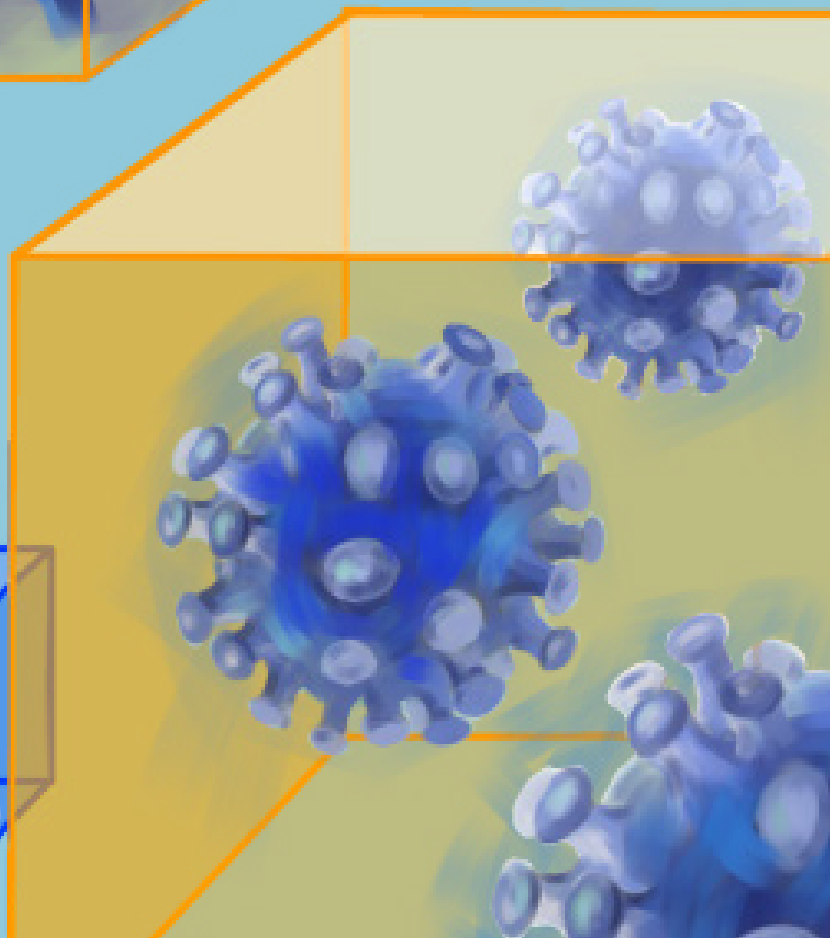
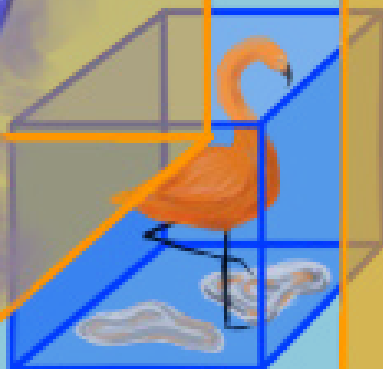
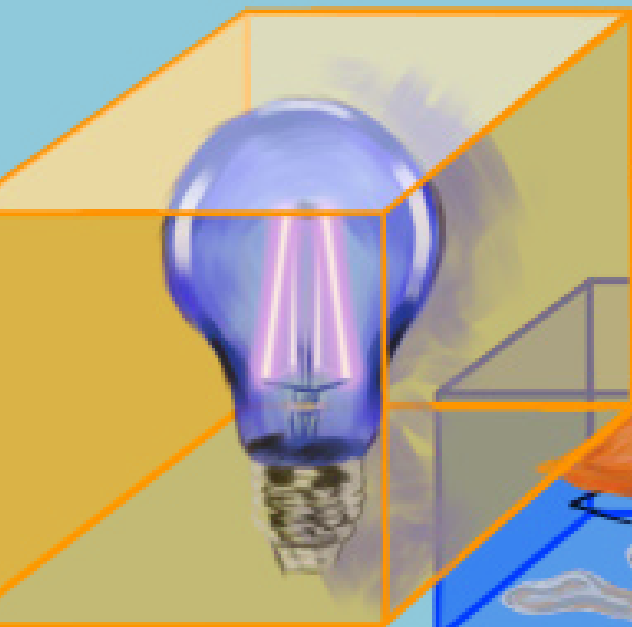
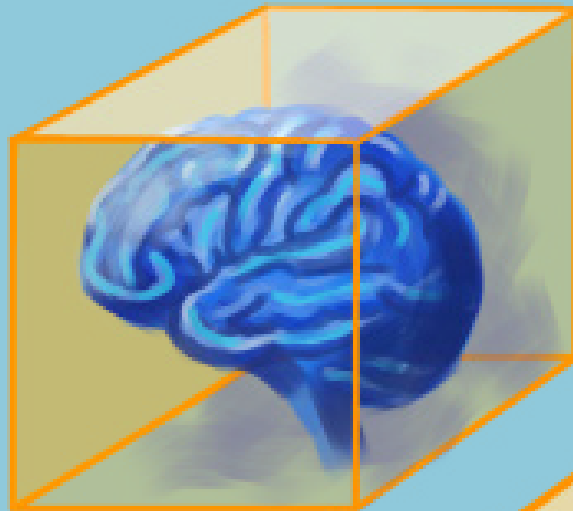
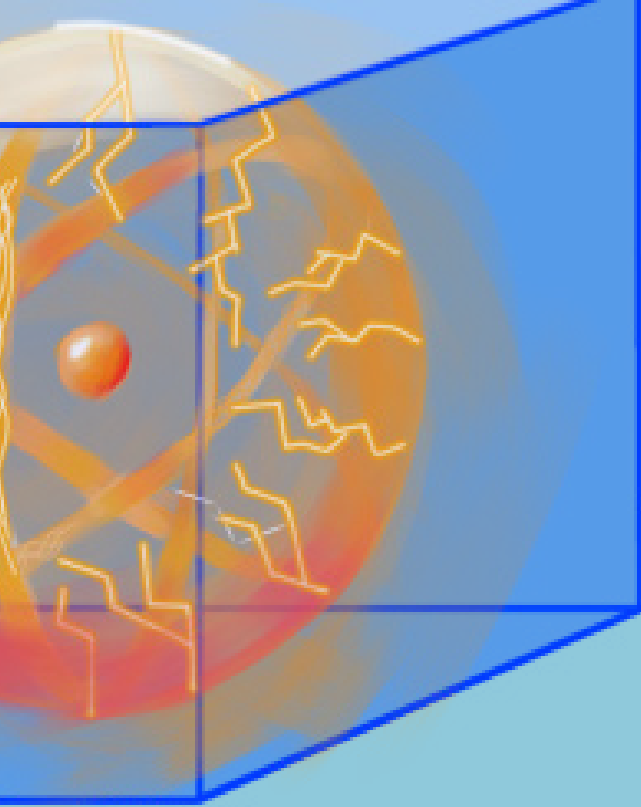


SCIENCE GREELEY

2022-2023 ISSUE I



EDITORIAL

The value of science lies largely in its ability to solve our problems. Throughout our history, we have seen its immense contributions in society, playing a key role in helping us tackle imposing complications.

Today, we still face a plethora of challenges, ranging from deadly diseases to a precarious natural environment. In this first issue of *Science Greeley*, we explore a sample of the diverse array of ways that science is being used to overcome these difficulties: from creating new renewable energy sources to combating illnesses, from raising awareness for environmental issues to enhancing our computational power.

At the present moment, it is difficult for us to fathom the future. But what we know to a certainty is that it is up to our generation to continue using science to confront the immense problems that we now face, and to fulfill our vision of a better world.

