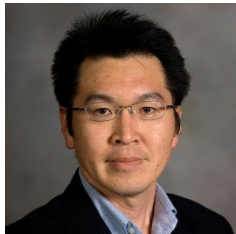


# NanoEarth (Virginia Tech National Center for Earth and Environmental Nanotechnology Infrastructure)

NNCI Annual Conference, October 27, 2023



Murayama  
Site Director



Michel  
Deputy Director



Hochella  
Director of User  
Development



Hull  
Facility Director;  
AD Innovation &  
Entrepreneurship



Marr  
Technical AD



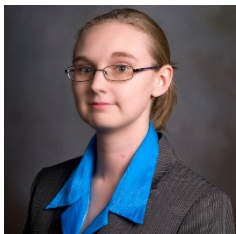
Pruden  
Technical AD



Schreiber  
Technical AD



Vikesland  
Technical AD



Pruitt  
Assistant  
Director



Sowers  
Facility  
Admin.



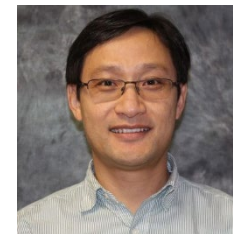
Velasquez  
Diversity & Outreach  
Coordinator



Lade  
Postdoctoral  
Associate



Horn  
Instrument  
Specialist



Leng  
Instrument  
Specialist



McCartney  
Instrument  
Specialist



TBD  
Instrument  
Specialists

# NanoEarth's Mission & Focus

## Mission

The mission of NanoEarth is to stimulate discovery and innovation, and to share knowledge of Earth and environmental nanoscience and nanotechnology

## Focus Areas

- Non-traditional areas of study
  - Geo and Earth Sciences
  - Environmental Sciences
  - Agricultural Sciences
- Diversity – MUNI (Multicultural & Underserved Nanoscience Initiative)
- Innovation & Entrepreneurship



What successful examples of programs, activities, and relationships in the current NNCI could be adapted or expanded for multiple sites in a future network to increase impact?

# NanoEarth Innovation Ecosystem

Goal: Provide an environment that fosters thriving industrial engagement, innovation and entrepreneurship.



**Matthew Hull**

Associate Director for Innovation and Entrepreneurship  
NanoEarth & NNCI Coordinating Office

- Entrepreneur-in-Residence (EiR)
- NTEC - NanoTechnology Entrepreneurship Challenge
- Research AND Entrepreneurship Experience for Undergraduates (REEU)
- Industry Engagement



Business Model Canvas				
<b>Key Partners</b> - DOE - Paint manufacturers - Advertisement agencies	<b>Key Activities</b> - Turgit Characterization - Market Research - Pigment Development	<b>Value Propositions</b> - More environmentally friendly product - Longer lasting pigments	<b>Customer Relationship</b> - Paint Manufacturers - Advertisers	<b>Customer Segments</b> - Companies that already mass produce dyes, that want a renewable and safe alternative
	<b>Key Resources</b> - Professional Lab - Graves Mountain Samples		<b>Channels</b> - Website - Email	
<b>Cost Structure</b> - Fabrication - Shipment - Marketing		<b>Revenue Streams</b> - Sale of dye - Pigmented vinyl		

COLLEGE OF AGRICULTURE AND LIFE SCIENCES  
 CENTER FOR ADVANCED INNOVATION IN AGRICULTURE  
 VIRGINIA TECH

Jointly hosted with the Center for Advanced Innovation in Agriculture (CAIA)

**NanoEarth Industry Speaker:**  
**Darren Anderson, PhD**  
 CEO and Co-Founder: Vive Crop Protection  
 danderson@vivecrop.com

Date: Monday, December 5, 2022  
 Time: 1:00 – 2:00 p.m.  
 Location: Fralin Hall Auditorium  
 (360 W Campus Drive, Virginia Tech)

