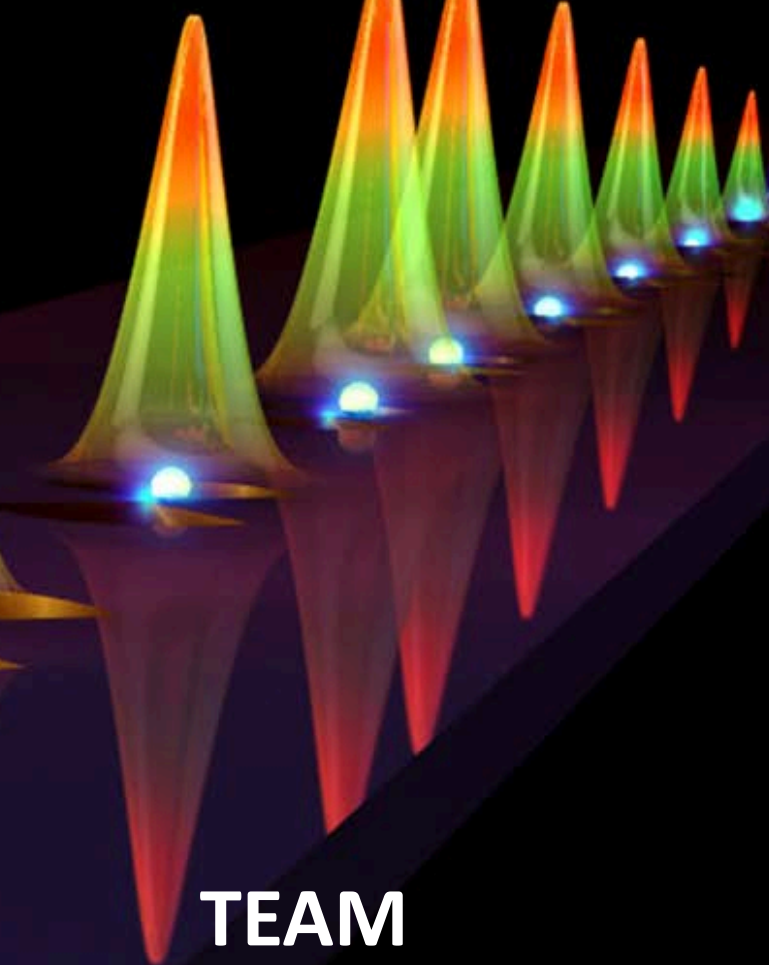
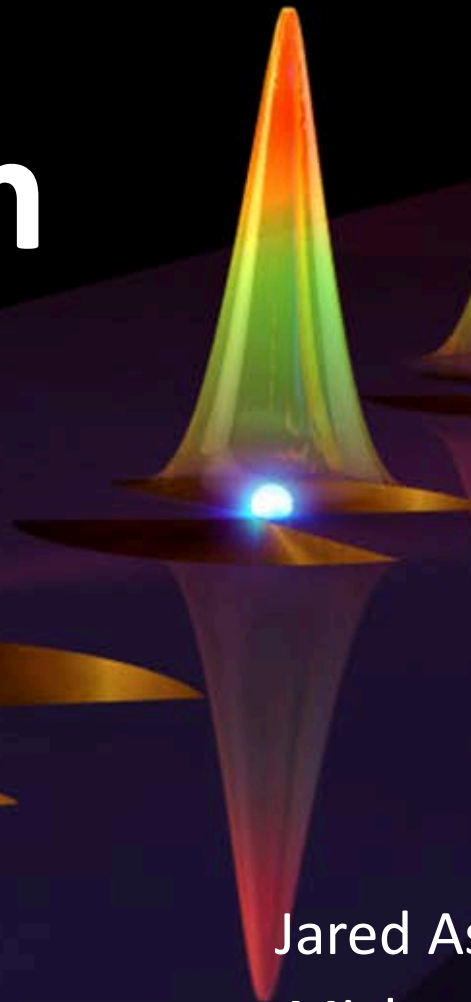