On behalf of everyone who contributed to this magazine, I would like to present to the reader the first issue of *Science Greeley*.

- Andrew Pang
Editor-in-Chief

Cover art by:
Sophia Kong

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RENEWABLE ENERGY SOURCE: RESIDENTS IN YOUR STOMACH

By: Jayden Cao

Art by: Michael Wang

How cool is carrying a power and sewage treatment plant in your stomach wherever you go? Our microbe friends might just allow us to do that.

The microbial fuel cell (MFC) is a renewable energy system that uses microorganisms to generate electricity. According to Beth Daley, the editor of *The Conversation U.S.*, MFCs work quite similarly to batteries. Similarly, MFCs consist of one positive side and one negative side. An external conductive circuit connects the two sides of the MFC. The conductive circuit captures the electrons released by microbes when they break down organic matter, and this accounts for electricity generation.

Typically, electricity-producing microorganisms are found mainly in anaerobic habitats for producing electricity in MFCs; however, Mehdi Tahernia, a scientist at the bioelectronics and microsystems laboratory of Binghamton University, suggests that a group of “weak” conductive bacteria, known as Gram-positive bacteria, may also qualify for the job.

Gram-positive bacteria were previously believed to be weak conductors because the layers surrounding the cells (known as cell walls) are thick and not capable of conducting electricity. Yet the recent realization of how Gram-positive bacteria transfer their electrons brought to light the possibility of using them in MFCs.

What’s fascinating is that some of these

Gram-positive bacteria are found in our guts! The human gut provides our bacteria friends with their happy place: an oxygen-poor yet nutrient-rich environment. Scientist Mehdi Tahernia claims that this anoxic environment turns out to be ideal for microbes to release and transfer electrons outside of the cell. Perhaps one day we could start charging our phones with the help of the residents that live inside of our stomachs. At that time, another function of the human stomach would possibly emerge in the field of physiology—producing electricity.

“...some of these Gram-positive bacteria are found in our guts.”

Moreover, the ideal organic matter for our microbe friends to break down to release electrons exist in wastewater. A wide variety of substances in wastewater could be used to “feed” microbes, ranging from simple compounds to complex mixtures. This opens up opportunities for MFCs and Gram-positive bacteria to not only produce renewable electricity but also purify water at the same time.

Even so, why bother?

According to Hannah Ritchie and Max Roser, the founder of *Our World in Data*, fossil fuels account for two-thirds of electricity generation worldwide. However, we cannot rely on fossil fuels to charge our phones and light our homes in the long run because they are non-renewable energy, meaning that one day they will run out. Renewable energy today accounts for one-third of global electricity generation, which is not enough to satisfy the world’s electricity demand if fossil fuels are depleted one day. Consequently, we must discover more clean electricity sources like MFCs to power the world.

Polluted water also contributes to nitrogen pollution, which harms both marine animals and mammals; sewage, furthermore, threatens the health of human beings. Dr. Johnson, a virologist from the University of Missouri,

remarks that sewage and untreated water increase the risk of diseases occurring and spreading. MFCs might just be the perfect helper to ease the burden of wastewater on the Earth and all living things.

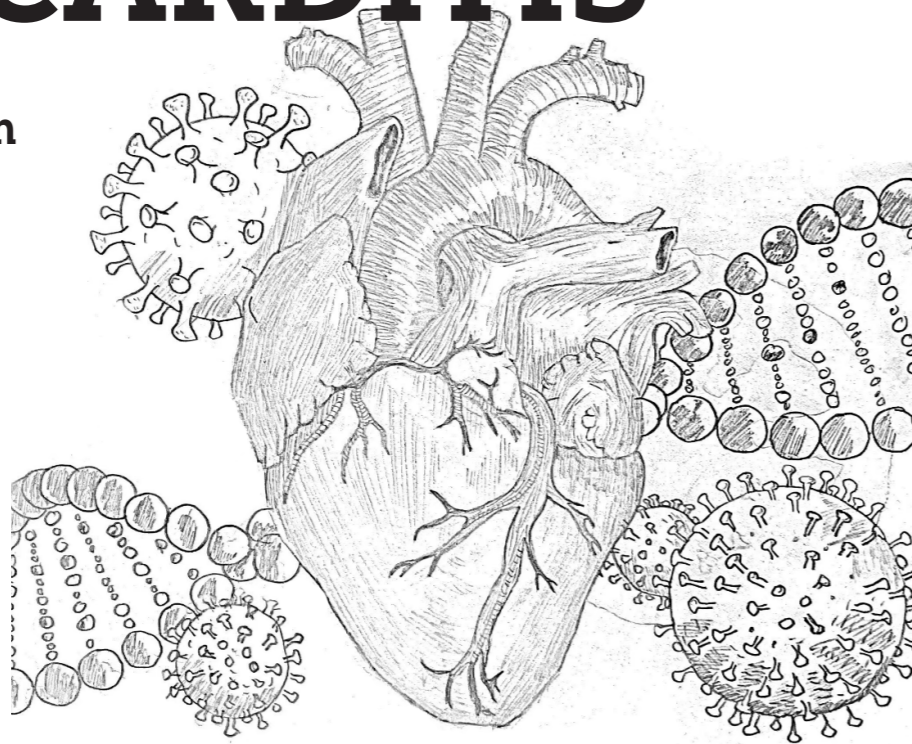
So, the next time you turn on your light switch, think about our microbe friends. Perhaps in the future, they would be powering your home or doing something much, much more magnificent.



COVID VACCINE-INDUCED MYOCARDITIS

By: Samuel Mullen

Art by: Michael Wang



CCOVID-19, a respiratory virus, completely shut the world down. The usually bustling and clamorous streets of cities fell silent, parks and sidewalks were deserted, restaurants and bars empty. The world appeared to be post apocalyptic. The first case of this deadly disease was reported on December 1, 2019 in Wuhan, China. The infection has caused millions of deaths across the world and many survivors of COVID-19 are scarred with health issues.

While COVID-19 is a respiratory illness,

a small portion of hospitalized patients with severe symptoms suffer from myocarditis - an inflammation of the heart muscle. 150 out of 100,000 hospitalized COVID-19 patients are afflicted with myocarditis. According to the CDC. In addition, myocarditis could result in chest pain, shortness of breath, heart failure, arrhythmias, which is the irregular beating of the heart, and even death.

In order to stop the spread of the virus, people should limit social gatherings, wear masks, and stay 2 meters apart from others. The isolation must have gotten to people's heads, because while in lockdown there was an increase

in demand for toilet paper, of all things. About a year after the virus first broke out a vaccine was developed and on December 11, 2020, and the FDA authorized the Pfizer-Bio-Tech COVID-19 vaccine for all individuals 16 years and older for emergency use. About 6 months later on May 10, 2021, the same Pfizer vaccine was approved for emergency use by the FDA for adolescents ranging from 12 to 15 years of age.

The Center for Disease Control stated that Minor and temporary side effects are common when administered the vaccine such as pain and redness where they got the shot, tiredness, headaches, nausea, and swollen lymph nodes. However, a miniscule portion of the people who received the mRNA (Pfizer-BioTech and Moderna) COVID-19 vaccine were diagnosed with myocarditis. While myocarditis cases from COVID-19 infection are considerably more serious than the ones that originated from the vaccination, the few "unlucky winners" still suffered chest pain, shortness of breath, and an inflamed heart muscle.

The heart disease was typically diagnosed within a week after the second shot of the mRNA vaccine, and it was most commonly found in male adolescents. Mayo Clinic says that Myocarditis can be diagnosed by performing various blood tests, an Electrocardiogram (EKG, ECG), an MRI (Magnetic Resonance Imaging) and an Echocardiogram.

