Parkside JOURNAL OF SCIENCE

VOLUME II ISSUE I

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UNIVERSITY OF WISCONSIN PARKSIDE

EDITOR'S NOTE

THOMAS STIRRAT
Editor In Chief

HOLDEN WHITLEDGE
Executive Editor

Dear Reader,

I am pleased to introduce the latest installation in the premier undergraduate research journal of University of Wisconsin-Parkside. Twice each year, the Parkside Journal of Science publishes interviews with distinguished UW-Parkside faculty, College of Natural and Health Sciences undergraduate student spotlights, and feature articles spanning diverse scientific disciplines.

This semester has been nothing short of a whirlwind of emotions with unique challenges presented at each turn. Suffice to say 2020 has been unprecedented in every way. With a global pandemic claiming the health and lives of millions around the globe, the restructuring of everyday life, economic destruction and disparities on a level never seen before, the dissemination of accurate and useful information is now more important than ever.

In this edition, we chose to explore different realms of scientific inquiry with an emphasis primarily on biological systems. Our writers were particularly fascinated by the discoveries shaping the modern world. As new scientific findings are continuously made, Parkside Journal of Science recognizes its immense duty in helping to distill some of this information and bring attention to it. Scientific journalism lies at the nexus of innovation, public dialogue, and understanding. Thus we hope to provide reliable, responsible and accurate reporting through our work. We are proud to represent this semester's issue of the Parkside Journal of Science.

We invite you to join us in exploring the many ways that research at UW-Parkside and beyond has had an impact in just the last year. Thank you for taking the time to read this issue, and GO RANGERS!

Sincerely,

Thomas Stirrat
Editor-In-Chief

FACULTY ADVISOR

HOM KANDEL, PHD

It is a great pleasure to present the new issue of the Parkside Journal of Science to our readers. We were encouraged by positive feedback to our first issue from the UW-Parkside community and alumni including the Chancellor Ford, Provost Ducoffe, Vice-Provost Wood, Dean Otu of the College of Natural and Health Sciences, Faculties, Students, and Alumni.

This issue of the Parkside Journal of Science is a collection of interesting topics in Biological Sciences such as the Cancer Biology, Stress and Immunity, Nutrition, Genetic Modifications, Symbiosis in Parasites and Faculty and Student interviews highlighting their research in Physics, Chemistry, and Biology. In future, we will also present research advances in other areas of Natural and Health Sciences such as Physics, Chemistry, Mathematics, and Geoscience and ensure you that we will continue to disseminate the advances in all branches of Natural Health and Sciences that convey their significance for new technology, knowledge, and daily life. In addition, we will continue to provide a forum to the Faculties and Students for the reporting of their research accomplishments in Natural and Health Sciences.

I would like to extend my warmest thanks to all members of the Parkside Journal of Science, Dean's Office, University Marketing and Design, Faculties and Students in College of Natural Health and Sciences for their outstanding support toward this journal. I am so happy with the contribution that all of you have made to the publication of this issue through your creative work which serves as a model of outstanding creativity and truly deserves excellent recognition.

Thanks for taking some time to read our new issue of the Parkside Journal of Science. I hope that you will find the articles and the interviews presented in this volume of the Parkside Journal of Science interesting and informative.

Yours Sincerely,

Hom Kandel, PhD
Advisor, Parkside Journal of Science

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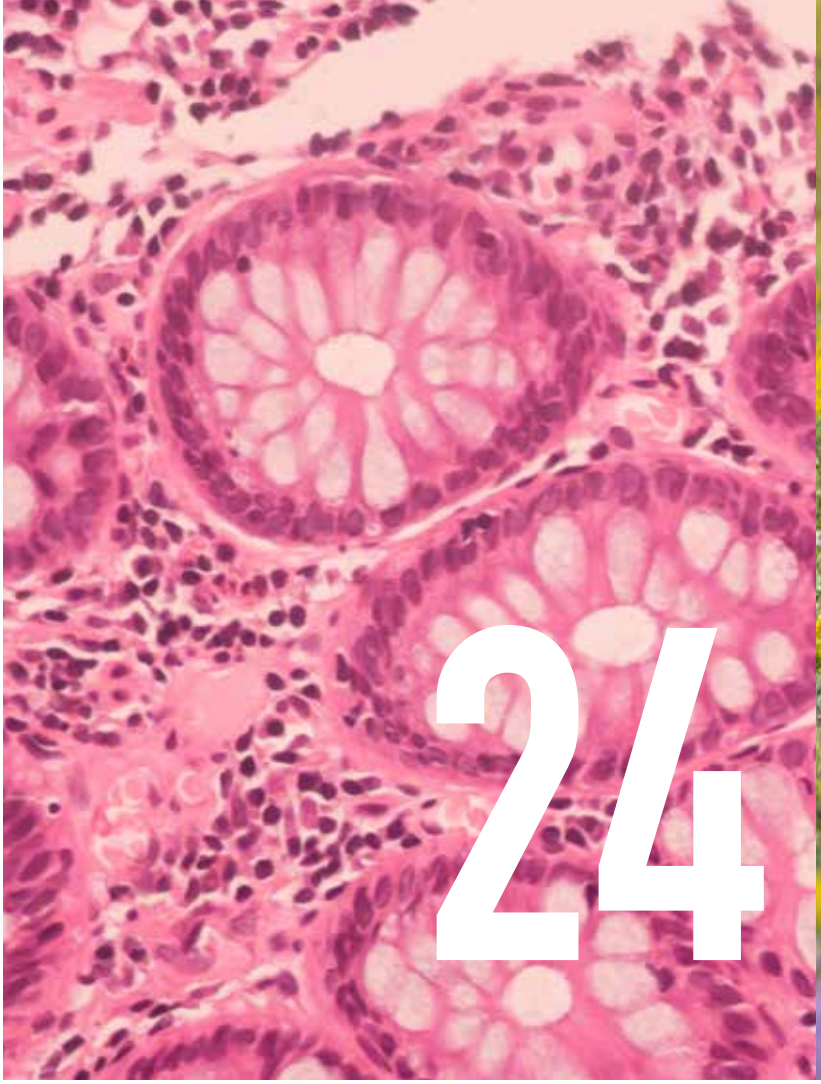

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STUDENT SPOTLIGHT

JOEL PONCE-AMBRIZ

BY JULIA JONES

Tell us a little bit about yourself!
My name is Joel Ambriz. I am 21, and I am majoring in physics as well as an applied math major. I'm from Mexico, but I moved to Kenosha when I was five.

How did you realize you wanted to study physics?
To be honest, I didn't know physics was a thing until my junior year of highschool. I took AP Physics in highschool and it was kind of just like love at first sight. When I started doing it everything clicked perfectly, and it felt right. That's when I knew I wanted to pursue physics.

What field are you most interested in Physics?
My favorite field is high energy physics, but the study of gravitation is also very interesting. We know it makes stuff fall down, and the whole space-time thing. How can we manipulate it? That's what I'm interested in.

Who is your favorite physicist?
My favorite physicist is of course Einstein; he came up with some out of this world ideas.

What crazy ideas in particular are you fond of from Einstein?
Relativity- that stuff is wacky! Plus he laid the foundation of wave-particle duality by showing that light consisted of particles called photons.

Tell us about your research, what are you working on right now?
Where to start... The research Dr. Parker and I are doing is in the computational physics field. It deals with the transition phase properties of a silicon material that starts in a diamond crystal phase and shifts to a different phase, called beta-tin (also a crystal structure), when pressure is applied. This has been done before but usually with a bulk, or normal-sized, material. What makes the research we're doing a bit different is that we're investigating the properties of a nanomembrane, which is much thinner (nanomembrane means it is of nanometer-scale). Our research uses a computational model based on a theory called density functional theory, which has been used by the science community to create extremely thin structures. By using this theory, we are able to make silicon nanomembranes, or at least simulate them and their corresponding properties through a computer program as they transition from one phase to another.

Why are you working on that specifically?
Dr. Gopalakrishnan, a professor from UW Platteville, reached out to Dr. Parker and told him about a technique to create the thin nanomembranes. He asked Dr. Parker to investigate

properties of the nanomembranes theoretically, and Dr. Parker asked me to help with that. We are currently doing this through computational methods, and later we can see if this holds experimentally.

What does your research process consist of?
This research is theoretical and computational, rather than experimental. Dr. Parker did a lot of the theoretical research, whereas I focused on the computational components. First I spent two months teaching myself the programs I had to use for the simulations and calculations. After that, I had to reproduce some of the properties that were extracted from the bulk material transition research that had already been done. I did that for a lot of different pseudopotentials, which are files that model the effects that the nucleus and inner shell electrons have on the other electrons in the system. The computer program we ran gave us raw data based on the density functional theory, so we had to figure out how to organize the data in such a way that it output properties such as transition pressure, volume, bulk modulus, etc., as well as electrical and vibrational properties of the bulk material. After investigating the bulk model, the next step was to formulate our model for the nanomembranes. Besides the density functional theory, the computer program also uses a model of the atomic structure to produce the transition properties; this was easy to input for bulk, but was more difficult for the nanomembrane model. One of the biggest parts of this process was to come up with a way to simulate the limited thickness of the nanomembrane, Dr. Parker derived a method for this. Once our model was complete, we again ran the program, this time to produce the transition properties of the nanomembrane structure, rather than the bulk. Currently we are working on verifying our calculations, because our results are not quite what we expected. We are doing this by changing some parameters to be more precise and recalculating to ensure that our final results are correct.

What's the next step with your research?
The next step is to investigate the vibrational and electrical properties. The information we would get from the vibrational properties is most important because by checking these we can see if the model for the nanomembranes is actually stable. In real life, materials are stable, so if we determine that our model is stable we know that experimentally it should work too. Something else that is interesting is that in the bulk material, the silicon structure is a semiconductor in the diamond phase, but once compressed it turns into metallic beta-tin. We will see if that happens with nanomembranes once we investigate the electrical properties. After that, from what I understand, we will be ready to publish.

What are the applications of the research you have done?
Moving forward, this phase transition must be conducted experimentally to see if the theoretical values we produced hold up to the experiential values. If the two sets of values align, this would show that our model and also the density functional theory are correct. In quantum, the most important thing to do for a system is to solve its wave function; once you do that, you can solve for other properties of the system. The density functional theory solves for the wave function, so if our model is correct, our wave function should also be correct, which would allow us to solve for other properties of the system using our model.

Silicon is an important material in the microelectronics systems industry, and with nanomembranes there are a few properties that allow us to do things we can't do with bulk. For example, besides being thinner, the nanomembranes are also more flexible, which means the silicon structure can be morphed into different shapes depending on what we want to achieve. Using nanomembranes we are also able to produce low energy lasers and reduce thermal conductivity. Overall, our research on nanomembranes adds a couple new properties that the science community can take advantage of; there is a vast range of material, mechanical, optical, and device applications possible for the innovation of microelectronics.

What was the most rewarding part of your research?
Definitely the coding. There were times when I was coding programs to get the properties

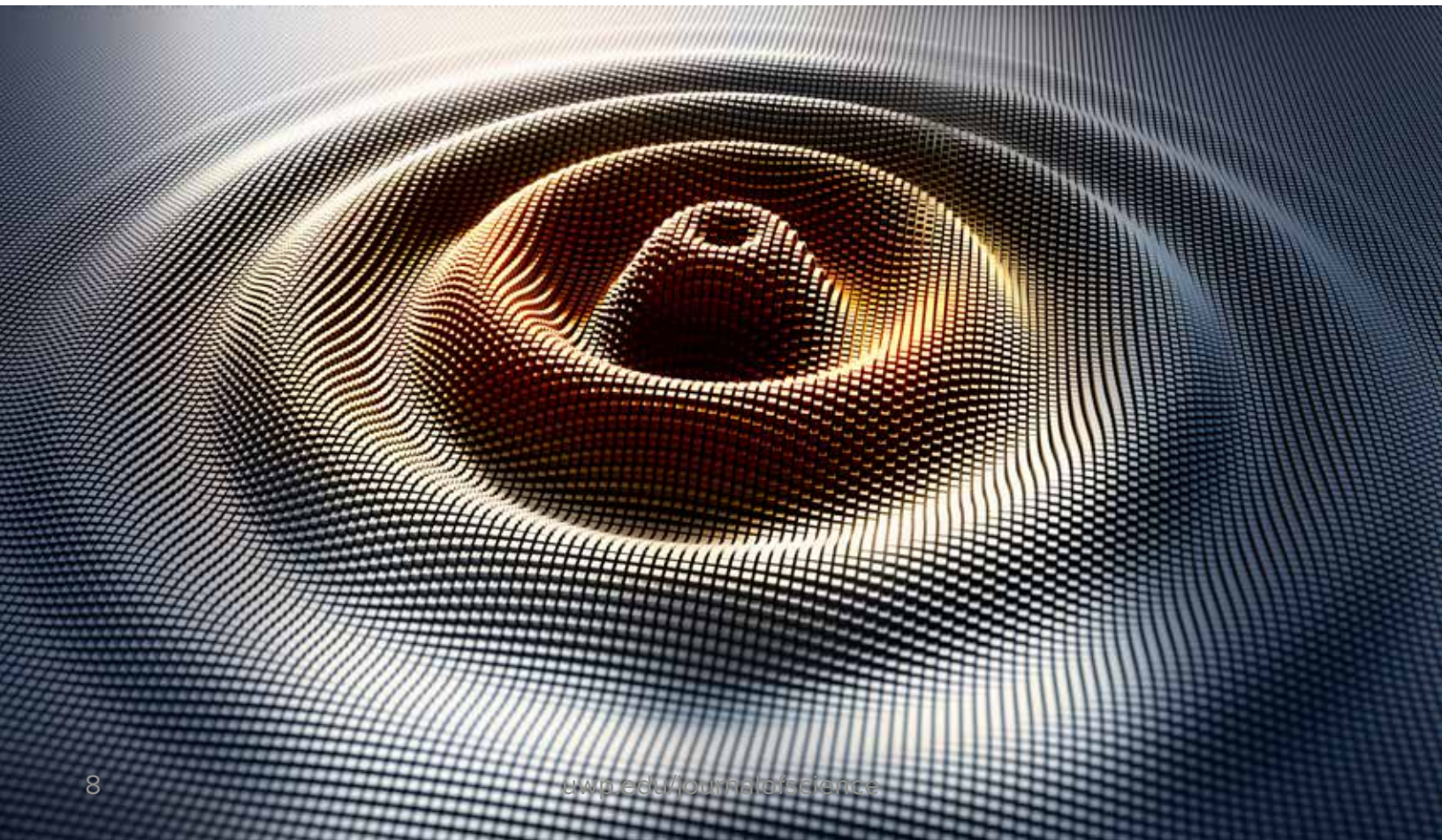
and although at first seemed simple, it quickly got super complicated. When I finally figured out the code, it was like figuring out a new way of thinking in the programming language itself, which was really cool. Also, once we finally got the nanomembrane model and obtained the properties, we saw they differed from the properties of the bulk structure, so it was interesting to see how the results of the nanomembrane model diverged from previous studies of the bulk.

