Total research expenditures, 1989 to 1999, in millions of dollars.
Penn State research activities and the benefits these programs bring to the Commonwealth showed continued growth in fiscal 1999.

Research expenditures are an important indicator of the volume of research activity undertaken by Penn State faculty, staff, and students, according to Eva J. Pell, Interim Vice President for Research. “As research activity increases, so do the benefits, including more jobs, better industrial products, safer food supplies, greater understanding of disease, a more modern national defense, and enhanced cultural and artistic opportunities. More research also means more ways for our students to be involved in the knowledge-generation process, a special feature of an education at a major research university.”

Health research activity, for example, increased more than 8 percent at the College of Medicine over the past fiscal year. The College of Medicine is well known for its development of an artificial heart. Other research programs focus on Alzheimer’s disease, AIDS treatment and prevention, cancer, diabetes, sleep disorders, and women’s health. Other research programs that contribute to healthier lives include the search for effective ways to reduce unwanted teen pregnancies, combat drug and alcohol abuse, prevent disease through improved nutrition, and make highways safer. Pennsylvanians’ well-being is also inspired by programs undertaken in the arts and culture that stimulate heritage tourism, sustain folklore traditions, promote music appreciation, and improve Pennsylvania’s recreational planning.

In fiscal 1999, for the first time, federally supported research at Penn State exceeded $200 million. These funds, the research, and the nearly 14,000 jobs the Association of American Universities estimates Penn State research brings, would go to other states if Penn State faculty, staff, and students did not successfully compete for them.

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 infrastructure, research support, and cost sharing.

For more information on research at Penn State, contact:

Eva J. Pell
Interim Vice President for Research
Interim 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
Research Administration

The Vice President for Research is an advocate for research, representing the University in all activities likely to produce major new research programs or facilities. The office is responsible for administering the University’s research budget and for ensuring compliance with all federal and state regulations.

Office for Regulatory Compliance

The Office for Regulatory Compliance is responsible for coordinating all non-financial regulatory functions, including the review and approval of research involving human subjects, vertebrate animals, biohazards, and isotopes.

Contact: Candice Yekel, Director (814-865-1775; orc@psu.edu; www.research.psu.edu/orc/)

Office of Sponsored Programs

The Office of Sponsored Programs helps Penn State faculty and staff obtain external funding from government agencies, private industries, and private foundations to support their creative and scholarly activities. In FY 1999, it oversaw the submission of 3,530 research proposals and processed 4,089 awards for $352 million. The Office of Research Information Systems supports the University’s research enterprise through the introduction and maintenance of information technologies for administering research grants and contracts. This year the office introduced SIMS, the Strategic Information Management System, which gives the University research community access to statistical data contained in Penn State’s sponsored programs database via the Worldwide Web.

Contact: Bob Killoren, Assistant Vice President for Research (814-865-3396; rak9@psu.edu; grants.psu.edu)

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.

Agricultural Sciences $65,692,000

Engineering $51,161,000

Eberly College of Science $50,910,000

Medicine $45,724,000

Earth and Mineral Sciences $39,182,000

Health and Human Development $20,872,000

Liberal Arts $14,964,000

Smeal College of Business $4,244,000

Education $3,805,000

Penn State Harrisburg $3,126,000

Penn State Erie $2,189,000

Arts and Architecture $552,000

Commonwealth College $543,000

Communications $173,000

Dickinson School of Law $189,000

Penn State Schuylkill $36,000

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 Intercollege Research Programs (IRP) for college faculty participating in IRP projects (see the following page).
### Strategic and Interdisciplinary Initiatives

More and more often, significant advances in knowledge and discovery are occurring at the boundaries of traditional disciplines. Penn State faculty members are at the forefront of advancing knowledge and education in a multitude of cross-disciplinary research areas, while over 500 graduate students are pursuing advanced degrees in one of the 13 Intercollege Graduate Degree Programs offered at Penn State. Nearly one third of Penn State’s research program resides within its interdisciplinary research units.

#### Research Funding by Other Units

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. University research and infrastructure support are also included.

