

## SC INBRE: A CATALYST FOR BIOMEDICAL RESEARCH DEVELOPMENT IN SOUTH CAROLINA

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### INTRODUCTION

At the very core of a university's mission is the process in which research - the generation of new knowledge - in a given discipline is coupled with the teaching of that discipline to students. This is true for the sciences, as well as for the arts, where technical and artistic limits are expanded by the scholarly work conducted by professors/mentors and their students.

The integration of research with teaching is traditionally at the center of graduate education, while undergraduate learning is still perceived as being primarily classroom-based, particularly by the public at large. However, there is ample evidence that such integration can also occur at the undergraduate level, with considerable benefits to the student, the institution, and ultimately the community. In the scientific and technical arena, the benefits of integration of research with undergraduate education are tangible and well documented (1-5). These benefits are not limited to sharpening a student's skills in the chosen discipline: research training has far-reaching effects on the overall maturity, work, and life skills of the trainees, as well as on their satisfaction with their own undergraduate experience. Graduates who have been involved in structured research in their undergraduate studies are more likely to continue on to graduate school and become researchers, and also more likely to work in an area closely related to their major. These individuals perceive themselves as being more inquisitive, better equipped to tackle and resolve problems, and more confident in their own abilities and leadership (1-5). In addition, there is compelling evidence that undergraduate research training is an effective means to recruit and retain students, particularly minority students, in science careers (6-9). In short, research training is highly beneficial to the training of a workforce prepared to adapt and respond to the demands of a knowledge-based economy. Therefore, predominately undergraduate institutions are seeking to increase their offerings in terms of research training not only to compete for the best students, but also to provide a high quality education that is responsive to the demands of the marketplace.

Research universities act as catalysts for economic development by providing a trained technical workforce in their geographic regions. A thriving academic research enterprise also stimulates ties to other research-intensive institutions and industry. Federally funded research support, needed to build and sustain a research enterprise, goes to relatively few institutions and is confined to a limited number of states. The Experimental Program to Stimulate Competitive Research (EPSCoR) at the National

Science Foundation, and other federal agencies, is committed to a more equitable distribution of research funds and opportunities across the national landscape. Based on estimates by the 2003 Bureau of Census, the Carnegie Foundation, and the National Science Foundation, the 27 EPSCoR jurisdictions (including South Carolina) have 20% of the U.S. population and 25% of all research universities, which employ 18% of academic scientists and engineers in the country; yet only receive 10% of the total federal research funding. These schools also educate a large number of MS and Ph.D. level scientists and engineers who go on to postdoctoral positions at non-EPSCoR states. Therefore, EPSCoR support benefits not only the states and institutions that are targeted directly, but the entire research enterprise in the country, by increasing the size, quality, and diversity of the postdoctoral fellow applicant pool.

In the biomedical research arena, the NIH response to the congressional mandate for an EPSCoR-like initiative is the Institutional Development Awards (IDeA) program at the National Center for Research Resources. This program funds a single IDeA Network for Biomedical Research Excellence (INBRE) grant in each of the 23 IDeA states and Puerto Rico, and provides support for Centers of Biomedical Research Excellence (COBRE) at research-intensive institutions.

#### SC INBRE: GOALS AND STRUCTURE

SC INBRE is a network of academic institutions working together to develop the biomedical research infrastructure in South Carolina. INBRE provides support for target faculty having the capacity to build sustainable programs that can increase student participation in research, with particular attention to the recruitment and retention of underrepresented minorities in biomedical research. SC INBRE, a five-year, \$17.3 million program, began in 2005 building upon BRIN, a five-year program devoted to building research infrastructure at predominately undergraduate institutions (PUIs). The network has evolved over the nine years since its inception. Dr. John Baynes, the original Principal Investigator of BRIN, deserves much credit for this program which has far-reaching beneficial effects on the biomedical research infrastructure in South Carolina.

South Carolina's three Comprehensive Research Universities (CRUs) – the University of South Carolina (USC), the Medical University of South Carolina (MUSC), and Clemson University, serve as mentor institutions to build the biomedical research enterprise at four Predominately Undergraduate Institutions (PUIs) - Claflin University, the College of Charleston, Furman University and Winthrop University, within the network. Twenty-four designated “outreach” institutions are linked to the network by the SC INBRE Outreach Core (Figure 1). The Administrative Core of SC INBRE is housed under the umbrella of the SC EPSCoR/IDeA State Office. The SC INBRE Program Coordinator, Dr. Scott Little, is the Director of the State Office, in which both INBRE Administrative Core staff and SC EPSCoR administrative staff are housed. This arrangement keeps overhead costs to a minimum and enables cooperation and integration across the various EPSCoR and IDeA programs in South Carolina.

