Team-Based Inquiry

Examples of Evaluation Capacity Building

NISE network
NANOSCALE INFORMAL SCIENCE EDUCATION

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Who Are We?

Sarah Cohn
Science Museum of Minnesota

Scott Randol
Oregon Museum of Science and Industry

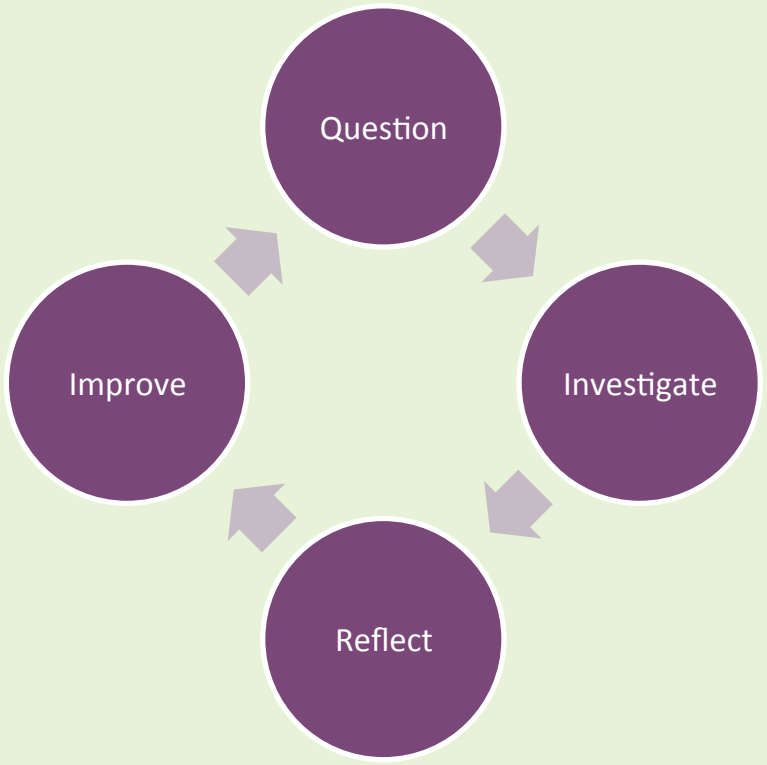
Caitlin Grothaus
Kentucky Science Center

Jolie Pelds
Science Center of Iowa

Meriel Stokoe
MOST – Milton J. Rubenstein Museum of Science & Technology

Team-Based Inquiry

An approach to empowering professionals to get the data they need, when they need it, in order to improve their products and practices and create successful educational experiences



- Systematic
- Led by non-evaluation professionals
- Collaborative and team based
- Small scale and focused
- Embedded in work

TBI Report Out

Kentucky Science Center

UNIVERSITY OF LOUISVILLE.
Micro/Nano Technology Center

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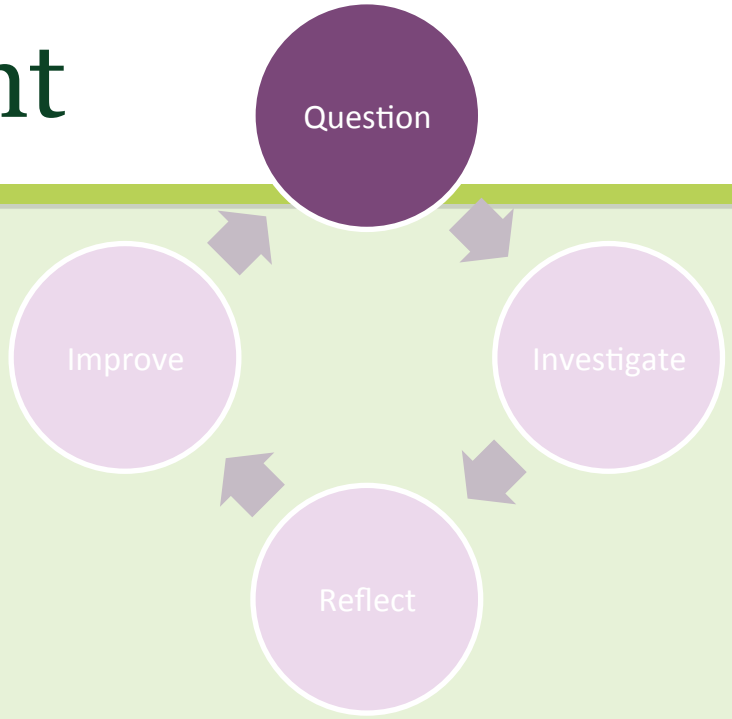
Afterschool Enrichment



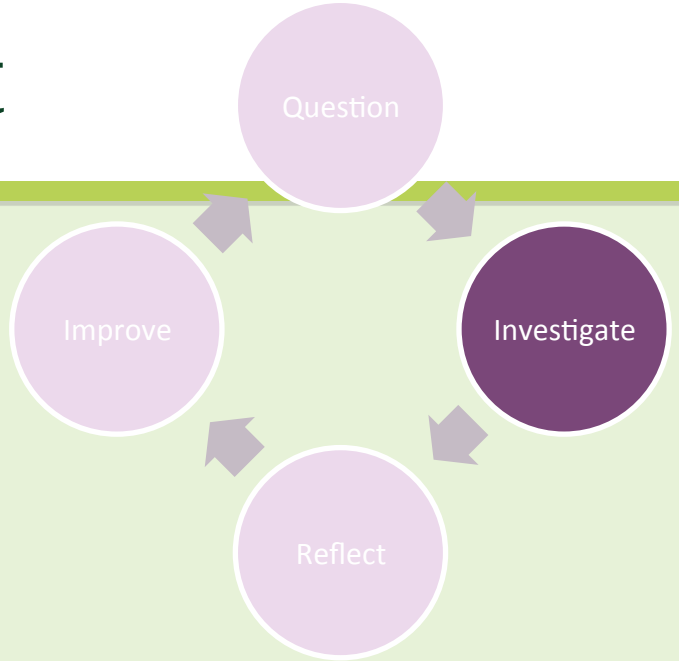
Our Project had Three Goals:

1. Introduce Students to Nanotechnology and the Maker Movement.
2. Ensure that Students Learn Interesting and Relevant Concepts.
3. Create a Widely Repeatable Program OR Program Components.

We Focused Our Study on Three Questions:

1. Have Students Become Familiar with Nanotechnology and the Maker Movement?
2. What Activities were Students Most Interested In?
3. What Components are Repeatable and Flexible Enough for Being “On the Road”.

Afterschool Enrichment



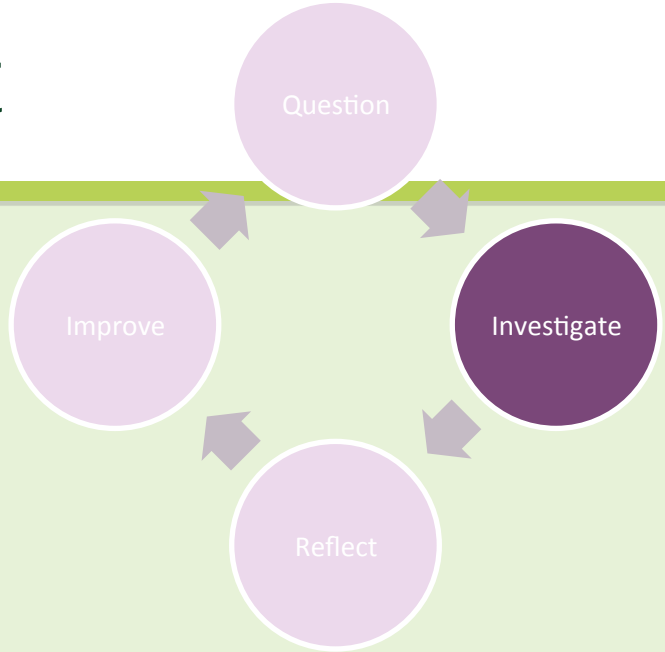
Used Three Sources of Data:

1. Observation Notes Taken by Facilitator
2. KWL Chart (I **K**now, I **W**ant to learn and I **L**earned)
3. Mind Map

Analyzed Data Three Different Times

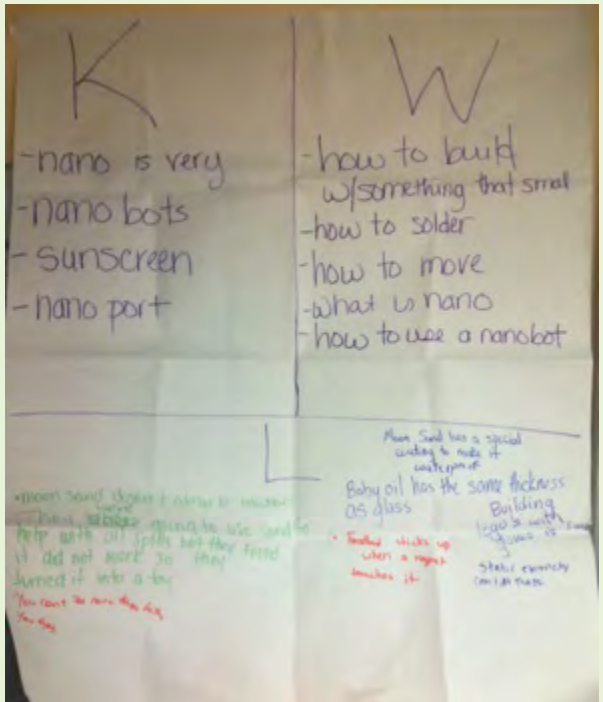
1. Have Students Become Familiar with Nanotechnology and the Maker Movement?
   - Tracked Words and Phrases Used Frequently on KWL and Mind Map
   - Some Team Interpretation of Comments Based on When Students Completed KWL Chart or Mind Map

