Investigators Continue On Path To ‘Higher Level of Excellence’

MU Faculty Tally $162 Million in External Sponsorship for FY 2004

At the September 17 ribbon-cutting ceremony for the University of Missouri-Columbia’s Life Sciences Center, Mike Chippendale, the center’s senior associate director and a driving force in making the $60-million facility a reality, spoke of the new building as a symbol of the “higher level of excellence” achieved by MU life science researchers.

“There is no other institution in the state that can match MU in life sciences research with respect to the combination of quality; uniqueness; breadth; integration of research, education and service; and the potential impact on economic development,” he said.

Chippendale’s comment to the assembled dignitaries on that sunny afternoon might just as well have been directed to all of the University’s faculty scientists and scholars, the hundreds of dedicated investigators with whom I, as MU’s chief research officer, am privileged to work every day.

Research and scholarship, innovation and discovery: these terms define the mission of all great research institutions. I think you’ll agree that this, our annual report of grants and contracts for the 2004 fiscal year, shows that MU faculty have attained a level of excellence in these areas that surpasses our already exemplary record of achievement.

Last year, for example, expenditures from external sponsors — dollars from non-MU sources spent by investigators during the course of their work — surpassed $162 million, an increase of 18 percent over our five-year expenditure average and the second-largest total ever recorded at MU. Our sponsored research spending from federal sources alone in FY 2004 topped $129 million. Based on the most recent data from the NSF, MU is ranked No. 2 among public universities in the Association of American Universities in growth of federal research for the past ten years.

MU’s relationship to the NSF has been particularly fruitful. During the previous fiscal year, MU was among the nation’s top 25 institutions in National Science Foundation funding for life sciences investigations. The University led the nation in awards from the National Science Foundation for plant genomic research.

In addition, during the past five years MU has received more research funding from the NSF than any other higher-education institution in the state of Missouri.

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MU currently boasts seven faculty members who have received prestigious NSF CAREER grants — a five-year, up to $500,000, award to younger faculty members who have proven their mettle as both world-class scientists and inspiring teachers.

Some examples of other FY 2004 awards and research projects on the MU campus include the following:

- $1.2 million from the National Science Foundation to Jay Thelen, assistant professor of biochemistry, to study plant seeds in order to use them as renewable sources of oil, protein, starch and fiber.

- $10 million from the National Science Foundation to Barbara Reys, professor of mathematics education, to fund the Center for the Study of Math Curriculum.

- $10 million from the National Institutes of Health to Wynn Volkert, professor of radiology, to help researchers at MU and Harry S Truman Memorial Veterans’ Hospital develop new, innovative methods of cancer detection and treatment.

MU has a wealth of other researchers, in a multitude of scientific and scholarly fields, who are making significant contributions. Among them are a health scientist whose work could make osteoarthritis a disease of the past, two biochemists whose efforts may help patients recover more quickly from strokes and heart attacks, and several plant scientists whose findings could boost world food stocks by improving the sustainability and yield of agricultural crops.

In addition, our humanities faculty boasts world-class researchers such as English professors Timothy Materer, who was awarded a National Endowment for the Humanities fellowship for 2004-05, and John Miles Foley, holder of the William H. Byler Chair in the Humanities and director of MU’s Center for Studies in Oral Tradition. Professor Foley has held Guggenheim, NEH, ACLS, Mellon and Fulbright fellowships, and he has published 18 books.

“We continue to be strong in our research funding awards and productivity,” says Chancellor Brady Deaton. “Our success in research across campus is a direct result of the quality of our world-class faculty.”

**Externally Sponsored Grants and Contracts**

**FY 2004**

| Proposals Submitted | Research | 1,556 | 563 | 2,119 |
| Active Funded Projects | 2,024 | 832 | 2,856 |
| Newly Awarded Projects | $108,772,687 | $51,717,615 | $160,490,302 |
| Expenditures | $115,254,992 | $47,638,815 | $162,893,807 |

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

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**A Leader in Long-Term Federal Growth**

Each year the National Science Foundation tallies federal funds spent on research at America’s most prestigious public universities. Their most recent figures show that, over the last ten years, growth rates at MU were the nation’s 2nd highest.
Long Strands in Small Packages

By understanding how strands of DNA are “packaged” within the nuclei of cells, the world’s scientists hope to gain new insights into how genes are expressed, or turned on and off, during the physical development of living things.

