CHEM MAJOR NEWS

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

Volume 28, Issue 2 | October 4, 2019

REGISTRATION

SET DATES:

October 14: Fall Break- No Classes!

October 28: Registration begins for Spring Term 2234 based on earned credits. You will receive your registration appointment from the Registrar.

October 28: Deadline to submit Monitored withdrawal to the Dean's Office.

October 31: Happy Halloween!

November 11: April 2023 (2234) graduation applications due in 140 Thackeray Hall.

November 20-27: Thanksgiving Recess. NO CLASSES!!

December 18: Have a great Holiday!

IMPORTANT: WHEN SHOULD YOU SEE YOUR ADVISOR?

Advisees who already have a permanent advisor should make their registration appointments with that advisor on or after October 14. Remember to bring a copy of your academic record with you to this meeting.

Advisees who (via an email to be sent October 01) were asked to select their permanent advisors should do so after October 06. See George Bandik or Sharon Mansfield in 107 Chevron Science Center.

New advisees (those who have NOT registered with the Chemistry Department before) should make an appointment with George (Room 107 Chevron), Dr. Huston or Dr. Ward on or after October 14.

2022-2023 ACS-SA Officers and Staff

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Shay Habeb-*Co-President*
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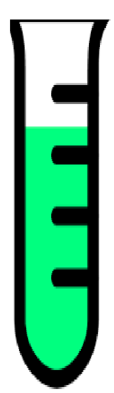

Holly Krug -*Tech Wizard*
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George Fritze-*Pharm Contributor*
Dhruthi Gundurao-*Feature Writer*
Victoria Zerbach- *Newsletter Editor*
Sophie Bazydola-*Green Chem Writer*

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

Dearest Readers,

Happy Fall! Or as some would probably prefer Pumpkin Spice Latte Season!

More often than not the Pumpkin Spice latte is the talk of the ton this season and nearly every sweet treat that we'll find this autumn will come in the exclusive pumpkin spice flavor. But did you know that most of these sweets are not actually made from pumpkins themselves but instead a combination of various chemicals that attempt to encapsulate the essence of fall?

Combinations of cinnamon, nutmeg, ginger, and clove are what we find in our beloved pumpkin lattes and cupcakes. These spices and various flavors have nothing to do with pumpkin, yet the sweet treats they flavor are consistently delicious. What about the chemistry of these spicy compounds makes us love them so much?

Now if you've taken organic chemistry, you will probably recognize some of these compounds and if you haven't rest assured you probably will once you've taken orgo. However, these spices don't produce a consistent flavor when used naturally. So, what do we use instead? Cinnamic aldehydes can be used to replicate cinnamon flavor, eugenol for clove, terpenes like sabinene for nutmeg, and zingiberene for ginger. Cinnamic aldehydes and eugenol are easily inferable structures in that cinnamic aldehydes are compounds that have a terminal carbonyl thus being classified as aldehydes and eugenol can be determined to be an alcohol based on the -ol nomenclature.

But what about terpenes and zingiberene? Terpenes are typically molecules composed of two to six isoprene molecules, also known as 2-methyl-1,2-butadiene molecules. 10% of nutmeg's makeup is essential oils. These essential oils are chiefly formed through the presence of terpenes thus making terpenes essential chemical compounds in producing the beloved pumpkin spice latte. Zingiberene, 2-Methylcyclohexa-1,3-diene, is also a monocyclic molecule considered a terpene because it contains 3 isoprene units (sesquiterpene). Zingiberene is the molecule that gives ginger its distinct flavor which is why it is used in pumpkin spice flavoring.

Some of you may be thinking...*Hmmm... if I can get my hands on all these compounds then I can instantly create the pumpkin spice flavor. Then I'll avoid paying exorbitant prices for my favorite coffee!* However, be wary dear readers because you would get no desirable flavor from doing that. It is only when these compounds are heated together via the Maillard reaction that you get the desired flavor of pumpkin spice. The Maillard reaction is known as a browning reaction where a reducing sugar, an amino acid and heat are combined to produce the desired flavor.

So, if you're feeling like you want to try making a treat with this season's favorite spice at home, you could try using a teaspoon of cinnamon, a half teaspoon of ginger, a half teaspoon of ground cloves and an eight of a teaspoon of nutmeg. Heat these up and add them to your drink. You can create a pretty acceptable substitute for the infamous Starbucks pumpkins spice flavor. However, don't try to go into your local chem lab to get the actual compounds to create the exact pumpkin spice flavor at home because I doubt it will end well.

