CHEM MAJOR NEWS

In Conjunction with the American Chemical Society
Student Affiliates at the University of Pittsburgh

Volume 32, Issue 1 September 1, 2023

American Chemical Society Student Affiliates
University of Pittsburgh

Welcome Back Letter

Welcome back handsome and beautiful people! We have survived to see another glorious year at Pitt. As fast as an electron in a cyclotron, summer has passed and the fall semester is, once again, upon us. Whether you were chilling at home, out on the beach somewhere, or stuck in a lab for 40 hours a week, I hope this summer brought you some relief from the hectic nature of the STEM undergraduate experience. Sadly, our break is over. I hope you are ready for another exciting chemistry-filled semester!

Fall semester has always felt like a fresh start to me. The weather is nice, my mind has had some time to revive itself from the deadly busy, frigid spring semester, and I get to see the smiling faces of good friends. However, certainly, stressful times are to be expected ahead. Yet, we have each other's support and company to look forward to. I am excited to see all the lovely faces and friendly chemistry folk at ACS meetings this year. I hope to see you there. This semester is sure to bring more great memories for everyone. And I can't wait to share fun new chemistry with y'all in this newsletter, along with our lovely newsletter crew!

School can be a hard grind, so I want to congratulate everyone for making it to another year. It is tough. There are long nights. And there are nearly sleepless weeks. We all have done amazing. And have put in the greatest effort we can. I believe that all of us have the capability to excel this semester. But, we all also deserve to take a break sometimes. So remember to do things that make you smile. Go for a walk. Swing by the Center for Creativity. Or stop into an ACS meeting. Hang out with some friends. Get some good food. Make a study group with people who make doing work feel less depressing. You are doing great. And I hope you are proud of yourself for your effort. This year is sure to be great!

Have a wonderful semester! Hail to Pitt!
Victoria Zerbach

2023-2024 ACS-SA Officers and Staff

Ahssan Sekandari – *Co-President*
Dhruthi Gunduaro – *Co-President*
Rebecca Babendreier – *Co-Vice President*
Shane Osborne – *Co-Vice President*
Christina Raad – *Secretary*
Dennis Skiba – *Co-Treasurer*
Donny Truong – *Co-Treasurer*

Holly Krug – *Technology Wizard*
Anna Welser – *Outreach Coordinator*
Joe Storey – *Outreach Coordinator*
Rebecca Hotton – *Feature Writer/Editor*
Victoria Zerbach – *Newsletter Editor*
Piper Read – *Green Chem Contributor*
Jimmy Rekowski – *Pharm Contributor*

Visit us at http://www.chem.pitt.edu/acs-sa/

INTRO TO GREEN CHEMISTRY

By: Piper Read, *Green Chem Writer*

Hi, my name is Piper Read, and I am your Green Chemistry Contributor for the 2023-2024 academic year. I am a senior chemistry major with a passion for environmentalism and climate science. Through the articles I write for the newsletter this year, I hope to increase awareness for sustainable practices in chemistry and draw attention to environmental issues that I believe chemists should be helping to solve. It is my hope that something somewhere in one of my articles throughout this year inspires you to live your life just a little bit more sustainably!

In the mid 1900s increasing attention on global warming, instances of cancer, birth defects, and genetic mutations, harm to the health of humans, ecosystems, and the environment, and a hole in the ozone layer prompted the establishment of green chemistry. The Pollution Prevention Act declared that US policy should be reshaped to eliminate pollution at the source through changes to raw material sourcing, production processes, and recycling2. Previous policies focused on treatment and disposal and often fell short of protecting the environment and our health. This new legislation also resulted in research grants funded by the EPA and the U.S. National Science Foundation, which increased interest and contribution to research in this field3. Funding, research, and overall interest in green chemistry, as well as policies that required changes in our usage of chemicals and the processes involving them, increased internationally. By the 1990s, networks of research and communication within green chemistry were developing in western countries. Today, green research is a fully interdisciplinary effort that spans STEM, social science, and the humanities and being performed right here on our campus and in nations all across the world.