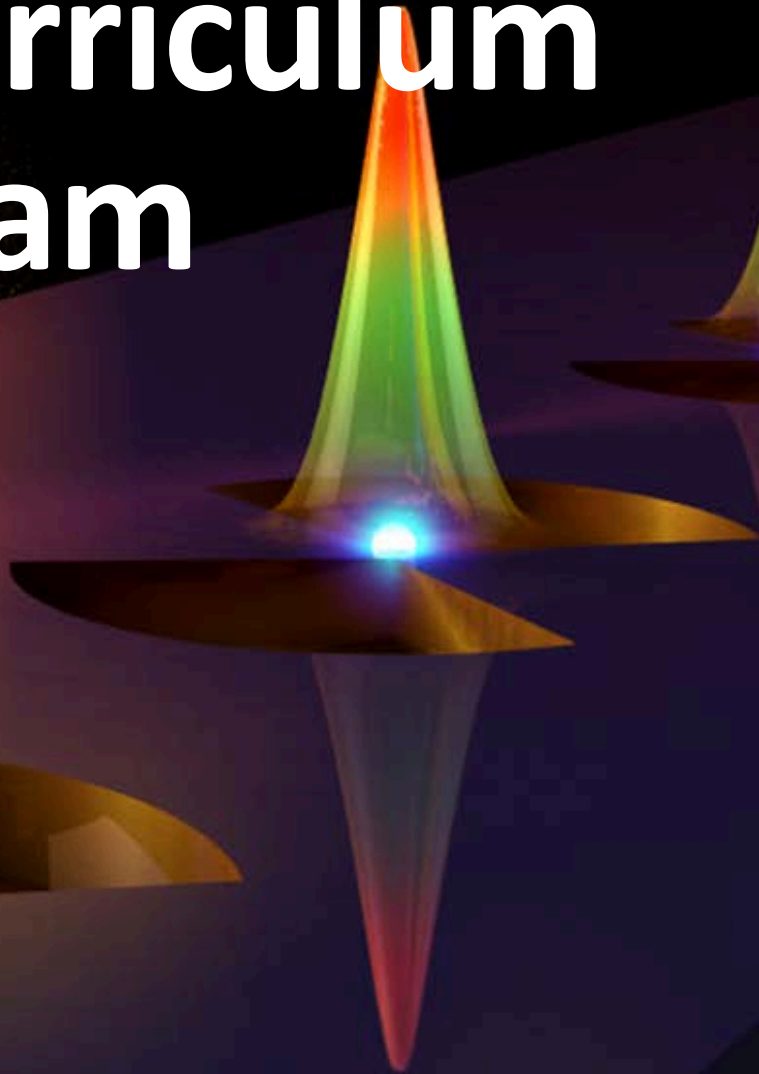


