely located in southern Africa, near the South Africa-Namibia border. “This is the largest study to date of African genetic diversity in the nuclear genome,” says Tishkoff, an associate professor with appointments in the School of Medicine and the School of Arts and Sciences. “There’s not only a large amount of linguistic and cultural diversity [in Africa], but also quite a bit of genetic diversity as well. We’ve barely begun to skim the surface on how much diversity there is among African populations.”

Tishkoff studied groups from around the world, focusing on 121 populations from Africa, as well as four of African-American descent, and 60 non-African groups. The findings, published in the journal *Science*, trace the genetic structure of Africans to 14 population clusters that correlate with ethnicity and shared cultural or linguistic properties.

The massive study was funded by a variety of sources, including the National Cancer Institute, the National Institutes of Health, and awards to Tishkoff from the L.S.B. Leakey and Wenner-Gren Foundations, the National Science Foundation, David and Lucile Packard, and the Burroughs...
Wellcome Foundation. Genotyping costs were supported by the National Heart, Lung, and Blood Institute Mammalian Genotyping Service.

The results have already helped scientists map ancient migrations of populations and determine that modern humans inhabited the rest of the planet by exiting near the middle of the Red Sea in East Africa. Tishkoff was surprised by the strong genetic connections between seemingly disparate populations, including pygmies from the Democratic Republic of the Congo and San bushmen from the southern part of Africa. “One is tropical, [while] the San are located more in a savannah area, and yet we see this evidence for common ancestry in the group,” Tishkoff notes.

The study illuminates African-American ancestry and could help other scientists identify genetic risk factors for diseases that ravage African Americans, including prostate cancer, hypertension, and diabetes.

Anthropologists, historians, and linguists will all be able to use Tishkoff’s findings to test theories of human migration, cultural evolution, and population history in Africa. Basic scientists, physicians, and public health officials may use the results to learn which genetic differences make people more susceptible to diseases such as HIV and malaria.

“Our goal has been to do research that will benefit Africans, both by learning more about their population history and by setting the stage for future genetic studies,” says Tishkoff. “We need to consider that there is a large amount of genetic diversity in Africa. There is no such thing as a representative African population.”

Higher Education Enrollment Has Expanded in the Past 30 Years, due in part to financial aid programs designed to help students break free of income restrictions.

But despite these and other efforts, an enrollment gap between lower and higher income students persists, suggesting some aid programs simply aren’t working.

Identifying effective and ineffective programs has been challenging because until recently there was no framework for organizing the existing approaches that encourage college enrollment.

A recent study published in The Journal of Higher Education by Laura Perna, associate professor in Penn’s Graduate School of Education, has corrected this oversight. Perna’s study provides a crucial first step in an empirical examination of the ways in which programs help expand higher education opportunities.

Perna joined with colleagues from the University of Virginia and the University of Georgia to look at 103 programs sponsored by federal and state government agencies in California, Florida, Georgia, Maryland, and Pennsylvania.

They found about 90 percent offer students some financial award, but only about 41 percent of programs target students with low financial resources.

“We offer one typology to help bring order to the many policies and programs that are designed to increase students’ college enrollment,” says Perna of the research, funded by Lumina Foundation for Education. “This typology provides a framework for asking such questions as: What’s an effective use of resources? What types of programs are making a difference?”

The variety of programs and redundancies in the system suggest that, across the board, efforts to promote college enrollment for underrepresented groups of students lack coherence and clarity, Perna says.

“We hope that policymakers, college leaders, and researchers will use this framework to take a step back and see what happens within a state to more efficiently use available resources and provide a more comprehensive approach to addressing the barriers that now limit college enrollment for many prospective students,” Perna says.
SOME SEE WI-FI AS THE GREAT EQUALIZER. A number of American cities—including Philadelphia, Atlanta, and tiny Chaska, Minn.—have attempted to close the digital divide by providing wireless internet access to all citizens.

Corporations, too, are getting in on the action. Starbucks offers Wi-Fi access in many of its stores, and McDonald’s offers the same in more than 15,000 locations worldwide.

Keith N. Hampton, an assistant professor of communication in Penn’s Annenberg School for Communication, curious about how public spaces are changing with the spread of this technology, examined whether wireless internet access in public spaces detracts from social interaction and decreases exposure to social diversity.

