Remote Access – Integrating High Tech Tools Into Your Classroom

NACK CENTER
WWW.NANO4ME.ORG

September 28, 2012

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Hosted by MATEC NetWorks ***www.matecnetworks.org***

Welcome to NACK's Webinar

Presenter

Dan Cavanaugh

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Outline

- What are my objectives in this webinar?
- What is the “nanoscale”?
- What is Remote Access?
- What will I need for Remote Access?
- What instruments are available by Remote Access?
- Break for Q&A
- What can my students do with Remote Access?
- How do I set up a Remote Access session?
- How will this benefit my students’, or my own, education?

Webinar Objectives

Upon completing this webinar program attendees will…

- **know** what Remote Access is based on its educational value.
- **recall** the materials needed to use Remote Access.
- **feel** comfortable setting up Remote Access sessions with NACK laboratory instructors.
- **recall** where to find resource material (e.g. pre-made labs) to help implement Remote Access lessons into curriculum.
- **be able** to work nanotechnology and Remote Access in to curriculum to serve specific content areas goals.

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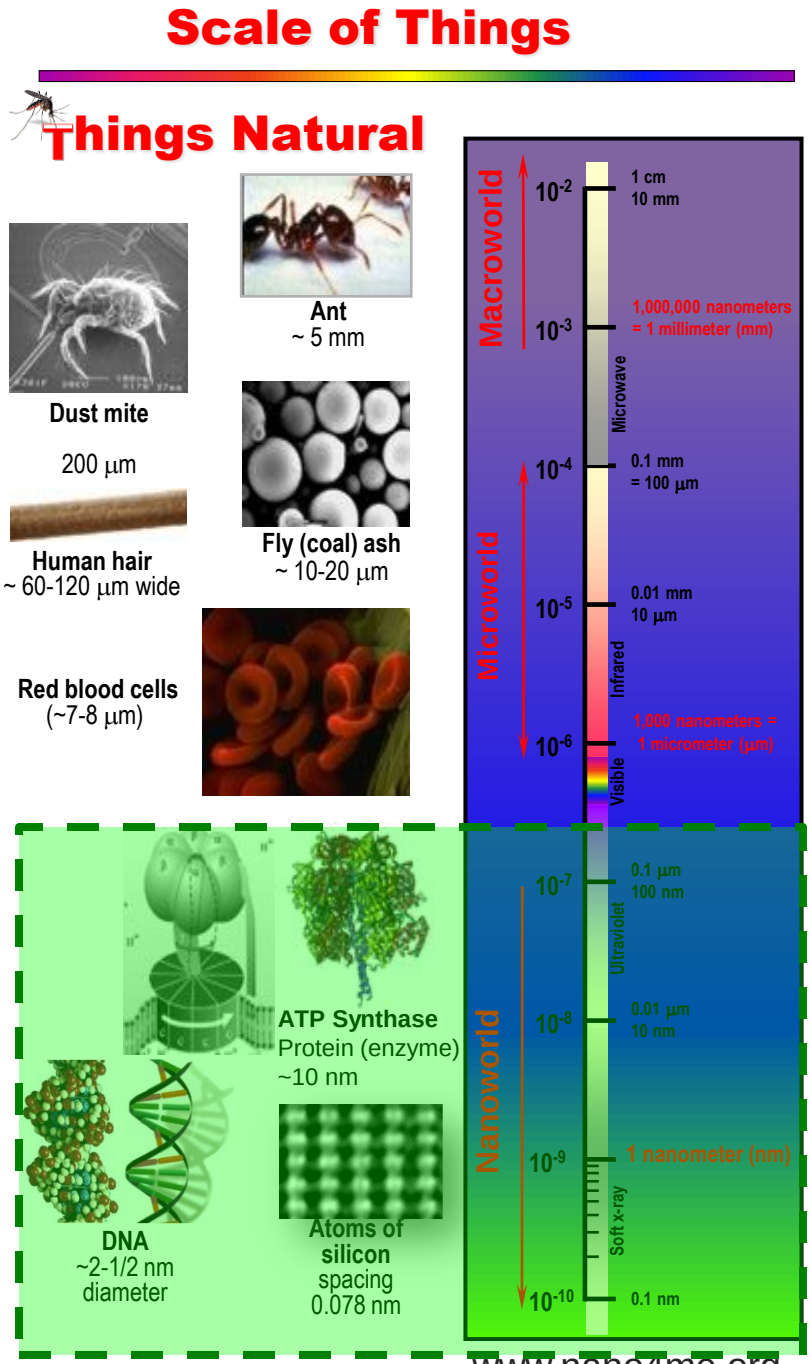
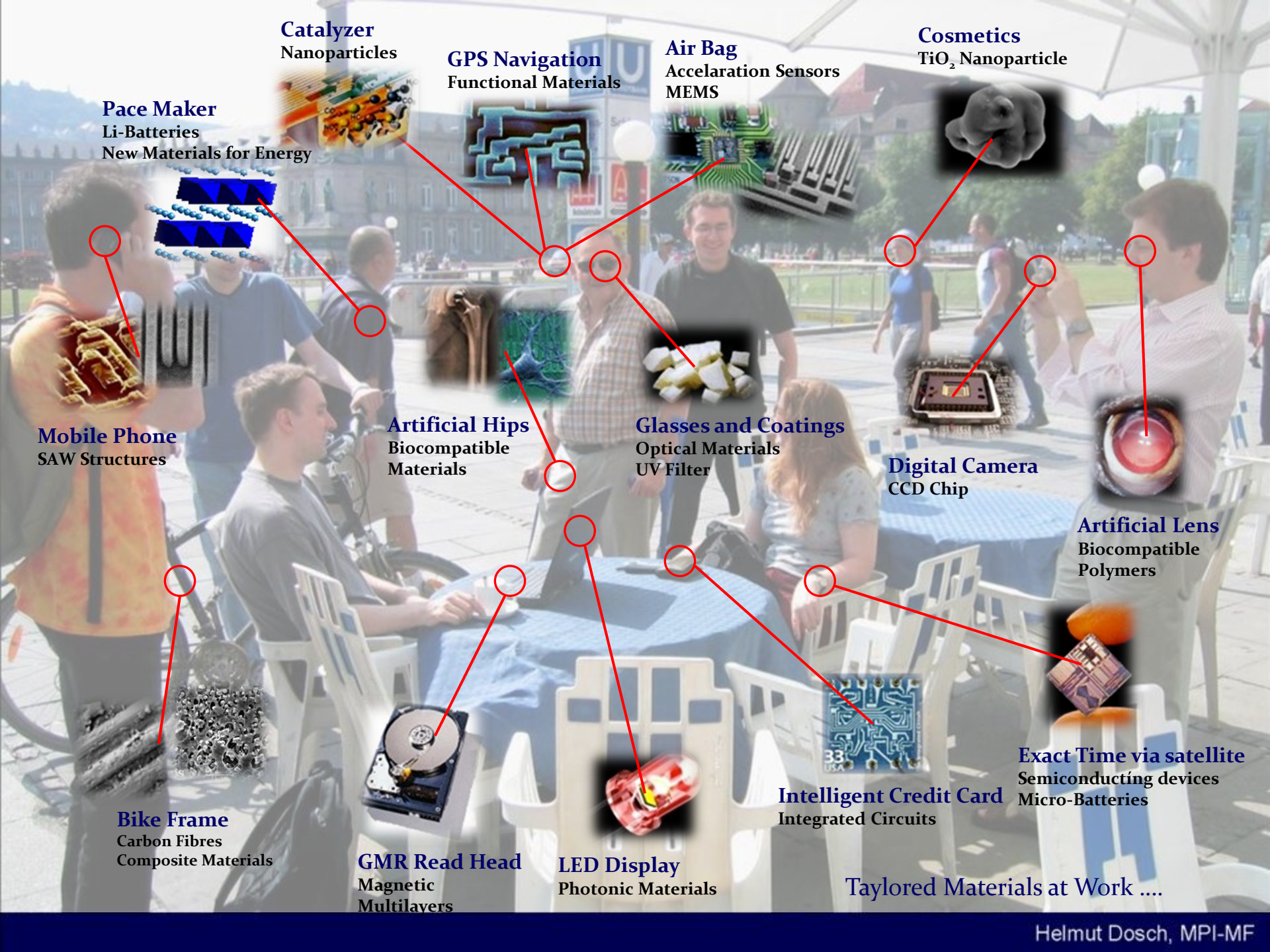
What is the "nanoscale"?

- Nanotechnology is not about a *thing*; it's about size
- The prefix nano means 1 billionth
  - Denoted as 1×10^{-9} or nm
- Nano-products have features 100 nm or smaller

Five silicon atoms lined up makes approximately 1.0 nm!



On a typical day...


Catalyzer
Nanoparticles
GPS Navigation
Functional Materials
Air Bag
Accelaration Sensors
MEMS
Cosmetics
TiO_2 Nanoparticle
Pace Maker
Li-Batteries
New Materials for Energy
Mobile Phone
SAW Structures
Artificial Hips
Biocompatible
Materials
Glasses and Coatings
Optical Materials
UV Filter
Digital Camera
CCD Chip
Artificial Lens
Biocompatible
Polymers
Bike Frame
Carbon Fibres
Composite Materials
GMR Read Head
Magnetic
Multilayers
LED Display
Photonic Materials
Intelligent Credit Card
Integrated Circuits
Exact Time via satellite
Semiconducting devices
Micro-Batteries
Taylored Materials at Work ....
Helmut Dosch, MPI-MF

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What is Remote Access (RA)?

- Students control Penn State* lab equipment in real-time through your desktop and analysis samples (sent in by you or from our library)
  - Sequential small group instruction or large group

*Other facilities across the US will make their equipment available for Remote Access in partnership with NACK

- Video conference with lab instructor through Skype, Google+, etc. for live expert lectures
- Connect to lab equipment through LogMeIn.com
- Usually 30 min. to 2 hours (Flexible scheduling)

- See is believing…

Short RA Video

http://youtu.be/DTXSWzYSW6w

Break for Q&A

Poll Question:
But the cost, right?

How much do you think a Remote Access session should cost?

A

B

C

D

Poll Question:
But the cost, right?

How much do you think a Remote Access session should cost?

Consider these Benefits of RA

- For Instructors:
  - No overhead or maintenance
  - Reduced preparation time
  - Increased student motivation

- For Students:
  - Exposure to otherwise inaccessible equipment
  - Provides relevance, background, and principles
  - Links students to university research facilities and university personnel
  - Shows that scientists are real people
    - “I can do this too!”

- For Community:
  - Efficient use of very expensive resources (>$1,000,000)
  - Better educated and engaged students prepared for industry

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Remote Access Requirements?

1. Computer (PC or Mac)

Please Update

2. Webcam & Microphone

3. Skype and Firefox

Download Firefox plugin for LogMeIn

(Plug-in)

4. Three button mouse or track-pad (must have scrolling)

5. Reliable Internet connection

6. Projector & Speakers recommended

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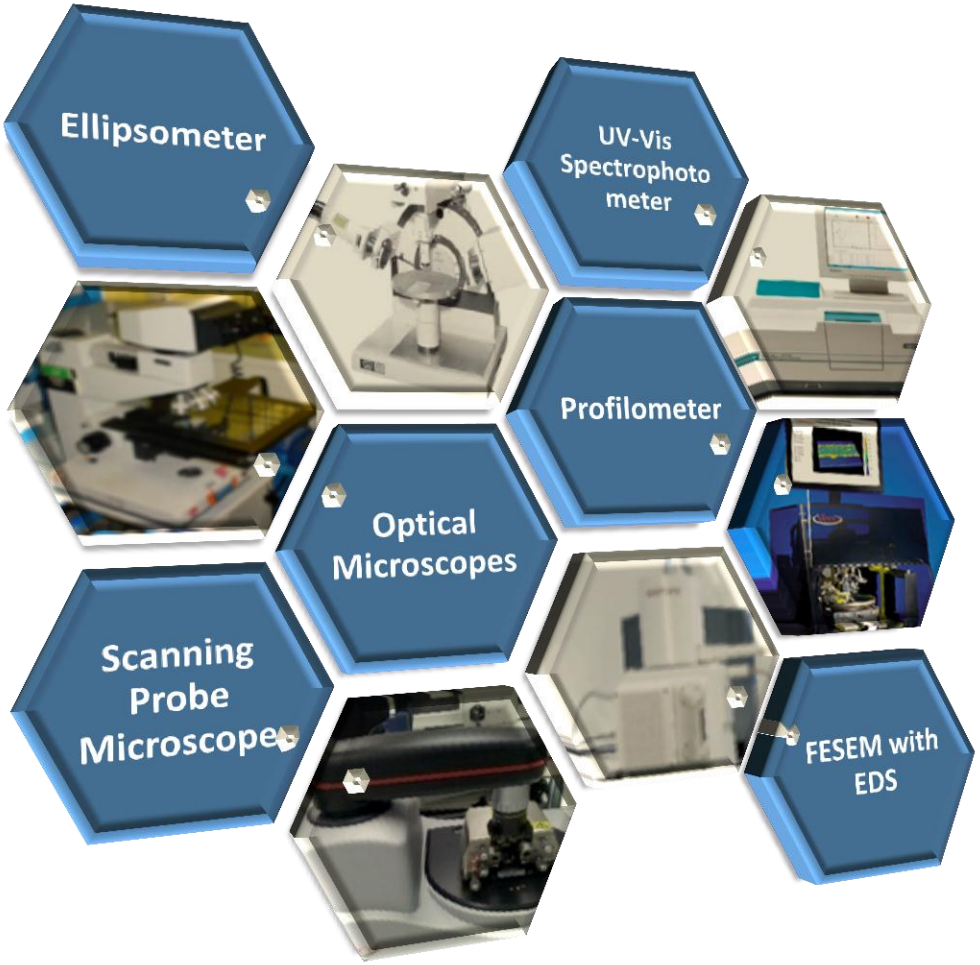
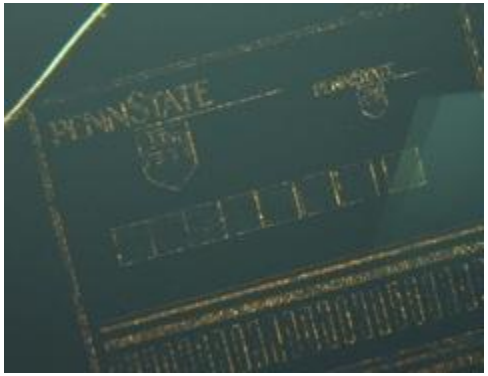
Remote Access Tool Set

- Capacities:
  - Chemical analysis
    - Nano particle, wire, etc. analysis
  - Thin film measurement
  - 2D profile
  - 2D + 3D high magnification/resolution topography
  - 2D + 3D compositional comparative imaging
  - 2D high magnification elemental mapping