Afterschool Enrichment

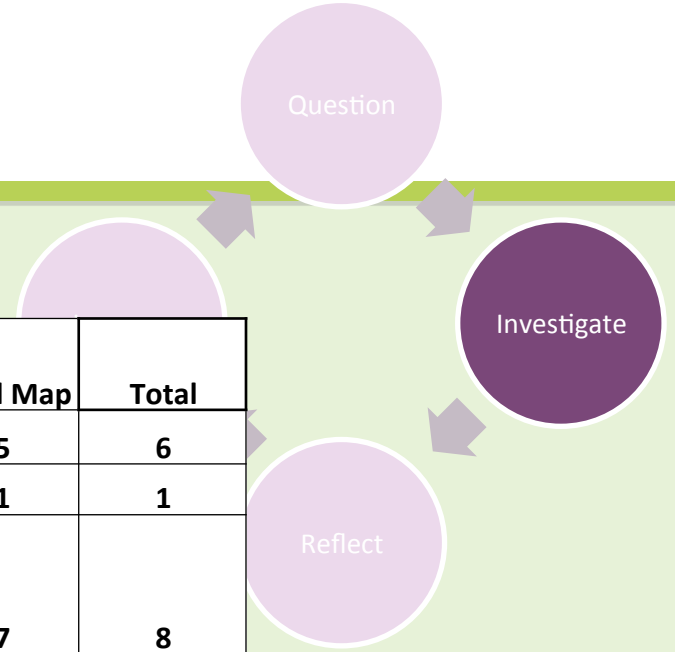


2. What Activities Were They Most Interested In?
   - Words and Phrases from KWL and Mind Map
   - Informally Tracked Which Activities Had the Longest Dwell Time
   - Informally Tracked Which Activities Produced the Most Discussion and Questions

3. What Components are Repeatable and Flexible For Being "On the Road"?
   - Looked at Ease of Transport, Amount of Consumable Materials, and Level of Engagement Demonstrated by Students
   - Level of Student Engagement Was Most Important Factor

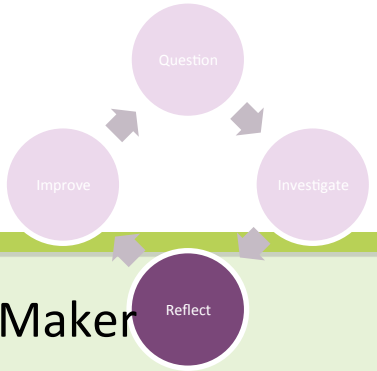


Afterschool Enrichment



Answer Item	What I Know	What I Want to Learn	What I Have Learned	Mind Map	Total
Small	1			5	6
Part of Our Daily Lives				1	1
Needs Special Equipment/Special Microscope			1	7	8
Hard to Manipulate		2	1	2	5
Nano Bots/Other Nano Products	2	1			3
Soldering (from Maker Component)		1			1
What is Nano		1			1
Specific Activity References (moon sand, sunscreen, invisibility cloak, ferrofluid, static electricity)	1		6		7
Total	4	5	8	15	32

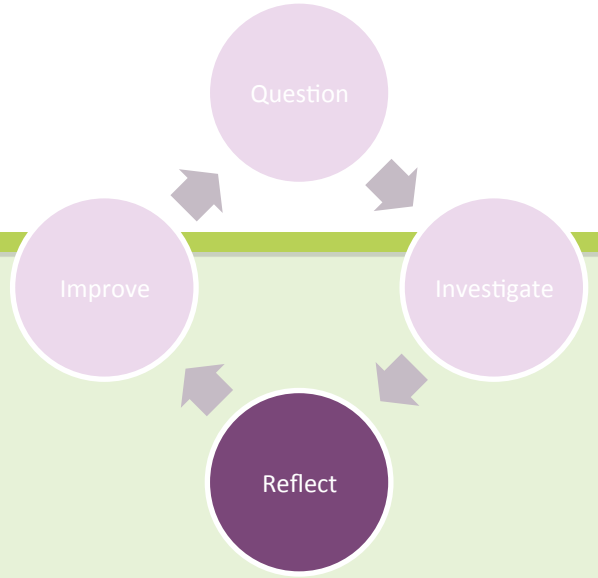
Afterschool Enrichment



1. Have Students Become Familiar with Nanotechnology and the Maker Movement?
   - Overall, Our Answer Would Be YES!
   - KWL and Mind Map Data Showed They Had Basic Understanding
   - Some Misconceptions
   - Maker Movement Less Conclusive Due to Low Enrollment, Did Show Competence with Soldering and Resiliency

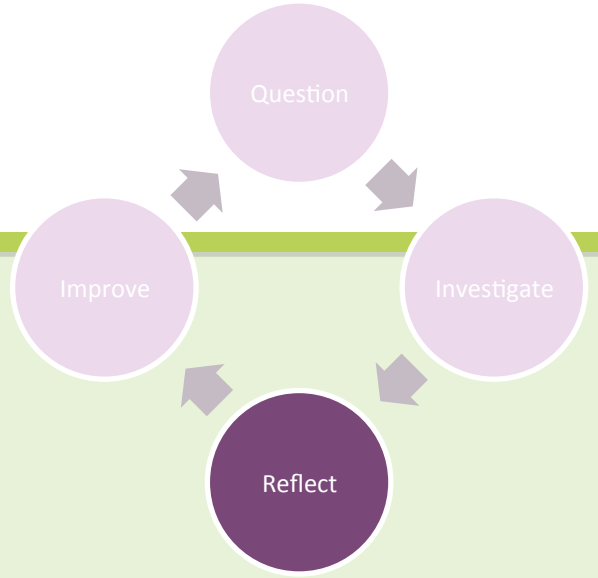
2. What Activities Were Students Most Interested In?
   - Several Activities Appeared on KWL and Mind Map – Assumed High Engagement
   - Other High Engagement Activities Included Simulated Fabrication, SEM Magnet Nanokit, Powers of Ten Game and TEM Nanokit
   - Cleanroom Safety Training, Meet a Nano Scientist and Field Trip to UofL MNTC all had High Levels of Engagement

Afterschool Enrichment



3. What Components are Repeatable and Flexible Enough For Being “On the Road”?
   - All NanoKits We Used Met the Criteria for Being Low on Consumables and Easy to Take on the Road. Some Were More Engaging for the Middle School Audience than Others.
   - Meet a Nano Scientist Day Was Highly Engaging and Very Worthwhile for Students, Can Present a Hardship for Nano Scientists Depending on Where Enrichment is Located.
   - Fabrication Simulation was also Highly Consumable but Very Engaging.

Afterschool Enrichment



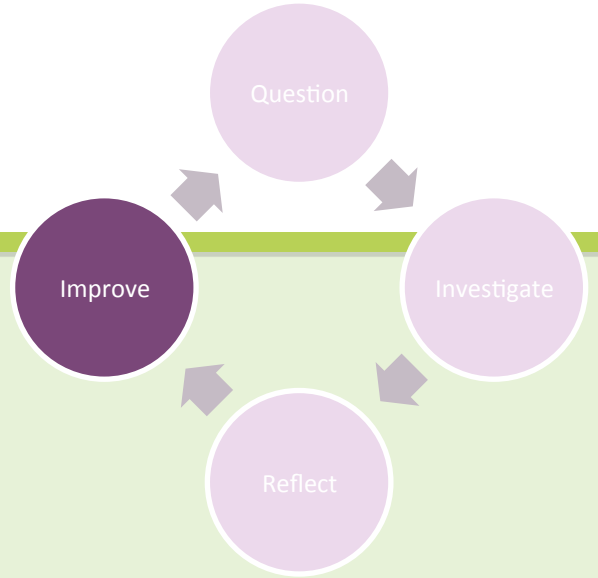
Patterns That We Saw:

Activities that Featured Adult Input/Leadership Seemed to Be More Engaging Than the Average Activity (ex: Cleanroom Safety Training, Simulated Microfabrication, Invisibility Cloak)

Activities that Had a High Success Rate (Lego House, Ferrofluid, Powers of Ten Nanokits) Tended to Have Longer Dwell Times and More Active Conversation.

Activities that Involved Examining an Item OR had a Low Rate of Success Were Not as Engaging (Butterfly, Computer Hard Drive).

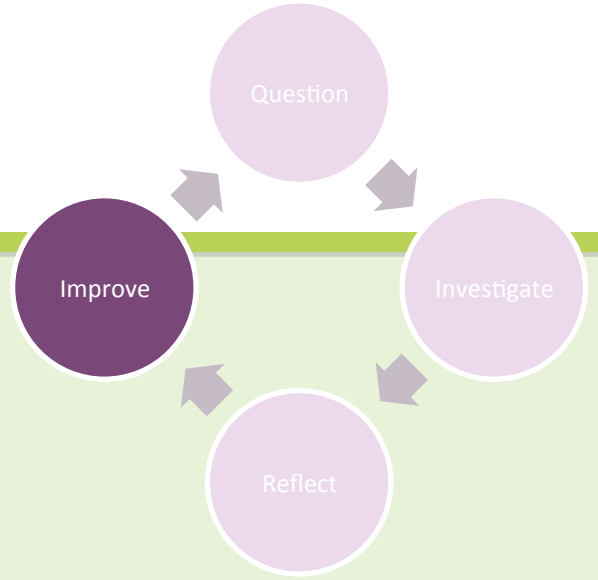
Afterschool Enrichment



Action Items:

1. Provide a More Comprehensive Nano Science Overview by Emphasizing that Working with Nanotechnology in the Cleanroom is Just One Way that Scientists Can Use Nano Science.
2. Eliminate Less Engaging Activities if Repeating for a Middle School Audience
3. Continue to Nurture Relationship with the University of Louisville Micro/Nano Technology Center to Ensure We Can Continue To Lean on Them for Support
4. Continue to Find New Ways to Integrate Nanokits into our Programming – A Recent Experience Was a Homeschool STEM Class.

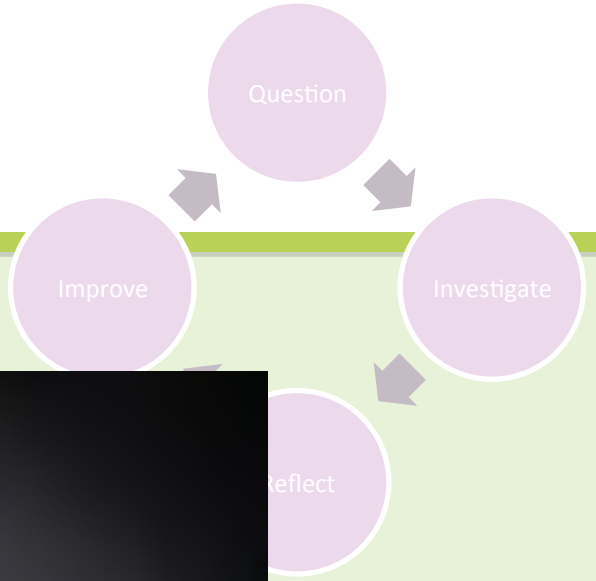
Afterschool Enrichment



Future TBI Questions

1. Would it be Sustainable to Have Multiple Nano Enrichments that have the Same Heavy Involvement From the MNTC? How Would That Affect Our Partnership with Them? How Can We Prevent Partner Fatigue?
2. How Can We Create Desire for more Nano Enrichments? How Can We Showcase the Relevancy of Nano Science While Still Showing Teachers How It Fits within the Current School Curriculum?