The blood tests that are performed check for cardiac enzymes, which are proteins in the blood that can determine if there has been any damage done to the heart, and will find patients being nagged by doctors to eat sugary foods and drink plenty of liquids. Testing for antibodies in the blood will find if there has been myocarditis due to an infection or in this case a vaccine. The Elec-

trocardiogram is done to check if there are any arrhythmias, by placing what feels like a thousand stickers attached to cables and leads on your chest. The hour-long MRI is conducted to get an accurate image of the heart. The Echocardiogram creates a moving image of the heart that allows the doctor to see how the blood is moving throughout the heart and its size.

Cases from the vaccine were usually mild and when patients took anti-inflammatory medications and rested. Patients would often feel better quickly. Despite this, Cardiologists should always be consulted when myocarditis has been diagnosed for planning return to exercise and sports, even if the patient has no symptoms. Once symptoms improve patients can resume normal daily activities; but they should wait for about 6 months to return to sports and exercise.

However, before returning to exercise, it is recommended that the patient receives an MRI of their heart, an EKG, appropriate blood tests, and wears a heart monitor for two weeks. When wearing the monitor they must exercise to make sure the heart functions properly during physical activity.

Myocarditis from the mRNA COVID-19 vaccine is a serious condition that must be treated by healthcare professionals, but it is extremely rare. The case is usually mild and can be treated easily. However, myocarditis from COVID-19 infection is much more severe, and over a hundred times more likely to occur than myocarditis induced from the vaccine. So while there is a slight chance that you can get myocarditis from the vaccine, receiving the vaccine remains the safer option, as per the National Institute of Health. Afterwards, the vaccine protects you from COVID-19, which decreases your chances of falling prey to a serious side effect from the global epidemic.

"...the few "unlucky winners" still suffered chest pain, shortness of breath, and an inflamed heart muscle."



**“When the world
is in trouble,
chemistry comes
to the rescue”**

2022 NOBEL PRIZE LAUREATE: CAROLYN BERTOZZI

By: Andrew Pang

On October 5th 2022, Carolyn Bertozzi was announced as one of the winners of the 2022 Nobel Prize in Chemistry. As the founder of an entire sub-branch of chemistry, a significant researcher into infectious diseases, and a one-time member of a heavy rock band, her career so far has been more than fruitful. These immense contributions to science have secured her a place among the most influential scientists in history.

Despite being born into a highly scientific family, Bertozzi's initial passion was music. Yet, pressured by her parents to give up this pursuit, she instead decided to invest into the field of medicine, and started taking pre-med courses at Harvard University. At first, biology captured her interest far more than chemistry, and she claimed that general chemistry "was just a box I had to check".

Yet it was all destined to change when Bertozzi took organic chemistry, a notoriously rigorous course that requires immense amounts of memorization. While many of her classmates struggled to understand the concepts, Bertozzi discovered newfound interest in the field – so much so that she changed to a chemistry major the following year. From that moment on, her life took a drastic turn.

After getting her PhD., Bertozzi trained as a postdoc in an immunology lab, where she studied the role of carbohydrates in immune systems. Specifically, they were interested in glycans, a type of complex carbohydrates that are found on the surface of cells. Glycans play a key role in cellular function, as they help cells to communicate with each other, regulate the activities of many proteins, and, most importantly for the study, assist in immune response. But Bertozzi and her colleagues were confronted by a significant issue: scientists at the time did not have the technology to properly image glycans; thus, studying their function was highly difficult. This was all the inspi-

"... scientists at the time did not have the technology to properly image glycans..."

ration Bertozzi needed to begin conducting her own line of research, which would ultimately lead her to the 2022 Nobel Prize.

Essentially, what Bertozzi did was create a tool to mark out glycans without disturbing normal biological processes. While it may not sound difficult, this project took her years to complete. Ultimately, Bertozzi made key modifications to fluorescent labels, a pre-existing technology, and allowed scientists to clearly observe glycans for the first time. In doing this project, she invented a new field of science: bio-orthogonal chemistry. This field deals with chemically modifying molecules within cells without disrupting other biological pro-

cesses. Such technologies are highly important, as they allow scientists to be able to effectively study specific biomolecules.

The applications of these technologies are broad, but Bertozzi mainly directed it into medicine and immunology. Along with her team, she utilized this powerful tool to further advances in our understanding of diseases such as tuberculosis, cancer, and, more recently COVID. Using this enhanced knowledge, Bertozzi and her team developed new diagnostic and therapeutic approaches to combat these illnesses. Currently, many of the technologies which Bertozzi created, both in the field of bioorthogonal chemistry and immunology, have been put into commercial use, and she herself has co-founded and contributed to multiple biotechnology startups.

The improvements in science which Bertozzi have spurred are immense; her pioneering work in

bioorthogonal chemistry has allowed scientists to study a highly essential biomolecule for the first time, and her later advances in immunology have also been significant. But nonetheless, the full potential of Bertozzi's achievements has hardly yet been exploit-

ed, and there remain many real-life problems that these technologies can be applied to.

"When the world is in trouble," Bertozzi said in a Nobel Prize interview, "chemistry comes to the rescue".

"many of the technologies which Bertozzi created... have been put into commercial use."

Bioorthogonal:

A type of reaction that can occur in a biological environment without affecting the function of biomolecules

(The term was first used by Bertozzi in 2003)

HARVESTING ENERGY FROM A LIGHT BREEZE



By: Ben Schifrin

Art by: Sophia Kong

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"The Wind Harvester could be the future of wind technology, maybe even in your home!"

In October, scientists from the Nanyang Technological University of Singapore made an engineering breakthrough with their new invention, the wind harvester. The 15 by 20 centimeter device is one of the smallest of its kind, and is capable of running under winds of only 2 meters per second. This makes it ideal for urban environments that require compact technology and where the crowded buildings slow the wind. The Wind Harvester could be the future of wind technology, maybe even in your home!

Wind Power

The body is constructed of fiber epoxy, a durable polymer, with the main attachment built of other inexpensive materials including copper, aluminum foil, and teflon, a chemical coating. When the machine interacts with wind, a plate moves back and forth from a stopper, creating charges on the film. Eventually, an electrical current forms as the charges flow from the aluminum foil to the copper film. During the testing process, the lab

concluded that the harvester was capable of powering 40 LED lights under consistent winds of 4 meters per second. The wind harvester was also able to power a sensor, which wirelessly transmitted room temperature data to a mobile phone. Even better, the device was able to power a machine and store energy to power itself in situations with no wind.

Commercializing

As of now, the Nanyang team are working towards commercializing the harvesters, with plans to replace smaller nonrenewable lithium-ion batteries. The leader of the project, Professor Yang Yaowen, said "[o]ur research aims to tackle the lack of a small-scale energy harvester for more targeted functions, such as to power smaller sensors and electronic devices." This leaves the prospect for wind power to become available to everyone, not just on private wind farms. In the future, the harvesters could power our cell phones, appliances, or even charge electric cars. The researchers said that the possibilities of The Wind Harvester are endless.

"In the future, the harvesters could power our cell phones, appliances, or even charge electric cars."

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A CURE TO RABIES

By: Amy Feng

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One of the longest rivals of mankind itself, the deadly illness rabies still poses a threat in the modern day. Known to humans for over 4,000 years, little progress has occurred over the centuries. Besides the remarkable invention of the post-exposure vaccination (PREP), which was created in the 19th century, rabies had otherwise been at a stalemate with humanity until recently.

