

the Periodical

Southern Adventist University Chemistry Department



Fall Outing Brings Together University's STEM Departments

On October 21 and 22, students and faculty from the Chemistry, Mathematics, and Physics & Engineering Departments and their associated clubs came together for their annual fall outing at Harrison Bay State Park. Some of our students and faculty arrived on Friday evening to have an evening meal and worship together and to camp overnight, while others joined them on Sabbath morning.

The Sabbath worship service, organized by Chemistry Club pastor Elias Hanson, began with a group singing. Chemistry Department Chair Brent Hamstra then gave a brief talk that aligned with the Seventh-day Adventist Church's annual Creation Sabbath emphasis. He pointed out that the Genesis creation account gives us information not only on the origin and development of our world, but on how to think about the world around us, as well. He pointed to the numerous instances of



Chemistry Club pastor Elias Hanson led Friday night worship during its fall outing.

God seeing and then making decisions based on that information, beginning at creation and continuing throughout the book, as a model for how scientists likewise need to be observant and draw conclusions based on observations.

Following worship, everyone enjoyed a meal prepared by the faculty and staff who attended and spent the afternoon hiking, canoeing, and enjoying the

wonderful fall weather. We are grateful for the opportunity to join together with students and faculty from other departments, and to Dennisse Blood for coordinating the planning for the event.

By Brent Hamstra

From the Department Chair

In this issue of *The Periodical*, you'll notice that we're highlighting our department's undergraduate research program. Some of you may wonder why a chemistry department at an undergraduate institution with limited faculty time for research, limited dedicated laboratory space for research, and limited funding for research would prioritize the development of a research program that provides research opportunities for every student who graduates from Southern Adventist University with a chemistry degree.

I believe that an active, thriving undergraduate program contributes to the personal and professional development of our faculty and students in ways that extend beyond the research laboratory. When our faculty engage in research, it motivates them to keep up with current developments in their areas of expertise. It positively impacts their work in the classroom, because it encourages them to focus on how the material they teach is practically applied in the laboratory. Perhaps most

importantly, research provides excellent mental exercise for our faculty, which leads to increased mental ability and improved mental health, better equipping them to serve our students in all aspects of their education.

When our students do research with us, they learn new laboratory techniques that they aren't exposed to in their laboratory coursework and learn how to apply old techniques in new ways. They learn how to design experiments and not just follow directions. They become more proficient in searching and reading the scientific literature. Because doing so is not just an academic exercise, it becomes part of their problem-solving process. We teach them how to write about their research in ways that will allow them to contribute to the scientific literature. In short, through involvement in research our students develop the skills, and abilities to become creators of knowledge and not just consumers of knowledge.

One might argue that research skills aren't valuable for most of our graduates, who plan to pursue careers as physicians, dentists, or



Brent Hamstra

pharmacists, and that our time would be better spent ensuring students have a broader, deeper knowledge base to prepare them for coursework in medical, dental, or pharmacy school. I would counter that the cognitive skills our students develop in their research will transfer effectively to their future work in diagnosing patients and developing treatment plans.

You can be a part of our research program. You may not be able to experiment with us in the laboratory, but you can contribute to our research by visiting <http://southern.edu/giveChemistry> and giving to the Chemistry Department Affinity Fund. Thank you for your partnership.

2022 December Chemistry Graduates and Their Plans for the Future



Richard Haynes
BS Biochemistry
Attend Medical School



Elaina Bergondo
BA Chemistry
Gap Year

Student Missions

Elias Hanson, Chemistry major

Hi there! My name is Elias Hanson, and I am a sophomore chemistry major. Last school year, I had the unique opportunity to serve as a student missionary in Rwanda, where I taught high school English and chemistry. I volunteered through an organization called Impact Hope, which sponsors refugee students to attend Adventist boarding schools. These individuals are the most hard working and grateful students I've ever met. I feel so blessed to have gone on this journey with God, and it is an experience I will always remember.

