



**MLSRB**  
MISSOURI LIFE SCIENCES RESEARCH BOARD

## Spending Plan

**Report to the Chair of the Senate Appropriations Committee  
And Chair of the House Budget Committee**

**December 1, 2007**

Prepared by:



## History and Mission

House Bill 688 was enacted in 2003 and created the Missouri Life Sciences Research Board (MLSRB) and the Missouri Life Sciences Research Trust Fund (Fund). According to the statute, “moneys in the life sciences research trust fund shall be used strategically, in cooperation with other governmental and not-for-profit private entities, to enhance the capacity of the state of Missouri's ability to perform research to better serve the health and welfare of the residents of the state of Missouri as a center of life sciences research and development by building on the success of research institutions located in Missouri, creating in and attracting to Missouri new research and development institutions, commercializing the life sciences technologies developed by such institutions, and enhancing their capacity to carry out their respective missions.”

The mission of the Board and the Fund is to:

- Enhance research capacity in life sciences to better serve the health and welfare of Missouri citizens;
- Promote Missouri as a center of life science research and development by building on the success of existing Missouri research institutions;
- Create and attract new research and development institutions; and
- Transform research into commercial life science technology.

In 2007, the Missouri General Assembly passed and Governor Matt Blunt signed into law, House Bill 7, which appropriated monies totaling \$13,455,465 to the Missouri Life Sciences Trust Fund. Pursuant to board policy approved April 12, 2007, Centers for Excellence should focus their make up, expertise and collaborations on agriculture research, specifically in the areas of bioenergy, plant science, and animal health and nutrition. The following resolution was approved by the Life Science Research Board:

“Be it resolved that the Life Science Research Board encourages full funding of the Life Science Research Trust Fund as recommended by Governor Blunt in his fiscal year 2008 budget and further specifies that it agrees with the recommendation to focus monies appropriated by the General Assembly on agriculture research in the areas of bioenergy, plant science, animal health and nutrition. Furthermore, the Life Science Research Board will not fund any human health research proposals.”

Language included in House Bill 7 providing funds to the Missouri Department of Economic Development for fiscal year 2008 also includes the following stipulations consistent with the governor’s budget request and the above referenced board resolution:

“Projects shall be limited to bioenergy projects, National Bio- and Agro-Defense Facility projects, Gateway Fund projects, Animal Health Corridor projects and/or Odor Abatement/Water Quality projects. These funds shall be used exclusively on animal or plant sciences projects.”

## **Research and Commercialization Missions**

The following guidelines are laid forth in state statute:

“All moneys appropriated by the general assembly from the life sciences research trust fund shall be appropriated to the life sciences research board to increase the capacity for quality of life sciences research at public and private not-for-profit institutions in the state of Missouri and to thereby:

(1) Improve the quantity and quality of life sciences research at public and private not-for-profit institutions, including but not limited to basic research (including the discovery of new knowledge), translational research (including translating knowledge into a usable form), and clinical research (including the literal application of a therapy or intervention to determine its efficacy), including but not limited to health research in human development and aging, cancer, endocrine, cardiovascular, neurological, pulmonary, and infectious disease, and plant sciences, including but not limited to nutrition and food safety; and

(2) Enhance technology transfer and technology commercialization derived from research at public and private not-for-profit institutions within the Centers for Excellence. For purposes of sections 196.1100 to 196.1130, "technology transfer and technology commercialization" includes stages of the regular business cycle occurring after research and development of a life science technology, including but not limited to reduction to practice, proof of concept, and achieving federal Food and Drug Administration, United States Department of Agriculture, or other regulatory requirements in addition to the definition in section 348.251, RSMo.

Funds received by the board may be used for purposes authorized in sections 196.1100 to 196.1130 and shall be subject to the restrictions of sections 196.1100 to 196.1130, including but not limited to the costs of personnel, supplies, equipment, and renovation or construction of physical facilities; provided that in any single fiscal year no more than ten percent of the moneys appropriated shall be used for the construction of physical facilities and further provided that in any fiscal year eighty percent of the moneys shall be appropriated to build research capacity at public and private not-for-profit institutions and twenty percent of the moneys shall be appropriated for grants to public or private not-for-profit institutions to promote life science technology transfer and technology commercialization. Of the moneys appropriated to build research capacity, twenty percent of the moneys shall be appropriated to promote the development of research of tobacco-related illnesses.”

## **Centers for Excellence**

On June 22, 2007 the MLSRB met to review the legislative action and funding requirements. The MLSRB voted to authorize the staff of the Missouri Technology Corporation (MTC) to provide administrative and support services to the MLSRB. They also approved the request for proposals (RFP) to establish the Centers for Excellence (CFE).

The first step in the process was the designation of four CFE across the state of Missouri. In order to be considered for selection as a CFE it must be established within a geographical area specified in sections 196.1100 to 196.1130, RSMo, and be comprised of a consortium of public and private not-for-profit academic, research, or health care institutions or organizations that have collectively at least fifteen million dollars in annual research expenditures in the life sciences, including a collective minimum of two million dollars in basic research in life sciences.