<table>
<thead>
<tr>
<th>Unit</th>
<th>Funding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applied Research Laboratory</td>
<td>$82,926,000</td>
</tr>
<tr>
<td>Intercollege Research Programs</td>
<td>$38,475,000</td>
</tr>
<tr>
<td>Materials Research Laboratory</td>
<td>13,208,000</td>
</tr>
<tr>
<td>Environmental Resources Research Institute</td>
<td>8,508,000</td>
</tr>
<tr>
<td>Pennsylvania Transportation Institute</td>
<td>7,875,000</td>
</tr>
<tr>
<td>Population Research Institute</td>
<td>4,496,000</td>
</tr>
<tr>
<td>Institute for Policy Research and Evaluation</td>
<td>3,187,000</td>
</tr>
<tr>
<td>Animal Resources Program</td>
<td>770,000</td>
</tr>
<tr>
<td>Institute for the Arts and Humanistic Studies</td>
<td>48,000</td>
</tr>
<tr>
<td>Other</td>
<td>383,000</td>
</tr>
<tr>
<td>Miscellaneous &amp; General Research</td>
<td>$6,959,000</td>
</tr>
<tr>
<td>Research and Technology Transfer</td>
<td>$4,341,000</td>
</tr>
</tbody>
</table>

#### Transfers to Colleges

To recognize and emphasize the importance of interdisciplinary collaboration in research, research support generated through the Applied Research Laboratory and the Intercollege Research Programs is credited to the colleges in accordance with the researchers’ faculty appointments.

<table>
<thead>
<tr>
<th>College/Program</th>
<th>Funding</th>
</tr>
</thead>
<tbody>
<tr>
<td>To Engineering</td>
<td>$11,294,000</td>
</tr>
<tr>
<td>To Earth and Mineral Sciences</td>
<td>9,335,000</td>
</tr>
<tr>
<td>To Agricultural Sciences</td>
<td>8,248,000</td>
</tr>
<tr>
<td>To Liberal Arts</td>
<td>5,041,000</td>
</tr>
<tr>
<td>To Eberly College of Science</td>
<td>4,638,000</td>
</tr>
<tr>
<td>To Smeal College of Business</td>
<td>1,580,000</td>
</tr>
<tr>
<td>To Health and Human Development</td>
<td>1,575,000</td>
</tr>
<tr>
<td>To Education</td>
<td>450,000</td>
</tr>
<tr>
<td>To Medicine</td>
<td>440,000</td>
</tr>
</tbody>
</table>
Intercollege Research Programs

Penn State’s Intercollege Research Programs (IRP) encompass a wide variety of academic, scientific, and artistic fields. They have longstanding research relationships with federal and state agencies, and with industry partners. They provide a home for concentrations of specialized instrumentation and facilities and for experienced support staffs. Most importantly, the IRPs provide an environment for catalyzing new ideas and for testing new research and education programs. They draw upon expertise from multiple colleges to focus on topics such as highway safety and next-generation vehicles; population growth and demographics; policies for public health, technology development, and economic growth; novel particulate, dielectric, piezoelectric, and thin film materials; biodiversity, bioremediation, and water quality; and the history of the book, the practice of biography, and the ethics of violence.

(1963) conducts interdisciplinary research in such areas as acid mine drainage and mine land reclamation, environmental impact assessment, hydrologic and environmental systems modeling, risk perception and public education, residuals and control technology, bioremediation and detoxification, and health and toxicology.

(1964) is the center for advanced study in the arts and humanities. Its grants and awards result in numerous conferences, symposia, exhibits, and performances throughout the academic year.

(1966) is the center of interdisciplinary problem-focused social and behavioral science research at Penn State, with special emphasis on health-care financing and service delivery, substance abuse prevention programs, economic development, science and technology policy, and field-based program evaluation.

(1962) promotes collaboration in materials development and implementation. Materials of interest include piezoelectrics for actuators and transducers, low and high permittivity materials, phosphors, low thermal expansion ceramics and nanoscale composites, and powders.

(1968) is an interdisciplinary research unit directed toward solving problems in intelligent transportation systems, vehicle systems and safety, pavements and materials, construction engineering and management, traffic engineering and operations, human factors and policy issues, and public transportation.

(1992) provides an organizational setting for interdisciplinary research to better understand such issues as continuing high rates of fertility, rural migration to magnet cities, the spread of HIV, infant and child health, and participation in formal education.

Applied Research Lab

Penn State’s largest single research unit is the Applied Research Laboratory (ARL), with annual research expenditures in excess of $80 million provided primarily by the U.S. Navy. Both the Department of Defense and the U.S. Navy have designated ARL as a strategic partner and one of their special University Affiliated Research Centers. The fundamental and applied research conducted at ARL helps provide the government with advanced technology essential for national defense. It also enhances the nation’s economic competitiveness by contributing to technology advancements in such diverse fields as manufacturing, materials processing, acoustic imaging for medical and industrial applications, communications, data and image processing, microelectromechanical devices for medical applications, and many more. Capitalizing on Penn State’s research strengths and upon its long history of successful partnership with the U.S. Department of Defense, the U.S. Marine Corps has recently selected Penn State as the Marine Corps Research University.