Afterschool Enrichment



TBI Report Out

Nanoscale in Pint Size Science

PINT SIZE SCIENCE

SCI

SCIENCE CENTER OF IOWA & BLANK IMAX® DOME THEATER

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Nanoscale in Pint Size Science

What is PINT SIZE SCIENCE ?

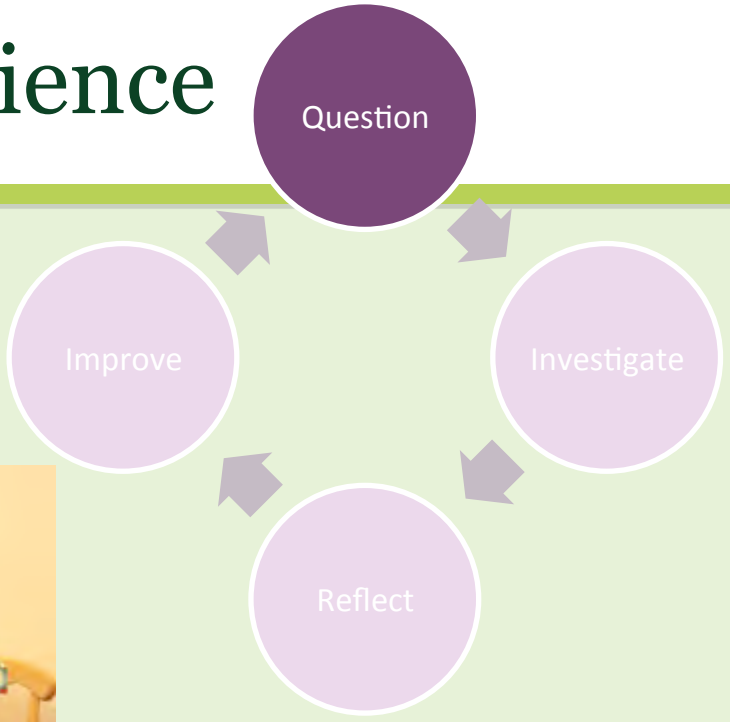
Nanoscale in Pint Size Science

Teachers in the Pint Size Science program participate in eight hours of professional development focused on STEM education, inquiry-based learning and science topics, including nanoscale.

Before the introduction of nanoscale to the professional development, science topics including the phases of matter, polymers and bacteria were covered. The addition of nanoscale curriculum was designed to increase the teachers understanding of these topics.

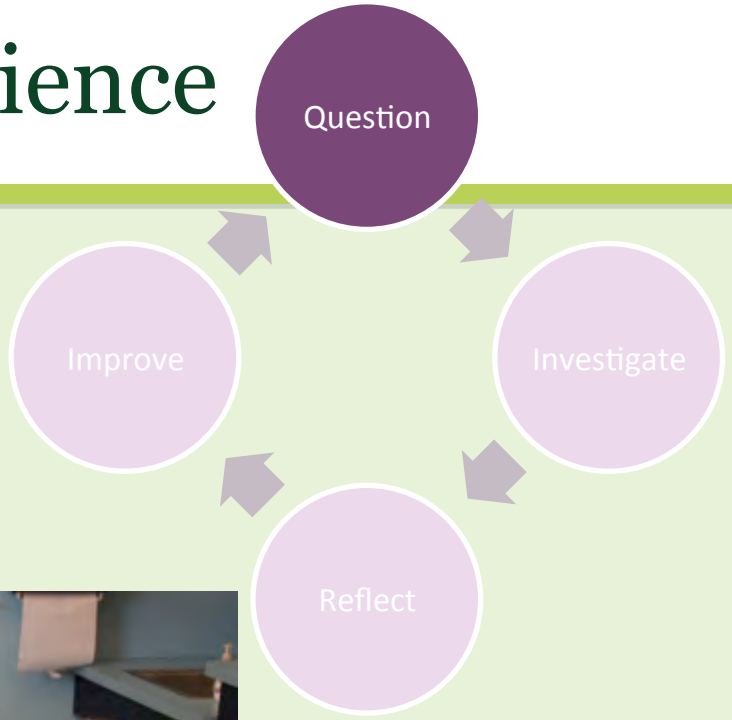
We wanted to try out this change in our curriculum with the preschool teachers here at the science center before using it with other teachers later in the summer.

Nanoscale in Pint Size Science



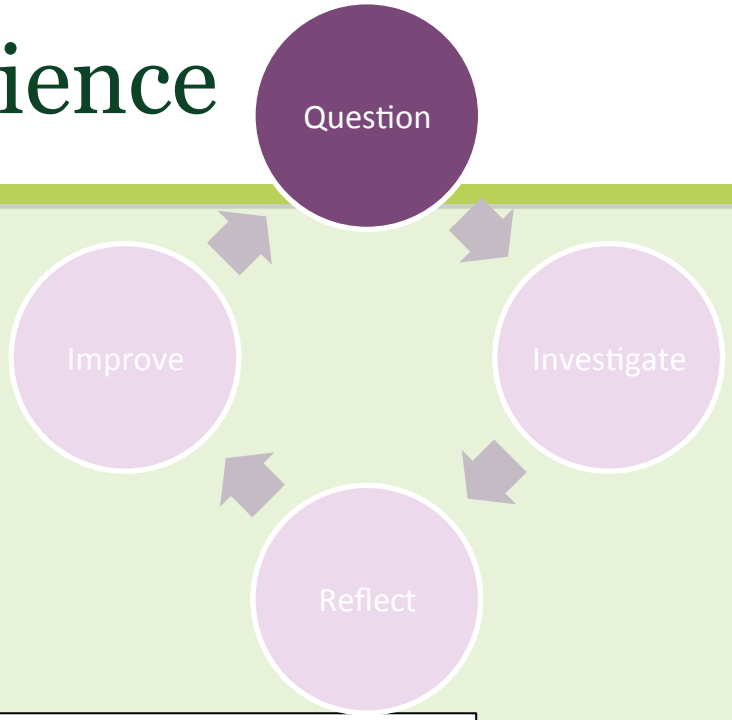
1. Do PreK-K teachers understand nanoscience and nanoscale?

Nanoscale in Pint Size Science



2. How can teacher's comfort level with nanoscience lead them to incorporate nanoscience in their curriculum?

Nanoscale in Pint Size Science



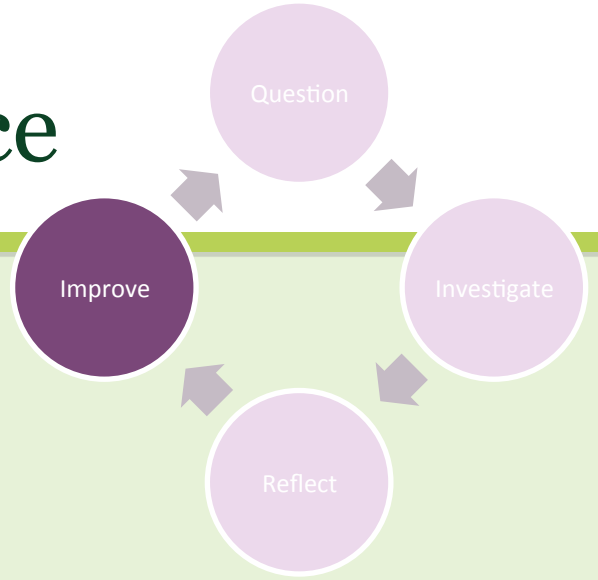
Prior Knowledge Probe

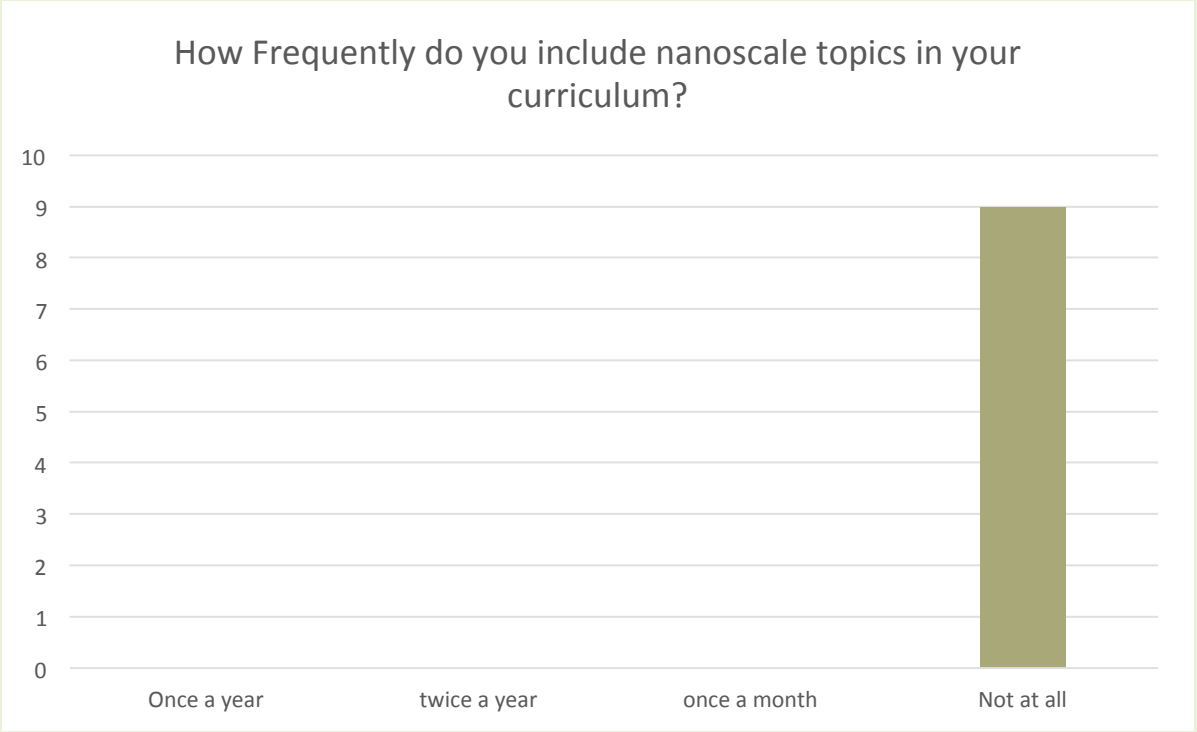
1. When you hear the word “Nano” what do you think of?

