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

Volume 31, Issue 6 March 13, 2023

CHEM MAJOR NEWS

Fall Term (2241) Registration

March 17 Deadline for applying for August 2023 graduation (208 Thackeray Hall).

March 20 Fall Term (2241) Registration begins **based on credits earned**.

→ ***You will be notified of your registration time on your my.pitt.edu page.***

Advisees who already have a permanent advisor should make their registration appointments with that advisor on or after March 17 for Fall Term (2241).

Advisees who were asked to select their permanent advisors (via an email sent Feb. 1) should schedule their Fall term registration appointment with their new advisor after March 13.

New advisees who have declared chemistry as his or her major within A&S should make an appointment with Dr. George Bandik, Dr. Ericka Huston, or Dr. Michelle Ward after March 13 for Fall Term (2241) in 107 CHVRN.

Departmental Honors? Here's How...

Students who wish to graduate with Chemistry Department honors must satisfy four departmental requirements. Students must have:

(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 or

Chem 1720 - Undergraduate Teaching

(d) completed Chem 1711-Undergraduate Research Writing.

Good luck as you strive towards academic excellence!

2021-2022 ACS-SA Officers and Staff

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

Leprechaun's Pot of Gold at the End of the Rainbow
By Dhruthi Gundurao – Feature Writer

So, you may be wondering what happens when we find the leprechaun and his pot of gold on St. Patrick's Day?

Well, it's safe to say that there's a reason why this is the item we want to find in the leprechaun's pot. As the 79th element in the periodic table, gold is not only a pirate's most prized possession but also metal with a multitude of practical usages. From being a part of circuits to having the potential to treat cancer, gold is an element that is creating bridges between science and myth, new and old.

Shiny and malleable, gold is one of the most recognizable metals to exist. Chemically speaking, it is a transition metal to which many of its unique properties can be attributed. As a transition metal it has high electron density which interferes with the typical orbital sorting order of electrons thus allowing its electrons in the two outermost shells to be able to form bonds. This behavior is atypical of what is expected during bonding as only the outer most shell, the valence shell, of atoms are expected to interact directly in bonding. To form gold an incomprehensible amount of energy is required as it can only be formed in exploding supernovas or through the collision of incredibly dense stars. Due to this difficulty of formation, gold is a relatively rare metal, and this rarity is what has made gold so historically coveted.

Gold is considered to have shaped the course of history and it is often speculated that without it human history would have been much different. Nearly 5,000 years ago it is speculated to have washed up the Nile River into the Ancient Egyptian Kingdom where its malleability and purity made it a much-desired commodity particularly for decoration. As such over the course of various empires gold became a status symbol and more importantly driving humans to diplomacy, mass migrations and even genocide.

In present day, gold plays an active role in a variety of medicine and medical practices. Specifically with cancer treatments gold nanoparticles and their research is of particular utility as the radioactive isotope, Au-198, can be used to destroy a tumor by direct injection as the radiation can kill the tumor without much spill into the rest of the body. Even more interesting in 2012 a group of researchers found that nanoparticles of the gold radioactive isotope could be linked to a compound in tea to treat prostate cancer because the tea compound is attracted to the cancer cells which then keeps the gold attached while the radiation process goes on. Outside of these biological reactions, gold also works as a heterogenous catalyst in a multitude of chemical reactions and is even often dispersed onto nanoparticles to increase surface area for reactions.

Most interestingly revolutionary research on gold nanoparticles has been happening right here at Pitt in the Chemistry department as well as the Department of Chemical Engineering. In 2013 Dr. Scott Mao in a combined effort with UVM made some revolutionary discoveries on the mechanical reliability of gold in miniaturized devices varying from gold nanoparticles used in medicine and electronics to gold nanowires used for touch screen panels and solar cells. Thus, showing not only the practical utility of gold nanoparticles but also the continued interest in gold as an element of interest.

As my time as feature writer comes to an end, I hope that you have learned interesting applications of chemistry. Moreover, I implore you my fellow peers to explore these varying real-life applications of chemistry because whether we like it or not science is everywhere!

