



# MISSISSIPPI

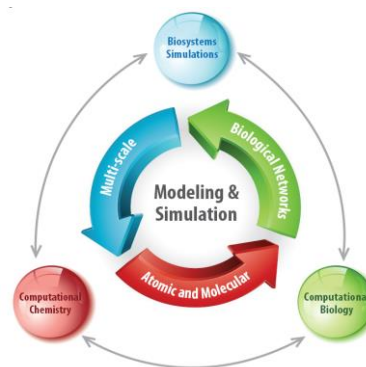
# EPSCoR

Working to develop a critical mass of faculty at research universities with expertise at the intersection of biosciences and high performance computing. Since 1989 NSF EPSCoR has contributed approximately \$56M to Mississippi in direct funding. The four research institutions in the State have provided the 20% mandated cost share. This funding allows cross-cutting research that addresses common problems in modeling and simulation across the three focus areas as indicated in the diagram to the right.

## SCIENCE AND ENGINEERING

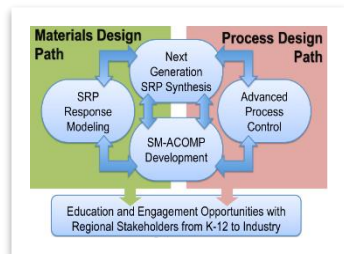
Mississippi's NSF EPSCoR RII Track I grant focuses on promoting integrated research in modeling and simulation of biologically relevant complex systems across multiple levels of scale ranging from nanoscale to whole organism.

*Modeling and Simulation of Complex Systems* addresses three critical focus areas—biological systems simulation, computational biology, and computational chemistry. Technologies from these three multidisciplinary areas are being integrated to address emerging scientific and workforce development challenges. Researchers from diverse fields are collaborating on complex multidisciplinary problems such as predicting the effects of inhaled nanoparticles and developing novel biomaterials, training students who will become the next generation of research leaders, and building a computationally skilled workforce.



Mississippi research institutions have received two NSF EPSCoR Track II grants totaling over \$4M.

**Current** NSF RII Track II funding focuses on establishing the Smart MATerials Design, Analysis, and



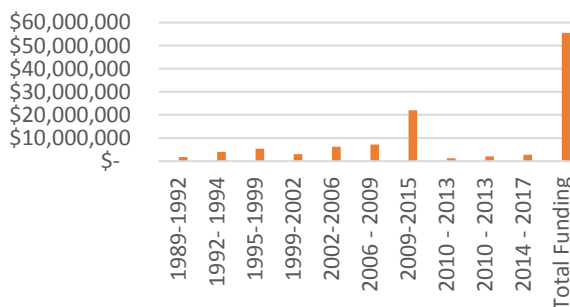
Processing (SMATDAP) Consortium. The consortium leverages cyberinfrastructure investments in Louisiana and Mississippi, regional intellectual talent in polymer synthesis and process control, and locally developed advanced polymerization monitoring technologies. This in turn accelerates stimuli responsive polymers (SRP) development to positively impact the economy. The key objective: to establish a sustained collaboration between LA and MS to solve nationally significant challenges in SRP discovery and manufacture, which the individual jurisdictions could not achieve on their own.

The **previous** funded NSF RII Track II grant focused on the Northern Gulf Coast to address the sustainability of economically important coastal fisheries, marine transportation, energy development and strategic national defense. Given the significance of these natural and built assets of this coastal region, and their vulnerability to natural and human disasters, the Northern Gulf Coastal Hazards Collaboratory (NG-CHC) was established.

## COMMERCIALIZATION

HumMod Integrated Whole-Body Physiology Modeling is a developed web-based, highly-accessible software and a dynamic mathematical macro-scale model of thousands of organ and organ systems describing circulation, respiration, metabolism, hormones, neural control, body fluids, and kidney and temperature regulation that allows scientists to build specialized physiological models in their area of interest. A domain name (<http://hummod.org>) has been purchased and serves as the site for dissemination of the simulation work done by researchers.

NSF EPSCoR Funding



## NASA EPSCoR IN MISSISSIPPI

All NASA EPSCoR projects are collaborations among multiple Mississippi universities. Mississippi's NASA EPSCoR program is managed alongside the Mississippi Space Grant Consortium (MSSGC), which was established in 1991 through NASA funding to the four Mississippi research institutions. Since then, the MSSGC has expanded to include all MS public universities, eight community colleges, and partnerships with educational institutions, industry and NASA Centers. The MSSGC mission is to (1) be a **gateway** to science, technology, engineering and mathematics (STEM) careers and activities for students and programs throughout all levels of education; (2) **enhance** aerospace and aerospace-related research opportunities at undergraduate and graduate levels; (3) **inspire** STEM students to pursue STEM careers; (4) **empower** the state's general public and community leaders through contributions to scientific literacy; and (5) **nurture** innovation that is Mississippi centric and globally aware.