2. List the following measurement units in order from smallest to largest. **milli nano micro meter**

3. How frequently do you include nanoscale topics in your curriculum?
Once a year Twice a year Once a month Not at all

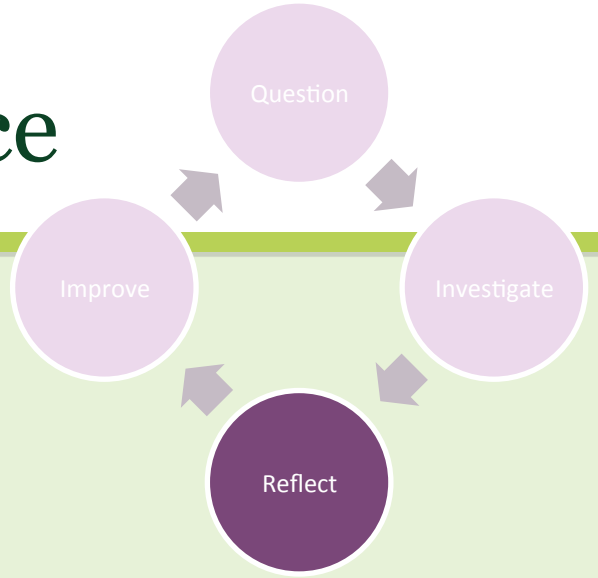
Nanoscale in Pint Size Science





Prior Knowledge Probe

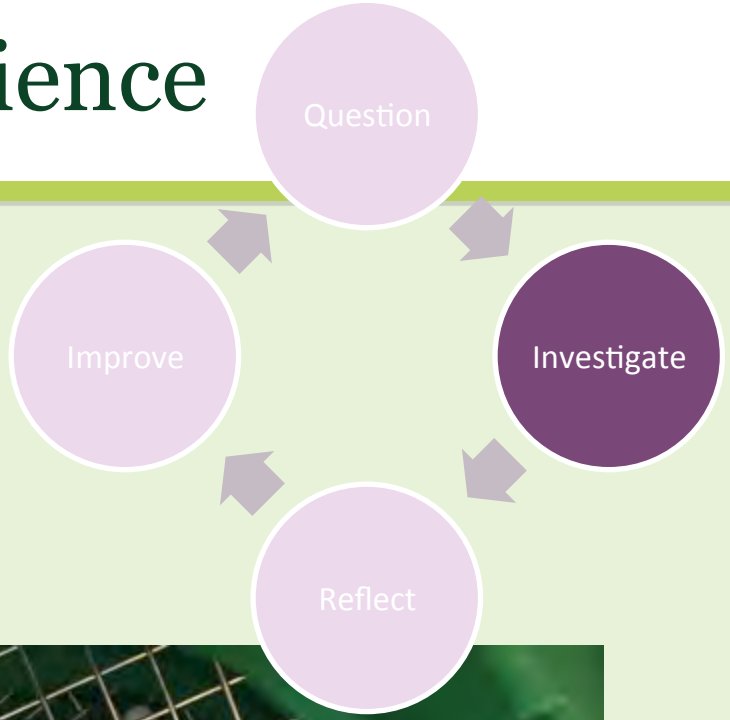
Nanoscale in Pint Size Science



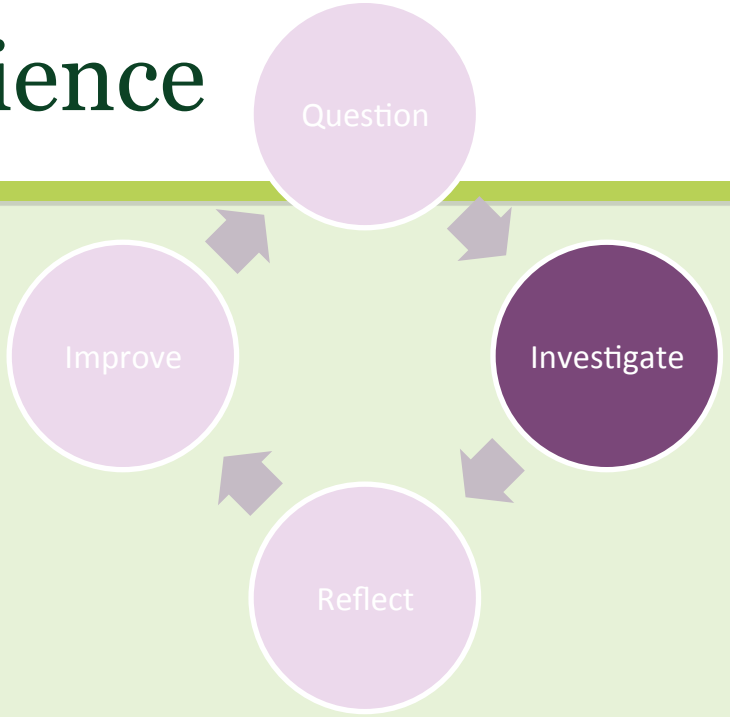
Nanoscale Topics and Examples used in the Professional Development:

Concepts	Materials
Particles are different sizes	Exploring Size: Ball Sorter
Particles act differently on a molecular level	Light Hydrogels

Nanoscale in Pint Size Science



Nanoscale in Pint Size Science



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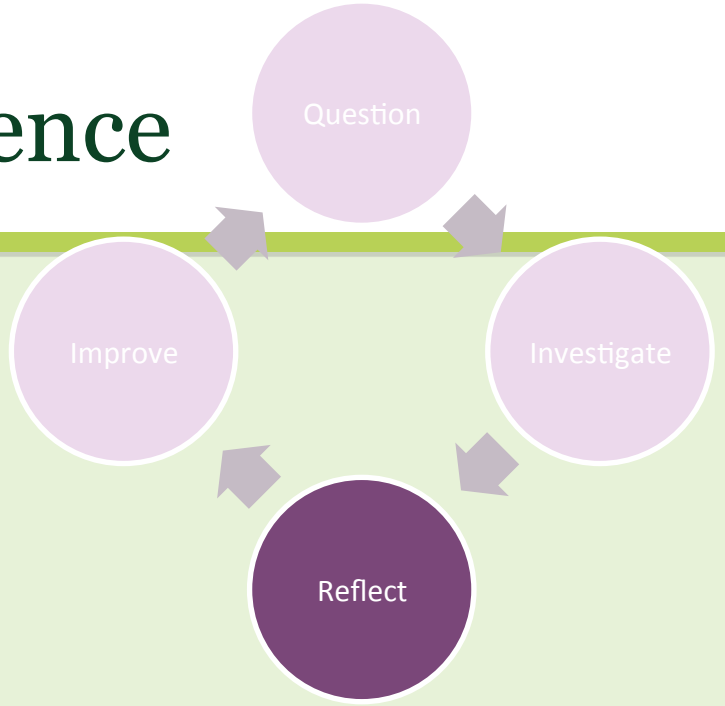


Post Professional Development Probe #1

1. When you hear the word “Nano” what do you think of now?

2. On a scale of from 1-5, how likely are you to incorporate more nanoscale topics into your curriculum?

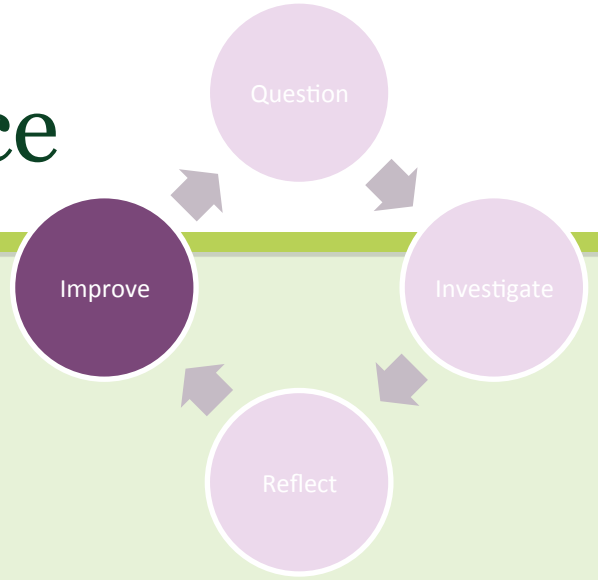
1	2	3	4	5
(not at all)				(very likely)

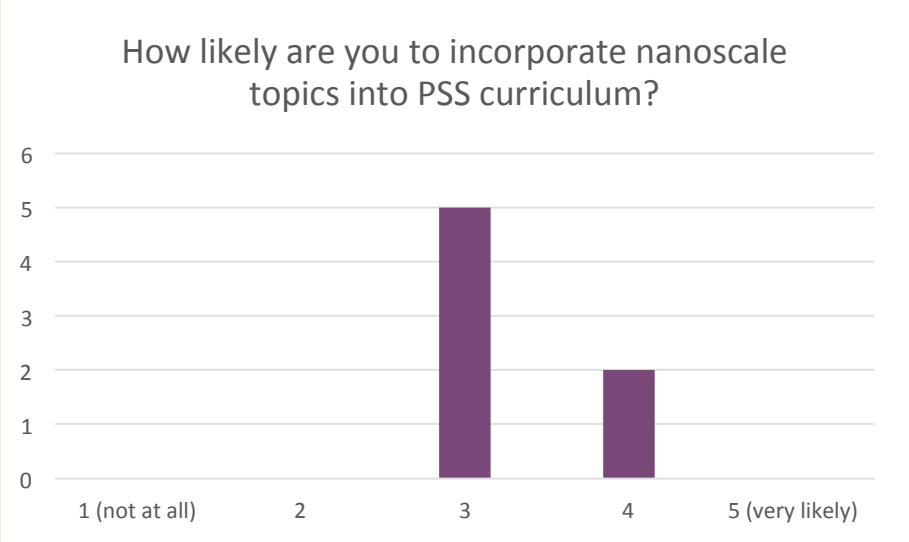
3. On a scale from 1-5, rate your comfort level with the term “Nano”.

