

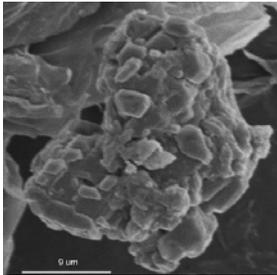
Student Impact—Alumni / Lab Assistant

Brian Jacobs

I am an alumna of the Nano Program at North Seattle College. I worked for a year as a Lab Assistant at the Nanotechnology Lab. One of the skills I learned was running Remote Access sessions. With my help, the R.A. client used TeamViewer to connect to and take control of our instruments, the most popular being our Scanning Electron Microscope (SEM).

We conducted two main types of sessions:

- One was educational, for schools and colleges. A session started with a brief explanation of the technology, followed by a guided hands-on session for each student. They piloted the machine and performed zooming, focusing and image capture on samples they had previously sent us. I prepared and mounted their samples on SEM stubs beforehand and loaded the samples into the SEM chamber prior to running each session. The thrill of a young student when they see the piece of snakeskin they sent in magnified 7500 times is palpable and electric.



- The other was for industrial clients. They sent in samples of industrial products for elemental analysis. I prepared and mounted the samples and scheduled a remote session. During such a session, I would drive the machine under the client's direction. Local companies found this service valuable, but it was even more valuable to me, as a student of the program. I saw several commercial uses of an SEM and interacted with scientists, engineers, inventors, and business people. I was offered a job before I had even graduated.

Remote Access sessions provide an invaluable service as an educational tool, and as a bridge between North Seattle College and local Industry.



RAIN @ HI-TEC



LET US KNOW

We hope you enjoyed this edition of the RAIN newsletter. We look forward to sharing our news and updates. We would really like to hear from you, if there is some subject or topic that you would like us to discuss or look into please let us know. You can also contact any member of the RAIN leadership team if you would too would like to become a RAIN partner. Visit us on Facebook, <https://www.facebook.com/nanotechnology.rain>.

Regards,
The RAIN Leadership Team



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The NACK Network, in the Penn State College of Engineering, is committed to supporting the development of two-year degree programs in micro and nanotechnology across the country by offering academic and educational resources.



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NANOWIRE

RAIN's Quarterly Newsletter



RAINDROPS

The Remotely Accessible Instruments for Nanotechnology (RAIN) Network is continuing to grow. With the recent addition of SUNY Poly, RAIN now has 15 providers (seven at community/technical colleges, seven at universities, and one secondary school district) that are ready to provide remote access experiences to classrooms, as well as other outreach venues across the country. Several more institutions are presently in the process of being added to our growing network. Two of the 2017 partner additions, The Research Triangle Nanotechnology Network (RTNN) and The Support Center for Microsystems Education, are featured in the "New RAIN Partners" section later in this newsletter.

What type of impact does a remote access experience have on students in the classroom? That is an excellent question! Jared Ashcroft of Pasadena City College attempted a response. He undertook a spring 2017 classroom study in partnership with several RAIN providers from across the country. You can read more about the results of this study, as well as the follow up plans, later in this newsletter.

RAIN providers were very busy in July in Salt Lake City. In addition to providing several successful RAIN-centric sessions and workshops at the MNT and High Impact Technology Exchange (HI-TEC) Conferences, 10 RAIN sites joined together to provide continuous live remote access sessions to conference attendees throughout 12 hours of the HI-TEC showcase.

The RAIN Network again plans to participate in the October 9 National Nanotechnology Day Activities. The National Nanotechnology Coordinating Office (NNCO) is spearheading the celebration, which includes a variety of community-led events and activities to raise awareness of the significance and importance of nanotechnology. On October 9 from 1 pm to 3 pm, several RAIN partner sites will host the "America Looks into the Nano World" activity, which will provide simultaneous remote access demonstration sessions to classrooms across the country. You can pre-register via the [RAIN open house page](#) or call 814-863-2955 to join a session during the event.

If you would like to learn more about bringing RAIN into your classrooms, please visit our [website](#). We are continuously looking for ways to improve and expand the RAIN network, so please contact us. Be sure to check us out and like us on [Facebook](#), where you can find more exciting news about the nano-world.

