

Hands On(line) Lab Education with Remote SEM

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This webinar is hosted by:



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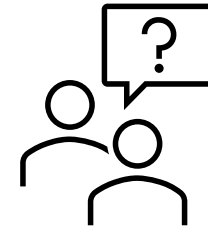


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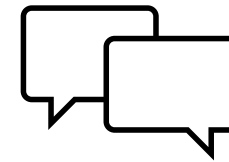
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Agenda

- Introduction
- Microscopy in the classroom
- Live demonstration of the Phenom desktop SEM
- Educator experiences & how you can get involved
- Summary

Hosts and Presenters:



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Zachary Gray
Applications Scientist
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PennState

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PennState

Hands On(line) Lab Education with Remote SEM

Zachary Gray



About Nanoscience Instruments and Analytical Services



- Team of scientists and engineers with backgrounds in physics, chemistry, materials science and engineering
- We provide training, application development and support
- Dedicated service department for ongoing instrument maintenance, repairs and upgrades
- Analytical Services division to support process and application development (ISO 9001:2015 Certified)



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Microscopy in the classroom

- Microscopes of all types have made their way into educational environments



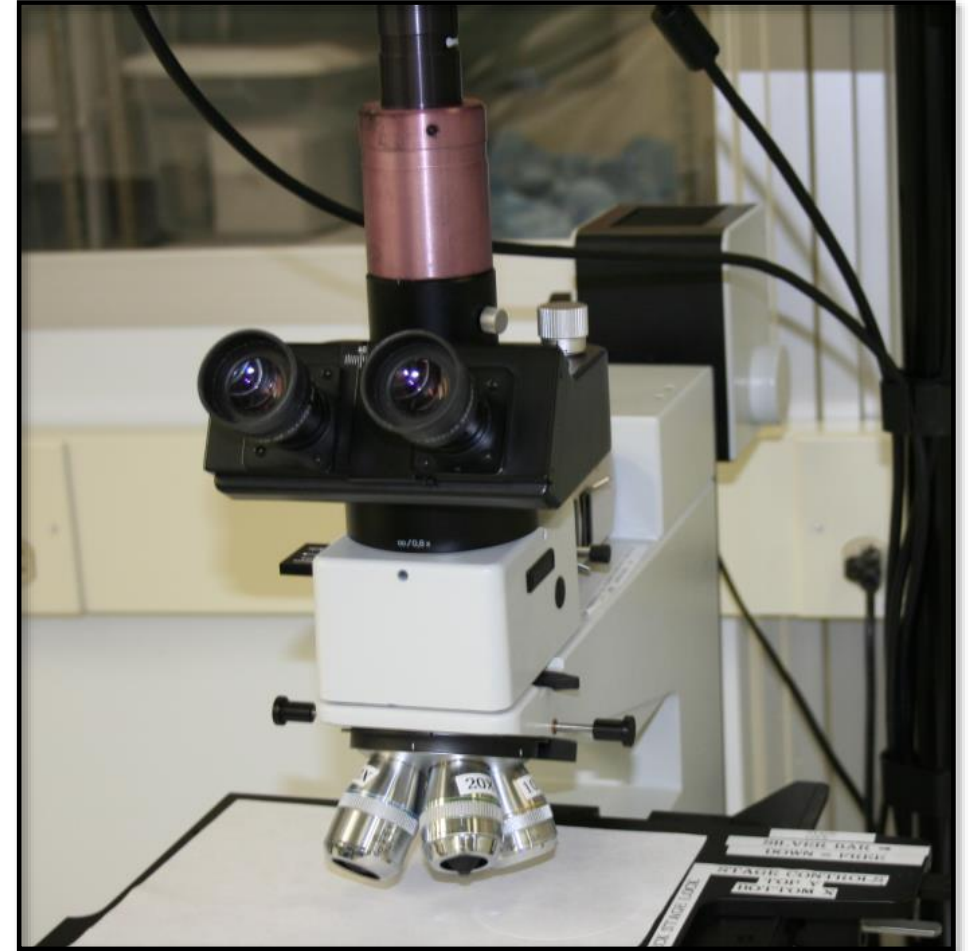
Compound light microscopes are the most common type of microscope found in classrooms today.

- Simple
- Low cost
- Readily available
- Small footprint

https://webcdn.leica-microsystems.com/fileadmin/_processed_/d/2/csm_Buffalo_State_College_student_microscope_classroom__e881e96f55.jpg

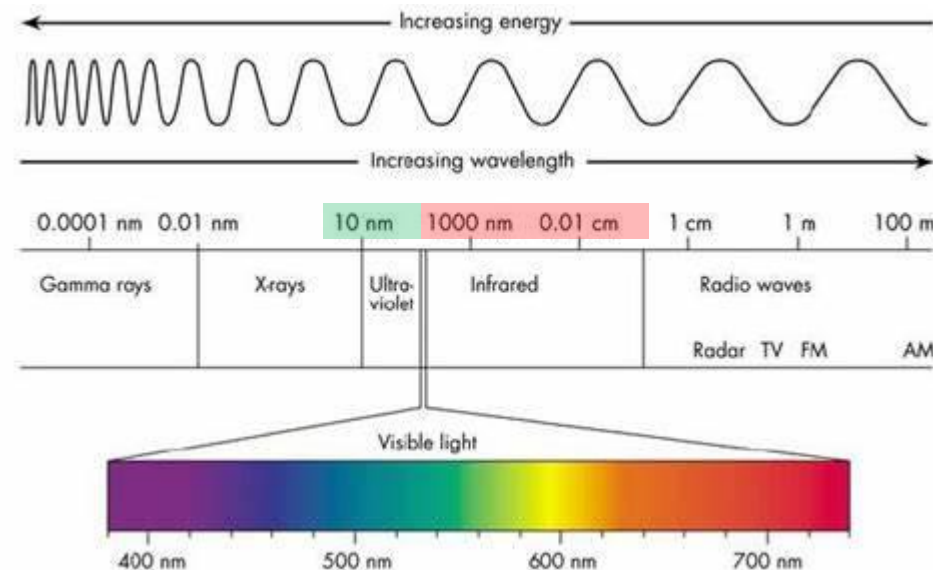
The Compound Light/Optical Microscope (OM)