For organizing purposes, each CFE was required to nominate a chairman and functional board of directors representative of the consortium of public and private not-for-profit academic, research, or health care institutions or organizations associated with their CFE with a focus agriculture research and commercialization.

Each CFE for life sciences research were required to appoint a screening committee. The centers, through their screening committees, then collected, prioritized, and forwarded to the MLSRB proposed research and commercialization initiatives for consideration for funding by the board. Members of each screening committee had to be generally familiar with the life sciences and current trends and developments with either technical or scientific expertise in the life sciences with an understanding of life sciences and with an understanding of the application of the results of life sciences research. No member of a screening committee could be employed by any public or private entity eligible to receive financial support from the life sciences research trust fund.

The MLSRB views the regional and statewide CFE as virtual organizations, whose purpose is to think strategically about the important life science research and commercialization initiatives important to their specific region, but also how these regional initiatives strengthen the state of Missouri's ability to compete on a larger regional and national scale. The centers were asked to develop the strongest possible proposals within their regions, looking to collaborate among other regions to enhance and strengthen the statewide base of research and development assets wherever possible.

### **CFE Award Information**

Four Centers for Excellence were designated by the Life Sciences Research Board on July 24, 2007, pursuant to sections 196.1100 to 196.1130, RSMo. They included the following geographic areas:

- (1) One St. Louis area center for excellence may be established within the geographical area encompassing the city of St. Louis and St. Louis, St. Charles, Jefferson, and Franklin counties. If any part of a municipality is located within any one such county and also encompasses a part of another county in this state, the entire area encompassed within the city limits of such municipality shall be a part of the geographical area of the St. Louis area center for excellence;
- (2) One Kansas City area center for excellence may be established within the geographical area encompassing Jackson, Clay, Andrew, Buchanan, and Platte counties. If any part of a municipality is located within any one such county and also encompasses a part of another county in this state, the entire

- area encompassed within the city limits of such municipality shall be a part of the geographical area of the Kansas City area center for excellence;
- (3) One Springfield center for excellence may be established within the geographical area encompassing Greene, Christian, and Webster counties;
  - (4) A Missouri statewide center for excellence may be established that shall encompass the institutions, agricultural research centers dedicated to the development of plant-made pharmaceuticals, and campuses within the University of Missouri system and those regions of Missouri not encompassed within another center for excellence; provided that the University of Missouri-Kansas City and the University of Missouri-St. Louis shall participate in the Centers for Excellence in their respective geographical regions.

### **Centers for Excellence Chairman**

Jim Baker, Ph.D.  
Vice President for Research and Economic Development  
Missouri State University  
901 South National Avenue  
Springfield, MO 65897

Roger N. Beachy, Ph.D.  
President  
Donald Danforth Plant Science Center  
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William Duncan, Ph.D.  
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Thomas L. Payne, Ph.D.  
Vice Chancellor for Agriculture  
Dean, College of Agriculture, Food and Natural Resources  
Director, Missouri Agricultural Experiment Station  
2-69 Agriculture Building  
University of Missouri  
Columbia, MO 65211

## Research and Commercialization Projects

The second step in the process was the approval of the RFP for the Research and Commercialization projects. This document was approved by the MLSRB on July 24, 2007. The RFP was emailed on July 27, 2007 to University presidents, chairs of the CFE and members of the Research Alliance of Missouri (RAM). The deadline for proposals to be submitted to the research board was September 7, 2007.

### Funds Available In Each Grant Category

Eighty percent, or \$10.5 million, is available for Life Science Trust Fund research grants.

Twenty percent, or \$2.6 million, is available for Life Science Trust Fund commercialization grants.

It should be noted that no more than 10 percent, or \$1.3 million, shall be used for the construction of physical facilities or “bricks and mortar.”

Furthermore, a single Center for Excellence shall not receive more than 50 percent or \$6.5 million. It should also be noted that no single institution or organization shall receive in any consecutive three fiscal year period more than 40 percent of the moneys appropriated to the Life Science Trust Fund.

### Proposal Criteria

- **Scientific and technical quality of the proposed project.** Proposals must address an important and relevant question(s) related to the specific research area(s) of interest to the Missouri Life Sciences Research Board (MLSRB). Merit review: scientific and technical significance, originality and likelihood of success of achieving external funding.
- **Expertise of Investigators/Collaborators.** Qualifications and research experience of the Principal Investigator, Co-Principal Investigators and collaborating investigators.
- **Quality of and degree of collaboration(s).** The plans for collaboration and interaction among the collaborating institutions and among the individual program participants. How the collaborative plans will foster more rapid and higher quality progress toward the program goals.
- **Sufficiency of plans to enhance future funding potential.** How the proposed program will provide leverage for future funding of program participants from federal, state or private funding sources. How the work of this project is anticipated to continue after the period of support provided by the MLSRB award.
- **Availability of facilities/resources needed for proposed research.** Resources currently available or being sought for performance of the proposed research including location and availability of access to required specialized facilities and/or

equipment. How the requested resources are key to the collaborative research effort in enabling both high priority research and research collaboration.