Green chemistry is a field that is rethinking our current procedures and processes in chemistry and engineering. It can look like reducing or eliminating the use of toxic chemicals, reducing chemical waste, or increasing the efficiency of chemical reactions[1]. It focuses on stopping pollution and harm to our planet at the source, rather than cleaning it up later. The EPA lists twelve principles of green chemistry, which highlight the variety of possible applications and research in this field. The principles are as follows:[4]

1. Prevent waste. Waste can be byproducts that would have to be disposed of, excess reagents, etc. The goal is to have zero waste or to be able to clean it up.

2. Maximize atom economy. The goal is to have the highest proportion of starting atoms in the final product, with few side reactions occurring and creating undesired products.

3. Design less hazardous chemical syntheses. The goal is to create chemicals that, during creation and use, pose little to no toxic risk.

4. Design safer chemicals and products. Design efficient yet nontoxic chemicals.

5. Use safer solvents and reaction conditions. Try to avoid "auxiliary chemicals", but when they are needed, use the safest ones possible.

6. Increase energy efficiency. Try to remain at room temperature and standard pressure for reactions. Deviating from these conditions requires large amounts of energy.

7. Use renewable feedstocks. Feedstocks are starting materials; use renewable ones rather than depletable ones whenever possible.

8. Avoid chemical derivates. Derivates will require additional reactants and generate more waste.

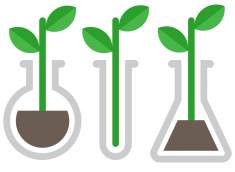
9. Use catalysts, not stoichiometric reagents. Catalysts are both consumed and produced by reactions, creating a cycle that reduces waste.

10. Design chemicals and products to degrade after use. In case products find their way into the environment, they should be designed so they break down into harmless substances.

11. Analyze in real time to prevent pollution. Monitor and control synthesis to minimize/eliminate the formation of byproducts.

12. Minimize the potential for accidents. Store chemicals properly to reduce the potential for chemical accidents that would pollute the surrounding environment.

While a lot of work still needs to be done, production and procedures surrounding chemicals have improved greatly since the 20th century, and some improvements to the health of the environment reflect that. Without green chemistry, much of this progress would not have been possible, proving this field to be an essential part of our response to health and environmental concerns.



A Season full of Nano: My Summer Research At-A-Glance

By: Rebecca Hotton, *Feature Writer*

Over the past few months, whenever asked by family members, friends, and even peers about how I'm spending my summer, I'm often met with a mix of awestruck and confused expressions when I announce, "I'm working in a lab synthesizing and characterizing metal nanoparticles!" My name is Rebecca Hotton, your new feature writer for the ACS newsletter for this year, and I've been fortunate enough to spend my summer as an undergraduate researcher in Professor Jill Millstone's Nanoparticle Synthesis and Characterization Lab here at Pitt. My goal as feature writer for the newsletter will be to write about (hopefully) interesting chemistry-related topics to teach everyone something new about the field or interesting applications of the concepts we learn in class!

As chemistry students, our professors often go to great lengths to expose us to the different areas of chemistry and the everyday applications of the concepts learned in the classroom. However, these applications are often limited to those in biology, medicine, or more technical applications engineering. Consequently, more niche fields, like nano chemistry, are not talked about nearly enough in introductory (or even higher-level) chemistry courses. Given that not many people know a lot about this up-and-coming field of study, I thought this would be an interesting introductory topic to write about for everyone in ACS this semester.

To begin I'll answer some of the most pressing questions you may have: What is a nanoparticle and why should I care about their synthesis and application? A nanoparticle is any particle on the scale of 1–100 nm. These particles are unique in the way that they will exhibit different properties from bulk materials due to their enhanced surface area-to-volume ratio. This drastically increased surface area-to-volume ratio means that there are a higher number of atoms able to interact and bond on the surface of the particle. Consequently, this changes and enhances their electronic properties, chemical reactivity, and catalytic behavior. In addition to the nanoparticle, which has all dimensions within the nanometer scale, other classes of nanomaterials have one or more dimensions within the nano size regime. The number of nano-dimensions and compositions of these nanomaterials will dictate their properties and applications.

Nanomaterials and particles have applications in nearly every field of science. These compounds can be used for higher performance batteries, solar cells, single-atom catalysts, and even cancer treatment! One of my favorite proposed applications for nanoparticles is the use of small gold nanoparticles for the photothermal treatment of cancerous tumors.

