

## The SUNY Oswego Global Laboratory

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Many studies have stressed the importance of graduating more students in the Science, Technology, Engineering and Mathematics (STEM) disciplines in order to maintain our nation's global competitiveness (National Academy of Sciences, National Academy of Engineering, and Institute of Medicine, National Academies Press, 2007). In fact the President's Council of Advisors on Science and Technology has called for an additional one million more STEM graduates over the next decade (PCAST report, 2012).

Such a goal requires renewed efforts at recruiting and retaining students in STEM. It is well established that involving undergraduates in research early in their careers has a beneficial effect on STEM retention (Seymour et al, 2004, Elgren et al 2006, Hunter et al 2007 and others).

In this article we describe efforts undertaken at the State University of New York at Oswego (SUNY Oswego) to increase participation in undergraduate research by faculty and students both on/off campus and abroad. This effort is completely in line with the SUNY Oswego vision statement that emphasizes engagement, academic rigor and a global perspective.

SUNY Oswego has a vibrant Summer Scholars program that emphasizes faculty and students, particularly freshmen and sophomores, to work together on 10 week long funded summer research projects on campus. Students and faculty collaborate to write proposals to secure this funding. This funding, from College alumni, amounts to roughly \$75,000/year and can be used for student/faculty stipends, research expenditures and equipment and travel. Additional support for undergraduate research is provided by the College in the amount of \$150,000 and is used for student and faculty stipends throughout the academic year. These significant funds, made available by the College, are powerful incentives for faculty to involve students in their research. In addition, every year, the College provides a housing scholarship for 6 weeks for up to 25 freshmen and sophomores.

Together with this, SUNY Oswego has initiated an innovative program that sends students abroad for research. The *SUNY Oswego Global Laboratory* sends students to leading research driven institutions around the world to undertake cutting edge research. Students are mentored by a faculty member from the host institution and are embedded in their mentor's research group. In some cases these research projects are in collaboration with Oswego faculty. Students can spend up to 10 weeks abroad. Students have undertaken research projects at the Federal University of Paraiba, Brazil, Federal University of Alagoas, Brazil, the University of Calcutta, India, the Indian Institute for Science, Bangalore, India, National Central University, Taiwan, amongst others.

Over the last four years, more than 130 students from around NY state have taken part in the *SUNY Oswego Global Laboratory*.

The projects undertaken include wetlands ecology, human computer interaction, protein genomics, biochemistry, astrophysics and epidemiology. The posters made by students can be viewed at [http://www.oswego.edu/research/global\\_laboratory/posters.html](http://www.oswego.edu/research/global_laboratory/posters.html).

SUNY Oswego has also provided research opportunities in Costa Rica, Democratic Republic of Congo, France, Sweden and Switzerland.

Funding for the *SUNY Oswego Global Laboratory* is provided by a mixture of external grants from agencies such as NSF, internal funding from alumni and host institutions, and private funding through Banco Santander. In the case of NSF grants, funding allows for airfare, accommodation for 6 weeks in the host country and a stipend of roughly \$1200 – a total funding level of about \$4000/student. In the case of funding through Banco Santander, all student expenses (airfare, accommodation, visas, health insurance) are covered with a further stipend of about \$1200/student. In the case of our placements at National Central University (NCU), Taiwan, SUNY Oswego and NCU both provide a scholarship of \$500/student – a total of \$1000/student. In addition, students going to a non-English speaking country for a significant length of time for academic study can get a GETGO scholarship that covers the return airfare through the SUNY Oswego Modern Languages department.

Students do receive academic credit for their Global Laboratory experience – in most cases this is a junior or senior level independent study of 3 credits that counts toward their degree and is on their transcript. Consequently, students are graded on their performance through consultation with their research mentor at their host institution.

The next pedagogical advance beyond undergraduate research is undergraduate research abroad, particularly in STEM fields. Participating students have transformational experiences, never leave STEM, and are very well equipped for the future with an international professional network. It is STEM retention and perseverance plus.

SUNY Oswego also strives to provide these opportunities to a very diverse group and thus has made major strides in broadening STEM participation. The SUNY Oswego Possibility Scholarship provides a completely debt free STEM education to academically talented students from NY State who are from socioeconomically disadvantaged backgrounds. These students have two funded research experiences: one on campus and one abroad through our Global Laboratory.

SUNY Oswego's CSTEP program helps students from diverse backgrounds succeed at College and obtain admission to licensed professions such as medicine. The program aggressively tries to involve its students in the College program such as the *Global Laboratory*. Over the last 4 years, over 40 CSTEP students have participated in the SUNY Oswego Global Laboratory. These experiences have been very useful for CSTEP students securing graduate admission in, for example, medical/dental/pharmacy school.

The Physics Department at SUNY Oswego has had external funding for research experiences abroad for the last 7 years. These have been concentrated in Astrophysics – firstly at the Federal University of Santa Catarina, Brazil and secondly at the National Central University, Taiwan. Recently we have formed strong collaborations with leading Astrophysics research institutions in India and have already sent two students to the Department of Physics and Astrophysics, University of Delhi, India to undertake research in the analysis of variable star data and the extra-galactic distance scale. These positions have been open to physics majors from across NY state: in the last 7 years we have had 38 students take part in 6 week long summer research experiences in Astrophysics either in Brazil or Taiwan or India.

Most liberal arts colleges have some sort of internal funding for undergraduate research. One way to start to develop an undergraduate research program is to use these funds to support some projects over the summer. Most liberal arts colleges will also have faculty with international connections. These two factors can easily be combined to start an initial project at a foreign institution. Most international institutions would welcome such undergraduate research visits: In 2011, the Department sent 6 students to the Graduate Institute for Astronomy, National Central University (NCU), Taiwan, for 6 weeks funded by the NSF. NCU decided to partially fund a further 10-15 SUNY undergraduate students to come to NCU in summer 2012. SUNY Oswego provided matching funds. Thus in summer 2012 no less than 17 undergraduate students from around SUNY came to undertake 6 week research projects in various STEM fields. Both SUNY Oswego and NCU benefited from this in different ways. SUNY Oswego was able to expand its Global Laboratory program whilst NCU was able to increase its international student involvement with some scope for recruiting international graduate students.

Thus a strategy for initiating an international research experience at a liberal arts college is to provide some initial seed funding and utilize existing faculty's international connections. Students undergo transformational experiences with important consequences for STEM retention and persistence.