**Affordable Learning Georgia Textbook Transformation Grants**

**Final Report for Mini-Grants**

# General Information

Date: December 19, 2019

Grant Round: 13

Grant Number: M68

Institution Name(s): University of Georgia

Team Members:

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Project Lead: Suzanne Ellenberger

Course Name(s) and Course Numbers: Freshman Chemistry I (CHEM 1211)

Final Semester of Project: December 2019

***If applicable to your project:***

Average Number of Students Per Course Section: 280

Number of Course Sections Affected by Implementation of Revised Resources: approximately five to seven in the fall and spring semesters and one in the summer term.

Total Number of Students Affected by Implementation of Revised Resources: approximately 1000-1200 per spring and fall semesters and 150 in the summer term

# 1. Project Narrative

At UGA the freshman chemistry courses, CHEM 1211 and 1212, serve a large number of students, typically 1000-1200 in the fall and spring semesters and approximately 150 in the summer terms. These courses recently adopted use of the OER OpenStax “Atoms First” textbook which has involved reorganizing the content and order of presentation of the topics. The lab experiments for CHEM 1211 are also being examined and new ones are being introduced.

The purpose of this mini-grant proposal is to develop several new CHEM 1211L experiments to better align the lab with the lecture content. We need to write approximately three to four new lab experiments for use in CHEM 1211L. An example of the proposed work is to replace the traditional Lewis structure and Valence Shell Electron Pair Repulsion (VSEPR) labs that utilize ball and stick models with experiments that instead utilize the molecular modeling program SemiChem Ampac. The UGA Chemistry Department recently purchased a site license for this program which is downloadable on student’s personal computers. This capability allows students to perform the experiment on their own devices during the lab period while TA’s are present to assist them and to then complete the lab at home if needed.

A benefit of incorporating the Ampac software program into the CHEM 1211 lab would be linear scaffolding of this technology. The same Ampac molecular modeling program is used in organic chemistry laboratory experiments and its use is being investigated in additional higher-level chemistry courses.

Three faculty members wrote the new experiments and had the drafts completed in April. They then worked with the lab coordinator and lab manager along with graduate student TA’s to work out any bugs with the protocol and program. The experiments were then formatted to be similar to existing experiments used in 1211L to ensure continuity, ease of recording data for the students and efficiency of grading by the Teaching Assistants. This portion of the work was completed prior to the beginning of the summer term.

The experiments were utilized for the first time in the CHEM 1211 early in the summer term class of approximately 150 students. Rather than performing the experiments in the lab, they were done in the classroom so all of the students would be present at once. The course instructor/lab coordinator, graduate student teaching assistant, lab manager and one of the faculty member authors were present to guide and assist students in performing the activity.

As students were downloading the software program to their computers a problem with Mac computers was experienced. Although prior to running the experiment during class, it was tested by instructors and graduate student Teaching assistants on both Mac and PC’s, this problem was experienced with student computers. In the time between testing the experiment and when it was implemented in class, the software has been updated and we are not notified of the new download and installation instruction. It became necessary to contact the software company, SemiChem, to obtain further instruction to avert the issue which resulted in generating a document with clear download instructions. An additional lesson learned was that too few copies of the instructions for navigating the software program were made and distributed. Ideally each student should have a copy of the “Building Structures in Agui” document. A further change would be to provide download instructions to the students at least a week prior to the activity so the software could already be installed on their computers and they had some familiarity with using and navigating the program.

The number of team members for this project was expanded to include two additional instructors. They assembled early in the fall semester to discuss whether any adjustments or changes in the activity were required in going forward to offer it as part of the Freshman Chemistry classes. These discussions resulted in rewriting the activity so it could be utilized in the lecture classes rather than the lab when the topics of molecular geometry and valence shell electron pair repulsion were introduced. In addition to the computer modeling component of the activity, use of ball and stick molecular modeling kits was added. The purpose of this was to provide students with both a tactile experience using the modeling kits and a three-dimensional perspective from the computer modeling portion of the activity. Funds from this ALG grant were used, in part, to purchase a number of molecular model ball and stick kits to augment the activity. One kit was shared between four to six students.

This revised activity was used in the fall 2019 semester with approximately 1200 students in all sections of the CHEM 1211 lecture. The activity was employed about one week after the topics of molecular geometry and valence shell electron pair repulsion were introduced. A survey was given to the students before the activity to query their understanding of these topics and a second survey was used after the activity to discern whether their understanding had improved.

Average results of the survey were as follows.

"I enjoyed the molecular modeling activity overall": 2.9/5

"I enjoyed the computer modeling more than building with the model kits": 2.2/5

"I enjoyed building with the models kits more than the computer modeling": 3.88/5

"I understand shape and polarity more than I did before the activity": 3.25/5

#  2. Materials Description

The newly created lecture activities are attached to the email message.

# 3. Materials Links

# 4. Future Plans

Numerous studies suggest that molecular modeling provides an opportunity to enhance the three-dimensional visual analysis of students thereby allowing them to perform at higher cognitive levels. We found that students gained a deeper understanding of the shapes of molecules, bond lengths and bond angles but enjoyed using the model kits more than the computer modeling. The Ampac program is also used in the UGA organic chemistry labs where students visualize electrostatic potential surfaces to emphasize negative and positive areas, vibrational spectra, and structure and reactivity. Continuing plans for this project include creating additional activities utilizing the Ampac software so general chemistry students gain expertise in the computer modeling program.

We plan to use this activity again in the spring 2020 semester in CHEM 1211 lecture classes but with more careful timing so it is used as an exploratory activity for molecular geometry and valence shell electron pair repulsion. Our effort to shorten the original activity to fit the time constraint of a 50-minute lecture class may have resulted in making the process too simplistic. The team plans to utilize more complex molecules in the next iteration. Additionally, the students seemed to like using the molecular modeling kits more than computer modeling so we plan to build an activity that only uses the model kits.