- Reflection of photons off a surface yields a true color image
- True color with large fields of view
- Max magnification is 1,000X (10x100)
- Limited depth of focus causes image blur from out of focus planes



The Microscope Maker's Rule

- You cannot look at things smaller than what you're looking at them with
- Examples:
 - Optical techniques: 400-700 nm lateral resolution limit of $\sim 0.2 \mu\text{m}$
 - SEM: wavelength of electron, more importantly, spot size of electron beam
 - AFM & Profilometer: end radius of tip/stylus



Nanotechnology Window
1-100 nm

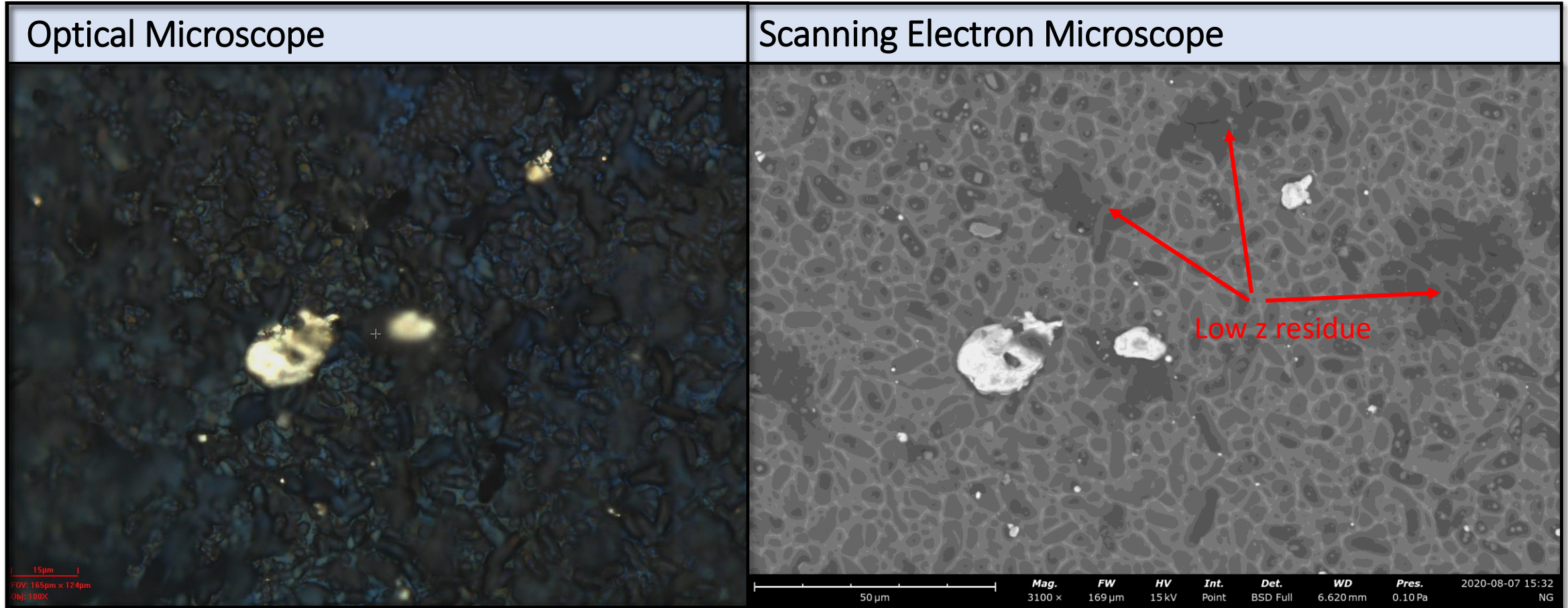
The Scanning Electron Microscope (SEM)

- Interaction of an electron beam with a surface provides an image
- Grayscale with large fields of view and best in class depth of field
- Wide magnification range. Tabletops up to 300,000x
- Elemental Identification also available