- **Intellectual Property Disposition Plan.** Adequacy of Intellectual Property Disposition Plan (IPDP) including material transfer agreements, nondisclosure agreements, licenses, etc., to the extent applicable. How intellectual property will be managed and developed.
- **Commercialization Potential.** How the proposed research and development effort will facilitate the potential commercialization of a discovery or innovation and the specific pathway for that process.
- **Strategic Alignment.** How the proposed research or commercialization proposal aligns with the state's strategic economic development and research priorities as determined by the Life Science Research Board.
- Realistic assessment of the scope of work proposed for a one (completed in 3 years, as above) year period of funding.
- Appropriateness of the proposed budget with regard to the scope of work.
- Potential contribution to the health and quality of life of the people of Missouri, whether in the intermediate or longer term.

## **Grant Awards**

Within the limits of available funds, awards were made to applicants whose proposals were judged most meritorious under the evaluation criteria and procedures defined by the Life Science Research Board. The LSRB determined which proposals would be funded, and any conditions that might pertain to the award of funds to each selected projects.

Life Science Trust Fund awards are to be made available within three to six weeks of the date of award notification. The expectation is that projects will be initiated within three months of award notification.

## **Scientific Peer Review Process**

The third step in the process was to initiate the Scientific Peer Review process in accordance with Section 196.1112, RSMo. The MLSRB approved the Peer Review RFP on July 27, 2007. The RFP was sent out on August 1, 2007.

The Scientific Peer Review RFP requested responses from organizations or individuals routinely providing scientific peer review and related consulting services for high technology sponsored research programs, provided neither the organization nor its employees and, where applicable, nor its parent organization nor employees thereof, have any financial interest in any current grant, nor will they have any financial interest in any new grant awarded through the Life Science Trust Fund Program during the term of the proposed contract.

The following qualifications were also requested:

1. Experience in advising technical grant programs sponsoring projects within the life sciences;
2. Intimate knowledge of best practices in scientific peer review;
3. Significant experience and knowledge of issues pertaining to competitive grant programs funded by state government, including conflict of interest avoidance and public rights and access to information;
4. Experience working with independent Web-based peer review systems.

One response was received from LYTMOS Group, LLC located in Lee's Summit, Missouri. They have considerable experience performing similar peer reviews in the states of Florida, Pennsylvania, Maryland, and Indiana and also in the Kansas City area. The MLSRB felt this company had the necessary experience and qualifications and, therefore, approved its proposal on September 12, 2007.

## **Budget**

The statute under Section 196.1115.3, RSMo, allows two percent of the total appropriation to be used for administrative costs of the board and the process. The following administrative budget was approved by the MLSRB on September 12, 2007.

### Life Sciences Research Board FY2007 Budget

Scientific Peer Review	\$158,000
Compensation for DED Staff	\$ 12,730
Compensation for MTC Director	\$ 41,200
Board Meeting Expenses	\$ 3,270
Additional Staffing for Post Award	\$ 40,000
Flexible Spending	<u>\$ 13,909</u>
Total	\$269,109

## **Spending Plan**

This spending plan is designed to enhance Missouri's position as a global leader in three important sectors of the life science economy – plant biotechnology, animal health, and animal nutrition. This focused approach centered around agriculture was recommended by Governor Blunt, the Governor's Council on Plant Biotechnology, and numerous members of the Missouri General Assembly. Specifically, the Governor recommended investments in the following areas: bioenergy, animal health, odor abatement, and water quality. He also recommended funds to support the University of Missouri's Gateway Fund and the National Bio- and Agro-Defense Facility.

The main reason for this focused approach is the inescapable fact that agriculture is Missouri's leading industry and affects every corner of the state from an economic standpoint. Another important factor, however, is that such an approach allows the state to build on tremendous strengths that already exist in plant biotechnology (where Missouri has more PhDs than any other state in the nation) and animal health and nutrition (where Kansas City area companies

account for nearly 32 percent of worldwide sales in the industry). Ultimately, it is thought that placing resources where demonstrated strengths already exist will bring about the greatest results and the best return on the state's investment.

Finally, Governor Blunt's strong support for the Life Science Trust Fund should be noted. This is the second year in a row that the Governor has recommended full funding, or 25 percent of Master Tobacco Settlement Agreement revenues, for this funding object. In fiscal year 2008, this total amounted to \$35.7 million. It should also be noted that Governor Blunt's strong support of research funding builds upon the legacy created by former Governor Christopher S. "Kit" Bond's administration, and carried on through Governor's Ashcroft, Carnahan, and Holden, which oversaw the creation of the "Food for the 21<sup>st</sup> Century Program," a program that provides several million in annual funding to the University of Missouri for research in four important areas: Animal Reproduction; Food, Feeds and Natural Products; Nutritional Sciences; and Plant Sciences. Since federal funds for agricultural research are quite limited in comparison to funds available for human health research, this program, in no small measure, helped pave the way for Missouri to become a leader in the agricultural sciences, thus providing an important building block for the Life Science Trust Fund investments listed in subsequent pages.

