RESEARCH INCENTIVE PROGRAM

SUMMARY OF RESULTS

FISCAL BIENNIUM 2006-2007

OVERVIEW

During the 2006-07 fiscal biennium the universities eligible to receive Research Incentive (formerly Research Challenge) Program awards received funding totaling $34,900,000. These universities, using the funds to enhance research productivity on their campuses, made awards of $34,488,153 to their faculty, research staff, and graduate students. Through the summer of 2008, these awards have resulted in new external research funding to these universities of over $292,715,000, that is, for every $1 awarded by the Research Incentive (RI) Program to the universities, they were able to generate $8.39 from external funding sources to support their research efforts.

Highlights of each university's use of these funds as well as the results they achieved are summarized in the following sections. The complete reports submitted by the universities are on file at the Ohio Board of Regents offices.

UNIVERSITY OF AKRON

Although awards were made both to individual faculty and groups of faculty collaborating on a research project, the majority of funds in this biennium, approximately 59%, were used to assist new faculty in starting up their research efforts. Research Incentive awards also assisted in supporting 11 students who received their M.S degree and 17 students who earned a PhD degree. In addition, 79 scientific papers were published in peer reviewed journals by the individuals working under these awards, and 10 patents were filed by the university as a result of these research projects.

One project, initially funded with RI funds and now funded by the National Science Foundation, is studying sediment cores from Lake Bosumtwi in South Africa. The study, which has provided valuable insight into the underlying dynamics of hydrologic processes, has continually involved four undergraduate students. This research experience provides these students educational training far beyond the normal classroom setting, and makes the student more likely to succeed in graduate school or in future geosciences employment.

Bowling Green State University

The University has carefully invested its Research Incentive Funds primarily in supporting new faculty, interdisciplinary research leading to innovation, and in expanding research capacity. In keeping with the state's efforts to focus research funding, we continue to support and to stimulate the inter-institutional collaborations and interdisciplinary research that address the state's priorities.

One of the projects funded was to design and prepare materials that can change their optical properties in the presence of trace amounts of explosives in the air (~ 10 ppb), while a second part of the project focused on the development of a portable instrument that can harness the propensity of such materials to detect explosives and translate this feature into a clear and unambiguous warning signal. Such a portable detection system would consist of a miniature air pump to sample the air close to the ground or to the surface of objects such as cargo containers, which may be richer in explosive vapors. The pump would deliver the air samples to the proprietary material developed in this project, which changes its light-emission properties in the presence of explosive vapors.

The work on this project generated preliminary results that allowed us to successfully compete for federal funding, $800,000 in NSF-EXP funding. As a part of this NSF-funded research, we have discovered new technology that allows fabrication of a heavy duty shipping wrap to replace the currently used wrapping materials. Similar to safety features incorporated in banknotes, the new wrapping materials also has incorporated nanoscopic fibers showing a glowing blue color when exposed to black light. The same material is sensitive to explosive vapors, which extinguish the blue glow. This absence of blue light is then used as a warning regarding the presence of explosives.

Case Western Reserve University

Research Incentive funds were used to provide initial support for twelve interdisciplinary research projects that involved eight faculty members from two or more schools at Case. Several of these projects, such as the one involving faculty from biomedical engineering and medicine that focused on nanoparticle, mediated targeted delivery of anti-cancer agents, resulted in a successful grant application to the National Institutes of Health.

Funds were also used to develop core facilities that enable collaborative research activities of several faculty or provide much needed research equipment. In this regard, these funds were used to provide critical support to the Center for Stem Cell and Regenerative Medicine. The Center is conducting cutting-edge research which is

translating into clinical and commercial applications. Current clinical applications being investigated include heart disease, adult stem cell transplantation, cancer, genetic disorders, and neurodegenerative diseases such as multiple sclerosis. An $8 million award in 2006 from the State of Ohio's Biomedical Research and Commercialization Program further validated the Center's ability to achieve its mission to utilize human stem cell and tissue engineering technologies to treat human disease.

