

Nanoscience For Teachers & Their Students

SDNI-NNCI Annual Educational Symposium 2020

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Nanoscience Summer Institute for Middle School Teachers

Goals

- Provide teachers with the support to be comfortable teaching nanoscience
- Inspire middle school students by training their teachers

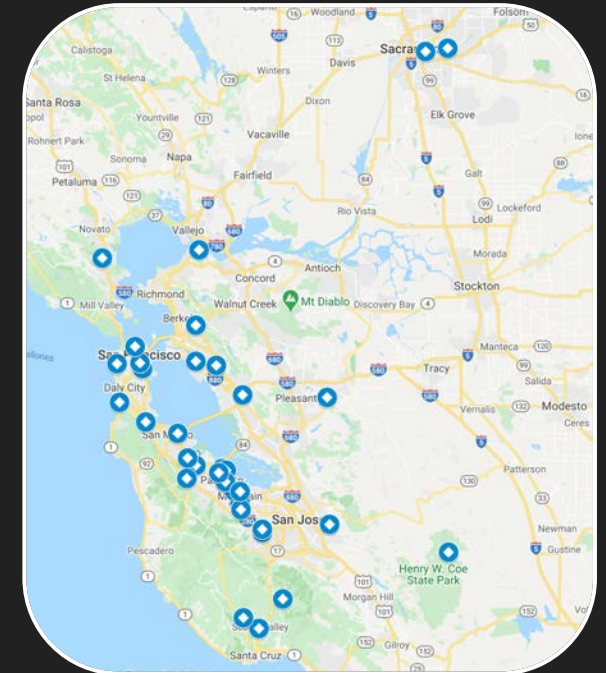
Motivation

- Typically middle school is when students lose their interest in science
- Fewer programs exist for middle school teachers
- Teachers provide broader and deeper impact for student and improve students' retention

Program

NanoSIMST: Nanoscience Summer Institute for Middle School Teachers

- Annual 4-day summer program held annually with follow up opportunities throughout the year (since 2017)
- Focus on Bay Area teachers, ~50% are from Title I schools
- Participation stipend (\$500), implementation stipend (\$300)



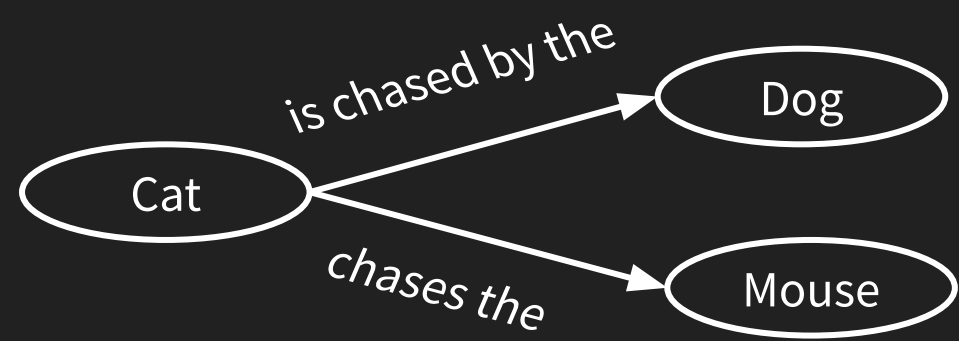
Day 1: Understanding Nano Monday, June 24		Day 2: Making Nano Tuesday, June 25		Day 3: Seeing Nano Wednesday, June 26		Day 4: Applying & Teaching Nano Thursday, June 27	
9:30 - 10:00	Check-In & Breakfast	9:30 - 10:00	Check-In & Breakfast	9:30 - 10:00	Check-In & Breakfast	9:30 - 10:00	Check-In & Breakfast
10:00 - 11:00	Welcome & Opener / Introductions Presurvey, paperwork	10:00 - 10:30	Opener & Debrief - discussion diamond	10:00 - 11:00	Guest lecture - Seeing Nano Katherine Swytu	10:00 - 10:30	Opener & Debrief
		10:30 - 11:00	Lithography reading			10:30 - 11:30	Career panel: Marcin, Caitlin, Roy, Max
11:00 - 12:00	Card sort activity - How big is it? (S1, 40 min) Gallery walk & discussion (10 min) 10 min break	11:00 - 12:00	Thin films Edible wafer Sunprint lithography 10 min break	11:00 - 12:00	10 min break Microscopes SPM, Foldscope	11:30 - 1:30	Lunch @ Faculty Club Campus Tour / Pictures
12:00 - 1:00	Intro to Nanotechnology - Angela	12:00 - 1:00	Guest lecture - Making Nano Dara Bobb-Semple	12:00 - 1:00	RAIN Network / with UCSD		
1:00 - 2:00	Lunch Break	1:00 - 2:00	Lunch break	1:00 - 2:00	Lunch break		
2:00 - 3:00	Shaking self assembly Floating self assembly	2:00 - 3:00	SNF tour & gowning - Uli & Phil	2:00 - 3:30	SNSF tour - TEM & AFM demo (2:30-3:30) 10 min break / transition	1:30 - 3:30	Lesson plan worktime
3:00 - 3:30	Discussion Self Assembly (student hat) 10 min break	3:00 - 4:00	10 min break / transition Sweet self assembly - encapsulation				
3:30 - 4:30	Activity review (teacher hat) Connect to learning (5Es)	4:00 - 5:00	5E's, Class Culture, and Equity Reflection, Gots & Needs	3:30 - 5:00	Nanoscience in the classroom Guided activity / planning template Reflection, Gots & Needs	3:30 - 4:30	Lesson plan presentations
4:30 - 5:00	Reflection, Gots & Needs, Question cards Closing logistics					4:30 - 5:00	Closing logistics - follow up Materials

