Penn State’s research expenditures last year totaled $440 million, a record high for the University.

This dramatic increase — about $47 million over the previous year’s figure — is one of the highest single-year increases in the history of American higher education. Research expenditures are an important indicator of the volume of research and creative activity undertaken by Penn State faculty, staff, and students. This remarkable level of expenditures indicates the exceptional ability of Penn State researchers to compete in the arena of ideas. Pennsylvania is a national leader in attracting federal research and development funding, ranking ninth among the 50 states, according to a 1998 study by the American Association for the Advancement of Science. More than half of these funds go to industrial firms, but almost one third is brought in by the Commonwealth’s colleges and universities — with Penn State among the leaders.

Through research at Penn State, we create knowledge. Penn State has a long tradition of fostering interdisciplinary research efforts. We create an environment of discovery that fosters learning and rewards creativity. Once a discovery is made we strive to see that its applications benefit society. Acknowledging our responsibility to society, we work to ensure that our research advances are developed and shared in a timely manner. Penn State encourages and supports the transfer of ideas and technologies to benefit the Commonwealth, the nation, and the world. Our goal is to bring our ideas and our inventions to bear on making life better.

For more information on research at Penn State, contact:
Eva J. Pell, Vice President for Research, Dean of the Graduate School, 304 Old Main, University Park, PA 16802; 814-863-9580 (phone); 814-863-9659 (fax); ejp@psu.edu; www.research.psu.edu
The FY2000 figures show a 12 percent increase in research expenditures from all sources. Expenditures on grants and/or contracts from federal sources rose nearly 13 percent, with increases from all of Penn State’s major federal supporters:

- Office of Naval Research (for ARL) support: up 16 percent to nearly $70 million, with the balance of U.S. Department of Defense support up 24 percent to nearly $21 million
- National Science Foundation: up 12 percent to almost $28 million
- NASA: up 9 percent to more than $11 million
- DHHS/National Institutes of Health: up 8 percent to approximately $66 million
- U.S. Department of Agriculture: up over 6 percent to nearly $11 million

Contract research expenditures, conducted for Commonwealth of Pennsylvania agencies like PennDOT, the Department of Environmental Protection, and the Pennsylvania Department of Agriculture, increased 15 percent. Research expenditures from all other external sources, such as industry projects, foundation grants, and subcontracts from other universities, increased an estimated 9.5 percent.

In FY 2000, the Office of Sponsored Programs oversaw the submission of 3,633 research proposals and processed 4,131 awards for $390 million. Contact: Bob Killoren, Assistant Vice President for Research (814-865-3398; rak9@psu.edu; grants.psu.edu)

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**Sources of Research Funding**

Federal support includes grants, contracts, cooperative agreements, and agricultural research appropriations. State support includes grants, contracts, and both agricultural and estimated general research appropriations. Private support and subcontracts from other universities are included under Industry and Other. The University’s contributions include research funding and support, as well as support for facilities and infrastructure.

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**Federal Funding of Research**

Federal support includes grants, contracts, cooperative agreements, and agricultural research appropriations. It does not include federal support that the University receives through subawards from state or local governments, industry, or other universities.

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**Research Funding by College**

These figures include grants, contracts, and cooperative agreements from federal, state, industry, and other private sources; research appropriations from the federal government and the Commonwealth of Pennsylvania; and University research and infrastructure support. The totals include funds transferred from the Intercollegiate Research Programs (IRP) for college faculty participating in IRP projects (see the following charts).
Strategic and Interdisciplinary Initiatives

Penn State faculty are at the forefront of advancing knowledge in a multitude of cross-disciplinary research fields, while over 500 graduate students pursue advanced degrees in the 13 interdisciplinary Intercollege Graduate Degree Programs. Many of Penn State’s interdisciplinary units have been in existence for 30 years, and their research programs have earned national and international preeminence. Complemented by more recently established programs such as the School of Information Science & Technology, the Environmental Consortium, or the Department of Biomedical Engineering, Penn State’s strategic and interdisciplinary initiatives encourage faculty and student research that transcends traditional disciplinary or college boundaries to expand our fundamental understanding of the natural world and of the human condition.