Signing off,
Dhruthi Gundurao

For references, please stop by CHVRN 107.

What Happened in East Palestine, Ohio?

By Sophie Bazydola – Green Chemistry Contributor

One month ago, news of a train derailment in East Palestine, Ohio slowly started to make national headlines. The derailment involved cars carrying up to 1.6 million pounds of hazardous chemicals in total, most of which entered the soil, water, or atmosphere through slow leaks or burning[1]. The accident is one of the largest environmental disasters in recent years. While residents were allowed to return in the week following the accident and clean-up and containment efforts continue in the area, many remain worried about the short- and long- term effects that the spill may have on the town's residents and the environment.

One major question following the accident was how the derailment of 38 train cars and a fire could have occurred[2]. Considering the high number of hazardous and flammable chemicals being carried by the train, one would expect better safety measures to be in place. The National Transportation Safety Board (NTSB) attributes the accident to a hot axle, which started to spark and catch fire. No alarm sounded to alert the crew of the train to take precautions or investigate. Representatives of the NTSB have said the accident was preventable, and as a result, Norfolk Southern, the operator of the train, is being held financially and legally responsible[2]. Still, many are calling on Norfolk Southern to take on higher safety standards to avoid another catastrophic derailment in the future.

Following the crash, the EPA listed six chemicals of concern following the spill: vinyl chloride, hydrogen chloride, phosgene, n-butyl acrylate, ethylene glycol monobutyl ether acetate, and 2-ethylhexyl acrylate[3]. Other chemicals involved include benzene, isobutylene, and polyvinyl chloride, though they are not believed to have reached the environment. Five tanks involved in the accident were carrying an estimated 900,000 pounds of vinyl chloride, making it the largest concern following the accident. The clean-up of vinyl chloride and the other chemicals was done through a control burn to avoid a possible explosion. Burning vinyl chloride poses further risks, as it breaks down into phosgene, hydrogen chloride, and carbon monoxide upon combustion[3]. Vinyl chloride and its combustion products are the most concerning contaminants from the crash, and next we'll look at why.

Hydrochloric acid is familiar to most people, and definitely familiar to anyone who has taken a chemistry course. In its gaseous form, it is a colorless to slightly yellow gas with a strong odor. It is an irritant of the skin, nose, and throat[4]. Hydrochloric acid usually contaminates the air. In the ground, it typically reacts with alkaline and buffer components of the soil, so it is unlikely to cause significant contamination. In the atmosphere, it is incorporated into cloud, rain, and fog. This leads to acid rain, which can cause damage to plant life if it occurs over a long period of time[5]. Overall, hydrochloric acid does not seem to be a huge concern for East Palestine and the surrounding area. It was not at detectable levels in the atmosphere following the accident and control burn, and no hydrochloric acid rain has been detected.

Phosgene ($COCl_2$) is a colorless gas and has a suffocating odor. It quickly decomposes in water, so water contamination is not an issue. However, it decomposes by gas-phase hydrolysis, an extremely slow process. As it decomposes, hydrochloric acid is produced, which could lead to acidification of water if phosgene is present at high concentrations[6]. Phosgene is an extremely strong respiratory irritant, primarily affecting the lungs. Very high exposure levels will often cause pulmonary edema. Phosgene has not been detected in East Palestine at levels above accepted concentrations, so it is likely not a huge concern for the residents or those living outside of East Palestine[7].

Much of the discussion about contaminants has focused on vinyl chloride. Vinyl chloride is the monomer for polyvinyl chloride (PVC), a type of plastic[8]. Vinyl chloride has been detected in water and air following the derailment, though not at levels that would cause great concern as they are, for the most part, below exposure limits[7]. Vinyl chloride is highly mobile in soil, which means it may reach and contaminate groundwater[8]. In surface water, vinyl chloride evaporates quickly, so it is not a long-term concern. Vinyl chloride does not accumulate in the environment and is subject to biodegradation and photochemical reactions, having a half-life of 1-2 days[8]. Vinyl chloride is toxic to humans and animals and is classified as a carcinogen. The effects on the liver are most understood, with even acute exposure having some effect[9]. Vinyl chloride exposure and contamination is definitely more worrisome than some of the other chemicals introduced to the environment by the derailment. So far though, no contamination of groundwater and wells have been detected, which is a good sign[1].