When I was a freshman, I was very apprehensive about doing something like this, because I thought it would disrupt my timeline for school. But after prayer and hearing stories from friends who had gone before, a desire grew on my heart to pause my personal pursuits and take time to be at the service of



Elias Hanson teaching class in Rwanda

others. Before I knew it, I found myself standing before a class of 30 kids with the responsibility of making sure they knew the thermodynamics behind phase changes. I quickly learned how palpable culture shock and imposter syndrome can be.

Thankfully, it was not long until I adjusted and teaching became easier. Even when my life reached some level of normalcy

in a foreign land, not a day went by where I couldn't see God's hand at work in and around me. Some people say that being a missionary will change your life or take your spiritual life to new heights. I've found that's not the case; however, being a missionary will show you your shortcomings and give you plenty of opportunities to be dependent on God. How you respond changes your life, not the experience itself. I've found that my life has changed, not because I served abroad, but because I put my life in Jesus' hands. That's something that doesn't take traveling to another country to do. It can be done right here, right now. Coming to Him is a decision I've never regretted; I encourage you to do the same.

By Elias Hanson



Elias Hanson releases some energy with students outside.



Students gather for morning worship.

Department Happenings

Research

Hello everyone, my name is Matthew P. Duffy, and I am one of the professors in the Chemistry Department who is doing research with the chemistry majors.

My area of study focuses on organophosphorus chemistry, which is a fancy way of saying that we make organic molecules with one or more phosphorus atoms mixed in. Now you might think, why stick a phosphorus atom on your organic molecule? Well, that is the interesting part. Because the chemistry of phosphorus is unique, having it attached to or a part of your molecule can sometimes change the properties of your molecules drastically. Take the molecule perylene (Figure 1), for example. It consists of just carbons and hydrogens (the hydrogens are omitted for clarity, but they are there if you remember your organic chemistry class).

One interesting aspect of perylene is that it fluoresces blue light when the molecule is excited, for example with UV light. Now let's add a phosphorus (and an oxygen for stability) so that we get a phosphaperylene (Figure 1). If we take a small amount of each of those molecules and put them in a solvent such as dichloromethane, you can see the fluorescence of the two different molecules when we shine a UV light on them (Figure 2). Compounds that fluoresce light under a stimulus can be used in organic light-emitting device (OLED) screens,

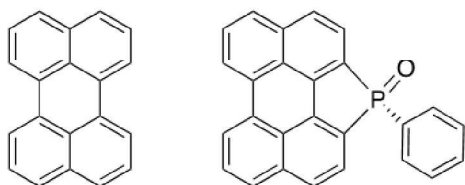


Figure 1. Perylene (left) and phosphaperylene (right).

which are being used more and more due to their lower energy consumption, higher brightness and contrast, the ability to be used in curved screens, etc. If you tried to modify perylene by adding more carbons and hydrogens to get it to fluoresce orange light instead of blue, it would be extremely difficult.

These are the types of things we are doing in our research group, making unique molecules with interesting properties. Making these molecules is not always easy and requires us to do reactions under inert conditions (without the presence of water or oxygen) with specialized glassware and materials that the typical organic chemistry students do not use. If the research students choose to do research under my supervision, I train them in using this specialized glassware and equipment.

In the past, alumni, friends, and families of Southern have donated to the Chemistry Department and we have used some of those funds to buy this specialized glassware and equipment, and we truly appreciate those who have contributed and continue to contribute.

The Chemistry Department requires all chemistry majors to have at least one semester of research experience, and I believe that this is wonderful and truly influential.

In research, you are constantly asking questions, testing those questions, running experiments, failing, succeeding, then failing again, learning to pick yourself up again and again, and trying to learn from each experience. I tell my students, "Research trains you for real life." A wonderful event that occurs yearly on campus and is hosted by Southern's McKee Library is Campus Research Day. Current students, recent graduates, and professors present their research to the entire university. I am honored to say that several of my research students have won awards at the Campus Research Day events over the past few years. I am very proud of the work the students are doing here in the Chemistry Department, as well as all over campus. I am proud of our university and truly feel God's presence here at Southern. Thank you for being part of Southern's friends, family, and alumni. Your invaluable contributions have helped the education and development of our students. Your support has played a crucial role in shaping the next generation, and we are grateful for all that you have done to help our students grow and succeed. We are proud of this community, and we look forward to continuing to work together to create a bright (pun intended) future for all of our students.