Legend

Pedagogy
Lab Tours
Activities
Lectures

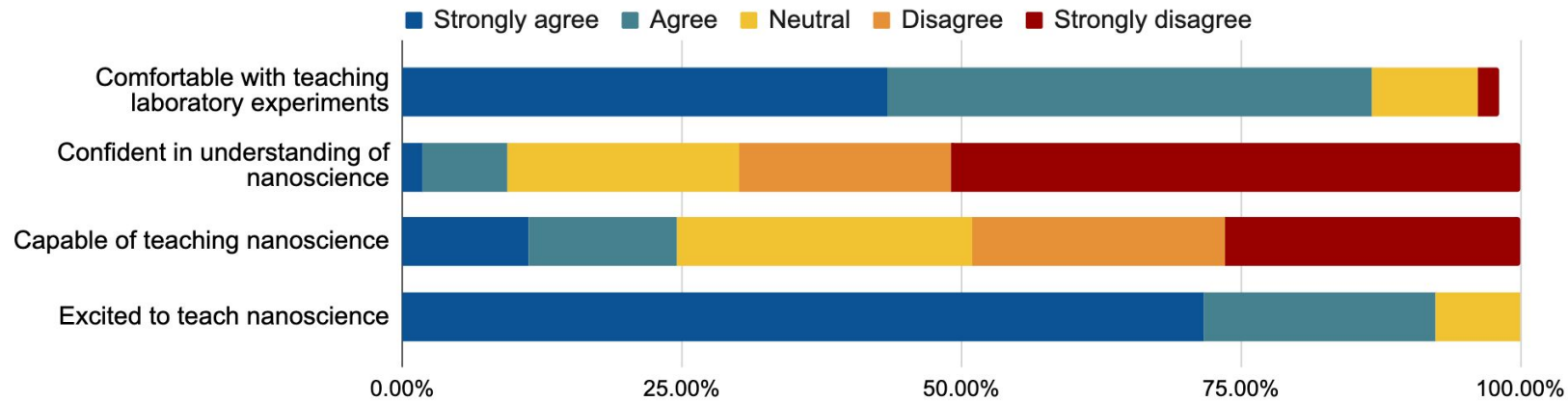
Evaluation & Assessment Methods

- Understand teachers content knowledge, confidence, and capacity for nanoscience through pre and post surveys
- Concept maps - visual representation of knowledge
 - Concepts are organized and relationships are shown by drawing lines between concepts to determine the development of a learner's knowledge over time