Research Consortia

Penn State has developed a strategic plan for investing in several research areas in which extensive faculty expertise and research capabilities provide the basis for national and international prominence. This strategic plan has resulted in the formation of the following research consortia:

Faculty contributing to these research consortia come from every college in the University, and many hold joint appointments shared between a home college and one of the consortia. Though administrative details vary, the research consortia share common objectives: They strive to provide opportunities for faculty interactions and to nurture communication and cooperation among a broad spectrum of researchers. The expanded vision resulting from dialogue at the boundaries of traditional disciplines has resulted in a multitude of new research thrusts. These include monitoring and modeling atmosphere evolution, developing novel processing and synthesis techniques for fabricating new materials, exploring the link between hormones and human aggression, and developing programs for improved child care in impoverished communities.

Contact: Robert 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)
Technology Transfer

For both faculty and students, the opportunity to do relevant and applied research is central to the educational experience. Through the following seven offices, the Technology Transfer Organization seeks to create and encourage relationships between University researchers and individual companies, industrial consortia, trade associations, and government agencies.

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, and environmental and life sciences.

Services:
- initiates relationships between the University and industry
- nurtures corporate partnerships to ensure customer satisfaction
- helps companies address nontechnical issues such as professional development, student recruiting and placement, co-op and internship programs, and outreach and distance education
- maintains extensive databases of information about Penn State faculty expertise, research laboratories, and other areas of interest to industry
- provides background data on industry as well as on individual companies to aid faculty and administrators

During FY 1999, Penn State engaged in 648 sponsored research projects with 367 Pennsylvania companies for a value of $18.3 million.

For example, John Tao, director of external technology at Air Products and Chemicals, wanted his company to be a nationwide leader in the compressed gas industry. He knew that to achieve this goal, the company would have to play an integral part in the most up-to-date technological research being done across the country. The Industrial Research Office saw that Tao’s goal was met — in the form of a three-year, multi-million dollar research alliance. The IRO created a strategic alliance management committee comprised of Air Products employees and Penn State faculty. They review proposals and decide which projects should get funded; at least 20 joint projects have grown out of the committee. One involves making the air separation process safer. The Penn State High Pressure Combustion Laboratory has simulated an industrial heat exchanger, with liquid oxygen flowing through an aluminum alloy tube surrounded by a shell of gaseous oxygen. Mechanical engineering Kenneth Kuo and his students have captured the process on high-speed film, research that will go far in defining safe operations.

Contact: Art Heim, Director (814-865-9519; aah1@psu.edu; www.research.psu.edu/iro/)

Ben Franklin Technology Center of Central and Northern PA

One of four regional centers of the Commonwealth’s Ben Franklin/IRC Partnership, the Ben Franklin Technology Center of Central and Northern Pennsylvania links public, private, and educational resources to help strengthen the high-technology components of the state’s economy.

Services:
- financial support
- technical and management expertise
- ways to improve business processes, productivity, and competitiveness
- access to University resources and expertise
- programs to transfer technology from the University

In FY 1999, the Ben Franklin Technology Center of Central and Northern PA funded 61 projects with Pennsylvania companies. Over $4.7 million of Ben Franklin funds and $10.9 million in private sector cash and in-kind funds combined to support projects that improved processes, developed new products, and/or trained the workforce of over 120 companies. To date, the Center has been responsible for the commercialization of 270 new products.

For example, in 1989, a chemist discovered that a combination of wax and capsaicin, a natural extract of cayenne pepper, would control insects effectively on plants. He began a company called Hot Pepper Wax. The company’s first product was an organic, biodegradable, insect repellant for fruits, vegetables, and ornamental gardens; it was very popular as a natural alternative to pesticides. When the company was ready to expand into the commercial farming and agricultural markets, it sought the independent research and testing capability of Penn State. The Ben Franklin Technology Center invested in the company which, with Penn State’s help, developed a commercial disease-control formula for fruit, vegetables, and ornamentals; a three-way product for roses; and a slug-control formula for vegetables and ornamentals.

Contact: Vic Russo, President/CEO (814-863-4881; vfrusso@psu.edu; www.benfranklin.org/)

PENNTAP

PENNTAP, the Pennsylvania Technical Assistance Program, helps Pennsylvania businesses and industry improve their competitiveness by providing free scientific and technical assistance and information to help resolve specific technical questions or problems that can be addressed within a limited amount of time.