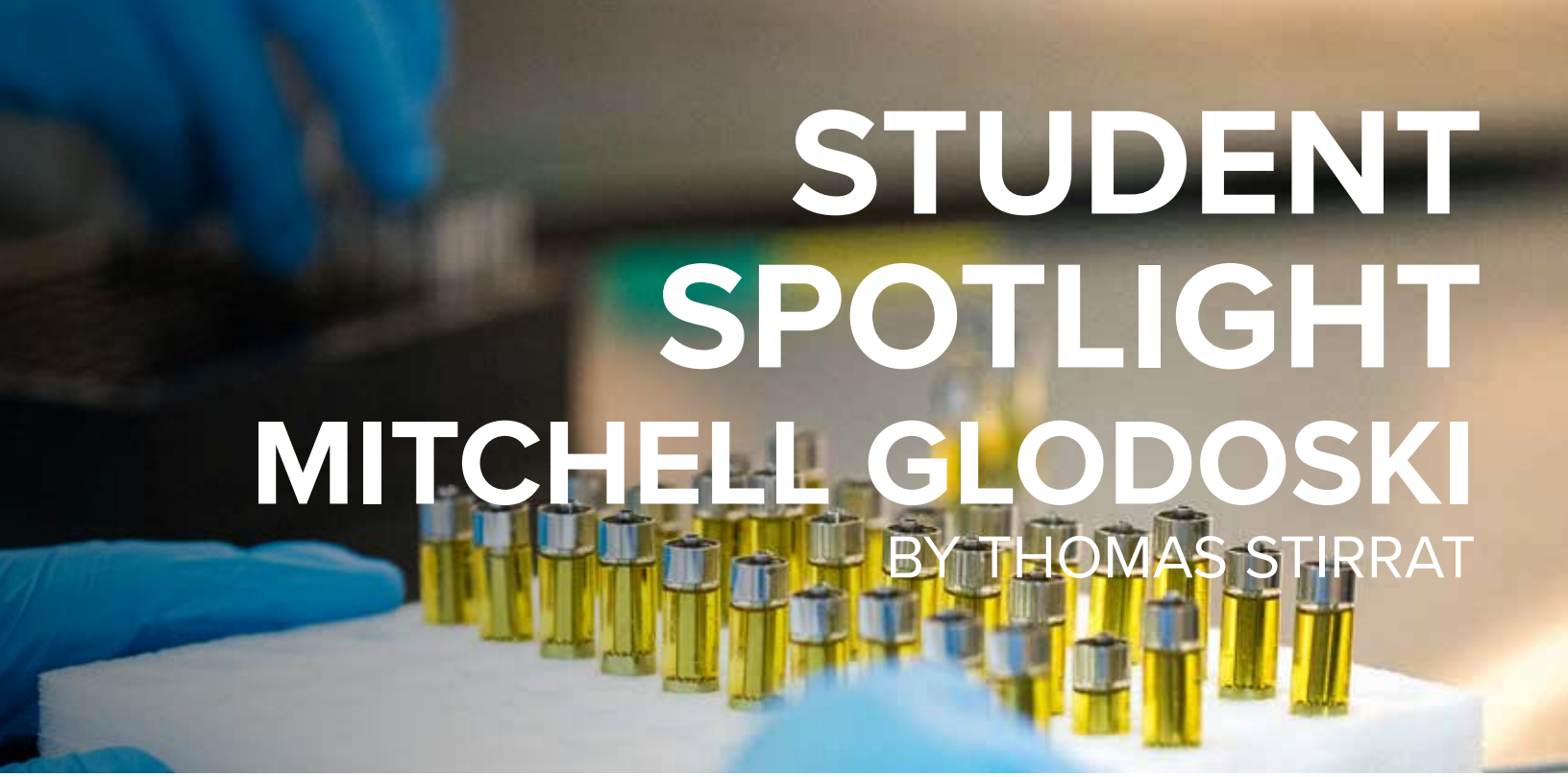
Most difficult aspect of your research?
The most difficult part was in the beginning, just trying to understand the concepts and learning the coding-- especially the bash language, that one was tricky.

You also did research with Dr. Mohazzabi last year, can you tell us a little bit about that?
The paper we published was called “Diffraction Pattern of a Rotating Grating.” It was really exciting because it was my first research project I had ever done. Paul did the theoretical thinking and I was responsible for verifying the data experimentally. Initially, we met up and came up with ways to execute the experiment. After that, each time we got together we furthered the investigation more and more until we eventually got the experimental results. The whole process (including writing the paper) took around two to three months.

That’s amazing that you plan to graduate with two research papers published, do you have any advice for students wanting to pursue research at UW-Parkside?
The most important thing is to contact your professors. They are really chill and will probably support you, just communicate with the faculty!

What are your plans for after Parkside?
I plan to go to graduate school, but I’m not sure where yet. I’d like to study gravitation; because we don’t understand it as much as other phenomena in physics. For example, we know a lot about electricity and magnetism, and we have been able to create a lot of technology based on that knowledge. If we could understand gravity to the level that we understand other physical phenomena there are huge possibilities for invention and technology, and that is really intriguing to me. I want to investigate the inner workings of gravity-- I enjoy the challenge and the mystery.





STUDENT SPOTLIGHT

MITCHELL GLODOSKI

BY THOMAS STIRRAT

Tell me about yourself (hobbies, interests, unique things done):
I'm an avid outdoorsman who enjoys cycling, canoeing, hiking, camping, and archery. I love working with animals and volunteer as a cat care volunteer at the Wisconsin humane society. I love to read, specifically fantasy, Sci-fi, and mystery being my favorite genres. I do a lot of tutoring and community science education, and working on at home chemistry projects (controlling and experimenting with soil pHs, soap making etc). The most interesting thing I've been a part of was medical work in Kenya in part with Ripples international.

What made you come to Parkside?
The smaller class sizes and actual professors teaching classes were a big draw. Furthermore, Parkside's excellent pre-med program fit my interests in continuing my education in the medical field.

What were your favorite parts of Parkside?
Going to the science nights was always fun and interesting as well as the libraries' community reads. Getting to know my professors personally was nice as I got to meet and work with some really amazing people.

Were you involved in any clubs at Parkside, if so which and to what degree?
I was involved in the chemistry club since my first year until graduation, during which I was a treasurer and outreach coordinator. I was also a part of several fun tours and demonstrational science projects.

Why did you decide to major in Chemistry and what are your career aspirations?
I've always had interests in chemical reactions and the science behind them from a young age from watching shows like myth busters. Being able to study and understand these processes and apply them to the real world was appealing to me. Pharmacy also involves far more biochemistry than most medical professions, and since I have a chemical background this will hopefully make understanding the pharmaceuticals easier.

Where do you see yourself in 10 years?
In ten years I see myself working as a floor pharmacist in a hospital while hopefully having opportunities to do foreign medical aid work.

Can you think of a specific role model who encouraged you down this path?
I have two aunts, one a general nurse, the other a nurse practitioner who instilled a fascination with medical science and inspired me to pursue a medical degree.

What kind of research are you involved in here at UW-Parkside?
Studying the stability of cannabinoids in over-the-counter oral ingestion hemp oils in the natural products lab with Dr. Lori Allen.

Tell us about your favorite part of your lab work:
Getting to use the Shimadzu Hemp analyzer, it really makes the analysis of the data easier.

What do you enjoy most about doing research?
Getting to develop a hypothesis and then put it to the test. It's always important to remember that even if the result wasn't what you expected, that if your experiments were consistent there's no such thing as a failed experiment since all data can be learned from.

What have you been doing this summer since graduating from Parkside?
Since graduating from Parkside, I have been working full time at PPG industries, a paint, coatings, and resin OEM (original equipment manufacturer) as a chemist technician, as well as getting ready to start grad school.

Do you think there needs to be more chemists? How could we attract more students to become interested in this field?
Absolutely, chemistry plays such an integral part of the natural world and a lack of chemistry knowledge is a major issue I see out and about. I think there are two big issues discouraging study in chemistry: while it can be a difficult subject, there are ample online resources that can make getting through classes way easier plus the tutoring help on campus when things get overwhelming. Secondly, I think there tends to be a misunderstanding of chemistry as this boring idea of people in lab coats in a lab mixing up vials. There isn't an aspect of your life that wasn't influenced by a chemist. The clothes you're wearing? Polyesters and nylons? Developed by chemists. Food you eat? Includes additives, safety testing, shelf stability, nutritional additions all worked on by chemists stored in packaging to help protect it from natural processes using chemical coatings. Like the outdoors? Environmental monitoring chemistry. Nuclear chemists in power plants, chemists working on cosmetic products, biochemists making medicines, whatever your interests are, there's likely a field of chemistry involved with it.

THE FUTURE OF GENETICALLY MODIFIED MOSQUITOS

by Jess Pedersen and Stephanie Haschker

What are genetically modified mosquitoes and what purpose do they serve?

Nice weather is always accompanied by those pesky little blood sucking mosquitoes. Scientists are currently finding new ways to control these pests without putting other wildlife at risk. The goal is to reduce the transmission of mosquito borne diseases as they cause great immense suffering around the world. Genetically modified mosquitoes are transgenic mosquitoes that have a promising future in reducing vector-borne disease, but what even are vector-borne diseases? The County of Los Angeles Department of Public Health defines a vector-borne disease as a "disease that results from an infection transmitted to humans and other animals by blood-feeding anthropoids, such as mosquitoes, ticks, and fleas. Examples of vector-borne diseases include Dengue fever, West Nile Virus, Lyme disease, and malaria" (Acute Communicable Disease Control).

Genetically modified mosquitoes are being designed in order to eradicate (with the help of vaccines and medications) the existence of these vector-borne diseases. Genetically modified mosquitoes are being looked at as a way of not only helping but making some of these diseases finally go extinct. Eradication would be the solution to socio-economic development problems that some nations are constantly facing. Many of these nations lack access to proper vaccines and medications, and are thus left with tools such as bed nets and insecticides, however, if GMO mosquitoes were implemented properly they could substitute for these other methods.

For most people, spraying for mosquitoes is undesirable due to the unpleasant chemicals they contain. This is in addition to the fact that they may be harming beneficial insects in

the process. This is where the need for GMO Mosquitoes enters the playing field. A GMO mosquito is an Aedes aegypti mosquito that is accompanied by the bacteria Wolbachia. This is a product of the U.S. (United States) based company MosquitoMate. In “Biology of Wolbachia” written by John H Werren, he says, “Wolbachia are a common and widespread group of bacteria found in reproductive tissues of arthropods”(Werren, 1997, p.1). The document then elaborates on how the bacteria is transmitted through sexual reproduction. What this means for the mosquitoes is that their offspring will die before ever reaching adulthood resulting in a lower mosquito population and a lowered risk of catching a disease that is carried by a mosquito without having to employ chemicals that damage the environment.

While the debut of these Mosquitoes would be a monumental public health initiative, there are still ethical and community concerns pertaining to the usage of these genetically modified organisms. In 2019, Fiona MacLeod elaborated on this subject in a project titled, “The optimal socialization of modified mosquitoes to combat infectious disease”. Fiona says that a huge roadblock is that communities lack a “clear understanding of the technology.” This prevents the innovation from being fully used properly. Fiona then further juxtaposes the public view on GMO mosquitoes to the anti-vaccine controversy in order to put the situation into a more conspicuous perspective where she remarks, “For example, consider the atmosphere surrounding the anti-vaccine controversy. Despite the doctor behind the fraudulent vaccine-autism link losing his medical license and extensive scientific evidence denying the association, there are still people today who are against vaccinating their children due to intrinsic fear of effects” (MacLeod, 2019, p.4). She is implying that scientists will have trouble introducing the mosquitoes in a way that the public feels comfortable with. Overall, it may be said that with mosquitoes evolving a resistance to the control methods of the past it seems that the inception of this invention is necessary in order to overcome the many maladies that are spread by mosquitoes. It appears the matter of ‘when the public accepts the development’ to be the final barricade needed to overcome.

How do genetically modified mosquitoes function?

The approach of using genetically modified mosquitoes to help control vector-borne diseases is completely reliant on the ability of

genetically modified mosquitoes to compete with wild-type mosquitoes. The function of these transgenic mosquitoes is to mate with the wild population and spread a gene that blocks the transmission chain to these vector-borne diseases, or the bacteria Wolbachia. The capability of these transgenic insects thus fully relies on their ability to survive and mate.

The discussion of the genetically modified mosquitoes is a fairly new topic.
The first documented discussion of this topic occured in 2002 during a workshop at the Wageningen University and Research Centre in the Netherlands. Many vector ecologists came from all over the world to primarily focus on the topic of transgenic mosquitoes. In this workshop, the ecologists come up with set objectives that the genetically modified mosquitoes would have to achieve before being released into nature.

