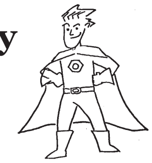
CHEM MAJOR NEWS

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



Volume 29, Issue 1 **September 3, 2021**

American Chemical Society Student Affiliates
University of Pittsburgh

As another school year begins, we would like to welcome everyone back, but especially the incoming class of 2025! As you begin to navigate Pitt, know that there are so many smiling faces ready to help you find your way. The American Chemical Society (ACS) specializes in making friendships with fellow science lovers through weekly meetings that explore future career paths, volunteering, networking, and (family friendly) social events.

Whether this is your first or last year at Pitt (or somewhere in between), you've all been to Chevron by now. With it's non-existent cell phone service and brutal architecture, Chevron will grow near to your heart by the year's end. Although you may miss all of the zoom malfunctions and attending lectures from your couch, we hope you will make great memories on campus this year. While eating dinner during class and Online shopping during lab are now pastimes, we here at the ACS empathize and will help you adjust back by providing something to munch on each week. Prepare to meet some great people, including George, through the ACS, if you haven't already.

We are excited to present you with a great lineup of speakers at our meetings this fall! Our plan is to hold in-person, weekly meetings on Fridays at 12:00 P.M. in 150 Chevron, but like scientists, we will adjust if things don't go according to plan. We hope to continue our ACS tradition of snacks and teats as guidelines allow.

Since September is the time to find new organizations on campus, be sure to check out the American Chemical Society (ACS) group. We are open to all majors, and you can fill out the included application if ACS is the right fit for you. Drop by our Welcome Back meeting and ask a board member any questions you may have. As the semester starts, good luck in all your classes and ask for help when you need it! Be sure to check out our free chemistry tutoring on the balcony and sign up if you'd like to volunteer to tutor chemistry classes. Remember to show yourself some compassion-you've been through a lot!

Hail to Pitt!

Taylor Tomlinson & Sarah Kulp

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*

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

Coding COVID-`19: Breaking Down Fundamental Features about COVID-19

Written by: Michael Kosky

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

For the past year, we have all been battling against the global pandemic that had begun in late 2019. A lot of information has been thrown around regarding the Severe Acute Respiratory Syndrome Coronavirus (SARS COVID-19) to the point where misinformation has been running rampant about COVID-19 across many communities.[1] Alongside misinformation is too much information, many articles do not seek to breakdown the fundamentals of what COVID-19 is as they expect the audience to know a fair deal about the science surrounding viruses. However, I seek to answer the fundamental questions people have about the virus like: What is it? How is it different from any other virus like the flu? What is a coronavirus? How does a vaccine help against COVID-19? Are the vaccines any different from other vaccines? What is a pandemic? We have all heard the jargon thrown around a lot but never stop to think about what the terminology means, what makes the COVID-19 different from other viruses or other pathogens, a generic species that causes disease. The goal of these articles is to provide simple, clear answers to these questions to help people understand the core features about the virus and to provide a base cin case another virus starts undergoing the same coverage as COVID-19.

What makes me qualified to discuss these matters is that I have been pursuing a degree in chemistry for several years now with a focus in biochemistry leading me to have taken several biology courses along the way. I have learned a great deal about how our genes function to continue our survival as I have taken a course specifically about genetics providing a great deal of insight about how our genes replicate and function. I firmly believe that making the information surrounding the virus as widely available as possible is key for everyone taking the necessary precautions and to lessen the fear surrounding the mysteries of the virus. I will start at the beginning going over what a virus is and what makes them different from other diseases.

For references regarding this information please go to Chevron 107.