## Funding Summary by Project Type

Funding Type	Funding Allocated
Research	\$10,500,000
Commercialization	\$ 2,600,000
<b>TOTAL</b>	<b>\$13,100,000</b>

## Funding Summary - Research

Proposal Number	Recipient	Project Title	Program Area	Funding Allocated
13234	University of Missouri-Kansas City (UMKC)	Bone Fracture Repair in Animals Using a New Bond Cement	Animal Health	\$786,998
13249	Missouri State University (MSU)	Insect-Deterrent and Antifeedant Properties of Ginkgo Biloba	Gateway Fund	\$52,953
13238	UMKC	Evaluation of Candidate Diagnostic Targets for Johne's Disease in Livestock	Animal Health	\$675,000
13321	University of Missouri-Columbia (UMC)	Advancing Animal and Plant Agricultural Sciences in Missouri	Animal, Plant, Environmental Science	\$3,381,568
13250	Washington University	Discovery and Utilization of Enzymes for Renewable Biofuels Production	Bioenergy	\$2,989,703
13248	University of Missouri-Rolla	Integrated Program for the Development of Microalgae as Sustainable Resources for Biofuels and Biomaterials	Bioenergy	\$526,906
13230	UMKC	Utrahigh-Throughput Sequence Profiling of Small RNA in Brachypodium Distachyon, an emerging model for Cereal and Biofuel Crops	Plant Science	\$558,020
13243	MSU	Grape Polyphenols: Potential for New Commercial Products and Enhanced Plant Health	Gateway Fund	\$897,955
13254	UMKC	Identification of Functional Replication and Transcription Linked to Residues for Chromatin Assembly by Histone H3 Proteins in the Corn Smut Ustilago and the Yeast Saccharomyces	Plant Science	\$318,624
13246	UMKC	Novel Therapeutic Strategies for the Treatment of Eye Diseases in Animal	Animal Health	\$312,273
			<b>TOTAL</b>	<b>\$10,500,000</b>

## **Research Project Summaries**

**Project # 13234:** Bone Fracture Repair in Animals Using a New Bond Cement  
**Award Amount:** \$786,998  
**Program Area:** Animal Health  
**Center for Excellence:** Kansas City  
**Lead Investigator:** David J. Eick, University of Missouri-Kansas City  
**Collaborators:** Donna M. Pacicca, The Children's Mercy Hospital

Pets and large animals, such as horses, currently benefit from biomaterials (materials used in medical devices that interact with the body) that are used to stabilize and heal bone fractures. Frequently, a bone cement is used to stabilize fractures and prosthetic devices such as those used for hip replacement in dogs with hip dysplasia, a disease that can cause crippling lameness and painful arthritis. The bone cement that is currently used for this purpose is a strong resin (called PMMA) that has several significant drawbacks – it impedes the healing of the bone due to severe toxicity and heat generation and it contracts while solidifying.

The scientists leading this project have developed a silorane-based resin that is superior to PMMA in several important ways. This resin, for example, maintains the same strength as PMMA without contracting or shrinking while drying. It is also less toxic and generates less heat. Additionally, preliminary data suggest this resin actually supports, rather than hinders, bone formation. The results of this study will be the development of composites that have enhanced strength and compatibility with the body. Fillers will be included in the form of hollow microspheres (biodegradable glass) that could be used to contain and act as carriers for antibiotics or growth factors that induce bone growth and blood vessel formation. Accomplishment of these goals will lead to a commercial application that will improve bone health in both large and small animals.

**Project # 13249:** Insect-Deterrent and Antifeedant Properties of Ginkgo Biloba  
**Award Amount:** \$52,953  
**Program Area:** Gateway Fund  
**Center for Excellence:** Springfield  
**Lead Investigator:** Maciej Pszczolkowski, Missouri State University

The goal of this research project is to develop a novel pest control strategy targeting internal fruit feeding insects. Codling moth, the most significant apple pest problem for Missouri growers, infests the fruit as “neonate,” or newborn, larvae within twelve hours after hatching from the egg and stays inside the fruit until its development is complete. Recently advocated Codling moth control measures that target adults are only at an early stage of development in Missouri and may not be effective enough to provide satisfactory control measures. Historically, broad-spectrum contact insecticides have been used to target larvae just after hatch. However, these insecticides pose a severe risk to human health, negatively impact the natural environment, and will soon be banned by the federal “Food Quality and Protection Act.” If no alternatives are commercially available after this pesticide is banned, it is estimated that Missouri apple growers will lose at least \$5.2 million in annual income.

It is already known that ethanolic extracts from Ginko biloba (a Chinese tree that is exceptionally resistant to insect pests) prevents apple infestation by Codling moth neonates. This study will determine which Ginko substances discourage neonates from infesting fruit. By identifying these substances, the study will open a new avenue for Codling moth control with substances derived from an herb which has been known to be beneficial to human health, thereby helping to reduce potential human health risks and minimize adverse environmental effects from currently used Codling moth control measures. The study will be undertaken in cooperation with an internationally recognized expert on modifying Codling moth larvae behavior with plant extracts. The results will be licensed to a Missouri-based company which produces chemicals for agricultural applications.