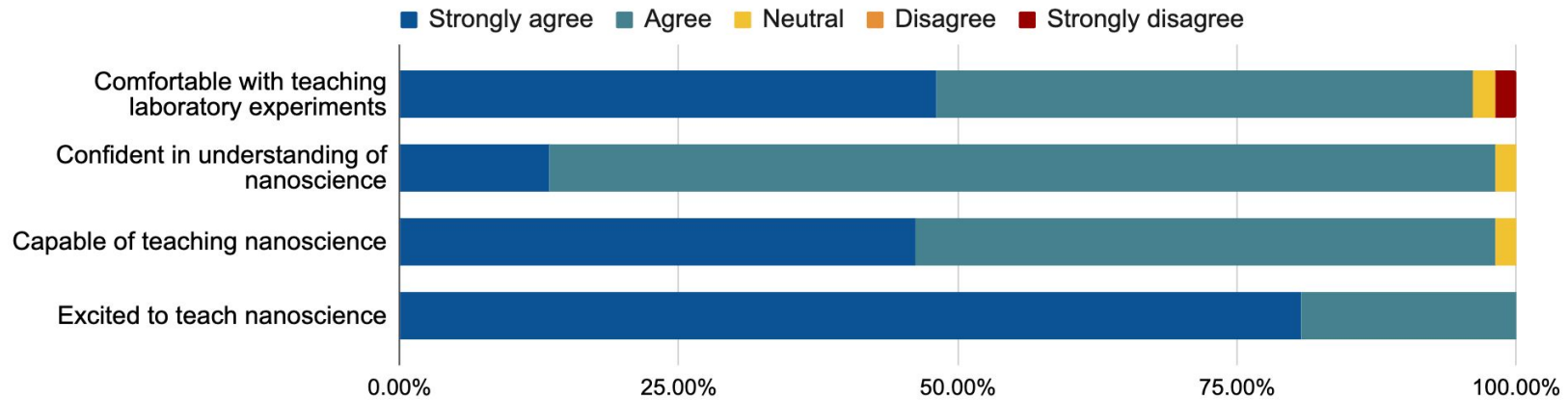


Points	Element
1	Concept vocabulary used
1	Valid relationship used
1	First branching
3	Successive branching