Green Chemistry

Green chemistry is a heavily studied and funded field in science ever since our very own Pittsburgher, Rachel Carson published her extremely successful and influential book Silent Spring, changing the way communities and industries view their impact on the environment for the following decades.[1] Green chemists and engineers are working to take their research and innovations out of the lab and into the board room through the creation of viable industrial products that can be embraced by today's industry leaders including but not limited to, reducing waste, improving energy efficiency, replacing hazardous substances, switching to renewable feedstocks, and designing products which degrade into innocuous chemicals after they have fulfilled their role; however, even with such great advancements in technology and discovery, more than 98% of all organic chemicals are still derived from petroleum.[2]

The Twelve Principles of Green Chemistry[3]

1. **Prevention**—It is better to prevent waste than to treat or clean up waste after it has been created.
2. **Atom Economy**—Synthetic methods should be designed to maximize the incorporation of all materials used in the process into the final product
3. **Less Hazardous Chemical Syntheses**—Wherever practicable, synthetic methods should be designed to use and generate substances that possess little or no toxicity to human health and the environment.
4. **Designing Safer Chemicals**—Chemical products should be designed to affect their desired function while minimizing their toxicity.
5. **Safer Solvents and Auxiliaries**—The use of auxiliary substances (e.g., solvents, separation agents, etc.) should be made unnecessary wherever possible and innocuous when used.
6. **Design for Energy Efficien** —Energy requirements of chemical processes should be recognized for their environmental and economic impacts and should be minimized. If possible, synthetic methods should be conducted at ambient temperature and pressure.
7. **Use of Renewable Feedstocks**—A raw material or feedstock should be renewable rather than depleting whenever technically and economically practicable.
8. **Reduce Derivatives**—Unnecessary derivatization (use of blocking groups, protection/ deprotection, temporary modification of physical/chemical processes) should be minimized or avoided if possible, because such steps require additional reagents and can generate waste.
9. **Catalysis**—Catalytic reagents (as selective as possible) are superior to stoichiometric reagents.
10. **Design for Degradation**—Chemical products should be designed so that at the end of their function they break down into innocuous degradation products and do not persist in the environment.
11. **Real-time analysis for Pollution Prevention**—Analytical methodologies need to be further developed to allow for real-time, in-process monitoring and control prior to the formation of hazardous substances.
12. **Inherently Safer Chemistry for Accident Prevention**—Substances and the form of a substance used in a chemical process should be chosen to minimize the potential for chemical accidents, including releases, explosions, and fires

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3. *Principles of Green Chemistry and Green Engineering. https://www.acs.org/content/acs/en/greenchemistry/what-is-green-chemistry/principles.html (accessed August 11, 2016)*

2201 Tentative ACS Fall Schedule

September

3 Officer Meeting

10 Welcome Back Meeting– *with pizza if possible*

17 Career Services – *with Emily Bennett*

24 Graduate School Talk – *with Dr. Jennifer Laaser*

October

1 Registration Talk-*with George* and Fall Birthday Celebration

8 National Chemistry Week Preparation

15 Fall Break

25 Pumpkin Painting on the Patio!

29 Healthcare Professions Roundtable Discussion

November

5 Exploring Undergraduate Opportunities in Chemistry

12 Industry in Pittsburgh – *with Ron Debiec, Covestro*

19 Green Chemistry Seminar – *with Dr. Nesta Bortey-Sam*

26 Thanksgiving Recess

December

3 Preparing for Saturday Sciences (to be held Saturday Dec 4, 2021)

10 Final Exam Send Off

Aromatic Addiction: How Nicotine Works

By: Jacob Kuzy

Though cigarette smoking has declined significantly in the United States over the last 50 years, tobacco continues to be one of the most widely used drugs.[1] According to the WHO, there are an estimated 1.3 billion tobacco users worldwide which includes smokeless forms.[2] This represents a major healthcare challenge due to the harmful effects of regular tobacco usage, most notably, various types of cancer. Nicotine is the main addictive compound in tobacco, binding to nicotinic acetylcholine receptors (nAChRs) in the brain as well as other tissues.[3] While not totally benign, nicotine is considered to have less detrimental effects on health compared to other compounds in tobacco.[2] In order to understand tobacco consumption, the properties and mechanisms of nicotine are an enticing target of biochemical research.