The problem with post-exposure vaccination is the time constraint; one must receive the vaccine within 48 hours, or else it proves ineffective. However, oftentimes, people either cannot access resources in the given time frame or they aren't aware they've been infected until symptoms occur. The species to transmit rabies most frequently in the United States are bats, and un-

fortunately, most aren't aware they've been bitten. Bats tend to have bites that are only a few inches in size. In other countries (specifically third world countries), stray dogs tend to transmit rabies the

most. In most of these countries, there aren't adequate resources and most people cannot receive PREP. Worldwide, there's over 60,000 deaths from rabies but only 2-3 happen in the United States. Once symptoms appear, rabies is almost 100% fatal with only one case documented where a person was able to fight off rabies while within a coma.

Rabies itself is a rather sim-

ple illness to understand. In order to contract rabies, the virus RABV has to be transmitted through direct contact (broken skin, eyes), and it's oftentimes transmitted through saliva. After infection, the virus will move slowly, creeping up towards the central nervous system damaging nerves along the way. There are four stages of rabies: incubation, prodromal phase, acute neurological phase and finally, coma. Incubation is the time period before the virus makes it to the central nervous system. There are no symptoms present during this phase, and if caught early enough, can be prevented by the pre-exposure vaccination. The prodromal phase happens next, and at this point, RABV has traveled through nerve cells and is entering the brain and spinal cord. The immune system will begin to react, and flu-like symptoms (fever, etc) will begin to occur. This phase lasts about 2-10 days, and by this

"Once symptoms appear, rabies is almost 100% fatal with only one case documented where a person was able to fight off rabies..."

point, it's too late for pre-exposure vaccination to be effective. Then, the acute neurological phase occurs. This is when extensive damage to the brain and spinal cord happens.

There are 2 types of acute neurological phases for rabies: paralysis and furious. People will have 'furious' rabies, where they are aggressive, oftentimes have seizures and are delirious. It lasts only a few days to a week. The others have paralysis, where they are unusually weak and will end up paralyzed, however this can last up to a month. The final stage is coma, when the body eventually collapses from

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weakness. This is the final stage of the infection, and death is the end result.

However, recently scientists have begun looking into cures and have identified a possible successful treatment: utilizing monoclonal human antibodies (mAbs). Antibodies recognize and counteract specific antigens (or proteins) that are on an illness. The clinical trials have currently been focused on rats, and other rodents. The monoclonal human antibodies are an antibody created in the lab, mixing a human antibody with a rat antibody, and creating a special mixture. In this case, the mAbs used were RVC20/RVC50. In the trials, the rats are injected with a strain of RABV. Usually, rats die around 10-13 days after exposure to the rabies virus, however scientists found that when

“scientists found that when utilizing mAbs, the rats have been able to be cleared of rabies even after the symptomatic stage”

utilizing mAbs, the rats have been able to be cleared of rabies even after the symptomatic stage. When given to rats at 6 days after exposure (when symptoms have already begun), the rats have been found to be completely eradicated of rabies with a 100% success rate. The later it's injected, the lower the success rate becomes. However for the most part, even at 8 days after exposure, most cases are successful with mAbs. Many rats have been able to live over 100 days after exposure!

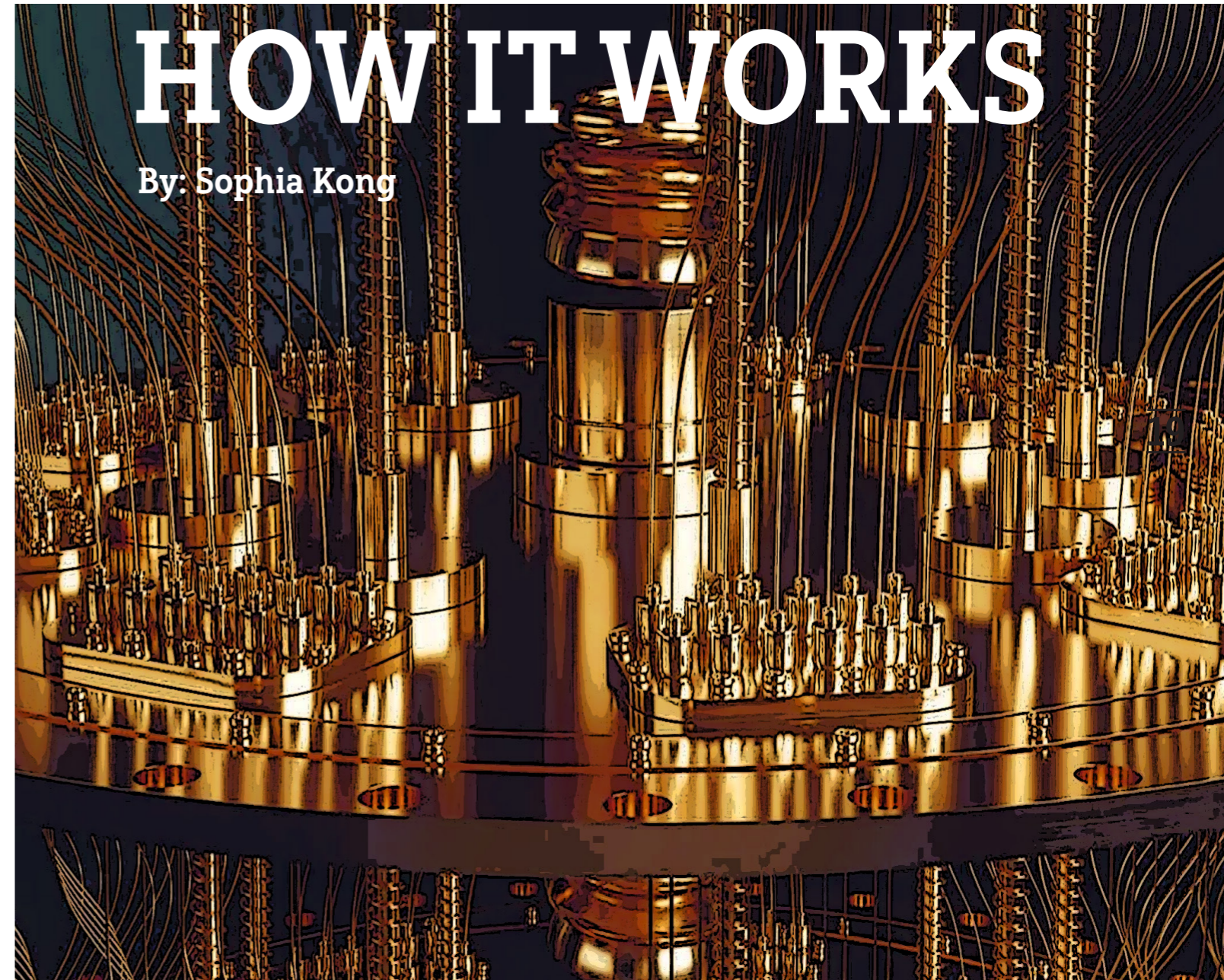
Scientists have found that the ways to inject the cure should be mixed, and should not just be one method. Intracerebroventricular infusion is a method that bypasses the blood brain barrier (a barrier that

blood forms that keeps 'bad' things out of the brain) and allows for high drug concentrations to enter central brain compartments. Intramuscular administration is a technique used to deliver medication deep into the muscles. When both of these methods of injection were used, scientists found that it was much more effective than just using one method of injecting alone. The scientists would do one intramuscular administration, and continuous intracerebroventricular infusion, which proved extremely effective. Higher doses are not necessarily more effective, as long as enough is used, the results will be the same.