Karen Cone, an MU associate professor of biological sciences who played a key role in mapping the maize genome, is one of the most prominent of these researchers. Last fall she received $6.6 million from the National Science Foundation to study the function of 150 to 200 genes involved in maize’s DNA packaging. It was the largest single grant awarded in the NSF’s $66-million plant genome research program.

Cone will collaborate with researchers at five other universities. The goal is to help breeders produce better plants and farmers better crops.

“If we discover how plant DNA packaging controls gene expression, then we will be able to manipulate the outcomes of genetic experiments and predict how genes get turned on and off in the right places at the right times in plant development,” Cone says. “Then we can help plant breeders figure out how to take advantage of what we have learned about DNA packaging and the relationship it has to gene activity.”

Potential benefits will not be limited to corn cultivation; the research could help people too.

“Our results might eventually have an impact on human disease where a defect in DNA packaging is the root of the
problem,” Cone says. “All eukaryotic organisms with a nucleus package [their] DNA in basically the same way.” Eukaryotes are characterized by cells that have a discrete nucleus containing genetic material and have evolved as a group to include humans and all other animals.

The collaborative aspect of the NSF research is valuable, she says, because it avoids duplication of effort and can speed results. “There is no way we could do all of these experiments by ourselves; it would take 10 years to try to do what we’re trying to accomplish in four,” Cone says. “It is better to team up and take advantage of people’s collective experience and expertise.”

New Insights Into an Old Reaction

RA INER GLASER, a professor of chemistry at MU, and his student Zhengyu Wu have demonstrated that the diazonium hydrolysis process — a two-step process described by Glaser as the “poster boy of physical organic chemistry” — is in fact accomplished via a single reaction. Their research was funded by the National Institutes of Health.

“I’ve thought about it for 20 years and always felt there was something wrong with it,” Glaser told journalists recently. “Now it makes sense, and there’s not one experiment I cannot explain with this new mechanism. This will be common knowledge for chemists and very influential because we will just know better how the reactions occur.”

Diazonium ions are important intermediates in the formation of azo dyes, the artificial yellows, reds and browns found in a variety of processed foods. The implications of Glaser and Wu’s discovery, however, go far beyond, say, making hot dogs appear more palatable.

Most important, Glaser says, is how the finding will affect current thinking about DNA connectivity. Of chief interest is nitrosation, the process in which amines, ammonia derivatives, react with nitric oxide or nitrous acid to create diazonium ions within DNA molecules.

Because the diazonium ions are not stable, they can react with other materials, causing so-called cross-link formations in DNA’s two strands.

Such cross-linking inhibits the ability of the strands to unravel and reform during cell division. The malfunction damages cells and could perhaps even cause them to become cancerous, the researchers say.

“Our work suggests that there might be other cross-links that have not yet been discovered,” says Glaser. “By knowing what happens to DNA, we can learn how it can be damaged. Once you know that, it’s the first step in finding how to fix it.”

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.
Two major donations will provide a boost to scientists, scholars and students working in the historic heart of the University of Missouri campus.

In February 2004, the School of Journalism received $31 million from the Donald W. Reynolds Foundation for the creation of a new Donald W. Reynolds Journalism Institute. The center will focus on advanced studies of journalism and its role in democratic societies.

The gift is the largest private donation ever to the University of Missouri. It will include up to $16.7 million for construction of the Reynolds Institute, to be housed on MU’s Francis Quadrangle. Another $1.8 million will fund technology and furnishings for the high-tech facility, with an additional $12.4 million available over a six-year period to fund the Institute’s staff salaries, programs and operations.

