The Bernard M. Gordon Center for Subsurface Sensing & Imaging Systems

Education Overview

Stephen McKnight
Education Thrust Leader

Claire Duggan
K-12 Outreach Coordinator

NSF Year Ten Site Visit
April 14-15, 2010
Gordon-CenSSIS Education Team

- **S McKnight, NU**
  - Education Thrust Leader

- **K Hicks, NU**
  - Partnership and Education Services Coordinator

- **M Ruane, BU**
  - Education Thrust Co-Leader

- **R Rodriguez-Solis and S Cruz-Pol, UPRM**
  - Education Thrust Co-leaders

- **B Yazici, RPI**
  - Education Thrust Co-leader

- **C Duggan, NU**
  - K-12 Outreach Coordinator

- **Paula Leventman**
  - Gordon-CenSSIS Evaluator and Diversity Coordinator
Curricular Innovations: CenSSIS Education Works at All Levels

Engineering Profession

Continuing Ed.

Grad.

Upper-class

Fresh

SSI Topics

"Distributed University"

Intro to SSI

Undergrad Research

Hi-Tech Tools & Toys

CenSSIS Scholars

K-12 Outreach

INU

RPI

MGH

RPI

MSKCC

BU

INL

UPRM

WHOI

LLNL
Graduate Pathways
“Introduction to Subsurface Sensing and Imaging Courses”

Upper-class technical elective offered at NU since 2002 and BU and RPI since 2003.

- **NU**: ECE1467 “Intro to SSI”
  - Team-taught: D. Brooks, C. DiMarzio in first three years
    - D. Brooks, E. Miller in 2006 and E. Marengo in 2008

- **BU**: SC500 “Intro to SSI
  - Prof. Bahaa Saleh
  - Cross-listed graduate and undergraduate course

- **RPI**: ECSE4963 “Intro to SSI,”
  - Team-taught: Prof. Roysam and Prof. Thomenius, Chief Technologist for Bioimaging at GE Global Research Center

- **UPRM**: “Intro to SSI” Seminar Series, Sp’04

The SSI Textbook Is A Major Outcome of the ERC

- All Partners Contributed
- Cambridge University Press
- Spring 2010 Release Planned
Technology Commercialization

Creative Effort over Time

- Basic Research
- Development
- Products
- Market

“Valley of Death”
Gordon Engineering Leadership Program

- MS degree or Graduate Certificate in Engineering Leadership – 1 Year Program
- Challenge Project in Technology Commercialization
- 33 Gordon Fellows in 2007, 2008 and 2009

Challenge Projects: Tied to ERC Industrial Partners and Technologies

**Industrial and Government Sponsors:**
- Analog Devices
- Analogic Corporation
- Bose Corporation
- Cipher Tech Solutions
- GE Healthcare
- Intelligent Medical Implants
- Lockheed Martin
- NeuroLogica Corporation
- Pacific Northwest Lab
- Physical Sciences, Inc.
- Raytheon Company
- Textron Systems
- US Air Force
- US Army Night Vision Lab

**Northeastern Programs:**
- BomDetec
- VOTERS
- ALERT

**Gordon-CenSSIS Technology Transfer:**
- Terahertz imaging
- Autonomous underwater vehicle
- Non-invasive and in vivo biopsy
- Hand-held skin cancer diagnostic microscope

**Faculty concepts:**
- Doppler stent
- Biased ferrites
- Forensic software
Undergraduate Pipeline
Undergraduate Research Involvement

Number of Students

Year 1, Year 2, Year 3, Year 4, Year 5, Year 6, Year 7, Year 8, Year 9, Year 10

Other
REU
Gordon-CenSSIS Scholar and SLC President, Sarah Brown has been involved with Gordon-CenSSIS since her freshman year
High-Tech Tools and Toys Lab

- Subsurface discovery lab for freshman
- In place at all four universities
- Expanded to five sections at NU
- Tool for outreach
Gordon-CenSSIS NU RA/TA Heidy Sierra Gil from UPRM working in the NU HTT&TL
HTT&TL Dissemination

- NU Freshman “Gateway” instructors incorporated HTT&TL-inspired modules in three honors sections in 2010

- New HTT&TL projects for DHS ALERT Research Center

- Community College outreach
  - 2010 Summer program for instructors from Middlesex CC, Northern Essex CC, and MassBay CC
HTT&TL-Inspired “Art Gallery Alarm”

Alex Puffer
Lexi Barlow
ALERT HTT&TL Spectroscopy Module
Can You Tell Olive Oil from Motor Oil?
K-12 Outreach
- ERC vision works to inspire students at all levels
- Sustained involvement with students
- Outreach to bring students into pipeline
- Program synergies
CenSSIS Leverages Over 15 Years of NEU Experience and Innovation in K-12 Education
Critical Components to supporting an Education Program

**Leadership** committed to education outreach

**Recognition** for faculty and students engaged in education outreach

Strong **partnerships** with teachers, school districts and Community Colleges
“RISING ABOVE THE GATHERING STORM”

What actions should federal policy makers take to enhance the science and technology enterprise so the United States can successfully compete in the global community of the 21st century?