Figure 2. These photos show perylene (left) and phosphaperylene (right) in dichloromethane under normal light (left photo) and under UV light (right photo).

Department Happenings (continued)

New Equipment in the Chemistry Department

In chemistry, we deal every day with atoms and molecules that we cannot see. We want to be able to understand their structure and how they are put together and interact with their surroundings. We need to understand them well enough to be able to make predictions on how they will behave under various sets of conditions and how we can manipulate them to produce the desired behavior or make desired products from reactions. To help us do this, we use various type of models, such as simple theoretical models like VSEPR, to predict three dimensional molecular shapes, more complex mathematical models in P-Chem to predict electronic structures or behaviors of substances, and simple physical models such as ball-and-stick models for looking at how atoms are bonded together to make molecules.

In General Chemistry when we learn about crystal structures, we are using the smallest, repeatable part of a crystal, its unit cell, to help learn about how the atoms or ions are packed into a three-dimensional array,

which atoms are touching each other, how the atomic size is related to the size of the unit cell, and how many atoms are packed into each unit cell. The typical ball-and-stick model is not very useful for most of these concepts. For many years we wanted what are known as space-filling models for the crystal unit cells, something that we could not buy. A number of years ago we were able to create three of these models (simple cubic, body-centered cubic, and face-centered cubic unit cells) using a 3D printer purchased by the university library. Figure 1 shows a ball-and-stick model versus a 3D printed space-filling model for a face-centered cubic crystal unit cell. Students also learn about unit cells for NaCl and CsCl type crystals. We were not able to print these, because they required the ability to print in two colors and the library printer could only print a single color at a time.

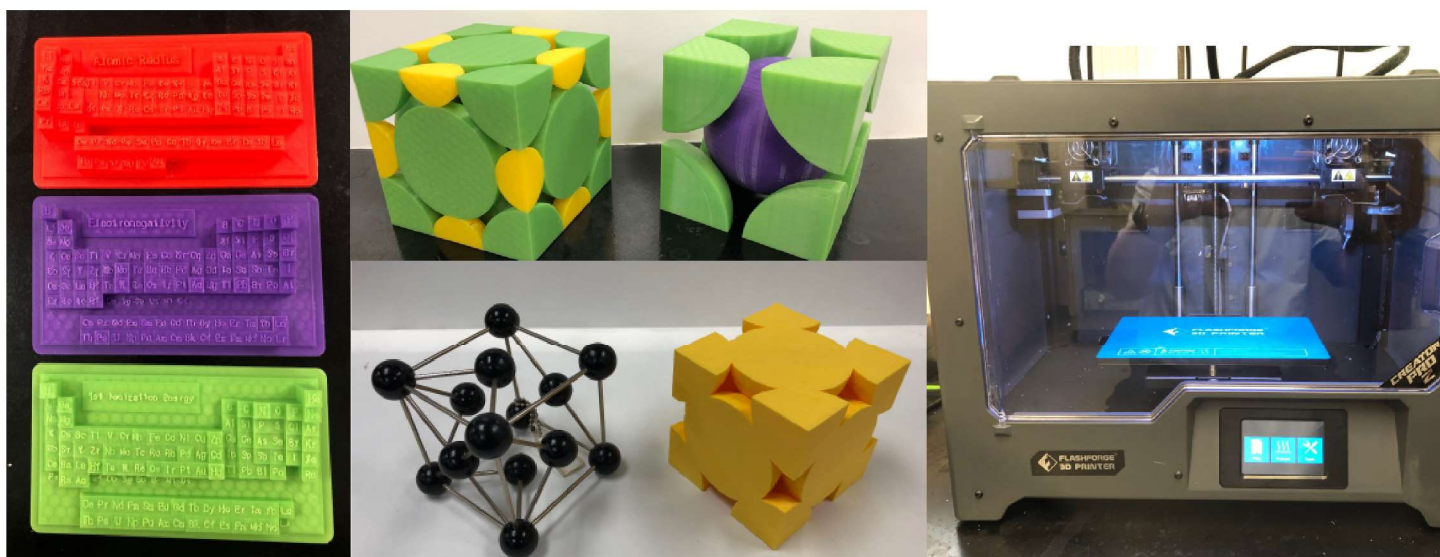
For Southern Adventist University's "Giving Day" in 2019, the Chemistry Department solicited donations to be used to purchase a multi-color 3D

