As one of the nation’s leading research universities, Penn State positively impacts our region, our state, our nation, and beyond. As the image on the cover of this report attests, the work we do even reaches to the depths of space.

The Swift satellite is an apt symbol for the fundamental human drive to extend the frontiers of understanding. As a land-grant institution, however, Penn State also places great emphasis on “translational” research: the work that turns basic discoveries into real-world applications.

The rewards of such work go beyond the advancement of knowledge. On rare occasions, a discovery may even result in significant royalties for the institution involved. But the real motivation for supporting translational research and technology transfer is to improve people’s lives—both directly, through impacts on human health and welfare, and indirectly, through economic development.

At Penn State, translational research takes place across the full breadth of disciplines. At a symposium last fall in University Park, for example (see page 7), dozens of Penn State scientists, engineers, and clinicians shared exciting advances occurring at the boundary of materials and biology that promise medical and societal benefits until recently unimagined. Another event—Innoventure 2005—showcased translational work being done at the College of Medicine in Hershey.

What follows is a breakdown and summary of Penn State’s research activity during FY 2005, and a sampling of research highlights. Whether the impact is global or local, the object of these efforts remains the same: to create new knowledge that improves people’s lives.

Eva J. Pell, Vice President for Research and Dean of The Graduate School
Total research expenditures at Penn State increased by 5 percent in FY 2005, moving from $607 million to $638 million. Included in this total was $365 million in funding from federal agencies, up from $349 million a year ago. Funding from the Department of Health and Human Services (including the National Institutes of Health) increased 6 percent, to $99 million. Department of Defense funding was up 5 percent, at $145 million. Funding from the National Science Foundation rose 4 percent to $52 million. In addition, research expenditures supported by the Commonwealth of Pennsylvania were up 30 percent to a total of $40 million.

A report released in November 2004 by the Pittsburgh accounting firm of Tripp Umbach provides several measures of just how important Penn State’s research activity is to the health and growth of Pennsylvania’s economy. Using 2003 research expenditure data, the authors report that “Penn State annually attracts more than $545 million to Pennsylvania from sources outside of the Commonwealth to support research activities.” Of that amount, more than $425 million remains in the state’s economy, generating an additional $1.7 billion in economic impact and supporting 16,000 jobs. Every dollar spent on research, the report found, generates 3.22 dollars for the state’s economy.

With $85.9 million in expenditures, Penn State ranks third nationally in industry-sponsored research. Last year the University engaged in 429 research projects with 235 companies in Pennsylvania, and over 1,500 projects with over 800 companies nationwide. In addition, Penn State actively supports economic development in the state and beyond through its offices of technology transfer, whose activities are detailed on pages 12 and 13 below.

One increasingly important way the University fosters economic development is through commercialization of its intellectual property in start-up companies. Over the past five years, an average of five new companies has been created annually. This year a new program, Discovery@Penn State, has been initiated to identify additional start-up opportunities.

Penn State has also been active in the Keystone Innovation Zone (KIZ) program created by Governor Edward G. Rendell to harness cutting-edge university research for high-tech economic development. The University is a partner in the I-99 Innovation Corridor KIZ, which includes 10 sites, one at Innovation Park and others in Centre, Blair, and Bedford counties, and also in a new KIZ located at the Philadelphia Navy Yard. At the Navy Yard, Penn State’s Applied Research Laboratory (ARL) is currently pursuing the establishment of a national center for industrial laser applications, a scaled-up version of ARL’s existing laser facility at University Park (see page 6). Penn State College of Medicine and Hershey Medical Center, with $100 million of funded research, is a key partner in the Harrisburg Market KIZ. In all, the University is active in ten KIZs across the state.

An important component in Penn State’s success is the wide-ranging quality of the University’s research program. According to National Science Foundation data for 2003, the latest year available, Penn State ranked 11th among all U.S. universities in R&D expenditures, and had more top-ten rankings for individual fields of study (15) than any school that finished above it.

With expertise across so many areas, it isn’t surprising that Penn State is a leader in interdisciplinary research. Taken together, the University’s five strategic research initiatives, in life sciences, materials, the environment, social sciences, and defense, accounted for $412 million in research expenditures, roughly 65 percent of the University’s total. One example of interdisciplinary strength is the Center for Infectious Disease Dynamics (CIDDD), described below on page 10. Created by collaboration among the Penn State Institutes of the Environment, the Huck Institutes of the Life Sciences, the College of Agricultural Sciences, and the Eberly College of Science, the CIDDD has rapidly established itself as a world-class center for the study of infectious diseases.