All in all, I hope this article has taught you a little about the amazing world of nano chemistry, or, if nothing else, has given you a cool fact to tell your peers to sound impressive during ice breakers or study dates. If you're interested in learning more about nanoscience, I recommend visiting https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6982820/ for a more comprehensive review.

September Drug of the Month: *Legembi*

By: Jimmy Rekowski, *Pharm Writer*

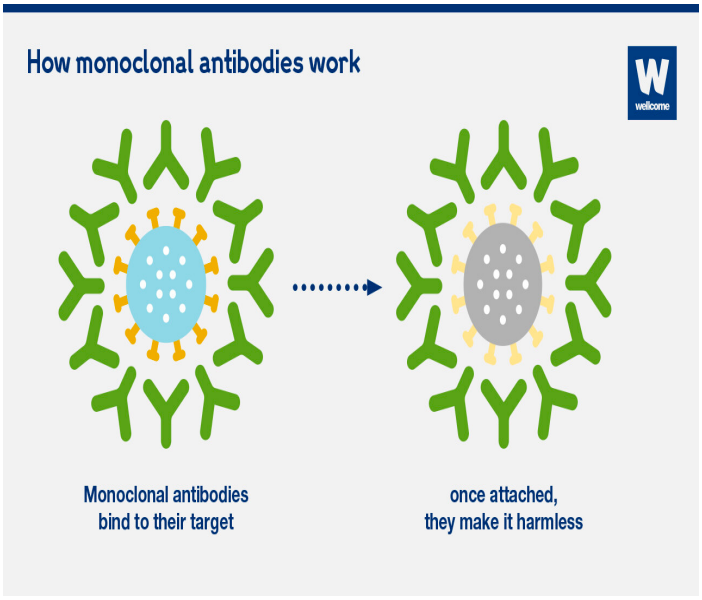
Alzheimer's disease is a progressive neurological disorder causing many cells to shrink, and often die. As the most common form of dementia, Alzheimer's disease accounts for 60-80% of dementia cases (*Alzheimer's Disease Facts and Figures,* 2023*).* Individuals, as well as their families, have their lives changed drastically after receiving an Alzheimer's diagnosis. With an aging population, and the traceable link of Alzheimer's to older populations, the disease will undoubtedly continue to be a problem into the future. This leads to questions of treatments or possible drugs to cure the disease. To date, no known cure for the disease exists, but pharmaceutical companies and universities continue to invest millions of dollars into research for one each year. In January of 2023, the U.S Food and Drug Administration approved a drug named *Leqembi*, through the "Accelerated Approval pathway" process, as a potential treatment for the disease. This "Accelerated Approval pathway" allows the FDA to approve drugs for serious conditions for instances where there is an extreme need for medical intervention.

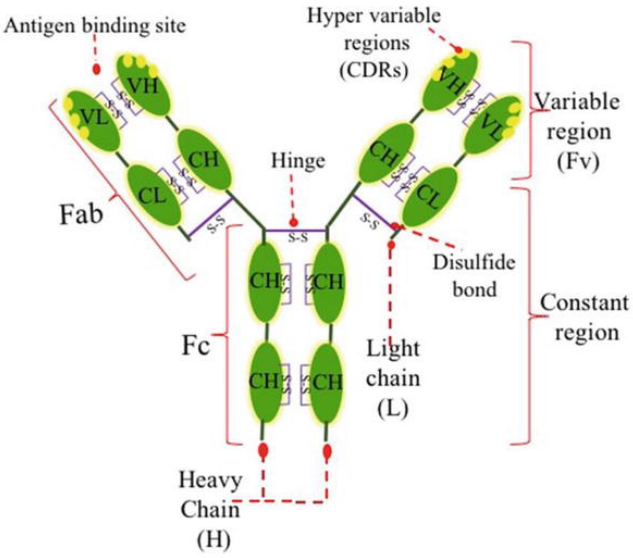
Leqembi is a immunotherapy treatment administered every two weeks through an IV infusion of the drug at hospitals or centers with the treatment. The treatments last for about an hour, which is approximately the amount of time it would take for each infusion. Although not produced as a cure for the disease, the prescription information states that *Leqembi* will be used with early Alzheimer's patients with elevated beta-amyloid plaques in the brain. Beta-amyloid plaques come from clumps of proteins, called beta-amyloid, which form the outer fatty membrane of nerve cells. The protein is sticky, causing these small clumps to block cell-to-cell signaling. This blockage of cell-to-cell signaling is commonly associated with Alzheimer's disease. The goal of the treatment is to slow the progression of the disease in the early stages, allowing for more time living a normal, independent life. The most common side effects during clinical trials were infusion-related reactions and other symptoms such as headache, cough, and diarrhea.