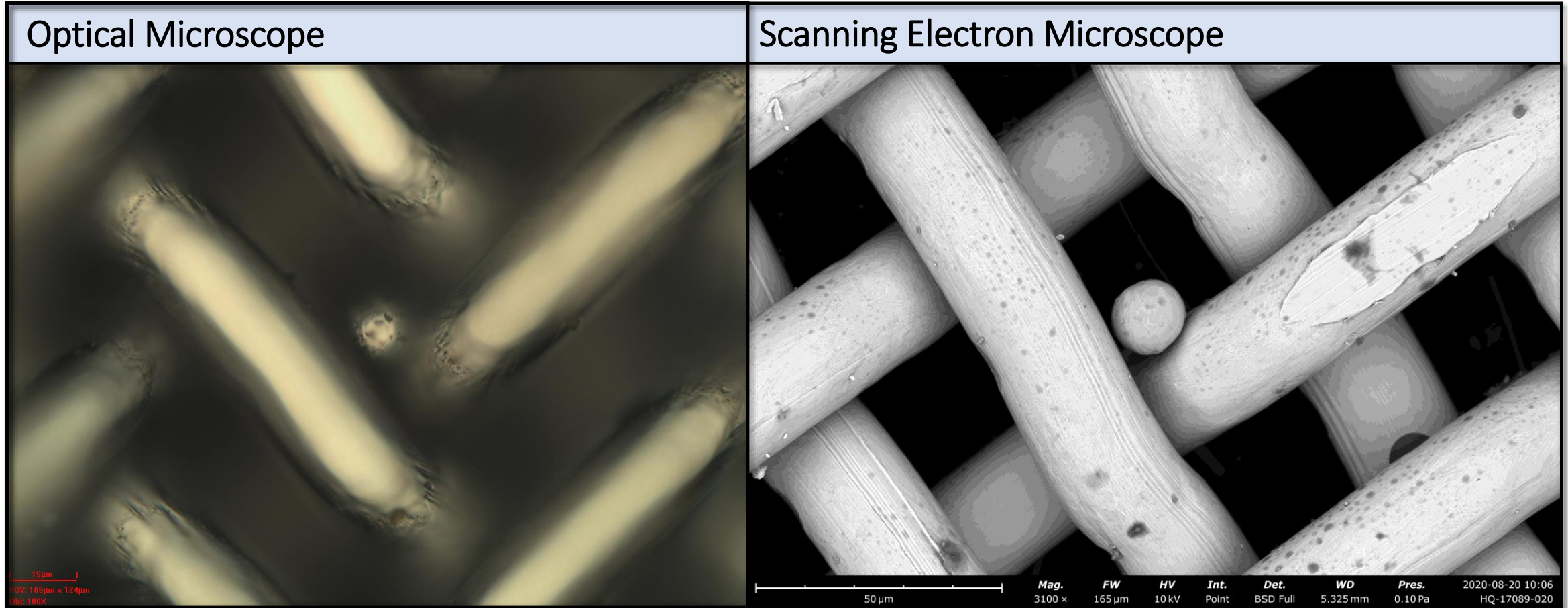
New Phenom Desktop SEM UI is ideally suited for remote access

Comparing OM to SEM in Practice



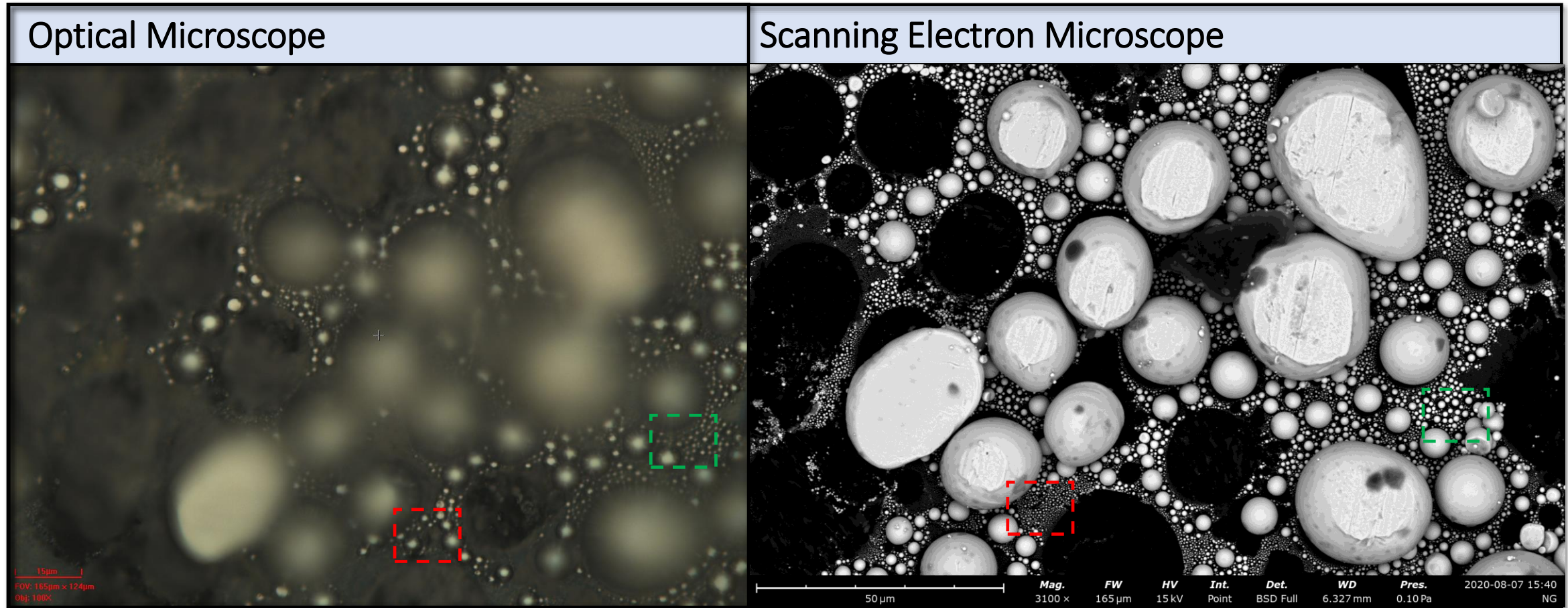
- Optical microscopy provides a true color image while SEM provides a range of grayscale values
 - SEM's z-contrast provides value added in a variety of applications

Comparing OM to SEM in Practice



- SEM offers best in class depth of field
 - Increased depth of field enables rapid inspection over large lateral areas.
 - SEM is *very* commonly used as a defect inspection instrument.