CENTRAL STATE UNIVERSITY

The Research Incentive program continues to be an invaluable resource for Central State University as it continues to build upon and expand its research capability. As proven in our success with a program supported by the National Nuclear Security Administration (NNSA) entitled, *Science, Technology, Engineering & Mathematics Upgrade and Outreach (STEM UP-OUT*), Central State's collaborative research capabilities within the STEM fields have been significantly enhanced.

The general objectives of the STEM UP-OUT Phase II Program are:

- To improve the quality of instruction in the CSU STEM curricula;
- To expand the academic and research capabilities of the CSU STEM Departments in areas of interest to NNSA and other organizations requiring STEM personnel;
- To increase the number of CSU students who continue on to graduate-level studies in professional fields of interest to NNSA; and to directly contribute to the mission of NNSA by providing an increased number of qualified, traditionally underrepresented minority science and engineering graduates for the workforce of NNSA and other organizations requiring staff with STEM backgrounds

UNIVERSITY OF CINCINNATI

Funding received from the RI Program continue to be critical for the success of the University of Cincinnati in obtaining significant extramural support from federal, industrial, private and Third Frontier sources. This support has been crucial for fostering development of innovative initiatives, enhancing the development of excellence and contributing to increased economic development in the region.

The Research Incentive Funds have been used for 4 basic functions:

- Recruitment and retention of world-class faculty
- Cost-sharing for extramural grant proposals and equipment funds

- Interdisciplinary research institutes/centers (with shared research cores)
- Undergraduate and graduate research programs

The College of Education used RI funds to support four major research foci in the College, two of which were a faculty-graduate student mentoring program and pedagogy research grant program. Faculty members in one college division, Criminal Justice, secured $1,622,213 in external grants and contracts during the 2005-2006 and 2006-2007 academic years. Much of these grant and contract awards were directly related to the research agendas of the faculty members funded by RI awards.

One of the initiatives of the College of Medicine funded with RI funds is (1) to support investigators in translating bench discoveries to bedside application by providing support for preliminary data for investigators who are initiating or changing directions of their careers so that they will be competitive in extramural grant submissions, and, (2) to support work directed at collecting preliminary data to support extramural grant applications for center or program project grants, training grants or areas in which there is a specific focus of interest in the College

CLEVELAND STATE UNIVERSITY

Among the projects funded by CSU's RI award was a collaborative study (CSU and University of Akron) designed to isolate, purify, and characterize metal binding proteins and their genes to advance knowledge of the mechanisms and control of metal accumulation. Heavy metal and other toxin contamination of the biosphere poses a major environmental and human health problem worldwide. Phytoremediation is a powerful method using plants to remove toxins from contaminated soils. It is especially promising for environmental clean-up, because other approaches such as treatment with chemicals or excavation of soil are often ineffective or very expensive. Certain plants, such as the dwarf sunflower, *Helianthus annuus*, are able to extract and accumulate metals from soil at much higher than average levels compared to many other plants. Sunflowers were the first flowers that grew at Chernobyl after the nuclear disaster and since then have been used for remediation of radioactive soils. Not only are plants useful for cleaning soils, the plant material can be harvested and compounds such as heavy metals can be recovered and reused. The cleaned soils are then available again for agriculture, park areas for recreation or other functions without posing a threat to human health. So from a technological as well as a medical point of view phytoremediation is an important tool. The project proposed that phytoremediation would be useful especially in Northeast Ohio where major industry-caused contamination is present. However, the molecular mechanism of plants to accumulate

and store toxins is poorly understood. By studying the phenomenon of metal accumulation as a physiological event, science could learn more about fundamental processes such as metal take up, selection, transport and sequestration, a process that also is important for trace elements needed by the plant. The project seeks to identify key proteins and their genes making it eventually possible to improve the accumulation potential of plants by genetic engineering.

