META-LESSONS: AN ORGANIZATIONAL APPROACH FOR PROFESSIONAL DEVELOPMENT INSTRUCTION

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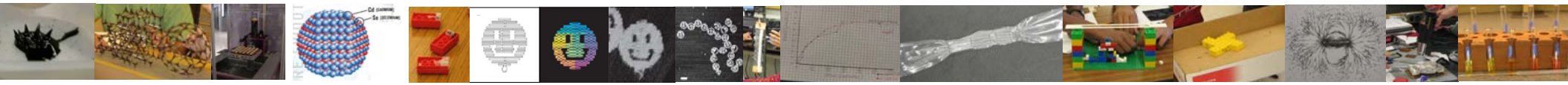


NCLT-PD META-LESSONS

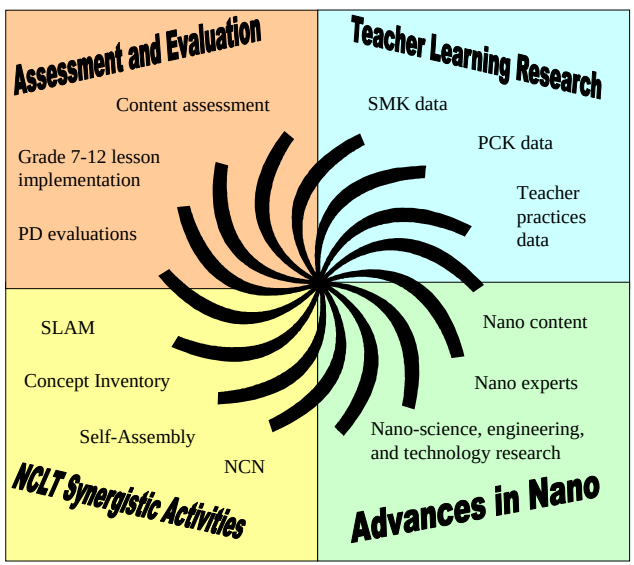
- Provide continuity and coherence between lessons about nano phenomena
- Draw the big ideas out of the lessons
- Focus on the importance of the nano threshold-Why and how is the nano range the place where properties and dominant forces, etc.

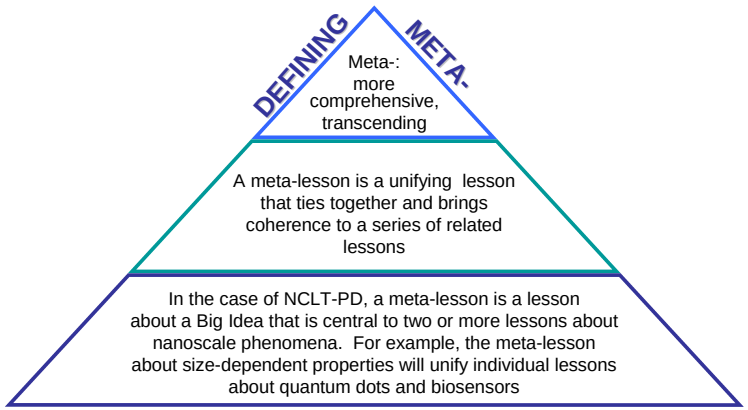
2007-2008 PD META-LESSONS

- **Size and Geometry**
  - Size and Scale
  - Allotropes of Carbon
  - Space Elevator
- **Dominant Forces**
  - Intermolecular Forces
  - Self-Assembly
  - DNA Origami
  - Ferrofluids
- **Size-Dependent Properties**
  - Quantum Dots
  - Biosensors
- **Tools and Instrumentation**
  - Scanning Probe Microscopy
  - Models and modeling
  - Lithography
- **Nano and Society**
  - Everyday Nano

DESIGN-BASED APPROACH TO PD

- Iterative process of design in which we utilize feedback from multiple sources to continually enhance and refine our work





QUANTUM DOTS LESSON

Claim	Evidence	Task
The teacher is able to recognize and cite evidence for the relationship between size and color of quantum dots.	1. The teacher's work includes a table that shows an explicit ordering of the quantum dots: Smallest → Largest Blue → Red 2. The teacher's work includes a written statement that will indicate that as the quantum dot goes from small to large, the color goes from blue to red along the visible spectrum.	1. Given solutions of quantum dots of various colors and the AFM image of each solution of quantum dots, ask teachers to construct a table that orders the QDs by color, from smallest to largest dot. 2. Write (in a full sentence) a general statement summarizing the relationship between size and color of QDs.

BIOSENSOR LESSON

Claim	Evidence	Task
The teacher is able to identify electrolytes and deduce how electrolytes affect a gold nanoparticle solution.	Teacher's work will include a description of the behavior of a gold nanoparticle solution in the presence of an electrolyte or non-electrolyte.	Given a series of electrolytic and non-electrolytic solutions teachers will 1. Test the solutions in a gold nanoparticle solution 2. Determine what is similar about solutions that caused a color change vs. those that did not.
The teacher is able to determine that the addition of an electrolyte causes gold nanoparticles to agglomerate and change the color of the solution.	Teacher's work will include a drawing of electrolyte addition to the gold nanoparticle solution where the particles are isolated pre-electrolyte addition and aggregated post-electrolyte addition which relates to red and blue solution colors respectively. Red ○ Electrolyte → Blue ○	1. Teachers will complete tasks above. 2. Teachers will draw a representation of pre-/post-electrolyte addition to a gold nanoparticle solution correlated with the color of the solution.

CONSTRUCT DRIVEN ASSESSMENT DESIGN

- A first pass at construct driven assessment design process
- Began with "unpacking" components to draw out connections between lessons and to overall meta-lesson concept
- Examining practicing 7-12 grade teachers in PD experience

NCLT ASSESSMENT GROUP

- → Properties that can be size-dependent include optical, catalytic, electrochemical, magnetic, and melting point.
- → The surface area-to-volume ratio increases as objects become smaller. As a result, the object's size approaches the nanoscale, the fraction of atoms that are on the surface increases and surface-related properties become more important.
- → Changing an object's size has a very small effect on the percentage of atoms on the surface at the macroscopic scale and a big effect at the nanoscale. Due to this, the size-dependency of a property can be very sensitive for a nanoscale objective.
- → The size-dependence of optical and magnetic properties of nanoscopic particles is also associated with the difference in electronic structure of small collections of atoms (e.g., gold) with that of bulk macroscopic material.
- → The electronic structure for a small collection of atoms (e.g., gold) is different than that of bulk macroscopic material.