Science Research Experience for Teachers (SRET)
Laboratory Observation Protocol (LOP)

The purpose of this Laboratory Observation Protocol (LOP) is to document the behaviors and activities of teachers, graduate students and scientists in a university laboratory setting. The LOP uses a past process evaluation project for Charlotte Teachers Institute on scientist-teacher collaborations (Rios, 2016). Four themes from that evaluation will guide structure of the LOP: Mentorship, Collaboration, Scientific Engagement, and Curriculum Development.

Two parts: ENVIRONMENT and THEMES

PART I
ENVIRONMENT

Describe the laboratory environment including key participants, equipment, materials and overall laboratory setting. Also describe the structure of the participants' groupings including the roles defined for each person and/or group.

The key participants in this science research experience were a physics professor, Dr. Susan Trammell who served as the lead scientist, six CMS K-12 teachers, and Emma and Ethan, a fourth and a fifth year graduate student completing a Ph.D. in Optical Science and Engineering who led the program experience and served as mentors to the CMS teachers. The teachers were split up between graduate students in two groups of three for two distinct projects. One of the projects, led by Emma, consisted of developing a new process, Light-Assisted Drying, to preserve proteins in an amorphous trehalose glass for transport and storage at room temperature. The other project, led by Ethan, involved hyperspectral imaging for cancer research. The hyperspectral imaging group used a single lab space while the protein stabilization group used two different lab spaces. Key equipment and materials in the lab used by the protein stabilization group include a thermal camera, a 1064 nanometer laser, and the Raman spectroscopy system in the second lab space that was used. Key equipment and materials used by the hyperspectral imaging group include an 1850 nanometer laser, a spectrometer, an ultraviolet laser, and a single pixel camera.

As part of this experience, all teachers had their own designated lab notebook to document the progress of the research. Also as part of this experience, teachers created research posters. Every day before working in the lab, teachers would have a 15-30 minute meeting with Dr. Trammell to work on these posters collectively within each group. Teachers also received help and feedback from their graduate student mentor during this process.

Author's note: All names used are pseudonyms.

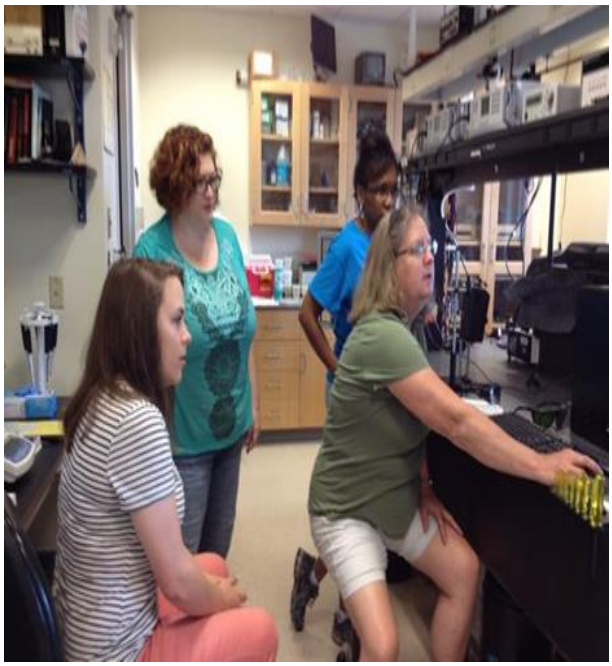
PART II
THEMES

THEME #1: MENTORSHIP

Definition of theme: The observed dynamic between graduate students and teachers in regards to the approach graduate students had in instructing and guiding teachers in the lab.

Evidence/Examples of theme:

Emma reviews Amanda's methods section for the research poster.

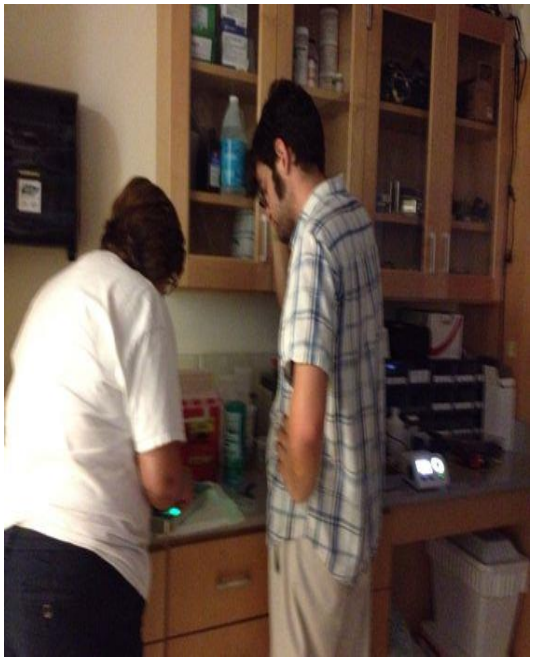


Emma directs Sarah as she focuses the thermal camera while the other teachers observe.