The rats were found to have normal weight, normal motor function and normal cognitive function through many different tests. Some of them included the open field test, where mice would be placed in a field and their behavior would be observed, or the rotarod test, which measures motor function. Although there still may be quite a bit of time for the treatment to be perfected and widespread, the discovery of the cure is already quite an achievement. In fact, the cure is already being put into use in places such as India right now. As scientists work to make the cure more cost efficient so that it's able to be offered to all, humanity should be ecstatic and thankful to these scientists for their contribution to the betterment of humanity.

QUANTUM COMPUTING: HOW IT WORKS

By: Sophia Kong



The advancement of technology and understanding of particle physics opens a new window of opportunities that presents itself in the form of quantum computing. You have probably noticed a rising trend of tech companies trying to build the first working quantum computer. However, what exactly is a quantum computer, and why is it so much better than the laptop you use for school? Quantum computing is an area of computer science that utilizes theories on the behavior of energy and matter at a very small scale (atomic and subatomic). The two main quantum theories that are important to know for now are superpositions and entanglement. Using the concepts of these two theories (and a few others), quantum computers can perform a myriad of functions that classical computers cannot.

Superposition

Superposition is a phenomenon in which a particle can be in a combination of two states until a measurement is made. To understand superposition (and why it's relevant), you must know how normal computing works. The smallest unit of information in classical computing is called a bit. A bit can store information as either a 0 or a 1. Quantum computing works in a similar way, instead with particles (ions, electrons, photons, etc) that represent a bit, oth-

erwise known as a qubit. However, the difference between a qubit and a bit is that a qubit has the ability to be both 0 AND 1, while a bit can only be 0 OR 1. Imagine a qubit as a coin being flipped. When the coin is in the air, it is both heads and tails, not one or the other, but both at the same time. The qubit's ability to be in a state of superposition allows it to store much, much more information than a bit, meaning as more qubits are used, the amount of information that can be stored increases exponentially which when compared to classical computers is a huge difference.

Entanglement

Entanglement is a quantum effect where the state of two different qubits in a superposition directly affects each other when measured. When a qubit in superposition is measured, the state of superposition collapses so that the qubit is no longer in a state of 1 AND 0 but 1 OR 0 (whether the qubit collapses into a 1 state rather than a 0 state is probabilistic). If two qubits in superposition are entangled, when those qubits collapse into a 1 or 0, you only need to know the state of one qubit for the state of the second qubit to be immediately known. You can see this as two people (Alice and Bob) wearing hats. If you know that Alice wears a red hat when Bob wears a blue hat and Alice wears a blue hat when Bob wears a red hat, you know what color hat Alice is wear-

“Superposition is a phenomenon in which a particle can be in a combination of two states.”

ing even if you only see Bob that day. When particles are entangled, they can be seen as a single entity despite their distance. Entanglement is important in developing new technology because it significantly improves the speed at which quantum computers process information by its ability to transport information instantaneously.

Problems That Quantum Computers Can Solve

Because of the massive computational power of a quantum computer (thanks to the theories of entanglement and superposition), quantum computers are able to solve complex problems that even a supercomputer is unable to solve. Quantum computers have the unique ability to solve problems with many many variables. Classical computers solve problems in a different way than we humans do. The way computers find solutions is by going through billions of operations per second and testing out every single possibility of a solution individually until the right answer appears. And this works a lot of the time until the number of possibilities of solutions becomes so great that even the best supercomputers are unable to solve it in a realistic amount of time. This is where quantum computers come in. Because quantum computers are able to store much more information and are faster, they are able to solve complex problems a lot faster. For example, finding the structure of proteins is a complex problem due to the numerous ways that amino acids can be connected and manners it can fold; however with quantum computing, finding the

structure can be a lot faster which can revolutionize the medical field.

Conclusion

In many ways, Quantum Computing is a groundbreaking field of science, redefining the boundaries of computational power. Taking advantage of our present understanding of matter and energy at atomic and subatomic levels, quantum technologies and concepts that were previously unimaginable have been now developed. However, these emerging technologies are still confronted by many difficult limitations – for instance, the environment. Due to the immense fragility of qubits, the presence of any external disturbances can alter the data considerably, leading to a loss of information. Consequently, many current quantum computers must be kept at temperatures nearing absolute zero (-273.15 C). Yet despite the challenges present, the potential of Quantum Computing is undeniable. Utilizing the theories of superpositions and entanglement, quantum computers may soon be able to take on a

“When particles are entangled, they can be seen as a single entity despite their distance.”

multitude of functions, ranging from Artificial Intelligence to Medicine. And wherever it is applied, fields and disciplines will experience immense breakthroughs, as humanity harnesses one of its most powerful tools yet.

MINDFULNESS: A NEW APPROACH TO ENHANCING ATHLETIC PERFORMANCE

By: Phoebe Hawthorne

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The numbers are astonishing. Mental health has drastically declined from COVID-19, but even before the pandemic, the commonality of anxiety and depression in people were still on a rise. There was a 27% increase of anxiety and 24% increase of depression (between 2016 and 2019) for adolescents. Despite these numbers calling for the need of mental health care, the number for those who receive it have decreased. In 2016, 82% of kids received mental health care services while in 2020 it was only 80%.

Historically, mental illnesses were always looked down on. People with mental illness were categorized as unfit for society; many ended up without treatment in jail or in a hospital that often were cruel and isolating environments. Fast forward to today, the acceptance of mental illnesses have come a long way; yet for sports this old view is still holding strong. There's always been that perspective of athletes being strong and powerful. They are expected to be in tip-top health mentally and physically because they're competing to be the best in their field. If they were to admit their mental illness, it would be perceived as weak and fragile.

Perfect examples of athletes facing backlash from society was when Biles, a gymnast, withdrew from several Olympics events and when Naomi Osaka, a tennis player, withdrew

from the 2021 French Open, both taking time for their mental health. In Osaka's case, her refusal to participate in press conferences due to anxiety and depression caused a heavy fine from the French Open officials. The directors of all four grand slams even issued statements that Osaka was risking banishment from an important and highly profitable tournament if she refused to face the media in the future.

Osaka and Biles are both breaking the norm and challenging a stigma that has been here for generations; normalizing mental health on an international scale. Even Nathan Chen, a figure skater, applauded them saying that he had no idea that withdrawing was even an option for athletes.

In recent research of mental health in sports, there's been two promising technological tools that could potentially reduce mental illnesses in athletes: mindfulness and ACT (acceptance and commitment therapy). Studies prove that these two methods have improved athletic performances and more importantly help them to lead a healthier and happier life outside of their sport.

Mindfulness

A former coach, Minkler partnered with psychologist Tim Pineau in a study on a women's lacrosse team at Marymount University in Arlington, VA. This experiment was to test if mindfulness training was effective to improve players' performance

"If they were to admit their mental illness, it would be perceived as weak and fragile."

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and their mental health. The training ranged from stationary meditations to physical exercises such as yoga, walking, throwing, and catching. Notably, they also conducted group discussions of letting go of mistakes. After 6 weeks of mindfulness training and follow ups, post-training surveys showed that players felt they were able to focus more on the game and were less anxious while playing. The mindfulness training helped not just their mental health, but improved their overall performance: before the mindfulness training the team had 15 losses and 4 wins, but afterwards they had more wins than losses. In 2019, researchers in the *Journal of Sports Psychology in Action* reported that, "The next season, the team won the regional conference championship."

Another study with the University of Miami football team supports this finding. Amishi Jha, a neuroscientist, and Al Golden, the coach, partnered up to track how well the football team was able to pay attention during pre-season training. The team was split into two groups: one was given a mindfulness meditation training and the other conducted a relaxation exercise training. After preseason, they were given the attention test again, and Jha confirms that while the results were worse overall, the conditions of those who regularly practiced mindfulness exercises dropped less drastically.