It is unlikely that East Palestine will ever fully recover from the disastrous environmental effects. Wildlife and residents of the town have been tragically affected. Residents have complained of chemical odors and physical symptoms such as headaches, coughs, and rashes[2]. They've also reported dead animals such as pets and livestock. Since the derailment occurred close to streams, the water was quickly affected. An estimated 3,500 fish died following the accident (as of Feb. 8)[2]. Even if the clean-up efforts are successful, those living near the spill will undoubtedly face mental and physical difficulties for the rest of their lives. We will not know the full extent of the damages caused until years from now, and it is unfortunate that civilians and the environment will have to pay for a rail company's negligence.

Sources:

1 Here's why it's hard to clean up toxic waste from the East Palestine train derailment
2 After the Ohio Train Derailment: Evacuations, Toxic Chemicals and Water Worries
3 East Palestine Train Derailment Air Monitoring Frequently Asked Questions
4 CDC Hydrogen Chloride
5 DCCEEW Hydrochloric Acid
6 Phosgene Health and Safety Guide
7 Roving Air Monitoring Results Summary Table
8 Technical Factsheet on: VINYL CHLORIDE
9 Toxicological Profile for Vinyl Chloride

March Drug of the Month: Tremfya(guselkumab)

By George Fritze – *Pharm Contributor*

As we reach the fourth edition of our drug of the month journey, we are looking at the tenth most advertised drug in the United States which aims to treat an often unrecognized yet common medical condition: plaque psoriasis. Just like some of the most advertised drugs in the US, this month's drug aims to fight internal inflammation from the source. Plaque psoriasis is an autoimmune disorder in which the body accelerates skin growth process to the point at which skin flakes off the body unusually rapidly. The result of this flaking skin is unsightly rashes seen throughout the body which can be painful or irritating. Globally, 2-3% of the population suffers from some form of psoriasis. While genetic factors are important in determining whether a person will experience psoriasis, there are a variety of other reasons such as stress, smoking, common skin injury, allergic reactions, and infections[1].

Janssen pharmaceuticals released Tremfya in 2017 as a subcutaneous injection intended for the treatment of moderate to severe plaque psoriasis. Using an autoinjector pen, a patient can administer a dose to their upper thigh or lower abdomen once every 8 weeks after an initially closer spaced 4 week starter dose. 70% of patients can expect to see 90% clearer skin after just 16 weeks into the treatment(that's only 3 doses)[2].

Tremfya works by blocking a protein in the body which is responsible for causing inflammation, especially of the skin. This protein is called interleukin 23 and is responsible for many unnecessary immune responses to small changes in external stimuli. As an "interleukin inhibitor", Tremfya actively blocks the binding site of the IL-23 molecule to the cell and prevents the cell from receiving the signal to trigger inflammation. However, what makes Tremfya particularly effective is that it has a combined mechanism of action and also binds to