UNIVERSITY OF DAYTON

One of the major uses of RI funds during this biennium was to further enhance and develop our collaborations with neighboring institutions in supporting the research initiatives of the State of Ohio and the Dayton-Miami Valley Region. Outreach to and partnerships with the community, industry, and other universities in the state are facilitated through our strong partnerships with these organizations.

One of the projects supported with RI funds was to develop an early, sensitive molecular marker to evaluate biocompatibility and toxicity of Nanomaterial. The impact of this work will reach beyond the establishment of a simple effective molecular marker for evaluating the mutagenic effects of NM on living cells. NM have enormous potential to revolutionize many fields and are currently being developed for diverse applications. As their use becomes more widespread, human exposure will necessarily increase. The potential hazards of NM are only now being identified, and there is a growing need for systematic toxicity and mutagenesis studies. The studies being conducted carry the potential for significant contributions in several fields of study in addition to medicine and health-related applications. This study is the first example to elevate the toxicity of NM including DNA damage response, cell proliferation, and cell death could provide a sensitive, early detection molecular marker to evaluate biohazards at Nanoscale material work sites. It also could be used as a sensitive means of evaluating new protective equipment, engineering control technology, and work practices to reduce the risks of occupational hazards. The project has now received support from the Air Force.

KENT STATE UNIVERSITY

Kent State University distributed its 2006/07 Research Challenge Funds to support projects in accordance with the Ohio Plan and KSU Institution's Plan for Use in biotechnology/bioinformation/biopreparedness, materials science, information science and social sciences. Proposals covering other STEMM areas also earned special consideration. Proposals demonstrating strong collaborative components were granted special priority.

One project supported was entitled *LIGHT-HARVESTING SEMICONDUCTING DISCOTIC LIQUID CRYSTALS FOR ORGANIC NANOSTRUCTURED PHOTOVOLTAICS: NEW OPPORTUNITY AND NEW CHALLENGE*. A team of Kent State scientists successfully designed and synthesized a series of novel nanoscale liquid crystalline porphyrins for organic nanostructured photovoltaics. These materials can be exceptionally homeotropically aligned into a highly ordered nanostructure in which the columns formed by intermolecular π-π stacking are spontaneously perpendicular to the film substrate. It is worthy to note here that the homeotropic alignment is extremely important for photovoltaic applications since this favorable molecular arrangement can provide the most efficient path for electrons and holes along the columnar axis and the light-harvesting molecules are arranged with the largest area toward the coming light. The research provides new and efficient pathways to the development of organic photovoltaics by a using homeotropically aligned crystal thin film. This award was leveraged to secure $630,000 that involved collaboration with industrial partners, with $550,000 of these funds being NSF SBIR/STTR research with Kent Displays, Inc. in Kent, Ohio. Scholarly outcomes from this research includes one chapter and four peer-reviewed publications, two US patents and one international patent, and six invited presentations at national and international conferences. Three graduate students were directly involved in the research and contributed in the preparation of the publications.

MIAMI UNIVERSITY

Since Miami University receives funds for “Incentives for Collaboration”, we have highlighted the program areas where those funds have been spent. These funds help 10 new faculty start their research programs. In addition over 20 faculty received funds to start new centers or initiate collaborations with industry or other Ohio institutions. All funding are aligned with the State of Ohio’s Third Frontier Program. Research Incentive funds are an important factor in our efforts to increase external funding for research at Miami University. As a result, external funding has increased in each of the past five years, and we expect that trend to continue.

On project funded was a proof-of-concept study for “developing an embedded sensor/actuator network for system identification, structural health monitoring and control by utilizing the external measured data set and by using inverse analysis”. The project tested whether embedded sensors can utilize vibration data collected from engineering structures for Structural Health Monitoring (SHM). The project also developed mathematical models and solution strategies related to the technology

developments necessary for successful SHM and Vibration Control. Some recent activities and accomplishments of this project include:

(a) In order to formulate the future research consistent with the requirements of the Air Force Research Lab (AFRL) the faculty investigator has presented his ideas and solution approach as a White Paper. Due to their active interest in Non-Destructive Evaluation (NDE) for corrosion/damage/material integrity characterization, he has conducted proof-of concept studies and presented results at the AFRL/AFMC and AFRL/RXLMP Directorates.

