

# RESEARCH 2003

THE UNIVERSITY OF MISSOURI-COLUMBIA SUMMARY OF GRANTS AND CONTRACTS



SPIRIT OF  
INQUIRY

# Investigators Reach New High in Research Expenditures

External Sponsorship of MU Research Tops the \$166 Million Mark

FOR MORE THAN 150 years, scientists and scholars at the University of Missouri-Columbia have used the power of science and scholarship to improve the lives of Missouri's citizens. As the head of MU's research division, I am committed to helping our faculty researchers maintain and improve upon this exemplary record of achievement. I think you'll agree that this, our annual report of grants and contracts for FY 2003, shows conclusively that we are building on a firm foundation.

Last year, for example, expenditures from external sponsors — dollars from non-MU sources spent by investigators during the course of their work — surpassed \$166 million, an increase of 17 percent over FY 2002 and the largest total ever recorded at MU.

Our sponsored research spending from federal sources alone topped \$100 million in FY 2003, also a record. From 1994-2001 (the most recent years for which figures are available) the National Science Foundation reported our rate of federal expenditure growth has surpassed that of every public member of the Association of American Universities.

Such numbers

demonstrate that our faculty researchers are well equipped to compete successfully against the nation's best researchers for highly competitive grants. They also demonstrate the resilience of MU's research enterprise during tough economic times.

One key to the success of our researchers has been MU's commitment to world-class facilities. Here too recent grants and contracts point toward a bright future. In this report you will learn more about newly funded projects that will greatly enhance the University's research enterprise. Among them are:

- ❑ A \$10 million grant from the National Institutes of Health that will fund the development of a new Cancer Imaging Center — a crucial component in the University's bid to become one of the nation's designated "comprehensive cancer" centers.
- ❑ A \$10.4 million grant to fund MU's new Swine Research and Resource Center, a facility that will solidify MU's position as a top institution in comparative medicine research.
- ❑ A \$10 million grant from the National Science Foundation to fund the Center for the Study of Mathematics Curriculum, an important research center dedicated to improving the way middle-grade teachers help students master mathematics.



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## FY 2003 Annual Report

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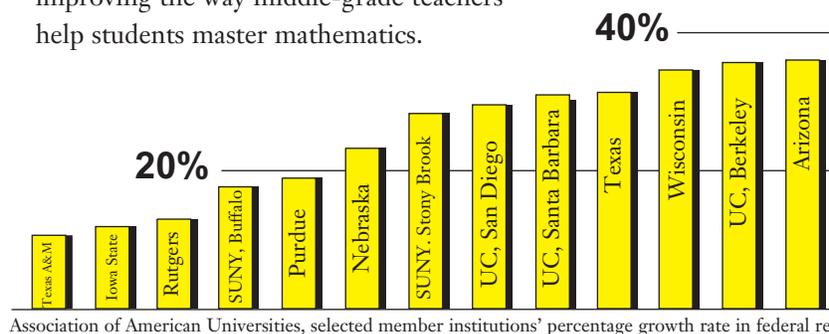
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**On the Cover:** Student researchers Katie Connolly and Gesulla Toussaint in the laboratory of Anand Chandrasekhar, an associate professor of biology. Last year more than 2,000 undergraduate researchers at MU received grants totaling more than \$3 million to support a wide range of scientific and scholarly investigations.



□ A \$4.5 million grant from the National Institutes of Health to fund the Missouri Arthritis Research, Rehabilitation and Training Center, MU's internationally-renowned center for improving quality of life for people with arthritis.

## Externally Sponsored Grants and Contracts FY 2003

	Research	Instruction and Public Service	Totals
Proposals Submitted	1,423	471	1,894
Active Funded Projects	1,973	910	2,883
Newly Awarded Projects	\$107,074,978	\$57,546,613	\$164,621,591
Expenditures	\$117,606,632	\$48,533,957	\$166,140,589

Faculty scientists and scholars associated with these and other MU centers for research and education have already established a record of excellence. We're confident that this new funding will allow them to continue their groundbreaking research for many years to come.

This year's report also provides an update on the progress of MU's new \$64 million Life Sciences

Center. The 50,000 square foot facility, funded by \$34 million in federal grants and \$30 million in state appropriations, will provide laboratory space for 350 faculty, staff, students and postdoctoral fellows. Interdisciplinary investigations conducted in the new center will not just raise the University's intellectual capital, but will be a boon to the state economy as well. Life sciences research will generate quality jobs, help turn discoveries into marketable technologies, produce products that create new businesses and corporate partnerships and attract a new generation of prominent faculty scientists and quality student researchers to MU.

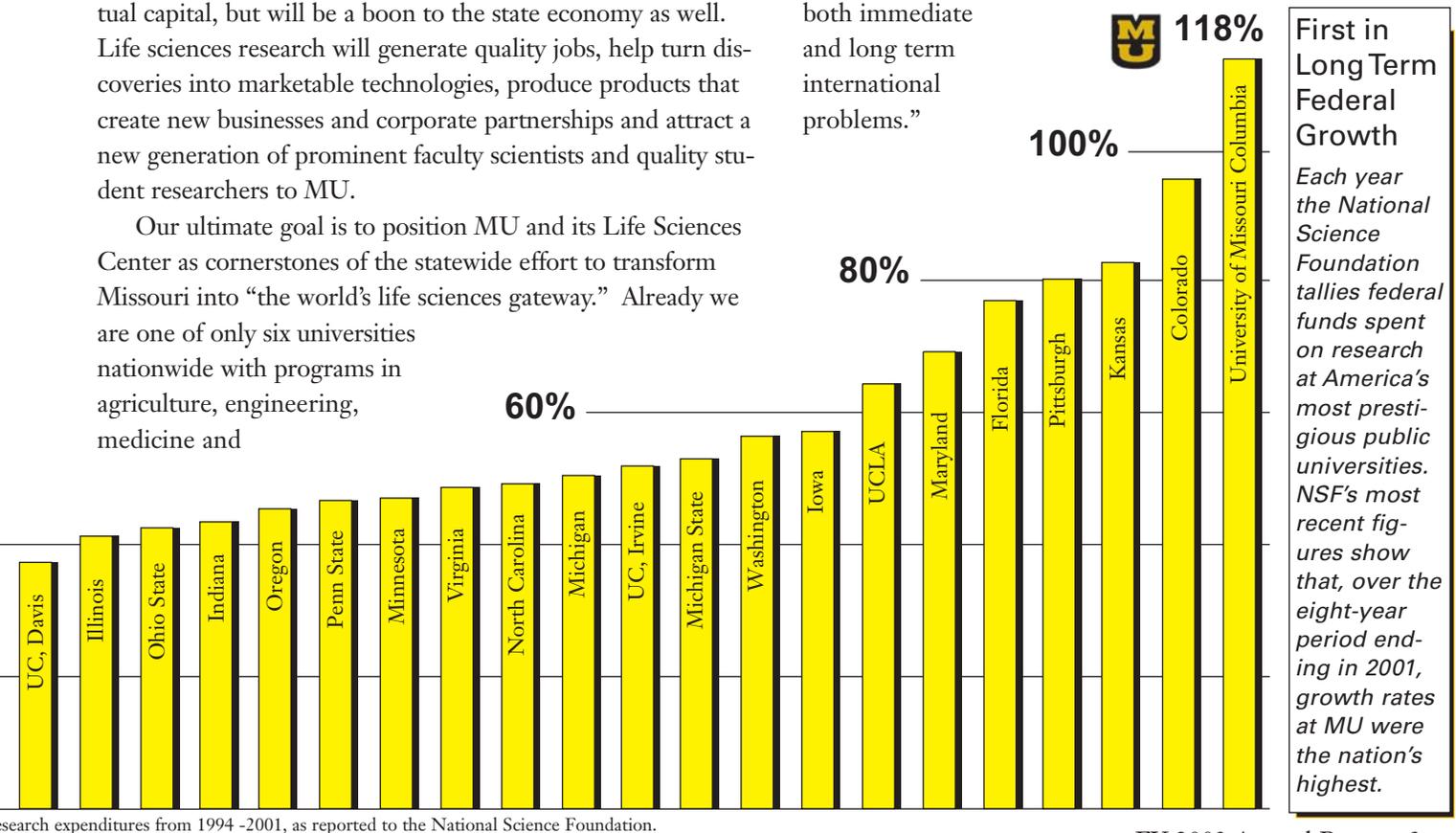
Our ultimate goal is to position MU and its Life Sciences Center as cornerstones of the statewide effort to transform Missouri into "the world's life sciences gateway." Already we are one of only six universities nationwide with programs in agriculture, engineering, medicine and