1	2	3	4	5
(not comfortable)				(comfortable)

4. How do you think you might incorporate nanoscale in your curriculum design?

Nanoscale in Pint Size Science





Post Professional Development Probe #1

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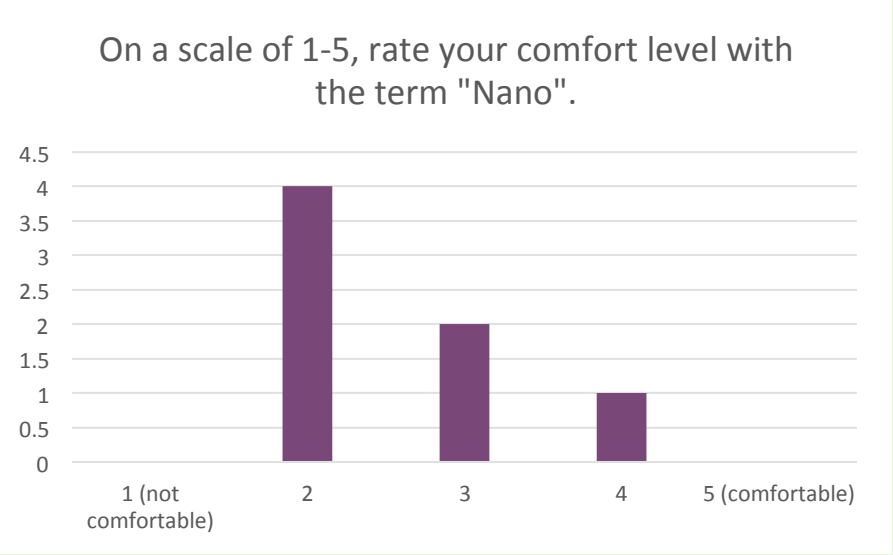
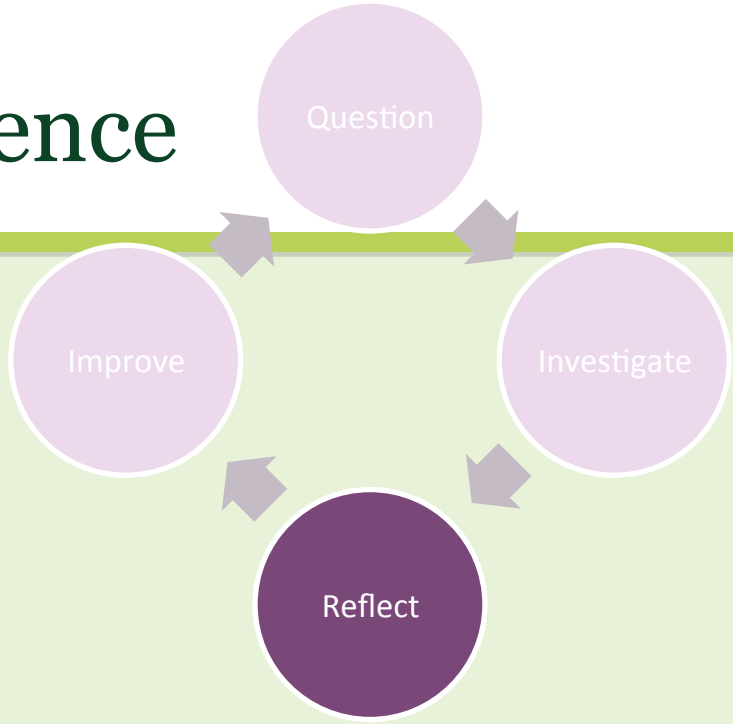
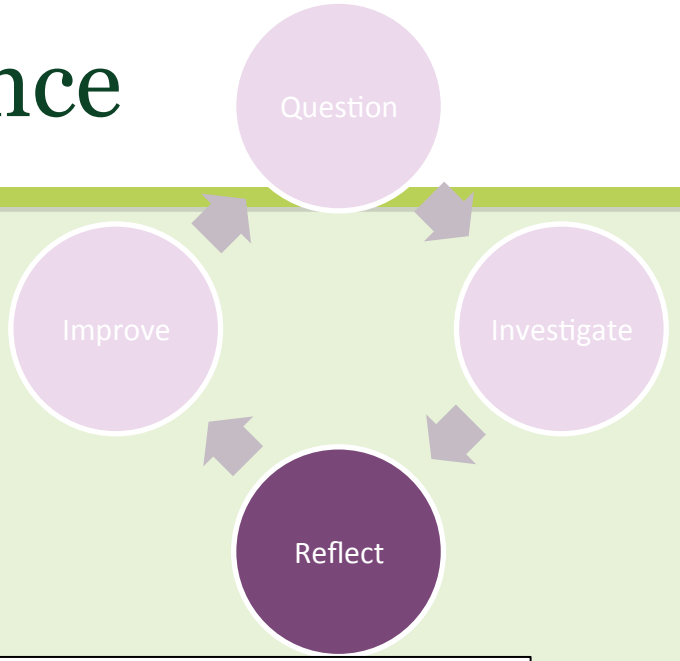


Nanoscale in Pint Size Science



Nanoscale in Pint Size Science



Post Professional Development Probe #2

1. When you hear the word “Nano” what do you think of now?

2. On a scale of from 1-5, how likely are you to incorporate more nanoscale topics into your curriculum?

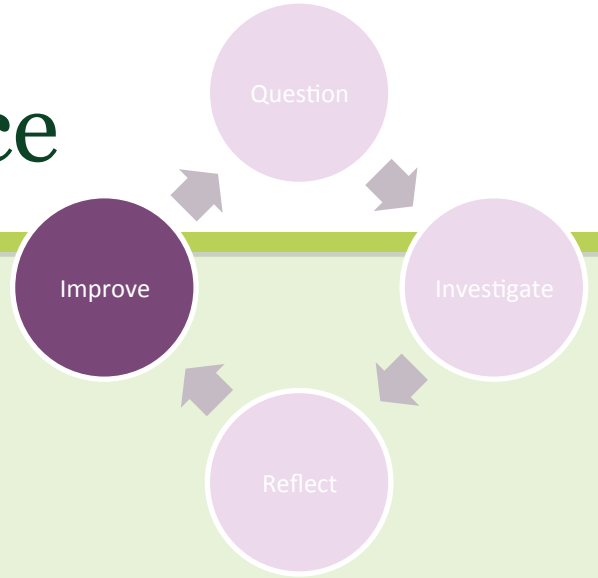
1 2 3 4 5
(not at all) (very likely)

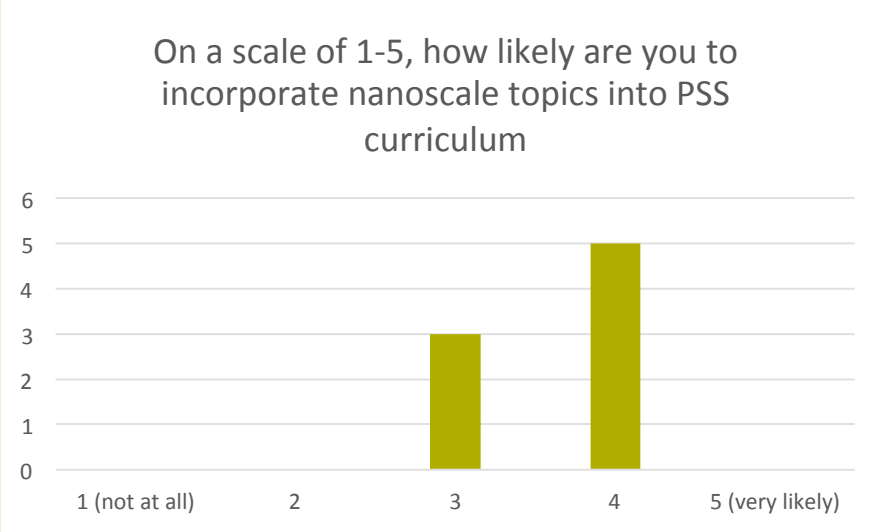
3. On a scale from 1-5, rate your comfort level with the term “Nano”.

1 2 3 4 5
(not comfortable) (comfortable)