Services:
- technical assistance by a state-wide network of technical specialists who have specific areas of expertise, such as computer system planning and updates, equipment selection, forest products industries assistance, process improvements, environmental assessments, pollution prevention and waste minimization, safety and health assessments, mechanical analysis, and product development assistance
brane between the shell and the egg is made up primarily of
can be used for pulp in paper. Best of all, the paper-thin mem-
from animal feeds to orange juice; finely ground, the shells
used in a variety of ways: rich in calcium, they can fortify foods
have to be carted away, which is costly. Yet eggshells can be
problem for both the egg industry and the Environmental
a method for separating eggs from their shell, a longstanding
For example, Professor Emeritus Joe MacNeil recently invented
for FY 1999 exceeded $1.5 million.
applications; 31 U. S. patents were issued. Royalty revenues
Penn State faculty and students disclosed 205 inventions in
For example, when GTY, a York-based wallcoverings company,
needed to evaluate what kinds of air-quality emissions prob-
they consulted an expert at PENNTAP. After
viewing the dense white smoke emanating from the company’s
exhaust stack, Warren Weaver, a senior technical specialist at
PENNTPA, knew the company would need an air pollution
control device. But he also made a creative proposition: In-
stead of simply controlling the problem, perhaps GTY’s ink
suppliers could come up with a way to eliminate it. They did.
After five months of research, Polytex Environmental Inks
developed a new “smokeless” ink that completely eliminated
GY’s smoke emissions. Polytex was ecstatic with the result,
which will save their customers money and help them comply
with EPA regulations. GTY was thrilled that Weaver’s sugges-
tion led to a savings of close to $1.5 million in cleanup costs
and substantial regulatory fines.
Contact: Jack Gido, Director (814-865-0427; jgido@psu.edu;
www.penntap.psu.edu)

Intellectual Property Office
The Intellectual Property Office manages and commercializes
intellectual property developed at Penn State.

Services:
- screens inventions and discoveries for patentability, commercial
  potential, and general marketability
- compiles lists of technologies available for licensing and of
  patents issued
- markets Penn State patents and copyrights to companies
  interested in new product development
- negotiates licensing arrangements, patent transfers, and joint
  business ventures with interested companies
- assesses the value of patent protection and supports the filing
  of patent applications

Penn State faculty and students disclosed 205 inventions in
FY 1999. The Intellectual Property Office filed 192 patent
applications; 31 U. S. patents were issued. Royalty revenues
for FY 1999 exceeded $1.5 million.
For example, Professor Emeritus Joe MacNeil recently invented
a method for separating eggs from their shell, a longstanding
problem for both the egg industry and the Environmental
Protection Agency. The shells attract vermin in landfills and
have to be carted away, which is costly. Yet eggshells can be
used in a variety of ways: rich in calcium, they can fortify foods
from animal feeds to orange juice; finely ground, the shells
can be used for pulp in paper. Best of all, the paper-thin mem-
brane between the shell and the egg is made up primarily of
collagen. Raw collagen is used in a host of biomedical ways
— such as the production of skin grafts, tissue replacement
products, angioplasty sleeves, and cornea repair — and sells
for up to $1,000 per gram. After trying a variety of methods,
MacNeil found that a type of meat grinder combined with a
delicate multibladed knife was able to scrape the shell clean.
Through the Intellectual Property Office, the invention has
been licensed to Cutler Eggs in Philadelphia, which is cur-
cently building a machine based on MacNeil’s prototype.
Contact: Tom Monahan, Director (814-865-6277;
tjm10@psu.edu; www.research.psu.edu/ipo/)

Research Commercialization Office
The Research Commercialization Office assists Penn State
faculty and staff with the creation of new companies based on
University research and technologies. Among its resources
is space for start-up companies in the Research Park small
business incubator and in the Zetachron Center for Science
and Technology Business Development, a gift of Dr. and Mrs.
Wally Snipes and family.

Services:
- promotes the start up of new companies in order to assist faculty
  and staff members in commercializing knowledge
- provides a University interface with multiple sources of early stage
  capital, such as seed funding programs, angel investors, venture
  capital funds, etc.
- assists new ventures by identifying mentors and potential
  management team members to accelerate company growth
- coordinates with the Intellectual Property Office and the Industrial
  Research Office to identify and focus available expertise and
  resources on start-up companies