veterinary medicine on the same campus. And when faculty from these areas team up with our outstanding faculty working in arts and sciences, human environmental sciences, nursing, and reactor-based research, no other

university, either here in the United States or abroad, will be able to match the unique combination of resources that MU will bring to Missouri's "high tech corridor."

Need more data? Visit our 'query- building' tool in the Publications section of our web site: [www.research.missouri.edu](http://www.research.missouri.edu)

MU research is on the move, and the nation is taking notice. As Provost Brady Deaton recently put it: "The knowledge our faculty acquire in the laboratory not only expands to the classroom but also to the state and the world, providing solutions to both immediate and long term international problems."



## Centers of Scientific and Scholarly Research Attract New Funding

### Cancer Imaging With Radiopharmaceuticals

**T**HE NATIONAL CANCER INSTITUTE (NCI), an agency within the federal National Institutes of Health, in July awarded MU a \$10 million grant to create a new Center for Single Photon-Emitting Cancer Imaging Agents.

The award is one of the largest research grants ever received by MU through a peer-reviewed, competitive government funding process. It will allow researchers at MU and the Harry S Truman Memorial Veterans Hospital to pioneer new, innovative methods of cancer detection and treatment.

The grant strengthens a formal agreement between MU and the Truman Memorial Veterans Administration Hospital to build a premiere cancer-imaging center. The center will be housed in the 9,000-square-foot radiopharmaceuticals laboratory located on the lowest level of the new outpatient center at the hospital.

Wynn Volkert, professor of radiology and leader of the project, said the recent development of the radiopharmaceuticals lab, made possible by a \$4 million federal appropriation procured by U.S. Senator Christopher “Kit” Bond, was one reason the NCI chose MU rather than Stanford University or Duke University for the center.

“I am very pleased that the initial \$4 million investment that I secured allowed MU to win this \$10 million cancer research contract,” said Sen. Bond. “This announcement underscores that MU is increasingly capable of competing for and winning front-line, big-dollar research awards.”

Radiopharmaceuticals are radioactive drugs that help doctors detect, diagnose and treat diseases. Doctors inject molecules “labeled” with radioisotopes into patients, where the molecular structure of the drug allows it to “target” specific tissues. Once the radioactive material reaches its target — whether the heart, liver, brain or a tumor — specialized instruments are used to produce an image that helps physicians make more informed diagnoses.

### Arthritis Rehabilitation Research and Training

**T**HE U.S. DEPARTMENT OF EDUCATION in October awarded MU investigator Jerry Parker, clinical professor of physical medicine and rehabilitation and director of Behavioral Health at Harry S Truman Memorial Veterans Administration Hospital, a \$4 million, 5-year grant for work with the Missouri Arthritis Rehabilitation Research and Training Center (MARRTC).

Established in 1971 as the MU Arthritis Center, today's center provides leadership in preventing and managing disabilities in persons with arthritis and related musculoskeletal diseases. Its staff includes faculty with a wide range of skills and areas of expertise, among them physicians, physical therapists, occupational therapists, health educators, nurses, biologists and social scientists. Parker says the center will put the funds to use in developing an online self-management program for older adults, research into the types of exercise and physical fitness that might work best for individuals with knee osteoarthritis,

## A New Home

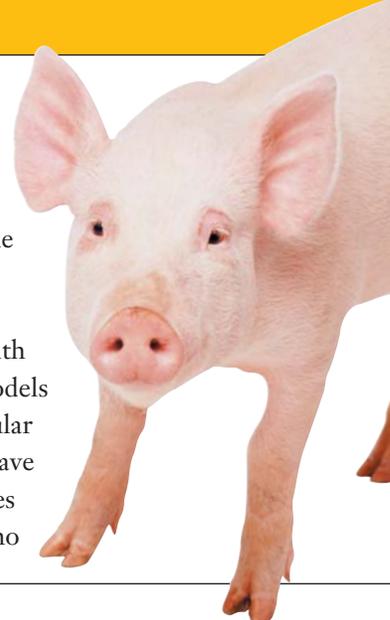
## for Swine Studies

**E**ARLIER THIS YEAR the National Institutes of Health in Washington, D.C., awarded the University of Missouri-Columbia close to \$10 million in research and construction grants for a one-of-a-kind center that will supply swine, and genetic material from swine, to researchers working to better understand a multitude of health issues.

“Because we had to compete against other major research institutions to receive this award, this is a particularly welcome recognition of our life sciences researchers and the expertise they bring to this campus,” said Jim Coleman, vice provost for research. “This will be the only swine research center in the nation, and it will serve

requests from all over the world. In addition, our own researchers will be working to solve some of the foremost health problems of the nation.”

Swine share unique anatomic and physiological characteristics with people, thus making them ideal models for the study of human cardiovascular diseases and diabetes. Pig organs have also emerged as excellent candidates for transplantation into humans who





## Arthritis Rehabilitation Research Is Improving Thousands of Lives

developing an arthritis prevention and self-management curriculum for migrant workers, and crafting a national strategic communication campaign. MARRTC is the nation's only federally funded arthritis rehabilitation research and training center.

"Arthritis is an often misunderstood and potentially disabling condition which diminishes the quality of life for

millions of Americans," said Parker. "More than seven million people in the United States report limitations due to arthritis, and each year arthritis causes some 44 million outpatient visits and costs approximately \$21.7 billion in medical care. This disease will continue to incapacitate millions of people in the future; it is imperative that we build a program that can combat its effects."



are in need of life-saving organ replacements.

MU was awarded \$7.1 million to fund center operations, and \$2.84 million to construct its building. Current plans call for the center to be located southeast of the MU Animal Sciences Research Center. The new swine facility will function as both a repository and distribution hub for swine models used in a variety of research.

The center will contribute to a virtually limitless number of research projects. Three particular areas of emphasis will include: development of new transgenic pigs, improving cryopreservation and detection of pathogens. Faculty researchers

Lela Riley, John Critser and Steve Kleiboeker from the College of Veterinary Medicine will join Randy Prather and Ed Rucker from the College of Agriculture, Food and Natural Resources to head up the facility's operations.

"While we will be a valuable resource to scientists, we also will be working on research projects and serving as a training ground for undergraduates and graduate students," Riley said. "The center will be invaluable in detecting pathogens in frozen sperm and embryos as well as in helping us improve the preservation techniques that ensure genetic material from one specific line of animals is never lost."

## Curriculum Reform Is Key to Improved Mathematics Skills



### Rethinking Mathematics Instruction

**F**OR YEARS educators across the country have labored to boost the performance of the millions of American students who struggle in mathematics. Studies indicate problems typically begin in the middle school years and grow worse as students advance. By graduation, problem solving skills of U.S. math students rank close to last among secondary students tested in 41 nations.