**Project # 13238:** **Evaluation of Candidate Diagnostic Targets for Johne’s Disease in Livestock**  
**Award Amount:** **\$675,000**  
**Program Area:** **Animal Health**  
**Center for Excellence:** **Kansas City**  
**Lead Investigator:** **Brian V. Geisbrecht, University of Missouri-Kansas City**  
**Collaborators:** **John P. Bannantine, National Animal Disease Center, U.S. Department of Agriculture**

Johne’s disease is a fatal livestock disease that results from a chronic infection of the gut (stomach and intestines) by the widely distributed environmental organism Mycobacterium avium paratuberculosis (MAP). The economic impact of Johne’s disease accounts for an estimated loss of \$1.5 billion per year to U.S. livestock producers. Johne’s disease is widely considered to be one of the most serious issues affecting livestock in Missouri.

In addition to livestock concerns, mounting evidence suggests that milk production from infected animal results in contamination of a large percentage of the nation’s dairy supply, since common methods of pasteurization do not destroy MAP. It is therefore essential for both economic and human health related reasons to have adequate methods of diagnosing Johne’s disease in cattle as well as methods for testing dairy products for MAP contamination. Unfortunately, affordable and effective tests for this organism and Johne’s disease have yet to be developed.

This study will examine target immunological biomarkers (fragments of DNA sequence that cause disease) derived from the MAP bacterium and assess the feasibility of translating these protein antigens (molecules that stimulate an immune response) into affordable diagnostics for MAP infection in livestock and their agricultural products.

**Project # 13321:** **Advancing Animal and Plant Agricultural Sciences in Missouri**  
**Award Amount:** **\$3,381,568**  
**Program Area:** **Gateway Fund, Odor Abatement, Water Quality, Plant Science, Animal Health, Life Sciences Capacity Enhancement**  
**Center for Excellence:** **Statewide**  
**Lead Investigator:** **Marc J. Linit, University of Missouri-Columbia**  
**Collaborators:** **Rod Geisert, University of Missouri-Columbia**  
**Jack Jones, University of Missouri-Columbia**  
**Rob Kallenback, University of Missouri-Columbia**  
**Monty Kerley, University of Missouri-Columbia**  
**Scott Peck, University of Missouri-Columbia**

**Collaborators continued:** Keith Striegler, University of Missouri-Columbia  
Jinglu Tan, University of Missouri-Columbia  
Jerry Taylor, University of Missouri-Columbia  
Jay Thelen, University of Missouri-Columbia  
John Walker, University of Missouri-Columbia  
Wenping Qiu, Missouri State University, Mountain Grove

This University of Missouri proposal focuses on strategic investments across a broad spectrum of research stages – basic, transitional, applied – in order to enhance Missouri’s position as a national leader in the agricultural sciences. These research projects will focus on both animal and plant science with a particular emphasis on building instrumentation and research equipment capacity, which is a major factor in attracting federal research dollars and, of course, serves as the tool that allows research scientists to develop new technologies. Specific projects will focus on measuring agriculture impacts on Missouri streams, developing livestock odor abatement strategies, improving feed efficiency for pasture-based dairy and beef cattle operations, and extensive study of plant genetics and proteins to improve crop yield. Findings from this research will not only enhance animal and plant productivity, but improve citizens’ quality of life while contributing to Missouri economic development efforts.

**Project # 13250:** Discovery and Utilization of Enzymes for Renewable Biofuels Production  
**Award Amount:** \$2,989,703  
**Program Area:** Bioenergy  
**Center for Excellence:** St. Louis  
**Lead Investigator:** Himadri Pakrasi, Washington University  
**Collaborators:** Largus (Lars) Angenent, Washington University  
Rajeev (Reggie) Aurora, Saint Louis University  
Richard Axelbaum, Washington University  
Roger N. Beachy, Donald Danforth Plant Science Center  
Pratim Biswas, Washington University  
Robert Blankenship, Washington University  
Jeffrey I. Gordon, Washington University  
Tuan-Hua David Ho, Washington University  
Monty Kerley, University of Missouri-Columbia  
Shelley Minter, Saint Louis University  
Ralph Quatrano, Washington University  
Monica Schmidt, Donald Danforth Plant Science Center  
Thomas Smith, Donald Danforth Plant Science Center  
Gary Stacey, University of Missouri-Columbia  
Teresa Thiel, University of Missouri-St. Louis  
Xuemin (Sam) Wang, University of Missouri-St. Louis  
Dong Xu, University of Missouri Columbia  
Oliver Yu, Donald Danforth Plant Science Center  
Zhanyuan Zhang, University of Missouri-Columbia

This proposal includes a comprehensive set of biofuels related research projects by members of the Missouri Biofuel Research Consortium in St. Louis, a group of 20 world class plant scientists. The projects focus on three areas: improving the efficiency of transforming biological materials into energy, enhancing the reliability and cost effectiveness of biofuels, and increasing

the efficiency of transforming sunlight into energy via biological materials (plants and algae). While fossil fuels will remain a critical fuel for energy generation in the foreseeable future, bio-derived fuels will be an important component of our regional and national energy portfolio. Availability of cheap, abundant energy is imperative for the economic prosperity and national security of any country. This proposal will help biofuels transition from a boutique to a primary energy source, improving both of these important ends.