The discovery of this treatment started in 2005 through the collaborative effort of two pharmaceutical companies, *Eisai* and *BioArctic*. *Leqembi* is a monoclonal antibody. Monoclonal antibodies are man-made antibodies derived from the cloning of a unique white blood cell. The antibodies are designed to seek out and target antigens (foreign materials) of interest. These antibodies, shown below, are formed

through a polypeptide chain of light and heavy chains, along with intramolecular covalent bonding (mainly disulfide bridges). This creates a unique opportunity for scientists to target any cells with the given antigen. In the case of Alzheimer's disease, *Leqembi* functions by targeting the amyloid β- peptide. To slow the progression, the treatment selectively binds to the peptide itself, acting to neutralize and remove the toxic aggregates. By removing the disease pathology, this helps in slowing the progression of the disease. This humanized immunoglobulin gamma 1 (IgG1) antibody treatment is directed against both the soluble and insoluble forms of the peptide.

Before production of *Lequembi*, a Swiss pharmaceutical company, *Neurimmune,* created a similar drug called *Aduhelm*, which was the first monoclonal antibody for the treatment of Alzheimer's disease (*Aduhelm for the Treatment of Alzheimer's Disease,* 2023). However, *Aduhelm* targets the more highly aggregated forms of the peptide, making it not as effective as *Lequembi*. Additionally, *Aduhelm* is administered via infusion while *Leqembi* is administered directly to the vein intravenously. *Leqembi* is currently undergoing ongoing trials for additional delivery methods of the drug and how this might change the effectiveness.





Sadeghalvad, M., & Rezaei, N. (2021)

2023 Tentative ACS Fall Schedule

September

1 Officers only meeting – pictures

8 Welcome Back meeting – pizza

15 Career Center – Ingrid Beute

22 Meet our new Chair – Haitao Liu

29 Talks by Undergraduate Students

October

6 Fall Break

13 Industry Day – PPG (Discussing Sustainability)

20 Registration – Ericka Huston

27 Fall Celebration – Pumpkin painting, cider, hot chocolate and pizza

November

3 Pharmacology Talk – Bruce Freeman

10 Graduate School – Steve Weber

17 Resume Day – Tim Tseng

24 Thanksgiving Recess

December

1 Pre-Professional Advising – Jennifer Bohland

8 End of Term Farewell – Snacks

American Chemical Society

Student Affiliates, University of Pittsburgh

Membership Application

This is a powerful professional organization for the benefit of individuals interested in chemistry and related fields. Our organization offers exciting extracurricular activities and many outstanding opportunities for our members, including:

1. **WEEKLY MEETINGS**-to plan activities, provide interesting speakers, discuss ideas, and keep students aware of what is happening in the scientific community.

2. **ANNUAL TRIPS**-Each year we sponsor (a) trip(s), to external chemistry environments, as well as for social enjoyment. Significantly reduced rates are available to active members. In the past few years we have traveled to New Orleans, Atlanta and New York.

3. **PROFESSIONAL NETWORKING**-Our organization has many opportunities to make contacts with professionals in both the scientific industry and academia. Student affiliates also have the opportunity to join the National ACS.

4. **SOCIAL ACTIVITIES**-We sponsor many activities throughout the year just for fun.

Our meetings are held every Friday at 12:00 p.m. in Room 150 Chevron Science Center. To join, scan the QR code and complete the application. Our first meeting will be September 8, 2023 but you may join any time throughout the year.

It is possible to be active even if you can not attend the meetings. For more information, contact one of our Officers or stop by Room 107 in CSC.