Comparing OM to SEM in Practice



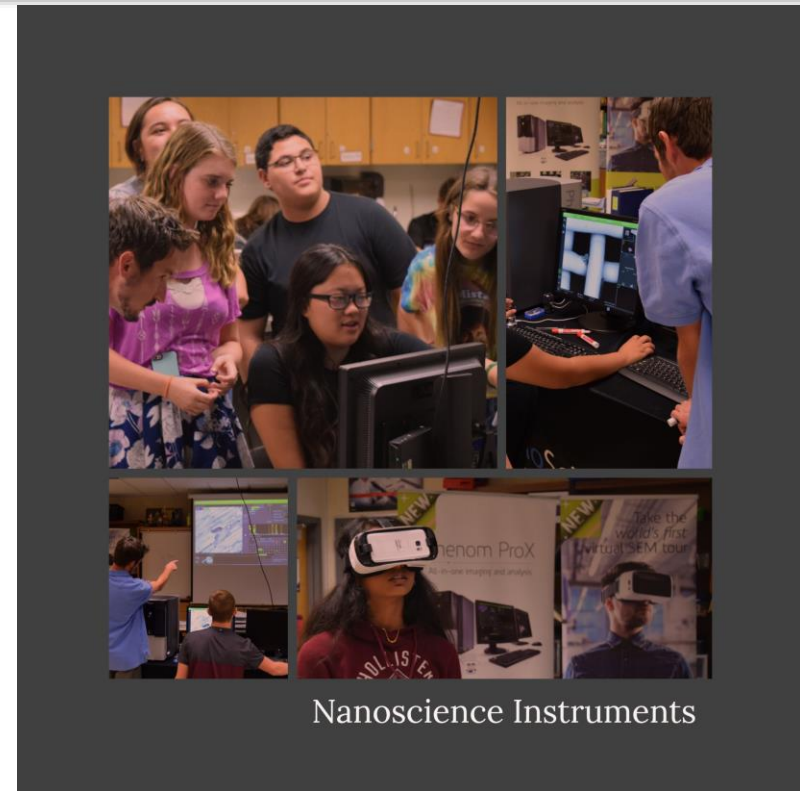
- SEM offers substantially higher resolution than OM
 - The ~1,000x-20,000x range opens a vast array of applications for SEM
 - Big picture: putting SEM on the resume is valuable to the student

Comparing OM to SEM in Practice

Optical Microscope

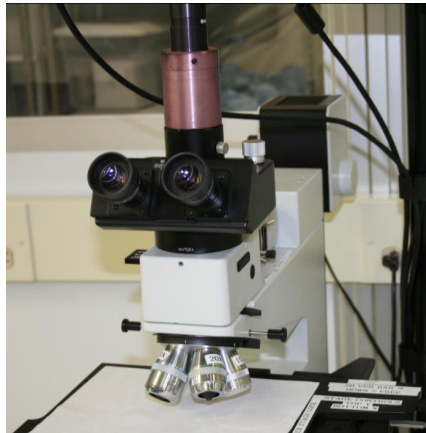
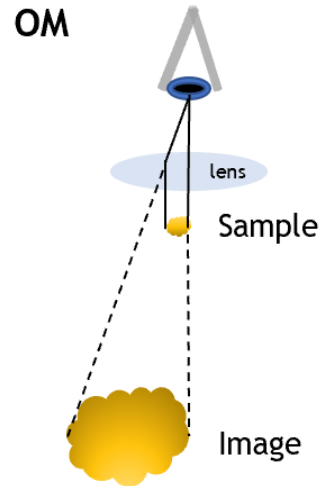


Scanning Electron Microscope

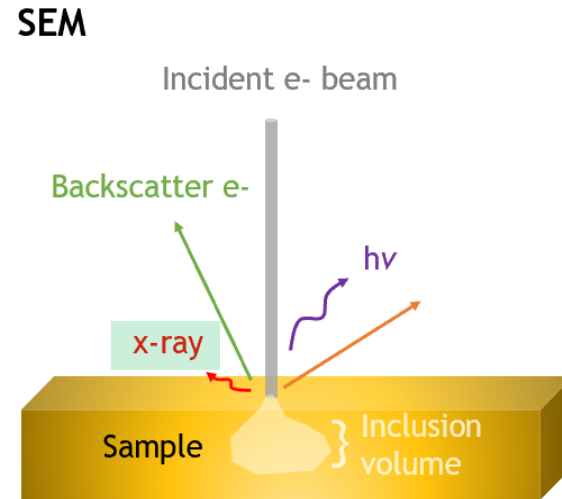


- The Phenom desktop SEM is user friendly from a K12 level through PhD

Summary: OM vs. SEM



Common in classrooms



Recently enabled in classrooms
(in person and remotely)

Comparison Table

Parameter	OM	SEM
Imaging Source	Photons	Electrons
Detector(s)	Eyepiece, Camera	BSD, SED, X-Ray
Ease of use	High	High
Throughput	High	High
Dedicated Operator	No	No
Max magnification	1,000x	>300,000x
Typical Max Resolution	~200 nm	~8 nm
Vacuum	No	Yes
Elemental Contrast	No	Yes
True color	Yes	No
Depth of field	Low	High

What has enabled SEMs to be more ideally equipped for remote access?

Towards Remote SEM Operation

Wishlist for remote operation

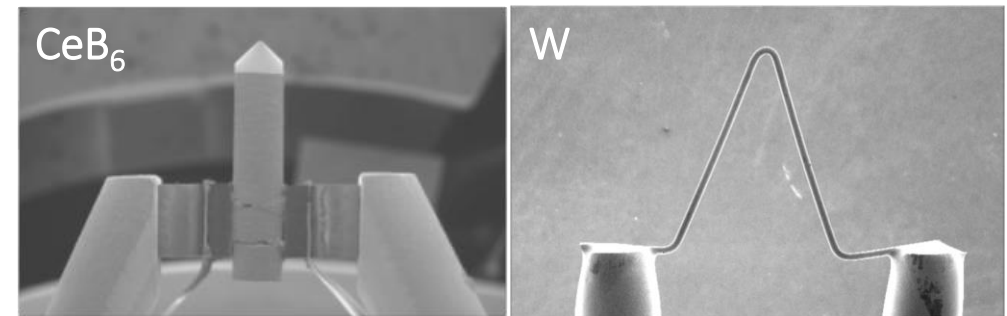
- No hardware controls
- Simplified software interface
- Automatic functions
- Single software package
- Easy data exporting and sharing

