Multidisciplinary microscopy course for undergraduate research students in the Natural Sciences

Brittani D. McNamee\textsuperscript{1} and James Perkins\textsuperscript{2}

\textsuperscript{1}Department of Environmental Studies, University of North Carolina Asheville
\textsuperscript{2}Department of Physics, University of North Carolina Asheville
UNCA Microscopy Courses: A Brief History

2004: SEM purchased through NSF MRI/RUI grant

2005 – 2012: SEM prep and Forensics courses taught by Bill Miller (ENVR) and Herb Pumphrey (BIOL)

2013 – present: “Methods in Microscopy”, 1-credit SEM prep course taught in Fall by Dr. Langille (ENVR), Dr. Perkins (PHYS), and/or Dr. McNamee (ENVR)

Fall 2016: “Methods in Microscopy” expanded to 3-credits and include instruction of light microscopy and X-ray diffraction
## “Methods in Microscopy”

<table>
<thead>
<tr>
<th>1-credit course</th>
<th>3-credit course</th>
</tr>
</thead>
<tbody>
<tr>
<td>does <strong>not</strong> count towards instructor course load</td>
<td>does count towards instructor course load</td>
</tr>
<tr>
<td>meet for 3-hr lab for 1&lt;sup&gt;st&lt;/sup&gt; 6 weeks</td>
<td>meet for 2.5 hr lecture and 2.5 hr lab each week</td>
</tr>
<tr>
<td>SEM</td>
<td>SEM and other electron microscopes, XRD, and light microscope</td>
</tr>
<tr>
<td>assignments include portfolio, practicum, and presentation of research project at UGR symposium</td>
<td>assignments include lab worksheets, portfolio, practicum, project abstract, presentation of research given during Finals</td>
</tr>
<tr>
<td>6-9 enrollment with 1 student from Warren Wilson College</td>
<td>13 enrollment</td>
</tr>
</tbody>
</table>
UGR Projects using SEM

- Identification of minerals in sulfide body within granite host at North Buncombe Quarry in Western North Carolina. M. Daniels and B. Governo (2017)

- Mapping garnet compositions in the Ashe Metamorphic Suite to show garnet thermal history. J. Corradino (2017)

- Growing Silver Nanowires. P. Friel (2016)


- Mineralogical studies of medium to high grade metamorphic rocks at Mount Mitchell State Park, North Carolina, USA. A. Coburn (2016)

Calculate optimal resolution at different light wavelengths and accelerating voltages.
Course Assignments

Calculate $Z_{\text{avg}}$ of different materials in a back-scattered electron (BSE) image.

calcite $\text{CaCO}_3$
tremolite $\text{Ca}_2\text{Mg}_5\text{Si}_8\text{O}_{22}(\text{OH})_2$
talc $\text{Mg}_3\text{Si}_4\text{O}_{10}(\text{OH})_2$

photo by B. McNamee
Course Assignments

Calculate and compare weight percents of elements in minerals (ideal amounts) to observed peak heights in energy dispersive spectra (EDS).

spectra from Mineralogy and Optical Mineralogy textbook DVD by M.D. Dyar, M.E. Gunter, and D. Tasa (2008)
Course Assignments

Identify optical properties of quartz and an unknown mineral using a polarized light microscope.

photos by N. Brown
Course Assignments

Identify mineral phases from X-ray diffraction patterns using WebMineral’s online XRD peak database.

quartz from CrystalDiffract database
Course Projects

Scanning electron microscope parameters for imaging insects

T. Elliott (previous semester)
Course Projects

Identification of unknown blue mineral found in quartzite cliffs of Sauratown Mountains, NC Piedmont

N. Brown
Course Projects

Chemical analysis of lab sample of a kidney stone

T. Dawson
Course Projects

Cement and aggregate relationships in coal fly ash concrete

B. Strausborger
What exceeded our expectations?

• Explore interdisciplinary uses of each instrument.

• Explore integration of different analyses.

• Encourage students to work on a research project.
What were the challenges?

• Increased enrollment created large lab groups or lab groups rotating every other week.

• Increased problems with equipment (or decreased troubleshooting time between users?)

• Time/lab management for 13 students and 2 professors from 3 different departments.
What do we want to do in the future?

• Continue the interdisciplinary approach.

• Alternate offering 1-credit option and 3-credit option.

• Tweak course structure by incorporating “Kanban” concepts.

• Make the course sustainable at UNCA.
Thank you!