**Project # 13248:**                    **Integrated Program for the Development of Microalgae as Sustainable Resources for Biofuels and Biomaterials**  
**Award Amount:**                    **\$526,906**  
**Program Area:**                    **Bioenergy**  
**Center for Excellence:**           **Statewide**  
**Lead Investigator:**               **Paul Nam, University of Missouri-Rolla**  
**Collaborators:**                    **Keesoo Lee, Lincoln University**  
    **Virgil Flanigan, University of Missouri-Rolla**  
    **Fabio Rindi, University of Alabama**

Scientists from multiple disciplines and institutions will work collaboratively to develop algae as a potential solution to growing energy and environmental challenges. This project seeks to: develop sustainable and less expensive methods for the capture and conversion of solar energy in algae; develop methods to use algae biomass as a renewable fuel source; and develop practical and environmentally responsible methods of carbon dioxide capture and sequestration. The major thrust of the research program will focus on the following: 1) identification of high yielding, hardy, pest resistant algae strains; 2) developing economically viable, commercial scale algae cultivation systems; 3) identifying an effective system for extracting oil from wet algae for conversion into biodiesel; and 4) testing methods for fermenting algae carbohydrates into ethanol. Integration of these innovations should yield a comprehensive algae cultivating and refining system that can economically mass-produce biomass feedstock for conversion into biofuels, biopolymers (plastics), and other valuable products.

**Project # 13230:**                    **Utrahigh-Throughput Sequence Profiling of Small RNA in Brachypodium Distachyon, an Emerging Model for Cereal and Biofuel Crops**  
**Award Amount:**                    **\$558,020**  
**Program Area:**                    **Plant Science**  
**Center for Excellence:**           **Kansas City**  
**Lead Investigator:**               **Julia Chekanova, University of Missouri-Kansas City**  
**Collaborators:**                    **Todd Mockler, Oregon State University**

Progress in understanding the basic biology and mechanisms of gene function in monocot grasses (the world's predominant grass species), including cereal species cultivated for food and feed, as well as dedicated biofuel crops such as switchgrass, has been severely constrained for many years due to the lack of convenient experimental systems (i.e. model crops). For example, RNA has emerged during the past decade as a key controller of genome function, yet very little information on small RNA function in monocot species is currently available. Brachypodium distachyon (a genetic relative of wheat, barley, and switchgrass) has recently emerged as a premier model for studying how genes function in more genetically complex temperate grasses because of its simple growth requirements, rapid life cycle, small size, and relatively simple "genome," or catalogue of hereditary information. This study will use the model grass,

Brachypodium, to fill the significant gap in knowledge that exists for monocot grasses such as wheat, barley, oats, and switchgrass. Ultimately, this new knowledge will benefit Missouri's agriculture and biofuels industry through higher yields for these crops and more efficient energy conversion.

**Project # 13243: Grape Polyphenols: Potential for New Commercial Products and Enhanced Plant Health**  
**Award Amount: \$897,955**  
**Program Area: Gateway Fund**  
**Center for Excellence: Springfield**  
**Lead Investigator: Laszlo Kovacs, Missouri State University**  
**Collaborators: Wenping Qiu, Missouri State University**  
**Richard Biagioni, Missouri State University**  
**Paul Durham, Missouri State University**  
**Daniel Schachtman, Donald Danforth Plant Science Center**  
**Oliver Yu, Donald Danforth Plant Science Center**

Grapes synthesize a plethora of polyphenolic compounds (such as tannins and lignins), many of which improve the health of both the plant and the human who consumes it or its product (e.g. wine or juice). This study will focus on two varieties, Norton and Cabernet Sauvignon, the former of which is the most prominent wine grape in Missouri. The project scientists will work to identify the individual compounds, or classes of compounds, that provide the health benefits provided by grapes and grape products. The resulting information will lead to the development of novel high-value grape products, such as wines, food supplements, and herbal condiments with scientifically-proven dietary value. This research project will also identify genes that direct polyphenol synthesis in the berries that respond most effectively to plant pathogens or diseases. Knowledge acquired from these studies will lead to healthier fruit products and hardier plants, resulting in improved human health and lower fungicide usage in Missouri vineyards.

**Project # 13254: Identification of Functional Replication and Transcription Linked to Residues for Chromatin Assembly by Histone H3 Proteins in the Corn Smut Ustilago and the Yeast Saccharomyces**  
**Award Amount: \$318,624**  
**Program Area: Plant Science**  
**Center for Excellence: Kansas City**  
**Lead Investigator: Jakob H. Waterborg, University of Missouri-Kansas City**

Fungi are often serious plant pathogens which threaten and diminish agricultural crops. In order to control fungi related diseases better, and to learn how one can directly interfere with or change fungal actions, control of gene expression must be better understood. This study uses Corn Smut, a fungal disease that infects corn, as a model. It seeks to understand the role specific histones (spools around which DNA winds) play in growth and development of the fungus. This basic research could eventually lead to applications to guard corn and other important cash crops from fungal diseases.