(b) He is working with local companies (Schneider-Electric (Square-D), Oxford, OH and EWI, Columbus, OH) and is in the process of conducting new experiments towards SHM of welded structures and NDE for weld characterization. As a result of this effort they have submitted a NSF GOALI (Grant Opportunities for Academic Liaison with Industry) with Schneider- Electric (Square-D).

(c) This research idea was shared with the SIMENS, Cincinnati, OH and a senior design project in the area of SHM/NDE entitled “Design of a Prediction Tool for Siemens Motors, Cincinnati” was successfully conducted by three undergraduate students. They are in the process of identifying second year design projects with SIEMENS and in formulating a long term collaborative mechanism with this company.

NORTHEASTERN OHIO UNIVERSITIES COLLEGE OF MEDICINE

Support of individual faculty projects was again the primary goal of the Research Incentive funding at YSU during this biennium, with the goal of leveraging these initial research efforts into support from external sources. As a result of this effort, NEOUCOM’s leverage ratio doubled since the last biennial report. Support by OBR Research Incentive monies led directly to a 5-year, $1.7 million NIH R01 award entitled, *G-Protein Coupled Receptors in Hearing Physiology.* In addition to this award, two other awards were received from NIH totaling over $280,000 and one from NSF to conduct collaborative research on the ecological and functional morphology of feeding.

Strategic use of RI funds to obtain core equipment supported the recruitment of our new NIH funded Chairperson of Integrative Medical Sciences along with two new outstanding junior faculty members.

OHIO STATE UNIVERSITY

Research Incentive funds play a vital role in helping the university meet the goals set out in its academic plan by assisting our faculty in obtaining extramural funding. Among the uses of these funds during the current biennium, OSU continued its efforts to develop a strong network of industrial partners, began a synergistic movement of the university in the area of materials research, and made additional investments in our strategic Targeted Investments in Excellence program.

In an effort to increase synergies in materials research at Ohio State, the Institute for Materials Research (IMR) was established in 2006 to serve as the gateway to the vast materials research enterprise at the university. The IMR is an interdisciplinary research center supported by the College of Engineering, the College of Mathematical and Physical Sciences, the Office of Research and the Office of the Executive Vice President and Provost. Representing more than 150 faculty and researchers from five colleges and more than a dozen departments on campus, the mission of the IMR is to create and sustain a coordinated, dynamic, world-class and state-of-the-art environment that fosters collaborative, interdisciplinary research in the science and engineering of materials that address the future needs of society. Research activities within the IMR range from the sub-nano to macro scales, from soft to hard materials, from basic phenomena to devices, and biology to agriculture, energy, communications, transportation and computation. The IMR coordinates existing and planned materials research activities, facilities and investments across the university. In the past year alone, the IMR guided development of 10 major external research proposals with total budget requests of $82,832,347. Of those 10, three awards have already been made, totaling $25,116,850, and an additional $21 million in proposals is still pending.

One of the strategic targeted investments this biennium was in the Public Health Preparedness Program. Recent threats of disease pandemics, bioterrorism, food-borne illnesses and natural disasters underscore the importance of public health preparedness in the United States. Worldwide, emerging and re-emerging infectious diseases have become a focal point of concern. The Public Health Preparedness team's research is expected to lead to improved detection, better monitoring, safer food, new diagnostic tools, therapies, and vaccines for human and animal diseases, including those resulting from bioterrorism and natural hazards. With the implementation of this program, Ohio State has the potential to become an international leader in public health preparedness.

OHIO UNIVERSITY

The seed money made available through Ohio Board of Regents Research Incentive program is an extremely important resource to seed the early stages of research. In today's environment it is virtually impossible to be competitive for funding without substantial preliminary results. The RI program continues to allow OU to enhance its research efforts. Two such efforts are described below.

