OrganicERs Newsletter Vol. 4 No. 2

Organic Education Resources

A *cCWCS* Community of Scholars

ALOC Workshop in Atlanta

The 2017 Active Learning in Organic Chemistry (ALOC) workshop took place in Atlanta from June 12 through 15. Twenty-four participants came from two- and four-year academic institutions all over the US, including one faculty member from Alaska! In addition to hearing about research supporting active learning, workshop participants had opportunities to try out technology useful for flipping the classroom. Tech tools introduced included LiveScribe pens, Doceri (iPad app), Explain Everything (iPad app), Nearpod, and OpenOChem. Collaborative Learning Techniques (CoLTs) and Classroom Assessment Techniques (CATs) were both introduced and implemented during the workshop. CATs and CoLTs used include: muddiest point, pros and cons, jigsaw, categorizing grid, concept maps, documented problem solutions, applications cards, student generated test questions, think-pair-share, and round robin/round table. On the final day of the workshop, Josh Ring (Lenoir-Rhyne University) shared his experiences with implementing specifications grading in his organic chemistry courses.

The Flipped Classroom and Team Learning at Ball State University

Ryan Jeske attended the Active Learning in Organic Chemistry workshop in Washington, DC in 2015. After the workshop, he decided to completely redesign his first semester organic chemistry class at Ball State University to a nearly 100% active learning format. Instead of lecturing at the chalkboard for the full 50-minute class period, the students now work in teams of 4 and solve problems presented on the screen. Most of the problems are answered via the iClicker classroom response system, taking advantage of the alphanumeric and multiple select answering features on the iClicker 2 remotes. Very little formal lecturing is used; instead, Ryan adds a small amount of lecturing/discussion at the end of each problem where he discusses the strategies used to answer the question and points out common student errors. Lecture material is presented using Khan Academy style screencapture videos. Approximately 6.5 hours of video are available. Thus, 45 hours of lecture has been distilled into less than 7 hours of online video. To help encourage students to read the text, watch videos and come to class prepared to discuss the problem set with their teammates, short quizzes are presented on Blackboard. These are due the evening before the chapter material begins, and also include one question about the videos to encourage increased viewership.

Last semester, he added a shared cloud folder to the classroom experience. Each group was encouraged to upload a photo of a drawing of their synthesis or mechanism answer, and the images were shared anonymously with the class via the projector. In this way, he was able to show some common student errors; also, this allowed students to see actual student drawings and responses, rather than the instructor’s correct version drawn on the screen, or just the Chem Draw version supplied in the answer slide of the problem set. Towards the end of the semester, participation in this activity started to decrease, so, during the upcoming semester, Ryan plans to randomly award clicker points to groups that submit photos in the hopes of encouraging more participation.

Anonymous surveys using a qualitative Likert scale have been administered at the end of the past 4 semesters. Ryan has found that 60% of students reported that they thought that they learned more with the active learning format, 71% were more confident at the end of the semester than they anticipated at the beginning of the semester, and 62% would be interested in taking another class using the active learning format. Importantly, only 21% said they would not want to take another class in this format. While the grade outcomes were about the same as previous semesters Ryan taught using a traditional chalkboard format, there was decrease in the withdraw rate, 10% vs. 2.5%. Positive written comments included:

“I liked that we could get other students’ insights and that some were able to explain it in a different way than Dr. Jeske”

“[I liked] seeing and working out problems before a test.”

“[The class] wasn't boring and I could stay focused.”

“I was able to teach my group after reading the book and doing the practice problems.”

For the upcoming semester, Ryan plans to incorporate more friendly competition into his classroom. He plans to offer teams extra participation points for high performance on quizzes and exams, and he plans to add some team quizzes each week as part of the problem set. It is hoped that these activities and rewards will increase the sense of comradery and teamwork amongst the team members.

Microwave Heating for Organic Teaching Labs and Undergraduate Research

Elizabeth Blue (2013 cCWCS ALOC Workshop in Charlotte, NC & 2011 cCWCS Green Chemistry Workshop in Eugene, Oregon), is always on the lookout for ways to improve and "green" the Organic Chemistry Teaching labs at Campbell University in Buies Creek, NC. In the spring of 2013, she sought quotes on laboratory-grade microwaves, since she had read an increasing number of journal articles about how microwave heating was being utilized in organic synthesis to increase yields, lower energy use, decrease reaction times, and in some cases, improve purity. In addition, she had run a few experiments in conventional (kitchen-grade) microwaves at workshops. A kitchen microwave was considered, but the features available in laboratory-grade microwaves seemed worth the added expense: the increased safety features (since flammable solvents would be used), temperature control, and the ability to run multiple reactions simultaneously for the teaching labs.

A CEM MARS 5 "demo" unit (most similar to CEM's current MARS 6 synthesis unit) with temperature control and 20 GlassChem reaction vessels was purchased for $12,342.32 (a similar new unit would have run ~$20,000). This unit had been lent out to laboratories to try out, but was offered with a 1-year repair warranty. Other companies that also sell laboratory microwaves are Milestone, Anton-Parr, and numerous others. The MARS 5 is particularly useful for teaching laboratories, as it can hold up to 24 reactions at a time. The thick-walled reaction tubes have pressure relief caps, limiting the pressure to 200 psi. The particular model purchased has a fiber-optic cable with a temperature sensor at the tip. The fiber-optic cable is threaded down into the microwave and fits down into a sapphire well of one of the reaction vessels for temperature control during the experiment. The maximum capacity of the GlassChem reaction vessels is 14 mL, and each tube must contain the same (or very similar) composition and volume so that heating can be as uniform as possible. There are models that also offer pressure control, if that feature is needed.