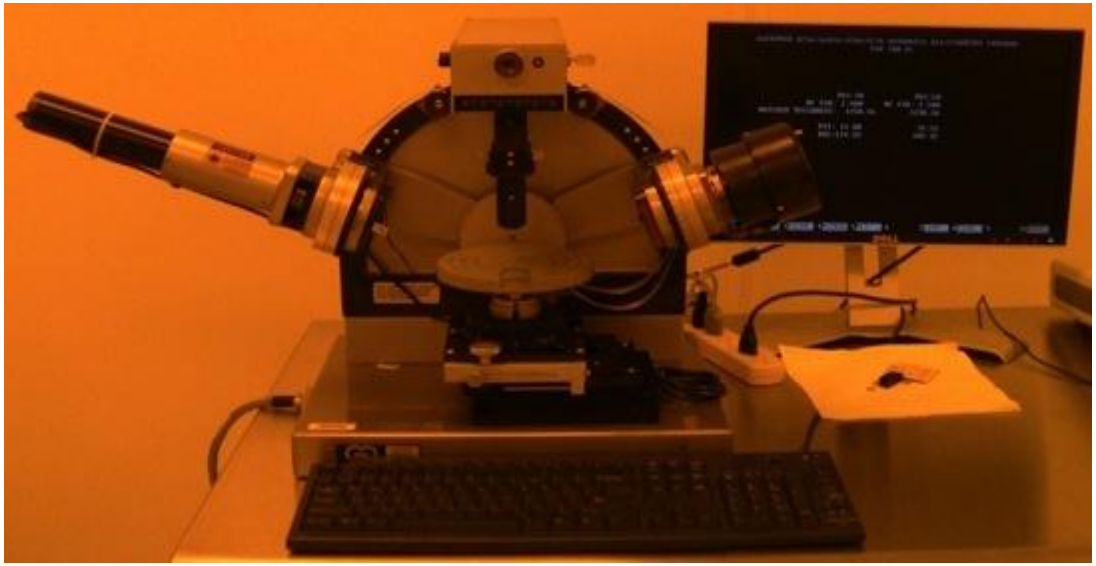


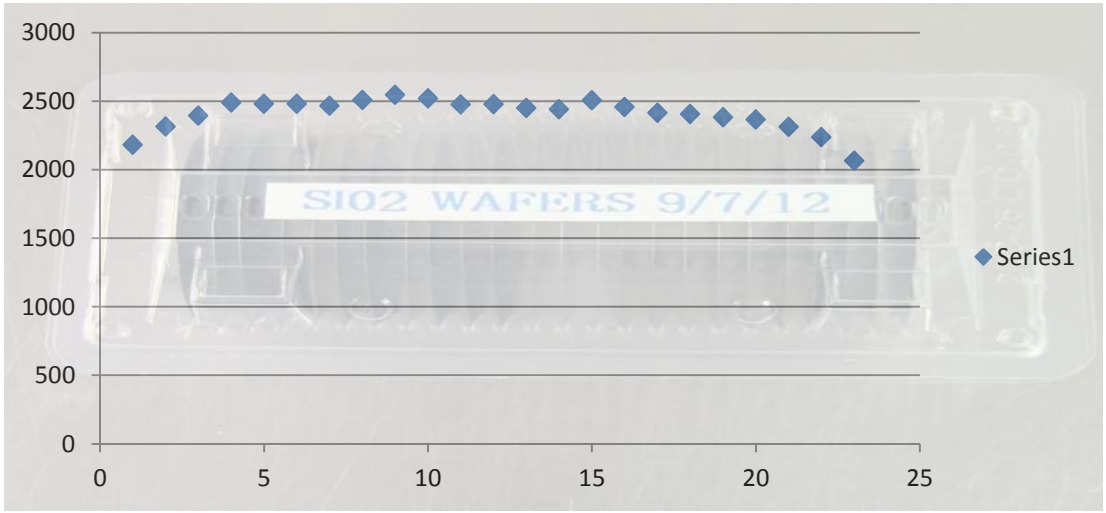
Optical Microscopes

- Modes of operation:
  - Brightfield
  - Darkfield
- Remote control:
  - Live viewing
  - Measuring
- Data output:
  - Point-to-point measurements (± 500 nm)
  - Digital image (≥10,000X)



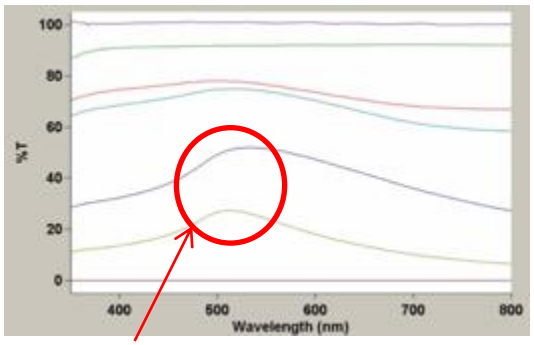
Ellipsometer





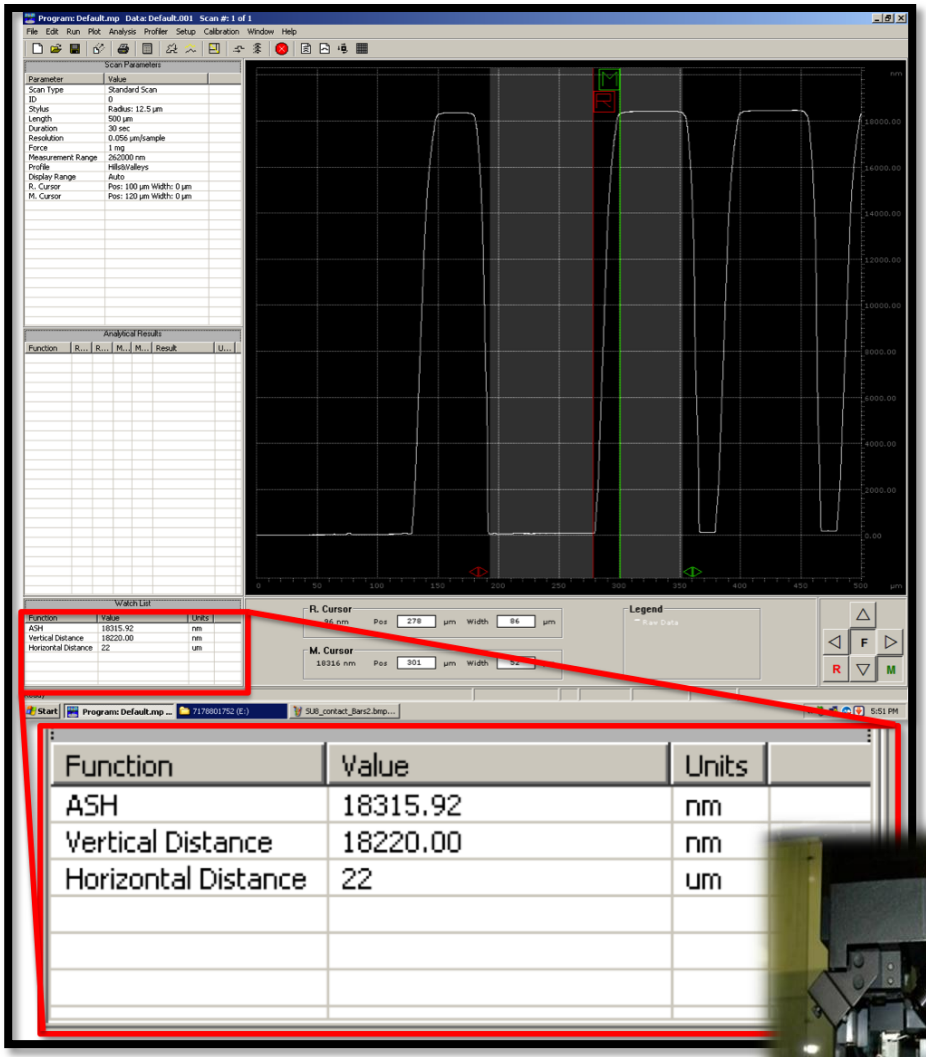
- Modes of operation:
  - Single angle
  - Double angle
- Remote control:
  - Live viewing
  - Measuring
- Data output:
  - Point thickness measurements (+ 0.5 nm)

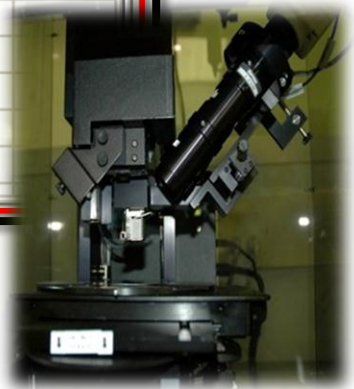
UV-Vis. Spectrophotometer



- Modes of operation:
  - Ultra Violate and Visible spectrum analysis
  - Absorption
  - Transmission
- Remote control:
  - Live viewing
- Data output:
  - Absorption/Transmission graph

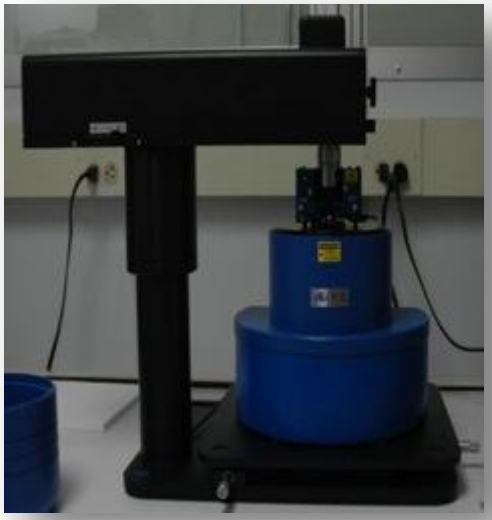
Profilometer



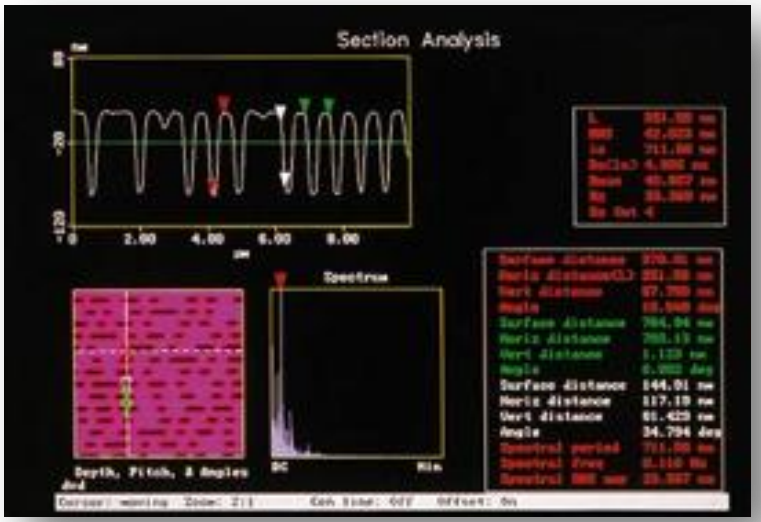


- Modes of operation:
  - Manual profiling
  - Automated ‘recipe’ 3D scanning
- Remote control:
  - Live viewing
  - Measuring
  - Scan instructing
- Data output:
  - Height and width with averaging (± 50 nm)
  - Roughness function
  - Profile trace 2D

Scanning Probe Microscopy [A.K.A AFM]



- Modes of operation:
  - AFM Contact
  - AFM Non-contact
  - AFM Intermittent contact ‘tapping’
  - Phase shift (composition)
  - MFM
  - STM
  - Liquid cell
  - Etc.
- Remote control:
  - Live viewing
  - Sample navigation
  - Scan instructing
  - Height and width with averaging (± <1 nm)
- Data output:
  - High resolution 2D image with ≥1,000,000X
  - High resolution 3D modeling
  - High resolution 2D profile



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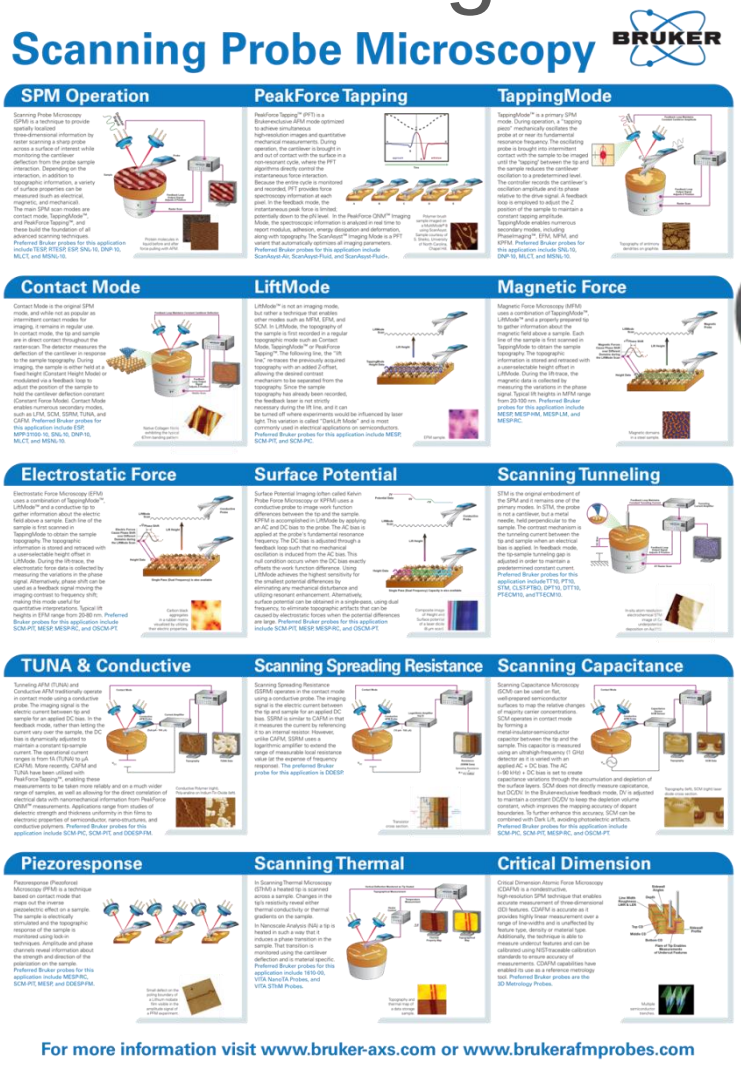
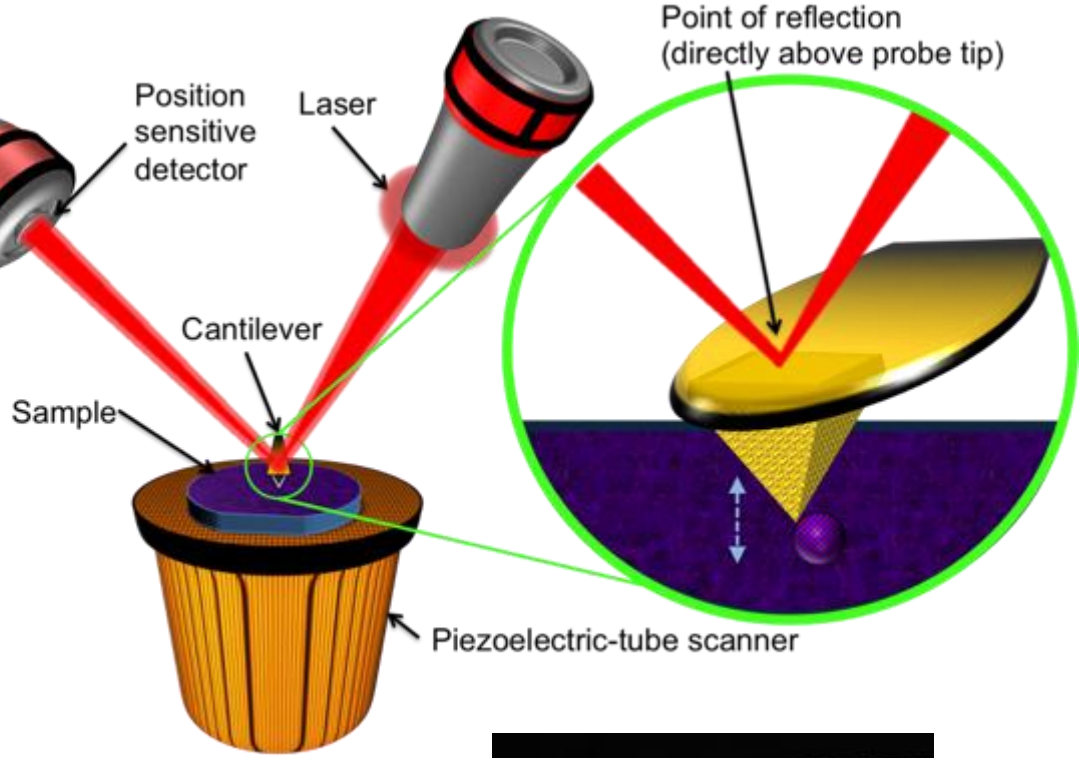
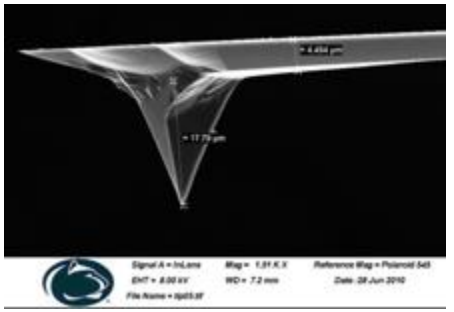
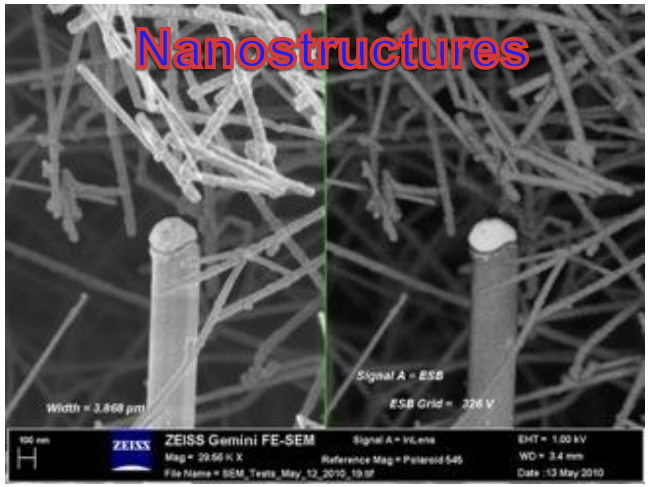