Have the transgenic mosquitoes been released into the wild population?
Yes, there have been trials of these transgenic mosquitoes released into the wild population. Two transgenic mosquito species have been released in Brazil, Cayman Islands, and Malaysia. In many cases, the mosquitoes were released to try and combat the rising number of cases of dengue. The release in Malaysia was a successful release of sterile males. As the authors recaps, “After extensive contained studies and regulatory scrutiny, a field release of engineered mosquitoes was safely and successfully conducted in Malaysia. The engineered strain showed similar field longevity to an unmodified counterpart, though in this setting dispersal was reduced relative to the unmodified strain” (Lacroix & Mckemey, 2012). Though there has been largely positive data from the trials run there is still public disdain.

What potential backlash do genetically modified mosquitoes face?
There are still many unknowns about the procedure of using genetically modified mosquitoes. As one author states, “First, there is an urgent need to develop a uniform process for dealing with the ethical, legal, and social issues related to GMM technology” (Scott et. al., 2002). Another problem that scientists discuss is the novel human-mosquito relationship that would be built in places where genetically modified mosquitoes would be released.

References

MacLeod, Fiona. (2019). The optimal socialization of modified mosquitoes to combat infectious disease. Senior Capstone Projects. 922. https://digitalwindow.vassar.edu/senior_capstone/922

Werren, J. (1997). Biology of Wolbachia. Annual Review of Entomology 1997, 42:1, 587-609. https://www.annualreviews.org/doi/pdf/10.1146/annurev.ento.42.1.587

Lacroix R, McKemey AR, Raduan N, Kwee Wee L, Hong Ming W, Guat Ney T, et al. (2012) Open Field Release of Genetically Engineered Sterile Male Aedes aegypti in Malaysia. PLoS ONE 7(8): e42771. https://doi.org/10.1371/journal.pone.0042771

André Sica de Campos, Sarah Hartley, Christiaan de Koning, Javier Lezaun, Lea Velho. (2017) Responsible Innovation and political accountability: genetically modified mosquitoes in Brazil. Journal of Responsible Innovation 4:1, pages 5-23. By Thomas W. Scott, Willem Takken, Bart G. J. Knols, Christophe Boëte Science04 Oct 2002 : 117-119

FLIPPING THE METABOLIC SWITCH

by Alex Lovely and Katie Wilson

The current species of human beings, Homo sapiens, have inhabited Earth for 300,000 years; and ancestors before us for millions of years (Smithsonian National Museum of Natural History, 2020). We have evolved from a deep-rooted genetic history. Throughout the evolutionary timeline, food resources have been scarce. It wasn't uncommon to endure periods of time consisting of days, weeks, or months where acquiring nutrients and calories was a struggle. Starvation wasn't an atypical cause of death. To accomodate for and withstand these periods our physiology adapted.

In an excerpt from the Joe Rogan's Experience podcast, Dr. Peter Attia MD discusses, "If our ancestors couldn't function when they were hungry, we wouldn't be here. It's not just that short-term adaptation to starvation is necessary, it's probably beneficial." As a species, we are genetically and physiologically identical to the humans that lived before the dawn of agriculture (Perlmutter, 2013). The mechanisms that our body developed to help ensure survival in times of starvation remain within our genetic makeup, and when activated, produce positive, hormetic effects. In the absence of calories, our bodies can direct effort to other life-sustaining causes. Gene sequences responsible for cellular repair and protection become activated, anti-oxidative defenses are increased, and inflammation is reduced (Perlmutter, 2018). In addition, these renovative processes are detected within the command center of the body: the brain. Stimulated production of brain-derived neurotrophic factor (BDNF), a protein that serves a critical role in the growth of new neurons as well as the function of current brain cells has been observed, which may serve as a link to combatting neurodegenerative diseases such as Alzheimer's and Parkinson's (Perlmutter, 2013).

Much contemporary research has been conducted on the concept of fasting, and this

approach to supplying the body with nutrients is becoming widely known as flipping the metabolic switch. Studies have shown that spacing and limiting eating periods triggers biochemical processes and pathways that improve physical performance and function. Fasting operates via reprogramming the body's natural circadian rhythms by only activating metabolic pathways during the allotted eating period; research suggests spacing 9-12 hours between each eating session is optimal (Patrick, 2019). Eating at certain times in the day supports the body's natural metabolism and frees fat stores by producing ketones and oxidizing fatty acids. Beta-Hydroxybutyric acid, a principle ketone that is produced at a dramatically higher rate when fasting is an ATP-dense fuel and has been associated with increased BDNF and mitochondrial production (Perlmutter, 2013).

Excluding water, the first comestible ingested into the body launches the metabolic clock for the day. Along with food, light exposure also helps initiate metabolic enzymes that later slow and shut down between the nine and twelve hour period (Patrick, 2019). To put this concept into perspective, think of an individual's daily productivity. Whether tasks are broken up or completed all at once, there is a period of time where productivity is optimum, and this is comparable to metabolism. For example, soon after an individual has eaten, blood sugar rises and insulin secretion increases as a response, which is released by beta cells inside of the pancreas. Insulin shuttles blood glucose into cells to allow the cells to utilize said glucose for energy. Excess glucose causes the liver to convert glucose into glycogen to be stored. When blood sugar is low, the pancreas informs the liver to release stored sugars in the form of glucagon that is produced by alpha cells. Decreasing the amount of time these enzymes are metabolizing makes way for emulating the body's natural clock, producing numerous benefits (Chaix, 2019).

In the morning (relative to when one last ate), food sensitivity is at its peak, permitting consumed calories to be properly metabolized. At night when melatonin begins to release, insulin secretion is decreased, making it more difficult for the body to process glucose. This can also negatively impact sleep quality as the body is directing effort to metabolism rather than the reparative processes operated during sleep. Thus, eating within the appropriate time period, when insulin is most active, is when metabolic benefits including losing fat, gaining lean muscle mass, and maintaining weight loss is best established.

Dr. Rhonda Patrick, biochemist and assistant scientist at Children's Hospital Oakland Research Institute, explores health and wellness topics including micronutrient deficiency correlations on aging, cancer and metabolism. Among her many studies on time-restricted eating she has found that fasting between 12-15 hours a day optimizes endurance, preserving lean muscle mass and function, and lowering hormones that are known to promote cancer growth (Patrick, 2019). Dr. Ruth Patterson, a professor and researcher at University of California San Diego as well as an administrator at the Transdisciplinary Center on Energetics and Cancer at UCSD, her inquiries and findings echo Dr. Patrick's. Dr. Patterson's research primarily focuses on the benefits of nightly fasting and has established that fasting at night may reduce the risk of chronic diseases and some cancers, including breast cancer. One study in particular found that women with a history of breast cancer mitigated the risk of recurrence by 40% via reducing the amount of eating time per day (Patterson, 2017). Another leading intellect within the interest of time-restricted eating is Dr. Satchidananda Panda, professor and researcher at the Salk Institute for Biological Studies. His research has shown health benefits such as improved sleep and motor coordination, disease prevention and even slowing the aging process of the heart through subscribing to time-restricted eating (Chaix, 2019). Panda has also found that by optimizing meal times, brain function increases while hindering development of neurodegenerative diseases.

The human body has evolved from a deep-rooted genetic history where constant availability and consumption of calories was not a reality. This presents an obvious distinction from modern times, where food supply is at its most abundant in the history of mankind, as food can be found at nearly every corner block. Is the human body designed to function with a constant overabundance of calories, or has it developed mechanisms to thrive through periods without? Current research suggests the latter, as overconsumption of food (along with more sedentary lifestyles; we aren't hunter-gatherers anymore) may serve as the root cause to chronic diseases such as heart disease and diabetes type 2. As new research is conducted and analyzed, better conclusions about how to optimize function of the human body relative to food consumption can be made.

References

American Heart Association News. (2019) Time-Restricted Eating is Growing in Popularity, But Is It Healthy? Retrieved April 26, 2020 from https://www.heart.org/en/news/2019/03/22/time-restricted-eating-is-growing-in-popularity-but-is-it-healthy

Chaix, A., Manoogian, E. N. C., Panda, S. (2019). When to Eat: The Importance of Eating Patterns in Health and Disease. Journal of Biological Rhythms,34(6), 579-581. https://doi-org.libraryproxy.uwp.edu:2443/10.1177/0748730419892105

Patterson, R. E., Sears, D. D. (2017). Metabolic Effects on Intermittent Fasting. Annual Reviews, 37(1), 371-393. https://doi.org/10.1146/annurev-nutr-071816-064634

Patrick, R. (2019). Time-Restricted Eating. Retrieved April 23, 2020 from https://www.foundmyfitness.com/topics/time-restricted-eating

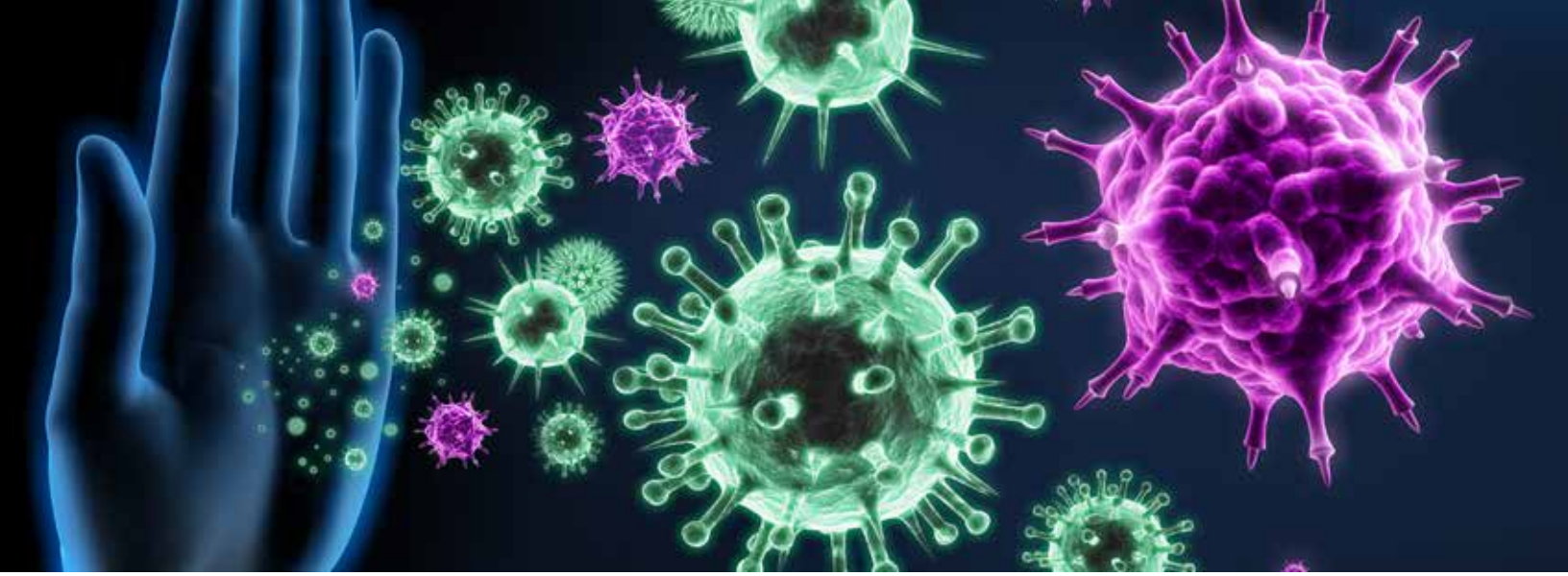
Perlmutter MD, D. (2013). Grain Brain: The Surprising Truth About Wheat, Carbs, and Sugar - Your Brain's Silent Killers. Little, Brown and Company.

Perlmutter MD, D. (2018). Benefits of Intermittent Fasting for Your Brain and Body. Retrieved April 23, 2020 from https://www.drperlmutter.com/benefits-of-intermittent-fasting/

Rogan, J. [PowerfulJRE]. (2018, April 24). Joe Rogan Experience #1108 - Peter Attia. [54:20 - 59:12]. https://www.youtube.com/watch?v=gP1NA5f4LfE

Smithsonian National Museum of Natural History (2020). What Does it Mean to be Human? Retrieved April 23, 2020 from http://humanorigins.si.edu/evidence/human-fossils/species/homo-sapiens

Tello, M. (2020, February 10). Intermittent Fasting: Surprising Update. Harvard Health Publishing. https://www.health.harvard.edu/blog/intermittent-fasting-surprising-update-2018062914156



THE INTERPLAY OF STRESS AND IMMUNITY

By Kamyiah Blackmon and Gabbie Jensen

Stress is sure to be encountered in the journey life. It resides in the crevices of our lives, hides from detection, only rearing its ugly head when we are at our most vulnerable. No matter who, where, or what we are doing, stress cannot be avoided. Stress is the way the human body responds to strain or tension which are simply the changes, events, and situations in our environment that affect our physical and mental health. When under stress one may experience anxiety, panic attacks, restlessness, and inflammation to name a few. Under such conditions, the brain sends impulses to our glands which in return produce additional hormones that help us to cope with this stress. However, if we are in circumstances where the stress is prolonged for a long duration of time and not properly taken care, one may experience complications to his or her health. If stress then alters our homeostasis, it has the power to negatively affect our immunity which is intimately related, therefore stress can decrease the ability of our immune system to function properly thereby putting us at even more risk.