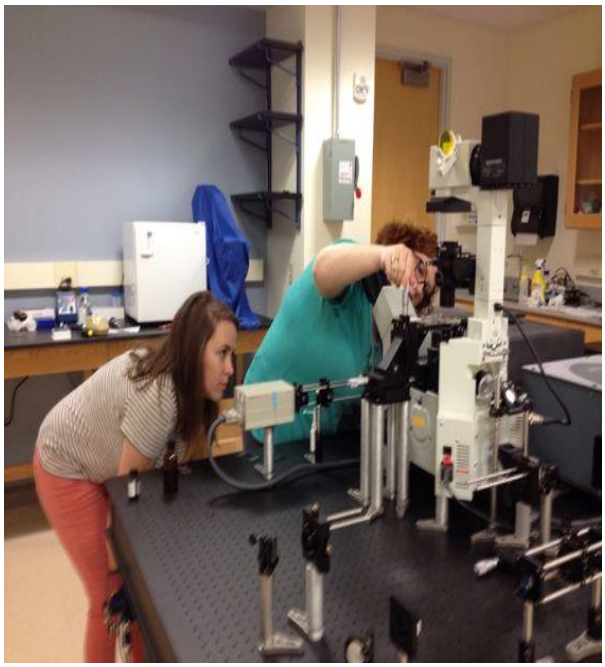
Emma helps Rachel clean slides.

Emma explaining lab procedure to the teachers and lead scientist, Dr. Trammell.

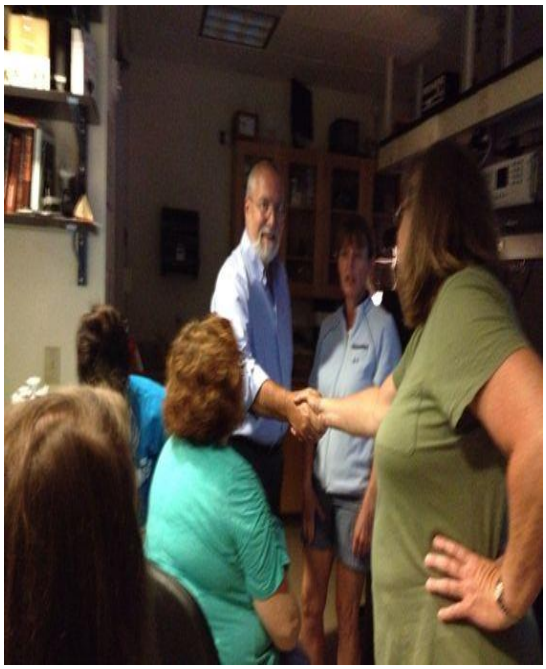
Ethan directs Linda as she takes a picture of a sample of liver that Jane was working with.



Ethan helps Jane work on a sample of liver by shining light with an infrared laser.



Rachel adjusts the position of the sample while being supervised by Emma.



Dr. Trammell introduces the teachers to the department chair, Dr. Glenn Boreman.

Ethan explains lab procedure to Jane while Linda observes.

Keywords of theme: help, explain, review, direct, supervise.

THEME #2: COLLABORATION

Definition of theme: The partnership the evaluator observed between teachers and graduate students working in the lab. The implementation of this program was based in collaboration between Ph.D. students in Optical Science and Engineering, classroom teachers, and a university scientist.

Evidence/Examples of theme:

Ethan asks Jane to upload her files to the lab shared folder on Google Drive.

Amanda and Sarah work together to clean slides.

Teachers work together to prepare slides.

Sarah works on a piece of liver and Linda helps document the experience by taking a picture.

Keywords of theme: shared, help, work together.