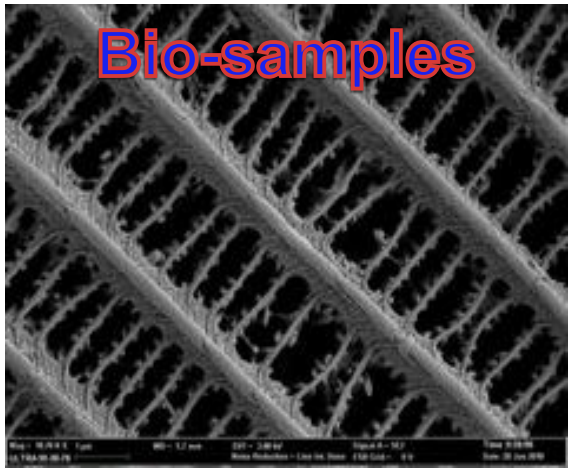
http://www.bruker-axs.com/posters_afm.html





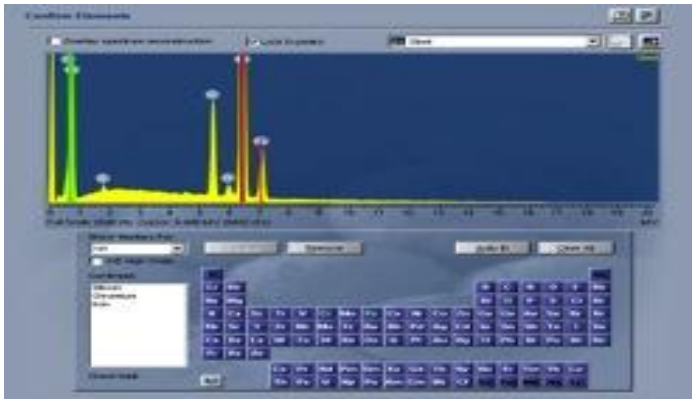
Field Effect Scanning Electron Microscope (FESEM)

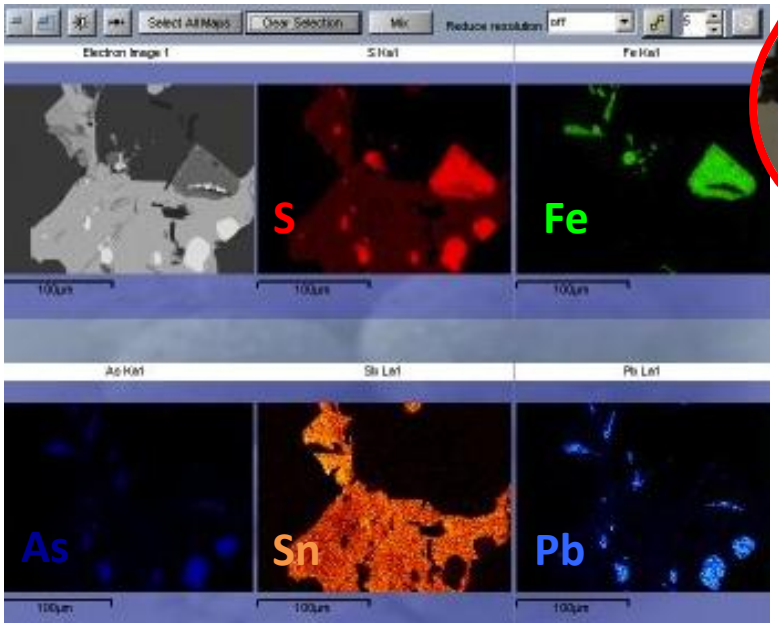




- Modes of Operation:
  - InLens (SE)
  - In-Lens Backscatted Electron (BSE)
  - Everhart Thornley (SE)
  - Energy selective Backscatter (BSE) (composition)
  - Energy Dispersive Spectroscopy (EDS)
- Remote Control:
  - Live viewing
  - Sample selection
  - Sample navigation
  - All imaging controls (mag., focus, Stig., brightness/contrast, etc.)
  - Point-to-point, etc., measuring
- Data Output:
  - High resolution 2D image with ≥1,000,000X
  - Elemental mapping

FESEM + Energy Dispersive Spectroscopy (EDS)





Where Can I Learn More About These Tools?

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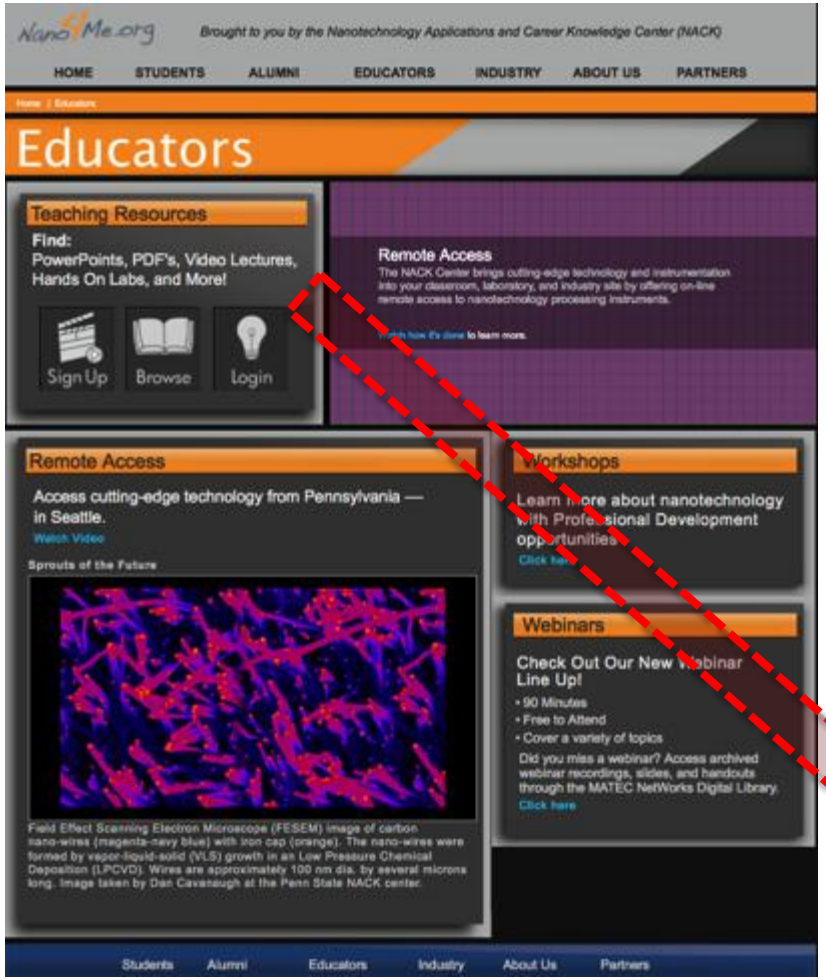

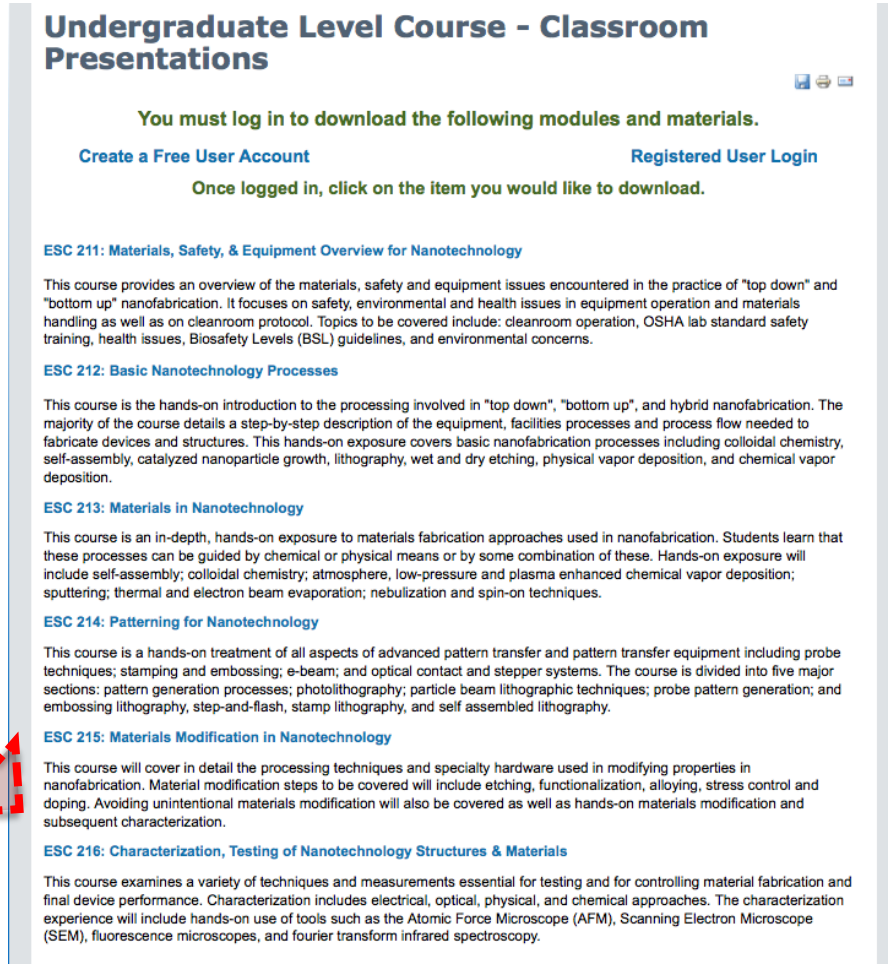

Undergraduate Level Course - Classroom Presentations

You must log in to download the following modules and materials.

Create a Free User Account Registered User Login

Once logged in, click on the item you would like to download.

ESC 211: Materials, Safety, & Equipment Overview for Nanotechnology

This course provides an overview of the materials, safety and equipment issues encountered in the practice of "top down" and "bottom up" nanofabrication. It focuses on safety, environmental and health issues in equipment operation and materials handling as well as on cleanroom protocol. Topics to be covered include: cleanroom operation, OSHA lab standard safety training, health issues, Biosafety Levels (BSL) guidelines, and environmental concerns.

ESC 212: Basic Nanotechnology Processes

This course is the hands-on introduction to the processing involved in "top down", "bottom up", and hybrid nanofabrication. The majority of the course details a step-by-step description of the equipment, facilities processes and process flow needed to fabricate devices and structures. This hands-on exposure covers basic nanofabrication processes including colloidal chemistry, self-assembly, catalyzed nanoparticle growth, lithography, wet and dry etching, physical vapor deposition, and chemical vapor deposition.

ESC 213: Materials in Nanotechnology

This course is an in-depth, hands-on exposure to materials fabrication approaches used in nanofabrication. Students learn that these processes can be guided by chemical or physical means or by some combination of these. Hands-on exposure will include self-assembly; colloidal chemistry; atmosphere, low-pressure and plasma enhanced chemical vapor deposition; sputtering; thermal and electron beam evaporation; nebulization and spin-on techniques.

ESC 214: Patterning for Nanotechnology

This course is a hands-on treatment of all aspects of advanced pattern transfer and pattern transfer equipment including probe techniques; stamping and embossing; e-beam; and optical contact and stepper systems. The course is divided into five major sections: pattern generation processes; photolithography; particle beam lithographic techniques; probe pattern generation; and embossing lithography, step-and-flash, stamp lithography, and self assembled lithography.

ESC 215: Materials Modification in Nanotechnology

This course will cover in detail the processing techniques and specialty hardware used in modifying properties in nanofabrication. Material modification steps to be covered will include etching, functionalization, alloying, stress control and doping. Avoiding unintentional materials modification will also be covered as well as hands-on materials modification and subsequent characterization.

ESC 216: Characterization, Testing of Nanotechnology Structures & Materials

This course examines a variety of techniques and measurements essential for testing and for controlling material fabrication and final device performance. Characterization includes electrical, optical, physical, and chemical approaches. The characterization experience will include hands-on use of tools such as the Atomic Force Microscope (AFM), Scanning Electron Microscope (SEM), fluorescence microscopes, and fourier transform infrared spectroscopy.