Scholars from MU, led by the husband-and-wife team of MU College of Education professors Bob and Barbara Reys have long urged educators and policy makers to rethink the way our nation's schools teach mathematics. Their efforts gained a significant boost in October with the

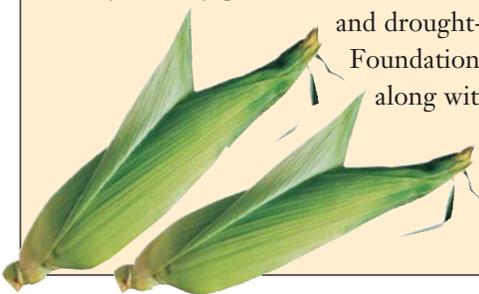
announcement that the National Science Foundation had awarded the Reys' a \$10 million grant to establish a Center for the Study of Mathematics Curriculum.

"This is the most prestigious award in the National Science Foundation's Directorate of Education and Human Resources," says Jim Coleman, vice provost for research. "This award will recognize MU and its partners as the national leaders in the study of K-12 mathematics curriculum. It will also continue the recognition of MU as a national leader in the area of mathematics education."

Over a five-year period, beginning in January 2004, the center will support doctoral students; curriculum interns; school, district and/or state curriculum leaders; and K-12 teachers in four partner school districts. The new center

### *Maize Genome Mapping Project Nears Completion*

Producing an integrated physical and genetic map for maize will allow researchers from around the world to more easily identify genetic traits beneficial to maize cultivation, thus expediting the process of developing new disease- and drought-resistant varieties. With initial funding of \$11 million from the National Science Foundation, and the infusion of \$2.2 million more NSF dollars in 2002, MU researchers — along with scientists from the University of Georgia, Clemson University and other prominent institutions of higher learning — have spent the past seven years working to crack corn's genetic code. Now their work is almost finished: Project researchers say a completed map is due for publication early in 2004.



## Director Named for LSC

aims to increase the production of doctoral students in mathematics education, conduct research focused on mathematics curriculum and increase teacher knowledge so that more students learn more mathematics.

Four school districts will serve as sites for the research, providing hands-on training of graduate students.

Researchers will study, among other issues, the evolution and use of mathematics textbooks, how these texts have influenced student learning, and the effectiveness of state curriculum guidelines adopted following the federal No Child Left Behind Act.

The center staff, which will include mathematics and education faculty as well as doctoral students, will engage in scholarly discussions with teachers, school administrators and other interested parties regarding mathematics curriculum issues. They will publicize their research findings through a comprehensive website, national and international curriculum conferences, and publication in curriculum monographs and academic journals.

### Seeking Answers to Coronary Artery Disease

**C**ORONARY ARTERY DISEASE kills thousands of men and women in the United States each year. Researchers have long known that obesity and physical inactivity are major risk factors for the condition, and that exercise is an effective way to stay heart healthy. But the genetic process regulating the relationship between exercise and disease-free arteries is less well understood.

In October, the National Institutes of Health awarded a \$3.5 million, 5-year grant to a pair of MU researchers working to learn more about the process behind the formation of potentially deadly plaque deposits in coronary arteries. MU researchers Harold Laughlin and Ed Rucker will focus on the activities of a particular gene that they believe is important in maintaining artery health. Laughlin and Rucker are eager to learn, for example, whether the gene is affected by regular exercise.

“Coronary artery disease is the leading cause of death in the United States,” says Laughlin, professor and chair of veterinary biomedical sciences. “We’ll be using the pig as a model for our research because pigs’ vascular system is very similar to humans. Some of our research will be looking at whether we can produce the enzyme that the gene produces in order to build healthier arteries.”

Laughlin said the recent announcement of a new Swine Resource and Research Center [see Page 4], along with the demonstrated expertise of MU faculty to diagnose the effects of exercise on the human body, were the reasons that MU was awarded the grant.

**A**FTER A nationwide search, MU officials announced in December that the director of the University’s new Life Sciences Center, scheduled for completion this spring, would not need to travel far to assume his post: He is Michael Roberts, distinguished curators professor of animal sciences at MU and member of the National Academy of Sciences.

“Mike Roberts is an international science leader with the vision, skill and credibility across campus, the state and the world to make the Life Sciences Center a key component in major discoveries for the benefit of the citizens of Missouri as well as those outside of our state,” said Provost Brady Deaton in a statement. “Under his leadership, our scientists will be working with colleagues in St. Louis, Kansas City and around the world to find answers to major human health, agricultural and environmental problems.”

As director, Roberts will be responsible for working with interdisciplinary teams across campus. Research programs housed in the center will harness new technologies to improve crop productivity, food safety, animal health and reproduction; to develop new treatments and diagnostics for human disease and to enhance environmental quality.

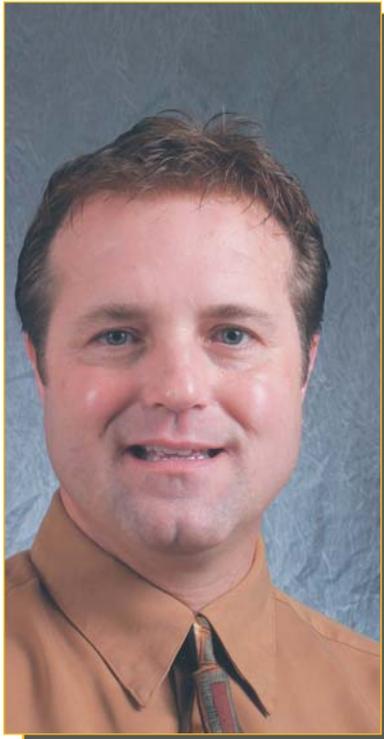
“I have a certain amount of trepidation because this represents a new venture for the University,” Roberts says. “I hope the center will be a welcoming place for the life sciences with seminars and a variety of exciting graduate and undergraduate research. It will be important that we work to become self-sustaining by generating a sufficient amount of research money.

“The state and federal government, private individuals and groups have made significant contributions toward this endeavor, and it’s important that we use that investment wisely.”



Michael Roberts to head the LSC

# TECHNOLOGY DEVELOPMENT



Jeffrey Phillips

## New Drug Eases Ulcers in Critically Ill Patients

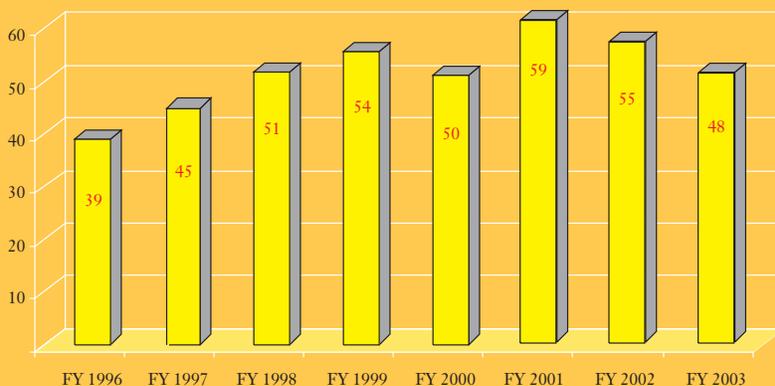
**C**RITICALLY ILL patients with stress ulcers often can't swallow medications because of their underlying critical condition. As a result, doctors trying to stem stress-related upper gastrointestinal bleeding must rely on liquid drugs administered by feeding tube or intravenous medicines.