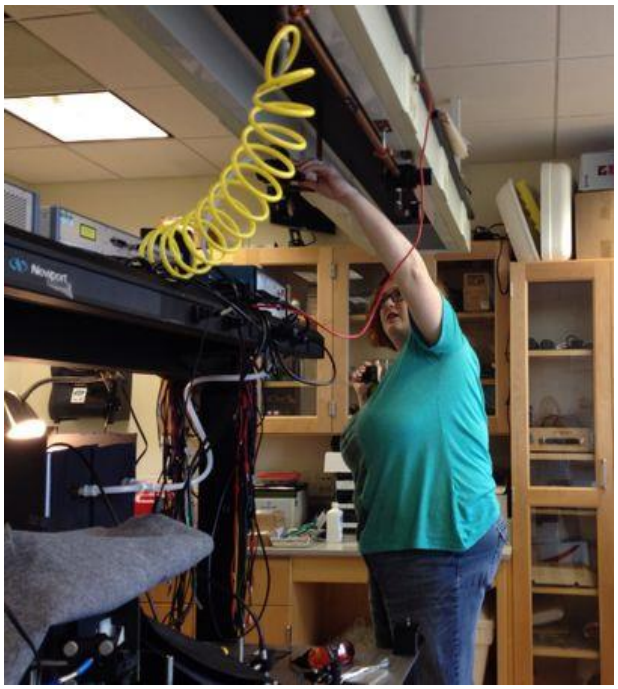
THEME #3: SCIENTIFIC ENGAGEMENT

Definition of theme: The ways in which key partners used scientific inquiry and participated in scientific practices. Key partners demonstrated different forms of scientific engagement by means of using university-level scientific equipment in the lab, attending lab meetings, posing scientific questions, and working towards creating a research poster.

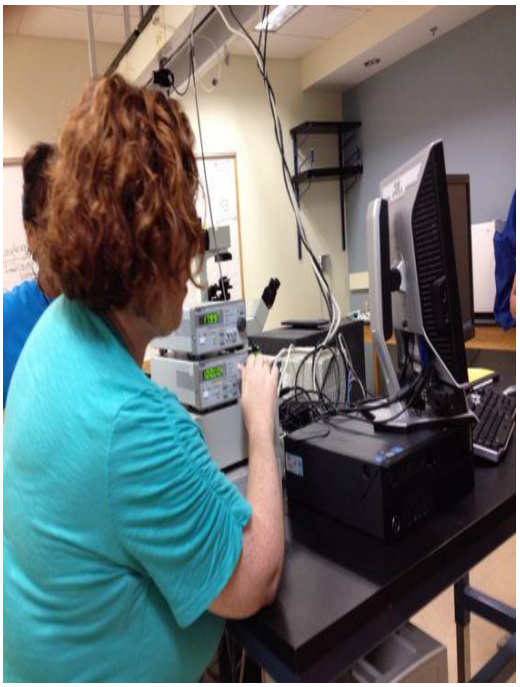
Evidence/Examples of theme:

A meeting in which Dr. Trammell and the graduate students review the progress of lab work to teachers.

Jane reviews and confirms details from lab notes with Dr. Trammell for the research poster.

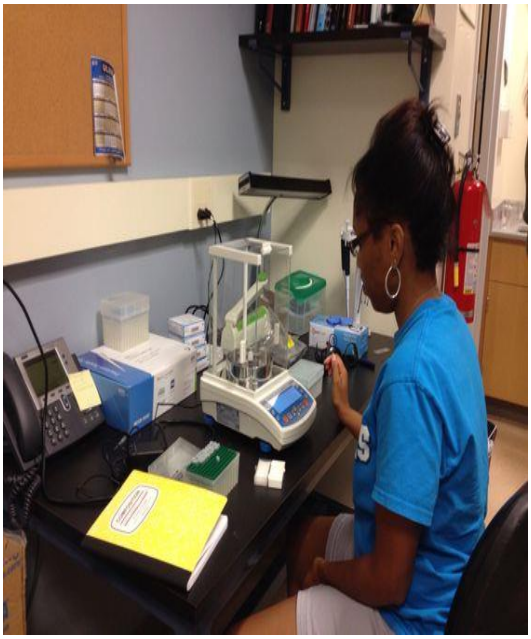


Rachel turns on the compressed dry air.