### Efficient Space Communications

A new NASA EPSCoR grant (2014-17) supports a collaboration by researchers at the University of Mississippi, Jackson State University and the NASA Jet Propulsion Laboratory to address challenges in space communications.

Communications among such units as rovers, spacecraft, space stations, satellites and ground-based control centers are critical to the success of NASA exploration missions. This project addresses these challenges by developing innovative techniques and protocols to significantly improve space communication performance. In another project supported by NASA Research Infrastructure Development (RID) funds, researchers are developing new materials to better protect space communication components from radiation damage.

### Protecting Spacecraft from Debris

Another NASA EPSCoR grant (2012-15) is enabling engineers at the University of Mississippi and Jackson State University to design materials that will enable spacecraft to withstand impacts of fast moving space debris, tiny meteoroids, and sub-atomic particles.



UM senior civil engineering student Rachel Tutor weaving quasi-three-dimensional S-Glass fibers for high velocity impact composites.

### Preserving the Health of Astronauts

A collaboration among researchers at Tougaloo College, the University of Mississippi Medical Center (UMMC) and NASA's Johnson Space Center is addressing adverse effects of high-energy radiation on astronauts' vestibular balance and immune functions during long term space missions. In a separate project, collaborators from the UM Medical Center, Mississippi State University, and the Johnson Space Center are developing countermeasures against microgravity-induced cardiac risks to astronauts.



Bela Soni, (seated) former Ph.D. computational engineering student at MSU is now a full-time faculty member at JSU and continues her research to simulate models of the human body—particularly the lungs, working collaborative with MSU.

## WORKFORCE DEVELOPMENT

Developing a highly skilled technical workforce is critical to Mississippi's economic growth and participation in today's global economy. With EPSCoR support, a critical mass of faculty at research universities is being developed with expertise in the computational sciences, at the intersection of biosciences and high performance computing, one of Mississippi's embryonic and niche areas.

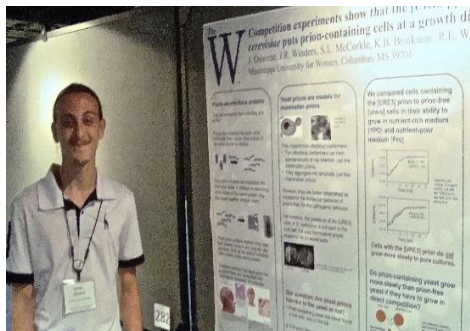
Computational sciences faculty, recruited through Mississippi EPSCoR, and students recruited to the computational sciences through integrated research and outreach efforts, are building the human capital necessary to provide Mississippi's workforce of the future.



The *University of Southern Mississippi's* (USM) recent renewal for the NIH INBRE brings the total amount of the grant – established in 2001 – to approximately \$52M. This

statewide network includes all five research-intensive institutions, six Partner Undergraduate Institutions and eight Outreach Institutions. The MS-INBRE represents the largest network of institutions in Mississippi with the mission to promote biomedical research and training in the State and to improve health in Mississippi.

Mississippi's INBRE supports a multidisciplinary research network with scientific themes in the areas of cancer, cardiovascular disease and infectious disease. As the state with the greatest incidence of cardiovascular deaths in the nation (50th rank), 46th rank for cancer and 35th rank for infectious diseases, these areas are of great interest to students and of vital importance to Mississippi and its health disparities populations.

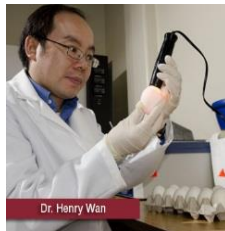


During the 7<sup>th</sup> Annual Mississippi NIH INBRE Research Symposium at the University of Southern Mississippi, participants interacted with students and faculty across the state of Mississippi. James Osbourne (left), 2014 Research Scholar, conducted research on infectious proteins or prions in Dr. Ross Whitwam's lab at Mississippi University for Women. His research explored the properties of the prions using simple baker's yeast. These prions in humans cause neurodegenerative diseases similar to Alzheimer's and Parkinson's disease. This past summer Osbourne presented his research at the National IDeA Symposium for Biomedical Research Excellence in D.C. which brings together researchers, professors and students from across the country to share ideas, network, form collaborations, and present their research.