Phenom's ease-of-use features

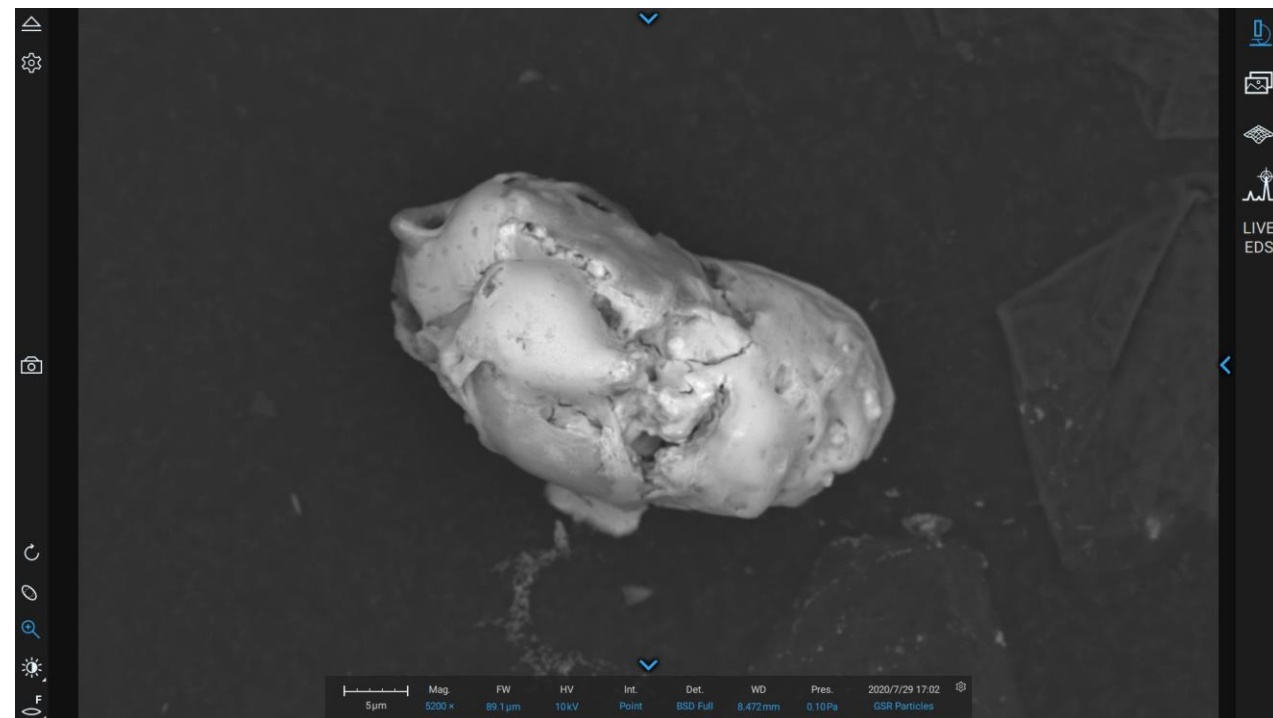
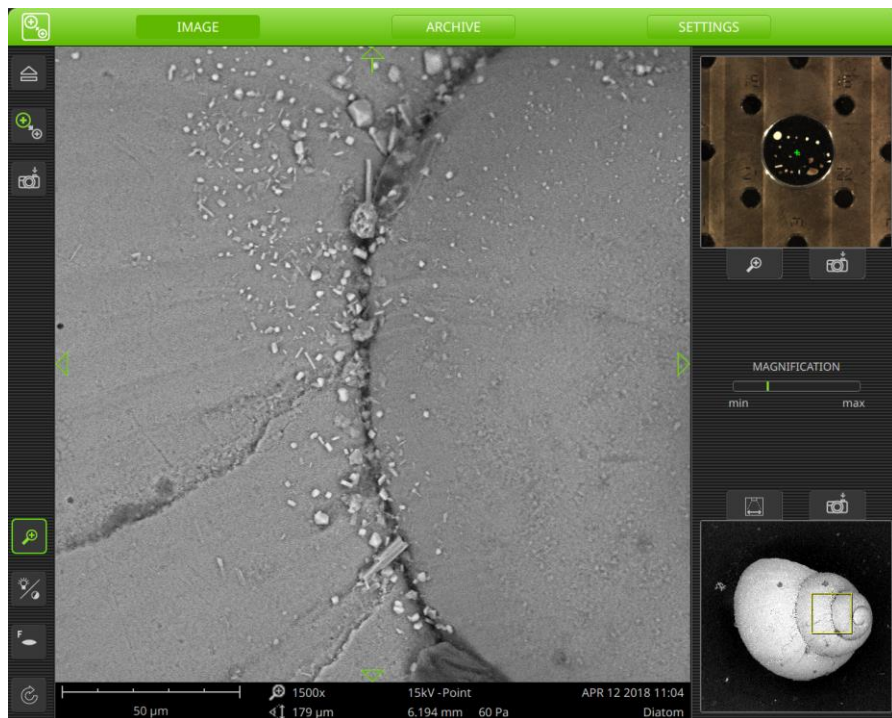
- ✓ No hardware controls
- ✓ Simplified software interface
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Phenom XL SEM: Remote Attributes

- Large sample stage: up to 36 samples
- User Friendly & User Proof
- Ultra Bright CeB₆ Source
 - Positive 'simple' user experience
 - Stigmation rarely required
 - High image quality even for novice users
- Simplified software interface



Phenom Desktop SEM UI Makeover



Old UI

- Developed for original Phenoms in 2006
- 3000+ systems (world's most popular SEM)
- Linux-based, runs directly on SEM

New UI

- Ground-up redesign, release in 2020
- Incorporated LOTS of user feedback
- Runs on Win 10 PC
- Integrated EDS, image stitching, etc.