printer. Thanks to the money we received, a Flashforge Creator Pro 2 (dual nozzle/extruder) printer (Figure 2) was purchased during the summer of 2022.

Figure 3 shows two of the first objects printed, the NaCl and CsCl cubic unit cell models. Figure 4 shows three other objects that have been printed, 3D bar charts showing periodic properties of elements such as atomic radii, first ionization energies, and electronegativities. Future projects that we are working on include 3D printing accurately shaped hydrogen p, d, and f atomic orbitals and also the possibility of printing some molecular orbitals.

The Chemistry Department would like to thank the donors who have helped us to purchase the 3D printer, which allows us to make more accurate models for use in our classroom teaching and hopefully increase student understanding with new ways of visualizing some of the things that they are learning about but cannot see.

By Bruce Schilling



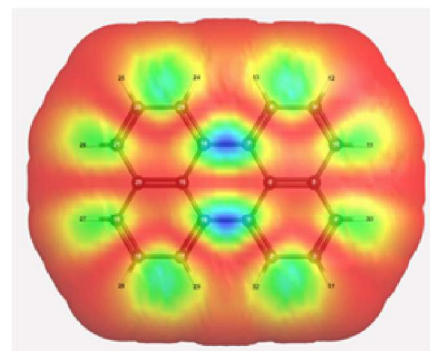
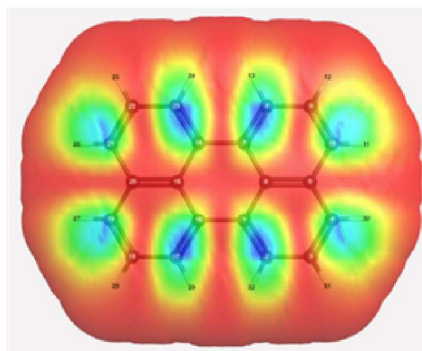
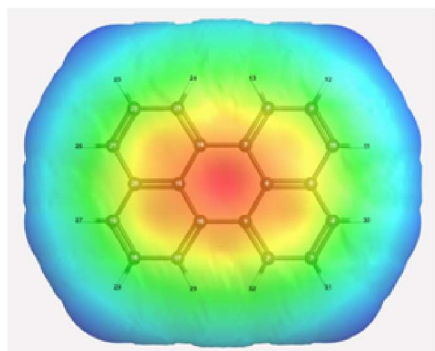
Department Happenings (continued)

Computational Chemistry Research

This summer I had the opportunity to participate in a Computational Chemistry for Chemistry Educators (CCCE) summer workshop offered in collaboration with the Extreme Science and Engineering Discovery Environment (XSEDE), supported by National Science Foundation grant number ACI-1548562), for which I received a small stipend. Example calculations include electron density and HOMO/LUMO mapping (see figure below).

The software can also be used to calculate UV-visible and NMR spectra. I expect that computational modeling will enable the distinguishing of various isometric forms of conjugated cations that are central to my research—something that cannot be done with currently available manufactured instrumentation. With the training I received, I will also be able to teach students in my research group and in Physical Chemistry how to use

the software to solve problems and explore new areas of chemistry. The software can also be employed in other areas of chemistry including organic, inorganic, and biochemistry applications. Through a generous grant from the Academic Research Committee of Southern Adventist University, we will be able to purchase the Spartan software package needed to do the computations.



For perylene molecule: left = electron density map (blue positive, red negative); center = HOMO; right = LUMO (blue region is the highest probability of location for HOMO and LUMO diagrams).