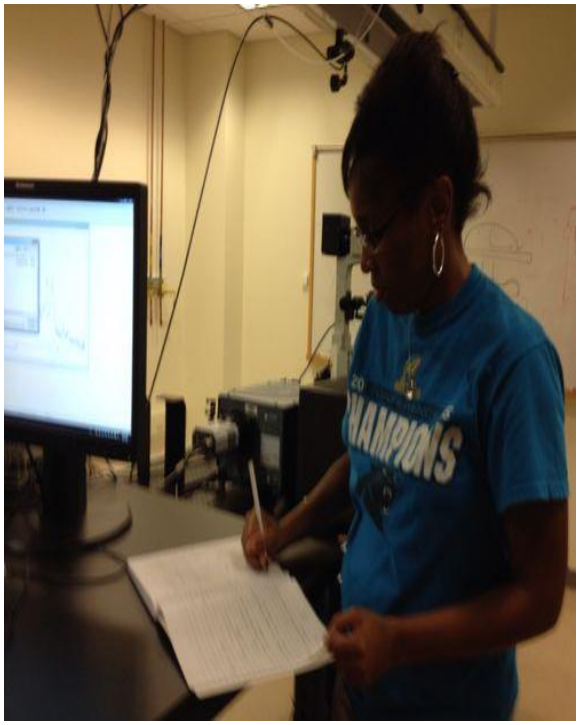


Rachel as she works with a laser.

Amanda works with vacuum grease.

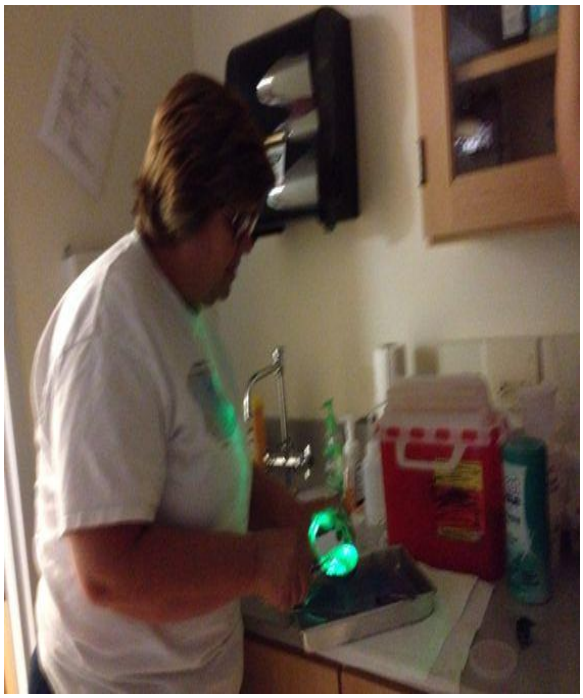


Amanda as she takes the mass of her initial water droplet.



Amanda taking lab notes in her lab notebook.

Sarah as she transports a water droplet.



Jane as she works with a sample of liver that has been lit up with an infrared laser.

Rachel pipettes the solution.

Jane works with the settings of a laser.

Rachel adjusting a slide for the microscope.

Keywords of theme: scientific inquiry, participate in scientific practices, scientific equipment in the lab, lab meetings, posing scientific questions, and working towards creating a research poster.

THEME #4: CURRICULUM DEVELOPMENT

Definition of theme: The ways in which teachers use gained knowledge and insight from their experience to work towards developing ways in which to implement these scientific concepts in their classroom.

Evidence/Examples of theme:

The teachers under the direction of one of the graduate students spoke about how they hoped to incorporate key general components from their experience into their classrooms. They all agreed with each other in regards to scientific concepts that were important to implement and they each provided different examples and insights on how they planned on doing so.

Karen, a high school IB teacher, spoke of using more open ended projects that focus more on the immersion into the process of science and research as opposed to only being focused on the end result. She hopes to emphasize the individual components that are integral to the process such as working with variables, taking measurements, considering how it affects the data and what that suggests in terms of outcomes.

Rachel, a K-6 science teacher, discussed emphasizing the importance of critical thinking as well as having an interdisciplinary approach which Karen also agreed was important. Rachel also emphasized how crucial it is to keep students motivated which is why she wants her science curriculum to spark interest by emphasizing learning through explanation and hands on activities. She also referred to an introductory activity involving a pendulum that the lead scientist used with them that she enjoyed and might use with her students. She also emphasized fostering confidence and talking with her students about misconceptions in STEM and encouraging girls and their scientific capabilities to hopefully inspire some of them to pursue STEM fields.

Amanda, a second grade teacher, said that she would implement scientific inquiry by having her science curriculum split into three units: explore, explain, and experiment. Explore would be an introductory unit based in promoting scientific curiosity. Explain would consist of providing scientific background regarding scientific process and vocabulary. It would also involve hands-on activities that would engage students and be open-ended and not strictly guided. Experiment would also involve hands-on activities, but ones that are much more focused and directed.

Keywords of theme: motivation, critical thinking, interdisciplinary, open-ended, explore, explain, experiment.