Purdue~NanoDays 2016

NanoDays™
The Biggest Event for the Smallest Science!
Educational activities about nanoscale science and engineering

April 13, 2016
6:00 - 8:00 p.m.
Activities for Girl Scouts & Birck Families

April 14-15, 2016
9:00 a.m. - 2:00 p.m.
Activities for K-12

Register your school, class, or group here! (Registration is required)
https://nanohub.org/groups/bnc/nanodays

By Swati Pol, Ph. D.
NanoDays Lead Organizer
Research Scientist,
Outreach and Engagement Officer, BNC
NanoDays is...

- A nationwide event celebrating nanoscale science and engineering
- Organized by the Nanoscale Informal Science Education Network (NISE Net)
- Held in all 50 states of the US, as well as other countries
- Hosted at more than 250 sites each year
- Enjoyed by over 470,000 participants annually
NanoDays is...

NanoDays engages people of all ages in learning about this emerging field of science, which holds the promise of developing revolutionary materials and technologies!
NanoDays Sites

2008-2015
Discovery Park in Purdue University
Discovery Park (DP) is a New Paradigm

• Purdue’s hub for interdisciplinary and translational research

• Conceived as a place where scholars from all disciplines could work together to define whole new areas of research and solve grand challenges
- Burton D. Morgan Center for Entrepreneurship
- Birck Nanotechnology Center
- Bindley Bioscience Center
- Discovery Learning Research Center
- Global Sustainability at Purdue
  - Center for the Environment
  - Energy Center
  - Purdue Climate Change Research Center
  - Center for Global Food Security
- ACCESS: Advanced Computational Center for Engineering and Sciences
  - Cyber Center
  - Rosen Center for Advanced Computing (ITaP)
- Oncological Sciences Center
- Regenstrief Center for Healthcare Engineering
- Gerald D. and Edna E. Mann Hall
- Hall for Discovery and Learning Research
It IS Happening Here!

For information on Discovery Park: http://www.purdue.edu/discoverypark
The Birck Nanotechnology Center
Building and Facilities

- general-purpose labs
- offices
- a 25,000 sq. ft. Class 1-10-100 cleanroom
- First integration of a bio-pharma cleanroom within a nanofabrication cleanroom

- Low vibration
- Ultra-pure water
- Temperature control better than ±0.01 °C (Hall Metrology Lab)
- Nanotechnology incubator for industry and start-up companies
Major Research Themes

- **NanoPhotonics** *(metamaterials)*
- **Computational Nanotechnology** *(home of the NSF nanoHUB)*
- **NanoElectronics** *(Carbon/Graphene electronics)*
- **Bio-Nanotechnology** *(with adjacent Bindley Bioscience Center)*
- **MEMS/NEMS** *(host for the NNSA PRISM Center)*
- **Nano-Energy** *(solar, thermoelectrics, batteries)*
Safety

Important safety information about the Birck Nanotechnology center
Emergency routs to Burton Morgan

Red = emergency exit

State Street

Bindley

Birck Nanotechnology Center

Parking lot

Intramural Drive

Burton Morgan

Housing

Housing
Tornado Shelter Areas
Our 7th NanoDays Event:
April 13-15, 2016

Wednesday, April 13 6-8 pm
Girl scouts & Birck families

Thursday, April 14 9am – 2pm
K-12 School Groups

Friday, April 15 9am – 2pm
K-12 School Groups

Over 800 registered attendees plus walk-ins!
NanoDays

April 13-15, 2016

NanoDays Purdue 2016

Imagine, discover, and explore a world that's too small to see. NanoDays is a nationwide celebration of nanoscale science, and you're invited! Come celebrate with us and enjoy nano-related activities throughout the Exhibit Halls of the Birk Nanotechnology Center at Discovery Park of Purdue University.

When:

April 13, 2016, 6pm-8pm: Activities for Girls scouts and Birk Families
April 14, 2016, 9am-2pm: Activities for K-12 Grade Students and General Audience (Just a Few spots Left)
April 15, 2016, 9am-2pm: Activities for K-12 Grade Students and General Audience

NanoDays is a free event and registration is required!
Purdue NanoDays: FB page & Event

https://www.facebook.com/events/441378306053288/

https://www.facebook.com/nano.purdue.edu/?ref=bookmarks
General Expectations for Volunteers

- Show up 30 minutes early
  - Check-in at BRK registration desk
  - Get your T-shirt, chick-fil-A coupon and certificate
  - Food (Coffee for AM volunteers, lunch for all)
  - Activity setup & Practice

- Present yourself well!
- Greet participants with a smile and engaging attitude!
- Introduce yourself
  - Give your name, what you are studying, and say something about why you are interested in your major
- Be positive and open to all questions

- Leave your station as clean as you found it, PM volunteers put the kit back into the box
- No chewing gum, no food at the demo table, limit cell phone use
Videos

https://nanohub.org/groups/bnc/nanodays

* How to interact with your audience
  - http://vimeo.com/32933974

* How to NOT interact with your audience
  - http://vimeo.com/32933894

* All training videos:
Engaging the Public in Nano
Nano \((10^{-9})\) is a prefix. A nanometer is very small. There are 1 billion nanometers in a meter. Nanoscale things often behave differently than larger things do.
What is Nano?