This is Dhruthi Gundurao, Newsletter Feature Writer signing off.

THE PLASTIC PROBLEM-GREEN CHEMISTRY

By: Sophie Bazydola-*Green Chem Writer*

The world has a plastic problem. Single-use plastics can be seen accumulating along the coastlines of oceans and riverbanks and littering the sides of roads. Microplastics—5 mm or smaller plastic fragments—pollute waterways, marine life, and even our own bodies[1]. Obtaining the raw material of plastic, petroleum (crude oil), requires drilling, which can pollute land and water when leaks or spills occur. Even as plastic breaks down—which takes hundreds of years—it breaks down into microplastics, which will forever exist in water, soil, and organisms. Plastic can be formed back into pellets and recycled. However due to inadequate recycling programs and high cosumption of plastic products, the United States recycles less than 10% of its plastic each year[2]. Our dependence on petroleum-based plastics has gotten out of control. Slowly, we are trying to find solutions. One such solution may be bioplastics.

Most of the plastic you'll find around our campus is not the common plastics you may be used to–the number 1 plastic PETE (polyethylene terephthalate), or the number 2 plastic HDPE (high-density polyethylene). Instead, they're marked with a number 7, a broad category of "other" plastics. In the case of the many single-use plastics on Pitt's campus, it means they are made from bioplastics. Bioplastics are partly or completely made from biomass sources like sugarcane or corn, or microbes such as yeast[3]. In theory, bioplastics should be able to break down faster than plastic and cause less damage doing so, while providing the same flexibility, strength, and longevity as petroleum-based plastics. This would provide an easier transition for consumers, whose change in plastic usage would only be in the materials from which they are made.

There are two main types of bioplastics: polylactic acid (PLA), typically derived from corn or sugar cane, and polyhydroxyalkanoate (PHA), made by microorganisms[4]. To make PLA, corn or sugar cane is dissolved in hot water and sulfur dioxide to break it into smaller components: protein, starch, and fiber. Starch is the desired product, as it is a long polysaccharide consisting of sugar monomers. When mixed with citric acid, starch joins to form longer polymers, which can then be used to manufacture plastic[4]. PLA plastic is commonly used to replace polyethylene, polystyrene, or polypropylene, and breaks down more easily than PHA[4]. To make PHA, microbes (typically genetically engineered) are put in carbon-rich environments and deprived of nutrients like nitrogen and phosphorus. This causes the microbes to make carbon reserves, which results in polymers like those in petroleum-based plastics[4]. PHA is most widely used in medical applications[4].

Compared to traditional plastics, bioplastics seem to be more sustainable. Life cycle assessments on different plastics found that the overall energy usage and damages to respiratory health associated with manufacturing are lower for bioplastics than those of non-bioplastics. The same assessment determined that bioplastics can also be biodegradable—at least, more so than non-bioplastics—and they emit fewer carcinogenic chemicals[5]. The feedstocks for bioplastics are also renewable and sourced locally instead of overseas, which reduces energetic costs, emissions, and keeps us from depleting nonrenewable resources. Bioplastics also reduce our reliance on fossil fuels, which is important in transitioning away from a dependence on nonrenewable resources and lowering our carbon footprints. Thus, bioplastics adhere to many of the principles of green chemistry and design. While bioplastics rank high in terms of green design, they are not a perfect solution to our overuse and mishandling of plastic, and they may be like traditional plastic in terms of environmental damage. The same life cycle assessment found that biopolymers pose risks to increases in eutrophication (excess nitrogen and phosphorous in bodies of water, leading to excess plant growth and depletion of oxygen in water) and eco-toxicity associated with their production[5]. Much of these risks are due to the feedstocks (corn and sugarcane) themselves, which are grown with pesticides and fertilizers; the writers suggest that feedstocks could be limited to those grown without these chemicals, and that it may improve the impact score of such plastics.