## CENTERS FOR BIOMEDICAL RESEARCH EXCELLENCE (COBRE)

*Center of Research Excellence in Natural Products Neuroscience (CORE-NPN)* is a research and educational program at the *University of Mississippi* (UM) funded by NIH's National Institute of General Medical Sciences (NIGMS) IDeA program. Now in its second phase of funding, the COBRE program has been awarded almost \$17M since 2006. Funding allows investigators to conduct state-of-the-art research to identify components and properties of natural products that affect the nervous system. Divisions and departments involved in the program include Medicinal Chemistry, Pharmacognosy, Pharmacology, Pharmaceutics, Psychology, Biology, Chemistry, and Biochemistry.

*Mississippi State University's* (MSU) NIH COBRE funding allows faculty to further research on diseases that affect animal and human health. The research is conducted among three core centers at MSU: the College of Veterinary Medicine, the Institute of Genomics, Biocomputing and Biotechnology, and the Institute for Imaging and Analytical Technologies. Researchers focus on projects that promote a greater understanding of infectious diseases to protect the safety of animals, humans, and the food supply.



Mississippi State University's NIH COBRE funding is furthering research focusing on Influenza A viruses which have been responsible for large losses of life around the world and continue to present a great public health challenge. These viruses can cause infections in birds, sea mammals, lower mammals (e.g., pigs, dogs, and horses), and ultimately humans. Previous studies have demonstrated that the structures of the carbohydrate receptors determine influenza host and tissue tropisms. However, the distribution and composition of the endogenous receptors are not well characterized, and the distribution of such structures within and across the host species is not fully understood. The goal of this proposal is to understand the receptor profiles for influenza A virus in its natural hosts and to identify any novel receptor specificities for influenza viral infection.



## The Obesity, Cardiorenal, Metabolic Diseases Center (OCMDC)

The Obesity, Cardiorenal, Metabolic Diseases Center (OCMDC) at the *University of Mississippi Medical Center* in Jackson, MS is a part of the National Institutes of Health (NIH) supporting thematic, multidisciplinary *Centers of Biomedical Research Excellence (COBRE)* across the country through its Institutional Development Award (IDeA) program.

Cardiovascular, renal and metabolic diseases are inextricably linked and are the leading causes of mortality and morbidity in the United States, especially in Mississippi, which has the highest prevalence of these diseases. Advancing understanding of how to prevent, treat, and cure these diseases is of great interest to our students and of vital importance to Mississippi and its health disparities populations. The OCMDC supports four major research projects and several pilot research projects of junior investigators who focus on cardiovascular, renal and metabolic diseases.



### Project I - Cardiometabolic Regulation by CNS Mechanisms

Alexandre A. daSilva, PhD, Assistant Professor, Department of Physiology and Biophysics

### Project II - Differential Control of Metabolic and Cardiovascular Functions by Leptin

Jussara M. doCarmo, PhD, Assistant Professor, Department of Physiology and Biophysics



### Project III - The Role of MMPs in the Progression of Diabetes-Induced Renal Injury

Jan M. Williams, PhD, Assistant Professor, Department of Pharmacology and Toxicology

### Project IV - Role of Eicosanoids in the Progression of Renal Disease in African Americans

Albert W. Dreisbach, MD, Associate Professor, Department of Medicine, Div. of Nephrology



## Center for Psychiatric Neuroscience (CPN)

The Center for Psychiatric Neuroscience (CPN) is a multidisciplinary research group at the *University of Mississippi Medical Center* funded by an *NIH COBRE* award. The primary mission of the CPN is to facilitate the transition of junior faculty researchers into independent neuroscientists with major research grant support. The CPN emphasizes research dedicated to the generation of knowledge about the relationship between basic neurobiology and clinical psychiatry. This area of research, i.e. psychiatric neuroscience, is an exciting field that has contributed many recent major discoveries regarding the biological bases of behavior.

Postmortem Brain Core provides post-mortem brain specimens from psychiatrically characterized subjects and matched normal control subjects for studies of human brain biology.

Animal Behavior Core provides a centralized facility with equipment, expertise and testing procedures, as a central base of physical space, mentoring and technical approaches for investigators seeking a functional whole animal measure of CNS activity under normal and pathological conditions.

Imaging Core is a centralized base for state-of-the-art microscopes and related equipment with advanced capabilities in the visualization, quantification and interpretation of neuronal systems at the cellular level. Training and assistance are provided in the use of microscopic equipment and quantitative morphological techniques as well as the design of experiments, performance and interpretation of results and writing of manuscripts and grant applications.

Molecular and Genomics Core supports genetic based research initiatives across all university departments and centers by providing technical expertise in molecular biology, molecular genetics and genomics through access to state-of-the-art technologies, training and mentoring to enhance basic and clinical research related to psychiatric diseases.