Key concepts:

1. Nano is small and different
2. Nano is studying and making tiny things
3. Nano is new technologies
4. Nano is part of our society and our future
1. * nano fabric
   * Sunblock
2. * Thin films
   * Stained glass window
3. * UV bracelets
   * nano sand
   * Surface area
4. * Measure yourself
5. * Nano Biology_Prof. Suter
   * Special microscopes_ nano feel
6. * Lego AFM
7. * Electric squeeze (Peizo electric)
8. * TEM
   * Invisibility cloak
9. * Optics_OSA/SPIE
   * Polarizers
   * Liquid crystal display
10. * nanoHUB_Carbon nanostructures_ Dr. Faltens
11. * Graphene
   * Compter Hard drives
12. * Rechargeable batteries_Prof. Pol
    * Electroplating
13. * Glowing Grass_H Zhang (4/14/)
    * Knudsen thermal force_ Prof. Alexeenko (4/15)
14. * nanoCellulose from trees_ Prof. Moon/Prof. Youngblood
15. * mini Nano-exhibit
16. * Mock cleanroom_NSAC
17. * nano-Ice Cream!
   BRK 2001 (4/13, 15)
   Burton Morgan (4/14)
NanoDays 2016: Activities

I. nano-IceCream : BRK 2001
II. Own Research Demo: BRK Atrium
III. NSAC mock-cleanroom : BRK 1001
IV. NanoDays Kit Activities : BRK Atrium
I. nano-IceCream : BRK 2001

Ice Cream is a Colloid

Volunteers:
* 04/13, 6-8pm
* 4/14, 15: Tim Miller & Kenny Schwartz

Colloid – material where one phase mixes into another

- Ice cream is a foam, emulsion, and sol!

Liquid nitrogen used to rapidly make ice cream
* Liquid nitrogen is extremely cold (-321 °F)
* Change in temperature when liquid nitrogen is poured is so rapid that cream does not have time to change to ice
* Tiny nanometer sized ice crystals form - like snow does on a very cold day
* This should make our ice cream very, very smooth!
II. Own Research Demo

<table>
<thead>
<tr>
<th>Booth</th>
<th>Title</th>
<th>Time</th>
<th>Lab</th>
<th>#of vols.</th>
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<tbody>
<tr>
<td>1</td>
<td>Optics: OSA and SPIE</td>
<td>All days</td>
<td>OSA/SPIE</td>
<td>10</td>
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<tr>
<td>2</td>
<td>nanoHUB: models and simulations of carbon nanostructures</td>
<td>All days</td>
<td>nanoHUB</td>
<td>5</td>
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<td>3</td>
<td>Precious Metals at the Nanoscale: More than Meets the Eyes</td>
<td>13-Apr</td>
<td>Prof. Alex Wei, <a href="mailto:alexwei@purdue.edu">alexwei@purdue.edu</a></td>
<td>3</td>
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<tr>
<td>4</td>
<td>Nanobiology: Biology at the nanometer micron scale</td>
<td>4/14, 15</td>
<td>Prof. Suter</td>
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<td>5</td>
<td>Rechargeable Batteries</td>
<td>14-Apr</td>
<td>Prof. Pol</td>
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<tr>
<td>6</td>
<td>Cellulose Nanocrystals-Nanomaterial from Trees</td>
<td>14-Apr</td>
<td>Prof. Youngblood</td>
<td>2</td>
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<tr>
<td>7</td>
<td>Build an aquifer</td>
<td>15-Apr</td>
<td>Emerging Leaders in Science and Society</td>
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<td>8</td>
<td>Glowing Grass: Observation of Photosynthetic Units</td>
<td>15-Apr</td>
<td>Prof. Jong Hyun Choi</td>
<td>2</td>
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III. NSAC mock-cleanroom

Mock cleanroom activity
organized by

NanoDays
The Biggest Event for the Smallest Science!