If bioplastics are not a good solution, then what is? The most important change that needs to be made right now is how we handle our plastic waste and stricter adherence to green design principles in manufacturing. When production of traditional plastics closely adheres to green design principles, they show lower life cycle assessment impact scores, meaning that they are less damaging to the environment[5]. With stronger regulations on plastic manufacturers at each stage of production—from the extraction of crude oil to distribution—we can lessen the damage that plastic makes before it reaches consumers. An overhaul of existing recycling programs is also necessary, so that a circular economy can be created for plastics products[7]. This means that, ideally, all plastic sold would be remade into pellets that can then be used to make new plastic products. If the world were successful in this massive overhaul of our plastics economy, as well as made a few other changes—like wider use of paper or compostable material, designed products for effective recycling, upscaled recycling collection efforts in moderate-to-low-income countries, and ended the export of plastic waste—it is estimated that plastic waste could be reduced by around 80%[7]. The solution to our plastic problem is not a new plastic—it is a new approach to the millions of tons of plastic waste we've already created, and the millions more we'll create if nothing changes.

For References, please see 107 CHVRN

Chemical Innovation in Nanoscience:

Why the American Chemical Society (ACS) Thinks We Should All Know About It

By: Victoria Zerbach, *Newsletter Editor*

In the last two decades the field of nanoscience and nanotechnology has expanded exponentially. The concept of nanotechnology was first introduced in 1959 by American physicist and Nobel Prize laureate Richard Feynman when he envisioned machine-like construction at the molecular level. But would you believe that nanoparticles and nanoscale structures have been used by humans as early as the fourth century AD? An outstanding feat of glass artistry from the Roman Empire, the Lycurgus cup, possesses the unique quality of dichroism. The cup appears green under direct light, and red-purple when light shines through it. The two colors are due to silver-gold nanoparticles of diameter 50-100 nm. The green color is linked with light scattering by colloidal dispersions of the silver nanoparticles. While the red-purple color is due to light absorption of the gold nanoparticles.

In the 21st century we are able to understand this phenomenon because of the development and implementation of transmission electron microscopy (TEM) and X-ray analysis. Thinking about "seeing" down to the atomic level makes me nerd-out in the most radical way. And the awesomeness of nanoscience isn't something we just have to read about. Have you heard about the Nanoscale Fabrication & Characterization Facility (NFCS) in the basement of Benedum Hall? This summer I was thrilled to have the chance to take TEM images and see how atomic force microscopy (AFM) works in the NFCS. And did you know, there are multiple labs in the Pitt Chemistry Department doing work on the nanoscale? In the basement of Chevron you can find students studying interfacial charge transfer and chiral induced spin selectivity in Dr. Waldeck's lab. I suggest reading the posters on the 9th floor to learn more about metal organic frameworks and nanoparticle superstructures being designed in Dr. Rosi's lab. Check out the chem faculty bios on the department website. You might be surprised how interested you are in what people are studying. Plus, you can find a never ending list of professors involved in nanoscale science at *nano.pitt.edu/research*. As Pitt students you have the awesome opportunity to get involved in research in almost any area you might be excited about. That's a reason why you made the right choice when you committed to Pitt.

The Pitt chemistry major offers an American Chemical Society (ACS) approved curriculum in which the students can pursue an ACS Certificate. An ACS-approved education offers a broad-based and rigorous curriculum that provides students with the tools to become effective professionals. This means that what we learn will help us be better chemists who have the intellectual, experimental, and communication skills to effectively do the job. Recently, the ACS guidelines were updated to require exposure to nanoscale chemistry in undergraduate education. The field of nanoscience has grown greatly. It would be highly surprising if you never ran into a situation where a familiarity with nanoscale systems might come in handy, especially since a large percentage of new research is in nanoscience. Furthermore, nanotechnology has important applications in microbiology and medicine. Interstitial injection of nanoparticles is a preferred method for targeted tissue treatments. And a great number of efforts are being made to treat solid cancer tumors using new “stealth” technologies for passive accumulation of injected nanoparticles. Additionally, nanotechnology is used to do cool things like capture carbon dioxide. Carbon capture is a growing endeavor to harvest excess carbon dioxide in the atmosphere and prevent more CO_2 from escaping factory flues. Whether you are studying chemistry, biology, or neurology, you’re pre-med or pre-dental, nanotechnology and nanoscience should be important to you.

For References, Please see 107 CHVRN

October Drug of the Month: Dupixent (Dupilumab)

By: George Fritze

Hello all! My name is George Fritze and I will be your pharmaceutical contributor for the Pitt ACS newsletter this semester. I am a junior chemistry major from a small town outside Philadelphia (how original :///) and I will be writing about every type, class, and category of drugs. This insert was inspired by the barrage of drug commercials which you see every day. From the goofy names to the funny commercials and the seemingly never-ending list of side effects, the actual purpose of most commercial drugs is lost on audiences, despite the somewhat groundbreaking science behind them. I hope I can capture your interest and hopefully help you learn a little something new this semester.