# MNTeSIG Curriculum Team



## TEAM

Jared Ashcroft  
Michael Lund  
Pamela Auburn  
Marco Curreli  
Abe Michelen

Cait Cramer  
Carol Bouvier  
Paul Weber  
Val Kovach  
Neda Habibi

# Our Team

# Mission and vision

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## Our mission:

- Give every high school and community college in America the resources to offer “micro” and “nano” technology courses or activities.

## Our vision:

- We envision every student in America to experience the “micro” and “nano” world before they enroll into a university.

# Goals

## Short term goals:

- Create “micro” and “nano” short activities:
  - Fun activities to introduce micro/nano
  - To be integrated into science courses (Chem, Phys, etc.).
    - Length: ~1-2 day
    - 1+ weeks

## Long term goals:

- Add labs
- Full semester or full year courses in “micro” and “nano” technologies.
  - High Schools
  - Community Colleges
- Large distribution capabilities. All digital.

# Accomplishments

# Our first product

- NACK donated an old video with micro/nano content
- Created a series of assignments



<https://www.youtube.com/watch?v=Joa7OyzEFGs>



degrees that work: Nanotechnology

18,512 views 53 likes 2 dislikes SHARE SAVE



Pennsylvania College of Technology  
4.63K subscribers

SUBSCRIBE

## How Mark Became a Nanotechnologist

Activities - How Mark Became a Nanotechnologist	
1) Mark goes to the Nanofabrication Lab at Penn State University 16 pts	✓
2) What is nanotechnology? 38 pts	✓
3) Taking classes in a cleanroom 37 pts	✓
4) What is nanofabrication? 56 pts	✓
5) Nanotechnology is all around you and in your future 33 pts	✓
6) Extra credit questions 25 pts	✓
Post activity survey	✓

Your Future in Nanotechnology	
Where you can to study nanotechnology	✓
Thank you!	✓

# How Mark Became a Nanotechnologist

1 Which of the following statements about the video below seem correct? Select



Courtesy of the Nanotechnology Applications and Career Knowledge (NACK) Network.

- The reason why Mark's class requires a bunny suit is to prevent people from introducing contaminants into the ultra-
- Mark and the other students get trained to operate the same type of equipment used in the semiconductor industry.
- Fabricating nanoscale devices and systems requires an understanding of design, chemistry, physics, biology, and eng
- Nowadays, students like Mark might have multiple careers in very different fields. A strong background in nanotechn
- Learning nanofabrication gave Mark superpowers, similar to the superheroes in Marvel movies. Mark is now unstoppable



2 Which of the following statements about "cleanrooms" are correct? Select all th

- If a human hair or a tiny piece of skin flake falls onto Mark's substrate, this will cause a lot of problems. So Mark mus
- A hospital operating room is much cleaner than Penn State's nanofabrication facility.
- Beyond the video - Particles of dust can be as small as 500 nanometers, thus are invisible to the naked human eye. I
- Equipment in the Nanofabrication Lab is costly and must be taken extra care. However, with proper training, student
- Mark must wear a bunny suit to avoid getting sick from the numerous viruses and bacteria present in this facility.



3 Which of the following statements about "critical dimensions" are correct? Selei

- According to Mark, items such as dust, hair, and bacteria are all larger than the critical dimension of his devices, thus
- Mark defines the "critical dimension" as the smallest size of any object/impurity that can be present in his devices wi
- Beyond the video - An example of "critical dimension" is the relative size of dust particles to that of LEGO bricks. For
- Beyond the video - Another example of "critical dimension" is the relative size of dust particles to that of transistors,

- Learning through a story...
- Short activity (1-2 hours)
- Appropriate for 8<sup>th</sup>-16<sup>th</sup> graders
- Large scale distribution through various LMSs (Canvas, Schoology, etc...)
- Aligned with NGSS
- Instructions for teachers and students, etc...

# Learning while having fun

1. Which of the following statements related to the video below seem correct?



- Courtesy of the Nanotechnology Applications and Career Knowledge (NACK) Network.
- In the next 30 years, nanotechnology is expected to bring more changes to society than all the technologies combined.
  - Nanotechnology is defined as the "art and science" of arranging molecules in long lines.
  - Nanotechnology could be described as the ability to produce or manufacture new materials, tiny devices.
  - Diamond, soot, and graphite are all materials made of the same type of atoms (carbon) but exhibit different properties.
  - Students like Mark can arrange atoms and molecules in pre-designed patterns. That is an example of nanotechnology.