NSAC
Nanotechnology Student Advisory Council
Purdue University

Front of BRK

Podium with laptop
Mock TEM
Mock cleanroom equipment (plasma etching/pecvd)

BRK 1001

Enter
Gowning area

Cleanroom poster

Air shower

Table with safety glasses and bouffant caps

De-gowning area

Exit

3D printing
cleanroom poster

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Contact: Manuel Ochoa, ochoam@purdue.edu
What is Nano?

Key concepts:

1. Nano is *small* and *different*
2. Nano is *studying* and *making* tiny things
3. Nano is *new technologies*
4. Nano is *part* of our society and our future
IV. NanoDays Kit Activities

Key concept 1: Nano is small and different.
Key concept 2: Nano is studying and making tiny things.

IV. NanoDays Kit Activities

Exploring Fabrication—Electroplating

How can scientists make a nickel look like a penny?

Exploring Properties—Electric Squeeze

How does movement make electricity?
IV. NanoDays Kit Activities

Key concept 3: Nano is new technologies
IV. NanoDays Kit Activities

Key concept 4: Nano is part of our society and our future
* Nano- mini exhibition

An engaging and interactive mini-exhibition for family audiences about nanoscale science, engineering, and technology.
IV. NanoDays Kit Activities

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<td><strong>Materials - Thin Films</strong></td>
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<td>4</td>
<td><strong>Products – Computer hard drives</strong></td>
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<td><strong>Products - Nano Fabric</strong></td>
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<td>6</td>
<td><strong>Products – Magic nano sand</strong></td>
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<td><strong>Properties – Invisibility</strong></td>
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<td><strong>Properties – Surface area</strong></td>
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<td><strong>The Electric Squeeze_piezoelectricity</strong></td>
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<td><strong>Build a giant puzzle</strong></td>
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<td><strong>Mock Cleanroom</strong></td>
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<td><strong>Dress Up Like a Nanoscientist</strong></td>
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<td>20</td>
<td><strong>Tools - TEM</strong></td>
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<td>21</td>
<td><strong>Tools-Mitten Challenge</strong></td>
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Exploring Materials - Graphene

This is a hands-on activity in which visitors use tape and graphite to make graphene and test the conductivity of graphite. They learn that graphene is a single layer of carbon atoms arranged in a honeycomb pattern. There are two versions of this activity, one that uses an LED to test the conductivity and one that uses a buzzer.


Exploring Materials - Thin Films

This is a hands-on activity in which visitors create a colorful bookmark using a super thin layer of nail polish on water. They learn that a thin film creates iridescent, rainbow colors.


Exploring Products - Nano Fabric

This is a hands-on activity exploring how the application of nano-sized whiskers can protect clothing from stains. Visitors investigate the hydrophobic properties of pants made from nano fabric and ordinary fabric.

http://nisenet.org/catalog/programs/exploring_products_-_nano_fabrics_nanodays_10_11
Exploring Tools - Transmission Electron Microscopes

This is a hands-on activity in which visitors use a model of a transmission electron microscope to image an object by looking at its shadow. They learn that scientists use special tools and equipment to work on the nanoscale.

http://nisenet.org/catalog/exploring-tools-transmission-electron-microscopes

Exploring Tools - Special Microscopes

This is a hands-on activity in which visitors use a flexible magnet as a model for a scanning probe microscope. They learn that SPMs are an example of a special tool that scientists use to work on the nanoscale.

http://www.nisenet.org/catalog/programs/exploring_tools_-_special_microscopes_nanodays_08_09_10_11

Exploring Properties - Electric Squeeze

This is a hands-on activity in which visitors investigate the properties of piezoelectric materials. They learn that piezoelectric materials have the special property to create electricity when their shape is changed and that when electricity is passed through them, they change shape.

http://www.nisenet.org/catalog/programs/exploring_properties_-_electric_squeeze
Exploring Products - Computer Hard Drives

This is a hands-on activity in which visitors use floating ring magnets to store data. They learn that computer hard drives are one of the most common applications of nanotechnology.

http://www.nisenet.org/catalog/programs/exploring_products_-_computer_hard_drives

Exploring Properties – Invisibility

This is a hands-on activity in which visitors investigate how glass objects can be "hidden" in some liquids. They learn that researchers can use nanotechnology to engineer new materials that interact with light in special ways.

http://www.nisenet.org/catalog/programs/exploring_properties_-_invisibility

Exploring Products – Sunblock

This is a hands-on activity comparing sunblock containing nanoparticles to ointment. Visitors learn how some sunblocks that rub in clear contain nanoparticles that block harmful rays from the sun.