Penn State’s national leadership in materials was recognized on May 18 when Gov. Rendell announced the commitment of $40 million in state funding for construction of a new Materials Research building. The new building will be connected to a second Life Sciences building planned for the center of the University Park campus, providing a locus for collaboration in the emerging field of bio-nanomaterials. The $120 million combined project is the largest in Penn State’s history.

Over the last 20 years, a remarkable pattern of sustained growth in both traditional areas and new ventures has made Penn State a true national leader in research.
**Statistical Snapshot**

**Total Research Expenditures, 1986-2005**

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<th>Fiscal year</th>
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**Federal Research Expenditures, 1986-2005**

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Sources of Research Funding
FY2005 Total - $637,911,000

Expenditures from Federal Agencies
FY2005 Total - $365,322,000

Research Expenditures by Performing Unit
FY2005 Total - $637,911,000

Other
Altoona College = $361,000
Behrend College = $4,358,000
Berks-Lehigh Valley College = $272,000
Capital College = $3,725,000
Commonwealth College = $1,608,000
Great Valley = $336,000
Penn College = $1,535,000
International programs = $54,000

DRRU
$142,494,000
Applied Research Lab = $120,942,000
Electro-Optics Center = $21,552,000

Other Colleges
$20,267,000
Arts & Architecture = $1,217,000
Communications = $69,000
Education = $7,297,000
Information Sci & Tech = $6,178,000
Law = $258,000
Smeal College of Business = $5,248,000

Eberly College of Science
$86,342,000

Health & Human Development
$43,140,000

Defense Related Research Units
$142,494,000

Agricultural Sciences
$81,807,000

Liberal Arts
$20,540,000

Engineering
$92,601,000

Medicine
$76,223,000

Earth & Mineral Sciences
$62,248,000

Other
$12,249,000
Shrinking Odors

Smelly socks? Don’t sweat it. NanoHorizons, Inc., a spin-off company located in Penn State’s Innovation Park, has engineered a nanoscale solution.

NanoHorizons will provide the crucial ingredient for a new line of anti-odor fabrics produced by ARC Outdoors/ArcticShield®, a leading manufacturer of outdoor apparel. The new fabric, sold under the brand-name E47, is laced with nanoscale particles of silver.

Silver’s antimicrobial properties have been touted since ancient times. Modern science confirmed that silver ions are highly lethal to microbes, including those that create odor. This knowledge eventually found its way into the textile industry in the form of silver-coated fibers, woven into ordinary fabrics. But such fibers are expensive and may lose antimicrobial properties over time.

Drawing on their expertise in applied nanotechnology, NanoHorizons scientists realized a better way: To maximize silver ion release not by adding more silver, but by increasing surface area.

They do this by engineering tiny, silver-bearing nanoparticles, “which permanently bond to specific target fibers at the molecular level,” says director of operations Daniel Hayes, who received his Ph.D. in engineering science and mechanics from Penn State. “The antimicrobial functionality of E47 fibers is uniformly distributed throughout the fiber and specifically engineered not to flake off, rub off, or wash out—leaving all the other properties of the fiber unchanged.”

The textile market is just the latest foray for the company, which was founded in 2002 by Penn State engineering professor Stephen Fonash. Focusing on nanotechnology applications in the drug discovery, microelectronics and healthcare industries, NanoHorizons has already produced QuickMass™, a thin-film system for mass spectrometry which speeds up molecular analysis for drug discovery; and a variety of nanomaterials for use in sensors for environmental control, respiration monitoring and medical diagnostics. In 2004, the company received a Frost & Sullivan 2004 “Excellence in Technology” award for the application of nanotechnology to drug discovery.

As a tenant in Innovation Park, NanoHorizons is part of the I-99 Innovation Corridor Keystone Innovation Zone (KIZ). “I can’t think of a better place to operate a high-tech engineering business,” says CEO Bob Burlinson. “Not only are we practically next door to Penn State’s $35 million nanofabrication facility, we’re within a five-hour drive of Philadelphia, Pittsburgh, Washington, D.C., Toronto, and New York.”

