

Research Provides Valuable Learning Experience for Undergraduates

It is very educational for students to perform undergraduate research under the direction of a faculty member as part of their undergraduate experience. The student learns many important and practical details that are often overlooked in the classroom and not contained



Professor Paul Berger

within a textbook. In addition, it partners an undergraduate student with a faculty member and provides an opportunity for one-on-one mentorship. It is also usually the first opportunity for the student to apply his/her budding engineering knowledge. The student gets first-hand experience that directly guides their post-graduate future. It can serve as a check-and-balance for the student in their decision making of which EE concentration pathway to choose in their sophomore/junior year. And, this choice will bias the student's future decisions and employment opportunities, so it must be made carefully. Thus, it must be an

amply informed decision and undergraduate research serves to identify these interests. Many undergraduate researchers go on successfully to graduate with their bachelors degree and either receive some top competitive job offers or enter graduate school for an advanced degree. Clearly, these students have the inside track versus their peers.

There are three ways for an undergraduate to participate. One is to take an Independent Study. Several credit hours are acceptable towards fulfilling any technical elective requirement. The second avenue is for the student to volunteer their services. But, the third and most successful is to be supported under an NSF Research Experiences for Undergraduates (REU). These take on two manifestations. One is as an REU Supplement to an existing NSF research grant or as a separate REU Site where a large group of REU students are collectively mentored. Sometimes limited internal funding is available at some institutions after a competitive selection process. The most productive use of the undergraduate students is to set aside about ten weeks during the summer recess and provide them with ample mentorship through a combination of faculty and graduate student oversight.

At Ohio State, Professor Paul R. Berger, is meeting this challenge head-on by heavily recruiting undergraduate researchers and including them in graduate level research. Over his ten years in academia, Berger has taken on a combined total of forty undergraduate researchers. Over the years, they have ranged from freshmen to seniors. Many of these students have graduated and entered graduate school seeking advanced degrees. One has even completed his Ph.D. degree and commenced as an Assistant Professor. See Berger's webpage for further details: <http://eewww.eng.ohio-state.edu/~berger/students.html>.

Since his relocation to Ohio State in 2000, Berger has mentored eleven undergraduate researchers and most recently seven undergraduate students participated in research over the 2002 summer. Berger has also been aggressive in reaching out to underrepresented groups to be included in this mentorship. This is important, because this is often the last academic level to achieve some balancing prior to entering the competitive private sector.

The research performed by the undergraduate students often

falls into four categories: (i) to expand the current semiconductor processing and characterization facilities by building new equipment and modifying or computerizing existing equipment, (ii) to model materials or devices using sophisticated software packages, (iii) to directly interact with graduate students on current research topics, and (iv) to initiate new avenues of research by first testing its viability. The later topic can be of great interest to the students, because it affords them the opportunity to investigate new pathways that are even more cutting edge than the sponsored research projects supporting the graduate students.

Berger's research group works on a variety of topics including ways to extend traditional Si CMOS microelectronics beyond the "brick wall" where no known solutions currently exist to realizing ultra-small transistors; new replacement technologies based upon quantum dots for computing at the single electron level after the demise of Si CMOS; and electronics and photonics based upon organic semiconductors for cheap and flexible devices that could be placed in displays and photovoltaic power supplies embedded in clothing or in SmartCards or other components for affordable distributed computing. Next year, Berger intends to be a role model by expanding his undergraduate research program to pool more EE faculty research groups by applying for an NSF REU Site that could foster 15-20 undergraduate researchers each summer.

Workshop Enhances Success



Each summer the OSU campus hosts a "Women in Engineering Workshop" aimed at improving the retention and success rate of incoming female engineering students. This summer 68 incoming freshmen participated. They spent a week on campus trying out various engineering activities in a variety of engineering departments. In Electrical Engineering, Professor Betty Lise Anderson led the group in designing and building a circuit that lights up their initials. Many of the students feel at first that they won't be able to complete this project, because they have never done anything like it before. But as the picture above shows, they always do succeed. In the process, they learn a little circuit design, get to exercise some engineering choices (like LED brightness versus battery life), learn how to solder and how to debug, and most of all learn to be less afraid of a challenge. The workshop is funded by General Motors and run by Lisa Abrams in the College of Engineering.