4. How do you think you might incorporate nanoscale in your curriculum design?

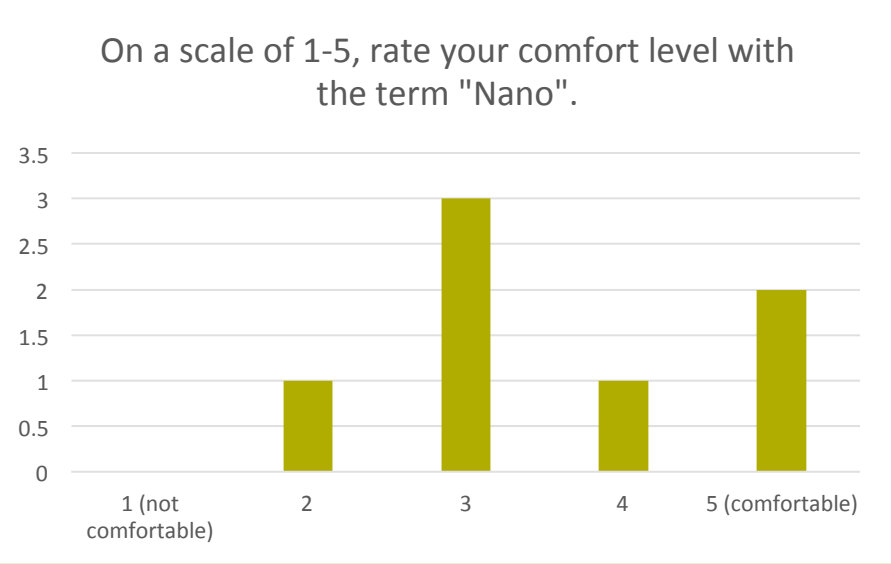
Nanoscale in Pint Size Science



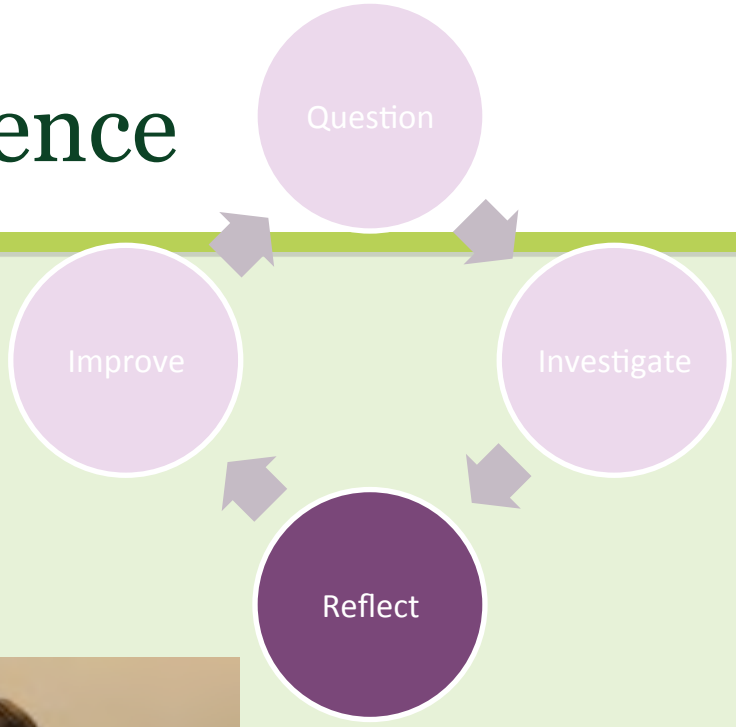


Professional Development Probe #2

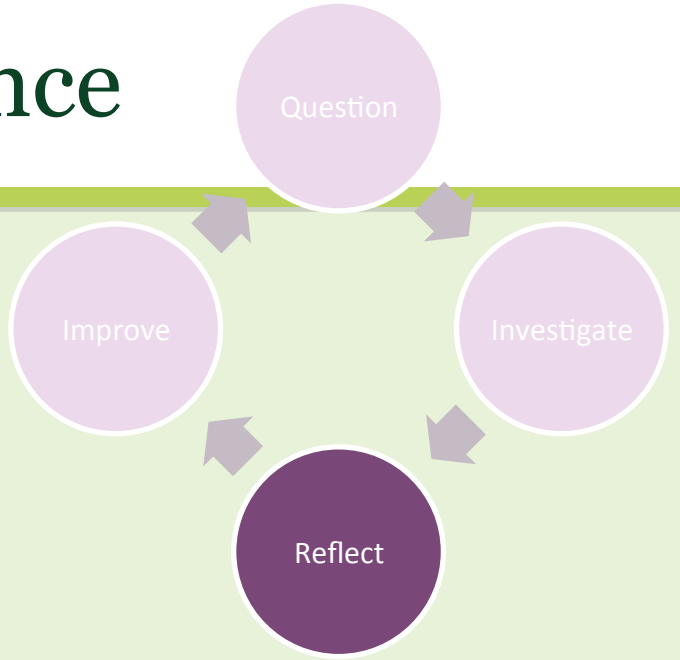
Post Professional Development Probe #2



Nanoscale in Pint Size Science



Nanoscale in Pint Size Science



Post Professional Development Probe #3

1. When you hear the word “Nano” what do you think of now?

2. On a scale of from 1-5, how likely are you to incorporate more nanoscale topics into your curriculum?

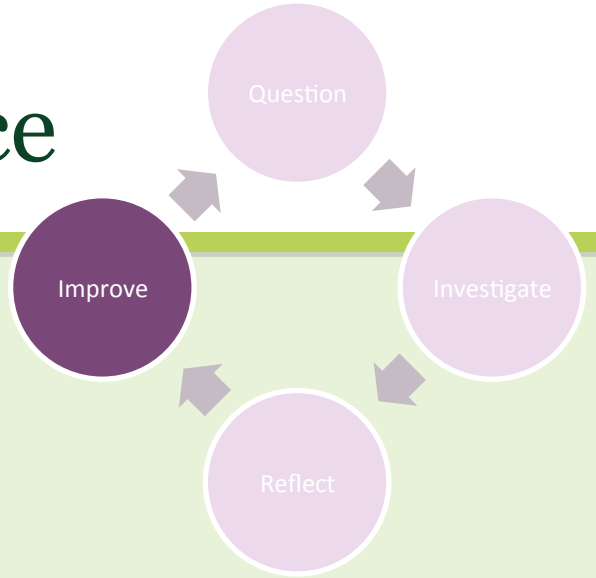
1	2	3	4	5
(not at all)				(very likely)

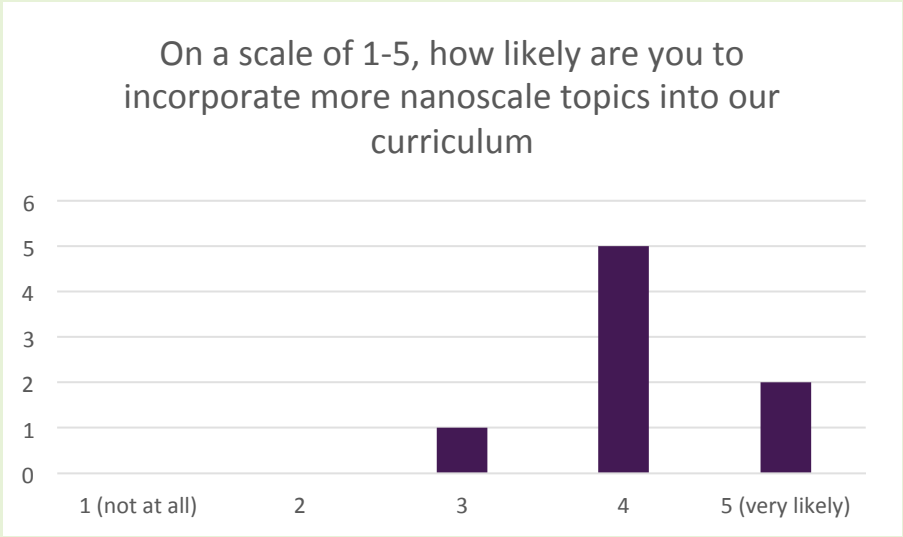
3. On a scale from 1-5, rate your comfort level with the term “Nano”.

1	2	3	4	5
(not comfortable)				(comfortable)

4. Give an example of how you would include nanoscale content in a Pint Size Science activity.

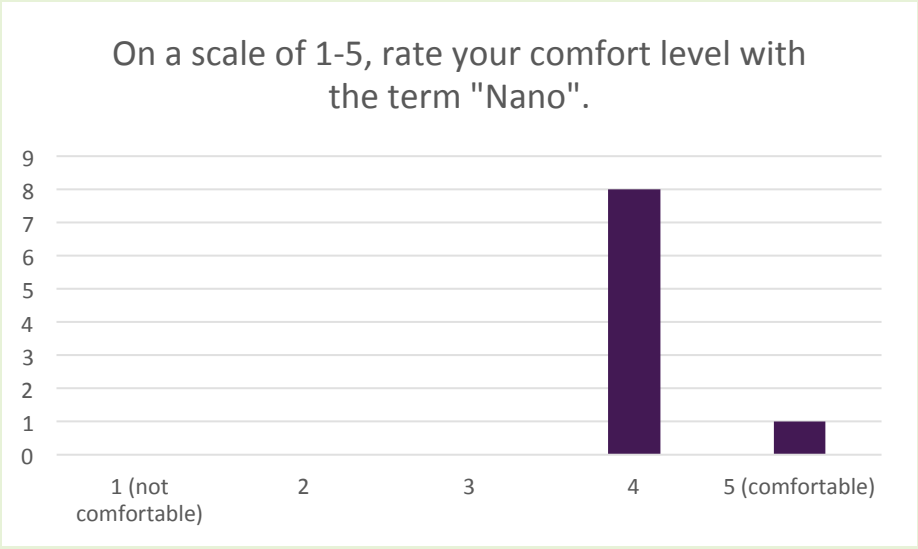
Nanoscale in Pint Size Science



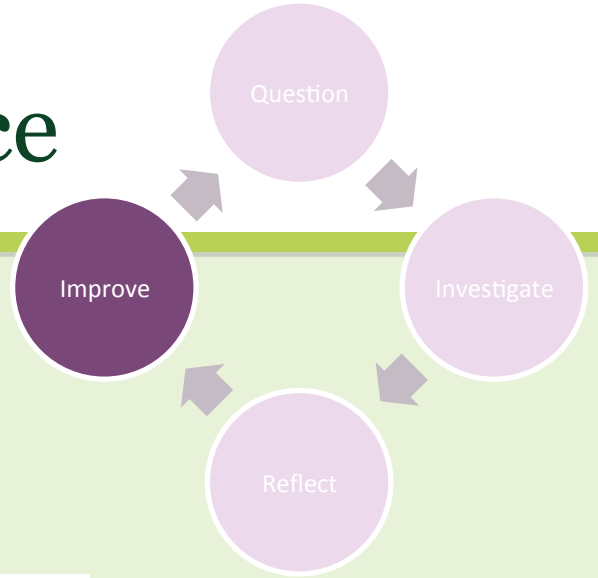


Professional Development Probe #3

Post Professional Development Probe #3



Nanoscale in Pint Size Science



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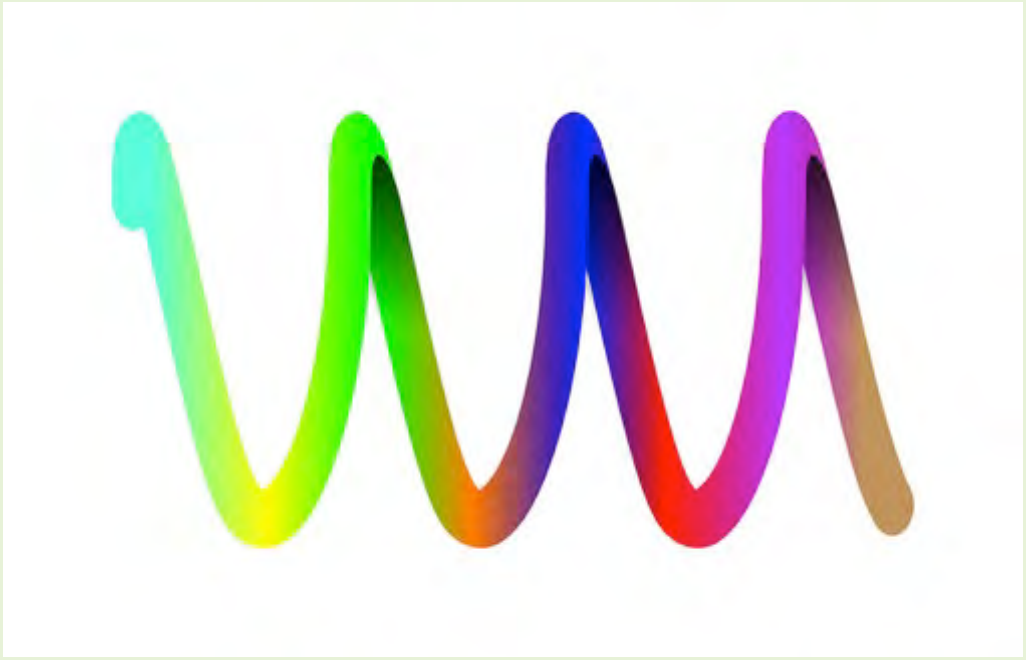