Zoom option is available for those off-campus

Nanotechnology in Agriculture - Getting on the Farm

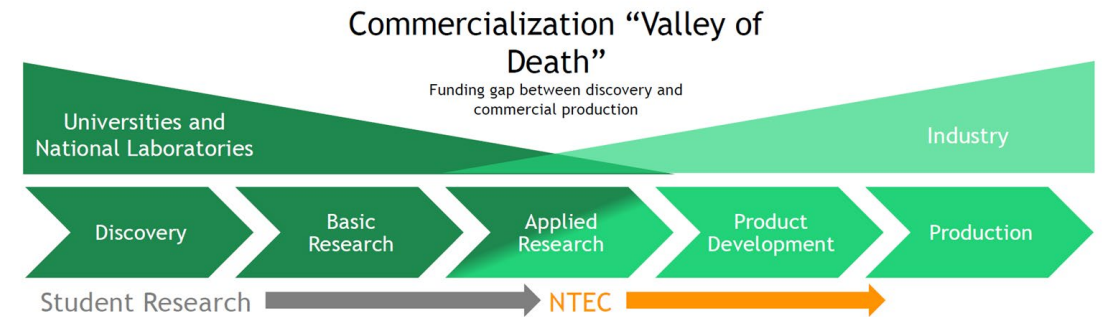


# NNCI Nanotechnology Entrepreneurship Challenge (NTEC)

Team #	Student Lead(s)	NNCI Site	Award Type	Mentor(s)	NTEC Title
35	Hunter Holden	SENIC (JSNN)	Diversity (\$1000)	Dr. Dennis LaJeunesse	Structural bacterial cellulose
36	Victor Mukora	NanoEarth	Regular (\$500)	Dr. Anne Brown	Applications of real-time machine learning to solar energy
37	Trayda Murakami	NanoEarth	Regular (\$500)	Dr. Matthew Hull, Ms. Tonya Pruitt	Women in NanoEARTH
38	Naimat K. Bari	NanoEarth	Regular (\$500)	Dr. Bahareh Behkam	Nanofibrous living materials for pathogen detection
39	Mayuk Sengupta	NanoEarth	Regular (\$500)	Dr. Marc Michel	Non-lethal ceramic/crystal tipped bullets
40	Micheal Erb Charles McKee	NanoEarth NanoEarth	Regular (\$500)	Dr. Marc Michel	Chemical upcycling of polystyrene waste in aryl ketones
41	Charlie Ver Beek Chloe Nyhart	NanoEarth NanoEarth	Regular (\$500)	Dr. Craig Tollin	The effect of organic dye used in an organic photovoltaic cell on efficiency
42	Cade Toth	NanoEarth	Regular (\$500)	Dr. Marc Michel	Characterization of natural iridescent iron oxyhydroxide from Graves Mountain, Georgia
43	Haoxuan (Angelo) Lyu	MANTH	Regular (\$500)	Prof. Marc G. Allen	Exploration of degradable encapsulants of bilayer wax systems
44	Ivonne Gonzalez Gamboa	SDNI (UC San Diego)	Diversity (\$1000)	Dr. Yves Theriault, Dr. Nicole Steinmetz	Nanoparticle-embedded pesticides for reduced environmental toxicity

Week	MVP	Business Model Generation	Customer Discovery
1	↓	Write your business thesis	↓
2		Customer segments and value propositions	
3		Channels and customer relationships	
4		Revenue streams	
5		Key resources, activities, and partnerships	
6		Cost structure	
7		NTEC Showcase	

Supported by Readings, Mentorship



**NTEC is NOT the same as a lab research project!**

Understanding the basic of lab research is great, but it's not enough to be successful in NTEC or make it as an entrepreneur.

The NNCI is helping develop a new generation of "nano savvy" innovators and entrepreneurs who can help solve real-world problems using nano-enabled technologies.



# Expanding & Strengthening the Innovation Ecosystem



**Primary Need: People** - Dedicated and clearly defined role for an Innovation and Entrepreneurship person at individual sites (similar to Education & Outreach, SEI, and Computation)