To learn more, see http://www.nanohorizons.com/

Laser Vision

Lasers are an increasingly vital tool for cost-efficient manufacturing. A growing roster of industries, including shipbuilding, aviation, bridge-building, and the biomedical device industry, depend on them for precision cutting, welding, coating, and countless other operations.

Since 1984, Penn State’s Applied Research Laboratory has been a leader in the development and testing of such applications. ARL’s laser-processing laboratory houses state-of-the-art CO₂, and fiber optic lasers for basic and applied research, and an affiliated consortium assists industrial partners in prototyping and proof-of-concept demonstrations. In 1995, the U.S. Navy named ARL’s Laser Division a Center of Excellence.

Now Penn State is looking to amplify its laser activity by establishing an industrial-scale facility at the Philadelphia Navy Yard. Modeled on the existing laboratory at University Park, the proposed facility would be the centerpiece of a new Keystone Innovation Zone (KIZ), which partners the Philadelphia Industrial Development Corporation with the U.S Navy, Ben Franklin Technology Partners, and Penn State.

The proposed facility will require 40,000-60,000 square feet of floor space, and will house production-scale lasers including a 15-kilowatt fiber optic TbYAG as well as multiple work stations, robotic systems, and a large gantry crane. It will allow scale-up and testing of components and processes before full-scale manufacturing, says Jogender Singh, chief scientist for ARL’s materials and manufacturing division. The anticipated price-tag of $15 million will be raised from federal, state, and local sources and includes the cost of the seven full-time engineers who will be required to support the facility.

“The idea is to establish a national center for industrial laser applications,” Singh says. The U.S. Navy predicts a need for 350-400 new vessels over the next 20-30 years, he notes, and the aviation industry predicts a need for some 34,000 commercial aircraft over the next decade. “Up to a third of the cost for this construction goes toward welding and cutting.” By locating in Philadelphia, the facility will also be well-placed to serve the 350 architectural/bridge-building firms, 350 transportation firms, and 350 biomedical firms that exist within a few hundred miles of the city, he adds.

Says Ed Liszka, ARL’s director: “This facility will be an economic-development magnet for the entire region.”

To learn more, see http://www.arl.psu.edu/capabilities/mm_laserproc.html
**CrossOver 2005**

From molecular motors that could power a “lab on a chip” for detecting viruses inside the body to wireless electrodes that translate brain activity into device-control signals, cutting-edge research was abundantly on display at CrossOver 2005, a two-day symposium held at University Park October 13-14. Sponsored by the Huck Institutes of the Life Sciences, the Materials Research Institute and the Penn State College of Medicine, the event’s stated objective was to explore the interface of the life sciences and materials at Penn State.

Representatives of more than 40 companies joined faculty and students from University Park and the Penn State College of Medicine in the new Life Sciences building adjacent to Eisenhower auditorium. External sponsors included the Life Sciences Greenhouse of Central Pennsylvania and Lampire Biological Laboratories.

Penn State president Graham Spanier made opening remarks, and keynote speakers included Kathie L. Olsen, deputy director of the National Science Foundation, and Donald Bone, director of the Corporate Science and Technology Office of Johnson & Johnson.

Thirty-two talks and 70 poster presentations conveyed the breadth of research being conducted in four interdisciplinary areas: biosensors, cancer, neuroscience and regenerative medicine.

Topics included work on a high-frequency, high-resolution biomedical ultrasound system that may soon be capable of imaging individual cells; a tissue-based biosensor that uses moth antennae to detect chemical weapons and land mines; new nanotechnology-based drug-delivery systems for finely targeted treatment of breast cancer and melanoma; and applications for adult-derived stem cells in regenerating bone and as vehicles for delivery of therapeutic genes.

Eva J. Pell, Penn State’s vice president for research, took the opportunity to formally recognize the more than 100 faculty and students whose names appear on the 46 patents issued to Penn State in 2004.

“The hope of this gathering,” said Channa Reddy, director of the Huck Institutes of the Life Sciences, “is that researchers will find a way to strengthen the interface between materials and medicine, and between the researchers at University Park and the College of Medicine at Hershey.”