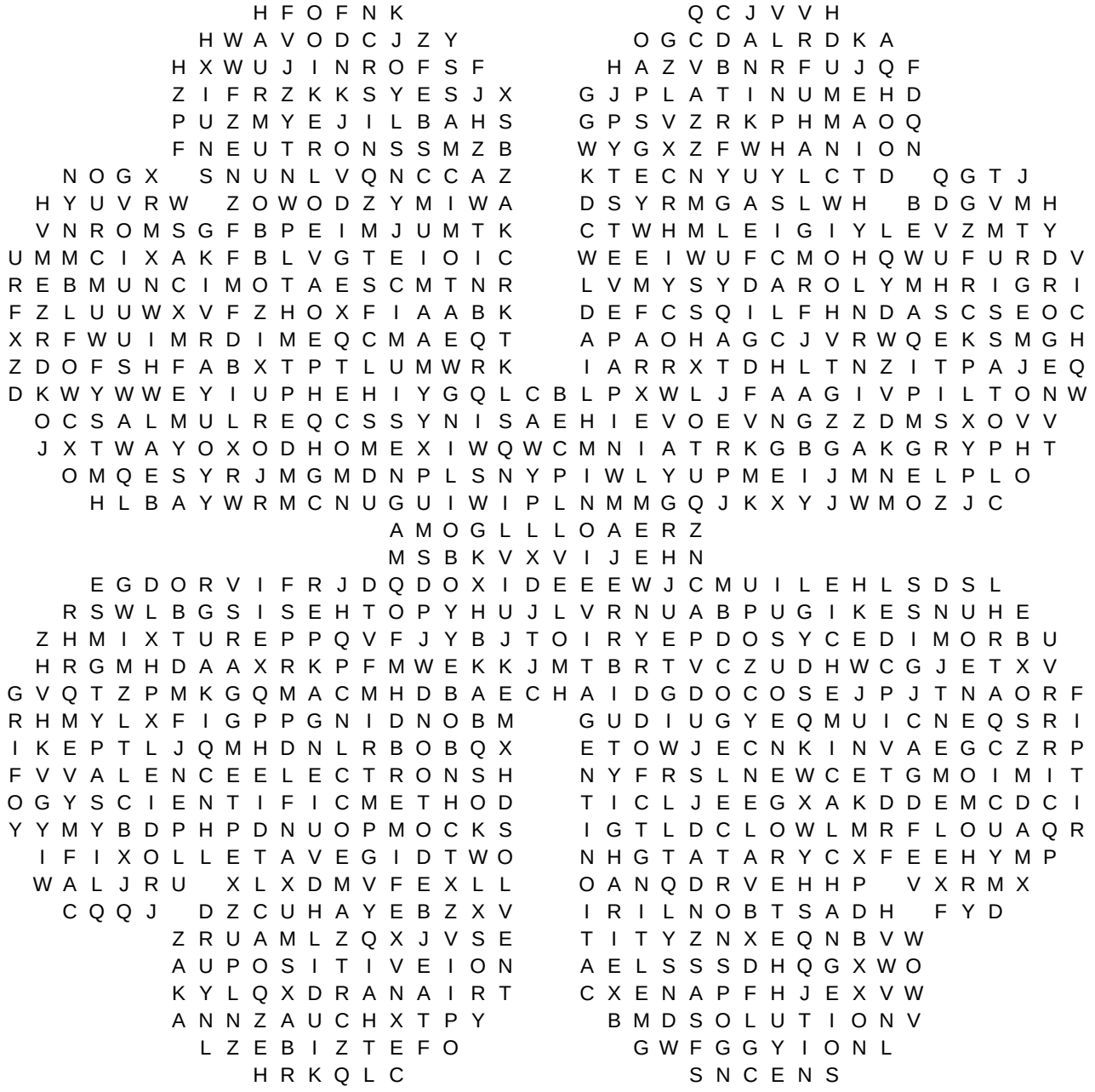
the cell itself that produces the IL-23 and can prevent it from spreading into its local tissue environment.

While Tremfya is among the most specific drugs we have discussed this semester, it is also one of the largest molecules. As a monoclonal antibody, this drug is made to mimic a natural antibody in the immune system and bind to corresponding receptor sites. Containing over 6000 carbon atoms, Tremfya is nearly identical to the structure of immunoglobin G1, a naturally occurring human protein. While much is known about the structure of immunoglobin G1, the complexity of the structure makes it nearly impossible to discuss its chemical properties in any meaningful sense. However, it is most definitely worthwhile to discuss the way in which these antibody treatments are becoming increasingly more available to the public, and how simple chemistry has greatly improved storage, production, and efficacy in recent years.