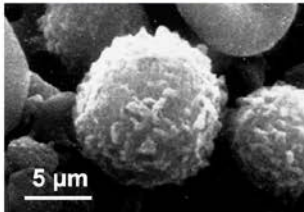


2. According to the video in question 1, which of the following statements are true?

- The length of the football field is 91,400,000 nanometers, clearly making a football field a nanoscale object.
- Even though the diameter of a human red blood cell is 8,000 nanometers, this type of cell is too large to be a nanoscale object.
- A single atom is less than 1 nanometer across, making it too small to be a nanoscale object.
- The prefix "nano" is used in the metric system to define a scale/dimension in the range of "one-billionth of a meter".
- When you hear the prefix "nano," immediately think as small as one-millionth of a meter!
- 100 nanometers and one-billionth of a meter are the same length.
- Beyond the video - The video mentions that the number of protons, neutrons, and electrons determine an atom's mass.

3. Beyond the video - The microscopy image below shows a human white blood cell.

• **Hint:** Use the scale bar at the bottom.



- 10-11 micrometers
- 7-8 micrometers
- 4-5 micrometers
- 0.05 millimeters
- 30-100 nanometers

- Short videos
- Assignments (auto-graded)
- All videos have captions

1. Which of the following statements about the origins and applications of nanotechnology discussed in the video are true?



- Courtesy of the Nanotechnology Applications and Career Knowledge (NACK) Network.
- Beyond the video - Nobel Laureate Richard Feynman hypothesized the possibility of arranging atoms to create patterns over 60 years ago.
  - The first time atomic manipulation was demonstrated, the letters USSR were spelled on a silicon substrate by scientists working at IBM.
  - A material with dimensions smaller than 100 nm tends to have different properties than the same material with larger sizes.
  - Examples of nanoscale items include a sheet of graphene and a silver nanoparticle with a diameter of 60 nm. Examples of bulk items include E. coli bacteria.



2. Which of the following statements about the daily applications of nanotechnology discussed in the video are true?

- Nanoscale gold can confer glass a ruby red color, which will never fade away. Evidence of this property include the colored glass windows of some European cathedrals.
- Applications of nanotechnology mentioned in the video include computer chips, band-aids with anti-bacterial silver nanoparticles, and car waxes with nanoparticles.
- Nanotechnology is expected to have significant impacts on healthcare. Some of the improvements brought to medicine include faster and more reliable lab tests.
- According to the video, "vectors" referred to artificial biological nanoparticles the size of a virus. These can be loaded with drugs for targeted delivery of the drugs.



3. Beyond the video - In what aspects of your life are you likely to find nanotechnology? Select all that apply.

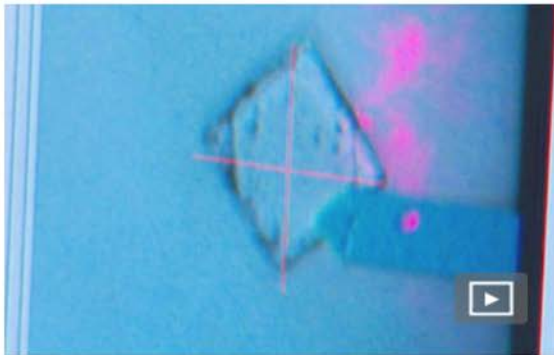
- The touch screen on your smartphones is enabled by glass coated with nanotechnology.
- Your jewelry is more comfortable to wear as it is made with a lighter version of gold atoms.
- If you drop your smartphone in the water, the electronics will not get wet as they are made water-proof with a layer of nanotechnology.
- When you are out in the sun, your skin is better protected from UV sun rays via nanoparticles in your sunscreen.
- Your smile may appear brighter due to nanoparticles in your toothpaste.