Donald W. Reynolds, who died in 1993, was a 1927 graduate of the School of Journalism. He parlayed an initial $1,000 investment — part of it borrowed — into one of the largest privately held communications companies in the United States.

On the other end of the Quad, MU’s engineers will soon benefit from a $7.5 million gift provided by Tom and Nell Lafferre — a donation that will be used for planning and construction of engineering facilities upgrades on the red campus and elsewhere.

At their November 2004 meeting, the Curators of the University of Missouri announced that, in recognition of the Lafferre’s generosity, the Engineering Building East will be renamed “Thomas and Nell Lafferre Hall.” Engineering Building East complex, parts of which date to 1893, houses the majority of the college’s classes.

Tom Lafferre earned both bachelor’s and master’s degrees from MU, as well as an MS from Washington University and an advanced management degree from Harvard University. He later joined Monsanto Corp. in St. Louis, where he eventually became vice president of operations. His wife, Nell, attended MU’s College of Education for one year.

Student scholars gain smart new space

At Ellis Library’s new James B. Nutter Sr. Family Information Commons, student researchers are using an array of high-tech tools to access a world of higher knowledge, and doing it in surroundings that make learning easy to love.

The Information Commons, housed in a renovated portion of the library’s reference section, was made possible by a $1 million gift from James B. Nutter Sr., a prominent Kansas City businessman.

“Libraries have traditionally served as a source of information, whether in books and journals, or in new digital media,” said Jim Cogswell, director of the MU Libraries. “We find that today’s students want more than information. They want spaces where they can work with one another.”

Five MU faculty named AAAS fellows

Five MU professors were named fellows of the American Association for the Advancement of Science in 2004 in recognition of their efforts toward advancing science or its applications.

AAAS, publisher of the journal Science, is an international non-profit organization dedicated to promoting scientific research and education throughout the world.

“This recognition demonstrates the impressive quality of our faculty at MU,” says Jim Coleman, vice provost for research. “To be recognized by their peers is an incredible honor for our researchers, who are making leading discoveries in their fields on a regular basis.”

Each awardee received a certificate and rosette pin at a “fellows forum” held February 19, 2005 at the AAAS Annual Meeting in Washington, D.C. The MU fellows were among 308 scientists and scholars selected nationwide.

They are:

- Sandra Abell, professor of science education, who was recognized for her work in elementary science education and leadership. Abell is director of the Southwestern Bell Science Education Center, an institution working to improve science teaching and learning among kindergarten through undergraduate students.
teaching program that relates chemistry to real-world events.

Emmanuel Liscum, professor of biological sciences, who was acknowledged for his contributions toward advancing biologists’ understanding of the genetic and biochemical components affecting plants’ responses to light.

John Charles Walker, professor of biological sciences, who was recognized for his pioneering work in the field of receptor-like protein kinases in plants. Currently, his lab investigates how plant genomes act as regulatory switches.

Candace Galen, professor of biological sciences, who was honored for her work in plant ecology and floral evolution. Galen is currently investigating how the ecological and evolutionary consequences of variation affect the characteristics of wildflowers.

Rainer Glaser, professor of chemistry, who was recognized for his research in chemistry and contributions to promote scientific literacy and communication. Glaser recently completed an investigation on the process of diazonium ion hydrolysis, a chemical reaction in which water replaces nitrogen in diazonium ions (please see Page 5). He is also the founder of “Chemistry Is in the News,” a teaching program that relates chemistry to real-world events.

Students using the commons will be able to take advantage of high-speed Internet access, e-mail, wireless laptop access, laser printing and scanning services, with staff members on-hand to provide assistance.

“This is a space where collaborative learning takes place,” Cogswell says, “where active minds share ideas and explore new outlooks, and where information becomes knowledge.”

A New Information Commons Makes Learning Easy to Love

another in small groups to share information and ideas in a secure, comfortable, and motivating learning environment.”