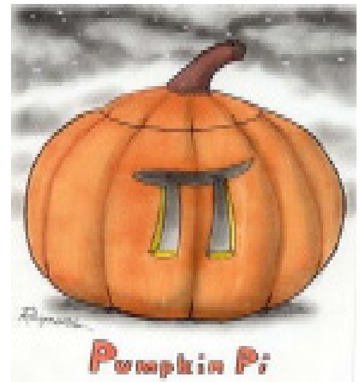
This month's drug is… drumroll please… Dupixent! Dupixent is a monoclonal antibody injection used to treat atopic dermatitis (eczema), asthma, and chronic rhinosinusitis with nasal polyposis. For all those who have not completed a graduate degree in pharmacology, this essentially means Dupixent is a prescription injectable pen containing ingredients that bind to and block proteins responsible for causing inflammation. These proteins are called interleukins and are produced en masse when the body detects allergens or undesirable foreign substances. This interleukin blocking ability makes Dupixent extremely effective against asthma, eczema, and a variety of other allergen-driven inflammation disorders. These conditions cause the immune system to overreact to very small changes in external stimuli and unnecessarily flood the bloodstream with interleukins, causing inflammation of the lungs, skin, and often a buildup of mucus.

Interleukin 4 and 13 are blocked by Dupixent using monoclonal antibody technology. The antibodies found in the injection bind to TH2 cells, block the activation site which would usually signal a need for interleukin, and hence, stop the unnecessary production of Interleukin 4 and 13 which causes inflammation. This technology allows Dupixent to block inflammation at the source, as opposed to the typical “band-aid” solutions such as steroids or bronchodilators which just help reduce the effects of inflammation.

While this all sounds very biological, the process of producing monoclonal antibodies requires a variety of techniques familiar to the chemistry classroom. For example, chromatography is typically used to purify and extract the antibodies from their in-vitro biological mediums. Fused mice T-cells produce the antibodies. Once enough are made, the antibodies sit among a solution of proteins, nucleic acids, lipids and many other biomolecules that are then sorted through with ion-exchange chromatography. Chromatography is a technique used to separate out different components of a mixture by taking advantage of their inherent chemical properties. For example, ion-exchange chromatography uses the specific pI of a substance to separate it from the other components. pI(-log(I)) is a measure of the pH of a solution in which the target molecule has a neutral charge. Under highly acidic conditions (low pH), a protein will be positively charged, and vice versa under highly basic conditions. Ion-exchange chromatography is done at the pI of the desired molecule, where the antibody is the only molecule in the solution with no charge. Therefore, during the separation process, all the unwanted proteins and biomolecules remain stuck to the positively or negatively charged resins of the chromatograph, while a solvent allows the neutral antibody to flow right through. This astounding chemical process allows pharmaceutical producers to filter very pure antibodies out of a slew of other biomolecules. Without it, Dupixent would not allow thousands of users to live every day worry free from inflammation.

Our October Schedule

Everyone is welcome to attend our weekly ACS-SA meetings. Every Friday at noon we get together in 150 Chevron Science Center to hear interesting talks, learn more about science and enjoy each other's company. Come join us for all of the following meetings.



October

07 National Chemistry Week Preparation
"Chemistry Is Out of This World"

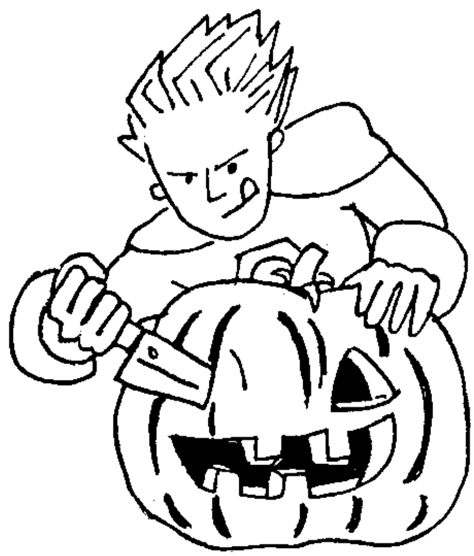
14 Fall Break- NO MEETING

21 All About Registration – *with Dr. George Bandik*

28 Pumpkin Painting on the Patio!

Halloween Pumpkin Fest

Come join the fun this October 28, 2022 as we drink apple cider and paint pumpkins on the patio in front of Chevron. Bring candles, dress up or do other Fall like things as the mood strikes you. BYOB (bring your own **blankets**...preferably lannel since we have a theme going and all). Come to a meeting or see George with suggestions or for more details.