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Live Demonstration



Questions?

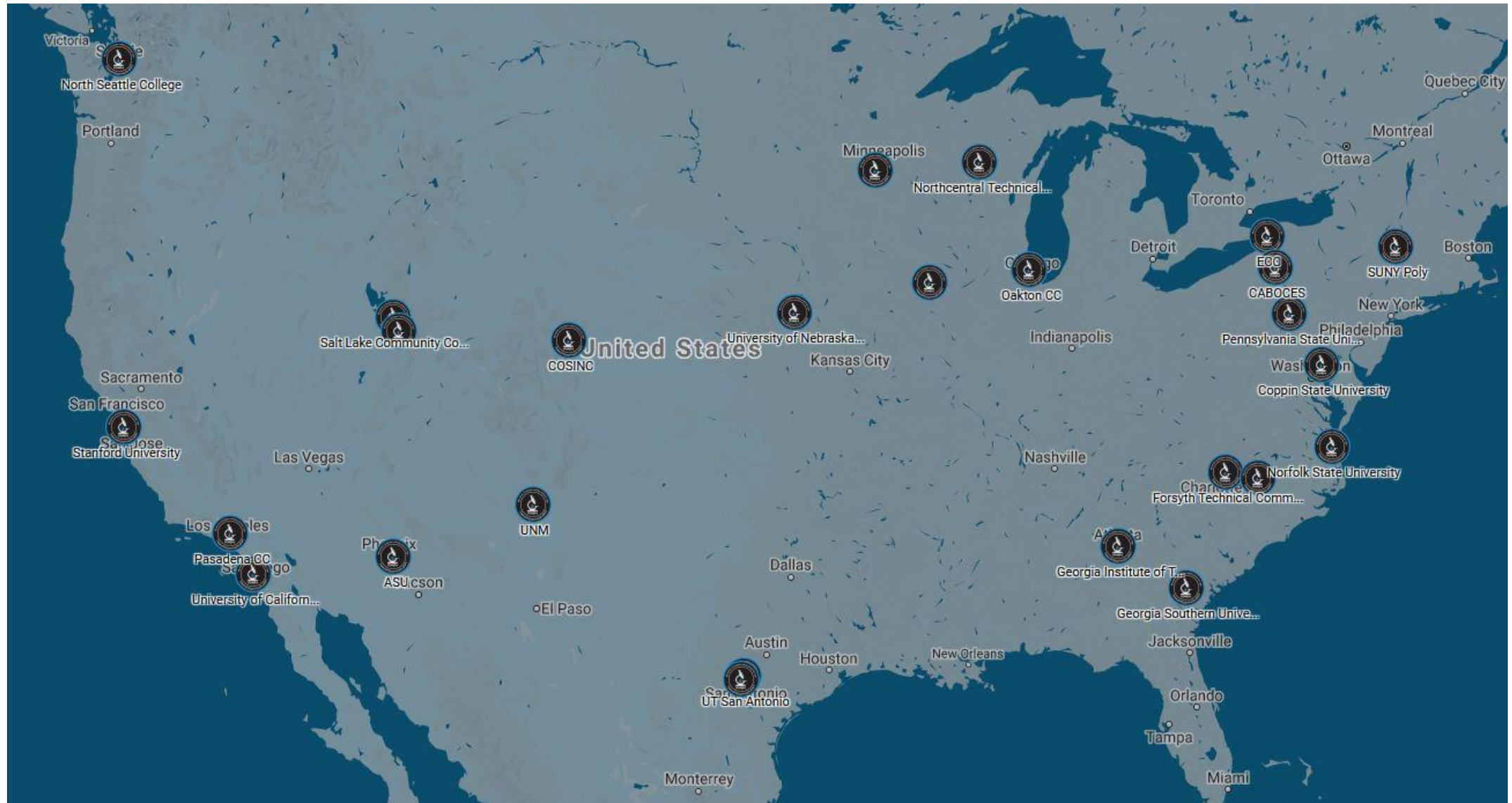


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<http://www.nano4me.org/remotearchive>