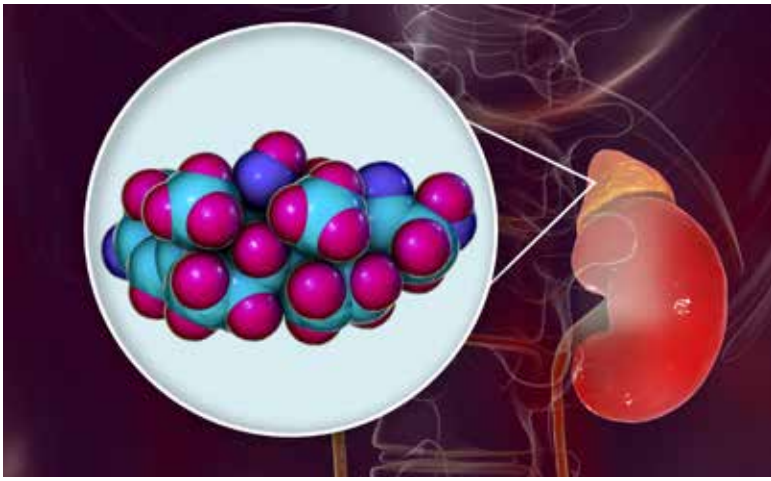
Stress can be caused by myriad factors, for instance: school, careers, losing a loved one, and many other difficult situations. Although it is common to experience stress under these circumstances, people who experience high levels of stress and experience it repeatedly over a long period of time may develop further health complications due to an exhausted immune system. For example, people diagnosed with Systemic Lupus Erythematosus have a preexisting weakened immune system due to the body mistakenly attacking its own healthy tissue. When lupus patients are under any form of stress they may experience a flare-up, which is a reactivation of symptoms that can cause abnormalities to worsen. Such symptoms include fatigue, muscle achiness, joint stiffness, fevers, and chest pains. However, In order to understand why our body reacts the way it does to stress, we have to shift our focus to the brain to gain a greater appreciation of the stress response.

Stress interacts with the immune system indirectly, by first targeting the endocrine system. The endocrine system's response to stress is what directly impacts the immune system's response. A brief background on the endocrine system will help provide clarity on how the brain can act as a mediator between

external factors and body systems. The human endocrine system, which, like most of our complex body systems, is largely controlled by the brain, and the brain's interactions with other parts of the body. It consists of numerous glands, including the hypothalamus, pituitary gland, liver, adrenals, and each gland has a very specific function in the body. Glands can produce hormones based upon the impulses from the brain, as well as react to hormones sent from other regions of the body. These hormones travel throughout the body via the bloodstream. In the case of a stressful situation, the endocrine system is the primary body system that reacts to these external factors, also termed environmental stressors. When a stressor is perceived, the hypothalamus, a group of neurons in the brain and the central organ controlling the endocrine system, is initiated. The hypothalamus controls the pituitary gland, the gland sitting right below it in the brain. The pituitary produces a variety of hormone signals that travel to other endocrine glands in the body and activate, or "excite" them, causing them to react. In the context of stress, the hypothalamus instructs the pituitary gland to send a hormone to the adrenal glands, which in return produces a hormone called cortisol.

Cortisol is a steroid hormone also known as a glucocorticoid, and its job is to increase energy. Cortisol accomplishes this by freeing stored glucose and fatty acids located in the liver. The stored glucose and fatty acids act as sources of fuel for the body when mobilized, thereby increasing the body's available energy levels. This has evolved in humans to enhance alertness, which can help the body prepare for an encounter with a perceived threat, often termed the "fight or flight" response. This chain of endocrine responses to stress is called the hypothalamic-pituitary-adrenal or "HPA" axis. The release of cortisol throughout a non-stressful day is normal; it is an essential hormone in our bodies, and it is needed for normal bodily functioning. However, the normal release of cortisol comes in a predictable pattern throughout the course of a day, and in a healthy amount. Prolonged stress can trigger the production of abnormally high amounts of cortisol. Normal amounts of cortisol help boost the immune response, but abnormally high amounts impair communication between the HPA axis and the immune system, leading to the development of numerous health complications. As explained, external stressors in our everyday environments directly trigger long term endocrine responses that in return influence how the immune system functions.

In summary, stress will continue to be a part of our everyday lives. However, it is important to learn how to manage and cope with stress in a healthy manner. If we are in circumstances where stress is prolonged, we may compromise our immunity and our bodily activity can decrease in function, therefore leaving our overall health at risk. Thus it is important to be aware and avoid such situations when possible.



References

(n.d.). Retrieved from https://www.apa.org/helpcenter/stress/effects-endocrine

Dansinger, M. (2019, June 2). The Endocrine System and Glands of the Human Body: Function and Disorders. Retrieved from https://www.webmd.com/diabetes/endocrine-system-facts

How Stress Affects the Immune System. (2014, November 12). Retrieved from https://www.psychologytoday.com/us/blog/how-the-mind-heals-the-body/201411/how-st ress-affects-the-immune-system

Your hormones. (n.d.). Retrieved from https://www.pituitary.org.uk/information/hormones/ Understanding lupus environmental triggers. (n.d.). Retrieved from https://www.lupus.org/resources/understanding-lupus-environmental-triggers

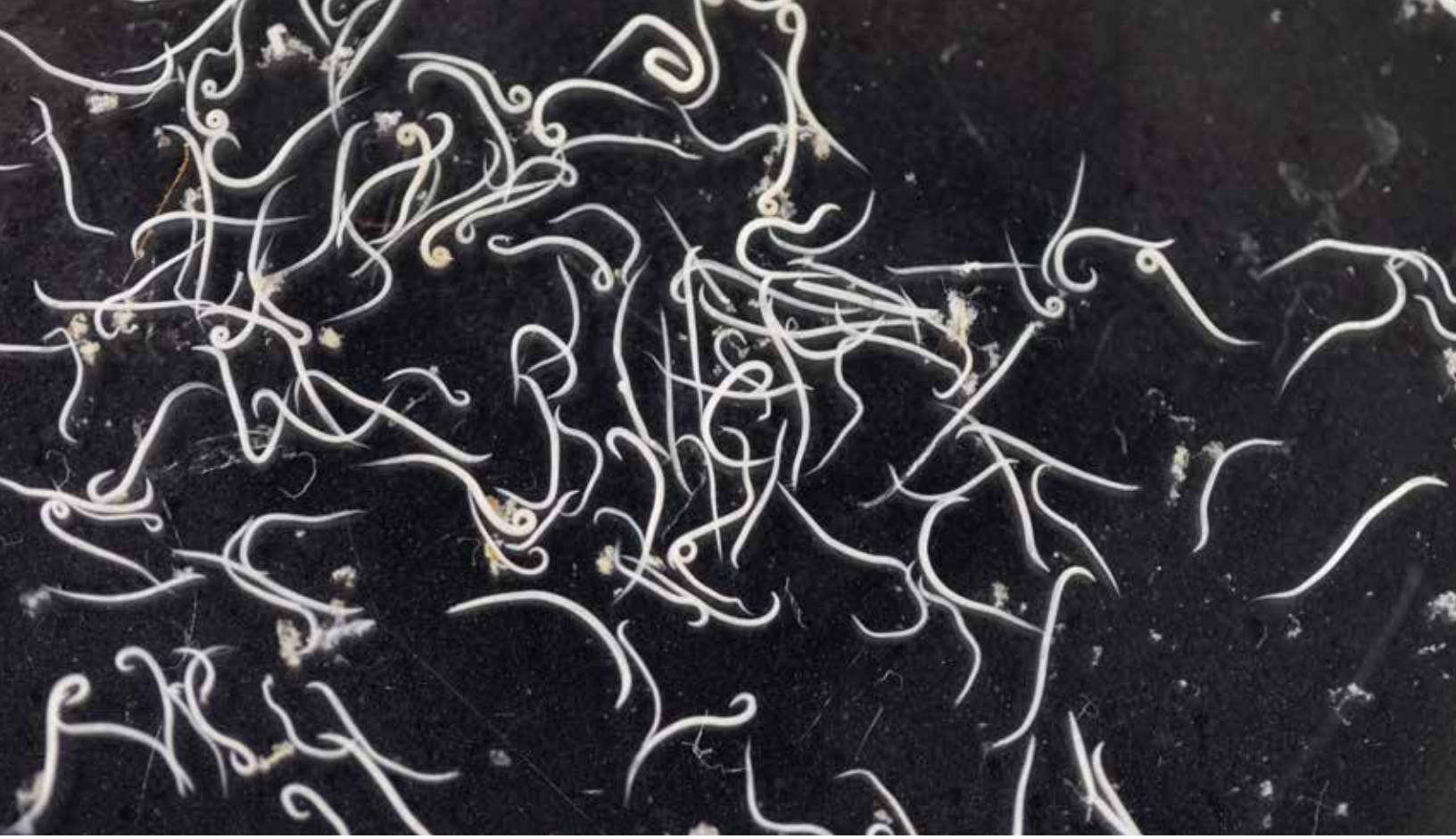
Iliades, B. C., & Lindsey, H. (n.d.). Lupus, Emotional Stress, and Depression - Lupus Center. Retrieved from https://www.everydayhealth.com/lupus/lupus-emotional-stress-and-depression.aspx

THE PROFOUND SYMBIOSIS OF PARASITES

By Jennifer Lavine

The female nematode Dracunculus Medinensis, also known as the Guinea Worm goes through a fascinating life cycle of parasitism within its infected host. There is a significant risk to those who live in countries with poor sanitation and to those who consume undercooked aquatic animals ("CDC – Guinea Worm Disease – Frequently Asked Questions", 2019). While there is currently no cure for the Guinea worm, intensive management is required once the worm manifests. "The adult female, which carries about 3 million embryos, can measure 600 to 800 mm in length and 2 mm in diameter" (World Health Organization, para. 1). According to the CK-12 foundation "parasitism" is defined as "a symbiotic relationship in which one species (the parasite) benefits while the other species (the host) is harmed."

The Guinea worm disease (GWD), also known as, Dracunculiasis is an infection caused by the nematode Dracunculus medinensis ("CDC – Guinea Worm Disease – Frequently Asked Questions", 2019). The parasite lacks a circulatory or a respiratory system, but has extensive digestive, reproductive, nervous, and excretory systems (Basyoni & Rizk, 2016). Contraction occurs after drinking from a pond containing guinea worm larvae. Furthermore, infection may take place via the consumption of raw or undercooked aquatic organisms. ("CDC – Guinea Worm Disease – Frequently Asked Questions", 2019) People residing in countries such as Chad, Ethiopia, Mali, and South Sudan are at most risk due to the high population of guinea worms. Although the fatality rate tends to be low, the disease is still unpleasant. It takes roughly one year for symptoms to begin showing due to the latency from the mother's pregnancy. The CDC illustrates that within a year from infection, the larvae will first penetrate the host's stomach, intestinal wall, abdominal cavity, and then finally the retroperitoneal space where the female and male will mate. Thereafter, the male will die, and the female will work her way down to the lower extremities of the host. Once the female worm comes to term, she will slowly rise to the skin in the lower extremities causing a blister to form. The blister causes the host to feel a very painful burning feeling while the larvae are being released. The blister takes between 24 and 72 hours to burst ("CDC – Guinea Worm Disease – Biology", 2015). The female protrudes through the host's lower extremities in hopes that she will release her larvae in water to continue the vicious cycle.



The complications from this parasite are further debilitated by the commonly associated secondary bacterial infections. The CDC expounds that with no drug or vaccine to help treatment or prevent GWD, management of GWD involves removing the whole worm and tending to the resulting wound ("CDC – Guinea Worm Disease – Management & Treatment", 2019). Once the wound is cleaned, the worm is then wrapped around a piece of gauze or a stick to maintain some surface tension. Then, the worm is gently and slowly pulled out because the worm has at this point likely grown to 2-3 feet. However, if the guinea worm breaks off at any point during removal, intense inflammation can occur as the remains are broken down within the lower extremities of the host ("CDC – Guinea Worm Disease – Disease", 2019). The management and removal of the Guinea worm is an extremely delicate process due to how fragile and painful the Guinea worm can be if it is not removed improperly. The complications from a failed Guinea worm removal can also result in abscesses, sepsis, and cellulitis ("CDC – Guinea Worm Disease – Management & Treatment", 2019).

References

Basyoni, M. M. A., & Rizk, E. M. A. (2016, December). Nematodes ultrastructure: complex systems and processes. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5118333/

CDC - Guinea Worm Disease - Biology. (2015, March 17). Retrieved from https://www.cdc.gov/parasites/guineaworm/biology.html

CDC - Guinea Worm Disease - Disease. (2019, August 28). Retrieved from https://www.cdc.gov/parasites/guineaworm/disease.html

CDC - Guinea Worm Disease - Frequently Asked Questions. (2019, August 28). Retrieved from https://www.cdc.gov/parasites/guineaworm/gen_info/faqs.html

CDC - Guinea Worm Disease - Management & Treatment. (2019, August 28). Retrieved from https://www.cdc.gov/parasites/guineaworm/treatment.html

Foundation, C. K.-12. (n.d.). 12 Foundation. Retrieved April 14, 2020, from https://www.ck12.org/book/cbse_biology_book_class_xii/section/17.2/

World Health Organization - Dracunculiasis (Guinea-worm disease). (n.d.). Retrieved April 14, 2020, from https://www.who.int/health-topics/dracunculiasis#tab=tab_1

SHOULD YOU VAPE?

By Sarah Allen

THE CONDENSED HISTORY OF VAPING

The idea of a vaporizing device dates all the way back to a patent first filed in May 1927 by Joseph Robinson (Robinson, 1930). This original device was meant to hold medicinal compounds which were then subsequently heated for inhalation delivery purposes. However, the modern e-cigarette, as we know, was invented by a Chinese pharmacist named Hon Lik in 2003. It arrived in the U.S. marketplace shortly thereafter where it soon gained immense popularity.

What is nicotine and why is it so addictive?
Nicotine is a highly addictive stimulant found within the majority of e-cigarette vaping liquids. Vapor particles carry the nicotine into the lungs where it is absorbed into the pulmonary venous circulation and then enters the arterial circulation (Benowitz, 2010). Once in the brain, it binds to nicotinic cholinergic receptors, which triggers the opening of channels and an influx of calcium into neurons. This results in a release of neurotransmitters (Benowitz, 2010). One of these neurotransmitters released, dopamine, signals for pleasure and reinforcement. Through this release, the brain learns to quickly associate vaping with pleasure. Conditioned behavior also contributes to vaping addiction. Even after the physical withdrawal symptoms such as irritability and anxiety subside from smoking cessation, conditioned behavior associates specific moods or situations with the reward of nicotine. After repeating these associations many times, such as always smoking during a work break, it becomes a powerful cue for the urge to smoke and can trigger relapse when the user encounters the same associated situations after cessation.