Kevin Walsh  
**KY Multiscale**



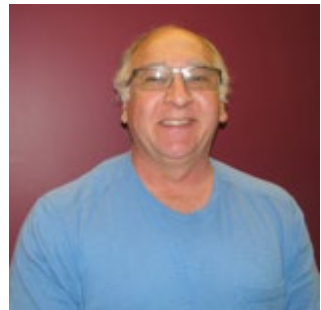
Andy Ligley  
**MONT**



Sara Ostrowski, Daniella Duran  
**nano@stanford**



Jenna Huttenmaier, Steve Wignall  
**NNF**



Kristin Field, Gerald Lopez, Pat Watson  
**MANTH**



Karl F. Böhringer  
**NNI**



Yves Theriault  
**SDNI**



Ying Jia  
**SHyNE**



Ron Olson  
**CNF**



Sherine Obare, Paul Joseph  
**SENIC**



Jessica Hauer  
**NCI-SW**



Mughees Khan  
**CNS**



Phillip Strader  
**RTNN**



Tonya Pruitt  
**NanoEarth**

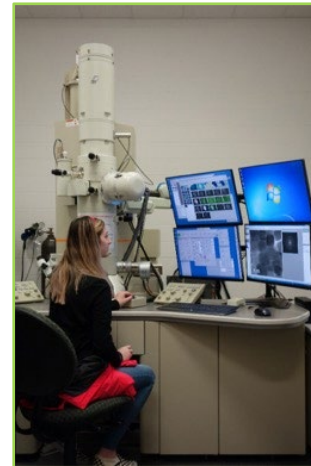
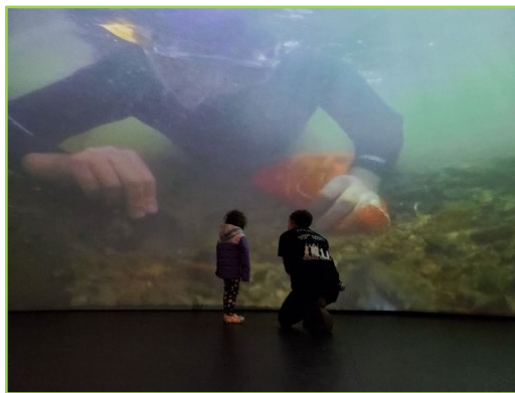


Pictured: Current I&E Working Group Members  
(14 sites represented)

# Research Community: Earth & Environmental Sciences

## Goal: Enhance the Earth/environmental capacity and impact of the NNCI

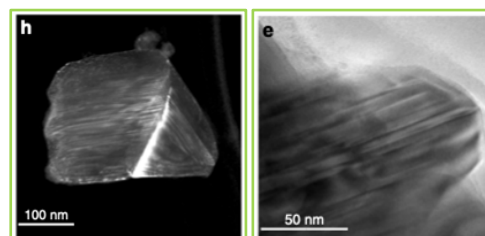
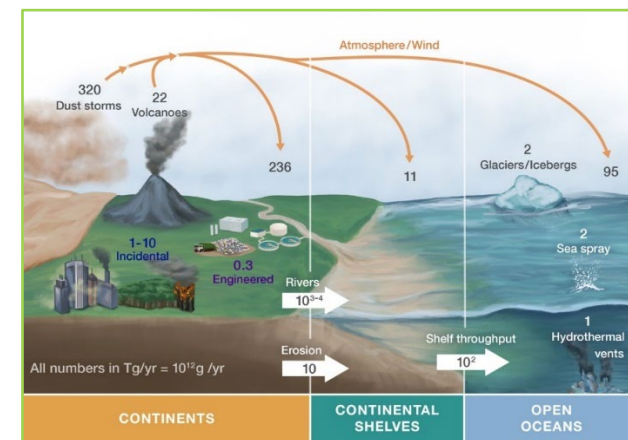
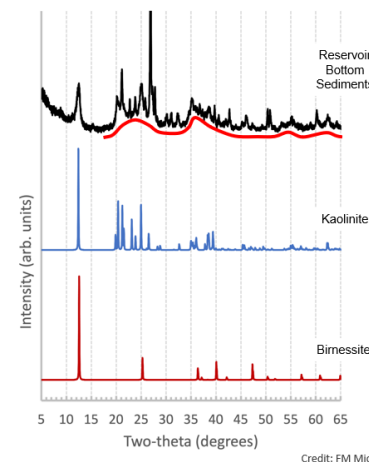
- Develop research tools and infrastructure to provide us with the capacity to approach more complex questions than ever before;
- Train the next generation of researchers to approach scientific inquiry in a way that crosses scales and scientific disciplines;
- Foster collaboration and convergent research across the network and beyond by helping us to consider multiple levels of organization and complexity in addressing key trans-disciplinary questions.



