CHEM MAJOR NEWS

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

Volume 28, Issue 2 **October 1, 2021**

REGISTRATION

SET DATES:

October 15: Fall Break- No Classes!

October 25: Registration begins for Spring Term 2224 based on earned credits. You will receive your registration appointment from the Registrar.

October 28: Add/Drop begins for Spring Term 2224

October 31: Happy Halloween!

November 11: April 2022 (2224) graduation applications due in 140 Thackeray Hall.

November 21: Thanksgiving Recess. NO CLASSES!!
December 18: Have a great Holiday!

IMPORTANT: WHEN SHOULD YOU SEE YOUR ADVISOR?

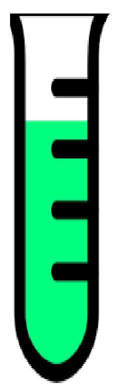
Advisees who already have a permanent advisor should make their registration appointments with that advisor on or after October 15. Remember to bring a copy of your academic record with you to this meeting.

Advisees who (via an email to be sent October 01) were asked to select their permanent advisors should do so after October 07. See George Bandik or LaShawn Youngblood 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.

2021-2022 ACS-SA Officers and Staff

Sarah Kulp-*Co-President*
Taylor Tomlinson-*Co-President*
Alex Crane-*Co-Vice-President*
Parker Staub-*Co-Vice-President*
Kate McCourt-*Co-Secretary*
Lauren Nedrow-*Co-Secretary*
Tyler Augi-*Co-Treasurer*



Jack Levickas-*Newsletter Editor*
Ari Freedman-*Technical Wizard*
Molly Nagle-*Senior Affairs Committee*
Franco Catalano -*Co-Treasurer*
Jacob Costantino-*Outreach Coordinator*
Paul Ghantous-*Outreach Coordinator*
Quincey Johnston-*Green Chemistry Contributor*

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

The Change to Electric: The Benefits, The Challenges, and the Tipping Point

Written by: Jack Levickas, *Chem Major News Editor*

With issues like global warming and environmental catastrophe quickly approaching, the change from gas powered cars to electric cars seems like an absolute necessity. The benefits of moving our civilization's transportation methods towards electric are abundant. The first and most clear is the issue of global warming. In 2019, the EPA reported that 29% of greenhouse gas emissions were a result of transportation. At nearly one-third of the total greenhouse gas emissions this makes transportation the largest contributor. Reducing this figure may not solve the issue entirely, but this is only one of the benefits of making the switch. The next major benefit of switching to electric is the reduction of maintenance required. With electric engines, oil changes and many other types of engine work will become obsolete, significantly reducing the cost of owning a car. Electric engines also cause much less wear on brakes, reducing the cost of owning, but also reducing the amount of automobile accidents. Another reason to make the change is simply that it is time to move on. For thousands of years our civilizations have been rapidly improving their technology, and it is vital that this trend continues. The first combustion engine was created almost 150 years ago, for reference there were still only 38 states in the United States at this time. The benefits of switching to electric vehicles are abundant, but the change does not come without challenges.

The major challenge of the change is the cost of developing and producing electric vehicles. The technology is rapidly evolving, and the cost of batteries is quickly dropping, but there is still a lot of progress that needs to be made. Automobile companies appear to be racing toward a solution, but until that solution is found it will be difficult for the electric car owning population to truly take off. In addition to the challenges faced by producers, there are still challenges faced by those who currently own electric vehicles. The first of these is the cost. While the price gap is quickly closing, an electric car still typically costs around $10,000 more than its gas-powered counterpart. This kind of price gap is not something that the common person is ready to overlook so easily. The next biggest problem consumers face is the charging time and range. With a gas-powered car, a person can simply spend about five minutes at a pump, then drive for hundreds of miles without needing to refuel. With electric cars, it could take up to twenty hours to fully charge, then only allow for about one-hundred miles of driving. With these problems still facing consumers and manufacturers, the age of only electric cars on the road still seems to be at least a few years away.

In 2021, it may be difficult to weigh the benefits of owning an electric car against the issues and find yourself purchasing one, but the gap is quickly closing. Each year more models become available, in both affordable and luxury ranges, and the desire to make the change seems to exist for both manufacturers and consumers. It is only a matter of time before we are looking at gas-powered cars in the same way that we look at the telegraph, the record player, and bell-bottom jeans: as relics of the past.