**Project # 13246:** **Novel Therapeutic Strategies for the Treatment of Eye Diseases in Animal**  
**Award Amount:** **\$312,273**  
**Program Area:** **Animal Health**  
**Center for Excellence:** **Kansas City**  
**Lead Investigator:** **Ashim K. Mitra, University of Missouri-Kansas City**

Topical administration is the most preferred and convenient route for treatment of veterinary eye diseases. However, drug levels absorbed by the eye for most topically applied drugs are less than one percent of the applied dose. Obviously this is an inefficient treatment method. The objective of this research project is to develop drug delivery strategies to significantly improve eye absorption of topically applied veterinary drugs such as erythromycin, prednisolone, acyclovir and bimatoprost for the treatment of bacterial keratitis, inflammations, viral corneal keratitis, and glaucoma. With these grant funds, scientists will continue research on a drug that, when added to eye medicine, results in greater solubility and eye absorption. In addition, a drug is being tested that uses microscopic particles suspended in a gel solution to increase the time the substance resides on the eye and sustains the release of the drug. This strategy allows a single treatment application for one week therapy, causing much higher efficacy of the applied medication, particularly in companion animals.

### **Funding Summary - Commercialization**

<b>Commercialization Proposal #</b>	<b>Recipient</b>	<b>Project Title</b>	<b>Program Area</b>	<b>Funding Allocated</b>
13323	Mid-America R&D Foundation	Commercialization of Value-Added Food-Grade Soybean Lines Developed by the University of Missouri and New Generation Functional Food Ingredients and Plant-Made Component for Nutritional Retail Products	Gateway	\$738,281
13324	UMC	Commercialization of a Proprietary Bull Fertility Test	Animal Health	\$400,000
13319	Donald Danforth Plant Science Center	Polyhydroxyalkanoates in Transgenic Oilseeds	Plant Science	\$1,136,719
13320	DT Search and Designs LLC	Animal Waste Phosphorous Management Systems	Odor Abatement, Water Quality, Bioenergy	\$325,000
			<b>TOTAL</b>	<b>\$2,600,000</b>

## **Commercialization Project Summaries**

<b>Project # 13323:</b>	<b>Commercialization of Value-Added Food-Grade Soybean Lines Developed by the University of Missouri and New Generation Functional Food Ingredients and Plant-Made Component for Nutritional Retail Products</b>
<b>Award Amount:</b>	<b>\$738,281</b>
<b>Program Area:</b>	<b>Gateway Fund</b>
<b>Center for Excellence:</b>	<b>Statewide</b>
<b>Lead Investigator:</b>	<b>Alex Stemme, Mid-America Research and Development Foundation, Jefferson City Henry T. Nguyen, Missouri Soybean Merchandising Council Chair and Director at the National Center for Soybean Biotechnology, University of Missouri-Columbia</b>
<b>Collaborators:</b>	<b>W. J. (Bill) Cook, Missouri Food and Fiber Ryan Schmidt, Soy Labs, LLC David A. Sleper, National Center for Soybean Biotechnology J. Grover Shannon, Delta Research Center, UM Richard J. Hofen, University of Missouri-Columbia</b>

This project seeks to commercialize several lines of food-grade soybeans that have been developed by University of Missouri research scientists. These genetic lines have novel and desirable characteristics such as high protein content, large seeds, and low saturated fat levels. These proprietary soybean varieties will be processed in Missouri into a variety of “functional food” ingredients (functional foods have significant health or disease fighting properties) and nutritional retail products.

This project will establish Missouri as the nation’s leading center of plant science research related to heart-healthy soy protein and functional food products, building on the success of the University of Missouri and its National Center for Soybean Biotechnology. The project also assists in creating and developing a new commercial research institution, AgBorn Genetics, LLC (AgBorn). It will also attract and further develop the commercial firms, Revolutionary Ingredient Technologies, LLC (RevingTech) and Soy Labs, LLC (Soy Labs). Ultimately, the project will deliver new, Missouri-born plant science technologies to the commercial marketplace in the form of functional food ingredients and nutritional retail products.

<b>Project # 13324:</b>	<b>Commercialization of a Proprietary Bull Fertility Test</b>
<b>Award Amount:</b>	<b>\$400,000</b>
<b>Program Area:</b>	<b>Animal Health</b>
<b>Center for Excellence:</b>	<b>Statewide</b>
<b>Lead Investigator:</b>	<b>Peter Sutovsky, University of Missouri-Columbia</b>
<b>Collaborators:</b>	<b>David Patterson, University of Missouri-Columbia</b>

This proposal seeks to commercialize a new, patented bull fertility test that will improve reproductive health and performance of dairy and beef bulls, thus adding to the bottom lines of many Missouri dairy and beef cattle producers. Current fertility evaluation in bulls is based on subjective methods introduced in the 1950’s. The test that is the subject of this grant represents an accurate, inexpensive, and commercialized viable approach to improving efficiency in this

area. This method centers on detection of sperm surface molecules that are found only in defective sperm cells, which provides a quick evaluation of bull fertility and diagnosis of reproductive disorders. Three technologies will be commercialized: 1) veterinarian's office fertility test kit; 2) reference laboratory service for bull fertility testing; 3) nanotechnology based semen purification kit to serve artificial insemination companies. Funding from this grant will be used to develop and commercialize second prototypes for the first two technologies and to develop a first prototype for the third technology. A start-up company spun off by the University of Missouri, or licensing to a Missouri-based animal health/artificial insemination company will be pursued as avenues for commercialization.