All microwaves have a minimum working load (the minimum amount of solvent required to safely run the microwave without damaging the magnetron), which varies depending on the solvent being used. Roughly speaking, the more polar the solvent, the more readily it responds to microwave heating. For the MARS 5, with most solvents and experiments, this usually means more than one reaction vessel must be run. For high absorbing solvents (such as low molecular weight alcohols), the minimum working load is 10 mL total solvent; for medium absorbing solvents (such as water or acetone) or low absorbing solvents (such as ethyl acetate or THF), the minimum working load is 50 mL total solvent (these values are specific to the MARS 5).

The unit was provided with a lab manual of experiments, but the particular experiment currently used in the teaching laboratories at Campbell is a Diels-Alder experiment modified from experiments in J. Chem. Ed. articles by Baar, et. al. (DOIs: 10.1021/ed800001x, 10.1021/ed082p1393). The Diels-Alder reaction nicely demonstrates the concept of atom economy and the students compare/contrast the effectiveness of a conventional (90 minute reflux) reaction to the microwave reaction. The microwave heating takes a total of 15 minutes (5 min ramp to 130 °C and 10 min holding at 130 °C). The students usually set up the reflux first, but have the microwave reaction worked up before the conventional reflux is complete. For most students, the % yield of the microwave reaction is higher, and the purity is similar to the conventional reflux (both quite high purity). However, occasionally for some groups, the purity of the conventional heating is slightly better. There is also the possibility of having students do calculations to compare energy usage in the two experiments in order to extend the green chemistry concepts. There is research to suggest that some of the advantage seen with microwave heating is due to the higher pressures that are achieved using the thick-walled reaction vessels. (https://dx.doi.org/10.1021/ar300318c) However, teaching lab investigations at Campbell on this particular Diels-Alder reaction have still resulted in better conversion, yields, and purity with the microwave heating when compared to pressure tubes in 130 °C silicon oil baths for time frames similar to the microwave reaction (15 min total heating time).

In addition to use in the teaching labs, this microwave has been used for numerous undergraduate student research projects and in the research techniques section of the organic teaching laboratory. Students have used the microwave to cut down their reaction times and obtain higher yields or higher purity in many instances. The minimum volume requirements discussed above can be a disadvantage when running research experiments; nonetheless, the microwave has overall been very useful in our research endeavors. If one were looking for a microwave to use only or primarily for research, or for very small teaching labs, a single-vessel microwave reactor like the CEM Discover SP model (or a similar model from another manufacturer) might be more useful.

In terms of maintenance, the purchase of a "demo" unit has probably led to higher maintenance than a new unit would. One circuit board had to be replaced during the 1-year warranty period due to corrosion. This repair was covered by the warranty. It is suspected that this corrosion was due to the microwave having likely been used for acid digestion when it was a demo model. Since the warranty period ended, the RAM battery has been replaced a couple of times at minimal cost (watch style battery), and the display stopped functioning and was replaced (cost of parts only ~$630, free advice and assistance from the CEM Technical Support Staff). This spring, the unit seemed to stop stirring properly during the Diels-Alder runs and resulted in poor conversion, so this will be another repair that needs to be seen to at the 4 year mark. There are many resources available on microwave heating, and many experiments published in the literature. Liz is happy to answer any questions about her experiences and experiments with the microwave at blue@campbell.edu.

Board Members' Picks

Some publications, presentations, and events that caught our interest

From Alexey Leontyev

The article explores the language used in several studies to describe the anomeric effect.

Filloux, C. M. The Problem of Origins and Origins of the Problem: Influence of Language on Studies Concerning the Anomeric Effect. *Angewandte Chemie International Edition*, **2015**, *54*(31), 8880-8894.

From Vincent Maloney

Having taught medium size classes (50 – 100 students) with the flipped pedagogy, the need to have student supplemental instructors in the face to face class during problem solving has become obvious. Jardine and Friedman's article provides insight about the preparation and training of such students for active learning.

Jardine, H. E. and Friedman L. A. **Using Undergraduate Facilitators for Active Learning in Organic Chemistry: A Preparation Course and Outcomes of the Experience** *J. Chem. Educ.*, **2017**, *94* (6), 703–709

Upcoming Events

Visualization in Science & Education, Gordon Research Conference, Lewiston, ME Aug. 6-11, 2017

253rd American Chemical Society National Meeting & Exposition

Washington DC, August 20-24, 2017

Midwest (MWRM)**,** ACS Regional Meeting, October 18 - 20, 2017'
Lawrence, KS

Rocky Mountain (RMRM), ACS Regional Meeting, October 25 - 28, 2017,
Loveland, CO

Southwest (SWRM)**,** ACS Regional Meeting, October 29 - November 1, 2017,
Lubbock, TX

Southeastern (SERMACS)**,** November 7 - 11, 2017, Charlotte, NC

ConfChem Online Conference, Fall 2017, Mathematics in First-Year Chemistry Instruction, October 26 – November 27, 2017, Online Conference