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Democratizing the Micro-Scale: A Simplified, Miniaturized SEM for K-12 and Informal Student Scientists

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Learners in K-12 schools and informal learning environments have historically had significantly less access to critical technologies than practicing scientists. They can observe pollen grains in basic light microscopes while studying plants, but cannot observe the surface structures that affect the pollens' dispersal. They can learn about structure-function relationships in insect anatomy, but not observe mechanosensory bristles on the eye of a fly they caught in their own classroom or learning space, nor the nanostructures enabling moths to hang upside-down on the ceiling. While today's student scientists have access to a great wealth of micro- and nano-scale images via the internet, they have so far been unable to take those images themselves. For K-12 student scientists and informal learners, direct observation of a great range of scientific phenomena has been impossible.

Using a new scanning electron microscope (SEM) called Mochii™ developed at Voxa in Seattle, WA, specifically designed for simplicity of use by non-specialists, students at The Evergreen School and at HiveBio Community Lab have begun directly imaging their own samples to personally observe scientific phenomena previously inaccessible via standard classroom light microscopy. (Fig. 1 & 2)

Having a high-resolution microscope in the classroom or informal learning environment permits much deeper exploration on the part of the students, rather than simply being passively presented with information and evidence from other sources. Working with this new technology is both highly engaging and accesses deep learning mechanisms through active learning. As more and more evidence is presented that active learning results in deeper conceptual understanding for learners[1], opportunities such as directly imaging one's own collected and prepared specimens become clearly beneficial to improving learning outcomes. Education researchers have further found that using real-world examples, and finding direct relevance and influence of the concepts they study, leads to greater learning outcomes and confidence for girls in their science education.[2] Personal preparation of students' own samples also leaves room for critical mistake-making and improving from those mistakes, as well as individual student-driven comparisons.[3] Pollen from different flowers, proboscises from different insects, root hairs from plants grown in different conditions demonstrate the great range of structures and strategies in the natural world that nature has optimized over millions of years of earth's history. A classroom SEM offers direct access to all of these structures for deeper science learning.

At Microscopy and Microanalysis 2015, we will present examples of learning opportunities developed utilizing the Voxa portable SEM, as well as SEM images taken by students of samples prepared and loaded by those students.

References:

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Figure 1. A 7-year-old student scientist exploring pollen grains in the Mochii™ via iPad interface.

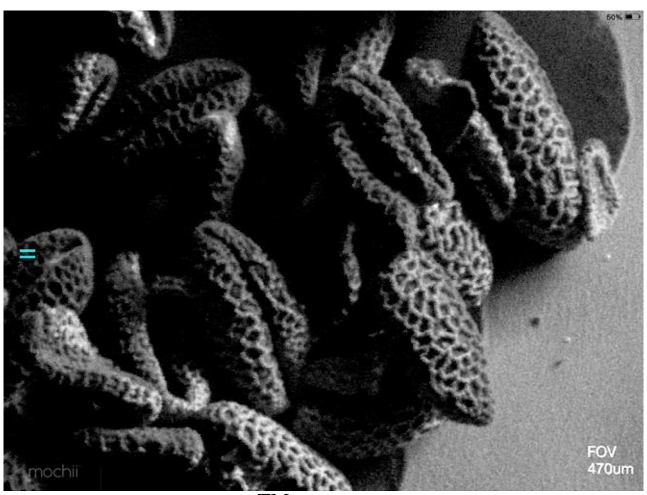

Figure 2. A Mochii™ image taken by the student scientist in Fig. 1.

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