**Project # 13319: Polyhydroxyalkanoates in Transgenic Oilseeds**  
**Award Amount: \$1,136,719**  
**Program Area: Plant Science**  
**Center for Excellence: St. Louis**  
**Lead Investigator: Jan Jaworski, Donald Danforth Plant Science Center**  
**Collaborators: Edgar Cahoon, Donald Danforth Plant Science Center**  
**Joseph Jez, Donald Danforth Plant Science Center**

Polyhydroxyalkanoates (PHA) are polyesters that are produced by microbes. Their physical properties and environmental benefits are uniquely suitable for industrial and medical use as biobased, sustainable and biodegradable plastics. This project is collaborative between scientists at the Donald Danforth Plant Science Center and Metabolix Inc. based in Cambridge, MA. Metabolix is a winner of the "Presidential Green Chemistry Award" for the development of PHA in plants, the focus of this commercialization project. The work funded by this grant will develop the technological foundation for efficiently producing these biomaterials in non-food crops and Metabolix scientists will be located at the Nidus Center for Scientific Enterprise in St. Louis. The project objectives are to produce bioplastics in transgenic oilseeds as a value added feedstock for biodiesel biorefineries.

**Project # 13320: Animal Waste Phosphorous Management Systems**  
**Award Amount: \$325,000**  
**Program Area: Odor Abatement, Water Quality, Bioenergy**  
**Center for Excellence: Kansas City**  
**Lead Investigator: Bill Junk, DT Search & Designs, LLC**  
**Collaborators: Dean Thompson, DT Search & Designs, LLC**  
**Gina Becker, Advanced Manufacturing Institute**  
**Sigifredo Castro, Advanced Manufacturing Institute**  
**Bret Lanz, Advanced Manufacturing Institute**  
**Kylo Heller, KLA Environmental Services, Inc.**  
**Frank Mercurio, KLA Environmental Services, Inc.**  
**Rick McKee, Kansas Environmental Management Associates**

EPA (Environmental Protection Agency) regulations require CAFO's to balance the waste nutrients they apply to crop land. Typically phosphorous is the most limiting factor. The recent surge in ethanol production has increased the amount of distiller's grain (an ethanol byproduct) available for use as a feed ingredient. DDGs (Dried Distiller's Grains) have been shown to increase the amount of phosphorous in animal waste by as much as 120 percent. This, coupled with the EPA waste application requirements, will require feedlots and dairies to either acquire more land or greatly reduce the use of DDGs. In most cases, additional land is unavailable.

Therefore, the only alternative is to decrease the phosphorus concentration in the waste, thereby allowing the CAFO to comply with EPA regulations and expand the use of DDGs. This project will demonstrate an economical, user-friendly system that significantly lowers phosphorous concentrations in lagoon wastewater. Funds will be used to construct a farm-scale, pilot phosphate reduction system for lagoon wastewater on Concentrated Animal Feeding Operations (CAFO's) that smaller-scale versions show reduce phosphorus levels by at least 75 percent.

## Project Summary

**Total Grant Funding:                   \$13,100,000**

**Total for Research:                   \$10,500,000**

Centers for Excellence	Requested Research Funds	# of Requested Projects	Awarded Research Funds	# of Awarded Projects	% of Available Funds Awarded
Kansas City	\$ 7,116,890	12	\$ 2,650,915	5	25.2%
Springfield	\$ 1,606,315	3	\$ 950,908	2	9.1%
St. Louis	\$ 4,210,849	1	\$ 2,989,703	1	28.5%
Statewide	\$12,962,501.33	18	\$ 3,908,474	2	37.2%
<b>Subtotals</b>	<b>\$25,896,555.33</b>	<b>34</b>	<b>\$10,500,000</b>	<b>10</b>	<b>100%</b>

**Total for Commercialization:       \$2,600,000**

Centers for Excellence	Requested Commercialization Funds	# of Requested Projects	Awarded Commercialization Funds	# of Awarded Projects	% of Available Funds Awarded
Kansas City	\$2,559,640	3	\$ 325,000	1	12.5%
Springfield	\$ 500,000	1	\$ 0	0	0%
St. Louis	\$1,326,775	1	\$ 1,136,719	1	43.7%
Statewide	\$4,586,459	4	\$ 1,138,281	2	43.8%
<b>Subtotals</b>	<b>\$8,972,874</b>	<b>9</b>	<b>\$2,600,000</b>	<b>4</b>	<b>100%</b>

## Awards Summary

Center for Excellence	Total Awards	Total Projects Awarded	Total % of Funds Available
Kansas City	\$ 2,975,915	6	22.7%
Springfield	\$ 950,908	2	7.3%
St. Louis	\$ 4,126,422	2	31.5%
Statewide	\$ 5,046,755	4	38.5%
<b>Total</b>	<b>\$13,100,000</b>	<b>14</b>	<b>100%</b>

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