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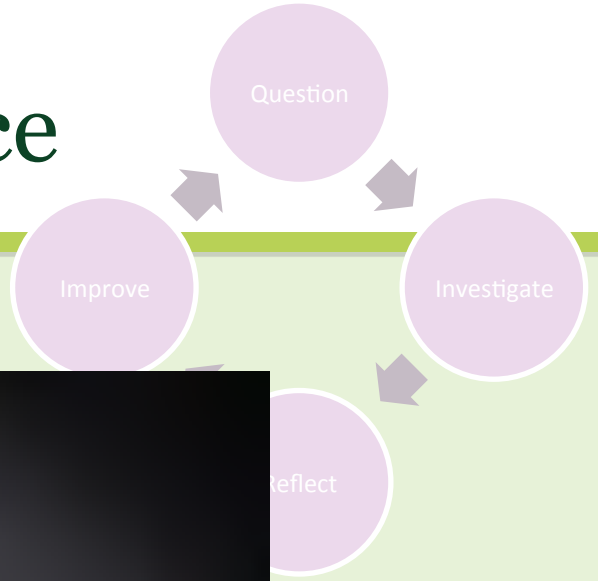


TBI Report

It's All About The Size Of It!

It's All About The Size Of It!

Project Overview

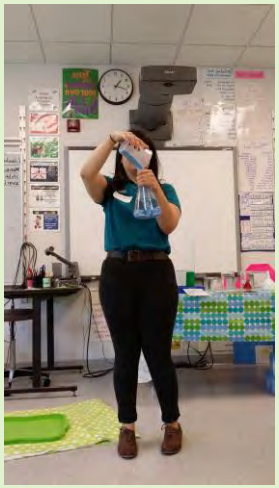
We wanted to expand our outreach by creating two new Traveling Science Programs focused on engaging audiences and informing them about the field of Nano.

- 45 minutes
- K-3rd grade
- 4th-8th grade

It's All About The Size Of It!

TBI Questions

1. Was our audience engaged?
2. Did the audience understand the concepts of Nano?



It's All About The Size Of It!

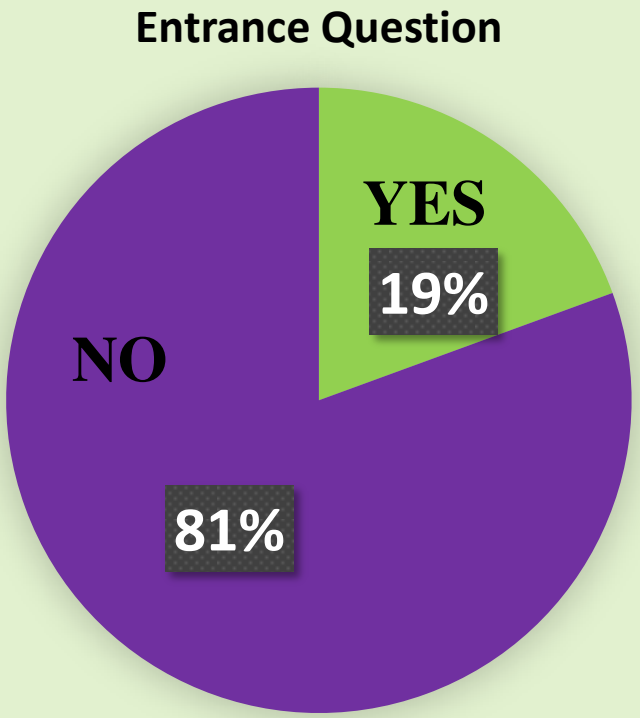
Data Collection Instruments

- **Embedded Evaluation**
  - **Entrance and Exit Questions**

Entrance Question

Have you heard of Nanoscale Science before?

- *YES or NO*



It's All About The Size Of It!

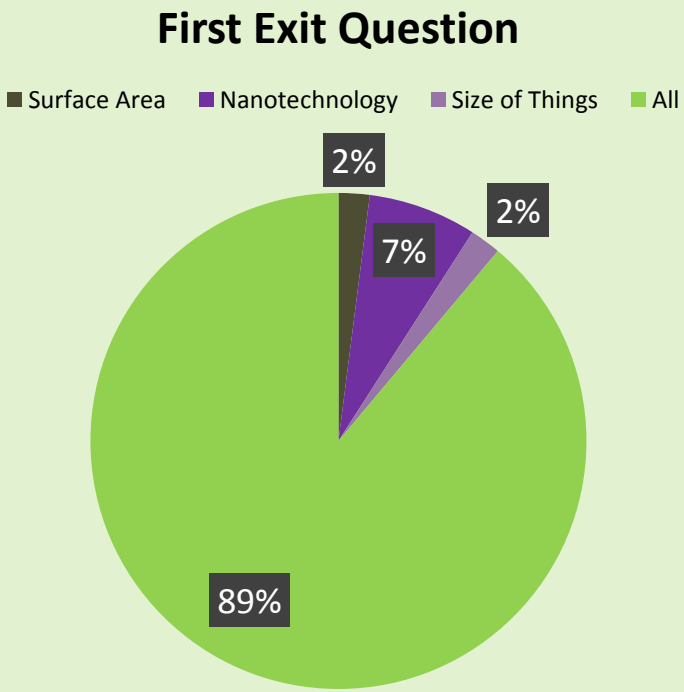
Exit Question

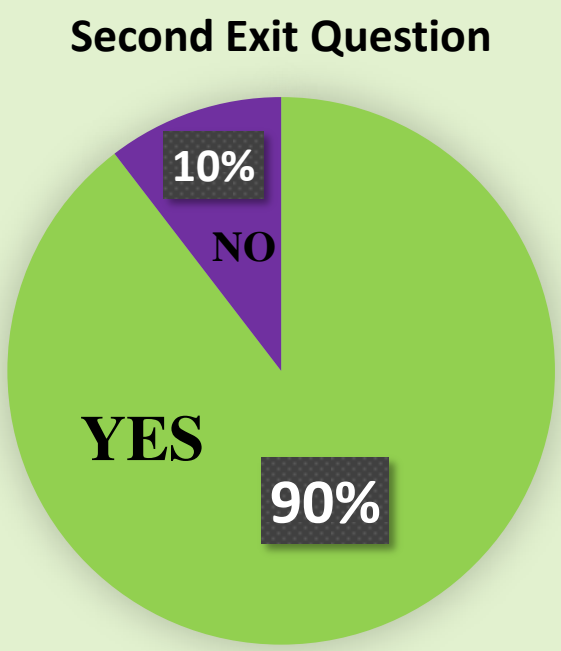
Based on this program what do you think Nanoscale Science Means?

- *Technologies*
- *Size of things*
- *Surface Area*
- *All*

Based on this program do you think you know more about Nanoscale Science?

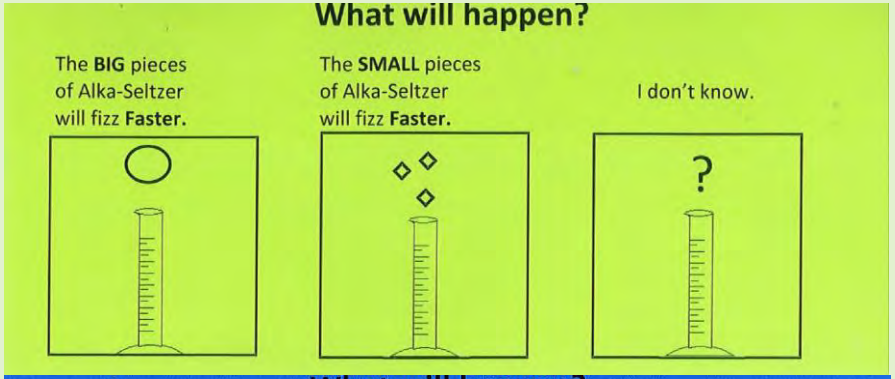
- *YES or NO*

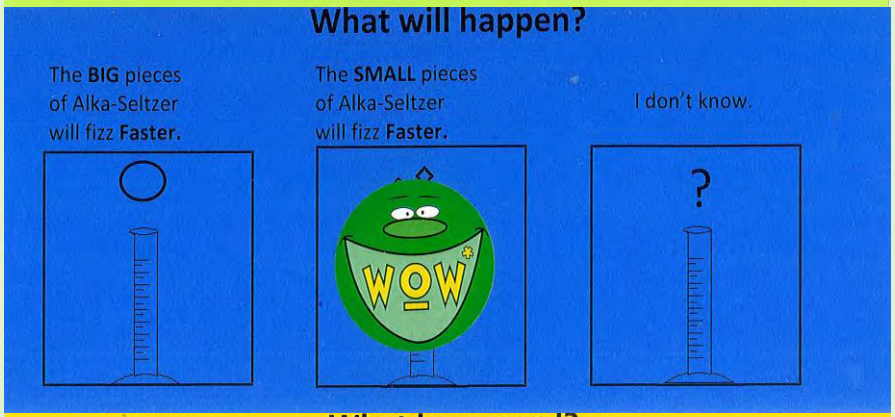


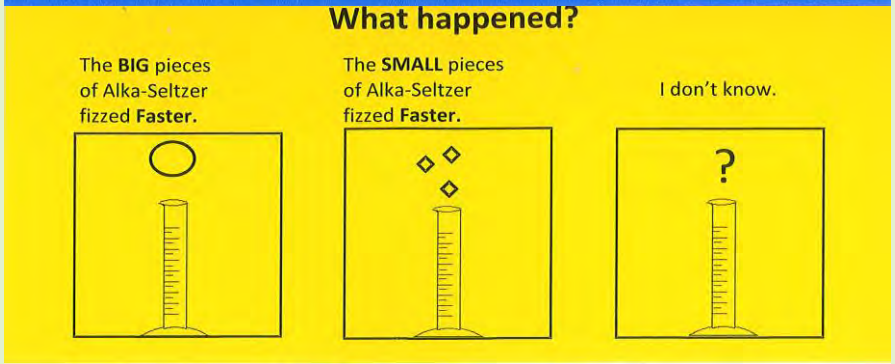


Its All About The Size Of It!