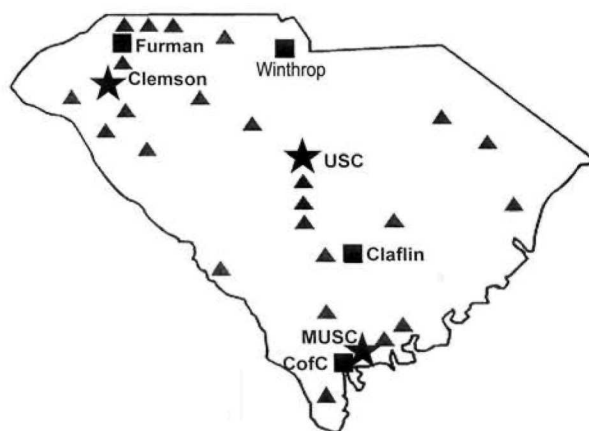


Figure 1: Seven institutions comprise the INBRE Network (stars: CRUs; squares, PUIs). The approximate location of outreach institutions is represented by triangles.

SC INBRE is built upon three specific aims: 1) development of research infrastructure for regenerative medicine at South Carolina's three CRUs, 2) development of biomedical research capacity at four PUIs; and 3) establishment of a statewide biomedical research network through bioinformatics and outreach cores. The network has established a "pipeline" for undergraduate students trained in the biomedical sciences (with particular emphasis on minority students) increasing the likelihood of matriculation into graduate programs in the biomedical sciences and the pursuit of scientific careers.

Salary and research support by SC INBRE provides target faculty with the means to build their research programs, create an environment in which to train students in research, and remain competitive beyond direct INBRE support. Target faculty receive course release time, and are asked to identify and work with research and career development mentors. Progress of target faculty toward their stated goals is monitored and encouraged by both institutional and statewide external advisory committees.

Support for CRU target faculty and core facilities fosters an increase in the number of investigators in the specific thematic area of regenerative medicine, building upon existing strengths and in accord with stated institutional goals for research enhancement. The goal, and condition for "graduation" from SC INBRE support, for a CRU target faculty is the establishment of an independent research program funded at the R01 level, or equivalent. Other important measures of success are the number and quality of publications produced, presentations given, and students trained, as well as evidence that the faculty members have established productive collaborations, and contribute to the overall development of a cohesive regenerative medicine research program in South Carolina.

SC INBRE support to PUI target faculty fosters the development of research educators equipped to provide their undergraduate students with well-structured and effective research training. The areas of research supported at the PUIs are not necessarily aligned with the regenerative medicine theme of SC INBRE, and in fact encompass a variety of themes and disciplines. Target faculty at the PUIs are also

expected to achieve research independence, in order to sustain programs initiated with INBRE resources. Research independence dictates a need for enhanced instrumentation, requiring sustained support of maintenance contracts and technical personnel. Faculty development at PUIs aims at enabling these faculty members to compete for extramural funding opportunities such as NIH/AREA, NSF/RUI, NSF/MRI and NSF/REU grants. Thanks in part to INBRE support, Furman University and the College of Charleston were able to submit strong applications to the Howard Hughes Medical Institute for major grants in support of undergraduate research programs (pending). An important measure of success for PUI faculty, in addition to publications and presentations, is clear evidence of increased undergraduate student participation in research, with student co-authorship in papers and presentations. Hence, SC EPSCoR/IDeA respects the character and traditions of PUIs, and does not seek to transform these institutions into comprehensive research universities.

An NIH required component of SC INBRE is a Bioinformatics Core to provide access to scientific literature and specific data analysis tools to all investigators and students throughout the network. The SC INBRE Bioinformatics core has evolved during the years, in response to the growing needs of network institutions. The BRIN Bioinformatics core had primarily provided access to the scientific literature and some data analysis tools to investigators at all network institutions. In addition to continuing those services, in the first two years of SC INBRE the Bioinformatics core has provided a host of workshops, training sessions, and scientific symposia (see also Dr. John Rose's article, in this issue). During this past year, the Core has evolved again, to add to its information support and training portfolio an active service component: the SC INBRE Biotechnology Core provides service and support for the conduction of experiments involving the application of genomics and proteomics methodologies, including gene expression analysis by any of the available microarray platforms and related data analysis services. The core taps into and augments the resources of existing genomics/proteomics facilities within the network, to bring the application of these state-of-the-art techniques within easy reach of researchers across the state (10).