Through a collaborative effort with the Chamber of Business
and Industry of Centre County, four start-up bio-technology
companies are currently being incubated at the Penn State
Zetachron Center. Each company is based on research from
University laboratories or directed by a Penn State alumnus.
For example, Mitotyping Technologies is one of three labs in
the country that analyzes mitochondrial DNA for law enforce-
ment officials, lawyers, and private citizens. The firm’s presi-
dent, Terry Melton, has a Ph.D. in genetics from Penn State;
she found business mentors in her field, potential investors,
and donated space in the Penn State Zetachron Center to
establish her business with the help of Penn State’s Research
Commercialization Office. Taking samples from hair shafts,
bones, old blood stains, and teeth, Melton sequences the
mitochondrial DNA to support or disprove claims about a
person’s identity. In one high-profile case, Melton proved
that Anna Anderson, the woman who purported to be the
Grand Duchess Anastasia, youngest daughter of the last Tzar
of Russia, was an imposter. Provided there is enough DNA to
test, Melton can use old samples, and recently helped solve a
three-year-old murder case by analyzing a blood stain on a
watchband.
Contact: Dan Leri, Director (814-863-6301; DanLeri@psu.edu;
www.research.psu.edu/roco/)
Small Business Development Center

The Small Business Development Center opened in October 1997 as a response to the needs of entrepreneurs in Centre and Mifflin counties. It is part of a national network of more than 950 centers, 17 of which are based at colleges and universities in the Commonwealth.

Services:

• business management consulting
• information and educational programs on such topics as Risk Management and Insurance, Legal Issues for a Small Business, Managing Employees, Small Business Taxes, and Starting a Payroll
• one-on-one counseling and seminars by University faculty and staff
• referrals to specialists in the area of international trade and government contracting
• referrals to outside consultants

Since its opening, the Small Business Development Center has consulted with 149 clients, providing 893 hours of consulting. As a result of the Center’s advice, 19 loans were approved totaling $1,527,500. In addition, 12 training events were held for a total of 185 attendees, resulting in 479 hours of training.

For example, starting a small business can be daunting. Developing the necessary financial, management, and planning skills takes time, patience, and education. Money is limited and hard choices must be made. That’s why the Small Business Development Center offers free monthly pre-business workshops. Tim Chronister attended one before he opened his custom wrought-iron shop, Jacob’s Ladder, in State College. “I knew what I wanted to sell and how I wanted to sell it but that was about it,” he recalls. “Issues such as regulations, investments, and taxes were completely foreign to me.” Later, the Center consulted with Chronister on the legal and practical aspects of start-up and on marketing his products on a limited budget.

Contact: Donna Holmes, Director (814-863-4293; dah17@psu.edu; www.research.psu.edu/sbdc/)

Penn State Research Park

Proposed by the University Board of Trustees in 1987 to assist in the economic revitalization of the Commonwealth, the Penn State Research Park is governed by the Research Park Management Corporation (RPMCo). University President Graham Spanier serves as chair of the board. Interim vice president for research Eva Pell is president and CEO.

Services:

• 130 acres of premier industrial and research space in a campus environment
• access to Penn State’s vast research and intellectual resources
• world-class information technology, including satellite uplink and downlink and access to fiber-optic telecommunications
• an award-winning technology transfer structure, including incubator space and marketing research
• availability of a trained workforce
• partnerships with local, regional, and state economic development organizations
• high quality of life in the surrounding communities

Phase One of the Penn State Research Park includes the Technology Center, the Materials Research Institute, the Penn Stater Conference Center/Hotel, and the Daybridge Child Care Center. The first building of Phase Two, 101 Innovation Boulevard, was completed in October 1998. This 50,000-square-foot facility is home to tenants employing more than 100 people. Along with the occupancy of 101 Innovation Boulevard, the infrastructure for Phase Two of the Research Park is now complete. Two additional multi-use buildings are currently planned, with groundbreaking in November 1999.

For example, Stelios Thomopoulous’s decision to locate his company, Intelnet, in the Penn State Research Park incubator has been a good one. The incubator offers “a homogenous environment of peer start-up companies that share similar concerns and problems, which is valuable,” he says. Intelnet specializes in fingerprint and face identification systems which are used for security and employee time records. With seven “integrated access control” products, the company provides customization of all of its software and hardware to meet the needs of its customers, which include Proctor & Gamble and Carbone of America. The company received some start-up funding from the Ben Franklin Partnership, located in the same building in the Research Park. That proximity, says Thomopoulous, plus the “commitment of partnership of the Chamber of Business and Industry for Centre County to the companies in the incubator,” have all contributed to the success of his company. Intelnet’s sales are expected to hit $2 million this year.

Contact: Karen Dickinson, Managing Director (814-865-2880; kld12@psu.edu; www.research.psu.edu/researchpark/)