The common’s 25,000-square foot area features 103 computers arranged in 75 workstations, 24 café seats, and numerous study areas divided by frosted glass paneled walls bearing the names of the state’s intellectual luminaries. In addition, it boasts comfortable lounge seats positioned beneath ornate wooden beams resembling tree branches.

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“This is a space where collaborative learning takes place,” Cogswell says, “where active minds share ideas and explore new outlooks, and where information becomes knowledge.”
If a woman’s own immune system could be coaxed into blocking the action of proteasomes — the enzymes that allow sperm to penetrate eggs in the ovary — safe and reliable contraception might become as easy as an annual injection. If “semen quality” tests could use protein markers to identify damaged sperm, infertility diagnostics and treatment for farm animals, pets, and people, could be improved.

These are just two of the fertility-related breakthroughs being pioneered by reproductive biologist Peter Sutovsky, an assistant professor of animal science and clinical obstetrics and gynecology at MU. Last year, with the help of the Office of Technology & Special Projects (OTSP) and a UK-based technology management firm, Sutovsky formed a privately-funded reproductive testing and technology development company to commercialize his intellectual capital. He predicts the company, called AndroLogika, will attract a wide range of clients.

“Initial customers are producers and breeders of cattle, hogs, horses and pets,” Sutovsky told a reporter working with the Missouri Innovation Center in a recent interview. “Expansion to human male infertility diagnostics and contraceptive development is planned in the second phase of company development.” AndroLogika has already earned national media attention, including a profile in the June 2004 edition of Discover Magazine.

“The economic development mission is very new to the University, so there are still many rules that need to be established and adjusted as we go,” Sutovsky says. “But the people at the Office of Research and the OTSP have both been of great help to us.”

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Entrepreneurs at MU

Greater numbers of start-up technology companies in Missouri are taking advantage of federal grants and contributing millions of dollars to the state’s economy — thanks to a program operated by University of Missouri Extension.

The Missouri Federal and State Technology Partnership (MoFAST) helps the U.S. Small Business Administration, MU Extension and its partners to bring government research and development awards to Missouri’s small businesses. The MoFAST program was established in 2002 to encourage businesses in the state to take advantage of the federal Small Business Innovative Research grant program (SBIR) and the Small Business Technology Transfer program (STTR).

In the previous year, Missouri small businesses had received a total of 16 awards from the SBIR and STTR programs, resulting in a state ranking of 46. After MoFAST implementation, Missouri received 40 awards infusing more than $8 million in federal money into Missouri’s entrepreneurial high technology start-up companies.

“Just 30 percent of states nationwide receive more than 50 awards per year,” says Mike Nichols, adjunct associate professor in the MU College of Engineering and state director of MU Extension’s MoFAST centers. “Thanks in large part to the MoFAST program, Missouri is now poised to enter that very select group.”

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Extension Program Boosts Small Business Support

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Licensing Income from MU Inventions

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FY 2004 Annual Report 9
Total sponsored research expenditures at the University of Missouri-Columbia remained near the all-time high recorded during the previous fiscal year, with investigators in FY 2004 tallying more than $115 million in external support. Expenditures generated from federal sources — most as a result of competitive grants — accounted for the bulk of sponsored research funding. As in previous years, faculty scientists and scholars working in medicine, agriculture, arts and science and engineering accounted for slightly more than 75 percent of total sponsored research expenditures. Because the work of investigations in these divisions and others has become increasingly interdisciplinary, the Office of Research has for the first time calculated both “shared” and “full” credit figures for sponsored-research dollars expended by the University's schools and colleges (please see table on the opposite page). Shared credit numbers represent each academic unit’s portion of the total amount expended on MU research. Full credit numbers, on the other hand, seek to assign a dollar value to the “productivity” of investigators working across disciplines, thus allowing the full value of a project to be reported multiple times for multiple units. Taken together, these numbers help demonstrate the dollar value of collaboration and interdisciplinary efforts at MU.