Finally, Graham Mertz, a quarterback for the University of Wisconsin-Madison, shares his personal experience with mindfulness training that supports Minker's and Jha's findings. After a disappointing season in 2020,

Mertz began to work with Chad McGehee, director of meditation training. The mindfulness training aided Mertz in finding out how to reset himself mentally between the 40 second offensive plays. He spent much of his time learning how to identify anchors to bring his attention back to the present and ignore the past play. As a result, his team played better, finishing the 2021 season with 8 wins, 4 losses, and a win in December's Las Vegas Bowl.

Ultimately, by shifting more time towards meditation and focus activities, athletes have been able to enhance their performance.

ACT

ACT is another technique that counselors use to help athletes improve their performance and mental health.

ACT tries to teach athletes to separate their competitive and personal identities. It tries to prevent a spiral of negative thoughts. It doesn't prevent them, but separates the thought to make it not personal.

A psychiatrist at the University of Putra Malaysia in Seri Kembangan, Eugene Koh Boon Yau, worked with three self-doubting triathletes that competed at international competitions, representing Malaysia. The 6 weeks Yau worked with the athlete consisted of labeling their thoughts and emotions to be able to accept the negative ones and then having them identify their values, what they wanted to be remembered for, and the importance of their career. This helps teach athletes to focus on

their performance without getting too stressed out about what the other people are doing around them. A triathlete that worked with Yau, Edwin Thiang, agrees that the training, "does help me with reducing anxiety and overthinking." The other athletes that worked with Yau agreed: One found it easier to accept thoughts of self-doubt when a competitor overtook him. Before the mental training this athlete would lose hope after a competitor passed him and would slow down, but after the mental training it didn't matter as much to him and he set a personal pace for himself during the race. Yau reported in the May 2021 *Journal of Sport Psychology in Action* that one of his other triathletes that he worked with said that the training helped him stay committed to physical training.

Mindfulness and ACT methods combined improves players movement and focus during the game, especially pushing past mental barriers of negative thoughts. Players trained by these methods are less likely to be angry or sad about mistakes they made, and are better able to work through issues during the game to return their focus back to the present. Mertz also shares that during his mindfulness training he realized that he was so focused on football that he was neglecting the other parts in his life. He learned to pay attention not only on the field, but also to his mental health. Studies using these techniques have proved that the ben-

efits of the training have consisted of improved focus on readings and better communication with friends and family. Concerning all of this information, Jha would like to test how mindfulness and ACT training might affect Olympic athletes.

Summary

Researchers using these techniques say they've seen similar off-the-field benefits for their student athletes, including improved focus on readings for class and better communication with friends and family. With those results in mind, Jha says she'd like to test how mindfulness and ACT

"...physical health is not the only thing that matters, but also peoples' emotions, and mental well-being."

training might work for Olympic teams. Jha in fact had several briefings with the US and Australian Olympic team representatives about her training. Although this is not definite, what she would plan is

to train the Olympic coaches to work with their athletes and track their rival's performance and their mental health. Perhaps Biles and Osaka withdrawing to focus on their mental health was a blessing in disguise. By taking a break, it helps show how significant mental health is and should be taken care of. Especially being athletes, it shows that physical health is not the only thing that matters, but also peoples' emotions, and mental well-being.

AI DETECTING MENTAL HEALTH ISSUES THROUGH TEXTING



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By: Mukul Battu

Let's say that you are struggling with mental health issues due to depression, the loss of a loved one, or a bad grade on a really important test. You're constantly texting your friends and trying to cope with the tough times that you are experiencing. Wouldn't some assistance come

in handy to resolve your depression? Well, say thank you to artificial intelligence.

AI has recently been linked to curing mental health decline in individuals through a very intriguing and shocking method - observing your text messages. Strange, right?

First, let's talk about AI, also known as artificial intelligence. Artificial intelligence refers to

computer systems that have the capability to mimic human tasks and often with superior efficiency. Some very common household artificial intelligence systems include speech recognition devices, language translation systems, and facial recognition systems. AI has been changing our life for about a decade and will continue changing our life as time progresses. One very important type of artificial intelligence is machine learning where the computer receives a model of data to base its results off of when it receives the actual information.

Now, let's discuss this astounding and shocking study. According to the University of Washington School of Medicine in Seattle, Washington, an artificial intelligence machine capable of identifying "red-flag" language in text messages has been invented. "Red-flag" language is considered harmful and could signal mental health decline. According to the website Healthitanalytics, a study published in the journal *Psychiatric Services* states that a specific artificial intelligence algorithm known as cognitive distortion is capable of detecting 'red-flag' language.

Due to the pandemic, mental health crises especially among teens have increased dramatically. Since social interactions were lacking during the pandemic, we weren't enjoying school enough, and we couldn't even step out of our homes. In fact, life is still not normal due to the COVID restrictions still in place.

In this study conducted by University of Washington researchers, text messages were exchanged between 39 patients and their respective doctors through a period of 12 weeks. After these data were collected (7,354 unique messages), the process known as "natural language processing" (NLP) was implemented. Human evaluators also graded the data to see if there were any

signs of cognitive distortion. Natural language processing is a useful process due to the fact that long strands of text can be shortened into meaningful summaries that are easier to comprehend. These could include long clinical notes or journal articles. NLP is mainly used in the medical field because of its ability to summarize lengthy articles to make it easier for physicians and even patients to comprehend. Moreover, NLP has been in many mental health studies. Hence, it is proven that the artificial intelligence system was able to detect mental health decline as well as human evaluators!

This study also shows that there are numerous benefits to this technology. First of all, this AI system could detect mental health issues in patients that humans would

not be able to pick up. This is also trusted because this AI was able to detect mental health decline as well as their human evaluator counterparts. AI could also help other doctors as well trying to figure out processes to help save a patient's life.

More importantly, this study is significant because mental health is a very serious issue in many people's lives today and more recently, we have seen more issues in the news about people suffering from mental health problems and this tool could possibly help. Mental health is a very important issue because look at this statistic, "1 in 25 Americans lives with a serious mental illness, such as schizophrenia, bipolar disorder, or major depression." That's approximately 13.5 million Americans!

Do you see the significance of this issue and how this technology could advance the healthcare field? You may not even be realizing it but mental health is a very important issue and our computer friends could be a huge part in solving it.

"...a specific artificial intelligence algorithm known as cognitive distortion is capable of detecting 'red-flag' language."

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MICROPLASTICS ARE DETRIMENTAL TO ANIMALS: HOW ABOUT HUMANS?

By: Sean Patrick-Sasaki

Art by: Sophia Kong



With the talk of microplastics and their potential danger for humans circulating around social media and the public health world, many may wonder whether they should be worried. Plastic waste has been accumulating rapidly in the environment since they were first observed in the Earth's oceans in the 1960s. Hence, they have made their way into the bodies of millions of marine organisms and even land organisms including humans. The question is whether microplastics pose a threat to human health. Do they really disrupt the endocrine system? Do they damage the liver? Can they even inhibit reproductive health?

What are Microplastics?

Before answering those questions, it is important to define what microplastics really are. Microplastics refer to microscopic plastic particles ranging from a few micrometers to 5 millimeters in size. Generally, the concern comes with samples that are under a millimeter in size, as this is when they become difficult to catch. Due to many plastics either being non-biodegradable or requiring decades to decompose, microplastics have begun to accumulate almost everywhere, including the air, ocean, and within organisms. Additionally, most commercial food products are now packaged in single-use plastic, further contributing to the buildup of plastic waste in the environment and exposing humans to microplastics.

How do they affect animals?