Cumulative NanoSIMST Presurvey Data, N=53

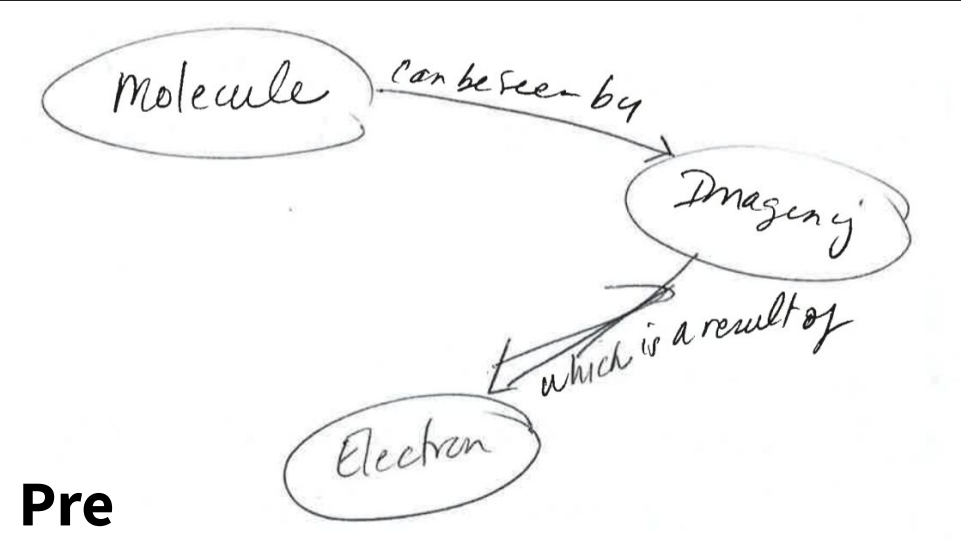


Cumulative NanoSIMST Postsurvey Data, N=53

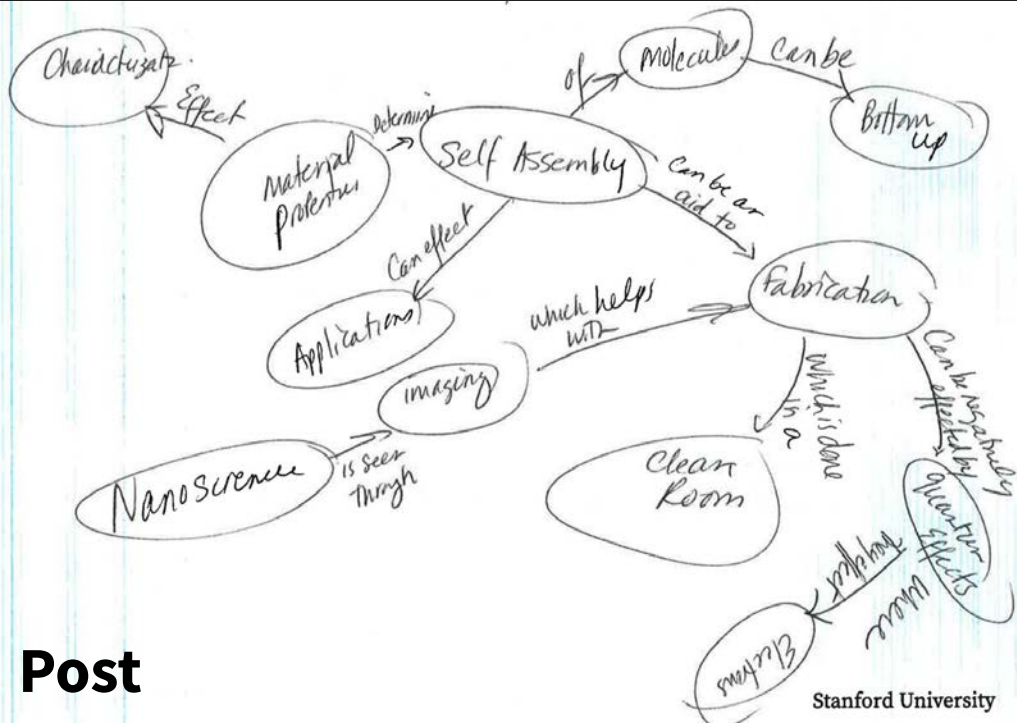


Pre and post survey data from NanoSIMST (2017 - 2020)

Concept Maps: Data



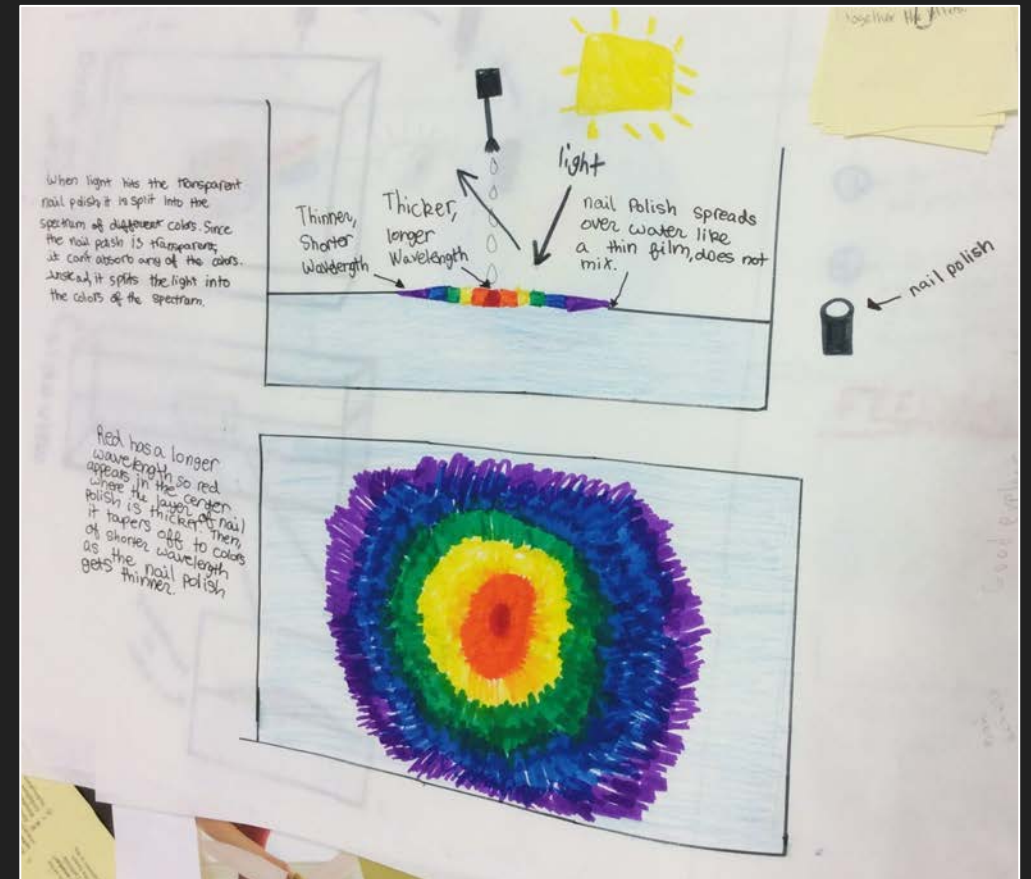
	Average Presurvey Concept Map	Average Postsurvey Concept Map
2017	9.9	14.9
2018	10.5	21.4
2019	14.1	21.1
2020	18.4	21.8
Average	13.2	19.8



Teacher Implementations: Kiruthika P.