But this too presents problems, says Jeffrey Phillips, research associate professor and director of research in MU's Department of Surgery. The I.V. form of the most potent medications, known as PPIs, is not very rapid in its action. Oral forms work more quickly, but are available only as granules or tablets that must be ground up. This destroys the enteric coating these PPIs need to withstand acid already built up in the stomach, thus neu-

tralizing their ability to inhibit further acid production. Phillips recently proposed a novel solution: Why not administer a single dose of sodium bicarbonate as an acid buffer, then wash crushed PPI granules down with an additional buffer? He reasoned that if even some of the drug were absorbed it would benefit the patient.

The result far surpassed these modest expectations. Not only did the buffer protect the drug in the stomach, but it substantially increased the speed at which the PPI entered a patient's blood stream. Following publication of his discovery, Phillips and OTSP teamed up with Santarus Inc. — a California company, to take a product based on Phillips' work through human clinical trials. If approved by the U.S. Food and Drug Administration, the treatment could reach the marketplace by the end of this year.

Total MU Intellectual Property Licenses, FY 1996 - 2003



## Marketing MU Discoveries

**T**he MU RESEARCH LABORATORY is each day some of the nation's most complex scientific questions. Often these discoveries are developed into products for the benefit of millions of Americans lead healthier lives.

The Office of Technology & Spreadsheets handles this discovery, development and commercialization.

First, the OTSP receives invention disclosures from the inventors. The OTSP then evaluates these disclosures to represent a patentable invention that meets the two criteria of patentability. The OTSP works with the inventor(s) and an outside company to commercialize the invention. If the OTSP works for royalties on the company's sales. If the inventor starts an enterprise, the OTSP will also assist in the process.

Although the previous fiscal year saw a decline in the number of patent applications published, the University were responsible for more than 100. The licensing income are expected to increase significantly.

OTSP remains committed to assisting inventors during their early, most vulnerable stages of technologies to the point at which they can start-up company built around the technology. The approach to commercializing the discoveries is a partnership between the inventors and the University with



## Discoveries for the Public Good

is a unique environment, an exciting place where the most creative minds work through a myriad of paths. This work results in important discoveries that enter the marketplace where, at their best, they can help improve the quality of our lives, happier lives.

Special Projects at MU works at the interface of the commercialization continuum.

Reviewing disclosures from faculty, staff and student researchers to determine whether they have commercial potential. When a disclosure

shows promise and commercial potential, technology and special projects staff members refer the disclosure to outside patent attorney to obtain a patent for the invention. Finally, the university commercializes the invention, usually by licensing the patent rights to a company in exchange for royalties. When the technology is sufficiently robust to sustain a new business, the university may be involved in establishing a start-up company.

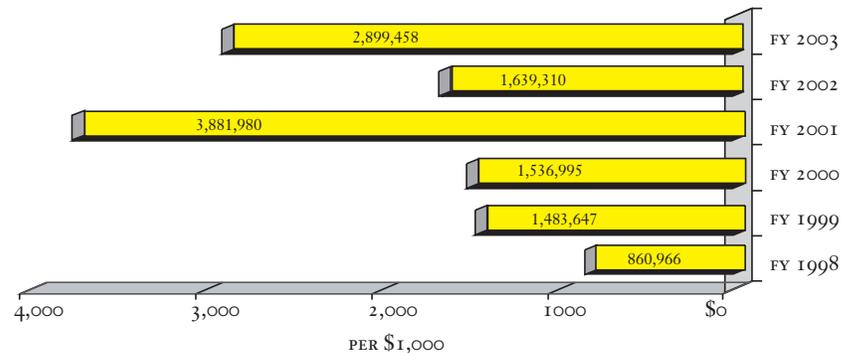
We saw a drop in the number of patent applications filed for the MU campus, but the number of patents pending rose to a record level in FY 2003. Active licenses generated at the end of the year were worth more than \$8.4 million in royalty income over the past three years — more than double the amount over the three-year period. With a more substantial patent portfolio, licenses and royalties are expected to increase substantially in future years.

By establishing a “technology business incubator” that will nurture start-up companies over the next several years. In addition, in FY04 we will establish a fund to develop new technologies that will become attractive to licensees or investors eager to provide capital for a start-up company. In short, MU is taking a more aggressive and entrepreneurial approach to the commercialization of its researchers. By contributing in this way to the public good, we hope to benefit all as well.

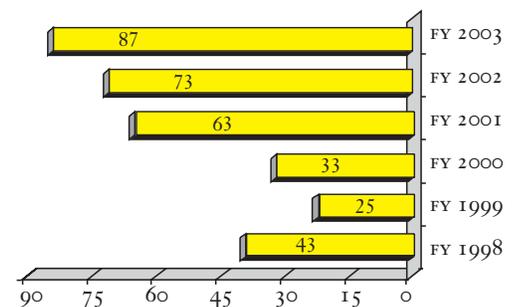
## Plastic from Plants Could Spur Biodegradable Bonanza

Brian Mooney, an MU research assistant professor of biochemistry, is working to enhance a system of agricultural plastic production that would create new market opportunities for corn and soybeans while reducing plastic in landfills. “Each year, 25 million tons of plastic end up in U.S. landfills,” Mooney says. “If we can replace some petroleum-based plastics with those made from a non-polluting, renewable resource such as plants, we can reduce that number and create new income for farmers.” The plastic Mooney hopes to produce is polyhydroxybutyrate-valerate, or PHBV, which is similar to petroleum-based plastic. “It’s flexible and moldable, and could be used to produce a wide range of products, from grocery bags and soda bottles to disposable razors and flatware,” he says. “The advantage of PHBV is that it’s 100 percent biodegradable.” In the mid-1990s, Monsanto successfully produced PHBV in plants, which the company called BIOPOL, Mooney says. “But they were only able to produce it in small quantities, about 3 percent dry weight. In order to be commercially viable, 14 percent or more is considered the threshold.” Mooney seeks to break this threshold by designing plants that produce raw materials for PHBV within leaf cells. His work is supported by a grant from the Consortium for Plant Biotechnology Research, a non-profit partnership of universities and private industry.

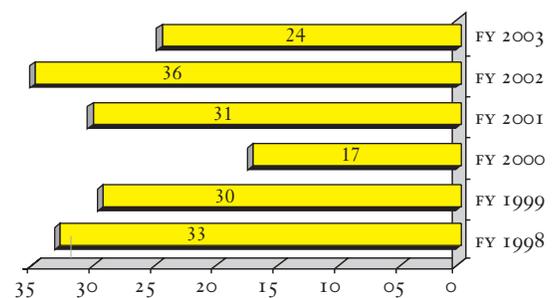
### Royalties from MU inventions



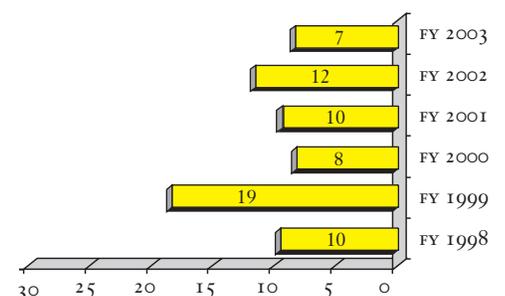
### Patent applications pending



### Patent applications filed

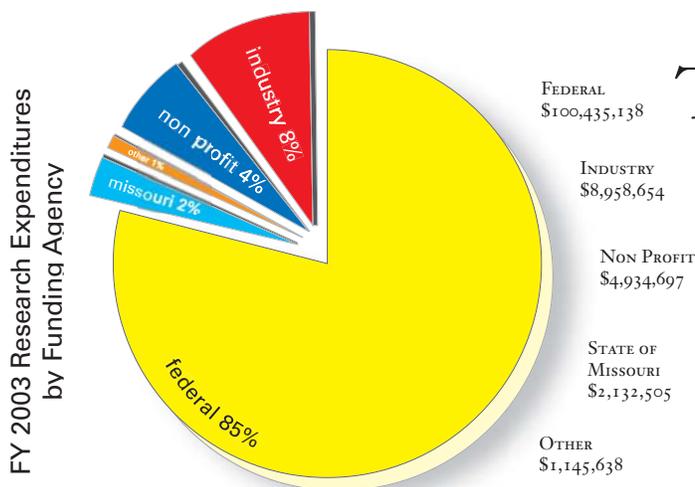


### Patents issued



# SPONSORED RESEARCH

## Faculty Investigators Again Reach New Highs In Research Support



TOTAL SPONSORED RESEARCH expenditures at the University of Missouri-Columbia reached a major milestone in FY 2003, surpassing for the first time the \$117 million mark.