For his research, Hampton observed Wi-Fi users at four paid and free cafes in Boston and Seattle. He found that while they spend less time interacting with the diverse blend of people in the public spaces, they interact with their large social networks. In a study published in New Media & Society, Hampton notes that Wi-Fi users are maintaining diverse networks online—even if they’re not interacting with people in their immediate surroundings.

“While wireless internet users tend to be less attentive to their surroundings than most other users of public spaces, they are not in the private ‘bubbles’ of interaction that characterize cell phone users,” he observes.

Hampton has also spent hundreds of hours observing people in seven public parks, plazas, and markets throughout the U.S. and Canada and is conducting an ongoing, longitudinal study that compares Super 8 footage of urban public spaces in the 1970s and 80s, with present-day observations.

Hampton says there is an interesting paradox in public Wi-Fi use.

“The time Wi-Fi users spend in online activities in public spaces may provide more opportunity for network maintenance and political participation than the time spent in the casual, fleeting interactions offered by most urban public spaces.”
A NEW WAY OF THINKING About Buildings

SOME OF THE BUILDINGS IN OUR LIVES GO ALMOST UNNOTICED. Others are soaring, expressive works of art that reward attention.

But as David Leatherbarrow argues in his most recent book, “Architecture Oriented Otherwise,” both kinds of buildings are necessary.

“Sometimes we love to look at buildings and find them beautiful and expressive of a place, a people, even a period of time,” says Leatherbarrow, a professor of architecture in Penn’s School of Design. “Other times, we don’t need the building to be obtrusive.”

In his book, Leatherbarrow notes the importance of thinking not just about the materials in a building, or the architect who designed it, but how the structure “performs,” including the effects it has on its inhabitants and on the surrounding landscape.

“I’d like to think that a structure’s role among the community of buildings is as important as each one’s individuality,” he says. “The part and the whole, the individual and the group, the single work and the ensemble—I don’t want to sacrifice one for the other. I want them to coexist.”

Leatherbarrow casts a critical historical eye on work by Renzo Piano, Le Corbusier, and Frank Lloyd Wright and cites George Howe’s 1932 PSFS building, located in Center City Philadelphia, as a prime example of a structure that works both at street level and as a key component of the city skyline.

“Good buildings get themselves interconnected with the world around them in those different ways,” he explains. “And what’s smart about [PSFS] is that it did so with foresight as to how the city would grow, as if the context that the building was fit into was not only the one that existed at the moment, but one that would exist in the future.”

“Sometimes we love to look at buildings and find them beautiful and expressive of a place, a people, even a period of time.”
Few issues are more controversial in America today than gun rights. In a nation where there is a gun for nearly every man, woman, and child—and more people use a firearm to commit suicide than homicide—professor Susan B. Sorenson is contributing a dispassionate body of research to a passionate national debate.

For more than 12 years, Sorenson has investigated the consequences of America’s relationship with firearms, identifying those individuals most likely to be involved in a fatal incident and testifying before Congress on what she has learned.

Her most recent study, published in Evaluation Review, illustrates the complex relationship between gun ownership, mental health, and suicide. Prior research established that suicide rates are higher among those who own or live with a handgun. The same goes for those suffering from mental health disorders. But is there a link between the two?

Using national survey data, Sorenson compared mental hardships among gun owners, those who live in a household with guns but don’t own one, and those who don’t have a gun in the home.

Her analysis identified no differences in mental health among these three groups. Regardless of proximity to a firearm, groups did not differ in their emotional and mental health, suggesting that the high risk of suicide among those near handguns is not related to a mental disorder.

“Other mental health issues that we didn’t examine, such as impulsivity and alcohol use, may be important. Alternatively, a person’s suicide risk may be greater simply because a gun, a highly lethal means of attempting suicide, is in the home,” says Sorenson, a professor in Penn’s School of Social Policy and Practice. “People tend to see this as an intractable problem, but exposure to guns may be far simpler to address than the complexities of mental illness.”

With limited research funding, scientists like Sorenson work to understand the effect guns have on the nation’s health. “There is a place at the policy-making table for this kind of research, for science that stands aside from the ideologies that dominate conversations about guns.”
In women with darker skin, the bruises and marks from such attacks may be difficult to find, even for trained medical professionals.

