

Focus on Success: Teaching Scanning Electron Microscopy at the Community College

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A Scanning Electron Microscope (SEM) is a technological asset typically reserved for the sole use of graduate students or research faculty. Can the SEM serve as a catalyst for sparking interest in STEM disciplines? Is it an effective teaching tool, and will electron microscopy students be successful without pre-requisites? Teaching scanning electron microscopy at Schoolcraft College has been applied to strengthening basic science and critical thinking skills, fostering partnerships, and stimulating student interest in research and industry careers.

Schoolcraft College is a community college located in Livonia, Michigan. The total student enrollment tops 39,000. Schoolcraft serves the southeastern Michigan counties of Wayne, Oakland, Washtenaw and primarily surrounding Detroit suburbs. It serves as a feeder school for University of Michigan-Dearborn, Wayne State University, Eastern Michigan University, Madonna University and Lawrence Technological University.

In 2006 construction began on a new 48,000 sq ft Biomedical Technology Center. Working interdepartmentally, the Sciences and Business & Technology Divisions proposed a scanning electron microscope for use by natural sciences, materials and metallurgy courses. Purchase and installation of a Zeiss EVO LS-15 was completed in September 2008, ready in time for fall classes. The Imaging and Analysis Laboratory was designed so the microscope would be a central feature of the classroom. The unique lab floor plan allows for both lecture delivery and collaborative work by incorporating group areas and front-facing seating. Media outputs and the large-format data projector facilitate presentation of SEM images and the microscope control software interface to the entire classroom.

The microscope specifications include a variable pressure system, an electronically cooled specimen stage and chamber humidity injection that optimizes it for life sciences work. In addition, a large 15" chamber was specified by the materials science faculty for use by the metallurgy courses.

The microscope was incorporated into the curriculum through development of Biology 140 Scanning Electron Microscopy. The BIOL 140 course introduces students to techniques necessary to prepare organic and inorganic specimens. Students also become familiar with the principles and operating modes of the SEM and the x-ray analysis system, electron-specimen interactions, image processing, elemental analysis, effects of microscope variables on images, routine maintenance and

the use of various microscope accessories and digital outputs. There are no pre-requisites for this course and maximum class size is 12.

The course is designed using performance based learning. Specific competencies are identified; performance standards are clearly stated and are made known to the learner in advance. The learner practices, then performs the competency and is assessed against a pre-set standard, not against other learners.

A typical SEM class session involves:

- Detailed briefing of the daily learning objectives and activities
- Lecture and demonstration
- Individual and collaborative learning activities
- Performance Assessment scored using a rubric
- Feedback to student

In addition to exams and lab assessments, students also complete a capstone project. The project synthesizes skills and knowledge and emphasizes development of a line of scientific inquiry. The project requires exercising various modes of SEM operation, technical skill and judgment. The outcome is an electronic portfolio of their SEM images and narrative which is presented to the class.



FIG. 1. Students using the Zeiss EVO LS-15 microscope.



FIG. 2. The SEM facilities at Schoolcraft College.