Program/Demo Title

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General Description

Type of program:
Facilitated activity/classroom activity

This activity describes how to utilize the Remote Access to Instrumentation through the The Nanotechnology Applications and Career Knowledge (NACK Center) at Penn State University.

Program Objectives

Big idea:
Access to Instrumentation used in Nanotechnology and Nanoscience such as AFM, SEM, UV-Vis virtually.

Learning goals:
As a result of participating in this program, visitors will be able to:

1. See how probing at the Nanoscale is done.
2. Using instruments to "see" at the nanoscale

NISE Network content map main ideas:

[ ] 1. Nanometer-sized things are very small, and often behave differently than larger things do.

[x] 2. Scientists and engineers have formed the interdisciplinary field of nanotechnology by investigating properties and manipulating matter at the nanoscale.

[ ] 3. Nanoscience, nanotechnology, and nanoengineering lead to new knowledge and innovations that weren't possible before.

[ ] 4. Nanotechnologies have costs, risks, and benefits that affect our lives in ways we cannot always predict.

National Science Education Standards:

[ ] 1. Science as Inquiry
- [ ] K-4: Abilities necessary to do scientific inquiry
- [ ] K-4: Understanding about scientific inquiry
- [ ] 5-8: Abilities necessary to do scientific inquiry
- [ ] 5-8: Understanding about scientific inquiry
- [ ] 9-12: Abilities necessary to do scientific inquiry
- [x] 9-12: Understanding about scientific inquiry

[ ] 2. Physical Science
- [ ] K-4: Properties of objects and materials
- [ ] K-4: Position and motion of objects
- [ ] K-4: Light, heat, electricity, and magnetism
- [ ] 5-8: Properties and changes of properties in matter
- [ ] 5-8: Motions and forces
- [ ] 5-8: Transfer of energy
- [ ] 9-12: Structure of atoms
- [x] 9-12: Structure and properties of matter
- [ ] 9-12: Chemical reactions
- [ ] 9-12: Motions and force
- [ ] 9-12: Conservation of energy and increase in disorder
- [ ] 9-12: Interactions of energy and matter

[ ] 3. Life Science
- [ ] K-4: Characteristics of organisms
- [ ] K-4: Life cycles of organisms
- [ ] K-4: Organisms and environments
- [ ] 5-8: Structure and function in living systems
- [ ] 5-8: Reproduction and heredity
- [ ] 5-8: Regulation and behavior
- [ ] 5-8: Populations and ecosystems
- [ ] 5-8: Diversity and adaptations of organisms
- [ ] 9-12: The cell
- [ ] 9-12: Molecular basis of heredity
- [ ] 9-12: Biological evolution
- [ ] 9-12: Interdependence of organisms
- [ ] 9-12: Matter, energy, and organization in living systems
- [ ] 9-12: Behavior of organisms

[ ] 4. Earth and Space Science
- [ ] K-4: Properties of earth materials
- [ ] K-4: Objects in the sky
- [ ] K-4: Changes in earth and sky
- [ ] 5-8: Structure of the earth system
- [ ] 5-8: Earth's history
- [ ] 5-8: Earth in the solar system
- [ ] 9-12: Energy in the earth system

[ ] 9-12: Geochemical cycles
[ ] 9-12: Origin and evolution of the earth system
[ ] 9-12: Origin and evolution of the universe

[ ] 5. Science and Technology
[ ] K-4: Abilities to distinguish between natural objects and objects made by humans
[ ] K-4: Abilities of technological design
[ ] K-4: Understanding about science and technology
[ ] 5-8: Abilities of technological design
[ ] 5-8: Understanding about science and technology
[x] 9-12: Abilities of technological design
[ ] 9-12: Understanding about science and technology

[ ] 6. Personal and Social Perspectives
[ ] K-4: Personal health
[ ] K-4: Characteristics and changes in populations
[ ] K-4: Types of resources
[ ] K-4: Changes in environments
[ ] K-4: Science and technology in local challenges
[ ] 5-8: Personal health
[ ] 5-8: Populations, resources, and environments
[ ] 5-8: Natural hazards
[ ] 5-8: Risks and benefits
[ ] 5-8: Science and technology in society
[ ] 9-12: Personal and community health
[ ] 9-12: Population growth
[ ] 9-12: Natural resources
[ ] 9-12: Environmental quality
[ ] 9-12: Natural and human-induced hazards
[ ] 9-12: Science and technology in local, national, and global challenges

