

2007-2008 NCLT Professional Development Summer Institute



Professional Development Work Circle Team

Kelly Hutchinson¹, Fatima Benaissa¹, Shanna Daly¹, David Sederberg¹, Alan Szeto¹, Randal Batchelor¹, Bill Fornes¹, Lynn Bryan¹, Nick Giordano¹, Eric Hagedorn², Matthew Edwards³, Lou Harnisch⁴, Weijie Lu⁵
 Purdue University¹, University of Texas at El Paso², Alabama A&M University³, Argonne National Laboratory⁴, Fisk University⁵



FOLLOW-UP ACTIVITIES

NEW LESSONS

NEW LESSONS

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

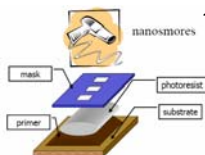
Ferrofluids

- 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.



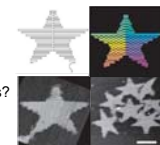
Lithography

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



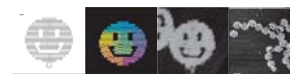
DNA Origami

- 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.



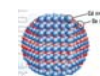
Skills

- Reading and interpreting scientific literature
- Communicating concepts to other students
- Designing representative models of science concepts
- Critiquing models of science concepts



Quantum Dots

- 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.
 - The larger the dot, the redder the light.
 - $E=hc/\lambda$. 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

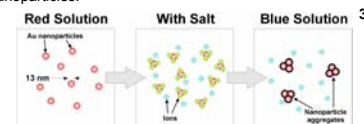


SAMPLE SUMMER INSTITUTE SCHEDULE (PURDUE)

Day	8:00 AM - 10:00 AM	10:00 AM - 12:00 PM	12:00 PM - 1:00 PM	1:00 PM - 2:00 PM	2:00 PM - 3:00 PM	3:00 PM - 4:00 PM	4:00 PM - 5:00 PM	5:00 PM - 6:00 PM	6:00 PM - 7:00 PM	7:00 PM - 8:00 PM
Monday	Registration Nick Giordano	Registration Nick Giordano	Registration Nick Giordano	Registration Nick Giordano	Registration Nick Giordano	Registration Nick Giordano	Registration Nick Giordano	Registration Nick Giordano	Registration Nick Giordano	Registration Nick Giordano
Tuesday	Registration Nick Giordano	Registration Nick Giordano	Registration Nick Giordano	Registration Nick Giordano	Registration Nick Giordano	Registration Nick Giordano	Registration Nick Giordano	Registration Nick Giordano	Registration Nick Giordano	Registration Nick Giordano
Wednesday	Registration Nick Giordano	Registration Nick Giordano	Registration Nick Giordano	Registration Nick Giordano	Registration Nick Giordano	Registration Nick Giordano	Registration Nick Giordano	Registration Nick Giordano	Registration Nick Giordano	Registration Nick Giordano
Thursday	Registration Nick Giordano	Registration Nick Giordano	Registration Nick Giordano	Registration Nick Giordano	Registration Nick Giordano	Registration Nick Giordano	Registration Nick Giordano	Registration Nick Giordano	Registration Nick Giordano	Registration Nick Giordano
Friday	Registration Nick Giordano	Registration Nick Giordano	Registration Nick Giordano	Registration Nick Giordano	Registration Nick Giordano	Registration Nick Giordano	Registration Nick Giordano	Registration Nick Giordano	Registration Nick Giordano	Registration Nick Giordano
Saturday	Registration Nick Giordano	Registration Nick Giordano	Registration Nick Giordano	Registration Nick Giordano	Registration Nick Giordano	Registration Nick Giordano	Registration Nick Giordano	Registration Nick Giordano	Registration Nick Giordano	Registration Nick Giordano
Sunday	Registration Nick Giordano	Registration Nick Giordano	Registration Nick Giordano	Registration Nick Giordano	Registration Nick Giordano	Registration Nick Giordano	Registration Nick Giordano	Registration Nick Giordano	Registration Nick Giordano	Registration Nick Giordano

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.
- Skills**
 - Designing experiments to discover trends
 - Comparing simulated experimental results to actual experimental results
 - Communicating results and evidence



- 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, what they are used for, and how they work.



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

- http://www.nbc.cornell.edu/mainstreescience/nanosmores_and_photolithography.pdf
- Rothmund P.W.K. (2006). Folding DNA to create nanoscale shapes and patterns. *Nature*, 440, 297-302.
- <http://jchemed.chem.wisc.edu/HS/Journal/Issues/2004/April/Subscriber/JCESp.p/JCE2004p0544AW.pdf>
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