**Contact:** Robert T. McGrath, Associate Vice President for Research, Director of Strategic and Interdisciplinary Initiatives (814-863-9580 phone; 863-9659 fax; mcgrath@psu.edu; www.research.psu.edu)

### INTERDISCIPLINARY FUNDING

These figures include grants, contracts, and cooperative agreements from federal, state, industry, and other private sources for research and research-support programs that are administered by units other than colleges. These include the Applied Research Laboratory (which for this fiscal year includes the Marine Corps Research University), the Research and Technology Transfer Organization (see the following pages), the six Intercollege Research Programs, and the four research consortia (under General University Research Support).

### RESEARCH CONSORTIA

Penn State is investing in four interdisciplinary areas in which extensive faculty expertise and research capabilities provide the basis for national and international prominence:

- Children, Youth, and Families Consortium
- Environmental Consortium
- Life Sciences Consortium
- Materials Research Institute

Faculty from every college are providing leadership and defining the scientific vision for these expanding strategic initiatives. Many faculty hold joint appointments, ensuring synergy among college and consortia objectives.

Dialogue at the boundaries of traditional disciplines has resulted in such new research thrusts as

- manipulation of biological materials at cellular and molecular levels to improve plant characteristics or for medical drug delivery systems
- computational modeling for predicting the evolution of Earth’s atmosphere
- probing radiation from deep space for expanding our understanding of cosmoogy and the origins of the universe
- exploring the relationships between hormones and human aggression
- understanding and treating drug and alcohol addiction
- developing programs for improved child care in impoverished and/or rural communities.
APPLIED RESEARCH LABORATORY

Penn State’s largest single research unit, with research expenditures of nearly $100 million, ARL provides the government with advanced technology essential for national defense, while giving the University access to advanced technology equipment and laboratory facilities. It is a Strategic Partner and Special University Affiliated Research Center for both the U.S. Navy and the Department of Defense.

ARL’s new virtual reality visualization cave
- provides Navy research programs with 3D visualization of hydraulic flows near submerged vehicles and propellers
- is a valuable resource for faculty members from any college competing for research awards within new federal programs such as the multi-agency initiative on information technology research.

MARINE CORPS RESEARCH UNIVERSITY

A new and rapidly growing research program at Penn State, the MCRU includes researchers from the Smeal College of Business Administration, the Center for Logistics Research, the College of Engineering, Outreach and Distance Education, the Schreyer Honors College, and the Applied Research Laboratory.

Active research and educational programs include
- logistics training for Marine Corps officers and base commanders
- research on non-lethal weapons being conducted by ARL, the Noll Physiology & Kinesiology Laboratory, and the Bioengineering Department
- research on protective structures for blast survivability.

INSTITUTE FOR THE ARTS AND HUMANISTIC STUDIES

Grants and awards garnered by members of IAHS have resulted in numerous conferences, symposia, exhibits, and performances.

Notable productions this year include
- “Dietrich Bonhoeffer and the Ethics of Violence”
- world premiere of “Paul et Virginie” by Jean Cocteau
- the Medieval Garden, supported by AT&T
- NEH-sponsored “Chaucer Ancient & Modern”
- “Mellon Seminar in Interpretation.”

ENVIRONMENTAL RESOURCES RESEARCH INSTITUTE

ERRI conducts research on acid mine drainage, mined land reclamation, environmental impact assessment, hydrologic and environmental systems modeling, risk assessment, bioremediation, toxicology, and environmental health.

