2007-2008 NCLT Professional Development Summer Institute

Professional Development Work Circle Team

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FOLLOW-UP ACTIVITIES

❑Poster Session

- ❑Teachers created posters on a nano-lesson they implemented in their class during the year.
- ❑Many lessons implemented were on size & scale and IMF.

❑Research Seminar

- ❑Bionanotechnology: Dr. Alex Wei (Purdue)
- ❑Size and Scale: Dr. Shawn Stevens (Michigan)

❑Big Ideas Workshop

- ❑Led by Dr. Shawn Stevens (Michigan)
- ❑Teachers formed small groups and discussed a particular big idea
- ❑Large group discussion ensued at the conclusion

❑Focus Group Evaluation

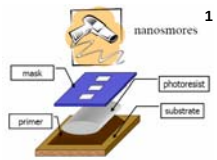
- ❑Positive feedback given by teachers

❑Ferrofluids

- ❑Learning Goals
  - ❑Perform the steps to synthesize a ferrofluid.
  - ❑Explain how the physical properties (appearance, viscosity) of a ferrofluid function in relation to its magnetic behavior.
  - ❑Understand the interdisciplinary nature of ferrofluids and nanotechnology and the many current and potential future applications of ferrofluids.
  - ❑Draw the magnetic field lines of force from a magnet and compare them to the spikes exhibited by a ferrofluid in a magnetic field.

❑Lithography

- ❑Learning Goals
  - ❑Lithographic techniques
  - ❑Applications of lithography
  - ❑Chemical reactions
  - ❑Properties of light
  - ❑Moore's Law
  - ❑Electron beam lithography
  - ❑Modeling of lithography



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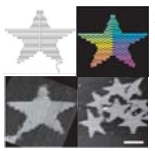
SAMPLE SUMMER INSTITUTE SCHEDULE (PURDUE)