Cases of rape and assault occur as often in darker-skinned women as in women with lighter skin but tend to go unreported, in part because victims do not report sexual victimization when there is little physical proof.

Now, a researcher in Penn’s School of Nursing has developed a way for medical professionals to find these hard-to-see injuries on rape and sexual assault victims. Marilyn Sommers, a professor of nursing, became interested in this topic while setting up a sexual assault forensic examiner program at a hospital.

“I’m not an examiner myself, so I watched a few of the exams and I noticed that I really wasn’t sure about the injury detection in women with dark skin,” she says. “I just couldn’t see it.”

For her study, published in The American Journal of Emergency Medicine, Sommers recruited 120 volunteers with various skin complexions.

After quantifying skin color from digital images and conducting statistical modeling, Sommers discovered that race is not a factor in identifying injuries, but skin color is. Funding for her work was provided by The National Institute of Nursing Research.

To help better identify injuries, Sommers hopes in the future to design computer software allowing medical professionals who complete rape exams to write down all the pertinent information, then run digital images through a computer to identify locations that look suspicious and need to be rechecked.

“It will increase the accuracy—being able to pick up injuries that may be missed on the first exam,” she says.

Still, Sommers stresses that the most important part of the forensic exam is the woman’s account of what happened.

“The DNA and the injury exam provide evidence of the assault, but the injury in and of itself [is not the most important].”
Some of these young people have jobs that don’t offer insurance. But others have jobs with insurance and still go without, opting instead to receive care in emergency rooms.

Tom Baker, a professor of law and health at Penn Law School, says when young people fail to purchase health insurance, even when it’s available through work or through a low-cost option, it can be because they consider it unnecessary or unappealing.

“From a pure risk-management perspective, for a lot of young people, it doesn’t feel like they need the health insurance,” he explains.

In order to make health insurance more enticing to young adults, Baker recommends a plan based on what was known in the late 19th century as “tontine life insurance.” In those days, policyholders who survived and paid their insurance premiums for a set period—usually 20 years—were rewarded with a deferred dividend. The amount of this monetary award depended on how many people were left in the pool at the end of the period.

Baker’s health insurance plan works in a similar way. Those who use very little health insurance over a three-year period would receive a deferred bonus. This, he says, recasts health insurance as a smart investment rather than an unnecessary expense.

For his study, conducted with a colleague from the University of Connecticut and published by Penn’s Institute for Law and Economics, Baker analyzed current and past insurance plans with an investment or lottery component. He also utilized the Medical Expenditure Panel Survey, a set of large-scale reviews of families and individuals, their medical providers, and employers across the United States.

“Research tells us that people want to use insurance, and so the idea is to give people who turn out not to need health care some benefit out of their health insurance,” says Baker. “If you didn’t use it, you still would get something out of it.”

Those who use their insurance often or above a defined monetary limit would not be penalized. Instead, they would be “rewarded” by having their insurance cover their medical issue.
Those who use very little health insurance over a three-year period would receive a deferred bonus.

Examining Financial Fragility in Mutual Funds

TOUGH FINANCIAL TIMES CAN PROMPT SOME NERVOUS MUTUAL FUND INVESTORS TO PULL UP STAKES. As other anxious investors take note of this behavior, they may rush to redeem their shares, too.

This phenomenon, an example of a “coordination failure,” contributes to financial fragility in the marketplace. Funds are forced to offset the loss of investors by adjusting portfolios and conducting costly trades—actions that can damage future returns and harm those still in the fund.

“A coordination failure arises when people start withdrawing their money from banks, funds, or markets just because they fear that other investors will do the same,” explains Itay Goldstein, an associate professor of finance at Penn’s Wharton School. “The run on the system becomes a self-fulfilling belief.”

In a recent paper, “Payoff Complementarities and Financial Fragility: Evidence from Mutual Fund Outflows,” Goldstein and colleagues from Duke and Columbia examined U.S. mutual funds from 1995 to 2005 and found this effect is more likely to be seen in illiquid funds, where assets are less easily converted to cash, than in funds with greater liquidity.

“If you hold your money in an illiquid fund and there is a little bit of bad news, then you’re much more likely to take your money out, due to the expectation that other investors’ redemptions will hurt the fund,” says Goldstein, who has studied financial fragility for nearly a decade. “We also show this is less likely in funds that are held by the biggest investors.”