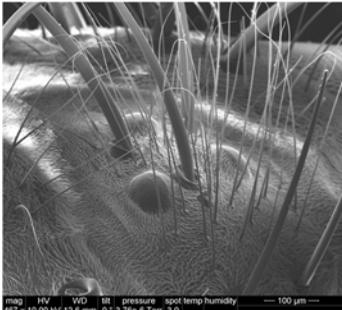


September 2017

NEW RAIN PARTNERS

Research Triangle Nanotechnology Network (RTNN)

The [Research Triangle Nanotechnology Network \(RTNN\)](#) formed in 2015 as one of 16 sites in the National Nanotechnology Coordinated Infrastructure. It is a partnership between North Carolina State University, the University of North Carolina at Chapel Hill, and Duke University. Collectively, these institutions are home to nine core nanotechnology facilities and over 100 principal faculty. The vision of RTNN is to enable innovative nanotechnology research and education through (1) open access to cutting-edge facilities, (2) engagement of diverse faculty and user populations, and (3) creative education and outreach programs.

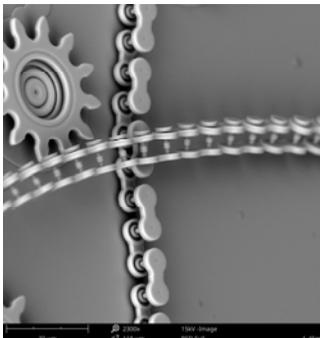


SEM image of a fly ocelli captured during a remote access session between RTNN staff members and seventh graders at Orange Charter School in Hillsborough, North Carolina.

In addition to remote access of instruments through the RAIN network, RTNN has several other outreach programs. A hands-on nanotechnology workshop for community college educators is offered every summer. RTNN's Kickstarter program provides support for non-traditional users to access nanotechnology facilities. Through the Coursera platform, "[Nanotechnology, A Maker's Course](#)," will be launched this fall. The course aims to introduce students to nanotechnology equipment through engaging video demonstrations in RTNN facilities. In addition, RTNN staff have developed nano-themed lesson plans for students of all ages. For more information about RTNN's programming, please visit our [website](#).

University of New Mexico—Support Center for Microsystems Education (UNM—SCME)

The [Support Center for Microsystems Education \(SCME\)](#) is located in Albuquerque, NM at the University of New Mexico's Manufacturing Training and Technology Center (MTTC). The MTTC's cleanroom allows students and educators the opportunity to learn how microsystems are fabricated by making a micro pressure sensor. The SCME provides hands-on kits with parts made in the cleanroom and holds multi-day fabrication workshops. The Center also provides online education and materials for downloads for educators and students as well as a [YouTube channel](#) with short lectures and animations.

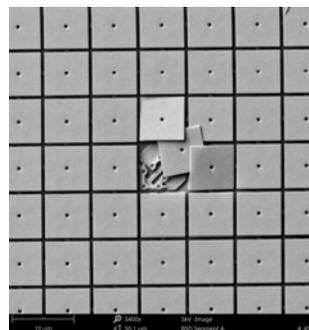


One of the "coolest" images SCME has acquired by a technician student as part of the MEMS Design competition sponsored by Sandia National Laboratories. The chain links are 11 microns, which means it takes 10 links to span a human hair.

SCME recently joined the rain network to offer educators the opportunity to interact with the Phenom Pro scanning electron microscope with EDS capability. We are reaching out to area K-12 partners as well as local microsystems companies to enable a cost effective method of characterization and analysis. In addition to providing the remote access capability, the SCME has developed a metrology mask design and samples for Rain participants. These 1 cm square chips were given out at the recent HI-TEC conference during the Micro Nano Tech special interest group session this last July.

SCME has a variety of MEMS devices that can be explored as part of the remote access activities and plans on acquiring many more to add to the gallery. MEMS are found in almost everything including your smart phone, smart watches, fitness trackers, cars, and the like - they provide your smart devices with the sensors they need to interact with the world. It is predicted that there will be over 1 trillion MEMS sensors connected to the internet of things by 2020!