As in previous years, faculty scientists and scholars working in medicine, agriculture, arts and sciences and engineering accounted for slightly more than 75 percent of spending. Expenditures generated from federal sources — most as a result of competitive grants — accounted for most of FY 2003 sponsored research funding, an increase of slightly more than 20 percent above last year's record high.

These gains have helped to sustain what has been a dramatic pattern of growth in sponsored program expenditures over the past six years. "This growth is a credit to our faculty and also represents a significant return on the state's investment in the University's mission enhancement process," says Mike Warnock, director of MU sponsored programs. "In addition to the knowledge generated through these projects, funds provided for their support yield critical economic benefits to the people of Missouri."

Among these benefits is job creation. Analysis using a rigorous economic impact model for FY 2003 data shows that research and development expenditures at MU supported some 8,000 Missouri jobs and contributed more than \$300 million to the state's economic development. MU is not just helping to create and sustain employment: We are training the next generation of professionals to fill these jobs. Today more and more MU students are engaged in research experiences that will give them the skills they need to fill high-tech positions. The majority of these students will choose to live and work in Missouri. Mission enhancement, particularly in life sciences, has also encouraged partnerships with industry. These include a recent \$2 million gift from Monsanto to fund the purchase of equipment for MU's new Life Sciences Center and a gift from the Soybean Growers' Association that will create three endowed chairs in plant biology.

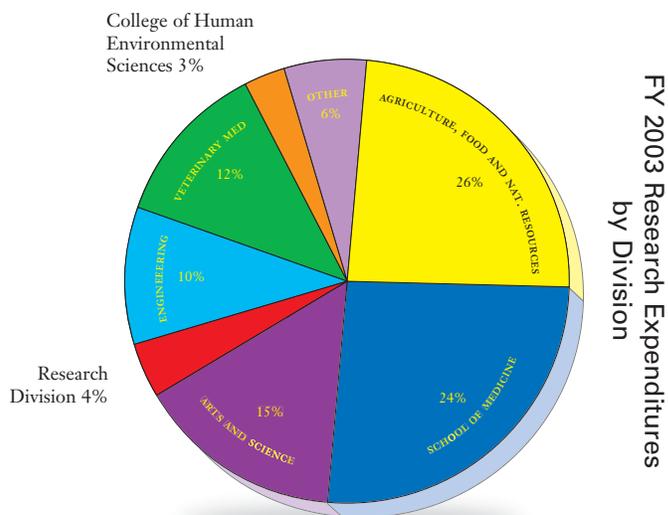
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### Expenditures and Awards

SPONSORSHIP by the federal government, Missouri's state government and various corporate and nonprofit agencies is crucial to the health of the University's research enterprise. In this report you will encounter charts and graphs that reflect the extent of these agencies' involvement in MU research.



Some are expressed in terms of expenditures, which represent resources spent by a researcher during a given fiscal year. Others are expressed as awards, which show the total amount of funds available for use, money often expended over a period of years.



# Research Expenditures By Division

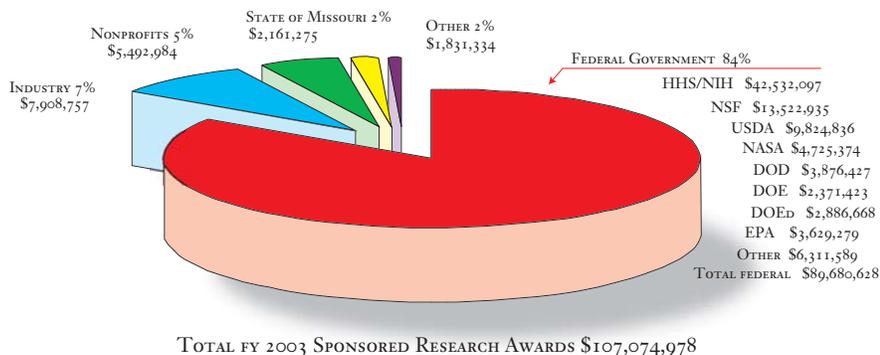
DIVISIONS	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
COLLEGE OF AGRICULTURE, FOOD AND NATURAL RESOURCES	\$19,700,082	\$23,077,327	\$22,399,175	\$25,708,633	\$31,825,666
SCHOOL OF MEDICINE	19,498,039	20,745,297	23,239,999	24,755,825	27,794,866
COLLEGE OF ARTS & SCIENCE	10,255,355	12,411,490	11,840,727	14,813,352	17,964,886
COLLEGE OF ENGINEERING	6,388,906	8,476,383	9,732,166	9,497,605	11,802,428
COLLEGE OF VETERINARY MEDICINE	5,747,790	5,030,682	7,247,528	8,864,168	13,552,135
RESEARCH DIVISION	4,115,937	4,869,308	3,558,552	4,142,611	4,769,589
COLLEGE OF HUMAN ENVIRON. SCIENCES	1,409,540	1,154,854	1,392,658	2,223,976	3,354,949
SINCLAIR SCHOOL OF NURSING	420,998	434,429	494,530	1,661,546	2,041,547
COLLEGE OF EDUCATION	643,764	737,090	646,933	1,039,213	1,567,517
GRADUATE SCHOOL	15,382	255,187	208,931	355,287	940,308
SCHOOL OF HEALTH PROFESSIONS	150,981	188,808	321,030	932,121	890,842
SCHOOL OF JOURNALISM	897,479	527,928	448,479	406,682	197,680
OTHER	418,312	189,315	122,184	463,327	904,219
TOTAL	69,662,565	78,098,098	81,652,892	94,864,346	117,606,632

## Infrastructure Awards Provide Infusion of Research Support

**T**HE growth of research expenditures in FY 2003 reflects an upward trend in the amount of extramural dollars awarded to MU faculty researchers during the four fiscal years beginning in FY 1999. While total research awards declined slightly during the previous fiscal year, new funding awards for infrastructure will likely boost both the near- and long-term prospects of MU's research enterprise.

"In a time of declining state funding, external grants for research and the development of institutional infrastructure become more and more important," says Vice Provost for Research Jim Coleman. "MU's faculty have not only been writing grants to support their research activity, but they have also been successful at gaining outside support for constructing and renovating current facilities. MU can boast of many entrepreneurial faculty who leverage their institutional support 5, 10, 20 or more times to win competitive grants that support the research community."