Chemical Properties:

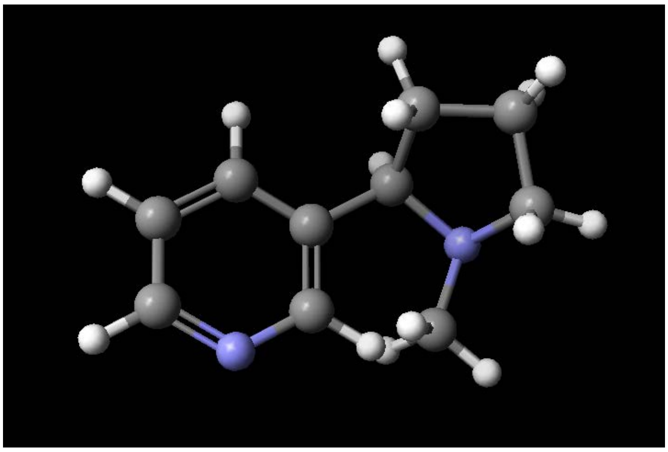

Figure 1: Nicotine, unprotonated

Nicotine or **3-(1-methylpyrrolidin-2-yl)pyridine** is an alkaloid most commonly found in the leaves of tobacco plants, but it is also present in trace amounts in other plants; it is thought to act as a botanical insecticide.[4,5] In the past, nicotine has been used as an insecticide and is toxic to humans in high doses. Alkaloids are defined as naturally occurring organic molecules containing a nitrogenous base.[3] Molecules such as morphine and ephedrine are also alkaloids.[5] Nicotine has two nitrogen atoms, one within a pyridine ring (6-membered ring farthest left) which is connected to a pyrrolidine ring. The pyrrolidine ring contains the tertiary amine- the most basic moiety in the molecule. Nicotine is thus classified as a weak base with a pKa of 8.0 which becomes important in the movement of nicotine throughout the body.[6]

Nicotine is also an optically active molecule, and the vast majority of nicotine in commercial tobacco appears as the S-enantiomer. When tobacco is ignited and smoked, some *(R)*-nicotine is found due to racemization during pyrolysis (decomposition from burning). *(S)*-nicotine is the biologically active form which is able to bind to nicotine acetylcholine receptors (nAChRs) in the brain.[6]

Physiological Mechanism:

Nicotine is most often inhaled as smoke through the lungs or chewed and absorbed through mucus membranes in the mouth.[3] In the lungs, nicotine is best absorbed in its unprotonated form so that the relatively non-polar molecule can pass through membranes from the lungs into the bloodstream. Chewing tobacco and snuff usually is sold in a more alkaline pH when more nicotine is protonated to allow absorption through oral mucosa.[3] The compound can also be absorbed through application to the skin with nicotine patches. This process explains the phenomenon of nicotine poisoning in tobacco harvesters exposed to wet tobacco leaves.[3]

When absorbed by the lungs as smoke, nicotine first passes into the pulmonary venous circulation headed towards the heart.[7] At typical blood pH of 7.4, nicotine is approximately 70% ionized and 30% un-ionized.[6] Though chewing tobacco is absorbed more quickly in the mucosa of the mouth, the rise in brain nicotine levels is slower. Only 2-8 seconds after inhaling from a cigarette, nicotine has reached the brain as well as several other tissues.[3] This rapid absorption time is a contributing factor to the addictiveness of cigarettes in particular. Nicotine binds with the highest affinity in the liver, kidney, spleen and lung, but most importantly in the brain where it rapidly crosses the blood-brain barrier to reach nAChRs.[3]

As nicotine binds to these receptors a variety of neurotransmitters are released, including dopamine, norepinephrine, acetylcholine, serotonin, and endorphins; these are main source of the felt effects of nicotine use.[3,7] Nicotine also activates the sympathetic autonomic nervous system which increases heart rate, blood pressure and constricts blood vessels. These effects are associated with increased risk of heart disease and stroke. From brain imaging studies, nicotine has been also shown to stimulate the prefrontal cortex, thalamus, and visual system. The physical effects of nicotine are felt for a relatively short amount of time with the half life of nicotine considered to be around 2 hours.[2]