For references, see the Green Chemistry insert page.

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 (2224).

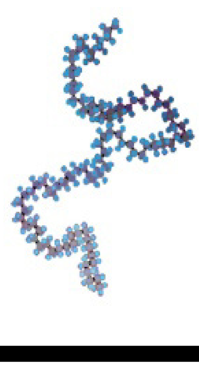
CHEM 1000
Mathematics for Chemists

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

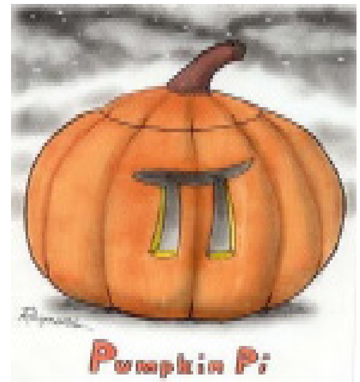
(b) a chemistry QPA of 3.25 or better

(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!

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

1 All About Registration -*with Dr. George Bandik*

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

15 Fall Break- NO MEETING

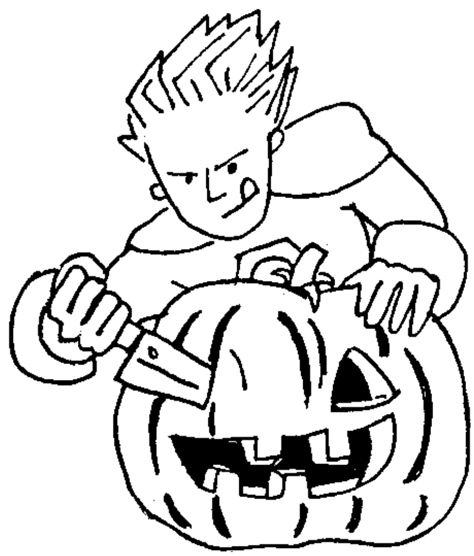
22 All About Registration – *with Dr. George Bandik*

25 Pumpkin Painting on the Patio!

29 Health Professions Round Table Discussion

Halloween Pumpkin Fest

Come join the fun this October 22, 2021 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 flannel since we have a theme going and all). Come to a meeting or see George with suggestions or for more details.



Who's This BEN Guy, 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.

What is a virus?

Written by: Michael Kosky

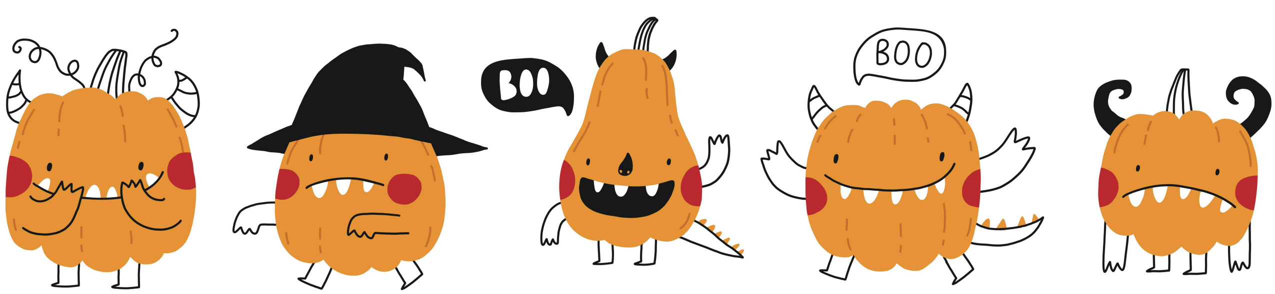
This is the second in an on-going series about the COVID-19 pandemic. Please look for future articles in upcoming editions of the Chem Major News.

Before discussing COVID-19, it is important to know and understand what a virus is and how they function in relation to other pathogens. Viruses are 1 of 5 types of pathogens that usually exist in 1 of 2 forms of genes called messenger ribonucleic acids (mRNA) or deoxyribonucleic acids (DNA). This genetic information is protected by combinations of proteins acting as a shell alongside some means to inject their genetic materials into the host cells. Viruses are incredibly small usually only measuring to be about 20 nm and up to about 500 nm in diameter.[2] Viruses can only be viewed under a microscope due to this incredibly small size. This allows viruses to be able to interact with a host through individual cells.