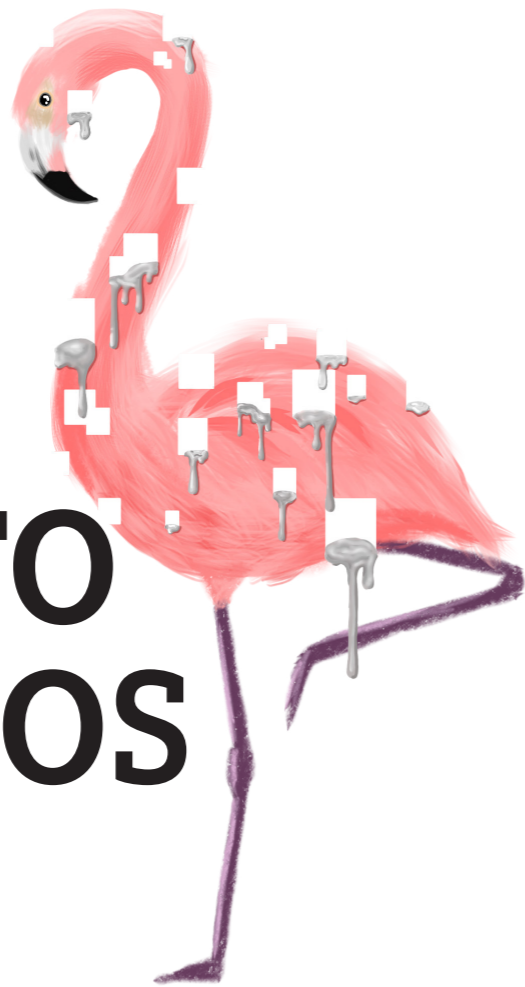
In recent years, scientists have begun researching the buildup of ocean microplastics and its impact on marine

life. Experts have observed that the deep ocean and Arctic glaciers serve as "huge sinks for these particles" (Parker, 2022). Studies on fish and other marine life have concluded that microplastics pose giant threats to the ocean's food webs and biodiversity. These small particles block the digestive system, contributing to malnutrition. They also leach into the bloodstream and potentially cause neurological damage, changing behavioral patterns. Lastly, they stunt growth and can cause the loss of critical senses. While these studies pose many concerns regarding the widespread use of plastic, it is important to note that the field of study is relatively new and not thoroughly documented.

How about humans?

A number of small-scale studies have concluded that microplastics are present in many regions of the human body, including feces and even the placenta of unborn babies. Further, a study at the Dutch National Organization for Health Research and Development found that microplastics can be transported via the bloodstream. Researchers at the University of Hull in the U.K. were surprised to find microplastics in the lower lung lobe. This may sound alarming, especially coupled with research conducted at California State University which found over 10,000 chemicals to be used in plastics, with over 2,400 of them being potentially harmful to humans in large quantities. However, scientists are not certain whether these smaller particles accumulating in the environment qualify as enough exposure to indicate harm, and will not be confirmed for many years to come according to Albert Rizzo, the American Lung Association's chief medical officer. In the meantime, the question turns to this: How can we go about making plastics safer?

LITHIUM MINING: A NEW THREAT TO FLAMINGOS



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By: Roshan Dhand

Art by: Sophia Kong

Scientists and politicians worldwide regard electric vehicles as a crucial tool in the fight against climate change. However, a main component of this sustainable technology is rechargeable batteries. Their production requires lithium, a finite material mined in Chile, Bolivia, and Peru. Nathan Senner, a population ecologist from the University of South Carolina, explains that as lithium demand rises, these countries' unique species and ecosystems face pro-

found danger.

In a recent study, expert Nathan Senner examined the impact of lithium mining and rising global temperatures on salt flat lakes or "salares" found in Chile. These lakes are located in the Atacama Desert plateau, the driest place on Earth. Their waters support the growth of cyanobacteria and diatom algae, food sources for the native Andean and James' flamingo species. Senner's team of ecologists gathered 30 years' worth of flamingo surveys, satellite imagery of the Chilean flats' water surface level, and data

regarding the lakes' cyanobacteria content.

The researchers learned that the 5 "salares" have shrunk at least 30 percent in surface areas since 1984. Senner believes the culprit is increased evaporation from recent climatic changes in wind, temperature, and humidity. Global warming has created more variability in surface temperatures and weather patterns, meaning certain places such as Chile experience intensified heatwaves. Even worse, long-term drying of the salt lakes has lowered food sources for the native flamingos.

However, Senner explains that lithium mining activity is strongly correlated with the declining flamingo population. Modern mining techniques begin with pumping water into the lake's crust. Then, lithium salts and other compounds gather in "refinement ponds" on the surface. In recent years, mining companies have utilized an estimated 400,000 liters of water per ton of lithium mined. This water is directly sourced from the Atacama Desert's groundwater reserves. The researchers determined that between 1986 and 2018, groundwater pumping increased from zero to 1.8 cubic meters per second. With more "refinement ponds" in the salt flats, the availability of cyanobacteria and diatom algae has decreased significantly. Over eleven years, populations of Andean and James' flamingos have declined by 12 and 10 percent, respectively.

The consequences of lithium mining and global warming extend beyond ecological destruction. Nathan Senner suggests that flamingo-based ecotourism in Chile, Bolivia, and Peru will also suffer. For one, Chile's Salar de Atacama is visited by thousands every year. However, as flamingo populations decline and salt lakes dry, its local economies may fail. The experts also believe wide-scale damage to South American flamingo populations may be

permanent. Senner explains that the Andean and James' flamingos reside exclusively in these "salares". Governments and organizations must preserve these hypersaline regions to prevent future damage to the economy, geographical beauty, and native species.

In a final discussion, Nathan Senner examines the two-faced nature of supporting certain "green" technology. The global demand for lithium is expected to quadruple in the next decade, meaning that mining in South America will only increase. More mining will accelerate the production of rechargeable batteries and the development of electric vehicles. Countries can then provide greater public access to electric vehicles and limit carbon emissions from motor vehicles. Despite these benefits, there remain many ecological consequences. This

"In recent years, mining companies utilize an estimated 400,000 liters of water per ton of lithium mined."

includes harm to the Chilean salt lakes, their flamingo populations, and local tourism-based economies.

While producing new technology is paramount to defeating climate change, it can also cause ecological damage or in-

tensify pre-existing environmental issues. Companies and governments must weigh the costs and benefits of sustainable technology, including solar panels and turbines. These sustainable technologies require the mining of precious metals under the Earth as well. However, modern advancements provide hopeful solutions to many of these issues including water supply. Researchers remark new water-efficient lithium extraction methods and lithium battery recycling may limit future ecological damage in South America, aiding in the preservation of native species including the beloved flamingoes.