#### SC INBRE: PROGRESS TO DATE

During the past three years, 30 faculty members have been targeted for INBRE support in South Carolina. Ten of these were new hires made possible by leveraging efforts and resources of EPSCoR and IDeA. These new hires are aligned with South Carolina EPSCoR/IDeA's strategy to develop the state's intellectual and scientific resources, by providing support for new junior faculty who bring with them expertise in specific areas not yet represented within our targeted areas of science and technology excellence. These investigators have produced 23 applications for extramural support, 11 of which originated at PUIs; and for the first time since the beginning of SC INBRE, faculty filed four patent applications, two licenses and two inventions across the network. Approximately 150 students, mostly undergraduate, have received research training in the past three years, and minority student participation in research has increased across the board, with several institutions (such as Winthrop University) exceeding their initial goals for minority student participation in SC INBRE supported research. SC INBRE administrative staff maintains a student tracking database used for program review and reporting purposes. These data will be used to prepare a competitive renewal of SC INBRE in 2009.

The Outreach Core provided summer research experiences for undergraduate students, collaborative faculty research programs, and postdoctoral academic career development (PACD). The PACD initiative, supported by INBRE and EPSCoR provides funding for one semester in the laboratory and one semester in the undergraduate classroom for selected postdoctoral fellows. This allows for increased exposure to the classroom for aspiring academic scientists, while also enhancing the research experience of undergraduate students. PACD scholars submit formal research, educational training, and career development plans for approval by the Outreach and Administrative Cores. The PACD initiative provided preliminary data used in two applications for postdoctoral training grants submitted to the NIH K-12 program: one from MUSC and Claflin University (funded) and the other from USC and Benedict College (pending). The Outreach Core has also provided support for research symposia and workshops, including the Annual Meeting of the South Carolina Academy of Science and the South Carolina Bioengineering Summit. Much of this support is in the form of travel for undergraduate students and invited speakers.

The success of SC INBRE, however, goes well beyond the numbers of faculty developed, students trained, and grants secured. SC INBRE has established a climate of cooperation, sharing of resources, and communication among network institutions that had traditionally operated in a somewhat insular fashion. The benefits of this shift are far reaching and their full impact on the biomedical research landscape in South Carolina will become much more evident with every year of implementation. In fact, one of the challenges for the SC INBRE administrative core is to track or measure the impact of the program, and communicate these results to the institutions, the NCRR and the public. Continuous evaluation and assessment of the program's impact is vital to our competitiveness for renewal of SC INBRE, and to the continuation of IDeA as a whole within NIH.

#### INBRE AS A CATALYST FOR CHANGE

The requirement for institutional commitment is key to the success of the program, because EPSCoR and INBRE are intended to stimulate sustainable change beyond the funding period. The \$17.3 million of federal INBRE support has been matched with over \$33 million in commitments by the participating institutions and the State. INBRE network institutions must fully embrace new research paradigms into their culture. Changes in the daily activities of faculty members and students involved in the program, the curriculum, and hours of research training are key metrics used for evaluation of the impact of the program. A shift in tenure and promotion criteria to encourage research and reward it properly is a metric for success. Tenure-track vs. non-tenure track lines, and working relationships within a department and with the higher administration all are subject to evaluation.

Compliance issues can be complicated and again require a high level of commitment by the institution. An essential step toward building research competitiveness is the establishment of necessary sponsored programs administration, including grants accounting personnel to ensure compliance with federal and state assistance regulations. The establishment and management of an Internal Review Board for research on human subjects, a Biosafety Committee, and an Institutional Animal Care and Use Committee are required for a participating INBRE institution.

In all cases, SC INBRE has served as a springboard for tremendous growth in biomedical research programs at network PUIs, with the addition of new faculty, the renovation of existing research facilities, and the implementation of new research training programs, all of which was made possible with INBRE funding and institutional resources.

It is evident that South Carolina INBRE has stimulated a profound change in research culture. The challenge, as we move forward, is to consolidate and sustain the newly developed culture and secure its future beyond the current funding period. Participating institutions are well aware of this challenge and, we believe, well equipped to take it on. We hope that other PUIs will participate in the competitive process necessary for renewal of funding for the South Carolina INBRE network.

Information about the SC INBRE and EPSCoR programs, including details on core facilities, programs, and resources available to faculty and students throughout the state can be found on the South Carolina EPSCoR/IDeA website at [www.scepscoridea.org](http://www.scepscoridea.org).

#### ACKNOWLEDGEMENTS

A sincere thank-you to the South Carolina EPSCoR/IDeA State Committee and their staff (Alysia Bridgman, Isabel Sanchez, Gray Ladd, and Lee Snelgrove); and the Office of Sponsored Awards Management at USC and staff member Andrea Ceselski. They do all the work needed to manage and evaluate SC INBRE, and provided us with the information needed to assemble this article. This paper was supported by the SC INBRE grant, 5P20RR016461 and NSF EPSCoR grant, EPS-0447660. The contents of this article are the sole responsibility of the Authors and do not represent the official position of the NIH or NSF.

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