Viruses are not considered to be living organisms. Defining what is categorically alive has been a complex question, but the accepted criterion for living creatures is the ability to respond to the environment, grow, reproduce, control their internal reactions to survive, being made of cells, and the ability to pass on traits. Viruses do not fulfill the ability to maintain themselves to survive, are not made of cells, nor can they reproduce on their own. Viruses can only reproduce by injecting their own genetic information into the nucleus, where all our genetic information is stored, so the host cell can replicate the virus's information over our own.[3] The virus relies on other organisms' ability to replicate DNA to be able to spread their own material as far as they can. Once replicated, the host will usually become ill due to the foreign substances interacting with cells and from the body acting against the invader. Unfortunately, cells are not the best at replicating genetic information. There are mechanisms in place to check your own DNA for errors, but mistakes can still pass quality control. This causes viruses to have small, random changes in their genetic information that will either alter the effects of the virus or have no change at all. The incorrect material is then spread and replicated again until the information has been locked in to their genetic information and spread around.

There are 5 different classifications of pathogens that are used to categorize potential causes of illness: bacteria, viruses, fungi, protozoa, and worms. All these pathogens, except for viruses, function by entering the body and will either release foreign chemicals causing illness, try to consume products found within our bodies, or reproduce. These pathogens usually damage tissues, groups of cells, in the hosts by releasing toxins. Each pathogen is alive but is not small enough to enter cells. This is the critical difference between viruses and other pathogens as viruses cannot reproduce on their own. Additionally, viruses alter the function of cells so that cells will not perform their vital functions.[4] Most of the pathogens rely on the same mode of transmission in which an individual needs to come in direct contact with another infected host. This is not limited to direct physical contact with the infected person as the active pathogens can be exhaled and be inhaled by a non-infected individual. Additionally, pathogens can live outside of the body for a prolonged period and find their way into a new host if the person touches any potential openings into their body. These methods affect all the pathogens with the exception to worms where they function a bit differently in that eggs of the worms need to find their way into a host rather than small particles or creatures.

Viruses are usually talked about only in the context of how they affect humans, but they can affect any living creature. Their genetic information is encoded to be able to affect a target species due to millennia of evolving alongside their hosts. Categorization of Virus break them down into families based around whether they are DNA or RNA based and into their physical features.



The Green Bang

Written by: Quincey J. Johnston, *Green Chemistry Contributor*

With Homecoming Weekend officially in the books for 2021 and a stunning laser and fireworks show graced the skies of Oakland, one might start to wonder not only about how fireworks and pyrotechnics are made, but how they affect our environment, as well (especially since this year's laser and fireworks show was a bit warmer than years past).

Pyrotechnics themselves exist within their own little subgroup in the world of energetic materials. These energetic materials include a lot of well-known high explosives, like the undoubtably familiar explosive trinitrotoluene (TNT). These explosives follow the principle of intramolecular oxidation, and when ignited by the detonator via a shock wave, the hydrocarbon backbone is rapidly oxidized by either the nitro- or organonitrate groups within the molecule; this oxidation releases a large amount of energy and gas within an incredibly limited volume. In comparison, pyrotechnics (i.e. fire) are often compound cocktails that react exothermically upon their ignition and are designed to react more slowly in comparison to the explosives mentioned above; pyrotechnics are also designed to specifically produce light, color, heat, gas, smoke, sound, and motion. These outward observations are either created via electron transfers or via oxidation-reduction reactions, making the most paramount parts of any modern pyrotechnical device the fuel (reductant) and the oxidizer (allowing the combustion to not have to rely on atmospheric oxygen).[1]

Regardless of if you're working with explosives or with classic pyrotechnics, the colors you're able to observe are produced by the elements that compose them, taking advantage of the different flame colors different elements produce. Fireworks themselves also require the addition of metal salts as a means of a coloring agent in addition to the pyrotechnic mixture. Here's a breakdown for you:

