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# Northeastern University Young Scholars Program

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# The Northeastern University Young Scholars Program

www.youngscholars.neu.edu

RESEARCH EXPERIENCES for TEACHERS AT NORTHEASTERN UNIVERSITY

## K-12 Outreach

**Providing students and teachers and community college faculty an opportunity to be introduced to current research is central to the educational outreach of the Gordon Center.**
**The Young Scholars Program began in 1989 in response to a national shortage of qualified U.S. citizens moving into STEM careers. Resurrected in 2005 through support from The Noyce Foundation, the NU Young Scholars Program (NUYSP) addresses a critical recommendation made in the recent national report, "Rising Above The Gathering Storm," by providing expanded experiential learning experiences in STEM for K–12 students.**
**The model developed at NU has been refined over the past 17 years to become a comprehensive learning experience for program participants and staff. NUYSP offers future scientists and engineers a unique opportunity for hands-on experience while still in high school. It also provides faculty and graduate students the opportunity to mentor our next generation of STEM professionals.**
**The program seeks to maintain a balance between academic and social components, providing students an opportunity to build relationships with university students and faculty in addition to fellow participants. Our objective is to create and support a STEM community well beyond the six-week summer experience.**

**Summer research internships are also wonderful opportunity for teachers to participate in active research projects in professional laboratory settings. The Northeastern University Research Experience for Teachers Program (RET) began in 2001 and has provided summer internships for 58 participants to date. The success of NU's program lies in the ongoing collaboration between participating teachers and the university research community. RET teachers seize the opportunity to positively impact the lives and education of their students while deeping their own content knowledge. RET's across the coutnry are bridging the gap between K-12 educational requirements and cutting edge reseach by creating innovative classroms that surpass the traditional ambiance of the American Educational experience.**

## Young Scholars Program

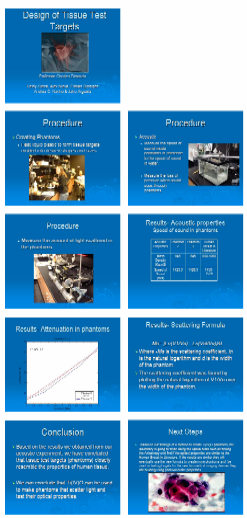
**Design of Test Targets for Biomedical Imaging**
**Professor Charles DiMarzio**
**Electrical and Computer Engineering**

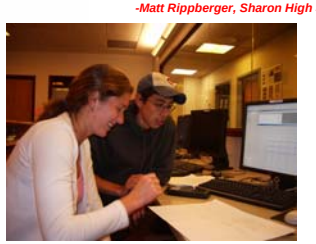
**Research Abstract**
**Biomedical imaging using the interaction of light and sound is a dual-wave sensing technique in which a diffusive photon fields interacts with a suspension of particles drive to coherent periodic motion by an imposed acoustic field. We are developing new techniques with the ultimate goal of imaging inside human tissue. Acousto-Photonic Imaging (API) is a particular application of this interaction between light and sound. A phase-modulated photon field emanates from the interaction region and carries with it information about the opto-mechanical properties of the insonated media. A technological barrier to API has been sensitivity since the flux of phase-modulated photons is very small and the incoherence of the resulting speckle pattern mandates sensing at the single-speckle level. A possible solution to this problem is to use a photorefractive crystal-based interferometry system to provide a reference wavefront that is matched to the wavefront that is scattered from the specimen, thereby providing a means of coherent detection over multiple speckles. There is a need of developing low-cost and effective test targets for pre-clinical testing of our new imaging methods. These targets have to resemble the optical properties as well as the acoustical properties of human tissue.**

**Research Activities/Experience**
**The research experience will involve the development and testing of targets (phantoms) using liquid plastic. We will have to measure the acoustic speed inside these phantoms using basic laboratory equipment.**
**We will also measure the optical properties of the phantoms using Titanium dioxide to resemble the scattering properties of human tissue.**
**With the experiment stated as above the students will explore the interaction of light and sound with human tissue and develop phantoms that will be of use in future experiments of the optical science laboratory.**