This is because institutional investors, such as banks, insurance companies, and state and local governments, know they control large shares of the fund’s assets and are therefore less concerned about the behavior of others.

Goldstein hopes that their findings will influence managers and regulators to change the way some funds are handled. He explains: “Mutual funds should be aware of it, and as a result, be more cautious, maybe hold more cash [and] put some restrictions on withdrawals.”
There’s a common stereotype that African Americans are obsessed with luxury items such as fancy cars, jewelry, and expensive clothes.

But Nikolai Roussanov, an assistant professor of finance at Penn’s Wharton School, doesn’t believe it is race itself that accounts for the attraction to these highly visible items. Instead, he thinks the answer lies in economics and conspicuous consumption, defined as the purchase of lavish material goods for the purpose of displaying wealth.

In a paper authored with colleagues from the University of Chicago, Roussanov found that what matters is one’s wealth relative to the surrounding community or peer group. If poor people live in a wealthy area, for example, they spend less on visible goods, since they’re not likely to catch up to wealthy residents. However, those from less affluent communities—no matter the race—need to spend more on visible goods to gain status and to counteract the effect of being associated with a poor group. And African Americans and Hispanics are more likely to live in lower income communities than whites, Roussanov notes.

“The logic of conspicuous consumption is that you want to be afforded the status you think you deserve based on your wealth and human capital and things that you have that are unobservable to others,” Roussanov says. “The way you earn that recognition is to show off that wealth somehow.”

Roussanov and his coauthors studied data from 1986-2002 in the Consumer Expenditure Survey, which collects information on American purchasing habits. He found that blacks and Hispanics spend 30 percent more than whites of comparable income on visible goods such as cars, clothing, and jewelry.

It makes sense, he says, that individuals would employ these visible spending habits.

“For a given individual, it is optimal to engage in this conspicuous consumption, potentially, because this is the way to achieve what you want to achieve in life,” says Roussanov. “You care about status just because you want to be treated well or because you need to project something about your human capital to get a good job or get a good partner.”
Build It Well, and They’ll Come

“For the last 50 years, we have been trying to bring businesses to cities, but maybe it makes more sense to attract people, and let business follow.”

San Antonio’s River Walk

TO STROLL ALONG BALTIMORE’S INNER HARBOR OR SAN ANTONIO’S RIVER WALK is to enjoy one of the more popular recent movements in urban planning—the addition of commercial recreation centers to the urban landscape.

Wharton real estate professor Albert Saiz sought to uncover just how much cities benefit from adding leisure to the landscape in his working paper, “Beautiful City: Leisure Amenities and Urban Growth.”

Saiz reviewed statistical data for 300 American cities during the dramatic developments of the 1990s designed to return people to urban centers after the painful loss of manufacturing jobs and suburban population flight.

He found that commercial attractions like new ballparks, aquariums, and shop-lined waterways not only appealed to tourists, but also to residents. Cities with those amenities grew faster, attracting more residents during the 1990s than those without. Housing and rent prices increased in “beautiful cities” as well.

Job creation, says Saiz, is sometimes given too much attention when a city plans for the future. Investments in city landscapes also pay off.

“Jobs are important,” he says. “But they, like people, move. We must create cities for residents. For the last 50 years, we have been trying to bring businesses to cities, but maybe it makes more sense to attract people, and let business follow.”

Saiz coined the term Central Recreation District, or CRD, to describe those areas of a city that contain the most recreational and historic sites. The effect of a CRD on the health of a neighborhood can be so profound, Saiz discovered, that many of these areas thrived despite lower-than-average income and lower-than-average education levels.

“The paradigm has changed,” Saiz explains. “People are richer now than they were in the mid-20th century, and so there’s a focus on ways to make the city more attractive for living and enjoying, for families and leisure.”
The University of Pennsylvania, in Philadelphia, is one of America’s premier research and teaching universities. As a member of the Ivy League, Penn has a proud history of academic excellence with 12 schools that offer undergraduate, graduate, and professional degrees to more than 24,000 students.
Visit www.upenn.edu/researchatpenn for updates on powerful discoveries that are driving change and improvement in the world.

On the front:
Children of the Mbugu tribe, from the Usambara mountain range in eastern Tanzania, participate in the largest study ever of African genetic data, led by Penn geneticist Sarah Tishkoff.