How do e-cigarettes affect our physical health?
The recent soar in usage of these products have led researchers to take a deeper dive into the adverse effects of e-cigarette consumption. E-cigarette or vaping product use-associated lung injury (EVALI) was first recognized by the Centers for Disease

Control and Prevention (CDC) in August 2019. Symptoms of EVALI include shortness of breath, cough, chest pain, tachycardia, nausea and vomiting. Unfortunately, little is known about the exact mechanism causing these symptoms. A study conducted in 2019 highlighted a particular problem that arose in airway cells. Alveolar macrophages are prominent airway innate immune cells located in the airway epithelial cells. Their role as phagocytes is to ingest and breakdown inhaled irritants, pathogens and apoptotic cells by "efferocytosis" to help reduce inflammatory responses in the damaged tissue (Chand, 2020). After exposure to vaping products, the phenotype and function of the alveolar macrophages were altered, leading to suppression of their efferocytotic activity, meaning a reduced ability to remove damaged cells leading to increased inflammation (Chand 2020). Additionally, vaping has been linked to an increased risk of myocardial infarction and circulatory issues by the American College of Cardiology in 2019. Nicotine, which can quicken heart rate and raise blood pressure, may thus be a contributing factor. The study, which included 96,467 respondents, compared cardiovascular health of e-cigarette users with nonsmokers. They found that e-cigarette users were a full 56 percent more likely to have a heart attack and 30 percent more likely to suffer from a stroke (ACC, 2019). E-cigarette users were also 44 percent more likely to have circulatory problems, such as blood clots (ACC, 2019).

But wait, isn't vaping better than smoking traditional cigarettes?

There are around six hundred ingredients in traditional cigarettes, and when burned, creates more than 7,000 chemicals. More than sixty of these chemicals are known to be cancer causing. However, e-cigarettes also produce harmful chemicals including acrolein, acetaldehydes and formaldehyde. Although overall less chemicals are produced when using vapes, these aldehydes can still cause lung and heart disease, and the acrolein may cause asthma and COPD. At this time, there is not enough research available to definitively link e-cigarettes to cancer. This is in part due to insufficient data of long term studies as e-cigarettes are a relatively new commodity. However, vaping would only be considered a better option when compared to regular cigarettes. Many e-cigarette users are young adults, and even children, who have never used traditional cigarettes regularly in the first place. A 2019 study published in the Journal of the American Medical Association surveyed over 18,000 students and found a high prevalence of e-cigarette usage (Cullen, 2019). Approximately 27 percent of high school students and 10 percent of middle school students reported "current e-cigarette usage" (Cullen, 2019). With the information currently available, the short answer to the question would be that, yes, e-cigarettes can be less harmful than traditional cigarettes. However, as research continues, e-cigarettes may continue to look less and less and appealing as we find out more about their possible adverse side effects.

References

Benowitz, N. L. (2010, June 17). Nicotine Addiction: NEJM. Retrieved April 14, 2020, from https://www.nejm.org/doi/full/10.1056/NEJMra0809890

Chand, H. S., Muthumalage, T., Maziak, W., & Rahman, I. (2020, January 14). Pulmonary Toxicity and the Pathophysiology of Electronic Cigarette, or Vaping Product, Use Associated Lung Injury. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6971159/#B49

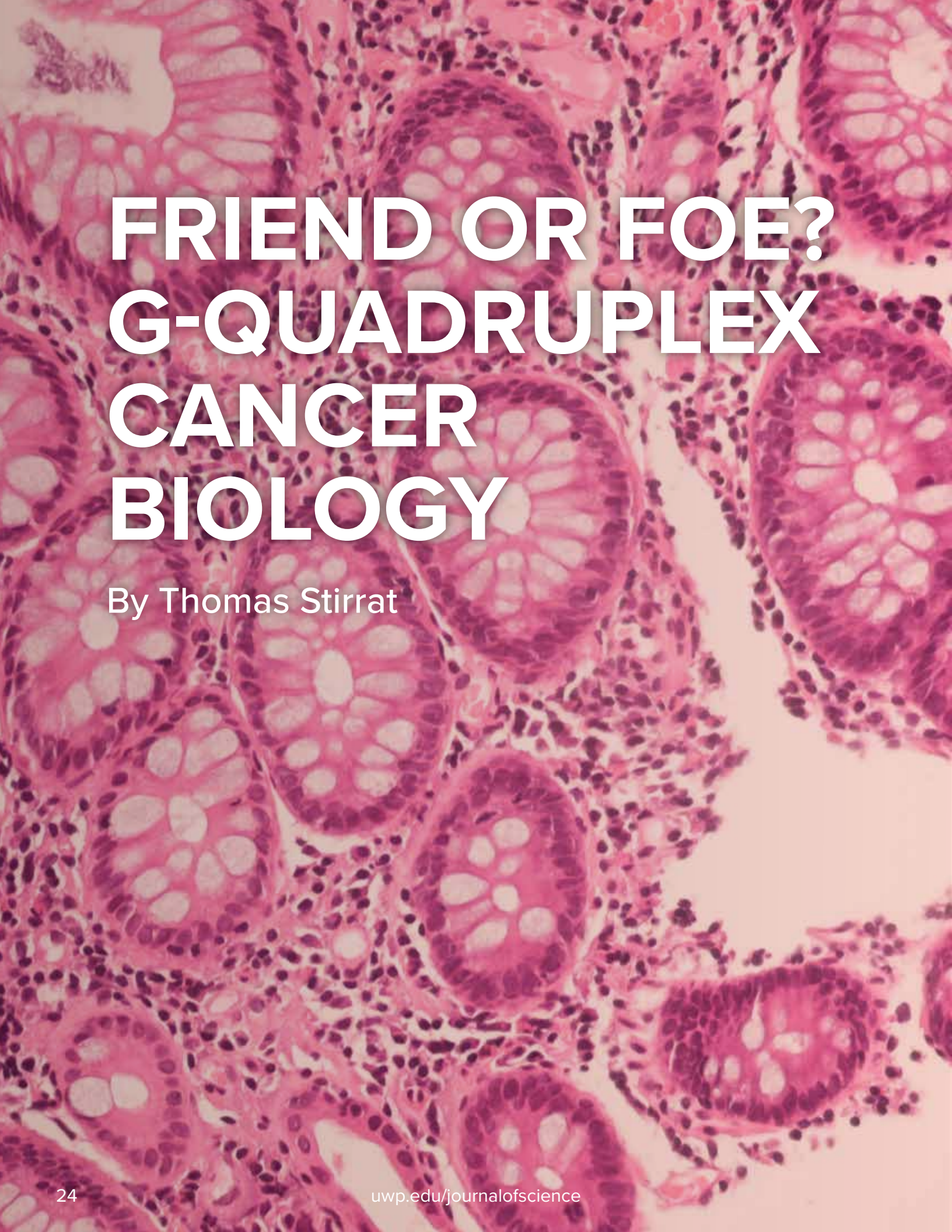
Cullen, K. A., Gentzke, A. S., Sawdey, M. D., Chang, J. T., Anic, G. M., Wang, T. W., ... King, B. A. (2019, November 5). e-Cigarette Use Among Youth in the United States, 2019. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/31688912

E-Cigarettes Linked to Heart Attacks, Coronary Artery Disease and Depression. (2019, March 7). Retrieved from https://www.acc.org/about-acc/press-releases/2019/03/07/10/03/ecigarettes-linked-to-heart-attacks-coronary-artery-disease-and-depression

E-cigarette or Vaping Product Use-Associated Lung Injury (EVALI). (n.d.). Retrieved April 14, 2020, from https://www.yalemedicine.org/conditions/evali/

Robinson, J. (1930). US1775947A. Location: United States https://patents.google.com/patent/US1775947

What's In a Cigarette? (2020, March 13). Retrieved from https://www.lung.org/quit-smoking/smoking-facts/whats-in-a-cigarette
(American Lung Association)



FRIEND OR FOE? G-QUADRUPLEX CANCER BIOLOGY

By Thomas Stirrat

HOW IS BREAST CANCER RELATED TO G-QUADRUPLEX DNA YOU ASK?

Sixty seven years ago Francis Crick and James Watson set out to elucidate the structure of DNA at Cambridge University. They published a paper in the journal Nature, titled “Molecular Structure of Nucleic Acids: A Structure for Deoxyribose Nucleic Acid.” This groundbreaking paper highlighted that DNA forms a double helical structure. However, a team coincidentally also from Cambridge University illuminated that an atypical configuration of DNA can also manifest in the shape of four strands, termed G-quadruplexes, within the human genome of living cells.

It was postulated that this structure plays a critical role in transcription, the transferring of information from DNA into mRNA which is subsequently translated into the language of proteins. This notion has gained traction recently as this specific conformation has been implicated in 22 model tumors of breast cancer. It is rather tricky to catch G-quadruplexes in the act so the team led by Professor Sir Shankar Balasubramanian and Professor Steve Jackson have employed pyridostatin to stop these quadruple helices right in their tracks, which acts by stabilizing and preventing them from unraveling. From here they used quantitative sequencing technology to study the models. The models were originally derived from biopsies of patients of the Addenbrooke’s Hospital, and then later transplanted into mice to fully form.

Cancer cells are always growing and dividing rapidly, this can lead to sizable parts of the genome being duplicated multiple times resulting in copy number aberrations (CNAs). Within these CNAs there are high numbers of G-quadruplexes, this means that they are a likely culprit in pushing down on the tumor’s gas pedal. Dr. Robert Hänsel-Hertsch out of Center for Molecular Medicine Cologne, states that: “The abundance and location of G-quadruplexes in these biopsies gives us a clue to their importance in cancer biology and to the heterogeneity of these breast cancers. Importantly, it highlights another potential weak spot that we might use against the breast tumour to develop better treatments for our patients.”

The group has shown that with 11 subtypes of breast cancer, each appears to have their own unique pattern of G4 forming varied transcriptional programming thus further complicating treatment modalities. Dr. Carlos Caldas, MD, professor of cancer medicine and director of the Cambridge Breast Cancer Research group remarks, “while we often think of breast cancer as one disease, there are actually at least 11 known subtypes, each of which may respond in different ways to different drugs.” However, with personalized medicine becoming the wave of the future identifying a certain tumor’s G4 structure may allow for precise treatment of that particular breast cancer subtype.

Synthetic molecules such as pyridostatin and another compound, CX-5461, which was used in a phase I trial against BRCA2-deficient breast cancer, have been spotlighted as potential tools in preventing the replication of DNA thus pressing the brakes on cell division. To halt the uncontrolled cell proliferation would be correcting the cancer’s root. It will be interesting to see in the future if G4s are present in other types of cancer, and if targeting them directly will prove to be an efficient method.

References

Hänsel-Hertsch, R et al. (2020). The landscape of G-quadruplex DNA structural regions in breast cancer. Nat Gen. DOI: 10.1038/s41588-020-0672-8

THE EXTRAORDINARY WORLD OF ENTOMOLOGY

DR. ORLOFSKE'S JOURNEY

By Eli Cortez

Dr. Jessica Orlofske has been fond of dragonflies since childhood, so it is no surprise she would later have a project dedicated to them. Catching bugs and raising caterpillars, coupled with her love for nature, had an immense effect on broadening her horizons as a biologist at a young age. Dragonflies, a few of which are endangered in Wisconsin, and other bugs are what led her to choose the field of ecology.

She stated, "I had no idea what I wanted to do for years it was the classic 'Biologist Syndrome' of, 'Oh I'll be a doctor, I'll be a vet, I'll be a dentist, I'll be a nurse, then I moved to zookeeper in order care of animals'". During high school, however, she found her calling; "I would occasionally get the chance to watch this show called John Acorn the Nature Nut that was on early Mornings on Animal Planet. He was an Entomologist and that gave me the realization that it was okay to like bugs, and that I could get a job studying bugs."

With a newfound passion for bugs, Dr. Orlofske reached out to the The Entomological Society of America and requested options for institutions that specialized in studying bugs. After deliberation, she settled on pursuing her undergraduate degree at the University of Wisconsin--Stevens Point. While attending, she decided to become a scientist during her freshman year. She applied her enthusiasm to the growing field of scientific inquiry. She would go on to double major in Biology and Wildlife Ecology. Before leaving, her introductory biology professor, also an Entomologist, recommended Iowa State University as a place to pursue her master's degree. "Embracing my childhood interest in bugs and deciding that I would try and make a career out of it" is what stuck with her in pursuing her graduate career. While pursuing her master's at Iowa State, Dr. Orloske found she had a fondness for teaching others, when she took up a position as a teacher's assistant; "What's better than learning about bugs? Teaching other people about bugs!" This inspiring transition of finding love for entomology, embracing that love, and applying it into teaching is what led Dr. Orlofske to the point she is now.

Dr. Orlofske, a Wisconsin native from Oak Creek, arrived at the University of Wisconsin--Parkside, UWP, as a distinguished professor and researcher in September of 2014. She has dedicated innumerable hours here teaching all biology majors the fundamentals of parasitology, biostatistics, and ecology. Additionally, Dr. Orlofske is in charge of her own research lab with an emphasis on ecology, entomology, and parasitology. The lab consists of a diverse group of students and faculty from different professional concentrations such as statistics, veterinary, environmental sciences,

and bioinformatics.

In her five years at UW-Parkside, Dr. Orlofske has conducted various projects. Currently, her major project is “Bio-Monitoring the Root River”, a river that flows through downtown Racine, Wisconsin. She stated “this involves sampling water, as well as aquatic insects as the primary focus.” She also mentioned that similar projects are being conducted in the wetlands of North Beach and Samuel Meyers Park; these projects measure the quality of restorations at those sites.