By Mitch Menzmer

Biblical Applications

“More Than What We Ask”

The story of King Solomon asking for wisdom always inspires me a lot. In 1 Kings chapter 3, the Bible says Solomon asked God: “Now, LORD my God, you have made your servant king in place of my father David. But I am only a little child and do not know how to carry out my duties. Your servant is here among the people you have chosen, a great people, too numerous to count or number. So give your servant a discerning heart to govern your people and to distinguish between right and wrong. For who is able to govern this great people of yours?” (verses 7-9, NIV). First, Solomon was humble and acknowledged he needed help. Second, he was asking for a discerning heart to help him better govern his people. He is not asking for something purely for himself; he is asking for something that can benefit others.

God recognized that and replied to Solomon: “Since you have asked for this and not for long life or wealth for yourself, nor have asked for the death of your enemies but for discernment in administering justice, I will do what you have asked. I will give you a wise and discerning heart, so that there will never have been anyone like you, nor will there ever be. Moreover, I will give you what you have not asked for—both wealth and honor—so that in your lifetime you will have no equal among kings. And if you walk in obedience to me and keep my decrees and commands as David your father did, I will give you a long life.” (verses 11-14, NIV). God was pleased by Solomon’s selfless request and granted him not just a wise and

discerning heart to help him rule his people, but also wealth and honor and a long life.

Christianity is not that popular in the rural area in China where I grew up. It was until I went to Peking University in Beijing that my teacher introduced me to Christianity and brought me to Christ. That teacher is a professor in physics who became a Christian during his PhD program in Australia. At that time, I knew I wanted to go abroad would be simply because I knew there is more freedom for me to learn about this God. I asked bravely for God to take me to the country He wanted me to be. I thought it should be America, but it ended up to be Australia. God knows everything. God had Moses spend his first 40 years in Egypt as a prince, then 40 years in Midian as a shepherd. When Moses was ready, God used him to bring the Israelites out of Egypt. My “40 years as a shepherd” was my five years in Australia.

God used my time in Australia to get me ready for my future family and work (as a teacher at Southern Adventist University. I walked into a church on campus on Saturday the first weekend after I arrived in Australia. I didn’t know it was a Seventh-day Adventist church, but I liked their church service and they also invited me for Friday night fellowship and Bible study. Later one of the members there offered me personal Bible study, and I got to know the truth more than before when I was in a Sunday church in China. I was baptized in Gateway SDA Church in Melbourne. My PhD (Biochemistry and Molecular

Biology) journey wasn’t easy, but I was super active and involved in campus ministry. I believe in “seek ye first the kingdom of God” (Matthew 6:33, KJV). I hosted a small group (we called it “a care group”) for three years in my apartment, and through that a few people got baptized or renewed their relationship with God. I used as much time as possible to reach out to other students or young adults.

Apparently God blessed me just as He blessed Solomon, giving him more than what he asked for! God did the same thing with me. I was asking that I could graduate from my PhD program within a reasonable amount of time. What God did was to let me graduate within a short time (four years) and work as a post doctoral researcher (10 months) so that I could have enough money to come to the United States! Of course, He also provided me a postdoc job at Johns Hopkins University in Maryland. In addition to that, He provided me a husband that I met in church the third day after I arrived in America! God never stops His amazing blessings when you have your whole heart submitted to Him!

In 2021, we heard God’s calling to join Southern. It’s a dream that came true. I believe when we pray for His kingdom and His will be done, He will grant us more than what we ask! He did that for Solomon and me, and He is doing that for each one of you!

We have a faithful and awesome God. Don’t you think so?

By Crystal Glassford



Power for Mind & Soul

Chemistry Department

P.O. Box 370

Collegedale, TN 37315

Phone: 423.236.2931

Fax: 423.236.1931

southern.edu/chemistry

facebook.com/chemistryatsouthern

Faculty & Staff

Brent Hamstra, PhD

Matthew Duffy, PhD

Mitch Menzmer, PhD

Nuvia Saucedo, PhD

Bruce Schilling, PhD

Tamie Suzuki, PhD

Crystal Zhang, PhD

Dennisse R. Blood, Office Mgr.