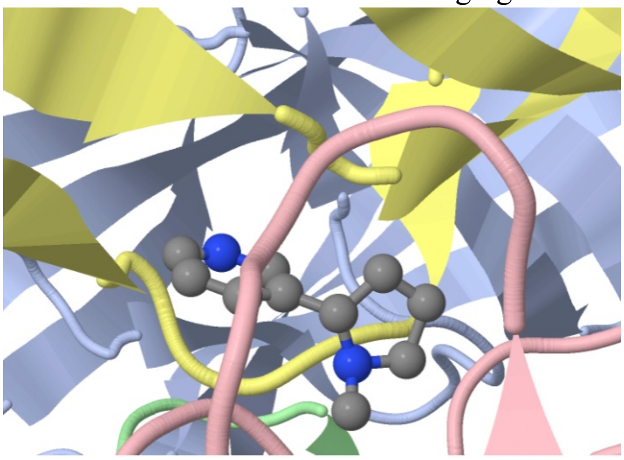

Figure 2: Nicotine in ligand binding site of AChBP[9,10]

Neuronal nicotine acetylcholine receptors are pentamers made up of combinations of alpha and beta subunits.[8] Though the complete mechanism of nicotine binding in nAChRs is not known, evidence from studies in mice suggest that both the alpha and beta subunit are involved in the ligand binding site.[8] In a Latvian research group, a novel protein called Acetyl Choline Binding Protein (AChBP) was created in order to study the binding domain of nAChRs. Nicotine as well as other ligands such as epibatidine, acetylcholine, and cytisine have been shown to bind at similar affinities to AChBP.[9] This mechanism provides a good model for the real-life interaction of nicotine and receptors in the human central nervous system.[9]

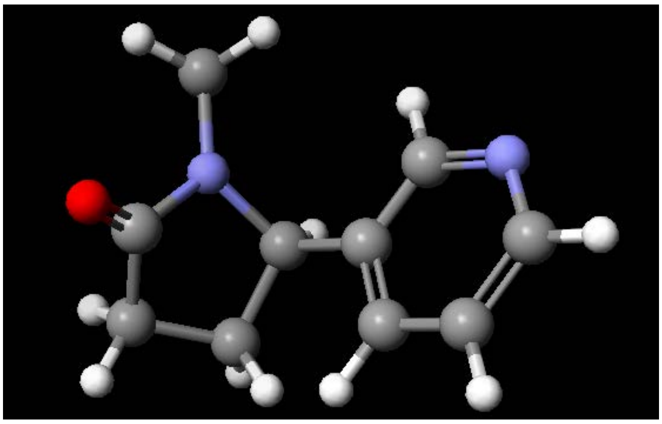

Figure 3: Cotinine

Metabolism of nicotine takes place in the liver, mainly through the enzyme CYP2A6 which converts nicotine to cotinine (Figure 3).[2] Cotinine can be used as a marker in urine to test if an individual has used nicotine. The rate of metabolism of nicotine is influenced by a number of genetic and environmental factors and plays a role in an individual's capacity for addiction.

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American Chemical Society

Student Affiliates, University of Pittsb gh

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 noon in Room 150 Chevron Science Center. To join, complete the application form below and come to one of our meetings. Our first meeting will be <u>September 10, 2021</u> but you may join any time throughout the year.

Name: ____

School Address: ____

____

Phone: ____

Major: ______________________ Year in School **Fr.** **So.** **Jr.** **Sr.**

E-mail: ____

May we include your name, number and e-mail on the published phone list? **YES** **NO**

To submit this form by mail, send it to ACS-SA, Box 24, Chevron Science Center, University of Pittsburgh, Department of Chemistry, Pittsburgh, PA 15260. Be sure to include the $15.00 dues <u>(make checks payable to the University of Pittsburgh)</u>. It is possible to be active even if you can not attend the meetings. For more information, see our display case in the lobby of Chevron Science Center.