To learn more, see http://www.huck.psu.edu/CrossOver2005/

**Honoring August Wilson**

When Pittsburgh native August Wilson—one of America’s most celebrated playwrights and the most famous African-American dramatist—died of liver cancer in early October of 2005, it came as a shock to most of his many fans.

Says associate professor of theater Charles Dumas, “Our School of Theatre, along with Penn State’s Africana Research Center and the Institute for Arts and Humanities, had co-sponsored an August Wilson festival last spring. At the time we had no idea of his physical condition. We had just wanted to honor a beloved artist of the Commonwealth.”

The celebration, which ran from April 28 to May 1 on the University Park campus, was jointly sponsored with Temple University and Pittsburgh’s Kuntu Repertory Theater, which Wilson co-founded in the mid 1970s. Penn State’s August Wilson festival had special significance, explains Dumas. “It was the first and only time while he was alive that all ten plays of the Decade Series had been produced, read and/or discussed.”

The “decade series” Dumas refers to is at the heart of Wilson’s legacy: a cycle of ten full-length plays, each in a different decade of the twentieth century. Nine of the ten plays (which include the Pulitzer Prize and Tony award-winning Fences) take place in Pittsburgh’s African-American community, where Wilson himself grew up. “These plays are not epic histories,” says Dumas, “but, rather, are narrative tales that exquisitely detail the lives of ordinary African-Americans caught up in the unfolding of America’s last century.”

After his diagnosis of inoperable cancer in June, Wilson raced against the clock to finish the tenth and last play in the series (also called “the Pittsburgh cycle,”) which he completed in August.

Several months later, Dumas attended the playwright’s funeral in Pittsburgh. “As his hundred car funeral caravan wound through the Hill in the rain on its way to Greenwood Cemetery,” remembers Dumas, “people on Pittsburgh streets held up hand-written signs praising and thanking the Pulitzer Prize winner” for giving voice so eloquently to a people and a century. “August Wilson is dead,” says Dumas sadly, “and we shall not see his kind again.”

To learn more, see http://www.outreach.psu.edu/C&I/WilsonFestival/

Charles Dumas, Wendell Franklin, Edloe Blackwell, and Alano Miller in the Pennsylvania Centre Stage production of August Wilson’s Fences.
Researchers at Penn State’s Applied Research Laboratory (ARL) have developed a prototype system that dramatically reduces the number of false alarms reported by commonly used chemical-weapons detectors.

The Multi-Sensor Analyzer/Detector (MSAD), as the prototype is called, works by combining a flame photometer, an ion mobility spectrometer, and a surface acoustic wave array to simultaneously and continuously sample air in its environment for chemical-weapon vapors, explains David Swanson, associate professor of acoustics.

“Each of these sensors is capable of detecting chemical vapors at non-lethal exposure levels,” Swanson says. “However, each sensor has vulnerabilities to false detections from common chemical vapors such as diesel exhaust and cleaning products.”

To overcome these weaknesses, the ARL team used a signal-processing software called CINET (for Continuous Interference Network), which was originally developed by ARL engineer James Stover for use in underwater vehicles. CINET simulates the reasoning process a weapons inspector would use when trying to determine danger based on data from multiple sensors. It rejects alarms by an individual detector when the other detectors do not corroborate the initial data, or when data falls outside the known ranges for chemical weapons. In 41 test trials conducted so far, “We were able to virtually eliminate false alarms,” Swanson reports. Through a cooperative agreement between Penn State and the U.S. Army Edgewood Chemical and Biological Center, ARL researchers developed a database of responses for all three sensors over a wide range of concentrations of both chemical weapons and common chemicals, such as cleaning supplies, that could be misinterpreted as dangerous by a detector.

The ARL software architecture allows the device to be operated from a secure location, remote from the area under surveillance, or as part of a mobile unit.

The prototype development team was led by Swanson and Andrew Mazzara, director of Penn State’s Institute for Non-Lethal Defense Technologies, and included ARL scientists and engineers as well as Penn State chemistry faculty. The project was supported by the Marine Corps Research University (MCRU), a partnership between Penn State and the U.S. Marine Corps that began in 1999.

Kuchera Defense Systems of Windber, Pa., also supported the research effort and has built a prototype for testing by the Marine Corps. The company will manufacture the MSAD units.