Exploring Size - Measure Yourself

This is a hands-on activity in which visitors mark their height on a height chart and discover how tall they are in nanometers. They learn that although being a billion nanometers tall sounds impressive, it doesn't mean they're super tall: it means a nanometer is super small. Visitors can also measure their hands in nanometers.

http://www.nisenet.org/catalog/programs/exploring_size_-_measure_yourself

Exploring Properties - Surface Area

This is a hands-on activity demonstrating how a material can act differently when it's nanometer-sized. Visitors compare the reaction rate of an effervescent antacid tablet that is broken in half with one that is broken into many pieces.

http://www.nisenet.org/catalog/programs/exploring_properties_-_surface_area_nanodays_08_09_10

Exploring Properties - UV Bracelets

This is a hands-on activity in which visitors use ultraviolet light to change the color of beads that contain photochromic dye. They learn that the UV beads change color as a result of nanoscale shifts in the shape of the dye molecules.
Communicating Research - Help students see the connections

- Research Topic 1
  - Structural Color
  - Manipulating Matter
  - Structure of Matter

- Surface Area
- Size-Dependent Properties

- Research Topic 2
  - Hydrophobicity
Inside the Box

Activity Guides

On the front:
Instructions for visitors

Exploring Properties—Electric Squeeze

Try this:
1. Attach the piece of red-foil-covered copper wire to the nickel.
2. What happens to the insulation?
3. How does this compare to the battery pack?

What’s going on?
Current flows through the copper wire, warming it and causing the insulation to shrink. As the wire expands, it warms up and the insulation expands.

How is this nano?
Electrically conducting copper wire and copper nanoparticles can be used to make conductive materials.

On the back:
Information for presenters

Learning objectives:
1. This activity uses simple circuits, and important concepts are introduced.
2. Students learn about current and voltage in circuits.

Materials:
- Battery
- Circuit board
- Copper wire
- Alligator clips
- Insulation

Related educational resources:
- Solar energy
- Renewable energy
- Electric circuits

Credits and rights:
Programs are supported by the National Science Foundation under Award No. 0969587. The opinions, findings, and conclusions or recommendations expressed in this document are those of the authors and do not necessarily reflect the views of the National Science Foundation.
Other Materials—making connections

- Posters
- Signs
- Videos
Example Activity

Tanya Faltens, Ph.D.
Educational Content Creation Manager, NCN

-information about nanoHub Outreach group
-demonstrate one of the NanoDays activities that has great ties to:
  - Nano and optical properties
  - Nano and products
  - Nano and the environment
This is a place where you can access all of our NanoDays materials.

You can have online discussions with other NanoDays volunteers and record notes about the activities that will help future volunteers.

https://nanohub.org/groups/outreach/collections

https://nanohub.org/groups/outreach/forum
Nanoscale Science and Technology Outreach

Overview

This community is a place to share information on teaching nanoscale science and technology as outreach, including informal education venues such as museums and after school programs. Resources on nanoHUB that are geared towards nanoscale science and technology outreach will be highlighted, and links provided to good material outside nanoHUB.

For those who join this group, community members can communicate with one another via email, the discussion board, wiki articles and blog. The discussion board may be a good place to talk about particular strategies, for example. In the projects area there is a searchable database of NanoDays activities that contains descriptions of all of the NanoDays physical kit activities from 2008 – 2014 along with links to the original instructions and video training. There is also a database of the Big Ideas in Nanoscience.

You can post notices for events on the group calendar and collaborate on projects with other members. You can also share items through the wiki pages. Within a wiki page, you can have text, upload files and images, and have links to material on the web. Wiki pages can be set up so that any group member can edit a page, or you can specify that only you as the page author can edit the page you create. Wiki pages may be a good way to share your nanoscience activity plans.

If you need assistance, send a message to Tanya Faltena through nanoHUB, or by direct email to tfaltena@purdue.edu. I will, from time to time, move the information to this overview page.

This group contains the following:
- Resources on nanoHUB for Nanoscale Science and Technology Outreach
- Purdue’s NanoDays Lectures for High School Students
- Resources on the Web for Nanoscale Science and Technology Outreach

Resources on nanoHUB for Nanoscale Science and Technology Outreach

Using nanoHUB to Introduce Middle School Students to Models and Simulations

Purdue University (2014)

Instructions for an activity that combines the use of physical models and the Crystal Viewer Simulation tool to make models and simulations more accessible to middle school students.
Activity Practice

You will have a chance practice facilitating your NanoDays activity.

As you practice the activity, think of questions to engage the students.
This presentation is based on work supported by the National Science Foundation under Grant No. 0940143.
Any opinions, findings, and conclusions or recommendations expressed in this presentation are those of the author(s) and do not necessarily reflect the views of the Foundation.
THANK YOU!

We couldn’t do this without you!