Grove City College
Chemistry eNewsLetter
Spring 2018

Departmental News

From Dr. Joe Augspurger, Chair

My first semester as chair of the department has been full and demanding. I want to again express thanks to Dr. Homan for his work as chair since 2004, and I already appreciate how much more work he did for the department than I knew. Our plan going forward is for the chair to serve for three years, and after two terms to be replaced.

Grove City provided me an opportunity to be prepared for my new responsibilities. GCC belongs to The Council of Independent Colleges (www.cic.edu), an association of nonprofit independent colleges and universities. They offered a three-day workshop for department chairs May 7-9 in Pittsburgh and GCC paid for four other chairs and me to attend.

One of the first things I had to do as a new chair was to participate in creating a welcome video for our department webpage. The College's Marketing department did a great job of creating the new video and you can see it here Chem Dept Video below "Department Overview" on the webpage.

To make our webpage more "attention-getting" to prospective students, we've rewritten the opening text on that page, and will be adding a video to highlight the importance of research in our program by early this fall.

This spring we added two minors to our Biochemistry major that took effect for this year's graduates. The Chemical Synthesis Minor will allow a student majoring in Biochemistry but who realizes they want to pursue a future which is more focused on chemistry to earn this minor by taking Inorganic Chemistry lecture and lab (431 and 422), Advanced Spectroscopy (453) and Advanced Synthesis Lab (458). The second minor, Health, which biochemistry majors can earn by taking Microbiology (Biol 407) and either Anatomy (Biol 341) or Physiology (Biol 346), was created to provide more explicit evidence of their preparation for careers in the health professions on their transcript. The department is due to complete an in-depth review of its curriculum soon.

There have been some significant changes in the leadership at Grove City this Spring. The Dean of the Hopeman School of Science, Engineering and Mathematics, Dr. Stacy Birmingham, announced that she was leaving at the end of the academic year. Our Assistant Dean, Dr. Tim Mohr (Electrical Engineering) will serve as Interim Dean, and Dr. Kristina (Odonish) Pazehoski (BIOC, '01), current chair of Biology, will serve as the Interim Assistant Dean next year.

Then it was announced that our provost, Dr. Robert Graham, is leaving to become the President of Redeemer University, a Christian university in Ontario, Canada. We will appreciate your prayers as the College seeks the right people to fill these leadership positions in the coming year.

In the rest of the eNewsLetter, you can read about new instrumentation, this year's graduates, and an example of the beauty of a liberal arts education – how an English major can do research in chemistry!

New instruments

We added two new instruments this year. The first is a microwave reactor, the Monowave 200, from Anton Paar, which will be used for both teaching and research. The microwave reactor allows us to do reactions at higher temperatures in a short time under inert atmosphere. Often, the formation of byproducts is reduced in microwave reactions as well. It is equipped with a special Ruby thermometer to ensure that the temperature inside the reaction vessel is monitored accurately. Dr. Kriley and his research students have used this instrument to do various reactions. Dr. Guevara had students use the microwave reactor in Advanced Synthesis (CHEM 458) to do a reaction that would conventionally take 24 hours at 200 degrees but can be done in the microwave in 11 minutes. She plans to also use it in her research. Dr. Kriley plans to use it for Inorganic Lab (CHEM 422) to make molybdenum carbonyl/pyridine compounds. The instrument was funded by a generous donor.

One of the challenging and yet very interesting aspects of studying nanoparticles is how to characterize these small particles to fully understand them. Utilization of conventional spectroscopy in various forms and development of more specialized instruments is seeking to overcome this challenge. One of these specialized instruments is the Particle Charge Detector (PCD) that we recently acquired. Manufactured in Germany by BTG, it is historically and predominantly used by the paper industry to determine charged particles (i.e., anionic trash) in the analysis of paper pulp. In Dr. Wong's research lab, however, they are working on one of the very first projects to utilize PCD to determine the charge of nanoparticles for the purposes of characterizing novel nanomaterials for antibacterial properties (see page 4).

The main concept of the PCD is analogous to an acid-base titration system. Unlike the latter, where acidic or basic solutions are used as titrants, a known concentration of positively or negatively charged titrants are used to "titrate" the charged solution until the streaming potential (a measure of the attraction between the surface charges on the nanoparticle and the ionic atmosphere surrounding it) reaches zero. The heart of the PCD contains a piston and a cell that is filled with 10 ml of the charged solution. In addition, two electrodes are imbedded in the cell so that the PCD can detect the electric potential due to the charged analyte. The piston moves up and down, creating a motion that sheers away the ionic atmosphere surrounding the charged analyte, allowing the charges from the titrant to surround the charged analyte instead. As a result, the charged analyte is neutralized and is detected by the PCD when the streaming potential reaches zero.

The funding to acquire this instrument came from the College's annual budget, whose source is tuition income.