The Digital Mirror Device (DMD) chip, made by Texas Instruments, are used in projection systems from the large scale systems found in today's movie theaters, to classroom projectors and even the pico projectors found in cell phones. Depending on the application, there are between 800,000 and 12,000,000 individually addressable mirrors on each chip. The 10-20 micron square individual mirrors can switch on and off thousands of times per second.



STUDENT IMPACT

Using RAIN in Conjunction with Problem-Based Learning to Promote Student Success

Jared Ashcroft and Brandon Rodriguez

Pasadena City College has been working with twenty-five Los Angeles area schools to implement remotely accessible instruments, specifically, scanning electron microscope (SEM) and electron dispersive spectroscopy (EDS) into K-12 classrooms through the RAIN Network. The remote technology was implemented concurrently with a problem-based learning (PBL) laboratory using geology and chemistry experiments to identify an unknown mineral sample from Death Valley.

Dr. Brandon Rodriguez, from the Educator Professional Development Collaborative at the Jet Propulsion Laboratory, has been instrumental in developing the lab and implementing in K-12 classrooms says:



Students investigating physical property of unknown mineral sample.

Over the past year, I have been very impressed with how the RAIN program could be implemented in K-12 classrooms. We have had great success in the past implementing NASA resources in schools, bridging earth and space science. However, thinking about the phenomena-based next generation science standards (NGSS) practices, having a real-time analysis connected to our lab activities has elevated our impact. For example, earlier this year we ran a geology lab based on NASA's Mars Sample Return program. Students explored rock samples based on the idea that a Martian rock sample send from Mars back to Earth. When students determined the nature of their sample, they were able to dial into a RAIN lab

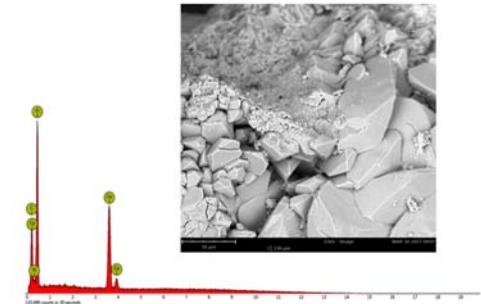
with the same sample and given the opportunity to interact with the technician, validating their conclusions. The live connection to scientists, especially in schools without easy access to scientific institutions, has given students a unique chance to interact with representative, collegiate science.

Students from each school RAIN and PBL were used were surveyed. From the data, it was clear the biggest impact from the lab was the remote SEM experience. They were able to use the imaging and elemental analysis to validate their limestone sample correctly. Especially of interest was the clear impact that the RAIN Network had on increasing the interest in science for underrepresented students, whom previously did not show any passion for obtaining a science degree. During the next year, we will continue implementing more RAIN labs into K-12 education and investigate the impact these labs have on student success.



Students using the RAIN Network to investigate mineral samples.

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SEM image and EDS Elemental Analysis of limestone sample obtained during remote session with K-12 students.

Student Impact—High School

Shrey Aeron, 10th grade

"Last year, we had the awesome chance of controlling a Scanning Electron Microscope (SEM) right from our very own classroom! Our job was to inspect strands of hair that Mrs. Baker (our teacher) had collected from a few different classmates and mailed to North Seattle College, where they were prepared for imaging. Until then, we had only seen samples under an SEM, but this time around, we were going to be the ones behind the magic. How cool was that?! We were trying to figure out which classmate was the "thief" by comparing their hair samples to the one "whodunnit". It was really intriguing to see the real-life use of the SEM in a forensic science application. Although we weren't there, it felt like we were the scientists, closely inspecting different parts of the hair, measuring the width using the ruler tool, and describing each sample's physical properties. This really made me interested in what we would see if we zoomed in even more, such as using a Transmission Electron Microscope (TEM). Would it help us examine the sample better?"

"The remote session revealed the vast world of applications for this scientific tool. Its use could range from biomimicry research to making cool looking art (anyone?). I strongly believe this is just the beginning of the world of nano, which might quite possibly help us seamlessly transition into the quantum universe."