# Primary Activity: Annual Virtual Workshops (2021, 2022, 2023)

Theme: New Frontiers of Nanoscience Research in the Earth and Environmental Sciences

- Topics areas have included:
  - A Nanoscience Approach to Understanding Environmental Samples
  - Role of Nanoparticles and Drinking Water Quality
  - Water Purification
  - Nano/Microplastics
  - Agriculture and Elemental Cycling
  - Sustainable Nanotechnology
  - Nanoscale Mineralogy of Meteorites
- “Office Hours” with the Experts
- All resources, including workshop video recordings, are available on the workshop website





# The Next Iteration of the Research Community

- Further develop the community
  - Both within NNCI and external
  - Not just workshop ‘attendees’ – actual community
- Expand Activities
  - More than a once per year workshop
  - Sessions at conferences (e.g., Goldschmidt)
  - Staff exchanges, seminars, etc.
- Output
  - Easily navigable resources
  - Environmental sample prep guides



<b>Nanotechnology in STEM</b>
Nanotechnology: an Emerging Science
Needs and Opportunities
An Emerging Teaching Opportunity
Evidence-based Teaching Practices
Background Nanoscience Resources for Instructors
Nanoscience Literature for Earth and Environmental Science
<b>Instruments and Analytical Methods Common to Nano</b>
Registry of Analytical Equipment
Ethics
National Nanotechnology Coordinated Infrastructure
Workshops and Events
Get Involved

## Instruments and Analytical Methods Common to Nanoscience

[Read more about Geochemical Instruments and Methods from Integrating Research and Education »](#)

### Browse Geochemical Analytical Instruments and Techniques

Each of these pages contains information about each instrument or technique including what it is, fundamental principles, how it works, applications, strengths and limitations, sample preparation, data collection, results, and preparation, and if available, literature and teaching activities/resources.

These resources were originally developed under the Integrating Research and Education project.

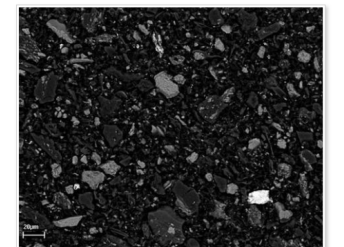
[Related: Browse the Nanoscience Registry of Analytical Instruments »](#)

#### X-ray Crystallography

- Single-crystal X-ray Diffraction--Christine M. Clark, Eastern Michigan University and Barbara L. Dutrow, Louisiana State University
- X-ray Powder Diffraction (XRD)--Barbara L. Dutrow, Louisiana State University and Christine M. Clark, Eastern Michigan University

#### Electron Microbeam

- Electron Probe Micro-analyzer (EPMA)--John Goode, University of Minnesota-Duluth
- Scanning Electron Microscopy (SEM)--Susan Swapp, University of Wyoming
- Wavelength Dispersive Spectroscopy (WDS)--Darrell Henry, Louisiana State University and John Goode, University of Minnesota-Duluth
- Energy Dispersive Spectroscopy (EDS)--John Goode, University of Minnesota-Duluth
- Back-Scattered Electron Imaging (BSE)--John Goode, University of Minnesota at Duluth
- X-ray Elemental Mapping--John Goode, University of Minnesota-Duluth
- Cathodoluminescence (SEM-CL)--Darrell Henry, Louisiana State University



An SEM image of coal

Panel Topic: How does NNCI support national research priorities, and how can this be enhanced in a future nanotechnology infrastructure?

# Focusing on National Research Priorities:

## Bottom Line: *There's a lot more than CHIPS!*

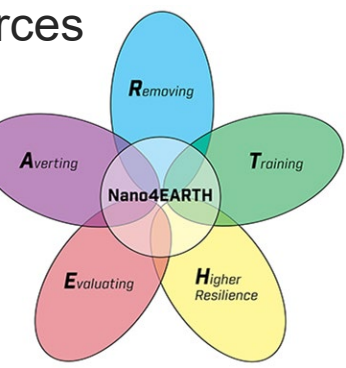
- NSF 10 Big Ideas
  - Growing Convergence Research
  - Navigating the New Arctic
  - NSF Includes
  - Understanding the Rules of Life
- NAE Grand Challenges
  - Providing Access to Clean Water



- USDA Priority Research Topics (Research Strategy: Cultivating Scientific Innovation)
  - Global Food Supply and Security
  - Climate and Energy Needs
  - Sustainable Use of Natural Resources

- EPA High-Priority Research Areas
  - Children's Environmental Health
  - Climate Change
  - Environmental Justice

- DOE Energy Earthshots



### NNCI Provides

- Infrastructure & Expertise
- Flexibility & Nimbleness
- Regional Focus w/i National Network
- Reach & Scalability
- Research Communities
- Workforce Development

### Enhancing a Future Nano Network

- Intensify democratization efforts
- Implement best practices & activities network wide
- Focus on connecting & growing a network of networks (e.g. research communities, regional networks, synergy with other facility networks)

# Acknowledgements



# Questions?