## Research Awards By Funding Agency and Amount



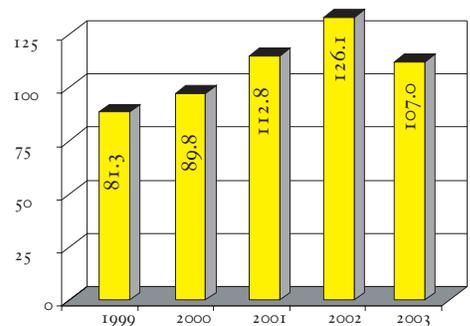
## RESEARCH EXPENDITURES; BY SPONSOR TYPE

	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
FEDERAL	\$52,094,879	\$61,681,306	\$64,292,034	\$80,257,091	\$100,435,138
INDUSTRY	8,311,786	6,137,384	7,505,540	6,620,205	8,958,654
NONPROFIT	6,007,521	7,065,910	6,648,709	5,411,448	4,934,697
STATE OF MISSOURI	2,304,187	2,518,899	2,337,467	1,977,644	2,132,505
OTHER	944,192	694,599	869,142	597,958	1,145,638
TOTAL	69,662,565	78,098,098	81,652,892	94,864,346	117,606,632

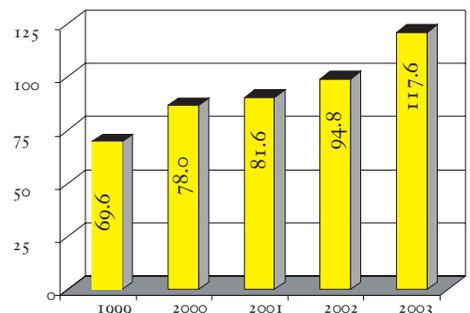
## RESEARCH AWARDS; BY SPONSOR TYPE

	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
FEDERAL	\$56,830,156	\$69,806,043	\$87,715,322	\$106,646,342	\$89,680,628
INDUSTRY	10,357,669	10,067,530	14,748,041	10,418,313	7,908,757
NONPROFIT	6,730,154	6,292,419	6,012,665	5,746,107	5,492,984
STATE OF MISSOURI	5,526,737	2,744,582	2,605,625	2,325,957	2,161,275
OTHER	1,868,776	921,236	1,740,589	981,972	1,831,334
TOTAL	81,313,492	89,831,810	112,822,242	126,118,691	107,074,978

Research awards, in millions, five-year trend

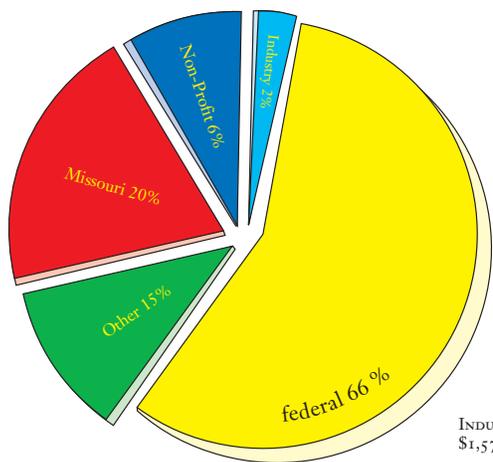


Research expenditures, in millions, five-year trend



# INSTRUCTION & PUBLIC SERVICE

## IPS Funding Bounces Back In FY 2003



FY 2003 IPS expenditures by agency (above) and division (right).

FEDERAL  
\$32,015,876

STATE OF MISSOURI  
\$9,655,357

NON-PROFIT  
\$3,378,892

OTHER  
\$1,904,473

INDUSTRY  
\$1,579,358

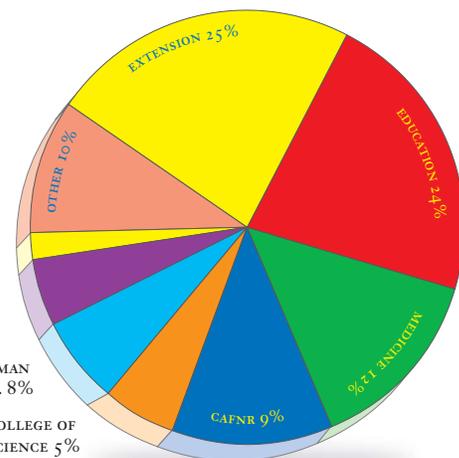
INSTRUCTION AND PUBLIC SERVICE (IPS) activities, conducted in concert with scholarly and scientific research, comprise an integral part of the MU mission.

In FY 2003, total instruction and public service expenditures at the University topped \$48 million, a three percent increase over last year's total and a new all-time high. IPS awards showed even more dramatic growth, surpassing last year's total by more than 27 percent and approaching record highs set in FY 2001.

As in the previous year, the College of Education and University Extension accounted for close to 50 percent of sponsored IPS activities, with programs in agriculture and medicine combining for another 21 percent of expenditure totals. Other colleges and schools also recorded FY 2003 gains that are worthy of note. Expenditures in the School of Health Professions, for example, were up almost one-third over last year, a figure reflecting the school's big jump in dollars awarded during FY 2002.

The School of Journalism continued its two-year trend of robust gains, tallying record-high totals in both its expenditures, up 61.9 percent, and its awards, which rose from a total of \$28,000 to more than \$1.2 million in FY 2003. The College of Arts and Science also recorded an impressive rise in awards, raising its FY 2002 total of just over \$2.3 million to more than \$3.1 million last year.

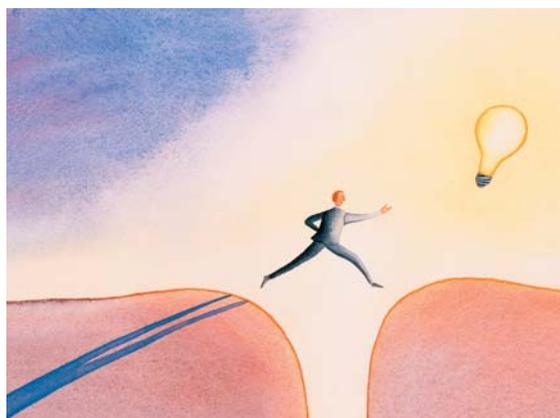
In FY 2003 the federal government remained the largest single sponsor of MU's IPS activity, with the U.S. Department of Health and Human Services, the Department of Education, the Department of Agriculture and the Environmental Protection Agency combining to contribute the greatest amount of federal support. State government was also a major source of IPS funding in FY 2003, weighing in at 15 percent of total support.



OFFICE OF RESEARCH 3%  
SINGLAIR SCHOOL OF NURSING 4%  
COLLEGE OF HUMAN ENVIRONMENTAL SCI. 8%  
COLLEGE OF ARTS AND SCIENCE 5%

## Renewed Emphasis on Student Discovery

UNDERGRADUATE STUDENTS AT THE University of Missouri-Columbia are participating in faculty-mentored research in ever-greater numbers, a development that promises to bring big benefits to individual student scientists, faculty investigators, and the research enterprise as a whole. Realizing the importance of hands-on experience for undergrads, University of Missouri-Columbia officials recently created the Office of Undergraduate Research. "It's our job to provide the resources for students who want to do research, but it is up to each student to approach a potential faculty mentor and make that connection," says Linda Blockus, director of the Office of Undergraduate Research. "Not only will it show the student's ambition, but it also will prepare them for what they'll face after graduation." Students are getting the message: In the previous fiscal year more than 2,000 undergraduate students at MU received close to \$2.7 million in grant funding for research projects in dozens of disciplines across campus.