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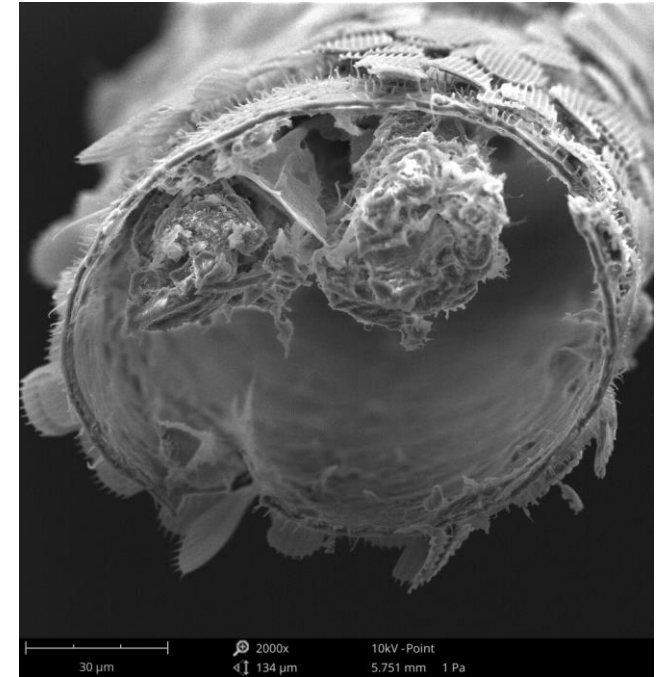
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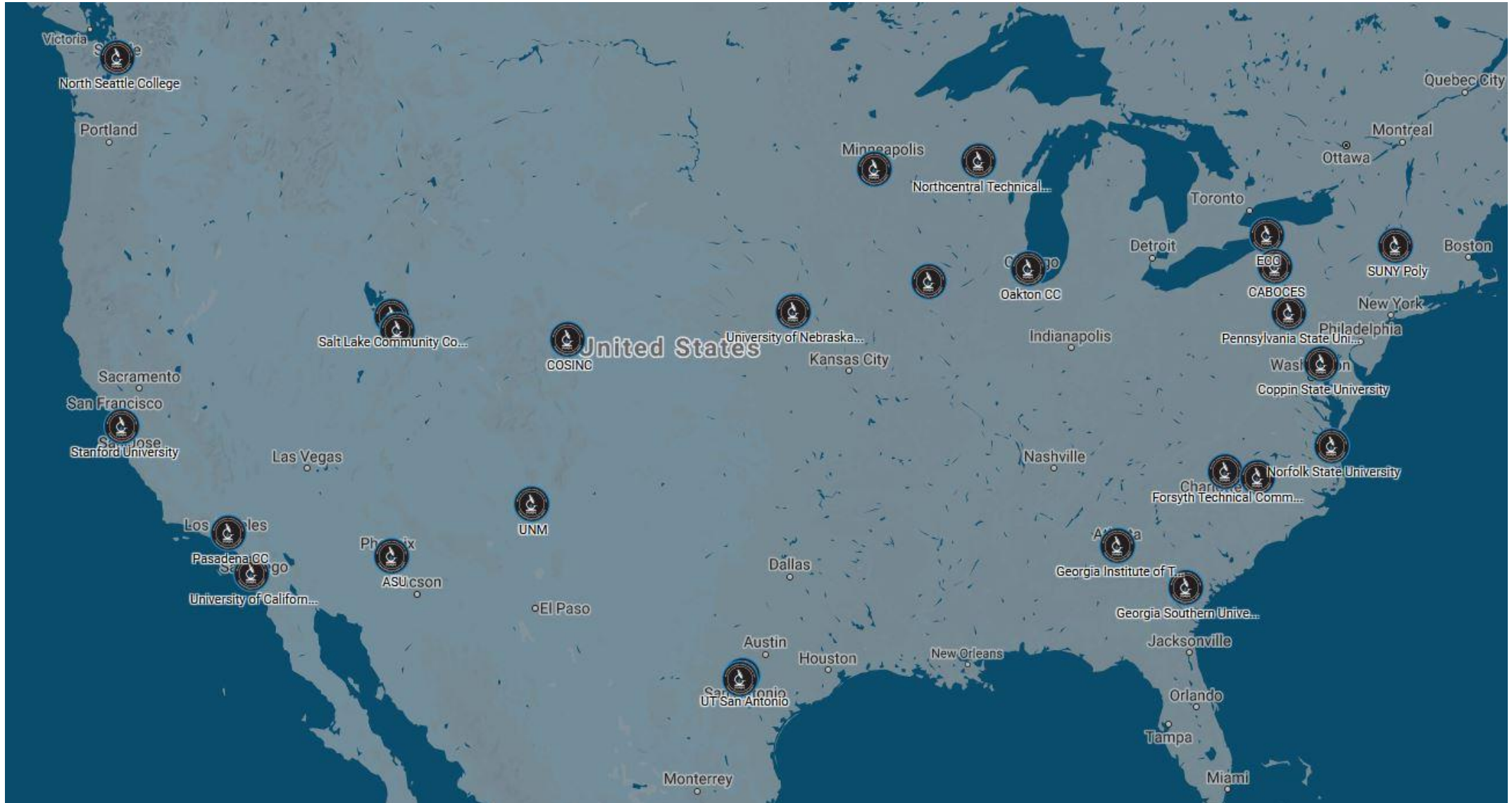
- Remote access already widely used across the nation
- With uncertain times ahead remote learning expected to become even more prominent
- SEM expands on the ability of basic light microscopy while maintaining its most desirable features
- SEM offers a variety of rich learning experiences technically
- For more information on using the Phenom SEM please feel free to watch our recorded webinar on exclusively this topic: <https://bit.ly/38simEK>