[ ] 7. History and Nature of Science
[ ] K-4: Science as a human endeavor
[ ] 5-8: Science as a human endeavor
[ ] 5-8: Nature of science
[ ] 5-8: History of science
[ ] 9-12: Science as a human endeavor
[x] 9-12: Nature of scientific knowledge
[ ] 9-12: Historical perspective

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Time Required

Set-up	Program	Clean Up
		
1-2 weeks before demo date	15 minutes-1hour	0 minutes

Background Information

Definition of terms

Nano is the scientific term meaning one-billionth (1/1,000,000,000). It comes from a Greek word meaning “dwarf.”

A nanometer is one one-billionth of a meter. One inch equals 25.4 million nanometers. A sheet of paper is about 100,000 nanometers thick. A human hair measures roughly 50,000 to 100,000 nanometers across. Your fingernails grow one nanometer every second.

(Other units can also be divided by one billion. A single blink of an eye is about one-billionth of a year. An eyeblink is to a year what a nanometer is to a yardstick.)

Nanoscale refers to measurements of 1-100 nanometers. A virus is about 70 nm long. A cell membrane is about 9 nm thick. Ten hydrogen atoms are about 1 nm.

At the nanoscale, many common materials exhibit unusual properties, such as remarkably lower resistance to electricity, or faster chemical reactions.

Nanotechnology is the manipulation of material at the nanoscale to take advantage of these properties. This often means working with individual molecules.

Nanoscience, nanoengineering and other such terms refer to those activities applied to the nanoscale. “Nano,” by itself, is often used as short-hand to refer to any or all of these activities.

Program-specific background

This document details steps required to arrange for a virtual access to instrumentation used for probing the nanoscale. The NACK center at Penn State University has set up a remote access to the Instrumentation available in their labs for educators to use in class. This facility is available free of cost to educators. Traditionally, an engineer from Penn State University orchestrates the instrument's use, while offering additional assistance via audio and visual internet software.

However if you are familiar with the equipment (AFM, SEM , UV-Vis) you can control it from your location using your computer, internet connection and **Skype**.

Intro to Remote Access: http://www.nano4me.org/educators.html#contenttop

Getting Started: http://nano4me.live.subhub.com/categories/remote_access_request/

Materials

1. Computer with *administrator* access to install plug-ins and software
2. High speed Internet connection
3. Speakers
4. Microphone
5. Projector connected to the same computer (for multiple viewers)
6. Web browser: **Mozilla Firefox** preferred
7. Voice Over Internet Protocol software with username and password: Skype

Set Up

Time:

Follow the instructions provided for setting up a time for Remote Access. It is better to contact the engineer at Nack Center (Sebastien Maeder) with enough lead time to ensure that you are able to get the dates and times you need for your demonstration. Ideally at least 2 weeks is required if you are a new user.

Program Delivery

Time:

The length of program can vary between 15 minutes to 1 hour long, depending on how much time you have available. It also depends on how detailed you would like the demo/class to be. If you doing it as an introduction to imaging at the nanoscale for your students, atleast 20 min would allow for a overview class.

Safety

NA

Talking points and procedure

The remote access demo can be done as part of a larger class with introduction to probing and imaging at the nanoscale. The NACK center has specific samples that you could request for demo. They are also willing to take your sample that you mail out ahead of time to them and then image it for you during the session.

Tips and troubleshooting

This is mainly intended as a teaching tool.

Common visitor questions

1. How does the SEM, AFM work?
2. What is SPM and how is it similar to AFM

Going further…

Here are some resources you can share with your visitors:
Center for Probing at the Nanoscale: http://teachers.stanford.edu/activities/

Clean Up

Time:

NA

Universal Design

This program has been designed to be inclusive of visitors, including visitors of different ages, backgrounds, and different physical and cognitive abilities.

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