	Sunday 5-Jul	Monday 6-Jul	Tuesday 7-Jul	Wednesday 8-Jul	Thursday 9-Jul	Friday 10-Jul	Saturday 11-Jul	Sunday 12-Jul	Monday 13-Jul	Tuesday 14-Jul	Wednesday 15-Jul	Thursday 16-Jul	Friday 17-Jul
	Breakfast (Hillenbrand)	Breakfast (Hillenbrand)	Breakfast (Hillenbrand)	Breakfast (Hillenbrand)	Breakfast (Hillenbrand)	Breakfast (Hillenbrand)			Breakfast (Hillenbrand)	Breakfast (Hillenbrand)	Breakfast (Hillenbrand)	Breakfast (Hillenbrand)	Breakfast (Hillenbrand)
8:30 - 11:30 AM		Welcome (30 min.) Nick Giordano Activity (30 min.) Icebreaker Kelly Hutchinson/ Shanna Daly Seminar (30 min.) NCLT Overview and Overview of Big Ideas Nick Giordano Seminar (30 min.) Intro to Nano Nick Giordano Discussion/Activity (30 min.) Nanotechnology Overview & Nano in Everyday Life Kelly Hutchinson/ Shanna Daly Assessment (30 min.) Bill Fornes/ Randal Batchelor (PHYS 154)	Activity (1.5 hours) Allotropes of Carbon David Sederberg Discussion (30 min.) Allotropes of Carbon Modeling Curriculum/ Adaptations David Sederberg Activity (1 hour) Size and Scale: Card Sort Kelly Hutchinson (PHYS 154)	Discussion (30 minutes) Intermolecular Forces Models/Curriculum/ Adaptations Shanna Daly/ Kelly Hutchinson Activity/ Discussion (1 hour) Models and Modeling Shanna Daly/ Lynn Bryan Activity (1.5 hours) Space Elevator David Sederberg (PHYS 154)	Discussion (1 hour) Electing Students' Conceptions Lynn Bryan Activity (2 hours) Ferrofluids David Sederberg/ Kelly Hutchinson (PHYS 154)	Seminar (1 hour) Microscopy Nick Giordano Activity (2 hours) Scanning Probe Microscopy: Designing a Tip and Probe and 3-D Scan Kelly Hutchinson (PHYS 154)			Activity (1 hour) Scanning Probe Microscopy: 3-D Scan and MFM Kelly Hutchinson Discussion (30 min.) SPM: Modeling/ Curriculum/ Adaptations Kelly Hutchinson Activity (1.5 hours) DNA Origami Shanna Daly/ Kelly Hutchinson (PHYS 154)	Discussion (45 min) Biosensors: Teacher Presentations and Modeling Curriculum/ Adaptations Kelly Hutchinson Discussion (2 hours, 15 minutes) Critique of Nanomodels Shanna Daly (PHYS 154)	Activity (1 hour) Quantum Dots Shanna Daly/ Fatima Benaissa Activity/ Discussion (1 hour) TEM Analysis and Modeling Curriculum/ Adaptations David Sederberg/ Kelly Hutchinson (PHYS 3rd Fl) Activity (1 hour) Lesson Planning/ Nano in My Curriculum Questions and Video Analysis Tool Lynn Bryan (PHYS 154)	Activity (1 hour) Lithography Nanocomore Fatima Benaissa/ Nick Giordano Discussion (30 min.) Lithography: Modeling/ Curriculum/ Adaptations Fatima Benaissa/ Nick Giordano Seminar (1 hour) Pharmacy Applications of Nano Jim Leary (PHYS 154) *30 min catch-up time or early dismissal	Research Seminar (1 hour) Students' Interests in Nanoscience Kelly Hutchinson Post Workshop Concept Evaluation (1 hour) Randal Batchelor Discussion (1 hour) Conceptual Inventory Alan Szeto/ Nick Giordano (PHYS 154)
11:30 AM - 1:00 PM		Lunch (Ford)	Lunch Seminar (1 hour) Students' Conceptions of Size and Scale Shawn Stevens (PHYS 242)	Lunch Seminar Properties of Carbon Nanotubes Tim Sands or Byron Pipes (PHYS 242)	Lunch (Ford)	Lunch Seminar Richmann (PHYS 242)	TEM Group Dave Sederberg Weekend RecSports Hours RSC: 8:00 AM - 6:00 PM (Sat) 11:30 AM - 6:00 PM (Sun) Pool 11:30 AM - 4:30 PM Weekend Meals at Hillenbrand Breakfast 7:00 - 8:30 AM Lunch 11:00 AM - 1:00 PM Dinner 5:00 - 6:30 PM	Lunch (Ford)	Lunch Seminar Simulations Sean Brophy (WTHR)	Lunch Seminar Nanodbio Alexander Wei (Birck)	Lunch (Ford)	Lunch (Ford)
1:00 - 5:00 PM	Registration (Hillenbrand Main Office)	Discussion (1 hour) Workshop Structure and Requirements Lynn Bryan Lab Tour (2 hours) Birck Nanotechnology Tour Activity (1 hour) Allotropes of Carbon David Sederberg (Birck)	Activity/ Discussion (1.5 hours) Models and Modeling Shanna Daly/ Lynn Bryan Activity (2.5 hours) Intermolecular Forces Shanna Daly/Kelly Hutchinson (PHYS 154)	Activity (3 hours) Space Elevator David Sederberg Discussion (30 min.) Space Elevator Modeling Curriculum/ Adaptations David Sederberg (PHYS 154) Seminar (1 hour) Nanoparticles Choi (ROOM?) Discussion (45 minutes) Lesson Planning/ Nano in My Curriculum Guidelines Lynn Bryan (PHYS 154) *45 min catch-up time or early dismissal	Activity (2 hours) Self-Assembly Shanna Daly Discussion (1 hour) Self-Assembly Modeling/ Curriculum/ Adaptations Shanna Daly (PHYS 154)	Tour (30 minutes) AFM Robinson Activity (1 hour) Scanning Probe Microscopy: 3-D scan and MFM Kelly Hutchinson Research Seminar (1 hour) Moore's Law and the Future of Electronics Mark Lundstrom Activity (15 minutes) DNA Origami Shanna Daly/ Kelly Hutchinson Focus Group (1 hour 15 minutes) Randal Batchelor (PHYS 154)			Discussion (30 min.) DNA Origami Modeling/ Curriculum/ Adaptations Shanna Daly/ Kelly Hutchinson Activity (2 hours) Biosensors Kelly Hutchinson Activity (1 hour) Lithography Fatima Benaissa/ Nick Giordano Activity (30 min) Quantum Dots Intro Shanna Daly (BRWN)	Activity (4 hours) Quantum Dots Shanna Daly/ Fatima Benaissa (BRWN)	*These activities occur at the same time, and participants are split into two groups Activity (2 hours) Lithography Fatima Benaissa/ Nick Giordano Activity/ Discussion (2 hours) Nanoscience in Everyday Life Pros & Cons of Nano Kelly Hutchinson/ Shanna Daly (Birck)	Activity Lesson Planning/ Nano in My Curriculum Lynn Bryan (PHYS 154)	Post Workshop Evaluations (1 hour) Randal Batchelor Assessment Focus Group (1.5 hours) Randal Batchelor Final Thoughts (30 minutes) Nick Giordano (PHYS 242)
	Dinner (Hillenbrand)	Dinner (Hillenbrand)	Dinner (Hillenbrand)	Dinner (Hillenbrand)	Dinner (Happy Hollow Park #4)	Dinner (Hillenbrand)			Dinner (Hillenbrand)	Dinner (Hillenbrand)	Dinner (Hillenbrand)	Dinner (The Trails) Posters and Presentations	Dinner (Hillenbrand)
Homework	None	Twitter Article; Modeling Reflection Worksheet	Modeling Article; IMF Applications	Students' Conceptions Articles		DNA Origami			Biosensor Articles; Quantum Dot Reading	Prosi/ Cons of Nanoscience; Quantum Dot Homework	Work on Poster Presentations		