To learn more, see http://live.psu.edu/story/11702

Better Sensing

Nanosolutions for Cancer

A Penn State College of Medicine study shows for the first time in an animal model that ceramide, a naturally occurring substance that prevents the growth of cells, can be administered through the bloodstream to target and kill cancer cells.

“Ceramide is the substance that accumulates in cancer tissues and helps to kill cancer cells when patients undergo chemotherapy and radiation,” says Mark Kester, professor of pharmacology. “By boosting the amount of ceramide through an injection in the bloodstream, our study in mice suggests that we can provide a stronger cancer-killing therapy without additional side effects.”

Administering extra ceramide is not as easy as it might seem. Injected directly into the bloodstream, ceramide is toxic. But Kester applied knowledge gained from previous laboratory studies in nanotechnology and encapsulated the ceramide in tiny bundles called liposomes, each less than 100 nanometers in diameter. (100 nanometers is roughly one-thousandth the thickness of a human hair.)

“The major problem with ceramide is that it is a lipid and therefore is not soluble in the systemic circulation,” Kester says. “Packaging ceramide in our nanoliposome capsules allows them to travel through the bloodstream without causing toxicity and release the ceramide in the tumor.”

Although the mechanism remains unknown, ceramide is inherently attracted to tumor cells. Once it enters these cells, the ceramide disrupts the mitochondria, the cell’s power source, causing apoptosis, or cell death. The ceramide also inhibits the growth of blood vessels that feed the tumor. In the study in mice, the ceramide bundles targeted and destroyed only breast cancer cells, sparing the surrounding healthy tissue.

Kester is now working with Penn State materials scientist Jim Adair to develop even smaller ceramide capsules called “molecular dots,” which could also carry fluorescent particles that would allow scientists to track them in the body. This new technology recently won the International Nanotechnology Business Idea competition sponsored by Case Western Reserve University, and is the
Stress and the Workplace

To what extent does a demanding career contribute to stress in one’s family life? That’s the central question behind a series of investigations being conducted by the Center for Work and Family Research (CWFR). Involving researchers in the departments of human development and family studies, hospitality management, biobehavioral health, psychology, and sociology, this interdisciplinary project, known as the Penn State Hotel Initiative, focuses on the work-family interface in the hotel industry.

Why study hotel managers? Karen Bierman, director of Penn State’s Social Science Research Institute, explains: “We’re trying to increase our understanding of the impact of working in a high-stress service industry that operates on a 24/7/365 basis. Hotel managerial work is a perfect example of this kind of profession.”

With funding from the Alfred P. Sloan Foundation, and led by Jeanette Cleveland, professor of psychology, and John O’Neill, assistant professor of hospitality management, the team launched pilot activities, including a qualitative study of 30 hotel managers and their partners or spouses, in March of 2003. In January 2005, with additional funding from the Sloan Foundation, the research moved into the next stage. With leadership from Ann Crouter, professor of human development and family studies, and O’Neill, the research team is currently collecting a variety of data, including interviews with top hotel executives and telephone surveys with managers and their spouses. An in-depth study of diary entries will examine the links between daily experiences on the job and mood, physical health, and family relationships.

In recognition of the project’s importance, in July 2005 Crouter and David Almeida, associate professor of human development, and their interdisciplinary team were awarded $1.3 million by the National Institute of Child Health and Human Development, establishing Penn State as one of four national centers to study the health benefits of family-friendly policies and practices in the workplace, and enabling the group to add the collection of biomarker data to the project.

The Penn State Hotel Initiative, notes Bierman, “is an innovative project that illustrates the power of interdisciplinary research and university-community partnerships to address critical social issues. Not only will this research illuminate connections between work stress, health, and family relations, it will provide critical information about how workplace policies and practices affect the well-being—and productivity—of employees.”

To learn more, see http://cwfr.la.psu.edu/projects/hotels.htm
Making a Difference

Before the world economic summit in Scotland last summer, the science academies of the G8 countries issued a statement stressing the “fundamental importance of science, technology and innovation in tackling a wide range of problems facing Africa.”

Scientific expertise is particularly needed for the harnessing of that continent’s vast natural resources as a force for economic growth. To foster that expertise, Penn State geophysicist Andrew Nyblade and colleagues in South Africa recently launched AfricaArray, a 20-year initiative to train and educate Africans in scientific fields vital to natural resource development.