Getty Images illustration

# Instruction & Public Serv. Expenditures By Division

	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
COLLEGE OF EDUCATION	10,014,316	11,168,476	10,560,061	11,763,029	11,876,026
UNIVERSITY EXTENSION	6,920,903	5,997,721	10,973,395	11,573,780	11,552,525
SCHOOL OF MEDICINE	5,729,159	5,666,927	6,599,422	6,450,993	5,941,380
COLLEGE OF AGRICULTURE, FOOD & NATURAL RESOURCES	4,876,383	6,543,284	5,568,708	5,045,156	4,216,019
COLLEGE OF HUMAN ENVIRON. SCI.	1,994,767	1,817,681	2,312,026	2,174,711	3,832,552
COLLEGE OF ARTS AND SCIENCE	2,712,316	2,144,178	2,695,248	2,123,255	2,384,419
SINCLAIR SCHOOL OF NURSING	1,939,666	2,378,638	2,967,157	2,302,891	1,981,921
OFFICE OF RESEARCH	448,676	586,203	919,230	1,170,864	1,673,110
SCHOOL OF HEALTH PROFESSIONS	199,731	313,886	209,176	799,162	1,027,745
GRADUATE SCHOOL	971,457	680,182	807,219	1,021,380	1,001,775
OFFICE OF THE PROVOST	713,988	922,322	818,328	744,948	827,553
SCHOOL OF JOURNALISM	101,082	291,459	358,325	368,428	596,748
COLLEGE OF ENGINEERING	838,144	647,171	806,205	431,864	555,576
COLLEGE OF VETERINARY MEDICINE	415,269	235,748	739,569	387,605	534,757
SCHOOL OF LAW	34,109	73,786	216,782	191,933	318,088
COLLEGE OF BUSINESS	1,488,532	875,658	117,188	1,970	0
STUDENT AFFAIRS	135,886	161,124	503,429	0	0
OTHER	124,176	75,675	224,645	354,317	213,763
<b>TOTAL</b>	<b>39,658,560</b>	<b>40,580,119</b>	<b>47,396,113</b>	<b>46,906,286</b>	<b>48,533,957</b>

## Reaping the Benefits of Integrated Research and Classroom Instruction

RECENT GAINS in IPS funding reflect in part a renewed commitment among faculty investigators and administrators to ensure that research and education at MU continually reinforce one another. "Research, instruction and public service are integrated and inseparable activities in a major research institution such as MU," says Jim Coleman, vice provost for research. "The excitement that characterizes intellectually and creatively engaged researchers and scholars enhances their performance in the classroom. This inspires their teaching and creates an environment of enthusiastic learning in students. Furthermore, the integration of research and education generates a synergy that helps to make certain that the findings and methods of research are quickly and effectively communicated to the broader community. This communication is essential for MU to fulfill its mission as a land-grant institution and effectively transfer the knowledge created at the university into solutions for the problems of people in the community."

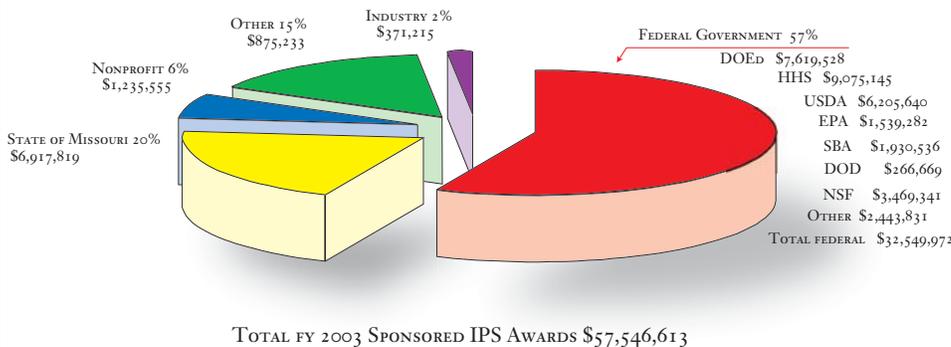
### IPS EXPENDITURES; BY SPONSOR TYPE

	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
FEDERAL	\$30,413,313	\$30,664,047	\$34,298,902	\$34,170,226	\$32,015,876
INDUSTRY	569,380	10,259	505,233	1,421,416	1,579,358
NONPROFIT	1,525,774	1,754,691	2,286,150	2,552,421	3,378,892
STATE OF MISSOURI	5,095,738	6,585,174	8,184,061	7,216,261	9,655,473
OTHER	2,054,355	1,586,466	2,121,767	1,945,962	1,904,473
<b>TOTAL</b>	<b>39,658,560</b>	<b>40,580,110</b>	<b>47,396,113</b>	<b>46,906,286</b>	<b>48,533,957</b>

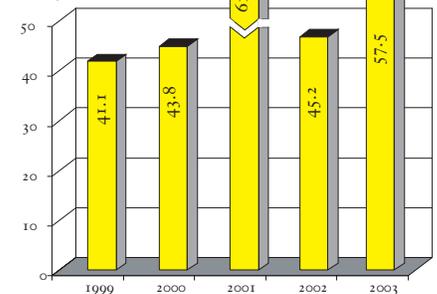
### IPS AWARDS; BY SPONSOR TYPE

	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
FEDERAL	\$21,646,037	\$31,077,243	\$45,612,729	\$35,853,060	\$32,549,972
STATE OF MISSOURI	14,864,855	7,951,856	8,324,713	6,917,819	11,618,538
INDUSTRY	473,215	754,592	455,180	371,215	1,006,218
NONPROFIT	1,935,247	2,850,862	5,754,954	875,233	3,555,325
OTHER	2,256,720	1,147,246	1,369,939	1,235,555	8,816,560
<b>TOTAL</b>	<b>41,176,074</b>	<b>43,781,799</b>	<b>61,517,515</b>	<b>45,252,882</b>	<b>57,546,613</b>

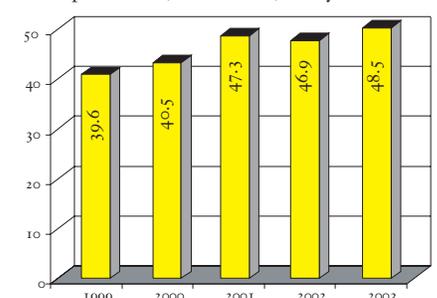
### IPS Awards By Funding Agency and Amount



IPS awards, in millions, five-year trend



IPS expenditures, in millions, five-year trend



# MU RESEARCH 2003 AND BEYOND

## MU Research: Working To Enhance Research and Scholarship for Missouri and the Nation

**T**HE OFFICE OF RESEARCH seeks to foster an academic environment in which MU's research, instruction, service, and economic development missions are enhanced through rigorous original research, creativity, and scholarship. The Office of Research also works to ensure that intellectual and creative achievements of MU faculty, students and staff are facilitated, celebrated and, when appropriate, transferred to the private sector.

MU and the Office of Research have a number of strengths in supporting research, scholarship and creative activity. Our culture of interdisciplinary work and trust has long been a strong point, with life sciences particularly well organized and the new Life Sciences Center providing a focal point for further development. The level of student involvement in research activities is high and growing, and Missouri's Congressional delegation is strongly supportive of research at MU.

The Research Division itself also offers a range of organizational and financial support: funding through PRIME and the Research Council; proposal assistance through a growing network of grant writers; compliance support through electronic tools and training opportunities; and various forms of protection and support for MU intellectual property as it is transferred to the marketplace.

That said, MU's administrative infrastructure for supporting research remains relatively immature for a research

university of our size. We are working to develop an administrative infrastructure that is more service-oriented, and are making strides toward implementing an improved system for tracking the return on our internal investments in research.

Perhaps the largest obstacle to MU strategic goals for the growth of research is the extent to which the physical infrastructure for research is not keeping pace with the growth of the enterprise.