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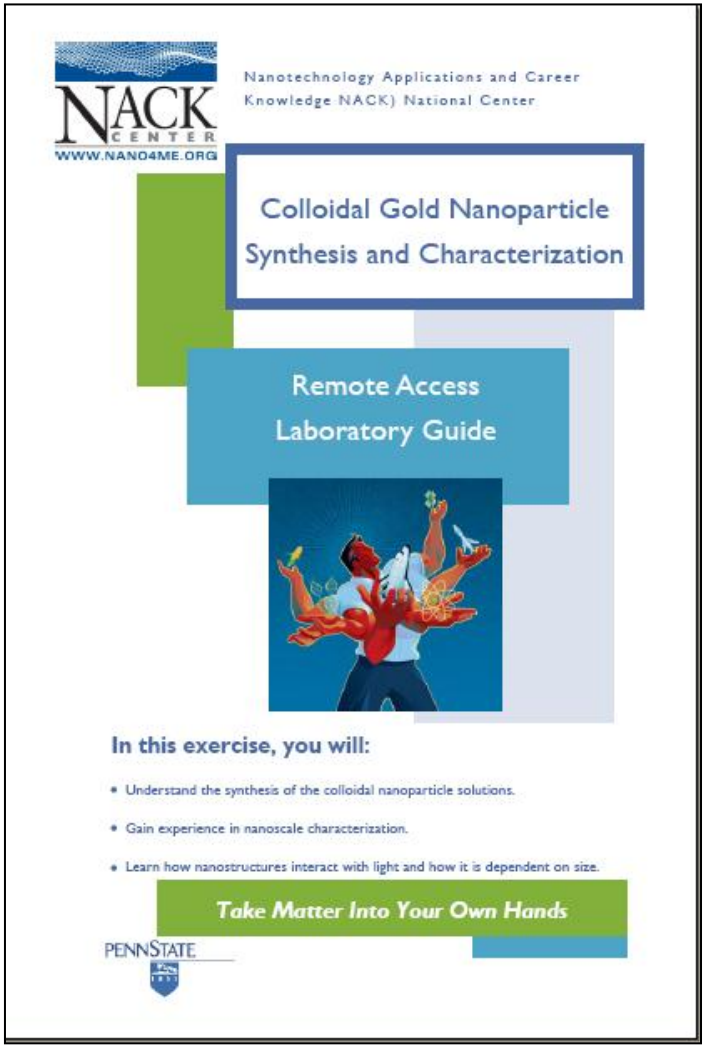
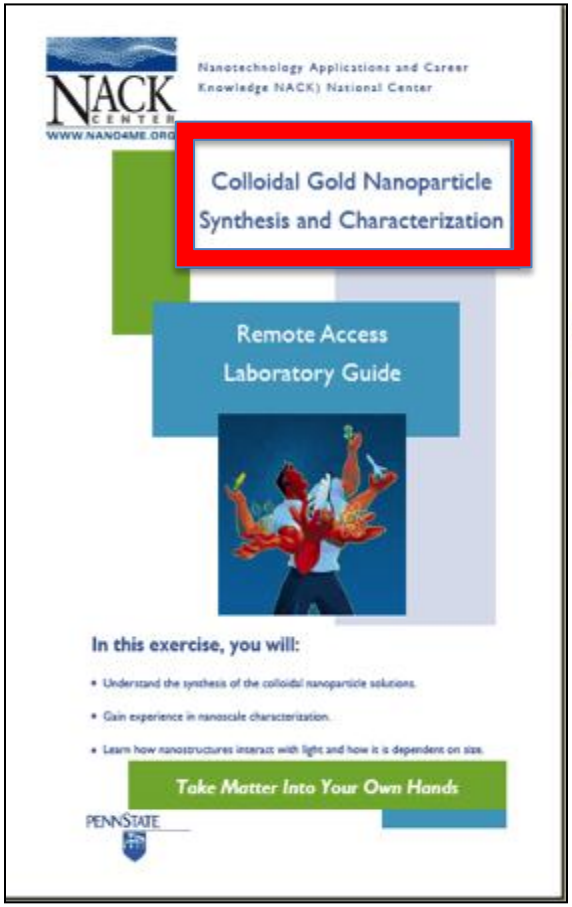
Remote Access Labs

- Pre-made and ready for printing
  - Students **qual**itatively analyze with you (hands-on experiment)
  - We **quant**itatively analyze together (remote characterization)
- Characterization tools are integrated into the lab structure
- Background, requirements, procedure, etc. are provided in the lab packet



Colloidal Gold Nanoparticle Synthesis and Characterization



The gold we know:

- Material properties don't change with size
  - Resistivity
  - melting point
  - optical absorption

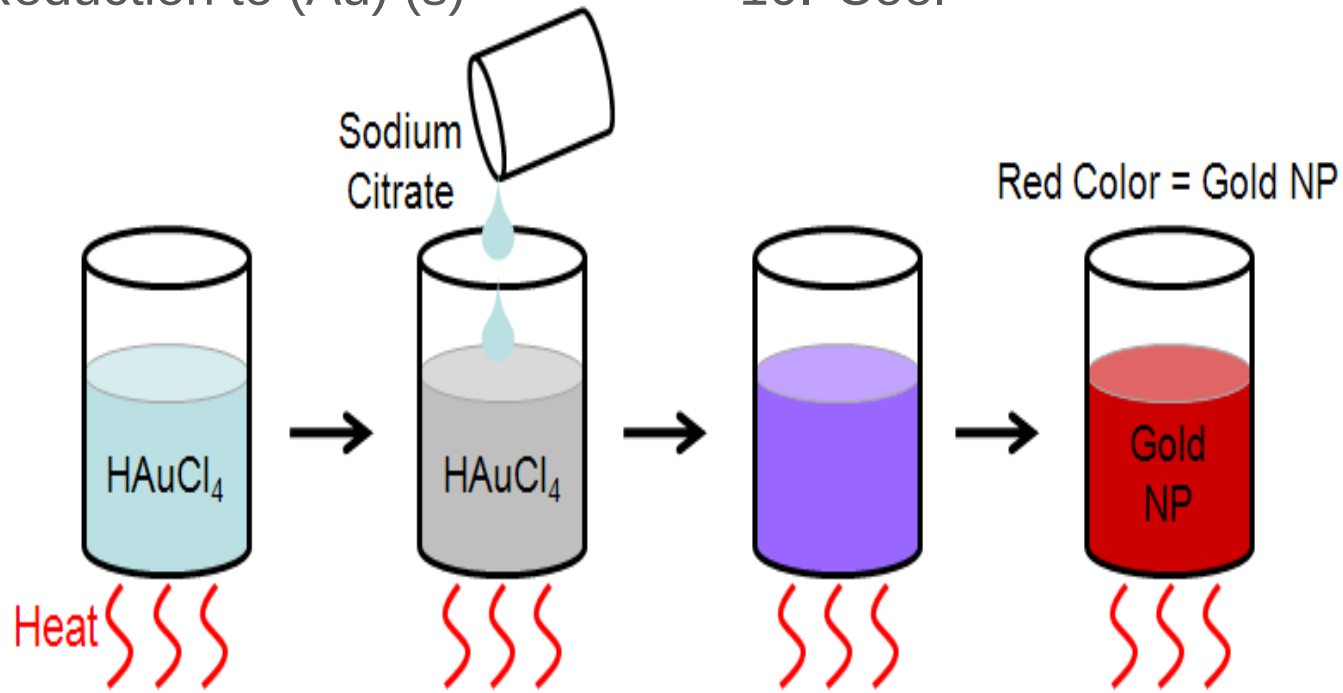
The gold we are discovering:

- Material do change with the size of the gold nanoparticle
- Plasmon resonance

Lab adapted from University of Wisconsin Madison (MRESEC) Video Lab Manuals
http://mrsec.wisc.edu/Edetc/nanolab/index.html

In Your Classroom

1. 50 ml DI water
2. 5 mL HAuCl4
3. Boil
4. Ionic solution (Au3+) (aq)
5. Reduction to (Au) (s)
6. Capping via citrate
7. 0.5 mL 1% sodium citrate
8. Boil
9. Clear, violet, red
10. Cool



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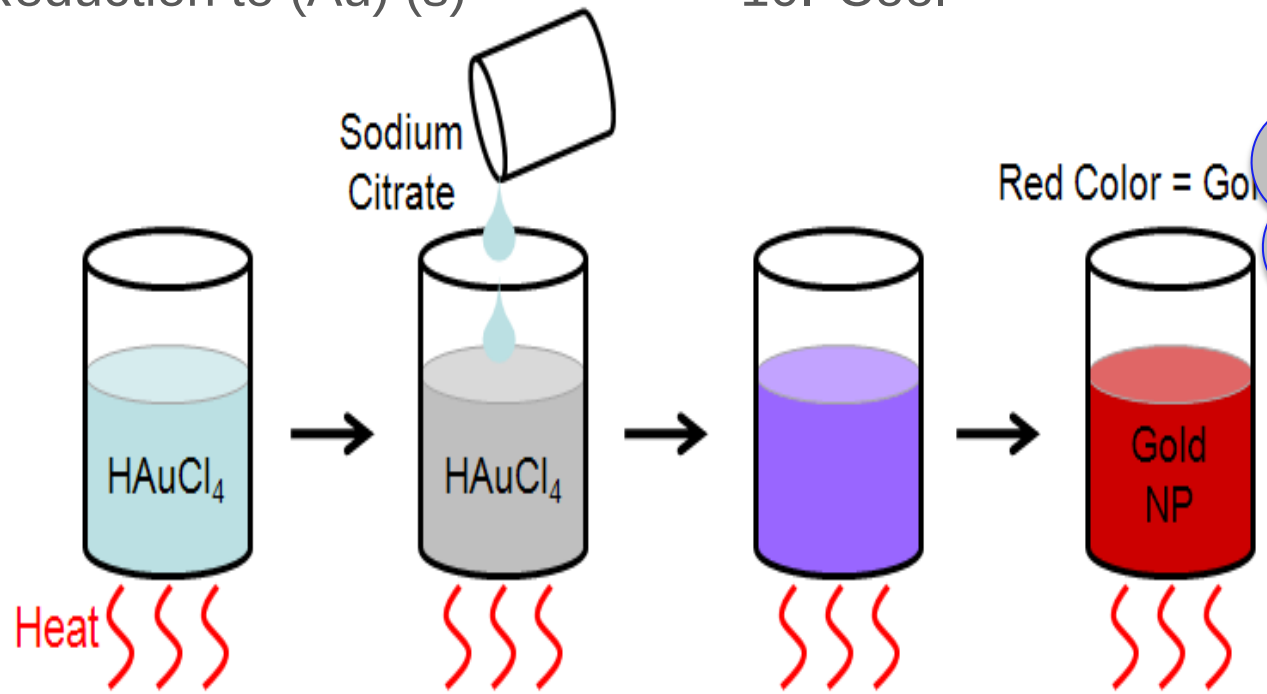

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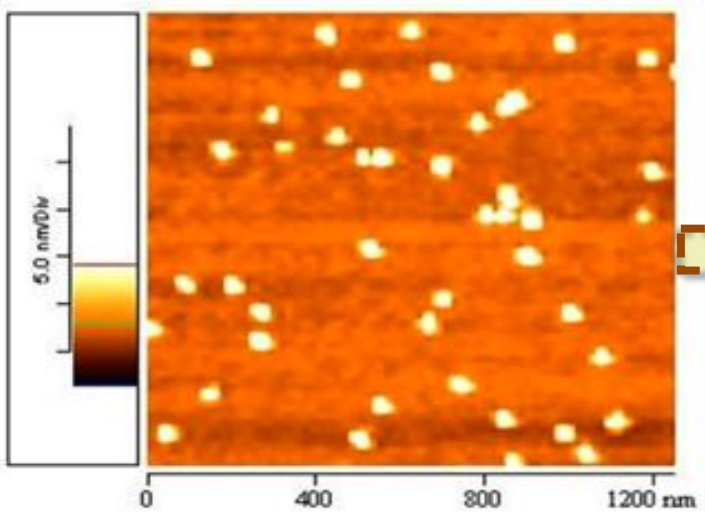
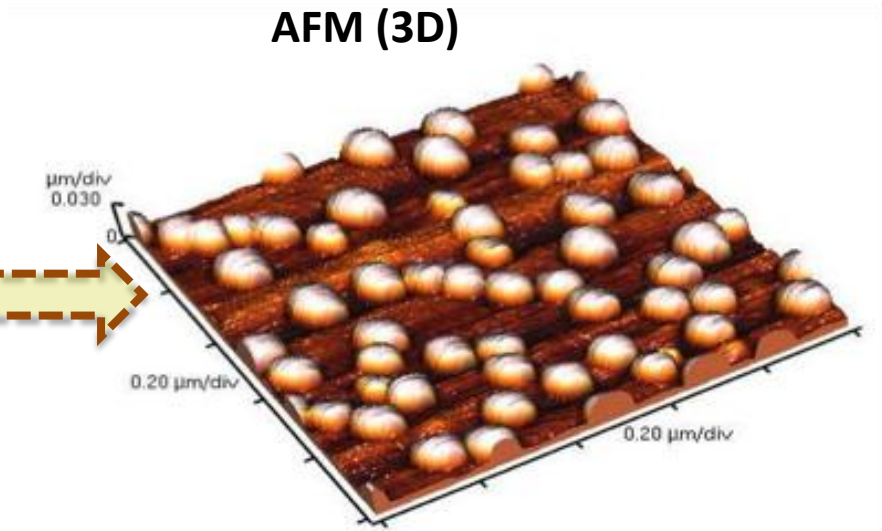
What Students Do With Remote Access

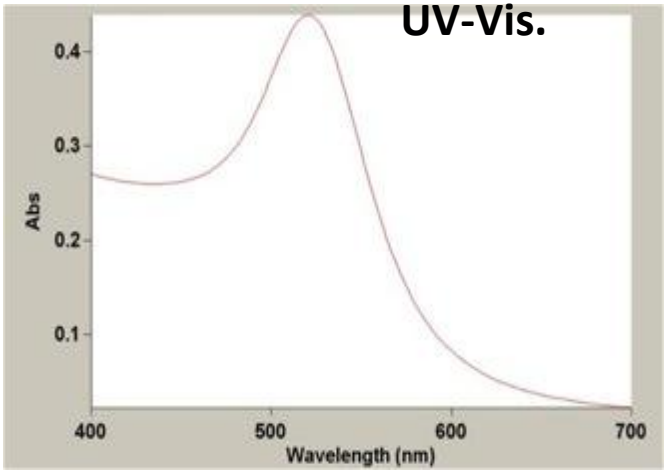
AFM (2D)



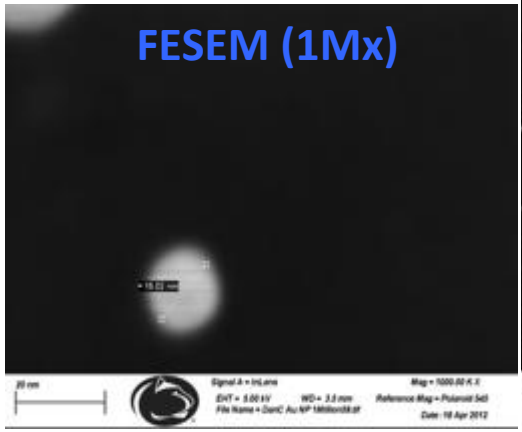
AFM (3D)



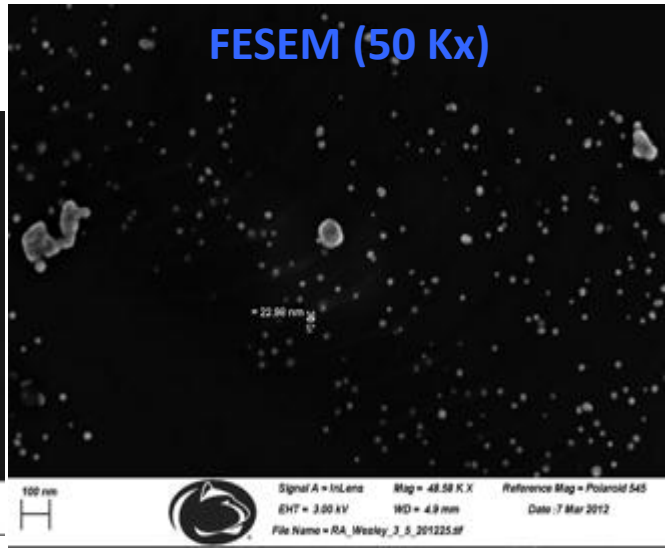
UV-Vis.