The Center for Advanced Materials Processing has been working on the development of low cost, light weight, conducting polymer composite with improved strength to be used in applications such as corrosion resistant electrodes, static discharge panels, and electromagnetic shielding. An RI award was used as matching funds to purchase an extruder/molder combination set to begin the project. Initial data resulted in successful proposals to both the Department of Energy and EMTEC for total funding of $240,000. A patent application for this technology has been filed by Ohio University. While polymers are currently the preferred materials for electrical insulation, many new applications are possible for a low cost conducting polymer. With data collected using research incentive funds, we were able to attract partners such as ASI based in Cedarville, Ohio, and Iten Industries based in Ashtabula, Ohio. The research and resulting partnerships have made Ohio University a leader in nano-composite electrode technology. Although many opportunities exist for nano-composite electrode technology, electrostatic precipitator (ESP) applications offer results that are attractive to everyone, cleaner air. In 1998, researchers from Ohio University developed a new generation of efficient novel ESPs by using polymer materials for all kinds of ESPs, new and retrofitted. The downside of the use of polymer components is that they are electrically non-conducting. To operate a polymer electrode based ESP, a conducting polymer is needed. Our research demonstrated that a strong, conducting product can be made at a much lower cost by adding fiberglass and nanofibers to a polymer resin. In cooperation with Ohio based partners, research continues to explore opportunities for additional cost effective commercial applications.

Research Investment support allowed a faculty member to venture into an area in which she had no prior research expertise, designing synthetic genes and expressing them in plant cells. From work arising from this initial seed money, she generated two NSF awards ($475,190), 3 USDA awards ($200,000), a Herman Frasch award ($80,000), and generate 44 patents/patent applications. Negotiations are currently in progress on a large licensing deal that is expected to be signed this month.

SHAWNEE STATE UNIVERSITY

Research Incentive funds have been instrumental in encouraging faculty research at Shawnee State. As our institutional goals change in response to the Chancellor's Strategic Plan, it is clear that we will have to play a more prominent role in the area of research, especially in collaboration with local businesses and industry. We are confident that past and continued support through the Research Incentive Program will help our institution to make the transition into this new era of Ohio's education system.

With the help of RI funds Shawnee State has continued its membership in and support of the Ohio Biological Survey (OBS). By cooperating with the professional staff of the 114 member organization, OBS gathers and disseminates objective scientific and technical information concerning the flora and fauna with which we share the Ohio, regional, national, and international environment. The data received from OBS is used for research and education purposes on projects related to Ohio's natural environment. Faculty also compete for small grants from OBS, participate in larger grant funded projects and nominate students to serve as interns on various research projects.

UNIVERSITY OF TOLEDO

Since the Medical University of Ohio merged with the University of Toledo as of July 1, 2007, this one report covers both institutions' activities using Research Incentive Program funds for this biennium. The funds awarded through the RI Program have been vital in the development of projects that have secured funding from both federal (NSF and NIH) and small business sources. These funds are helping to advance the University of Toledo and Ohio's reputation in developing areas of research and also hold promise in advancing the generation of businesses and jobs in northwestern Ohio.

Using the funds from a RI award, a research group focused on two applications of ionic liquids that have the potential to be of commercial interest. The first goal was to develop methods of incorporating ionic liquid-based extraction solvents into microextraction devices. Analytical microextractions are extremely important in the pharmaceutical industry as they can quickly detect any trace impurities that result from a pharmaceutical formulation or modification. The researchers focused particularly on developing unique ILs that have the capability of dissolving molecules of interest (i.e., starting materials from common pharmaceutical reactions, esters and fatty acid methyl esters commonly found in flavors and fragrances, and by-products produced from gasoline combustion). The preliminary results from the RI award led to a successful

application for an Early Faculty CAREER Award from the National Science Foundation. In addition, the research group currently has one patent pending related to this work.

