NanoGrande: electron microscopy pedagogy and outreach by a collaboration of scientists and artists

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We will describe a project bringing together undergraduate students from nanotechnology and visual arts, faculty in engineering/science and the visual arts and members of the Capital District Microscopy Microanalysis Society to collaborate on electron microscope pedagogy and outreach using art-science. Strong focus was placed on both the scientific and the artistic aspects of the imaging, something which allowed us to juxtapose and discuss disciplinary perspectives while at the same time implementing a pedagogical capstone event that reinforced material covered in a series of weekly laboratories on electron microscopy physics and operation. Thirty-two undergraduates taking Frontiers of Nanotechnology or Photography courses collaborated on putting together the art-science show. Students from the nanotechnology course brought to the collaboration information about scanning electron microscopy imaging technique and sample preparation acquired through weekly hands-on laboratories with the instrument. Students from the photography course brought experience on image composition and aesthetics to the table, and shared these insights with the nano students. The students worked together to image materials both directly related to the nanotechnology course, such as carbon nanotubes, electrospun fibers and clay nanocomposites with embedded quantum dots, as well as samples from everyday life (bees, sandpaper, etc.). This project brought together thirty-two students from a wide range of majors: Chemistry, Biology, Electrical Engineering, Computer Engineering, Mechanical Engineering, Bioengineering, Psychology, Neuroscience, Sociology/Social Sciences, History and Visual Arts. The students cumulatively worked 150 hours with the SEM in groups of two or less in order to complete the preparatory laboratories and acquire the final images. Eighty people gathered for the public event organized in collaboration with the Capital District Microscopy and Microanalysis Society (CDMMS), which included a colloquium on electron microscopy and art-science by Bowser and as well as a talk from the artist’s perspective by documentary photographer Bubriski. CDMMS members interviewed the students, ranked the images based on a set of specific criteria, and provided direct feedback through discussions with the students. Two faculty members from Union’s art department judged the images from the aesthetic points of view. Different sets of winning images were selected independently by the two professional groups. Following the event, selected student work was exhibited in the Wikoff Gallery for several weeks. The images are currently being incorporated into community outreach programs in collaboration with the Kenney Center at Union College.

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Fig. 1. Artist’s Statement: Working with the SEM has presented me with a new horizon in my exploration of the visual world as a fine art and documentary photographer. I have always considered the camera and photography as tools for creating bridges of understanding between the viewer and the visual realities of our world. Photography can stir our curiosity by presenting us with new ways of seeing the familiar as well as familiar ways of encountering the unknown.

As a documentary photographer who for years photographed throughout the Himalayas I was fascinated by how the SEM allows us to see the real world in ways that go beyond our regular visual encounter with our environment. The SEM technology lets us view the sample specimen from above as if doing aerial reconnaissance and then drop down onto the surface of the sample with an intimacy of exploring an unknown intriguing landscape on foot.

For a number of sessions at the SEM I have explored one honeybee. Through the visualizing technology of the SEM the honey bee has become an entire world of exploration with landscapes that change from what appear to be fern or bamboo forests to thorn thickets of the bee's abdomen to broad expanses of spiked landscapes of the bee’s wings. When I navigate the surfaces of the honey bee in search of compelling and beautiful visual compositions I cannot help but think of the photographic landscapes of Edward Weston, Ansel Adams and Paul Caponigro, the drawings of Albrecht Durer and Leonardo da Vinci, or the accomplished artful drawings by one of the very first microscopists Robert Hooke.

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