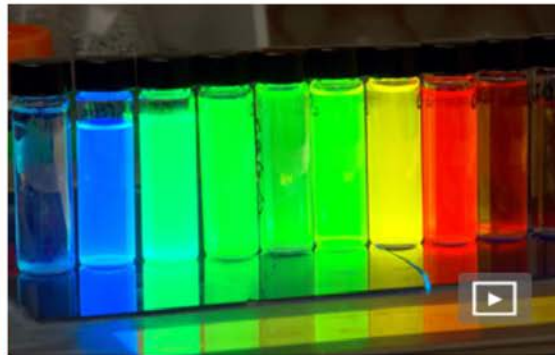
# Future Work

# NBC Learn short activities

- Reach out to NSF and NBC Learn for licensing opportunities



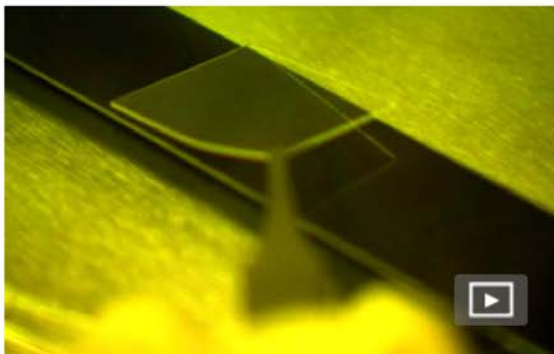
Why is something only billionths of a meter in size so important



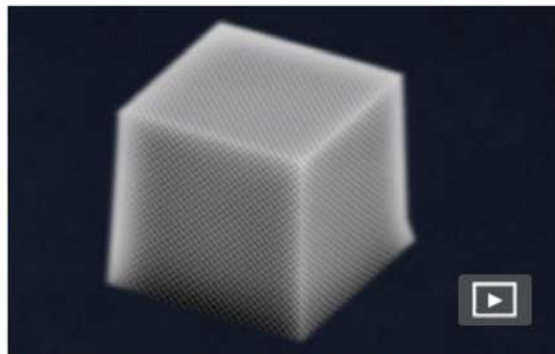
Quantum dots are helping to produce brighter, more vivid color in displays



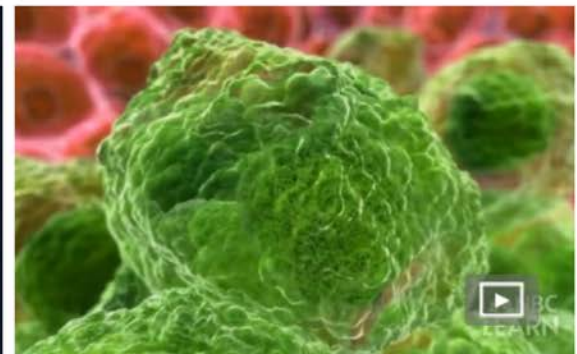
You may have nanotechnology in your pocket and not even know it



How could something only billionths of a meter thick defend against water, wear, and even bacteria



New materials are breaking the rules by behaving in very unexpected ways



Nanotechnology may one day sense, diagnose, and even treat cancer

# SEM short activities

- Microscopy activity
- SEM-focused
- Utilize the remote-access network RAIN

About RAIN (Remotely Accessible Instruments for Nanotechnology):



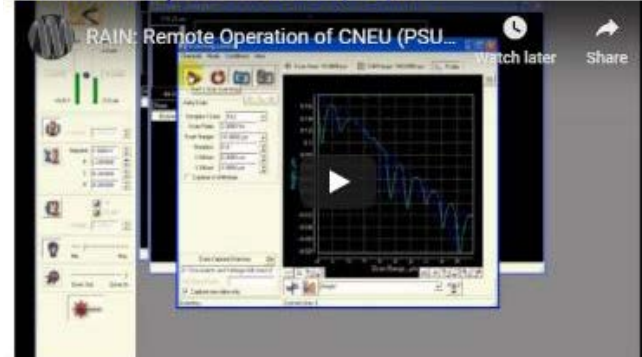
RAIN Operation of CNEU (PSU) FESEM:



Remote Access Connection:



RAIN Remote Operation of CNEU (PSU) AFM:



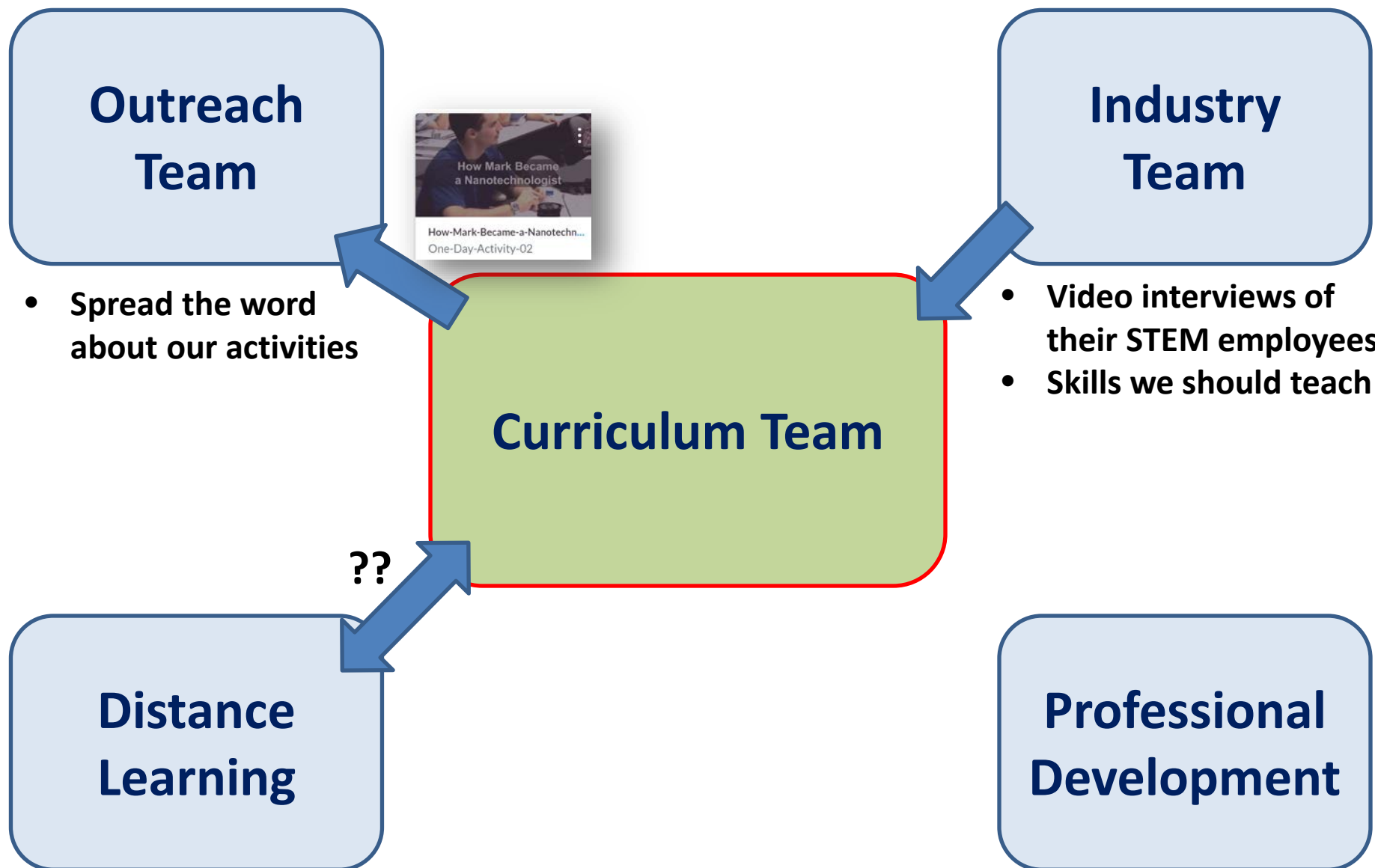
# Longer activities

- **Later....**
- Semester long courses
- Based on Omni Nano's digital curriculum