“The bottom line is that we continue to be a really high quality research institution,” says James Coleman, vice provost for research. “We were second in research growth among all AAU public universities; we were in the top 25 in annual life sciences funding from the National Science Foundation; we were No. 1 last year, according to the NSF, in plant genomic research; just two years ago we were second in research funding related to elementary and secondary school science education; and our psychology department is among the top 25 recipients of NIH funding in the country.”

These and other successful MU research programs, Coleman adds, provide tangible benefits to the entire University community and the public it serves. Last year, for example, research at MU created some $380 million in economic impact in Missouri — activity that helped to create, according to an internal economic analysis, more than 8,000 jobs in Columbia and around the state.

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In addition to providing dollars directly to faculty investigators, funding agencies also provide support for “facilities and administration” cost borne by the institutions where scientists work. Because the rate at which these costs can be “recovered” from funders is based on the real cost of building and maintaining a university’s research infrastructure, a trend toward higher rates of F&A recovery tends to reflect an increase in the size of investigations conducted by its scientists and scholars.
Despite expenditure dip, fed support stays strong

Federal award totals showed a healthy gain in FY 2004, though expenditures declined slightly. The dip is not surprising given the large amounts expended during the previous fiscal year to build MU’s new Life Sciences Center. When adjusted to exclude construction costs, MU’s research expenditures and awards from both federal and other sources have, in fact, risen in each of the past five years (please see chart on Page 15).

Research Awards By Funding Agency and Amount

Federal research awards, in millions, 5-year trend

Federal research expenditures, in millions, 5-year trend
INSTRUCTION & PUBLIC SERVICE

IPS Support Remains Strong in ‘04

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

Instruction and public service expenditures at the University topped $47.6 million in FY 2004, a total representing a slight decline from last year's record high, but one that remains well above MU's 5-year IPS expenditure average.

Newly awarded IPS funds totaled more than $51.7 million. As in the previous year, the College of Education and University Extension each accounted for the lion's share of sponsored IPS activities. Between them the two programs expended more than $26 million, or about 50 percent, of this fiscal year's sponsored IPS funding. Programs in agriculture and medicine combined for another 22 percent, with the School of Medicine posting its highest-ever IPS expenditure total at $8.39 million — an increase of some 70 percent over FY 2003.

In FY 2004 the federal government remained the largest single sponsor of the University's IPS activity, providing slightly more than 66 percent of total expenditures and more than 75 percent of newly awarded funds. State government also remains an important source of IPS funding, though the percentage of support provided by the State of Missouri in FY 2004 for the first time dropped below 20 percent, declining to just over 16 percent of expenditures and 12 percent of awards.

Because projects in most MU divisions have become increasingly interdisciplinary, the Office of Research has for the first time calculated both "shared" and "full" credit figures for IPS-support dollars awarded to MU's schools and colleges (please see the table on opposite page). Shared credit numbers represent each academic unit's portion of the total amount awarded to MU researchers. Full credit numbers, on the other hand, seek to assign a dollar value to the "productivity" of faculty working across disciplines by allowing the full value of an award to be reported multiple times in multiple units. Taken together, these numbers help demonstrate the dollar value of collaboration and interdisciplinary efforts at MU.

Overcoming ‘Interruptions’ In Math Learning

FOR MOST CHILDREN learning mathematics is, at best, a challenge. For those students struggling with learning disabilities, math learning can seem impossible. It need not be so, says MU psychology professor and mathematics education expert David Geary. By identifying "interruptions in learning" — and the disabilities that trigger them — psychology researchers may well be able to successfully diagnose and treat most forms of childhood innumeracy.

Geary recently received the prestigious MERIT (Method to Extend Research In Time) award from the National Institute of Child Health and Human Development, an agency of the National Institutes of Health. The award, given to researchers who have demonstrated superior performance and production, will allow Geary an opportunity to extend his study for up to 10 years with a guarantee of funding support. "Never before have we had the resources to do this type of longitudinal study to focus solely on mathematical learning and disabilities," he says.