*"The Young Scholar's Program is a great way to spend your summer. It was incredible. I kept having these moments, especially in the lab, when I couldn't believe how lucky I was. It's a completely new experience to work in an actual lab. No matter what project you have, you will learn so much during the six weeks that you are at Northeastern. It's not just scientific learning. There is a lot of that, but there is another kind of education that goes on at the Young Scholar's Program. You learn how to wake yourself up, get yourself to work, and be responsible for certain tasks. In addition, it is a lot of fun. There are awesome field trips every Thursday, which take you to places like the Haystack Observatory and the Army Labs in Natick. And, of course, there was a trip to Six Flags at the end of the program. Getting paid is an added bonus. It's not like work. You don't just try to get through it; you actually enjoy what you're doing, and getting paid becomes of secondary importance.*
*No matter what kind of science you like, there is a lab at Northeastern that you will love. I was in a biology lab, and it was the best thing that ever happened to me. There's hardly a day that goes by when I don't think of YSP with nostalgia. It was the most fun I've ever had in my life. It's a great opportunity to make friends, and the friendships actually last, despite the distances that separate your homes. And, to top it all off, YSP helps you get a head start on the college admissions process, so you aren't filling out the forms and writing your college essay the night before it's due. It puts a perspective on the college life, by allowing you to work with college students as well as the professors.*
*Trust me, the Young Scholars Program is the best summer job you will ever have. It is fun, exciting, and... well, there are no words good enough to describe it! It's just too incredible for words!"*
*-Natasha Fedan, Belmont High School*

*"There are so many advantages the Young Scholars Program has over any other summer job. First off, learning to get around the great city of Boston, and feel what it is like to be a college student is fantastic. The people I met at the Young Scholars Program were all interesting and I found that I could relate to every one of them. As a senior in High School, college is always the subject of conversation, and the YSP definitely helped me get into gear. Not only did we go on field trips to Mass General, Natick Army Labs, and many others to introduce us to the many professions of the science/technology world, Ryan and Lindsay made us write some of our college essays and had them proofread by others you want to do is go out doesn't sound like fun, but trust me, it takes a huge load of pressure off come September; when all of your buddies are at home writing and stressing, you'll be out doing whatever you want to. Everybody in the program got to work on interesting projects and learned how to use state-of-the-art technology, as well as learn how to work in a real research lab. It's a completely different experience than the high school labs. An added bonus to the Young Scholars Program is the money. There are other programs like this, I am told, at MIT, but it costs $5,000 per summer. So, as well as doing interesting research and meeting interesting people, you get paid -- what's not to like about this? The YSP was an amazing experience for me, and I whole-heartedly recommend it to anybody who has the chance."*
*-Matt Rippberger, Sharon High School*



## Research Experience for Teachers

**Clean up of contaminated soils by bio-electrochemical techniques**
**Dr. Akram Alshawabkeh – Civil and Environmental Engineering**

**Research abstract**
**In-situ aerobic bioremediation processes are attractive, efficient and cost-effective methods that can be used widely for the clean up of contaminated groundwater systems. Successful implementation of in situ bioremediation is dependent upon the effective supply of electron donors/acceptors and nutrients into the porous medium. Microbial processes require an electron donor, macronutrients (e.g., nitrogen and phosphates), micronutrients, trace nutrients, and an electron acceptor. The availability of dissolved oxygen as electron acceptor, however, is considered one of the essential variables governing intrinsic aerobic biodegradation rate in soil and groundwater. Long-term addition of oxygen to subsurface systems presents an engineering problem because of the limited solubility of oxygen in water, the heterogeneity of soil, the preferential flow paths, and the limited hydraulic conductivity of fine-grained soils (e.g. less than 10-4 cm/sec). A possible method for increasing dissolved oxygen levels at contaminated sites is by electrolysis.**
**This research investigates the potential applications of direct current in enhancing in-situ aerobic biodegradation of contaminants. Direct current of few Amp/m2 is used to generate and inject dissolved oxygen into a low permeability soil by electro-osmosis. Once oxygen is generated at the anode, its progress throughout soil will be monitored. The microbial activity in the soil will be assessed and correlated to the travel rate of oxygen through the soil.**

**Research activities/experience**
**This study will involve using different measurement techniques, including Gas Chromatography (GC), Ion Chromatography (IC), Total Organic Carbon (TOC) analysis, Chemical Oxygen Demand (COD) analysis, and others. Biological activity assessment will involve bacterial culturing and maintenance techniques, microcosm studies and growth rate determination.**
**The participant is expected to work jointly with graduate students in the laboratory. He/she will need to ultimately develop an understanding in electrochemistry and microbial activities. The participant is expected to develop the skills of preparing environmental samples for analyses.**

## Connections to the Classroom

***With the ever-increasing focus on the environment, the addition of investigations into the remediation of contaminated soils and wastewater brings a "real-life" component to the science curriculum. While not all of the techniques used in this work can transfer to the classroom, aspects can be used. Students can investigate the conversion of an oil spill by oil-degrading microbes into masses of food and non-toxic living cells. Students can also investigate the effect of rain on a contaminated soil sample by tracking the level of iron contamination through spectroscopic means.***

**Research Experiences for Teachers at Northeastern University**
Claire Duggan, Program Director

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