2018 Graduates

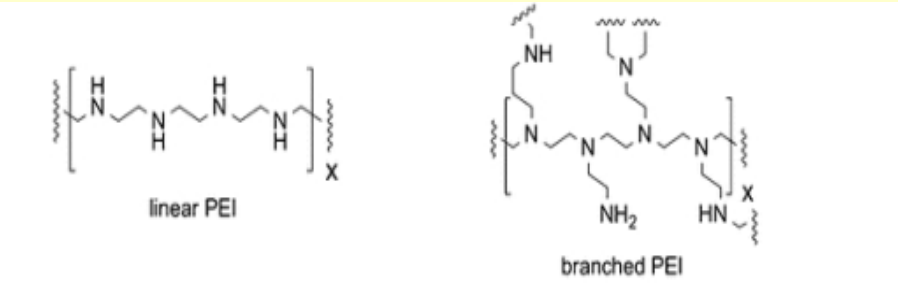
We were blessed to graduate another class that was both large in number and quality! On campus, Jonathan Dabbs was elected Homecoming King last fall and Drew Thibault (cross country/track) was named Sportsman of the Year this spring. Two grads have found jobs in the chemical industry, one is starting medical school at Thomas Jefferson, one starting physical therapy school at Franklin Pierce, one entering seminary at Gordon Conwell, and one teaching in a classical high school. This class has nine members beginning PhD programs this fall, the highest number of any class over the last 20 years. They're going to Wisconsin, Virginia, Case Western, Pitt, Duquesne, Iowa, RPI, and New Hampshire (Dr. Guevara sent a student back to her graduate Alma Mater in her first year!). Five students earned ACS certified degrees, bringing our total to 14 in our first three years of offering the certification.

We will miss you, class of 2018! God bless you are you serve Him in the years to come!

1st row: Margi Haiss, Mary Robison, Lacey Murray, Natalie Ziemer. 2nd row: Ellen Upton, Emily Gifford, Rachel Mee, Danielle Hiener. 3rd row: Drew Thibault, Brian Lee, Jonathan Dabbs. 4th row: Adam Rish, Elija Bombeck, Ben Dumm. 5th row: Jacob Armbrecht, Matt Genzink, Tim Graybill, Ian Ferraro. Not pictured: Grant Macy and Pat Sabados.

Research Profile – Bethany Haughey

Dr. Wong joined the Chemistry Department in the Fall of 2015 and in the three years since has made significant progress developing a research program focused on the characterization of polyethyleneimine (PEI) nanoparticles. PEI is well-known for its ability to bind with double-stranded DNA (dsDNA) and plays an important role in gene therapy. While there is no literature that describes how PEI binds with dsDNA (even though it has been used for almost forty years), it is suspected that it is an electrostatic interaction. Aside from gene therapy, PEI is also emerging as a nanoparticle that exhibits antibacterial properties. PEI contains positively charged amine groups and comes in two forms: branched (BPEI) or linear (LPEI).



In the fall of 2016, junior Bethany Haughey (pictured at left) came into Dr. Wong's office and asked Dr. Wong to take her on as a research student. What made that so unusual was that Bethany was an English major. She was pursuing a minor in biology, serving a President of the Chinese Club on campus, and playing first violin in the orchestra – an epitome of a student pursuing a liberal arts education. While she does not identify herself as a "science" person, she wanted to explore science and has taken all the biology classes a pre-med student would need to take, as she was considering medicine as a career at that time.

Bethany's first contribution to the project began with a literature search, from which she learned that BPEI was more affective in antibacterial activity. Therefore, the experimental work began analyzing BPEI's charge properties. Four samples of BPEI with varying molecular weights (800, 1300, 25k and 750k, as measured by Dynamic Light Scattering) were studied to determine the relationship between molecular weight and charge using our Particle Charge Detector (PCD) (see page 2). While a general trend was observed that charge increases with the molecular weight of BPEI, the charge seems to reach a maximum at 25k, evidenced by the greatest amount of titrant was needed to neutralize this sample in the PCD. This data is consistent with literature that reports that nanoparticles with a molecular weight 25k are most effective for gene transfection. The 750k molecular weight BPEI exhibits a lesser charge, which is suspected to be due to oversaturation of charges.

Bethany chose the 25k molecular weight BPEI (at 1 mg/mL) for more detailed study and mimicked each process involved in the protocol for successful gene transfection. The three main steps in transfection are 1) heating the water to 80 degrees Celsius prior to the addition of BPEI, 2) adjusting the pH of the solution to 7.00, and 3) filtering the BPEI solution with 0.22 µm microfilters. From this experiment, it was evident that the change in pH has great effect on the neutralization of the BPEI solution. Each step in the gene transfection process was run in triplicate, and the observed standard deviations were alarmingly large.

Bethany presented these results at both the Harvard National Collegiate Research Conference for undergraduates and PITTCON. For the Harvard conference, she had to prepare a verbal presentation of her poster in front of judges while at PITTCON she made a conventional poster presentation.

Bethany graduated in May, Magna Cum Laude with High Honors in English, with plans to pursue graduate work in the humanities. Lisa Ma, a junior chemistry major, started working on this project this Spring, and will be continuing the work under Dr. Wong. Her initial work determined that the cause of the large standard deviations was contamination between trials. Adding 1M hydrochloric acid before a DI water rinse lead to standard deviations for each run that were much smaller.

The next step in their work will be to demonstrate the reproducibility of their results and then move onto new experiments, using this more effective washing method between runs.