FESEM (1Mx)



FESEM (50 Kx)



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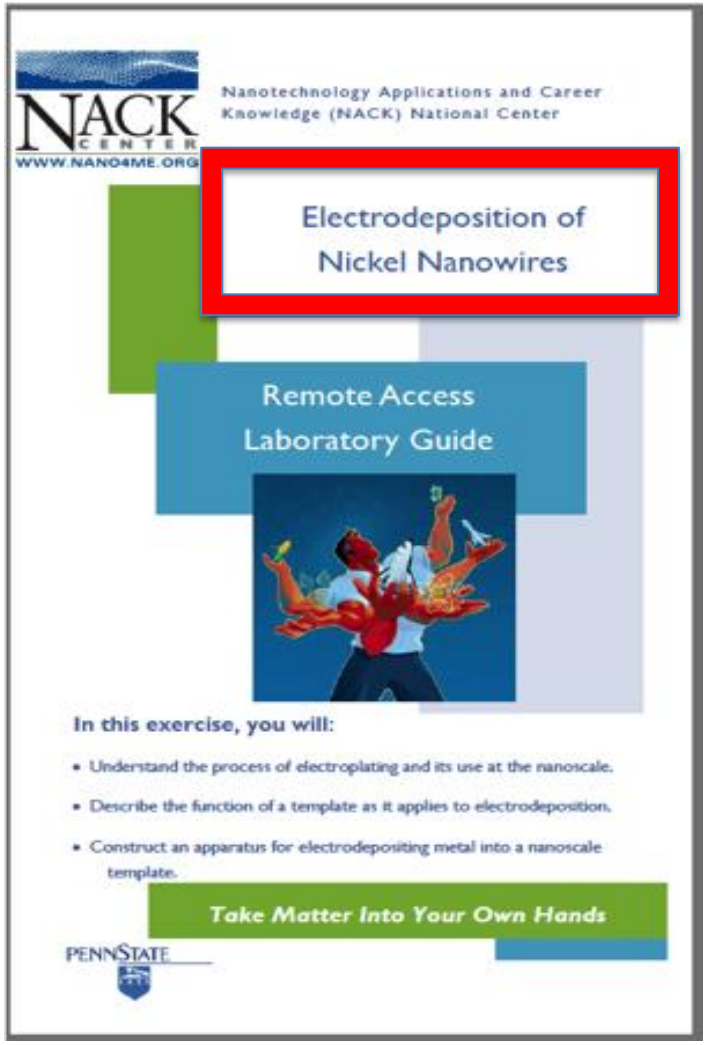
Electrodeposition of Nickel Nanowires



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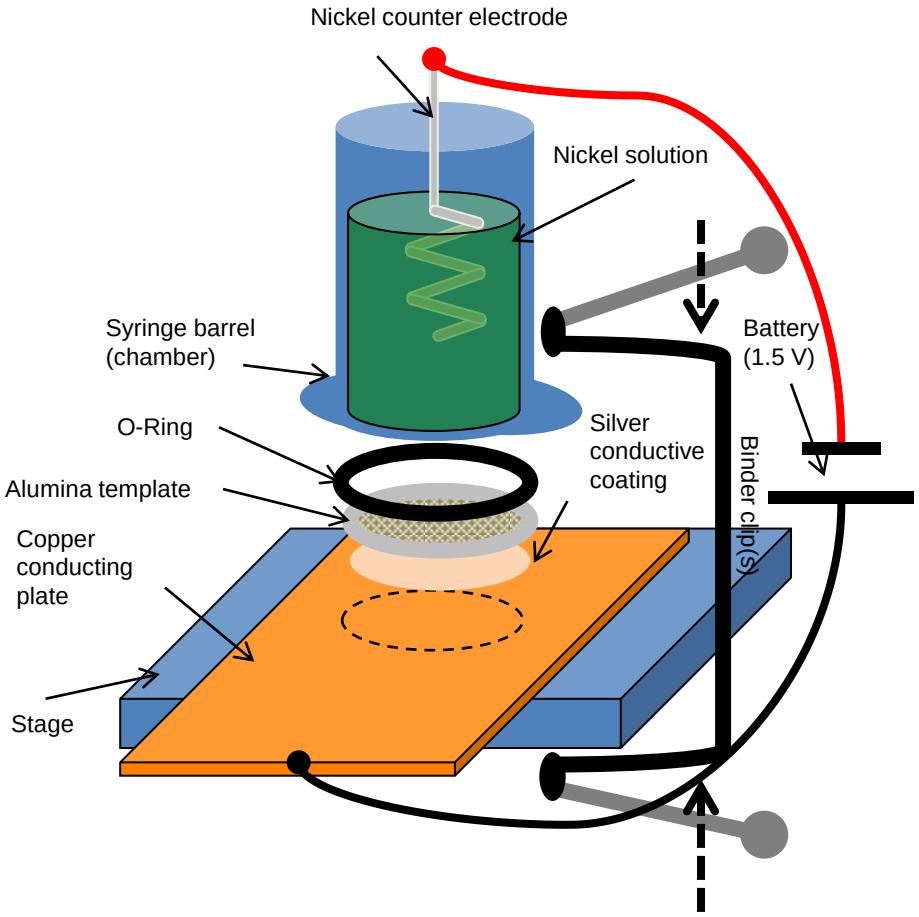
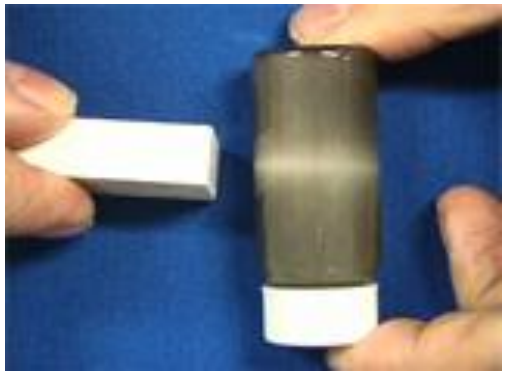
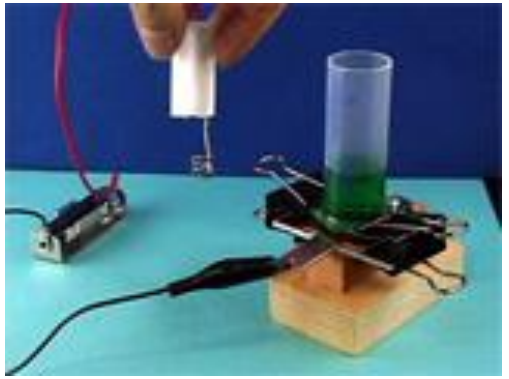
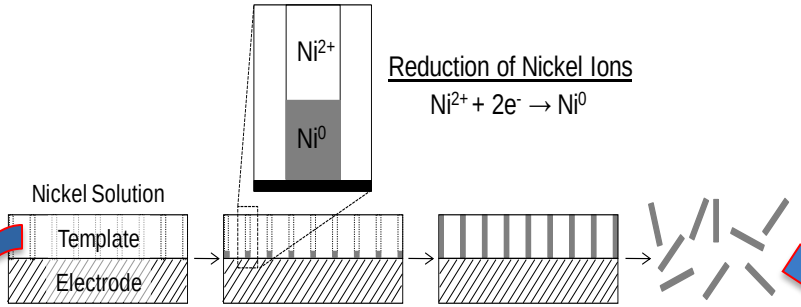