- Sodium = yellow
- Strontium = red
- Barium = green
- Copper (in the presence of Chlorine) = blue

Some compounds, such as $Ba(NO_3)_2$ and $Sr(NO_3)_2$, are spectacular multitaskers, and can act as both a coloring agent and as oxidizers. Any white or silver effects you may observe from pyrotechnics is only a result of incandescence, which often results from burning metal fuels, such as magnesium and titanium, at incredibly hot temperatures.[1]

Now, this all sounds well and good, right? Well, maybe not so much. Fireworks in particular often rapidly emit large volumes of pollutants into the surrounding atmosphere, which causes extreme levels air pollution in some of the worst cases. Air pollution generated as a result of fireworks, specifically, can result in serious health problems, as well, because certain pollutants that are released, such as atmospheric particulate matter (PM) and sulfur dioxide, can collect in incredibly high concentrations and thus can cause acute respiratory ailments even with minimal exposure. Firework smoke plums also often contain a significant number of toxins, such as heavy metals and perchlorates, which can also cause serious damage to human health.

Though many controls are regulations are enacted around the world to reduce firework pollution, with some countries going so far as to ban the use and sale of fireworks, their use in traditional festivals and celebrations makes banning them outright incredibly difficult.[2]

So, what can we do to mitigate the various harms of pyrotechnic pollution? Work to reduce their pollution, to start![2] "Green" pyrotechnics generally works to avoid perchlorates and heavy metals, and should be made of compounds that are inexpensive, easy to synthesize, and nonhygroscopic. The reduction of smoke and particulate matter can generally be reduced by a higher nitrogen content, as it would thus decrease the amount of dinitrogen produced as a main product of the reaction. It also happens to make the pyrotechnics clearer, as smoke doesn't end up clouding the desired pyrotechnic effect with any solid reaction products. However, it is the cost of materials that holds us back here, as nitrogen-rich pyrotechnics simply cannot compare to the large-scale production of the fireworks we most often see today.[1]

1. G. Steinhauser, T. M. Klapötke, Using the Chemistry of Fireworks to Engage Students in Learning Basic Chemical Principles: A Lesson in Eco-Friendly Pyrotechnics. *ACS Publications* (2010) (available at https://pubs.acs.org/doi/10.1021/ed800057x).
2. S. Fan, Y. Li, C. Liu, Are Environmentally Friendly Fireworks Really "Green" for Air Quality? A Study From the 2019 National Day fireworks display in Shenzhen. *ACS Publications* (2021) (available at https://pubs.acs.org/doi/10.1021/acs.est.0c03521).

References for the 'Change to Electric'

Staff, MotorTrend. "The Auto Industry And EVs: Where We Are and What's Coming Nexter Years of Crying Wolf?" *MotorTrend*, MotorTrend, 26 Apr. 2021, www.motortrend.com/features/auto-industry-ev-electric-vehicle-progress-future/.

Castelvecchi, Davide. "Electric Cars and Batteries: How Will the World Produce Enough?" *Nature News*, Nature Publishing Group, 17 Aug. 2021, www.nature.com/articles/d41586-021-02222-1.

Research, Hearst Autos. "Electric Cars: Pros and Cons." *Car and Driver*, Car and Driver, 10 Nov. 2020, www.caranddriver.com/research/a32758614/electric-cars-pros-and-cons/.

Demuro, Doug, et al. "Electric Cars: Benefits and Drawbacks." *Autotrader*, 26 May 2021, www.autotrader.com/car-tips/electric-cars-benefits-and-disadvantages-208155.

EPA, Environmental Protection Agency, www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions.

"A Brief History of the Internal Combustion Engine." *A Brief History of the Internal Combustion Engine - _remembers | TÜV NORD*, www.tuev-nord.de/explore/en/remembers/a-brief-history-of-the-internal-combustion-engine/.

References for ‘What is a Virus’

Maxmen, A. Massive Google-Funded COVID Database Will Track Variants and Immunity. Nature 2021.

Size and shape. https://www.britannica.com/science/virus/Size-and-shape.

Virus. https://www.genome.gov/genetics-glossary/Virus.

Viruses: Structure, Function, and Uses. Molecular Biotechnology 1995, 3 (1), 75–75.