“The primary goal is education,” Nyblade says. Initially, AfricaArray will focus on developing the geophysics program at the University of Witwatersrand in Johannesburg, South Africa, a founding partner along with Penn State. It will then expand educational programs to other universities across the continent. African students will be allowed to work for up to 6 months per year at affiliated universities outside Africa, Nyblade says.

But AfricaArray also has an important research goal: To improve and update the seismic network spanning the African continent. That network, Nyblade says, is an unevenly spaced grid of outdated sensors, with large areas still uncovered. The researchers hope both to upgrade existing facilities and to build new observatories that may eventually include other kinds of geophysical and environmental sensors.

An improved seismic network would help mitigate earthquake disasters related to mining, a problem which claims many lives each year in South Africa, Nyblade says. “There are also geophysical features in the crust that are of potential economic value. Seismic data can be used for locating these, as well as water resources.”

Such data should also finally solve one of the important mysteries of geophysics: the exact nature of the so-called African superplume, a large hotspot in the mantle beneath eastern and southern Africa. According to Nyblade, the superplume is “the biggest seismic anomaly anywhere. It’s a first-order feature on our planet.”

AfricaArray is being run under the auspices of the Alliance for Earth Sciences, Engineering and Development in Africa (www.aeseda.psu.edu), and was recently awarded $3 million from the National Science Foundation, and additional core funding from the South African National Research Foundation. Nyblade and his African colleagues are currently seeking additional governmental and industrial support.

To learn more, see http://africaarray.psu.edu/
important? Researchers hope the data collected by Swift will lead to even more critical scientific breakthroughs, such as detailed knowledge about the merger of black holes with neutron stars; the position of the first stars that formed in the universe; and detection of Einstein’s exotic gravitational waves, still only theoretical.

The significance of Swift’s mission has been confirmed by a recent honor: Popular Science magazine recognized the satellite with a “Best of What’s New” award and featured it in their December 2005 issue.

“It’s great to know that Popular Science is as excited about our nifty new observatory as we are,” comments John Nousek. “I can’t think of any other satellite as versatile. With its lightning-fast reactions, Swift is making its namesake proud—catching gamma-ray bursts on the fly, just like the bird it was named for.”

To learn more, see http://www.swift.psu.edu/

FROM PROTEINS TO PANDEMICS

Though its importance is incontrovertible, you won’t find the Center for Infectious Disease Dynamics (CIDD) on any Penn State map. That’s because the center is a “virtual” one, bringing together laboratory scientists, field scientists and theoreticians from disparate disciplines to solve some of the most pressing problems in infectious disease research.

The CIDD team, which has expertise in fields as diverse as immunology, physics, architecture and ecology (among many other disciplines), “takes advantage of the deep strengths we have at this university,” comments Bruce McPherson, associate dean of research and graduate education in the College of Agricultural Sciences. This mix of expertise is deliberate. “To tackle key questions—such as what makes a virus jump from one species to another to cause a pandemic—we need a highly interdisciplinary approach,” stresses Peter Hudson, the center’s co-director.

Despite being spread out across the University, CIDD-affiliated faculty members and students get together regularly for group lunches, seminars, and invited workshops. “Collaboration makes CIDD a true team,” notes Bill Easterling, director of the Penn State Institutes of the Environment (PSIE). “Faculty members often work together on research proposals and, together, report their research results in prestigious journals such as Science and Nature.”

For example, Eddie Holmes (an evolutionary biologist) and Bryan Grenfell (a population biologist) have been studying influenza evolution. In a recent editorial in the journal Science, they stressed how effective pandemic preparedness requires global surveillance of wild birds, farm animals and humans—along with fundamental science into pathogen biology, and research into vaccine design.

Hudson’s research on wildlife disease ecology shows how disease flows through wild animal populations. This work throws light on possible ways to control diseases that jump from one species to another.

Other CIDD researchers are looking at childhood infections, host-parasite interactions, and an array of issues related to disease transmission and immunity. The work ranges in scale from sub-cellular to metapopulation, but regardless of the level, the focus remains on finding the interrelated concepts—and solutions—that will shed new light on pressing issues.

Says Easterling unequivocally, “The spectacular rise of the Center for Infectious Disease Dynamics has established Penn State as a world leader in the study of infectious diseases.”