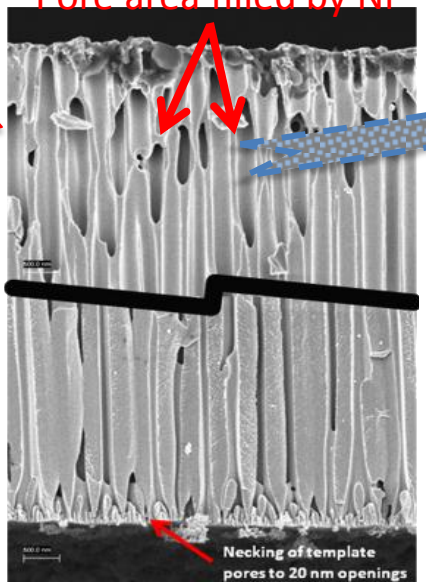


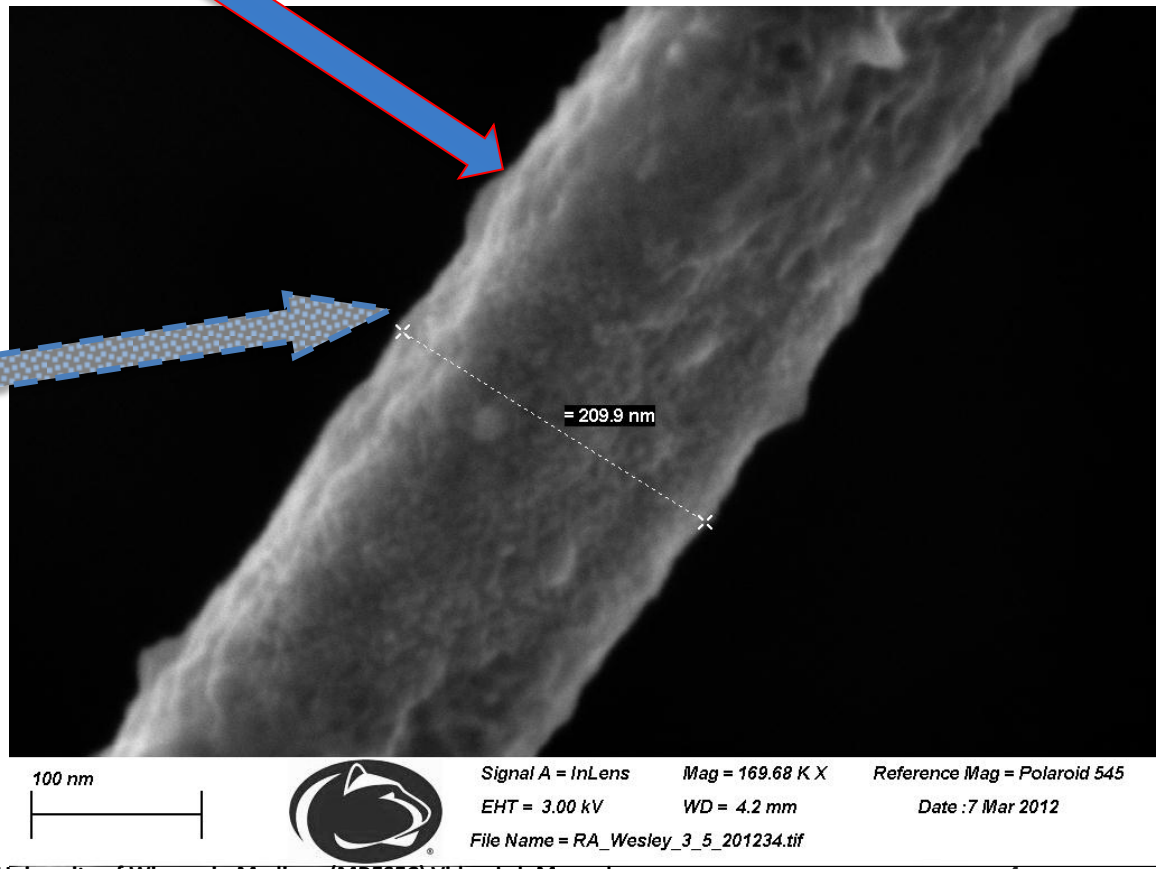


What Students Do With Remote Access

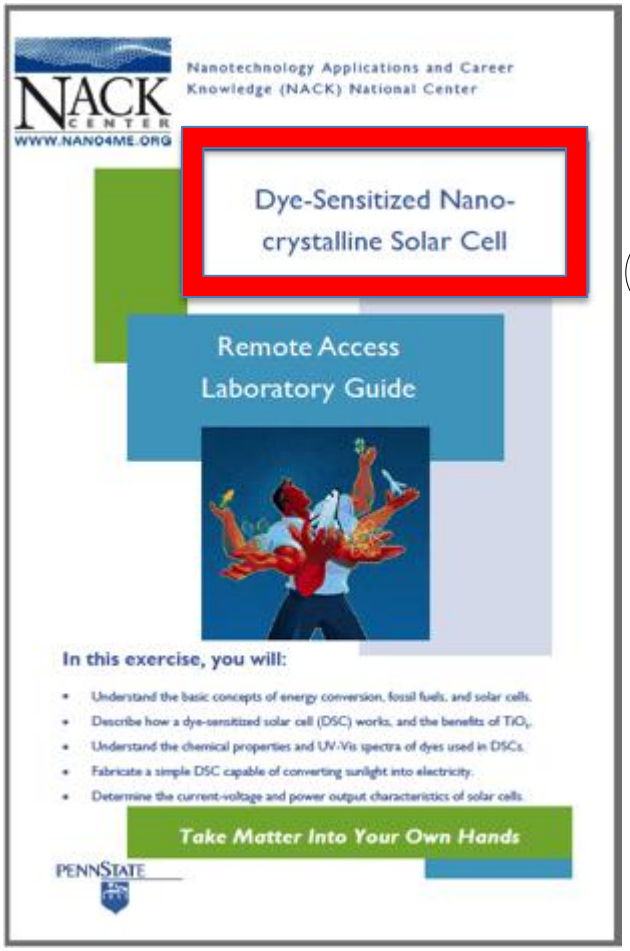


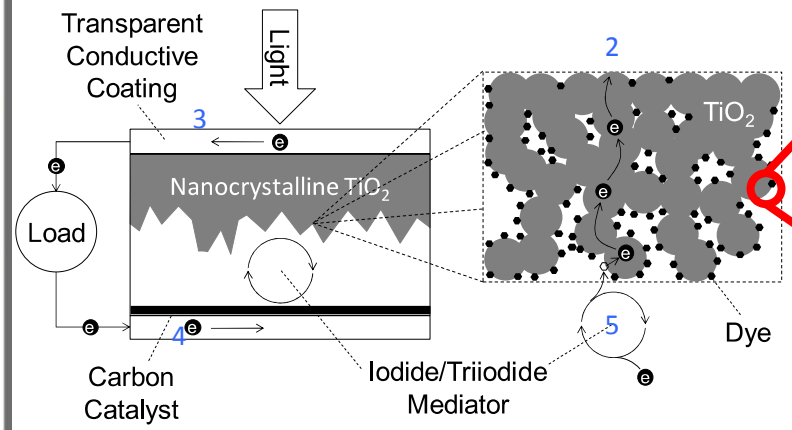
Pore area filled by Ni

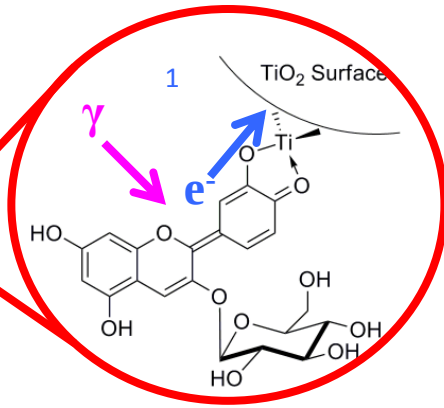




Dye-Sensitized Nano-crystalline Solar Cell



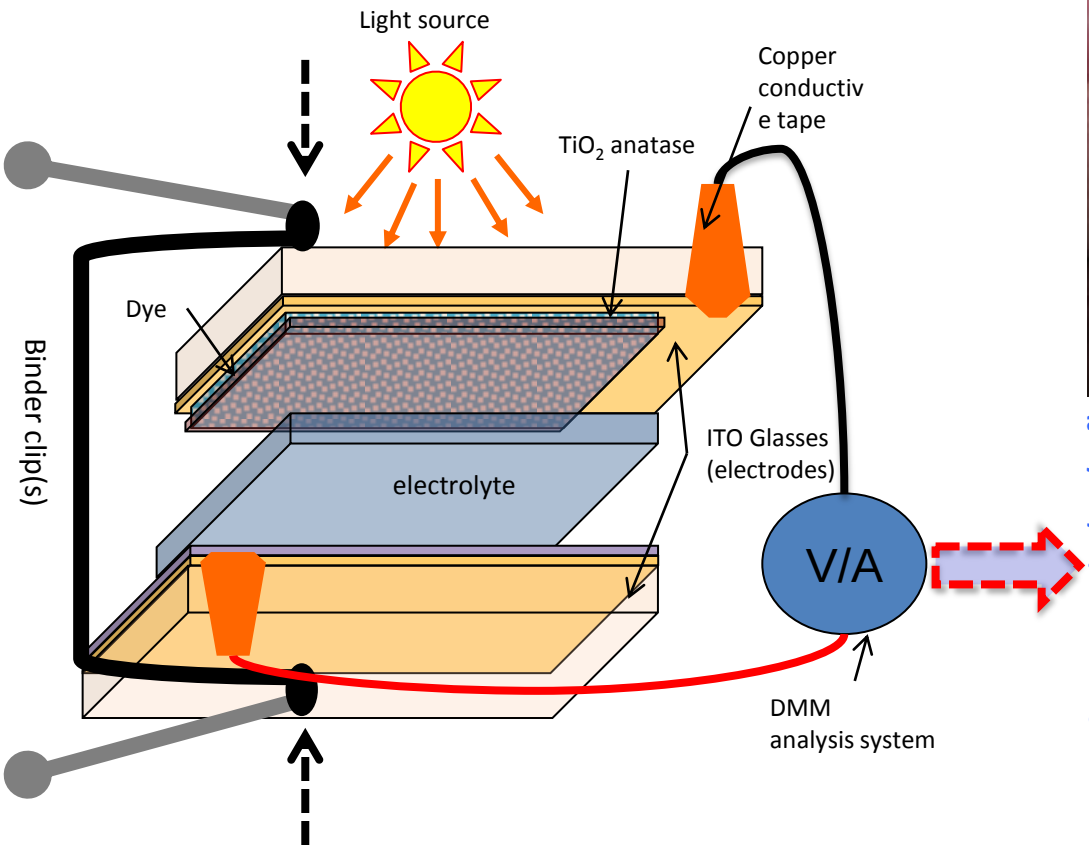


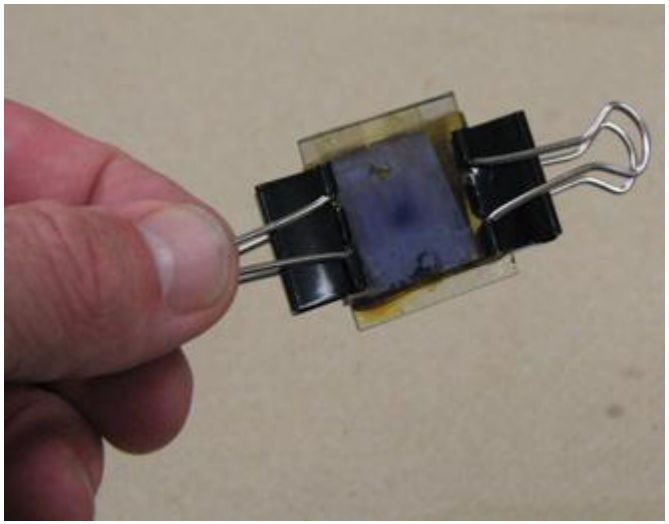


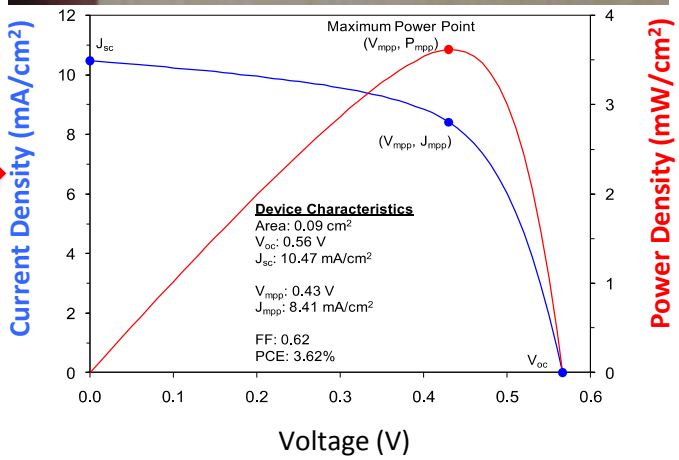
1. Photon excites anthocyanin dye molecule
2. Dye ejects sufficiently high in to TiO_2 anatase (band gap 3.2 eV)
3. ITO glass conducts electrons to load
4. Carbon on ITO glass conducts charge to iodide/triiodide mediator (electrolyte)
5. iodide/triiodide reduces the previously oxidized dye molecule back to neutral state = complete circuit

Lab adapted from University of Wisconsin Madison (MRESEC) Video Lab Manuals
http://mrsec.wisc.edu/Edetc/nanolab/index.html

In Your Classroom

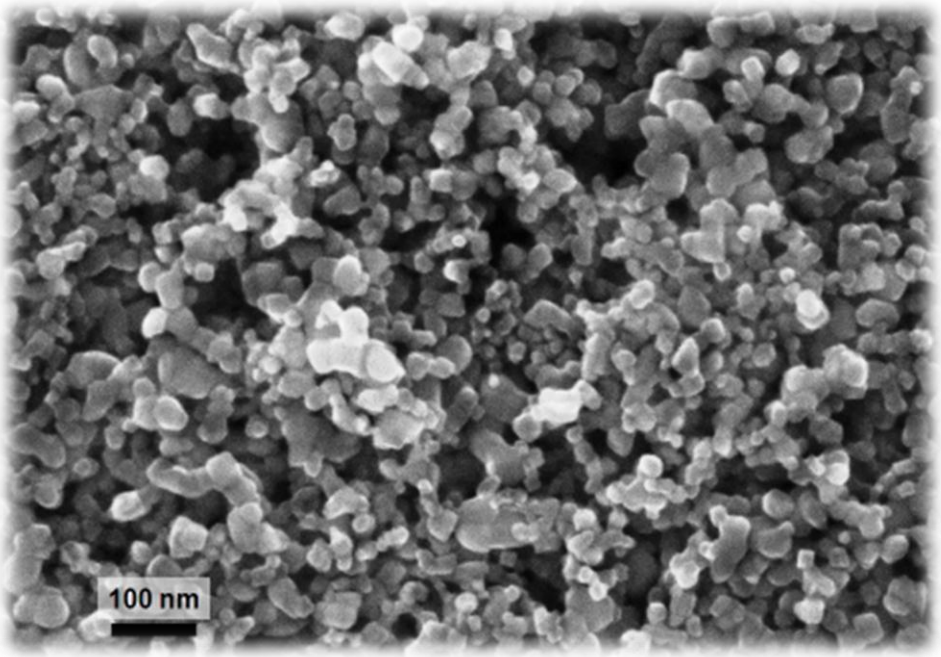






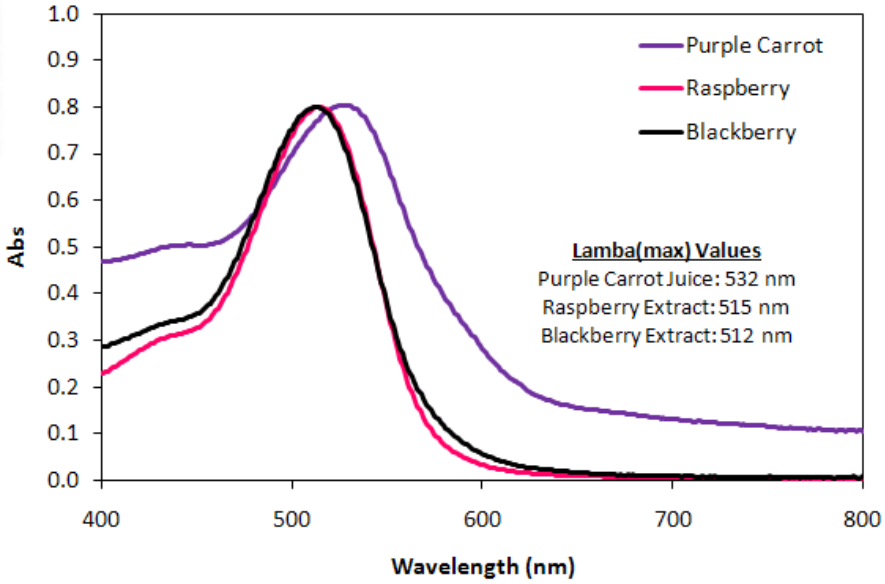
Lab adapted from University of Wisconsin Madison (MRESEC) Video Lab Manuals
http://mrsec.wisc.edu/Edetc/nanolab/index.html

What Students Do With Remote Access



FESEM of TiO_2 anatase

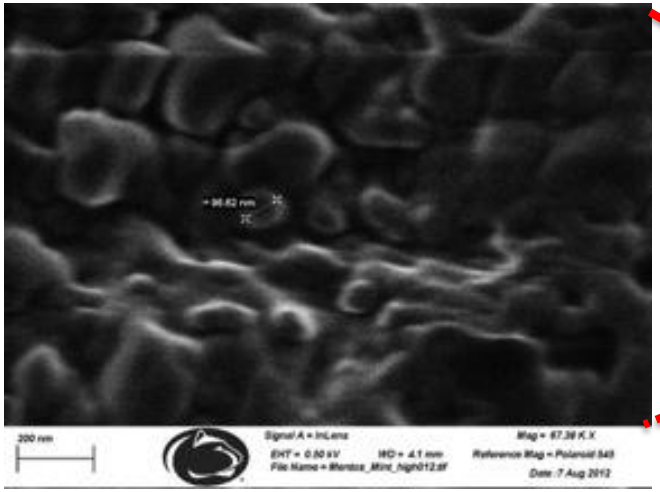
UV-Vis. of Anthocyanin dye

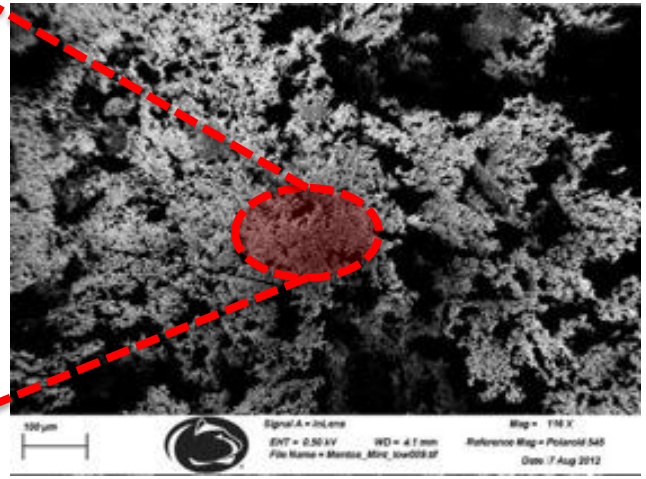


Lab adapted from University of Wisconsin Madison (MRESEC) Video Lab Manuals
http://mrsec.wisc.edu/Edetc/nanolab/index.html

More Remote Access Ideas

- We are always looking to develop new labs
  - Mentos mint candy + Diet coke (surface roughness and nucleation sites)
  - Cellulose and food products

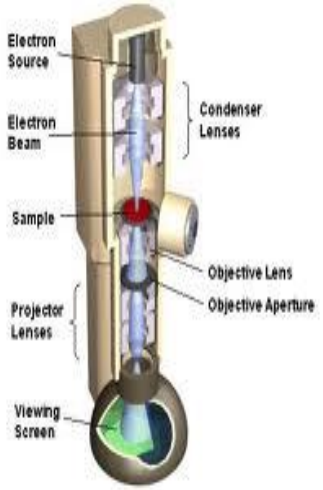


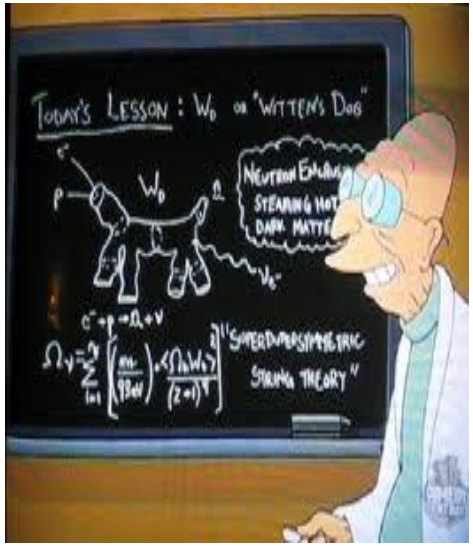


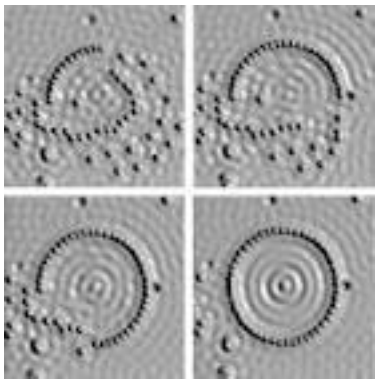
- Do you have any suggestions?
  - I'd love to hear your ideas!

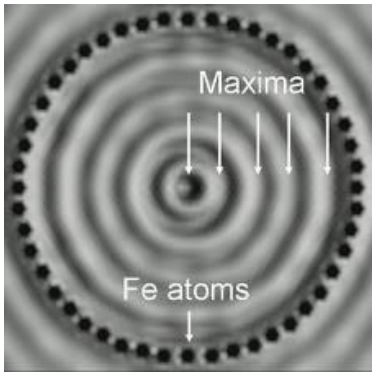
Break for Q&A

What Will Be The **Learning Outcome** For My Remote Access Session?