Surface Area and Prediction Sheets







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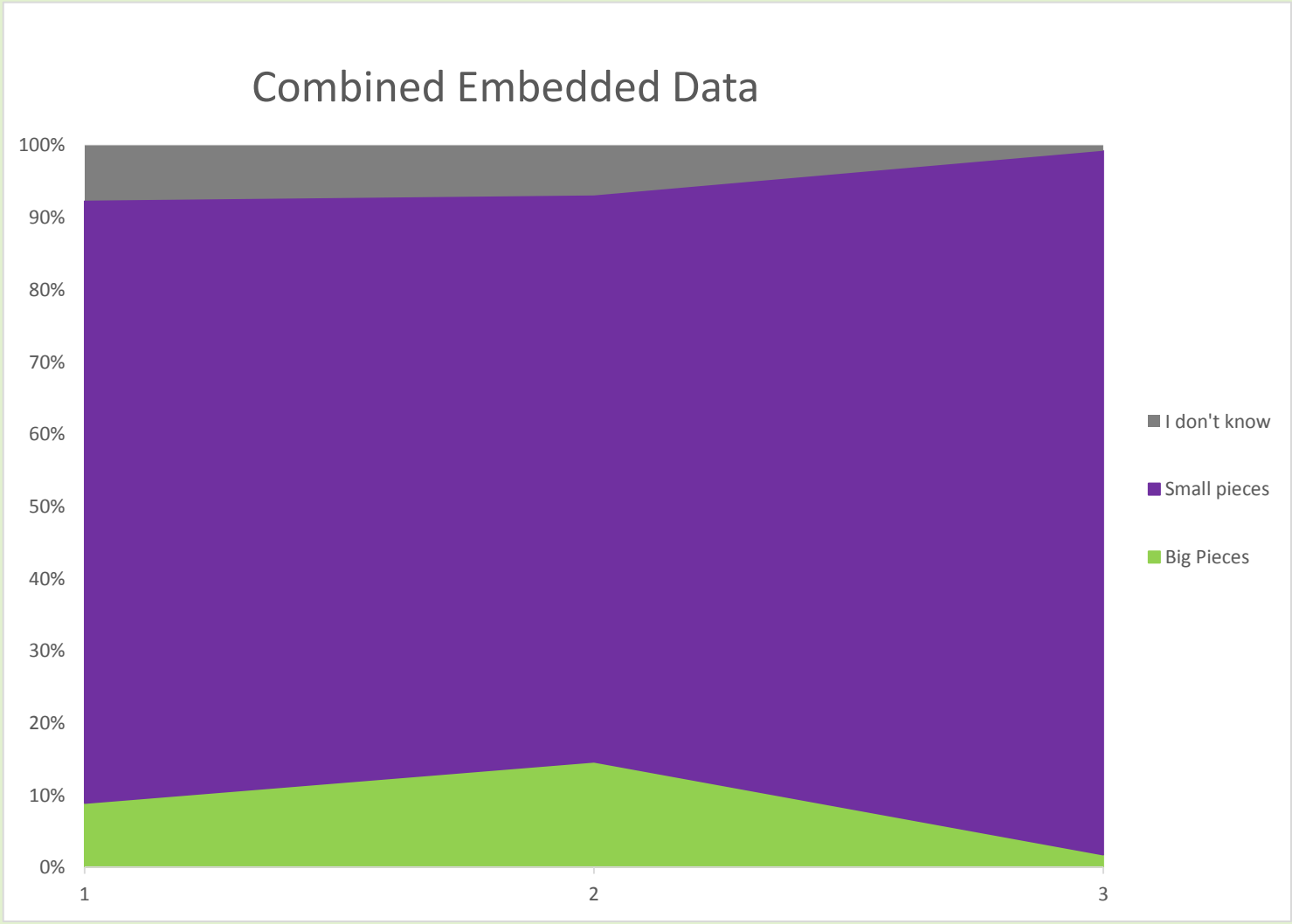

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Teacher Feedback Surveys

DATE: _____ TEACHER NAME: _____ SCHOOL/GROUP: _____ AGE OF AUDIENCE: _____

Feedback Survey

Help us improve the program you just saw!
Please take a few minutes to share your opinions below.

1. What aspects of the activity did your students respond to the most? Why was that?

2. What aspects of the activity did your students respond to the least? Why was that?

3. What did you like most about this Traveling Science Program?

4. How could this Traveling Science Program be improved?

5. How familiar were your students with Nanoscience before the presentation?

Not at All Familiar		Somewhat Familiar		Very Familiar
1	2	3	4	5

6. How has your students' understanding of Nano changed after seeing the program?

Not at All		Some Change		Significant Change
1	2	3	4	5

Thank you for your time and feedback!
Before you leave, please return your completed survey to a staff member.

Facilitator Initials: ☐

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Survey Results

Positive Key Words:

- Engaging
- Interactive
- Visual
- Demonstrations
- Hands-on Participation
- Voting/Predicting

Students' Favorite Aspects of the Show:

- Hydrophobic Sand and Lab Coat
- Alka-Seltzer Experiment

Suggested Improvements

- Possible pre-activities, to give the students background
- Video or pictures of more Nano Technology
- More hands-on opportunities
- Longer presentation
- None

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Improvements Being Made

- Working to improve our surface area explanation
- Added more pictures of Nano Technology
- Will continue to include the prediction sheets
- Switching out one of the demonstrations for a more engaging one
- We are developing pre-activities, but in the meantime we are directing people to www.nisenet.org

It’s All About The Size Of It!

Discussion

Sarah Cohn
Science Museum of Minnesota

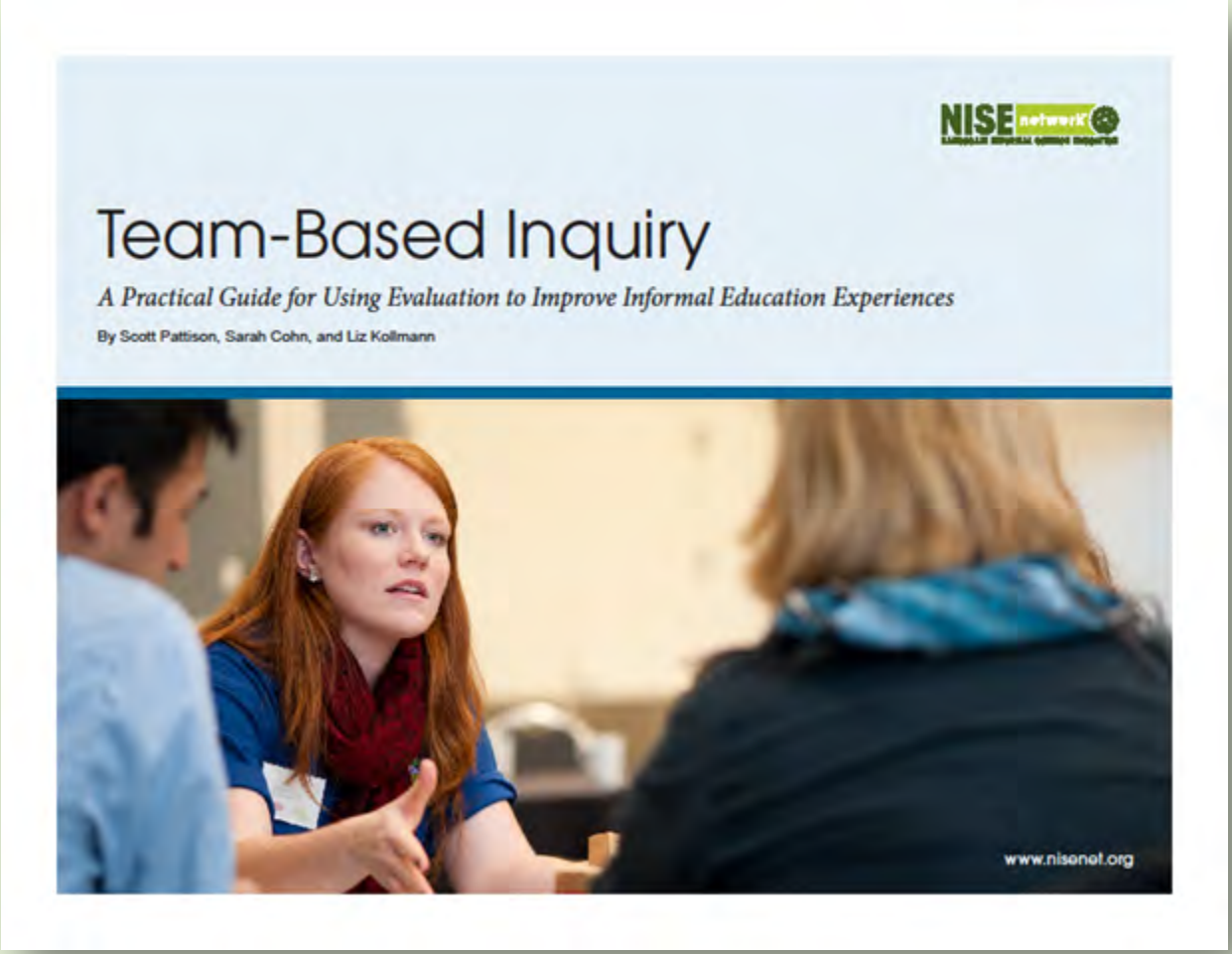
Scott Randol
Oregon Museum of Science and Industry

Caitlin Grothaus
Kentucky Science Center

Jolie Pelds
Science Center of Iowa

Meriel Stokoe
MOST – Milton J. Rubenstein Museum of Science & Technology

TBI Guide



www.nisenet.org/catalog/tools_guides/team-based_inquiry_guide

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Any opinions, findings, and conclusions or recommendations expressed in this presentation are those of the authors and do not necessarily reflect the views of the Foundation.