Cross section of mosquito leg

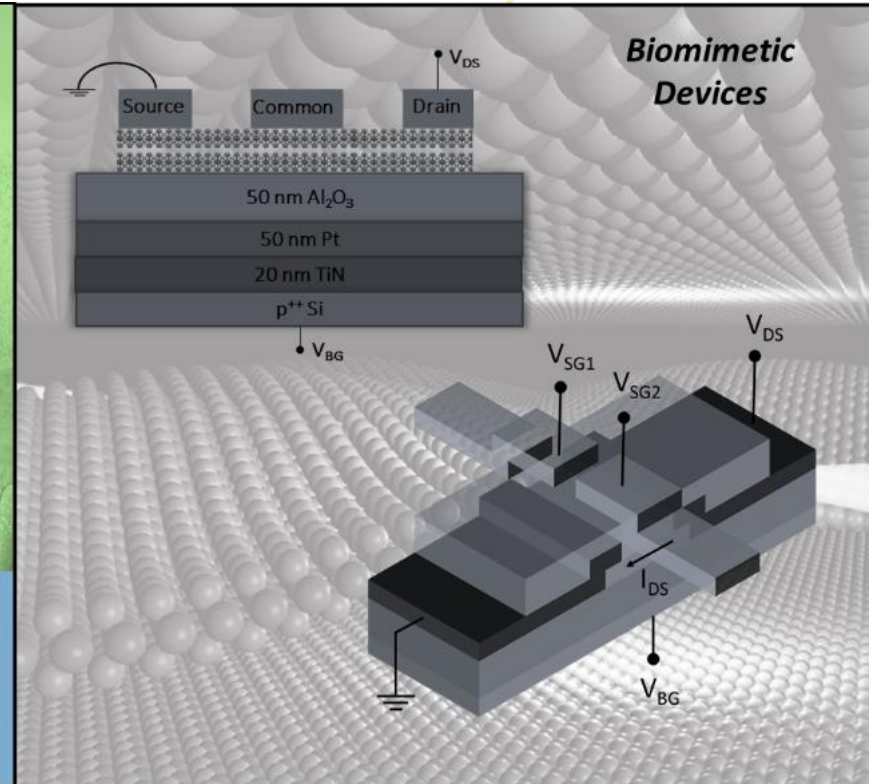
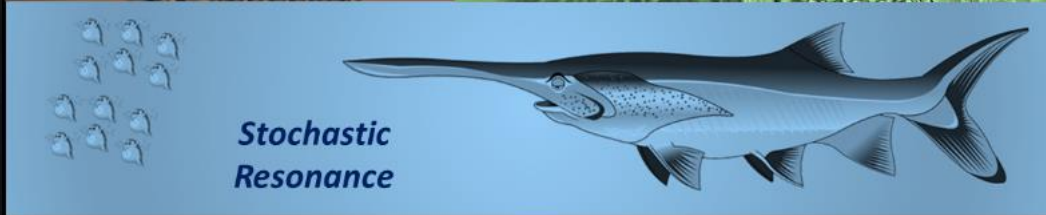
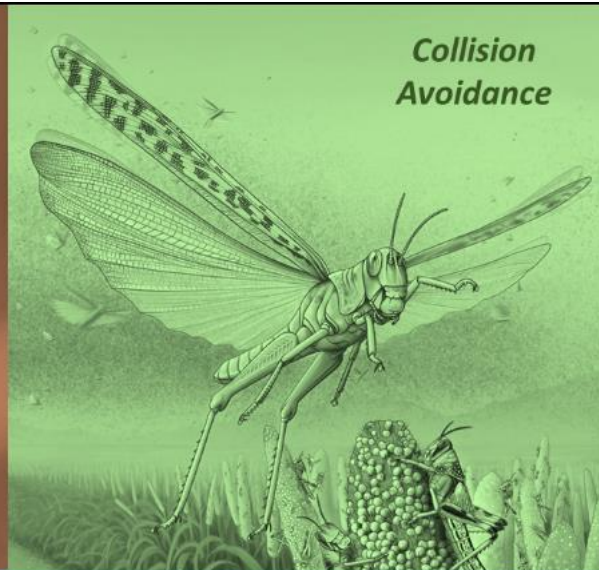
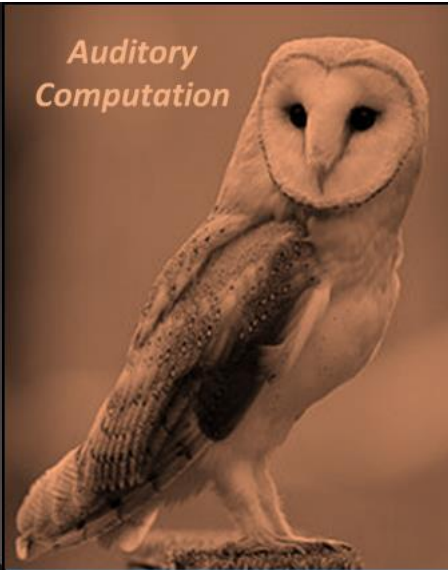
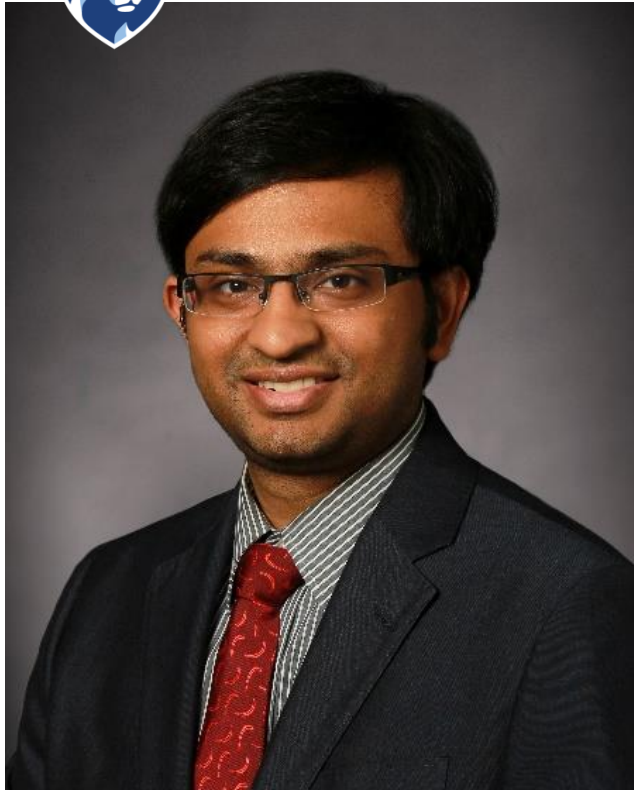
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Upcoming Webinar: January 28, 2021, 1 pm EST
***Novel Two-dimensional (2D) Materials and Devices
for Biomimetic Sensing and Computing***

<https://cneu.psu.edu/news>

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