▶ Pre-Course Surveys	✓	+	⋮
▶ Unit 1 - Introduction to Nanotechnology	✓	+	⋮
▶ Unit 2 - The Metric System and Comparison of Sizes/Scales	✓	+	⋮
▶ Unit 3 - Imaging at the Nanoscale	✓	+	⋮
▶ Unit 4 - Forces and Matter at the Nanoscale	✓	+	⋮
▶ Unit 5 - Nanomaterials and Nanostructures	✓	+	⋮
▶ Unit 6 - The Large Surface-to-Volume Ratio of Nanomaterials	✓	+	⋮
▶ Unit 7 - Basic Concepts of Materials Science	✓	+	⋮
▶ Unit 8 - Tuning the Properties of Nanomaterials	✓	+	⋮

# Collaborating with Other Teams

# Collaboration with other teams



**Want to Join?**

# Meetings




- The Curriculum Team meets one week after the MNTeSIG general meeting (same time and day of the week).
- (Usually on a Friday)














# File sharing: Google Drive




- Sharing syllabi and course descriptions of micro and nano tech course at our institutions.




 Ivy Tech - AS NANOTECHNOLOGY - OFFICAL POLICY  
  Adobe Acrobat Document

 Ivy Tech - MEMS 103 - Microsystems and Electronics  
  Adobe Acrobat Document




 Ivy Tech - NANO 200 - Solid State Devices in Nanotechnology  
  Adobe Acrobat Document




 Ivy Tech - NANO 204 - Materials in Nanotechnology  
  Adobe Acrobat Document




 Ivy Tech - NANO 207 - Bioapplications of Nanotechnology  
  Adobe Acrobat Document




 Ivy Tech - NANO 290 - Nanotechnology Internship  
  Adobe Acrobat Document




 WLAC - Approved Nanotechnology courses by the State of CA  
  Adobe Acrobat Document




 WLAC - Chem 242 - ENVIRONMENTAL, HEALTH, & SA...  
  Adobe Acrobat Document




 Ivy Tech - MEMS 101 - Introduction to Microsystems  
  Adobe Acrobat Document




 Ivy Tech - NANO 100 - Fundamentals of Nanotechnology  
  Adobe Acrobat Document




 Ivy Tech - NANO 202 - Charcterization and Testing of Na...  
  Adobe Acrobat Document




 Ivy Tech - NANO 205 - Patterning for Nanotechnology  
  Adobe Acrobat Document




 Ivy Tech - NANO 208 - Patterning and Materials Modification for Na...  
  Adobe Acrobat Document




 UVU - SYLLABUS PHYS 2800 S 2020 Post Class  
  Adobe Acrobat Document




 WLAC - Chem 240 - FUNDAMENTALS OF NANOTECH...  
  Adobe Acrobat Document




 Ivy Tech - MEMS 102 - Microsystems Characterization  
  Adobe Acrobat Document




 Ivy Tech - NANO 111 - Materials, Safety and Equipment Overview f...  
  Adobe Acrobat Document

 Ivy Tech - NANO 203 - Basic Nanotechnology Processes  
  Adobe Acrobat Document

 Ivy Tech - NANO 206 - Materials Modification in Nanotechnology  
  Adobe Acrobat Document

 Ivy Tech - NANO 282 - Nanotechnology - Special Topics  
  Adobe Acrobat Document

 Wheeling High School Harper College\_PHS170\_Bouvier-19 20  
  Adobe Acrobat Document

 WLAC - Chem 241 - APPLICATIONS OF NANOTECHNOLOGY - Course...  
  Adobe Acrobat Document

# Welcome to Join

- Do you enjoy:
  - Creating lessons?
  - Creating assignments?
- Do you teach “micro” or “nano” courses?
- What skills do you have?
- What new ideas would you like to bring?

**Let's talk more during the Breakout Session!**