Who's This <u>BEN</u> <u>Guy</u>, Anyway??!!

Benzoyl Peroxide the Free Radical Man (affectionately known as Ben) is our ACS-SA mascot. You have probably seen him around the chemistry department and on our yearly ACS-SA T-shirt. From now on when you see Ben, think of the ACS-SA. Why not come to a meeting to learn more about what we are all about. Fridays at Noon in 150 CHVRN.

SOME COURSES JUST FOR YOU...

If you are looking or something new and different this term, why not try one of the following courses being offered this coming Spring Term (2234).

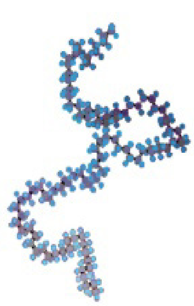
CHEM 1000
Mathematics for Chemists

THIS COURSE OFFERED THROUGH THE CHEMISTRY DEPARTMENT IS STRONGLY RECOMMENDED IN PLACE OF MATH 240-CALCULUS 3. IT IS OFFERED BOTH FALL AND SPRING TERMS. IF YOU HAVE ALREADY TAKEN MATH 240 YOU HAVE MET THE MATH REQUIREMENT FOR THE MAJOR.

Mathematical methods, in particular linear algebra and differential equations, are important in many areas of chemistry. This course provides a background in those and other mathematical methods that will be used in subsequent Physical Chemistry courses. The course will begin with a brief look at topics currently covered in Math 240-Calculus 3 that are important for chemists. It will them move on to linear algebra and look at topics such as systems of linear equations, matrices, determinants, eigenvalue problems and basis sets. The course will finish with a look at important types of differential equations (DEs), including first order DEs, linear systems of DEs, higher order DEs. The material covered in this course will better prepare our majors for their advanced work in physical chemistry.

CHEM 1600
The Synthesis and Characterization of Polymers

What makes really long molecules behave differently



from short ones? How can it be that everything from your socks to your laptop is made from polymers? What changes must you make in a polymer to go from making bullet-proof vests to making teddy bear fur? Did you know that every time you paint a wall or use super-glue you are doing polymer chemistry? In this course you will get an overview of all aspects of polymer science including synthesis (you need 99.9% yields to make polymers!); purification (you can't, so you have to make them right the first time); characterization (how can you figure out if your polymer weighs 10,000 or 1,000,000 g/mol?), thermal properties (you need to know that your plastic flip flops won't melt on hot pavement) and mechanical properties (elastic polymers make skinny jeans; rigid ones make motorcycle helmets—you don't want to mix them up!). Bonus: When you make a polymer in lab, you get to play with it!

A Few Important Reminders:

Chem 1140-Preparative Inorganic Chemistry is our advanced inorganic laboratory course offered each Spring Term. **Chem 1130-**Inorganic Chemistry is a pre or co-requisite for this course. If you are working towards an ACS-Certified degree, this course is a degree requirement.

If you have wondered about what goes on the upper floors of our building you might want to consider registering for **Chem 1700**. This one credit seminar course allows two different faculty members each week to speak on their own research interests. Over 70% of our graduating seniors in Chemistry participate in our undergraduate research program and this course is a great way to learn more about your options and your department.

Finally, if you are interested in pursuing an honors degree in Chemistry the requirements students must have are:

(a) an overall QPA of 3.00 or better

(b) a chemistry QPA of 3.25 or better

(c) have completed at least 2 credits of Chem 1710-Undergraduate Research

(d) completed Chem 1711-Undergraduate Research Writing.

Good luck as you strive towards academic excellence!

PITT PHARMACY EARLY IMMERSION DAY

SATURDAY, OCTOBER 22, 2022
FROM 1 - 4 PM
AT SALK HALL

SCAN QR CODE TO SIGN UP!

JOIN US FOR:

- ✓ Information sessions
- ✓ Tours
- ✓ Student panels
- ✓ And more!

For more information contact:
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