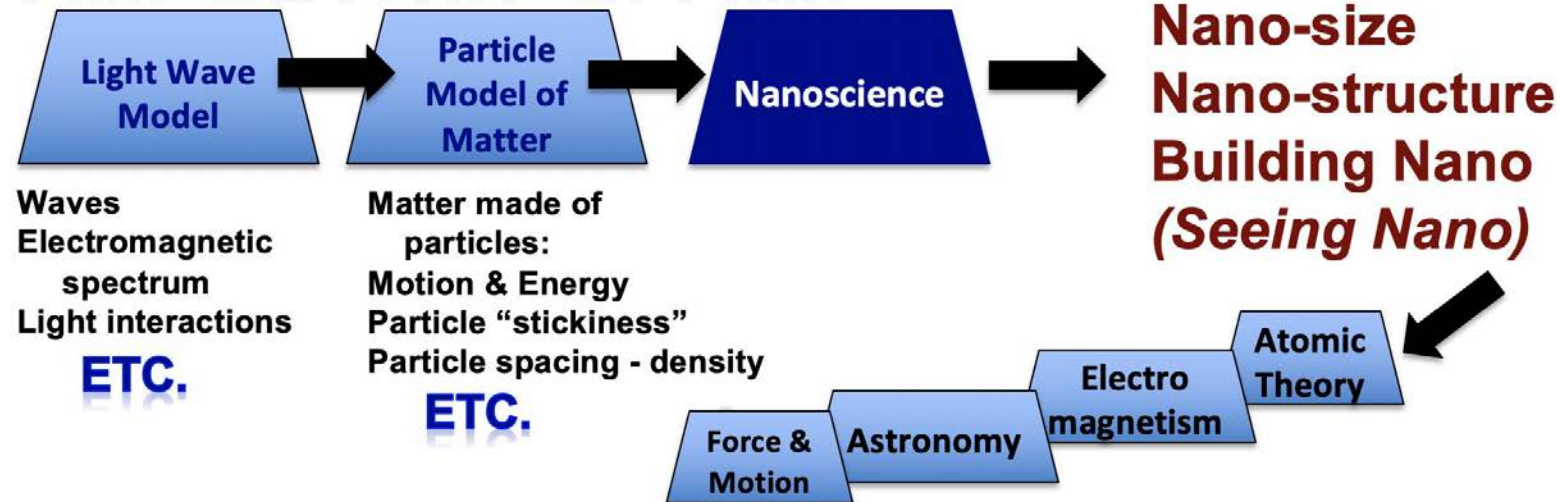
MS-PS4-2: Develop and use a model to describe that waves are reflected, absorbed, and transmitted through various materials

1. Color My World
2. **Polish My Name Tag***
3. How to Model: Color My World
4. Model: Polish My Name Tag
5. Pencil Lines
6. Mirror Activity
7. Direct Instruction & Notes
8. Prism Activity
9. Polish My Name Tag: Group Revision Model
10. **Sun Print Lithography***
11. **Intel Clip: The Making of a Chip***



Teacher Implementations: Jenny T.

CONCEPTUAL FLOW:



DEVELOPING A CONCEPTUAL UNDERSTANDING
OF THE "NANO" BY OBSERVING VISIBLE PHENOMENA
ACTIVITY → NANO-EXPLANATION

Teacher Implementations: Jenny

NANOSCIENCE UNIT STORYLINE:

Some stuff is REALLY small, and size affects properties...



Teacher Implementations: Jenny

NANOSCIENCE UNIT STORYLINE:

Some stuff is REALLY small, and size affects properties...

Nano-size:

MICROSCOPIC → NANOSCOPIC...