In terms of experimental projects, her lab measures insect metabolomics, which is described as “looking at how small molecules associated with biochemistry differ between insects that experience different stressors. Can we detect when an insect is in trouble before it dies?” According to her, this is an advantage in favor of taking a smaller sample size to bio-monitor. In her own words, the central theme of her lab is, “applications of invertebrates for bio-monitoring.”

Ever since Orlofske arrived at the UW-Parkside, her lab activities have changed quite frequently. When Orlofske started, she spent more time in the laboratory than the classroom due to fewer students and newer projects. “I would work one on one with students, each week, processing samples, talking about field work, which still happens, but probably not as intensely as what it was then.” Orlofske explained. “Now I have students who can work together and train each other, and collaborate as a better learning alternative anyway”. In the summers, when her time is more flexible, Orlofske spends her time out in the field with her students conducting work. Currently, Dr. Orlofske’s lab activities consist of sorting and counting (sorting and counting), in addition to some molecular work such as PCR, DNA extractions, metabolomics, on many of her projects.

No research can be done without any difficulties and Dr. Orloske has not been immune - facing her fair share of challenges. In addition to the standard scientific research difficulties Dr. Orlofske has also faced logistical issues. “Many of my projects span multiple semesters and it’s sometimes hard to have continuity of students working on those projects for that length of time,’’ she explains. Field work is usually conducted in the summer and occasionally fall, while the spring is time for presentations. In the research aspect, metabolomics tends to be the real scientific difficulty, as Orlofske has a background in Biology, not Chemistry. Moreover, the field work is made difficult only due to lack of material to work with on or off of.

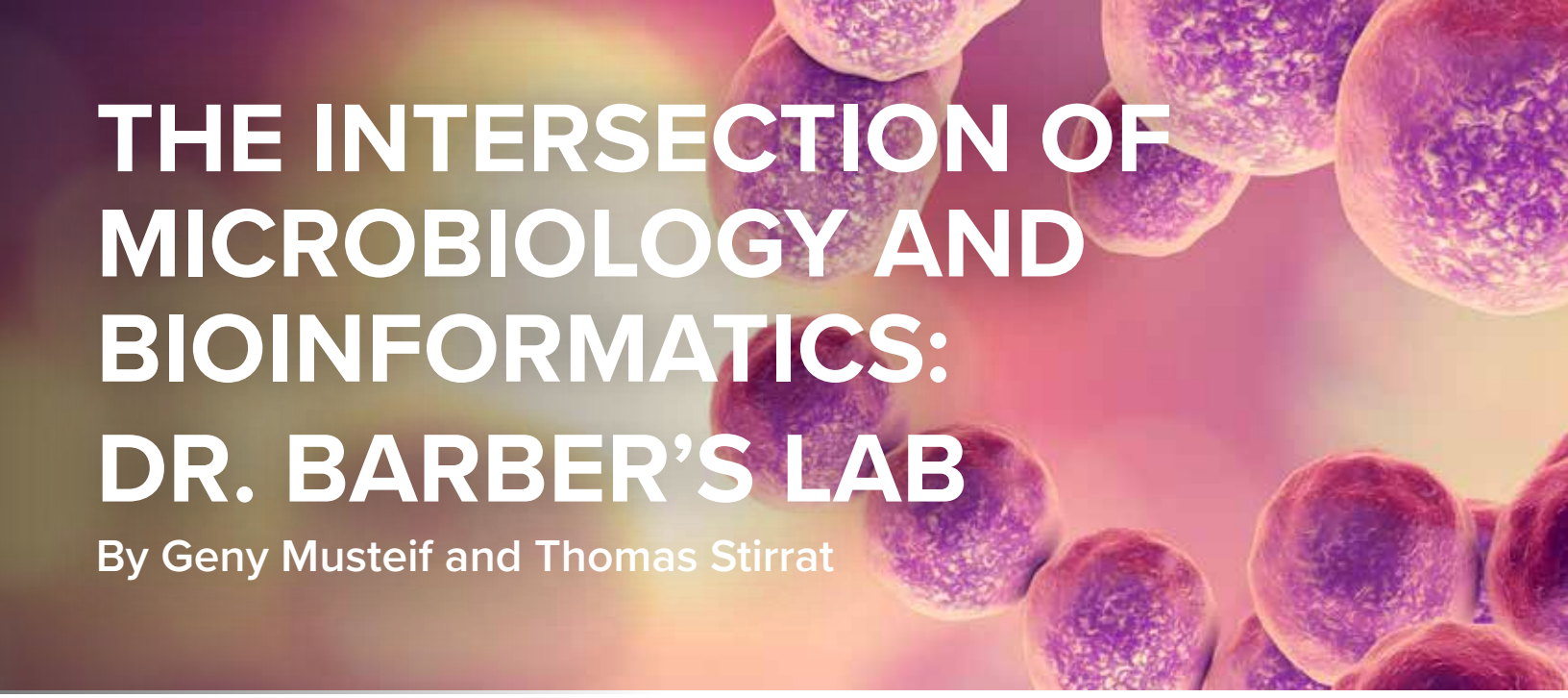
“That’s an easy question!” Dr. Orlofske responded to the question of what is most rewarding about her work.“It’s watching my students develop into professionals and scientists. The research is the icing on the cake, but the best part is watching my students get excited about their projects, come to me with their latest find, the data they’ve collected, and growing into independent researchers. Even if they leave and don’t stay in entomology, they are better scientists for having this experience.”

When talking to a general audience, such as in her lectures to non-bio majors, Dr. Orlofske usually would apply the concepts and themes of her research into the terms of healthcare, as this is something most people can relate to. “I like questions that ask how an insect or habitat

is doing?" "The tools I use are a lot similar to the tools that a doctor would use, just for different circumstances, certain diagnostics, scans, blood samples taken, but just with ecosystems. A very nice parallel with healthcare that allows me to relate with a general audience."

Above all, her greatest accomplishments are the accomplishments of her students. She experiences her students winning travel awards at conferences, national scholarships, and free trips to speak at NCUR. "I don't take credit for those (accomplishments), but I contributed in some way to that. Largely through helping expose them to that activity, the experience of research. That's really rewarding." She explains. "Personally, my lab and its contributions to the study of the Root River is important, as it is being watched by the world, and my students are aiding in that."

"The key to science in general I think is that it should be made engaging, safe, fun and approachable. Dr. Orlofske elaborates on when asked how to get people into science. "Getting kids, from kindergarten to high school to go outside is essential. They must be reassured that bugs are our allies, they pollinate our food, they protect us from pests, recycle nutrients, etc. Providing some of the positive side of these, and exciting outdoor activities, are a great way to reach out to people, even if they aren't interested in bugs, this could allow for interest into other scientific fields, as well."



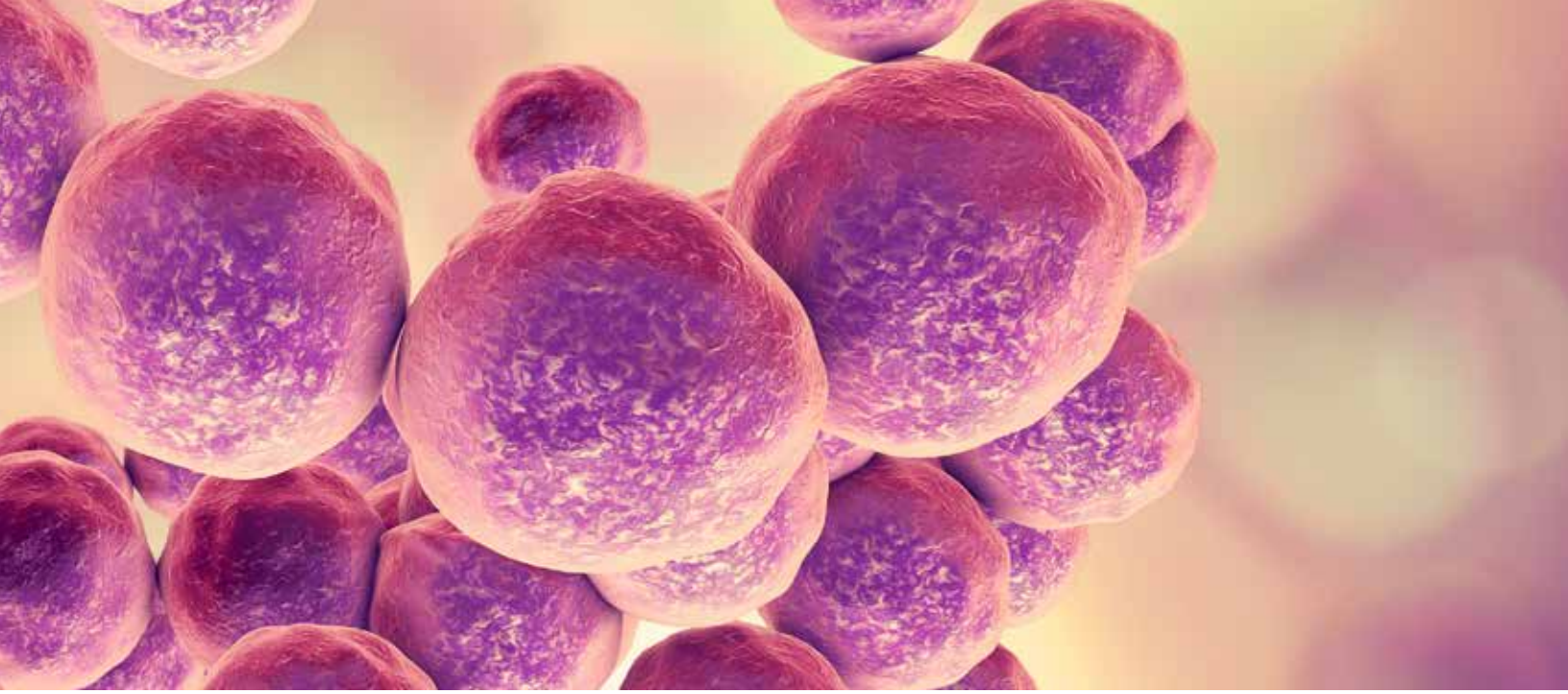
THE INTERSECTION OF MICROBIOLOGY AND BIOINFORMATICS: DR. BARBER'S LAB

By Geny Musteif and Thomas Stirrat

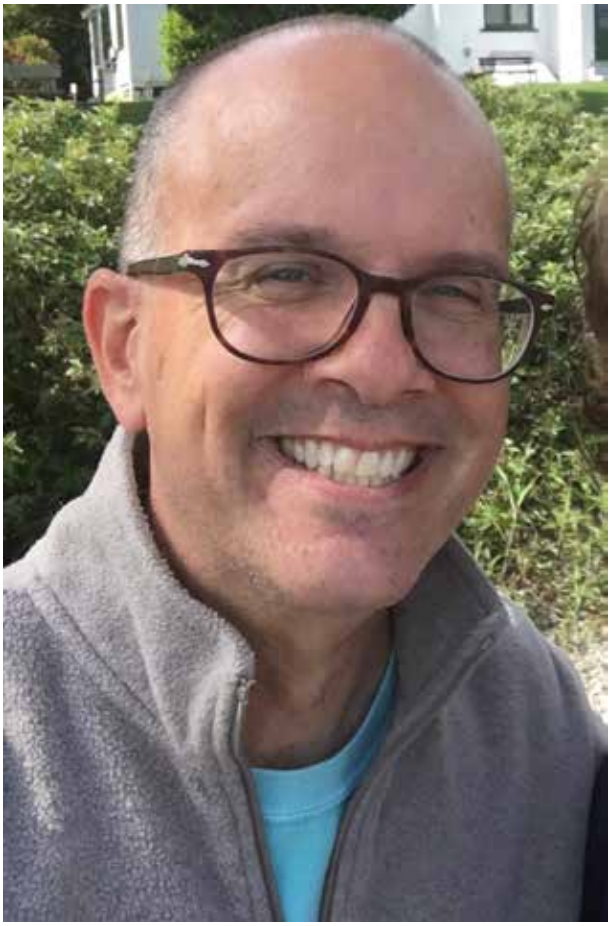
Dr. Robert Barber, an Associate Professor in the Department of Biological Sciences was initially a chemistry major but changed his mind after his first semester opting to try out Microbiology. He joined Dr. Abigail Slayer's lab during his undergraduate years, who was a source of inspiration in his research goals and teaching approaches. He was fascinated with the inquiry research offered. He graduated with a Bachelor of Science from the University of Illinois Urbana-Champaign in Microbiology, followed by a PhD in Cellular and Molecular Biology from the University of Wisconsin Madison, and a postdoctoral position in Biochemistry and Molecular Biology at Pennsylvania State University. Influential Professors like Dr. Slayer, Dr. Timothy Donhoe and Dr. James G. Ferry were all outstanding mentors that helped guide Dr. Barber in arriving at his career today.

During his senior year in undergrad, he worked on his thesis project studying antibiotic resistance in Bacteroides. Bacteroides are found in anaerobic infections and have a beneficial relationship with their host in the gut. The bacteria in the human colon contains up to 25% of Bacteroides. Recently he has recycled back to using Bacteroides as a model system. In his lab, students are identifying and studying natural enzyme variants of fatty acid kinases—fatty acid kinase is a "two-component enzyme system" that is required for extracellular fatty acid uptake. They are cloning, expressing, and biochemically characterizing these enzymes to test their properties. Human intestinal microbes have some of the same enzymes with unique properties. The long-term goal of this research is to provide insight regarding the contribution of intestinal microflora to fatty acid metabolism within the human gut. By linking the correlation between "high intestinal butyrate levels and low incidence of colon cancer." Butyrate in the intestines plays a "regulatory role in transepithelial fluid transport" and improves mucosal inflammation. Several studies have shown that butyrate prevents the inhibition of colorectal cancer. "I think that microflora-human interactions will be the most impactful area of study in the next 20 years on many levels ranging from health to understanding our evolutionary place in biology."