Recent awards include
- a $2.5 million research grant from the National Science Foundation to study the forces affecting bacterial adhesion to surfaces; improved understanding and control of these forces could lead to breakthroughs in prevention of tooth decay and infections associated with human artificial implants
- a $1.6 million award from the Pennsylvania Governor’s Office for characterization of soil quality across the state
- PASDA, a worldwide web site for search, display, and retrieval of data on Pennsylvania’s environment.

POPULATION RESEARCH INSTITUTE

PRI focuses on such issues as continuing high rates of fertility, rural migration to magnet cities, the spread of HIV infection, infant and child health, and participation in formal education. PRI’s advanced computing and Geographical Information Systems units provide advanced information technologies for data processing and display to faculty from all colleges conducting demographic research.

Current research projects include
- Biodemographic Models of Reproductive Aging, funded by DHHS for nearly $400,000.

INSTITUTE FOR POLICY RESEARCH AND EVALUATION

IPRE emphasizes problem-focused social and behavioral science on healthcare financing and service delivery, substance abuse and prevention, economic development, science and technology policy, and field-based program evaluations.

IPRE is supported by
- federal agencies such as the NSF, the NIH, and the USDA
- private sources such as the Ford Foundation, the Spencer Foundation, and RAND
- state and local agencies such as the PennDOT and the Philadelphia Workforce Development Corporation.

MATERIALS RESEARCH LABORATORY

MRL promotes collaboration in materials development and application. Its many strengths include piezoelectric materials for actuators and transducers, high and low permittivity materials, powders/particulate materials, microwave processing, materials in the environment, and nanoscale composites.

An award this year from the Keck Foundation will establish a $1.2 million hybrid processing facility which
- complements other cleanroom facilities on campus
- enhances capabilities for fabricating and conducting research on microelectrical mechanical systems (MEMs), optoelectronic devices, and new classes of smart materials and devices.

Penn State students routinely finish in the top five in national competitions on design and operation of fuel efficient or hybrid-fueled future vehicles.
Technology Transfer

Through the integrated efforts of the Research and Technology Transfer Organization at Penn State, federal, state, private, and industrial funds are transformed into benefits for everyone from the smallest town in Pennsylvania to the largest national and international corporations.

Contact: Gary W. Weber, Assistant Vice President for Research, Director of Technology Transfer (814-863-9580; gweber@psu.edu; www.research.psu.edu)

NEW INITIATIVES

The following initiatives highlight the entrepreneurial spirit of Penn State’s Research and Technology Transfer Organization:

Linking Research, Teaching, and Commercialization

Salimetrics, a company devoted exclusively to saliva testing, was founded by Douglas Granger, Eve Schwartz, and Richard Supina. The laboratory specializes in designing assays and testing saliva samples for various biological markers. For researchers who cannot conduct their own assays, Salimetrics has state-of-the-art facilities to rapidly process samples.

Salimetrics could become the diagnostic testing fluid of the future, the company’s founders believe. It could revolutionize medical care, from health monitoring to drug testing. Its impact could be felt everywhere from medical clinics to businesses interested in monitoring employees’ health. Saliva testing is readily accepted in Europe; the company believes it is only a matter of time before it catches on in the U.S. One of the first applications has been to screen for HIV infections. In the future, it may be possible to use saliva to diagnose other infections, behavioral health problems, and possibly cancer.

Salimetrics maintains strong ties to Penn State research, to ensure that technical and scientific support and the quality of its assay kits and services remain consistently high. The company’s objective is to support investigators worldwide with innovative products and laboratory services. The Research Commercialization Office found initial space for Salimetrics at Zetachron; the company has since moved to space in Innovation Park.

Equity Licensing to Commercialize Agricultural Sciences

EIEICO, Inc., was formed in 1999 through the Intellectual Property Office and with financial support from Ben Franklin to license and develop inventions owned by the Penn State Research Foundation. With cooperation from the Research Commercialization Office, space was identified in the Zetachron facility. EIEICO operates as a parent company which establishes subsidiary companies; it focuses on agricultural products developed by Penn State’s faculty. Frank P. Slattery Jr., a private investor, is chairman of the board. Joseph S. Duffy is president and CEO. Douglas L. Greger, one of the inventors, is Chief Technology Officer.