Monoclonal antibody modification has become an extremely important mechanism to boost the efficacy of these molecules within the body. As large chains of amino acids, scientists are looking to add “handles” to various regions of an antibody which can be done using relatively fundamental organic processes. Glutamic acid has carboxylic acids perfect for esterification. Cystine have thiol groups apt for amine linking. Lysine has amine groups suitable for nucleophilic reactions. All these characteristic structures associated with primary amino acid structure provides researchers with a multitude of opportunities to modify the antibody to a precise structure. This allows the biological aspects of the molecule to function properly in the body with synthetic and medicinal modifications tagging along for the ride. Tremfya stands as just one of the many prescription MAbs which can change people’s lives through this terrific scientific and chemical process.

For references, please stop by CHVRN 107.

WHAT YOU HAVE LEARNED IN CHEMISTRY



WORD LIST:

AMY BIHAG
ANION
ATOMIC MASS
ATOMICNUMBER
ATOMIC THEORY
BOILING
BONDING
BROMIDE
CATION
CHEMICAL CHANGE
CHEMICAL REACTION
COMPOUND
ELECTRONS
ELEMENT
EVA TELLO
GOLD
HELIUM
HETEROGENEOUS
HOMOGENEOUS
HYDROGEN
HYPOTHESIS
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LEAD
MAGNESIUM
MELTING
MIXTURE
NEGATIVEION
NEUTRONS
OXIDE
PHYSICAL CHANGE
PLATINUM
POSITIVEION
POTASSIUM
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SOLUTION
SOLVENT
STEVE PAPIN
VALENCEELECTRONS
VALENCY

CHEM 1310/2370: Synthetic Organic Chemistry

with an emphasis on Natural Products and Drug Discovery/Development

Fall Semester 2023
M & W @ 11:00-11:50 AM (2 credits)
Dr. Peter Wipf (*pwipf@pitt.edu*)

In this intermediate level undergraduate/introductory graduate level course you will be able to:

- Refresh sophomore organic chemistry principles and applications
- Learn about retrosynthesis and the chemistry of natural products
- Study examples for rational drug design and disease-relevant structure-activity relationships, including the drug discovery of anticancer agents
- Learn about scale-up and the development of green chemistry principles in drug pilot plant synthesis and production

Who will benefit:

- Chemistry, Chemical Engineering, Bioengineering, Biology, Neuroscience and Pre-Med students who would like to deepen their organic chemistry understanding and explore complex molecule synthesis and drug discovery principles and applications
- Chemistry graduate students who are interested in organic chemistry and synthesis and want to be well prepared for Chem 2320.

ACS-SA Schedule for the Spring Term

MARCH	**17**	**It's Registration Time Again**
	24	**Dr. Scott Crawford, NETL**
	31	**Open Meeting**
APRIL	**07**	**Officer Nomination for 2023-2024**
	14	**SENIOR SEND-OFF - Officer Election**
	21	**SENIOR FAREWELL**

CAMPAIGN! VOTE! WIN!

Have you ever wanted to lead a nationally acknowledged award winning student group? If you aspire to such things why not consider running for an office with our ACS-SA group. We boast some 100 + members and have been recognized for the past 30 years by the national ACS for outstanding programing.

Nominations for our 4 elected positions: president, vice president, treasurer, and secretary will be held on April 8th at our weekly meeting, 12:00 Noon in 150 CHVRN, and elections will be held on April 15th.

We will need to fill several volunteer positions. We need a Green Chemistry Contributor and a Newsletter Editor. We also need a Tech Wizard and Outreach Coordinators. If you are interested in any of these positions, please let us know.

SMALL GRANTS FOR YOUR PROJECTS.

The A&S Office of Undergraduate Research, Scholarship and Creative Activity is offering small grants for your individual research or teaching projects, presentations or creative endeavors. These grants of up to $500 are available for the following kinds of expenses:

research/project supplies
travel if you are going to present a paper at a conference or perform in an artistic endeavor.

To apply for a research/creative endeavors or travel/ presentation grant, you must:

1. Find a faculty sponsor for your project.
2. Complete the application form. Include a detailed description of your project or travel plans and budget.
3. Return the signed form to the Office of Undergraduate Research, Scholarship and Creative Activity, 209 THACK.

Happy St. Patrick's Day!!