The day-to-day activities while doing research is rough with teaching courses "at a primarily undergraduate institution." There are two ways students are engaged in his research. "One, a research advisor has a project for many students to contribute a small part." Second, the "project" is in the hands of one or two students. When students are engaging in research, Dr. Barbers' day involves finding time for both to ensure that the students are working safely and understand the research. Once the students gain the experience needed, then they are allowed "to work more independently." However, there are still day-to-day checkups



to ensure that they are all on the same page. The day involves great communication, and problem-solving. One of the most difficult aspects of his research is “finding time and money”. The most rewarding aspects of his research are seeing his students learn and “finding out things no one else knows”



Dr. Barber encourages students who are undecided about what they want to do after graduation to get involved in the research. He said, “No other extracurricular experiences offer what working on a research project does. It involves problem-solving, critical thinking and application. You will learn more in one semester doing research than a whole year of coursework.”

A burst in prokaryotic genome sequencing efforts in the early 2000s were led by the growth in numbers of DNA sequencing centers or DNA sequencing ‘fiefdoms’ across the United States at various academic institutions. Since that time, much of these efforts have been consolidated at instutions such as the Joint Genome Institute (JGI) funded by the Department of Energy (https://jgi.doe.gov/). The Barber laboratory has participated in three collaborative prokaryotic genome sequencing projects: Methanosarcina acetivorans (sequenced by the Broad Institute at MIT); Rhodobacter sphaeroides str. 2.4.1 (sequenced by JGI); and Methanosaeta concilii GP6 (now called Methanothrix soeghenii, the name for this species was a point of contention for a decade and resolved in 2014) (sequenced by University of Washington). In each case, these projects engaged researchers from multiple institutions who contributed their knowledge to interpretation of the genome sequences.

However, as time progressed algorithms

for auto-annotating the genome sequences improved, so the number investigators necessary for working on a prokaryotic genome sequence diminished. For instance, interpretation of Methanothrix soehgenii genome sequence was conducted by two principal investigators at Clemson University along with myself and two of my graduate students, with my laboratory serving as the lead. Participating in these genome sequencing projects also provided an opportunity to work with raw genomic data and consider developing tools that could aid in discerning information from this type of approach. Following the advice of my postdoctoral mentor regarding science, we opted to 'go where others were not' regarding genome sequence analyses.

At the time, numerous prediction and comparative tools were being developed to interpret information based upon gene sequences. A former graduate student, Michael Bose, was instrumental in developing two applications that were published that instead focused on comparison of intergenic sequences, and secondly on genome sequence dark matter, prophage sequences. A database and web-site were implemented allowing any investigator to extract the DNA sequences between genes within a given prokaryotic genome sequence, and then compare those intergenic sequences to intergenic sequences in other prokaryotic genome sequences. Such comparisons reveal potential conserved DNA sequences that may serve as binding sites for transcriptional regulators. In a proof of concept experiment, a former graduate student, Mickey (Sarto) Burg, purified and showed that a Methanosarcina acetivorans SmtB/ArsR transcriptional regulator bound to a DNA sequence identified through use of this database.

In the early days of genome sequencing and even today, there will be stretches of predicted open reading frames that have very little in common with known genes. Often, this so-called 'dark matter' is associated with viruses or phage that have integrated into the genome sequence. Taking a cue from this observation, Mike Bose developed an algorithm based upon initial comparison of genes within a genome sequence to a database of known prophage genes as well as other aspects of prophage integration and gene neighbor comparisons to set-up a predictive web site that investigators could use to characterize prophage sequences readily within prokaryotic genome sequences. Fortunately or unfortunately, our efforts were recognized by other bioinformatic research groups and even bioinformatics institutes and our nascent efforts were quickly eclipsed. However, it is noteworthy to point out that Mike's publication detailing ProphageFinder was one of only three applications developed at basically the same time, and it has garnered over 100 citations on GoogleScholar despite the application only being unique and available for a short time. Still, we remain undeterred as there continues to be at least one software project available for development in the laboratory.

'Why sequence genomes?' Genome sequencing reveals genetic and metabolic potential within an organism that can be applied to understanding it's physiology as well as possible population, community and ecosystem level interactions. It's not the secret of life, but it goes a significant way towards it. For example, determination of the genome sequence of Methanothrix soehgenii, which is considered the predominant methane producer on Earth, and two other related species Methanosaeta harundacea and Methanosaeta thermophila, allows comparisons that provide insight into genome evolution among these methanoarchaeal species. M. soehgenii (3 Mb) has a genome that is ~50% larger than M. thermophila (1.9Mb). As determined by three former graduate students, Michelle (Harnack) Van Allen, Liyang Zhang, and Brittany Dobrowski, a substantial driver for this size difference is mobile genetic elements, whose integration has not only added DNA, but also had consequences on gene regulation and recombination within the genome. Understanding the alterations and their effects in the M. soehgenii genome sequence could provide insights to improve methane yields from anaerobic digesters or, alternatively, decrease methane production in rice paddies.

While interesting and valuable, the in silico analyses associated with genome sequencing is not the only research avenue in the Barber laboratory. We contend the rate limiting step in understanding a genome sequence is knowledge of the biochemical activities therein. That is, auto-annotation has limits and too often limited or incorrect functions are ascribed to gene products identified in genome sequences. As a result, we spend most of our time examining genome sequences to identify interesting gene products that we would like to characterize. Very early on, two graduate students, Kham Sou Her and Jackie (Wood) Merten, along with two undergraduates, John Cairo and Melissa Meland, performed genetic studies in Rhodobacter sphaeroides to investigate the role of various proteases in this organism's physiology. However, due to apparent redundancy in physiological roles, this quickly became more work than benefit. As a result, we moved to a research model of cloning, expressing, purifying, and in vitro characterization of interesting enzyme variants. That is, predictions about an enzyme's activity are made based upon it's sequence and genomic context, and if these predictions suggest a novel aspect to the enzyme's function, then it gets characterized. From the start, we focused on two enzyme families: PfpI/DJ-1 and ASKHA superfamily of phosphotransferases. The PfpI/DJ-1 family appears ubiquitous in biology with 135,000 gene sequences identified to date (although some genome sequences contain multiple genes). PfpI designation is for Pyrococcus furiosus protease I and this was the first family member characterized as an enzyme with a trimeric structure that functions as a hyperthermophilic protease. A few years later the human homolog, DJ-1, which exhibits alleles associated with early onset Parkinson's disease was characterized and this enzyme forms a dimeric structure acting as a redox sensitive chaperone. So, as you can see quaternary structure appears to be a determinant or at least a contributor to the enzyme's function. Notably, trimeric enzymes appeared to be limited to the Archaea domain, while Bacteria and Eukarya seemed to encode only dimeric enzymes. However, given the vast number of identified gene sequences, we decided to test this observation. The approach was rather simple. An undergraduate, Amy Sainski, identified key amino acids involved in formation of the trimeric structure in Archaea, then look for a bacterial sequence that matches at these key positions. We identified a candidate in Desulfovibrio vulgaris str. Hildenborough and Liyang Zhang cloned the gene, expressed the gene product, and purified the protein. The enzyme forms a trimeric structure as predicted. Regrettably though, the enzyme does not exhibit protease or chaperone activity under the conditions tested. So, further characterization of this enzyme as well as a R. sphaeroides homolog is waiting for the right student.

The ASKHA superfamily of phosphotransferases includes short chain and branched chain fatty acid kinases, sugar kinases, Hsc70, and actin. Among these our focus is on short chain fatty acid kinases, which are enzymes that perform the reversible ATP-dependent phosphorylation of fatty acids such as acetate, propionate, butyrate, etc. These enzymes have key roles in prokaryotic carbon metabolism and utilization, and contribute substantially to the global carbon cycle. For instance, two-thirds of atmospheric methane is derived from the methyl group of acetate, and a substantial contributor to this production is initiated by the acetate kinase of Methanosarcina species. Our approach has been to examine gene sequences predicted to encode short chain fatty acid kinases and identify ones with amino acid substitutions that might influence their activities in manners not readily apparent from auto-annotated genome sequences. Gundeep Singh and Jessica Castillo Venegas cloned and performed preliminary studies with a predicted butyrate kinase from Desulfovibrio vulgaris str. Hildenborough, that had a single substitution (a proline instead of an alanine) in a position predicted to contribute to the acyl-binding pocket of this enzyme. Maxwell Bachochin performed a detailed analysis of this enzyme and showed that this enzyme has substantially higher affinity for fatty acids, particularly butyrate and isobutyrate, than other characterized butyrate kinases. Using

the same methodology, Michelle (Harnack) Van Allen and Maxwell Bachochin have shown the R. sphaeroides acetate kinase, whic has multiple interesting amino acid substitutions, exhibits similar activity on primary fatty acids ranging in length from 2 to 8 carbons. This activity implicates this enzyme in Rhodobacter sphaeroides polyhydroxyalkanoate biosynthesis, which is a prokaryotic carbon storage medium similar to glycogen in animals or starch in plants. The study of this enzyme family continues with the work of Brittany Dobrowski and Lauren Prochniak who are characterizing predicted short chain fatty acid kinases found within Bacteroides species that inhabit the human gut. Preliminary work indicates that the amino acid substitutions identified in these enzymes lead to decreased activity on short chain fatty acids (C2-C5), and greater activity on medium chain fatty acids (C6-C8) and potentially even longer fatty acids. As a result, these enzymes could have a role in producing secondary metabolites that function in host-microbe interactions.

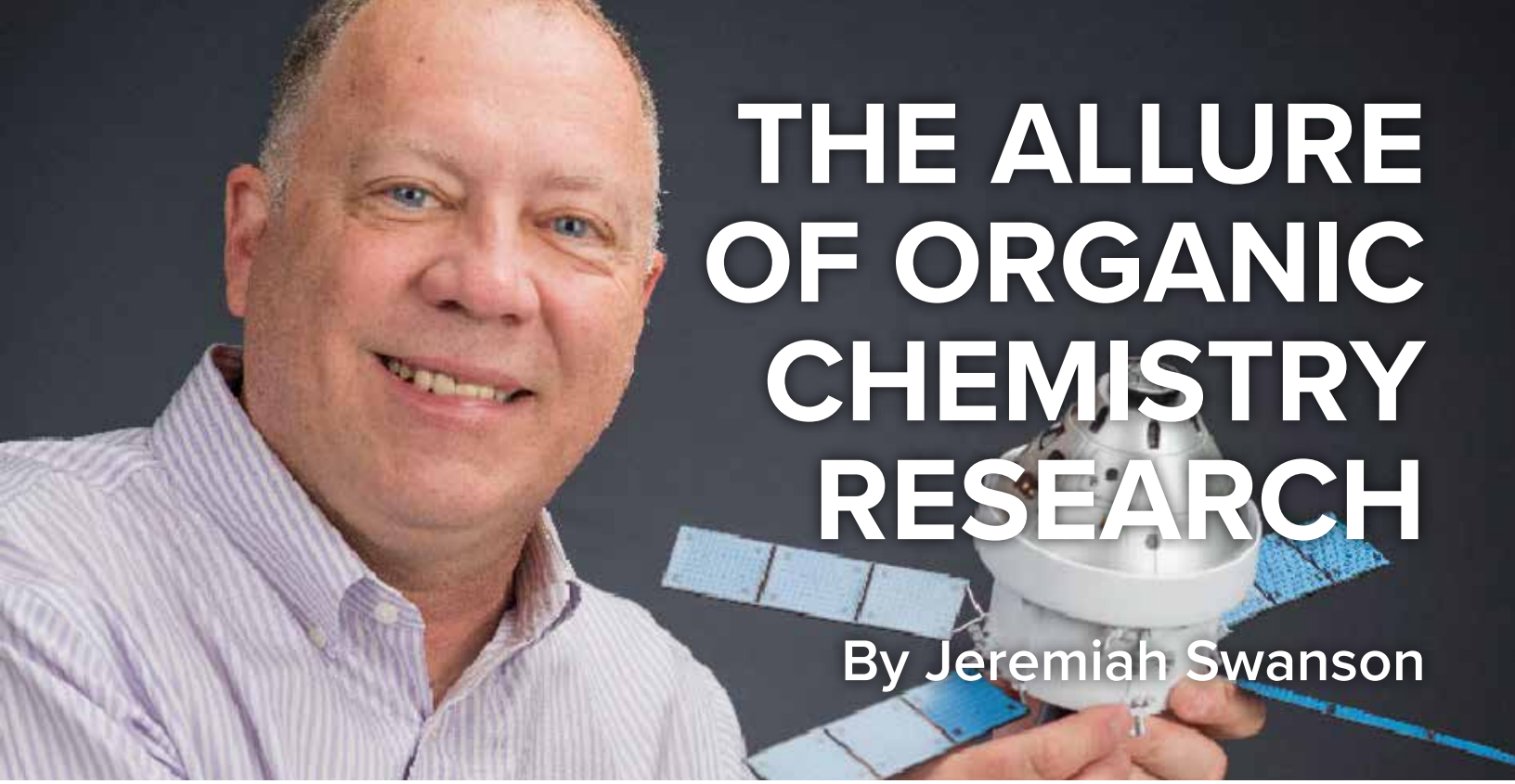
In summary, my laboratory's research interests may appear somewhat promiscuous. It's rarely boring learning something new. Truly, if someone were to ask me my model system, my response would be 'biology'. The common thread that I see regarding the intent of this work is the identification and revelation of potential for a gene product, which in my own mind is an analogy for my approach to teaching. For instance, I continue to have interest in developing useful pedagogical tools for integration into biology curricula. Years ago, I published a 'sweet' card game for understanding amino acid sequence comparisons based upon the card game 'Golf'. Recently, Quinn Allbee and myself have developed Python programs and associated files for instruction in computer programming to map alleles associated with genetic disease. Regrettably, not every student who has made a contribution to these and other projects were named. It does not minimize their contributions, rather highlights the ongoing nature of these projects as well as the challenges of science and obtaining meaningful results.

References

Canani, Roberto Berni, et al. "Potential Beneficial Effects of Butyrate in Intestinal and Extraintestinal Diseases." World Journal of Gastroenterology, Baishideng Publishing Group Co., Limited, 28 Mar. 2011, www.ncbi.nlm.nih.gov/pmc/articles/PMC3070119/.