NEW LESSONS

❑DNA Origami

- ❑Inquiry Questions
  - ❑How do scientists and engineers get DNA to self-assemble into shapes?
- ❑Learning Goals
  - ❑DNA can fold.
  - ❑Each DNA base is attracted to a specific other base (A and T, C and G). These are called base pairs.
  - ❑Components and their environment can be designed so that a patterned structure results from a self-assembly process.
  - ❑An AFM scan allows scientists to determine if their designed DNA pattern has formed.
- ❑Skills
  - ❑Reading and interpreting scientific literature
  - ❑Communicating concepts to other students
  - ❑Designing representative models of science concepts
  - ❑Critiquing models of science concepts



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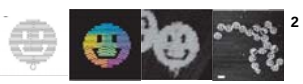

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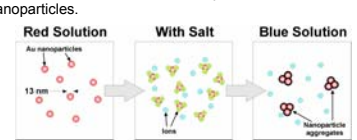
❑Biosensors

- ❑Inquiry Opening
  - ❑Many people die from lead poisoning, what are some cheap easy way to detect the presence of lead or other molecules?
- ❑Learning Goals
  - ❑Students will understand properties of electrolytes such as ionic versus covalent bonding.
  - ❑Students will discover how electrolytes affect a solution of gold nanoparticles.



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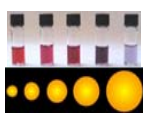
  - ❑Students will learn that although a color change occurs, which usually indicates a chemical change, only a physical change is occurring rather than a chemical change.
  - ❑Students will understand spectroscopy (absorbance vs. wavelength).
  - ❑Students will understand that you see red because green light (520 nm) is absorbed.
  - ❑Students will understand that the size of the particles affects the color absorbed.
  - ❑Students will gain a deeper understanding of biosensors, what they are,hat they are used for, and how they work.



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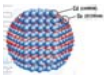
- ❑Skills
  - ❑Communicating results and evidence

NEW LESSONS

❑Quantum Dots



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- ❑Inquiry Questions
  - ❑What is a quantum dot?
  - ❑How are quantum dots of specific colors synthesized?
  - ❑What is the relationship between quantum dot color and size, and the corresponding wavelength and energy of light emitted?
- ❑Learning Goals
  - ❑Reaction time of the reactants controls the color of the quantum dot.
  - ❑As the color of a quantum dot goes from red to purple, the wavelength of light emitted becomes shorter.

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  - ❑The larger the dot, the redder the light.
  - ❑E=hc/λ. As the wavelength of light emitted decreases, the energy associated with that wavelength increases.
  - ❑Energy level diagrams: The energy associated with an electron in the shell of quantum dot can be modeled graphically.

  - ❑A Transmission Electron Microscope (TEM) can be used to determine the size of nanostructures.
- ❑Skills
  - ❑Designing experiments to discover trends
  - ❑Comparing simulated experimental results to actual experimental results
  - ❑Communicating results and evidence

CONNECTIONS

- ❑**Network for Computational Nanotechnology (NCN)**
  - ❑Creating simulations for activities
    - ❑Biosensors
    - ❑Quantum Dots
- ❑**ScienceScape (Purdue)**
  - ❑Outreach of nano-lessons to 7-9th grade girls
- ❑**Gifted Educational Research Initiative (Purdue)**
  - ❑Super Saturday: gifted middle-school students
- ❑**Big Ideas Conference (Michigan and SRI)**
- ❑**Work Circles (NCLT)**
  - ❑Nano-SLAM
  - ❑Self-Assembly
  - ❑Concept Inventory

REFERENCES

1. http://www.nbtc.cornell.edu/mainstreetscience/nanosmores_and_photolithography.pdf
2. Rothemund P.W.K. (2006). Folding DNA to create nanoscale shapes and patterns. *Nature, 440*, 297–302.
3. http://jchemed.chem.wisc.edu/HS/Journal/Issues/2004/Apr/clicSubscriber/JCESupp/JCE2004p0544AW.pdf10
4. http://www.nbi.dk/~pmhansen/gold_color_size.jpg
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6. http://www.rsc.org/chemistryworld/restricted/2006/July/BiosensorsMakeItBig.asp