Current products include a poultry feed withdrawal supplement to reduce the risk of meat contamination by microbial pathogens during processing, developed by Regina Vasilatos-Younken; a gel drug-delivery system to more effectively manage farm animal reproduction, invented by Daniel R. Deaver; and a genetic marker for meat quality traits, discovered by Doug Greger and commercialized by an EIEICO subsidiary, Templar Sciences. The license and royalty agreement for the Livestock Genetic Marker technology has been signed with a global swine genetics company.

Collaboration with the Commonwealth

The Pittsburgh Digital Greenhouse is a collaborative initiative sponsored by the Commonwealth of Pennsylvania. The Industrial Research Office worked closely with the PDG starting in June 1999 to develop an industry cluster around the application of System on Chip (SOC) technology in the digital multimedia and networking markets. The PDG includes 17 corporate members, as well as partnerships with universities, private foundations, and regional development organizations.

The PDG offers two solicitations yearly for SOC-related research. In Fall 1999, $1.9 million was awarded for ten projects; Penn State received some $650,000 for four projects. In Spring 2000, one Penn State project was funded for $150,000; total awards were $1 million. In the third round of proposals, currently being reviewed, anticipated funding is $2 million.
INTELLIGENT PROPERTY OFFICE

The IPO manages and commercializes intellectual property developed at Penn State. It evaluates inventions for patentability and develops strategies to market them to industry.

<table>
<thead>
<tr>
<th></th>
<th>FY99</th>
<th>FY00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Invention Disclosures</td>
<td>205</td>
<td>193</td>
</tr>
<tr>
<td>U. S. Patent Applications</td>
<td>191</td>
<td>274</td>
</tr>
<tr>
<td>Issued Patents</td>
<td>32</td>
<td>46</td>
</tr>
<tr>
<td>Revenues</td>
<td>$1,551,038</td>
<td>$3,520,262</td>
</tr>
</tbody>
</table>

INDUSTRIAL RESEARCH OFFICE

Responding to requests for assistance, the IRO identifies and directs University faculty expertise, technical capabilities, and research centers to a company’s needs, and gives specific and personal attention in order to determine where University resources might prove most beneficial. The IRO focuses on industries of significant importance to the Commonwealth, such as materials, agribusiness, information technology, environmental, and life sciences.

<table>
<thead>
<tr>
<th></th>
<th>FY2000</th>
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</thead>
<tbody>
<tr>
<td>Industry R&amp;D Direct Involvement</td>
<td>$4.6 million</td>
</tr>
<tr>
<td>Industry R&amp;D Facilitated</td>
<td>$3.9 million</td>
</tr>
<tr>
<td>State Initiatives Facilitated</td>
<td>$4.0 million</td>
</tr>
</tbody>
</table>

INNOVATION PARK AT PENN STATE

Building construction and a change of name highlighted the past year’s activities. The name Innovation Park at Penn State reflects the innovative ideas that form the basis of the Park: the growing scope of technology being developed within the University, commercialized, and brought to the marketplace.

<table>
<thead>
<tr>
<th></th>
<th>1993 - 2000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tenants</td>
<td>38</td>
</tr>
<tr>
<td>Employees</td>
<td>770</td>
</tr>
<tr>
<td>Total Acres</td>
<td>118</td>
</tr>
<tr>
<td>Acres Developed</td>
<td>46</td>
</tr>
<tr>
<td>Buildings Occupied</td>
<td>5</td>
</tr>
<tr>
<td>Square Feet Under Roof</td>
<td>403,000</td>
</tr>
<tr>
<td>Square Feet Under Construction</td>
<td>37,000</td>
</tr>
</tbody>
</table>

PENNTAP

PENNTAP helps Pennsylvania’s smaller businesses improve their competitiveness by providing free technical assistance to help resolve specific technical questions or needs that can be addressed within a limited amount of time. PENNTAP serves every county in Pennsylvania with a network of technical specialists who have specific areas of technical expertise.