Ericson, Megan E, et al. "Role of Fatty Acid Kinase in Cellular Lipid Homeostasis and SaeRS-Dependent Virulence Factor Expression in Staphylococcus Aureus." MBio, American Society for Microbiology, 1 Aug. 2017, www.ncbi.nlm.nih.gov/pubmed/28765222.

Wexler, Hannah M. "Bacteroides: the Good, the Bad, and the Nitty-Gritty." Clinical Microbiology Reviews, American Society for Microbiology (ASM), Oct. 2007, www.ncbi.nlm.nih.gov/pmc/articles/PMC2176045/.



THE ALLURE OF ORGANIC CHEMISTRY RESEARCH

By Jeremiah Swanson

Dr. Daryl R. Sauer currently teaches ten different chemistry classes, including the organic chemistry suite (1, 2, advanced and lab), at the University of Wisconsin - Parkside. Dr. Sauer began his undergraduate studies at the University of Wisconsin - Parkside as a Music Major. Dr. Sauer played the Saxophone in the Jazz band, Bassoon in the Orchestra, Clarinet, Tuba in a marching band, and Piano. In his second year of studies, after taking Organic Chemistry, he switched his major from Music to Chemistry. After graduating from Parkside Dr. Sauer turned down acceptances from the Big Ten schools, University of Texas, and Purdue among others to attend a graduate school that had a professor focusing on research that he found very interesting. After earning a PhD from South Florida University, he continued studying chemistry with world renowned professors for an additional two years in a post-doctoral fellowship at Ohio State University. After his Ohio State Fellowship Dr. Sauer was hired at Abbott Laboratories where he worked in industry for 25 years. He identified new technologies for drug discovery by traveling the world and looking at new science to see if it could be applied towards creating new drugs. Dr. Sauer is an author on 30 peer-reviewed publications.

What projects are you currently working on?
Dr. Sauer has two projects he is currently working on. The first project is working with NASA to utilize electricity to conduct chemistry in space. When NASA sends a manned mission to Mars it will be a 2-3-year mission and they may need to make drugs or other organic compounds while there. It is not feasible for NASA to take an entire chemistry stock room with them during space travel. The second project is to make nutritional beverages that can improve cognition and muscle mass in people. This would also be a great food for space travel because if you have a drink that gives you energy, makes you smarter, and makes you stronger then it is a win-win. This nutritional beverage would also be a good beverage for adults and elderly people.

What made you choose Chemistry as a field of study?
"I realized I probably didn't want to make a living being a band director the rest of my life." Dr. Sauer recalls thinking during his undergraduate studies. He really enjoyed Chemistry and decided to pursue that instead.

Can you describe your day to day activities in your laboratory?
Before going into the laboratory he thinks of new molecules to make, then decides how to make them. His daily activities in the lab mostly include using organic chemistry to make new molecules both through traditional chemicals and also electrochemistry. He makes use of a lot of the analytical equipment in the SE Johnson laboratory along with the MMR in the Organic laboratory. After creating new molecules in the lab he will purify them and characterize them in the laboratory.

What made you choose this area of research?
Dr. Sauer interviewed the head of NASA Medical Research and learned of the scientific issues and challenges associated with traveling to Mars. The issues of having very limited resources for years on end and with limited resources to deal with waste products. He thought this was a very interesting topic and could be solved with electrochemistry. They have plenty of electricity in space and if they could synthesize drugs and molecules using only electricity with little to no waste products in space this would solve many issues.

Who influenced you the most throughout your career?
His undergraduate professor at Parkside who allowed Dr. Sauer as an undergraduate to conduct a lot of interesting research on campus. Also, his professors at the U-South Florida and Ohio State University. He attributes these early influencers as being the most impactful to his successful career in chemistry.

What is the most difficult aspect of your research?
Funding and resources are the most difficult aspects of his research. Our laboratories are good here at Parkside, but we do not have everything that is needed to conduct the type of research that Dr. Sauer is doing, and he must sometimes find outside facilities to do various tests. The limited amount of time that students stay in his laboratory due to the undergraduate timeline is also a difficult hurdle with students frequently graduating.

What is the most rewarding aspect of your research?
When students realize how chemistry applies to their lives or career. When students graduate and continue onto graduate school, get a job in chemistry, start their own business, or win awards. These are examples of when he can see students understanding the science of chemistry and he feels the most rewarded.

When did you realize you wanted to become a scientist?
Dr. Sauer confessed to always liking science. He recalled that as a child he had a chemistry kit set up in his basement. He came to college as a Music major because he had a scholarship which acted as an entry point into college.

What accomplishment are you most Proud of?
In no order there are a few accomplishments that Dr. Sauer is most proud of. Developing many green chemistry techniques which allow people to do chemistry safer and easier is one of them. Also, being among the first people to use and develop microwave techniques in the industrial sector that are widely used to this day is another. He is proud of the accomplishments of getting the space research currently underway at Parkside started. When his students have success whether it is simply graduating, continuing to graduate school, or getting a job in the industry he knows that he had a part in helping his students achieve their goals and that is always satisfying.

What would be the best approach to getting more people into this field?
Showing people that chemistry applies to every aspect of their life. What does the octane of your gasoline mean? How is the medicine that you take when you are sick created and how does it work? How is the plastic in your water bottle created? What are the good and bad things about these materials? You should show people how great chemistry is to increase their interest. Finding what intrigues people and finding an area of science that appeals to those curiosities is how you get people interested in science.

Do you have any publications coming out within the next year?
Dr. Sauer is expecting to have publications within the next year. Specifically on the nutritional beverage research as well as for his electrochemistry research.

What do you think makes a student a good candidate to apply to work in your lab here at UW-Parkside?
A student that has done well in Organic Chemistry I, Organic Chemistry II, and has demonstrated proficiency in Organic Chemistry laboratory. Organic Chemistry laboratory is not a prerequisite to apply to work in Dr. Sauer's lab, but he does want to observe students in the Organic Chemistry laboratory class for a period to ensure they have adequate competence in the laboratory.

If you were starting your Chemistry path over where would you start knowing what you know now?
Dr. Sauer said he would not change his path. He would still attend Parkside for undergraduate studies. He believes Parkside gave him an advantage over other students that attended larger schools because of the research experiences during his undergraduate time at Parkside. When he went on to Graduate school, he was immediately allowed to work in the laboratory due to his past laboratory experience at Parkside while most of his classmates had to wait a year.

Do you have any interesting stories you would like to share?
Herbert C. Brown, a Nobel Prize in Chemistry recipient, was giving a Seminar at Parkside and as he concluded his seminar, he called Dr. Sauer to the front of the auditorium and hand-delivered an acceptance letter from Purdue Graduate School.

Is there anything else that you would like to convey to our audience? (comments, advise, etc...)?
Dr. Sauer was a first-generation college student and worked at a lumber yard while attending school. He displays a lot of his patents, that covers an entire wall of his office, not to show off his intelligence and many achievements but to show students that even if you are a poor kid from Kenosha, a first-generation college student, and struggling to pay for college, that you can too achieve great things. He came back to Parkside to give back to the Parkside community.

What is the name of the performance drink you are currently working on?
The performance drink is at the stage of early discovery and a commercial name hasn't been conceived yet.

What is the chemical basis behind it, how does it differ from a protein or energy drink? What parts of its structure are important to its function? Do you believe this has advantages over competitor products?
The chemical structure of the active component of the drink is novel and hasn't been disclosed yet. A patent filing is underway. The compound is unique and offers advantages over current drinks. It doesn't contain protein, however, it is designed to boost energy and build muscle mass.

What advancements have you made in your MARS mission electrochemistry work? What specific compounds are you analyzing and how do they differ from the ones used on Earth?
At the moment we have identified reactions which would be useful for the production of various pharmaceuticals and which can be conducted with the limited resources which will be available during space travel and extraterrestrial colonization. We are currently verifying the electrochemical reactions in the laboratory.

How do you come up with new molecular formulas which you patent? For our readers can you discuss the process of testing these for therapeutic properties?
The novel chemical structures are conceived by combining a knowledge of the chemical structures required for biological activity, a knowledge of synthetic organic chemistry to prepare the molecules, and experience in the field of medicinal chemistry to design molecules which possess drug-like properties. These properties include favorable oral absorption, physiological distribution, metabolism and excretion (ADME) and safety.

In one of your papers, you discuss 4-(4-pyridyl)-benzamides, what properties of this compound make it suitable for treating Rho Kinases (ROCKs)?
These compounds are novel, potent, and selective inhibitors of the Rho Kinases of interest. In addition they have a very good ADME profile and as such have the potential to be a novel treatment for prevention of cerebral vasospasm and the cerebral ischemic symptoms caused by subarachnoid hemorrhage surgery, for the treatment of glaucoma and ocular hypertension, and for cancer as anti-invasive and anti-tumor agents.

How was 4-(4-pyridyl)-benzamides discovered? What makes it so especially interesting?
These compounds, like many others, were discovered by screening chemical collections (hundreds of thousands of chemical compounds) against a target of interest. When a "hit" is discovered (i.e. a chemical that inhibits or activates the biological target of interest) the medicinal chemists will make slight changes in the molecule to improve the potency, selectivity and ADME profile. This process may require the synthesis of 2,000 to 10,000 compounds and can take 5-10 years. The goal is to find a novel, patentable, safe compound which possesses the characteristics of a good drug.

What are Rho Kinases and how are they modulated?
Rho-associated protein kinase (ROCK) is a kinase belonging to the AGC (PKA/ PKG/PKC) family of serine-threonine kinases. It is involved mainly in regulating the shape and movement of cells by acting on the cytoskeleton. Research over the past two decades has shown that ROCK signaling plays an important role in many diseases including cardiovascular disease, neurodegenerative diseases such as Alzheimer's disease, Parkinson's disease, and amyotrophic lateral sclerosis, and cancer. As such, researchers are developing ROCK inhibitors for treating these diseases. For example, ROCK inhibitors have potential to prevent cancer from spreading by blocking cell migration thus stopping cancer cells from spreading into neighboring tissue.

Can you discuss the properties of 1,3-dihydroindol-2-one and how it can be used for the control and/or prophylaxis of various vasopressin-dependent or oxytocin-dependent diseases?
This class of compounds can be used to regulate the interactions of vasopressin or oxytocin with their receptors. The goal is to regulate the hormones activity in a way which is beneficial.

What is a vasopressin-dependent or oxytocin-dependent disease? How did you get involved in this work and what made you interested in this molecule in particular?
Vasopressin is a peptide hormone that is involved in blood pressure regulation, tonicity of body fluids, and psychological disorders such as autism, major depressive disorder, bipolar disorder, and schizophrenia. It may also improve cognitive function. Oxytocin is also a peptide hormone that affects social behavior, anxiety, wound healing and autism. They are structurally related and released under similar conditions. As both are peptides, they are difficult to produce and they can only be administered via injection. Our goal was to find small, orally available molecules that would mimic the positive attributes of these hormones and could be administered as a pill.

Can you tell us about the continuous-flow microfluidic electrochemical device (Flux Module)? What makes it a practical new laboratory tool to facilitate electrochemical synthetic transformations?
Electrochemistry is an environmentally safe and sustainable way to do chemistry by reducing or eliminating the use of dangerous chemicals. However, it has not been highly utilized by the chemistry community. We developed this tool as an efficient and practical way to help organic chemists use electrochemistry routinely. In addition, as it is a flow device, the reaction is done in a tube instead of a flask or container. This means that the reaction is infinitely saleable, meaning you can make as much or as little material as you would like. Much like a garden hose, the longer you let it run the more material you get.

What do you wish more people knew about chemistry? Do you miss being involved in the industrial sides of chemistry more as compared to teaching? What prompted the change?
I do wish people would appreciate and understand chemistry more. Chemistry affects every second of our daily lives and I feel the more one understands chemistry the more beneficial it can be for our health, day-to-day functions and careers.

I am fortunate to have had the opportunity to work in both an industrial setting and an academic setting, and I have truly enjoyed both experiences. In the industrial setting I went to work every day with the desire and motivation to create pharmaceuticals which might benefit, and perhaps save many people. In academics I come to work every day with a desire to help students achieve their dreams and aspirations.

As a first-generation graduate of Parkside the change from industry to academics was easy for me. My chemical career started at Parkside and I had an opportunity to retire after what I considered a successful career. I wanted to come back to Parkside and try to give back and help students get a great education and have limitless opportunities both personally and professionally.

What led to you attaining so many patents? What was this process like? Is there anything you would like to see when chemists try to patent their ideas?
My research group developed chemical technologies that were applicable to the discovery of novel drugs in a number of therapeutic areas. As pharmaceutical research and development is extremely costly, it is critical to protect your intellectual property. As such, we always would patent our novel discoveries. To patent something it must be novel and you have to provide data proving that you really made the product and that it actually works as you describe. Thus all of the claims and data have to be well documented and scientifically accurate. It can be a challenging process.

Are there any other topics with which you could go into more detail with us regarding? Many people seem very interested in your NASA research, what does your timeline look like for this? Does electrochemistry differ in space? What challenges have you encountered while working on this project?
The main challenges with electrochemistry are trying to mimic chemistry that has been previously done with chemicals and then to discover new chemistry that hasn't been done with chemicals. In addition, there are challenges with only using reagents which would be available in space. Lastly, doing chemistry in zero-gravity will present technical challenges which must be considered.

What discovery/finding research-wise are you most proud of in your career?
I was involved in research that involved the use of microwaves and polymer supported reagents to perform organic chemistry in a way that was faster, safer and more efficient than traditional chemical techniques. This new technology was highly utilized by chemists around the world, particularly in the pharmaceutical industry. It was always rewarding when I would hear that scientists were using chemistry that I helped discover in their own research.

What techniques are commonly used in your laboratory for individuals/candidates interested in your work?
The students in my lab utilize synthetic organic chemistry, green chemistry, electrochemistry and microwave accelerated synthesis as part of their research.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