To learn more, see www.cidd.psu.edu
For faculty and students at Penn State, the opportunity to do relevant and commercially useful research is an important component of the educational experience, and fulfills a central mission of the University to serve the people of the Commonwealth. Through the integrated efforts of the seven Technology Transfer units, federal, state, and industry funds are transformed into benefits for all. These seven units cover every aspect of the commercialization process, from linking industrial research sponsors with faculty; to patenting and licensing; to assisting start-ups with incubation and advice; to providing convenient physical facilities for companies of all sizes at the expanding Innovation Park.

In FY 2005, Penn State has made great strides in encouraging the formation of start-up companies based on Penn State technologies. The first step was taken in the year 2000 when the University and The Penn State Research Foundation (PSRF) created new policies to more easily accept equity in companies through license agreements. Since that time, PSRF has executed 29 equity-based license agreements. The second advance was the preparation of the Research Administration Guideline 14 (RAG14) “What to Expect When Licensing a Penn State Technology Into a Start-up Company.” The most recent step is a new initiative called Discovery@Penn State. In collaboration, the Intellectual Property Office, Research Commercialization Office and Industrial Research Office will proactively screen Penn State technologies with the aim of identifying the most suitable candidates for a start-up company. The ultimate goal of Discovery@Penn State is to double the number of Penn State start-up companies formed per year.

To learn more, see http://www.techtransfer.psu.edu/
The Intellectual Property Office manages all intellectual property developed at Penn State, assessing the commercial potential of approximately 200 University inventions per year, formulating and implementing patent and marketing strategies, and negotiating license agreements.

Penn State continues to accept equity positions in start-up companies through license agreements. Since 1999, Penn State has executed a total of 29 equity-based licenses.

**Invention Disclosures**

167

**U. S. Patent Applications**

157

**Issued Patents**

46

**Revenues**

$3.3 million

**Cumulative Equity Held**

29

NOTE: The figures above are for the calendar year, January-December 2005. Not included in revenue is the equity Penn State holds in start-up and established companies.

The Intellectual Property Office, the Research Commercialization Office (RCO) facilitates the process. RCO’s team of experienced liaisons works closely with industrial clients, offering them significant opportunities to explore new technologies and negotiating sponsored research agreements for collaborative projects, including “Master Agreements” defining their long-term, multi-project partnerships with the University. Currently, Penn State University Park has Master Agreements with over 20 companies. In addition, the College of Medicine and Hershey Medical Center has agreements with 11 companies.

Nationally, Penn State ranks 3rd in industry-sponsored research funding. During FY 2005, the RCO assisted 46 companies in generating new research, totaling $11 million. RCO’s ultimate aim is to identify the opportunities that will help our clients meet their research needs and provide a smooth contracting path forward so clients can quickly benefit from the capabilities of Penn State researchers.

**Industrial Research Office**

For businesses interested in pursuing collaborations with Penn State’s science and technology-based researchers — over 2,500 strong — the Industrial Research Office (IRO) facilitates the process. IRO’s team of experienced liaisons works closely with industrial clients, offering them significant opportunities to explore new technologies and negotiating sponsored research agreements for collaborative projects, including “Master Agreements” defining their long-term, multi-project partnerships with the University. Currently, Penn State University Park has Master Agreements with over 20 companies. In addition, the College of Medicine and Hershey Medical Center has agreements with 11 companies.

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**Research Commercialization Office**

The mission of the Research Commercialization Office is to assist Penn State faculty and staff in the formation of new companies based on University research and technologies. Working in partnership with Penn State’s Intellectual Property Office, the RCO screens inventions for patentability and market potential, and helps identify sources of early stage capital such as seed funding programs, angel investors, and venture capital funds. In addition, RCO aids in identifying mentors and potential management-team members who can lend guidance to the new business enterprises. Space for start-up companies is available in the Innovation Park at Penn State and in the Penn State Zetachron Center for Science and Technology Business Development, a gift of Dr. and Mrs. Wally Snipes and family.


Recent graduates are Mitotyping Technologies, EIEICO, Centre Ingredient Technologies, Keystone Food Science, Salimetrics, and VideoMining, Inc.