<table>
<thead>
<tr>
<th></th>
<th>FY2000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Requests for Technical Assistance</td>
<td>750</td>
</tr>
<tr>
<td>Clients Cost Savings</td>
<td>$4,900,00</td>
</tr>
<tr>
<td>Clients Sales Impact</td>
<td>$2,900,00</td>
</tr>
<tr>
<td>Clients Capital Investments</td>
<td>$4,700,000</td>
</tr>
<tr>
<td>Jobs Created/Retained</td>
<td>60 / 110</td>
</tr>
<tr>
<td>Clients Satisfied</td>
<td>99%</td>
</tr>
</tbody>
</table>

RESEARCH COMMERCIALIZATION OFFICE

The RCO helps Penn State faculty and staff create new companies based on University research and technologies. Among its resources is space for start-up companies in the Innovation Park and in the Zetachron Center for Science and Technology Business Development, a gift of Dr. and Mrs. Wally Snipes and family.

BEN FRANKLIN TECHNOLOGY CENTER OF CENTRAL AND NORTHERN PENNSYLVANIA, INC.

One of four regional centers of the Commonwealth’s Ben Franklin/IRC Partnerships, the BFTC provides financial support, technology and management experience, and ways to link public, private, and educational resources to help strengthen the high-technology components of the state’s economy. During FY00, 53 research projects were funded with over $4.4 million in Ben Franklin funds and $8.3 million in private sector cash and in-kind funds. In the seven funded training projects, 1,400 employees from over 200 companies received training.

<table>
<thead>
<tr>
<th></th>
<th>1985 - 2000</th>
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<tbody>
<tr>
<td>Jobs Created</td>
<td>6,196</td>
</tr>
<tr>
<td>Jobs Retained</td>
<td>4,247</td>
</tr>
<tr>
<td>Companies Created</td>
<td>476</td>
</tr>
<tr>
<td>Companies Expanded</td>
<td>624</td>
</tr>
<tr>
<td>Products Commercialized</td>
<td>288</td>
</tr>
<tr>
<td>Production Processes Improved</td>
<td>198</td>
</tr>
</tbody>
</table>

SMALL BUSINESS DEVELOPMENT CENTER

The Penn State SBDC opened in October 1997 as a response to the needs of entrepreneurs in Centre and Mifflin counties. In June 2000, an outreach center was created in Lewistown to serve clients in Mifflin County. The SBDC is part of a national network of more than 950 centers, 16 of which are based at colleges and universities in the Commonwealth. The SBDC has provided counseling to 360 clients, in areas shown below:

Penn State is committed to affirmative action, equal opportunity, and the diversity of its workforce. This publication is available in alternate media on request. U.Ed. RES01-22
On the front cover of this year’s Annual Report, and shown here actual size, is an ultrasonic micro-motor developed by Kenji Uchino, professor of electrical engineering and member of Penn State’s Materials Research Laboratory. The motor, which is 1.5 mm in diameter, can reach a maximum speed of 2000 rpm. It incorporates high-power piezoelectrics and a new disk-type transformer invented in Uchino’s lab.

On this page, Tiara, a new variety of *Pelargonium x domesticum* patented by Richard Craig, the Styer Professor of Horticulture and Botany at Penn State. The University began research on the Pelargonium in 1958; since the breeding program for Regal Pelargoniums was initiated in 1977, 12 patented cultivars have been created.

Both photographs taken in the Penn State Digital Photography Studio by Gerald Lang, professor of art, and Jennifer Tucker, an M.F.A. graduate of Penn State’s School of Visual Arts.