PROPERTIES

NANOSCALE: **SURFACE TENSION, ADHESION
FORCES DOMINATE (NOT GRAVITY)**

NANOSCALE: **SURFACE AREA TO VOLUME RATIO
AFFECTS REACTIONS**

NANOSCALE: **LIGHT WAVES INTERACT DIFFERENTLY**

Nano-structure:

IRON-BASED NANOPARTICLES → MAGNETIC LIQUID
(FERROFLUID)

SHEETS OF NANOSTRUCTURES → MACRO ▲

Building Nano:

NANOPARTICLE SELF-ASSEMBLY

USING LIGHT WAVES - **PHOTOLITHOGRAPHY**

USING POLYMER CROSS-LINKING - **SPHERIFICATION**

Program Development

- Modify the program according to teacher feedback:
 - Experiments are low cost, simple, with little to no equipment needed (less ‘chemistry’)
 - More pedagogy support
 - Longer workshop (5 days)
- Support SENIC / Georgia Tech to implement NanoSIMST program
- Adapting program to virtual platform in 2020 due to pandemic constraints



NanoSIMST 2020

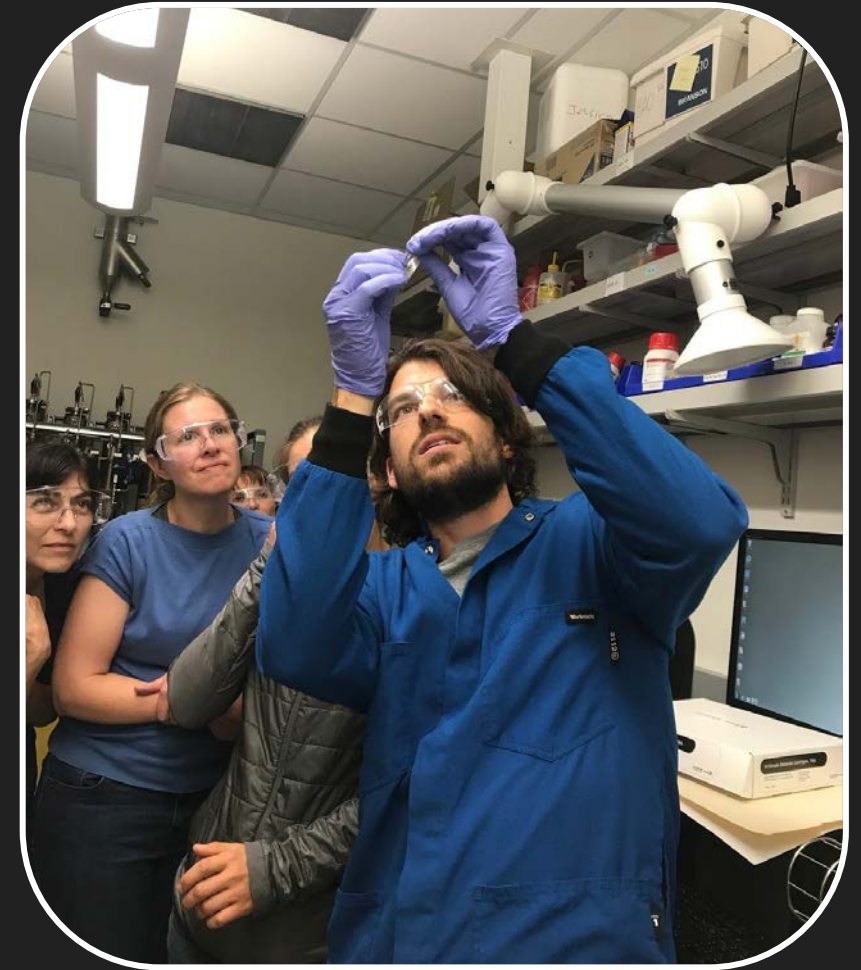
- Hired two NanoSIMST alumni to bridge the gap between content and pedagogy
- Program went completely virtual, created & mailed kits
- Zoom morning and afternoon, two hour sessions per day
- Recorded and posted sessions [here](#) and hope to adapt to a massive open online course



"I liked meeting teachers, discussing, visiting labs and clean room virtually. Also I was amazed by the function of electron microscopes and the way it was presented to us in the an unprecedented circumstance due to coronavirus pandemic."

Summary & Future Work

- 43 teacher-alumni have introduced more than 2,200 middle school students to nanoscience
 - Continued to support teachers through classroom visits & (remote) tours
- Continue to expand the program through NNCI (UCSD, NNF, MINIC)
- Continue running program at Stanford, expand to remote CA, pilot online, and other education spaces
- Evaluate the program to understand the efficacy of the program and maintain quality as it scales to new sites



Thank you!
Questions?

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