Penn State’s Technology Transfer units also include the Pennsylvania Technical Assistance Program (PENNTAP) and the Small Business Development Center (SBDC), both now housed in the University’s Outreach division. PENNTAP provides technical assistance for small companies, and SBDC provides one-on-one consultation for entrepreneurs in Centre and Mifflin counties. For more information on these units, see [www.penntap.psu.edu](http://www.penntap.psu.edu) and [www.research.psu.edu/spdc/](http://www.research.psu.edu/spdc/)

For more than two decades Ben Franklin Technology Partners (BFTP) has been an international model for innovation in technology-based economic development. The state-funded program operates regionally with four centers strategically located throughout the Commonwealth.

The BFTC of Central and Northern Pennsylvania provides technology-based regional companies with the information and services they need to strengthen their position in today’s competitive marketplace. The “21st century enterprises” BFTC serves are typically in areas such as information technology, life sciences, communications, advanced manufacturing, advanced materials and environmental technology.

Through financial support and help with research, marketing and networking, BFTC aids entrepreneurs in these sectors to grow their businesses at every stage. In particular, BFTC strives to link public, private, and educational resources to diversify and strengthen the high technology components of the state’s economy.

For FY 2005, 46 research projects were funded with over $4.68 million in Ben Franklin funds and $13.5 million in private-sector cash and in-kind funds.

Circuit board.
In its eleventh year of operation, Penn State’s Innovation Park continues to grow in its mission to facilitate collaborations between business and University research that will result in new technologies and boost the region’s economy.

Innovation Park consists of 118 acres of land designated for business development, adjacent to the University Park campus at the interchange of I-99 and U.S. Route 322. Buildings completed and currently under construction total 750,000 square feet, and at its capacity the Park can accommodate about 1.4 million square feet of development.

Eva J. Pell, vice president for research and dean of the graduate school, comments, “The goals of the Park are technology transfer, economic development, retention and recruitment of entrepreneurial faculty, and the formation of partnerships with business that will result in sponsored research opportunities and work force development.”

“Ultimately,” adds Pell, “these activities will contribute to job creation and strengthening of the economic base of the region.”

They are already doing so. A total of 48 tenants now make their headquarters in Innovation Park, with 926 employees supporting their activities. The park’s close proximity and involvement with the University confers benefits on both the corporate tenants and the student body. In the past year, Innovation Park-based companies gave 67 Penn State students internships and hired 41 Penn State graduates for permanent positions.

The new Outreach Innovation Building, completed in the first quarter of 2005 and marking the end of the second phase of the Park’s development, is already meeting one of its goals: to expand Penn State’s reach across the Commonwealth and beyond. In addition to the newly-renamed WPSU TV/FM (which now serves over 500,000 listeners in 12 central counties of the Commonwealth, 24 hours a day), the Outreach Building is also home to the University’s Continuing Education and World Campus divisions. The latest technology helps all three tenants reach new listeners and learners: WPSU now offers its features through podcasts, while Continuing Education and World Campus use computing advances to expand opportunities for, respectively, non-traditional study and long-distance learning on a global scale.

The second structure completed in early 2005 is a multi-tenant building at 328 Innovation Boulevard, developed by a private partnership, Innovation Capital Partners. The 75,000 square-foot building, the first to be constructed in the park’s third phase, is fully leased by a number of tenants representing a wide range of specialties, including satellite communications applications, architecture and engineering, accounting, law, weather forecasting and procurement consulting. Innovation Capital Partners is currently in the planning process for another multi-tenant building to be constructed at 330 Innovation Boulevard starting in 2006.

In addition, the University is a partner in the I-99 Innovation Corridor Keystone Innovation Zone (KIZ), which includes one site at Innovation Park and nine others in Centre, Blair, and Bedford counties.

The KIZ sites are designed to create entrepreneurial opportunities by aligning the combined resources of the University, private business, business support organizations, commercial lenders and others in hopes of driving the region’s economy with the creation of long-lasting jobs. It is also designed to provide opportunities for the talent emerging from Penn State’s undergraduate and graduate programs. In FY 2004, half of Innovation Park’s 42 tenants used Penn State student interns while a quarter of the businesses employed a total of 17 Penn State graduates.

As it grows into the 21st century, Innovation Park continues to fulfill its promise, serving as a remarkable catalyst for successful collaborations between the University and the private sector.

To learn more, see http://www.innovationpark.psu.edu/.
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