Introducing Synchrotrons into the Classroom
Office of Educational Programs
Cyber-enabled Remote Access
Bringing Big Science into the Classroom: BNL's NSLS and CFN
Monday, May 24, 2010

Over 100 Registered Attendees, over 50% were High School Teachers and Administrators
What is InSynC?

• A program to enable high school teachers and students to gain remote access to synchrotron beamtime through a competitive, peer-reviewed proposal process.

• The program will train both teachers and students to formulate a hypothesis-driven scientific problem and learn the skills of writing a competitive beamtime proposal.

• Supported and Funded the NSLS and DOE’s Office of Workforce Development for Teachers and Scientists (WDTS) to enhance science education at the high school level.
Who Can Participate?

- This program has started with local Long Island high schools.
- Any high school science program can participate.
- We anticipate that in the future the program will be expanded to a nationwide competition and involve all US synchrotrons.
Implementation

3-Day Teacher Training Course

Teachers & Students formulate a hypothesis and experiment

Teachers & Students submit proposal

Proposals receive 1-4 rating

Score too low for this cycle: Classroom Visit

Peer Review

Highest rated scheduled for beamtime

July 2010
Where Are We Now?

- First set of proposals were submitted on October 22\textsuperscript{nd}.
- Reviews were completed and proposals scored by a panel of synchrotron scientists worldwide with expertise in education and outreach.
- Proposal Examples: collection and analysis of micrometeorites, effectiveness of household water filters, chemistry of biofilms, structural biology
- Two proposals were allocated beamtime in December 2010.
Beamtime Allocation Ceremony

Monday, November 29, 2010

- Proposals allocated beamtime:
  - Microbial Biofilm as a Remediation Tool for Copper Contaminated Freshwater (Diana Soehl, Elwood-John H. Glenn High School)
  - Effectiveness of Common Household Water Filters Using X-Ray Fluorescence Microprobe (Ashley Bloch, Islip Middle School; Michael Vaccariello, Sachem East High School)
What’s Next?

Available Beamlines & Beamtime:

- Initially, approximately 1-2 days of beamtime per cycle will be allocated on 3 beamlines at the NSLS.
- These will include:
  - X-ray fluorescence microprobe beamline
  - Infrared microscopy beamline
  - Protein crystallography beamline
- As additional beamlines are outfitted, more beamlines will be made available.
Infrared Microscopy Beamline

These beamlines focus bright beams of infrared light to a very small size (1/10 size of human hair) to image the organic makeup of materials.

Examples: biological materials, plastics, fibers, soils.
Science Example: Fingerprint Composition

- **Problem:** Forensic evidence shows that children’s fingerprints “disappear” faster than adults’ prints.

- **Experiment:** The infrared microscope images the oil and protein components of fingerprints.

- **Results:** Differences in oil composition are responsible for the volatility of children’s prints.

Synchrotron X-ray Microprobes

• These beamlines focus these bright X-ray beams to very small size (<10 µm ...f.y.i human hair is ~100 µm diameter) to:
  – Examine the distribution of elements at micron scale with femtogram sensitivity (0.000 000 000 000 001 g)
  – Evaluate the molecular form of these elements in natural samples
  – Provide chemical information as an imaging experiment
Science Examples: X-ray microprobe

- Pollutants in urban NJ brownfields
- Increasingly converted into green spaces by allowing natural succession to proceed unassisted
- insects such as leafminers alter and cycle metals

- Cretaceous fossil of a stonefly (Liaoning, China, ~125 million years old)
- X-ray fluorescence microprobe allows for chemical imaging of remnants of soft tissue that is not optically visible

*Ideal for analysis of samples as-is with no sample preparation*
Remote Access from the Classroom
InSynC...

- Engages high school teachers and students to formulate hypothesis-driven experiments
- Provides research experience to entire classrooms rather than individual students
- Addresses many of the key recommendations made by the National Academies in the National Curriculum Standards (i.e. inquiry based learning)
- Provides student access to the Nation’s premier science facilities, the same facilities Nobel-prize winning researchers have used

Summary

2003 and 2009 Nobel Prizes in Chemistry

Rod MacKinnon, Venkatraman Ramakrishnan, Thomas Steitz
Participating School Districts so far

Longwood       Babylon       Eastport South Manor
Riverhead      Shelter Island Mt Sinai
William Floyd  Islip          Elwood
Bellport       Hauppauge     North Babylon
Patchogue-Medford Deer Park    Sachem
Sayville

For additional information...

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