The second goal of the research was to examine the unique role in which ILs can be used to solubilize or swell lignocellulose. The team's efforts were guided by the aforementioned approach in developing new ILs that are capable of swelling lignocellulosic biomass, thus making the biomass amendable for hydrolysis and fermentation into ethanol. This technology may have tremendous implications in biofuel research as it places Ohio in the forefront of this rapidly growing area of research. Currently, SuGanit Systems Inc. has licensed patents from the University of Toledo and is currently planning on carrying out scale-up experiments on the UT campus. This will enable both undergraduate and graduate students to be involved in a process that will revolutionize how alternative energy is produced and utilized.

WRIGHT STATE UNIVERSITY

Fifty-eight projects were funded during this biennium using RI funds. Thirteen of these were for promising new faculty hired in strategic areas for Wright State University. Thirty-three Early Start/Augmentation awards were made. This competition requires investigators to have submitted a proposal for external funding with first year costs exceeding $40,000. Five awards were made in the Major Collaboration competition. This competition is held on an ongoing basis with the aim of helping teams of investigators (including investigators from other Ohio universities) to prepare significant external proposals on the order of NIH Program Project grants. Finally, four awards were made under the Technology Commercialization competition, a program is intended to expand the benefits of Wright State University research accomplishments through technology development leading to commercial applications.

An Early Start/Augmentation award to support algorithm development for non-cooperative signal exploitation was extremely useful in the University's pursuit of multiple avenues of future funding. This research, with applications in academic, military and industrial arenas, helped to solidify major partnerships with the Air Force Research Laboratory, The Ohio State University, and industrial contacts. Through the Wright Brothers Institute, we have received more than $400,000 in Air Force funding for the project entitled *Multi-Sensor/Multi-Modal Sensor Development and Algorithm Research for Urban Vigilance*. More recently, we have partnered with The Ohio State University in their multi-million dollar contract for the *Center for Automatic Target Recognition*.

A Major Collaboration/Infrastructure award was made to partially support the development of three interdisciplinary collaborations in which advanced data management and analysis expertise can play a key role in addressing significant challenges of biomedical research. Preliminary work by collaborative teams of life science researchers and computer scientists facilitated the submission a successful grant application to the National Heart, Lung and Blood Institute. The proposal entitled "Semantics and Services Enabled Problem Solving Environment for *Trypanosoma cruzi*," will provide $1.6M over a four year period to develop and demonstrate a novel ontology-driven semantic problem-solving environment (PSE) for *T. cruzi*. The project involves active collaboration with the National Center for Biomedical Ontology (NCBO) located at Stanford University and with researchers at the University of Georgia.

YOUNGSTOWN STATE UNIVERSITY

Youngstown State University made investments using Research Incentive Funds in research centers, individual faculty projects, and collaborative infrastructure/facilities during this biennium. Several examples of these investments are given in the following paragraphs.

One individual project funded was the study of ways to release the energy stored in nuclear isomers. Nuclear isomers have the potential for use as long-life power sources for a variety of specialized applications. This research project is focused on finding ways to "turn-on" the energy inside the isomers. This research group, including not only a faculty member, but also teams of undergraduate and graduate students, collaborates with several high energy national research laboratories in this country as well as abroad. They have recently been awarded a $1M grant from the Department of Defense to continue their research.

RI funds were also used to continue to support the PACER (Presidential Academic Centers for Excellence in Research) Program. During this period four centers were supported:

- Center for Advanced Numerics, Complexity, and Networking
- Center for Environmental Monitoring and Restoration
- Center for Hydraulics Research and Education
- Electromagnetic Field Research and Instrumentation Center

Use of "Incentive for Collaboration" funds is specifically oriented toward projects that provide broad access to YSU instrumentation facilities through the internet. Access to Internet 2 for high speed data transfer and remote control of instruments for specific

research groups are examples. YSU has taken the lead for several years in establishing a national network of smaller colleges and masters degree universities who can share access to analyzed chemical instrumentation at YSU and other institutions.