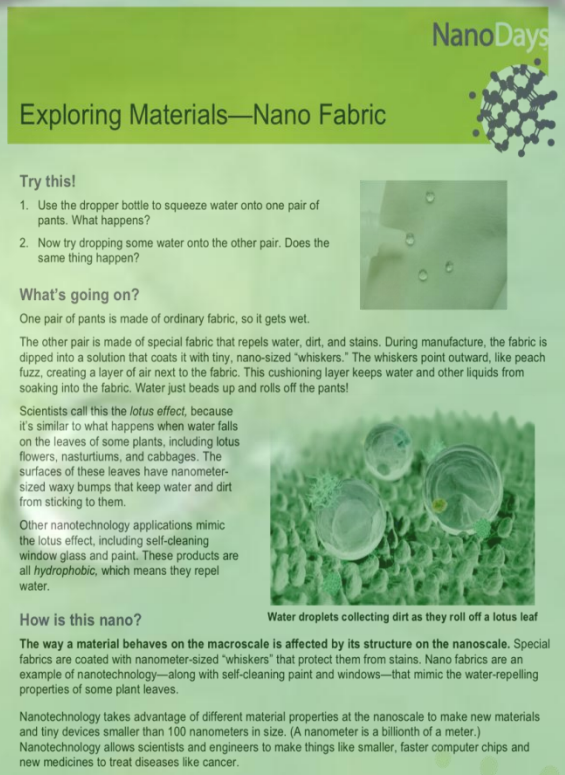




RA's can utilize experienced instructors and tool set for many focal points:

- Equipment training/study
- Exploring Nanotech. & Sci. topics
- Investigating Engr. & Sci. principles (core content)
- Simply to analyze experimental results

What Can I Incorporate Into RA?



NanoDays

Exploring Materials—Nano Fabric

Try this!

1. Use the dropper bottle to squeeze water onto one pair of pants. What happens?
2. Now try dropping some water onto the other pair. Does the same thing happen?

What's going on?

One pair of pants is made of ordinary fabric, so it gets wet.

The other pair is made of special fabric that repels water, dirt, and stains. During manufacture, the fabric is dipped into a solution that coats it with tiny, nano-sized "whiskers." The whiskers point outward, like peach fuzz, creating a layer of air next to the fabric. This cushioning layer keeps water and other liquids from soaking into the fabric. Water just beads up and rolls off the pants!

Scientists call this the *lotus effect*, because it's similar to what happens when water falls on the leaves of some plants, including lotus flowers, nasturtiums, and cabbages. The surfaces of these leaves have nanometer-sized waxy bumps that keep water and dirt from sticking to them.

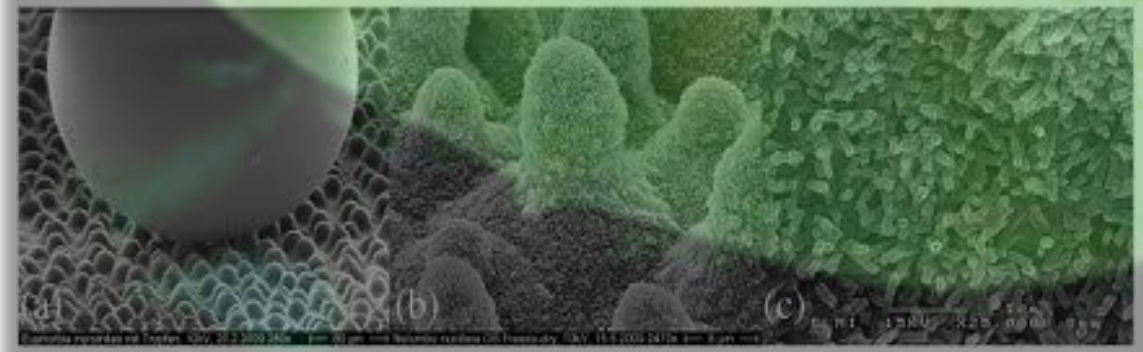
Other nanotechnology applications mimic the lotus effect, including self-cleaning window glass and paint. These products are all *hydrophobic*, which means they repel water.

Water droplets collecting dirt as they roll off a lotus leaf

How is this nano?

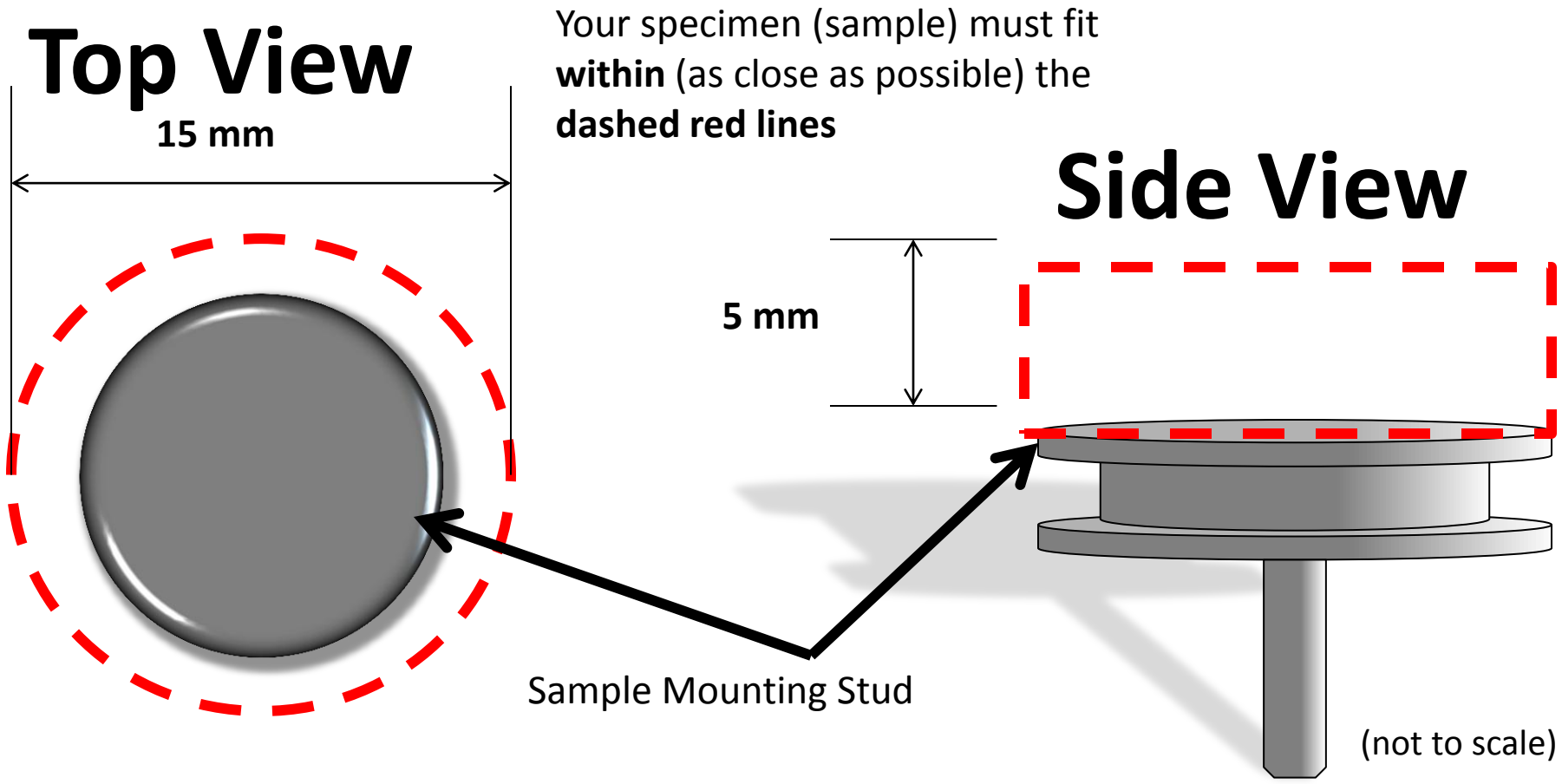
The way a material behaves on the macroscale is affected by its structure on the nanoscale. Special fabrics are coated with nanometer-sized "whiskers" that protect them from stains. Nano fabrics are an example of nanotechnology—along with self-cleaning paint and windows—that mimic the water-repelling properties of some plant leaves.

Nanotechnology takes advantage of different material properties at the nanoscale to make new materials and tiny devices smaller than 100 nanometers in size. (A nanometer is a billionth of a meter.) Nanotechnology allows scientists and engineers to make things like smaller, faster computer chips and new medicines to treat diseases like cancer.



- Focus on local science and technology centers
  - Museums
  - Universities
  - Business
- Enhance other nanotech. activities (e.g. NanoDays)
- Utilize RA in studying science and engineering principles

Brief Guide to Selection: Size



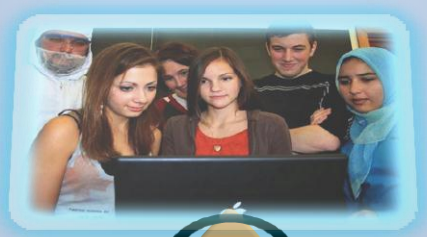
Brief Guide to Selection: Materials

- Many kinds of materials can be imaged with the FESEM, but some cannot undergo the imaging process:
  - Biological samples should be inanimate and dried prior to shipping
    - Dissect larger specimen to fit size requirements
  - Samples will be placed under “high vacuum” (5 X 10^-7 Torr)
    - Materials that might outgas or expand should not be used
      - » NO sealed hollow items
  - Samples should be conductive
    - Dialectic materials will need to be specially prepared for imaging, which will take extract time (~15 min.) BUT is not a disqualifier
  - Samples must be in solid state or suspended in a volatile solvent (e.g. acetone, IPA)
      - » NO gels or pastes (dry powders are okay)
- RA instructor will have the final inspection and decision for specimen feasibility
- RA instructor can discuss characterizing methods to obtain needed results

Outline

- What are my objectives in this webinar?
- What is the “nanoscale”?
- What is Remote Access?
- What will I need for Remote Access?
- What instruments are available by Remote Access?
- Break for Q&A
- What can my students do with Remote Access?
- How do I set up a Remote Access session?
- How will this benefit my students’, or my own, education?

The path to Remote Access



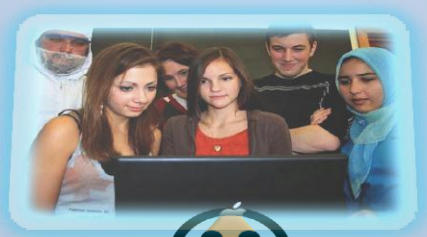
Results & Feedback

Conduct Remote Access lesson/lab

Prepare for lesson

Request a Remote Access session

Requesting a Remote Access session



Send sample(s)

Watch “Guide to Remote Access” video

Schedule test with RA instructor

Fill-out Request Form

Go to nano4me.org

Prepare for lesson

Run test with RA instructor

Set up computer + AV software

Watch video modules (HW?)

Review RA ready lab material

Using Remote Access for lesson

Provide RA feedback

Collect data

Students operate tool

RA provides as-needed instruction

Log in to Remote Access

Conduct classroom lesson

Outline

- What are my objectives in this webinar?
- What is the “nanoscale”?
- What is Remote Access?
- What will I need for Remote Access?
- What instruments are available by Remote Access?
- Break for Q&A
- What can my students do with Remote Access?
- How do I set up a Remote Access session?
- How will this benefit my students’, or my own, education?

Remote Access Benefits

- **For Instructors:**
  - **No overhead or maintenance**
  - **Reduced preparation time**
  - **Increased student motivation**
  - **Multiple learning motifs**
  - **Links teachers to university research facilities and personnel**
  - **Efficient use of very expensive resources (>$1,000,000)**
  - **Labs and learning objectives are already developed**

- **For Community:**
  - **Reduces overall cost of many peoples education**
  - **People (students) with greater self-efficacy**
  - **Better educated and engaged students prepared for industry**

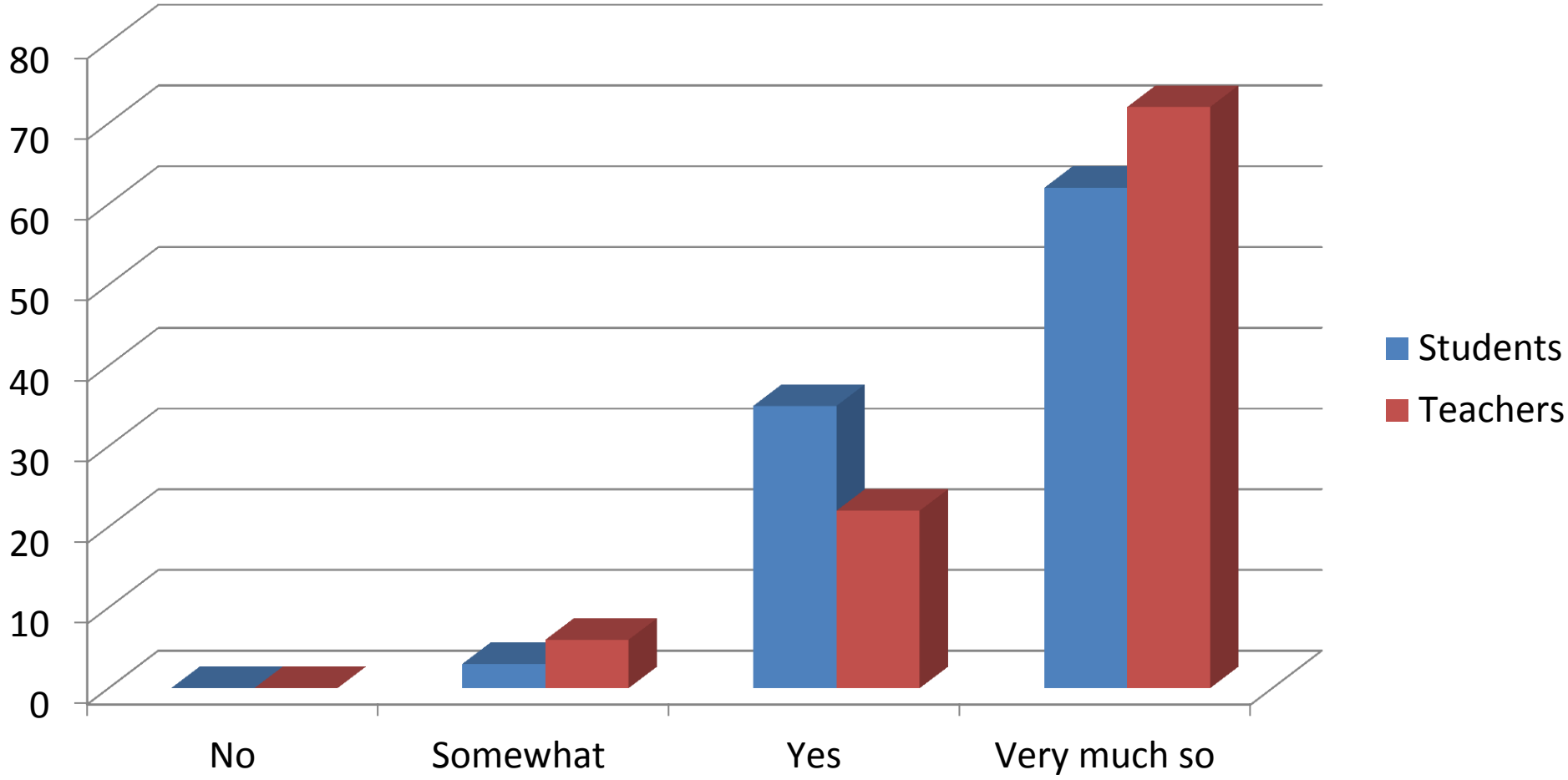
- For Students:
  - Exposure to otherwise inaccessible equipment
  - Provides relevance, background, and principles
  - Increased student motivation to learn
  - Engaging, holistic approach
  - Links students to university research facilities and university personnel
  - Shows that scientists are real people
    - “I can do this too!”
  - “Hands-On” Experience

What Is The Feedback Like?