Geary and his team will study 300 children from kindergarten through middle school. Some of the research involves standard achievement and ability tests, as well as more difficult cognitive experimental tests. For example, Geary will examine how a child solves a math problem — be it simple or complex — and will test memory, attention control and amount of information retained. The goal, he says, is to identify children who possess a strong ability to learn but have low achievement levels, and then to discover why this happens.
MU’s continued strong showing in IPS awards, particularly awards from federal sources, reflects an ongoing 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.

IPS Awards By Funding Agency and Amount

Fed Awards Promote Research, Teaching Integration

Federal IPS awards, in millions, 5-year trend

Federal IPS expenditures, in millions, 5-year trend
THE OFFICE OF RESEARCH is working to promote an environment in which the intellectual and creative activities and achievements of MU's faculty, students and staff are facilitated, celebrated and, when appropriate, transferred to the private sector.

Our goal, echoing that of the UM System and the University of Missouri's strategic plan, is to participate in the building of a “premier, world-class destination university with an exceptional and richly diverse student body, faculty, and staff.” Five of the six strategic themes for the UM System include goals that intersect with the research enterprise here at MU.

Some of these are familiar: boosting our investment in selected programs, enhancing interdisciplinary research, becoming a leader in life sciences, fostering economic development, and improving the research infrastructure. Others, however, will give us pause this year as we develop plans for their achievement by 2010. Among these goals are recruiting additional faculty members who are members of the National Academy of Sciences, improving financial compensation for MU's faculty and staff, building the highest quality information technology infrastructure, and raising the total of our annual external research expenditures to the $300 million mark.

The campus plan speaks to our stewardship of a “priceless state resource” as a land-grant university for the 21st century that offers a new model for a university in the public service, a public-private partnership university. Our land-grant status carries a unique obligation to improve the civic, economic, health and educational well-being of all Missourians.

Several recurring themes in the campus plan are reflected in this year's Master Plan for Research and Technology Development: research incentives, research infrastructure, technology transfer, recruitment and retention of top faculty, and external funding for research and creative projects.

Like the campus plan, our Master Plan for Research and Technology Development is not a summary of all that we currently do, or even of all the things that we hope to do in the future. Instead, it is intended as a tightly focused set of high-priority tasks for the current year. The Research Division's goals for the 2004-05 academic year have been chosen to build on existing strengths while also addressing areas of need.

Goal 1: Provide top-notch services and compliance functions that enhance the ability of MU faculty to do research, creation, scholarship, and innovation.

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

Goal 3: Develop and promote investment strategies to sustain and grow the research enterprise. Such growth will allow students greater access to our world-class faculty and state-of-the-art facilities, and will ensure that MU research continues to enhance the lives of people in our state, nation and the world.

With these goals in mind, the division's leadership meets twice each year to assess our progress and adjust our course. The Master Plan is the result of these sessions: It contains goals and objectives for each office within the research division. Examples of this year's objectives include plans to:

- Establish a faculty committee to advise the vice provost for research on ways to increase recovery of facilities and administration costs and to optimize the allocation of
research resources.

- Work with the School of Medicine and the Dalton Cardiovascular Research Center to integrate diabetes and cardiovascular research across campus.
- Develop a framework for incentive plans aimed at encouraging more entrepreneurial activity by MU faculty.
- Develop and implement a more user-friendly oversight procedure for behavioral research involving human subjects.
- Support the welfare of animal subjects through acceptable per diem charges, a plan to improve animal research infrastructure, and campus-wide accreditation by AAALAC.
- Continue to expand the grant writer network and its support of faculty research.
- Develop a model sponsored program administration operation by moving toward more proactive operations and by working to better meet the needs of the University’s research community.
- Implement an effective training program for efficient utilization of administrative tools and processes to conduct sponsored projects.
- Begin construction of OTSP’s new technology incubator and implement its support program.
- Raise awareness among non-science faculty members of opportunities to involve undergraduates in research and creative activity.

We invite you to read more about these assignments, along with the specific tasks associated with them, by visiting the “research publications” section of our newly redesigned web site: www.research.missouri.edu.
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.