TEN THOUSAND TEACHERS, TEN MILLION MINDS

*Increase America’s talent pool by vastly improving K-12 mathematics and science education.*

Recommendations For Teachers

- Summer Institutes
- Science and mathematics master’s programs
- AP and pre-AP training
- K-12 curriculum materials modeled on world-class standards

Recommendations for Students

- Statewide specialty math/science high schools
- Inquiry-based learning
- Summer internships and research opportunities
Current Programs

- Boston Science Partnership/North Shore Partnership (Middle and High School Teachers and STEM University faculty)
- Step-UP (Mayor’s Initiative) (Elementary, Middle and High School)
- Research Experiences for Teachers (RET) (Middle and High School Teachers, CC faculty)
- RE-SEED (Middle School Classrooms)
- Algebra Plus (Middle School Students)
- Exxon Mobil Bernard Harris Summer Science Program (Middle School Students)
- Young Scholars Program (High School Students)
- GK-12 Program (Middle and High School Classrooms)
- Boston Summer Advanced Mathematics/Bridge to AP (High School Students)
- STEP-UP (NSF)
Research Experience for Teachers

Goal: “Strengthening the skills of 250,000 current teachers through summer institute training programs...” (Rising Above the Gathering Storm)

- Provide participants with an extended research/design experience
- Build a collaborative teacher/professor community
- Develop leadership skills of participants
- Share best practices
- Build connections to the classroom
- 80 teachers to date (over 7000 students) have spent their summers working at Northeastern University.
- 32 public school districts spanning six states


“Back in the Classroom”

“I now truly understand the importance of higher learning and the incorporation of ‘real life’ application.”

“I now place more focus on inquiry and thus my students are participating in a more question-driven curriculum.”

“I try to work engineering into my curriculum more often than I used to.”

“Personally, the program has rejuvenated me as a teacher. Although I have only been teaching for five years now, I was at a point where I was feeling bogged down by all the standardized tests and administrative “red tape” so to speak. This program has again made me realize why I love to teach. There is nothing better than being able to educate, evoke understanding, and inspire individuals.”

RET rekindled a love of research. Science is about solving problems that no one knows the answer to. I sometimes lose [sight of] that in all of the mess in public education.”

Responses from participants on what impact participation in the RET program had on how and what they taught.
Partnerships with Community Colleges

Collaboration with NSF STEP

- Support the Partner Faculty Network (PFN)

- Summer Research Opportunities - Provide Community College faculty and students access to REU and RET opportunities.

- Supporting professional development for CC Faculty - "How People Learn"

- Replicate Northeastern University’s Summer Bridge Program at interested Community Colleges and develop a Transfer Bridge Program for Community College students transitioning to Northeastern University.

- Expand academic mentoring and support. Identify promising practices and provide professional development opportunities for all partners.

- ITEL Scholarship – (NSF/S-STEM) Scholarship Support form Incoming Freshman and Community College Faculty

- Introduce High Tech Tools and Toys to Community College Partners
What I took away from my experience in the NU RET program*

1) "Inquiry": promoting a scientific atmosphere for students (similar to the real world) where the answers are yet to be discovered.

2) Lab journaling: for both myself & the students. Use pen. date. time. titles. data. research. etc.

3) Professional collaboration: the "how to's" when it comes to working with colleagues: language, ideas, development, etc.

4) Several new "cool" techniques: plasma machine. hemacytometer. passages. microfluidics & more.

5) A deeper understanding: of what a life in research "truly" is: repetition, grants, sacrifice, reward, learning from failures, aseptic techniques, honesty, integrity...

6) Interdisciplinary connections: Knowledge is not static! Science depends on the numbers from math, as well as language, culture, history, etc.

7) Fun!: There are plenty of opportunities to make light of serious situations; a stop to smell the roses message- what’s the use of all this science & technology if we don't know how to enjoy it :o)

8) Working with students (high school and college): It was an excellent preview of what my career would be like if I ever graduate from middle school education.

9) Lesson plans: This aspect of my teaching evolves daily & has been accelerated by this experience with some extremely valuable tools e.g. backwards design & putting the "life" in life science.

*Jason Souza, Middle School Science Teacher, Newton Public Schools, Newton, MA
Young Scholars Program

Offers future scientists and engineers a unique opportunity for hands-on experience while still in high school

1. Introduce students to the research environment
2. Prepare students for college
3. Increased exposure to STEM pathways
4. Teach students to work collaboratively
5. Maintain a Network of Support

- 275 student participants to date
- 94 percent have chosen to major in a STEM-related field including Biology, Chemistry, Computer Science, Engineering, Nursing, Physics, and Pre-Med at prestigious universities across the country.
Two pairs of Boston area high school students present their summer research projects for Northeastern's Young Scholars Program

http://www.northeastern.edu/news/multimedia/video.html?contentID=DVOhNGgA9UGmbakW31Wm3A

STEM Showcase

Seniors Robert Powers (left, Belmont High School) and Lucy Salles (right, Revere High School) display their poster

Seniors Vanessa Zamy (left, Boston Latin Academy) and Dora Pepo (right, Quincy High School) display their poster

Photos by Craig Bailey
An unprecedented collaboration among five private universities, the City of Boston and the Boston Public Schools to help **close the achievement gap**.

- Comprehensive, Coordinated Services
- Academic Support for Schools
- Quality Extended Learning Opportunities
- Health and Wellness Programs
- Parent and Community Engagement
CenSSIS Scholars – K12 Outreach

University Students hosting field trips, Serving as counselors for summer programs, assisting with statewide science fairs and regional events.

The ExxonMobil Bernard Harris Summer Science Camp (BHSSC)

Building Bridges Competition

Tutoring

Field Trips

After School Programs

Science Club for Girls

College Awareness Days for High School and Community College Students
Moving toward sustainability…

The Center for STEM Education

ALERT
Broader Impacts..

- YSP Programs in all Gen 3 ERCs
- National Networking / Leadership Development RET participants
- ERC best practices (Group Page)
- Toolkits for Successful Program Models
- Sharing program models with other Federal Agencies