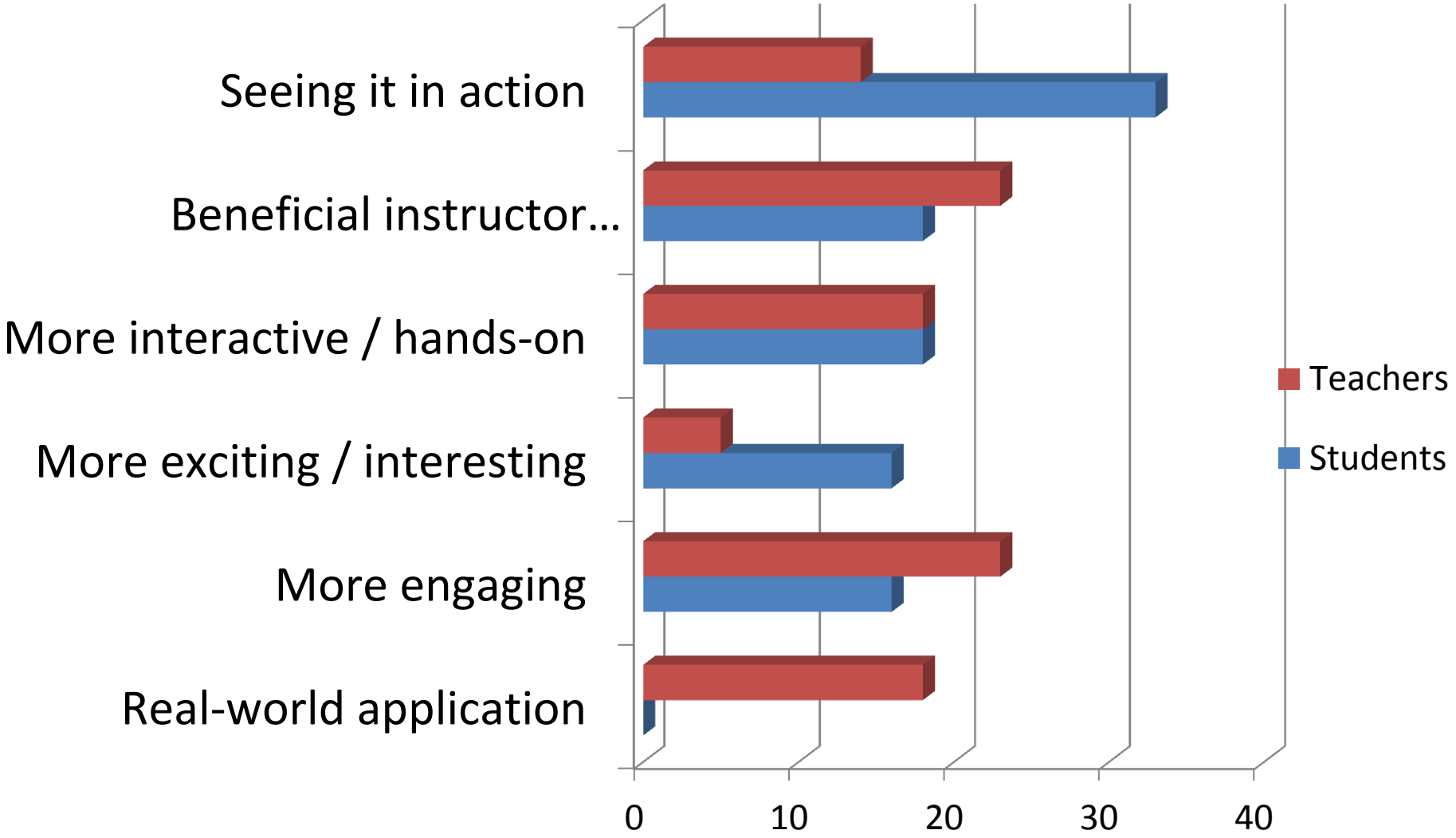
- Pilot study
- Student data
  - 89 completed surveys
- Teacher data
  - 18 completed surveys
- All data is presented as percentages out of 100%

Did You Find The Instructor Engaging?

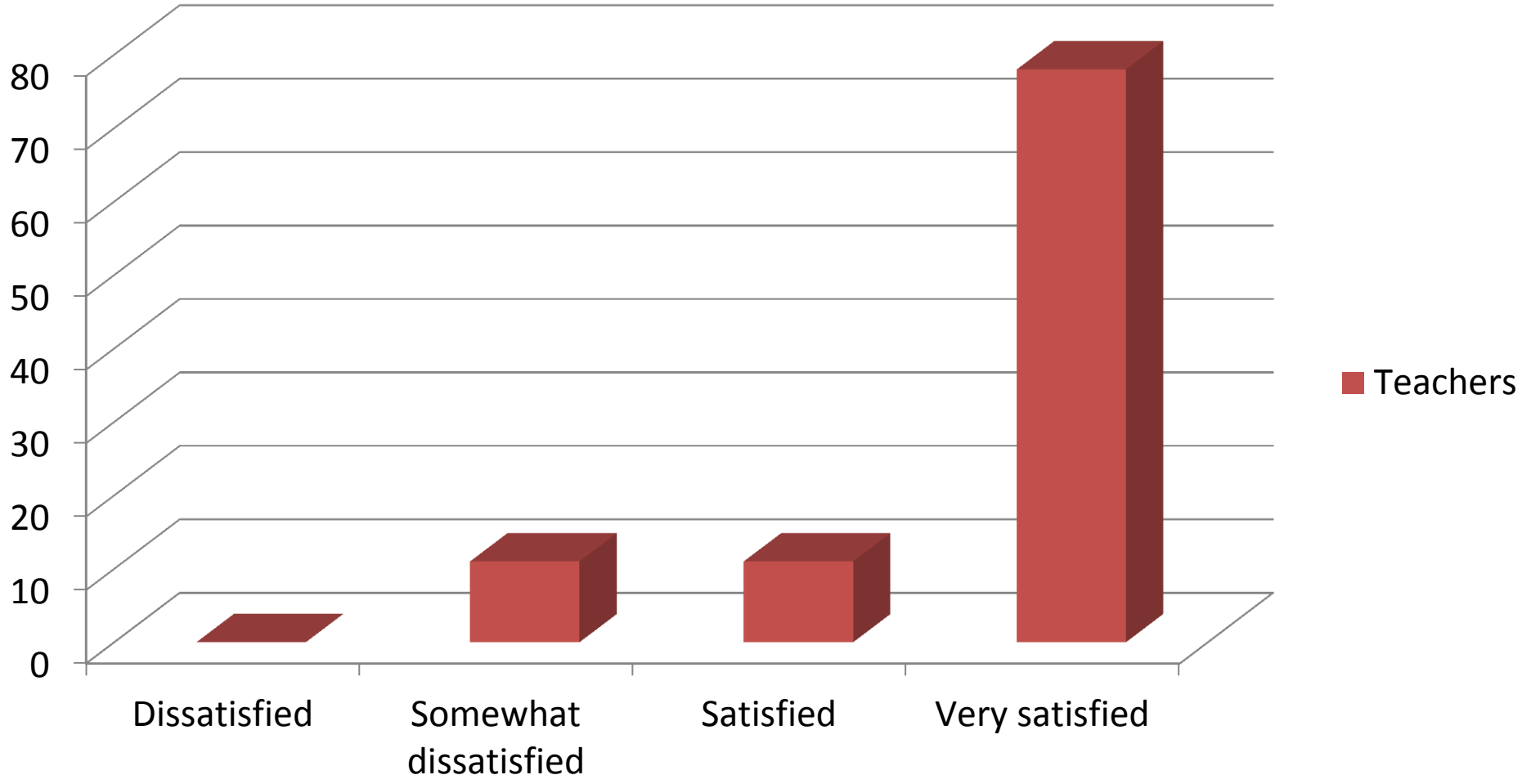
(Did they capture your attention, make the material interesting and/or fun?)



More Valuable Than Text-book and/or Lecture-based Learning?



What Was Your Overall Impression Of The Remote Activity? (Including videos, labs, tools, instructor presence, etc.)



Student Responses

"These labs are so much more engaging than learning from a book, because you are able to see how things work, and even control them, first-hand. I have nothing but good things to say about the remote lab experience."

"This experience was amazing. At my scholastic level, I have never used equipment that showed such a dramatic end result. Sebastien was really cool to let us actually control what we wanted to see. For me, traditional textbook learning does not compare to this hands-on learning experience. The visual experience really opened my eyes to nanotechnology."

Conclusion

- Advanced instruments are even more powerful with Remote Access to hi-tech tools is available to classrooms across the country
- Students gain valuable understanding in a way that WORKS!
- Minimal barrier to entry: We **want** you to participate
- Results have been extremely positive
- Future of RA
  - NACK at Penn State is in the process of helping other institutions make their tools available through NACK Remote Access.
  - Multiple physical Remote Access sites will be available through the NACK nano4me.org site by next year.

Who Can I Talk To About RA?

- Dan C. (Cavanaugh)

  dwc174@engr.psu.edu

  814-867-2948

nano4me.org

~~No~~ small THANK YOU!

I hear and I forget.
I see, and I remember.
I do, I understand.

--Confucius

The value of a college education is not the learning of many facts but the training of the mind to think.

--Albert Einstein

Where can I find more information on Nanotechnology in general? (programs, tools, advancements, jobs)

- www.nano4me.org
- www.nano.gov
- www.nnin.org (nano ed. portal)
- www.newpa.com
- www.lehigh.edu/nano
- www.nclt.us
- www.mrsec.wisc.edu
- www.nisenet.org
- www.nanohub.org
- www.matec.org (networks here)
- www.sciencedaily.com
- www.powerofsmall.org
- www.smalltimes.com
- www.nanotechproject.org
- www.thenanotechnologygroup.org
- www.workingin-nanotechnology.com
- www.careervoyages.gov/nanotechnology
- www.nanoguys.com
- http://www.diigo.com/list/nsdlworkshops/web-seminar-nano

Resources: Remote Access

MIT iLabs

http://www.ilabcentral.org/

NASA

http://www.nasa.gov/centers/ivv/about/foremployees_ra.html

Enabling Virtual Access to Latin-America Southern Observatories (EVALSO)

http://www.evalso.eu/evalso/

Remote Access to Instrumental Analysis for Distance Education in Science (2005)

http://www.irrodl.org/index.php/irrodl/article/view/260/404

IEEE--Remote-access education based on image acquisition and processing through the Internet (2003)

http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=1183678

National Science Teachers Association

http://www.nsta.org/publications/news/story.aspx?id=59475

Resources: Government Organizations

National Nanotechnology Initiative
http://www.nano.gov

National Nanotechnology
(nano Ed. portal)
http://www.nnin.org/nnin_edu.html

NIOSH Safety and Health Topic: Nanotechnology
http://www.cdc.gov/niosh/topics/nanotech/about.html

EPA Center for Environmental Implications of Nanotechnology
http://www.ceint.duke.edu/

NASA (two separate links)
http://www.nasa.gov/centers/ames/research/technology-onepagers/nanotechnology-landing.html
http://quest.nasa.gov/projects/nanotechnology/resources.html

USDA
http://www.csrees.usda.gov/nanotechnology.cfm

Consumer Product Safety Commission
http://www.nano.gov/node/139

CDC
http://www.cdc.gov/niosh/topics/nanotech/

National Cancer Institute
http://nano.cancer.gov/

National Institute of Standards and Testing
http://www.nist.gov/nanotechnology-portal.cfm

Nano You (European Union)
http://nanoyou.eu/

Resources: NSF & Educator Affiliates

NSF
http://www.nsf.gov/news/overviews/nano/index.jsp

Nano4me.org for educators
http://nano4me.org/educators.html#contenttop

NanoEd
http://www.nanoed.org/

Nanoscale Information Science Education Network (NISE)
http://www.nisenet.org/

Nano Education Portal of the Nanotechnology Center for Learning and Teaching (NCLT)
http://community.nsee.us/index.phpoption=com_content&view=frontpage&Itemid=227

Nano-Link
http://www.nano-link.org/index.html

Center for Advanced Materials and Nanotechnology
http://www.lehigh.edu/nano/

Southwest Center for Microsystems Education
http://scme-nm.net/scme_2009/

University of Wisconsin-Madison Materials Research Science and Engineering Center
http://mrsec.wisc.edu/MR--Home.php

Maricopa Advanced Technology Education Center
http://www.matec.org/

University of Puerto Rico
http://www.upr.edu/

DiscoverNano (Northwestern University)
http://www.discovernano.northwestern.edu/index_html

Mid-content Research for Education and Learning (NanoLeap)
http://www.mcrel.org/NanoLeap/

NanoZone
http://nanozone.org/index.htm

Making Stuff (Stronger, Cleaner, Smaller, Smarter)
http://www.pbs.org/wgbh/nova/tech/making-stuff.html

Northeast Advanced Technological Education Center (NEATEC)
http://www.neatec.org/

Recourses: Private/Independent

The Project on Emerging Nanotechnologies (PEN)
http://www.nanotechproject.org/

Network for Computational Nanotechnology
https://nanohub.org/groups/ncn

PBS for kids
http://pbskids.org/dragonflytv/nano/wans_701.html

Nanooze (kids magazine)
http://www.nanooze.org/

Sciencedaily (Nanotechnology)
http://www.sciencedaily.com/news/matter_energy/nanotechnology/

Small Times
http://www.electroiq.com/nanotech.html

The Nanotechnology Group Inc.
http://www.tntg.org/

Power of Small
http://powerofsmall.com/

Nano Letters (journal)
http://pubs.acs.org/journal/nalefd?cookieSet=1

American Chemical Society Nanotation (journal)
http://community.acs.org/nanotation/

Nanodictionary
http://www.nanodic.com/

Diigo (nanotechnology web-seminars)
http://www.diigo.com/list/nsdlworkshops/web-seminar-nano

National Council for Advanced Manufacturing
http://www.nacfam.org/

Institute of Nanotechnology
http://www.nano.org.uk/careers-education/education

European Nanotechnology Gateway
http://www.nanoforum.org/

Nanopolis (Exploring Nanotechnology)
http://nanotech.nanopolis.net/

NanoTecNexus
http://www.nanotecnexus.org/nanobionexus

Foresight Institute
http://www.foresight.org/

How Can We Better Serve You?

Whether you are joining us live or watching the recorded version of this webinar, please take 1 minute to provide your feedback and suggestions.

http://questionpro.com/t/ABkVkZORVG

Webinar Recordings

To access this recording, slides and handout visit

nano4me.org/webinars.php

Events Calendar

October 1-4: *Workshop*	Nanotechnology Course Resources II Patterning, Characterization & Applications
November 13-15: *Workshop*	Hands-On Introduction to Nanotechnology for Educators
December 14: *Webinar*	Societal and Ethical Issues in Nano - Part II

Visit www.nano4me.org for more details about these and other upcoming webinars.

Thank You!

Thank you for attending the

NACK Center webinar

Remote Access – Integrating High Tech Tools Into Your Classroom