### Our Goals

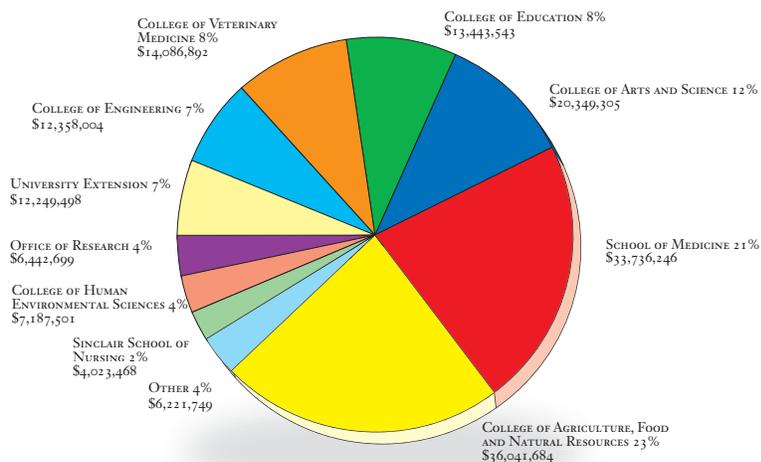
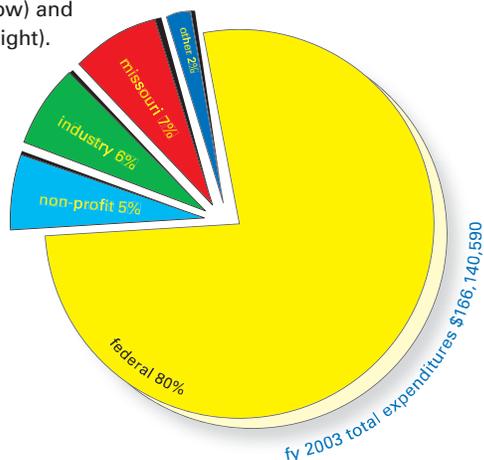
Research Division goals for the 2003-04 academic year involve building on our strengths while also addressing areas of need:

*Goal 1:* Provide top-notch services and compliance functions that enhance the ability of MU faculty to conduct research, pursue scholarly investigations, and pioneer technical innovations.

*Goal 2:* Create a research-centered academic environment by developing connections between the research enterprise and all of the institution's other activities, including the development of a broader foundation for research support with internal and external stakeholders.

*Goal 3:* Financially sustain and grow the research enterprise in order to allow students better access to prominent faculty and state-of-the-art research facilities. Only by mentoring the next generation of researchers will MU be posi-

FY 2003 Totals by agency (below) and division (right).



## Research, Instruction & Public Service FY 2003 Totals

tioned to continue its role as a leader in using science and scholarship to pursue new knowledge.

### Our Assignments

The division's leadership meets twice each year to assess progress and adjust our course. Our *Master Plan for Research and Technology Development* is the result of these sessions. The plan contains goals and objectives for each office within the Research Division. Highlights of this year's objectives include the following:

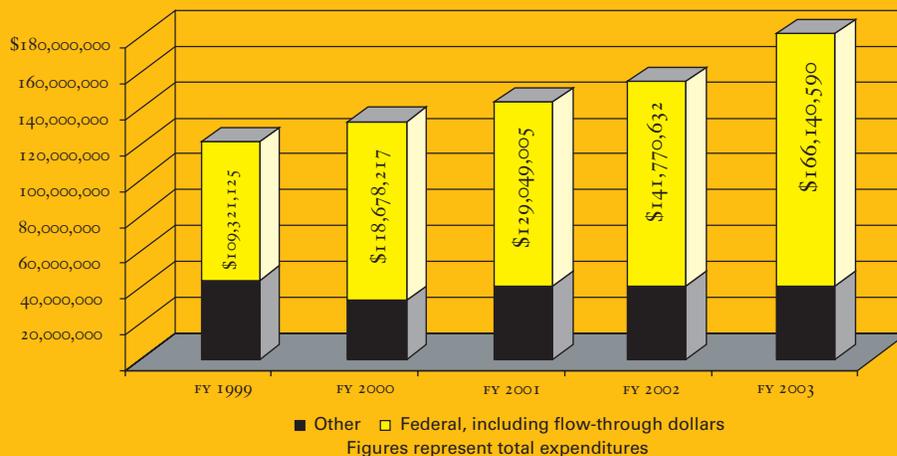
- Open the new MU Life Sciences Center;
- Implement a trial program for facilitating large, interdisciplinary proposals;
- Develop a plan to ensure that MU has the animal care and greenhouse facilities necessary to support growth in life sciences research;
- Account for returns on investments in PRIME, Research Council and Research Incentives funds;
- Develop a model sponsored program administration by implementing more pro-active operations that anticipate researchers' needs;
- Work with the Provost's office to build undergraduate research; and
- Support a fund for the development of nascent University technology.

The complete *Master Plan* is available from the Office of Research (573-882-9500) or via the Internet at: [www.research.missouri.edu](http://www.research.missouri.edu).

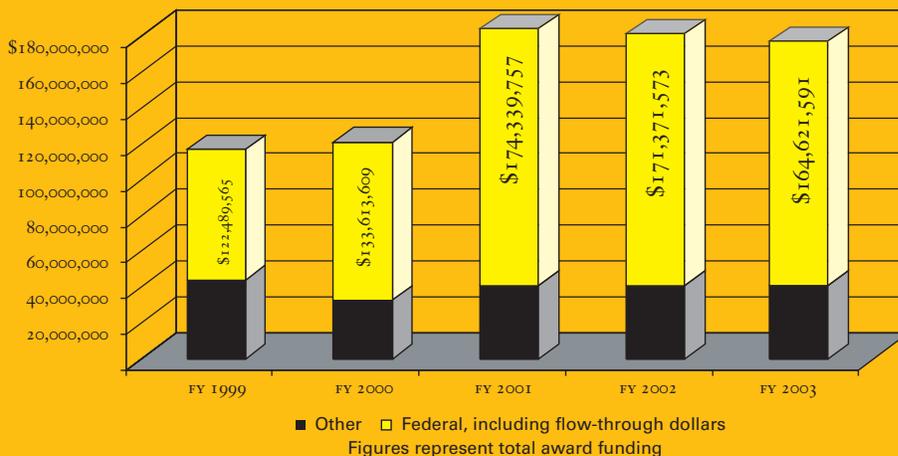
**D**URING FISCAL YEAR 2003, scientists and scholars at MU posted impressive levels of combined research and IPS funding. And the size and scope of MU's research enterprise continue to grow. Credit world-class faculty researchers, says Jim Coleman, vice provost for research.

"Over the last year, MU's faculty have won research grants by participating in some of the most rigorous competitions for research money in the world, breaking all previous records at MU for research funding," Coleman says. "This success is self-perpetuating — it creates a sense of momentum and self-confidence across campus that facilitates the creation of new ideas, interdisciplinary interactions, and the continued success of our research enterprise. It also raises our stature throughout the national and international research communities."

TOTAL SPONSORED RESEARCH & IPS EXPENDITURES, FIVE-YEAR TREND



TOTAL SPONSORED RESEARCH & IPS AWARDS, FIVE-YEAR TREND





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## mission

the mizzou

THE UNIVERSITY OF MISSOURI-COLUMBIA, established in 1839, is the oldest public research institution west of the Mississippi River. MU's mission in research and student education is to provide enhanced opportunities and challenges in the humanities, arts, sciences and selected professional fields. MU also aspires to achieve national and international prominence for its research and educational contributions. As such, we are committed to building on our research strengths in basic and applied biological and biomedical sciences; nuclear and related physical and engineering sciences; and selected social and behavioral sciences. We will continue to strengthen our leadership role in agriculture and journalism. And because of our large enrollment of undergraduates, MU will enhance the core disciplines required for all those seeking baccalaureate degrees, giving special attention to areas such as languages and mathematical sciences that provide the necessary foundation for a truly educated citizenry.