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BIBLIOGRAPHY

Article 1:

Anthes, E. (2021, May 7). From the wastewater drain, solid pandemic data. *The New York Times*. <https://www.nytimes.com/2021/05/07/health/coronavirus-sewage.html>

Obileke, K., Onyeaka, H., Meyer, E. L., & Nwokolo, N. (2021). Microbial fuel cells, a renewable energy technology for bio-electricity generation: A mini-review. *Electrochemistry Communications*, 125(107003), 107003. <https://doi.org/10.1016/j.elecom.2021.107003>

Ritchie, H., Roser, M., & Rosado, P. (2022). Energy. *Our World in Data*. <https://ourworldindata.org/electricity-mix>

Tahernia, M., Plotkin-Kaye, E., Mohammadifar, M., Gao, Y., Oefelein, M. R., Cook, L. C., & Choi, S. (2020). Characterization of electrogenic gut bacteria. *ACS Omega*, 5(45), 29439–29446. <https://doi.org/10.1021/acsomega.0c04362>

Article 2:

A brief history of mental illness and the U.S. mental health care system. (n.d.). Uniteforsight.org. Retrieved January 3, 2023, from <https://www.uniteforsight.org/mental-health/module2>

Baton Rouge Behavioral Hospital. (2020, January 13). The Surprising History of Mental Illness Treatment. Baton Rouge Behavioral Hospital. <https://batonrougebehavioral.com/the-surprising-history-of-mental-illness-treatment/>

De La Cruz, M. H. (2021, July 30). In a sea of support for Simone Biles, there's razor-sharp criticism. *WXIA*. <https://www.11alive.com/article/sports/olympics/simone-biles-critics-backlash-after-tokyo-withdrawal/85-bbdc94fa-1189-44b2-a469-7f3af2acf8d7>

Osorio, A., Alker, J., Park, E., Burak, E. W., Lawson, N., & Dwyer, A. (2022, March 24). Research update: Children's anxiety and depression on the rise. Center For Children and Families. <https://ccf.georgetown.edu/2022/03/24/research-update-childrens-anxiety-and-depression-on-the-rise/>

Silber, T. (2021, December 23). Simone Biles faced backlash, but mental health experts and teammates alike offered support. *Ragan's Workplace Wellness*. <https://raganwellness.com/simone-biles-faced-backlash-but-mental-health-experts-and-teammates-alike-offered-support/>

Yeager, A. (2022, January 26). How mindfulness-based training can give elite athletes a mental edge. *Science News Magazine*. <https://www.sciencenews.org/article/athlete-mental-health-mindfulness-psychology-elite-olympics>

ZirinTwitter, D., BroderTwitter, D., Barber IITwitter, R. D. W., BrodnerTwitter, S., HeerTwitter, J., Galindo, F., The NationTwitter, & SmithTwitter, M. D. (2021, June 2). Naomi Osaka and the growing backlash against athletes who dare to speak out. *Nation* (New York, N.Y.: 1865). <https://www.thenation.com/article/society/naomi-osaka/>

Article 3:

Bowman, C. F. (2022). What is quantum computing? In *How Things Work* (pp. 215–234). Chapman and Hall/CRC.

Dargan, J. (2022, September 5). 81 quantum Computing Companies: The ultimate list for 2023. *The Quantum Insider*. <https://thequantuminsider.com/2022/09/05/quantum-computing-companies-ultimate-list-for-2022/>

Dilmegani, C. (2021, April 11). Quantum Entanglement: What is it & Why is it Important in 2023? *AIMultiple*. <https://research.aimultiple.com/quantum-computing-entanglement/>

Frankenfield, J. (2018, May 26). Quantum computing: Definition, how it's used, and example. *Investopedia*. <https://www.investopedia.com/terms/q/quantum-computing.asp>
Vidick, T. (n.d.). What is entanglement and why is it important? *Caltech Science Exchange*. Retrieved January 3, 2023, from <https://scienceexchange.caltech.edu/topics/quantum-science-explained/entanglement>

Wilczek, F. (2016, April 28). Entanglement made simple. *Quanta Magazine*. <https://www.quantamagazine.org/entanglement-made-simple-20160428/>

Article 4:

Buehler, J. (2022, March 15). Lithium mining may be putting some flamingos in Chile at risk. *Science News Magazine*. <https://www.sciencenews.org/article/lithium-mining-flamingo-technology-climate-change>

Article 5:

Andrea, P. (2022, October 12). AI spots signs of mental health issues in text messages on par with human psychiatrists: UW study. *Fiercebiotech.com*. <https://www.fiercebiotech.com/medtech/ai-spots-signs-mental-health-issues-text-messages-par-human-psychiatrists-uw-study>

Data and statistics. (2022, March 31). *Cdc.gov*. https://www.cdc.gov/mentalhealth/data_publications/index.htm

Erin, M. (2022, January 14). What Are the Benefits of Natural Language Processing Technology? *Health IT Analytics*. <https://healthitanalytics.com/features/what-are-the-benefits-of-natural-language-processing-technology>

Shania K. (2022, October 13). AI Tool Can Detect Signs of Mental Health Decline in Text Messages? *Health IT Analytics*. <https://healthitanalytics.com/news/ai-tool-can-detect-signs-of-mental-health-decline-in-text-messages>

Article 6:

Assistant Secretary for Public Affairs (ASPA). (2020, December 12). COVID-19 vaccines. *Hhs.gov; US Department of Health and Human Services*. <https://www.hhs.gov/coronavirus/covid-19-vaccines/index.html>

Boehmer, T. K., Kompaniyets, L., Lavery, A. M., Hsu, J., Ko, J. Y., Yusuf, H., Romano, S. D., Gundlapalli, A. V., Oster, M. E., & Harris, A. M. (2021). Association between COVID-19 and

myocarditis using hospital-based administrative data - United States, March 2020–January 2021. *MMWR. Morbidity and Mortality Weekly Report*, 70(35), 1228–1232. <https://doi.org/10.15585/mmwr.mm7035e5>

CDC. (2022, September 20). Possible side effects after getting a COVID-19 vaccine. Centers for Disease Control and Prevention. <https://www.cdc.gov/coronavirus/2019-ncov/vaccines/expect/after.html>

CDC. (2022, September 27). Myocarditis and pericarditis after mRNA COVID-19 vaccination. Centers for Disease Control and Prevention. <https://www.cdc.gov/coronavirus/2019-ncov/vaccines/safety/myocarditis.html>

Myocarditis. (2022, May 20). *Mayoclinic.org*. <https://www.mayoclinic.org/diseases-conditions/myocarditis/diagnosis-treatment/drc-20352544>

Article 7:

Jansen, K. (2020). Carolyn Bertozzi. *C&EN Global Enterprise*, 98(9), 37–37. <https://doi.org/10.1021/cen-09809-feature7>

Rogers, K., & Gregersen, E. (2022). Carolyn R. Bertozzi. In *Encyclopedia Britannica*.

Article 8:

NTU Singapore scientists develop inexpensive device that can harvest energy from a light breeze and store it as electricity. (2022 October 10). *School of Civil and Environmental Engineering*. <https://www.ntu.edu.sg/cee/news-events/news/detail/ntu-singapore-scientists-develop-inexpensive-device-that-can-harvest-energy-from-a-light-breeze-and-store-it-as-electricity>

Article 9:

da Silva, V. H., Murphy, F., Amigo, J. M., Stedmon, C., & Strand, J. (2020). Classification and quantification of microplastics (<100 μm) using a focal plane array-Fourier transform infrared imaging system and machine learning. *Analytical Chemistry*, 92(20), 13724–13733. <https://doi.org/10.1021/acs.analchem.0c01324>

History and Future of plastics. (2016, July 18). *Science History Institute*. <https://www.sciencehistory.org/the-history-and-future-of-plastics>

Parker, L. (2022, April 25). Microplastics are in our bodies. How much do they harm us? *National Geographic*. <https://www.nationalgeographic.com/environment/article/microplastics-are-in-our-bodies-how-much-do-they-harm-us>

Article 10:

de Melo, G. D., Sonthonnax, F., Lepousez, G., Jouvion, G., Minola, A., Zatta, F., Larrous, F., Kergoat, L., Mazo, C., Moigneu, C., Aiello, R., Salomoni, A., Brisebard, E., De Benedictis, P., Corti, D., & Bourhy, H. (2020). A combination of two human monoclonal antibodies cures symptomatic rabies. *EMBO Molecular Medicine*, 12(11), e12628. <https://doi.org/10.15252/emmm.202012628>

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Join our team!

Contribute to our next issue! We meet in J-104 on both blue and orange days! Feel free to stop by, or email sciencegreeley@gmail.com for more information.

